Nevada
Environmental
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Project

DOE/NV--1389

National Nuclear Security Administration

Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 539: Areas 25 and 26 Railroad Tracks, Nevada Test Site, Nevada

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June 2010

Environmental Restoration
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U.S. Department of Energy
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STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 539: AREAS 25 AND 26 RAILROAD TRACKS, NEVADA TEST SITE, NEVADA

U.S. Department of Energy
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Las Vegas, Nevada

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Date: 05/25/2010

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STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 539: AREAS 25 AND 26 RAILROAD TRACKS, NEVADA TEST SITE, NEVADA

Approved by: /s/ Kevin J. Cabble Date: 05/25/2010

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Federal Project Director
Environmental Restoration Project

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List of Acronyms and Abbreviations

Ac	Actinium
Am	Americium
amsl	Above mean sea level
ASTM	American Society for Testing and Materials
bgs	Below ground surface
CAA	Corrective action alternative
CAI	Corrective action investigation
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure report
Cs	Cesium
CSM	Conceptual site model
D&D	Decontamination and decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
E-MAD	Engine Maintenance, Assembly, and Disassembly
ESTM	Engine Transport System Maintenance
EPA	U.S. Environmental Protection Agency
ETS-1	Engine Test Stand No. 1
Eu	Europium

List of Acronyms and Abbreviations *(Continued)*

FAL	Final action level
FFACO	*Federal Facility Agreement and Consent Order*
ft	Foot
gal	Gallon
GIS	Geographic Information Systems
IDW	Investigation-derived waste
in.	Inch
K	Potassium
LCS	Laboratory control sample
MDC	Minimum detectable concentration
mi	Mile
mrem/yr	Millirem per year
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	*Nevada Administrative Code*
NAD	North American Datum
Nb	Niobium
NCRP	National Council on Radiation Protection and Measurements
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NNES	Navarro Nevada Environmental Services, LLC
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NRDS	Nuclear Rocket Development Station
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
PAL	Preliminary action level

List of Acronyms and Abbreviations *(Continued)*

Pb	Lead
PPE	Personal protective equipment
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAPP	*Quality Assurance Project Plan*
QC	Quality Control
RadCon	Radiological Control
RBCA	Risk-based corrective action
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
RL	Reporting limit
R-MAD	Reactor Maintenance, Assembly, and Disassembly
RMSF	Radioactive Materials Storage Facility
RPD	Relative percent difference
SAFER	Streamlined Approach for Environmental Restoration
SAIC	Science Applications International Corporation
SL	Screening level
Sr	Strontium
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
SWL	Static water level
TBD	To be determined
TCA	Test Cell A
TCC	Test Cell C
TCLP	Toxicity characteristic leaching procedure
TED	Total effective dose
Th	Thorium

List of Acronyms and Abbreviations *(Continued)*

Tl	Thallium
TLD	Thermoluminescent dosimeter
TNT	Transient Nuclear Test
TPH	Total petroleum hydrocarbons
U	Uranium
UR	Use restriction
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
%R	Percent recovery
μm	Micrometer

Executive Summary

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions needed to achieve closure for Corrective Action Unit (CAU) 539, Areas 25 and 26 Railroad Tracks, as identified in the *Federal Facility Agreement and Consent Order* (FFACO). A modification to the FFACO was approved in May 2010 to transfer the two Railroad Tracks corrective action sites (CASs) from CAU 114 into CAU 539. The two CASs are located in Areas 25 and 26 of the Nevada Test Site:

- 25-99-21, Area 25 Railroad Tracks
- 26-99-05, Area 26 Railroad Tracks

This plan provides the methodology for field activities needed to gather the necessary information for closing the two CASs. There is sufficient information and process knowledge from historical documentation and investigations of similar sites regarding the expected nature and extent of potential contaminants to recommend closure of the CAU 539 Railroad Tracks CASs using the SAFER process. Additional information will be obtained by conducting a field investigation before selecting the appropriate corrective action for each CAS. The results of the field investigation should support a defensible recommendation that no further corrective action is necessary. If it is determined that complete clean closure cannot be accomplished during the SAFER, then a hold point will have been reached and the Nevada Division of Environmental Protection (NDEP) will be consulted to determine whether the remaining contamination will be closed under the alternative corrective action of closure in place with use restrictions. This will be presented in a closure report that will be prepared and submitted to the NDEP for review and approval.

The sites will be investigated based on the data quality objectives (DQOs) developed on December 14, 2009, by representatives of U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office; Navarro Nevada Environmental Services, LLC (NNES); and National Security Technologies, LLC. The DQO process has been used to identify and define the type, amount, and quality of data needed to determine and implement appropriate corrective actions for each Railroad Tracks CAS in CAU 539.

The following text summarizes the SAFER activities that will support the closure of CAU 539:

- Perform site preparation activities (e.g., utilities clearances, radiological surveys).
- Collect *in situ* dose measurements.
- Collect environmental samples from designated target populations (e.g., lead bricks) to confirm or disprove the presence of contaminants of concern (COCs) as necessary to supplement existing information.
- If no COCs are present at a CAS, establish no further action as the corrective action.
- If COCs exist, collect environmental samples from designated target populations (e.g., clean soil adjacent to contaminated soil) and submit for laboratory analyses to define the extent of COC contamination.

If a COC is present at a CAS, NNES will consult NDEP to determine the path forward, then either:

- Establish clean closure as the corrective action. The material to be remediated will be removed, disposed of as waste, and verification samples will be collected from remaining soil, or
- Establish closure in place as the corrective action and implement the appropriate use restrictions.

The CAU 539 SAFER Plan has been developed in accordance with the FFACO that was agreed to by the State of Nevada; DOE, Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. Under the FFACO, this SAFER Plan will be submitted to NDEP for approval. Fieldwork will be conducted following approval of the SAFER.

1.0 Introduction

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions necessary for the closure of Corrective Action Unit (CAU) 539: Areas 25 and 26 Railroad Tracks, Nevada Test Site (NTS), Nevada. It has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management (FFACO, 1996; as amended March 2010). A modification to the FFACO was approved in May 2010 to transfer the two Railroad Tracks corrective action sites (CASs) from CAU 114 into CAU 539.

A SAFER may be performed when the following criteria are met:

- Conceptual corrective actions are clearly identified (although some degree of investigation may be necessary to select a specific corrective action before completion of the corrective action investigation [CAI]).
- Uncertainty of the nature, extent, and corrective action must be limited to an acceptable level of risk.
- The SAFER Plan includes decision points and criteria for making data quality objective (DQO) decisions.

The purpose of the CAI will be to document and verify the adequacy of existing information; to affirm the decision for clean closure, closure in place, or no further action; and to provide sufficient data to implement the corrective action. The actual corrective action selected will be based on the results of characterization activities implemented under this SAFER Plan. This SAFER identifies decision points developed in cooperation with the Nevada Division of Environmental Protection (NDEP), where the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) will reach consensus with NDEP before beginning the next phase of work.

The Railroad Tracks CASs within CAU 539 are located in Areas 25 and 26 of the NTS. The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). The two CASs within CAU 539 are shown on Figure 1-2 and listed below:

- 25-99-21, Area 25 Railroad Tracks
- 26-99-05, Area 26 Railroad Tracks

There is sufficient information and process knowledge from historical documentation and investigations of similar sites (i.e., the expected nature and extent of contaminants of potential concern [COPCs]) to recommend closure of CAU 539 using the SAFER process (FFACO, 1996; as amended March 2010).

1.1 SAFER Process Description

Corrective action units that may be closed using the SAFER process have conceptual corrective actions that are clearly identified. Consequently, corrective action alternatives (CAAs) can be chosen before completing a CAI, given anticipated investigation results.

The SAFER process combines elements of the DQO process and the observational approach to plan and conduct closure activities. The DQOs are used to identify the problem and define the type and quality of data needed to complete closure of each CAS. The purpose of the CAI phase is to verify the adequacy of existing information used to determine the chosen corrective action and to confirm that closure objectives were met.

Use of the SAFER process allows for technical decisions to be made based on incomplete but sufficient information and the experience of the decision maker. Based on a detailed review of historical documentation there is sufficient process knowledge to close CAU 539 Railroad Tracks CASs using the SAFER process. Any uncertainties are addressed by documented assumptions that are verified by sampling and analysis, data evaluation, and onsite observations, as necessary. Closure activities may proceed simultaneously with site characterization as sufficient data are gathered to confirm or disprove the assumptions made during selection of the corrective action. If, at any time during the closure process, new information that indicates that closure activities should be revised is discovered, closure activities will be re-evaluated as appropriate.

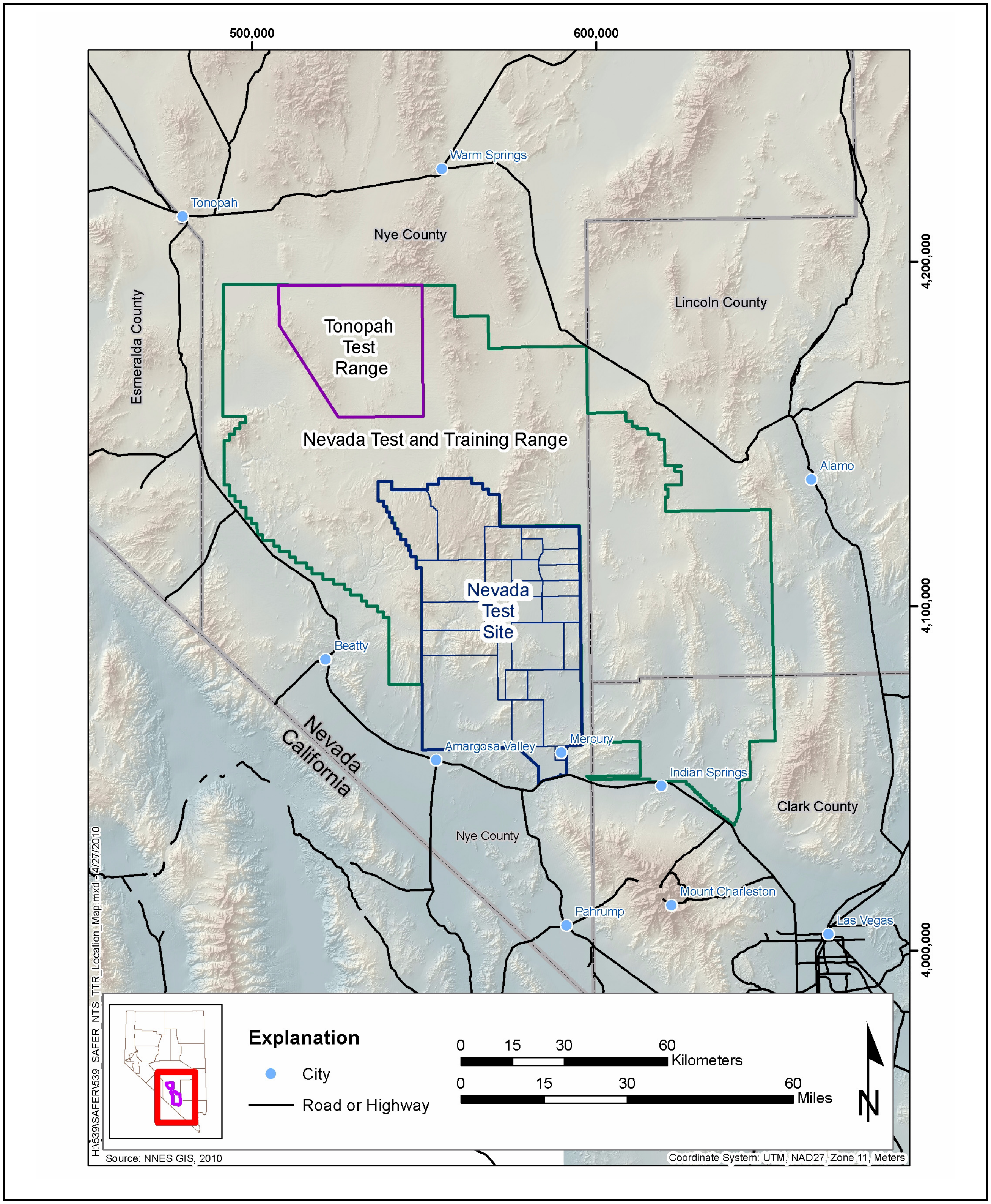

Figure 1-1
Nevada Test Site

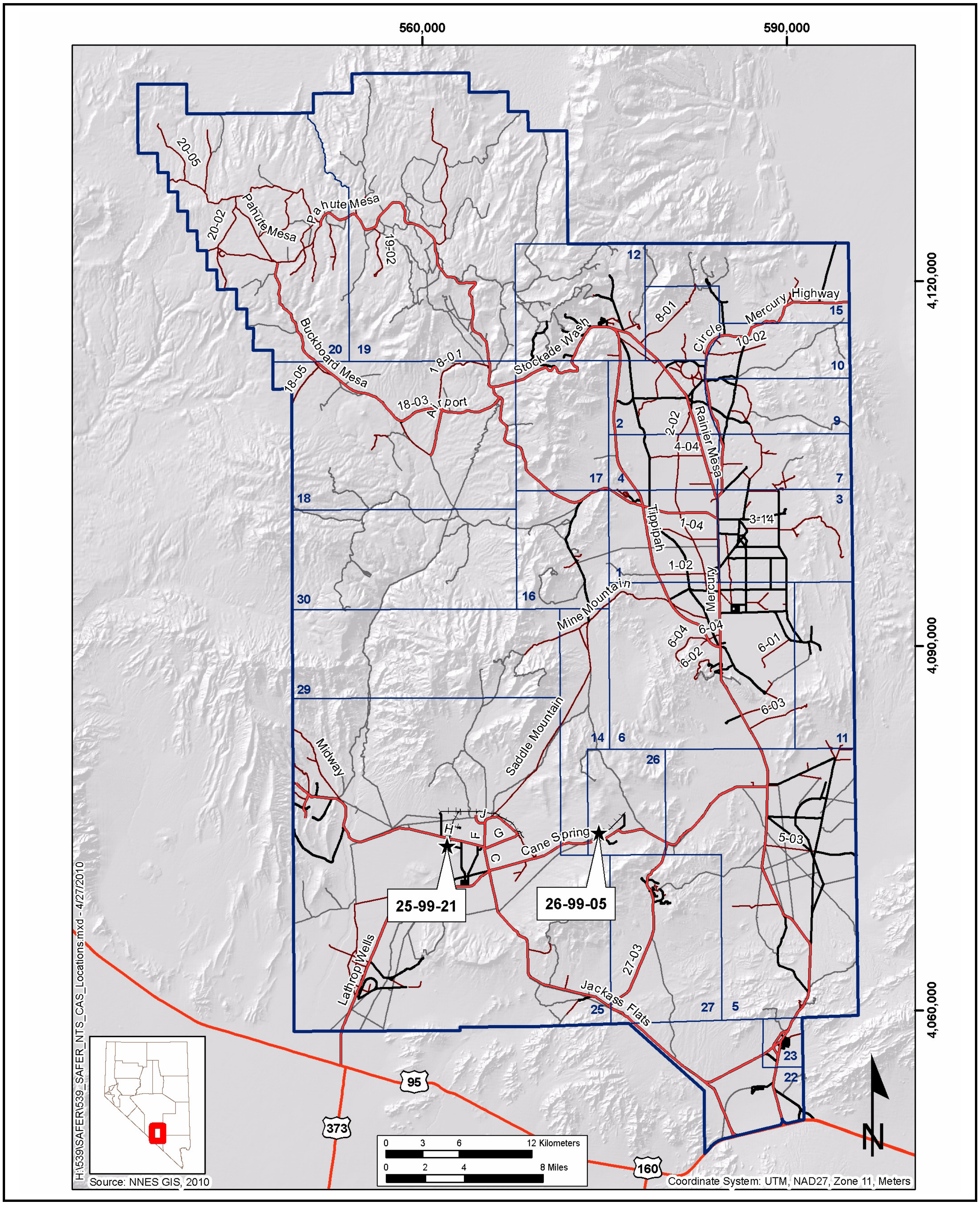

Figure 1-2
CAU 539, CAS Location Map

1.2 Summary of Corrective Actions and Closures

The decision process for closure of CAU 539, Areas 25 and 26 Railroad Tracks, is summarized in Figure 1-3. This process starts with the initial CAI in which the appropriate target population(s) within each CAS (defined in the DQO process, Appendix B) is sampled. If contaminants are detected at concentrations that are above the final action levels (FALs) and remediation can be accomplished during the SAFER, the nature and extent of contamination will be delineated by additional sampling. However, contingencies are built into the process in the event new information that indicates the selected closure option should be revised is identified. The process ends with closure of the site based on laboratory analytical results of the environmental samples and the preparation of a closure report (CR). Corrective action alternatives of closure in place and clean closure will be evaluated for each CAS with contaminants above FALs.

Decision points that require a consensus be reached between the NNSA/NSO and NDEP before continuing are indicated in Figure 1-3.

In addition to the previously discussed hold/decision points, work may be temporarily suspended until the issue can be satisfactorily resolved if any of the following unexpected conditions occur:

- Conditions outside the scope of work are encountered.
- Radiological screening yields results that require an upgrade in procedures to continue survey work in specific areas.
- Elevated levels of additional contaminants of concern (COCs) that were not originally identified as being present at the sites are found.
- Unexpected conditions, including unexpected waste and/or contamination, are encountered.
- Out-of-scope work activities are required due to the detection of other COCs that would require re-evaluating a disposal pathway, such as with hazardous or low-level waste.
- Unsafe conditions or work practices are identified.
- The conceptual site model (CSM) is shown to be incorrect.

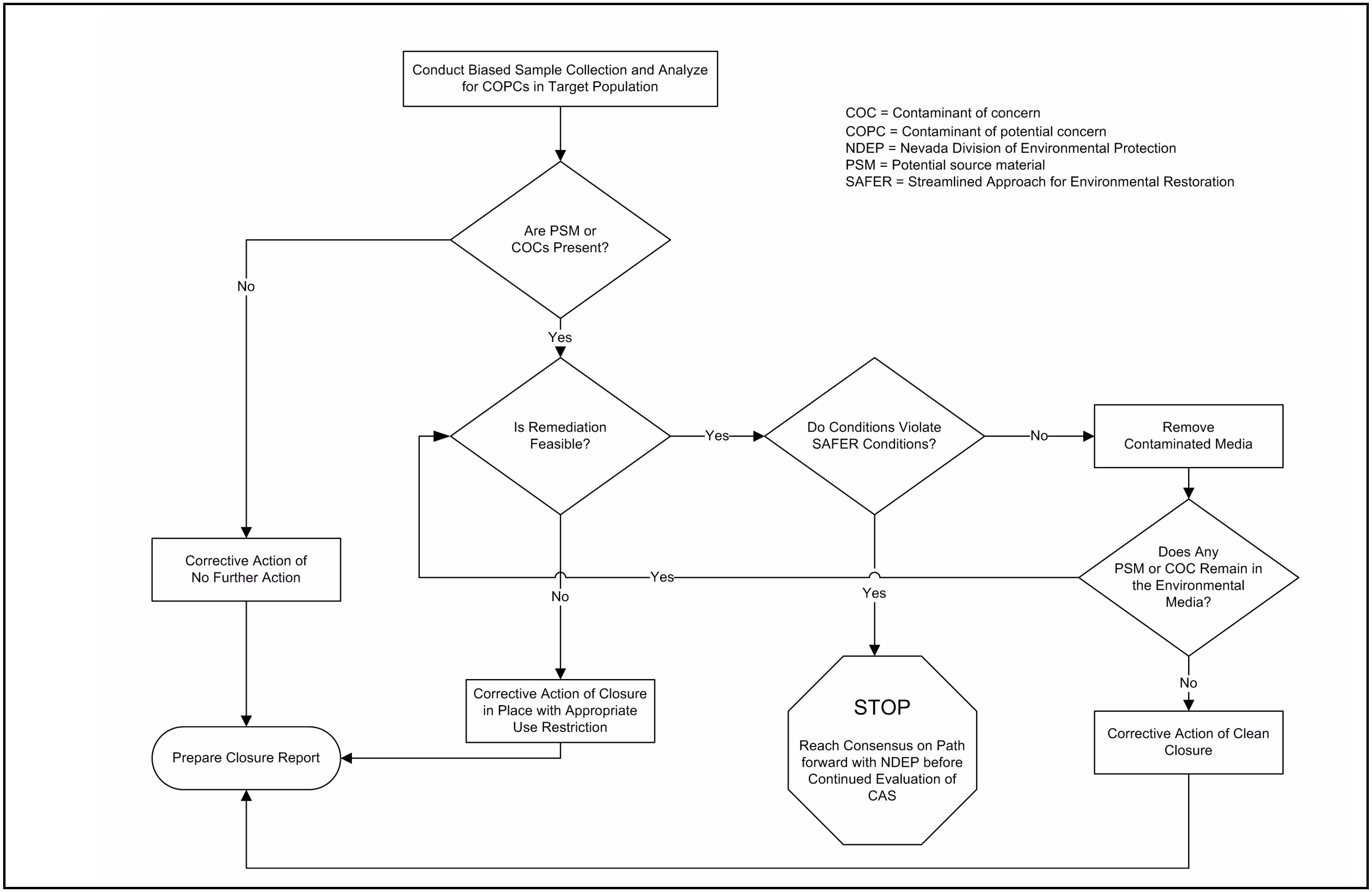

Figure 1-3
CAU 539 Closure Decision Process

2.0 Unit Description

The Railroad Tracks CASs within CAU 539 are located within Areas 25 and 26 of the NTS (Figure 1-2). The operational history, process knowledge, and existing information for each CAS is summarized in this section. This information has been obtained through historical document reviews, engineering drawing and map reviews, and interviews with past and present NTS employees. Because of the age of the activities, some uncertainty remains regarding general knowledge of past operations for these CASs. Site-specific historical documentation pertaining to each CAS is also limited. Based on the process knowledge and information about the CASs, assumptions were made to formulate a CSM that describes the most probable scenario for the current conditions at each CAS. Section 3.2.5 provides additional information on the CSM developed for the Railroad Tracks CASs in CAU 539.

