RECORD OF TECHNICAL CHANGE

Technical Change No. CAIP-1

Page 1 of 2

Project/Job No. IS05-040

Date 05/24/2005

Project/Job Name CAIP for CAU 145: Wells and Storage Holes, Rev. 0, September 2004

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

David Strand

(Name)

Task Manager – Industrial Sites

(Title)

Description of Changes:

Section 3.3.3, Page 26, first sentence: Change text from, "...scaled from 25 to 15 millirems (mrem/yr)..." to "...based on 25 millirem per year (mrem/yr)".

Table 3-3, Page 29: For "Soil" values only, change values of 5th column of the table (PAL) to reflect the 25 mrem/year dose exposure values as follows:

Americium-241: from "7.62 pCi/g" to "12.7 pCi/g"

Cesium-137: from "7.3 pCi/g" to "12.2 pCi/g"

Cobalt-60: from "1.61 pCi/g" to "2.7 pCi/g"

Plutonium-238: from "7.78 pCi/g" to "13 pCi/g"

Plutonium-239/240: from "7.62 pCi/g" to "12.7 pCi/g"

Strontium-90: from "503.0 pCi/g" to "838 pCi/g"

Uranium-234: from "85.9 pCi/g" to "143 pCi/g"

Uranium-235: from "10.5 pCi/g" to "17.5 pCi/g"

Uranium-238: from "63.2 pCi/g" to "105 pCi/g"

Table 3-3 Explanation, Page 30: In superscript "b" explanation, change text from "...scaled from 25 to 15 mrem/yr dose..." to "...based on 25 mrem/yr dose...".

Section A.1.6.2.3, Page A-42, first sentence: Change text from, "...scaled from 25 to 15 mrem per year dose..." to "...based on 25 mrem/yr dose..."

Justification:

The Preliminary Action Levels (PALs) values for radiological isotopes in the environment are calculated based on 25 mrem per year exposure level, not 15 mrem per year, as agreed between NNSA/NSO, NDEP and SNJV for the Industrial Sites project.

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 145: Wells and Storage Holes, Rev.0, September 2004

Approved By:

Sabine Curtis

Date 5-21-05

NNSA/NSO Project Manager

Janet Geggli-W

Date 5/20/05

NNSA/NSO Environmental Restoration Division Director

Date _____

NDEP

Applicable Project-Specific Document(s):

Corrective Action Investigation Plan for Corrective Action Unit 145: Walls and Storage Holes, Rev.0, September 2004

Approved By:

Sabine Curtis

Date

5-21-05

NNSA/NSO Project Manager

Janet Appell-W

Date

5/20/05

NNSA/NSO Environmental Restoration Division Director

Don Cole

Date

5/20/05

NDEP

Nevada
Environmental
Restoration
Project

DOE/NV--1008

Corrective Action Investigation Plan for Corrective Action Unit 145: Wells and Storage Holes, Nevada Test Site, Nevada

Controlled Copy No.: ____

Revision No.: 0

September 2004

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CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 145: WELLS AND STORAGE HOLES, NEVADA TEST SITE, NEVADA

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

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**CORRECTIVE ACTION INVESTIGATION PLAN FOR
CORRECTIVE ACTION UNIT 145:
WELLS AND STORAGE HOLES,
NEVADA TEST SITE, NEVADA**

Approved by: _____ Date: _____

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: _____ Date: _____

Robert Bangerter, Acting Division Director
Environmental Restoration Division

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List of Acronyms and Abbreviations

bgs	Below ground surface
BJY	Buster-Jangle
BN	Bechtel Nevada
BOP	Blowout preventer
CADD	Corrective Action Decision Document
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	Code of Federal Regulations
CI	Cast iron
cm	Centimeter
COC	Contaminant of concern
COPC	Contaminant of potential concern
cpm	Counts per minute
CSM	Conceptual site model
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
ETS	Effects Test Support

Acronyms and Abbreviations (Continued)

FFACO	<i>Federal Facility Agreement and Consent Order</i>
FID	Flame ionization detector
FSL	Field-screening level
ft	Foot (feet)
ft ²	Square feet
ft/yr	Feet per year
FWP	Field Work Permit
GPS	Global positioning system
GRO	Gasoline-range organics
HASP	Health and Safety Plan
HWAA	Hazardous Waste Accumulation Area
ID	Inside diameter
IDW	Investigation-derived waste
in.	Inch
IRIS	Integrated Risk Information System
IS	Industrial Sites
ISMS	Integrated Safety Management System
LASL	Los Alamos Scientific Laboratory
LCS	Laboratory control sample
LLNL	Lawrence Livermore National Laboratory
LRL	Lawrence Radiation Laboratory
m	Meter
MDL	Minimum detection limit

Acronyms and Abbreviations (Continued)

mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mi	Mile
mi ²	Square miles
mrem/yr	Millirem per year
mR/h	Milliroentgen per hour
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	<i>Nevada Administrative Code</i>
NCRP	Nation Council on Radiation Protection and Measurement
NDEP	Nevada Division of Environmental Protection
NEPA	<i>National Environmental Policy Act</i>
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NRS	<i>Nevada Revised Statutes</i>
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
PAL	Preliminary action level
PCB	Polychlorinated biphenyls
POC	<i>Performance Objective for the Certification of Nonradioactive Hazardous Waste</i>
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal

Acronyms and Abbreviations (Continued)

QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RadCon	Radiological control
RCRA	<i>Resource Conservation and Recovery Act</i>
RMA	Radioactive materials area
ROTC	Record of Technical Change
RPD	Relative percent difference
SAA	Satellite Accumulation Area
SDWS	<i>Safe Drinking Water Standards</i>
SNJV	Stoller-Navarro Joint Venture
SVOC	Semivolatile organic compounds
SW	Solid waste
TPH	Total petroleum hydrocarbon
TSCA	<i>Toxic Substance Control Act</i>
USGS	U.S. Geological Survey
UST	Underground storage tank
µg/L	Micrograms per liter
µg/kg	Micrograms per kilograms
VOC	Volatile organic compounds
%R	Percent recovery

Executive Summary

This Corrective Action Investigation Plan (CAIP) contains project-specific information for conducting site investigation activities at Corrective Action Unit (CAU) 145: Wells and Storage Holes. Information presented in this CAIP includes facility descriptions, environmental sample collection objectives, and criteria for the selection and evaluation of environmental samples.

Corrective Action Unit 145 is located in Area 3 of the Nevada Test Site, which is 65 miles northwest of Las Vegas, Nevada. Corrective Action Unit 145 is comprised of the six Corrective Action Sites (CASs) listed below:

- 03-20-01, Core Storage Holes
- 03-20-02, Decon Pad and Sump
- 03-20-04, Injection Wells
- 03-20-08, Injection Well
- 03-25-01, Oil Spills
- 03-99-13, Drain and Injection Well

These sites are being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives. Additional information will be obtained by conducting a corrective action investigation (CAI) prior to evaluating corrective action alternatives and selecting the appropriate corrective action for each CAS. The results of the field investigation will support a defensible evaluation of viable corrective action alternatives that will be presented in the Corrective Action Decision Document.

One conceptual site model with three release scenario components was developed for the six CASs to address all releases associated with the site.

The sites will be investigated based on data quality objectives (DQOs) developed on June 24, 2004, by representatives of the Nevada Division of Environmental Protection; U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office; Stoller-Navarro Joint Venture; and Bechtel Nevada. The DQOs process was used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 145. The following two decisions statements were identified to resolve the DQO problem statement:

- Decision I: “Is any contaminant of concern (COC) present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?” A COC is defined as any contaminant associated with a CAS activity that is present at concentrations exceeding its corresponding action level. If a COC is detected, then Decision II must be resolved. Otherwise, the investigation for that CAS is complete.
- Decision II: “If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?” Sufficient information is defined as:
 - Volume of media containing any COC bounded by analytical sample results in lateral and vertical directions
 - Information needed to characterize investigation-derived waste for disposal
 - Information needed to determine potential remediation waste types
 - Information needed to evaluate the feasibility of remediation alternatives

[Appendix A](#) provides a detailed discussion of the DQO methodology and the DQOs specific to each CAS.

Based on existing data and process knowledge, the contaminants of potential concern for CAU 145 include constituents associated with volatile organic compounds, semivolatile organic compounds, petroleum hydrocarbons, polychlorinated biphenyls, asbestos, *Resource Conservation and Recovery Act* metals, aluminium, beryllium, and radionuclides.

The scope of the CAI for CAU 145 includes the following activities:

- Relocate surface debris and/or equipment as necessary to allow access to sampling locations.
- Perform visual surveys at all CASs to identify any staining, discoloration, disturbance of native soils, or any other indication of potential contamination.
- Perform video mole surveys and radiological characterization surveys at all CASs with wells, tanks, holes, and/or piping to assess physical layout, identify possible residual materials, locate breaches or tie-ins within the piping, and determine whether sources are plugged and sealed, if possible.
- Perform field screening and/or radiological swipe sampling on applicable CAS-related media.
- Collect and analyze samples from locations as described in [Section 4.0](#) of this report.

- Collect required quality control samples.
- Collect samples of investigation-derived waste, as needed, for waste management and minimization purposes.
- Collect soil samples from background locations, if necessary.
- Collect and analyze bioassessment samples, if appropriate (e.g., if VOC concentrations exceed field-screening levels in a pattern that suggests that a plume may be present).
- Stake or flag sample locations and record coordinates through global positioning system surveying in Universal Transverse Mercator projection, North American Datum 1927.

The general technical approach for investigation of CAU 145 will consist of the following activities:

- Inspect the injection well, sump, tank, drain pit, core storage hole, and/or piping for debris and for evidence of organic or inorganic contaminants. Survey for radiological contaminants. If either are present, collect samples from the waste or environmental media for analysis.
- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present and/migrating. In general, field activities will consist of collecting soil samples at biased locations according to approved procedures.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.

Additional samples will be collected and analyzed for the purpose of waste characterization and developing corrective action alternatives for the disposal of the waste.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, 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 investigation activities at Corrective Action Unit (CAU) 145: Wells and Storage Holes, 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 State of Nevada, the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DoD). Corrective Action Unit 145 is located in Area 3 of the NTS, which is approximately 65 miles (mi) northwest of Las Vegas, Nevada ([Figure 1-1](#)). Corrective Action Unit 145 is composed of the six Corrective Action Sites (CASs) shown on [Figure 1-1](#) and listed below:

- 03-20-01, Core Storage Holes
- 03-20-02, Decon Pad and Sump
- 03-20-04, Injection Wells
- 03-20-08, Injection Well
- 03-25-01, Oil Spills
- 03-99-13, Drain and Injection Well

All six CASs are located in Area 3. Corrective Action Site 03-20-01 consists of seven core storage holes located in a fenced area within the Core Complex in Area 3 of the NTS, north of 3-03 Road. Corrective Action Site 03-20-02 consists of a former decontamination pad, sump, piping, and soil immediately surrounding these features located northeast of the intersection of Mercury Highway and 7-01 Road. Corrective Action Site 03-20-04 consists of four nearby injection wells, a steel-cased hole, concrete pads, concrete drainage channels, a steam plant decontamination pad, associated subsurface piping that originates from the steam plant pad, a surface discharge point, and affected surface/near-surface soils surrounding and downgradient of the discharge, all of which are within the Area 3 Subdock. Corrective Action Site 03-20-08 consists of an injection well, decontamination pad, sump, catch basin, and associated piping located in the J-6 Containment Yard, part of Area 3 Camp. Corrective Action Site 03-25-01 consists of the affected surface/near-surface soils surrounding and down gradient of potentially hydrocarbon-stained soils, concrete pads, and concrete drainage channels, located in the former Pipe Straightening Area of the Area 3 Subdock. Corrective Action Site 03-99-13 consists of an injection well, drain pit, and associated piping from three former buildings in the Core Complex of Area 3.

Figure 1-1
Nevada Test Site Map with CAU 145 CAS Locations

The corrective action investigation (CAI) activities will include field inspections, radiological surveys, video mole surveys, and sampling of media, where appropriate. Analytical data will also be obtained to support waste management decisions.

1.1 Purpose

The CASs in CAU 145 are being investigated because hazardous and/or radioactive constituents may be present in concentrations that could potentially pose a threat to human health and/or the environment.

1.1.1 Corrective Action Unit History and Description

Corrective Action Unit 145, Wells and Storage Holes, consists of six inactive sites located in the western portion of Area 3. The six CAU 145 sites consist of injection wells, core storage holes, sumps, drains, a catch basin, potential hydrocarbon-impacted soils, piping and a surface discharge point. The CAU 145 sites were all used to support nuclear testing conducted in the Yucca Flat area from the 1950s through the 1970s. Operational histories for each CAU 145 CAS are detailed in [Section 2.2](#).

1.1.2 DQO Summary

The sites will be investigated based on data quality objectives (DQOs) developed by representatives of the Nevada Division of Environmental Protection (NDEP), DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO), Stoller-Navarro Joint Venture (SNJV), and Bechtel Nevada (BN). The DQOs are used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 145. This CAIP will describe the investigation developed to collect the data needs identified in the DQO process. While a detailed discussion of the DQO methodology and the DQOs specific to each CAS are presented in [Appendix A](#) to this document, a summary of the results of the DQO process is provided below.

The DQO problem statement for CAU 145 is: “Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the CASs in CAU 145.” To address this question, the resolution of two decisions statements is required:

- Decision I: “Is any contaminant of concern (COC) present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?” A COC is defined as any contaminant associated with a CAS activity that is present at concentrations exceeding its corresponding action level. If a COC is detected, then Decision II must be resolved. Otherwise, the investigation for that CAS is complete.
- Decision II: “If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?” Sufficient information is defined as:
 - Volume of media containing any COC bounded by analytical sample results in lateral and vertical directions
 - Information needed to characterize investigation-derived waste (IDW) for disposal
 - Information needed to determine potential remediation waste types
 - Information needed to evaluate the feasibility of remediation alternatives

The informational inputs and data needs to resolve the problem statement and the decision statements were generated as part of the DQO process for this CAU and are documented in [Appendix A](#). The information necessary to resolve the DQO decisions will be generated for each CAU 145 CAS by collecting and analyzing samples generated during a field investigation. The presence and nature of contamination at each CAS will be determined by sampling locations that are determined to be the most probable to contain COCs if they are present anywhere within the CAS. If it is determined that COCs are present at a CAS while defining the nature of contamination, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives as defined by the DQOs in [Appendix A](#).

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO processes, the scope of the CAI for CAU 145 may include the following activities:

- Relocate surface debris and/or equipment as necessary to allow access to sampling locations.
- Perform visual surveys at all CASs to identify any staining, discoloration, disturbance of native soils, or any other indication of potential contamination.
- Perform video mole surveys and radiological characterization surveys at all CASs with wells, tanks, holes, and/or piping to assess physical layout, identify possible residual materials,

locate breaches or tie-ins within the piping, and determine whether sources are plugged and sealed, if possible.

- Perform field screening and/or radiological swipe sampling on applicable CAS-related media.
- Collect and analyze media samples from locations as described in [Section 4.0](#).
- Collect required quality control samples.
- Collect samples of IDW, as needed, for waste management and minimization purposes.
- Collect soil samples from background locations, if necessary.
- Collect and analyze bioassessment samples, if appropriate (e.g., if natural attenuation or biodegradation will be considered as corrective alternatives).
- Stake or flag sample locations and record coordinates through global positioning system (GPS) surveying in Universal Transverse Mercator projection, North American Datum 1927.

Contamination originating from activities not identified in the conceptual site model (CSM) of any CAU 145 CAS will not be considered as part of CAU 145 unless the CSM and the DQOs are modified to include the release. As such, contamination originating from these sources will not be considered for sample location selection, and/or will not be considered COCs for Decision II. If such contamination is present, the investigation will be suspended to re-evaluate contributing source areas, the scope of CAS boundaries, and the contamination may be identified as part of a new or other existing CAS.

1.3 CAIP Contents

[Section 1.0](#) presents the purpose and scope of this CAIP, while [Section 2.0](#) provides background information about CAU 145. Objectives of the investigation, including CSMs, are presented in [Section 3.0](#). Field investigation and sampling activities are discussed in [Section 4.0](#), and waste management issues for this project are discussed in [Section 5.0](#). General field and laboratory quality assurance (QA) and quality control (QC) requirements (including collection of QC samples) are presented in [Section 6.0](#) and in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The project schedule and records availability are discussed in [Section 7.0](#) and [Section 8.0](#) provides a list of references.

[Appendix A](#) provides a detailed discussion of the DQO methodology and the DQOs specific to each CAS, while [Appendix B](#) contains information on the project organization.

The health and safety aspects of this project are documented in the contractor's *Industrial Sites (IS) Health and Safety Plan* (HASP) and will be supplemented with a site-specific field work permit (FWP) written prior to the start of field work.

Public involvement activities are documented in the "Public Involvement Plan" contained in Appendix V of the FFACO (1996). The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and will be supplemented with a site-specific field management plan that will be developed prior to field activities.

2.0 Facility Description

Corrective Action Unit 145 is comprised of six CASs which were grouped together based on the geographical location of the sites (Area 3), technical similarities (storage holes or wells), and the agency responsible for closure (NNSA/NSO). Three CASs (03-20-04, 03-20-08, and 03-99-13) contain injection wells used to dispose of decontamination fluids. One CAS (CAS 03-20-01) is seven core storage holes, CAS 03-25-01 is stained soil (possibly from oil spills), and CAS 03-20-02 is a decontamination pad, underground storage tank (UST), and sump that received unknown fluids. Descriptions and figures for each of the CASs are presented in [Appendix A](#).

2.1 Physical Setting

The following section describes the general physical setting of Area 3 of the NTS. General background information pertaining to topography, geology, hydrogeology, and climatology are provided for these specific areas or the NTS region in the *Geologic Map of the Nevada Test Site, Southern Nevada* (USGS, 1990); *CERCLA Preliminary Assessments of DOE's Nevada Operations Office, Nuclear Weapons Testing Areas* (DRI, 1988); *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977); and the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996).

A geological and hydrological setting description for these CASs is detailed below. All six CAU 145 CASs are on Yucca Flat.

Corrective Action Sites 03-20-01, 03-20-02, 03-20-04, 03-20-08, 03-25-01, and 03-99-13 are located on the western side of Area 3 within the intermontane basin of Yucca Flat on the eastern part of the NTS. This valley is slowly being filled with alluvial and colluvial deposits eroding from the surrounding foothills (Laczniak et al., 1996). Three primary rock types represent the composition of the alluvium. The oldest are Paleozoic limestones (calcium carbonates) and mixed gravel-sand-silt (clastic) sedimentary rocks. Around the perimeter of Yucca Flat, where layers of younger rock have been removed by erosion, the Paleozoic sedimentary deposits are exposed and are being eroded. The second unit contributing to valley fill is the Climax stock, an intrusive igneous unit of Mesozoic age found at the north end of Yucca Flat. Where overlying surface material has eroded, this rock also

contributes to the alluvial inflow. The third source contributing to the alluvium is extrusive igneous units of Cenozoic age. Depending on the composition, temperature, and dissolved gases at the time of deposition, the volcanic material can take the form of ash falls, ash flows, and some lava flows. In addition, rock sediment from the surrounding uplands is transported during sporadic rainstorms. As sediment moves onto the basin, transport ability is lost, resulting in thick, poorly-sorted alluvial deposits. The average thickness of alluvium in Yucca Flat is 300 meters (m), but can be as thick as 2,000 m in some places (LLNL, 1982). The thickness of alluvium at any of the CAU 145 CASs is not known precisely, but Test Well A, located approximately 1 mi southeast of 03-20-01, penetrated 1,870 ft of alluvium (Wuellner, 1994).

