Nevada
Environmental
Restoration
Project

DOE/NV--818

Corrective Action Investigation Plan for Corrective Action Unit 5: Landfills, Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

May 2002

Environmental Restoration
Division

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

RECORD OF TECHNICAL CHANGE

Technical Change No. 1

Project/Job No. 831841-02030080

Date 09/17/2002

Project/Job Name Industrial Sites CAU 5: Landfills. Nevada Test Site. Nevada

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

Dustin R. Wilson	Task Manager
(Name)	(Title)

Justification: The addition of Section 4.2.2.4 is required to include interpreted buried waste boundaries based on geophysical survey data and to propose biased sample locations and intervals for each CAS.

Change:

After Section 4.2.2.3, insert the following:

Section 4.2.2.4 ***Phase I Sample Locations and Intervals***

Geophysical surveys (SAIC, 2002) were conducted at each of the CAU 5 CASs to define the lateral and vertical extent of disposed waste by methods described in Section 4.2.2.1. The geophysical surveys delineate metallic and conductive disposal features well, but nonmetallic boundaries are not as well delineated. Biased sample locations and field-screening sampling intervals for the CASs were selected based upon the geophysical results and interpretations in accordance with Section 4.2.2.3. In the field during excavation, these sample locations may be moved.

Select biased sample locations will be excavated to determine the depth of cover and depth of disposal. Depending on the depth of cover identified and the base of the disposal feature, the upper and lower field-screening sampling intervals may be adjusted. The Site Supervisor will be responsible for implementing planned sampling activities and will determine, based on Data Quality Objective requirements, the final number and location of soil samples to be collected for analyses at an off-site laboratory. Field-screening results and other biasing factors will be used to select samples for the off-site analyses listed in Section 3.2. At a minimum, the sample interval adjacent to the base of the disposal feature at each biased location will be submitted for off-site analysis.

Target sample locations are adjacent to disposal feature boundaries in order to determine if contamination is migrating from the waste. If it is determined that any sample location is within a disposal feature, the location will be moved, as necessary, to the boundary of the disposal feature. The proposed biased sample locations and field-screening sampling intervals targeted for the landfill features at each CAS are discussed below.

CAS 05-15-01

Interpreted geophysical data defined the existence of buried waste material existing within a series of trenches at this CAS as shown in Figure 4-1. Trenches 1, 2, and 3 trend southwest to northeast. Trench 4 is located east of the other three trenches and trends northwest to southeast. Proposed field-screening sample locations are shown in Figure 4-1. The bases of Trenches 1 and 2 are approximately 6 to 8 feet (ft) below ground surface (bgs) and the bases of Trenches 3 and 4 are estimated at 10 to 12 ft bgs. Field-screening sample collection intervals targeted for Trenches 1 and 2 are at 4 to 5 ft, 7 to 8 ft, 12 to 13 ft, and 17 to 18 ft. Field-screening sample collection intervals targeted for Trenches 3 and 4 are at 4 to 5 ft, 7 to 8 ft, 11 to 12 ft, 16 to 17 ft, and 21 to 22 ft.

CAS 05-16-01

Interpreted geophysical data defined the existence of buried waste material existing within one trench (Trench 1) at this CAS that is trending east-west and may also extend across a larger area to the south of the grid area as shown in Figure 4-2. Proposed field-screening sample locations are shown in Figure 4-2. The base of Trench 1 is approximately 10 to 12 ft bgs. Field-screening sample collection intervals targeted for Trench 1 are at 4 to 5 ft, 7 to 8 ft, 11 to 12 ft, 16 to 17 ft, and 21 to 22 ft. A subsurface metallic target was identified to the southwest of Trench 1. The base of this feature was not been identified with geophysics. Field-screening sample collection intervals for the subsurface metallic target will be determined in accordance with Section 4.2.2.3 after the depth of the base is determined by excavation.

CAS 06-08-01

Interpreted geophysical data define the existence of buried metallic waste material existing within two trenches (Trenches 1 and 2) at this CAS. These trenches trend northwest to southeast and may extend further to the northwest as shown in Figure 4-3. Geophysical data also indicate the presence a buried metallic anomaly (Anomaly A). Historical aerial photos indicate that two trenches (Potential Trenches 3 and 4) existed northeast of, and parallel to, Trench 1. These trenches were not evident in the geophysical data. This may have been due to surface interferences or the absence of metallic waste material (including the possibility that the trenches were backfilled and not used for waste disposal). Proposed field-screening sample locations are shown in Figure 4-3. Additional locations may be necessary for Potential Trenches 3 and 4 if excavations determine the presence of buried waste material. The bases of these disposal features were not determined with geophysics. Field-screening sample collection intervals will be determined in accordance with Section 4.2.2.3 after the depths of the bases are determined by excavation.

CAS 06-15-02 and CAS 06-15-03

Geophysical surveys for CASs 06-15-02 and 06-15-03 were performed concurrently due their proximity. Interpreted geophysical data defined the existence of several trenches and landfills across the survey grid. The presence of both metallic and conductive (nonmetallic) waste were identified.

Nine Conductive Waste Areas (CWAs) have been identified from the interpreted geophysical data as shown in Figures 4-4 and 4-5. Four trenches/landfills (TLF) were identified as containing subsurface metallic debris. The following text describes the sites and targeted biased sample locations and intervals beginning with CAS 06-15-02.

CWA 6 - Signage designates this conductivity anomaly area as a sanitary landfill. Three field-screening sample locations are proposed along a northeast-southwest trending line that coincides with an Electrical Imaging traverse (see Figure 4-4). Field-screening sample collection intervals targeted for CWA 6 will begin at the buried waste material/native soil interface (estimated at 20 to 22 ft bgs) with sample collection intervals of 21 to 22 ft, 26 to 27 ft, and 31 to 32 ft.

CWA 7 (TLF3) - A metallic waste area was identified from the geophysical data within CWA 7 defined boundaries. Two field-screening sample locations are proposed along the perimeters of TLF3, one on each of the northeast and southwest perimeters (see Figure 4-4). Both locations will be directly within the defined conductivity anomaly. The approximate depth of the waste at these locations is 18 to 20 ft bgs. Field-screening sample collection intervals targeted for CWA 7 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 24 to 25 ft, and 29 to 30 ft bgs.

CWA 8 - Geophysical data identified this small conductivity anomaly. The proposed field-screening location (see Figure 4-4) will be drilled to determine the presence of buried debris. Field-screening sample collection will begin at the buried waste material/native soil interface and continue at 5 and 10 ft below this interface.

CWA 9 (TLF 4) - A metallic waste area was identified from the geophysical data within CWA 9 defined boundaries. Three field-screening sample locations are proposed along the perimeters of TLF4, one on each of the northeast, southeast, and southwest perimeters (see Figure 4-4). All locations will be directly within the defined conductivity anomaly. The approximate depth of the waste 22 to 24 ft bgs. Field-screening sample collection intervals targeted for CWA 9 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 23 to 24 ft, 28 to 29 ft, and 33 to 34 ft bgs.

CWA 1 - Three field-screening sample locations are proposed along the northeast, northwest, and southwest perimeter of the CWA (see Figure 4-5). The approximate depth of the waste is 18 to 20 ft bgs. Field-screening sample collection intervals targeted for CWA 1 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 24 to 25 ft, and 29 to 30 ft.

CWA 2 - Two field-screening sample locations are proposed along the northeast and northwest perimeter of the CWA (see Figure 4-5). The approximate depth of the waste is 18 to 20 ft bgs. Field-screening sample collection intervals targeted for CWA 2 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 24 to 25 ft, and 29 to 30 ft bgs.

CWA 3 - Three field-screening sample locations are proposed along the northeast, southeast and southwest perimeters of the CWA (see Figure 4-5). The approximate depth of the waste is 18 to 20 ft bgs. Field-screening sample collection intervals targeted for CWA 3 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 24 to 25 ft, and 29 to 30 ft bgs.

CWA 4 - Seven field-screening sample locations are proposed along the perimeter of the CWA (see Figure 4-5). Four sample locations are along the northeast perimeter, one on the northwest, and two on the southwest. The approximate depth of the waste is 18 to 20 ft bgs. Field-screening sample collection intervals targeted for CWA 4 are at 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, 24 to 25 ft, and 29 to 30 ft bgs.

CWA 5 (TLF1 and TLF2) - Two metallic waste areas (TLF1 and TLF2) were identified from the geophysical data, one within the CWA 5 defined boundaries and the other mostly outside the CWA 5 boundary to the southeast (see Figure 4-5). Three field-screening sample locations are proposed along the perimeter of TLF1, two on the northeast and one on the northwest perimeter (see Figure 4-5). The northeast locations will be directly within the defined conductivity anomaly. The approximate depth of the waste area is 8 ft bgs. Field-screening sample collection intervals targeted for TLF1 are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, and 18 to 19 ft bgs.

Three field-screening sample locations are proposed along the northeast perimeter of TLF2 (see Figure 4-5). The approximate depth of the waste area is 22 to 24 ft bgs. Field-screening sample collection intervals targeted for TLF2 are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, 18 to 19 ft, 23 to 24 ft, 28 to 29 ft, and 33 to 34 ft bgs.

CAS 12-15-01

Interpreted geophysical data defined the existence of both metallic and metallic buried waste. Five areas of conductive waste have been identified as shown in Figure 4-6. Three trenches containing metallic waste trending northwest-southeast were identified. A linear metallic feature was also identified and indicates the presence of a possible underground utility. Area 1 includes four trenches according to historic aerial photos. Because these trenches were not clearly defined by geophysics, sample locations are proposed based on these photos. Sample collection intervals will be based on biasing factors as determined during drilling and in accordance with Section 4.2.2.3.

Area 5 - One field-screening sample location is proposed within Area 5. The proposed location will be drilled to determine the presence of buried debris. Field-screening sample collection will begin at the buried waste material/native soil interface and continue at 5 and 10 ft below this interface.

Area 2/Trench 1- Four field-screening sample locations are proposed along the perimeter of Area 2/Trench 1. The approximate depth of the waste is 12 to 14 ft bgs. Field-screening sample collection intervals targeted for Area 2/Trench 1 are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, 18 to 19 ft, and 23 to 24 ft.

Area 3/Trench 2 - Four field-screening sample locations are proposed along the perimeter of Area 3/Trench 2. The approximate depth of the waste is 10 ft bgs. Field-screening sample collection intervals targeted for Area 3/Trench 2 are at 5 to 6 ft, 10 to 11 ft, 15 to 16 ft, and 20 to 21 ft.

Trench 3 - Two field-screening sample locations are proposed along the perimeter of Trench 3. The field-screening sample collection intervals for Trench 3 will be generated based on the depth of buried waste determined via excavation and Section 4.2.2.3.

CAS 20-15-01

Interpreted geophysical data defines metallic and nonmetallic subsurface anomalies. A trench-like feature trending east-west was identified with possible metallic waste within an area of possible conductive material as shown if Figure 4-7. The depth of the trench is approximated at 12 to 14 ft bgs. Four field-screening sample locations are proposed along the perimeter of metallic debris anomaly (see Figure 4-7). Field-screening sample collection intervals targeted are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, 18 to 19 ft, and 23 to 24 ft bgs.

CAS 23-15-03

Interpreted geophysical data defined the existence of several metallic and conductivity anomalies in the Disposal and Landfill Areas. These anomalies are shown in Figures 4-8 and 4-9. The following text describes the areas and proposed biased sample locations and intervals beginning with Disposal Area.

Disposal Area - Four metallic waste areas and two conductive disposal features trending north-south are within the Disposal Area (see Figure 4-8). Six field-screening sample locations are proposed along the perimeter of the Metallic Waste Areas, within areas of conductivity, and within roped off areas. The field-screening sample collection intervals for the Disposal Area will be generated based on the depth of buried waste determined via excavation and Section 4.2.2.3.

High Conductivity Area 1/Trench 1 - Eight field-screening sample locations are proposed along the perimeter of this disposal feature (see Figure 4-9). The field-screening sample collection intervals for this anomaly will be generated based on the depth of buried waste determined via excavation and Section 4.2.2.3.

High Conductivity Area 2/Trench 2 - Seven field-screening sample locations are proposed along the perimeter of this disposal feature (see Figure 4-9). The depth of the trench is approximated at 12 to 14 ft bgs. The two southern most locations are estimated based on inconclusive geophysics due to surface interferences and may be modified based on exploratory excavations. Field-screening sample collection intervals targeted are at 4 to 5 ft, 9 to 10 ft, 13 to 14 ft, 18 to 19 ft, and 23 to 24 ft bgs.

High Conductivity Area 3/Trench 3 - Four field-screening sample locations are proposed along the perimeter of this disposal feature (see Figure 4-9). The depth of the trench is approximated at 5 ft bgs. The southern most location is estimated based on inconclusive geophysics due to surface interferences and may be modified based on exploratory excavations. Field-screening sample collection intervals targeted are at 2 to 3 ft, 5 to 6 ft, 10 to 11 ft, and 15 to 16 ft bgs.

High Conductivity Area 6/Trench 4 - Four field-screening sample locations are proposed along the perimeter of this disposal feature (see Figure 4-9). The depth of the trench is approximated at 6 ft bgs. The northern most location is estimated based on inconclusive geophysics due to surface interferences and may be modified based on exploratory excavations. Field-screening sample collection intervals targeted are at 3 to 4 ft, 6 to 7 ft, 11 to 12 ft, and 16 to 17 ft bgs.

Trench 5 -Two field-screening sample locations are proposed along the perimeter of this disposal feature (see Figure 4-9). The depth of the trench is approximated at 8 ft bgs. Field-screening sample collection intervals targeted are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, and 18 to 19 ft bgs.

High Conductivity Area 4/Trench 6 - Three field-screening sample locations are proposed along the perimeter of the metallic anomaly portion of this disposal feature (see Figure 4-9). The depth of the trench is approximated at 8 ft bgs. Field-screening sample collection intervals targeted are at 4 to 5 ft, 8 to 9 ft, 13 to 14 ft, and 18 to 19 ft bgs.

High conductivity area 5 - One field-screening sample location is proposed within this disposal feature (see Figure 4-9). The proposed location will be drilled to determine the presence of buried debris. Field-screening sample collection will begin at the buried waste material/native soil interface and continue at 5 and 10 ft below this interface.

Section 8.0, Add the following references:

SAIC, see Science Applications International Corporation.

Science Applications International Corporation. 2002. *Surface Geophysical Survey Final Report, Industrial Sites Project-CAU 5, Nevada Test Site,* June. Harrisburg, PA.

Technical Change No. 1

Project/Job No. 831841-02030080

Project/Job Name Industrial Sites CAU 5: Landfills, Nevada Test Site, Nevada

Date 09/17/2002

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 5: Landfills, Nevada Test Site, Nevada,* **Rev. 0 DOE/NV–818.**