2.1 CAS 25-99-21, Area 25 Railroad Tracks

Corrective Action Site 25-99-21 consists of suspected releases of radioactive material from nuclear rocket machinery transported on railroad cars to the soil/ballast surrounding the railroad tracks. Any other releases identified during the corrective action investigation will also be included in this CAS (e.g., several known locations adjacent to the railroad tracks where lead bricks were identified).

2.1.1 History and Process Knowledge

In the early 1960s, a program area known as the Nuclear Rocket Development Station (NRDS) was established in Area 25 of the NTS. The program, known as Project Rover, conducted full-scale testing of reactors, engines, and rocket stages to evaluate the feasibility of developing nuclear reactors for the United States space program. Several major facilities were built in Area 25 to support NRDS activities. Collectively, these facilities cover approximately 8,000 acres and include the Engine Maintenance, Assembly, and Disassembly (E-MAD) Facility; Reactor Maintenance, Assembly, and Disassembly (R-MAD) Facility; Test Cell A (TCA) Facility; Test Cell C (TCC) Facility; and Engine Test Stand No. 1 (ETS-1). In addition to the primary facilities, supporting facilities were present along the tracks (e.g., decontamination stations, Radioactive Materials Storage Facility [RMSF]) (NNES, 2009a).

The facilities were all interconnected via a railroad line used to transport the reactors, equipment, and various other items used in the testing activities. The vibrations and shaking of the railcar carrying reactors, equipment, and various items related to testing activities as it traveled over the railroad tracks may have resulted in the release of radioactive materials, including fuel flecks, to the surrounding soil. When Project Rover ended in 1973, NRDS activities were concluded, and use of the railroad was discontinued (NNES, 2009a).

The Area 25 Railroad Tracks location is approximately 9.6 mi long and has been inactive since 1973. It is, therefore, in a variety of conditions: in some areas, the railroad tracks are undisturbed, while other portions have been partially disturbed (e.g., spikes pulled out but ties and rail remain, rail gone but ties remain); some sections are covered by native material, while other sections are covered with concrete. Portions of the railroad tracks have been elevated over washes, pass through roads, or in some instances, have been sheared off at newer road intersections or crossings. Regardless of track conditions, the potential releases will be investigated along the entire length of the railroad. Where the railroad extends into a facility (e.g., the E-MAD Facility), the tracks are considered as part of this investigation until they enter a building in the facility at which point they are not within the scope of the CAS. A facility is defined as the Real Estate/Operations Permit boundary.

Figures 2-1 through 2-5 show the sections of tracks in Area 25 along with associated facilities (e.g., E-MAD, ETS-1, TCA, TCC, and R-MAD) and other track features (e.g., crossings, switches).

2.1.2 Available Characterization Information

There are 21 CASs in 14 CAUs that are associated with, located near, or within Area 25 Railroad Tracks CAS. Figure 2-6 shows the 21 Area 25 CASs, which include the decontamination and decommissioning (D&D) activities associated with TCA, TCC, E-MAD, and R-MAD. Work is ongoing at TCC, and the railroad tracks may be included in the final use restriction (UR); Navarro Nevada Environmental Services, LLC (NNES), will coordinate with the management and operating contractor during investigation of the railroad tracks at the TCC, or at other facilities where work is being conducted.

Only seven of the 21 CAS investigations specifically addressed releases related to the railroad operations and/or provide analytical data and radiological walkover survey data that support the