Surface water is a transient phenomenon within Yucca Flat, occurring only after intense rainstorms. For this reason, surface water is not utilized within Yucca Flat. The only significant open body of water in Yucca Flat is Yucca Lake, a shallow intermittent lake that is dry most of the year.

The NTS lies within the Death Valley ground-water flow system. The Death Valley flow system covers an area about 15,800 square miles (mi²) of the southern Great Basin. The flow system consists of volcanic rock in the west, carbonate rock in the east and is estimated to transmit more than 70,000 acre-feet (ft) of groundwater annually. The region is characterized by low rainfall, intermittent streams, internal surface drainages, and large, sparsely-distributed springs. (ERDA, 1977)

The movement of groundwater in the area is mainly due to hydraulic gradients and characteristics of rocks such as permeability and porosity. Area 3 is located in the Ash Meadows subbasin. The carbonate-rock aquifer is the major aquifer in addition to the valley-fill and volcanic aquifers in Yucca Flat region. Groundwater in the subbasin flows southwest towards Ash Meadows. Groundwater discharges 25 mi southwest of Mercury at a rate of 6 to 55 feet per year (ft/yr) (Laczniak et al., 1996). The springflow has been estimated at 17,000 acre-ft/yr (ERDA, 1977). Water also leaves the Ash Meadows subbasin through transpiration. Annual transpiration from Ash Meadows has been estimated at 10,500 acre-ft (Laczniak et al., 1996).

Perched water is not known to occur in significant quantities within the aquifers or aquitards beneath Yucca Flat. In Yucca Flat, the intrabasin movement of groundwater is downward from the younger

into the older aquifers; thus the water is semiperched (Winograd and Thordarson, 1975). It is unknown if semiperched water is present at any of the CAU 145 CASs.

Mean annual precipitation at the Buster-Jangle intersection (BJY) recording station (near CAS 03-20-02) has been recorded at 6.32 inches (in.) (NOAA, 2004).

2.2 Operational History

The following subsections provide a description of the use and history of each CAS in CAU 145 that may have resulted in potential contaminant releases to the environment. The CAS-specific summaries are designed to illustrate all significant, known activities. To support the information provided in this section, field observation notes have been added to the CAS histories, where appropriate, to describe existing conditions observed during site visits on May 25, 2004, and June 17, 2004. The second field visit included representatives from NDEP, NNSA/NSO, and NNSA/NSO contractors.

2.2.1 CAS 03-20-01, Core Storage Holes

Corrective Action Site 03-20-01 consists of seven core storage holes located in the Core Complex in Area 3 of the NTS, approximately 0.2 mi north of 03-01 Road. The Core Complex was run by Los Alamos Scientific Laboratory (LASL) (predecessor to Los Alamos National Laboratory) and Lawrence Radiation Laboratory (LRL) (predecessor to Lawrence Livermore National Laboratory) from approximately 1961 until the mid 1970s. The Core Complex included the Core Storage Building, Core Handling Building, and WX-6 Effects Test Support Building. The activities within these buildings included the processing of core samples, the decontamination of “PIGs,” and the disassembly of equipment. According to interviewees, the “PIGs” were devices placed underground near a test and used to collect debris from a detonation. Following a detonation, the “PIGs” were brought to the surface, transported in a lead-lined truck, and stored in seven core storage holes (CAS 03-20-01) for several days to “cool.” When the cores (i.e., “PIGs”) were ready for retrieval, they were placed in the pit located within the Core Handling Building (CNC-11) located within the Core Complex. The “PIG” was scraped and the scrapings were sent to Albuquerque for radiochemistry testing (Neagle, 2002 and 2003). The wastewater and possibly solid waste from the activities associated with all three of the Area 3 Core Complex buildings was discharged into a

nearby injection well (CAS 03-99-13). [Figure A.1-3](#) provides a general layout of CAS 03-20-01 features.

2.2.2 CAS 03-20-02, Decon Pad and Sump

Corrective Action Site 03-20-02 consists of a decontamination pad, sump, possible UST or leachfield, and subsurface piping located at the BJY intersection at the northwest corner of Area 3. The decontamination pad (also called the BJY pad or B.J.W.Y.E pad) was originally used in the 1950s and early 1960s as a launching station for large balloons used in atmospheric testing. The pad was later used for the inspection and decontamination of drilling rigs and field vehicles and most recently used for inspection of field vehicles. Wastewater from decontamination activities likely drained from the pad surface to piping in the northeast corner of the pad which flows to the sump. South of the sump is a 9- by 23-ft area protected by bollards that appears to be the location of an UST or leachfield. The specific use, dimensions, contents, and current condition of the UST or leachfield are uncertain. It is believed that if the area includes an UST, it may have been used as a fuel tank to support the balloon tests (Hayes, 2003). [Figure A.1-4](#) provides a general layout of CAS 03-20-02 features.

2.2.3 CAS 03-20-04, Injection Wells

Corrective Action Site 03-20-04, Injection Wells, consists of four injection wells (Sites A - D), a steel-cased hole (Site E), concrete pads, concrete drainage channels, a steam plant decontamination pad, associated piping, a surface discharge point, and affected surface/near-surface soils surrounding and downgradient of the discharge ([Figure A.1-5](#)). All features of CAS 03-20-04 are located in the former Area 3 Subdock complex north and east of the Mercury Highway and 03-01 Road intersection. Activities associated with the complex included degreasing, cleaning, repairing of worn drill bits, and realigning bent drilling rods. The decontamination pad was used for steam-cleaning activities. The wastewater from these activities discharged via piping to the surface discharge point and adjacent soils. Activities at the Pipe Straightening Shed near injection well sites B and D ([Figure A.1-5](#)) are believed to have released effluent to the two injection wells. [Figure A.1-5](#) provides a general layout of CAS 03-20-04 features. The use of the steel-cased hole (Site E) is unknown and no documentation was found referring to its existence. During the 2004 site visits the hole was open and appeared to contain liquid at 12 to 15 ft below ground surface (bgs). It is believed

that each of the four injection wells received wastes from the activities conducted within the Area 3 Subdock Complex but no historical documentation was located to confirm the nature or quantity of any releases.

2.2.4 CAS 03-20-08, Injection Well

Corrective Action Site 03-20-08 consists of an injection well, decontamination pad, sump, catch basin, and associated piping located in the southwest corner of the J-6 Containment Yard, part of Area 3 Camp. The J-6 Containment Yard in the Area 3 Camp was used primarily for testing of blowout preventers (BOPs) and for decontamination activities. Sometime before 1965, a decontamination pad and catch basin were built as part of the J-6 containment yard. The decontamination pad, located southwest of the LASL Postshot Yard Building, was used for the decontamination of the containment trailer, BOPs, drill bits, and assemblies. Wastewater from the decontamination process drained into the sump that is located in the center of a 40 x 30 ft decontamination pad. When the sump reached capacity, the wastewater drained through underground piping to a catch basin located 180 ft south of the sump and decontamination pad. In 1980, the injection well located 60 to 70 ft south of the decontamination pad was drilled. It is believed that wastewater drained from the sump to the injection well after 1980. Once in the well, the wastewater would leach into the subsurface soil through the open bottom. It is unknown if the pipes that lead from the sump to the injection well have been sealed or if the sump or catch basin were used for any other purpose after 1980. The well is reported to be 100 ft deep (Fenix & Scisson, 1989; RSN, 1991) with 98-in. inside diameter (ID) steel casing extending to 35 ft bgs and a hole diameter of 64 in. below the base of the casing. Process knowledge suggests the hole was filled with gravel from 35 to 100 ft bgs. The well is covered with two metal plates approximately 9 ft long and surrounded by orange snow fencing with a label "EC-12."

2.2.5 CAS 03-25-01, Oil Spills

Corrective Action Site 03-25-01 consists of potentially hydrocarbon-stained soil as well as the adjacent affected surface/near-surface soils and related concrete pads and drainage channels. Corrective Action Site 03-25-01 is located in the Pipe Straightening Area of the Area 3 Subdock Complex where drill pipe was reportedly straightened and repaired. It was previously reported that the stained soils encompass approximately 100 square feet (ft²) and are possibly where crankcase or

lubricating oil was discharged (DOE, 1988). During site visits in 2004, staining was observed on the outside edges of portions of the existing concrete drainage channels and appears to be asphalt or tar-based material that may be related to construction of the former Pipe Straightening Shed.

2.2.6 CAS 03-99-13, Drain and Injection Well

Corrective Action Site 03-99-13 consists of an injection well, drain pit, and associated piping connecting three former buildings in the Area 3 Core Complex. The Area 3 Core Complex was operated by LASL and LLNL from approximately 1961 until the mid 1970s. The activities within these buildings included processing core samples, decontaminating “PIGs,” and disassembling equipment. The Core Handling Building is where the core samples were cleaned, rinsed, and prepared for testing. Core debris and decontamination fluids were discharged into a large drain pit on the western side of the Core Handling Building and flowed to the injection well. The piping included in this CAS originates at three different locations: the former Core Storage Building, the former Core Handling Building, and the former WX-6 Building. Historical records are unclear as to if, or what, effluent was discharged into the injection well but it is assumed that piping from the Core Storage, WX-6, and Core Handling Buildings discharged wastewater from cleaning/decontamination of equipment and cores.

2.3 Waste Inventory

Materials remaining from past activities conducted at, or near, each CAS may be considered hazardous and/or radioactive waste by current standards. Historical information and site visits indicate that the sites contain solid wastes such as construction materials, equipment, asbestos, and other miscellaneous debris. Unknown volumes and concentrations of petroleum hydrocarbons, various chemical compounds, and/or radionuclides may have been released to surface, near-surface, and deep subsurface soil at some of these sites.

The following subsections discuss the CAS-specific waste inventories.

2.3.1 CAS 03-20-01, Core Storage Holes

Because the hole interiors have not yet been surveyed, the waste inventory at this CAS does not include any material inside the holes. Long-lived fission/activation products from the “PIGs” are

potentially present at the bottom surface of the core storage holes or in the underlying soil. No equipment and very little miscellaneous debris exists in the immediate vicinity of the seven core storage holes.

2.3.2 CAS 03-20-02, Decon Pad and Sump

Solid waste items identified at CAS 03-20-02 include a small rusted metal can, a small amount of miscellaneous building material debris, and a larger nearby pile of building debris to the west of the decontamination pad. It is possible that waste in the sump will be identified when the sump cover is removed. Wastewater entering the sump may have contained degreasing agents, drilling lubricants, oils, greases, unspecified solvents, radionuclides, metals, acids, and/or detergents. The contents of the UST or leachfield south of the sump are also unknown and will be investigated.

2.3.3 CAS 03-20-04, Injection Wells

Solid waste items identified at CAS 03-20-04 include a small amount of miscellaneous building material debris, a few scattered asbestos-containing floor tiles south of sites B and D, and abandoned piping and pipe insulation. Unknown volumes and concentrations of petroleum hydrocarbons, various chemical compounds, and/or radionuclides may have collected in the injection wells and/or been released to the subsurface soil. Waste and wastewater may contain degreasing agents, drilling lubricants, oils, greases, unspecified solvents, radionuclides, metals, acids, detergents, asbestos, and/or domestic (sewage) waste.

2.3.4 CAS 03-20-08, Injection Well

Solid waste items identified at CAS 03-20-08 include abandoned drilling equipment, piping, and wiring in the yard south of the injection well. Residual sludge/sediment remains in the injection well and may exist in the sump, catch basin, and/or associated piping. Unknown volumes and concentrations of petroleum hydrocarbons, various chemical compounds, and/or radionuclides may have collected in the injection well and/or been released to the subsurface soil. Based on previous sampling conducted in September 2001, the volume of residual sludge in the injection well is estimated to be 890.5 cubic feet (6,645 gallons).

2.3.5 CAS 03-25-01, Oil Spills

Stained surface soil was observed in portions of the CAS that may represent total petroleum hydrocarbons (TPH)-impacted soil waste. Some scrap piping (with fiberglass insulation) and valves are present at the site. Floor tiles that contain asbestos are located just south of the site and are part of CAS 03-11-01.

2.3.6 CAS 03-99-13, Drain and Injection Well

No solid waste items were identified at CAS 03-99-13; however, unknown volumes of residual sediments may remain in the drain, injection well, or associated piping. Discharged effluent that may remain or have been released to the surrounding soil may contain degreasing agents, drilling lubricants, oils, greases, solvents, radionuclides, metals, acids, detergents, asbestos, and/or domestic (sewage) waste.

2.4 Release Information

Process knowledge and historical information provides evidence that releases of effluent have occurred at the several CASs with injection wells and/or surface discharges. Potentially affected media for all CASs include surface and shallow subsurface soil immediately surrounding CAS features. Deep (> 10 ft bgs) subsurface soil is also potentially affected for CASs 03-20-04, 03-20-08, and 03-99-13. Exposure routes to site workers include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, structures, and possibly asbestos-containing materials. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

The following subsections contain CAS-specific descriptions of known or potential releases associated with CAU 145 and additional information can be found in [Section A.1.1](#) of [Appendix A](#).

2.4.1 CAS 03-20-01, Core Storage Holes

There is little reason to suspect that any equipment, materials, or operations directly associated with this CAS released significant contamination to surrounding environmental media; however, any release would be included as part of this CAS. Releases of small quantities of potentially

contaminated debris from the insertion, storage, and removal of cores into/out of the core storage holes are possible.

2.4.2 CAS 03-20-02, Decon Pad and Sump

Based on historical information and process knowledge, the primary source of potential environmental contaminants released to soil within CAS 03-20-02 is wastewater discharged into, and leaching from, the sump. Residual contaminants contained in the wastewater may remain in the sump, piping, and/or surrounding subsurface soils. It is possible the sump is connected to a leachfield in the area marked by bollards south of the sump. A leachfield would also have the potential for contaminant release. If an UST exists south of the sump, the tank may have leaked, creating a potential release of contaminants to soil surrounding and beneath the tank.

2.4.3 CAS 03-20-04, Injection Wells

Based on historical information and process knowledge, the primary sources of potential environmental contaminants released to soil within CAS 03-20-04 include steam-cleaning effluent discharged from the surface discharge point, direct discharge of waste into the injection well, and wastewater discharge into the injection wells. Residual contaminants contained in the waste and wastewater may remain in the injection wells, cased hole, sump, piping, and/or surrounding subsurface soils.

2.4.4 CAS 03-20-08, Injection Well

As with CAS 03-20-04, the primary sources of potential environmental contaminants released to soil include steam-cleaning effluent discharged to the sump or catch basin, direct discharge of waste into the injection well, and wastewater discharge into the injection wells. Previous sampling of the injection well indicates both liquid and sludge waste are present. Residual contaminants contained in the wastewater may remain in the injection wells, sump, catch basin, and/or surrounding subsurface soils.

2.4.5 CAS 03-25-01, Oil Spills

There is soil staining identified along portions of the concrete drainage channels of the CAS. The orientation and extent of staining recently observed suggests the staining may be the result of building construction/sealing or asphalt paving rather than a past hydrocarbon spill. If a spill did occur there is the potential for release of petroleum hydrocarbons into the surrounding and underlying surface and near-surface soils.

2.4.6 CAS 03-99-13, Drain and Injection Well

Based on historical information and process knowledge, the primary source of potential environmental contaminants released to soil within CAS 03-99-13 is effluent discharged from the injection well to the surrounding subsurface soil.

2.5 Investigative Background

Several surface geophysical investigations using electromagnetic techniques were completed over CAU 145 CASs in the last two years and were used to confirm the physical layout of CAS-related features. Results of these geophysical surveys may aid in the decision-making process upon implementation of this CAIP. Except for limited field notes and analytical data directly associated with sampling of one injection well in CAU 145 (CAS 03-20-08), no remediation information for the CAU 145 CASs has been identified. Previous investigation results for CAS 03-20-08 are discussed in the section below. [Section 2.5.2](#) discusses *National Environmental Policy Act* (NEPA) documentation for CAU 145.

2.5.1 CAS 03-20-08, Injection Well

Sampling of liquid and sludge for the injection well was completed by BN in September 2001 as part of an investigation of CAU 322, a nearby CAU. Field notes confirm the physical layout depicted on engineering drawings and presence of both aqueous and solid waste within the injection well. Two discrete samples (one liquid, one solid) were collected from the well on September 6, 2001. The liquid sample was collected using a bailer from 16.5 to 18 ft bgs and was described as a dual-phase sample. The top phase “resembled waste oil” and the bottom phase was described as “relatively clear water” (BN, 2001). The solid/sludge sample collected below the liquid was collected using a piston

sampler at approximately 34 ft bgs. The sample was described as “black sludge that is almost solid.” Both samples were screened for radionuclides and no elevated readings were noted.

Both samples were analyzed for total (gross) alpha activity, total (gross) beta activity, gamma spectroscopy, *Resource Conservation and Recovery Act* (RCRA) metals, polychlorinated biphenyls (PCBs), TPH (diesel-range organics [DRO], gasoline-range organics [GRO], and oil), tritium, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs). Chemical data was reviewed and could not be Level IV validated due to lack of documentation but is used here as screening data. Radiological results were reported to be just above background values. Other than acetone (78 micrograms per liter [$\mu\text{g/L}$]) and petroleum hydrocarbons (TPH = 5,385 milligrams per liter [mg/L]), no compounds were detected in the aqueous sample. Analytical results for the solid/sludge sample show levels of contamination above preliminary action levels (PALs) within the injection well for three compounds (1,2-dichlorobenzene; bis (2-ethylhexyl)phthalate; and arsenic) and petroleum hydrocarbons. Constituents detected include acetone; 1,2-dichlorobenzene; ethylbenzene; isopropylbenzene; p-isopropyltoluene; naphthalene; n-propylbenzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; xlyenes; bis (2-ethylhexyl)phthalate; several RCRA metals; and petroleum hydrocarbons. However, only 1,2-dichlorobenzene; bis (2-ethylhexyl)phthalate; arsenic; and petroleum hydrocarbons were detected at concentrations exceeding PALs. Because bis (2-ethylhexyl)phthalate is a common laboratory contaminant and there is no known history of production or release of phthalates at the site, the compound will not be added to the list of targeted analytes.

2.5.2 National Environmental Policy Act

The *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996) includes site investigation activities such as those proposed for CAU 145.

In accordance with the NNSA/NSO NEPA compliance program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 145. This checklist compels NNSA/NSO project personnel to evaluate their proposed project activities against a list of potential impacts that include, but are not limited to: air quality, chemical use, waste generation, noise level,

and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 145 and formulation of the CSM. Also presented is a summary listing of the contaminants of potential concern (COPCs) and PALs for the investigation. Additional details and figures depicting the CSM are located in [Appendix A](#).

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 CSM developed for CAU 145 includes information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. The CSM ([Figure 3-1](#)) was designed to be pertinent to all physical and chemical properties of this CAU and to capture the commonalities of the CASs. The CSM includes four separate release scenario components. [Table 3-1](#) identifies the CSM components that apply to each CAS.

- The Surface/Near-Surface Release CSM component represents contamination of surface and near-surface areas due to both point and nonpoint source releases of run-off generated from decontamination and steam-cleaning activities and possibly a surface hydrocarbon release.
- The Injection Well (Deep) CSM component applies to CASs 03-20-04, 03-20-08, and 03-99-13 and describes contamination of subsurface soil due to release of liquid wastes from injection wells (or disposal holes).
- The Core Storage Hole Release CSM component describes contamination of soil due to debris from core storage surrounding the core storage holes.
- The UST Release CSM component describes contamination of subsurface soil due to leakage of liquid wastes from a potential underground tank and associated piping.

