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FY 2008 Phased Construction Completion Report for Exposure Units Z1-01, Z1-03, Z1-38, and Z1-49 in Zone 1 at the East Tennessee Technology Park, Oak Ridge, Tennessee

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Date

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FY 2008 Phased Construction Completion Report for Exposure Units Z1-01, Z1-03, Z1-38, and Z1-49 in Zone 1 at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—March 2008~~December 2007~~

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Accelerated Cleanup Activities at the
East Tennessee Technology Park
under contracts DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

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ACRONYMS

AP	assessment point
ARAR	applicable or relevant and appropriate regulation
ARL	average remediation level
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	contaminant of concern
COPC	contaminant of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DQO	data quality objective
DRO	diesel range organics
DVS	Dynamic Verification Strategy
DWP	Dynamic Work Plan
ELCR	excess lifetime cancer risk
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
EU	exposure unit
FCN	Field Change Notice
FFA	Federal Facility Agreement
FIDLER	field instrument for the detection of low energy radiation
FY	fiscal year
GRO	gasoline range organics
HI	hazard index
HVSS	Happy Valley Service Station
ISL	initial screening level
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
NFA	no further action
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PCCR	Phased Construction Completion Report
PID	photoionization detector
PRG	preliminary remediation goal
QAPP	Quality Assurance Program Plan
QC	quality control
RA	remedial action
RAO	remedial action objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RL	remediation level
ROD	Record of Decision
SL	screening level
SU	soil unit
SVOC	semivolatile organic compound
TAL	target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
TM	technical memorandum

TSDRF	treatment, storage, disposal, or recycle facility
UST	underground storage tank
VOC	volatile organic compound
WAC	waste acceptance criteria

EXECUTIVE SUMMARY

The *Record of Decision for Interim Actions in Zone 1, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1997&D2, Zone 1 ROD) defined four geographic areas in Zone 1 that required evaluation for unrestricted industrial use to 10 ft bgs. Exposure units (EUs) in three of these areas are addressed in this Phased Construction Completion Report (PCCR) (Z1-49 in the K-901 Area, Z1-38 in the Duct Island Area, and Z1-01 and Z1-03 in the K-1007 Ponds Area).

Portions of the Duct Island, K-901, and K-1007 Ponds Areas were addressed in the Phased Construction Completion Report for the Duct Island Area and K-901 Area in Zone 1 (DOE 2006a) and the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b), which recommended the remedial actions (RAs) in EUs Z1-01, Z1-03, Z1-38, and Z1-49 reported in this PCCR.

The four EUs included in this PCCR comprise 81.1 acres. Based on results of the Dynamic Verification Strategy (DVS) evaluation and the RAs completed in those EUs (see Table ES.1), all of the 81.1 acres assessed have been recommended for unrestricted industrial use to 10 ft bgs. As used in this PCCR, the term no further action refers to soils and subsurface infrastructure.

Table ES.1. Remedial actions performed at Z1-01, Z1-03, Z1-38, and Z1-49

Site name	EU	DVS assessment/RA
S-21 Happy Valley Service Station FFA site	Z1-01	RA complete/NFA
K-1055 Gasoline/Diesel Station Tanks FFA site	Z1-03	RA complete/NFA
Duct Island South soil mounds	Z1-38	RA complete/NFA
K-895 Cylinder Destruct Facility FFA site	Z1-49	RA complete/NFA

DVS = Dynamic Verification Strategy
EU = exposure unit
FFA = Federal Facility Agreement
NFA = no further action
RA = remedial action

The Zone 1 ROD remedial action objectives were developed to support the future use of ETTP as a commercial industrial park. Therefore, remediation criteria were designed for the protection of the future industrial worker under the assumption the worker normally would not have the potential for exposure to soils at depths below 10 ft bgs. Accordingly, the Zone 1 ROD requires land use controls to prevent disturbance of soils below 10 ft deep and restricts future land use to industrial/commercial activities. In response to stakeholder comments, the U.S. Department of Energy agreed to reevaluate the land use restrictions. This document includes a screening evaluation to determine the likelihood that land use controls in portions of Zone 1 could be modified to (1) eliminate the restriction on disturbance of soils below 10 ft bgs where data indicate the absence of residual contamination at any depth would result in an unacceptable risk to the future industrial worker, and (2) permit alternative land uses that would be protective of future site occupants. Results of this evaluation indicated a high probability that the restrictions on the disturbance of soil below 10 ft bgs could be safely eliminated for all four EUs discussed in this document (81.1 acres).

A qualitative screening evaluation considered the likelihood that unrestricted land use would be protective of future site occupants. Based on this qualitative assessment, all but one of the EUs assessed in this PCCR are assigned a low probability for consideration for release for unrestricted land use.

This PCCR details the purposes for this report and the RAs performed. Historical and DVS analytical data used in support of this PCCR are provided on a compact disc with this document and also can be accessed through the Oak Ridge Environmental Information System.

1. INTRODUCTION AND PURPOSE

The purpose of this Phased Construction Completion Report (PCCR) is to present the results of the remedial actions (RAs) performed in exposure units (EUs) Z1-01 and Z1-03 in the K-1007 Ponds Area, Z1-49 in the K-901 Area, and Z1-38 in the Duct Island Area of Zone 1 at the East Tennessee Technology Park (ETTP) in Oak Ridge, Tennessee. The RAs were performed as specified in the Phased Construction Completion Report for the Duct Island Area and K-901 Area in Zone 1 (DOE 2006a) and the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b).

East Tennessee Technology Park is located in the northwest corner of the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) in Oak Ridge, TN (Fig. 1). ETTP encompasses a total land area of approximately 5000 acres, which has been subdivided into Zone 1 (~1400 acres), Zone 2 (~800 acres), and the Boundary Area (~2800 acres).

Zone 1 was used historically for light industrial purposes and includes waste disposal sites, open undeveloped acreage, and a previously industrialized power generation facility and associated buildings. Buildings, infrastructure, scrap metal yards, and waste disposal sites remain in Zone 1. The Record of Decision for Interim Actions in Zone 1 (DOE 2002) (Zone 1 ROD) specified that the future land use for Zone 1 be classified as unrestricted industrial for the top 10 ft bgs. For the purpose of describing release sites listed in Appendix C of the Federal Facility Agreement (FFA) (DOE 1992), Zone 1 was divided into four geographic areas [K-901 Area, Powerhouse Area, Duct Island Area, and K-1007 Ponds Area (see Fig. 1)]. The boundaries of these areas are based on natural boundaries of major water bodies, topographic divides, surface water drainages, and/or property boundaries.

The main text of this report describes the Dynamic Verification Strategy (DVS) and scope of work performed and the RAs completed. The scope and approach for performing DVS activities that lead to the RAs are presented in Sects. 2 through 4. Remedial actions performed in fiscal year (FY) 2008 are presented in Sects. 5 through 10. Land use controls of these areas are described in Sect. 11, and the status of all Zone 1 EUs as of the publication date of this PCCR is presented in Sect. 12.

Table 1 lists the RAs performed and their EUs, EU Groups, and areas.

Table 1. Zone 1 RA locations

Zone 1 EU Area	Zone 1 EU Group	EU	RA site
K-1007 Ponds	Happy Valley Service Station	Z1-01	S-21 Happy Valley Service Station USTs
	K-1007 Ponds	Z1-03	K-1055 Gasoline/Diesel Station USTs
K-901	K-901-A North	Z1-49	K-895 Cylinder Destruct Facility
Duct Island	Duct Island South	Z1-38	Duct Island South soil mounds

EU = exposure unit
RA = remedial action
UST = underground storage tank

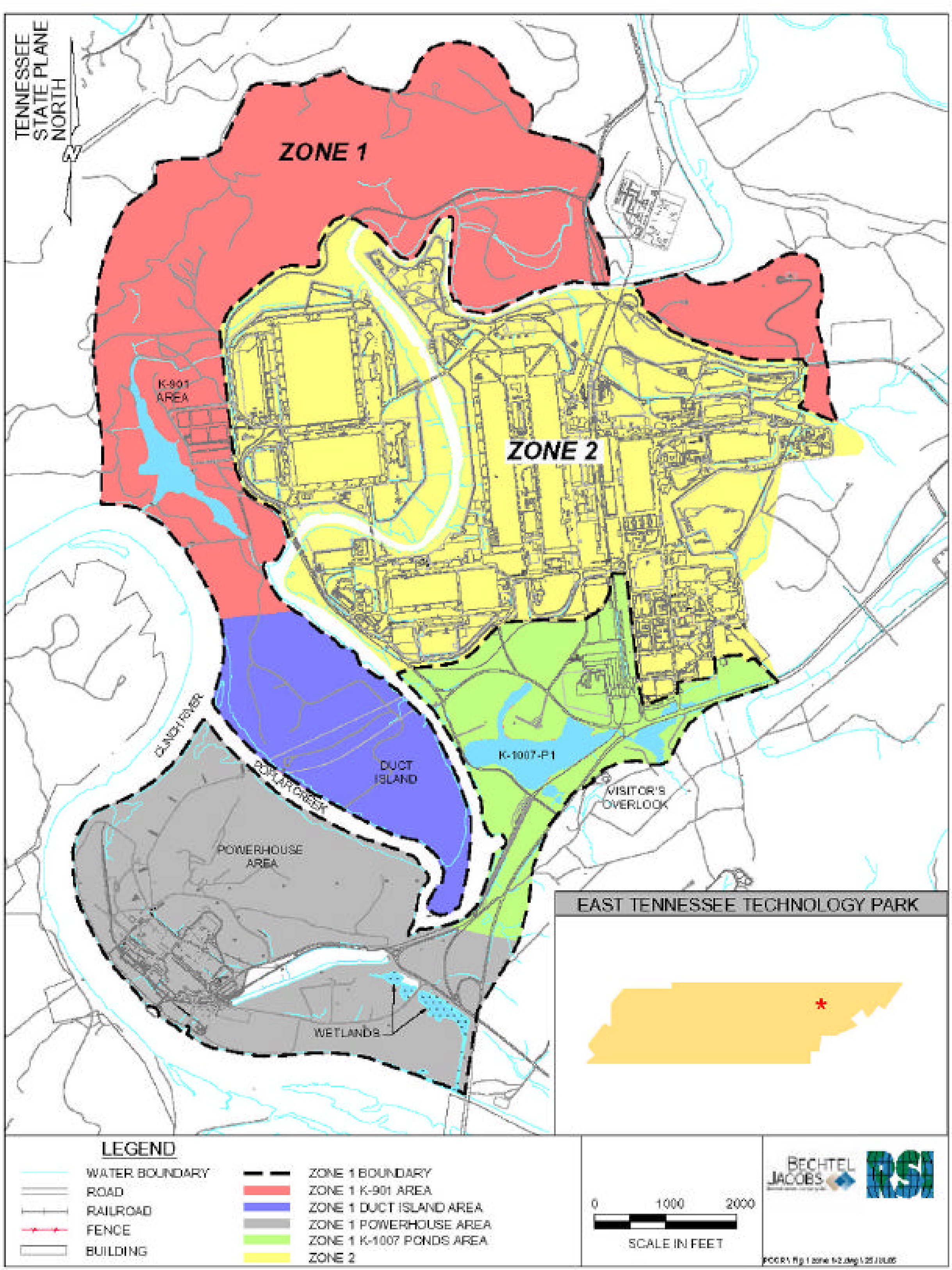

Fig. 1. ETTP site map with Zone 1 geographic areas.

2. PROJECT DESCRIPTION

2.1 SCOPE

This section describes the scope and process for performing DVS characterization activities in Zone 1 that lead to the recommended RAs.

2.1.1 Exposure Unit Groups

The Zone 1 ROD divided the area of Zone 1 into 80 EUs ranging in size from 4.3 to 70.1 acres. Each EU represents a hypothetical area over which an industrial worker would be exposed to contaminated soil in the interval 0-10 ft bgs. The acreage of each EU has been calculated based on the estimated EU boundaries defined in the Zone 1 ROD. For the Zone 1 DVS characterization program, the EU boundaries and acreage calculations were refined. Acreages presented in this document have been rounded to one decimal place. Calculation of the acreages resulted in some discrepancies from the acreages reported in the ROD because of boundary refinement and increased level of accuracy.

To facilitate planning and field program execution, the 80 EUs were grouped into 17 EU groups (see Fig. 2). The Zone 1 EU groups, EUs, and associated total EU group acreages are shown in Table 2.

DVS activities that resulted in the recommendation to perform the RAs included in this PCCR are reported in the Phased Construction Completion Report for the Duct Island Area and K-901 Area in Zone 1 (DOE 2006a) and the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b). The scope and approach for performing these activities are described in Sects. 2 through 4.

Remedial action activities were performed in the Happy Valley Service Station Group, K-1007 Ponds Group, K-901-A North Group, and Duct Island South Group (see Sects. 5 through 10).

2.1.2 Excluded Acreage

Many of the EUs in Zone 1 have been addressed in previous PCCRs. For several EUs, the final status determination has not been made because characterization is incomplete or recommended remedial actions have not been performed. Aside from those EUs included in previous PCCRs, ongoing operations or incomplete RA also excludes the following EUs from this PCCR:

- EU Z1-09 in the Firehouse and Ash Pile Group,
- EU Z1-11 in the Firehouse and Ash Pile Group,
- EUs Z1-17 through Z1-22 and Z1-26 in the K-722 Area Roads Group,
- EUs Z1-27 through Z1-33 in the K-770 Group, and
- EUs Z1-66 and Z1-70 in the K-25 Contractor Spoils Area Group.

These EUs will be included in a future PCCR or the Zone 1 Remedial Action Report (RAR).