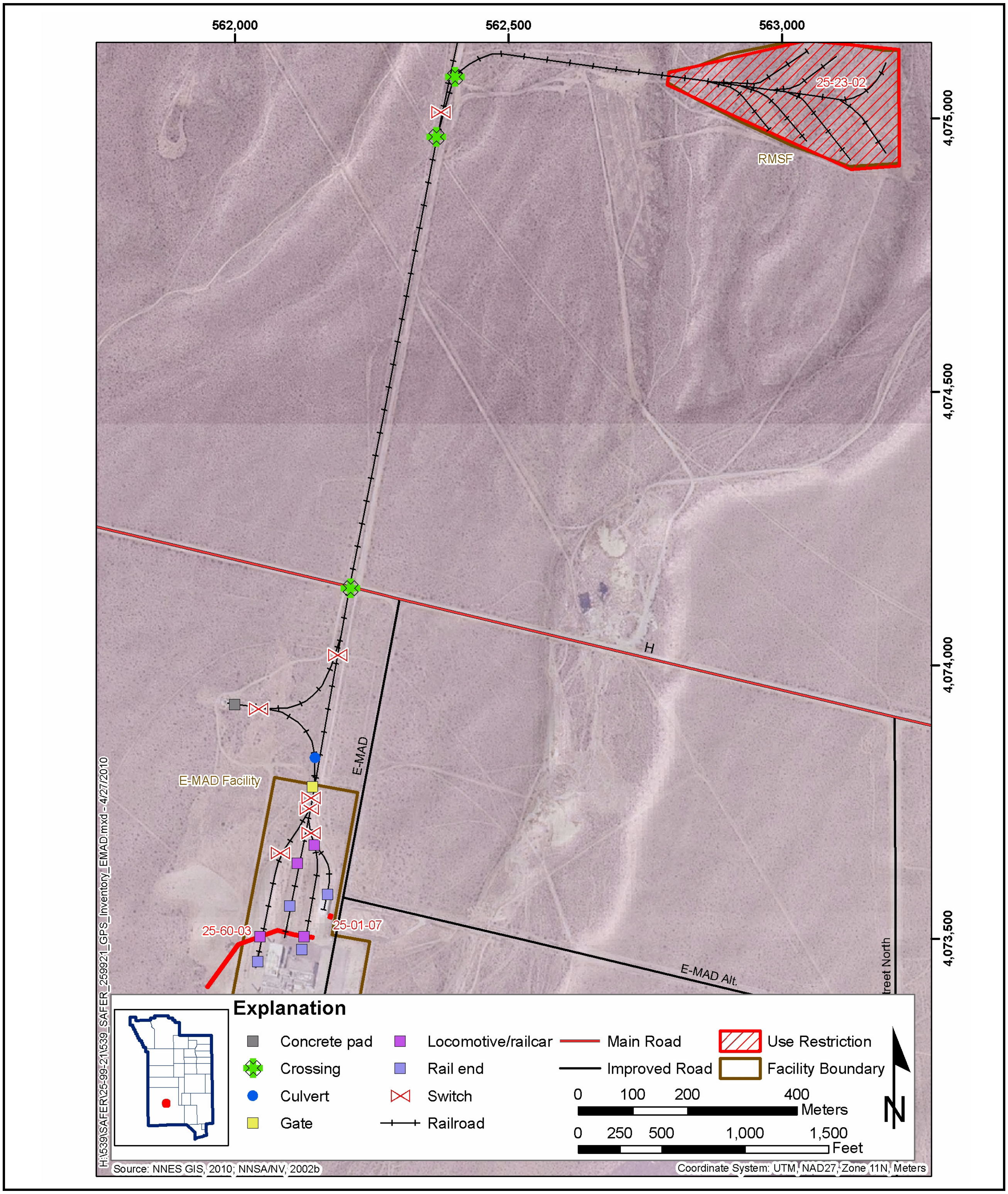

Figure 2-1
CAS 25-99-21, Area 25 Railroad Tracks, Railroad and E-MAD Facility

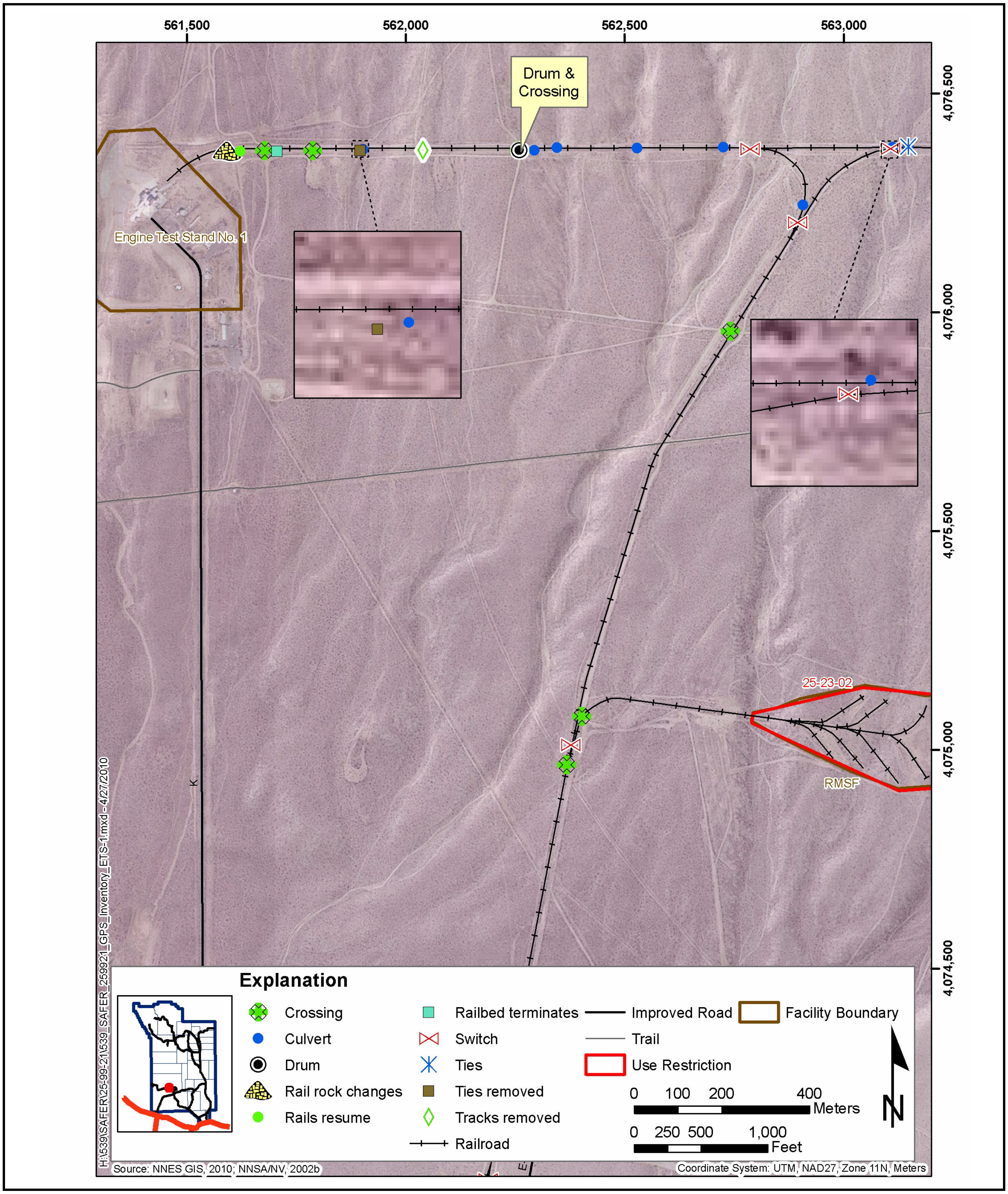

Figure 2-2
CAS 25-99-21, Area 25 Railroad Tracks, Railroad and ETS-1

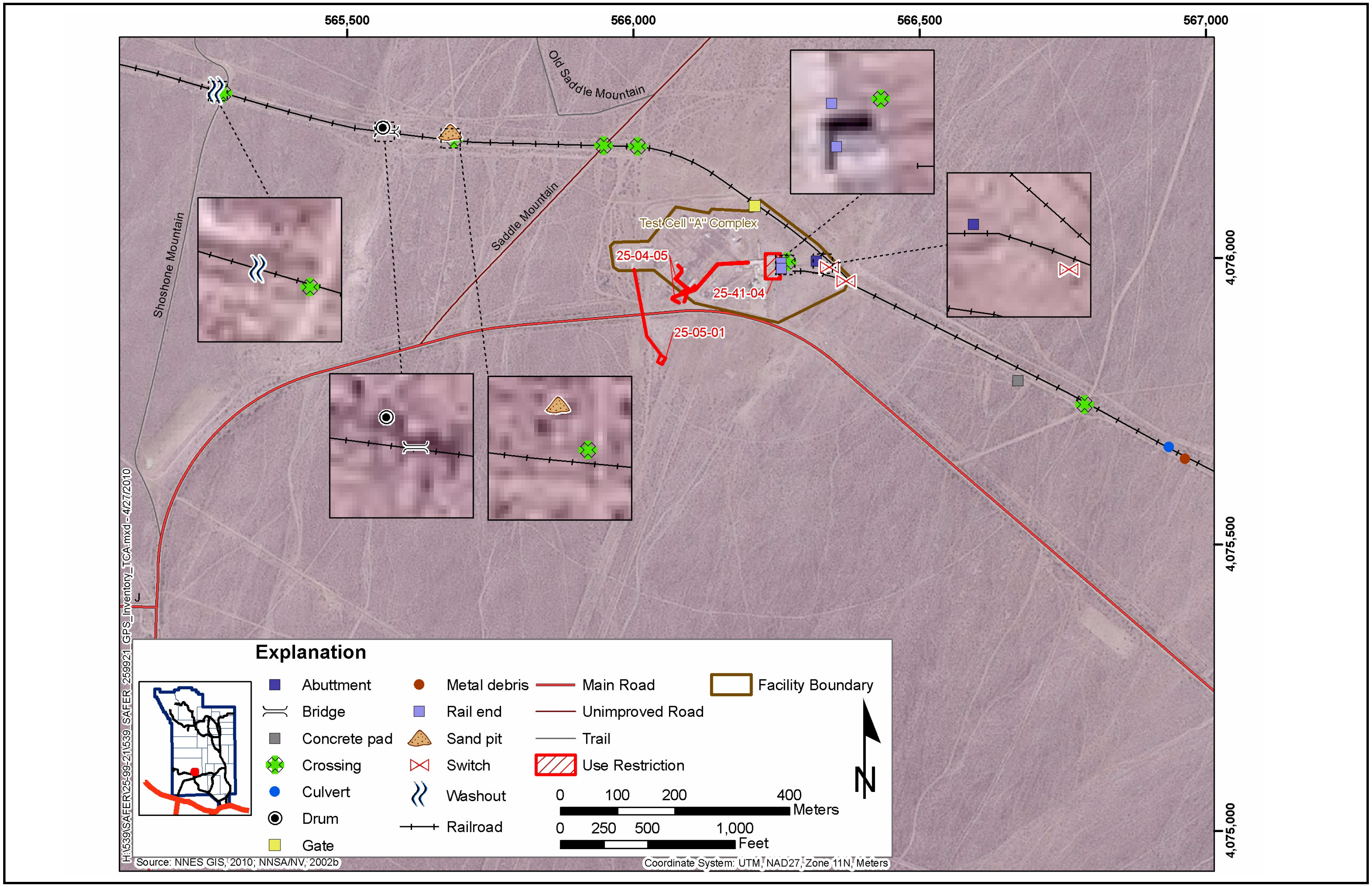

Figure 2-3
CAS 25-99-21, Area 25 Railroad Tracks, Railroad and TCA

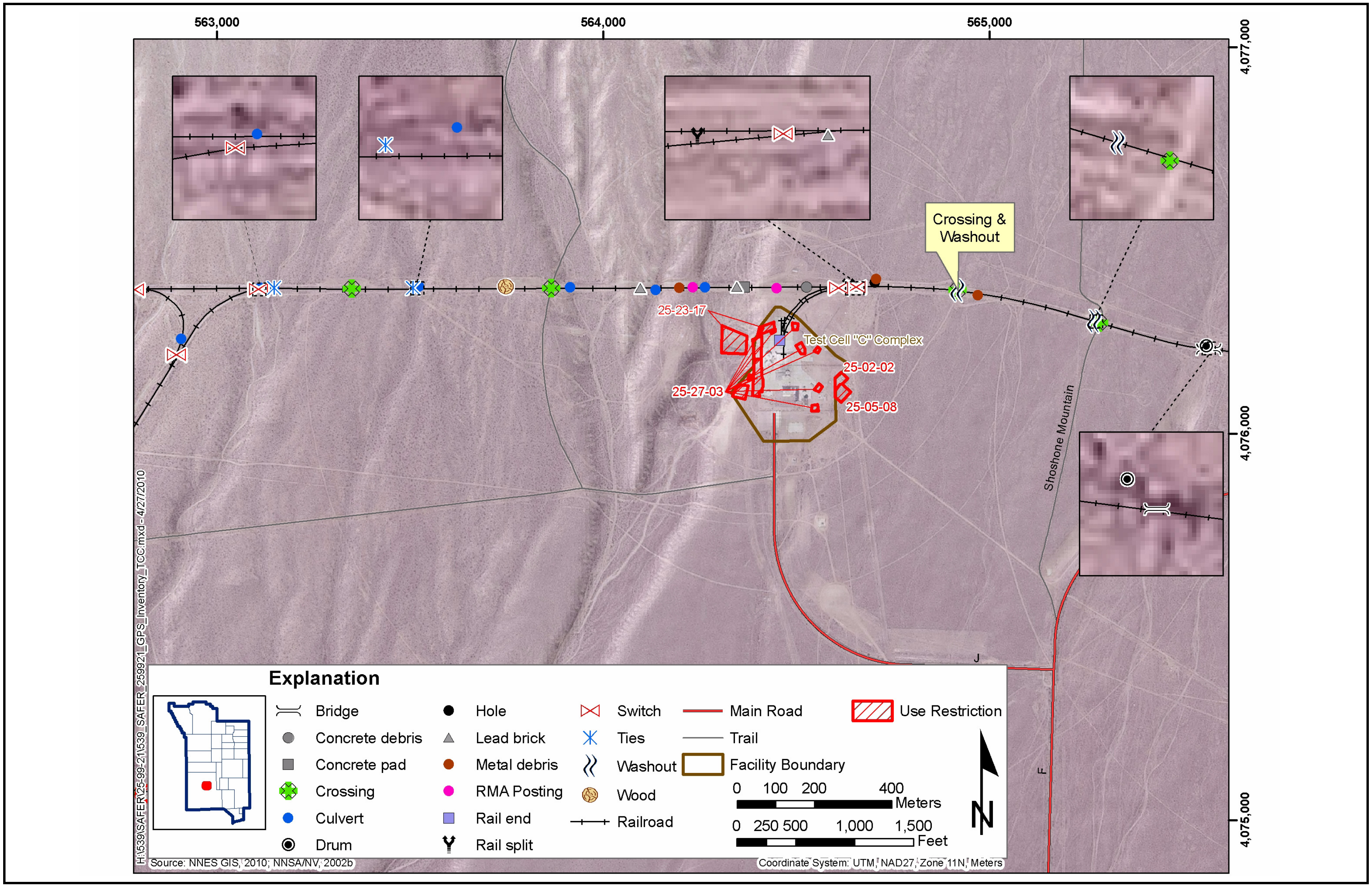

Figure 2-4
CAS 25-99-21, Area 25 Railroad Tracks, Railroad and TCC

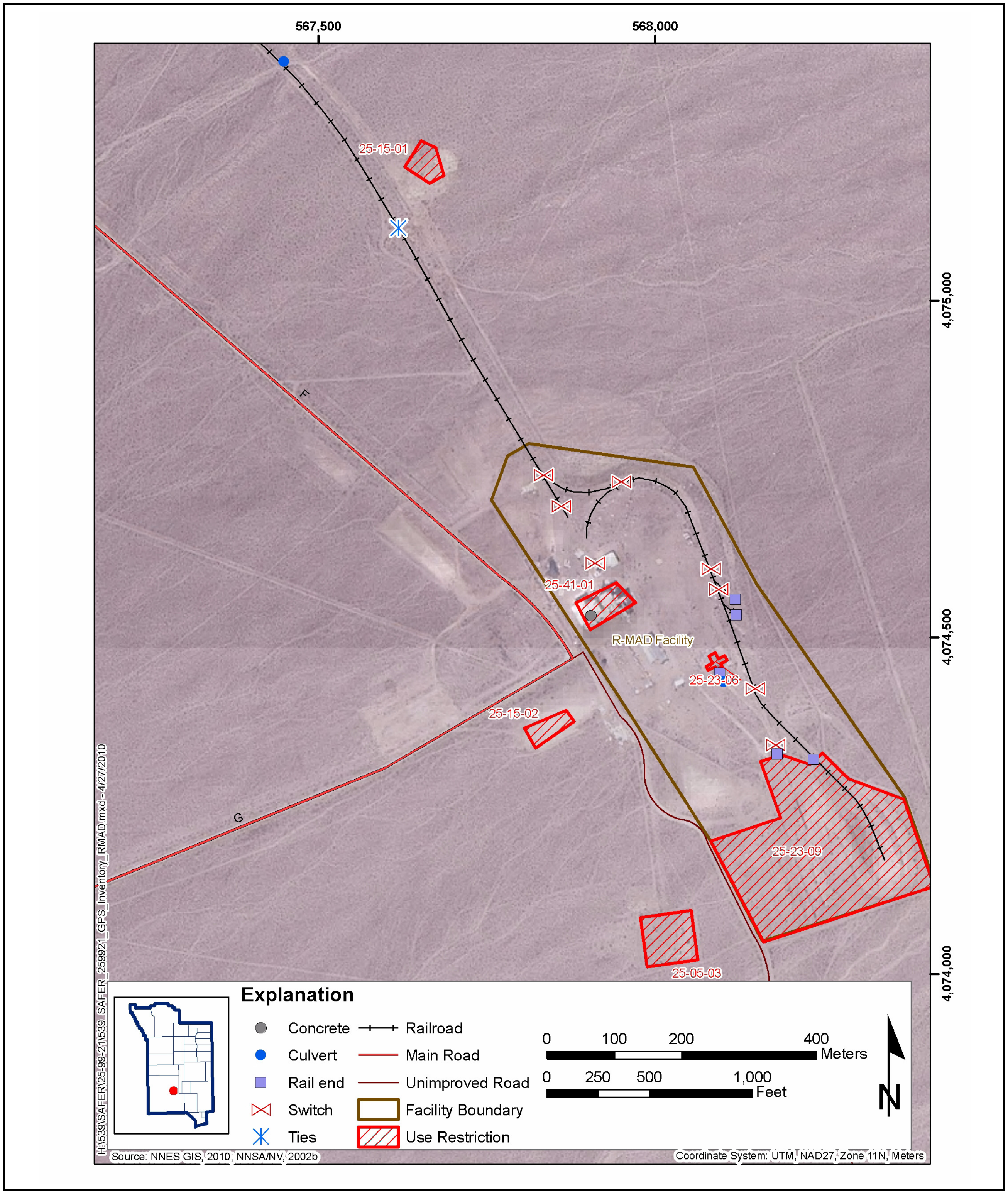

Figure 2-5
CAS 25-99-21, Area 25 Railroad Tracks, Railroad and R-MAD Facility

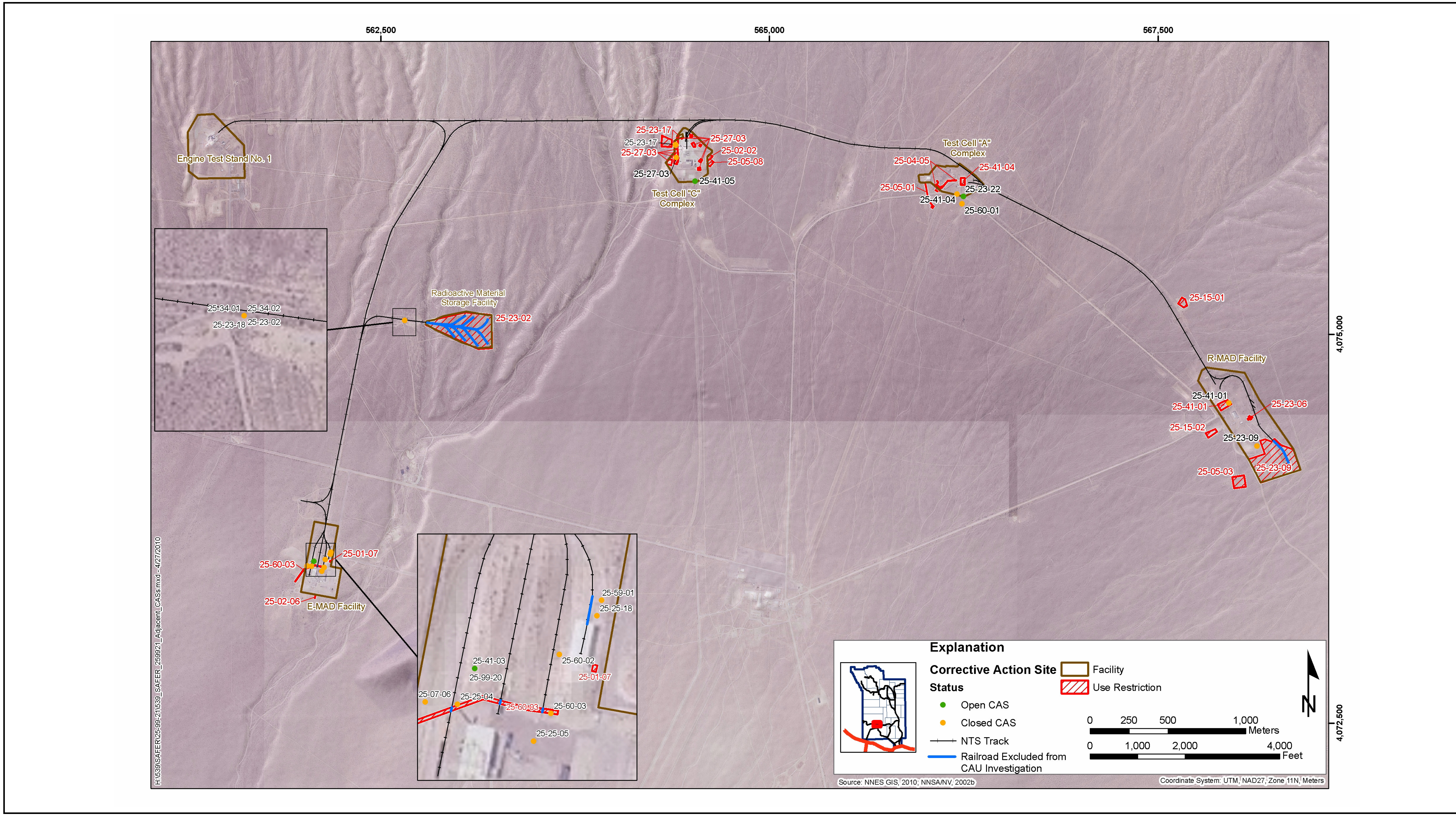

Figure 2-6
Associated Area 25 CAS Locations

decision to exclude those sections of railroad tracks from this investigation. Summaries of closure alternatives based on radiological contamination for the seven CASs are provided below to support the decision to exclude those portions of the railroad previously investigated and closed from further investigation. Closure activities varied between no further action, clean closure, and close in place with URs.

- CAU 143, CAS 25-23-09: The investigation of the R-MAD waste dump included portions of the East Track and the railroad spur leading to the East Trestle. Radiological COCs were identified in the vicinity of both railroad spurs in addition to other CAS components. The closure alternative implemented consisted of close in place with UR. The portions of the East Trestle spur and the East Track located within the currently fenced UR area will be excluded from further investigation.

- CAU 168, CASs 25-34-01, 25-34-02, 25-23-18, and 25-23-02: All four CASs are located within the RMSF. Radiological COCs were identified in association with the railroad tracks and railroad cars located within the "inner" perimeter fence. However, portions of the tracks between the outer perimeter fence and inner perimeter fence were not specifically addressed. Different closure alternatives were implemented at the four CASs located within the RMSF perimeter fence line. The closure alternative implemented at CASs 25-34-01 and 25-34-02 consisted of no further action. Corrective Action Site 25-23-18 implemented the clean close alternative. The closure alternative implemented at CAS 25-23-02 consisted of close in place with UR. The portions of the railroad tracks within the inner perimeter fence line will be excluded from further investigation.

- CAU 557, CAS 25-25-18: Two areas of soil staining from an oil discharge related to railroad operations were investigated on the railroad tracks located directly north of Building 3901. Analtyical data and walkover surveys confirmed there were no COCs above action levels, which led to a no-further-action closure alternative. Approximately 90 feet (ft) of railroad tracks north of Building 3901 included in this CAS was investigated; therefore, this portion of the tracks will be excluded from further investigation.

- CAU 165, CAS 25-07-06: The investigation of the decontamination pad located on the railroad spur leading into the E-MAD hot bay included a specific portion of the railroad. Radiological contamination above action levels was identified on the concrete pad, railroad tracks, and surrounding soils related to decontamination activities. The closure alternative implemented was clean closure, which included the removal of the decontamination pad and associated portions of the railroad tracks. The area where the tracks were removed during clean closure will be excluded from further investigation.

Other CAS investigations in Area 25 addressed potential contamination on or near the railroad; however, these CASs are retained for further investigation because either the analytical data were lacking or the section of the railroad was not adequately characterized in the CRs. Summaries of selected investigations at other CASs are provided below.

- CAU 254, CAS 25-23-06 (R-MAD): This investigation characterized the Decontamination Facility (Building 3126) in which a railroad spur carried railcars to the facility for decontamination. The investigation characterized the building structure, the concrete decontamination pads outside of the building, and surrounding soils. The railroad tracks were not investigated outside the building exterior. Building 3126 and the railroad tracks inside the building have since been removed; however, a UR still exists for access into and under the concrete foundation and surrounding soils; access and use of the ground surface is unrestricted. Based on the closure activities and UR, CAU 539 will need to include the railroad tracks spur up to the remaining Building 3126 foundation. The UR boundary is not expected to pose a conflict for CAU 539 intrusive activities.

- CAU 116, CASs 25-41-05 and 25-23-20 (TCC): The investigation consists only of Building 3210 and the attached concrete shield wall, and the Nuclear Furnace Piping. Demolition of Building 3210 and the nuclear furnace piping was conducted from June 11 to September 29, 2009. The railroad tracks were not included in this CAU, and therefore will be investigated during the CAU 539 Railroad field activities.

- CAU 529, CAS 25-23-17 (TCC): Topopah Wash (Parcel C) was investigated for the Kiwi Transient Nuclear Test (TNT) excursion in which ground zero is located on the railroad tracks (concrete pad). A land area walkover survey was conducted north and south of the railroad and showed elevated radiological results near the railroad tracks. However, sampling and further characterization did not include the railroad tracks and/or railroad grade itself and focused on the wash itself. Therefore, CAU 539 will include all portions of the railroad tracks through Parcel C. No UR exists in this area; however, the area is posted as a radioactive material area (RMA).

- CAU 566, CAS 25-99-20 (E-MAD): This CAS is being investigated at the E-MAD Facility where the exterior releases related to E-MAD operations will be investigated. Part of those investigations include the visible spills and releases from various railroad cars/locomotives/engines still parked on the railroad tracks adjacent to the E-MAD Facility. Corrective Action Unit 539 will not address those releases to be covered under CAS 25-99-20. Although the releases are mostly hydrocarbon/oil related, radiological COPCs will be addressed. Therefore, the Area 25 Railroad Tracks CAS will characterize the railroad tracks only up to the location of railroad cars on each spur. If no railroad car exists on a spur, then the tracks will be characterized up to where the tracks enter an existing building or structure.

- CAU 115, CAS 25-41-04 (TCA Facility): The D&D activities at TCA did not include specific railroad releases. However, D&D activities have previously dismantled the TCA buildings in which the tracks entered and a recent closure activity included placing new cement over the existing TCA foundation where the railroad tracks once entered. Based on the scope of CAU 375, the CAU 539 investigation will not include the railroad tracks inside the fence line.

- CAU 375, CAS 25-23-22 (TCA): This CAS investigation will address the contaminated soils site near TCA associated with the testing of nuclear rocket motor development. The railroad tracks inside the TCA fence line are included in CAU 375 investigation and therefore will not be addressed by the CAU 539 Railroad CAI. However, the railroad tracks outside the fence line will be included in the CAU 539 Railroad CAI.

2.2 CAS 26-99-05, Area 26 Railroad Tracks

Corrective Action Site 26-99-05 consists of suspected releases of radioactive material from nuclear-powered machinery transported on railroad cars to the soil/ballast surrounding the railroad tracks. Any other releases identified during the corrective action investigation will also be included in this CAS (e.g., several known locations adjacent to the railroad tracks where lead bricks were identified).

2.2.1 History and Process Knowledge

In 1958, Project Pluto was initiated to demonstrate the feasibility of using a nuclear-powered ramjet engine to propel a supersonic low-altitude missile. Between 1961 and 1964, six experimental tests were conducted in Area 26 to develop the nuclear reactor for the ramjet. The facilities built to support Project Pluto were Building 2201 (Maintenance, Assembly, and Disassembly Building), also known as the Pluto Facility, and the testing area that included Building 2203 (Test Bunker) and two other buildings. The reactors were tested on a pad on the north side of the Test Bunker. A remote-controlled railroad system was used to transport the reactors from the Pluto Facility to the Test Bunker for testing (NNES, 2009a).

The Pluto Facility and Test Bunker were interconnected via a railroad line used to transport the reactors, equipment, and various other items used in the testing activities. During transport of the testing equipment, the vibrations and shaking of the railcar carrying reactors, equipment, and various items related to testing activities may have resulted in the release of radioactive materials, including fuel flecks, to the surrounding soil. A vehicle washdown station is located on the railroad approximately 150 ft east of the Pluto Facility. The initial decontamination of the reactors occurred on the railroad test cars at the washdown station and then again at Building 2201 (NNES, 2009a).

The railroad tracks extend approximately 2 mi between the Pluto Facility and the Test Bunker in Area 26. The tracks are in various states of disrepair. In some areas, the railroad tracks are undisturbed, while other sections have been disturbed (e.g., spikes pulled out but ties and rail remain, entire track removed). Portions of the railroad tracks travel over small washes. Regardless of track conditions, the entire length of the tracks will be investigated. Where the railroad extends into a facility or structure, the tracks are considered as part of the facility and not within the scope of the Railroad Tracks CAS.

Figures 2-7 and 2-8 provide information regarding the conditions and locations of associated facilities of the Area 26 Railroad Tracks.

2.2.2 Available Characterization Information

There are three CASs within three CAUs that are associated with, located near, or encompass the Area 26 Railroad Tracks. Two of the CAS investigations addressed potential contamination on or near the railroad; however, either specific analytical data were lacking or the portion of the railroad investigated was not characterized fully to exclude those portions from further investigation. Figure 2-9 shows the associated Area 26 CASs.

- CAU 165, 26-07-01: The vehicle washdown station that sits atop the railroad tracks east of the Pluto Facility was investigated during CAU 165 activities. A radiological walkover survey was performed. Areas of elevated radioactivity were identified in soils adjacent to the railroad tracks but were directly attributed to carbonized fuel flecks. The fuel flecks were removed, and the areas were resurveyed. The results of the resurveyed areas show no remaining elevated radioactivity in the areas. The railroad tracks were included in the initial investigation. However, because this represents only a very small area, the railroad tracks will also be included in the CAU 539 investigation.

There are a few CASs in Area 26 where field investigations have occurred or are presently being conducted. The railroad tracks have not been included in these investigations; therefore, the tracks will be included in the CAU 539 Railroad investigation. Summaries of these investigations at other CASs are provided below.

- CAU 168, CAS 26-19-02: The investigation at this CAS characterized the Contaminated Waste Dump #2 adjacent to the railroad but did not investigate the tracks or railroad grade. Therefore, the railroad tracks will be investigated during the CAU 539 Railroad CAI.

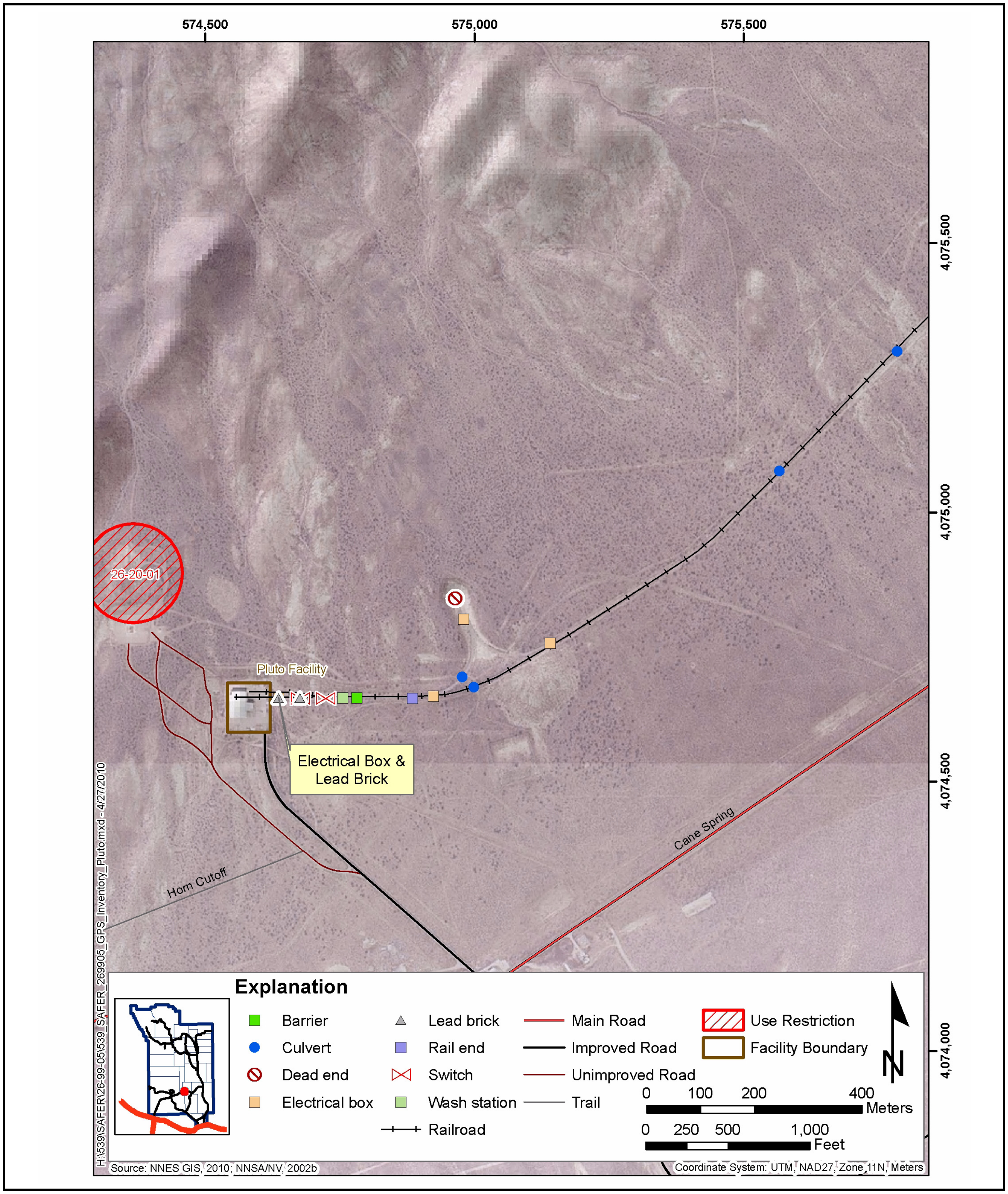

Figure 2-7
CAS 26-99-05, Area 26 Railroad Tracks, Railroad and Pluto Facility

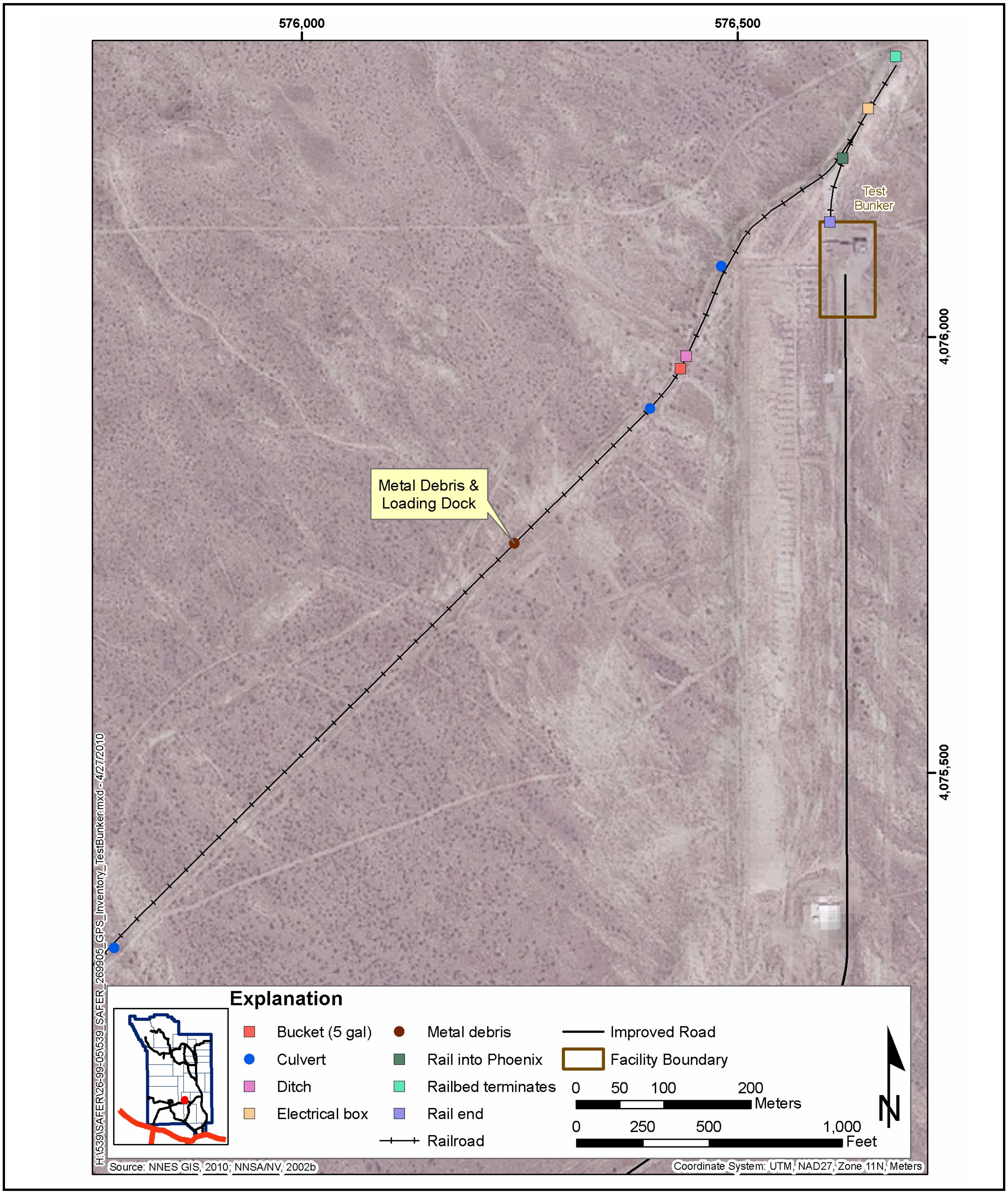

Figure 2-8
CAS 26-99-05, Area 26 Railroad Tracks, Railroad and Test Bunker

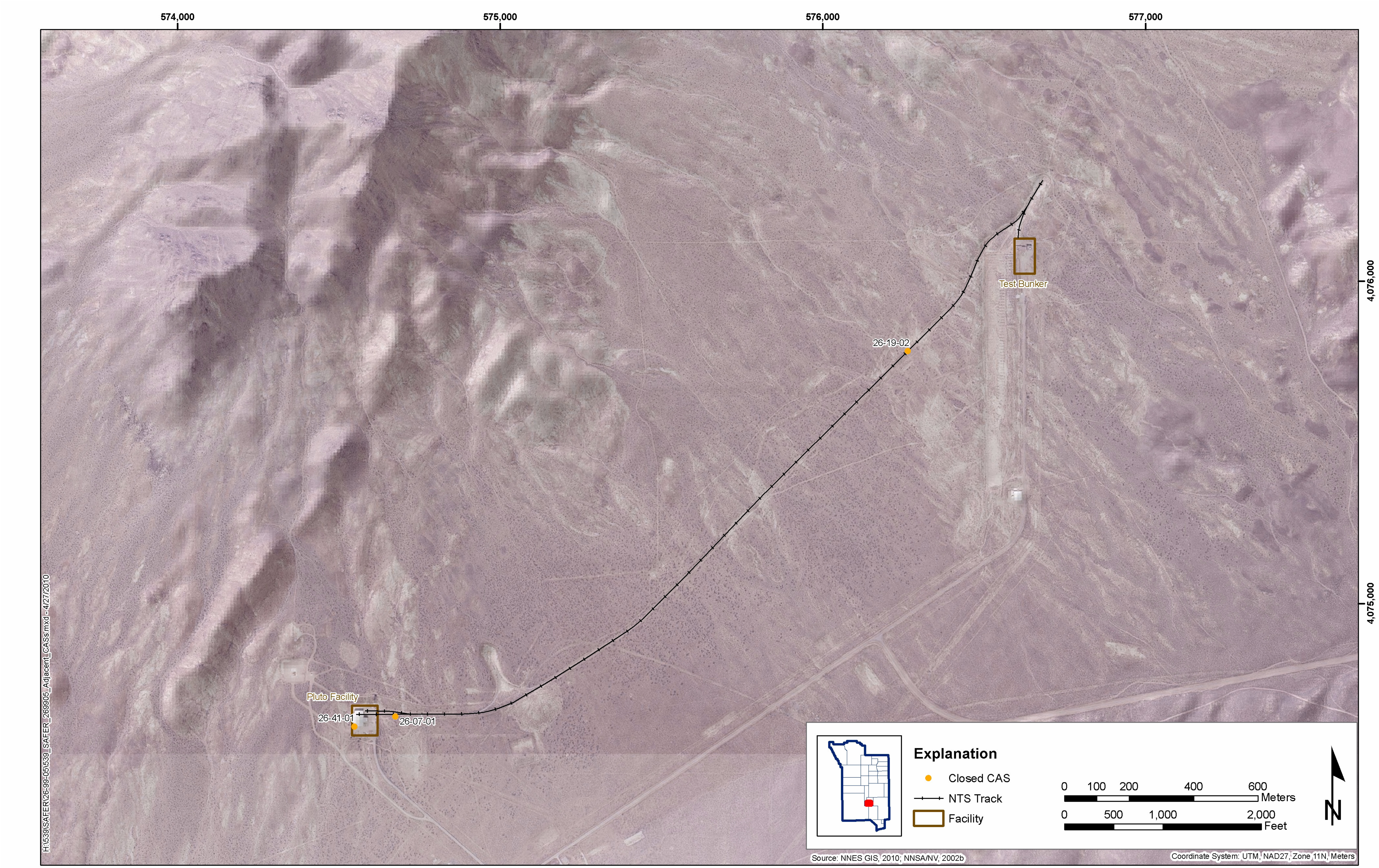

Figure 2-9
Associated Area 26 CAS Locations

- CAU 117, CAS 26-41-01 (Pluto Facility): The Pluto investigation addressed only the releases at Building 2201, the water tower, and the wood shed. The investigation also focused on the facility boundary. The railroad tracks and grade were not investigated during this CAU investigation. Therefore, the railroad tracks will be included in the CAU 539 Railroad field investigation.