[Section A.1.2.3](#) of [Appendix A](#) provides more detailed information on the CSM as presented for DQO formulation.

If evidence of potential contamination that is outside the scope of the presented CSMs is identified during investigation activities, the situation will be reviewed and a recommendation will be made as

Figure 3-1
CAU 145 Conceptual Site Model

Table 3-1
CSMs Components and Associated CASs

Conceptual Site Model (CSM) Component	03-20-01	03-20-02	03-20-04	03-20-08	03-25-01	03-99-13
Surface/Near-Surface Release CSM	X	X	X	X	X	X
Injection Well (Deep) Release CSM			X	X		X
Core Storage Hole Release CSM	X					
UST Release CSM		X				

to how best to proceed. In such cases, identified decision makers will be notified and given the opportunity to comment on and/or concur with the recommendation.

The following sections discuss future land use and the identification of exposure pathways (i.e., combination of source, release, migration, exposure point, and receptor exposure route) for the CAU.

3.1.1 Future Land Use

As described in this section, the land-use zone where the CAU 145 CASs are located dictate that future land uses will be limited to nonresidential (i.e., industrial) activities. All CAU 145 CASs are located in the land-use zone described as the “Nuclear and High Explosives Test Zone.” This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities. The Nuclear Test Zone is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. (DOE/NV, 1998).

3.1.2 Contaminant Sources

The primary contaminant sources are discussed in detail in [Section 2.4](#) and [Section A.1.2.3](#) and include industrial, chemical, and radiological wastes potentially managed in CAU 145 CASs.

Surface/Near-Surface Release CSM sources include:

- Surface disposal of discarded equipment and materials

- Run-off from decontamination activities
- Breaks in near-surface piping
- Surface overflow of effluent from CAS-related features (such as sumps, injection wells, or the catch basin)
- seepage from a potential leachfield

Injection Well (Deep) Release CSM sources include:

- Effluent from open-bottom injection wells

Core Storage Hole Release CSM sources include:

- Surface disposal of radioactive effluent and/or materials
- Subsurface disposal of radioactive effluent and/or materials

UST Release CSM sources include:

- Leakage from a potential UST and related piping

3.1.3 Release Mechanisms

Release of contamination would be attributed to direct release to the surface (spills, overflows, and run-off), surface and subsurface release of contaminants through discharge to an injection well, leakage of underground piping, potential migration along underground utility trenches, and erosion of various contaminants off the surface of solid materials.

3.1.4 Migration Pathways

An important element of the CSM in developing a sampling strategy is the expected fate and transport of contaminants (how contaminants migrate through media and where they can be expected in the environment). Fate and transport of contaminants are presented in the CSM as the migration pathways and transport mechanism that could potentially move the contaminants throughout the various media. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media. Contaminant characteristics include, but are not limited to: solubility, density, and adsorption potential. Media characteristics include permeability, porosity, water

saturation, sorting, chemical composition, and organic content. In general, contaminants with low solubility, high affinity for media, and high density can be expected to be found relatively close to release points. Contaminants with high solubility, low affinity for media, and low density can be expected to be found further from release points. These factors affect the migration pathways and potential exposure points for the contaminants in the various media under consideration.

The degree of contaminant migration at CAU 145 is largely unknown but is expected to be minimal based on the affinity of the COPCs for soil particles, and the low precipitation and high evapotranspiration rates typical of the NTS environment. Potential evapotranspiration (the evaporative capacity of the atmosphere at the soil surface) at the NTS is significantly greater than precipitation, thus limiting vertical migration of contaminants. The annual average precipitation for this region is only 3 to 6 in. per year (Winograd and Thordarson, 1975). The total potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997). Therefore, recharge to groundwater from precipitation is not significant at the NTS and does not provide a significant mechanism for migration of contaminants to groundwater.

Because of the low volatility of the targeted analytes, an airborne release subsequent to the initial contaminant release is not considered a significant release pathway. The main process of migration through the air would be through windblown dust. If VOCs, SVOCs, metals, or petroleum hydrocarbons adsorbed to the fine soil particles, a small amount of migration could be expected via the airborne pathway. For subsurface mechanisms and surface migration without scouring, it would be expected that contaminant levels decrease with horizontal and vertical distance from the point of release. Contamination, if present, is expected to be contiguous to the release site.

3.1.5 Exposure Points

Exposure points for the Surface/Near-Surface Release CSM are expected to be discrete locations of surface contamination where visitors and site workers will come in contact with soil surface.

Exposure points for the Injection Well (Deep) and Core Storage Hole components of the CSM also include the possibility of subsurface contamination where site workers may come in contact with subsurface soil during remediation or construction activities. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

3.1.6 Exposure Routes

Exposure routes to site workers or military personnel include oral ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils.

3.1.7 Additional Information

Topographic information, climatic conditions, geology, groundwater data, and floodplain information for the CAU are well documented. These are available and have been addressed in the CSM or will be considered during corrective action, as necessary. No further information is required.

General surface and subsurface soil descriptions as well as specific structure descriptions will be observed and recorded during the CAI. It is not anticipated that active utilities will be impacted by the investigation.

3.2 Contaminants of Potential Concern

The COPCs for CAU 145 are the comprehensive list of all of the analytes reported from the analytical methods identified in [Table 3-2](#). Analytical results for the COPCs listed in [Table 3-2](#) will be requested from Decision I environmental samples taken at each of the CASs. The list of COPCs is intended to encompass all of the contaminants that could potentially be present at each CAS.

Targeted analytes for CAU 145 were identified through a review of site history, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Targeted analytes are those contaminant constituents that may be reasonably suspected to be present at any CAS. Targeted analytes for each CAS are also listed in [Table 3-2](#).

Chemical COPCs are defined as the analytes reported from the analytical methods for which the U.S. Environmental Protection Agency (EPA) Region 9 has established Preliminary Remediation Goals (PRGs) (EPA, 2002a) or for which toxicity data are listed in the EPA Integrated Risk Information System (IRIS) database (EPA, 2001b). Radiological COPCs are defined as the radionuclides reported from the analytical methods listed in [Table 3-2](#).

**Table 3-2
Analytical Program^a
(Includes Waste Characterization Analyses)**

Corrective Action Site	03-20-01	03-20-02	03-20-04	03-20-08	03-25-01	03-99-13
Analysis/COPC						
Organics						
TPH (DRO)		X	X	T	T	X
TPH (GRO)		X	X	T	T	X
PCBs		X	X	X	X	X
VOCs		X	X	X (T for Acetone)	X	X
SVOCs		X	X	X (T for 1,2-dichlorobenzene)	X	X
Metals						
RCRA Metals, Beryllium	X (T for lead)	X	X	X (T for Arsenic)	X	X
Radionuclides						
Gamma Spectrometry	T, N	N	N	N	N	T, N

T = Targeted Analyte

X = COPC

N = Results of gamma analysis will be used to determine if further radioanalytical analysis is warranted.

^aThe contaminants of potential concern are the analytes reported from the analytical methods listed.

Each COPC that is detected in a sample at concentrations exceeding the corresponding PAL becomes a COC for subsequent sampling to define the extent of contamination (Decision II). These step-out samples will be collected and analyzed for the COCs identified by the Decision I sampling.

However, if Decision II samples are collected prior to nature-of-contamination data becoming available, then the step-out samples will be analyzed for the full list of parameters specified in [Table 3-2](#).

The radionuclides resulting from the atmospheric testing are not intended to drive the nature and extent determinations under this investigation. For CAU 145, source characterization is the focus of the sampling and analysis activities. Radiological analyses will be included in the analytical suite to determine if site-specific processes released radioactive constituents to the environment and to support the disposal of IDW and potential waste management decisions.

3.3 Preliminary Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not intended to be used as cleanup or final decision levels. However, they are useful in screening out analytes that are not present in sufficient concentrations to warrant further evaluation; therefore, streamlining the consideration of remedial alternatives. The comparison of laboratory results to action levels and the evaluation of potential corrective actions will be included in the investigation report. If applicable, final action levels will be proposed (along with the basis for their selection) in the investigation report where they will be used to evaluate the potential corrective actions.

3.3.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA Region 9 Risk-Based PRGs for chemical constituents in industrial soils (EPA, 2002a). Background concentrations for RCRA metals and zinc will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established PRGs that are listed in the EPA IRIS database (EPA, 2001b), the protocol used by the EPA Region 9 in establishing PRGs (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

3.3.2 Total Petroleum Hydrocarbon PALs

The PAL for TPH is the action limit in soil of 100 parts per million (ppm) per the *Nevada Administrative Code* (NAC) 445A.2272, "Contamination of Soil: Establishment of Action Levels" (NAC, 2003).

3.3.3 Radionuclide PALs

The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurements (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled from 25 to 15 millirems (mrem/yr)

dose constraint and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

Solid media such as concrete and/or structures may pose a potential radiological exposure risk to site workers if contaminated. The radiological PAL for solid media at the surface will be defined as the unrestricted-release criteria defined in the *NV/YMP Radiological Control (RadCon) Manual* (DOE/NV, 2000).

3.4 DQO Process Discussion

This section contains a summary of the DQO process that is presented in [Appendix A](#). The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action or closure in place). The DQO process was implemented by completing the following seven steps:

- State the problem.
- Identify the decision.
- Identify the inputs to the decision.
- Define the boundaries of the study.
- Develop a decision rule.
- Specify tolerable limits on decision errors.
- Optimize the design for obtaining data.

The DQO strategy for CAU 145 was developed at a meeting on June 24, 2004. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented.

The problem statement for CAU 145 is: “Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the CASS in CAU 145.” To address this question, the resolution of two decisions statements is required:

- Decision I: “Is any COPC present in environmental media within the CAS at a concentration exceeding its corresponding action level?” Any contaminant associated with a CAS activity that is present at concentrations exceeding its corresponding action level will be defined as a COC. If a COC is detected, then Decision II must be resolved. Otherwise, the investigation for that CAS is complete.
- Decision II: “If a COC is present, is sufficient information available to evaluate potential corrective action alternatives?” Sufficient information is defined to include:
 - Volume of media containing any COC bounded by analytical sample results in lateral and vertical directions
 - Information needed to characterize IDW for disposal
 - Information needed to determine potential remediation waste types
 - Information needed to evaluate the feasibility of remediation alternatives

Decision I samples will be submitted for the analytical methods listed in [Table 3-2](#). The analytical requirements for the CAU 145 COPCs are listed in [Table 3-3](#) and [Table 3-4](#).

Table 3-3
Analytical Requirements for Radionuclides for CAU 145
(Page 1 of 2)

Parameter/Analyte	Matrix	Analytical Method	MDC ^a	PAL ^{b,c}	Laboratory Precision	Percent Recovery
Gamma Spectroscopy						
Americium-241	water	EPA 901.1 ^d	50 pCi/L ^e	50 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2 ^g	Laboratory Control Sample Recovery 80-120 ^h Percent Recovery (%R)
	soil	HASL-300 ^f	2.0 pCi/g ^e	7.62 pCi/g		
Cesium-137	water	EPA 901.1 ^d	10 pCi/L ^e	10 pCi/L		
	soil	HASL-300 ^f	0.5 pCi/g ^e	7.3 pCi/g		
Cobalt-60	water	EPA 901.1 ^d	10 pCi/L ^e	10 pCi/L		
	soil	HASL-300 ^f	0.5 pCi/g ^e	1.61 pCi/g		
Tritium						
Tritium	water	EPA 906.0 ^d	400 pCi/L	4.0E+05 pCi/L		
	soil	lab specific	400 pCi/g ^o	4.0E+05 pCi/L ^o		
Other Radionuclides						
Plutonium-238	water	ASTM D3865-02 ⁱ	0.1 pCi/L	0.1 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2 ^g	Laboratory Control Sample Recovery 80-120 ^h Percent Recovery (%R) Chemical Yield 30-105 ^j %R
	soil	ASTM C1001-00 ^k	0.05 pCi/g	7.78 pCi/g		
Plutonium-239/240	water	ASTM D3865-02 ⁱ	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1001-00 ^k	0.05 pCi/g	7.62 pCi/g		
Strontium-90	water	ASTM D5811-00 ⁿ	1.0 pCi/L	1.0 pCi/L		
	soil	HASL 300 ^f	0.5 pCi/g	503.0 pCi/g		
Uranium-234	water	ASTM D3972-02 ^l	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02 ^m	0.05 pCi/g	85.9 pCi/g		
Uranium-235	water	ASTM D3972-02 ^l	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02 ^m	0.05 pCi/g	10.5 pCi/g		
Uranium-238	water	ASTM D3972-02 ^l	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02 ^m	0.05 pCi/g	63.2 pCi/g		

Table 3-3
Analytical Requirements for Radionuclides for CAU 145
 (Page 2 of 2)

- ^aThe MDC is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.
- ^bThe PALs for soil are based on the National Council on Radiation Protection and Measurements (NCRP) Report No. 129, *Recommended Screening Limits for Contaminated Soil and Review of Factors Relevant to Site-Specific Studies* (NCRP, 1999) scaled from 25 to 15 mrem/yr dose and the guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).
- ^cThe PALs for liquids are set equal to the MDC.
- ^d*Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)
- ^eMDCs vary depending on the presence of other gamma-emitting radionuclides in the sample and are relative to the MDC for Cs-137.
- ^f*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997)
- ^gND 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. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)
- ^h*EPA Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994a; and 1995)
- ⁱ*Standard Test Method for Plutonium in Water* (ASTM, 2002b)
- ^jGeneral Radiochemistry and Routine Analytical Services Protocol (GRASP) (EG&G Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium and strontium.
- ^k*Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy* (ASTM, 2000a)
- ^l*Standard Test Method for Isotopic Uranium in Water by Radiochemistry* (ASTM, 2002a)
- ^m*Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry* (ASTM, 2002c)
- ⁿ*Standard Test Method for Strontium-90 in Water* (ASTM, 2000b).
- ^oUnits of pCi/L will be calculated based on the result for pCi/g and percent soil moisture as calculated by the laboratory. The PAL for tritium in soil is based on the Underground Test Area Project limit of 400,000 pCi/L for discharge of water containing tritium to an infiltration basin/area (NNSA/NV, 2002b).

ASTM = American Society for Testing and Materials
 MDC = Minimum detectable concentration
 PAL = Preliminary action level
 pCi/g = Picocuries per gram
 ND = Normalized difference
 pCi/L = Picocuries per liter

Table 3-4
Analytical Requirements for Nonradiological COPCs for CAU 145*
(Page 1 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD) ^a	Percent Recovery (%R) ^b
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous	8260B ^c	Parameter-specific EQLs ^d	Not Applicable (NA)	Lab-specific ^e	Lab-specific ^e
	Soil					
Toxicity Characteristic Leaching Procedure (TCLP) VOCs						
Benzene	Aqueous	1311/8260B ^c	0.050 mg/L ^d	0.5 mg/L ^f	Lab-specific ^e	Lab-specific ^e
Carbon Tetrachloride			0.050 mg/L ^d	0.5 mg/L ^f		
Chlorobenzene			0.050 mg/L ^d	100 mg/L ^f		
Chloroform			0.050 mg/L ^d	6 mg/L ^f		
1,2-Dichloroethane			0.050 mg/L ^d	0.5 mg/L ^f		
1,1-Dichloroethene			0.050 mg/L ^d	0.7 mg/L ^f		
Methyl Ethyl Ketone			1.0 mg/L ^d	200 mg/L ^f		
Tetrachloroethene			0.050 mg/L ^d	0.7 mg/L ^f		
Trichloroethene			0.050 mg/L ^d	0.5 mg/L ^f		
Vinyl Chloride			0.050 mg/L ^d	0.2 mg/L ^f		
Total Semivolatile Organic Compounds (SVOCs)	Aqueous	8270C ^c	Parameter-specific EQLs ^d	NA	Lab-specific ^e	Lab-specific ^e
	Soil					
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C ^c	0.10 mg/L ^d	200 mg/L ^f	Lab-specific ^e	Lab-specific ^e
m-Cresol			0.10 mg/L ^d	200 mg/L ^f		
p-Cresol			0.10 mg/L ^d	200 mg/L ^f		
Cresol (total)			0.30 mg/L ^d	200 mg/L ^f		
1,4-Dichlorobenzene			0.10 mg/L ^d	7.5 mg/L ^f		
2,4-Dinitrotoluene			0.10 mg/L ^d	0.13 mg/L ^f		
Hexachlorobenzene			0.10 mg/L ^d	0.13 mg/L ^f		
Hexachlorobutadiene			0.10 mg/L ^d	0.5 mg/L ^f		
Hexachloroethane			0.10 mg/L ^d	3 mg/L ^f		
Nitrobenzene			0.10 mg/L ^d	2 mg/L ^f		
Pentachlorophenol			0.50 mg/L ^d	100 mg/L ^f		
Pyridine			0.10 mg/L ^d	5 mg/L ^f		
2,4,5-Trichlorophenol			0.10 mg/L ^d	400 mg/L ^f		
2,4,6-Trichlorophenol			0.10 mg/L ^d	2 mg/L ^f		
Polychlorinated Biphenyls (PCBs)	Aqueous	8082 ^c	Parameter-specific EQLs ^g	50 mg/kg ^f	Lab-specific ^e	Lab-specific ^e
	Soil					
Total Petroleum Hydrocarbons (TPH) [C ₆ - C ₃₈]	Aqueous Gasoline	8015B modified ^c	0.1 mg/L ^h	NA	Lab-specific ^e	Lab-specific ^e
	Soil Gasoline		0.5 mg/kg ^h			
	Aqueous Diesel		0.5 mg/L ^h			
	Soil Diesel		25 mg/kg ^h			

Table 3-4
Analytical Requirements for Nonradiological COPCs for CAU 145*
(Page 2 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision	Percent Recovery (%R)
INORGANICS						
Total RCRA Metals, plus Beryllium						
Arsenic	Aqueous	6010B ^C	0.01 mg/L ^{h, i}	NA	20 ^j	Matrix Spike Recovery at 75-125 ⁱ Laboratory Control Sample Recovery at 80 - 120 ⁱ
	Soil	6010B ^C	1 mg/kg ^{h, i}		35 ^h	
Barium	Aqueous	6010B ^C	0.20 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	20 mg/kg ^{h, i}		35 ^h	
Beryllium	Aqueous	6010B ^C	0.005 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	0.5 mg/kg ^{h, i}		35 ^h	
Cadmium	Aqueous	6010B ^C	0.005 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	0.5 mg/L ^{h, i}		35 ^h	
Chromium	Aqueous	6010B ^C	0.01 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	1 mg/kg ^{h, i}		35 ^h	
Lead	Aqueous	6010B ^C	0.003 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	0.3 mg/kg ^{h, i}		35 ^h	
Mercury	Aqueous	7470A ^C	0.0002 mg/L ^{h, i}		20 ^j	
	Soil	7471A ^C	0.1 mg/kg ^{h, i}		35 ^h	
Selenium	Aqueous	6010B ^C	0.005 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	0.5 mg/kg ^{h, i}		35 ^h	
Silver	Aqueous	6010B ^C	0.01 mg/L ^{h, i}		20 ^j	
	Soil	6010B ^C	1 mg/kg ^{h, i}		35 ^h	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B ^C 1311/7470A ^C	0.10 mg/L ^{h, i}	5 mg/L ^f	20 ^j	Matrix Spike Recovery at 75-125 ⁱ Laboratory Control Sample Recovery at 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		

*Footnote:

1. See Table 3-3 for the analytical requirements for radionuclides.

Table 3-4
Analytical Requirements for Nonradiological COPCs for CAU 145*
 (Page 3 of 3)

^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: $RPD = 100 \times \{(|A_1 - A_2|) / [(A_1 + A_2) / 2]\}$, 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: $\%R = 100 \times (A_s - A_u / A_n)$, 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 U.S. 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) Parts 260-268 (CFR, 2003a)

^g EPA *Contract Laboratory Program (CLP) Statement of Work for Organic Analysis* (EPA, 1988b; 1991; and 1994b)

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

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

Definitions:

EQLs = Estimated quantitation limits

mg/L = Milligrams per liter

mg/kg = Milligrams per kilogram

NA = Not applicable

RPD = Relative percent difference

%R = Percent recovery

4.0 Field Investigation

This section contains a description of the activities to be conducted to gather and document information from the CAU 145 field investigation.