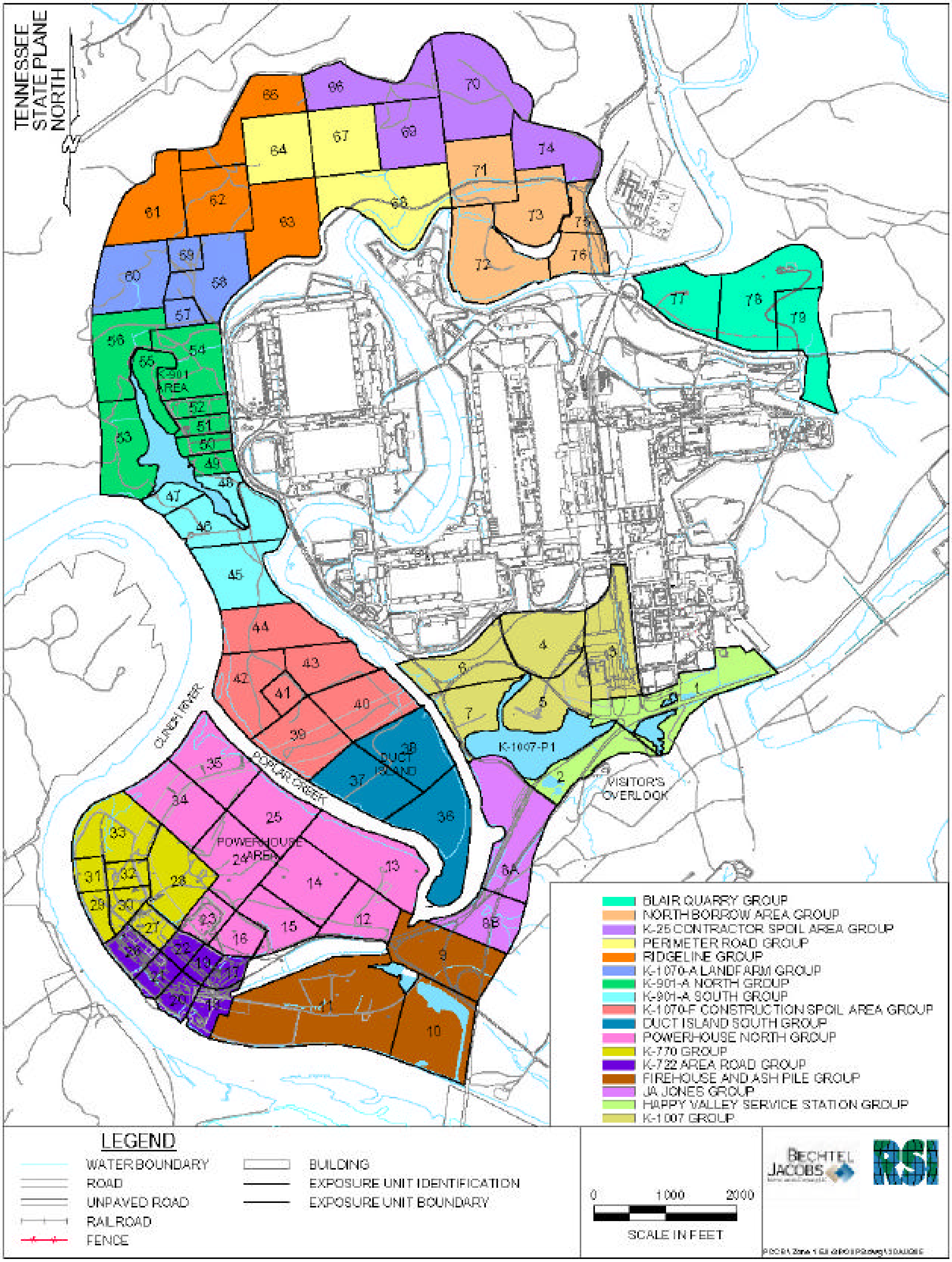

Fig. 2. EUs and EU groups in Zone 1.

Table 2. Zone 1 EU areas, EU groups, and EU group acreages

EU group	EUs	Acreage (acres)
K-1007 Ponds Area		
Happy Valley Service Station Group	1 and 2	41.9
K-1007 Ponds Group	3, 4, 5, 6, and 7	98.5
J.A. Jones Group	8A and 8B	46.1
	K-1007 Ponds Area total acreage	**186.5**
Powerhouse Area		
Firehouse and Ash Pile Group	9, 10, and 11	120.2
Powerhouse North Group	12, 13, 14, 15, 16, 23, 24, 25, 34, and 35	168.2
K-722 Area Roads Group	17, 18, 19, 20, 21, 22, and 26	38.8
K-770 Group	27, 28, 29, 30, 31, 32 and 33	65.5
	Powerhouse Area total acreage	**392.7**
Duct Island Area		
Duct Island South Group	36, 37, and 38	65.5
K-1070-F Group	39, 40, 41, 42, 43, and 44	100.9
	Duct Island Area total acreage	**166.4**
K-901 Area		
K-901-A South Group	45, 46, 47, and 48,	52.1
K-901-A North Group	49, 50 , 51, 52, 53, 54, 55, and 56	88.0
K-1070-A Group	57, 58, 59, and 60	51.0
Ridgeline Group	61, 62, 63, and 65	87.5
Perimeter Road Group	64, 67, and 68	72.4
K-25 Contractor Spoils Area Group	66, 69, 70 and 74	93.9
North Borrow Area Group	71, 72, 73, 75, and 76	83.9
Blair Quarry Group	77, 78, and 79	67.1
	K-901 Area total acreage	**595.9**
	Total all areas	**1341.5**

EU = exposure unit

2.1.3 Data Quality Objectives and Soil Unit Classifications

The first action taken under the DVS characterization program was to assemble data quality objective (DQO) scoping packages (BJC 2004a and 2004b). These scoping packages provided a compilation and evaluation of facility records and presented the results of previous sampling to provide the basis for soil unit (SU) classification and determination of additional sampling needs. This classification generally followed the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) in which the probability that an area has been impacted and the extent of the impact form the basis for classification. The purpose of SU classification was to develop a graded approach so that soils with the highest probability of contamination received the highest level of scrutiny and those with the lowest probability of contamination received the lowest level of scrutiny.

The SUs were classified as follows:

- Class 1 [high to moderate probability that contaminants exceed remedial action objectives (RAOs)],
- Class 2 (moderate to low probability that contaminants exceed RAOs),
- Class 3 (impacted areas with low probability of contamination above RAOs), or
- Class 4 (no impact from anthropogenic activities).

The breakdown of the soil classification for acreage addressed by this PCCR includes the following:

- 0.8 acres in Class 1 SUs;
- 2.8 acres in Class 2 SUs;

- 76 acres in Class 3 SUs; and
- 1.5 acres in Class 4 SUs.

In each case, the probability of contamination was based on a thorough review of historical data, aerial photographs, records, and personnel interviews. Systematic soil sampling activities and full coverage radiological walkover surveys under the DVS were focused primarily on Class 1 and Class 2 SUs. Class 3 and 4 SUs are evaluated by walkover assessments, which included historic photograph analysis, records research, visual inspection, limited radiological survey, and selected biased sampling based on walkover assessment observations and measurements.

2.1.4 Federal Facility Agreement Sites

A total of 81.1 acres are addressed in the four EUs included in this PCCR. Based on results of the DVS evaluation and RAs performed, all of the 81.1 acres are recommended for unrestricted industrial use to 10 ft bgs. Remedial actions completed in FY 2008 at the following sites are addressed in Sect. 5 of this document:

- S-21 Happy Valley Service Station FFA Site in EU Z1-01,
- K-1055 Gasoline/Diesel Station Tanks FFA Site in EU Z1-03,
- Duct Island South soil mounds in EU-38, and
- K-895 Cylinder Destruct Facility FFA site in EU Z1-49.

In addition, NFA was reached for four FFA sites in EU Z1-03 in the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b) but their final status assessment awaited the final assessment on EU Z1-03. These sites include:

- K-1047 Motor Pool Repair Shop FFA site;
- Building 665 Steam Oil Storage Area FFA site;
- South Plant Area Lab Drain Lines FFA site; and
- K-1027 Service Station FFA site.

Final status assessments are made in this PCCR for the above sites.

2.2 DVS CHARACTERIZATION APPROACH

This section presents the DVS approach to soils characterization, rationale supporting the conclusions reached, and communications necessary to make key decisions throughout the DVS process. Through characterization activities, DVS provides information to support decisions on if an action is needed. Additionally, DVS supports decisions on the extent of an action and, through confirmation sampling, whether the action is complete. The DVS process is further defined in the Zone 1 Remedial Action Work Plan (RAWP) (DOE 2007).

The DVS process was designed to provide sufficient data to determine if a RA is needed. To meet this goal, a sampling strategy was developed based on the likelihood of a RA being required. Six key components that comprise the DVS characterization include the following:

- Planning (Sect. 2.2.1),
  - Acreage classification (Sect. 2.2.1.1) and

— DQO scoping (Sect. 2.2.1.2)

- Class 1 and Class 2 SU characterization approach (Sect. 2.2.2),
- Class 3 and Class 4 SU characterization approach (Sect. 2.2.3),
- Program execution (Sect. 2.2.4),
- Action/no further action (NFA) decision/communication (Sect. 2.2.5), and
- Documentation and records (Sect. 2.2.6).

During the DVS planning stage (first component), the acres of interest were classified into SUs according to their potential level of contamination as described in Sect. 2.1.3 and the DQOs were applied to develop a sampling plan. Because of different probabilities for the presence of contamination, different SU classifications had different characterization strategies (second and third component). However, a base survey and sampling program was developed for all SU classifications and presented during DQO scoping (BJC 2004a). This base program was modified during field implementation as additional characterization needs were identified. The Class 1 and Class 2 SU base programs consisted of radiological walkover and geophysical surveys, where appropriate, and systematic sampling supplemented by biased sampling. The Class 3 and Class 4 SU base programs consisted primarily of visual inspections and radiological screening surveys with biased sampling conducted based on inspection and survey observations. Techniques used to accomplish SU characterization were implemented in the field (fourth component). Another DVS stage included RA Core Team decision making and communication, which was associated with all sampling programs (fifth component).

The RA Core Team's primary function is created to streamline planning and accelerate the completion of all actions at ETTP to accelerate site closure. This team, which uses a formalized, consensus-based process where members reach agreement on key closure issues and strategies, consists of representatives from the parties to the FFA [DOE, U.S. Environmental Protection Agency (EPA), and Tennessee Department of Environment and Conservation (TDEC)] and DOE's accelerated closure contractor.

The following subsections provide an overview of each DVS characterization process component.

2.2.1 Planning

Two key parts of the planning component that required RA Core Team concurrence include the following:

- SU classification, and
- DQO scoping for sampling plan development.

2.2.1.1 SU classification

The planning activity began with the land area within each EU Group being classified as either impacted or non-impacted by ETTP plant activities. This initial classification included compilation and review of existing information from historic aerial photographs, maps, drawings, and other facility records. After this initial activity, the land areas were assigned SU classifications as defined in Sect. 2.1.3. FFA sites are typically designated as Class 1 or Class 2 SUs.

2.2.1.2 DQO scoping

Once the area under consideration was classified into a SU, the quantity and quality of existing data and other information was evaluated against the DQO requirements for sufficiency and quality, and a DQO scoping package (BJC 2004a) was developed for base program surveying, sampling, and analysis. Some of the work described below (e.g., field survey results) was used to design the DQO scoping package and is considered part of the planning process. The scoping package, including the SU classifications, was presented to the RA Core Team for concurrence at a DQO scoping meeting conducted on January 19, 2005. The agreed-to plan was then documented in the Dynamic Work Plan (DWP) (BJC 2004c). Any additional sampling and analysis was added to the program with RA Core Team concurrence. The DWP identified sample locations and analysis requirements, including the use of real-time field measurements where applicable.

Per the DVS process, a portion of characterization samples were analyzed for an extensive list of potential contaminants. Fixed laboratory analyses were performed for a suite of analytes [volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, polychlorinated biphenyls (PCBs)] and a radiological analytical suite that included gamma spectroscopy, alpha spectroscopy, thorium-isotopic, uranium-isotopic, ^{99}Tc, and radium-specific analyses. All identified contamination was evaluated to determine if action was needed for the EU, and the decisions were based on the evaluation of identified contamination that considered the following:

- Primary and secondary contaminants of concern (COCs) identified in the Zone 1 ROD,
- Contaminants of potential concern (COPCs) identified during the risk evaluation process, and
- EU-specific COCs identified during characterization that resulted in an unacceptable EU risk.

Documentation included a summary of existing data, an assessment of data gaps in DQO scoping packages, and documentation of the base survey and sampling program in the Zone 1 DWP. Concurrence on the base program was reached by the Core Team and documented on concurrence forms.

2.2.2 Class 1 and Class 2 SU Characterization Approach

Implementation of the Class 1 and Class 2 SU characterization program included the steps listed below. Details on each step are provided in Sect. A.8 of the *Quality Assurance Project Plan for Soil Characterization Activities under the Dynamic Verification Strategy at the East Tennessee Technology Park, Oak Ridge, Tennessee* (QAPP), which is included in the Zone 1 RAWP (DOE 2007) as Appendix A.

- Step 1—Completed ecological impact assessment prior to significant disturbance (clearing).
- Step 2—Cleared to provide access (as required).
- Step 3—Performed radiological walkover surveys (where historic surveys are unavailable) and geophysical surveys (burial sites).
- Step 4—Selected systematic sample locations and additional biased sample locations based on survey results.
- Step 5—Performed base program and initial biased sampling.
- Step 6—Evaluated field and laboratory data.
- Step 7—Selected additional biased sample locations based on field measurements and laboratory results.