2.3 Summary of Investigation

Table 2-1 is a summary of the railroad tracks investigation approach. Portions of the tracks in Areas 25 and 26 that have been investigated and closed during previous CAU investigations will be excluded from CAU 539.

Table 2-1
Railroad Tracks Investigation Approach

Facility	Investigation Approach
E-MAD	Railroad tracks will be investigated up to the location of the railroad cars on each spur. The potential releases under the railroad cars will be addressed during the CAU 566 CAS 25-99-20 investigation. If railroad cars are not present, the CAU 539 Railroad investigation will characterize the tracks up to where they enter the existing building. At the Engine Transport System Maintenance (ETSM) building, the tracks will be investigated up to the northern edge of the CAU 557 CAS 25-25-18 boundary. This CAS has been investigated and closed. The former decontamination pad and area where the railroad tracks were removed during the CAU 165 investigation will not be included in the CAU 539 Railroad CAI.
R-MAD	Tracks will be investigated up to the portions of the East Trestle spur and East Track located within the fenced UR. The railroad spur up to the remaining Building 3126 foundation will also be investigated. Any other tracks in the R-MAD Facility will be investigated up to the existing buildings.
Test Cell A	CAU 539 will investigate the railroad tracks up to the fence line. The tracks within the facility are included in the scope of CAU 375.
Test Cell C	Railroad tracks will be investigated up to the existing buildings.
RMSF	Railroad tracks will be investigated up to the UR boundary at the inner perimeter fence line.
ETS-1	The CAU 539 investigation will include the tracks within the fence line up to the existing structures/buildings.
Pluto	Railroad tracks leading up to the Pluto Facility, including the small portion of tracks where the vehicle washdown station is situated and the portion of the railroad tracks extending from the gate to the building, will be included in this investigation.
Test Bunker	The CAU 539 investigation will include the railroad tracks and the gravel road bed extending up to the underground RMA posted area on the north side of the Test Bunker.

3.0 Data Quality Objectives

3.1 Summary of DQO Analysis

This section contains a summary of the DQO process that is presented in Appendix B. The DQO process is a strategic planning approach based on the scientific method that is 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.

The DQO strategy for CAU 539, Areas 25 and 26 Railroad Tracks, was developed at a meeting with decision makers on December 14, 2009. 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 identified and documented.

The problem statement for CAU 539 is: "Existing information on the nature and extent of potential contamination is insufficient to evaluate CAAs and confirm closure of the two Railroad Tracks CASs in CAU 539." To address this question, the resolution of two decisions statements is required:

- Decision I: "Is any COC present in environmental media within the CAS at a concentration exceeding its corresponding FAL?" For the judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC.

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

  - Identifying the volume of media containing any COC bounded by analytical sample results in lateral and vertical directions.

  - The information needed to characterize investigation-derived waste (IDW) for disposal.

  - The information needed to determine potential remediation waste types.

The presence of a COC would require a corrective action. A corrective action may also be necessary if there is a potential for wastes that are present at a site to be released to the environment and impose COCs into site environmental media. To evaluate the potential for site wastes to result in the introduction of a COC to the surrounding environmental media, the following conservative assumption was made:

- For nonliquid wastes, the concentration of any chemical contaminant in soil (following degradation of the waste and release of contaminants into soil) would be equal to the mass of the contaminant in the waste divided by the mass of the waste.

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

Samples related to releases associated with the nuclear rockets will be submitted to analytical laboratories for the analyses listed in Table 3-1. Samples related to other releases (e.g., spills, lead bricks) will be submitted for analyses specific to the type of release (Table 3-1). The COPCs reported for each analysis are listed in Table 3-2.

Table 3-1
Analytical Program[a]

Analyses	CAS 25-99-21	CAS 26-99-05
Organic COPCs		
SVOCs	X[b]	X[b]
VOCs	X[b]	X[b]
Inorganic COPCs		
RCRA Metals	X[b]	X[b]
Beryllium	X	X
Radionuclide COPCs		
Gamma Spectroscopy	X	X
Isotopic U	X	X
Sr-90	X	X

[a]The COPCs are the constituents reported from the analytical methods listed.
[b]Analytical method may be included dependent upon type of release investigated.

RCRA = *Resource Conservation and Recovery Act*
Sr = Strontium
SVOC = Semivolatile organic compound
U = Uranium
VOC = Volatile organic compound

X = Required analytical method for all samples submitted

Table 3-2
Constituents Reported by Analyses

VOCs		SVOCs		Metals	Radionuclides
1,1,1,2-Tetrachloroethane	Carbon tetrachloride	2,3,4,6-Tetrachlorophenol	Di-n-octyl phthalate	Arsenic	**Gross Alpha/Beta**
1,1,1-Trichloroethane	Chlorobenzene	2,4,5-Trichlorophenol	Dibenzo(a,h)anthracene	Barium	
1,1,2,2-Tetrachloroethane	Chloroethane	2,4,6-Trichlorophenol	Dibenzofuran	Beryllium	**Alpha-Emitting**
1,1,2-Trichloroethane	Chloroform	2,4-Dimethylphenol	Diethyl phthalate	Cadmium	Pu-238
1,1-Dichloroethane	Chloromethane	2,4-Dinitrotoluene	Dimethyl phthalate	Chromium	Pu-239/240
1,1-Dichloroethene	Chloroprene	2-Chlorophenol	Fluoranthene	Lead	U-234
1,2,4-Trichlorobenzene	cis-1,2-Dichloroethene	2-Methylnaphthalene	Fluorene	Mercury	U-235
1,2,4-Trimethylbenzene	Dibromochloromethane	2-Methylphenol	Hexachlorobenzene	Selenium	U-238
1,2-Dibromo-3-chloropropane	Dichlorodifluoromethane	2-Nitrophenol	Hexachlorobutadiene	Silver	
1,2-Dichlorobenzene	Ethyl methacrylate	3-Methylphenol[a] (m-cresol)	Hexachloroethane		**Beta-Emitting**
1,2-Dichloroethane	Ethylbenzene	4-Methylphenol[a] (p-cresol)	Indeno(1,2,3-cd)pyrene		Sr-90
1,2-Dichloropropane	Isobutyl alcohol	4-Chloroaniline	n-Nitroso-di-n-propylamine		
1,3,5-Trimethylbenzene	Isopropylbenzene	4-Nitrophenol	Naphthalene		**Gamma-Emitting**
1,3-Dichlorobenzene	Methacrylonitrile	Acenaphthene	Nitrobenzene		Ac-228
1,4-Dichlorobenzene	Methyl methacrylate	Acenaphthylene	Pentachlorophenol		Am-241
1,4-Dioxane	Methylene chloride	Aniline	Phenanthrene		Co-60
2-Butanone	n-Butylbenzene	Anthracene	Phenol		Cs-137
2-Chlorotoluene	n-Propylbenzene	Benzo(a)anthracene	Pyrene		Eu-152
2-Hexanone	sec-Butylbenzene	Benzo(a)pyrene	Pyridine		Eu-154
4-Isopropyltoluene	Styrene	Benzo(b)fluoranthene			Eu-155
4-Methyl-2-pentanone	tert-Butylbenzene	Benzo(g,h,i)perylene			K-40
Acetone	Tetrachloroethene	Benzo(k)fluoranthene			Nb-94
Acetonitrile	Toluene	Benzoic acid			Pb-212
Allyl chloride	Total xylenes	Benzyl alcohol			Pb-214
Benzene	Trichloroethene	Bis(2-ethylhexyl)phthalate			Tl-208
Bromodichloromethane	Trichlorofluoromethane	Butyl benzyl phthalate			Th-234
Bromoform	Vinyl acetate	Carbazole			U-235
Bromomethane	Vinyl chloride	Chrysene			
Carbon disulfide		Di-n-butyl phthalate			

[a]May be reported as 3,4-Methylphenol or m,p-cresol.

Ac = Actinium
Am = Americium
Co = Cobalt
Cs = Cesium
Eu = Europium
K = Potassium
Nb = Niobium
Pb = Lead
Pu = Plutonium
Th = Thorium
Tl = Thallium

The list of COPCs is intended to encompass all of the contaminants that could potentially be present at each CAS. These COPCs were identified during the planning process through the review of site history, process knowledge, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs.

During the review of site historical documentation, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the Railroad Tracks CASs, some of the COPCs were identified as targeted contaminants at specific CASs. Targeted contaminants are those COPCs for which evidence in the available site and process information suggests that they may be reasonably suspected to be present at a given CAS. The targeted contaminants are required to meet more stringent completeness criteria than other COPCs, thus providing greater protection against a decision error. Targeted contaminants for CAU 539 Railroad Tracks CASs are identified in Table 3-3.

Table 3-3
Targeted Contaminants for CAU 539

CAS	Chemical Targeted Contaminants	Radiological Targeted Contaminants
25-99-21 and 26-99-05	Lead	Am-241, Co-60, Cs-137, Nb-94, Sr-90, U-235, U-238

Decision II samples will be submitted for the analysis of all unbounded COCs. In addition, samples will be submitted for analyses as needed to support waste management or health and safety decisions.

The data quality indicators (DQIs) of precision, accuracy, representativeness, completeness, comparability, and sensitivity needed to satisfy DQO requirements are discussed in Section 7.2. Laboratory data will be assessed in the CR to confirm or refute the CSM and determine whether the DQO data needs were met.

To satisfy the DQI of sensitivity (presented in Section 7.2.6), the analytical methods must be sufficient to detect contamination that is present in the samples at concentrations equal to the corresponding FALs. Analytical methods and minimum detectable concentrations (MDCs) for each CAU 539 Railroad COPC are provided in Tables 3-4 and 3-5. The MDC is the lowest concentration of a chemical or radionuclide parameter that can be detected in a sample within an acceptable level of error. The criteria for precision and accuracy in Tables 3-4 and 3-5 may vary from information in the *Industrial Sites Quality Assurance Project Plan* (QAPP) as a result of the laboratory used or updated/new methods (NNSA/NV, 2002a).

3.2 Results of the DQO Analysis

3.2.1 Action Level Determination and Basis

The preliminary action levels (PALs) presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation, therefore streamlining the consideration of remedial alternatives. The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial*

Table 3-4
Analytical Requirements for Radionuclides for CAU 539

Analysis[a]	Medium or Matrix	Analytical Method	MDC[b]	Laboratory Precision	Laboratory Accuracy
Gamma-Emitting Radionuclides					
Gamma Spectroscopy	Aqueous	EPA 901.1[c]	< PALs	RPD 35% (non-aqueous)[d] 20% (aqueous)[d] ND -2<ND<2[e]	LCS Recovery (%R) 80-120[f]
	Non-aqueous	GA-01-R[g]			
Other Radionuclides					
Isotopic U	All	U-02-RC[g]	< PALs	RPD 35% (non-aqueous)[d] 20% (aqueous)[d] ND -2<ND<2[e]	Chemical Yield Recovery (%R) 30-105[h] LCS Recovery (%R) 80-120[h]
Sr-90	Aqueous	EPA 905.0[c]			
	Non-aqueous	Sr-02-RC[g]			
Gross Alpha/Beta	Aqueous	EPA 900.0[c]	< PALs	RPD 35% (non-aqueous)[d] 20% (aqueous)[d] ND -2<ND<2[e]	MS Recovery (%R) Lab-specific[i] LCS Recovery (%R) 80-120[h]
	Non-aqueous	SM 7110 B[k]			
Tritium	Aqueous	EPA 906.0[c]			
	Non-aqueous	Laboratory Procedure[j]			

[a]A list of constituents reported for each method is provided in Table 3-2.
[b]The MDC is the minimum concentration of a constituent that can be measured and reported with 95% confidence.[k]
[c]*Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA, 1980).
[d]*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).
[e]*Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997).
[f] *SW-846 On-Line, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2009b).
[g]*The Procedures Manual of the Environmental Measurements Laboratory* (DOE, 1997).
[h]Professional judgment and other industry acceptance criteria are used.
[i]Accuracy criteria are developed in-house using approved laboratory standard operating procedures in accordance with industry standards and the NNES Statement of Work requirements (NNES, 2009b).
[j]Laboratory standard operating procedures in accordance with industry standards and the NNES Statement of Work requirements (NNES, 2009b).
[k]*Standard Methods for the Examination of Water and Wastewater* (Clesceri et al., 1998).

EPA = U.S. Environmental Protection Agency
LCS = Laboratory control sample
MS = Matrix spike
ND = Normalized difference
NNES = Navarro Nevada Environmental Services, LLC
PAL = Preliminary action level
RPD = Relative percent difference
%R = Percent recovery

Table 3-5
Analytical Requirements for Chemical COPCs for CAU 539

Analysis[a]	Medium or Matrix	Analytical Method	MDC[b]	Laboratory Precision	Laboratory Accuracy
Organics					
VOCs	All	8260[c]	< PALs	Lab-specific[d]	Lab-specific[d]
TCLP VOCs	Leachate	1311/8260[c]	< Regulatory Levels	Lab-specific[d]	Lab-specific[d]
SVOCs	All	8270[c]	< PALs	Lab-specific[d]	Lab-specific[d]
TCLP SVOCs	Leachate	1311/8270[c]	< Regulatory Levels	Lab-specific[d]	Lab-specific[d]
Inorganics					
Metals, plus Beryllium	All	6010/6020[c]	< PALs	RPD 35% (non-aqueous) 20% (aqueous)[e] Absolute Difference ±2x RL (non-aqueous)[f] ±1x RL (aqueous)[f]	MS Recovery (%R) 75-125[c] LCS Recovery (%R) 80-120[c]
Mercury	Aqueous	7470[c]			
	Non-aqueous	7471[c]			
TCLP Metals	Leachate	1311/6010/7470[c]	< Regulatory Levels		

[a]A list of constituents reported for each method is provided in Table 3-2.
[b]The MDC is the minimum concentration of a constituent that can be measured and reported with 99% confidence (EPA, 2009b).
[c]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2009b).
[d]Precision and accuracy criteria are developed in-house using approved laboratory standard operating procedures in accordance with industry standards and the NNES Statement of Work requirements (NNES, 2009b).
[e]*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).
[f]*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004).

RL = Reporting limit
TCLP = Toxicity characteristic leaching procedure

Sites Project Establishment of Final Action Levels (NNSA/NSO, 2006). This process conforms with *Nevada Administrative Code* (NAC) Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2008a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2008b) requires the use of American Society for Testing and Materials (ASTM) Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards (i.e., FALs) or to establish that corrective action is not necessary."

This RBCA process, summarized in Figure 3-1, defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- Tier 1 evaluation - sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in this SAFER Plan). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.
- Tier 2 evaluation - conducted by calculating Tier 2 site-specific target levels (SSTLs) using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total petroleum hydrocarbons (TPH) concentrations will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.
- Tier 3 evaluation - conducted by calculating Tier 3 SSTLs on the basis of more sophisticated risk analyses using methodologies described in ASTM Method E1739 that consider site-, pathway-, and receptor-specific parameters.

Evaluation of DQO decisions will be based on conditions at the site following completion of any corrective actions. Any corrective actions conducted will be reported in the CR.

The FALs (along with the basis for their selection) will be defined in the CR, where they will be compared to laboratory results in the evaluation of site closure.

3.2.1.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA *Regions 3, 6, and 9 Regional Screening Levels for Chemical Contaminants at Superfund Sites* for chemical contaminants in industrial soils (EPA, 2009a). Background concentrations for *Resource Conservation and Recovery Act* (RCRA) metals will be used instead of screening levels (SLs) when natural background concentrations exceed the SL, as is 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 SLs, the protocol used by the EPA Region 9 in establishing SLs (or similar) will be used to establish PALs. If used, this process will be documented in the CR.

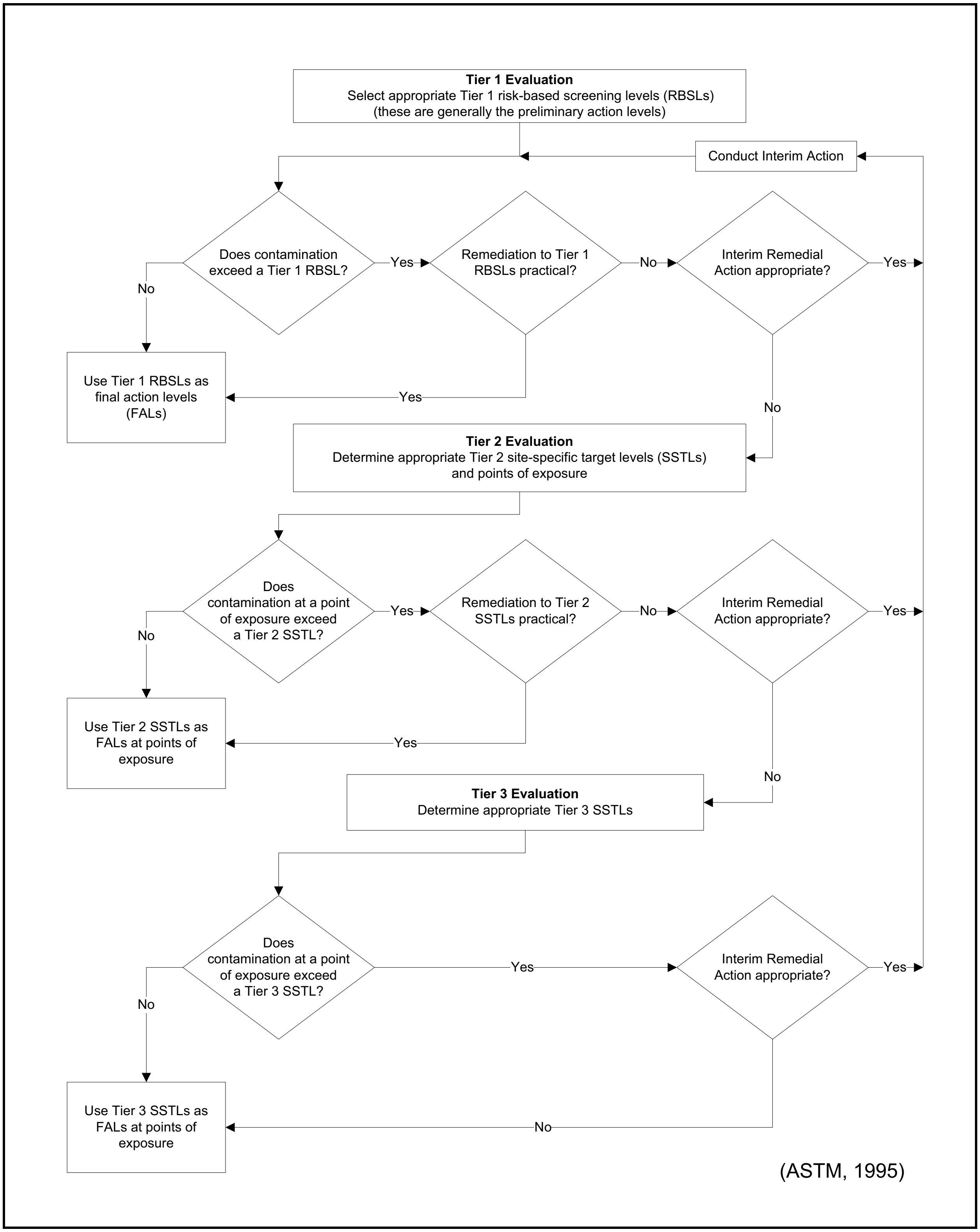

Figure 3-1
Risk-Based Corrective Action Decision Process

3.2.1.2 Radionuclide PALs

The PALs for radiological contaminants (other than tritium) are based on the screening limits recommended in National Council on Radiation Protection and Measurements (NCRP) Report No. 129 for construction, commercial, and industrial land-use scenarios (NCRP, 1999) using a 25-millirem-per-year (mrem/yr) dose constraint (Murphy, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). These PALs are based on the construction, commercial, and industrial land-use scenario provided in the NCRP Report and are appropriate for the NTS based on the land-use and exposure scenarios presented in Section B.2.2.6.