Approved By: Kevin Cabble for Date 9-17-02

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Runore Wycoff Date 9-17-02

Runore C. Wycoff, Division Director
Environmental Restoration Division

Client Notified Yes X No ___ Date 9-17-02

NDEP Concurrence Yes ___ No ___ Date ___

NDEP Signature ___

Contract Change Order Required Yes ___ No X

Contract Change Order No. Not Applicable

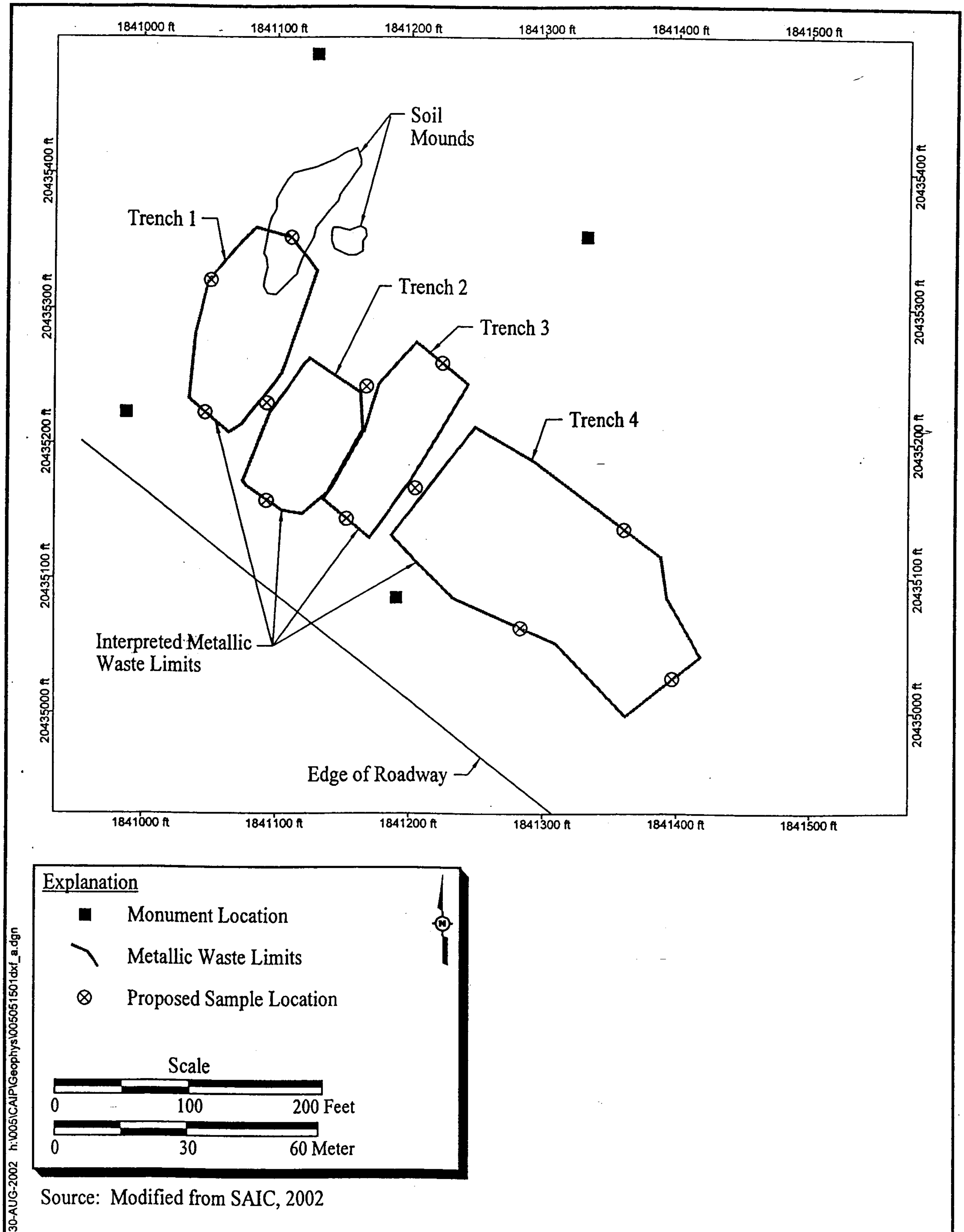


Figure 4-1
CAS 05-15-01

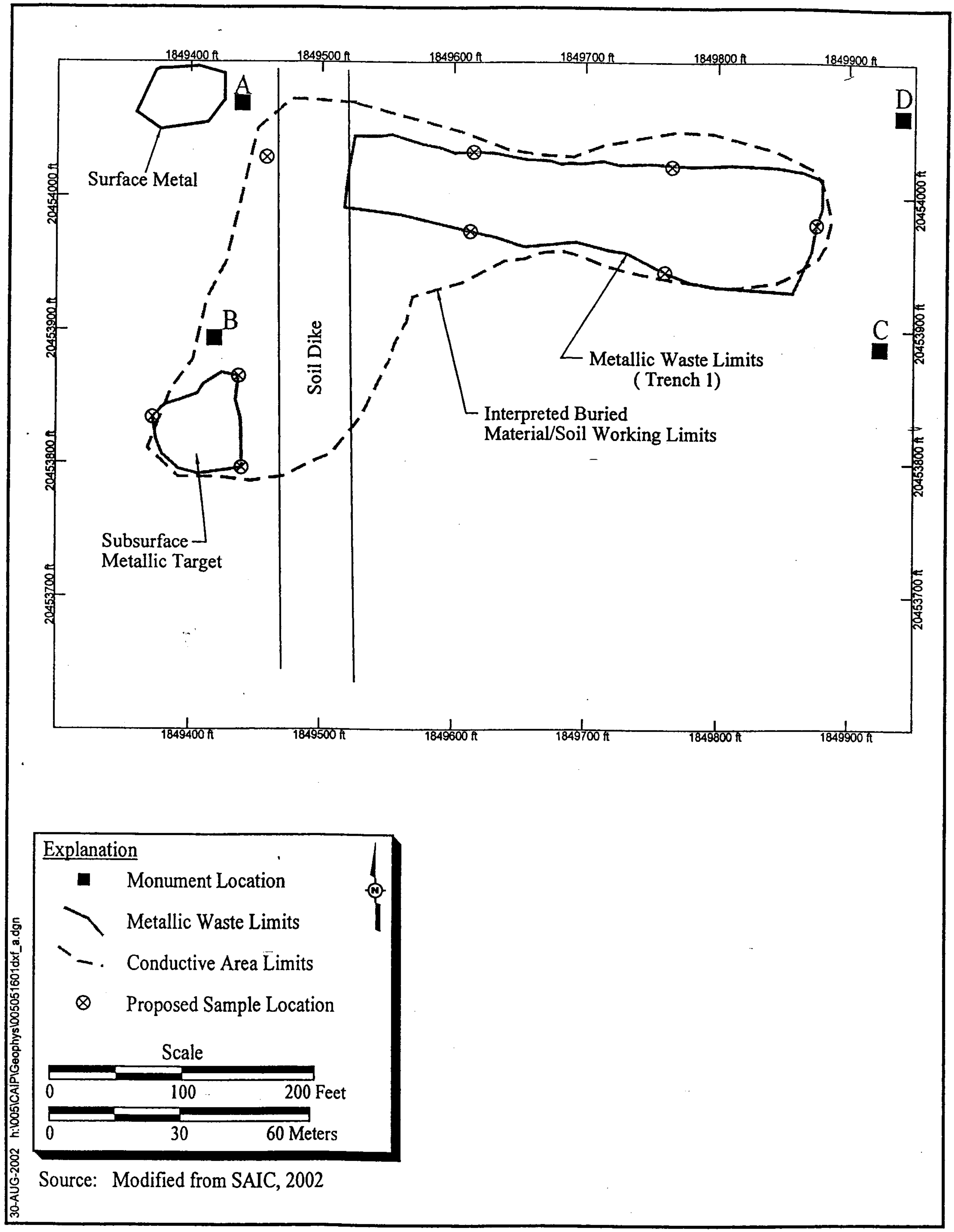


Figure 4-2
CAS 05-16-01

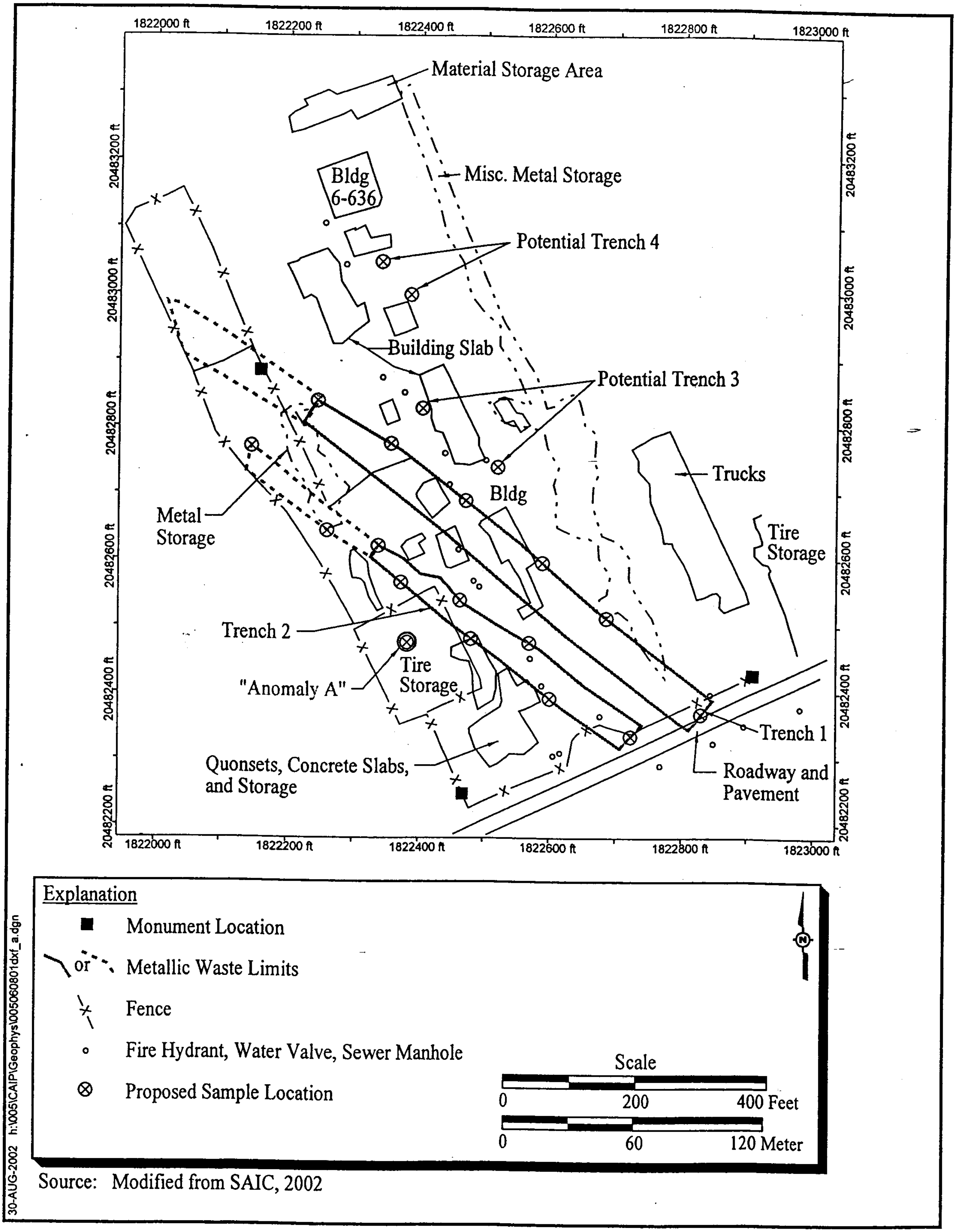


Figure 4-3
CAS 06-08-01

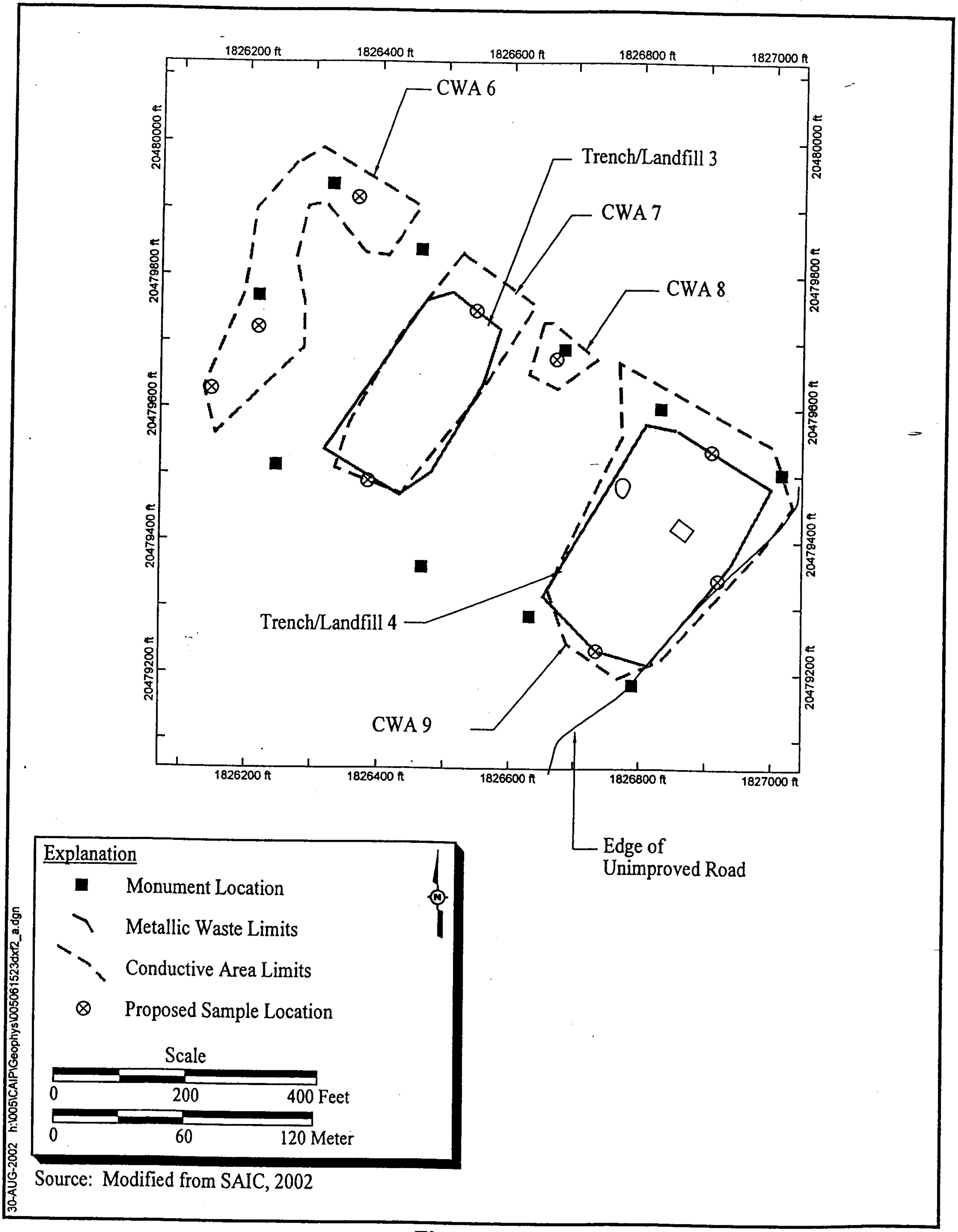


Figure 4-4
CAS 06-15-02

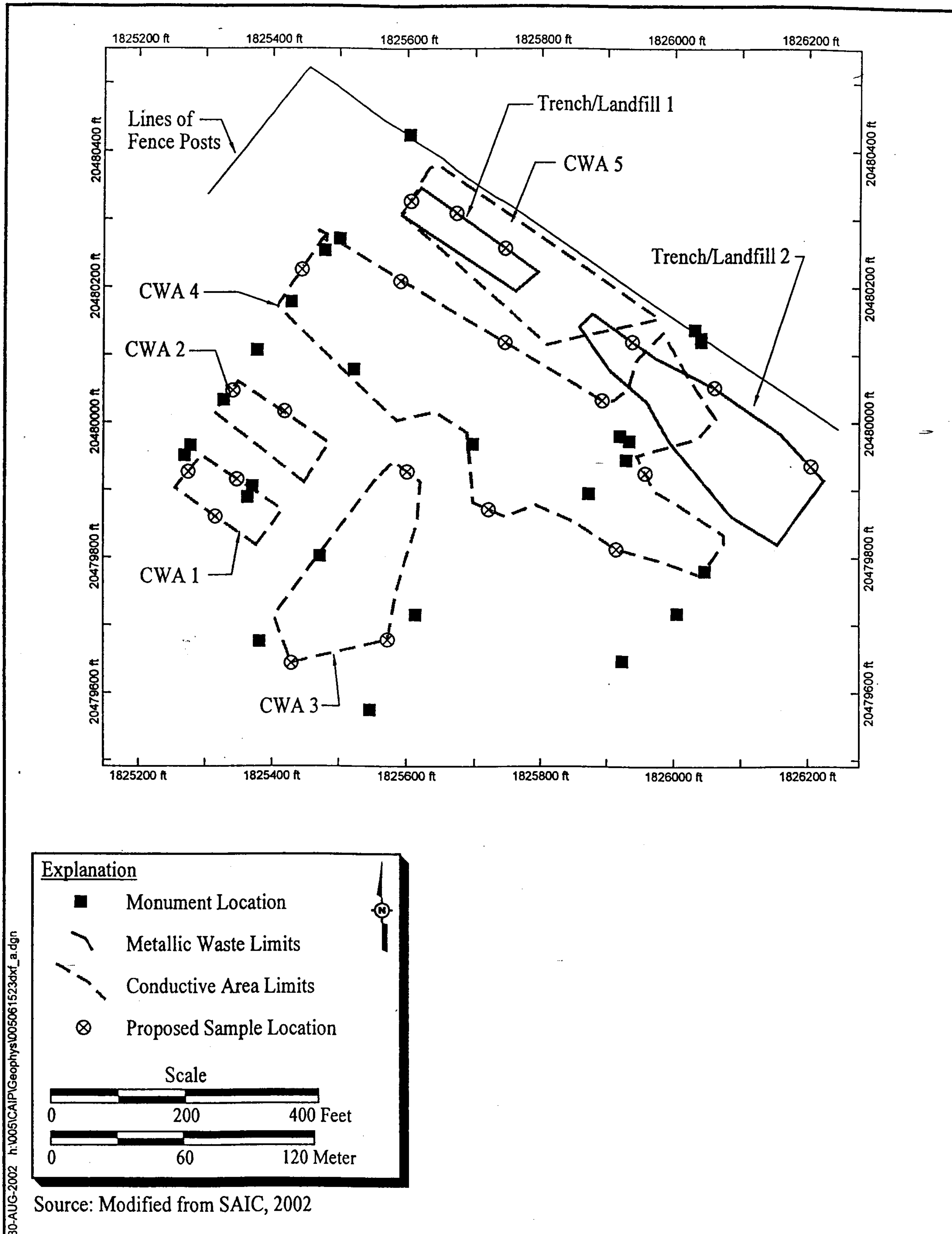
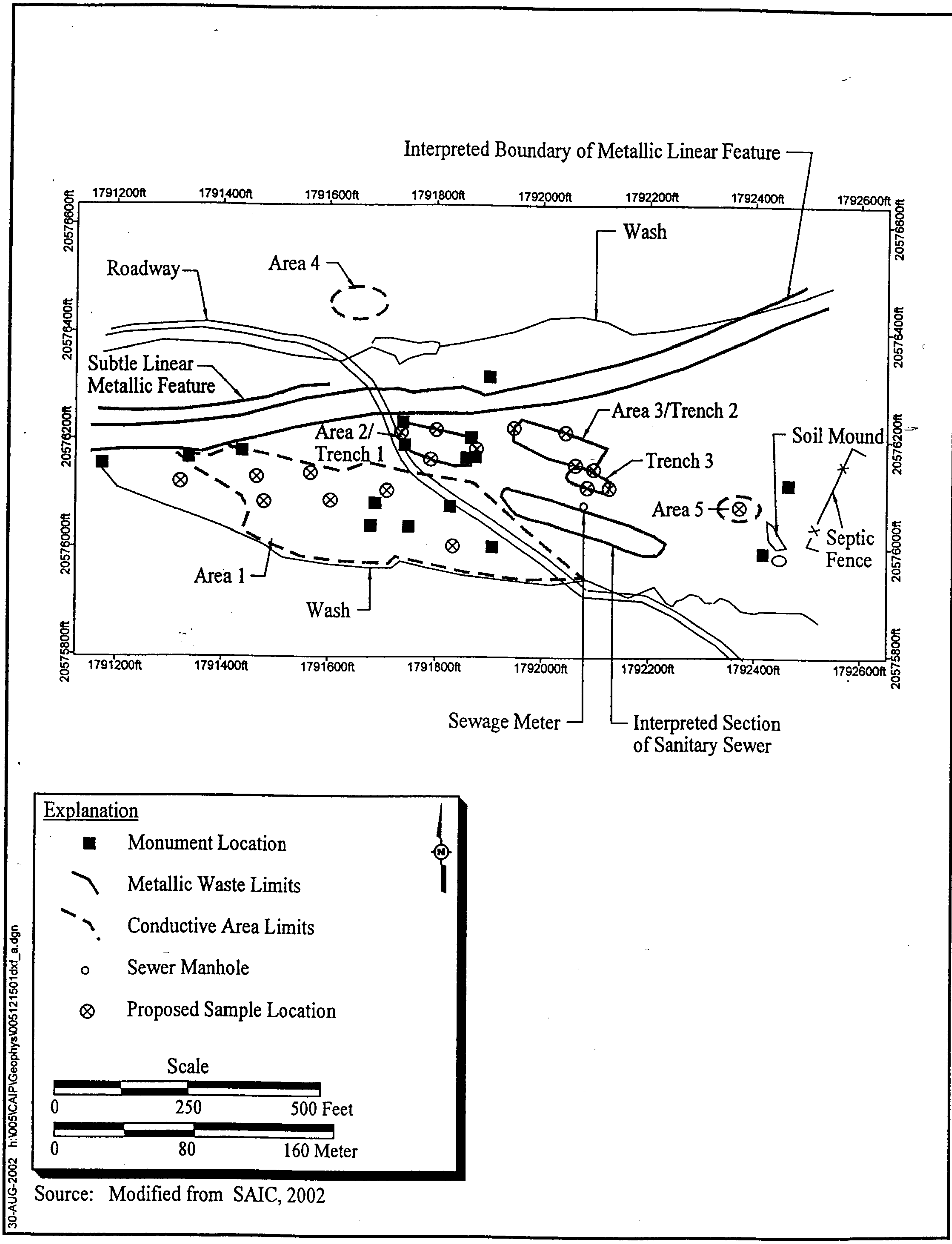
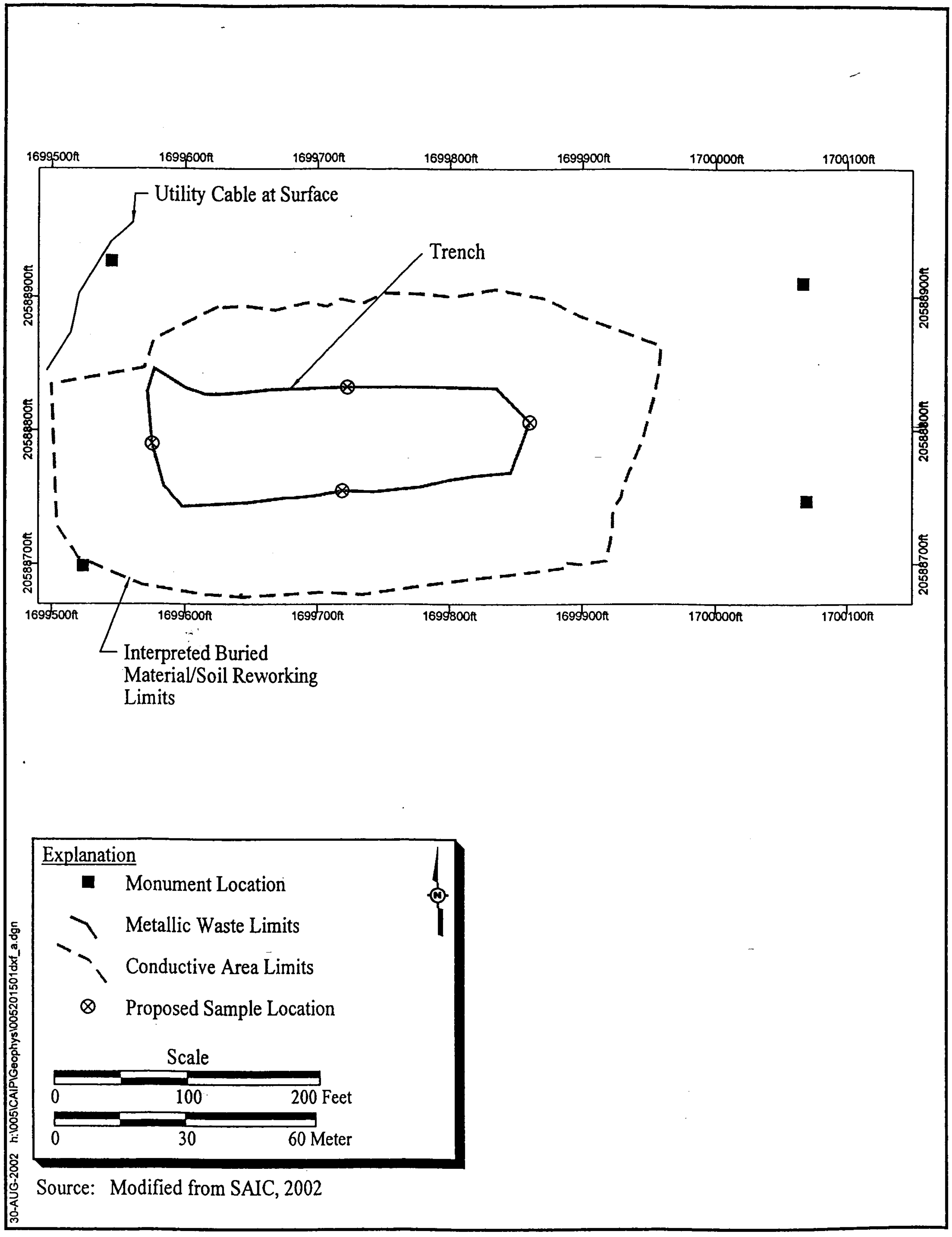


Figure 4-5
CAS 06-15-03



Source: Modified from SAIC, 2002

Figure 4-6
CAS 12-15-01



Source: Modified from SAIC, 2002

Figure 4-7
CAS 20-15-01

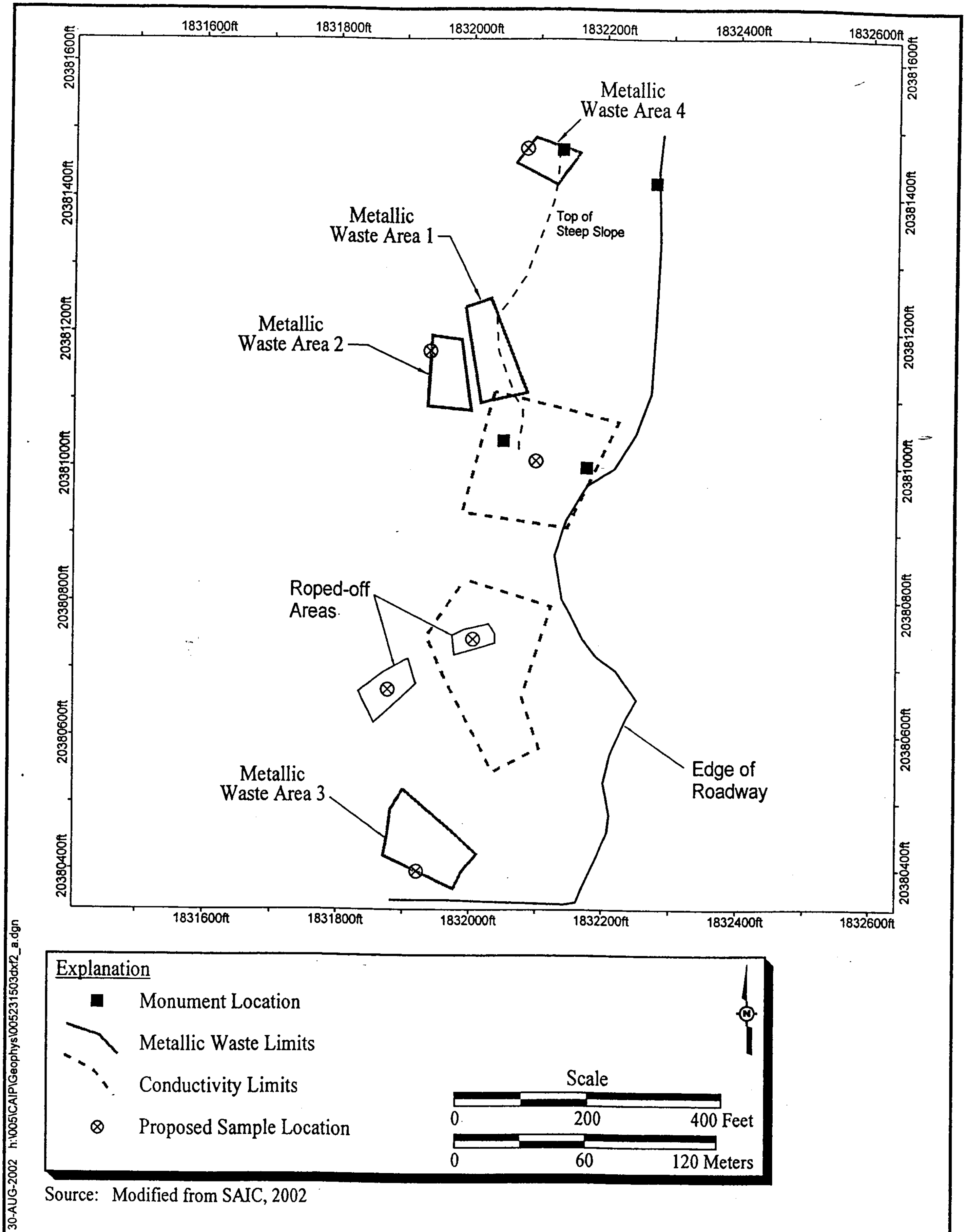
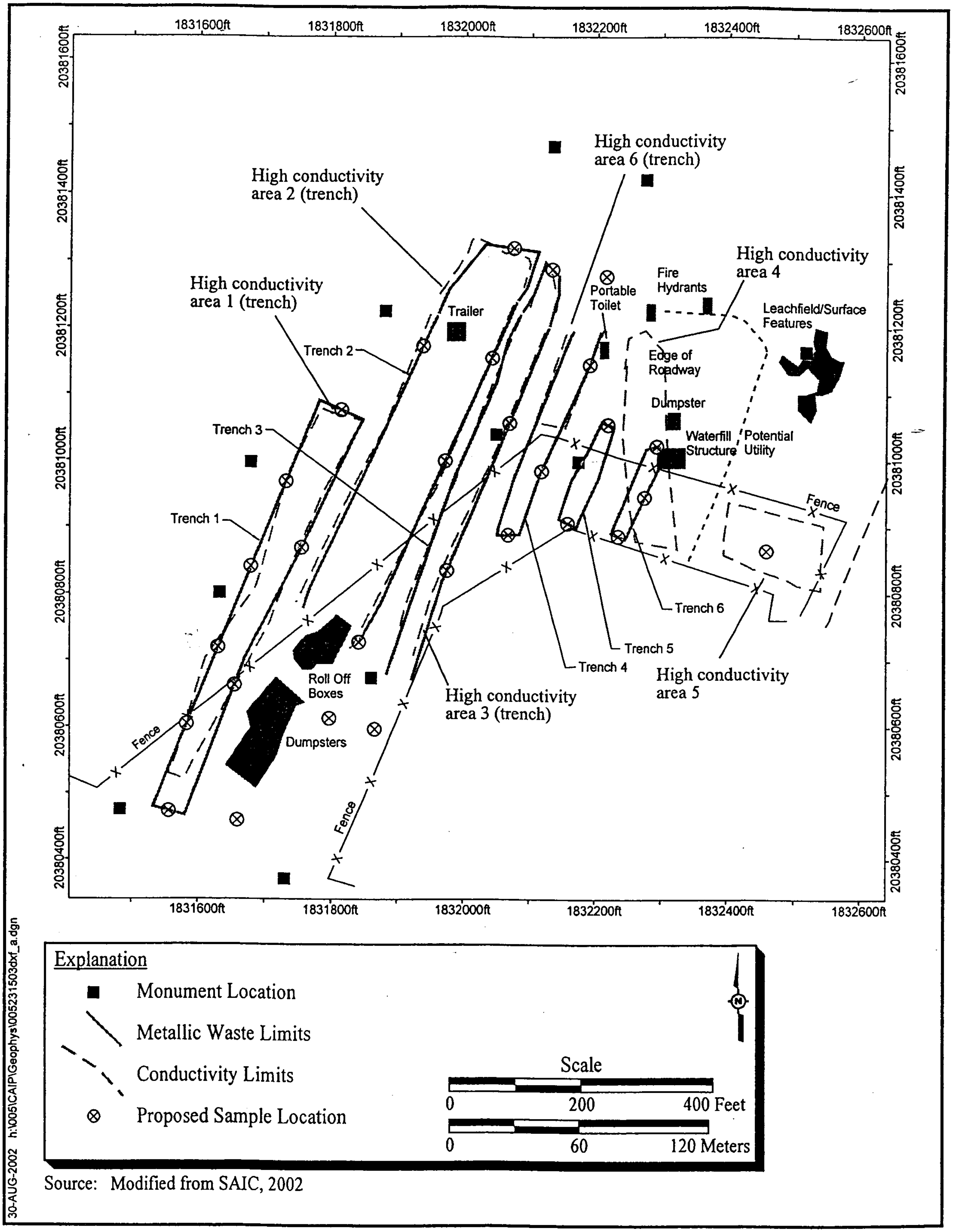


Figure 4-8
CAS 23-15-03 (Disposal Area)



Source: Modified from SAIC, 2002

Figure 4-9
CAS 23-15-03 (Landfill Area)

Available for public sale, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800.553.6847
Fax: 703.605.6900
Email: orders@ntis.fedworld.gov
Online ordering: ***http://www.ntis.gov/ordering.htm***

Available electronically at ***http://www.doe.gov/bridge***

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Phone: 865.576.8401
Fax: 865.576.5728
Email: reports@adonis.osti.gov

DOE/NV--818

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 5: LANDFILLS, NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

May 2002

CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 5:
LANDFILLS,
NEVADA TEST SITE, NEVADA

Approved by: Signature Approval   Date: 5/28/02

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approval   Date: 5/28/02

Runore C. Wycoff, Division Director
Environmental Restoration Division

Table of Contents

Table of Contents (Continued)

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

List of Tables

List of Acronyms and Abbreviations

amsl	Above mean sea level
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BHC	Benzene hexachloride
BN	Bechtel Nevada
CADD	Corrective Action Decision Document
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
CRQL	Contract-required quantitation limit
CSM	Conceptual site model
CP	Control point
DEHP	Di(2-ethyhexyl) phthalate
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
EIS	Environmental impact statement

List of Acronyms and Abbreviations *(Continued)*

EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
FADL	Field activity daily log
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening results
ft	Foot (feet)
GRASP	General Radiochemistry and Routine Analytical Services Protocol
HASP	Health and safety plan
IDW	Investigation-derived waste
in.	Inch(es)
IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System
IT	IT Corporation
ITLV	IT Corporation, Las Vegas Office
LCSD	Laboratory control sample duplicate
LCS	Laboratory control sample
MDC	Minimum detectable concentration
mi	Mile
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
M&O	Management and Operating Contractor
MOSA	Methods of soil analysis
MRL	Minimum reporting limit
MS	Matrix spike

List of Acronyms and Abbreviations *(Continued)*

MSD	Matrix spike duplicate
NA	Not applicable
NAC	*Nevada Administrative Code*
ND	Normalized difference
NEPA	*National Environmental Policy Act*
NDEP	Nevada Division of Environmental Protection
NDEM	Nevada Department of Environmental Management
NNSA/NV	U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office
NRS	*Nevada Revised Statute*
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
PA	Preliminary assessment
PAL	Preliminary action level
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
PFTC	Protective Forces Training Complex
POC	Performance objective criteria
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control

List of Acronyms and Abbreviations *(Continued)*

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
SD	Standard deviation
SDG	Sample delivery group
SDWS	Safe Drinking Water Standards
SSHASP	Site-specific health and safety plan
SVOC	Semivolatile organic compound
TCLP	Toxicity characteristic leaching procedure
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
UTM	Universal transverse mercator
VOC	Volatile organic compound
WSI	Wackenhut Services, Inc.
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
%R	Percent recovery

Executive Summary

This Corrective Action Investigation Plan contains the project-specific information including facility descriptions, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit 5: Landfills, Nevada Test Site, Nevada. The results of the field investigation will support a defensible evaluation of corrective action alternatives in the Corrective Action Decision Document.

Corrective Action Unit 5 is comprised of the following Corrective Action Sites:

- 05-15-01, Sanitary Landfill
- 05-16-01, Landfill
- 06-08-01, Landfill
- 06-15-02, Sanitary Landfill
- 06-15-03, Sanitary Landfill; Burn Pit
- 12-15-01, Sanitary Landfill
- 20-15-01, Landfill
- 23-15-03, Disposal Site

The eight corrective action sites in Corrective Action Unit 5 are located in Areas 5, 6, 12, 20, and 23 of the Nevada Test Site. The data quality objective process was used to identify and define the type and quality of data needed to complete the investigation phase of the Corrective Action Unit 5 corrective action process. A phased approach was developed to address the data needs during the investigation. The Phase I investigation will determine if contaminants of potential concern are present in concentrations exceeding preliminary action levels which define a contaminant of concern. If laboratory data obtained during Phase I indicates the presence of a contaminant of concern, Phase II will be implemented to determine the extent of the contaminant of concern. The process will continue based on the laboratory analytical results of the environmental samples and conclude once all the data required for corrective action are obtained. Corrective action closure alternatives (e.g., no further action, close in place) will be evaluated for each corrective action site with a contaminant of concern. Phase I data collection will be conducted at all corrective action sites.

Based on process knowledge, the primary contaminants of potential concern for Corrective Action Unit 5 are total petroleum hydrocarbons. To address uncertainty associated with other contaminants of potential concern, the Phase I analytical program will include volatile organic compounds, semivolatile organic compounds, *Resource Conservation and Recovery Act* metals plus nickel and zinc, total petroleum hydrocarbons, polychlorinated biphenyls, pesticides (Corrective Action Site 23-15-03 only), dioxins, and radionuclides (plutonium-239, americium-241, and strontium-90 at Corrective Action Sites 06-15-02 and 06-15-03 only). Based on the results of Phase I sampling, the analytical program for Phase II characterization may be reduced.

In general, field activities will consist of collecting soil samples at biased locations by appropriate methods. If Phase II is necessary, soil samples will be collected from horizontal and vertical step-outs to bound the extent of contamination.