A flow diagram outlining the details of this characterization approach and associated decisions made for Class 1 and Class 2 SUs is presented in Fig. 3. Along with the planning component (acreage classification and DQOs) defined in Sects. 2.2.1.1 and 2.2.1.2, Steps 1 through 4 above constitute the base program for characterizing Class 1 and Class 2 SUs.

Once the RA Core Team concurred on the DWP, including the sampling plan, the first phase of field work (Steps 1 and 2 above) began by preparing the site and conducting an ecological impact assessment where significant clearing was necessary to conduct characterization activities.

Field radiological and geophysical surveys (Step 3) were performed several weeks to months prior to the actual sampling activity. This lead time allowed for evaluation of the survey data and supported the selection of a set of biased sample locations to evaluate the survey results. Geophysical surveys were used to define the boundaries of buried waste at landfill disposal sites or the presence of other buried objects [underground storage tanks (USTs)] and materials.

Radiological walkover surveys were used to define the limits of radiological contamination in surface soils. Results of the radiological walkover and geophysical surveys were used in determining the need for biased sample locations where elevated radiological readings or geophysical anomalies occurred (Step 4). (These survey results were used during the confirmation sampling phase to identify potential excavation boundaries.) After receiving concurrence from the RA Core Team, any identified biased sample locations identified from these survey results were included in the base sampling program.

With the base program defined and agreed to by the RA Core Team, characterization field work began (Step 5). Each EU Group was characterized according to the specific details initially presented during DQO scoping and finalized in the DWP. Soil sampling was performed using standard field methods and following EPA Region IV standard operating procedures.

The predominant method of sample acquisition for subsurface soil to depths up to 30 ft was Geoprobe® sampling. Surface and shallow interval soil sampling was done predominantly using hand augers. The standard DVS sampling methodology was to composite samples taken from the 0-0.5-ft interval, 1.5-2.0-ft interval, and 2.0-10.0-ft interval. This sample composite protocol is presented in Attachment C to the QAPP. Discrete interval samples were collected based on the following two criteria (Steps 5, 6, and 7):

- A field screening method that showed an elevated level for a COC in a segment of a core or
- Initial analytical results from samples submitted to a laboratory showed an action level [25% of an average remediation level (RL)] for one or more COCs was exceeded in the composite sample (Steps 6 and 7).

For the first criterion, field screening methods were used as part of the field characterization activity (Step 5). Two field screening methods used on soil cores included VOC screening using hand-held meters and radiological screening using core-scanning devices developed specifically for the DVS program. The purpose of field screening was to allow sample collection for laboratory analysis of specific core intervals most likely to have contamination in addition to collection of the composite sample. Collection of the most-likely contaminated segment of the core ensured existing contamination was represented in the analytical results. Recognition of potential VOC contamination also allowed the core segment to be collected for analysis prior to compositing so that any VOCs present were not lost by volatilization.

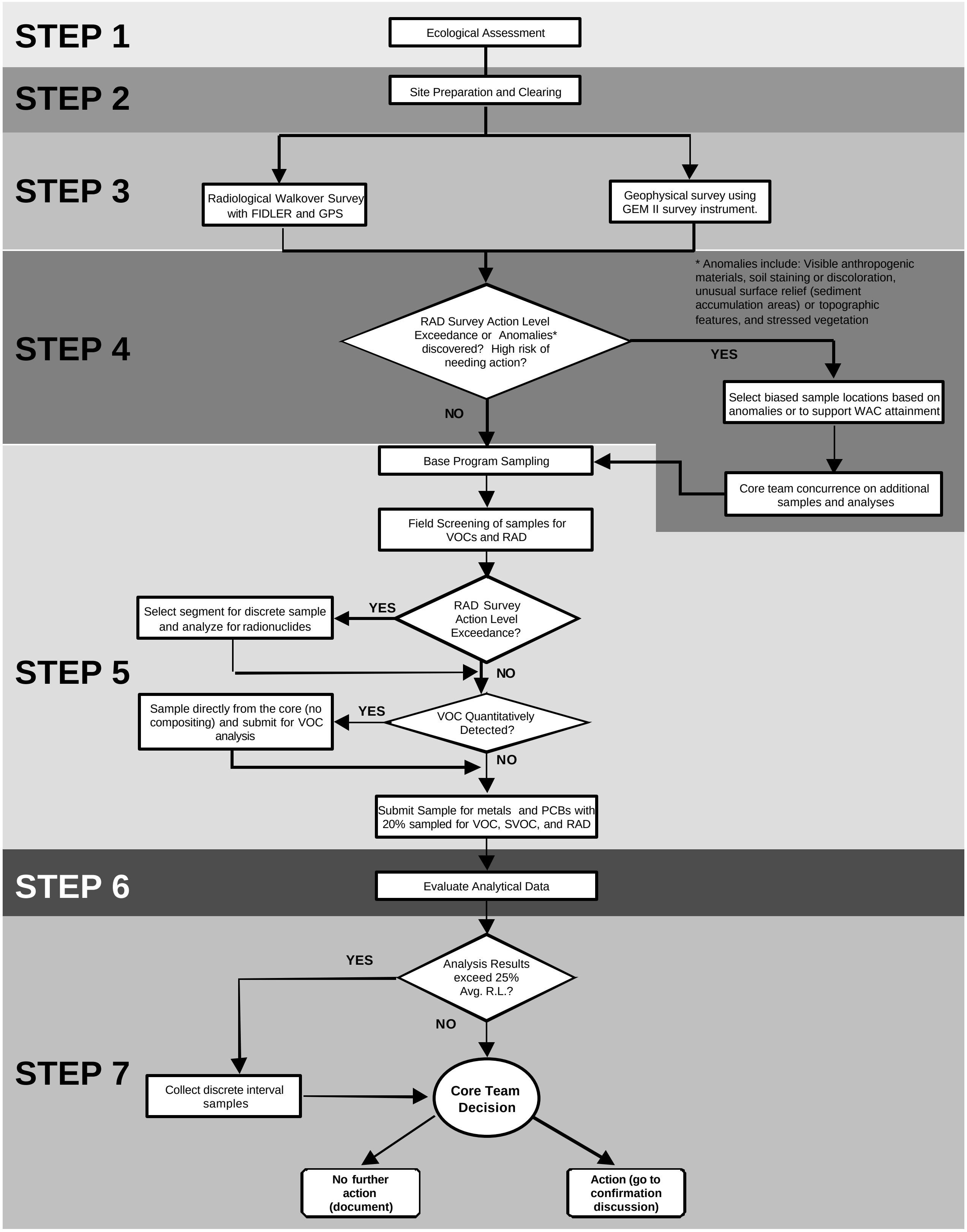

Fig. 3. Zone 1 DVS Class 1 and Class 2 SU sampling and analysis decision process flow.

The second criterion was based on analysis of laboratory results. The base program required all samples to be analyzed for metals and PCBs. To support the risk assessment, a randomly selected 20% of all samples were also analyzed for VOC, SVOC, and radiological analyses (Step 5). If laboratory-reported results indicated that action levels were exceeded in any of the randomly-selected composite samples, the location with elevated results was resampled for the specific parameters of concern and three discrete intervals were sent for analysis: 0-0.5 ft., 0.5 ft.-2.0 ft., and a selected interval in the 2.0-10.0 ft interval (Steps 6 and 7).

Current EPA laboratory analytical methods were used to provide risk assessment quality data as required by the DQO process and as stipulated in the DWP for all composite samples, discrete samples, and samples sent for full-suite analysis. All information collected was documented in the appropriate EU or EU Group technical memorandum (TM).

2.2.3 Class 3 and Class 4 SU Characterization Approach

A flow diagram outlining the characterization approach taken for Class 3 and Class 4 SUs and the associated decisions with the approach are presented in Fig. 4. Decisions associated with this approach included the following queries:

- Were there anthropogenic features, areas of elevated radiation, or sediment accumulation areas that required biased sampling and analysis?
- Did the EU exceed the RAOs from the Zone 1 ROD and, therefore, require action? (Results from Class 1 and 2 SU evaluations were needed to make this final EU-level assessment.)

Assessment of the Class 3 and Class 4 SU acreage proceeded independently of the Class 1 and Class 2 SU investigations. To begin, a visual walkover survey was conducted of the area. Class 3 and Class 4 SU assessments were performed in the winter months, when possible, to facilitate inspection in the heavily wooded portions of Zone 1. These assessments were conducted in accordance with the *Class 3 and Class 4 Soil Unit Walkover Assessment Protocol* included in Attachment C to the QAPP. The walkover survey was conducted to systematically inspect Class 3 and Class 4 SUs along transects to established systematic grid assessment locations, map observed features, and collect radiological screening data to support the action/NFA decision.

This assessment focused on identifying anthropogenic features, delineating boundaries of the features, and determining if sampling of the features was warranted. Anthropogenic features identified in the Class 3 and Class 4 SUs of Zone 1 were broadly inclusive of any feature that present as the result of any human activity. Identifying any unnatural conditions in the remote areas of the site, where little to no industrial activity occurred, was a very conservative approach to the site assessment protocol for clearing large tracts of peripheral lands in Zone 1. Anthropogenic features as defined in the Class 3 and Class 4 SU walkover assessment protocol included areas of radiation survey anomalous readings (above two times area background), visible anthropogenic materials (such as concrete, asphalt, metal debris, rubble, and rubbish), soil staining or discoloration, and/or stressed vegetation. In addition, crews were instructed to identify areas of unusual topographic relief, low areas where sediment would accumulate, and mounds of soil unusual for the local topographic conditions. This very broad definition of anthropogenic features provided a thorough assessment of the Class 3 and Class 4 SUs in Zone 1.

Within these peripheral lands, there have been activates that caused local land disturbances such as clearing for power line corridors, forest roads, and patrol roads, which were performed by bulldozing vegetation and rough grading the ground surface. The brush piles and soils were mounded along the perimeter of the clearing where the vegetative matter decayed and left numerous low earthen mounds. Obvious dump sites and local indiscriminant dumping mounds were selected for sampling. Earthen mounds clearly associated with clearing operations were not selected for sampling.

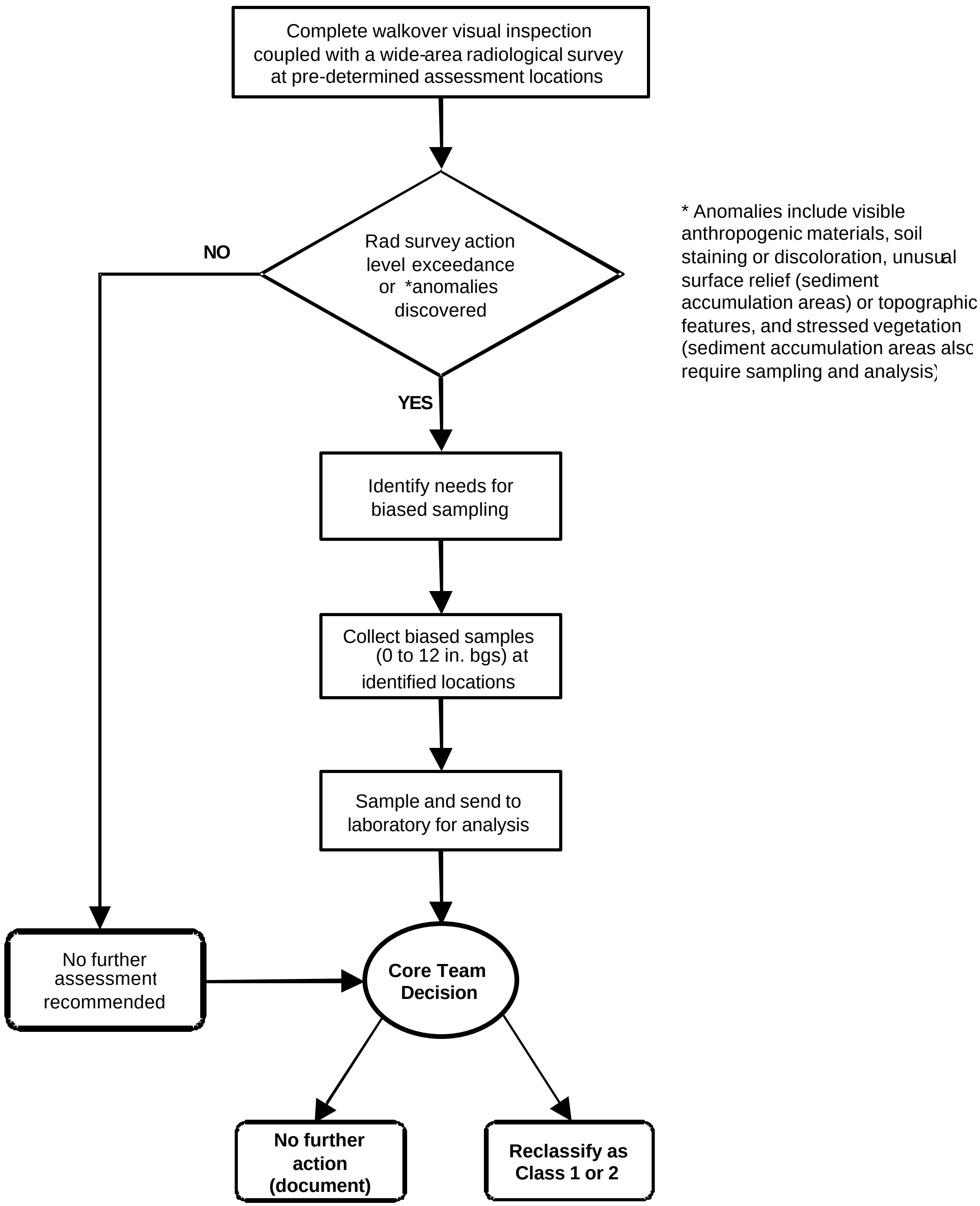

Fig. 4. Zone 1 DVS Class 3 and Class 4 SU sampling and analysis decision process flow.