3.2.2 Hypothesis Test

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

- Baseline condition – closure objectives have not been met.
- Alternative condition – closure objectives have been met.

Sufficient evidence to reject the null hypothesis is:

- The identification of the lateral and vertical extent of COC contamination in media, if present.
- Sufficient information to properly dispose of IDW and remediation waste.

3.2.3 Statistical Model

A judgmental sampling design will be implemented to select sample locations and evaluate DQO decisions for CASs 25-99-21 and 26-99-05. The sample design will assume that the data represent the highest concentration at the site, and the statistical test will be to compare results to fixed threshold values (i.e., FALs) on a point-by-point basis.

3.2.4 Design Description/Option

The judgmental sampling approach will be used to collect *in situ* dose measurements and samples from locations most likely to contain COCs, if present, within each CAS. Because individual sample results, rather than an average concentration, will be compared to FALs at the CASs undergoing judgmental sampling, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest as defined in Section B.5.1. To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for Decision I samples to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in Section B.4.2.1. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals selected by the 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 judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

3.2.5 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 the future land use, contaminant sources, release mechanisms, migration pathways, exposure points, and exposure routes. The CSM was used to develop appropriate sampling strategies and data collection methods. The CSM was developed for CAU 539 Railroad Tracks CASs using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs. Figure 3-2 depicts a tabular representation of the conceptual pathways to receptors from CAU 539 Railroad sources. Figure 3-3 depicts a graphical representation of the CSM. If evidence of contamination that is not consistent with the presented CSM is identified during CAI activities, the situation will be reviewed, the CSM will be revised, the DQOs will be reassessed, and a recommendation will be made as to how best to proceed. In such cases, participants in the DQO process will be notified and given the opportunity to comment on and/or concur with the recommendation. A detailed discussion of the CSM is presented in Appendix B.

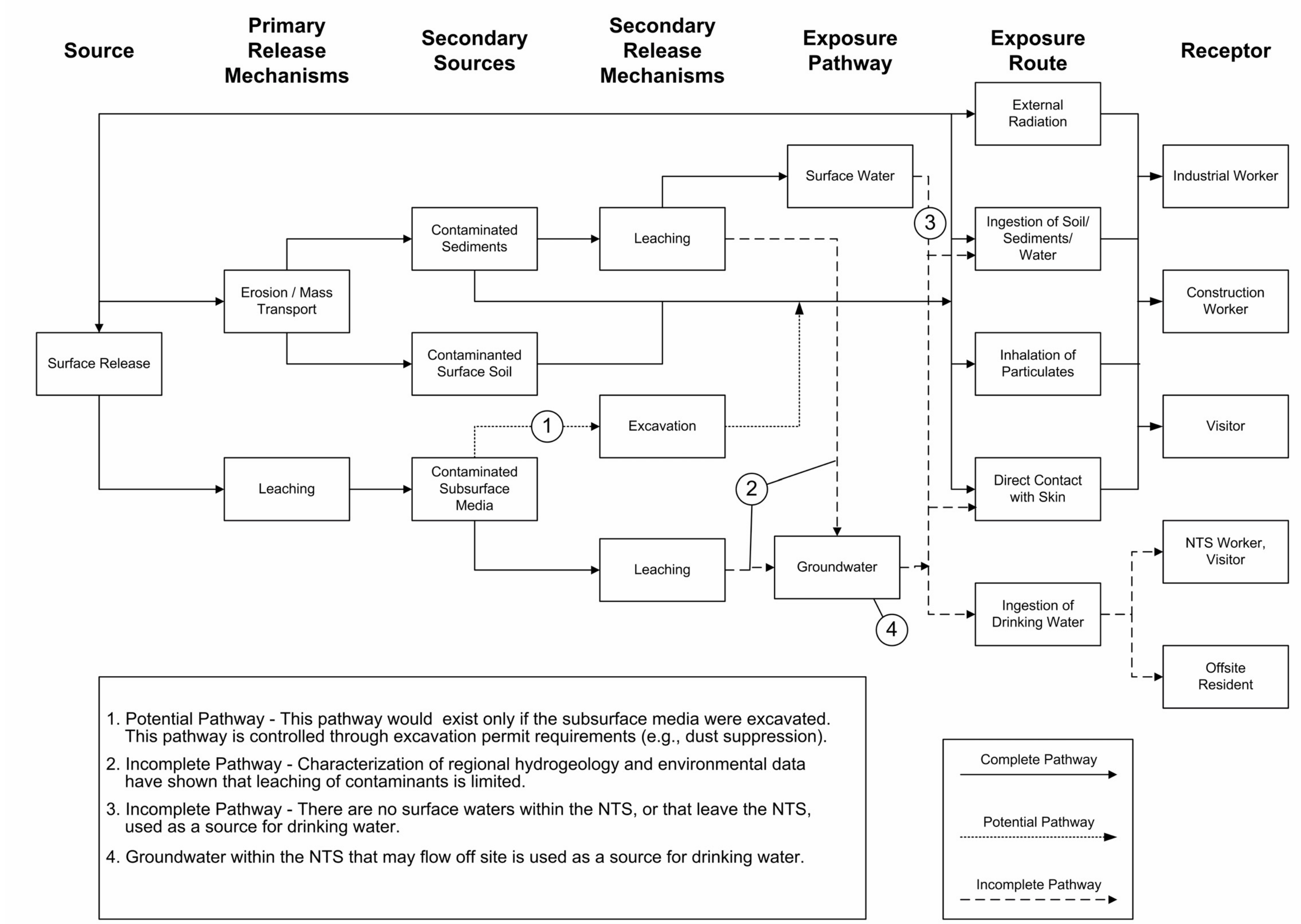

Figure 3-2
Conceptual Site Model Diagram for CAU 539 Railroad Tracks CASs

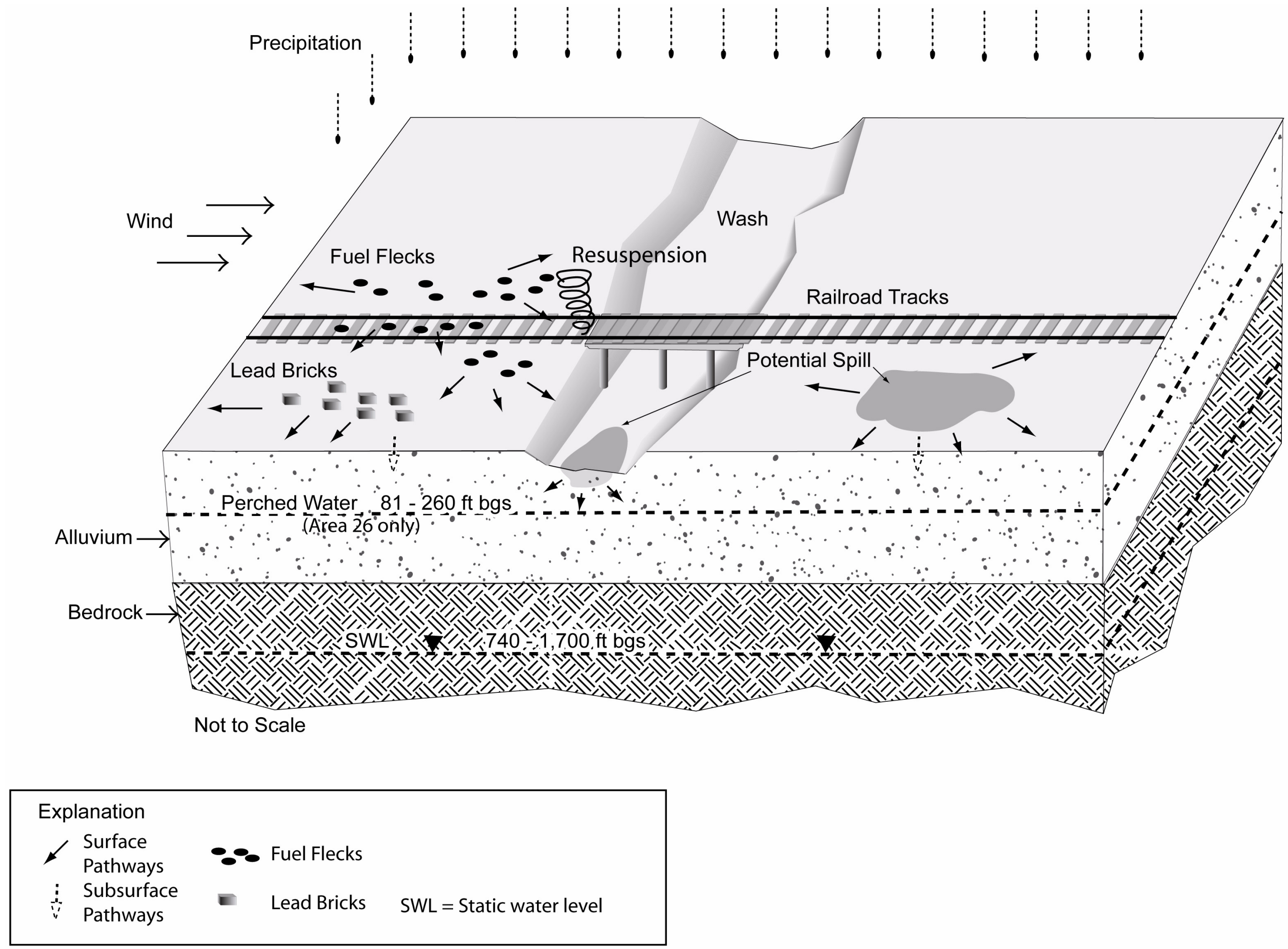

Figure 3-3
CAU 539 Conceptual Site Model

4.0 Field Activities and Closure Objectives

This section of the Railroad SAFER Plan provides a description of the field activities and closure objectives for the CAU 539 Railroad Tracks CASs. The objectives for the field activities are to determine whether COCs exist. If remediation is to be accomplished during the SAFER, then the extent of COCs will be determined so that a closure alternative may be implemented. All sampling activities will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable, approved procedures and instructions.

4.1 Contaminants of Potential Concern

The COPCs for CAU 539 Railroad Tracks CASs are defined as the list of constituents represented by the analytical methods identified in Table 3-1 for Decision I environmental samples taken at each of the CASs. The constituents reported for each analysis are listed in Table 3-2.

The list of COPCs is intended to encompass all of the contaminants that could potentially be present at each CAS. These COPCs were identified during the planning process through the review of site history, process knowledge, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Contaminants detected at similar NTS sites were also included in the COPC list to reduce the uncertainty about potential contamination at the CASs in the absence of complete information regarding activities performed at the CAU 539 Railroad sites.

During the review of site historical documentation, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs, some of the COPCs were identified as targeted contaminants at specific CASs. Targeted contaminants are those COPCs for which evidence in the available site and process information suggests that they may be reasonably suspected to be present at a given CAS. The targeted contaminants are required to meet more stringent completeness criteria than other COPCs, thus providing greater protection against a decision error. Targeted contaminants for CAU 539 Railroad Tracks CASs are identified in Table 3-3.

4.1.1 Radionuclides

Process knowledge of the activities at the facilities connected by the railroads and along the tracks provides reasonable expectation of the presence of radionuclide contamination. It is expected that the majority of radiological contamination will be located on either side of the railroad tracks with a portion being present in between the tracks due to the shaking and vibrations of the railcars.

The potential sources of radiological contamination include both fission- and activation-related radionuclides. Activation products may be present if material activated during testing were spilled from railcars during transport. Fission products may also have fallen from railcars during transport of reactors, equipment, and various items related to testing activities.

The COPCs for both CASs include the following radionuclides associated with both fission and activation products typically associated with nuclear reactors and engines: Am-241; U-234/235 and -238; Eu-152, -154, and -155; Sr-90; Cs-137; Co-60; and Nb-94. Other radionuclides may be present at low-activity concentrations.

4.1.2 RCRA Metals and Beryllium

It is anticipated that RCRA metals may be present in the soil along the railroad; lead bricks have been found in both Areas 25 and 26. Corrective Action Unit 539 also contains beryllium legacy sites associated with R-MAD, E-MAD, TCA, TCC, ETS-1, and the Pluto Facility. Fuel elements containing a mixture of highly enriched uranium dioxide and beryllium oxide were handled at the E-MAD Facility and transported along the railroad. Therefore, soil samples will be analyzed for beryllium.

4.1.3 Volatile and Semivolatile Organic Compounds

Volatile and semivolatile organic compounds are found in fuels, oil, greases, and wood preservatives on railroad ties. As such, VOCs and SVOCs may be present in the soil along the tracks in Areas 25 and 26 where releases may have occurred.

4.2 Remediation

The DQOs developed for the CAU 539 Railroad Tracks CASs identified data gaps that require additional data collection before identifying and implementing the preferred closure alternative for each CAS. A decision point approach, based on the DQOs, for making remediation decisions is summarized in Figure 1-3. The presence of contamination, if any, is assumed to be confined to the spatial boundaries of the sites as defined in the DQO process and CSM.

If COCs or potential source materials (PSMs) are identified within a CAS based on the initial CAI results, that CAS will be further assessed before implementing closure activities. If COPCs are not present at concentrations exceeding FALs, the CAS will be recommended for no further action. The objective of the initial investigation strategy is to determine whether COCs or PSMs are present. Laboratory analytical results will be used to confirm the presence or absence of COCs.

If COCs are present, or it is decided that COCs may be present based on the presence of biasing factors, a corrective action of removal for disposal may be implemented and additional verification samples taken from biased locations within an excavation. If PSM is determined to be present within the CAS, the material will be removed and verification samples will be collected. Materials that are not considered PSM may remain in place.

The judgmental sampling strategy is presented in Appendix B. Predetermined biased sample locations may be justified by the Site Supervisor, based on the criteria for satisfying DQO data needs listed in Appendix B. Additional samples may be collected for waste management characterization and disposal purposes.

The closure strategy for the CAU 539 Railroad Tracks CASs under this SAFER process consists of the following stages:

- Collecting external dose measurements
- Sampling environmental media for COCs
- Identifying and sampling PSMs
- Removing PSMs
- Performing verification sampling

4.2.1 Sampling for COCs and PSMs

Surface and shallow subsurface soils will be sampled using hand sampling (e.g., hand scoop, shovel, or augering) and/or backhoe excavation methods. Table 4-1 summarizes the sampling approach to achieve closure objectives for the two Railroad Tracks CASs in CAU 539. Potential source material samples will also be collected from wastes that have the potential for future release of a COC to environmental media. At the Railroad Tracks CASs, lead bricks that meet the PSM criteria are present, and therefore will be removed and disposed of without the need for direct sampling of the bricks. Detailed information regarding the sampling plan is outlined in Appendix B.

4.3 Verification

The information necessary to satisfy the closure criteria will be generated for the CAU 539 Railroad Tracks CASs by collecting and analyzing external dose measurements and samples generated during the field investigation. If a COC is present and removal of the COC can be accomplished, verification sampling of remaining environmental media will be required. The verification samples will be collected from the approximate center of the bottom of the excavation below the vertical boundary and at lateral boundaries. The final locations and numbers of verification samples to be collected will be determined in the field based on the presence of any biasing factors as listed in Section B.4.2.1 of Appendix B, the size of the excavation, site conditions, and the professional judgement of the Site Supervisor. All verification sample locations must meet the DQO decision needs and criteria stipulated in Appendix B. The number and location of verification samples will be justified in the CR.

If a COC is present and removal of the COC cannot be accomplished, information on the extent of COC contamination will be obtained by collecting step-out (Decision II) samples. Decision II sampling will consist of further defining the extent of contamination where COCs have been confirmed. Step-out (Decision II) sampling locations at each CAS will be selected based on the CSM, biasing factors, field-survey results, existing data, and the outer boundary sample locations where COCs were detected. In general, step-out sample locations will be arranged in a triangular pattern around areas containing a COC at distances based on site conditions, COC concentrations, process knowledge, and other biasing factors. If COCs extend beyond step-out locations, additional Decision II samples will be collected from locations further from the source. If a spatial boundary is

Table 4-1
Sampling Approach for CAU 539 Railroad Tracks CASs

CAS	Total Number of Samples	Sample Location	Minimum Number of Sample Locations	Minimum Number of Samples per Location	Sample Collection Requirements[a,b]	Samples Submitted for Analysis[c]	Sampling Method Alternatives
25-99-21	TBD[d]	Ballast	10[d]	1	Representative sample of ballast	Surface sample	Hand sampling
		Subsurface soil beneath ballast			Representative sample of soil below ballast	Subsurface samples	
		Lead bricks	TBD[d]	1	Representative sample of soil below lead bricks	Subsurface samples	
26-99-05	TBD[d]	Ballast	4[d]	1	Representative sample of ballast	Surface sample	Hand sampling
		Subsurface soil beneath ballast			Representative sample of soil below ballast	Subsurface samples	
		Lead bricks	TBD[d]	1	Representative sample of soil below lead bricks	Subsurface samples	

[a]For worker protection, field screening will not be conducted if a strong odor and/or visual evidence suggests contamination is present.
[b]Additional samples may be collected at the discretion of the Site Supervisor.
[c]Additional samples may be submitted at the discretion of the Site Supervisor.
[d]Samples will only be collected at locations where biasing factors are observed.

TBD = To be determined

reached, the CSM is shown to be inadequate, or the Site Supervisor determines that extent sampling needs to be re-evaluated, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be re-evaluated.

The closure objectives will have been met and the CAS will be proposed for closure if the following conditions are met:

- A COC is not present at a CAS, or a COC is present and the extent of all COCs has been defined.
- Potential source material is not present at a CAS, or the PSM has been removed from the CAS.
- Information is sufficient to characterize remediation waste and IDW for disposal.

Because this SAFER Plan only addresses contamination originating from the Railroad Tracks CASs, it may be necessary to distinguish overlapping contamination originating from other sources. For example, contamination originating from E-MAD Facility releases will not be addressed in the CAU 539 Railroad CAI.

Modifications to the investigation strategy may be required should unexpected field conditions be encountered at any CAS. Significant modifications shall be justified and documented in a Record of Technical Change before implementation. If an unexpected condition indicates that conditions are significantly different than the corresponding CSM, the activity will be rescoped and the decision makers will be notified. Field activities at CAU 539 Railroad Tracks CASs include site preparation, sample location selection, sample collection activities, waste characterization, photodocumentation, and collection of geographic coordinates.

4.4 CAS Site Preparation

Site preparation activities to be completed before sampling activities for the Railroad Tracks CASs include the following:

- Remove vegetation, if necessary.
- Place thermoluminescent dosimeters (TLDs) in Areas 25 and 26 to obtain field background measurements. Three TLDs will be placed in Area 26, and six TLDs will be placed in Area 25.

- Place TLDs along 20 transects perpendicular to the tracks in areas with the highest gamma walkover results, at bridges/culverts, at crossings/switches, and at other locations based on site walk observations.
- Obtain TLD background and external dose measurements for 94 days (exposure period equivalent to one year for an industrial worker).
- Select discrete sample locations based on the highest TLD results.

Detailed information regarding sampling activities at each CAU 539 Railroad Tracks CAS is presented in Appendix B.

4.5 Closure

The following activities, at a minimum, have been identified for closure of these CASs:

- If no COCs or PSMs are detected or identified, the CAS will be closed with no further action.
- If COCs are identified and clean closure cannot be accomplished during the SAFER, then a hold point will have been reached and NDEP will be consulted to determine whether the remaining contamination will be closed under the alternative corrective action of closure in place. The appropriate URs will then be implemented and documented in the SAFER CR.
- If COCs are identified and clean closure can be accomplished during the SAFER, clean closure will be the preferred CAA. The material to be remediated will be removed and disposed of as waste, and verification samples will be collected in remaining soil. Verification analytical results will be documented in the SAFER CR.

The decision logic behind the activities is provided in Figure 1-3.

Following completion of the CAI, the following actions will be implemented:

- Removing all equipment, wastes, debris, and materials associated with the CAI.
- Removing all signage and fencing (unless part of a corrective action, or demarcation signs).
- Grading site to pre-investigation condition (unless changed condition is necessary under a corrective action).
- Inspecting site and certifying that restoration activities have been completed.

4.6 Duration

Table 4-2 provides a tentative duration of activities (in calendar days) for SAFER activities.

Table 4-2
SAFER Field Activities

Duration (days)	Activity
10	TLD Installation
3	Site Mobilization
20	Fieldwork
28	Sample Analysis
42	Data Validation and Assessment
195	Closure Report
180	Waste Management and Disposition

5.0 Reports and Records Availability

Reports generated during ongoing field activities will be provided to NDEP upon request. Historical information and documents referenced in this document are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Federal Sub-Project Director. This document is available in the DOE public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Federal Sub-Project Director.

6.0 Investigation/Remediation Waste Management

Management, transportation, and disposal of the waste generated during the CAU 539 Railroad Tracks field investigation will be in accordance with all applicable DOE orders, EPA and U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP. Wastes will be characterized based on these regulations using process knowledge, field-screening, and analytical results from investigation and waste samples. Waste types that may be generated during the field investigation include: sanitary, industrial, low-level radioactive, hazardous, hydrocarbon, or mixed wastes.

Disposable sampling equipment, personal protective 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, conservative estimates of total waste contaminant concentrations may be made based on the mass of the waste, the amount of contaminated media contained in the waste, and the maximum concentration of contamination found in the media. Direct samples of IDW may also be taken to support waste characterization. There are no known listed chemicals, therefore, all waste will be characterized based on their attributes.

6.1 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.

6.2 Potential Waste Streams

Waste generated during the corrective action activities may include the following potential waste streams:

- Personal protective equipment 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., lead brick)
- Field-screening waste (e.g., spent solvent, disposable sampling equipment, and/or PPE contaminated by field-screening activities)

The onsite management and ultimate disposition of wastes will be determined based on a determination of the waste type (e.g., sanitary, low-level, hazardous, hydrocarbon, mixed), or the combination of waste types. A determination of the waste type will 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 NTS Radiological Control (RadCon) Manual (NNSA/NSO, 2010) shall be used to determine whether such materials may be declared nonradioactive. Onsite IDW management requirements by waste type are detailed in the following sections. Waste management activities will follow all current regulations and requirements.