4.1 Technical Approach

The information necessary to resolve the DQO decisions will be generated for each CAU 145 CAS by collecting and analyzing samples generated during a field investigation. The presence and nature of contamination at each CAS will be evaluated by collecting samples at biased locations that are determined to be most probable to contain COCs if they are present anywhere within the CAS. These locations will be determined based on the identification of biasing factors. If it is determined that COCs are present at a CAS while defining the nature of contamination, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

Sample locations may be changed based on site conditions, obvious debris or staining of soils, field-screening results, or professional judgement. The Site Supervisor has the discretion to modify the biased locations, but only if the modified locations meet the DQO decision needs and criteria stipulated in [Appendix A](#).

Since this CAIP only addresses contamination originating from the CAU, it may be necessary to distinguish overlapping contamination originating from other sources. For example, potential, surface and/or shallow subsurface contamination originating from CAU 224, CAS 03-05-01 leachfield adjacent to CAS 03-20-04 will not be addressed under CAU 145. To determine if contamination is from the CAU or from other sources, soil samples may be collected from locations outside of the CAU 145 CAS boundaries.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered at any CAS. Significant modifications shall be justified, documented, and approved on a Record of Technical Change (ROTC) prior to implementation. If an unexpected condition indicates that conditions are significantly different than the corresponding CSM, the activity will be re-evaluated and the identified decision makers will be notified.

4.2 Field Activities

Soil samples will be collected at selected locations using hand/power auger, hand tools, excavation, direct-push, and/or various drilling methods (e.g., hollow-stem auger, rotary sonic, or other applicable methods), as appropriate. [Table 3-3](#) and [Table 3-4](#) provide the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be followed during this CAI. All quality control requirements for field and laboratory environmental sampling and analysis will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable, approved procedures.

Activities to be conducted under this CAIP may include:

- Relocate surface debris and/or equipment as necessary to allow access to sampling locations.
- Perform visual surveys at all CASs to identify any staining, discoloration, disturbance of native soils, or any other indication of potential contamination.
- Perform video mole surveys and radiological characterization surveys at all CASs with wells, tanks, holes, and/or piping to assess physical layout, identify possible residual materials, locate breaches or tie-ins within the piping, and determine whether sources are plugged and sealed, if possible.
- Perform field screening and/or radiological swipe sampling on applicable CAS-related media.
- Collect and analyze samples from locations as described in this section.
- Collect required QC samples.
- Collect samples of IDW, as needed, for waste management and minimization purposes.
- Collect soil samples from background locations, if necessary.
- Collect and analyze bioassessment samples, if appropriate (e.g., if VOC concentrations exceed field-screening levels in a pattern that suggests that a plume may be present).
- Stake or flag sample locations and record coordinates.

4.2.1 Sample Location Selection

Biasing factors will be used to select the most appropriate sample locations and field screening will be used to select the most appropriate samples from a particular location for submittal to the

analytical laboratory. Biasing factors to be used for selection of sampling locations will include the following:

- Documented process knowledge of source and location of release.
- Visual evidence of discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination.
- Presence of debris or equipment.
- Presence of areas of elevated activity based on the results of radiological surveys.
- Field-screening results.
- Previous sample or screening results.
- Experience and data from investigations of similar sites (i.e., professional judgement).
- Additional samples will be collected, as necessary, for waste characterization.

As biasing factors are identified and used for selection of sampling locations, they will be documented in the appropriate field documents. The CAS-specific sampling strategy and the estimated locations of biased samples for each CAS are presented in [Appendix A](#).

4.2.2 Decision I Activities

The objective of the Decision I strategy is to determine if COCs are present within the CAS boundaries. Decision I sampling strategy targets locations and media most likely to be contaminated with COCs. A detailed, CAS-specific sampling strategy is discussed in [Section A.1.8](#) of [Appendix A](#), while general activities are outlined below.

After initial visual, video, and radiological surveying, Decision I surface soil samples (0 to 0.5 ft bgs) will be collected from selected locations based on the biasing factors listed in [Section 4.2.1](#). If biasing factors are present in soils below locations where Decision I samples were removed, subsurface Decision I soil samples will also be collected by hand augering, backhoe excavation, direct-push, or drilling techniques, as appropriate. Decision I subsurface soil and aqueous samples will be collected at depth intervals detailed in [Section A.1.8](#) of [Appendix A](#). The contents of the UST (if any) in CAS 03-20-02 or any residual sediment or debris in CAS-related features will be sampled

to determine if the contaminant source material contains COCs. If the source material does not contain COCs and no tank or piping breaches are noted, it will be determined that the soil underlying the source also does not contain COCs.

4.2.3 Decision II Activities

Step-out (Decision II) sampling locations will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other biasing factors listed in [Section 4.2.1](#). In general, step-out sample locations will be arranged in a triangular pattern around areas containing a COC at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. At each step-out location, screening samples will be collected at the maximum depth where COCs were encountered and from at least one additional depth interval. If the field-screening results (FSRs) are not greater than field-screening levels (FSLs), one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. A minimum of one clean sample (i.e., COCs less than PALs) will be collected from each lateral and vertical direction and submitted for laboratory analysis to define the extent of COC contamination. The lateral and vertical extent of COCs will be established based on validated laboratory analytical results (not field screening).

The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions. This sampling approach is designed to bound the COCs both vertically and horizontally. Where sampling locations are modified by the Site Supervisor, the justification for these modifications will be documented in a field logbook or field activity daily log. [Section 3.4](#) provides the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be used when analyzing the COPCs. The analytical program for each CAS is presented in [Table 3-3](#). All sampling activities and quality control requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable, approved procedures.

4.3 Bioassessment Tests

If organic COCs are present and natural attenuation or biodegradation are evaluated as corrective action alternatives, bioassessment may be conducted on the contaminated media. Bioassessment is a

series of tests designed to evaluate the physical, chemical, and microbiological characteristics of a site. Bioassessment tests are used to determine nutrient availability, pH, microbial population density, and the ability of the microbial population to grow under enhanced conditions.

Bioassessment samples may be collected if, for example, biasing factors suggest that a fuel or solvent plume may be present.

4.4 Safety

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

- Potential hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., heavy metals, VOCs, SVOCs, and petroleum hydrocarbons), adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations.
- Proper training of all site personnel to recognize and mitigate the anticipated hazards.
- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and use of appropriate personal protective equipment (PPE).
- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, and high wind).
- Radiological surveying for alpha/beta and gamma emitters to minimize and/or control personnel exposures; use of the "as-low-as-reasonably-achievable" principle when dealing with radiological hazards.
- Emergency and contingency planning to include medical care and evacuation, decontamination, spill control measures, and appropriate notification of project management. The same principles apply to emergency communications.

- If potential asbestos-containing material is identified (CFR, 2003c; NAC, 2004d), it will be inspected and/or samples collected and handled by appropriately trained personnel.

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 145 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 of in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP.

5.1 Waste Minimization

Investigation activities are planned to minimize IDW generation. This will be accomplished by incorporating the use of process knowledge, visual examination, and/or radiological survey and swipe results. When possible, disturbed media (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 potential waste streams:

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

- Decontamination rinsate
- Environmental media (e.g., soil)
- Surface debris in investigation area (e.g., discarded equipment or asbestos tiles)
- Field screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)

Office trash and lunch waste will be sent to the sanitary land fill by placing the waste in the dumpster. Each waste stream generated will be reviewed and segregated at the point of generation by the following waste types:

- Sanitary waste
- Hazardous waste pending analysis
- PCB waste pending analysis
- Radioactive waste pending analysis

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 RadCon Manual (DOE/NV, 2000) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in [Table 5-1](#).

5.3.1 Sanitary Waste

Sanitary IDW generated at each CAS (such as lunch, personal, and office supply trash) will be collected in plastic bags, sealed, and be placed in a dumpster located near Building 23-153 in Mercury for ultimate disposal in a sanitary waste landfill.

**Table 5-1
Waste Management Regulations and Requirements**

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS ^a 444.440 - 444.620 NAC ^b 444.570 - 444.7499 NTS Landfill Permit SW13.097.04 ^c NTS Landfill Permit SW13.097.03 ^d
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii ^e
Hazardous	RCRA ^f , 40 CFR 260-282	NRS ^a 459.400 - 459.600 NAC ^b 444.850 - 444.8746 POC ^g
Low-Level Radioactive	NA	DOE Orders and NTSWAC ^h
Mixed	RCRA ^f , 40 CFR 260-282	NTSWAC ^h POC ^g
Hydrocarbon	NA	NTS Landfill Permit SW13.097.02 ⁱ
Polychlorinated Biphenyls	TSCA ^j , 40 CFR 761	NRS ^a 459.400 - 459.600 NAC ^b 444.940 - 444.9555
Asbestos	TSCA ^j , 40 CFR 763	NRS ^a 618.750-618.840 NAC ^b 444.965-444.976

^a Nevada Revised Statutes (NRS, 2003a, b, c)

^b Nevada Administrative Code (NAC, 2004a, b, c, d)

^c Area 23 Class II Solid Waste Disposal Site (NDEP, 1997a)

^d Area 9 Class III Solid Waste Disposal Site (NDEP, 1997c)

^e Nevada Test Site Sewage Lagoons (NDEP, 1999)

^f Resource Conservation and Recovery Act (CFR, 2003a)

^g Nevada Test Site Performance Objective for the Certification of Nonradioactive Hazardous Waste (BN, 1995)

^h Nevada Test Site Waste Acceptance Criteria, Revision 5 (NNSA/NSO, 2003)

ⁱ Area 6 Class III Solid Waste Disposal Site for hydrocarbon waste (NDEP, 1997b)

^j Toxic Substance Control Act (CFR, 2003b, c)

CFR = Code of Federal Regulations

DOE = U.S. Department of Energy

NA = Not applicable

NAC = Nevada Administrative Code

NDEP = Nevada Division of Environmental Protection

NRS = Nevada Revised Statutes

NTS = Nevada Test Site

NTSWAC = Nevada Test Site Waste Acceptance Criteria

POC = Nevada Test Site Performance Objective for the Certification of Nonradioactive Hazardous Waste

RCRA = Resource Conservation and Recovery Act

TSCA = Toxic Substance Control Act

5.3.1.1 Special Sanitary

Hydrocarbon waste is defined as waste containing more than 100 milligrams per kilogram (mg/kg) of TPH contamination (NAC, 2003). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with Nevada regulations.

Asbestos-containing materials that may be encountered or generated during this investigation will be managed and disposed of in accordance with appropriate federal (CFR, 2003c) and State of Nevada (NAC, 2004d) regulations.

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

5.3.2 Hazardous Waste

Corrective Action Unit 145 will have waste storage areas established according to the needs of the project. Satellite accumulation areas (SAAs) and hazardous waste accumulation areas (HWAAs) will be managed consistent with the requirements of federal and state regulations (CFR, 2003a; NAC, 2004b). The HWAAs will be properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers and labeled as appropriate. All containerized waste will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 260-282 (CFR, 2003a). 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.

The HWAAs will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous wastes will be characterized in accordance with the requirements of Title 40 CFR 261 (CFR, 2003a). No RCRA “listed” wastes have been identified at CAU 145. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT to a permitted treatment, storage, and disposal facility (CFR, 2003a).

5.3.2.1 Management of Personal Protective Equipment

Personal protective equipment and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated. Any IDW that meets this description will be segregated and managed as potentially “characteristic” hazardous waste. This segregated population of waste will either be (1) assigned the characterization of the soil/sludge that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil/sludge sample results to determine how much soil/sludge would need to be present in the waste to exceed regulatory levels. Waste that is determined to be hazardous will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. The PPE and sampling equipment that are not visibly stained, discolored, or grossly contaminated and that are within radiological free-release criteria will be managed as nonhazardous industrial waste.

5.3.2.2 Management of 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 (CFR, 2003a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NSO Fluid Management Plans for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate that is contaminated at 5x to 10x SDWS will be disposed of in an established infiltration basin or

solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

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

5.3.2.3 *Management of Soil*

This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. This waste stream is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste stream is to place the material back into the borehole/excavation in the same approximate location from which it originated. If this cannot be accomplished, the material will either be managed in the area of concern by berming and covering next to the excavation, or by placement in a container(s). The disposal of soil may be deferred until implementation of corrective action at the site. Containerized soil determined to be hazardous will be subject to RCRA and other applicable storage time requirements.

5.3.2.4 *Management of Debris*

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

5.3.2.5 Field-Screening Waste

Field test kits, if used, may result in the generation of small quantities of hazardous wastes. In the event that hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2003a). On radiological sites, this may increase the potential to generate mixed waste; however, the generation of a mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with [Section 5.3.5](#) of this document.

5.3.3 Polychlorinated Biphenyls

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2003b). 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 in accordance with 40 CFR 761 (CFR, 2003b), State of Nevada requirements (NAC, 2004c), and agreements with NNSA/NSO.

5.3.4 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment 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 RadCon Manual (DOE/NV, 2000), will be used to determine if such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2 of the current version of the NV/YMP RadCon Manual (DOE/NV, 2000), 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 sections 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) (NNSA/NSO, 2003). 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 when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NSO, 2003).

5.3.5 *Mixed Waste*

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2003a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as DOE requirements for radioactive waste. The waste will be marked with the words “Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis.” Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituents below Land Disposal Restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site if the waste meets the requirements of the NTSWAC (NNSA/NSO, 2003). Mixed waste not meeting Land Disposal Restrictions will require development of a treatment and disposal plan under the requirements of the Mutual Consent Agreement between DOE and the State of Nevada (NDEP, 1995).

6.0 Quality Assurance/Quality Control

The overall objective of the characterization activities described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 145. [Section 6.1](#) and [Section 6.2](#) discuss the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure. Unless otherwise stated in this CAIP or required by the results of the DQO process (see [Appendix A](#)), this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002a).

6.1 Quality Control Field Sampling Activities

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

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

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

6.2 Laboratory/Analytical Quality Assurance

Criteria for the investigation, as stated in the DQOs ([Appendix A](#)) and except where noted, require laboratory 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 data quality indicators (DQIs) as they relate to laboratory analysis.

6.2.1 Data Validation

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

6.2.2 Data Quality Indicators

Data quality indicators are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance). The quality and usability of data used to make DQO decisions will be assessed based on the following DQIs:

- Precision
- Accuracy/bias
- Representativeness
- Comparability

- Completeness
- Sensitivity

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 following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

The Industrial Sites QAPP (NNSA/NV, 2002a) documents the actions required to correct conditions that adversely affect data quality both in the field and the laboratory. All DQI performance criteria deficiencies will be evaluated for data usability and impacts to the DQO decisions. These evaluations will be discussed and documented in the data assessment section of the CADD. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

6.2.3 Precision

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

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

Precision is a quantitative measure used to assess overall analytical method and field sampling performance as well as to assess the need to “flag” (qualify) individual parameter results when

**Table 6-1
Laboratory and Analytical Performance Criteria for
CAU 145 Data Quality Indicators**

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria presented in Table 3-3 and Table 3-4 . Variations between field duplicates should not exceed 20 percent.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for precision are not met. Evaluate the effect on meeting the DQI of completeness.
Accuracy	Laboratory control sample, matrix spike, and surrogate results should be within specified acceptance windows. Laboratory method blanks should be below the required detection limit.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met. Evaluate the effect on meeting the DQI of completeness.
Sensitivity	Laboratory detection limits must be less than or equal to respective PALs.	Cannot determine if COCs are present or migrating at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives and on meeting the DQI of completeness.
Comparability	Sampling, handling, preparation, analysis, reporting, and data validation must be performed using approved standard methods and procedures.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Representativeness	Decision I samples identify COCs if present anywhere within the CAS. Analyses will be sufficient to detect any COCs present in the samples. Decision II samples identify true extent of COCs.	Analytical results will not represent true site conditions. Inability to make appropriate DQO decisions.
Nature Completeness	80% of the CAS-specific COPC analytes have valid results. 90% of target analytes are valid.	Cannot make decision on whether COCs are present.
Extent Completeness	90% of target analytes used to define extent of COCs are valid.	Extent of contamination cannot be determined.
Clean Closure Completeness	90% of target analytes are valid.	Cannot determine if COCs remain in soil.

corresponding QC sample results are not within established control limits. Therefore, performance metrics have been established for both analytical methods and individual analytical results.

The RPD criteria to be used for assessment of precision for laboratory duplicates are the parameter-specific criteria listed in [Table 3-3](#) and [Table 3-4](#). The RPD criteria to be used for assessment of precision for field duplicates is less than 20 percent. The RPD 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 judgement about the quality of the reported analytical results.

6.2.4 Accuracy

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). For organic analyses, laboratory control limits are used for evaluation of percent recovery. The acceptable control limits for organic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 2002a). Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates. Accuracy for radiochemical analyses will be evaluated based on results from LCS and MS samples. The LCS sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS will be prepared with each batch of samples for analysis by a specific measurement.

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. It is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

The criteria for chemical analyses to be used for assessment of accuracy are parameter-specific criteria. The percent recovery parameter performance criteria for accuracy will be compared to percent recovery results of spiked samples. This will be accomplished as part of the data validation process. The percent recovery 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.

6.2.5 Representativeness

Representativeness is the degree to which sample characteristics accurately and precisely represent a characteristics of a population or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developing the sampling strategy during the DQO process such that false negative and false positive decision errors are minimized. The criteria listed in DQO Step 6 - Specify the Tolerable Limits on Decision Errors are:

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

These are qualitative measures that will be used to assess measurement system performance for representativeness. The assessment of this qualitative criterion will be presented in the investigation report.

6.2.6 Completeness

Completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. For judgemental sampling, completeness will be evaluated using both a quantitative measure and a qualitative assessment. The quantitative measurement to be used to evaluate completeness is presented in [Table 6-1](#) and is based on the percentage of measurements made that are judged to be valid. The completeness goal for targeted analytes and the remaining COPCs is 100 percent and 80 percent, respectively. If these criteria are not achieved, the dataset will be assessed for potential impacts on making DQO decisions.

The qualitative assessment of completeness is an evaluation of the sufficiency of information available to make DQO decisions. This assessment will be based on meeting the data needs identified in the DQOs. An evaluation of completeness will be presented in the investigation report.

6.2.7 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). The criteria for the evaluation of comparability will be that all sampling, handling, preparation, analysis, reporting, and data validation were performed using approved standard methods and procedures. This will ensure that data from this project can be compared to regulatory action levels that were developed based on data generated using the same or comparable methods and procedures. An evaluation of comparability will be presented in the investigation report.