The general technical approach for investigation of CAU 5 will consist of the following activities:

- Perform geophysical and geodetic surveys.
- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present or migrating.
- Collect required quality control samples.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.
- Collect soil samples and test for geotechnical/hydrologic parameters.
- Collect soil samples for bioassessment, as appropriate.
- Collect additional samples for waste characterization, as necessary.

This Corrective Action Investigation Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to be 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*, this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Field work will be conducted following approval of the 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 investigations at Corrective Action Unit (CAU) 5: Landfills, 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. Eight Corrective Action Sites (CASs) comprise CAU 5 (Figure 1-1) and consist of unlined landfills where disposal operations occurred between 1952 and 1992. The CASs are in Areas 5, 6, 12, 20, and 23. The eight CASs are:

- 05-15-01, Sanitary Landfill
- 05-16-01, Landfill
- 06-08-01, Landfill
- 06-15-02, Sanitary Landfill
- 06-15-03, Sanitary Landfill; Burn Pit
- 12-15-01, Sanitary Landfill
- 20-15-01, Landfill
- 23-15-03, Disposal Site

1.1 Purpose

Corrective Action Unit 5 is being investigated because disposed waste may be present without appropriate controls (e.g., use restrictions and adequate cover) and hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment. The NTS has been used for various research and development projects including nuclear weapons testing. The eight CASs consist of unlined landfills where disposal operations occurred between 1952 and 1992. Large volumes of solid waste were produced from these projects. Instead of managing solid waste at one or two disposal sites, the practice on the NTS was to dispose of solid waste in the vicinity of the project (Elle, 1996). Additional CAS-specific information is provided in Section 2.0, Section 3.0, and in Appendix A.

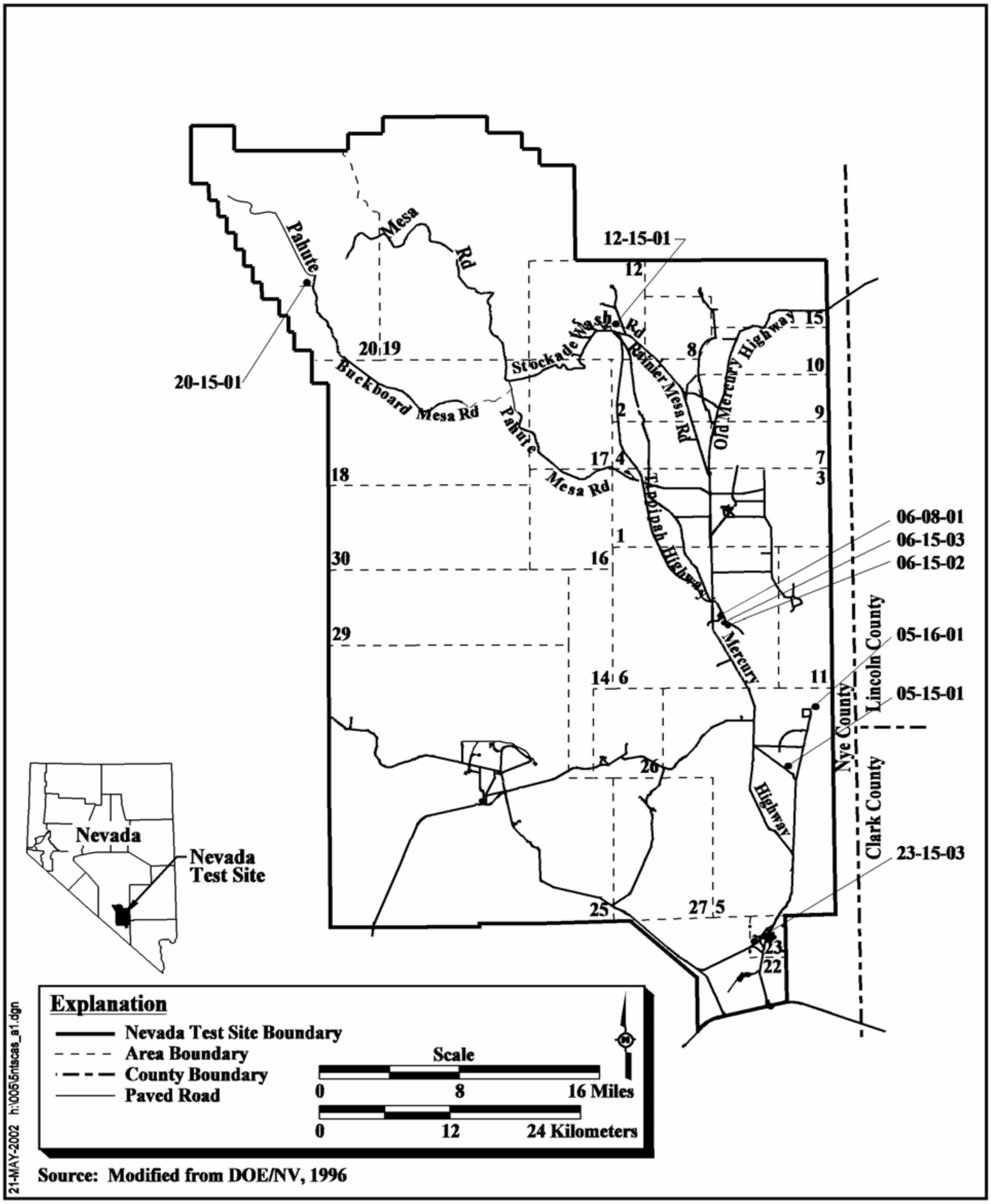


Figure 1-1
Nevada Test Site and CAU 5 Site Map

The Nevada Division of Environmental Protection (NDEP) (Liebendorfer, 1996a) determined existing information and process knowledge on the expected nature and extent of contamination are insufficient to select preferred corrective actions (e.g., no further action, close in place); therefore, additional information will be obtained by conducting a corrective action investigation at the CAU 5 CASs.

The CASs will be investigated based on data quality objectives (DQOs) developed by representatives of NDEP and DOE, National Nuclear Security Administration Nevada Operations Office (NNSA/NV). The DQOs are used to identify and define the type and quality of data needed to develop and evaluate appropriate corrective actions for CAU 5. This CAIP will describe the investigation developed to collect these data. The general purpose of the investigation is to ensure that adequate data is collected to provide sufficient and reliable information to identify, evaluate, and technically defend potentially viable corrective actions (e.g., no further action, close in place). A phased approach has been selected to generate the data needed to satisfy the DQOs.

1.2 Scope

The scope of the CAU 5 investigation is to generate the information needed to resolve the decision statements identified in the Phase I and Phase II DQO process. A-two phase approach has been selected to collect information and generate data to satisfy the criteria needed to resolve the decision statements developed during the DQO process.

The Phase I decision statements are to determine if disposal of waste has occurred, if existing disposal feature covers are adequate, and if a contaminant of concern (COC) has migrated from disposal features. Contaminants of concern are defined as contaminants of potential concern (COPCs) that are present in samples at concentrations above preliminary action levels (PALs) defined in Section 3.3. If data indicates that a COC has migrated, then the Phase II investigation will be conducted to determine the vertical and lateral extent of contamination. Due to the potentially dangerous nature of buried waste (i.e., compressed gas cylinders, medical waste, or asbestos), most sample locations will be biased adjacent to disposal feature boundaries using vertical borings. This approach assumes that any significant contamination will migrate laterally as well as vertically.

The scope of the corrective action investigation for CAU 5 includes the following Phase I and Phase II activities to address the criteria for each decision statement:

- Phase I - Perform geophysical surveys to confirm the presence or absence of disposed waste within a CAS and to verify the boundaries of the disposal areas within the CAS, as practical.
- Phase I - Penetrate disposal feature covers via excavation or drilling to make direct measurements of the covers' thicknesses.
- Phase I - Perform geodetic surveys to determine the slope of disposal feature covers.
- Phase I - Collect environmental samples for laboratory analyses to confirm the presence or absence of disposed waste if geophysical surveys are inconclusive, and to determine if contaminants at concentrations exceeding PALs have migrated beyond disposal features.
- Phase I - Collect soil samples for the analysis of geologic and hydrologic properties.
- Phase I - Collect soil samples for bioassessment, if biasing factors suggest a hydrocarbon or solvent plume may be present.
- Phase II - At CASs where a COC has been identified, collect additional environmental samples and submit for laboratory analysis to define the vertical and lateral extent of migration.
- Phase I and II - Collect Quality Control (QC) samples for laboratory analyses to ensure that the data generated from the analysis of investigation samples meet the requirements of the data quality indicators (DQIs).
- Phase I and II - To comply with regulatory requirements for waste disposal, collect samples of investigation-derived waste (IDW), as needed, and submit for laboratory analysis.

1.3 CAIP Contents

The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994a) and the site-specific field management plan that will be developed prior to field activities. Section 1.0 presents the purpose and scope of this CAIP and Section 2.0 provides the background information for the CAU. The objectives, including the general conceptual site model (CSM), are presented in Section 3.0. Field sampling activities are discussed in Section 4.0, and waste management issues are discussed in Section 5.0. General field and laboratory quality assurance (QA) and QC issues (including collection of QC samples) are presented in Section 6.0 of this CAIP and also in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002). The health and safety aspects of this project are documented in the IT Corporation, Las Vegas Office (ITLV), *Health and Safety Plan* (HASP) (IT, 2001b), and will be supplemented with a site-specific health and safety plan (SSHASP) written prior to the start of field work. The project schedule and records-availability information for this document are discussed in Section 7.0. Section 8.0 provides a list of references. Appendix A provides the DQO summary and Appendix B contains information on the project organization. Appendix C contains responses to NDEP comments on the draft CAIP. Public involvement activities are documented in the "Public Involvement Plan," Appendix V, of the FFACO (1996).

2.0 Facility Description

The CASs were grouped into CAU 5 based on their geographical location, technical similarities, and agency responsibility for closure.

2.1 Physical Setting

The following sections describe the general physical setting for Areas 5, 6, 12, 20, and 23 as it pertains to topography, geology, and hydrogeology.

2.1.1 Area 5

The CAS 05-15-01 and CAS 05-16-01 landfills are located in Area 5 in the Frenchman Flat basin. Most of Area 5 is in the vicinity of Frenchman Lake, which is a playa occupying a topographic depression at the center of the Frenchman Flat basin.

The complex geology of Frenchman Flat produced a varied stratigraphy. The alluvium thickness ranges from a thin covering along the valley edges to perhaps as much as 3,000 feet (ft) below ground surface (bgs) in the north central portion of Frenchman Flat (DOE/NV, 1999a). The playa is formed of sedimentary deposits over 990 ft deep. The sands, gravels, silts, and clays form a level flood plain. Because the sediments are relatively impervious to water, large shallow ponds form on the playa during times of seasonal precipitation. In the southern portion of Frenchman Flat, the soils tend to be more alkaline. The soils in and around Frenchman Flat have the highest salt concentrations of any of the soils on the NTS. High carbonate levels lead to the development of hardpan (e.g., caliche). This hardpan layer is usually within 3 ft bgs. (DOE/NV, 1986)

Frenchman Flat is within a closed basin without external surface drainage for water. Surface water is virtually absent in Area 5. Direct rainfall averages 4 inches (in.) per year at Frenchman Flat. Runoff from the mountains occurs during brief intense storms, which mostly occur during the summer. The runoff collects in the lowest points in the ephemeral Frenchman Lake playa. (REECo, 1991b)

CAS 05-16-01 is located on the alluvial fan on the northeast edge of Frenchman Flat. To divert surface water away from the Radioactive Waste Management Site (RWMS), an engineered dike system was constructed. (REECo, 1991b) Part of this dike crosses through the landfill separating the western one-third of the landfill from the remainder of the CAS.

Water Well 5b is located approximately 3 mi southwest from CAS 05-16-01 and was drilled 900 ft into the alluvium near CAS 05-15-01. The static water level is approximately 684 ft bgs (DOE/NV, 1996). An unknown quantity of water recharges annually from the surface and shallow alluvium into the deeper Paleozoic carbonate rocks of the regional aquifer. The groundwater flows at depth to the southwest eventually discharging at Ash Meadows southwest of the NTS (DOE/NV, 1996).

2.1.2 Area 6

All three landfills within Area 6 are near the large, dry Yucca Lake bed. The CAS 06-08-01 landfill is beneath the active Area 6 Equipment Yard. Corrective Action Sites 06-15-03 and 06-15-02 are slightly southeast of CAS 06-08-01 and border the large, dry Yucca Lake bed.

Area 6 is within the Yucca Flat intermontane basin which is typical of basin-and-range structures. The alluvium and tuff-filled valleys are rimmed mainly by sedimentary and volcanic rocks. In the lowland areas, the consolidated rock units are overlain with alluvium. On the alluvial fans, the alluvium comprises interbedded gravel, sand and silt with varying degrees of cementation. (Cornwall, 1972)

The landfills are located approximately 20 ft above the Yucca Lake Playa at a surface elevation of approximately 3,940 ft. About 10 ft of poorly sorted and weakly consolidated alluvium was exposed in the walls of the landfill while open (i.e., under construction or operational). The alluvium thickness was estimated to be up to 200 ft. (Frazier, 1988)

Area 6 is located in the Ash Meadows Groundwater Basin. Given the type of stratigraphy of the Yucca Lake Playa, groundwater moves slowly through playa deposits and nonfractured volcanic rocks (DOE/NV, 1996). The groundwater flow rate within valley-fill deposits is dependent on the amount of clay and mineralization and on the degree of consolidation (DOE/NV, 1996). The groundwater generally moves downward through alluvium and bedrock to the aquifer, flowing southwest and discharging at Ash Meadows (DOE, 1988). The nearest water table data is Well C-1, which is located about one mile to the southeast. The water level at Well C-1 is about 1,540 ft bgs (DOE/NV, 1996).

2.1.3 Area 12

The CAS 12-15-01 landfill is located in Area 12 at 5,080 ft above mean sea level (amsl) between two hills of exposed bedrock. Between these two hills, the landfill lies within relatively flat-lying deposits of alluvium and colluvium composed of unconsolidated to moderately cemented boulders, cobbles, pebbles, and sand. The alluvial and colluvial deposits within the region can reach thicknesses up to 6,534 ft. (Sargent and Orkild, 1973; Frizzell and Shulters, 1990)

Based on the alluvial and colluvial thicknesses, the bedrock underlying the CAS can reach thicknesses of as much as 6,500 ft to 14,500 ft bgs. The static composite water level in the vicinity of the CAS is approximately 1,540 ft bgs. This depth is based on information from Well ER-12-1 located near the base of the eastern slope of Rainer Mesa, along side the U12e tunnel access road where it passes the base of Dolomite Hill. Well ER-12-1 is located 2.3 mi from the CAS. (DRI, 1996)

Groundwater discharge is to the Amargosa groundwater system located south-southwest of the NTS (Winograd and Thordarson, 1975).

2.1.4 Area 20

The CAS 20-15-01 landfill is located in Area 20 and is positioned in an ashflow tuff which breaks up into a fine granular material when excavated. Drill hole U-20ao is located approximately 3,500 ft northwest of the CAS (Davis, 1988). U-20ao was drilled to a total depth of 2,150 ft bgs. The borehole was drilled through a sequence of welded ash-flow deposits, ash-flows and associated bedded tuffs, and terminated in rhyolitic lavas. Physical properties were assessed for the upper 722 ft of the stratigraphic sequence. In general, the physical properties assessment found that the vitric bedded tuffs and alluvium have higher porosities, as well as significant permeabilities. The denser lavas and welded ash-flow tuffs tend to have lower porosities, but have higher permeabilities due to fractures. The zeolitized bedded tuffs have very low permeabilities (REECo, 1993). This stratigraphy isolates the surface impoundment producing an aquifer at a depth of 1,956 ft

(REECo, 1993). Surface water runoff from the edges of the CAS is directed away from the landfill by the natural slope of the terrain (Davis, 1988).

2.1.5 Area 23

The CAS 23-15-03 landfill and dump site are located on an alluvial fan south of the Red Mountain Range in Area 23 at approximately 3,690 ft amsl (USGS, 1983). An unnamed monitoring well located about 0.7 mile (mi) from the active Area 23 Sanitary Landfill showed layers of sand and gravel with periodic silt from 90 ft to 935 ft bgs; caliche/limestone and medium coarse sands from 935 to 1,039 ft bgs; layers of fine sand, sandstone chunks, fine gravel and clay, to sandstone clasts and gravels, and to gravels and pebbles from 1,039 to 1,200 ft bgs; and coarse grained quartzite-dolomite from 1,200 to 1,338 ft bgs. The monitoring well revealed two perched water layers. These layers were encountered at 500 ft bgs and 1,080 ft bgs and were 1-ft and 11-ft thick, respectively. The static water level was at 1,150 ft bgs. (BN,1997)

The nearest potable water well, Army Well 1, is located approximately 3.5 mi to the southwest and is 3,154 ft amsl. The static water level depth at this well is 690 ft bgs. (DOE/NV, 1996)

2.2 Operational History

The following subsections provide a description of the use and history of each of the CASs in CAU 5 that may have resulted in a potential release to the environment. The CAS-specific summaries are designed to illustrate any significant known waste-generating activities or release. In general, solid waste landfills consisted of burn pits and trenches measuring approximately 300 by 12 ft and about 12 ft deep (Norvell, 2001a). Interviewees reported that open burning was a common practice until 1972 to reduce the amount of waste and suggested that anything could be found in these landfills (Neagle, 2001). One interviewee reported no radiological waste was put in any of the CAU 5 landfills (Hoar, 2001a); however, another interviewee (Tefft, 2001) stated that he dumped a cow from the U.S. Environmental Protection Agency (EPA) Farm into the Area 6 Landfill trenches (i.e., CAS 06-15-02 or CAS 06-15-03). The EPA Farm cows were used to determine the animal intake and retention of radionuclides (DOE/NV, 1997a). Landfills were routinely covered with native soil when they became inactive (Norvell, 2001a).

2.2.1 CAS 05-15-01, Sanitary Landfill

This landfill was first identified as a CAS on August 21, 1995, by an ITLV field crew while on tour of NTS landfills with personnel from the DOE. The landfill was operational from 1965 to 1971 and is presumed to cover a 300 by 240-ft area delineated by four concrete monuments. Waste disposal in the landfill may have included solid, liquid, and sludge waste. Mounds are obvious on the landfill surface and are believed to be covered trenches of waste. A depression in the soil cover is possibly a trench or disposal pit whose cover has subsided more than the surrounding areas. Although the physical boundaries of any burn pits were unable to be visually verified, burning is evident by burned debris (e.g., wood, metal) protruding through the landfill surface.

2.2.2 CAS 05-16-01, Landfill

This landfill was first identified as a CAS on August 21, 1995, by an ITLV field crew while on tour of NTS landfills with personnel from the DOE. The landfill received construction debris from 1965 to 1971. The CAS is located partially within the Area 5 RWMS site boundary. As many as four trenches are believed to have been used to burn material before it was covered. The cover appears to be native soil with some vegetation that has begun to invade the area. Four concrete monuments delineate an area of approximately 505 by 160-ft that is presumed to be the boundaries of this landfill. Metal debris is located on the landfill surface. The RWMS flood control dike runs north and south across the width of the landfill and cuts through the western one-third of the landfill. An area of subsidence is located just east of the RWMS flood control dike.

2.2.3 CAS 06-08-01, Landfill

The CAS consists of a landfill located under the active Area 6 Equipment Yard. This landfill was first identified in 1994 in the *Surveillance on Inactive Landfills at the NTS* (DOE/NV, 1994b). The landfill is alleged to have been operational between 1969 and 1974, but historical aerial photos show open trenches in the southwest corner in 1967. The dimensions of the landfill are unknown. The entire equipment yard area was measured to be 2,200 by 1,000 ft. Four landfill monuments were identified.

The landfill is believed to have accepted solid, liquid, and sludge waste types that included construction debris, garbage, rubbish, and refuse, and possibly waste from the Area 6 cafeterias and support facilities. The equipment yard ground surface is currently covered with compacted soil and peagravel.

Several diesel, oil, hydraulic oil, and waste oil releases have been documented to have occurred on the equipment yard or landfill cover as a result of vehicle maintenance and vehicle part failures. The spills on the surface of the operations equipment yard have Nevada Division of Environmental Management (NDEM) case numbers and were properly reported to NDEP under subject regulations (Elle, 1995). Other small releases were determined to be below reporting thresholds and are not reportable to NDEP. Operational spills and incidents that occurred after 1996 are not legacy and not subject to FFACO inclusion.

2.2.4 CAS 06-15-02, Sanitary Landfill

This CAS consists of a landfill located along the southwestern edge of Yucca Lake positioned between CAS 06-15-03 to the north and the Hydrocarbon Landfill to the south. The CAS was first identified during a review of the *Potential Solid Waste Management Units* (DOE/NV, 1992a) and the *Environmental Survey Action Plan* (DOE/NV, 1990). The landfill was in use in 1974. The date it became inactive is not certain with possible dates ranging from 1976 to 1989. There is also a sign present at the landfill that reads, “Sanitary Landfill Closed Jan. 1, 1976.” The landfill measures 750 by 384 ft. The landfill is marked by the landfill monuments that read, “Sanitary Landfill.”

The landfill was designed to accept waste from Areas 3, 5, and 7 as well as the Area 6 Control Point (CP) Compound. The types of waste that were disposed into the landfill are believed to consist of solid, liquid, sludge, sanitary trash, construction debris, concrete, asphalt, refuse, empty barrels, and oil. The close proximity to CAS 06-15-03 and vague historical references suggest that this site may potentially have received some of the same wastes as the CAS 06-15-03 landfill.

2.2.5 CAS 06-15-03, Sanitary Landfill; Burn Pit

This CAS consists of a landfill and a burn pit and is located along the southwestern edge of Yucca Lake in Area 6, adjacent to CAS 06-15-02. The exact size of the landfill is not known; however, during the preliminary assessment process, the landfill (based on the monuments) was measured at approximately 888 ft by 574 ft. Based on preliminary assessment (PA) field observations, the landfill is believed to lie within the boundaries marked by the concrete landfill monuments. The CAS was first identified during a review of the *Potential Solid Waste Management Units* (DOE/NV, 1992a) and the *Environmental Survey Action Plan* (DOE/NV, 1990).

The landfill was designed to collect waste from various areas in the NTS including Areas 3, 5, and 7, as well as trash from the Area 6 CP Compound. It may have received test animals from the Area 15 EPA Farm. The types of waste that were disposed into this landfill include diesel fuel, dead animals, aerosol cans, sewage waste, trash, and possibly other types of waste. The landfill boundaries are believed to be marked by monuments that read, “Sanitary Landfill,” “Dead Animals,” “Aerosol Cans,” and “Sewage Waste.”

This CAS was often confused with CAS 06-15-02 due to its proximity to CAS 06-15-02. The date the CAS 06-15-03 landfill became inactive is uncertain. The landfill in CAS 06-15-03 was reported to have become inactive in January 1974; however, an aerial photograph dated 1982 shows trenches in the landfill that appear to be open. An interviewee states that he recalls using the trenches around 1986. Other documentation and interviews suggest dates of inactivity to include 1975 through 1980 or 1989.

2.2.6 CAS 12-15-01, Sanitary Landfill

This CAS was first identified during a review in Section L of the *Resource Conservation and Recovery Act (RCRA) Part B Permit Applications for Waste Management Activities at the Nevada Test Site* (DOE/NV, 1992b) and was described as being an inactive landfill thought to possibly contain hazardous wastes. According to historical documentation (Elle, 1996 and Liebendorfer, 1996a) and interviews (Hoar 2001a and Norvel, 2001a), solid waste was generated at the Area 12 Camp and disposed or burned at this landfill between 1961 and 1987. Kitchen grease from the Area 12 camp was disposed in this landfill between 1985 and 1987. The landfill was reported during an interview to have been associated with nearby tunnel testing (Neagle, 2001). The landfill includes nine burial trenches. Based on the CAS layout, an area identified as the western landfill consists of the waste trenches that are located to the west of a dirt access road which runs through the CAS from northwest to southeast. The eastern landfill includes both the sanitary landfill and all the waste trenches found to the east of the same road. Four of these trenches are identified by monuments indicating that “Kitchen Grease” was disposed in them, two trenches are labeled as having received “Kitchen Grease/Aerosol Cans,” and three trenches are identified by monuments marked “Sewage.”

To the west side of the dirt road, there is a concrete pad which is part of a discharge station for portable toilet vacuum trucks. The active septic piping runs adjacent to the landfill from the discharge station to a flow metering station, and then to either the leachfield or sewage lagoons located east of the CAS. The concrete pad and associated septic piping are not included in the scope of this CAS.

A decontamination effort at Area 12 was conducted after the accidental venting from the Baneberry weapons-related test. As a precaution, all food, including canned goods from the cafeteria, was reportedly buried in the “Area 12 Disposal Pit” (Brown, 1971) during the decontamination effort. Interviewees report that this landfill did not receive radioactive materials that resulted from the decontamination efforts (Hoar, 2001a).

2.2.7 CAS 20-15-01, Landfill

The landfill is located on the edge of Pahute Mesa about 300 ft west of the Buckboard Mesa Road and 0.5 mi south of the Pahute Mesa Road intersection. An as-built engineering drawing indicates that the landfill is approximately 542-ft long and 233-ft wide (REECo, 1969). This landfill was initially identified as being “clean” at the time the *Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites* (REECo, 1991a) was published. According to the *NDEP Landfill Inventory Survey* (NDEP, date unknown), the landfill was 0.2 acres at the time the survey was conducted and was a “sideslope” type of operation that received approximately 50 tons per year of separated wood and construction wastes. Due to the lack of waste manifests, the type of waste and waste volume at this landfill is also unknown.

Historical documentation and interviews indicate that this landfill accepted construction waste contributed by construction test activities (Davis, 1988) and possibly sanitary sewage during its operational time frame from 1982 through 1991 (Hoar, date unknown and 2001b; REECo, 1992). It is unlikely that waste was burned at this landfill because regulations prohibited the open burning of waste after December 1972 and no physical evidence of burning waste was identified during the PA process.

Aerial photography indicates that this landfill was a single excavation or open dump and did not contain trenches (RSL, date unknown; and Holmes and Narver, 1985). A borrow pit located across the access road from the landfill is used for road construction soil and is not associated with the landfill (Neagle, 2001). The known extent of the landfill is covered with uncompacted soil with a small amount of construction debris lying on the surface. Four monuments denoting the landfill boundaries identified the site as a construction landfill. There is a sign adjacent to the west side of the landfill that reads, "Danger High Voltage" (RSL, unknown). Another sign shown in a photograph reads, "Landfill Closed" (RSL, unknown).

2.2.8 CAS 23-15-03, Disposal Site

The CAS consists of a surface disposal area and a landfill in close proximity to one another. The landfill is located within and adjacent to the Area 23 Sanitary Landfill compound and the disposal area is located within the Wackenhut Services, Inc. (WSI) Protective Forces Training Complex (PFTC) (Doyle, 2001). This complex includes an administrative and classroom building (Building 1103), five firing ranges, support structures, and an ammunition and pyrotechnics storage building (Building 1101).