6.2.1 Sanitary Waste

Sanitary IDW generated at each CAS will be collected, managed, and disposed of in accordance with the sanitary waste management regulations and the permits for operation of the U10c Industrial Waste Landfill.

Sanitary IDW generated at each CAS will only be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in a roll-off box located in Mercury, or other approved roll-off box location. The number of bags of sanitary IDW placed in the roll-off box will be counted as they are placed in the roll-off box, noted in a log, and documented in the field activity daily log. These logs will provide necessary tracking information for ultimate disposal in the U10c Industrial Waste Landfill.

6.2.2 Low-Level Radioactive 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 (RCA). 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 NTS RadCon Manual (NNSA/NSO, 2010), will be used to determine whether 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 whether a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Wastes in excess of Table 4-2 values will be managed as potential radioactive waste and be managed in accordance with this section and any other applicable 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, 2009). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated RMA or RCA when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NSO, 2009).

6.2.3 Hazardous Waste

The Railroad Tracks CASs will have waste accumulation areas established according to the needs of the project. Satellite accumulation areas and HWAAs will be managed consistent with the requirements of federal and state regulations (CFR, 2009a; NAC, 2008a). The HWAAs will be properly controlled for access, and will be equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers. All containerized hazardous waste will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265 Subpart I (CFR, 2009b). 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 waste will be characterized in accordance with the requirement of Title 40 CFR 261. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT requirements to a permitted treatment, storage, and disposal facility (CFR, 2009a).

6.2.4 Hydrocarbon Waste

Hydrocarbon soil waste containing more than 100 milligrams per kilogram (mg/kg) of TPH 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, 2006), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with Nevada regulations.

6.2.5 Mixed Low-Level Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2009a), agreements between NNSA/NSO and the State of Nevada, and 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 constituent concentrations 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, 2009), the NTS NDEP permit for a Hazardous Waste Management Facility (NDEP, 2005), and the RCRA Part B Permit Application for Waste Management Activities at the NTS (DOE/NV, 1999). Mixed waste constituent concentrations exceeding 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).

6.2.6 Polychlorinated Biphenyls

The management of polychlorinated biphenyls (PCBs) is governed by *Toxic Substances Control Act* and its implementing regulations at 40 CFR 761 (CFR, 2009c). Polychlorinated biphenyl 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 CAI. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2009c) as well as State of Nevada requirements, (NAC, 2008b) guidance, and agreements with NNSA/NSO.

6.3 Management of Specific Waste Streams

6.3.1 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, and also evaluated for radiological contamination. Staining and/discoloration will be assumed to be the result of contact with potentially contaminated media such as soil. Gross contamination is the visible contamination of an item (e.g., clumps of soil/sludge on a sampling spoon or free liquid smeared on a glove). While gross contamination can often be removed through decontamination methods, removal of gross contamination from small items, such as gloves or booties is not typically conducted. Any IDW that meets this description will be segregated and managed as potentially “characteristic” hazardous waste. This segregated population of waste will either: (1) be assigned the characterization of the soil/sludge that was sampled, (2) be 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 equipment that is not visibly stained, discolored, or grossly contaminated and that is within the radiological free-release criteria will be managed as nonhazardous sanitary waste.

6.3.2 Management of Decontamination Rinsate

Rinsate at CAU 539 will not be considered hazardous waste unless there is evidence that the rinsate may 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, 2009a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

6.3.3 Management of Soil

This waste stream consists of soil removed for disposal during soil sampling, excavation, and/or drilling. This waste stream will be characterized based on laboratory analytical results from representative locations. If the soil is determined to potentially contain COCs, the material will either be managed on site or containerized for transportation to an appropriate disposal site.

Onsite management of the waste soil will be allowed only if it is managed within an area of concern and it is appropriate to defer the management of the waste until the final remediation of the site. If this option is chosen, the waste soil shall be protected from run-on and run-off using appropriate protective measures based on the type of contaminant(s) (e.g., covered with plastic and bermed).

Management of soil waste for disposal consists of placing the waste in containers, labeling the containers, temporarily storing the containers until shipped, and shipping the waste to a disposal site.

The containers, labels, management of stored waste, transport to the disposal site, and disposal shall be appropriate for the type of waste (e.g., hazardous, hydrocarbon, mixed).

Note that soils placed back into a borehole or excavation in the same approximate location from which it originated is not considered to be a waste.

6.3.4 Management of Debris

This waste stream can vary depending on site conditions. Debris that requires removal for the investigation activities (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 may 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, by placement in a container(s), or left on the footprint of the CAS and its disposition deferred until implementation of corrective action at the site.

7.0 Quality Assurance/Quality Control

The overall objective of the characterization activities described in this SAFER is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each Railroad Tracks CAS in CAU 539.

The data from the TLD measurements will also meet rigorous data quality requirements. The TLDs will be obtained from, and measured by, the Environmental Technical Services group at the NTS. This group is responsible for a routine environmental monitoring program at the NTS. The program includes a campaign of TLDs that are emplaced at pre-established locations across the NTS for the monitoring of external dose. The TLDs are replaced and read quarterly. Details of this campaign can be found in the *Nevada Test Site Environmental Report 2006* (NNSA/NSO, 2007). The TLDs will be submitted to the Environmental Technical Services group for inclusion in their routine quarterly read of the NTS environmental monitoring TLDs. The TLDs will be analyzed using automated TLD readers that are calibrated and maintained by the National Security Technologies, LLC, Radiological Control Department in accordance with existing quality control (QC) procedures for TLD processing. A summary of the routine environmental monitoring TLD quality control efforts and results can be found in Section 5.2.1 of the *Nevada Test Site Environmental Report 2006* (NNSA/NSO, 2007). In general, the average relative percent difference between pairs of environmental TLDs was 2.5 percent for the year 2006. Certification is maintained through the DOE Laboratory Accreditation Program for dosimetry.

Sections 7.1 and 7.2 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 SAFER Plan or required by the results of the DQO process (see Appendix B), this CAI will adhere to the Industrial Sites QAPP (NNSA/NV, 2002a).

7.1 Sample Collection 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 CAI, as determined in the DQO process, is as follows:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Control blanks for TLDs (5 per 100 field TLDs)
- Equipment rinsate blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per uncharacterized lot of source material that contacts sampled media)
- Field duplicates (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20 collected)
- Field blanks (may be 1 per 20 environmental samples, 1 per day, or 1 per CAS depending on site conditions and agreement of DQO participants)
- Laboratory QC samples (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20 collected)

Additional QC samples may be submitted based on site conditions at the discretion of the Task Manager or 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).

7.2 Applicable Laboratory/Analytical Data Quality Indicators

The DQIs 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
- Completeness
- Comparability
- Sensitivity

Table 7-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts on 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 criteria for precision and accuracy in Tables 3-4 and 3-5 may vary from information in the Industrial Sites QAPP as a result of the laboratory used or updated/new methods (NNSA/NV, 2002a).

Table 7-1
Laboratory and Analytical Performance Criteria for CAU 539 DQIs

DQI	Performance Metric	Potential Impact on Decision If Performance Metric Not Met
Precision	At least 80% of the sample results for each measured contaminant are not qualified for precision based on the criteria for each analytical method-specific and laboratory-specific criteria presented in Section 7.2.1.	The affected analytical results from each affected CAS will be assessed to determine whether there is sufficient confidence in analytical results to use the data in making DQO decisions.
Accuracy	At least 80% of the sample results for each measured contaminant are not qualified for accuracy based on the method-specific and laboratory-specific criteria presented in Section 7.2.2.	The affected analytical results from each affected CAS will be assessed to determine whether there is sufficient confidence in analytical results to use the data in making DQO decisions.
Representativeness	Samples contain contaminants at concentrations present in the environmental media from which they were collected.	Analytical results will not represent true site conditions. Inability to make appropriate DQO decisions.
Decision I Completeness	80% of the CAS-specific COPCs have valid results. 100% of CAS-specific targeted contaminants have valid results.	Cannot support/defend decision on whether COCs are present.
Decision II Completeness	100% of COCs used to define extent have valid results.	Extent of contamination cannot be accurately determined.
Comparability	Sampling, handling, preparation, analysis, reporting, and data validation are performed using standard methods and procedures.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Sensitivity	Minimum detectable concentrations are less than or equal to respective FALs.	Cannot determine whether COCs are present or migrating at levels of concern.

7.2.1 Precision

Precision is a measure of the repeatability of the analysis process from sample collection through analysis results. It is used to assess the variability between two equal samples.

Determinations of precision will be made for field duplicate samples and laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same source under similar conditions in separate containers. The duplicate sample 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 may include matrix spike duplicate (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 corresponding QC sample results are not within established control limits.

The criteria used for the assessment of inorganic chemical precision when both results are greater than or equal to 5x reporting limit (RL) are 20 and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x RL, a control limit of ±1x RL and ±2x RL for aqueous and soil samples, respectively, is applied to the absolute difference.

The criteria used for the assessment of organic chemical precision are based on professional judgment using laboratory-derived control limits.

The criteria used for the assessment of radiological precision when both results are greater than or equal to 5x MDC are 20 and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x MDC, the normalized difference (ND) should be between -2 and +2 for aqueous and soil samples. The parameters to be used for assessment of precision for duplicates are listed in Table 3-5.

Any values outside the specified 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. The performance metric for assessing the DQI of precision on DQO decisions (Table 7-1) is that at least 80 percent of sample results for each measured contaminant are not qualified due to duplicates exceeding the criteria. If this performance metric is not met, an assessment will be conducted in the CR on the impacts to DQO decisions specific to affected contaminants and CASs.

7.2.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement to the true value. It is used to assess the performance of laboratory measurement processes. 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). Accuracy will be evaluated based on results from three types of spiked samples: matrix spike (MS), LCS, and surrogates (organics). 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.

The criteria used for the assessment of inorganic chemical accuracy are 75 to 125 percent for MS recoveries and 80 to 120 percent for LCS recoveries. For organic chemical accuracy, MS and LCS laboratory-specific percent recovery criteria developed and generated in-house by the laboratory according to approved laboratory procedures are applied. The criteria used for the assessment of radiochemical accuracy are 80 to 120 percent for LCS and MS recoveries.

Any values outside the specified 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 laboratory 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 may be evaluated when determining the usability of the affected data.

The performance metric for assessing the DQI of accuracy on DQO decisions (Table 7-1) is that at least 80 percent of the sample results for each measured contaminant are not qualified for accuracy. If this performance metric is not met, an assessment will be conducted in the CR on the impacts to DQO decisions specific to affected contaminants and CASs.

7.2.3 Representativeness

Representativeness is the degree to which sample characteristics accurately and precisely represent characteristics of a population or an environmental condition (EPA, 2002). Representativeness is ensured by carefully developing the CAI sampling strategy during the DQO process so that false negative and false positive decision errors are minimized. Meeting the criteria listed below will ensure that sample results will adequately represent actual site characteristics:

- For Decision I judgmental sampling, 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 CR.

7.2.4 Completeness

Completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. For judgmental 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 7-1 and is based on the percentage of measurements made that are judged to be valid. For the judgmental sampling approach, the completeness goal for targeted contaminants and the remaining COPCs is 100 and 80 percent, respectively. If this goal is 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 and will be presented in the CR. Additional samples will be collected if it is determined that the number of samples does not meet the completeness criteria.

7.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 2002). 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 CR.

7.2.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2002). The evaluation criterion for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding FALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives. This assessment will be presented in the CR.

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Appendix A

Project Organization

A.1.0 Project Organization

The NNSA/NSO Federal Sub-Project Director is Kevin Cabble. He can be contacted at (702) 295-5000.

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 NNSA/NSO Federal Sub-Project Director be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report before the start of field activities.

Appendix B

Data Quality Objective Process

B.1.0 Introduction

The DQO process described in this appendix is a seven-step strategic systematic planning method used to plan data collection activities and define performance criteria for the field investigation of CAU 539, CASs 25-99-21 (Area 25 Railroad Tracks) and 26-99-05 (Area 26 Railroad Tracks). The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to determine the appropriate corrective actions, to verify the adequacy of existing information, to provide sufficient data to implement the corrective actions, and to verify that closure was achieved.

The CAU 539 Areas 25 and 26 Railroad Tracks CAI will be based on the DQOs presented in this appendix as developed by representatives of NDEP and NNSA/NSO. The seven steps of the DQO process presented in Sections B.2.0 through B.8.0 were developed in accordance with *EPA Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006) and the CAS-specific information presented in Section B.2.0.

The DQO process presents a judgmental sampling approach. In general, the procedures used in the DQO process provide:

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

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

B.2.0 Step 1 - State the Problem

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

A modification to the FFACO was approved in May 2010 to transfer the two Railroad Tracks CASs from CAU 114 into CAU 539. The two CASs—CAS 25-99-21, Area 25 Railroad Tracks, and CAS 26-99-05, Area 26 Railroad Tracks—are addressed in this SAFER and consist of the following:

- Potential radiological releases to soil beneath and adjacent to the railroad tracks associated with historical operations of the railroad in Areas 25 and 26.
- Potential releases of organic and inorganic constituents to the surface soil adjacent to the railroad that may present an unacceptable risk to human health and the environment.

The problem statement for the CAU 539 Railroad Tracks CASs is: "Existing information on the nature and extent of potential contamination is insufficient to evaluate CAAs and confirm closure of the two Railroad Tracks CASs in CAU 539."

B.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP and NNSA/NSO.

B.2.2 Conceptual Site Model

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

The CSM was developed for the CAU 539 Railroad Tracks CASs using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs.

The CSM consists of:

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

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

The applicability of the CSM to the CASs is summarized in Table B.2-1 and discussed below. Table B.2-1 provides information on CSM elements that will be used throughout the remaining steps of the DQO process. Figure B.2-1 represents site conditions applicable to the CSM and depicts the surface and shallow subsurface releases associated with the railroad tracks, lead bricks, and other potential releases related to normal operation of the railroad, such as hydrocarbon spills.

Table B.2-1
Conceptual Site Model Description of Elements for Each CAS in CAU 539

CAS Identifier	25-99-21	26-99-05
CAS Description	Area 25 Railroad Tracks	Area 26 Railroad Tracks
Site Status	The two railroads are inactive and abandoned. Portions of the railroad are located near currently active facilities (e.g., ETS-1) or facilities undergoing D&D (e.g., R-MAD).	
Exposure Scenario	Occasional Use Area	
Sources of Potential Soil Contamination	Release of fuel flecks and potentially other radioactive material to the ballast and soil beneath the two railroads. Other unspecified organic or inorganic (e.g., lead) releases from the use of the railroad.	
Location of Contamination/ Release Point	Surface and subsurface soil below the railroad tracks and 5 ft laterally of the tracks. Soil beneath and adjacent to the lead bricks.	
Amount Released	Unknown	
Affected Media	Surface and shallow subsurface soil along tracks.	
Potential Contaminants	Radionuclides (Am-241; Cs-137; Co-60; Eu-152, -154, and -155; Nb-94; Sr-90; U-234/235, and -238), Lead, Beryllium, SVOCs, VOCs	
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for migration of contaminants. Surface water runoff may provide for the transportation of some contaminants within or outside of the footprints of the CASs (e.g., Topopah Wash).	
Migration Pathways	Vertical transport expected to dominate over lateral transport due to small surface gradients. There will be a component of lateral migration due to the raised road bed.	
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Groundwater contamination is not expected. Lateral and vertical extent of COC contamination is assumed to be within the spatial boundaries.	
Exposure Pathways	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.	

B.2.2.1 Contaminant Release

Any contaminants released from CAU 539 Railroad Tracks CASs, regardless of physical or chemical characteristics, are expected to exist within the ballast and/or in the soil adjacent to the release in lateral and vertical directions. For both CASs, the primary locations for radiological contaminants are the ballast and underlying soils and surface and subsurface soil where ballast is not present and

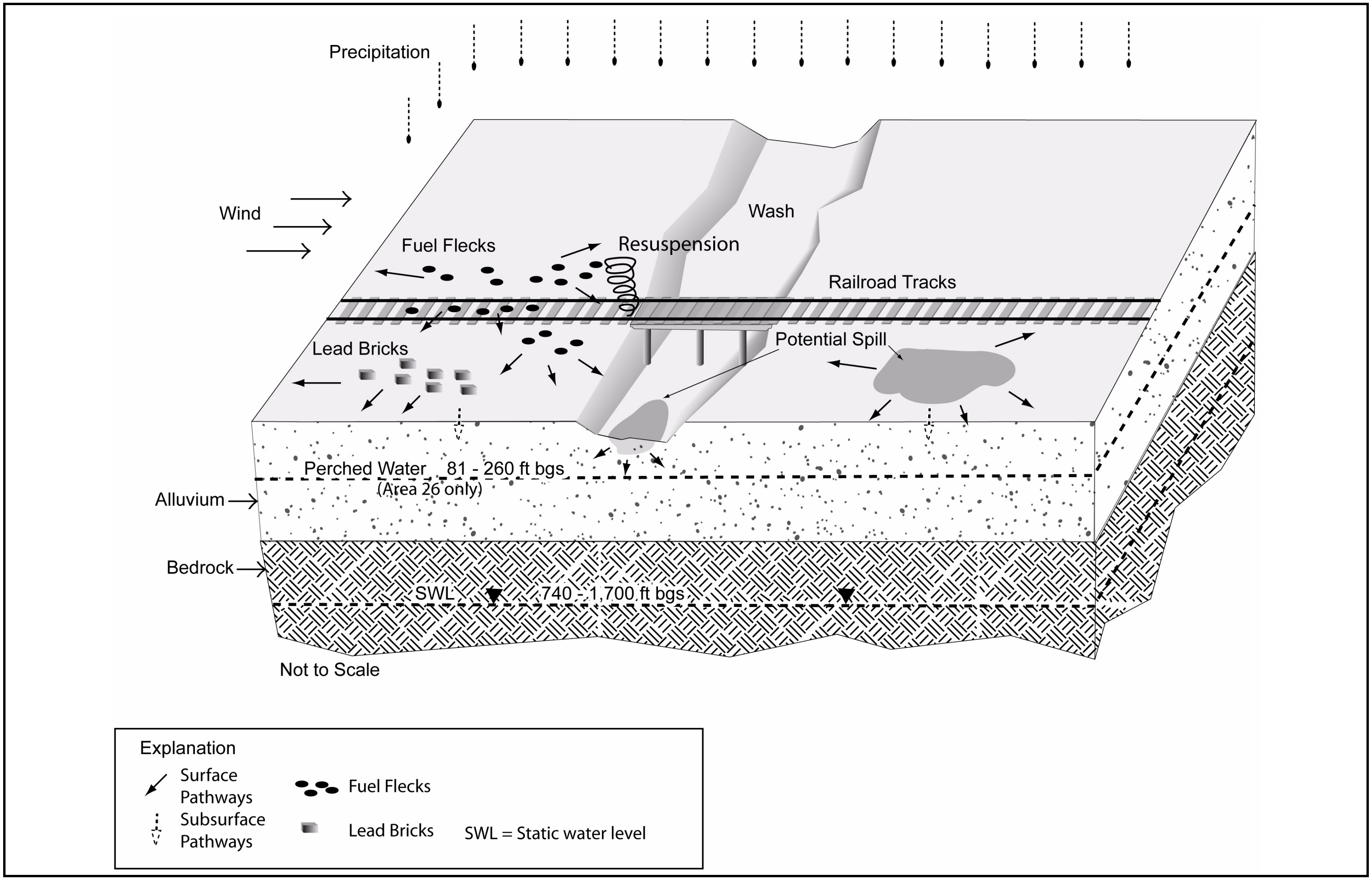

Figure B.2-1
Conceptual Site Model for CAU 539 CASs

5 ft laterally from the tracks in Areas 25 and 26. At the locations where lead bricks were discovered adjacent to the tracks, the primary location for contaminants to be released to the environment is in the soil below the bricks. At any potential spills or other releases, the primary location for contaminants to be released to the environment is in the soil below and adjacent to the release.

The CSM accounts for potential releases resulting from fuel flecks and potentially other radioactive materials that were shaken loose from the railcars carrying reactors, equipment, and other items related to testing activities between the various testing facilities. The CSM also accounts for potential releases resulting from the lead bricks, potential spills, and other releases related to railroad operations.

B.2.2.2 Potential Contaminants

The COPCs were identified during the planning process through the review of site history, process knowledge, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Because complete information regarding activities performed at the CAU 539 sites is not available, contaminants detected at similar NTS sites were included in the contaminant lists to reduce uncertainty. The list of COPCs is intended to encompass all of the contaminants that could potentially be present at each CAS.

The COPCs for both CASs include the following radionuclides associated with both fission and activation products typically associated with nuclear reactors and engines: Am-241; U-234/235 and -238; Eu-152, -154, and -155; Sr-90; Cs-137; Co-60; and Nb-94. Other radionuclides may be present at low-activity concentrations.

Nonradiological COPCs include beryllium, lead, VOCs, and SVOCs. The specific COPC is dependant upon the type of release identified. Lead is a COPC due to the identified presence of lead bricks within each CAS. Other potential releases involving organic constituents (e.g., diesel spill) may be present; VOCs and SVOCs are groups of compounds that would contain the organic COPCs. Beryllium is included in the list of COPCs because beryllium legacy sites are associated with R-MAD, E-MAD, TCA, TCC, and ETS-1 in Area 25, and the Pluto Facility in Area 26.

The COPCs will also include creosote on railroad ties and hydrocarbons related to the operation of the railroad cars.

The COPCs applicable to Decision I environmental samples from each of the CASs of CAU 539 are defined as the detectable constituents reported from the analyses stipulated in Table B.2-2. The radionuclides that will be reported from the gamma spectroscopy analysis have some naturally occurring radionuclides (e.g., K-40). These naturally occurring radionuclides are not considered COPCs.

Table B.2-2
Analytical Program[a]

Analyses	CAS 25-99-21	CAS 26-99-05
Organic COPCs		
SVOCs	X[b]	X[b]
VOCs	X[b]	X[b]
Inorganic COPCs		
RCRA Metals	X[b]	X[b]
Beryllium	X	X
Radionuclide COPCs		
Gamma Spectroscopy	X	X
Isotopic U	X	X
Sr-90	X	X

[a]The COPCs are the constituents reported from the analytical methods listed.
[b]Analytical method may be included dependant upon type of release investigated.