A systematic grid with a random starting point was used to establish each assessment point (AP), with approximately one point per acre. A field instrument for detection of low-energy radiation (FIDLER) (Ludlum™ 44-17 detector, 2 in. × 2 mm) was carried by the survey crews. Background conditions were established for the EU group based on the *Class 3 and Class 4 Soil Unit Walkover Assessment Protocol*, which is found in Attachment C of the Zone 1 RAWP. The screening level (SL), which determined the need for further consideration and detailed evaluation, was twice the group mean background value. Approximately halfway to each AP, a mid-point was counted and surface features were described. Class 3 and 4 SU radiological surveys were conducted at APs, mid-points, and discretionary points during the Class 3 and Class 4 SU walkover assessments. Anthropogenic features or areas of elevated activity were also characterized using the FIDLER with 30-second counts at discretionary survey points.

Biased soil samples from identified anomalies were collected and analyzed for metals, radionuclides, and PCBs. Approximately 20% of the biased samples were sent for larger suites of analytes to aid in identifying previously unrecognized, site-related soil contaminants.

Biased sample locations also were identified in sediment accumulation areas, which were defined as areas where runoff from large portions of the SU and surrounding areas converged and had the potential for sediment deposition. The chemical and radiological composition of sediment accumulation area soils or sediments was representative of the upstream conditions and elevated levels of contamination were indicative of an upgradient source. Biased samples collected from these areas were sent to a laboratory for radionuclide, metal, VOC, SVOC, and PCB analysis to identify previously unrecognized site-related soil contaminants.

2.2.4 Program Execution

Soil sample collection was performed following EPA Region IV standard sampling methods and procedures. DVS base program sampling was tailored to the site-specific conditions and samples were collected in the 0-10 ft depths in all Class 1 and Class 2 SUs.

Four working conceptual site models (CSMs) were used for the EUs included in this document. The CSM for the S-21 Happy Valley Service Station and K-1055 Gasoline/Diesel Station Tanks FFA sites in EUs Z1-01 and Z1-03, respectively, involved leaks of VOCs (diesel and gasoline fuels) into the subsurface soils at depths equivalent to and below the base of a UST. A surface disposal of soils was applied to the Duct Island South soil mounds in EU Z1-38. The CSM for the K-895 FFA site in EU Z1-49 involved a surface release of radiological contaminants to a localized area in a constructed pier that extended into the K-901 Pond.

For the Class 1 and 2 SUs, the DVS program required at least 20% of all sample locations be drilled and sampled to a depth of 10 ft bgs. Sample borings were completed using Geoprobe® direct push equipment (Models 54DT and 54LT) and samples were collected in acetate liners and capped upon recovery. All boreholes were logged and described according to EPA Region IV guidance. All soil cores were scanned in the field for the presence of radioactive contaminants using the Model T Radiological Soil Core Screening System. The core screening action level was set to correspond to approximately 80% of the average remediation level (ARL) for U-238 (40 pCi/g). The core scanner SL was based on a background soil core for which a daily baseline value was determined. The SL varies slightly from day to day in response to local ambient radiological conditions and the natural activity of the background soils specific to the EU Group. SLs are set at the observed daily baseline (commonly in the range of 135-150 cpm) plus 65 cpm and are in the range of 200 cpm (±20 cpm), which provides 100% accuracy for identifying gamma-emitting radioactive contamination in soils in excess of 40 pCi/g.

Results of field activities discussed in this PCCR indicate the SLs for baseline plus 65 cpm consistently identified radiological constituents at 10 pCi/g or greater in soil cores. When the SL was exceeded, a discrete interval soil sample was collected for radiological analysis.

The acetate liners were split in the field and the core was screened for the presence of VOCs. When VOCs were detected > 5 ppm using a hand-held photoionization detector (PID), a discrete interval soil sample was collected for analyses. Approved sample containers were used at these sites and managed according to EPA Region IV protocols.

At base program sample locations, three intervals of the soil core were composited according to protocol described in the QAPP (Attachment C to Appendix A of the Zone 1 RAWP). The compositing procedure stipulated that equal volumes of soil from the 0-0.5-ft interval, 0.5-2.0-ft interval, and a selected section of core in the 2.0-10.0-ft interval were collected and thoroughly mixed to form a composite soil sample. The interval selected for inclusion in the soil composite was based on visual observation of the sample and targeted to select the most contaminated portion of the soil core. The selection was based on visual observations such as staining, odor, soil contacts, obvious waste, or the presence of unnatural materials. This methodology provided a physical composite that represented the average contaminant profile for the entire 0-10-ft interval. All base program composite samples were analyzed for PCBs and TAL metals and were screened in the field for the presence of VOCs (> 5 ppm) and radioactivity (in excess of two times background). Discrete interval samples were collected for VOC and radiological analyses if field SLs were exceeded (refer to the Zone 1 QAPP for specific procedures.)

The DVS program also required 20% of all sample locations be drilled and sampled to 10 ft bgs. At surface contamination sites such as the K-709 Switchyard, the base program focused in the 0-2.0-ft interval where contaminant releases would have occurred. However, 20% of the locations were drilled and sampled to 10 ft bgs. The program also required at least 20% of all samples be analyzed for a full suite of COCs, including VOCs, SVOCs, metals, PCBs, and radioisotopes. Locations to be drilled to depth and samples for full suite of analyses both were randomly selected. This selection process resulted in full suite analyses being performed on both surface and shallow interval samples and some deep soil samples.

Changes to the base program plan included dropping inaccessible sample locations (e.g., areas of steep slopes or obstructions such as roads or heavy dead-fall areas) and moving locations due to shallow refusal (e.g., buried concrete and metallic debris and rubble). These changes were documented on Field Change Notice (FCN) forms and presented to the Core Team for concurrence. Drops and moves occurred at less than 5% of the base program planned locations. Locations moved more than 5 ft from the planned grid node are identified by the inclusion of an "M" in the location ID.

At sites of surface contamination, the base program plan stipulated sampling the 0-2.0-ft interval to focus the evaluation on areas where contamination levels would be the highest. Sampling in these areas was performed using the Geoprobe®, and two 2-ft-interval composite samples were collected using the standard sampling method. In these areas, 20% of the base program sample locations were drilled to 10 ft at randomly selected locations and 20% of all locations (0-2.0 ft and to depth) were analyzed for a full suite of constituents. Soil cores at these sites also were screened in the field for VOC and radiological contamination as was performed at the landfill sites.

Biased sampling was performed in addition to the base program sampling. Biased locations were selected based on results of the geophysical surveys, radiological walkover surveys, and as "step-out" locations to base program samples that had indications of significant concentrations of contamination. Biased samples drilled to 10 ft were collected from the 0.5-ft interval, 0.5-2.0-ft interval, and a selected section of core in the 2.0-10.0-ft interval. Surface soil samples were generally collected as five-point composites to provide area coverage of radiological surface anomalies, surface-distributed mounds of soil, or small waste piles. The intent of surface compositing was to provide an average contaminant profile for a localized surface area.

The sampling procedures and methods complied with EPA Region IV guidance. Sampling equipment, shipping containers, and quality assurance/quality control (QC) requirements also followed the same guidance. Standard laboratory analytical methods were used and data management and QC procedures complied with EPA criteria. Detailed discussion of the field and laboratory requirements is found in Attachment C of the Zone 1 RAWP, which was reviewed and approved at the RA Core Team.

When results of the field and analytical work were received, the RA Core Team evaluated the data and determined if action was appropriate. The action/NFA decision was based on one or more of the following criteria:

- Exceedance of a maximum RL at any location,
- Exceedance of an average RL across the EU,
- Unacceptable future threat to groundwater, and/or
- Unacceptable cumulative excess lifetime cancer risk (ELCR) of $> 1 \times 10^{-4}$ and hazard index (HI) > 1 across the EU.

Sample results were evaluated for the 0-10-ft soil interval and were not depth dependent. Contamination anywhere within the 0-10-ft interval had an equal weighting in the risk assessment and was presumed to be equally accessible to an industrial worker. Soil sample compositing provided data representative of the 0-10-ft interval. Discrete interval sampling was selected based on field screening for VOCs and radioactivity identified by soil core screening. This approach provided a very conservative evaluation of soil conditions and had an equivalent consideration in the risk assessment methodology. Selection of intervals for inclusion in soil core composite samples was based on visual observation and included the portion of the soil core that had the highest probability of being contaminated. Visual cues included but were not limited to bedding contacts, porous and permeable intervals, staining, and odor. Discrete sample interval depth information is included in the data set on the compact disc provided with this document. Major stratigraphic differences (i.e., 2 ft of cover material over fill) are referenced in the text where appropriate.

An area-weighted mean of the data in each EU was used to compare the average composition of the EU to the average RLs. Risk was evaluated by area-weighting the results. Because the data within an EU were unevenly distributed across the SUs (i.e., SUs with greater probability of contamination had a higher density of samples), weighting was based on the areal extent of the SUs in the EU. For those SUs with little probability of contamination and few, if any, sample results (i.e., Class 3 and Class 4 SUs), background concentrations of COCs as defined in the *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003a) were used in the weighted-average calculations for the EU risk assessments and comparison to average RLs.

Data collected for the original background data set for ETTP (DOE 1993a) was not representative of the ETTP site soils nor were statistical calculations performed in accordance with current EPA guidance. To resolve these issues, additional samples were collected and statistics were recalculated to comply with EPA guidance. Samples were collected from the B soil horizon of the Rome and Upper Knox formations to supplement the original data set and were collected from approximately 12-24 in. below the ground surface and only analyzed for radiological constituents and inorganic elements. The comparison of site data versus background data in this PCCR was made using methods from *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA 2002). Soil background data used in this document are presented in the *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003a) and not those presented in the earlier report.

If elevated (i.e., above background) concentrations were found, the sample results were used, even if sparse, after the SU was reclassified as a Class 1 or Class 2 SU. Results of the action/NFA evaluation were documented in the EU Group TM, which were provided to the RA Core Team for early review but are formally submitted for approval as appendices to the PCCRs or RAR The risk RAO was developed in the Zone 1 ROD to allow identification of new COCs because there was uncertainty that all COCs had been identified in the historical data sets. If the risk assessment identified contaminants requiring remediation that did not have associated RLs, remediation was recommended if the risk was found to be unacceptable.

2.2.5 Documentation and Records

All information, data, documents, and records necessary to support the decisions presented in this PCCR will be transferred to the post-decision document file upon approval of the PCCR. Referenced documents that will become part of this file are listed in Sect. 13. Additional records include but are not limited to boring logs, field log books, field sample logs, radiological surveys and associated maps, field change notices, Core Team concurrence forms, and analytical data packages. The post-decision document file is available through the DOE Oak Ridge Office Information Center. Analytical data, field data, and sample location maps will be archived in OREIS.

3. PROJECT REQUIREMENTS

Requirements for the characterization activities, final status assessments, and RAs originated with the Zone 1 ROD (DOE 2002), which presented certain specific soil RAs that were required in Zone 1 and provided general guidelines for addressing the remainder of the soils. In response to the guidelines for addressing Zone 1 soils, the DVS was developed to present specific requirements for addressing soils and making action/NFA decisions. As stated in Sect. 1.5 of the Zone 1 ROD, it is possible additional contaminants could be identified during remedy implementation or confirmation.

3.1 ZONE 1 RECORD OF DECISION

The Zone 1 ROD (2002a) presented the selected remedy for environmental remediation of contaminated areas within Zone 1 at ETTP. An evaluation of existing data was performed and it was determined in the Zone 1 ROD that the following five sites had sufficient characterization data to demonstrate unacceptable risk and warrant selection of an action for soil:

- Blair Quarry;
- Miscellaneous contaminated soil, including the K-895 Cylinder Destruct Facility in the K-901 Area;
- Soil in the Powerhouse North Area;
- K-770 scrap metal and debris in the Powerhouse North Area; and
- K-710 sludge beds and Imhoff tanks in the Powerhouse North Area.

The Blair Quarry site has been remediated and is addressed in the Duct Island and K-901 Areas PCCR (DOE 2006a). Characterization results for the K-895 Cylinder Destruct Facility are presented in the same PCCR, and the defined RA is described in this PCCR. Characterization of soil in the Powerhouse North Area and any eventual RA ~~is waiting~~will follow ~~on~~ removal of the K-770 scrap metal and debris to make the soil accessible for characterization. Removal of the K-770 scrap metal and debris was completed in March 2007. ~~has not yet begun as of this PCCR.~~ The Powerhouse North Area soils and K-770 scrap metal and debris RAs will be reported in a future PCCR or the Zone 1 RAR. ~~Evaluation of the K-710 sludge beds and Imhoff tanks is ongoing.~~ The K-710 sludge beds and Imhoff tanks removal was completed in September 2006.

In addition, the Zone 1 ROD specified that a DVS be developed to address the characterization of soils in other areas in Zone 1 with insufficient data to determine if an action is required. The key criterion listed in the Zone 1 ROD for the action/NFA decision and determination of a RA is successful is the RAOs presented in Table 3.

Table 3. Remedial action objectives and protection goal for Zone 1

Remediation issue	Protection goal
Future land use	Protect human health under an unrestricted industrial land use to a risk level not to exceed 1×10^{-4}.
Groundwater resources	Control leaching and migration from contaminated soil to help minimize further impacts to groundwater

Other key aspects of the ROD include the determination of future land use as unrestricted industrial to 10 ft bgs, protection of the industrial worker from soil exposure identified as the primary risk driver, development of a risk assessment methodology based on EUs, and definition of a list of soil COCs with corresponding soil RLs. The Zone 1 ROD established two RLs for each COC. The maximum RL was the concentration which a COC may not exceed at any location within an EU. The average RL is the average COC concentration within an EU which, when exceeded, means the RAO risk protection goal has not been met. The Zone 1 ROD COCs and associated RLs are presented in Table 4.