Both areas are covered and dirt roads have been constructed on the surface. Transportainers, vehicles, conexs, dumpsters, and other items are currently being stored on the surface of the landfill while the surface of the disposal area is littered with spent and unspent small arms ammunition from training exercises conducted in the WSI PFTC.

Information has not been identified indicating how this site was first identified in the FFACO; however, historical documents revealed that the site was identified as a solid waste management unit in 1987 (Frazier, 1987).

The disposal area is approximately 700-ft long by 100-ft wide on the north end and 215-ft wide on the south end. It was active from 1970 to 1973. Material was burned in the disposal area between 1970 and 1971, then the area continued to be used for surface dumping until 1973. Material was covered in 1972 and 1973 with asphalt removed from 200 Hill and then covered by soil (Norvell, 2001b). Burned tires and other material (e.g., tire soap) can be seen on the ground surface. Tire soap appears as a “green ooze” in two fenced areas located on the southern edge of the arterial road that runs through the northern segment of the disposal area.

The landfill began being used for burning in 1952 (Frazier, 1987). The burn pit is located in the western most portion of the landfill and is separated from the other trenches to the east by a large disturbed area that may or may not have been used for disposal purposes. The burn pit was open from 1952 until 1971. In 1971, burning operations ceased and the area was used as a landfill until 1976. During the mid to late 1980s the solid waste trenches were completely filled in (Doyle, 2001) and became the foundation for the Area 23 Sanitary Landfill support operations in 1993 (Kendall, 1993).

Directly east of the landfill are the Area 23 Hazardous Waste Trenches (CAU 112), which were closed in accordance with FFACO regulatory requirements (Elle, 1996). The active Class II Area 23 Sanitary Landfill receives nonhazardous solid waste (BN, 1997).

2.3 Waste Inventory

Process knowledge, interviews with former site employees, and general historical landfill practices indicate that waste disposed in the landfills may include portable toilet waste, burned debris (e.g., tires), oil, grease, hydraulic fluids, antifreeze, miscellaneous construction materials (e.g., light ballasts, asbestos), and potentially hazardous wastes. These sources did not indicate that any of the CASs addressed by this CAU were or were not used to dispose of material considered to be hazardous waste by current standards. There is sufficient process knowledge to indicate that radiological COPCs were not introduced to the CASs with the exception of CAS 06-15-02 and CAS 06-15-03 (Alderson, 2002). Former landfill workers that were interviewed reported that radioactive materials (i.e., animal carcasses) from the EPA Farm experiments were disposed in the CAS 06-15-02 landfill and perhaps the CAS 06-15-03 landfill. Additional review of the radioanalytes used in these experiments concluded that low concentrations of long-lived radioanalytes (e.g., plutonium-239) used in animal studies along with the use of short-lived radioanalytes preclude the possibility of encountering radiological contaminants that are detectable with handheld radiological survey instruments at CAS 06-15-02 (Alderson, 2002). To confirm that radioactive materials are not migrating from either CAS 06-15-02 or CAS 06-15-03, samples will be collected and analyzed for isotopic plutonium, strontium-90, and gamma-emitting radionuclides (i.e., americium-241).

Available information was evaluated during the DQO process, and a list of potential contaminants was developed and is described further in Section 3.2.

According to historical documentation (e.g., DOE/NV, 1992a; Frazier, 1987) and interviews (e.g., Hoar 2001a; Norvel, 2001a), large volumes of solid waste and possibly containerized liquid were produced from and disposed in the vicinity of NTS projects. Trenches and surface dumping were utilized to dispose the waste. Open burning of waste in trenches or on the surface was a common practice to minimize the volume of waste to be buried. The landfills were covered with native soil when they became inactive. Concrete monuments, often denoting waste streams, were placed to identify the presumed landfill boundaries. No disposal records were identified during the preliminary assessment of this CAU; therefore, the specifics of the waste disposed is mostly dependent upon interviewees and historical documents. The types of waste suspected to be present in each of the CASs is summarized below.

CAS 05-15-01, Sanitary Landfill; and CAS 05-16-01, Landfill - Construction debris disposal and burning activities are the primary sources of potential waste at these two CASs. The types of waste believed to have been accepted at these CASs consist of solid, liquid, and sludge.

CAS 06-08-01, Landfill - Waste types at this CAS include disposed and burned construction debris, garbage, rubbish, and refuse, in addition to the waste received from the Area 6 cafeteria and support facilities on a daily basis.

CAS 06-15-02, Sanitary Landfill; and CAS 06-15-03, Sanitary Landfill; Burn Pit - The sources of potential waste at these two landfills are expected from solid, liquid, and sludge. The sources of potential waste at CAS 06-15-02 are from the previous disposal of construction debris, concrete, asphalt, refuse, empty barrels, oil, Area 6 CP Compound trash, and related burning activities.

It is believed that the CAS 06-15-03 landfill was constructed to accept waste from various areas in the NTS, including Areas 3, 5, 7, and trash from the Area 6 CP Compound. It may have received test animal carcasses from the Area 15 EPA Farm. Live animals were injected with radioactive materials for these experiments (DOE/NV, 1995) and their remains may have been disposed in the CAS 06-15-03 landfill upon the completion of the experiments. Animal carcasses, primarily not associated with biological testing, were routinely doused with diesel fuel to facilitate the decaying process and/or burned. The test animal carcasses may potentially serve as a release source for plutonium-239, americium-241 (Alderson, 2002), and strontium-90 (Adams, 2002).

Based on the presence of landfill monuments and historical information, the type of wastes expected consists of solid (e.g., construction debris, sanitary waste, animal remains), liquid (e.g., aerosol cans, diesel fuel), and sludge (e.g., sewage waste). The close proximity of CAS 06-15-02 to CAS 06-15-03 and vague historical references suggest that CAS 06-15-02 may potentially have received some of the same wastes as CAS 06-15-03.

CAS 12-15-01, Sanitary Landfill - According to historical documentation (Elle, 1996 and Liebendorfer, 1996a), interviews (Hoar, 2001a and Norvell, 2001a), and site visits, the source of potential waste for this landfill is the disposal of solid waste from Area 12 Camp, construction debris, refuse, sewage, wood, metal, rubbish, garbage, kitchen grease, aerosol cans, and associated burning activities. A decontamination effort at Area 12 was conducted after the accidental venting from the Baneberry weapons-related test. As a precaution, all food, including canned goods from the cafeteria, was reportedly buried in the Area 12 Disposal Pit (Brown, 1971) during the decontamination effort. Interviewees report that this landfill did not receive radioactive materials that resulted from the decontamination efforts (Hoar, 2001a).

CAS 20-15-01, Landfill - This landfill allegedly accepted construction waste from Pahute Mesa (Elle, 1996) and possible sanitary waste. It is unlikely that waste was burned at this landfill because regulations prohibited the open burning of waste after December 1972 and no physical evidence of burning waste was identified during the PA process.

CAS 23-15-03, Disposal Site - This site is assumed to have received the majority of its waste from Areas 22 and 23 due to its proximity to Mercury. The types of wastes at this CAS may include burned solid, liquid, sludge, and containers (i.e., aerosol, liquids, and compressed gas).

Potentially hazardous steam jenny wastewater, including pesticide rinse water, from Quonset 800 was disposed in the hazardous waste trenches. Due to the proximity of the hazardous waste trenches to the landfill, the steam jenny wastewater may have also been disposed in the landfill (DOE/NV, 1990). Pesticide analytes were detected from the laboratory analysis of samples collected in the Quonset 800 area during the corrective action investigation of CAU 340, NTS Pesticide Release Sites. The pesticide analytes included 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; chlordane; aldrin; alpha-benzene hexachloride (BHC), beta-BHC, and gamma-BHC (also known as Lindane); dieldrin; endosulfan I; endosulfan II, endosulfan sulfate; endrin; endrin aldehyde; heptachlor; and heptachlor epoxide. (DOE/NV, 1998a).

2.4 Release Information

The PA process did not identify any known releases from the CASs; however, the potential for releases from the CASs exists based on the general CSM developed during the DQO process. The landfills are inactive and abandoned and no monitoring has taken place to determine if contaminants are migrating vertically or laterally. The sources of potential releases are varied, but are generally representative of the general CSM elements. Contaminated solid, liquid, and sludge waste may have been directly disposed into unlined landfill trenches or directly to the surface. Contaminants may have migrated into and impacted soil surrounding the disposed waste. Exposure pathways are limited to oral ingestion, inhalation, and dermal contact of soils by site workers due to disturbance of contaminated soils.

The Area 6 Equipment Yard was in place before the construction of CAS 06-08-01. As the Area 6 Equipment Yard expanded, the yard was constructed over the inactive CAS 06-08-01. Several releases involving diesel, oil, hydraulic oil, and waste oil have been documented (Clark, 1991; Clark, 1992a; Clark 1992b; Latham, 1996a; Latham, 1996b; and Schlick, 1996). The spills on the surface of the Area 6 Equipment Yard have NDEM Case Numbers (Elle, 1992) and were properly reported to NDEP under *Nevada Administrative Code* (NAC) 445A.347(2)(c) (NAC, 2000e). Small releases were not reported if they were determined to be below reporting thresholds. A review of the available release records indicate that releases were remediated or the volume of release was limited and should not have significantly impacted the landfill.

A leachfield connected to an active septic system servicing WSI buildings 1101 and 1103 may extend into the northeastern portion of CAS 23-15-03. The leachfield is not considered to be a part of the scope of this CAS. A leachfield connected to an active septic system servicing the Area 12 camp has recently been installed near the east end of the CAS 12-15-01 landfill. It is uncertain if the sewage from these leachfields have impacted these landfills. Any physical impacts to the landfills by the leachfields may become evident during the investigation of these CASs.

2.5 Investigative Background

A surveillance of inactive landfills at the NTS was conducted in 1993. The purpose of the surveillance was to determine which of the inactive landfills on the NTS required additional work to ensure compliance with State of Nevada solid waste regulations.

Four CAU 5 landfills were identified in this surveillance. The surveillance stated that "…the markers should be dated with the years the landfills were operational and the year they were covered." No action was required for CASs 06-08-01 and 06-15-02. It was stated in the surveillance that the above mentioned CASs had landfills that were active prior to 1991 (Elle, 1994).

On March 25, 1996, DOE, Nevada Operations Office (DOE/NV) submitted a letter to NDEP to promote the CAU 5 landfills from Appendix II to Appendix IV of the FFACO which would essentially close the landfills with no further action (Elle, 1996). In July of 1996, NDEP responded by indicating that the types of wastes disposed in the landfills were "...inadequately described, lacking information supporting a determination that these sites were not hazardous or that contaminants were not migrating from them into the environs..." (Liebendorfer, 1996a). The NDEP concluded that due to the absence of acceptable documentation, none of the CASs could be confirmed closed and transferred to Appendix IV of the FFACO. The eight CASs within CAU 5 ultimately remained in Appendix II of the FFACO (Liebendorfer, 1996b).

No previous characterization or remediation information has been identified for the CAU 5 CASs. However, analytical results for some of the hydrocarbon releases that occurred within the Area 6 equipment yard and within the vicinity of CAS 06-08-01 are available and show total petroleum hydrocarbons (TPH) and Toxicity Characteristic Leaching Procedure (TCLP) metals were detected in the soil below regulatory levels. A review of the available release records indicate that releases were remediated or the volume of release was limited and should not have significantly impacted the landfill.

In accordance with the NNSA/NV *National Environmental Policy Act* (NEPA) Compliance Program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 5. This checklist is used by NNSA/NV project personnel to evaluate their proposed projects against a list of several potential impacts which 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 NEPA documentation by the NNSA/NV NEPA Compliance Officer.

The following subsection describes previous sampling efforts that were conducted at locations within or near CAS 06-08-01 and CAS 23-15-03.

2.5.1 Previous Sampling Efforts

Area 6 Equipment Yard

The Area 6 Equipment Yard was in place before the construction of CAS 06-08-01. As the Area 6 Equipment Yard expanded, the yard was constructed over the inactive CAS 06-08-01. Several releases involving diesel, oil, hydraulic oil, and waste oil have been documented (Clark, 1991; Clark, 1992a; Clark 1992b; Latham, 1996a; Latham, 1996b; and Schlick, 1996). The spills on the surface of the Area 6 Equipment Yard have NDEM Case Numbers (Elle, 1992) and were properly reported to NDEP under *Nevada Administrative Code* (NAC) 445A.347(2)(c) (NAC, 2000e).

Area 23 Surface Disposal Site

Five surface soil samples consisting of soil and green ooze were collected as preliminary information for CAS 23-15-03 (Stokowski, 1999). Analytical results indicated that the green ooze did not contain regulated constituents above PALs. Analytes detected were acetone; toluene; trichlorofluoromethane; methylene chloride; 2-butanone; ethyl benzene; m, p-xylene; styrene; bis(2-ethylhexyl)phthalate; 2-methylnapthalene; phenanthrene; chlordane; lindane; 4, 4’-DDT; heptachlor; 4, 4-DDD; dieldrin; heptachlor epoxide; 4, 4’-DDE; aroclor-1254; arsenic; selenium; barium; chromium; cadmium; mercury; and lead. The area sampled is in the central portion of the disposal site within CAS 23-15-03 in CAU 5.

3.0 Objectives

This section presents an overview of the DQOs for CAU 5 and the development of the general CSM. Also presented are the COPCs and PALs for the investigation.

3.1 Conceptual Site Model

The CSM describes the most probable scenario for current conditions at each site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. The general CSM was developed for CAU 5 using assumptions formulated from historical background information, potential contaminant sources, knowledge from studies of similar sites, and data from previous sampling efforts presented in Section 2.0. A discussion in Section A.1.1.3 also provides information on the CSM.

3.1.1 Future Land Use

Future land-use scenarios limit future uses of the CASs to various nonresidential (i.e., industrial) uses. Exposure scenarios for sites located within the NTS boundaries are limited by the future land-use scenarios to site workers who may be exposed to COPCs through oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris (e.g., equipment, concrete) due to inadvertent disturbance of these materials. Alternative 3, *Expanded Use,* is used to consider future land-use scenarios at the NTS to include all currently planned and proposed projects, all currently ongoing NNSA/NV and interagency programs and operations described in Alternative 1, *Continue Current Operations (No Action Alternative)*, and potential project activities resulting from other DOE Environmental Impact Statements (EISs). (DOE/NV, 1996)

The CAU 5 CASs are within the following future land-use zones (DOE/NV, 1998b):

- Research, Test, and Experiment Zone - CAS 05-15-01
- NTS Reserved Land-Use Zone - CAS 05-16-01, CAS 06-15-02, CAS 06-15-03, and CAS 23-15-03
- Defense Industrial Land-Use Zone - CAS 06-08-01

- Nuclear and High Explosive Test Land-Use Zone - CAS 12-15-01
- Nuclear Test Land-Use Zone - CAS 20-15-01

3.1.2 Exposure Pathways

Exposure pathways to site workers include oral ingestion, inhalation, and dermal contact of soils due to disturbance of contaminated soils.

Groundwater is not expected to have been impacted because of its significant depth and the environmental conditions (i.e., arid climate and relatively low permeability soils) are not conducive to downward migration. Groundwater contamination is not considered a likely scenario at CAU 5. The depth to groundwater varies for each CAS from 684 ft bgs in Area 5 to 2,600 ft bgs in Area 12. Perched water layers may be present near CAS 23-15-03 in Area 23 at 500 ft bgs and 1,080 ft bgs (BN, 1997).

3.1.3 Release Mechanisms

Release mechanisms at the CAU 5 CASs include direct release to the surface or trenches, release of contaminants through burning activities, and leaching of contaminants from materials.

3.1.4 Migration Pathways

Percolation of precipitation through soil serves as a driving force for downward migration of contaminants. However, the annual average precipitation on the valleys ranges from 3 to 6 inches and on most of the ridges and mesas precipitation averages less than 10 inches. The potential annual evaporation was estimated to range from 60 to 82 inches per year, or roughly 5 to 25 times the annual precipitation. (Winograd and Thordarson, 1975).

Contamination, if present, is expected to be contiguous to the release site. Concentrations are expected to decrease with distance and depth from the landfills and disposal areas. In the case of surface disposal areas, surface contamination concentrations are expected to decrease outward from the edges of the dump site. Surface soil downgradient of any surface release would more likely be impacted than upgradient surface soil.

3.1.5 Exposure Points

Exposure points are most likely in subsurface soil at the base of landfills or at the base of the depression in areas of subsidence located within the surface boundaries of a landfill. Exposure points for a disposal site are most likely at the interface between the disposal site and the native ground surface as in the case of CAS 23-15-01. At CASs where the disposal site is located within the surface boundaries of a landfill, the exposure point would be expected at the interface of the disposal site and the native surface. It is possible that sludge layers may be present within the landfills where COPCs would be expected at the base of the individual sludge and the native soil fill material separating the layers.

3.1.6 Additional Information

Additional topographic information for CAU 5 will be limited to the vicinity of the CASs. The information to be gathered primarily consists of the presence of an arroyo cross-cutting the surface nearby and within CASs, such as CAS 23-15-03. In addition, geodetic surveys will be conducted on landfill covers.

General surface and subsurface soil descriptions will be observed and recorded during the corrective action investigation. If bedrock is contacted during the investigation, then the stratigraphy and lithology will be recorded as well.

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

Groundwater data for the CAU is known and has been addressed in the CSM. No further information is required.

Existing floodplain studies are available and will be considered during corrective action, as necessary. No further information is required.

The presence of infrastructures is known. Additional information regarding the potential impact of infrastructures on four CASs will be determined during the corrective action investigation. The infrastructures and their respective CASs are the equipment yard associated with CAS 06-08-01; the

RWMS dike near CAS 05-16-01; the active leachfield, active landfill, and WSI facility near CAS 23-15-03; and the active sewage piping, leachfield or sewage lagoons, and flow metering station, at CAS 12-15-01.

3.2 Contaminants of Potential Concern

Types of contaminants that might be present were identified through a review of site history documentation, process knowledge, personal interviews, and inferred activities associated with the CAU. Table 3-1 provides a list of COPCs.

Table 3-1
Phase I Contaminants of Potential Concern for CAU 5

CAS	Chemical COPCs	Radiological COPCs	Source of Information
05-15-01	Diesel fuel, grease	None identified	Neagle, 2001; IT, 2001a
05-16-01	Diesel fuel	None identified	Neagle, 2001
06-08-01	Diesel fuel	None identified	Neagle, 2001
06-15-02	Diesel fuel, oil	Plutonium-239, Americium -241, Strontium-90	Norvell, 2001a; Alderson, 2002;
06-15-03	Diesel fuel, oil	Plutonium-239, Americium -241, Strontium-90	Alderson, 2002
12-15-01	Diesel fuel, grease, solvents	None identified	Neagle, 2001; Norvell, 2001a; IT, 2001a
20-15-01	None identified	None identified	Not Applicable
23-15-03	Diesel fuel; 4,4’ - DDD; 4,4’-DDE; 4,4’ - DDT; chlordane; aldrin; alpha, beta, and gamma BHC; dieldrin; endosulfan I; endosulfan II; endosulfan sulfate; endrin; endrin aldehyde; heptachlor; heptachlor epoxide	None identified	Neagle, 2001; Norvell, 2001b; DOE/NV, 1998a

Laboratory analysis of environmental soil samples will provide the means for quantitative measurement of the COPCs. To ensure that laboratory analyses are sufficient to detect contamination in soil samples at concentrations exceeding the minimum reporting limit (MRL), Phase I chemical and radiological parameters of interest have been selected for each CAS. For each CAS, the Phase I chemical parameters for soil samples include:

- Volatile organic compounds (VOCs)
- Semivolatile organic compounds (SVOCs)
- Polychlorinated biphenyls (PCBs)
- Pesticides (for CAS 23-15-03 only)
- Petroleum hydrocarbons (diesel- and gasoline-range organics [C_6-C_{38}])
- RCRA metals, plus nickel and zinc
- Dioxins (only if PCBs are detected)

Phase I radiological parameters include:

- Gamma-emitting radionuclides (i.e., americium-241)
- Strontium-90 (only if field-screening results [FSRs] for beta exceed field-screening levels [FSLs] at CAS 06-15-02 and CAS 06-15-03 only)
- Isotopic plutonium (for CAS 06-15-02 and CAS 06-15-03 only)

If additional sampling is necessary, parameters will be limited to COCs identified by Phase I analytical results, and the appropriate NNSA/NV and NDEP representatives will be notified.

3.3 Preliminary Action Levels

Laboratory analytical results for soil samples will be compared to the following PALs to evaluate if COCs are present or migrating:

- *EPA Region 9 Risk-Based Preliminary Remediation Goals* (PRGs) for chemical constituents in industrial soils (EPA, 2000).
- Background concentrations for metals will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic. 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 Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- The TPH action limit of 100 mg/kg per the NAC 445A.2272 (NAC, 2000e).
- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992; DOE/NV, 1999b). The PAL is equal to the minimum detectable concentration (MDC) for isotopes not reported in soil samples from undisturbed background locations or if the PAL is less than the MDC (see Table 3-3).

For detected chemical COPCs without established PRGs, a similar protocol to that used by EPA Region 9 will be used in establishing an action level for those COPCs listed in the Integrated Risk Information System (IRIS) Database (EPA, 2002).

The comparison of laboratory results to PALs will be discussed in the Corrective Action Decision Document (CADD). Laboratory results above action levels indicate the presence of COCs at levels that may require corrective action. The evaluation of potential corrective actions and the justification for a preferred action will be included in the CADD based on the results of this field investigation. Proposed cleanup levels will be presented in the CADD.

3.3.1 Field-Screening Levels

Field screening may be instituted in the field to assist in providing additional semiquantitative measurements. The field-screening results (FSRs), along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following action levels may be used for on-site field screening:

- The VOC field-screening level (FSL), using the headspace method, is 20 parts per million (ppm) or 2.5 times background, whichever is greater.
- The TPH field-screening level is 75 ppm measured using an appropriate field-screening method (e.g., Handby or an equivalent method).
- The radiological (alpha and beta/gamma) FSL for soil samples is the mean background count rate plus two times the standard deviation of the mean background activity (Adams, 1998).

Field-screening concentrations exceeding FSLs for radionuclides indicate potential contamination at that sample location. This information will be documented and the investigation will be continued in order to delineate the extent of contamination. Additionally, this data may also be used to select discretionary samples to be submitted for laboratory analysis.

3.4 DQO Process Discussion

The DQOs are qualitative, semiquantitative, and quantitative statements that define the type, quantity, and quality of data required to support evaluations of potential closure alternatives for CAU 5. The

DQOs were developed to identify data needs and clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes.

Details of the DQO process are presented in Appendix A. During the DQO discussion for this CAU, the informational inputs or data needs to resolve problem statements 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 such as 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 conceptual model and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs may be used, such as sensitivity.

The DQO decision flow process applied to the CAU 5 investigation is depicted in Figure A.1-2. This decision process starts with a Phase I investigation for all CASs. If laboratory data obtained from the Phase I investigation indicates the presence of COCs, the process will continue with a Phase II investigation. The process ends with no further investigation of the site based on the laboratory analytical results of the environmental samples and having all the data required for selection of a corrective action. The corrective action alternative closure-in-place will be evaluated for each CAS with COCs.

Analytical methods and MRLs for each chemical parameter are provided in Table 3-2. The MRL is a practical reporting limit that ensures data generated by the laboratory will be usable by the investigation.

Radiation MRLs were developed considering both the MDCs and the PALs (Adams and Dionne, 2000). The MDCs, PALs, and MRLs for radionuclides are provided in Table 3-3. The MDC is the smallest amount of activity of a particular parameter that can be detected in a sample with an acceptable level of error. The MDCs listed in Table 3-3 are typical default levels available for a commercial radioanalytical laboratory.