X = Required analytical method

During the review of site history documentation, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs, some of the COPCs were identified as targeted contaminants at specific CASs. Targeted contaminants are those COPCs for which evidence in the available site and process information suggests that they may be reasonably suspected to be present at a given CAS. The targeted contaminants are required to meet more stringent completeness criteria than other COPCs, thus providing greater protection against a decision error (see Section B.7.1). Targeted contaminants for both CAU 539 CASs are identified in Table B.2-3.

Table B.2-3
Targeted Contaminants for CAU 539 Railroad Tracks CASs

CASs	Chemical Targeted Contaminant	Radiological Targeted Contaminants
25-99-21 and 26-99-05	Lead	Am-241, Co-60, Cs-137, Nb-94, Sr-90, U-235, U-238

B.2.2.3 Contaminant Characteristics

Contaminant characteristics include, but are not limited to, solubility, density, and adsorption potential. In general, contaminants with large particle size, low solubility, high affinity for media, and/or high density can be expected to be found relatively close to release points. Contaminants with small particle size, high solubility, low affinity for media, and/or low density are found further from release points or in low areas where evaporation of ponding will concentrate dissolved constituents.

B.2.2.4 Site Characteristics

Site characteristics are defined by the interaction of physical, topographical, and meteorological attributes and properties. Physical properties include permeability, porosity, hydraulic conductivity, degree of saturation, sorting, chemical composition, and organic content. Topographical and meteorological properties and attributes include slope stability; precipitation frequency and amounts; precipitation runoff pathways; drainage channels and ephemeral streams; and evapotranspiration potential. Migration pathways and transport mechanisms relevant to the present investigation are discussed in Section B.2.2.5.

Area 25: Jackass Flats lies within the Alkali Flat-Furnace Creek Ranch sub-basin. Depths to groundwater for the three water supply wells located within Area 25 are 1,041 ft, 928 ft, and 740 ft below ground surface (bgs) (USGS, 1995). The movement of groundwater within Jackass Flats is to the southwest, ultimately discharging into areas within the Amargosa River Valley (DRI, 1988; DOE, 1988).

Area 25 contains Jackass Flats, which is an intermontane valley bordered by highlands on all sides except for a large drainage outlet to the southwest. Elevations range from 3,400 to 5,600 ft above mean sea level (amsl). The Jackass Flats basin is underlain by alluvial, colluvial, and volcanic rocks of Cenozoic age. The alluvium and colluvium are above the saturated zone throughout most of

Jackass Flats. Paleozoic sedimentary rocks, limestone, and dolomite occur at greater depths (NNSA/NV, 2001).

Area 26: Area 26 is generally bounded on the southwest by the low drainage divide between Wahmonie Flat and Jackass Flats, on the northwest by Lookout Peak, on the northeast by small rugged hills that are unnamed, and on the south by Skull Mountain. Area 26 is located midway between Jackass Flats and Frenchman Flat. The portion of Area 26 of concern to CAU 539 Railroad CAI is an intermontane valley bordered by highlands on all sides except for drainage outlets to the southwest and southeast. Area 26 is located in the transition zone between the northern edge of the Mojave Desert and the southern portion of the Great Basin Desert. Elevations where Project Pluto facilities are present range from 4,200 to 4,400 ft amsl (NNSA/NV, 2001).

A perched water table occurs in a zone of highly fractured bedrock in Area 26. Static perched water levels range from 81 to 167 ft bgs. The perched water may extend to depths exceeding 261 ft bgs before encountering rocks with a low-fracture permeability. The regional water table is thought to be at a depth of approximately 1,700 ft bgs (NNSA/NV, 2001).

B.2.2.5 Migration Pathways and Transport Mechanisms

Migration pathways include the lateral migration of potential contaminants as a result of surface water runoff across surface soils/sediments and vertical migration of potential contaminants through subsurface soils due to percolation. Contamination, if present, is expected to be contiguous to the release points. The Area 25 Railroad Tracks location is dissected by numerous ephermal drainages of which Topopah Wash is the primary drainage in the area. Topopah Wash, originating in the Calico Hills, bisects Jackass Flats and also joins with the Amargosa River, further to the east (DRI, 1996). Contaminants released into Topopah Wash are subject to much higher transport mechanisms than contaminants released to other surface areas. Topopah Wash is generally dry but is subject to infrequent, potentially intense stormwater flows. These stormwater flow events provide an intermittent mechanism for both vertical and horizontal transport of contaminants. In Area 26, although a minimal number of small drainages cross the railroad, there are no major/primary drainages present to provide a significant horizontal transport mechanism.

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, due to the low permeability of the alluvium throughout both areas, high potential evapotranspiration rates (annual potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 inches [in.] [Shott et al., 1997]), and low precipitation rates (approximately 5.72 in. per year in Area 25 as measured from station 4JA [ARL/SORD, 2009], and approximately 7.71 in. per year in Area 26 at nearby Cane Spring [ARL/SORD, 2009]), percolation of infiltrated precipitation at the NTS does not provide a significant mechanism for vertical migration of contaminants to groundwater (DOE/NV, 1992). Environmental contamination is, therefore, expected to be limited to the area near release points. Other potential minor transport of contamination may include wind-borne material and material pushed along road crossings within release areas. Based on the particle size of fuel flecks associated with radiological releases from railroad cars, wind-borne transport of radioactive fuel flecks is expected to be minor.

B.2.2.6 Land-Use and Exposure Scenarios

Human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil or debris due to inadvertent disturbance of these materials, or irradiation by radioactive materials. The land-use and exposure scenarios for the CAU 539 Railroad Tracks CASs are listed in Table B.2-4. These are based on NTS current and future land use (DOE/NV, 1998). Portions of CASs 25-99-21 and 26-99-05 are located adjacent to and outside existing facilities and structures; however, these facilities are not expected to be used as assigned work stations for NTS site personnel. These sites, therefore, are classified as occasional work areas. Other abandoned portions of the railroads are at remote locations without any site improvements and where no regular work is performed. However, the possibility still exists that site workers could occupy any of these locations on an occasional and temporary basis, such as when a military or training exercise is being conducted (e.g., former Test Bunker facility). Therefore, these sites are classified as occasional work areas.

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

CAS	Record of Decision Land Use Zone	Exposure Scenario
25-99-21 and 26-99-05	Research Test and Experiment Zone This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development, and testing projects and activities.	Occasional Use Area Worker will be exposed to the site occasionally (up to 80 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.

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

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

B.3.1 Decision Statements

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

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

- Identifying the volume of media containing any COC bounded by analytical sample results in lateral and vertical directions.
- The information needed to characterize IDW for disposal.
- The information needed to determine potential remediation waste types.

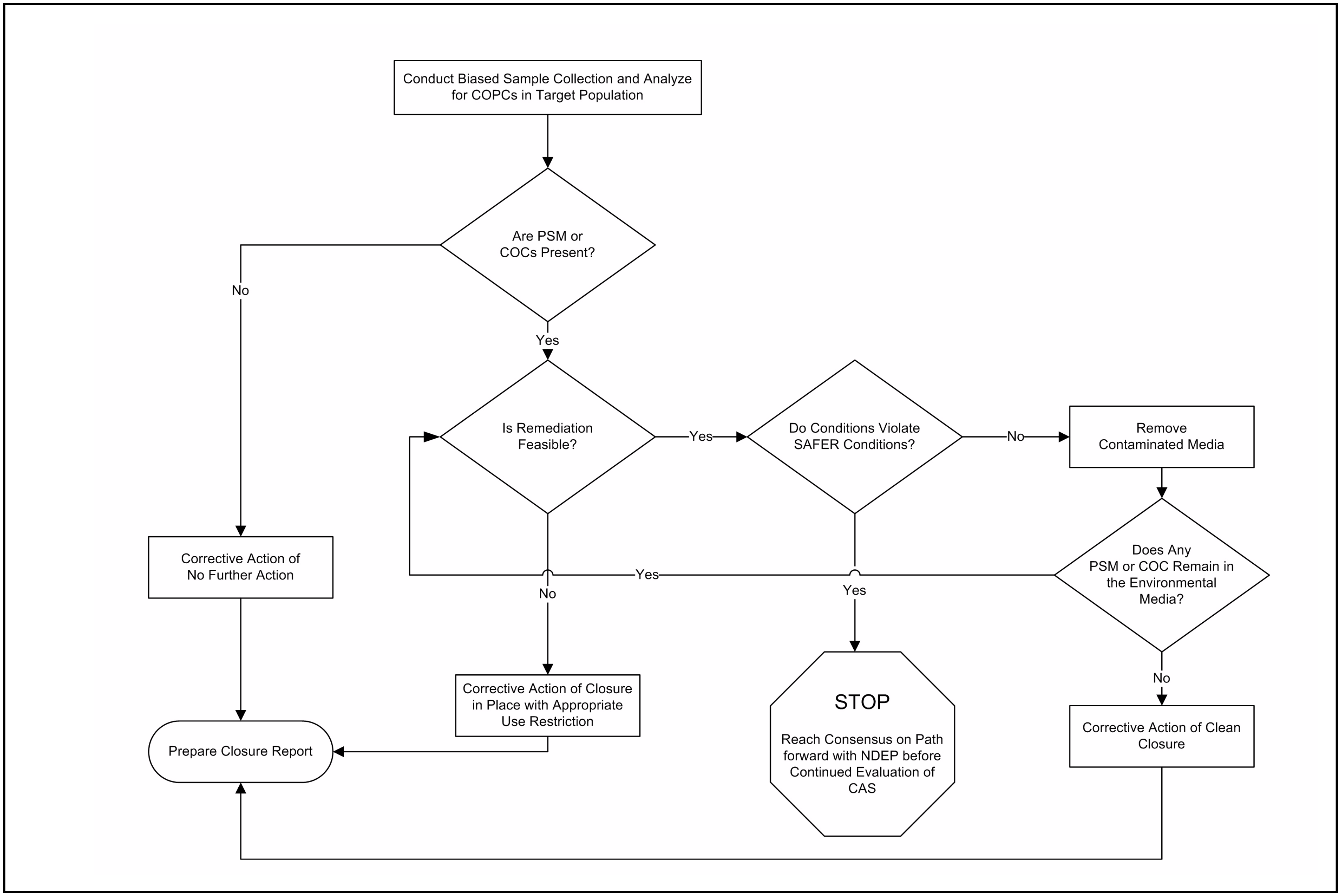

Figure B.3-1
SAFER Closure Decision Process for CAU 539 CASs

The presence of a COC would require a corrective action. A corrective action may also be necessary if there is a potential for wastes that are present at a site to impose COCs into site environmental media if the wastes were to be released. To evaluate the potential for site wastes to result in the introduction of a COC to the surrounding environmental media, the following conservative assumption was made:

- For nonliquid wastes, the concentration of any chemical contaminant in soil (following degradation of the waste and release of contaminants into soil) would be equal to the mass of the contaminant in the waste divided by the mass of the waste.

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

B.3.2 Alternative Actions to the Decisions

This section identifies actions that may be taken to solve the problem depending on the possible outcomes of the CAI.

B.3.2.1 Alternative Actions to Decision I

If no COC associated with a release from the CAS is detected, then further assessment of the CAS is not required, and the CAA of no further action will be selected. If a COC associated with a release from the CAS is detected, then additional sampling will be conducted to determine the extent of COC contamination.

B.3.2.2 Alternative Actions to Decision II

If sufficient information is available to define the extent of COC contamination and confirm that closure objectives were met, then further assessment of the CAS is not required. If sufficient information is not available to define the extent of contamination or confirm that closure objectives were met, then additional samples will be collected until the extent is defined.

If the extent of the contamination is defined and remediation can be accomplished during the SAFER, then clean close the site by removing the contaminated media until all COCs have been removed. If the collection of verification samples confirm that all the contaminated media have been removed, then the clean closure objectives will have been met. If the extent of contamination has been determined and additional remediation cannot be accomplished, then the contaminated area will be closed in place with appropriate URs.

B.4.0 Step 3 - Identify Information Inputs

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

B.4.1 Information Needs

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

- Samples must be collected in areas most likely to contain a COC (judgmental sampling) and areas most likely to exceed a 25-mrem/yr total effective dose (TED).
- The analytical methods and *in situ* measurements must be sufficient to detect a 25-mrem/yr dose for radiological releases.
- The analytical suite selected must be sufficient to identify any COCs present in the samples for nonradiological releases.

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

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

B.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, or other appropriate sampling methods, as well as collection of dose rate measurements using TLDs. The environmental samples will be submitted to analytical laboratories meeting the quality criteria stipulated in the Industrial Sites QAPP

(NNSA/NV, 2002a). Screening levels/nonvalidated data (e.g., radiological surveys) will be used to guide the detailed judgmental sampling; however, only validated data from analytical laboratories will be used to support DQO decisions. Sample collection and handling activities will follow standard procedures.

Radiological data collected will estimate the TED at each selected transect along the railroad. The TED will be determined by summing the internal and external dose components. For internal dose, sample results will be used to calculate internal dose using the Residual Radioactive (RESRAD) computer code (Yu et al., 2001). External dose will be determined by collecting *in situ* measurements using TLDs. Decision criteria are based on the maximum TED estimate at any given transect. Information on decreasing TED rate trends will be generated through soil sampling and calculating TED rates from Decision II samples, and correlating the dose with distance from point of release.

All waste characterization data must be sufficient to meet the quality requirements of the designated waste acceptance criteria. Waste disposal documentation, field surveys, and other appropriate information may also be used to ensure corrective actions were completed as planned.

B.4.2.1 Sample Locations

Design of the sampling approaches for the CAU 539 CASs must ensure that the data collected are sufficient for selection of the CAAs (EPA, 2002). To meet this objective, the samples collected from each site should be from locations that most likely contain a COC, if present. These sample locations, therefore, can be selected by means of biasing factors used in judgmental sampling (e.g., a stain likely containing a spilled substance). Because sufficient data are available to develop a judgmental sampling plan, this approach was used to select locations for sampling environmental media at the CASs. Biasing factors include areas of elevated radiological readings and piles of lead bricks.

B.4.2.1.1 Judgmental Approach for Sampling Location Selection

Decision I sample locations at CASs 25-99-21 and 26-99-05 will be determined based upon the likelihood of the soil containing a COC, if present at the CAS. These locations will be selected based on field-screening techniques, biasing factors, the CSM, and existing information. Analytical suites for Decision I samples will include all COPCs identified in Table B.2-2.

Field-survey techniques will be used to select appropriate sampling locations by providing semiquantitative data. Field screening may also be used for health and safety monitoring and to assist in making certain health and safety decisions. The following field-survey methods and biasing factors may be used to select biased sample locations at CAU 539 CASs:

- Walkover radiological surveys: A radiological gamma walkover survey was conducted in August and September 2009 using a hand-held TSA PRM470 scintillation radiation detector coupled with a Trimble global positioning system to identify any areas with elevated radiological readings. The survey was conducted along each track of the railroad. Any points of interest were also surveyed. The results of the survey show various levels of readings ranging from indistinguishable from background to elevated readings. Elevated radioactivity was detected in four primary areas along the railroad tracks: TCC, the posted radiological materials area near TCC, TCA, and R-MAD. All features and points of interest were documented. The information and the data generated during the survey are archived in the Geographic Information Systems (GIS).

- Radiological surveys will be conducted under any railroad trestles during the initial phase of the field effort. If these surveys show radiological contamination, the sample locations will be adjusted accordingly.

- Elevated radiation: *In situ* TLD measurements will be used to select soil sample locations with the highest elevated reading above surrounding background soil.

- Stains: Any discolored soil, material, or other surfaces.

- Drums, containers, equipment, or debris: Materials that may have been used at, or added to, a location and that may have contained or come in contact with hazardous or radioactive substances at some point during their use. Note that, during the initial site visits, drums full of railroad spikes and piles of lead bricks were observed.

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

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

- Experience and data from investigations of similar sites that have radiologically contaminated soil.

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

- Other biasing factors: Factors not previously defined for the CAI, but become evident once the investigation of the site is under way.

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

B.4.2.2 Analytical Methods

Analytical methods are available to provide the data needed to resolve the decision statements. The analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) are provided in Tables 3-4 and 3-5.

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

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

B.5.1 Target Populations of Interest

The population of interest to resolve Decision I ("Is any COC present in environmental media within the CAS?") is any location within the CAS that contains contaminant concentrations above a FAL. In the case of radionuclides, the population of interest is any location where the TED exceeds the FAL. The populations of interest to resolve Decision II ("If a COC is present, is sufficient information available to evaluate potential CAAs?") are:

- Each one of a set of locations bounding contamination in lateral and vertical directions.
- IDW or environmental media that must be characterized for disposal.
- Remediation waste.

B.5.2 Spatial Boundaries

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

Table B.5-1
Spatial Boundaries of CAU 539 CASs

CAS	Spatial Boundaries
25-99-21 and 26-99-05	The lateral boundary for railroad releases is 1 mi (to allow for migration due to erosion); the vertical boundary (depth) is limited to 10 ft bgs.
	The boundary for the lead bricks is within 5 ft laterally from the bricks, and 10 ft bgs vertically.
	For other potential releases, the vertical boundary is limited to 10 ft bgs below the release point, and the horizontal boundary is 50 ft laterally from the release point.

B.5.3 Practical Constraints

Practical constraints that may affect the ability to investigate this site include military activities at the NTS, utilities, threatened or endangered animal and plants, unstable or steep terrain, and/or access restrictions.

B.5.4 Define the Sampling Units

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

B.6.0 Step 5 - Develop the Analytic Approach

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

B.6.1 Population Parameters

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

For radiological judgmental ballast and subsurface sampling results, the population parameter is the TED. For ballast results, the TED is composed of external dose results from TLDs and the internal dose calculated from the soil samples using RESRAD (Yu et al., 2001). For subsurface sampling results, the TED is the internal and external doses calculated from the soil samples using RESRAD.

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

B.6.2 Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation and, therefore, streamline the consideration of remedial alternatives. The RBCA process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2009a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2009b) requires the use of ASTM Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards (i.e., FALs) or to establish that corrective action is not necessary."

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

- Tier 1 evaluation - conducted by comparing sample results from source areas (highest concentrations) to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the SAFER Plan). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

- Tier 2 evaluation - conducted by calculating Tier 2 SSTLs using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total TPH concentrations will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.

- Tier 3 evaluation - conducted by calculating Tier 3 SSTLs on the basis of more sophisticated risk analyses using methodologies described in ASTM Method E1739 that consider site-, pathway-, and receptor-specific parameters.

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

B.6.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA *Regions 3, 6, and 9 Regional Screening Levels for Chemical Contaminants at Superfund Sites* (EPA, 2009) for industrial soils. Background concentrations for RCRA metals will be used instead of SLs when natural background concentrations exceed the SL, as is often the case with arsenic on the NTS. Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established SLs, the protocol used by EPA Region 9 in establishing SLs (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

B.6.2.2 Radionuclide PALs

The PALs for radiological contaminants (other than tritium) are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenarios (NCRP, 1999) scaled to 25-mrem/yr dose constraint (Murphy, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). These PALs are based on the construction, commercial, and industrial land-use scenarios provided in the NCRP Report and are appropriate for the NTS based on future land use scenarios as presented in Section B.2.2.6.

B.6.3 Decision Rules

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

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

The decision rules for Decision I are:

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

- If no COC associated with a release from the CAS is detected, then further assessment of the CAS is not required and the CAA of no further action will be selected.

- If a waste is present that, if released, has the potential to cause the future contamination of site environmental media, then a corrective action will be determined, else no further action will be necessary.

The decision rules for Decision II are:

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

- If the extent of the contamination is defined and additional remediation can be accomplished during the SAFER, then clean close the site by removing the contaminated media until all contamination has been removed. If the extent of contamination has been determined and additional remediation cannot be accomplished during the SAFER, then the contaminated area will be closed in place with appropriate URs and the extent of contamination defined.

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

B.7.0 Step 6 - Specify Performance or Acceptance Criteria

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

B.7.1 Decision Hypotheses

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

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

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

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

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

- Developing and achieving concurrence of CSMs (based on process knowledge) by stakeholder participants during the DQO process.

- Conducting validity testing of CSMs based on investigation results.

- Evaluating data quality based on DQI parameters.

B.7.2 False Negative Decision Error

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

B.7.2.1 False Negative Decision Error for Judgmental Sampling

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

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

- For Decision I, having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS. For Decision II, having a high degree of confidence that the sample locations selected will identify the extent of COCs.
- Having a high degree of confidence that analyses conducted will be sufficient to detect 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 must be collected in areas most likely to be contaminated by COCs (supplemented by random samples where appropriate). Decision II samples must be collected in areas that represent the lateral and vertical extent of contamination (above FALs). The following characteristics must be considered to control decision errors for the first criterion:

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

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

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

To satisfy the third criterion, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, and completeness as defined in the Industrial Sites QAPP (NNSA/NV, 2002a) and in Section 7.2 of this SAFER Plan. The DQIs of precision and accuracy will be used to assess overall analytical method performance as well as to assess the need to potentially "flag" (qualify) individual contaminant results when corresponding QC sample results are not within the established control limits for precision and accuracy. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the analyte performance criteria based on an assessment of the data. The DQI for completeness will be assessed to ensure that all data needs identified in the DQO have been met. The DQI of comparability will be assessed to ensure that all analytical methods used are equivalent to standard EPA methods so that results will be comparable to regulatory action levels that have been established using those procedures. Strict adherence to established procedures and QA/QC protocol protects against false negatives. Site-specific DQIs are discussed in more detail in Section 7.2 of this SAFER Plan.

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

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

B.7.3 False Positive Decision Error

The false positive 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.

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

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

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

Step 7 of the DQO process selects and documents a design that will yield data that will best achieve performance or acceptance criteria. A judgmental sampling scheme will be implemented to select sample locations and evaluate analytical results for CASs 25-99-21 and 26-99-05 in CAU 539. Sections B.8.1 and B.8.2 contain general and specific information about collecting Decision I and Decision II samples under judgmental sampling designs. These sections also provide CAS-specific sampling activities, including proposed TLD placement and/or sample locations, when applicable.