Table 4. Chemicals and radionuclides required for analysis in Zone 1 DVS samples[a] and their evaluation criteria[b]

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG	Background	Groundwater SL	Residential PRG
Metals (mg/kg)						
Aluminum			100,000	40,300		7,614
Antimony			410	1.52	144	3.1
Arsenic	900	300	16	14.95	66.3	0.39
Barium			67,000	124.93	9150	537
Beryllium	6,000	2,000	1,900	2.20		15
Boron			100,000			1,600
Cadmium			450	0.22U		3.7
Calcium				2400		
Chromium			640	44.88	172	22
Cobalt			130,000	42.00		138
Copper			41,000	22.48		313
Iron			100,000	58,600		2,346
Lead			800	37.91	3370	400
Lithium			20,000	48.94		156
Magnesium				3,300		
Manganese			19,000	2,200		176
Mercury	1,800	600	310	0.17		2.35
Molybdenum			5,100			39
Nickel			20,000	26.07		156
Potassium				5,074.69		
Selenium			5,100	1.47		39
Silver			5,100	0.6U		39
Sodium				497		
Thallium			67	0.4U	10.8	0.52
Uranium			200			1.56
Vanadium			1,000	65.47		7.8
Zinc			100,000	89.70		2346
Radionuclides (pCi/g)						
Cesium-137	20	2	1.1			0.06
Cobalt-60			0.6			0.04
Gross alpha activity						
Gross beta activity						
Neptunium-237	50	5	2.7			0.13
Potassium-40			27	32.12		0.11
Radium-226	15	5	0.26	1.25		0.01
Technetium-99			9,000			0.25
Thorium-232	15	5	0.176	1.95		0.01
Thorium-234			33,000			1330
Uranium-234	7,000	700	330	1.47	61.1	4.02
Uranium-235	80	8	4.0		61.1	0.2
Uranium-238	500	50	18	1.47	61.1	0.74
Pesticides and PCBs (ug/kg)						
PCB-1016	100,000	10,000	37,000			393
PCB-1221	100,000	10,000	7,436			112
PCB-1232	100,000	10,000	7,436			112
PCB-1242	100,000	10,000	7,436			112
PCB-1248	100,000	10,000	7,436			112
PCB-1254	100,000	10,000	7,436			112

Table 4. (continued)

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG	Background	Groundwater SL	Residential PRG
PCB-1260	100,000	10,000	7,436			112
Polychlorinated biphenyl	100,000	10,000	7,436			112
Semivolatile Organic Compounds (ug/kg)						
1,2,4-Trichlorobenzene			220,000			6,216
1,2-Dichlorobenzene			600,000			110,330
1,3-Dichlorobenzene			600,000			53,135
1,4-Dichlorobenzene			79,000			3,447
2,3,4,6-Tetrachlorophenol			18,000,000			183,309
2,4,5-Trichlorophenol			62,000,000			611,031
2,4,6-Trichlorophenol			62,000			611
2,4-Dichlorophenol			1,800,000			18,331
2,4-Dimethylphenol			12,000,000			122,206
2,4-Dinitrophenol			1,200,000			12,221
2,4-Dinitrotoluene			25,000			715
2,6-Dinitrotoluene			25,000			715
2-Chloronaphthalene			23,000,000			493,664
2-Chlorophenol			240,000			6,340
2-Methyl-4,6-dinitrophenol			62,000			611
2-Methylnaphthalene			190,000			5,592
2-Methylphenol			31,000,000			305,515
2-Nitrobenzenamine			1,800,000			18,277
2-Nitrophenol						
3,3'-Dichlorobenzidine			38,000			1,081
3-Nitrobenzenamine			18,000			1,833
4-Bromophenyl phenyl ether						
4-Chloro-3-methylphenol						
4-Chlorobenzenamine			2,500,000			24,441
4-Chlorophenyl phenyl ether						
4-Methylphenol			3,100,000			310,000
4-Nitrobenzenamine			180,000			18,330
4-Nitrophenol						
Acenaphthene			29,000,000			370,000
Acenaphthylene			29,000,000			370,000
Aniline			3,000,000			42,742
Anthracene			100,000,000			2,200,000
Benz(a)anthracene			21,000			621
Benzenemethanol			100,000,000			1,833
Benzo(a)pyrene			2,100			62
Benzo(b)fluoranthene			21,000			621
Benzo(ghi)perylene			29,000,000			231,595
Benzo(k)fluoranthene			210,000			6,215
Benzoic acid			100,000,000			24,000,000
Bis(2-chloroethoxy)methane						
Bis(2-chloroethyl) ether			5,800			218
Bis(2-chloroisopropyl) ether			74,000			2,884
Bis(2-ethylhexyl)phthalate			1,200,000		2,350,000	34,741
Butyl benzyl phthalate			100,000,000			1,200,000
Carbazole			860,000			24,319
Chrysene			2,100,000			62,146
Di-n-butyl phthalate			62,000,000			611,000
Di-n-octylphthalate			25,000,000			244,000
Dibenz(a,h)anthracene			2,100			62
Dibenzofuran			1,600,000			14,526
Diethyl phthalate			100,000,000			4,900,000
Dimethyl phthalate			100,000,000			61,000,000
Diphenyldiazene			160,000			4,422
Fluoranthene			22,000,000			230,000
Fluorene			26,000,000			275,000
Hexachlorobenzene			11,000			304
Hexachlorobutadiene			180,000			1833
Hexachlorocyclopentadiene			3,700,000			36,550
Hexachloroethane			620,000			6,110
Indeno(1,2,3-cd)pyrene			21,000			621

Table 4. (continued)

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG	Background	Groundwater SL	Residential PRG
Isophorone			5,100,000			512,000
N-Nitroso-di-n-propylamine			2,500			69.5
N-Nitrosodimethylamine			340			9.54
N-Nitrosodiphenylamine			3,500,000			99,261
Naphthalene			190,000			5,592
Nitrobenzene			100,000			1,964
Pentachlorophenol			90,000			2,979
Phenanthrene			29,000,000			23,160
Phenol			100,000,000			1,800,000
Pyrene			29,000,000			231,600
Pyridine			620,000			6,110
Volatile Organic Compounds (ug/kg)						
1,1,1-Trichloroethane			1,200,000		97,900	198,200
1,1,2,2-Tetrachloroethane			9,300			408
1,1,2-Trichloroethane			16,000		1,370	729
1,1-Dichloroethane			1,700,000			50,640
1,1-Dichloroethene			410,000		1,750	12,350
1,2-Dichloroethane			6,000			278
1,2-Dichloropropane			7,000			342
2-Butanone			110,000,000			2,230,000
2-Hexanone						
4-Methyl-2-pentanone			47,000,000			528,100
Acetone			54,000,000			1,413,000
Benzene			14,000		1,150	643
Bromodichloromethane			18,000			824
Bromoform			2,200,000			61,570
Bromomethane			13,000			390
Carbon disulfide			720,000			35,530
Carbon tetrachloride			5,500		2,770	217
Chlorobenzene			530,000			15,070
Chloroethane			65,000			3,026
Chloroform			4,700		1,230	221
Chloromethane			160,000			4,685
Dibromochloromethane			26,000			1,109
Ethylbenzene			400,000			186,400
Methylene chloride			210,000		241	9,107
Styrene			1,700,000			438,210
Tetrachloroethene			13,000		4,720	484
Toluene			520,000		502,000	65,600
Total Xylene			420,000			27,000
Trichloroethene			1,100		1,720	53
Vinyl chloride			7,500		176	79
cis-1,2-Dichloroethene			150,000			4,294
cis-1,3-Dichloropropene			18,000			777
trans-1,2-Dichloroethene			230,000			6,949
trans-1,3-Dichloropropene			18,000			777
Diesel Range Organics[c]					100 mg/kg	
Gasoline Range Organics[c]					100 mg/kg	

[a]Reference Appendix A of the RDR/RAWP (DOE 2007a).
[b]Chemicals and radionuclides listed here include all of the Zone 1 soils COCs and other chemical and radionuclides considered potential contaminants at ETTP. Analytical laboratories for DVS samples often report the results for chemicals and radionuclides not listed here and historical data may include analyses for chemicals and radionuclides not reported in DVS samples. When there is a detection in either a DVS or historical sample of a chemical or radionuclide not listed here, the concentration is compared to its 1×10^{-5} industrial PRG and 1×10^{-6} residential PRG which can be found at these websites: RAD – http;//epa-prgs.ornl.gov/cgi-bin/epa-prgs/rad_calc and Chemical – http://www.epa.gov/region09/waste/sfund/prg.
[c]Diesel range organics and gasoline range organics apply when there is an UST under investigation. The 100 mg/kg limit for protection of groundwater is based on State of Tennessee UST regulations.

COC = contaminant of concern
DVS = Dynamic Verification Strategy
ETTP = East Tennessee Technology Park
PRG = preliminary remediation goal
RAD = radiological
RAWP = Remedial Action Work Plan
RL = remediation level
RDR = Remedial Design Report
SL = screening level
UST = underground storage tank

3.2 DYNAMIC VERIFICATION STRATEGY

The DVS was developed as required by the Zone 1 ROD and was designed to provide sufficient data to fill data gaps and conduct final status assessments for all of Zone 1. DVS also was designed to facilitate real-time decision making. The DVS was focused on the soil characterization aspects identified in the Zone 1 ROD to determine where action was needed. Acreage classification was used to progressively focus investigation efforts in areas where there was a moderate to high probability of soil contamination (see Sect. 2.1.3). It was also conceived as a process to verify information compiled during previous investigations with the presumption being that the vast majority of the acreage in Zone 1 had little or no contamination. This strategy was designed to obtain data to support this presumption and incorporate flexibility to facilitate rapid collection of additional data should the presumption prove to be false based on the data results. The strategy was dynamic in order to gather adequate data with minimal iterations of site investigation planning and mobilization.

The DVS addresses the requirements of the Zone 1 ROD RAO with the DQO process. Step 5 of the DVS DQOs presented four decision rules whereby any particular land area in Zone 1 was deemed to have met the RAO requirements (see Table 5).

Table 5. DVS decision rules for Zone 1 soils

Decision rule	If	Then	Otherwise
1	the concentration of any COC in a localized area ("hot spot" nominally a 50-ft radius) within an EU to a depth of 10 ft exceeds the maximum RL,	remediate the localized area of elevated contamination until the COC concentration is less than the maximum RL.	No action for protection of industrial worker
2	the mean concentration value of any soil COC to a depth of 10 ft exceeds the average RL within an EU,	remediate the elevated areas of contamination until the mean COC concentration over the EU is less than the respective RL.	No action for protection of industrial worker
3	the industrial risk across the EU to a depth of 10 ft is above 1×10^{-4} ELCR or target organ HIs exceed 1,	remediate the elevated areas of contamination until the residual risk over the EU is below the risk levels and evaluate the need for action if target HIs exceed 1.	No action for protection of industrial worker
4	the site-specific contaminants in groundwater exceed MCL or site-specific, mass-based soil SLs[a] calculated for a site for the protection of groundwater are exceeded above the water table or bedrock surface (whichever is shallower),	evaluate the impacts of remediating the site.	No action for the protection of groundwater

[a]Soil SLs for the protection of groundwater are presented in the Zone 2 ROD (DOE 2005).

COC = contaminant of concern
DVS = Dynamic Verification Strategy
ELCR = excess life-time cancer risk
EU = exposure unit
HI = hazard index
MCL = maximum contaminant level
RL = remediation level
SL = screening level

3.3 FINAL STATUS EVALUATION PROCESS

The final status of each EU in Zone 1 and the action/NFA decision was determined by evaluating the EU in terms of the four decision rules. Descriptions of the action/NFA evaluation processes for each decision rule are presented in Sect. 3.3.1. A discussion of special data uses and considerations in the action/NFA evaluations is included in Sect. 3.3.2. A risk screening was performed to evaluate the industrial land use of each EU as defined in the Zone 1 ROD. A qualitative risk screening also was conducted against 1×10^{-6} residential preliminary remediation goals (PRGs) to evaluate unrestricted use of each EU. This evaluation had no bearing on the action/NFA decision and is provided at the request of the Core Team to facilitate future decisions regarding land use controls. A description of this evaluation is presented in Sect. 3.3.3.

3.3.1 Action/No Further Action Decision

The process whereby EUs were evaluated against the four DVS decision rules (Sect. 3.2) is described in the following text and presented graphically in Fig. 5 as Steps 1 through 4.

Decision Rule 1—Maximum RL evaluation. Zone 1 soils chemical and radionuclide COC concentrations were screened against their maximum (not to exceed) RLs as defined in the Zone 1 ROD. If any compound was detected at a concentration above its maximum RL, an action was required. Maximum RLs and the COCs to which they applied are presented in Table 4.

Decision Rule 2—Average RL evaluation. The mean value across an EU of the detected concentrations for each Zone 1 soils COC was screened against the respective average RL. If the average detected concentration of any COC across an EU was less than the average RL for that COC, then the overall average concentration of the COC (which included nondetected results and area-weighting) also had to be below the average RL.

If the EU average detected concentration of Zone 1 soils COC exceeded the average RL for that COC, then the EU average was calculated using the detected values and half the detection limit for all the nondetect results. If the EU average for this calculation was still in excess of the Zone 1 average RLs, then an area-weighted mean for the EU was calculated (Sect. 3.3.2). If the area-weighted mean concentration of the COC was above the Zone 1 average RL for the COC, then action was required. Average RLs and the COCs to which they applied are presented in Table 4.