Table 3-2
Analytical Requirements for CAU 5
(Page 1 of 4)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision[a]	Percent Recovery (%R)[b]
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous Soil	8260B[c]	Parameter-specific estimated quantitation limits[d]	Not Applicable (NA)	Laboratory-specific[e]	Laboratory-specific[e]
Toxicity Characteristic Leaching Procedure (TCLP) VOCs						
Benzene	Aqueous	1311/8260B[c]	0.050 mg/L[d]	0.5 mg/L[f]	Laboratory-specific[e]	Laboratory-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 Soil	8270C[c]	Parameter-specific estimated quantitation limits[d]	NA	Laboratory-specific[e]	Laboratory-specific[e]
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C[c]	0.10 mg/L[d]	200 mg/L[f]	Laboratory-specific[e]	Laboratory-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 Soil	8082[c]	Parameter-specific (CRQL)[g]	NA	Laboratory-specific[e]	Laboratory-specific[e]
Dioxins (includes Furans)	Aqueous	8290	0.00001 μg/L	NA	Laboratory-specific[e]	Laboratory-specific[e]
	Soil		0.01 μg/kg			
Total Petroleum Hydrocarbons (TPH) [C_6-C_{38}]	Aqueous Gasoline	8015B modified[c]	0.1 mg/L[h]	NA	Laboratory-specific[e]	Laboratory-specific[e]
	Soil Gasoline		0.5 mg/kg[h]			
	Aqueous Diesel		0.5 mg/L[h]			
	Soil Diesel		25 mg/kg[h]			
Ethylene Glycol	Aqueous Soil	8015B[c] modified	To be determined upon minimum detectable limit study	NA	Laboratory-specific[e]	Laboratory-specific[e]

Table 3-2
Analytical Requirements for CAU 5
(Page 2 of 4)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision[a]	Percent Recovery (%R)[b]
Total Pesticides						
4,4'-DDD	Aqueous	8081A[c]	0.1 µg/L[g]	NA	Laboratory-specific[e]	Laboratory-specific[e]
	Soil		3.3 µg/kg[g]			
4,4'-DDE	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
4,4'-DDT	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
Aldrin	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
alpha chlordane	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
beta chlordane	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
alpha (BHC)	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
beta (BHC)	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
delta (BHC)	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
gamma - BHC (Lindane)	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
gamma - Chlordane	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
dieldrin	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
endosulfan I	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
endosulfan II	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
endosulfan sulfate	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
endrin	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
endrin aldehyde	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
endrin keytone	Aqueous	8081A[c]	0.1 µg/L[g]			
	Soil		3.3 µg/kg[g]			
heptachlor	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
heptachlor epoxide	Aqueous	8081A[c]	0.05 µg/L[g]			
	Soil		1.7 µg/kg[g]			
methoxychlor	Aqueous	8081A[c]	0.5 µg/L[g]			
	Soil		17.0 µg/kg[g]			
toxaphene	Aqueous	8081A[c]	5.0 µg/L[g]			
	Soil		170.0 µg/kg[g]			

Table 3-2
Analytical Requirements for CAU 5
(Page 3 of 4)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision[a]	Percent Recovery (%R)[b]
TCLP Pesticides						
alpha chlordane	Aqueous	1311/8081A[c]	0.0005 mg/L[g]	0.03 mg/L[f]	Laboratory-specific[e]	Laboratory-specific[e]
gamma chlordane			0.0005 mg/L[g]	0.03 mg/L[f]		
endrin			0.001 mg/L[g]	0.02 mg/L[f]		
heptachlor			0.0005 mg/L[g]	0.008 mg/L[f]		
heptachlor epoxide			0.0005 mg/L[g]	0.008 mg/L[f]		
Lindane (Gamma-BCH)			0.0005 mg/L[g]	0.4 mg/L[f]		
methoxychlor			0.005 mg/L[g]	10.0 mg/L[d]		
toxaphene			0.05 mg/L[g]	0.5 mg/L[d]		
INORGANICS						
Total Metals						
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[o]	
Barium	Aqueous	6010B[c]	200 µg/L[h, i]		20[i]	
	Soil	6010B[c]	20 mg/kg[h, i]		35[o]	
Cadmium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[o]	
Chromium	Aqueous	6010B[c]	10 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[o]	
Lead	Aqueous	6010B[c]	3 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	0.3 mg/kg[h, i]		35[o]	
Mercury	Aqueous	7470A[c]	0.2 µg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		35[o]	
Nickel	Aqueous	6010B[c]	40 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	4 mg/kg[h, i]		35[o]	
Selenium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[o]	
Silver	Aqueous	6010B[c]	10 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[o]	
Zinc	Aqueous	6010B[c]	20 µg/L[h, i]		20[i,]	
	Soil	6010B[c]	2 mg/kg[h, i]		35[o]	
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			0.1 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			0.1 mg/L[h, i]	5 mg/L[f]		

Table 3-2
Analytical Requirements for CAU 5
(Page 4 of 4)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision[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	NA	Relative Percent Difference (RPD) 20% (Aqueous) 35% (Soil)[l] Normalized Difference (ND) -2<ND<2[k]	Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l]				
Gross Alpha/Beta-emitting radionuclides	Aqueous	EPA 900.0[j]				
Isotopic Plutonium	Aqueous	ASTM D3865-97[m]				Chemical Yield 30-105[n]
	Soil	HASL-300[l]				
Strontium-90	Aqueous	ASTM D5811-95[m]	The Minimum Reporting Limits and Minimum Detectable Activities for Radionuclides are given in Table 3-3	NA	Relative Percent Difference (RPD[a]) 20% (Aqueous)[h] 35% (Soil)[l] Normalized Difference (ND) -2<ND<2[k]	Chemical Yield 30-105[n] Laboratory Control Sample Recovery 80-120[l]
	Soil	HASL-300[l]				
Geotechnical and Hydrological Properties	Soil	See Table 4-1	NA	NA	Laboratory-specific	Laboratory-specific

[a]Relative percent difference (RPD) is used to calculate precision. Precision is estimated from the RPD 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 $\{(|A_1-A_2|)/[(A_1+A_2)/2]\}$, where
A_1 = Concentration of the parameter in the initial sample aliquot,
A_2 = Concentration of the parameter in the duplicate sample aliquot
[b]The %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: %R = 100 x (A_s-A_u/A_n), where
A_s = Concentration of the parameter in the spiked sample,
A_u = Concentration of the parameter in the unspiked sample,
A_n = Concentration increase that should result from spiking the sample
[c]The EPA *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, 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* (CFR) Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2001a)
[g]EPA *Contract Laboratory Program (CLP) Statement of Work for Organic Analysis* (EPA, 1988b; 1991; and 1994c)
[h]*Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002)
[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 (ND) is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties: $S - D / \sqrt{(TPU_S)^2 + (TPU_D)^2}$
Evaluation of Radiochemical Data Usability (Paar and Porterfield, 1997)
[l]*Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)
[m]American Society for Testing and Materials (ASTM, 1996)
[n]*General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991)
[o]Sampling and Analysis Plan (Field Sampling and Quality Assurance Project Plan) with Guidance USEPA Region IX, March 1997 (EPA, 1997)

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

Table 3-3
Minimum Detectable Concentrations, Preliminary Action Levels, and Minimum Reporting Limits for Radionuclides in Samples Collected at CAU 5

Isotope	Soil and Sludge			Liquid		
	MDC[a] (pCi/g)	PAL[b] (pCi/g)	MRL[c] (pCi/g)	MDC[a] (pCi/L)	PAL[b] (pCi/L)	MRL[c] (pCi/L)
Plutonium-239/240	0.05	0.106	0.05	0.1	9.0	0.1
Strontium-90	0.5	1.17	0.5	1.0	1.0	1.0
Americium-241 (by gamma spectrometry)	2.0[d]	2.0	2.0	50[d]	50	50

[a]MDC is the minimum detectable concentration. It is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.
[b]PAL is the preliminary action level and 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, 1999b). 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]MRL is the minimum reporting level. It is set equal to 5 times the MDC, or if 5 times the MDC is greater than the PAL, the MRL is set equal to the MDC.
[d]MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.

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

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 5.

4.1 Technical Approach

The technical approach for CAU 5 consists of activities to be conducted prior to and during the corrective action investigation. This technical approach consists of, but is not limited to, the following activities:

- Perform geophysical surveys.
- Perform geodetic surveys.
- Collect Phase I samples from biased locations and submit for laboratory analysis as described in Section 3.2 and Section 3.4.
- Collect required QC samples.
- Collect waste characterization samples, as needed.
- Collect samples to define extent of contamination, if necessary.
- Collect samples from native soils and analyze for geotechnical/hydrologic parameters.
- Collect bioassessment samples if biasing factors suggest a hydrocarbon or solvent plume may be present.
- Mark sample locations and collect coordinates in universal transverse mercator (UTM), Zone 11, North American Datum 1927, meters coordinate system.

These activities may be conducted at any point during the investigation as deemed most efficient and appropriate by the Site Supervisor.

4.2 Field Activities

This section provides a description of the field activities for CAU 5. A phased approach to DQO decision-making has been chosen to address the data collection activities. Biased sampling will be conducted during the investigation to address both Phase I and Phase II data needs. Process knowledge indicates that contamination, if any, is confined to the spatial boundaries of the sites as defined in the DQO process and the CSM. If Phase I determines that COCs are migrating from a CAS, the extent of contamination will be determined (Phase II) before evaluating corrective action alternative requirements. Only COCs will be considered during Phase II.

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). The NDEP's concurrence with the ROTC is required prior to proceeding with investigation activities significantly different from those described in this document. If contamination is more extensive than anticipated, the maximum investigation depth will be limited by the capabilities of the equipment used to collect subsurface soil samples. If this occurs, the investigation will be rescoped.

Samples will be collected at biased sampling locations by rotary sonic drilling, hollow stem auger drilling, and/or excavation, as appropriate. Table 3-2 provides the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be used when analyzing for the COPCs. All sampling activities and QA/QC requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002) and other applicable procedures. Other governing documents include a current version of the ITLV HASP (IT, 2001b) and an approved SSHASP prepared prior to the field effort.

As required by the DOE Integrated Safety Management System (ISMS) (DOE/NV, 1997b), these documents outline the requirements for protecting the health and safety of the workers and the public, and procedures for protecting the environment. The ISMS program requires that site personnel will take every reasonable step to 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, SVOCs, 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 personal protective equipment (PPE).

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

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

4.2.1 Site Preparation Activities

Site preparation may be required by the NTS Management and Operating (M&O) Contractor prior to the investigation. Site preparation may include, but not be limited to, removal and proper disposal of surface debris and temporarily moving staged equipment (e.g., dumpsters at CAS 23-15-03, heavy equipment at CAS 06-08-01).

4.2.2 Phase I Activities

The objective of the Phase I strategy is to determine the lateral and vertical extent of disposed waste, the disposal feature cover characteristics (i.e., slope, thickness, and permeability [for comparison to subsurface permeability]), and the presence of COCs in or migrating from disposal features. Site-specific geophysical surveys, geodetic surveys, and biased sampling will be conducted during Phase I to make these determinations.

Geophysical surveys will be conducted to estimate the lateral and vertical extent of disposed waste. Geodetic surveys will be conducted to determine the slope of disposal feature covers. Direct measurement of the disposal feature covers will be obtained via excavation or drilling. The permeability of disposal feature covers and underlying subsurface soil will be determined by biased sampling and testing. The presence of migrating COCs will be determined by biased sampling and laboratory analyses. A comparison of laboratory analytical results from this phase against PALs will be used to confirm the presence or absence of migrating COCs. Biased sampling locations will be determined based on the results of the geophysical surveys and other biasing factors. An ROTC to this CAIP will be prepared to define planned sampling locations once the geophysical survey results have been interpreted. The Site Supervisor has the discretion to modify these locations and minimize samples submitted for laboratory analyses, but only if the decision needs and criteria stipulated in Section A.1.3 are satisfied.

The Phase I sampling strategy targets locations and media most like to be contaminated by migrating COCs. Appendix A lists the target populations for Phase I. Section A.1.3.1 and Table A.1-3, Table A.1-4, and Table A.1-5 identify the primary biasing factors and information needs in selecting data collection locations for Phase I decisions.

4.2.2.1 Geophysical Surveys

Geophysical surveys will be conducted at each of the CAU 5 CASs to define the lateral and vertical extent of disposed waste. Electromagnetic (EM) induction methodology using instruments such as the Geonics EM31 and EM61 will be used to determine the approximate lateral extent of disposed waste. Trench orientation will also be acquired from the results of these surveys. The grid spacing for data collection locations will be 10 ft. This spacing may be increased to 20 ft for CAS 06-08-01 due to its large area. The EM31 will be the primary instrument. The EM61 will be used to supplement EM31 data as necessary, especially near areas of interference (i.e., utilities and fences).

Electrical imaging (i.e., resistivity) methodology using instruments such as the Advanced Geosciences, Inc. SuperSting (or equivalent) will be used to determine the approximate vertical extent of disposed waste. The number and length of data collection traverses will be determined based on the results of the EM surveys. Seismic methodology may be used as an alternative.

4.2.2.2 Geodetic Surveys

Geodetic surveys will be conducted to determine the slope of the disposal feature covers. These surveys will be conducted in accordance with standard industry procedures.

4.2.2.3 Intrusive Investigation

Intrusive investigation activities such as drilling, excavation, or other appropriate methods will be used to collect biased surface and subsurface soil samples and determine the existing cover thickness. Biased locations for these activities will be determined based on the results of the geophysical surveys and other biasing factors.

The existing cover thickness will be determined by excavating or drilling into the covers at select locations. The minimum thickness measured will be assumed for the cover of the individual disposal feature (e.g., trench, pit, mound). During the use of tape measures, personnel will ensure that the tape is intact, does not contain knots, and is taut prior to recording the direct measurement.

The permeability of disposal feature covers and soil underlying the base of disposal features will be determined by collecting soil samples with coring device for laboratory testing. The collection and testing method requirements are provided in Section 4.2.4.

Rotary sonic drilling, hollow stem auger drilling, excavation, or other appropriate methods will be used to access sample intervals for laboratory analysis and/or testing at select locations to determine soil permeability and determine if a COC is present or has migrated. Due to the potentially dangerous nature of buried waste (i.e., compressed gas cylinders, medical waste, or asbestos), most sample locations will be biased adjacent to disposal feature boundaries using vertical borings. This approach assumes that any significant migration of contaminants will have both lateral and vertical components. Potential disposal features identified by inconclusive geophysics may be accessed directly at the discretion of the Site Supervisor. Disposal features may also be accessed directly if it is determined by the SS that the activity is within safety requirements (e.g., limited potential for dangerous buried waste). Sites with multiple disposal features in close proximity to each other will be treated as one area of concern. Therefore, sample locations will be selected adjacent to the outer boundaries of the outer disposal features with limited locations between disposal features. The frequency of sample locations will be based on biasing factors and be approximately between 75 and 150 ft with a minimum of one per lateral side of each CAS. The distance between locations may be increased based on process knowledge or other biasing factors that support a limited potential for the presence or migration of COCs (e.g., CAS 20-15-01).

Sample intervals will be selected from the biased locations focusing on any COC that may have migrated from the walls and base of subsurface disposal features. The frequency of sample intervals above the disposal feature base will vary depending on the estimated depth as determined by the geophysical surveys. The frequency will be such that sample intervals will be approximately spaced evenly between the estimated cover bottom and a sample interval at the disposal feature base. The frequency will not be less than every 5 ft nor greater than every 2.5 ft. Two additional samples will be collected 5 and 10 ft below the disposal feature base. One surface sample, one sample at 5 ft bgs, and one sample at 10 ft bgs will be collected at locations adjacent to surface disposal features. Both strategies may be required where a disposal feature exhibits both characteristics, as may be the case at a portion of CAS 12-15-01. The sampling frequency may be decreased based on process knowledge or other biasing factors that support a limited potential for the presence or migration of COCs (e.g., CAS 20-15-01).

Select samples will be submitted for laboratory analysis of the Phase I chemical and radiological parameters identified for each CAS in Section 3.2. Analytical requirements are listed in Table 3-2. Laboratory volume requirements are laboratory-specific and will be described in the contractor's CAU 5 Field Instructions. Quality assurance and quality control requirements for sample collection are discussed in Section 6.0.

4.2.3 Phase II Activities

Phase II efforts will consist of further characterizing sites where COCs have been confirmed to be present or migrating. Phase II data will be used to define the extent of contamination. Only the COCs confirmed to be present will be analyzed for during Phase II. This parameter selection process will be applied independently to each CAS as discussed in Section A.2.4.4.

For all CASs in Phase II, the lateral and vertical extent of contamination will be bounded by a minimum of one laboratory analytical soil sample showing COC concentrations below PALs.

The spatial boundaries that apply to each CAS for Phase II are defined in Table A.2-2. If the nature and/or extent of contamination is inconsistent with the CSM or if contamination extends beyond the spatial boundaries identified in Table A.2-2, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and is within the spatial boundaries, sampling will continue to define extent.

The potential Phase II target populations are discussed in Section A.2.4.1 in Appendix A. Phase II target populations will be limited to those related to distinct Phase I target populations with COCs.

Drilling is the preferred method of soil sample collection, but excavation may also be used as appropriate. Biased soil samples will be collected from step-out sample locations during the Phase II investigation. The step-out sample locations will be determined prior to Phase II sampling based on process knowledge and analytical results from Phase I.

Step-out sample locations will be selected approximately 15 ft from outer boundary Phase I sample locations where COCs were detected. If biasing factors indicate COCs extend beyond the proposed Phase II sample locations, further step-out locations may be necessary. As field data are generated, the Site Supervisor has the discretion to modify these locations but only if the modified locations meet the decision needs and criteria stipulated in Section A.2.3. At each Phase II location, soil samples will be collected at the depth(s) and at 5 ft below the lowest depth where COCs were encountered. In general, samples submitted for laboratory analysis will be those that define the lateral and vertical extent of COCs. Additional samples will be collected to define the extent of COCs if necessary.

4.2.4 Geotechnical/Hydrological Analysis and Bioassessment Tests

Soil samples will be collected to measure geotechnical/hydrological parameters. These samples include:

- Three samples at each CAS from native soil below the base of disposed waste
- Three samples at each CAS from existing soil cover material unless additional cover work (e.g., more soil) may be required

Additional samples will be collected at a given CAS if soil types are encountered that are not represented in those mentioned above.

Samples may be collected to determine bioassessment parameters at select sites. These samples 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. Other equivalent or superior testing methods may be used. Bioassessment is a series of tests (Van Hout, 2002) designed to evaluate the physical, chemical, and microbiological characteristics of a site. 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 suggest a hydrocarbon or solvent plume may be present. The bioassessment methods are listed in Table 4-2.

Table 4-1
General Geotechnical and Hydrological Analysis for CAU 5

Geotechnical Parameter	Methods
Moisture content	ASTM[a] D 2216-92/D 4643-93
Bulk density[b]	ASTM[a] D 2937-94; MOSA[c] Chapter 13
Calculated total porosity[b]	MOSA[c] Chapter 18
Saturated hydraulic conductivity	ASTM[a] D 2434-68(94); MOSA[c] Chapter 28
Calculated unsaturated hydraulic conductivity	van Genuchten[d]
Particle-size analysis/soil classification	ASTM[a] D 422-63(90)
Moisture characteristics	ASTM[a] D 2325-68(94); MOSA[c] Chapter 26;

[a]Annual Book of ASTM Standards: "Construction" (ASTM, 1996)
[b]Analysis can only be conducted on samples collected using a drilling method able to collect samples in 2.5- by 6-in. brass sleeves (Smith, 2001).
[c]Method of Soil Analysis (Soil Science Society of America, 1986)
[d]*Soil Science Society of America Journal*, "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils" (van Genuchten, 1980)

MOSA = Methods of Soil Analysis

Table 4-2
Bioassessment Tests for Soils

Parameter	Method	Minimum Detection Limit
Heterotrophic Microbial Population	Standard Methods 9215A[a]	<10
Degrading Microbial Population	Standard Methods 9215A[a]	<10
pH	Standard Methods 4500H+[a]	NA
Moisture	ASTM -D 2216[b]	NA
Phosphate	Standard Methods PE - Ascorbic Acid[a]	Soil: 2.5 mg/kg
Ammonia	Standard Methods 4500-NH3[a]	Soil: 4.0 mg/kg
Simulation	IT BAC016[c]	NA

[a]Standard Methods for the Examination of Water and Wastewater (APHA, 1998)
[b]Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures (ASTM, 1998)
[c]IT Corporation proprietary

NA = Not applicable
mg/kg = Milligrams per kilogram

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 5 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 analyses of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminants 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 in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP.

Asbestos-containing materials will be managed and disposed in accordance with appropriate federal (i.e., *Toxic Substances Control Act*) (USC, 1976) and State of Nevada *Nevada Administrative Codes* (NAC, 2000d) regulations. Materials that are thought to potentially contain the hantavirus will be managed and disposed in accordance with appropriate health and safety procedures.

Decontamination activities will be performed according to approved contractor procedures specified in the contractor field sampling instructions and as appropriate for the COPCs likely to be identified at CAU 5.

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 (such as soil removed during trenching) or debris will be returned to its 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

Waste generated during the investigation activities will include the following:

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

Each waste stream generated will be segregated, and further segregation may occur within each waste stream.

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 radiological survey/swipe results. Table 4-2 of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000b) 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.

5.3.1 Sanitary Waste

The IDW that is known to be sanitary waste only, may be segregated and dispositioned as it is generated if it meets the waste acceptance criteria for sanitary waste disposal facilities. Sanitary IDW generated at each CAS will be collected in plastic bags, sealed, labeled with the CAS number from

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] NTS Landfill Permit SW13.097.02[e]
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii[f]
Hazardous	RCRA[g]	NRS 459.400 - 459.600[h] NAC 444.850 - 444.8746[i] POC[j]
Low-Level Radioactive	NA	DOE Orders and NTSWAC[k]
Mixed	RCRA[g]	NTSWAC[k] POC[k]
Polychlorinated Biphenyls	TSCA[l]	NRS 459.400 - 459.600[h] NAC 444.940 - 444.9555[n]
Asbestos	TSCA[m]	NAC 444.965-444.976[o]

[a]*Nevada Revised Statues* (NRS) (1998a)
[b]*Nevada Administrative Code* (2000a)
[c]Area 23 (NDEP, 1997a)
[d]U10c Crater located in Area 9 (NDEP, 1997c)
[e]Area 6 Hydrocarbon Landfill (NDEP, 1997b)
[f]Nevada Test Site Sewage Lagoons (NDEP, 1999)
[g]*Resource Conservation and Recovery Act*, 40 CFR 260-282 (CFR, 2001a)
[h]*Nevada Revised Statues* (1998b)
[i]*Nevada Administrative Code* (2000b)
[j]*Performance Objective for the Certification of Nonradioactive Hazardous Waste* (POC) (BN, 1995)
[k]Nevada Test Site Waste Acceptance Criteria, Revision 3 (DOE/NV, 2000a)
[l]*Toxic Substance Control Act*, 40 CFR 761 (CFR, 2001d)
[m]*Toxic Substance Control Act,* 40 CFR 763 (CFR, 2001e)
[n]*Nevada Administrative Code* (2000c)
[o]*Nevada Administrative Code* (2000d)

NA = Not applicable

each site in which it was generated, 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, and noted in a log, as well as documented in the Field Activity Daily Log (FADL). These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill.

5.3.2 Hydrocarbon

Hydrocarbon waste is defined as waste containing more than 100 milligrams per kilogram (mg/kg) of TPH contamination (NAC, 2000e). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with applicable regulations.

5.3.3 Low-Level Waste

Radiological swipe surveys and/or direct scan surveys may be conducted on reusable sampling equipment and the 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, 2000b), 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 low-level radioactive waste, 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. Wastes in excess of Table 4-2 values will be managed as potential 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 plan, DOE Orders, and the requirements of the current version of the Nevada Test Site Waste Acceptance Criteria (NTSWAC) (DOE/NV, 2000a). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated radioactive materials area (RMA), or 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 (DOE/NV, 2000a).

5.3.4 Hazardous Waste

Corrective Action Unit 5 is not a RCRA “listed” site. The CAU will have waste storage areas that are properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers in accordance with 49 CFR

173 (CFR, 2001f). All containerized waste will be handled, inspected, and managed in accordance with 40 CFR 265, Subpart I (CFR, 2001a). These provisions 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 wastes shall not contact one another. Satellite accumulation areas (SAAs) will be managed consistent with the requirements of 40 CFR 262.34(c)(1) (CFR, 2001c).

Waste storage areas will be inspected regularly and 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 40 CFR 261 (CFR, 2001b) and this document. Hazardous wastes will be transported by an approved hazardous waste transporter to an appropriate permitted treatment, storage, and disposal facility.

5.3.4.1 Sites Where RCRA "Characteristic" Constituents are COPCs

Personal Protective Equipment - PPE and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated. Any materials that display these characteristics 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/NV and the State of Nevada. The PPE/equipment that is not visibly stained, discolored, or grossly contaminated will be managed as sanitary waste in accordance with Section 5.3.1.

Decontamination Rinsate - Rinsate 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 a visible sheen, 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. 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/NV and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NV 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 SDWS will be disposed in an established infiltration basin or solidified and disposed as sanitary waste or low-level waste in accordance with the respective sections of this document.

- Nonhazardous rinsate which is contaminated at greater than 10x SDWS will be disposed in a lined basin or solidified and disposed as sanitary waste or low-level waste in accordance with the respective sections of this document.

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). Material that is containerized at a site where hazardous constituents are COPCs will be labeled “Hazardous Waste Pending Analysis.” The disposition of containerized material may be deferred until implementation of corrective action at the site.

Field Screening Waste - 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 as a separate waste stream.

5.3.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA or subject to agreements between NNSA/NV 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/NV 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 at the NTS Area 5 Radioactive Waste Management Site if the waste meets the requirements of the NTSWAC (DOE/NV, 2000a). 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).

5.3.6 Polychlorinated Biphenyls and Radioactive Polychlorinated Biphenyls Waste

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) and its implementing regulations at 40 CFR 761 (USC, 1976). 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, 2001d) as well as State of Nevada requirements, guidance, and agreements with NNSA/NV.

6.0 Quality Assurance/Quality Control

The primary objective of the corrective action investigation described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 5. The following two subsections (Section 6.1 and Section 6.2) discuss the QA and QC of the field sampling performance, including the collection of field QC samples, and the QA/QC requirements for laboratory performance and data quality (i.e., acceptability and usability) for use in the decision-making process to achieve closure. 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) have been satisfied.

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

The discussion of the DQIs, including the datasets, will be provided in the CAU 5 CADD to be developed at the completion of the corrective action investigation.

6.1 Quality Control Field Sampling Activities

Field QC samples will be collected in accordance with approved 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 samples collected. The minimum frequency of collecting and analyzing QC samples established for this investigation include:

- Trip blanks (1 per sample cooler containing VOC investigation samples)
- Equipment rinsate blanks (1 per sampling event [i.e., Phase I and Phase II] for each type of decontamination procedure performed)
- Source blanks (1 per lot of source material that contacts sampled media)
- Field duplicates (A minimum of 1 per CAS per matrix and 1 per 20 environmental samples, if more than 20 samples are collected)

- Field blanks (1 per 20 environmental samples either per day or at the discretion of the Site Supervisor)

- Matrix spike/matrix spike duplicate (MS/MSD) (A minimum of 1 per CAS per matrix and 1 per 20 environmental samples, if more than 20 samples are collected). Some radioanalytical measurements (e.g., gamma spectrometry) do not require MS/MSD.

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, 2002).

6.2 Laboratory and Analytical Quality Assurance

Criteria for Phase I and Phase II, as stated in the DQOs (Appendix A) and, except where noted, require laboratory and analytical quality data 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, 2002), except where otherwise stipulated in this CAIP. All organic and inorganic laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Contract Laboratory Program National Functional Guidelines* (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 and analyzed, and that the results met 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 CAU 5 CADD. If the DQOs are not met, impact to the corrective action alternatives for closure will be evaluated. Based on the evaluation, the appropriate corrective action will be selected and implemented (e.g., refine CSM, resample) to fill data gaps.

6.2.2 Data Quality Indicators

Data quality indicators are quantitative and qualitative descriptors used in determining the degree of acceptability or usability of data. The DQIs established to evaluate the quality of CAU 5 data are precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data quality indicators are used to evaluate the entire measurement system, the laboratory measurement processes (i.e., analytical method performance), and individual analytical results (i.e., parameter performance).

Precision, accuracy, and sensitivity are quantitative measures used to assess the overall analytical method and field-sampling performance as well as to assess the need to qualify the usability of 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. Based on an assessment of the data, data qualified as estimated for reasons of precision or accuracy may also be considered to meet the parameter performance criteria.

Representativeness and comparability are qualitative measures, and completeness is a quantitative measure. Representativeness, comparability, and completeness are used to assess the overall measurement system performance.

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, 2002) requires conditions (i.e., nonconformances) that adversely affect data quality, both in the field and the laboratory, be documented. Corrective action required to mitigate adverse field conditions are tracked to verify its successful implementation. 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 CAU 5 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 sample handling, preservation, and storage along 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

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 5 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 the original samples 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 evaluating completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample (LCS) results and matrix spike (MS) results should be within analytical method-specific criteria discussed in Section 6.2.4.	Data that do not meet the performance criteria will be evaluated for purposes of evaluating 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 at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Consistent sampling, handling, preparation, analysis, reporting, and validation criteria will be used. Approved standard methods and procedures will be used to analyze and report the data.	Inability to combine data with data obtained from other sources in an effort to contribute to common interpretation and analysis.
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.
Phase I Completeness	80% of the CAS-specific samples and analyses identified in the CAIP have valid results.	Cannot make decision on whether COCs are present above PALs with high confidence.
Phase II Completeness	100% of the CAS-specific samples and analyses used to define extent of COCs.	Decision of whether or not extent of contamination has been bounded cannot be determined.

among a replicate set of measurements of the same property under similar conditions. This agreement is expressed as the RPD between duplicate measurements (EPA, 1996). The RPD is determined by dividing the difference between the replicate measurement values by the average measurement value and multiplying the result by 100, as listed below:

$$RPD = \{|a_1 - a_2|/[(a_1 + a_2)/ 2]\} \times 100$$

Where:

a_1 = concentration of the parameter in the initial sample aliquot, and
a_2 = concentration of the parameter in the duplicate sample aliquot.