These CASs are combined for discussion of investigation activities because both CASs will be investigated in the same manner and both CASs have similar releases of fuel flecks and potentially other radioactive material to the soil surrounding the railroads from the transport of reactors and equipment between testing facilities. Lead bricks were also discovered along each railroad. Figure B.8-1 shows the current site conditions of the railroad in CAS 25-99-21, and Figure B.8-2 shows the current site conditions of the railroad in CAS 26-99-05.

Figure B.8-1
Current Site Conditions at CAS 25-99-21

Figure B.8-2
Current Site Conditions at CAS 26-99-05

B.8.1 Decision I Sampling

A judgmental sampling approach will be implemented for the Decision I investigation of the CAU 539 Railroad Tracks CASs. Because individual sample results, rather than an average concentration, will be used to compare to FALs at the CASs undergoing judgmental sampling, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest as defined in Section B.5.1. To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for

Decision I samples to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in Section B.4.2.1. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals selected by the 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 judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

B.8.1.1 Decision I Radiological Sampling Approach

The following subsections describe, in general order, the Decision I radiological sampling approach for both CAU 539 Railroad Tracks CASs. Radiological data collected will estimate the TED at selected transects along the railroad that represent the maximum dose to receptors. The TED will be determined by summing the internal and external dose components. Analytical results from soil samples will be used to calculate internal dose using RESRAD computer code (Yu et al., 2001). External dose will be determined by collecting *in situ* measurements using TLDs.

Internal dose is the combination of doses resulted from ingestion and inhalation of radioactive material (Yu et al., 2001). For the CAU 539 Railroad Tracks CASs, there is no ingestion pathway by food and water consumption because of the designated land-use scenarios (DOE/NV, 1998). That leaves only soil ingestion and inhalation as the potential pathway for internal dose to the receptor.

The primary determining factor for soil ingestion and inhalation is the direct contact with the contaminated soils. Particle size and solubility also need to be considered while conducting the dose assessment for soil ingestion and inhalation (Yu et al., 2001).

The configuration and location of the Railroad Tracks CASs precludes any constant direct worker contact with potentially contaminated soils. The PSM (fuel flecks) has physically settled inside the environmental media (e.g., ballast), and resuspension of those flecks would have to be caused by intrusive activities. Coupled with the extremely low solubility of the fuel flecks and low precipitation on the NTS, the migration potential is significantly limited.

The effects of nuclear fuel particles, released to the environment, on humans have been assessed in a few epidemiological and theoretical studies. These studies are based on occupational exposure and exposure to uranium fuel particles released from the Chernobyl accident. A study of nuclear fuel particle resuspension as a result of anthropogenic activities has shown that the concentration of large particles (12 to 20 micrometers [μm]) in air increased by more than an order of magnitude than the concentration of fine particles (2 to 4 μm) (Garger et al., 1998). This trend of increased concentration in air for larger particles as a result of anthropogenic activities has been reported for other radioactive aerosols (Kim et al., 2006). As discussed, the fuel flecks (i.e., the PSM) have settled into the environmental media (soil and ballast) and, as a result, there is an extremely low potential for the fuel flecks to be re-suspended into the air as a result of non-anthropogenic activities. Therefore, it is highly improbable to have fine fuel-fleck material pose an inhalation issue.

Studies of the solubility of nuclear fuel particles from the Chernobyl reactor indicated that the dissolution rate constant decreased (for all nuclides) with increasing particle size. The decreasing inhalation dose with size and increasing dose with lower solubility may counterbalance each other for fission products (Garger et al., 2004).

Ingestion of insoluble particles, such as nuclear fuel compounds, does not pose significant radiological health effect. Uranium oxide (e.g., UO_2, UO_3) particles are not absorbed to any significant extent. Fission products are also absorbed poorly in their elemental form, and they are almost metabolically inert when fused in a uranium matrix (Lang et al., 1995). Under the designated land-use scenario, the significance from short-term intrusive activities particle resuspension at the Railroad Tracks CASs on the inhalation and soil ingestion dose is negligible.

Decision criteria are based on the maximum TED estimate at any given transect. Information on decreasing TED rate trends will be generated through soil sampling and calculating TED rates from Decision II samples, and correlating the dose with distance from point of release.

B.8.1.1.1 Collection of In Situ TLD Dose Measurements

To collect *in situ* dose measurements and provide a biasing factor for soil sample selection, TLDs will be placed at transects perpendicular to the railroad tracks. A total of 25 transects will be selected for TLD placement with 20 transects along the Area 25 Railroad Tracks and 5 transects along the

Area 26 Railroad Tracks. The selection criteria for placement of the TLDs include: (1) highest radiological readings from the gamma walkover survey conducted in August and September 2009; (2) areas with road crossings, switches, or trestles that could increase vibrations of railcars; and (3) culverts and/or bridges that could increase vibrations of railcars.

The TLD transect locations for CAS 25-99-21 are shown in Figure B.8-3. Based on the TLD dose measurements, a minimum of five transects will be selected for surface and subsurface soil sampling. Locations will be selected in areas most likely to be contaminated based on the conceptual model and other biasing factors outlined in Step 3 of the DQO process (e.g., field screening). The soil beneath and adjacent to the lead bricks at CAS 25-99-21 will be sampled during Decision I activities.

The five TLD transect locations for CAS 26-99-05 are shown in Figure B.8-4. Based on the TLD dose measurements, a minimum of two transects will be selected for surface and subsurface soil sampling. Locations will be selected in areas most likely to be contaminated based on the conceptual model and other biasing factors outlined in Step 3 of the DQO process (e.g., field screening). The soil beneath and adjacent to the lead bricks at CAS 26-99-05 will be sampled during Decision I activities.

Each selected transect will be further surveyed with handheld radiological instruments across the railroad tracks and on both sides of the railroad grade to determine locations of maximum radiological screening values. A maximum of four TLDs will be placed at locations along the transect. Figure B.8-5 is a conceptual diagram depicting where TLDs may be located within a transect. The TLDs will be placed at a height of 1 meter and remain in place for approximately 94 days so that an external dose representative of an exposure period of one industrial worker year (2,250 hours) can be determined. For the concrete-covered railroad tracks north of TCC, at least one of the eight randomly selected inspection locations falling within the posted radioactive material area will have a TLD measurement collected.

B.8.1.1.2 Ballast Samples

To provide data for calculating internal dose, ballast/soil samples will be collected at the TLD locations on transects indicating the highest external dose measurements. In Area 25, a minimum of five transects will be selected for biased sample collection, and a minimum of two transects will be selected in Area 26. One sample location within each transect will be selected based on the highest individual TLD reading within that transect. The sample will be collected from the ballast material as follows:

- Collect ballast from the surface to the ballast/native soil interface.
- Sieve the ballast to remove size fractions greater than 0.25 in.
- Spread out the sieved ballast on a pan and field-screen with radiological instruments so that radioactive fuel flecks can be identified and removed.
- After removal of the fuel flecks, the soil will be collected in sample bottles for analysis. The fuel flecks within the ballast will be monitored by the TLDs, and not removing them from the ballast could double the dose results.

Sufficient ballast will be collected to generate enough fine materials for the sample. The fine material represents the inhalation and ingestible fraction required for an internal dose to a receptor. Figure B.8-5 is a conceptual diagram depicting the surface sample profile within a transect.

B.8.1.1.3 Subsurface Samples

To investigate the potential for vertical migration of COPCs through the ballast and provide exposure data for receptors conducting intrusive work on the railroad ballast, subsurface soil samples will be collected at the same location as the surface samples. The subsurface samples will be collected from the top of the ballast/native soil interface to 6 in. below the interface. If radioactive fuel flecks are present within the soil matrix, the sample will be split into two aliquots. One aliquot will be collected and analyzed, leaving the fuel flecks within the soil matrix to represent the internal dose (inhalable and ingestible fraction). The other aliquot will be field-screened with radiological instruments to identify and remove radioactive fuel flecks before collection and analysis of the soil. Figure B.8-5 is a conceptual diagram depicting where the subsurface sample profile may be located within a transect.

B.8.1.1.4 Concrete-Covered Railroad Tracks Samples

During a preliminary site walkover, one section of the Area 25 Railroad Tracks, north of the TCC, was identified where concrete was poured between the tracks directly upon the ballast and railroad ties. Although not documented, the manner and appearance of the poured concrete suggests the concrete may have been used as a walking platform for railroad workers rather than to cover

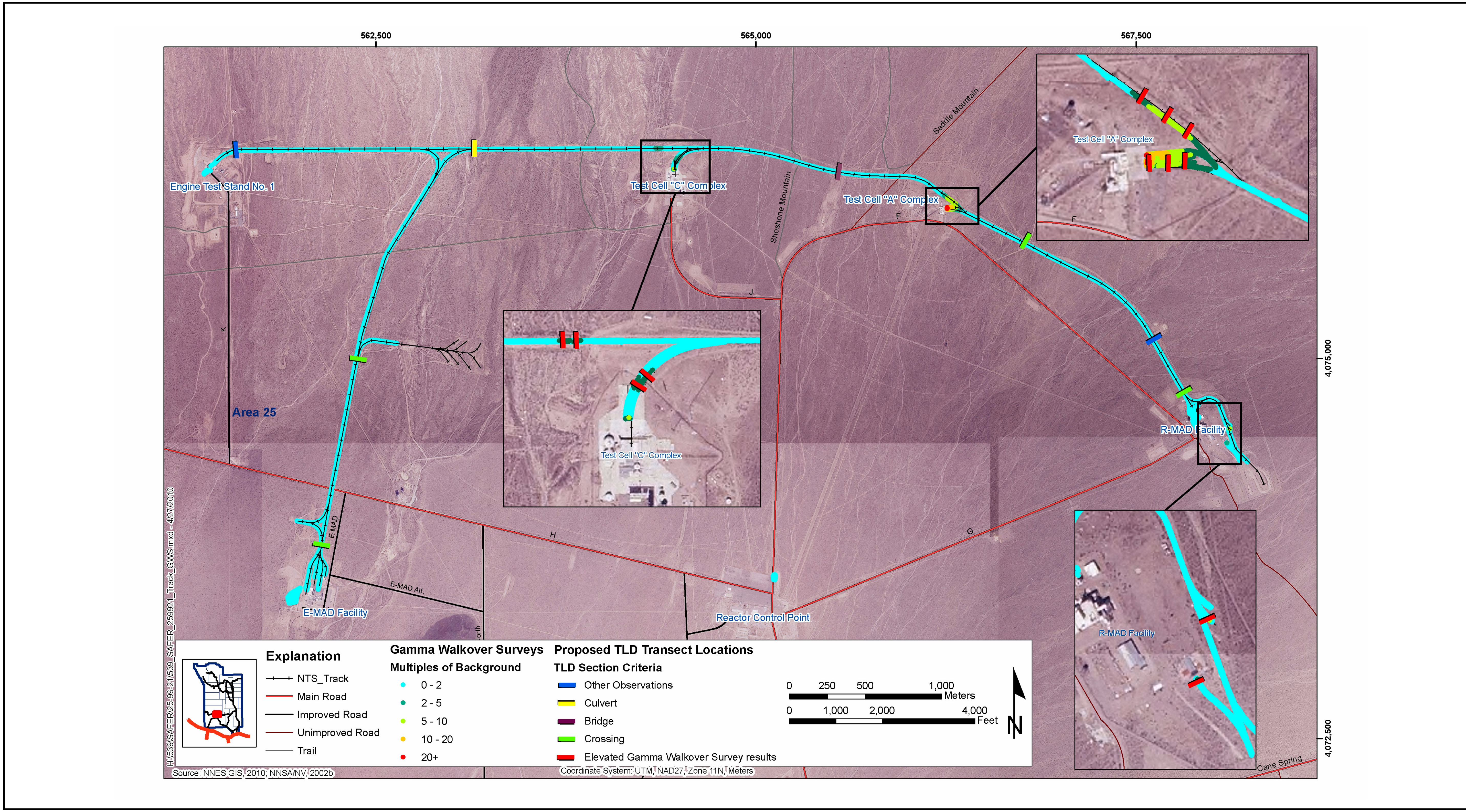

Figure B.8-3
Proposed TLD Locations at CAS 25-99-21

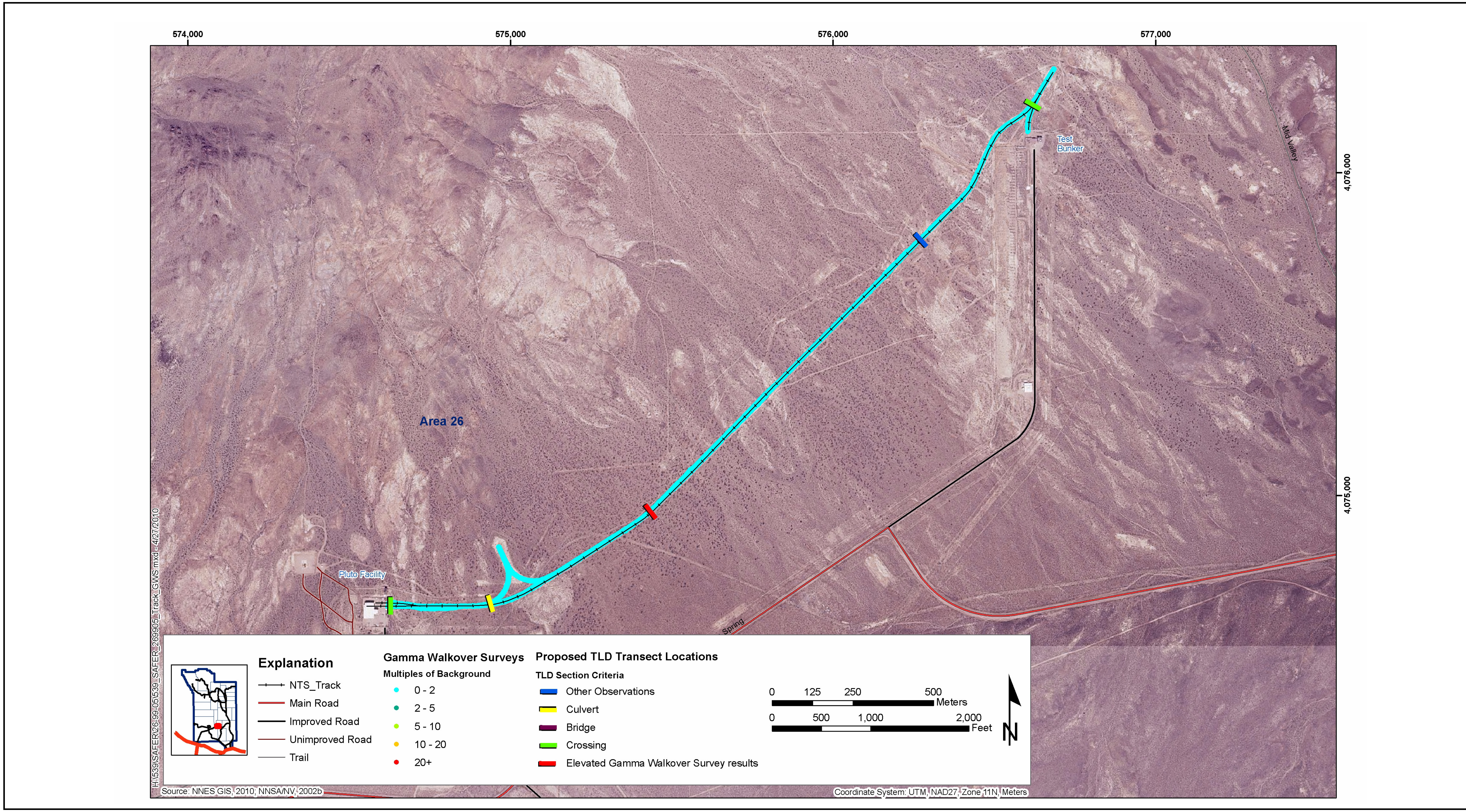

Figure B.8-4
Proposed TLD Locations at CAS 26-99-05

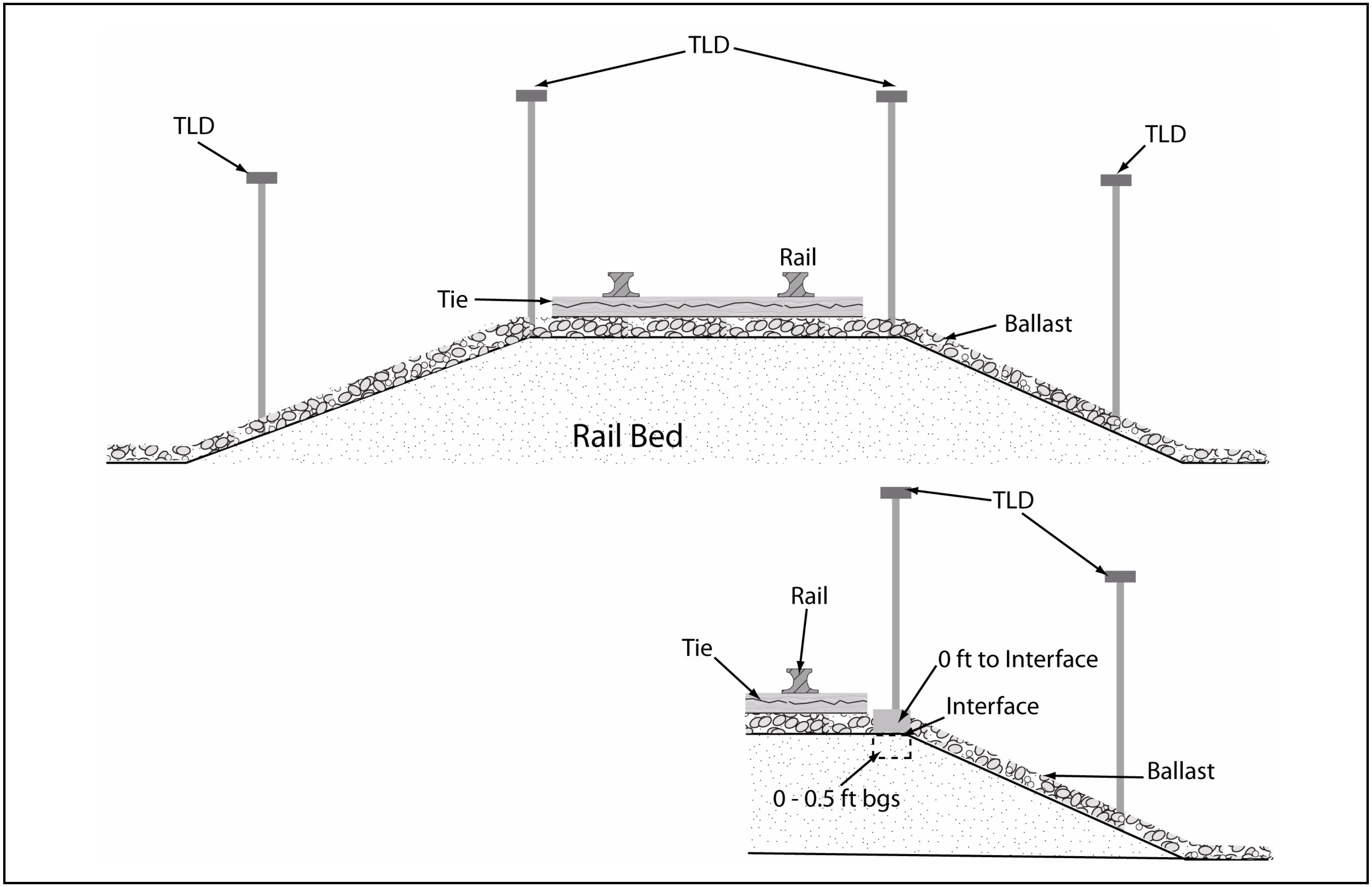

Figure B.8-5
Conceptual Diagram of TLD Placement and Sample Profiles

radiological contamination. However, these concrete-covered sections will be inspected to determine whether Decision I samples need to be collected. For each identified section of concrete-covered track, the following Decision I activities will be implemented:

- The total length of concrete-covered track will be measured.
- Eight randomly selected locations along the total length of concrete-covered track will be inspected for biasing factors.
- At each randomly selected location, the concrete will be broken, and the underlying 12 in. of ballast/soil will be field-screened with radiological instruments.
- If elevated radiological readings (greater than background plus two standard deviations) are detected, then a soil sample will be collected. If no elevated radiological readings are detected, then no sample will be collected.
- During investigation, any other biasing factors (e.g., staining) that may warrant additional sampling will be noted.

B.8.1.2 Decision I Nonradiological Sampling Approach

Nonradiological soil samples will be collected along the railroad tracks if biasing factors are identified (e.g., lead bricks, staining). Additional soil samples may be collected based on the site walkover observations and visual inspection of soils underlying the ballast at select TLD transects, crossings, roads, and the concrete-covered railroad tracks.

Sampling at the lead brick locations will consist of collecting one soil sample beneath the lead bricks. The lead bricks will be removed and placed in a waste drum. A shovel full of soil directly under the lead brick(s) will be placed in another waste drum and managed as “Hazardous Waste Pending Analysis” and potentially “Rad Waste Pending Analysis.” One confirmatory soil sample will then be collected.

For other potential releases, the location and depth of soil sample collection will be based on biasing factors (e.g., area of darkest stained soil or directly below release point if known).

B.8.2 Decision II Radiological and Nonradiological Sampling

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

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Appendix C

Nevada Division of Environmental Protection Comments

(1 Page)

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Addendum Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 114: Area 25 EMAD Facility, Nevada Test Site, Nevada	**2. Document Date:**	1/25/2010
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Federal Sub-Project Director:	Kevin J. Cabble	**6. Date Comments Due:**	2/24/2010
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850, ext. 233	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Section 4.5, Page 40	Mandatory	In this section, it is stated that closure may be determined based on whether removal of contaminants of concern (COCs) is feasible/not feasible. This criterion is much to general. Provide additional discussion that defines "feasible" and describes how NSO will determine, in the event COCs are present, which closure alternative to pursue (clean closure versus closure in place).	If COCs are identified and clean closure cannot be accomplished during the SAFER, then a hold point will have been reached and NDEP will be consulted to determine whether the remaining contamination will be closed under the alternative corrective action of closure in place. If COCs are identified and clean closure can be accomplished during the SAFER, clean closure will be the preferred CAA. This approach was taken throughout the document where "feasible" had been used. Conditions were identified and the action that would be taken was defined.	

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