Decision Rule 3—Cumulative risk assessment. The first step in evaluating the cumulative risk associated with an EU was to perform a risk screen to determine if further assessment in the form of a risk calculation was required. The risk screen consisted of comparing the data to average RLs and the EPA Region IX PRGs (ELCR $< 1 \times 10^{-5}$ or HI of 1). If the concentration of any chemical or radionuclide exceeded either an average RL or an industrial PRG (except as described in Sect. 3.3.2), then the complete EU dataset was evaluated to determine if the cumulative effect of all chemicals and radionuclides in the EU would cause the EU to fail the 1×10^{-4} risk criterion established in the Zone 1 ROD. If such a determination was made, a risk calculation[a] was conducted. Additional detail on the risk calculation is documented in *Supporting Documentation for Preliminary Remediation Goals Used in the Dynamic Verification Strategy Sampling Program, East Tennessee Technology Park, Oak Ridge, TN* (BJC 2006), which is currently being finalized. EPA Region IX industrial PRGs (1×10^{-5}) for chemicals and radionuclides analyzed under the DVS are also presented in the document.

[a]The number of samples to adequately characterize the EU and evaluate risk was determined in the DQO scoping process with the Core Team. Available DVS and historical data were utilized when risk calculations were performed.

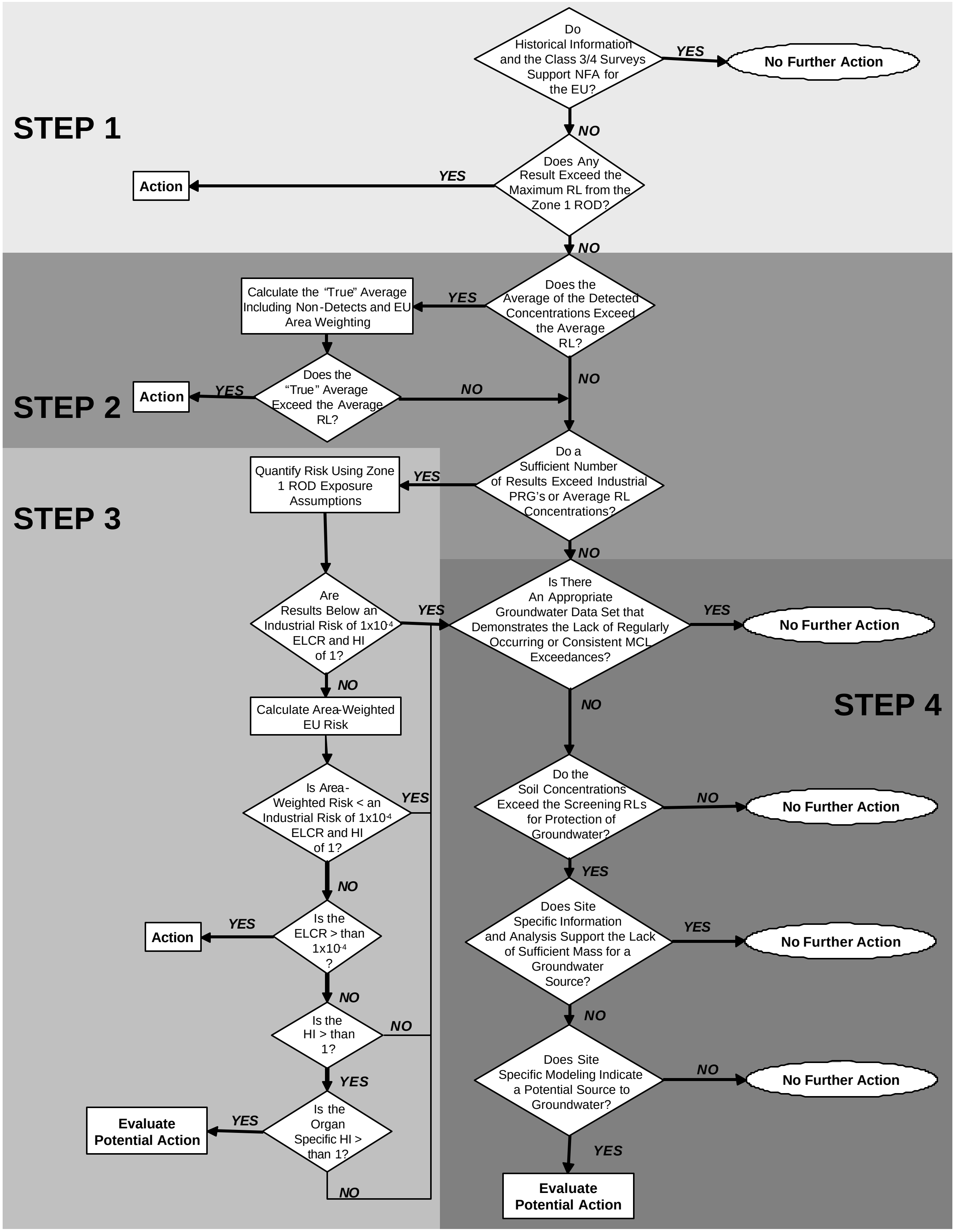

Fig. 5. Risk evaluation process.

If a risk calculation was required after performing the risk screen, then the risk was determined in accordance with the Zone 1 ROD by first calculating the risk based on the available EU data. If the calculated risk was below an industrial 1×10^{-4} ELCR or target organ HI of 1, then NFA was appropriate. If the calculated risk was not below the listed industrial ELCR or target organ HI, then an EU area-weighted calculation was performed.

Because data collection was focused on areas of potential contamination, the resultant data population was more representative of specific portions of an EU than the total EU. According to the Zone 1 ROD, it is the total EU over which risk is to be evaluated. To account for this over-emphasis of potentially contaminated areas, an area-weighted risk calculation for each chemical and radionuclide was performed according to the averaging method described in Sect. 3.3.2, and the cumulative risk was calculated on the area-weighted averages as stated in the Zone 1 RAWP (DOE 2007).

If the area-weighted calculation resulted in an acceptable ELCR ($< 1 \times 10^{-4}$) and HI (< 1), a NFA determination was made. However, if the calculation resulted in an unacceptable ELCR, then the EU could not be cleared for industrial land use and an action determination was made. If the area-weighted approach resulted in an unacceptable HI, an individual target organ HI review was conducted. If individual target organ HIs exceeded 1, then an assessment of the need for action was conducted in accordance with the Zone 1 RAWP (DOE 2007).

Decision Rule 4—Threat to groundwater. A threat to groundwater by Zone 1 soils was evaluated by reviewing existing area groundwater data for maximum contaminant level (MCL) exceedances that occurred on a regular basis. If the groundwater data were sufficient and there were no consistent MCL exceedances, then NFA was appropriate. If the groundwater data were insufficient to discern regular MCL exceedances, or the data were sufficient and regular MCL exceedances were observed, then soil concentrations were screened against the SLs for the protection of groundwater as defined in the Zone 2 ROD (DOE 2005). If additional evaluation was required based on the screening, site-specific modeling was conducted. If modeling results indicated a site could be a potential source of contamination to groundwater, consideration of an action was required. A sitewide ROD, scheduled to be issued in 2006, will evaluate available site data for threats to groundwater. Data generated from the DVS process will be included in this ROD. Groundwater SLs for chemicals and radionuclides analyzed under the DVS are presented in Table 4.

Underground storage tanks at ETTP, including those in Zone 1 and Zone 2, are specifically addressed in the Zone 2 ROD. State UST regulations are applicable or relevant and appropriate regulations (ARARs) for all ETTP tanks according to the Zone 2 ROD. Therefore, closure will be performed according to State of Tennessee regulations. Tanks that can be demonstrated to be clean (i.e., containing no fluids that could adversely effect groundwater) and show no soil contamination present that indicates a leak will be closed in place by filling. Tanks that contain residual fluid and/or where soil contamination indicates a leak will be removed according to state UST regulations.

3.3.2 Special Data Uses and Considerations

Circumstances requiring special data uses and considerations during EU action/NFA evaluations fell into three categories: (1) evaluation of Class 3 and Class 4 SUs for which there was no analytical data; (2) area-weighted averages; and (3) chemicals and radionuclides with regulatory limit concentrations less than or similar in value to background concentrations.

Class 3 and Class 4 SU evaluations. In some EUs, historical information and Class 3 and Class 4 SU walkover assessments provided sufficient information to support the NFA determination. Class 3 and Class 4 SU walkover assessments included visual observations of the SU acreage, collection of radiological survey data, and selected biased sampling where survey results or observations indicated the presence of impacted soils.

Area-weighted averages. Area-weighted averaging was accomplished by calculating the fraction of the total area of an EU that contained the contaminated soil (called a contaminant area fraction). The remaining area of the EU constituted a remaining acreage area fraction. The average concentrations of soil constituents in the area of contamination were calculated and then multiplied by the contaminant area fraction. Average soils concentrations then were calculated for the remaining acreage area of the EU using all available sample results or, if no sample data were available, using background concentrations. These average concentrations were multiplied by the remaining acreage area fraction and the area-weighted EU average then was calculated as the sum of the fractions.

Regulatory limit versus background concentrations. The industrial PRGs for arsenic, Cs-137, K-40, Ra-226, Th-228, and Th-232 are less than or similar in value to their respective background concentrations, resulting in the industrial PRG being exceeded in all or most instances in which the chemical or radionuclide was detected. The Zone 1 ROD recognized this issue as it pertained to Ra-226, Th-228, and Th-232 and declared the data not be used for risk calculations. Instead, health hazards associated with the presence of these radionuclides in Zone 1 soils were evaluated by comparing to the RLs for Ra-226 and Th-232, which contains Th-228 in its decay chain.

When a risk screen was conducted as part of the Decision Rule 3 evaluation (see Sect. 3.3.1), secondary concentration comparisons were made in response to PRG exceedances by arsenic, Cs-137, and K--40 before proceeding with the cumulative effects evaluation that led to performing risk calculations for the EU. The industrial PRG for arsenic (15.9 mg/kg) was very close in value to the arsenic background concentration (14.95 mg/kg). Although no local background value existed, the industrial PRG for Cs-137 (1.13 pCi/g) was low enough that this ubiquitous nuclear fallout radionuclide exceeded its PRG in most instances where it is detected, and the industrial PRG for K-40 (2.73 pCi/g) was less than the background concentration for K-40 (32.12 pCi/g). The secondary concentration comparisons that were performed compared arsenic concentrations to the arsenic Zone 1 soils average RL, Cs-137 concentrations to the Cs-137 Zone 1 soils average RL, and K-40 concentrations to the K-40 background value. If any of these secondary concentration comparisons resulted in an exceedance, then the complete EU dataset was evaluated for cumulative effects as described in Sect. 3.3.1.

3.3.3 Qualitative Risk Screening for Unrestricted Use

While not required by the Zone 1 ROD, a qualitative risk screening for unrestricted use was conducted to determine the possibility for releasing the EUs without institutional controls. Results of this screening are discussed in Sect. 11 and are provided for information only and do not form the basis for action. For this screening, average concentrations were compared to 1×10^{-6} residential PRGs and ETTP soils background values from Table 4 in *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003a). EPA Region IX 1×10^{-6} residential PRGs and ETTP soil background values for the chemicals and radionuclides analyzed under the DVS are presented in Table 4.

4. FINAL STATUS ASSESSMENTS

The RAs were performed as specified in the Phased Construction Completion Report for the Duct Island Area and K-901 Area in Zone 1 (DOE 2006a) and the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b). Remedial actions performed in the Duct Island, K-901, and K-1007 Ponds Areas are presented in Sect. 5.

The Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 Appendix B (DOE 2006b) delayed final status assessment on the following FFA sites in EU Z1-03 pending performance of the K-1055 Gas/Diesel Station Tanks FFA site RA:

- K-1047 Motor Pool Repair Shop FFA site;
- Building 665 Steam Oil Storage Area FFA site;
- South Plant Area Lab Drain Lines FFA site; and
- K-1027 Service Station FFA site.

Since this PCCR documents the performance of the K-1055 Gas/Diesel Station Tanks FFA site RA, and neither the four FFA sites nor the remainder of EU Z1-03 have decision rule exceedances, NFA is appropriate for the four FFA sites and EU Z1-03.

Analytical data obtained as part of the RAs assessed in this PCCR are provided with this report on a compact disc. Data are also available in the Oak Ridge Environmental Information System (OREIS). Access to the database is available by contacting DOE.

5. REMEDIAL ACTIONS

This section describes the RAs performed in Zone 1 during FY 2007 (see Table 6 and Fig. 6). Each subsection summarizes the characterization that supported the RA and describes the findings and activities performed. The data obtained to support the RAs accompany this PCCR and can also be accessed through the OREIS.

Table 6. Zone 1 RA locations

Zone 1 EU Area	Zone 1 EU Group	EU	RA site
K-1007 Ponds	Happy Valley Service Station	Z1-01	S-21 Happy Valley Service Station USTs
	K-1007 Ponds	Z1-03	K-1055 Gasoline/Diesel Station USTs
K-901	K-901-A North	Z1-49	K-895 Cylinder Destruct Facility
Duct Island	Duct Island South	Z1-38	Duct Island South soil mounds

EU = exposure unit
RA = remedial action
UST = underground storage tank

Underground storage tank RAs followed the rules of TDEC Chap. 1200-1-15-06(7)(e)(4) in the Happy Valley Service Station (HVSS) Group (EU Z1-01) and the K-1007 Ponds Group (EU Z1-03) based on recommendations documented in the Phased Construction Completion Report for the K-1007 Ponds Area and Powerhouse Area in Zone 1 (DOE 2006b). Remedial actions at the K-895 Cylinder Destruct Facility in EU Z1-49 and Duct Island South soil mounds sites in EU Z1-38 were performed based on recommendations documented in the Phased Construction Completion Report Duct Island Area and K-901 Area (DOE 2006a). The final report for completion of the recommended RAs is contained in this section and Sects. 6 through 10.