Determinations of precision will be made for field duplicate samples and/or 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; laboratory control sample duplicates (LCSDs) for organic, inorganic, and radiological analyses.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria to be used for assessment of precision for chemical analysis are the parameter-specific criteria listed in Table 3-2. The RPD criteria for precision are based on laboratory-specific control limits. Control limits are evaluated 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 as a guideline.

The assessment of precision will only be conducted for analytical results when both the sample and duplicate results are above the instrument detection limit or method detection limit, as applicable. Consequently, when both the sample and duplicate results are “nondetects” or analytical results are below the applicable limit of detection for the instrument or method, associated sample results are not included in the calculation of precision.

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 analysis 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. However, inorganic laboratory sample duplicate RPD values outside the established control criteria do result in the qualification of associated analytical results as estimated. Qualified data does 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 potential impact on data applicability in meeting the DQOs.

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 the DQOs, and results of the assessment will be documented in the CADD.

6.2.3.2 Precision for Radiological Analysis

The parameter performance criteria for precision will be compared to the RPD or ND results of duplicate samples. The criteria for assessment of the radiological 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 limit indicate that analytical results for associated samples are valid. The RPD control limit for radiological measurements has been set at 35 percent for soil and 20 percent for water. 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 of 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 sample result
TPU	=	total propagated uncertainty
TPU_S	=	2 sigma TPU of the sample
TPU_D	=	2 sigma TPU of the duplicate

The control limit for the ND 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 the DQOs, 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. Accuracy 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, 2002). This is calculated by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

The accuracy of the laboratory control sample (LCS) determination is expressed as %R by the following:

$$\%\ R = \frac{\text{Amount of Analyte Measured}}{\text{Amount of Analyte Added}} \times 100$$

The accuracy of the MS determination is expressed as a percent recovery by the following:

$$\%\ R = \frac{\text{MS Sample Result} - \text{Sample Result}}{\text{Amount of Analyte Added}} \times 100$$

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).

The %R criteria to be used will be based on laboratory-specific control limits. For organic analyses, laboratory control limits 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.

6.2.4.2 Accuracy for Radiological Analysis

Accuracy for radiological 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 radiological 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 limit 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.

6.2.5 Representativeness

Representativeness 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. Representativeness may be assured by reviewing field documentation, operating in accordance with approved procedures and plans, conducting field surveillances, and field-collected blank data.

6.2.6 Completeness

Completeness is a quantitative evaluation of the overall 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 sample locations sampled, percentage of samples analyzed, and the measurements made that are judged to be valid. Percent completeness for measurement usability (not rejected) is determined by dividing the total number of valid analyses by the total number of analyses per CAS 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), and samples that were collected and sent but never received by the laboratory. If these criteria are not achieved, the dataset will be assessed for potential impacts on meeting DQOs.

Critical parameters for CAU 5 Phase I are identified in Table 6-2; they are defined as those parameters suspected to be present in the target population. Critical parameters have been identified through process knowledge and by reviewing historical documentation. For critical parameters, 80 percent of the analytes must have valid results to meet completeness objectives.

Critical parameters for Phase II samples are the COCs identified based on Phase I analytical results.

Table 6-2
Critical Parameters for CAU 5 Phase I[a]

CAS	Critical Chemical Parameters	Critical Radiological Parameters
05-15-01	TPH (C_6 - C_{38})	None
05-16-01	TPH (C_6 - C_{38})	None
06-08-01	TPH (C_6 - C_{38})	None
06-15-02	TPH (C_6 - C_{38})	Isotopic Plutonium, Americium-241, Strontium-90
06-15-03	TPH (C_6 - C_{38})	Isotopic Plutonium, Americium-241, Strontium-90
12-15-01	TPH (C_6 - C_{38}), VOC, SVOCs	None
20-15-01	None	None
23-15-03	TPH (C_6 - C_{38}), pesticides	None

[a]Critical parameters for Phase II will be determined based on Phase I analytical results.

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, and validation criteria in accordance with approved procedures. Approved standard methods and procedures will also be used to analyze and report the data (e.g., Contract Laboratory Program [CLP], CLP-like data packages). An evaluation of this qualitative criterion will be presented in the CAU 5 CADD.

6.2.8 Sensitivity

Sensitivity is a quantitative parameter that evaluates the capability of a method or instrument to measure parameter concentrations at or near decision levels. The evaluation criteria for this parameter will be that measurement sensitivity (detection limits) is lower than 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.

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. Geophysical surveys will continue if necessary and planning documents will be revised based on geophysical survey results.
- Day 149: The field work, including sample collection activities, will commence. Samples will be shipped to meet laboratory holding times.
- Day 275: The field investigation will be completed.
- Day 335: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD has not been established.

7.2 Records Availability

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

8.0 References

Adams, S.R., IT Corporation. 1998. Memorandum to R. McCall (Science Applications International Corporation) regarding methodology for determining action levels for CAU 407, the Roller Coaster RADSAFE Area, 16 June. Las Vegas, NV.

Adams, S.R., and B.J. Dionne, IT Corporation. 2000. Memorandum to J.M. Moore (Science Applications International Corporation) entitled, “CAU 262 Proposed Minimum Reporting Levels (MRLs) for Radionuclides in Soil/Solids/Sludge and Water,” 25 April. Las Vegas, NV.

Adams, S.R., IT Corporation. 2002. Email to L. Linden (Science Applications International Corporation) regarding potential for strontium-90 at CAU 5 CASs 06-15-02 and 06-15-03, 20 May. Las Vegas, NV.

Alderson, Stacey, IT Corporation. 2002. Email to L. Linden (Science Applications International Corporation) regarding CAU 5 radiological parameters, 10 January. Las Vegas, NV.

American Public Health Association. 1998. *Standard Methods for the Examination of Water and Wastewater, 20 Edition.* Washington, D.C.

American Society for Testing and Materials. 1996. Section 04.08 and 04.09, “Construction.” In the *Annual Book of ASTM Standards*. Philadelphia, PA.

American Society for Testing and Materials. 1998. “Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil - Aggregate Mixtures.” West Conshohocken, PA.

APHA, see American Public Health Association.

ASTM, see American Society for Testing and Materials.

Bechtel Nevada. 1995. *Nevada Test Site Performance Objective Criteria for Certification of Nonradioactive Hazardous Waste*, Rev. 0, G-E11/96.01. Las Vegas, NV.

Bechtel Nevada. 1997. Application for Permit to Operate a Class II Solid Waste Disposal Site at the Nevada Test Site, Area 23 Disposal Site, October. Las Vegas, NV.

BN, see Bechtel Nevada.

Brown, J.J., Reynolds Electrical & Engineering Co., Inc. 1971. Memorandum to File entitled, “Decontamination and Control of Area 12 Camp and Portal Areas Period beginning 4 January 1971,” 4 February. Las Vegas, NV.

CFR, see *Code of Federal Regulations*.

Clark, G.A., Reynolds Electrical and Engineering Co. 1991. Letter entitled, "Sample Analysis Results," 4 June. Mercury, NV.

Clark, G.A., Reynolds Electrical and Engineering Co. 1992a. Letter entitled, "Sample Analysis Results," 2 March. Mercury, NV.

Clark, G.A., Reynolds Electrical and Engineering Co. 1992b. Letter entitled, "Sample Analytical Results," 13 July. Mercury, NV.

Code of Federal Regulations. 2001a. Title 40 CFR, "Protection of the Environment," Parts 260-282. Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001b. Title 40 CFR, "Protection of the Environment," Part 261, "Identification and Listing of Hazardous Waste." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001c. Title 40 CFR, "Protection of the Environment," Part 262.34, "Standards Applicable to Generators of Hazardous Waste, Subpart C - Pre-Transport Requirements, Accumulation Time." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001d. Title 40 CFR, "Protection of the Environment," Part 761, "PCBs." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001e. Title 40 CFR, "Protection of the Environment," Part 763, "Asbestos." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001f. Title 49 CFR, "Shippers-General Requirements for Shipment and Packaging," Part 173. Washington, DC: U.S. Government Printing Office.

Cornwall, H.R. 1972. *Geology and Mineral Deposits of Southern Nye County, Nevada*, Nevada Bureau of Mines and Geology Bulletin 77. Reno, NV: Mackay School of Mines, University of Nevada.

Davis, E.P., Reynolds Electrical & Engineering Co., Inc. 1988. Letter entitled, "Area 20 Construction Landfill," 22 December. Las Vegas, NV.

Desert Research Institute. 1996. ER-12-1 Completion Report. Prepared by C. Russell, et al., for U.S. Department of Energy, Nevada Operations Office, DOE/NV/10845-36UC-703. Las Vegas, NV.

DOE, see U.S. Department of Energy.

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

Doyle, M., Wackenhut Services Inc. 2001. Record of teleconference with A. Dudley (Science Applications International Corporation) regarding the Protective Forces Training Complex, 1 October. Las Vegas, NV.

DRI, see Desert Research Institute.

EG&G Rocky Flats. 1991. *General Radiochemistry and Routine Analytical Services Protocol (GRASP)*, Version 2.1, July. Golden, Colorado: Nellis Air Force Base, NV; Remote Sensing Laboratory Photo Laboratory, Rocky Flats Plant.

Elle, D.R.,U.S. Department of Energy. 1992. Letter entitled, "Review of 1991 Spill Files," 02 March. Mercury, NV.

Elle, D.R., U.S. Department of Energy, Nevada Operations Office. 1994. Surveillance report (FY94EPDSR004) on inactive landfills at the Nevada Test Site, 16 February. Las Vegas, NV.

Elle, D.R., U.S. Department of Energy, Nevada Operations Office. 1995. Letter entitled, "Final Reports for a Release of Petroleum Products, Nevada Division of Emergency Management (NDEM) Case Numbers H920219B, H920324B, H920903A, and H921117B," 4 May. Carson City, NV.

Elle, D.R., U.S. Department of Energy, Nevada Operations Office. 1996. Letter to G. J. Sieren (NDEP) entitled, "Notice of Completion of Inactive Solid Waste Disposal Units on the Nevada Test Site (NTS)," 25 March. Las Vegas, NV.

EPA, see U.S. Environmental Protection Agency.

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

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

Frazier, A.R., Reynolds Electrical & Engineering Co, Inc. 1987. Letter to F.E. Bingham (DOE/NV) entitled, "Information Regarding Potential Releases from Solid Waste Management Units," 2 October. Las Vegas, NV.

Frazier, A.R., Reynolds Electrical & Engineering Co., Inc. 1988. Letter entitled, "Revised Nevada Test Site Sanitary Landfill Operation and Maintenance Plan," 29 July. Las Vegas, NV.

Frizzell, V.A. and Shulters, J. 1990. Geologic Map of the Nevada Test Site, Southern Nevada, Miscellaneous Investigations Series, Map I-2046, 1:100,000 scale. Prepared for the U.S. Geological Survey. Denver, CO.

Hoar, K., U.S. Department of Energy, Nevada Operations Office. Date Unknown. *Table 1 Solid Waste Disposal Sites at NTS (per Ken Hoar)*. Las Vegas, NV.

Hoar K., U.S. Department of Energy, Nevada Operations Office. 2001a. Interview with B. Moyer-Durham (Science Applications International Corporation) regarding CAS 12-15-01, 9 October. Las Vegas, NV.

Hoar, K., U.S. Department of Energy, Nevada Operations Office. 2001b. Record of meeting with T. Roberts (Science Applications International Corporation) regarding Areas 12 and 20 landfills, 12 September. Las Vegas, NV.

Holmes and Narver. 1985. Historical aerial photographs showing CAS 20-15-01, photograph numbers 9673 and 966. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

IT, see IT Corporation.

IT Corporation. 2001a. Field Activity Daily log for CAU 5 site visit on December 18. Las Vegas, Nevada.

IT Corporation. 2001b. *ITLV Health and Safety Plan,* March, ITLV/13052--105, Rev. 0. Las Vegas, NV.

Kendall, E.W., Reynolds Electrical & Engineering Co., Inc. 1993. Letter to B. Yoerg (DOE/NV) entitled, "Expansion of Area 23 Landfill," 16 April. Las Vegas, NV.

Latham, A.R., Bechtel Nevada. 1996a. Memorandum entitled, "Data Report for Sample Delivery Group W980," 20 May. Mercury, NV.

Latham, A.R., Bechtel Nevada. 1996b. Memorandum entitled, "Data Report for Sample Delivery Group V032," 29 May. Mercury, NV.

Liebendorfer, P., State of Nevada Division of Environmental Protection. 1996a. Letter to K. Hoar (DOE/NV) entitled, "Notice of Completion of Inactive Solid Waste Disposal Units on the Nevada Test Site (NTS); Notice Dated 25 March 1996," 8 July. Carson City, NV.

Liebendorfer, P., State of Nevada Division of Environmental Protection. 1996b. Letter to D. Shafer (DOE/NV) entitled, "Responsibility for and movement of landfill sites within the FFACO; Notice dated 14 August 1996," 26 September. Carson City, NV.

McArthur, R.D., and R.L. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (Science Applications International Corporation) entitled, "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines.

NDEP, see Nevada Division of Environmental Protection.

Neagle, C. 2001. Bechtel Nevada (Retired). Interview with R. Bull (Science Applications International Corporation) and B. Iverson (GeoTrans) regarding CAUs 5 and 140 landfills, 1 October. Las Vegas, NV.

Nevada Administrative Code. 2000a. NAC 444.570 - 444.7499, "Solid Waste Disposal." Carson City, NV.

Nevada Administrative Code. 2000b. NAC 444.850 - 444.8746, "Disposal of Hazardous Waste." Carson City, NV.

Nevada Administrative Code. 2000c. NAC 444.940 - 444.9555, "Polychlorinated Biphenyl." Carson City, NV.

Nevada Administrative Code. 2000d. NAC 444.965 - 444.976, "Disposal of Asbestos." Carson City, NV.

Nevada Administrative Code. 2000e. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

Nevada Division of Environmental Protection. Date Unknown. *Nevada Division of Environmental Protection Landfill Inventory Survey.* Las Vegas, NV.

Nevada Division of Environmental Protection. 1995. *Mutual Consent Agreement Between the State of Nevada and the U.S. Department of Energy for the Storage of Low-Level Land Disposal Restricted Mixed Waste*, 7 June. Transmittal from P. Liebendorfer (NDEP) to D. Elle (DOE/NV). Carson City, NV.

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

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

Nevada Division of Environmental Protection. 1997c (as amended in August 2000). *Class III Solid Waste Disposal Site; U10C, Area 9 of the NTS*, Permit SW 13 097 03. Carson City, NV.

Nevada Division of Environmental Protection. 1999. *State of Nevada Water Pollution Control General Permit*, No. GNEV93001. Carson City, NV.

Nevada Revised Statues. 1998a. NRS 444.440 - 444.620, "Collection and Disposal of Solid Waste." Carson City, NV.

Nevada Revised Statues. 1998b. NRS 459.400 - 459.600, "Disposal of Hazardous Waste." Carson City, NV.

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

Norvell, D., Bechtel Nevada. 2001a. Interview with B. Bordelois (Science Applications International Corporation), A. Dudley (Science Applications International Corporation), and B. Iverson (GeoTrans) regarding CAUs 5 and 140 landfills, 17 September. Las Vegas, NV.

Norvell, D., Bechtel Nevada. 2001b. Record of teleconference with A. Dudley (Science Applications International Corporation) regarding Area 23 landfill, 9 October. Las Vegas, NV.

Paar, J.G., and Porterfield, D.R. 1997. *Evaluation of Radiochemical Data Usability,* April, ES/ER/MS-5.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Remote Sensing Laboratory. Date Unknown. Historical aerial photographs showing CAS 20-15-01, photograph number 7880-16. Nellis Air Force Base, NV: Photo Library.

Reynolds Electrical & Engineering Co., Inc. 1969. Engineering Drawing, 20-LF-C1, "Construction landfill as-built topography & section," 27 March. Mercury, NV: Archives and Records Center.

Reynolds Electrical & Engineering Co., Inc. 1991a. *Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites*, Areas 16-20, Volume 4 of 5, DOE/NV/10630-18. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1991b. *Operation and Maintenance Plan Area 5 Radioactive Waste Management Site*, October. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992. *Detailed Site Activity Summary NTS Cleanup and Restoration*, 14 May. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1993. *Operations and Maintenance Plan Class III Construction Landfill Area 20-Construction Borrow Pit*, January. Las Vegas, NV.

RSL, see Remote Sensing Laboratory.

Sargent, K.A., and P.P. Orkild. 1973. Geologic Map of the Wheelbarrow Peak – Rainier Mesa Area, Nye County, Nevada Miscellaneous Geologic Investigations, Map I-754, 1:48,000 scale. Prepared for the U.S. Geological Survey. Washington, DC.

Schlick, D.L., Bechtel Nevada. 1996. Memorandum entitled, "Further Excavation of Spill 96-008, Area 6 Equipment Yard," 27 June. Las Vegas, NV.

Smith, R., Daniel B Stephens & Associates. 2001. Facsimile to L. Linden (Science Applications International Corporation) regarding sample requirements for geotechnical and hydrological analyses, 11 April. Las Vegas, NV.

Soil Science Society of America. 1986. *Methods of Soil Analysis*, 2nd Edition, Part 1. Madison, WI.

Stokowski, J.E., IT Corporation. 1999. Memorandum to Laurie Plumber (WSI) entitled, "Transmittal of Analytical Sample Results at the Area 23 Shooting Range, Nevada Test Site," 7 December. Las Vegas, NV.

Tefft, M., Bechtel Nevada. 2001. Interview with A. Dudley (Science Applications International Corporation) regarding the Area 15 Environmental Protection Agency cows, 1 October. Las Vegas, NV.

United States Code. 1976. 15 USC 2601 et seq., *Toxic Substances Control Act*. Enacted by Public Law No. 94-469, as amended. Washington, DC: U.S. Government Printing Office.

USC, see *United States Code*.

U.S. Department of Energy. 1988. *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada*, DOE/EH/OEV-15-P. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

U.S. Department of Energy. 1997. *Environmental Measurements Laboratory Procedures Manual*, HASL-300, 28th Ed., Vol. I. New York, NY.

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

U.S. Department of Energy, Nevada Operations Office. 1986. *Environmental Assessment for the LGF Spill Test Facility at Frenchman Flat, Nevada Test Site*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1990. *Environmental Survey Action Plan*, March. Mercury, NV.

U.S. Department of Energy, Nevada Operations Office. 1992a. *Potential Solid Waste Management Units*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1992b. *RCRA Part B Permit Application for Waste Management Activities at the Nevada Test Site, Section L Potential Solid Waste Management Units,* Volume IV. Las Vegas, Nevada.

U.S. Department of Energy, Nevada Operations Office. 1994a. *Project Management Plan*, Rev. 0. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1994b. *Surveillance on Inactive Landfills at the NTS*, 16 February. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1995. *Decontamination and Decommissioning Subproject Characterization Work Plan*, DOE/NV--392. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996. *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, DOE/EIS 0243*, August. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997a. *Corrective Action Decision Document for Area 15 Environmental Protection Agency Farm Laboratory Building, Corrective Action Unit No. 95*, DOE/NV--477, August. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997b. *Integrated Safety Management Policy*, DOE Order NV P 450.4. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998a. *Corrective Action Decision Document for Corrective Action Unit 340: Pesticide Release Sites, Nevada Test Site, Nevada*, DOE/NV--525. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998b. *Nevada Test Site Resource Management Plan*, DOE/NV-518. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1999a. *Corrective Action Investigation Plan for Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nevada*, July. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1999b. *Nevada Test Site Annual Site Environmental Report for Calender Year 1998*, DOE/NV-11718-361. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000a. *Nevada Test Site Waste Acceptance Criteria*, DOE/NV-325, Rev. 3. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000b. *NV/YMP Radiological Control Manual*, Rev. 4, DOE/NV/11718-079. Prepared by A.L. Gile of Bechtel Nevada. Las Vegas, NV.

US Ecology and Atlan-Tech. 1992. *Environmental Monitoring Report for the Proposed Ward Valley, California, Low Level Radioactive Waste (LLRW) Facility.* Auburn, CA.

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032 (NTIS/PB80-224744; CD ROM; National Environmental Publications Internet Site (NEPIS) http://www.epa.gov/cincl). Cincinnati, OH.

U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003. Washington, DC.

U.S. Environmental Protection Agency. 1988a. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, SOW No. 788, EPA/540/R-94/093. Washington, DC.

U.S. Environmental Protection Agency. 1988b. *Contract Laboratory Program Statement of Work for Organic Analysis*, SOW No. 2/88, EPA/540/R-94/096. Washington, DC.

U.S. Environmental Protection Agency. 1991. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 1.8, EPA/540/R-94/078. Washington, DC.

U.S. Environmental Protection Agency. 1994a. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA/540/R-94/013. Washington, DC.

U.S. Environmental Protection Agency. 1994b. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 3.0, EPA/540/R-94/076. Washington, DC.

U.S. Environmental Protection Agency. 1994c. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 3.1, EPA/540/R-94/073. Washington, DC.

U.S. Environmental Protection Agency. 1995. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 4.0, EPA/540/R-95/121. Washington, DC.

U.S. Environmental Protection Agency. 1996. *Test Method for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI. Washington, DC.

U.S. Environmental Protection Agency. 1997. *Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) with Guidance*, Region IX. San Francisco, CA.

U.S. Environmental Protection Agency. 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008. Washington, DC.

U.S. Environmental Protection Agency. 2000. Memorandum from S.J. Smucker to PRG table mailing list regarding *Region IX Preliminary Remediation Goals (PRGs)*, 1 August. San Francisco, CA.

U.S. Environmental Protection Agency. 2002. "Integrated Risk Information System (IRIS) Database." As accessed at www.epa.gov/iris/index.html on May 14, 2002.

USGS, see U.S. Geological Survey.

U.S. Geological Survey and U.S. Atomic Energy Commission. 1983. Camp Desert Rock Quadrangle, Nye County, NV.

van Genuchten, M. 1980. "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils." In *Soil Science Society of American Journal*, 44: 892-898. Madison, WI.

VanHout, A., IT Corporation. 2002. Email to L. Linden (Science Applications International Corporation) regarding sample requirements for bioassessment, 2 April. Las Vegas, NV.

Winograd, I.J., and W. Thordarson. 1975. *Hydrogeologic and Hydrochemical Framework, South Central Great Basin Nevada-California, with Special Reference to the Nevada Test Site,* U.S. Geological Survey Professional Paper 712-C. Denver, CO: U.S. Geological Survey.

Appendix A

Data Quality Objectives

A.1.0 Seven-Step DQO Process for Phase I Investigations

The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection activity (EPA, 2000a). The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend potentially viable corrective actions (e.g., no further action, close in place). The existing information about the nature and extent of contamination at the eight CASs in CAU 5 is insufficient to evaluate and select preferred corrective actions. The CAU 5 investigation will be based on DQOs developed by representatives of NDEP and NNSA/NV.

Eight CASs comprise CAU 5. Two CASs are in Area 5, three CASs are in Area 6, and one CAS each in Areas 12, 20, and 23. The eight CASs are:

- 05-15-01, Sanitary Landfill
- 05-16-01, Landfill
- 06-08-01, Landfill
- 06-15-02, Sanitary Landfill
- 06-15-03, Sanitary Landfill; Burn Pit
- 12-15-01, Sanitary Landfill
- 20-15-01, Landfill
- 23-15-03, Disposal Site

This section presents the seven-step DQO process for a Phase I investigation. All CASs will begin with a Phase I investigation. If a COPC is detected at concentrations above PALs, the COPC will be identified as a COC. If a COC is identified, the CAS containing that COC will undergo a Phase II investigation as presented in Section A.2.0.

A.1.1 Step 1 - State the Problem

Step 1 defines the problem that has initiated the CAU 5 site investigation. This step identifies the DQO planning team members, describes the problem, and develops a CSM.

A.1.1.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NV, ITLV, and BN. The primary decision-makers include NDEP and NNSA/NV representatives. Table A.1-1 lists representatives from each organization in attendance for the January 23, 2002, DOQ Kickoff meeting.

Table A.1-1
DQO Meeting Participants

Participant	Affiliation
Jim Bolden	ITLV
John Fowler	ITLV
Charlotte Franky	ITLV
Joe Hutchinson	ITLV
Lynn Kidman	ITLV
Sean Kosinski	NNSA/NV
Linda Linden	ITLV
Beth Moyer-Durham	ITLV
John Nicklas	ITLV
Allison Urbon	BN
Steve Ward	ITLV
Jeanne Wightman	ITLV
Dustin Wilson	ITLV
John Wong	NDEP
Ted Zaferatos	NDEP

BN - Bechtel Nevada
NNSA/NV - National Nuclear Security Administration Nevada Operations Office
ITLV - IT Corporation, Las Vegas Office
NDEP - Nevada Division of Environmental Protection

A.1.1.2 Describe the Problem

Corrective Action Unit 5 is being investigated because:

- Disposed waste may be present without appropriate controls (e.g., use restrictions and adequate cover).
- Hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment.

A.1.1.3 Develop Conceptual Site Model

The CSM describes the most probable scenario for current conditions at a site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. An accurate CSM is important as it serves as the basis for all subsequent inputs and decisions throughout the DQO process.

An important element of a CSM is the expected fate and transport of contaminants, which infer 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 characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and particle size (i.e., metals). Media characteristics include permeability, saturation, particle size, sorting, 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.

Groundwater contamination is not considered a likely scenario at CAU 5. The depth to groundwater varies for each CAS from as shallow as 684 ft bgs in Area 5 to as deep as 2,600 ft bgs in Area 12. Perched water layers are a potential near CAS 23-15-03 in Area 23.

The CSM has been developed for CAU 5 using historical background information, knowledge from studies at similar sites, and data from previous sampling efforts. Section A.1.1.3.1 develops and discusses the conceptual model. Figure A.1-1 shows the generalized CSM.