6.2.8 Sensitivity

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

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of October 22, 2004), the following is a tentative schedule of activities (in calendar days):

Duration (days)	Activity
10	Site Preparation
76	Field Work Preparation and Mobilization
55	Sampling
160	Data Assessment
180	Waste Management

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. This document is available in the DOE public reading facilities 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.

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Appendix A

Data Quality Objectives

A.1.0 Data Quality Objectives Process for CAU 145

The DQO process described in this appendix is a seven-step strategic planning approach based on the scientific method that is used to plan data collection activities at CAU 145, Wells and Storage Holes. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend recommended corrective actions (i.e., no further action, closure in place, or clean closure). Information about the nature and extent of contamination at the CASs in CAU 145 is insufficient to evaluate and select preferred corrective actions at this time; therefore, a CAI will be conducted.

The CAU 145 CAI will be based on the DQOs presented in this appendix as developed by representatives of the NDEP and the NNSA/NSO. The seven steps of the DQO process developed for CAU 145 and presented in [Section A.1.2](#) through [Section A.1.8](#) were developed based on the CAS-specific information presented in [Section A.1.1](#) and in accordance with *EPA Guidance for Quality Assurance Project Plans* (EPA, 2002a). This document identifies and references the associated EPA Quality System Document for DQOs entitled, *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000), upon which the DQO process presented herein is based.

The DQO process presents a judgemental sampling approach in accordance with the EPA *Data Quality Objectives for Hazardous Waste Site Investigations* (EPA, 2000) and *EPA Guidance for Quality Assurance Project Plans* (EPA, 2002a). In general, the procedures used in the DQO process provide:

- A scientific basis for making inferences about a site (or portion of a site) based on environmental data or process knowledge.
- A basis for defining decision performance criteria and assessing the achieved decision quality of the data collection design.
- Criteria for knowing when site investigators should stop data collection (i.e., when sufficient information is available to make decisions).

A.1.1 CAS-Specific Information

The six CASs in CAU 145 are located in Area 3 of the NTS, as shown in [Figure A.1-1](#) and [Figure A.1-2](#). The CASs include:

- 03-20-01, Core Storage Holes
- 03-20-02, Decon Pad and Sump
- 03-20-04, Injection Wells
- 03-20-08, Injection Well
- 03-25-01, Oil Spills
- 03-99-13, Drain and Injection Well

The following sections ([Section A.1.1.1](#) through [Section A.1.1.6](#)) present CAS-specific information on the physical setting, operational history, sources of potential contamination, previous investigation results, and COPCs.

The CAS-specific COPCs are described in the following CAS descriptions and listed in [Table A.1-1](#). Many of the COPCs are based on process knowledge of activities conducted rather than specific knowledge of a release. As a result, many of the Decision I COPCs for the CAI are considered the class of contaminants for a given analytical suite. Targeted analytes are defined as those contaminants that are known or reasonably suspected to be present within the CAS based on previous sampling, process knowledge, geographic setting, and/or operational site history. Possible COPCs are defined as those contaminants that may be present within a CAS based on contaminants found at other NTS sites and the uncertainty concerning the history of potential releases from the CAS.

A.1.1.1 CAS 03-20-01, Core Storage Holes

Corrective Action Site 03-20-01 consists of seven core storage holes located in a fenced area within the Core Complex in Area 3 of the NTS, north of 3-03 Road. The core storage holes are numbered 1 through 7 (from east to west) and are located just north and west of the Core Storage Building concrete slab foundation ([Figure A.1-3](#)). Each hole casing is 2 ft in diameter and #2 through #7 are each set in the center of a 5- by 6-ft concrete slab. According to existing historical documentation, core storage holes #2 through #7 are 10 ft deep. The casing of core storage hole #1 extends 2 ft above ground surface, whereas the other six holes are flush with the ground surface. Each hole is covered with a rusty, double metal door.

Figure A.1-1
CAU 145, CAS Location Map

Figure A.1-2
CAU 145, CAS Location Map in Area 3

Table A.1-1
CAU 145 Contaminants of Potential Concern

Corrective Action Site	03-20-01 Core Storage Holes	03-20-02 Decon Pad and Sump	03-20-04 Injection Wells	03-20-08 Injection Well	03-25-01 Oil Spills	03-99-13 Drain and Injection Well
COPC						
Organics						
TPH (DRO)		X	X	T	T	X
TPH (GRO)		X	X	T	T	X
PCBs		X	X	X	X	X
VOCs		X	X	X, (T for Acetone)	X	X
SVOCs		X	X	X, (T for 1,2-Dichlorobenzene)	X	X
Metals						
RCRA Metals, Beryllium	T for Lead	X	X	X, (T for Arsenic)	X	X
Radionuclides						
Gamma Spectroscopy	T, N	N	N	N	N	N

T = Targeted Analyte

X = Possible COPC

N = Results of gamma analysis will be used to determine if further radioanalytical analysis is warranted.

Physical Setting and Operational History - Corrective Action Site 03-20-01 is located in the Core Complex in Area 3. The Core Complex included the Core Storage Building, Core Handling Building, and WX-6 Effects Test Support (ETS) Building. The activities within these buildings included the processing of core samples, the decontamination of “PIGs,” and the disassembly of equipment. The “PIGs” were devices used to collect debris from a detonated device. According to interviewees, the “PIGs” measured approximately 20 in. in diameter and 5 ft in length. Following a test, the “PIGs” were stored in the core storage holes (CAS 03-20-01) until they were ready for retrieval. The waste from the activities associated with all three of these buildings was discharged into an injection well (CAS 03-99-13). [Figure A.1-3](#) is a site sketch of the area including CAS boundaries.

Information on the operational history for this CAS presented below comes from interviewees (Hayes, 2000; Neagle, 2002 and 2003). According to an interviewee, the seven core holes were used to store hot “PIGs.” “PIGs” are cylinder-like devices that captured earthen debris from above the detonated device. The debris then underwent radiochemistry studies. It is believed that because the

Figure A.1-3
CAU 145 Site Sketch of CAS 03-20-01

high cost of post-shot drilling the “PIGs” were being tested as an alternative. The same emplacement hole was used for the testing device and the “PIGs.” The device was placed and backfilled, and then the “PIG” was placed above the device in the adjacent subsurface. After the detonation, the “PIGs” were retrieved by cables, transported via a lead-shielded truck, and placed in the core storage holes for several days to “cool.” When the “PIGs” were ready, personnel would dress in radiological protective clothes and would remove the “PIG” with a rack. The “PIG” was then placed in the pit located within the Core Handling Building (CNC-11) located within the Core Complex. The “PIG” was scraped and the scrapings were sent to Albuquerque for radiochemistry testing. The remainder of the “PIG,” along with the PPE and debris, would be disposed of in disposal holes near the landfill in Area 3. All equipment and building surfaces were decontaminated and the rinsate was disposed of down the drain pit that flowed into an injection well located outside the northeast corner of the building (CAS 03-99-13).

Sources of Potential Contamination - The primary source of potential contamination at CAS 03-20-01 comes from the storage and decontamination of “PIGs.” According to historical records, the “PIGs” were stored in the Core Storage Holes immediately after retrieval and later removed for inspection, testing, and decontamination (DOE, 1988b; Bingham, 1992c). Small amounts of radionuclide-contaminated soil and debris could have dislodged from the outside surface of the “PIGs” within the holes and potentially contributed a wide range of radioactive fission products. Of these products, only long-lived fission/activation products are likely to remain today. Although there are no documented incidences of direct releases to the environment (e.g., debris collecting in the holes or dumping of contaminated material into the holes), the potential for such releases does exist.

Previous Investigation Results - Radiological survey results for this CAS have been identified from a 1990 Site Monitoring/Demarcation Checklist (REECo, 1990). Areas surveyed include the Core Building, Core Building Sealed Hole, Core Shack, Capped Hole #1, ETS building, and gas tanks. Results from Capped Hole #1 (core storage hole #1) show readings of 100 counts per minute (cpm) beta/gamma, 0 cpm alpha, and 0.03 milliroentgen per hour (mR/h) at 1 and 30 centimeters (cm) downhole. Based on these values, it is unlikely significant radiological contamination exists at the surface or in the upper portion of the holes.

Contaminants of Potential Concern - The COPCs identified for CAS 03-20-01 are shown in [Table A.1-1](#). The COPCs specifically targeted for this CAS include lead and long-lived gamma-emitting fission/activation products based on the types of releases that potentially occurred from “PIG” storage and removal operations. Based on process knowledge, no additional COPCs are expected at this CAS.

A.1.1.2 CAS 03-20-02, Decon Pad and Sump

Corrective Action Site 03-20-02, Decon Pad and Sump, consists of a former decontamination pad, sump, piping, and soil immediately surrounding these features located northeast of the intersection of Mercury Highway and 7-01 Road. A vent pipe in the area also suggests that an UST may be present, although recent geophysical surveys were inconclusive.

Physical Setting and Operational History - Corrective Action Site 03-20-02, Decon Pad and Sump, is located in the extreme northwest corner of Area 3 of the NTS just northeast of the intersection of Mercury Highway and 7-01 Road. The approximately 250- by 100-ft rectangular concrete pad was originally a launching station for large balloons used for atmospheric testing. The decontamination pad has also been called the BJY pad and the B.J.W.Y.E. pad. After the late 1960s, the pad was used intermittently to wash dirt and grime from drilling rigs and other vehicles after field activities (DOE, 1988b). The wastewater drained to a sump through a pipe at the northeast corner of the decontamination pad. The wastewater and any contaminants therein percolated into the soil within the sump. Estimates on the amount of effluent generated at the pad are not available. More recently, the BJY pad was used to inspect field vehicles, but repairs and maintenance are believed to have taken place elsewhere. No drains are visible on the pad, but the pad is partially obscured by gravel piles and the northern edge of the pad consists of a drainage swale leading to the piping at the northeast corner of the pad. There are various cutoff posts in a row at the northern end and towards the southern end of the decontamination pad. Rusted metal railings run parallel to the pad on the east and west sides of the northern half of the pad.

The sump is located approximately 50 ft northeast of the decontamination pad ([Figure A.1-4](#)). The fenced area containing the sump measures 10 by 10 ft. Four metal posts and a connecting chain mark the area. The large metal cover is approximately 6 ft in diameter and the depth of the sump has been reported as 10 ft bgs (DOE, 1988a) but has not been verified. “Underground Radioactive Material”

Figure A.1-4
CAU 145 Site Sketch of CAS 03-20-02

signs are lying on the ground at each of the four sides. The associated piping includes a pipe connecting the northeast corner of the pad to the sump. A section of the piping is visible approximately 15 ft northeast of the decontamination pad. An UST or leachfield may also exist approximately 40 ft south of the sump and is identified by 12 white, metal posts (bollards). The area encompassed by the bollards measures 9 by 23 ft and has a vent pipe extending above the ground surface in the southern end of the area. It is unknown if any piping connects the sump and the UST or leachfield, what the possible UST was used for, what the dimensions of the UST or leachfield are, when the UST or leachfield was installed, or if the UST or leachfield remain in place. Recent geophysical surveys (Fahringer, 2004) suggest the UST does exist but are inconclusive. An electrical substation, a concrete block, concrete hoist pads, and a metal cover are also in the area, but they are not believed to have any impact on this CAS.

Sources of Potential Contamination - The primary source of potential contamination is washdown water from vehicles and equipment decontaminated on the large pad. Wastewater discharges from the cleaning of vehicles and various equipment are thought to have flowed directly into a drain in the northeast corner of the pad and piped directly to the sump. The discharges would potentially contribute degreasers, oils, coolants, gasoline, diesel, solvents, cleaning fluids and possibly radionuclides to the sump. If the sump has an open bottom as reported (DOE, 1988a; DRI 1988) the soil directly below the sump may have been impacted. It is possible that piping may connect the sump to a leachfield or UST to the south of the sump. The UST or leachfield, if present, could also be a source of potential contamination. Soil in direct contact of piping could be impacted if any breaches in the associated piping are identified.

Previous Investigation Results - A radiological survey was completed in January 2004 over the pad and sump area of CAS 03-20-02 and results were reported in February 2004 (Alderson, 2004). Maximum total counts were 1.3 times background and 1.6 times mean and no removable contamination was encountered. It was concluded that this site will not require additional radiological support for future activities at the surface. A geophysical survey was completed at CAS 03-20-02 area in early 2004 (Fahringer, 2004). Results suggest the area marked with steel bollards south of the sump mark an underlying UST but do not identify any piping to or from the UST or sump. Clay piping may be present but not detected in the geophysical survey.

Potential Contamination - General COPCs associated with run-off and wastewater from the decontamination pad into the sump include solvents, degreasers, coolants, oils, gasoline, diesel, and cleaning fluids. If the suspected UST exists, it may have leaked unknown contents. The UST contents were likely diesel, gasoline, compressed gas, or possibly wastewater collected from the sump. The following classes of contaminants have the potential to be found in CAS 03-20-02 based on common NTS concerns and/or process knowledge: long-lived gamma-emitting fission/activation products, PCBs, VOCs, SVOCs, TPH, and RCRA metals with beryllium.

A.1.1.3 CAS 03-20-04, Injection Wells

Corrective Action Site 03-20-04, Injection Wells, consists of four injection wells, a steel-cased hole, concrete pads, concrete drainage channels, a steam plant decontamination pad, associated subsurface piping that originates from the steam plant pad, a surface discharge point and affected surface/near-surface soils surrounding and down gradient of the discharge.

Physical Setting and Operational History - Corrective Action Unit 145, CAS 03-20-04, Injection Wells, is located within the Area 3 Subdock of the NTS, just northeast of the Mercury Highway and 03-03 Road intersection. The CAS includes four separate sites termed “Injection Wells,” which may or may not actually be injection wells. These sites are referred to as Sites A, B, C, and D in this document and in [Figure A.1-5](#), [Figure A.1-6](#), and [Figure A.1-7](#). An additional steel-cased hole was identified during a recent geophysical survey of the area and is referred to as Site E. This site will be included as part of CAS 03-20-04.

The Area 3 Subdock Complex operated from the 1970s to 1985 primarily for cleaning and repairing worn drill bits and realigning bent drilling rods. All of the buildings at the Subdock have been removed; however, the foundations of several buildings remain, including the concrete foundation of the steam plant facility. According to an interviewee and historical documentation, this facility was used for the steam cleaning of drilling pipe, bits, and other drilling related equipment (Bingham, 1992a and b; McGlothlin, 2003). At the Steam Plant, steam from heated water was used to remove dirt, grease, etc., from the drilling parts. The northern portion of the Steam Plant facility consists of a decontamination pad, and the southwest portion consists of a dressing pad with a pillar jib crane mast. The drain located in the northeast corner of the Steam Plant decontamination pad was used to discharge effluent east from the building through a pipe to a surface discharge point

Figure A.1-5
CAS 145 Site Sketch of CAS 03-20-04

Figure A.1-6
CAS 145 Site Sketch of CAS 03-20-04, Sites A, C, & E

Figure A.1-7
CAS 145 Site Sketch of CAS 03-20-04, Sites B & D

(Figure A.1-6) The decontamination pad with the drain, piping, and discharge point are all part of the scope of CAS 03-20-04.

According to an engineering drawing (REEC Co, 1971), a new 20 by 20 ft wash pad was added north of the Steam Plant in 1971. An injection well is located in the center of the pad (Figure A.1-6, Site A). The wash pad (also referred to as decontamination pad) and injection well were used in conjunction with operations at the Steam Plant, and are included in the scope of CAS 03-20-04. The cover of the injection well measures approximately 3 ft in diameter and is perforated. Another of the injection wells associated with CAS 03-20-04 is located east of the new wash pad (Figure A.1-6, Site C). This injection well is not connected to a building or cement pad, and its exact purpose is unknown. The well casing extends about 8 in. above ground surface and has two 4-in. diameter holes on opposite sides of the exposed casing. The well cover is solid and is approximately 2 ft in diameter.

The Steam Plant Decontamination Pad is located southeast of Site A. This decontamination pad was used for steam-cleaning equipment related to drilling activities. The drain located in the northeast corner of the Steam Plant Decontamination Pad measures 2 ft in diameter and is approximately 1.5 ft deep. This drain was used to discharge effluent east from the Steam Plant through a pipe to a surface discharge point. This piping is 4 in. in diameter and approximately 75 ft in length. The dimensions of the surface discharge point have not been determined.

Approximately 600 ft northwest of the Steam Plant foundation is another complex of concrete pads, drainage channels, and two injection wells believed to be the site of a Pipe Straightening Shed. Activities at the Pipe Straightening Shed are believed to have released effluent to the two injection wells in the area (Figure A.1-7, Sites B and D). At this facility, bent drilling pipes were straightened after being cleaned of dirt, grease, and pipe dope. Concrete drainage channels surround the former Pipe Straightening Shed and are believed to have been used to direct effluent into Site B injection well. The western side of the well casing at Site B is perforated to allow effluent to flow into it and the cover measures approximately 2 ft in diameter. The injection well at Site D in this area is located between concrete pads in the northwest corner of the concrete drainage channels. The well is covered by plywood. The depth of the well has not been measured but has been reported as 2 ft (DOE, 1988a). Its exact purpose at this facility is uncertain. Hydrocarbon stains are present on portions of the concrete pads and concrete drainage channels in this area. These hydrocarbon stains, concrete

pads, and concrete drainage channels are covered under the scope of CAS 03-25-01 (Section A.1.1.4).

In March 2004 a geophysical survey was completed over most of the Area 3 Subdock and an open hole at Site E (Figure A.1-6) was identified south of Site A. The open hole has steel casing with an approximate diameter of 15 in. that is bent and/or torn at the top and is visible from the surface to approximately 13 ft bgs where liquid is visible. This hole does not appear to have any piping associated with it and its exact purpose at this facility is uncertain; however, it is included in the scope of this CAU. Other facilities were located at the Subdock; however, those facilities are not believed to have been associated with the injection wells included in CAS 03-20-04.

Sources of Potential Contamination - The primary sources of potential contamination are wastewater discharges from decontamination of piping and drill parts at the Steam Plant Decontamination Pad, wastewater discharges from the Pipe Straightening Pad, the discharge point, and injection wells into the surrounding soils. It is unknown what constituents were present in the wastewater discharges or injection wells.

Previous Investigation Results - Three separate geophysical surveys have been completed in the CAS 03-20-04 area. A geophysical survey was completed in 2002 (Shaw, 2002) over the 0.76 acre area surrounding CAU 224, CAS 03-05-01. The area was characterized by a graded dirt surface with three concrete pads including the former steam plant pad and adjacent piping to the east of the pad. The concrete pad at the northern end of the survey for CAS 03-05-01 is the concrete pad associated with Site A and the manhole cover for Site C is visible in the survey maps. The concrete pad in the southwestern portion of the survey for CAS 03-05-01 is the Steam Plant. The metal debris at the northern edge of the Steam Plant foundation correspond to the location of the cover for the drain at the Steam Plant Decontamination Pad. This survey revealed two lines extending from the steam plant to the east, one of which appears to be the water line to a surface discharge point.

A 0.7 acre geophysical survey of CAU 219, CAS 03-11-01 (Shaw, 2002.) was also completed in 2002. This survey included the cover for the injection well at Site B shown in the northern portion of the survey area and is labeled “metal sewer cover.” No piping is shown leading to or from Sites A, B, or C.

A third geophysical survey was completed over a majority of the western portion of the Area 3 Subdock in early 2004 (Fahringer, 2004). Results show numerous utility lines in the Subdock and identify existing concrete pads including the concrete channels around the injection wells at Sites B or D but do not identify any piping to or from the injection wells at these sites.