5.1 HAPPY VALLEY SERVICE STATION DECISION-RELATED CHARACTERIZATION

The S-21 HVSS was built early in the history of the site to serve the workers and residents of Happy Valley who occupied the temporary housing facilities located south of Highway 58. The service station was operational from the early 1940s through about 1950. Site photos from 1951 do not show the service station buildings at the S-21 location. The number of tanks and their condition was unknown prior to characterization sampling.

Work at the site was initiated as a geophysical survey performed as part of the UST investigations conducted in the late 1990s. A large magnetic anomaly was identified in the area of the S-21 Service Station that was associated with the USTs left in place following demolition of the surface facilities. The site was identified as a Class 2 SU in the DVS characterization DQO package and four soil borings were placed in proximity to the geophysical anomaly. Soil samples were collected and analyzed for VOCs, SVOCs, metals and diesel, and gasoline range organic compounds. Sample results indicated low concentrations of contaminants were present in near surface soils but no significant release of fuel compounds had occurred at the site.

The following text is taken from the final approved 2006 PCCR: "A UST site is located in EU 1 of the HVSS EU Group. However, there is no current groundwater usage within one mile of the site, the UST is above the average water table for the area, and the high clay content of the native soils makes UST-related contaminants highly immobile. Underground storage tanks at ETTP, including those in

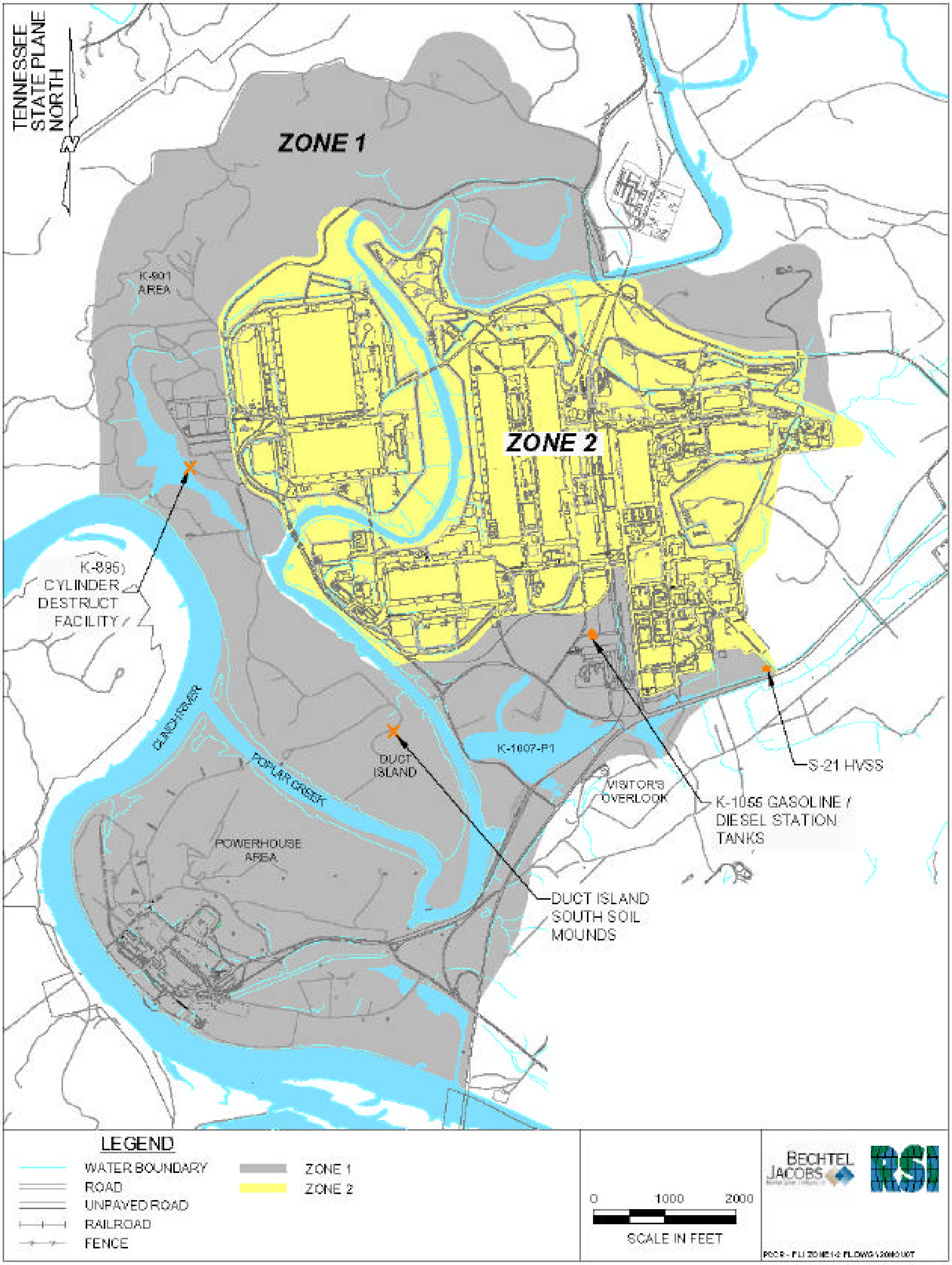

Fig. 6. Location of RAs performed in Zone 1 during FY 2008.

Zone 1 and Zone 2, are specifically addressed in the Zone 2 ROD. State of Tennessee UST regulations are ARARs for all ETTP tanks according to the Zone 2 ROD." Therefore, closure was performed according to State UST regulations.

There were four DVS systematic sample locations and two historical sample locations at the S-21 HVSS FFA site, which is the Class 2 SU. Sampling at five of the six locations was divided into samples collected from 0 to 10 ft bgs and samples collected from depths > 10 ft bgs (samples are in the > 10 ft bgs group only if the starting depth of the sample is > 10 ft bgs).

For the samples collected from 0-10 ft bgs, metal background concentrations were exceeded by barium in 6 samples (maximum concentration of 130 mg/kg in EU1-203), cadmium in 12 samples (maximum concentration of 4.3J mg/kg in EU1-204), copper in EU1-201 (23 mg/kg), lead in 2 samples (maximum concentration of 100 mg/kg in EU1-204), nickel in 2 samples (maximum concentration of 42 mg/kg in EU1-204), and zinc in EU1-204 (480 mg/kg). No 1×10^{-5} industrial PRGs, Zone 1 soils RLs, or groundwater SLs for metals were exceeded.

Twenty-three SVOCs were detected in the samples collected from 0-10 ft bgs. Industrial PRGs of 1×10^{-5} were exceeded by benzo(a)anthracene in EU1-203 (60,000 ug/kg), benzo(a)pyrene in six samples in EU1-203 (maximum of 50,000 ug/kg), benzo(b)fluoranthene in EU1-203 (89,000 ug/kg), and dibenz(a,h)anthracene in EU1-203 (6300J ug/kg). The average detected concentration for benzo(a)pyrene in the Class 2 SU in EU 1 was 9211 ug/kg. No groundwater SLs for SVOCs were exceeded.

One VOC, toluene, was detected in sample 422 from the 0-10 ft bgs depth interval (13J ug/kg). No 1×10^{-5} industrial PRGs or groundwater SLs for VOCs were exceeded.

Diesel-range organics were detected in 10 samples collected from the 0-10 ft bgs depth interval. The DRO concentration exceeded 100 mg/kg in four of the samples with a maximum detected DRO concentration of 1200 mg/kg in the 0.5-2 ft sample collected at EU1-203. The average detected concentration for the 10 samples was 207 mg/kg. Concentrations of DROs were > 100 ppm in three surface soil samples (0.5-2 ft) at locations EU1-201, EU1-202, and EU1-203 to the northeast and west sides of the UST. The maximum reported value (1200 mg/kg) was in the EU1-203 sample at 0.5-2 ft bgs. These results indicated there was a diesel spill on the ground surface. Only one sample reported DRO at a depth correlative to the bottom of the UST. These data do not indicate a leaking UST, which is substantiated because there were no reported DRO detections in the downgradient monitoring well.

Gaseline-range organics were detected in three samples from the 0-10 ft bgs depth interval. The maximum GRO concentration of 9.6 mg/kg occured in the 9-10.5 ft bgs interval of EU1-201.

Two SVOCs (2-methylphenol and 4-methylphenol) were detected in three samples collected from a depth > 10 ft. No 1×10^{-5} industrial PRGs or groundwater SLs for SVOCs were exceeded.

Two VOCs were detected in EU1-201 [(1-methylpropyl)benzene in the 11.1-11.4 ft bgs sample (9.1J ug/kg) and acetone in the 10.2-10.5 ft bgs sample (21J ug/kg)]. No 1×10^{-5} industrial PRGs or groundwater SLs for VOCs were exceeded.

~~For samples collected from 0 to 10 ft bgs, metal background concentrations were exceeded by barium, cadmium, copper, lead, nickel, and zinc. No 1×10^{-5} industrial PRGs, Zone 1 soil RLs, or groundwater SLs for metals were exceeded.~~

~~Twenty-three SVOCs were detected in samples collected from 0 to 10 ft bgs. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene exceeded the 1×10^{-5} industrial PRGs. No groundwater SLs for SVOCs were exceeded. One VOC, toluene, was detected in a sample from the 0 to 10 ft bgs depth interval and no 1×10^{-5} industrial PRGs or groundwater SLs for VOCs were exceeded.~~

~~Diesel-range organics (DROs) were detected in 10 samples collected from the 0 to 10 ft bgs depth interval. The average detected concentration for the samples was 207 mg/kg, and the DRO concentration~~

exceeded 100 mg/kg in four of the samples. Only one sample reported DRO at a depth correlative to the bottom of the UST. These results indicated a diesel spill on the ground surface. Gasoline range organics (GROs) were detected in three samples from the 0to 10 ft bgs depth interval. In contrast, only two samples collected from a depth >10 ft bgs had DROs detected, and GROs were detected in the same sample (8.1 mg/kg).

A total of two SVOCs were detected in three samples collected from a depth >10 ft. No 1×10^{-5} industrial PRGs or groundwater SLs for SVOCs were exceeded. Two VOCs were detected (benzene and acetone) and no 1×10^{-5} industrial PRGs or groundwater SLs for VOCs were exceeded.

The information presented above formed the basis of the recommendation to close the tanks in place at the HVSS site. Additional data were collected by the RA Program to determine if soils excavated at HVSS could be returned into the excavation following the tanks being filled, and to determine the nature of the fluid in the tanks. Field investigations revealed there were four tanks, all containing some liquids, present at the site—three 15,500-gal and one 5,500-gal. Six additional soil borings were drilled to depths from 10-16 ft bgs. Soil samples were collected from the interval with the highest PID readings and in the soils immediately above and below the associated interval. Results from these samples were below the TDEC UST initial screening levels (ISLs) criteria for soil with commercial use. Toxicity Characteristic Leaching Procedure (TCLP) metals were analyzed for on the samples from four of the six locations. Water samples were collected from each of the four tanks and were analyzed for VOCs, SVOCs, metals, and radioisotopes.

5.2 HAPPY VALLEY SERVICE STATION REMEDIAL ACTION

Results of the laboratory analyses reported no contaminants were present that would pose a risk of exposure to an industrial worker and no potential source of contamination to local groundwater was present. It was concluded appropriate to close the tanks in place and use the soils to backfill the excavation following the removal of liquids from the tanks and backfilling with flowable fill. Concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds in the tank water samples ranged from 1to 5 ppm, which required transport and disposal of the water at an approved treatment, storage, disposal, or recycle facility. The fluids were pumped from the tanks in August 2007. and dispositioned at Clean Harbors, Chattanooga, TN (see Table 8). Flowable fill was pumped into the tanks (see Fig. 7) to prevent collapse and soils from the excavation were placed back into the excavation.

Fig. 7. Happy Valley Service Station tank grouting.

Closure of the HVSS site was completed on August 28, 2007, with all actions being approved ~~by~~ with Core Team concurrence as described in FCN-ETTP-Zone 1-052. Six samples instead of four were collected from the tank hold as prescribed by TDEC UST regulations because preprobing indicated the presence of multiple USTs. These samples were obtained between April 30 and September 20, 2007. The results were below the TDEC UST ISL criteria for soil with commercial use. Concentrations of BTEX and MtBE were not detected in any of the soil samples. Although, naphthalene was detected at three of the six sample locations, the maximum concentration detected (0.69 mg/kg) was less than ISL criteria (403 mg/kg). The excavated area was seeded with domestic grass Fig. 8.

Fig. 8. Happy Valley Service Station restoration end state.

5.3 K-1055 GASOLINE/DIESEL STATION DECISION-RELATED CHARACTERIZATION

The K-1055 Gasoline/Diesel Station was in use from as early as 1944 as a gasoline station for ETTP. In 1948, plans were completed to install USTs for dispensing diesel oil. There are no records pertaining to the installation and no precise information on how or when the station was shut down and the building demolished. The number of tanks and their condition were unknown prior to characterization sampling performed to support the RA activities. Work at the site was initiated as a geophysical survey performed as part of UST investigations conducted in the late 1990s. Two large magnetic anomalies were identified in the area as associated with USTs left in place following demolition of the surface facilities. The site was identified as a Class 2 SU in the DVS characterization DQO package and four soil borings were placed in proximity to each of the two geophysical anomalies. Soil samples were collected and analyzed for VOCs, SVOCs, metals, DROs, and GROs.