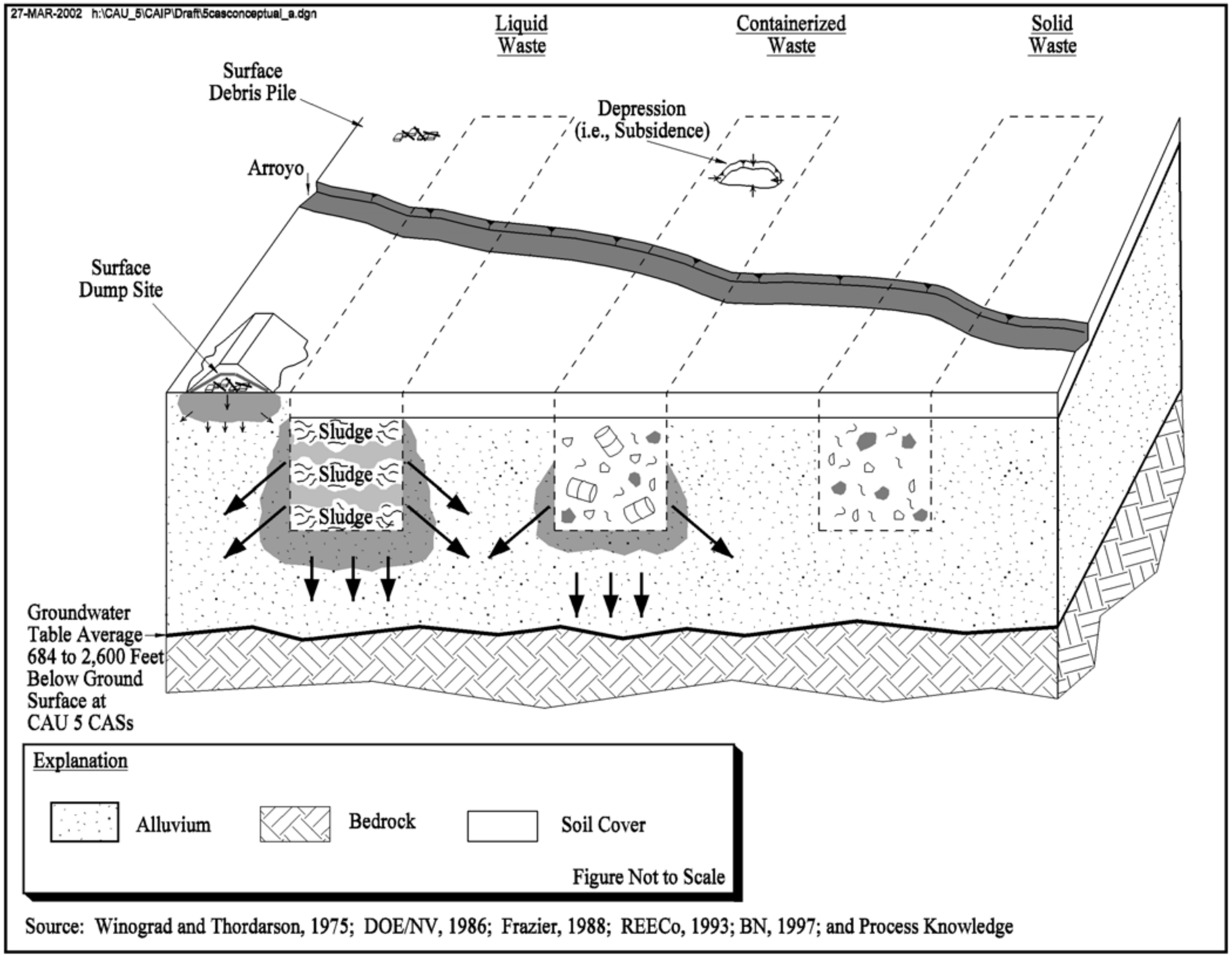


Figure A.1-1
Generalized Conceptual Site Model for CAU 5

Future Land-Use Scenarios

Future land-use scenarios limit future uses of the CASs to various nonresidential (i.e., industrial) uses (DOE/NV, 1998b). The future land-use scenarios for CAU 5 are presented in Table A.1-2.

Exposure scenarios for sites located within the NTS boundaries are limited by the future land-use scenarios to site workers who may be exposed to COPCs through oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris (e.g., equipment, concrete) due to inadvertent disturbance of these materials.

A.1.1.3.1 General Conceptual Site Model

All eight CASs are included in the general CSM developed for CAU 5.

According to historical documentation and interviews, instead of managing solid waste at one or two disposal sites, the practice was to dispose solid waste in the vicinity of the activity. Trenches, mounds, and open pits were utilized to dispose and bury waste streams that included, but were not limited to various combinations of construction debris, sanitary waste, radiologically contaminated materials (i.e., animal carcasses), and potentially hazardous wastes. Open burning was a common practice at landfills up to 1971. Waste was routinely soaked with diesel fuel and allowed to burn to minimize the waste volume. Open pits and trenches were both used to burn and dispose solid waste. Liquid wastes including raw sewage and kitchen grease were transported to and discharged at designated trenches within various CAU 5 CASs.

Subsurface soils are the potentially affected media where leachable solid and/or liquid waste may have contributed contamination. Any contamination would be attributable to direct release to the surface and/or subsurface of solid waste, residual fluids in discarded containers, release of contaminants through burning activities, erosion of various contaminants off the surface of solid materials, and leaching of contaminants from materials. No disposal records were identified for these landfills; therefore, materials disposed in each landfill is based on historical information and interviews.

The amount of leachate generated in any of the landfill sites is unknown, but is assumed to be minimal based on low precipitation and high evapotranspiration rates. Historical documentation

Table A.1-2
Future Land-Use Scenarios for CASs Within CAU 5[a]

CAS	Zone	Zone Description
05-15-01	Research, Test, and Experiment Land-Use Zone	Designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. Includes compatible defense and nondefense research, development, and testing projects and activities.
05-16-01 23-15-03 06-15-02 06-15-03	NTS Reserved Land-Use Zone	Includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and DoD land-navigation exercises and training.
06-08-01	Defense Industrial Land-Use Zone	Designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, material processing, and pulsed power.
12-15-01	Nuclear and High Explosive Test Land-Use Zone	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.
20-15-01	Nuclear Test Land-Use Zone	Area reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.

[a]*Nevada Test Site Resource Management Plan* (DOE/NV, 1998b)

states that the landfills are not lined with engineered barriers and no monitoring has taken place thus far to determine if any contaminants are migrating vertically or laterally. Subsurface lateral migration is limited to the geophysical properties such as permeability, porosity, and hydrologic conductivity. The presence of a hardpan layer (i.e., caliche) at some of the CASs would limit vertical migration of contaminants. Surface lateral migration is not a concern because the landfills are covered by soil. Over time, the disturbed areas of the sites have revegetated and miscellaneous debris has been deposited on top. Additionally, CAS 06-08-01 landfill is covered by the Area 6 Equipment Yard and the CAS 23-15-03 landfill is covered by a portion of the active Area 23 Sanitary Landfill.

Concrete monuments denoting waste streams were later put in place to identify the presumed landfill boundaries. The landfill covers appear to be constructed to grade with invader or secondary species proliferating, particularly on the older landfills. Recent site visit surveys indicate that minor erosion and subsidence has occurred at a few of the landfills.

Figure A.1-1 shows a generalized representation of the general CSM and the following text provides additional details to supplement the model.

COPCs/Released Material

Interviews with former site employees, review of historic documents, and interpretations of aerial and ground photographs indicate that the sources of potential contamination related to the CAU 5 CASs are varied, but are generally representative of the CSM. The CAS-specific COPCs are discussed below. The CAS-specific release information, migration routes, exposure pathways, and affected media are discussed in Section 2.4.

In addition to CAS-specific COPCs, various materials may have been disposed at the CAU 5 CASs as indicated by general historical landfill practices. The following materials may have the potential to impact the CASs and are also being considered based on their relationship to general landfill practices. They include:

- VOCs from the disposal of solvents (Norvell, 2001), portable toilet wastes (e.g., formaldehyde), and benzenes, toluene, and pyrolytic oil, consisting of ethyl benzene, from the burning of tires (CIWMB, 2002)

- SVOCs from burning tires to include pyrolytic oil consisting of naphthalenes, anthracene, thiazoles, amines, Di (2-ethyhexyl) phthalate (DEHP) (BuildingGreen, Inc., 2001), and phenols from sewage effluent (Ballock, 2001)
- Petroleum hydrocarbons from the use/disposal of diesel and gasoline, and oil, grease, and pyrolytic oil (CIWMB, 2002)
- PCBs from the disposal of hydraulic fluids and light ballasts (Frazier, 1988)
- RCRA metals typically associated with hydrocarbons
- Nickel, lead, cadmium and zinc is a product from burning waste and tires (CIWMB, 2002)
- Waste Oil, including hydraulic oil (Elle, 1995)
- Polyaromatic hydrocarbons byproduct from partial burning of waste
- Antifreeze (i.e., ethylene glycol) (Norvell, 2001)

Asbestos was used in construction materials used at the NTS until the 1980s. The asbestos containing material transite was observed during a site visit to CAS 05-15-01 and CAS 12-15-01.

CAS 05-15-01, Sanitary Landfill. This landfill accepted solid and liquid waste that may exhibit hazardous and sanitary characteristics. Open burning is evident by partially burned debris (e.g., wood, metal) found on the landfill cover. Sewage may have been directly disposed in trenches. The following specific COPCs identified for this CAS are based on process knowledge, interviews, historical documents, and field observations:

- Diesel fuel for burning waste (Neagle, 2001)
- Grease container observed during site visit (IT, 2001)

CAS 05-16-01, Landfill. This landfill is believed to have been used as burn pits for construction debris and rubbish. The specific COPCs identified for this CAS are based on process knowledge, interviews, historical documentation, and field observations:

- Diesel fuel for burning waste (Neagle, 2001)

CAS 06-08-01, Landfill. This landfill is believed to have accepted construction debris, garbage, rubbish, and refuse. The landfill may have also received waste from the Area 6 cafeterias and support facilities on a daily basis. Burning may have also taken place at this landfill. Several diesel, oil, hydraulic oil, and waste oil releases have been documented in the equipment yard to the southwest corner of the landfill, but are not expected to have impacted the landfill. These spills were properly reported to NDEP under the appropriate regulation for spill notification and are not part of this CAS. The following specific COPCs identified for this CAS are based on process knowledge, interviews, historical documentation and field observations:

- Diesel fuel for burning waste (Neagle, 2001)

CAS 06-15-02, Sanitary Landfill. This landfill was established to accept waste from Areas 3, 5, and 7, as well as the CP Compound in Area 6. The types of waste that were disposed in this landfill have not been determined but are believed to include the Area 6 CP Compound trash, construction debris, concrete, asphalt, empty barrels, and oil. The close proximity of the landfill to CAS 06-15-03 and vague historical references suggest that this site potentially may have received some of the same wastes as the landfill in CAS 06-15-03. The following specific COPCs were identified for this CAS based on process knowledge, interviews, historical documentation, and field observations:

- Diesel fuel for burning waste (Norvell, 2001)
- Oil (Norvell, 2001)
- Pu-239 from the disposal of EPA Farm test animals (Alderson, 2002)
- Americium-241 from the disposal of EPA Farm test animals (Alderson, 2002)

CAS 06-15-03, Sanitary Landfill; Burn Pit. The landfill was designed to collect waste from various areas in the NTS, including Areas 3, 5, and 7, as well as trash from the Area 6 CP Compound and test animals from the Area 15 EPA Farm. The types of waste that were disposed in this landfill include diesel fuel for burning, dead animals, aerosol cans, sewage, trash, and possibly any other type of waste. The following specific COPCs identified for this CAS are based on process knowledge, interviews, historical documentation, and field observations:

- Diesel fuel for burning waste (Norvell, 2001)
- Oil (Norvell, 2001)
- Pu-239 from the disposal of EPA Farm test animals (Alderson, 2002)
- Americium-241 from the disposal of EPA Farm test animals (Alderson, 2002)

CAS 12-15-01, Sanitary Landfill. According to historical documentation and interviews, solid waste created at the Area 12 Camp was disposed and/or burned at this landfill. Kitchen grease from the Area 12 camp was disposed in the landfill. Due to the lack of waste manifests, the type of waste and waste volume at this landfill is unknown. Monuments indicate that kitchen grease, aerosol cans, and sewage were disposed in the landfill. As a precaution, canned goods from the Area 12 Mancamp were buried in this landfill during the decontamination activities following accidental venting from the Baneberry weapons-related test (Hoar 2001a and 2001b; and Brown, 1971). The following specific COPCs identified for this CAS are based on process knowledge, interviews, historical documentation and field observations:

- Diesel fuel for burning waste (Neagle, 2001; and Norvell, 2001)
- Grease (i.e., kitchen) (Frazier, 1987; and IT, 2001)
- Solvents (e.g., aerosol cans) (IT, 2001)

CAS 20-15-01, Landfill. The Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites identified this site as a sanitary landfill (REECo, 1991). This landfill allegedly accepted construction waste from Pahute Mesa and possible sanitary waste. According to an NDEP Landfill Inventory Survey (date unknown), the landfill was 0.2 acres at the time the survey was conducted and was receiving approximately 50 tons per year of separated wood and construction wastes. Due to the lack of waste manifests, the type of waste and waste volume at this landfill is unknown. It is unlikely that waste was burned at this landfill because regulations prohibited the open burning of waste after December 1972 and no physical evidence of burning waste was identified during the PA process.

- No specific COPCs were identified for this CAS.

CAS 23-15-03, Disposal Site. Historical documentation indicates that the majority of waste received by both the disposal area and the landfill came from Areas 22 and 23. Potential waste includes sanitary waste, pathological wastes, rubbish, refuse, construction debris, asbestos, and possibly pesticide contaminated steam jenny wastewater. The site is in close proximity of the active Area 23 Sanitary Landfill and to the Hazardous Waste Trenches that have been closed in accordance with the appropriate regulatory requirements. Both of these activities may have impacted this CAS. The following specific COPCs identified for this CAS are based on process knowledge, interviews, historical documentation, and field observations:

<u>Disposal Area</u>

- Diesel fuel to burn waste (Neagle, 2001)

Landfill

- Diesel fuel to burn waste (Neagle, 2001)
- Pesticides – potential disposal of pesticides, to include 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; chlordane; aldrin; alpha-, beta-, and gamma-BHC (also known as lindane); dieldrin; endosulfan I; endosulfan II, endosulfan sulfate; endrin; endrin aldehyde; heptachlor; heptachlor epoxide (DOE/NV, 1998a)

Affected Media

Affected media includes subsurface soil surrounding the disposed waste.

Location of Contamination/Release

The native soil interface adjacent to the disposed waste is the most likely place to find soil contamination. Any contaminants migrating from these CASs, regardless of physical or chemical characteristics, are expected to be in soil adjacent to disposal feature walls and floors.

Transport Mechanisms

Contaminants may have been transported by infiltration of precipitation through soil covers which serves as a driving force for downward migration of contaminants; however, the annual average precipitation in this region ranges from 3 to 6 in. and less than 10 in. on most of the ridges and mesas (Winograd and Thordarson, 1975). Contaminants may have also been transported by the release of liquids directly to trenches; however, this practice has been discontinued.

Preferential Pathways

Preferential pathways at the CASs are expected to be limited to typical vertical migration due to gravity and minor lateral migration due to any voids or confining layers.

Lateral and Vertical Extent of Contamination

Contamination, if present, is expected to be contiguous to the site. Concentrations are expected to decrease with distance and depth from the sites. Groundwater contamination is not considered a likely scenario at CAU 5 based on the following information:

- Area 5 - Depth to groundwater is about 684 ft bgs (DOE/NV, 1986)
- Area 6 - Depth to groundwater is about 1,540 ft bgs based on the nearest water well, Well C-1 (Frazier, 1988)
- Area 12 – Depth to groundwater in the region varies from about 800 ft to as much as 2,600 ft bgs (Winograd and Thordarson, 1975)
- Area 20 – Depth to groundwater was measured at 1,956 ft bgs in the U-20ao drill hole located 3,500 ft northwest (REECo, 1993)
- Area 23 – Depth to groundwater was measured at 1,150 ft bgs in a monitoring well approximately 0.67 mi from CAS 23-15-03. In addition, the monitoring well revealed two perched water layers. These layers were encountered at 500 ft bgs and 1,080 ft bgs and were one-ft and 11-ft thick, respectively. (BN, 1997)

A.1.2 Step 2 - Identify the Decision

This step develops a decision statement and defines alternative actions. Figure A.1-2 is a flow chart that identifies decisions and alternative actions appropriate for a Phase I investigation.

A.1.2.1 Develop a Decision Statement

Two decision statements are required for a Phase I investigation. Decision I is “Determine if disposal of waste has occurred.” Decision II is “Determine if a COC has migrated.”

A.1.2.2 Alternative Actions to the Decision

If disposal of waste has not occurred, further assessment of the CAS is not required. If disposal of waste has occurred, resolve Decision II.

If a COC has not migrated, further assessment of the CAS is not required. If a COC has migrated, initiate a Phase II investigation.

A.1.3 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action level, and identifies sampling and analysis methods that can meet the data requirements.

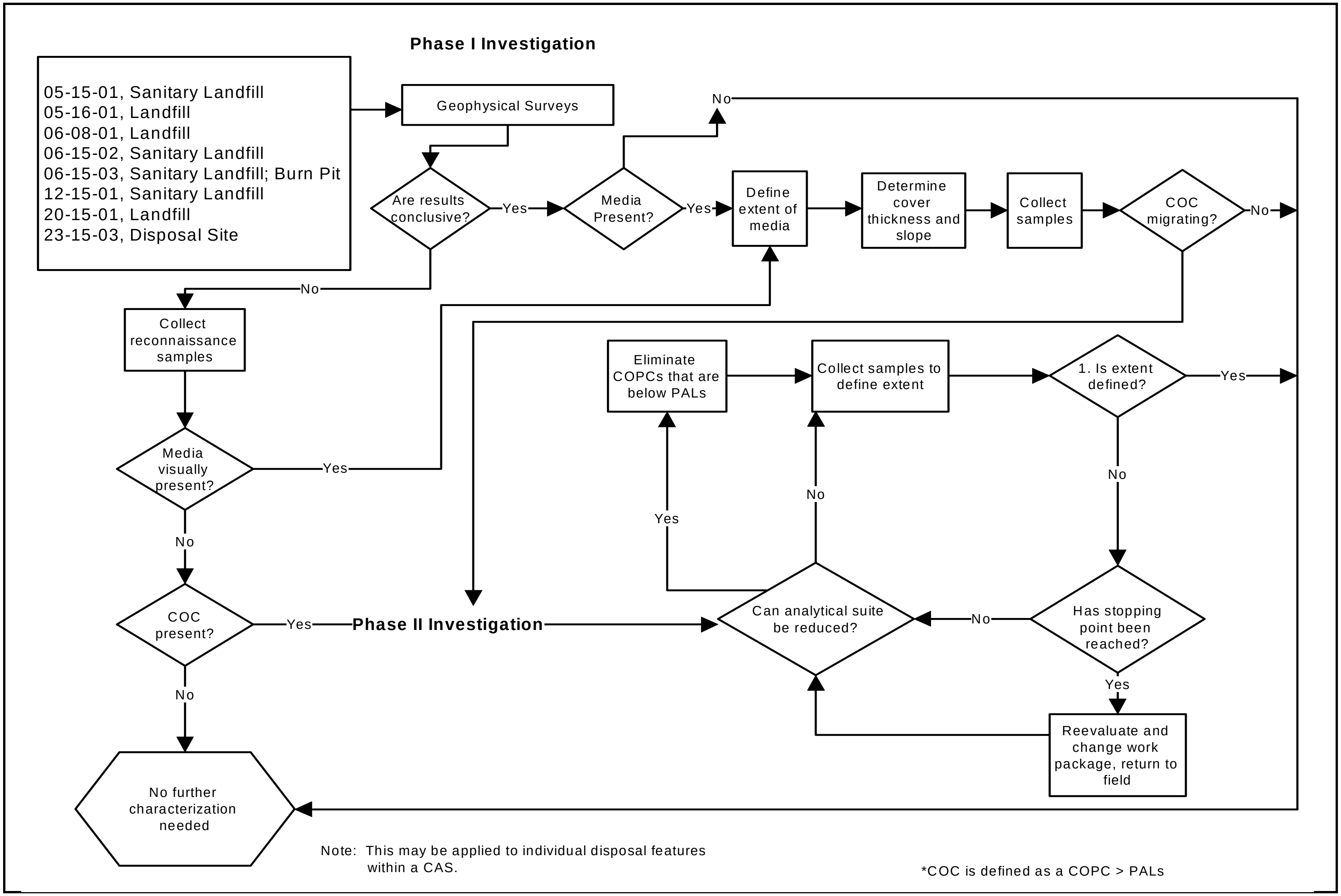


Figure A.1-2
Decision Diagram for CAU 5 Investigation

A.1.3.1 Information Needs and Information Sources

In order to determine if disposal of waste has occurred, data must be collected and analyzed following these two criteria: (1) data must be collected in areas most likely to contain disposed waste, and (2) the data collection method must be adequate to detect any disposed waste.

In order to determine if a COC has migrated at a particular CAS, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to be contaminated by migration (i.e., adjacent to the lateral and vertical extent of waste), and (2) the analytical suite selected must be sufficient to detect any contamination present in the samples.

Biasing factors to support these criteria include:

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

Table A.1-3 and Table A.1-4, list the information needs, the source of information for each need, and the proposed methods to collect the data. 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 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 systems because the intended use of the data is to resolve primary decisions (i.e., rejecting or accepting the null hypothesis) and/or verifying 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

Table A.1-3
Information Needs to Resolve Phase I Decision I

Information Need	Information Source	Collection Method	Data Type/Metric
Decision I: Determine if disposal of waste has occurred. Criteria 1: Data will be collected in areas most likely to contain disposed waste.			
Location of disposed waste	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
	Site visit and field observations	Conduct site visits and document field observations	Qualitative – CSM has not been shown to be inaccurate
Decision I: Determine if disposal of waste has occurred. Criteria 2: Data collection method must be adequate to detect any disposed waste.			
Physical characteristics of disposed waste	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
	Geophysical surveys	Perform geophysical surveys using appropriate methods	Semiquantitative – Surveys based on biasing criteria stipulated in DQO Step 7
	Inspection of biased samples	Visual inspection via drilling or excavation	Qualitative – CSM has not been shown to be inaccurate
Identification of all potential contaminants (only needed if geophysics are inconclusive)	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
Analytical results (only needed if geophysics are inconclusive)	Data packages of biased samples	Appropriate sampling techniques and approved analytical methods will be used	Quantitative – Validated analytical results will be compared to PALs

Table A.1-4
Information Needs to Resolve Phase I Decision II

Information Need	Information Source	Collection Method	Data Type/Metric
Decision II: Determine if a COC has migrated. Criteria 1: Samples will be collected in areas most likely to be contaminated by migration			
Lateral and vertical extent of disposed waste	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
	Site visit and field observations	Conduct site visits and document field observations	Qualitative – CSM has not been shown to be inaccurate
	Geophysical surveys	Perform geophysical surveys using appropriate methods	Semiquantitative – Sampling based on biasing criteria stipulated in DQO Step 7
Decision II: Determine if a COC has migrated. Criteria 2: Analyses must be sufficient to detect contamination in samples.			
Identification of all potential contaminants	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites; a full suite of analyses will be utilized	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
Analytical results	Data packages of biased samples	Appropriate sampling techniques and approved analytical methods will be used	Quantitative – Validated analytical results will be compared to PALs

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 may not be as rigorous as 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 on 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 judgement 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.1.3.2 Determine the Basis for the Preliminary Action Levels

Site workers may be exposed to contaminants through oral ingestion, inhalation, or dermal contact (absorption) of soil during disturbance of this media. Laboratory analytical results for soils will be compared to the following PALs to evaluate if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment:

- *EPA Region 9 Risk-Based Preliminary Remediation Goals for Industrial Soils* (EPA, 2000b).
- Background concentrations for metals when natural background exceeds the PRG, as is often the case with arsenic; 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 Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- TPH action limit of 100 ppm per the NAC 445A.2272 (NAC, 2000).
- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992; BN, 1996).

For detected chemical COPCs without established PRGs, a protocol similar to EPA Region 9 will be used in establishing an action level for those COPCs listed in IRIS (EPA, 2002).

A.1.3.3 Potential Sampling Techniques and Appropriate Analytical Methods

Geophysical Surveys

Electromagnetic surveys will be used to determine presence/lateral extent of applicable waste. Resistivity and/or seismic surveys will be used to determine presence/vertical extent of applicable waste. Geophysical surveys will follow standard procedures. Note: Direct soil sampling may be required if geophysical surveys are unable to conclusively determine the presence of disposed waste.

Geodetic Surveys

Geodetic surveys will be conducted in accordance with standard industry procedures.

Soil Sampling

Drilling, excavation, or other appropriate sampling methods will be used. Sample collection and handling activities will follow standard procedures.

The Industrial Sites QAPP (NNSA/NV, 2002), unless otherwise stipulated in the CAIP, provides analytical methods and laboratory requirements (e.g., detection limits, precision and accuracy requirements). Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Specific analyses required for the disposal of IDW are identified in Section 5.0 of this CAIP.

To ensure that laboratory analyses are sufficient to detect contamination in soil samples at concentrations exceeding the MRL, Phase I chemical and radiological parameters of interest have been selected for each CAS. Solid media (e.g., concrete, wood) will not be analyzed by a laboratory for chemical or radiological parameters.

For each CAS, the chemical and radiological parameters for Phase I soil samples include:

- Total VOCs
- Total SVOCs
- PCBs
- Total Pesticides (for CAS 23-15-03 only)
- TPH (diesel- and gasoline-range organics [C_6-C_{38}])
- Total RCRA metals, plus nickel and zinc

- Gamma Spectrometry (for CAS 06-15-02 and CAS 06-15-03 only)
- Isotopic Plutonium (for CAS 06-15-02 and CAS 06-15-03 only)

A.1.4 Step 4 - Define the Boundaries of the Study

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. Note: Due to the potentially dangerous nature of buried waste (i.e., compressed gas cylinders, medical waste, or asbestos), the types of waste disposed in the CAU 5 CASs will not be determined.

A.1.4.1 Define the Target Population

The Phase I Decision I target populations are:

- Disposed waste
- COC concentrations in waste of potential disposal features not conclusively identified by geophysical surveys or visual observations

The Phase I Decision II target populations are:

- COC concentrations in soil adjacent to disposal feature walls
- COC concentrations in soil below the base of disposed waste in the plane of disposal feature walls

These target populations represent locations within the CAS that will encounter contamination, if migration has occurred. Additional target populations may also be sampled during a Phase I investigation, at the discretion of the Site Supervisor. While these samples may not directly support Phase I decision-making, they will be used if a CAS is elevated to a Phase II investigation.

A.1.4.2 Identify the Spatial and Temporal Boundaries

The spatial boundaries that apply to each CAS in a Phase I investigation are the survey and sample locations selected for Phase I sampling.

Temporal boundaries are those time constraints set up by weather conditions and project schedules. Significant temporal constraints due to weather conditions are not expected in Areas 5, 6, and 23. However, snow in Areas 12 and 20 may affect site access during the winter months of December, January, and February. Moist weather may place constraints on sampling and field screening contaminated soils because of the attenuating effect of moisture in samples (e.g., alpha/beta-emitting radionuclides). There are no time constraints on collecting samples as environmental conditions at all sites will not significantly change in the near future and conditions would have stabilized over the years since the sites were last used.

A.1.4.3 Identify Practical Constraints

The NTS-controlled activities may affect ability to characterize these sites, especially at CAS 06-08-01 and CAS 23-15-03 where portions of each site lie beneath the currently active Area 6 Equipment Yard and the Area 23 Sanitary Landfill, respectively. Underground utilities are expected to exist at some of the sites which may limit intrusive sampling locations and adverse weather conditions may affect road access and delay the investigations at CAS 12-15-01 and 20-15-01 during the December, January, and February winter months. Table A.1-5 indicates other practical constraints that may be encountered at each CAS.