A memorandum from S.L. Alderson to B.S. Bailey (Alderson, 2004) reports results of a radiological survey that was conducted at CAS 03-20-04 on January 23, 2004. The survey covered an area of approximately 19,794 ft² (the southeast portion of the entire CAS). The results show maximum counts 1.3 times background and 1.2 times mean counts and that no removable contamination was encountered, so the site will not require radiological support for any future activities. The document also includes a figure showing the results of the survey.

Potential Contamination - The nature of the wastewater discharges from each source in CAS 03-20-04 is unknown. General COPCs associated with run-off and wastewater from these sources are likely to include solvents, degreasers, coolants, oils, gasoline, diesel, and cleaning fluids. Because the nature of contamination is unknown, the following classes of contaminants have the potential to be present within CAS 03-20-04 based on common NTS concerns and/or process knowledge: long-lived gamma-emitting fission/activation products, PCBs, VOCs, SVOCs, TPH (both DRO and GRO), and RCRA metals with beryllium.

A.1.1.4 CAS 03-25-01, Oil Spills

Corrective Action Site 03-25-01, Oil Spills, consists of hydrocarbon-stained soil and the adjacent affected surface/near-surface soils, concrete pads, and concrete drainage channels; all of which are located in the former Pipe Straightening Area. There are a total of three small concrete pads. The concrete drainage channels run between the three concrete pads. Hydrocarbon staining is present on portions of the concrete channels, concrete pads, and soil in this area ([Figure A.1-7](#)). Sites B and D in CAS 03-20-04 are also located in this area.

Physical Setting and Operational History - CAS 03-25-01 is within the Area 3 Subdock in Area 3 of the NTS, adjacent to Sites B and D of CAS 03-20-04. Previous investigations (DOE, 1988a) reported that the stained soils of CAS 03-25-01 encompass approximately 100 ft² and are possibly where

crankcase or lubricating oil was discharged. Site conditions in early 2004 show soil staining still exists but is discontinuous along the concrete drainage channels.

Sources of Potential Contamination - The source of contamination in this CAS may be a discharge of crankcase or lubricating oil onto the concrete drains and surrounding surface soils. The location of soil staining observed in a recent field visit suggests a very limited extent of contamination and the possibility that staining was not due to a spill but rather related to construction of a temporary shed in the vicinity of the concrete channels.

Previous Investigation Results - A 0.7 acre geophysical survey of CAU 219, CAS 03-11-01 completed in 2002 (Shaw, 2002) included the southern end of CAS 03-25-01. The cover for the CAS 03-20-04 Site B injection well is shown in the northern portion of the survey area and is labeled “metal sewer cover.” The survey shows subsurface piping leading from the southern concrete pad of CAS 03-25-01 to the western side of CAS 03-11-01 pad.

Potential Contamination - Because the visible surface-soil staining has been reported as oil spills, all petroleum hydrocarbons (TPH, both DRO and GRO) are considered targeted analytes. Based on process knowledge, no additional COPCs are expected at this CAS.

A.1.1.5 CAS 03-20-08, Injection Well

Corrective Action Site 03-20-08, Injection Well, consists of an injection well, decontamination pad, sump, catch basin, and associated piping located in the J-6 Containment Yard, part of Area 3 Camp (Figure A.1-8). The injection well was drilled in 1980 to drain wastewater from the sump and catch basin, which were installed before 1965. The well is posted as a “Wastewater Disposal Hole” and is immediately north of a fenced “Caution Radioactive Material” area where the catch basin is located and drilling parts are stored.

Physical Setting and Operational History - CAS 03-20-08 is located southwest of the LASL Post-shot Building in the J-6 Containment Yard in Area 3 of the NTS. The J-6 Containment Yard was used primarily for testing of BOPs and for decontamination activities. A decontamination pad measuring 30 by 40 ft and located southwest of the LASL Post-shot Yard Building, was used for the decontamination of a containment trailer, BOPs, drill bits, and assemblies. The wastewater from the

Figure A.1-8
CAS 145 Site Sketch of CAS 03-20-08

decontamination process was drained into the sump that is located in the corner of the pad. When the sump reached capacity, the wastewater was drained through the underground piping to a catch basin located 180 ft south of the sump and pad. According to an engineering drawing (REECo, 1965) the catch basin measures 40 ft² and is 5 ft deep but has not been observed during recent Preliminary Assessment field visits due to its location within a posted “Caution Radioactive Material” area. In 1980, an injection well located 60 to 70 ft south of the decontamination pad was drilled. The well is reported to be 100 ft deep (Fenix & Scisson, 1989; RSN, 1991) with 98-in. ID steel casing extending to 35 ft bgs and a hole diameter of 64 in. below the base of the casing. Process knowledge suggests the hole was filled with gravel from 35 to 100 ft bgs. The well is covered with two metal plates approximately 9 ft long and wide enough to cover the well and is surrounded by orange snow fencing. It is believed that the wastewater drained from the sump to the injection well. Once in the well, the wastewater would leach into the ground through an open bottom. It is unknown if the pipes that lead from the sump to the injection well have been sealed or if the catch basin was used for any other purpose after 1980. It is uncertain when the decontamination activities occurred; however, a REECo engineering drawing dated 1965 shows the presence of the sump and catch basin.

Sources of Potential Contamination - Historical records are unclear as to if, or what, effluent was discharged into the sump or catch basin but it is suspected that both drained to the surrounding soil before the injection well was installed and to the well after its installation in 1980. Decontamination activities may have discharged COPCs such as diesel, grease, oils, and cleaning fluids into the decontamination pad and catch basin. The potential also exists for the inadvertent discharge of radioactive effluent from these decontamination activities.

Previous Investigation Results - Two geophysical surveys were completed in the areas north and east of the injection well (SAIC, 2003; Fahringer, 2004b). Both surveys show piping running from the sump to the injection well. Additionally, both surveys show a utility line running northeast from the injection well towards the LASL Post-shot Building. The area south of the injection well has not been surveyed due to the “Caution Radioactive Material” postings and large quantity of metal present at the surface. One walk-over radiological survey was performed by SNJV personnel in January 2004 (Alderson, 2004c). Results indicate long-lived gamma-emitting fission/activation products are close to background at the surface and that future activities at the surface will not require radiological support.

Sampling of liquid and sludge from the injection well was completed by BN in September 2001 as part of an investigation of CAU 322, a nearby CAU. According to field notes, liquid was encountered in the well at approximately 16.5 ft bgs. The base of the liquid was reported as 18 ft bgs with a soft bottom. A bailer was used to collect a liquid sample that was reported as a dual-phase sample. The top phase “resembled waste oil” and bottom phase was “relatively clear water.” A second sample of the solid/sludge below the liquid in the well was collected using a piston sampler at approximately 34 ft bgs. The sample was described as “black sludge that is almost solid.” Both samples were screened for radionuclides and no elevated readings were noted. Both samples were analyzed for gross alpha, gross beta, gross gamma, RCRA metals, PCBs, TPH (DRO, GRO, and oil), tritium, SVOCs, and VOCs. Radiological results show activities just above background. Other than petroleum hydrocarbons (TPH = 5,385 mg/L) and acetone (78 µg/L), no compounds were detected in the liquid sample. Analytical results for the solid/sludge sample indicate three compounds (1,2-dichlorobenzene; bis (2-ethylhexyl) phthalate; and arsenic) and petroleum hydrocarbons were detected above PRGs.

Potential Contamination - The following are targeted analytes based on previous sampling results: TPH (DRO and GRO); arsenic; and 1,2-dichlorobenzene. Because bis (2-ethylhexyl)phthalate is a common laboratory contaminant and there is no known history of production or release of phthalates at the site, the compound will not be added to the list of targeted analytes. The following classes of contaminants are potentially present in CAS 03-20-08 based on common NTS concerns and/or process knowledge: RCRA metals, beryllium, PCBs, other SVOCs, and VOCs.

A.1.1.6 CAS 03-99-13, Drain and Injection Well

Corrective Action Site 03-99-13, Drain and Injection Well, consists of an injection well, drain pit, and associated piping coming from three former buildings in the Core Complex of Area 3 at the NTS. The Core Complex was run by LASL and LLNL.

Physical Setting and Operational History - CAS 03-99-13 is located within a fenced area posted as a “Radioactive Contamination Area” in the Core Complex in Area 3 of the NTS. According to engineering drawings there are various waste lines from the Core Storage, WX-6, and Core Handling Buildings to the well ([Figure A.1-9](#)). The activities within these buildings included processing core samples, decontaminating “PIGs,” and disassembling equipment. The Core Handling Building also

Figure A.1-9
CAS 145 Site Sketch of CAS 03-99-13

included a drain pit. The Core Handling Building is where the core samples were cleaned, rinsed, and prepared for radiochemical testing. Core debris and decontamination fluids were discharged into this drain pit and flowed to the injection well. According to engineering drawings, piping originating at the Core Handling Building may have also discharged waste from a restroom facility within the building. Two engineering drawings (Holmes and Narver, 1967 and date unknown) show the injection well as a 48-in. diameter waste sump with a 100 ft depth. The drillers report for the injection well indicates 48-in. diameter casing extends to 96 ft bgs (Fenix & Scisson, 1966).

During a recent site visit, the casing of the injection well was measured as approximately 3 ft in diameter and approximately 3.5 ft above ground surface. The well is on a small concrete pad that is in poor condition. There is a handle with wire roping on the injection well cover. The fenced area surrounding the injection well shares a side with an electrical substation. The drain pit is located on the foundation of the former Core Handling Building. The Core Handling Building foundation measures 60 by 40 ft; the drain pit is located along the west side of the foundation and measures 39 by 9 ft. The drain pit has been covered with two metal plates. The piping included in this CAS originates at three different locations, the former Core Storage Building, the former Core Handling Building, and the former WX-6 Building. A 4-in. cast iron (CI) pipe leads from the Core Storage Building to the injection well; a 12-in. CI pipe leads from the Core Handling Building to the injection well; and a 6-in. CI pipe leads from the WX-6 Building to the injection well.

Sources of Potential Contamination - Historical records are unclear as to if, or what, effluent was discharged into the injection well but it is assumed that piping from the Core Storage, WX-6, and Core Handling Buildings discharged wastewater from cleaning decontamination of equipment and cores. Therefore, this wastewater has the potential to contain RCRA metals, beryllium, low-level radionuclides, TPH, SVOCs, VOCs, oils, and cleaning fluids.

Previous Investigations - A series of three radiological investigations were completed by REECO between 1990 and 1995 as part of the Site Demarcation Checklist completion (REECO, 1990, 1992a, 1992b, and 1995). Most recent results (REECO, 1995) of the sealed hole were 0.03 mR/h at 1 cm for the north, south, and east walls and 0.02 mR/h at 1 cm for the west wall. The results also showed 0.02 mR/h at 30 cm for the south, east, and west walls and 0.03 mR/h at 30 cm for the north wall. A walk-over radiological survey was performed in portions of this CAS in conjunction with the

Preliminary Assessments CAU 145 investigation. Results indicate no evidence of long-lived gamma-emitting fission/activation products in the soils above background.

Potential Contamination - Low levels of long-lived gamma-emitting fission/activation products are suspected based on historical operations associated with operations within this vicinity of this CAS. The following classes of contaminants have the potential to be found at CAS 03-99-13 based on common NTS concerns and/or process knowledge: VOCs, SVOCs, TPH, PCBs, and RCRA metals with beryllium.

A.1.2 Step 1 - State the Problem

This step identifies the DQO planning team members and decision makers, describes the problem that has initiated the CAU 145 investigation, and develops the CSMs.

A.1.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, SNJV, and BN. The primary decision makers include NDEP and NNSA/NSO representatives. [Table A.1-2](#) lists representatives from each organization in attendance for the June 24, 2004, final DQO meeting.

A.1.2.2 Describe the Problem

Corrective Action Unit 145 is being investigated because:

- Oil, grease, 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.
- Effluent discharges into the sumps and injection wells potentially contaminated the soil adjacent to and below the discharge structures and possibly groundwater.
- Discharged wastes may be present without appropriate controls (i.e., use restrictions, adequate cover).

As a result of the above conditions, hazardous and/or radioactive constituents may be present at these CASs at concentrations that could pose a potential threat to human health and the environment. The problem statement for CAU 145 is: “Existing information on the nature and extent of potential

Table A.1-2
CAU 145 DQO Meeting Participants
June 24, 2004

Participant	Affiliation
Stacey Alderson	SNJV
Robert Boehlecke	SNJV
Sabine Curtis	NNSA/NSO
Peter Fahringer	SNJV
Barbara Ground	SNJV
Jeff MacDougall	NDEP
Patrick Morris*	BN
David Nacht*	BN
Barbara Quinn	SNJV
David Strand	SNJV
Ted Zaferatos	NDEP

SNJV - Stoller-Navarro Joint Venture

NDEP - Nevada Division of Environmental Protection

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

BN - Bechtel Nevada

* - June 8, 2004 Pre-DQO Meeting Participant

contamination is insufficient to evaluate and recommend corrective action alternatives for the CASs in CAU 145.”

A.1.2.3 Develop Conceptual Site Models

Conceptual Site Models describe the most probable scenarios for current conditions at a CAS and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. They are the basis for assessing how contaminants could reach receptors both in the present and future by addressing contaminant nature and extent, transport mechanisms and pathways, potential receptors, and potential exposures to those receptors. Accurate CSMs are important as they serve as the basis for all subsequent inputs and decisions throughout the DQO process. Land-use descriptions help define exposure scenarios that are the basis for assessing how contaminants could reach potential receptors both in the present and future. [Table A.1-3](#) summarizes the land-use designation and associated description for the CAU 145 CASs. Based on land use,

Table A.1-3
CAU 145 Future Land-Use Scenario

CAS	Zone	Zone Description
03-20-01	Nuclear and High Explosives Test Zone	This area is designated within the Nuclear Test Zone for additional underground nuclear weapons test and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities. The Nuclear Test Zone is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests.
03-20-02		
03-20-04		
03-20-08		
03-25-01		
03-99-13		

Source: (DOE/NV, 1998)

current and future receptors are limited to industrial and construction workers as well as military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.

One CSM was developed for CAU 145 using information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. The CSM was designed to be pertinent to all physical and chemical properties of this CAU and to capture the commonalities of the CASs. The CSM is shown in [Figure A.1-10](#). The CSM has four release scenario components:

- Surface/near-surface releases
- Core storage hole releases
- Injection well (deep) releases
- UST releases

The CSM elements include a source, piping, sump, drain, catch basin, tank, surface discharge point, injection well, and storage holes.

The applicability of the release scenario components of this CSM to each CAS are summarized in [Table A.1-4](#) and discussed below. [Table A.1-4](#) provides information on CSM elements that will be used throughout the remaining steps of the DQO process. If additional elements are identified during

Figure A.1-10
Conceptual Site Model for CAU 145

Table A.1-4
CAU 145 Conceptual Site Model
Description of Elements for Each CAS in CAU 145

CAS Identifier	03-20-01	03-20-02	03-20-04	03-20-08	03-25-01	03-99-13
CAS Description	Core Storage Holes	Decon Pad and Sump	Injection Wells	Injection Well	Oil Spills	Drain and Injection Well
Applicable CSM Release Scenario Component(s)	Surface/Near-Surface & Core Storage	Surface/Near-Surface & UST	Surface/Near-Surface & Injection Well	Surface/Near-Surface & Injection Well	Surface/Near-Surface	Surface/Near-Surface & Injection Well
Site Status	Sites are inactive and/or abandoned					
Exposure Scenario	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.					
Affected Media	Surface and shallow subsurface soils for surface component, subsurface soils for deep component.					
Sources of Potential Soil Contamination	Effluent discharge through unlined sumps, catch basin, surface discharge point, possible leachfield or injection well via subsurface piping connected to sources. Leakage from a possible UST.					
Location of Contamination/Release Point	Surface soils immediately surrounding source of contamination such as sump, piping or decon pad; near surface soils at breaks or junctions in piping, laterally and vertically out from subsurface point sources such as injection wells, USTs, and storage holes.					
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for migration of contaminants. However, due to the arid environment of the NTS, percolation of precipitation is very small and migration of contaminants has been shown to be very limited. Evaporation potentials significantly exceed available soil moisture from precipitation (i.e., 3 to 10 in.) (USGS, 1995). Surface water run-off may provide for the transportation of some contaminants within or outside of the footprints of the CASs.					
Preferential Pathways	Surface drainages down gradient of sources have minor impact due to low grade; in general lateral migration dominate over vertical migration. Flow from injection wells could be preferential.					
Lateral and Vertical Extent of Contamination	Unknown. Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Groundwater contamination is not expected. Depth to groundwater in Area 3 in recently sampled wells varies from ~1,197 to 1,610 ft bgs (USGS and DOE, 2004). Surface migration may occur as a result of run-off.					
Amount Released	Unknown					
Potentially Released Material	COPCs released in wastewater effluent from equipment decontamination, storage, and maintenance.					

the investigation that are outside the scope of the CSM, the situation will be reviewed and a recommendation will be made as to how to proceed. In such cases, identified decision makers will be notified and given the opportunity to comment on, or concur with, the recommendation.

Surface/Near-Surface Release Component - The surface/near-surface release component of the CSM applies to all six CAU 145 CASs. At each CAS a general source(s) is identified as contributing to potential soil contamination. Potential soil contamination may be associated with a direct release from the operation of the facility or through release of effluent generated within that facility. The facility may be a former building, decontamination pad, injection well housing, surficial and near-surface piping, possible leachfield, or a surface discharge point. The location of release points are assumed to be contiguous with the general source but could be potentially widespread throughout the CAS boundary. The extent of contamination is unknown; however, based on the transport mechanism of surface run-off, lateral contamination would be predominant over vertical contamination. For a leachfield, lateral and vertical extent of contamination would be variable depending on the amount and rate of effluent discharge. Leachfields were designed to disperse effluent within the leachfield and allow liquid to percolate downward into the underlying native soil.

Injection Well (Deep) Release Component - This CSM component applies to CASs 03-20-04, 03-20-08, 03-99-13 and shows conceptually how effluent was discharged from injection wells, then dispersed to the surrounding subsurface soil. The injection wells were designed to allow the release of effluent as conceptually shown on [Figure A.1-10](#). The injection wells are assumed to be point sources for soil contamination. The location of potential contamination can be expected within a defined boundary laterally and vertically based on the discharging of effluent out of the base of the injection well into surrounding subsurface soils.

Core Storage Hole Release Component - This CSM component applies only to CAS 03-20-01, Core Storage Holes. Since the construction of the bottom and sides of the core storage holes is unknown, it is unknown whether they released any contaminants to the surrounding subsurface soils. If the holes are opened bottomed, they can be thought of as point sources for soil contamination in the shallow subsurface soil. The location of potential contamination can be expected to fall within a defined boundary laterally and vertically based on the any release out of the base of the storage holes into surrounding subsurface soils.

UST Release Component - This CSM component may or may not apply to CAS 03-20-02, Decon Pad and Sump. Since the presence of an UST at CAS 03-20-02 is unknown, it is also unknown if contaminants may have been released to the surrounding subsurface soils through leakage of the UST or associated piping.

The location of potential contamination can be expected to fall within a defined boundary laterally and vertically based on the any release out of the base of the UST or piping into surrounding subsurface soils.

Affected Media - For the surface/near-surface release CSM, the affected media are the surface and subsurface soils surrounding and down gradient of the source area, associated piping in direct contact with the effluent and subsurface soils beneath piping if a breach or rupture of the piping occurred, open bottomed sumps, a catch basin, and a potentially leaking UST.