Table A.1-5
Practical Constraints Identified for CAU 5

CAS	Utilities Likely to be Encountered[a]	Topography/Site Conditions Likely to Effect Planned Activities	Structures (e.g., materials) Likely to Effect Planned Activities	Area Subject to Access Restrictions[b]
05-15-01	No	No	No	Yes
05-16-01	Yes	Yes	Yes	Yes
06-08-01	Yes	No	Yes	Yes
06-15-02	Yes	No	No	No
06-15-03	Yes	No	No	No
12-15-01	Yes	Yes	Yes	No
20-15-01	Yes	Yes	No	No
23-15-03	Yes	Yes	Yes	Yes

[a]Utility constraints are subject to change as detailed information is collected prior to commencement of investigation activities and will be appropriately documented. All CASs will be surveyed for utilities prior to field activities in accordance with the SSHASP.
[b]Access restrictions include both scheduling conflicts on the NTS with other entities and areas posted as contamination areas requiring appropriate work controls, and areas requiring authorized access.

Source: Site visits on 12/18/01 and 01/08/02 (IT, 2001 and IT, 2002)

A.1.4.4 Define the Scale of Decision Making

The scale of decision making in a Phase I investigation is defined as the CAS.

A.1.5 Step 5 - Develop a Decision Rule

This step integrates outputs from the previous step 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.1.5.1 Specify the Population Parameter

For geophysical surveys, individual results will be the population parameter and compared against method-specific parameters. If sampling is performed to support inconclusive geophysical results, the maximum observed concentration of each COC will be the population parameter.

Because the sampling to resolve Decision II is biased towards concentrations of migrated contaminants, the population parameter will be the maximum observed concentration of each COC within the target population.

A.1.5.2 Choose an Action Level

Action levels were defined in Section A.1.3.2.

A.1.5.3 Measurement and Analysis Methods

Electromagnetic, resistivity, and possibly seismic geophysical surveys will be used to resolve Decision I. If necessary, the measurement and analysis methods discussed below for Decision II will be used.

The measurement and analysis methods in the Industrial Sites QAPP are capable of achieving the expected range of values to resolve Decision II. The detection limit of the measurement method to be used is less than the PAL for each COPC unless specified otherwise in the CAIP. See Section A.1.3.3 for additional details.

A.1.5.4 Decision Rule

If evidence of waste disposal is obtained, then Decision II must be resolved. If evidence of waste disposal is not obtained, then the decision will be no further action. If evidence is inconclusive, samples will be collected to determine if the concentration of any COPC in a target population exceeds the PAL for the COPC. If so, that COPC is identified as a COC and a Phase II investigation will be conducted. If the COPC concentration is less than the PAL, then the decision will be no further action.

If the concentration of any COPC in a target population exceeds the PAL for the COPC, then that COPC is identified as a COC and a Phase II investigation will be conducted. If the COPC concentration is less than the PAL, then the decision will be no further sampling.

A.1.6 Step 6 - Specify the Tolerable Limits on Decision Errors

The approach for resolving Decision I relies on assuming that historical disposal activities occurred within a distinct geographical area and disposed waste will be responsive to geophysical surveys or direct sampling and/or analysis if geophysical surveys are inconclusive. Only appropriate geophysical methods will be used to determine if disposal of waste has occurred. If geophysical results are inconclusive, then visual observation of waste or validated analytical results (quantitative data) will be used to determine if COCs are present. The baseline condition (i.e., null hypothesis) and alternative condition for Decision I are:

- Baseline condition – Disposed waste is present and contaminant migration may have occurred or a COC is present.

- Alternative condition – Disposed waste is not present and/or a COC is not present.

The sampling approach for resolving Decision II relies on biased sampling locations such as knowing the location of disposed waste; therefore, random sample locations are not considered. Only validated analytical results (quantitative data) will be used to determine if COCs are migrating. The baseline condition and alternative condition for Decision II are:

- Baseline condition – A COC has migrated.
- Alternative condition – A COC has not migrated.

A.1.6.1 False Rejection Decision Error

The false rejection (alpha) decision error would mean deciding that:

- Disposed waste or a COC is not present when it is, increasing the risk to human health and the environment.

- A COC has not migrated when it has, increasing risk to human health and environment.

A false rejection decision error (where consequences are more severe) is controlled by meeting these criteria: (1) having a high degree of confidence that the geophysical survey areas and/or sample locations selected will identify disposed waste or COCs (only necessary if geophysics are inconclusive for discrete potential disposal features) if present anywhere within the CAS, (2) having a high degree of confidence that the sample locations selected will identify COCs if migrating from the CAS, and (3) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

To satisfy the first two criteria, Phase I data and samples will be collected in areas most likely to contain disposed waste, contain COCs where geophysical results were inconclusive, and be contaminated by any migrating COCs. To accomplish this, the following characteristics are considered:

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

These characteristics were considered during the development of the CSM. The biasing factors listed in Section A.1.3.1 will be used to further ensure that these criteria are met.

To satisfy the third criterion, all Phase I samples will be analyzed for the chemical and radiological parameters listed in Section A.1.3.3. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.1.6.2 False Acceptance Decision Error

The false acceptance (beta) decision error would mean deciding that:

- Disposed waste or a COC is present when it is not, resulting in increased costs for unnecessary characterization.
- A COC has migrated when it has not, resulting in increased costs for unnecessary characterization.

For determining if disposed waste is present, the false acceptance decision error is controlled by well-established methodology, experienced personnel, and direct sampling where geophysical results may be inconclusive.

For determining if COCs are present or migrating, the false acceptance 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/quality control 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.1.6.3 Quality Assurance/Quality Control

Geophysical survey instruments will be calibrated in accordance with manufacturer's instructions and periodic calibrations will be performed in accordance with approved procedures.

Quality control samples will be collected as required by established procedures. The required QC samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment rinsate blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per 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 sampling day, whichever best exemplifies field conditions)

- Matrix spike/matrix spike duplicate (minimum of 1 per matrix per 20 environmental samples or 1 per CAS if less than 20 collected). Some radioanalytical measurements (e.g., gamma spectrometry) do not require MS/MSD.

Additional QC samples may be submitted based on site conditions.

The following DQIs: precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002). 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.

A.1.7 Step 7 - Optimize the Design for Obtaining Data

Geophysical surveys, geodetic surveys, and biased sampling will be conducted at CAU 5 during Phase I investigations. Geophysical surveys will be conducted to estimate the lateral and vertical extent of disposed waste. Biased sampling locations will be determined based on the results of the geophysical surveys and other biasing factors listed in Section A.1.3.1. The Site Supervisor has the discretion to modify these locations and minimize samples submitted for laboratory analyses, but only if the decision needs and criteria stipulated in Section A.1.3 are still satisfied.

The following sections provide general Phase I investigation activities. The CAS-specific Phase I investigation activities will be developed as CAS-specific data becomes successively more detailed.

A.1.7.1 Geophysical Surveys

Geophysical surveys will be conducted at each of the CAU 5 CASs to define the lateral and vertical extent of disposed waste. Site preparation will be conducted the NTS Management and Operating Contractor prior to the surveys. Site preparation will include removal and proper disposal of surface debris and temporarily moving staged equipment (e.g., dumpsters at CAS 23-15-03, heavy equipment at CAS 06-08-01).

Electromagnetic induction methodology using instruments such as the Geonics EM31 and EM61 will be used to determine the approximate lateral extent of disposed waste. Trench orientation will also be acquired from the results of these surveys. The grid spacing for data collection locations will be 10 ft. This spacing may be increased to 20 ft for CAS 06-08-01 due to its large area. The EM31 will be the primary instrument. The EM61 will be used to supplement EM31 data as necessary, especially near areas of interference (i.e., utilities and fences).

Resistivity methodology using instruments such as the Advanced Geosciences, Inc. SuperSting will be used to determine the approximate vertical extent of disposed waste. The number and length of data collection traverses will be determined based on the results of the EM surveys. Seismic methodology may be used as an alternative.

A.1.7.2 Intrusive Investigation

Intrusive investigations will be conducted at each of the CAU 5 CASs to determine the existing cover thickness and determine if a COC is present or has migrated. Biased locations for these activities will be determined based on the results of the geophysical surveys and other biasing factors listed in Section A.1.3.1.

The existing cover thickness will be determined by excavating or drilling into the covers at select locations. The minimum thickness measured will be assumed for the cover of the individual disposal feature (e.g., trench, pit, mound).

Rotary sonic drilling, hollow stem auger drilling, or excavation will be used to access sample intervals for laboratory analysis at select locations to determine if a COC is present or has migrated. Due to the potentially dangerous nature of buried waste (i.e., compressed gas cylinders, medical waste, or asbestos), most sample locations will be biased adjacent to disposal feature boundaries. Potential disposal features identified by inconclusive geophysics may be accessed directly at the discretion of the Site Supervisor. Sites with multiple disposal features in close proximity to each other will be treated as one area of concern. Therefore, sample locations will be selected adjacent to the outer boundaries of the outer disposal features with limited locations between disposal features. The frequency of sample locations will be based on biasing factors and be approximately between 75 and 150 ft with a minimum of one per lateral side of each CAS.

Sample intervals will be selected from the biased locations focusing on any COC that may have migrated from the walls and base of subsurface disposal features. The frequency of sample intervals above the disposal feature base will vary depending on the estimated depth as determined by the geophysical surveys. The frequency will be such that sample intervals will be approximately spaced evenly between the estimated cover bottom and a sample interval at the disposal feature base. The frequency will not be less than every 5 ft nor greater than every 2.5 ft. Two additional samples will be collected 5 and 10 ft below the disposal feature base. One surface sample, one sample at 5 ft bgs, and one sample at 10 ft bgs will be collected at locations adjacent to surface disposal features. Both strategies may be required where a disposal feature exhibits both characteristics, as may be the case at a portion of CAS 12-15-01.

A.2.0 Seven-Step DQO Process for Phase II Investigations

This section discusses the DQO process for a Phase II investigation for any CAS that requires further assessment based on Phase I results. If COCs are identified, the CAS will proceed to a Phase II investigation.

A.2.1 Step 1 - State the Problem

Refer to Section A.1.1 for information regarding Step 1.

A.2.2 Step 2 - Identify the Decision

This step develops a decision statement and defines alternative actions. Figure A.1-2 is a flow chart that identifies decisions and alternative actions appropriate for Phase II investigation.

A.2.2.1 Develop a Decision Statement

The decision statement for a Phase II investigation is “Determine the extent of a COC.”

A.2.2.2 Alternative Actions to the Decision

If extent of a COC is defined, further assessment of the CAS is not required. If extent is not defined, reevaluate site conditions and collect additional samples.

A.2.3 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action level, and identifies sampling and analysis methods that can meet the data requirements.

A.2.3.1 Information Needs and Information Sources

In order to determine the extent of a COC, samples must be collected at locations to bound lateral and vertical extent of COCs. Samples will only be analyzed for those parameters that exceeded PALS (i.e., COCs) in Phase I samples. Biasing factors to support these information needs may include:

- Geophysical surveys
- Documented process knowledge on source and location of release
- Field observations
- Field-screening results
- Historical sample results
- Experience and data from investigations of similar sites
- Professional judgement
- Phase I sample results

Table A.2-1 lists the information inputs, the source of information for each input, and the proposed methods to collect the data. Additional information is provided in Section A.1.3.1.

A.2.3.2 Determine the Basis for Preliminary Action Levels

Laboratory analytical results will be compared to the applicable PALs presented in Section A.1.3.2 to determine if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment (i.e., COCs).

A.2.3.3 Potential Sampling Techniques and Appropriate Analytical Methods

Section A.1.3.3 provides details regarding potential sampling techniques. To ensure that laboratory analyses are sufficient to detect contamination in samples, chemical and radiological parameters will be selected based on Phase I analytical data. Only those COCs identified during Phase I will be analyzed for during Phase II. This parameter selection process will be applied independently to each CAS as discussed in Section A.2.4.4, “Scale of Decision Making.”

A.2.4 Step 4 - Define the Boundaries of the Study

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.

A.2.4.1 Define the Target Population

The potential Phase II investigation target populations for each CAS are:

- COC concentrations in soil at step-out locations around each CAS
- COC concentrations in soil below Phase I samples

Table A.2-1
Information Needs to Resolve the Phase II Decision

Information Need	Information Source	Collection Method	Data Type/Metric
Decision: Determine the extent of a COC			
Identification of applicable Phase II contaminants	Data packages of Phase I biased samples	Review Phase I analytical results to select Phase II COCs.	Quantitative - Only COCs identified in Phase I will be analyzed for in Phase II.
Extent of Contamination	Field observations	Document field observations.	Qualitative - CSM has not been shown to be inaccurate.
	Field-screening results	Conduct field screening with appropriate instrumentation.	Semiquantitative - FSRs will be compared to FSLs.
	Phase II analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs.	Quantitative - Validated analytical results will be compared to PALs to determine COC extent.

Phase II target populations will be limited to those related to distinct Phase I target populations with COCs. These target populations represent locations within the system that, when sampled, will provide sufficient data to address data needs discussed in Section A.2.3.

A.2.4.2 Determine the Spatial and Temporal Boundaries

The spatial boundaries that apply to each CAS for a Phase II investigation are shown in Table A.2-2. In general, geographic boundaries are defined by the impacted soil. Intrusive activities are not intended to extend into CASs not in CAU 5. Temporal boundaries are defined in Section A.1.4.2.

A.2.4.3 Identify Practical Constraints

Practical constraints are listed in Section A.1.4.3.

A.2.4.4 Define the Scale of Decision Making

The scale of decision making in a Phase II investigation is defined as the extent of contamination in soil from which characterization samples were collected.

Table A.2-2
Spatial Boundaries for Phase II Investigation Sites

CAS	Spatial Boundary	
	Horizontal	Vertical
05-15-01 Sanitary Landfill	100 ft buffer around the CAS.	50 ft bgs
05-16-01 Landfill	100 ft buffer around the CAS. The active Area 5 RWMS will not be entered. The Area 5 RWMS flood dike will not be modified.	50 ft bgs
06-08-01 Landfill	100 ft buffer around the CAS. Area 6 Equipment Yard structures will potentially require modification of some investigation locations.	50 ft bgs
06-15-02 Sanitary Landfill	100 ft buffer around the CAS. The Area 6 Hydrocarbon Landfill will not be entered.	50 ft bgs
06-15-03 Sanitary Landfill; Burn Pit	100 ft buffer around the CAS.	50 ft bgs
12-15-01 Sanitary Landfill	100 ft buffer around the CAS. Discharge station and structure will potentially require modification of some investigation locations.	50 ft bgs
20-15-01 Landfill	100 ft buffer around the CAS.	50 ft bgs
23-15-03 Disposal Site	100 ft buffer around the CAS. Landfill bordered by the active Area 23 Sanitary Landfill and the closed Area 23 Hazardous Waste Trenches. The Disposal Area is bordered by the WSI PFTC. An active leachfield services WSI PFTC Buildings 1100 and 1103 and is located within the northern portion of the landfill.	50 ft bgs

A.2.5 Step 5 - Develop a Decision Rule

This step integrates outputs from 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.2.5.1 Specify the Population Parameter

The population parameter will be the maximum observed concentration of each COC within the target population(s).

A.2.5.2 Choose an Action Level

Action levels were previously defined in Section A.1.3.2.

A.2.5.3 Measurement and Analysis Methods

The measurement and analysis methods in the Industrial Sites QAPP (NNSA/NV, 2002) are capable of achieving the expected range of values. The detection limit of the measurement method to be used is less than the PAL for each COPC unless specified otherwise in the CAIP. See Section A.1.3.3 for additional details.

A.2.5.4 Decision Rule

If the observed concentration of any COPC in a sample exceeds the PALs, then additional samples will be collected to define extent. If the concentration is less than PALs, then the decision will be that the extent has been defined in the vertical and/or lateral direction.

If contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Table A.2-2, 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 to define extent.

A.2.6 Step 6 - Specify Tolerable Limits on Decision Errors

The sampling approach for the Phase II investigation relies upon biased samples; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative) will be used to determine COC extent.

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

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

A.2.6.1 False Rejection Decision Error

The false rejection (alpha) decision error would mean accepting that the extent of a COC has been defined when it has not, increasing risk to human health and environment.

A false rejection decision error (where consequences are more severe) is controlled by meeting these criteria: (1) having a high degree of confidence that the sample locations selected will identify the extent of COCs; and (2) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

To satisfy that the first criterion is met, the Phase II data collection will sample areas that represent vertical and lateral extent of contamination by considering the following characteristics:

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

These characteristics were considered during the development of the CSM. The biasing factors listed in Section A.2.3.1 will be used to further ensure that the first criterion is met.

To meet the second criterion, Phase II samples will be analyzed for those chemical and radiological parameters that were identified as COCs in Phase I samples. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.2.6.2 False Acceptance Decision Error

The false acceptance (beta) decision error would mean accepting that the extent of a COC has not been defined when it really has, resulting in increased costs for unnecessary corrective action.

The false acceptance decision error is controlled by protecting against false positive analytical results. False positive results are typically attributed to laboratory errors and sampling/handling errors. Quality assurance/quality control 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.2.6.3 Quality Assurance/Quality Control

Quality assurance/quality control protocols are presented in Section A.1.6.3.

A.2.7 Step 7 - Optimize the Design for Obtaining Data

Biased sampling for laboratory analysis will be conducted at CAU 5 during Phase II investigations. Biased sampling locations will be determined prior to the investigation, based on process knowledge and analytical results from the Phase I investigation. As field data are generated (e.g., geophysical surveys, field-screening, Phase I analytical results), the Site Supervisor has the discretion to modify these locations but only if the modified locations meet the decision needs and criteria stipulated in Section A.2.3.

Step-out sample locations will be selected approximately 15 ft from outer boundary Phase I sample locations where COCs were detected. If biasing factors indicate COCs extend beyond the proposed Phase II sample locations, further step-out locations may be necessary. At each Phase II location, soil samples will be collected at the depth(s) and at 5 ft below the lowest depth where COCs were encountered. In general, samples submitted for laboratory analysis would be those that define the lateral and vertical extent of COCs. Additional samples will be collected to define the extent of COCs if necessary.

Drilling is the preferred method of soil sample collection, but excavation may also be used as appropriate.

A.3.0 References

Alderson, S., IT Corporation. 2002. Email to L. Linden (Science Applications International Corporation) regarding CAU 5 radiological parameters, 10 January. Las Vegas, NV.

Balloch D., David Balloch & Associates Pty. Ltd. 2001. "Sewage Effluents." As accessed at http://members.ozemail.com.au/~dballoch/sewage.html on 9 October.

Bechtel Nevada. 1996. *U.S. Department of Energy Nevada Operations Office Environmental Data Report for the Nevada Test Site - 1994*. Prepared by S.C. Black and Y.E. Townsend. Las Vegas, NV.

Bechtel Nevada. 1997. Application for Permit to Operate a Class II Solid Waste Disposal Site at the Nevada Test Site, Area 23 Disposal Site, October. Las Vegas, NV.

BN, see Bechtel Nevada.

Brown, J.J., Reynolds Electrical & Engineering Co., Inc. 1971. Memorandum to file entitled, "Decontamination and Control of Area 12 Camp and Portal Areas for Period beginning 4 January 1971," 4 February. Las Vegas, NV.

BuildingGreen, Inc. 2001. "Disposal of Fluorescent Lamps and ballasts." As accessed at www.buildinggreen.com/features/ds/disposal.html on 25 September.

California Integrated Waste Management Board. 2002. "Characterizing Burn Dumps in California," LEA Advisory #56, Attachment 2. As accessed at http://www.ciwmb.ca.gov/LEAAdvisory/56/attach1.htm on 16 January.

CIWMB, see California Integrated Waste Management Board.

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

Elle, D., U.S. Department of Energy, Nevada Operations Office. 1995. Letter entitled, "Final Reports for a Release of Petroleum Products, Nevada Division of Emergency Management (NDEM) Case Numbers H920219B, H920324B, H920903A, and H921117B," 4 May. Carson City, NV.

EPA, see U.S. Environmental Protection Agency.

Frazier, A.R., Reynolds Electrical & Engineering Co., Inc. 1987. Letter entitled, "Information Regarding Potential Releases from Solid Waste Management Units," 2 October. Las Vegas, NV.

Frazier, A.R., Reynolds Electrical & Engineering Co., Inc. 1988. Letter to F. Bingham (DOE/NV) entitled "Revised NTS Sanitary Landfill Operation and Maintenance Plan," 29 July. Las Vegas, NV.

Hoar, K., U.S. Department of Energy, Nevada Operations Office. 2001a. Interview with B. Moyer-Durham (Science Applications International Corporation) regarding CAU 5, 9 October. Las Vegas, NV.

Hoar, K., U.S. Department of Energy, Nevada Operations Office. 2001b. Interview with T. Roberts (Science Applications International Corporation) regarding Area 12 and Area 20 landfills, 12 September. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 2001. Field Activity Daily Log for CAU 5 site visit on December 18. Las Vegas, NV.

IT Corporation. 2002. Field Activity Daily Log for CAU 5 site visit on January 8. Las Vegas, NV.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (Science Applications International Corporation) entitled, "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

McArthur, R.D., and F.L. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

Neagle, C., Reynolds Electrical & Engineering Co., Inc. (Retired). 2001. Interview with B. Bull (Science Applications International Corporation) and B. Iverson (GeoTrans) regarding CAUs 5 and 140 landfills, 1 October. Las Vegas, NV.

Nevada Administrative Code. 2000. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

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

Norvell, D. Bechtel Nevada. 2001. Interview with B. Bordelois and A. Dudley (Science Applications International Corporation), and B. Iverson (GeoTrans) regarding CAUs 5 and 140 landfills, 17 September. Las Vegas, NV.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical & Engineering Co., Inc. 1991. Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1993. *Operations and Maintenance Plan Class III Construction Landfill Area 20-Construction Borrow Pit*, January. Las Vegas, NV.

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

U.S. Department of Energy, Nevada Operations Office. 1986. *Environmental Assessment for the LGF Spill Test Facility at Frenchman Flat, Nevada Test Site*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998a. *Corrective Action Decision Document for Corrective Action Unit 340: Pesticide Release Sites, Nevada Test Site, Nevada*, DOE/NV--525. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998b. *Nevada Test Site Resource Management Plan*, DOE/NV--518. Las Vegas, NV.

U.S. Ecology and Atlan-Tech. 1992. *Environmental Monitoring Report for the Proposed Ward Valley, California, LLRW Facility.* Rosewell, GA.

U.S. Environmental Protection Agency. 2000a. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.

U.S. Environmental Protection Agency. 2000b. *Region IX Preliminary Remediation Goals (PRGs).* Prepared by S.J. Smucker. San Francisco, CA.

U.S. Environmental Protection Agency. 2002. "Integrated Risk Information System (IRIS) Database." As accessed at www.epa.gov/iris/index.html on May 14, 2002.

Winograd, I.J., and W. Thordarson. 1975. *Hydrogeologic and Hydrochemical Framework, South Central Great Basin Nevada-California, With Special Reference to the Nevada Test Site*, U.S. Geological Survey Professional Paper 712-C. Denver, CO: U.S. Geological Survey.

Appendix B

Project Organization

B.1.0 Project Organization

The NNSA/NV Project Manager is Janet Appenzeller-Wing. Her telephone number is (702) 295-0461.

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

Appendix C

Responses to NDEP Comments

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 5: Landfills, Nevada Test Site, Nevada.	2. Document Date: March 2002
3. Revision Number: 0	4. Originator/Organization: IT Corporation
5. Responsible DOE/NV ERP Subproject Mgr.: Janet Appenzeller-Wing	6. Date Comments Due: April 29, 2002
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: Ted Zaferatos, NDEP, 486-2856	9. Reviewer's Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1) Section 2.5 Pages 18 - 19 First Three Paragraphs		The CAU 5 Corrective Action Sites (CASs) have not been closed. (Refer to the September 26, 1996 letter from Paul Liebendorfer to David Shafer, which confirmed agreement on this point between the Department of Energy and the NDEP). As each of the CASs within CAU 5 is being characterized and options proposed, consideration should be given to the current Nevada Administrative Code (NAC) for identification of the Applicable or Relevant and Appropriate Requirements (ARARs). Pertinent sections of the NAC, including NAC 444.743 and NAC 444.6891-6894, were originally codified in 1993.	Section 2.5, second paragraph, last sentence: Deleted the phrase, "therefore, may be closed in accordance with the 1989 solid waste regulations Nevada Administrative Code (NAC) 444." Section 2.5, third paragraph, last sentence: Replaced with, "The eight CASs within CAU 5 ultimately remained in Appendix II of the FFACO (Liebendorfer, 1996b)."	Yes
2) Appendix A Section A.1.3.2 Pages A-17 - A-19 Last Paragraph		Same comment as Comment No. 1.	Section A.1.3.2, last paragraph: Deleted paragraph, "In accordance with applicable regulations (NAC 444.738), the final cover of these landfills must be compacted to a minimum uniform thickness of 24 in. and the top slope should be from 2 to 4 percent to drain surface runoff (NAC, 1991)."	Yes
3) Appendix A Section A.1.5.4 Page A-23 2nd Paragraph		Same comment as Comment No. 1.	Section A.1.5.4, second paragraph: Deleted paragraph, "If the minimum cover thickness is greater than 24 in. and the cover slope is adequate to drain surface runoff (i.e., 2 to 4 percent), then cover repair will not be required during any corrective action. Otherwise, cover repair will be required during corrective action." Decision II, "Determine if existing covers are adequate," and related discussion was removed from the DQOs. The existing cover thickness, slope, and geotechnical parameters will be determined as discussed in Section 4.0 to support closure decisions.	Yes

[a] Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to DOE/NV Environmental Restoration Division, Attn: QAC, M/S 505.

Distribution

*Provide a copy in distribution of Rev. 0, and subsequent revisions if applicable. Copies of only the NDEP-approved document will be distributed to others.

	Copies
Paul J. Liebendorfer State of Nevada Bureau of Federal Facilities Division of Environmental Protection 333 W. Nye Lane, Room 138 Carson City, NV 89706-0851	1 (Controlled)*
D.R. Elle Bureau of Federal Facilities Division of Environmental Protection 1771 E. Flamingo Rd., Suite 121-A Las Vegas, NV 89119	1 (Controlled)*
Sabrina Lawrence Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Operations Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Controlled)*
Janet Appenzeller-Wing Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Operations Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*

Sean Kosinski Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Operations Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*
Jeffrey L. Smith Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
Allison Urbon Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
Dustin Wilson IT Corporation/Las Vegas P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)*
FFACO Support Office IT Corporation/Las Vegas P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)
Linda Linden IT Corporation/Las Vegas P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)*
IT Corporation Central Files P.O. Box 93838 Las Vegas, NV 89193	1 (Uncontrolled)*
Manager, Southern Nevada FFACO Public Reading Facility P.O. Box 98521, M/S NLV040 Las Vegas, NV 89193-8521	1 (Controlled) 1 (Uncontrolled)

Manager, Northern Nevada FFACO Public Reading Facility c/o Nevada State Library & Archives Carson City, NV 89701-4285	1 (Uncontrolled)
Technical Information Resource Center U.S. Department of Energy National Nuclear Security Administration Nevada Operations Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831	1 (Uncontrolled, electronic copy)