For both the core storage hole and injection well (deep) release CSM the affected media are the subsurface soils at and down gradient of the discharge points.

Location of Contamination/Release Points - For CAU 145 CASs, the presence of COPCs in soils may have resulted from designed or accidental releases as discussed above and depicted on the CSM (Figure A.1-10). The location of contamination CAU 145 CASs is unknown and potential release points are assumed consistent with the CSM.

Transport Mechanism(s) - An important element of a CSM is the expected fate and transport of contaminants in the environment, 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 and chemical characteristics of the contaminants and media. Contaminant characteristics include biodegradation potential, solubility, density, particle size, and affinity for nonmobile particles (adsorption). Media characteristics include permeability, porosity, hydraulic conductivity, total organic carbon content, 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 are more susceptible to factors that can move them through various media; therefore, can be expected to be found further from release points.

Migration of potential contamination is assumed to be minimal based on the affinity of the COPCs for soil particles, and the low precipitation and high evapotranspiration rates typical of the NTS environment. Run-off could cause lateral migration of contaminants over the ground surface for the release scenarios described. Contaminants may also have been transported by infiltration and percolation of precipitation through soil, which would serve as the primary driving force for downward migration. Mixing of the surface soils as a result of grading or construction activities could also move COPCs into deeper intervals and extend COPCs further laterally. The migration of organic constituents (e.g., petroleum hydrocarbons) can be controlled to some extent by their affinity of organic material present in the soil. However, this mechanism is considered insignificant because of the lack of organic carbon in the desert soil. Migration of certain inorganic constituents (e.g., metals in waste oil, radionuclides) is controlled by geochemical processes, such as adsorption, ion exchange, and precipitation of solids from solution.

Contaminants migrating to regional aquifers is not considered as a significant pathway at CAU 145 based on the significant depth to groundwater. Groundwater levels at the CAU 145 CAS locations (all in Area 3) are approximately 1,610 ft bgs. Environmental conditions at the NTS (e.g., low annual average precipitation rates, high potential evapotranspiration, and low permeability soils) are not conducive to significant downward migration.

Airborne release subsequent to initial contaminant release is not considered a significant release pathway. The main process of migration via the airborne pathway would be through windblown dust with COPCs adsorbed to the fine soil particles. This process could result in the deposition of COPCs beyond the CAS boundaries; however, it would be expected that contaminant levels decrease with distance from the point of release and distributed consistent with prevailing wind direction.

Preferential Pathways - Preferential pathways for contaminant migration at most of the CAU 145 CASs are expected to have only a minor impact on contaminant migration or none at all. All of the CASs are thought to have effluent discharged into a sump, collection basin, injection well, or surface drainage which have potential to increase lateral transport prior to infiltration. When the distribution systems within these CASs were operational, any breaches that may have occurred in the distribution piping may have allowed liquids to contaminate soils preferentially along the pipeline due to the disturbed nature of the subsurface soils. This could allow contamination to travel laterally to a small

degree. Although the preferential pathways for contaminant migration is considered in the development of the sampling strategies and sampling contingencies discussed in the CAIP, primary consideration will be given to the release and transport mechanisms.

Lateral and Vertical Extent of Contamination - If contamination is present at CAS 03-25-01, it is expected to be confined to the surface and near-surface soils. Deeper contamination is likely to exist at the CASs with injection wells (03-20-04, 03-20-08, and 03-99-13) and may exist at the core storage holes (03-20-01) if the bases of the holes are open to the surrounding soil. If an UST is present at CAS 03-20-04, contamination of the subsurface soils at and below the base of the tank may exist. Concentrations of contaminants are expected to decrease with distance (both laterally and vertically) from the release point(s). For releases at the surface, lateral migration may occur as a result of storm events when precipitation rates exceed infiltration (stormwater run-off). However, these events are infrequent. Surface migration is a biasing factor considered in the selection of sampling locations. As stated previously, downward contaminant transport is expected to be limited due to low annual average precipitation rates, high potential evapotranspiration, and low permeability soils; but is unknown because the volumes of material released are unknown.

A.1.3 Step 2 - Identify the Decisions

This step develops a decision statement and defines alternative actions appropriate for Decision I and Decision II.

A.1.3.1 Decision Statements

Decision I: “Is any PCOC present in environmental media within the CAS at a concentration exceeding its corresponding action level?” Any contaminant associated with a CAS activity that is present at concentrations exceeding its corresponding action level will be defined as a COC. If a COC is detected, then Decision II must be resolved. Otherwise, the investigation for that CAS is complete.

Decision II: “If a COC is present, is sufficient information available to evaluate potential corrective action alternatives? Sufficient information is defined to include:

- Volume of media containing any COC bounded by analytical sample results in lateral and vertical directions
- Information needed to characterize IDW for disposal
- Information needed to determine potential remediation waste types
- Information needed to evaluate the feasibility of remediation alternatives

A.1.3.2 Alternative Actions to the Decision

If no COCs are present, further assessment of the CAS is not required. If COCs are present, resolve Decision II.

If the extent of COCs is defined in both the lateral and vertical directions, further assessment of the CAS is not required. If the extent of COCs is not defined, re-evaluate site conditions and collect additional samples.

A.1.4 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, and identifies sampling and analysis methods that will allow reliable comparisons with action levels.

A.1.4.1 Information Needs and Information Sources

To resolve Decision I (determine if a COC is present at a given CAS), sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to contain a COC; and (2) the analytical suites and associated minimum detection limits (MDLs) selected must be sufficient to detect any COCs present in the samples below their corresponding PALs. Biasing factors to support these criteria include:

- Documented process knowledge on source and location of release
- Visual evidence of discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination
- Interpretation of hot spots based on the results of radiological or geophysical surveys
- Presence of residual materials within piping based on video survey data

- Field-screening results
- Previous sample or screening results
- Presence of debris or equipment
- Experience and data from investigations of similar sites

To resolve Decision II (determine the extent of contamination if a COC is present at a given CAS), samples need to be collected and analyzed following these two criteria: (1) samples must be collected in areas contiguous to the contamination but where contaminant concentrations are below action levels; and (2) the analytical suite selected must be sufficient to detect unbounded contaminants at action level concentrations.

A.1.4.2 Sources of Information

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

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

As discussed in [Section A.1.4.1](#), the collection, measurement, and analytical methods will be selected so that results will exist for all COPCs at CAU 145. This effort will include field screening; video mole surveys; soil, sediment, and liquid sampling; and laboratory analysis to determine the presence of COPCs and extent of identified COCS.

Waste characterization sampling and analysis has been included to support the decision-making process for waste management, and to ensure an efficient field program. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the CAIP.

A.1.4.3.1 Field Screening

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

- TPH - A gas chromatograph or equivalent instrument or method may be used to screen for weathered diesel or other heavier carbon chain compounds. The TPH field-screening level (FSL) is established at 75 ppm.
- VOCs - A flame ionization detector (FID) using the headspace method, or equivalent instrument or method may be used to screen for volatiles in soil. The VOC FSL is established as 20 ppm or 2.5 times background, whichever is greater.
- Radionuclides - A handheld alpha- and beta/gamma survey meter may be used to screen for long-lived gamma-emitting fission/activation products. Radionuclide FSLs are CAS-specific and will be calculated prior to sample collection, based on background levels. If determined appropriate, on-site gamma spectroscopy or an equivalent method may be used to screen samples.

Field-screening techniques provide semiquantitative data that can be used to guide additional soil sampling activities and waste management decisions.

A.1.4.3.2 Video Mole Surveys

A video mole survey of wastewater lines may be conducted to inspect the current physical condition and layout of the CAS distribution systems, as necessary. Video surveys allow a visual assessment of the system's integrity and can be used to identify breaches that may have resulted in a release.

Subsurface features may be excavated to gain additional access for inspection or sampling or to introduce the video system. The video survey may also include the introduction of a gamma detector into the pipeline to detect residual radioactivity, which may provide additional biasing factors for sampling. Based on CAU 145 site history and documentation, it is not expected to encounter piping associated with an active distribution system.

A.1.4.3.3 Radiological Scanning and Swipe Sampling

Radiological scanning and swipe sampling may be conducted on drain pipes; core storage holes, sumps, and injection well interiors; and/or residual materials present with the investigation areas. A handheld alpha, beta/gamma detector may be used to scan the item of interest. In addition, a downhole dose rate probe may be used to survey the injection wells and storage holes. If

contamination is indicated, swipe samples will be collected and counted. This technique identifies radiological conditions of the investigation areas and determines their subsequent release status.

A.1.4.3.4 Soil and/or Sediment Sampling and Measurement Methods

Based on the results of the video mole survey, piping may be excavated at points of suspected residual hold-up or breaches and visually inspected. If an adequate volume of residual material is present and accessible, samples will be collected. Soil beneath detectable breaches may also be sampled. Any discolored or stained soil within the CAS boundaries will be sampled, particularly in the footprint of CAS 03-25-01 where oil spills are thought to have stained the surface soils.

Samples will be collected by grab sampling, hand auguring, direct push, backhoe excavation, drilling, or other appropriate sampling methods. Sample collection and handling activities will be conducted in accordance with approved procedures. It may be appropriate to use excavation in selected areas to determine if contaminated soil has been covered with clean fill.

A.1.4.3.5 Liquid Sampling and Measurement Methods

Any liquids encountered in the injection wells or the UST will be sampled using appropriate sampling techniques such as bailer or low-flow sampling. Sample collection and handling activities will be conducted in accordance with approved procedures.

A.1.4.3.6 Analytical Methods

The analytical methods for CAU 145 samples submitted to analytical laboratories are shown in [Table A.1-5](#). The targeted analytes and possible COPCs identified for CAU 145 vary with each CAS and are listed in [Table A.1-1](#). Not every analytical method listed in [Table A.1-6](#) will be applied to every sample submitted for laboratory analysis. All Decision I samples will be analyzed for gamma-emitting isotopes regardless of which man-made radionuclides have been identified as suspected isotopes. The gamma spectroscopy results will serve as an indicator for the need to perform additional isotopic analysis (e.g., isotopic plutonium analysis if americium-241 is detected). The additional isotopes that may require isotopic analysis may be treated as suspected COPCs for additional Decision I analysis. Alternatively, a newly identified isotope above PALs, may become a COC parameter for Decision II sampling and analysis.

Table A.1-5
Analytical Methods for Decision I Laboratory Analysis

Analytical Parameter	Analytical Method	
	Liquid	Soil/Sediment/Sludge
Volatile Organic Compounds	SW-846 8260B ^a	SW-846 8260B ^a
Semivolatile Organic Compounds	SW-846 8270C ^a	SW-846 8270C ^a
RCRA Metals plus beryllium	SW-846 6010B ^a (mercury - 7470A ^a)	SW-846 6010B ^a (mercury - 7471A ^a)
Polychlorinated Biphenyls	SW-846 8082 ^a	SW-846 8082 ^a
Total Petroleum Hydrocarbons (C ₆ - C ₃₈)	SW-846 8015B ^a (modified)	SW-846 8015B ^a (modified)
Gamma Spectroscopy	EPA Procedure 901.1 ^b	HASL-300 ^c

RCRA = Resource Conservation and Recovery Act
SW = Solid Waste

^aEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, Parts 1-4, SW-846 (EPA, 1996)

^bPrescribed Procedure for Measurements of Radioactivity in Drinking Water (EPA, 1980)

^cThe Procedures Manual of the Environmental Measurements Laboratory (DOE, 1997)

The suspected COPCs are given greater importance in the decision-making process relative to possible COPCs. For this reason, more stringent performance criteria are specified for suspected analyte DQIs (Section 6.0 of the CAIP). Possible COPCs are defined as classes of contaminants that include all the analytes reported from the respective analytical methods that have PALs; those analytes are listed in [Table A.1-6](#) for the various analytical methods proposed for this CAI. The possible COPCs also aid in reducing the uncertainty concerning the history and potential releases from the CASs and help in the accurate evaluation of potential contamination. If a COPC, either suspected or possible, is detected in any sample at a concentration above the respective PAL, the COPC will be identified as a COC. During Decision II sampling and analysis, all COCs are considered suspected parameters. Sections 3.0 and 6.0 of the CAIP further provide the analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed during this CAI. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Analytical requirements (e.g., methods, detection limits, precision, and accuracy) are specified in the Industrial Sites QAPP (NNSA/NV, 2002) unless superseded by the CAIP. These requirements will ensure that laboratory analyses are sufficient to

**Table A.1-6
Analytes for CAU 145**

VOC	SVOC	TPH	PCB	Metals	Radionuclides
1,1,1-Trichloroethane 1,1,1,2-Tetrachloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene cis-1,2-Dichloroethene trans-1,2-Dichloroethene 1,2-Dichloroethane 1,2-Dichloropropane 1,2,3-Trichloropropane 1,2,4-Trimethylbenzene 1,2-Dibromo-3-chloropropane 1,2-Dibromoethane 1,3,5-Trimethylbenzene cis-1,3-Dichloropropene trans-1,3-Dichloropropene 2-Butanone 2-Chlorotoluene 4-Methyl-2-pentanone Acetone Benzene Bromobenzene Bromochloromethane Bromodichloromethane Bromoform Bromomethane Carbon disulfide Carbon tetrachloride Chlorobenzene Chloroethane Chloroform Chloromethane Dibromochloromethane Dibromomethane Dichlorodifluoromethane Ethylbenzene Isopropylbenzene Iodomethane Methyl tertiary butyl ether Methylene chloride N-Butylbenzene N-Propylbenzene sec-Butylbenzene Styrene tert-Butylbenzene Tetrachloroethene Toluene Trichloroethene Trichlorofluoromethane Trichlorotrifluoroethane Vinyl acetate Vinyl chloride Xylene	1,2,4-Trichlorobenzene ^a 1,2-Dichlorobenzene ^a 1,3-Dichlorobenzene ^a 1,4-Dichlorobenzene ^a 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2,4-Dichlorophenol 2,4-Dimethylphenol 2,4-Dinitrophenol 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Chloronaphthalene 2-Chlorophenol 2-Methylphenol 2-Nitroaniline 3,3'-Dichlorobenzidine 4-Bromophenyl phenyl ether 4-Chloroaniline 4-Methylphenol 4-Nitrophenol Acenaphthene Acenaphthylene Aniline Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Benzoic Acid Benzyl Alcohol Bis(2-chloroethoxy) methane Bis(2-chloroethyl)ether Bis(2-chloroisopropyl)ether Bis(2-ethylhexyl) phthalate Butyl benzyl phthalate Carbazole Chrysene Dibenzo(a,h)anthracene Dibenzofuran Diethyl Phthalate Dimethyl Phthalate Di-n-butyl Phthalate Di-n-octyl Phthalate Fluoranthene Fluorene Hexachlorobenzene Hexachlorobutadiene ^a Hexachlorocyclopentadiene Hexachloroethane Indeno(1,2,3-cd)pyrene Isophorone Naphthalene ^a Nitrobenzene N-Nitroso-di-n-propylamine N-Nitrosodimethylamine N-Nitrosodiphenylamine Pentachlorophenol Phenanthrene Phenol Pyrene Pyridine	Total Petroleum Hydrocarbons (C ⁶ - C ³⁵) DRO, GRO	Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 Aroclor-1248 Aroclor-1254 Aroclor-1260	Arsenic Barium Beryllium Cadmium Chromium Lead Mercury Selenium Silver	Am-241 Cs-137 Co-60 Eu-152 Nb-94 Pu-238 Pu-239/240 Sr-90 U-234 U-235 U-238

^aMay be reported with VOCs

detect contamination in samples at concentrations exceeding the minimum reporting limit (MRL). Specific analyses, if any, required for the disposal of IDW are identified in [Section 5.0](#) of the CAIP.

For sampling performed to define the extent of contamination (Decision II) at the six CASs, samples may be collected and analyzed only for identified COCs. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list of parameters for that particular CAS. For samples collected to define the extent of contamination, targeted analytes are the identified COCs.

A.1.5 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 the 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.1.5.1 Define the Target Population

Target populations are dependant upon the CSM developed for CAU 145. These target populations represent locations within the CAS that, when sampled, will provide sufficient data to resolve the primary problem statement. Decision I target populations represent locations within the CAS that contain COCs, if present. Decision II target populations are locations within the CASs where COC concentrations are less than PALs and are contiguous to areas of COC contamination in lateral and vertical directions.

A.1.5.2 Identify the Spatial and Temporal Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination at each CAS, as shown in [Table A.1-7](#). Contamination found beyond these boundaries may indicate a misrepresentation in the CSM and would require re-evaluation of the CSM before the investigation could continue. With the exception of CASs 03-20-01 and 03-99-13 in the Area 3 Core Complex and CASs 03-20-04 and 03-25-01 in the Area 3 Subdock, each CAS is considered geographically independent and intrusive activities are not intended to extend into the boundaries of neighboring CASs.

Table A.1-7
Spatial Boundaries of CAU 145 CASs

Corrective Action Site	Spatial Boundaries
03-20-01, Core Storage Holes	100 ft laterally from the storage holes and 50 ft bgs vertically
03-20-02, Decon Pad and Sump	100 ft laterally from the decon pad, piping and sump; up to 25 ft bgs vertically
03-20-04, Injection Wells	100 ft laterally from pads, piping, injection wells and discharge point unless overlapping with another CAS/CAU. Vertically 25 ft bgs except 200 ft for injection wells.
03-20-08, Injection Well	100 ft laterally from sump, injection well, catch basin and piping and 25 ft vertically; 200 ft laterally and vertically from injection well
03-25-01, Oil Spills	100 ft laterally from any visible staining, 25 ft bgs vertically
03-99-13, Drain and Injection Well	100 ft laterally from drain and 25 ft vertically; 200 ft laterally and vertically from injection well

Temporal boundaries are those time constraints, set-up, weather conditions, and project schedules. Significant temporal constraints due to weather conditions are not expected. Moist weather may place constraints on sampling and field screening contaminated soils because of the attenuating effect of moisture in samples (e.g., alpha-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.1.5.3 Identify Practical Constraints

Other NTS activities may affect the ability to characterize this CAU. Underground utilities may exist at the site, which may limit intrusive sampling locations. Other practical constraints include rough terrain and access restrictions. Access restrictions include scheduling conflicts on the NTS with other entities, areas posted as contamination areas requiring appropriate work controls, physical barriers (e.g., fences, buildings, steep slopes), and areas requiring authorized access.

A.1.5.4 Define the Scale of Decision Making

The scale of decision making in Decision I is defined as the CAS. The scale of decision making for Decision II is defined as a contiguous area contaminated with any COC originating from the CAS within the boundaries established in [Table A.1-7](#)

A.1.6 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.1.6.1 Specify the Population Parameter

The population parameter for Decision I data is the maximum observed concentration of each COC within the target population. The population parameter for Decision II data will be the observed concentration of each unbounded COC in any sample.

A.1.6.2 Choose an Action Level

The PALs presented in this section are to be used for site screening purposes. They are not intended to be used as cleanup or final action levels. However, they are useful in screening out analytes that are not present in sufficient concentrations to warrant further evaluation; therefore, streamline the consideration of remedial alternatives. At a given CAS, each COPC that is detected in a sample at concentrations exceeding the corresponding action level becomes a COC. The comparison of laboratory results to action levels and the evaluation of potential corrective actions will be included in the investigation report. If applicable, final action levels will be proposed (along with the basis for their selection) in the investigation report.

A.1.6.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA Region 9 Risk-Based PRGs for chemical constituents in industrial soils (EPA, 2002c). Background concentrations for RCRA metals and zinc will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998). For detected chemical COPCs without established PRGs that are listed in the EPA Integrated Risk Information System (IRIS) database, the protocol used by the EPA Region 9 in establishing PRGs (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

A.1.6.2.2 Total Petroleum Hydrocarbon PALs

The PAL for TPH is the TPH action limit of 100 ppm as listed in the NAC 445A.2272, “Contamination of Soil: Establishment of Action Levels” (NAC, 2003).

A.1.6.2.3 Radionuclide PALs

The PALs for radiological contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled from 25 to 15 mrem per year dose constraint and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

A.1.6.3 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.

A.1.6.4 Decision Rule

The decision rule for Decision I is:

If the population parameter of any COPC in a target population exceeds the action level for that COPC, then that COPC is identified as a COC, and Decision II samples will be collected. If biasing factors (e.g., staining) are present, then Decision II sampling may be conducted prior to confirming contamination through analytical results. If COPC concentrations are less than the corresponding action level, then the decision will be no further action.

The decision rule for Decision II is:

If the observed concentration of any COC in a Decision II sample exceeds its action level, then additional samples will be collected to complete the Decision II evaluation. If all observed COC population parameters are less than action levels, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction as determined by the limits defined in Step 6 described in [Section A.1.7](#).

If contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in [Table A.1-7](#), 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 the nature and extent of contamination.

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

The purpose of this step is to specify performance criteria for the decision rule. Setting tolerable limits on decision errors is neither obvious nor easy. It requires the planning team to weigh the relative effects of threat to human health and the environment, expenditure of resources, and consequences of an incorrect decision. Section 7.1 of the EPA QA/G-4HW guidance (EPA, 2000) states that if judgemental sampling approaches are used, quantitative statements about data quality will be limited to measurement error. Measurement error is influenced by imperfections in the measurement and analysis system. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, and data reduction. If measurement errors are not controlled they may lead to errors in making the DQO decisions.

This section provides an assessment of the possible outcomes of DQO decisions and the impact of those outcomes if the decisions are in error.

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

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

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

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

Decisions and/or criteria have false rejection (false negative) or false acceptance (false positive) errors associated with their determination. The impact of these decision errors and the methods that will be used to control these errors are discussed in the following subsections. In general terms,

confidence in DQO decisions based on judgmental sampling results will be established qualitatively by:

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

A.1.7.1 False Rejection Decision Error

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

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

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

For Decision II, this error is reduced by:

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

To satisfy the first criterion, Decision I samples will be collected in areas most likely to be contaminated by COCs (supplemented by random samples where appropriate). Decision II data collection will sample areas that represent the lateral and vertical extent of contamination. The following characteristics are considered for both decisions to accomplish the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties, natural and man-made
- Hydrologic drivers

These characteristics were considered during the development of the CSM and selection of sampling locations. The biasing factors listed in [Section A.1.4.1](#) will be used to further ensure that these criteria are met.

To satisfy the second criterion, Decision I samples will be analyzed for the appropriate chemical and radiological parameters presented in [Section A.1.1](#) and listed in [Section A.1.4.3](#). Decision II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs.

To satisfy the third criterion, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness defined in the Industrial Sites QAPP (NNSA/NV, 2002). The goal is 90 percent completeness for suspected COPCs at biased sample locations. The goal is also 90 percent completeness for identified COCs in Decision II locations. The dataset and individual sample results will be evaluated to determine if these goals have been met and/or if the data is sufficient to make a decision. A discussion of this evaluation will be included in the CADD. In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in [Section 6.0](#) of the CAIP. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.1.7.2 False Acceptance Decision Error

The false acceptance (beta) decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for unnecessary sampling and analysis.

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/QC samples such as field blanks, trip blanks, laboratory control samples, and method blanks are used to determine if a false positive analytical result may have occurred. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross contamination.

A.1.7.3 Quality Assurance/Quality Control

Radiological survey instruments and field-screening equipment will be calibrated and checked in accordance with the manufacturer's instructions and approved procedures.

Quality control samples will be collected as required by established procedures. The required QC samples include the following, but additional QC samples may be submitted based on site conditions.

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

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

This section provides the general approach for obtaining the information necessary to resolve Decision I and Decision II. A judgemental (nonprobabilistic) sampling scheme will be implemented to select sample locations and evaluate analytical results. Judgmental sampling allows the methodical selection of sample locations that target the populations of interest (defined in Step 4) rather than nonselective random locations.

Since individual sample results, rather than an average concentration, will be used to compare to action levels, statistical methods to generate site characteristics will not be necessary. Section 0.4.4 of the EPA's *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000) guidance states that the use of statistical methods may not be warranted by program guidelines or site-specific sampling objectives. The need for statistical methods is dependent upon the decisions being made. Section 7.1 of this EPA guidance states that a nonprobabilistic (judgmental) sampling design is developed when there is sufficient information on the contamination sources and history to

develop a valid CSM and to select specific sampling locations. This design is used to confirm the existence of contamination at specific locations and provide information (such as extent of contamination) about specific areas of the site.

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the target populations as defined in [Section A.1.5.1](#). To meet this criterion, a biased sampling strategy will be used for Decision I to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field screening and biasing factors. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present. The Site Supervisor has the discretion to modify the sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

To meet the DQI of representativeness for step-out (Decision II) samples (that Decision II sample locations represent the target population defined in [Section A.1.5.1](#)), sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other field screening and biasing factors. In general, sample locations will be arranged in a triangular pattern around the Decision I location at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location and the depth of the incremental step-outs will be based on the deepest contamination observed at all locations. A clean sample (i.e., COCs less than action levels) collected from each step-out direction (lateral or vertical) will define extent of contamination in that direction. The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions.

A.1.8.1 General Investigation Strategy

The initial investigative activities to be conducted for CAU 145 will include visual inspection and photodocumentation of all six CASs as well as removal of sump and well covers for visual and video surveys within the sumps, wells, and piping.

At all CASs with accessible subsurface piping, a video survey will be conducted from within the piping to identify residual material, breaches, or unknown tie-ins. Site conditions and conditions of the piping may not allow a 100 percent video survey. If the video survey identifies breaches and/or conditions that may have provided a means for effluent reach to the surrounding soils, then Decision I samples may be collected at those locations for laboratory analysis. If no breaches or residual effluent is identified during the survey, then Decision I sampling adjacent to and within the buried portions of the pipelines will not be necessary.

Following the initial visual inspection and/or video surveys, Decision I soil sample locations will be identified and samples collected for laboratory analysis. The selection of these locations considers the biasing factors listed in [Section A.1.4.1](#) and features of the CSM. If site conditions are encountered during the Decision I surface sampling or the video survey results suggest shallow subsurface contamination exists, then subsurface Decision I samples may be collected immediately. Decision I surface, shallow subsurface, and deep subsurface soil samples will be collected for laboratory analysis of the parameters identified in [Section A.1.4.3.4](#) and [Section A.1.4.3.5](#). Additional samples may be taken at the discretion of the Site Supervisor or Waste Management Lead.

Decision II (step-out) sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs above PALs were detected in the Decision I samples. Decision II locations will also be selected based on the elements of the CSM and other biasing factors. If biasing factors indicate a COC extends beyond the planned step-outs (i.e, field screening), locations may be modified or additional Decision II samples may be collected from incremental step-out locations as determined by the project staff. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location and the depth of the incremental step-outs will be based on the deepest contamination observed at all locations. For subsurface sampling locations, generally two consecutive soil samples with results below field-screening action levels are required to define the vertical extent of contamination. Generally, the uppermost “clean” sample from each location will be submitted for laboratory analysis. Contaminants determined not to be present in Decision I samples may be eliminated from Decision II analytical suites.

The following sections discuss CAS-specific investigation activities, including proposed sample locations. The proposed sampling locations are illustrated for each CAS in [Figure A.1-11](#) through

[Figure A.1-15](#), located at the end of the section. Due to the possibility of buried features (e.g., structures and utilities), sample locations may be relocated based upon actual field conditions, review of engineering drawings, and information obtained during the site visit. However, the new locations will meet the decision needs and criteria stipulated in [Section A.1.4.1](#).

A.1.8.2 CAS 03-20-01, Core Storage Holes and CAS 03-99-13, Drain and Injection Well

This section discusses both CASs located at the Area 3 Core Complex Facilities:

- CAS 03-20-01, Core Storage Holes
- CAS 03-99-13, Drain and Injection Well

These CASs are combined for discussion of investigation activities because lateral migration of COPCs within the Core Storage Holes area (CAS 03-20-01) has the potential to impact the drain and injection well of CAS 03-99-13. Due to the potential for overlapping CAS boundaries, certain Decision I and potential Decision II samples near the core storage holes may be representative of one or more CASs.

Prior to Decision I sampling, the lid of each of the seven storage holes and the injection well will be removed and a radiological survey (using a downhole dose rate probe) will be completed on the interior of each hole. The depth to solid media in the injection well will be determined prior to sampling. A video survey may also be conducted if the bottom of the holes is not visible from the surface. A video survey of CAS 03-99-13 piping will be conducted to investigate the general condition of the piping for breaches or unknown tie-ins. The drain pit cover(s) will be removed, if possible, to survey the drain pit. If breaches are encountered along any piping, biased soil samples will be collected at the breach point and analyzed. The piping may not be surveyed 100 percent due to typical blockages such as rodent nests and debris or the possibility that the original piping and drains contributing effluent to the injection well may have been sealed.

Proposed Decision I sampling locations at CASs 03-20-01 and 03-99-13 are shown in [Figure A.1-11](#). During Decision I sampling in CAS 03-20-01, a minimum of five surface samples will be collected adjacent to the core storage hole pads. One sediment/soil sample will be collected from the bottom of each of the seven Core Storage Holes if they are open-bottomed and at the first interval where FSRs are less than FSLs. If the holes have a cased bottom, a minimum of five subsurface soil samples will

be collected at a depth equal to, or greater than, the Core Storage Hole total depth and at the first interval where FSRs are less than FSLs. If solids or liquids are present at the bottom of the holes, a sample of each matrix (i.e., liquid, sludge, solid) will be collected to determine the nature of potential contamination. Any sampling locations outside of the holes will be selected on biasing factors (i.e., staining, low points) and site conditions as documented during the initial visual inspection.

Corrective Action Site 03-99-13 piping will be sampled where breaches, if any, have been noted during the video survey. Additionally, any media (i.e., liquid, sludge, solids) encountered within the drain pit and injection well that can be readily sampled, will be sampled and submitted for analysis. A minimum of two surface locations adjacent to the injection well will be sampled to characterize the surface soil adjacent to the injection well. It is proposed that at least one location adjacent to the injection well be drilled and sampled and at regular intervals from the base of casing to at least 125 ft bgs to determine the extent of contamination around the uncased portion of the injection well. Samples will be field screened and the two intervals with the highest FSRs will be submitted for laboratory analysis in addition to the surface and first interval where FSRs are less than FSLs. If the deepest sample interval is not submitted for analysis, it will be held for analysis.

It is not anticipated that sampling will be performed on, or adjacent to, the foundations of the former Core Storage Building, former Core Handling Building, or former WX-6 Building except within the drain pit of the former Core Handling Building since these foundations are not considered sources and are outside the CAS 03-99-13 boundaries. The inlet of piping leading from these three buildings to the injection well will be sampled if accessible. Additional locations may be sampled based on field screening results or at the discretion of the Site Supervisor.

Decision II step-out samples may be collected, as described [Section A.1.8.1](#). The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors and primarily field screening of Decision I samples.

A.1.8.3 CAS 03-20-02, Decon Pad and Sump

Prior to Decision I sampling, the cover to the sump northwest of the large concrete pad will be removed and both a visual and radiological survey will be completed. A video survey of piping leading to/from the sump will be conducted to investigate the general condition of the piping for

Figure A.1-11
Proposed Sampling Locations at CASs 03-20-01 and 03-99-13

breaches or unknown tie-ins. An attempt will be made to complete a video survey of the potential UST through the vent pipe as well. Intrusive activities may be needed to locate the boundaries of the tank.

During Decision I sampling, a minimum of eight samples will be collected of the surface soils adjacent to the large concrete pad believed to be used for decontamination. Additional samples may be collected of any debris on the pad and/or any stained areas. One or more surface soil samples will be collected from the pad to sump pipe opening, adjacent to each side of the sump, and at the vent pipe area.

Sampling of the sump will take place after the cover has been removed. One sample of each matrix will be collected from within the sump and UST, if present. A soil sample in the soil horizon underlying the base of the sump and at the first interval where FSRs are less than FSLs will also be collected adjacent to the sump in at least three locations. Decision I soil samples will be collected beneath the inlet and outlet end pipes of the UST, if present, and at the first interval where FSRs are less than FSL at these locations in the soil horizon underlying the base of the tank. Surface samples may be collected in areas of potential tank overflow. If any breaches are identified along the piping within this CAS, excavation and sampling will be conducted to determine if COPCs are present outside the pipe. [Figure A.1-12](#) shows the proposed Decision I sample locations.

If the area bounded by the metal posts includes a leachfield and not an UST, soil samples will be collected from a minimum of three locations. In addition, at least one sample of each matrix present within the leachfield will be sampled. A surface soil sample and at least one soil sample below the leachfield piping will be collected at each location sampled within this area.

Decision II step-out samples may be collected, as described in the introduction to [Section A.1.8](#). The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors and primarily field screening of Decision I samples.

A.1.8.4 CAS 03-20-04, Injection Wells

Prior to Decision I sampling, the cover to the sumps and wells in this CAS will be removed and visual surveys will be completed to determine the dimensions of each feature. A video survey of piping

Figure A.1-12
Proposed Sampling Locations at CAS 03-20-02

leading to/from the sumps and/or injection wells will be conducted to investigate the general condition of the piping for breaches or unknown tie-ins. If any breaches are identified, excavation and sampling will be conducted to determine if COPCs are present in adjacent soil.

Asbestos-containing tiles are present southeast of Site B and associated with CAU 219, CAS 03-11-01. Because these tiles are outside the scope of this CAS, they will only be addressed as a health and safety issue and may be removed from the sampling areas within this CAS.

Proposed Decision I sampling locations at CAS 03-20-04 are shown in [Figure A.1-13](#). Samples will be collected of each matrix in every feature that received waste. These features include the injection wells at sites A, B, C, D, and E and the drain on the northeast corner of the Steam Plant Decontamination Pad.

A minimum of three surface soil samples will be collected near the surface discharge point, one directly below the discharge pipe and two approximately 10 and 20 ft down gradient within the surface depression. Additional surface soil samples will be collected at three to four points adjacent to Site A pad, and at least one point adjacent to Sites B, C, and D. Biasing factors will aid in the selection of soil to be collected.

For the injection wells, it is proposed that at least one additional location, adjacent to the injection well, be drilled and sampled at the surface and at regular intervals from the base of casing to at least two intervals below where FSRs are less than FSLs to determine the extent of contamination around the uncased portion of the injection well. Samples will be field screened and the two intervals with the highest FSRs will be submitted for laboratory analysis in addition to the surface and first interval where FSRs are less than FSLs. If the deepest sample interval is not submitted for analysis, it will be held for analysis.

Decision II step-out samples may be collected, as described in the introduction to [Section A.1.8](#). The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples.

Figure A.1-13
Proposed Sampling Locations at CAS 03-20-04

A.1.8.5 CAS 03-20-08, Injection Well

Prior to Decision I sampling, the cover to the sump and catch basin will be removed and a visual survey will be completed to determine the dimensions of each feature. A radiological swipe of the sump interior also be completed. A video survey of piping leading to/from the sumps and catch basin will be conducted to investigate the general condition of the piping for breaches or unknown tie-ins. If any breaches are identified, excavation and sampling will be conducted to determine if COPCs are present in adjacent soil.

Decision I surface soil samples will be collected adjacent to the four sides of the decontamination pad, injection well, and catch basin as shown in [Figure A.1-14](#). Additional samples may be collected if staining, FSRs, or other site conditions warrant additional sampling.

Previous investigative work by BN in 2001 included sampling the injection well (BN, 2001). Identification and sampling of two matrices (liquid and solid) within the CAS 03-20-08 injection well was completed. Both samples contained TPH above the action level of 100 mg/kg per NAC 445A.2272 (NAC, 2003). It is anticipated that the injection well will be resampled and that a minimum of one sample per matrix will be collected and submitted for analysis. It is proposed that at least one additional location, adjacent to the injection well, be drilled and sampled at the surface and at regular intervals from 35 ft (base of steel casing) to at least 125 ft bgs to determine the extent of contamination around the uncased portion of the injection well. Samples will be field screened and the two intervals with the highest FSRs will be submitted for laboratory analysis in addition to the surface and first sample below where FSRs are less than FSLs. If the deepest sample interval is not submitted for analysis, the sample will be held.

Additional Decision II step-out samples may be collected for any COCs identified, as described in the introduction to [Section A.1.8](#). The Site Supervisor will determine if additional Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples.

A.1.8.6 CAS 03-25-01, Oil Spills

Decision I samples will be collected to confirm the nature of suspected contaminants and to investigate the vertical and lateral extent of potential contamination in the in areas of soil staining. A minimum of four soil samples will be collected to correspond with areas of most prevalent surface

Figure A.1-14
Proposed Sampling Locations at CAS 03-20-08

staining ([Figure A.1-15](#)). Additional samples may be collected at the discretion of the Site Supervisor to delineate the extent of potential hot spots and to adequately characterize the nature and extent of potential contamination. All soil samples will be field screened for TPH and VOCs. Samples will be collected at the surface (0 to 6 in.) and at two intervals below the deepest visible staining or where FSRs are less than FSLs at all locations.

A minimum of four Decision II samples will be collected outside the stained area concurrently with Decision I samples during the initial sampling effort to determine the lateral extent of contamination. Additional Decision II step-out samples may be collected, as described in the introduction to [Section A.1.8](#). The Site Supervisor will determine if additional Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples.

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Appendix B

Project Organization

B.1.0 Project Organization

The NNSA/NSO Project Manager is Janet Appenzeller-Wing and she can be contacted at (702) 295-0461. The NNSA/NSO Task Manager is Sabine Curtis and she can be contacted at (702) 295-0542.

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 NNSA/NSO Project Manager be contacted for further information.

Appendix C

Responses to NDEP Comments

NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

1. Document Title/Number <u>Draft Corrective Action Investigation Plan for Corrective Action Unit 145: Wells and Storage Holes, Nevada Test Site, Nevada</u>					2. Document Date <u>August 2004</u>				
3. Revision Number <u>0</u>					4. Originator/Organization <u>Stoller-Navarro</u>				
5. Responsible DOE/NV ERP Project Mgr. <u>Janet Appenzeller-Wing</u>					6. Date Comments Due <u>September 13, 2004</u>				
7. Review Criteria <u>Full</u>					9. Reviewer's Signature				
8. Reviewer/Organization/Phone No. <u>Jeff MacDougall, NDEP, 486-2865</u>									
10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept					
1) Pages 17 and 24		On pages 17 and 24 of the draft document, mention is made of the chemical bis(2-ethylhexyl)phthalate as a detected constituent in solid/sludge from CAS 03-20-08. Since this chemical is a common laboratory contaminant, please provide a detailed rationale as to why it should be included in the SVOC analysis. If none can be given, then change the lab analysis plan to exclude it.	There is no historical record of phthalate production or release at this site suggesting the reported bis(2-ethylhexyl)phthalate is a likely laboratory contaminant. Bis(2-ethylhexyl)phthalate will be removed as a targeted analyte, and will be excluded from contaminant nature and extent analysis unless additional evidence warrants its inclusion.	Yes					

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