The K-1055 Gasoline/Diesel Station tanks location was incorrectly identified during DQO scoping and the Class 2 SU samples originally designated for this FFA site were dropped prior to DVS characterization. The FFA site location was correctly identified in EU Z1-03 prior to the start of field work and eight biased sample locations were reassigned. Sampling was conducted at discrete depth intervals at each location.

Metal background concentrations were exceeded by antimony in RR-S03 (6.08J mg/kg), barium in 4 samples (maximum concentration of 250 mg/kg in EU3-211), cadmium in 32 samples (maximum concentration of 2.5J mg/kg in EU3B-213), chromium in EU3B-201 (87J mg/kg), copper in 10 samples (maximum concentration of 105 mg/kg in RR-S03), lead in 4 samples (maximum concentration of 280 mg/kg in RR-S03), mercury in EU3B-215 (0.29J mg/kg), nickel in 4 samples (maximum concentration of 167J mg/kg in RR-S03), selenium in 2 samples (maximum concentration of 1.6J mg/kg in EU3B-202), thallium in 2 samples (maximum concentration of 13.5J mg/kg in RR-S03), and zinc in 2 samples (maximum concentration of 494J mg/kg in RR-S03). The groundwater SL for thallium (10.8 mg/kg) was exceeded in RR-S03 (13.5J mg/kg). No 1×10^{-5} industrial PRGs or Zone 1 soils RLs for metals were exceeded.

PCB-1248, PCB-1254, and PCB-1260 were detected in samples collected from EU-3 and the maximum PCB concentration as for PCB-1260 in EU4B-204 and EU3B-206 (160 ug/kg). No 1×10^{-5} industrial PRGs or Zone 1 soils RLs were exceeded.

Five different radionuclides exceeded their background concentrations in samples collected from EU-3, including Ra-226 in three samples (maximum concentration of 2.06 pCi/g in EU3B-202), Th-228 in EU3B-207 (2.08 pCi/g), Th-230 in nine samples (maximum concentration of 2.08 pCi/g in EU3B-202), U-234 in five samples (maximum concentration of 2.4J pCi/g in EU3B-202), and U-238 in five samples (maximum concentration of 1.89 pCi/g in EU3B-202). Other than those radionuclides excluded from PRG discussion, no 1×10^{-5} industrial PRGs, Zone 1 soils RLs, or groundwater SLs for radionuclides were exceeded.

Twenty-one different SVOCs were detected in samples collected from EU-3 and no 1×10^{-5} industrial PRGs or groundwater SLs for SVOCs were exceeded. Fifteen different VOCs were detected in samples from this EU and no 1×10^{-5} industrial PRGs or groundwater SLs for VOCs were exceeded.

From samples collected in EU-3, DROs were detected in 19 (maximum concentration of 1500 mg/kg in EU3B-205) and GROs were detected in 3 (maximum concentration of 37 mg/kg in EU3B-205). The locations of these organic chemical detections were associated with the K-1055 Gas/Diesel Station Tanks FFA Site.

~~Metal background concentrations were exceeded by barium, cadmium, chromium, copper, iron, lead, nickel, selenium, and zinc. No 1×10^{-5} industrial PRGs, Zone 1 soils RLs, or groundwater SLs for metals were exceeded. Eight samples showed detection of PCB-1254 and PCB-1260, but no 1×10^{-5} industrial PRGs or Zone 1 soils RLs for PCBs were exceeded. Radionuclide background concentrations were~~

~~exceeded by Ra-226, Th-228, Th-230, U-234, and U-238. Other than the radionuclides excluded from PRG discussions, no 1 × 10^{-5} industrial PRGs, Zone 1 RLs, or groundwater SLs for radionuclides were exceeded.~~

~~Twenty SVOCs were detected in the eight samples with concentrations less than 1 × 10^{-5} industrial PRGs and groundwater SLs for SVOCs. Thirteen VOCs were detected in four samples but the 1 × 10^{-5} industrial PRGs and groundwater SLs for VOCs were not exceeded.~~

~~Diesel range organics were detected in 19 samples and GROs were detected in three samples. The average detected concentration of DROs at the site was 122 mg/kg.~~

This information formed the basis of the recommendation to close the tanks in place at the K-1055 Gasoline/Diesel Station site. Additional data were collected to determine if soils excavated from this site could be returned to the excavation following filling of the tanks and to determine the nature of the fluid present in the tanks at the site. Using a Geoprobe®, it was determined no USTs were present at the K-1055 South location, therefore, no additional samples were collected and a UST closure was not required in this area. Three adjacent petroleum USTs were identified at the K-1055 North site, which is north of the patrol road. Tank investigations revealed the three tanks (two 15,500 gal and one 5,500 gal) all contained some liquids (water/diesel).

Ten borings were drilled to depths from 12.5 to 16 ft bgs. Soil samples were collected from the interval with the highest PID readings and in soils immediately above and below the associated interval. Analyses for BTEX, MtBE, lead, and radionuclides were performed on each sample. One sample was collected from the tank containing sludge. Analyses of the semi-solid material included TCLP analyses for VOCs, SVOCs, metals, and radionuclides. Water samples were collected from each of the other two tanks and analyzed for VOCs, SVOCs, metals, and radioisotopes.

Six of the samples were collected from the tank hold of the two adjacent USTs and the results were below TDEC UST ISL criteria for soil with commercial use. Benzene, toluene, and xylene were detected in one of the six samples. The maximum concentration detected for these analytes compared to the regulatory limit were benzene (2.8 mg/kg in EU03-2W-407) (commercial ISL 3.8 mg/kg), toluene (2.3 mg/kg in EU03-2W-407) ~~-~~(commercial ISL 62.2 mg/kg), and xylene (28 mg/kg in EU03-2W-407) ~~-~~(commercial ISL 88 mg/kg). Ethylbenzene was detected at a maximum concentration of 14 mg/kg in three of the six samples (2.3 mg/kg in EU03-2W-405, 2.5 mg/kg in EU03-2W-444, and 14 mg/kg in EU03-2W-407), which is less then the commercial use ISL of 1310 mg/kg. Naphthalene was detected at five of the six sample locations at a maximum concentration of 15 mg/kg in EU03-2W-408), which is less than the ISL of 403 mg/kg.

Four of the samples were collected from the tank hold of the third K-1055 east UST. The additional samples were collected adjacent to the tank per TDEC UST regulations and the results were below the TDEC UST ISL criteria for soil with commercial use. Benzene, toluene, ethylbenzene, and xylene were all reported as nondetected in each of the four samples, while naphthalene was reported as nondetected in three of the four samples. Naphthalene was detected at one sample location with a maximum concentration of 0.43 mg/kg, which is significantly less than the TDEC UST ISL of 403 mg/kg.

Results of the laboratory analyses reported no contaminants that would pose a risk of exposure to an industrial worker and one soil sample with benzene reported at 2.8~~00~~ m~~u~~g/kg in EU03-2W-407, which is a potential source of contamination to local groundwater. However, no other samples reported benzene above the groundwater protection criteria, indicating a very minor localized area of contamination.

5.4 K-1055 GASOLINE/DIESEL STATION REMEDIAL ACTION

Although the tanks met the criteria to be closed in place, they were removed at the request of the Reindustrialization Program (see Fig. 9). Water in the tanks was disposed of at an approved treatment, storage, disposal, or recycle facility. Fluids were pumped from the tanks in August 2007. The tanks were then removed and size reduced on September 4, 2007, and transported to the ORR landfill for disposal. Soils from the excavation were returned into the excavation and site closure was completed on August 28, 2007. The RA Core Team concurred with all actions as described in FCN-ETTP-Zone 1-049 and FCN-ETTP-Zone 1-065. The excavated area was seeded with domestic grass (see Fig. 10).

Fig. 9. K-~~1005~~ 1055 Gasoline/Diesel Station north tank removal.

Fig. 10. K-1055 Gasoline/Diesel Station restoration end state.

5.5 K-895 CYLINDER DESTRUCT FACILITY DECISION-RELATED CHARACTERIZATION

The K-895 Cylinder Destruct Facility in EU Z1-49 operated from 1965 to 1975 for the disposal of UF_6 cylinders from defective tanks, which were breached and the contents released into the K-901 Holding Pond. Contamination in soils and on the bulkhead posts was identified at levels above Zone 1 RLs. The following text is taken from the K-901 North EU Group Technical Memorandum, which was included in the Duct Island Area and K-901 Area PCCR (DOE 2006a).

The K-895 Cylinder Destruct Facility Site "was identified for RA in the Zone 1 ROD based on historic sample data. Additional data were collected as part of the DVS program to confirm the extent of contamination and to provide data for a full suite of COCs in support of EMWMF waste acceptance criteria (WAC) attainment. Both historic and DVS soil sample data reported radiological COCs in excess of Zone 1 maximum RL concentrations in the K-895 Pier Area of the site." Based on historic and DVS sampling at the K-895 site, a removal action was identified.

The extent of the impact covered an area approximately 10 ft by 10 ft on the tip of the pier that extends into the K-901-A Holding Pond. Both historic and DVS samples outside the immediate area of the K-895 Pier Area in the Class 1 SU and further east in the Class 3 SU reported sporadic detections of three metals above background levels, including cadmium at EU49-101 (3.6 mg/kg), nickel at 8-006 (28.2 mg/kg), and selenium at P8-004 (1.7 mg/kg). Polychlorinated biphenyls were detected in several samples outside the immediate area of contamination, with a maximum reported concentration of 110 ug/kg at P8-007. Several radionuclides, including Ra-226 at P8-007 (4.24 pCi/g), Th-228 at P8-005 (2.21 pCi/g), Th-230 at P8-004 (3.37 pCi/g), U-234 at P8-007 (27.49 pCi/g), and U-228 at P8-007 (43.49 pCi/g) were elevated above background levels and U-238 was above the industrial use PRG. Concentrations of radiological COCs appeared to increase with proximity to the K-895 Cylinder Destruct Facility. Within the Class 1 SU area, PAHs were detected frequently in samples at very low concentrations (14-300 ug/kg). Toluene and acetone were detected in historic sample P8-004 within the Class 1 SU at concentrations < 100 ug/kg. Biased surface soil samples were collected in the eastern portion of EU Z2-49 to verify elevated Class 3 SU assessment survey measurements of ambient radiation were the result of shine from the nearby K-1066-K Cylinder Yard. Analytical results for these samples reported no elevated radiological COCs above background levels. ~~Both historic and DVS samples outside the immediate area of the K-895 Pier Area in the Class 1 SU and further east in the Class 3 SU reported sporadic detections of cadmium, nickel, and selenium above background levels. PCBs with a maximum reported concentration of 110 ug/kg were detected in several samples outside the immediate area of contamination. Several radionuclides, including Ra-226, Th-228, Th-230, U-234, and U-228, were elevated above background levels, and the U-238 result was above the industrial use PRG. Concentrations of radiological COCs appeared to increase with proximity to the K-895 Cylinder Destruct Facility. Polyaromatic hydrocarbons were detected frequently in samples within the Class 1 SU area at very low concentrations. Toluene and acetone were detected in one historic sample within the Class 1 SU. Biased surface soil samples were collected in the eastern portion of EU Z1-49 to verify that elevated Class 3 SU assessment survey measurements of ambient radiation were the result of shine from the nearby K-1066-K Cylinder Yard. Analytical results from these samples reported no elevated radiological COCs above background levels~~.

5.6 K-895 CYLINDER DESTRUCT FACILITY REMEDIAL ACTION

During the summer of 2007, soils removed from the K-895 site and a small adjacent area were shipped to Energy*Solutions*, Utah (see Fig. 11). The closure radiological walkover survey of the area identified elevated radioactivity on the wooden piers that bounded the site along the shoreline of the K-901 North Pond. Removal of the wooden piers was necessary and a RA Core Team concurrence was approved for this removal. Results from five samples collected from the wooden piers indicated shipment to Energy*Solutions* was necessary.

Fig. 11. K-895 wooden pier removal.

The piers were anticipated to contain mixed radioactive waste that would have to be disposed of at Energy*Solutions*, UT. Five samples for WAC attainment were obtained and analyzed for total/TCLP metals, PCBs, total/TCLP semivolatiles, and radiological constituents. The piers were removed on August 14-15, 2007, and placed in three B-25 boxes and shipped to Energy*Solutions* on August 29, 2007. The restoration end state is shown in Fig. 12.

5.7 DUCT ISLAND SOUTH SOIL MOUNDS DECISION-RELATED CHARACTERIZATION

An area of soil disposal was identified along the access road to the power line corridor in EU Z1-38 of the Duct Island South EU Group. The soil mounds were identified as having elevated radioactivity by the Class 3 assessment field crews. Samples were collected at two biased locations on the soil mounds by the DVS Characterization Program.

Based on results of the Class 3 and Class 4 SU walkover assessment and DVS sampling performed, it was concluded the area of small earthen mounds contained PCB-1260 contamination above maximum RLs and a removal action was required. Remedial action reduced the concentrations of Cs-137, U-235, and U-238 to less than the Zone 1 average RLs over the EU. Similarly, metals and radionuclide concentrations were reduced to less than the Zone 1 industrial use PRGs, and concentrations of several COCs above groundwater soil SLs were removed.

Each mound consisted of a series of coalesced soil piles. There were two large mounds and four small mounds. Results for PCB-1260 at locations EU38B-01 and EU38B-02 were 110,000 ug/kg (Max RL = 100,000 ug/kg and Avg RL = 10,000 ug/kg). Radioactive contamination was identified during the radiation walkover survey with values ranging from 4820-3328 CPM (background = 1956 CPM). Post-RA PCB confirmation sample results are compiled below:

- EU38-9C-401 500 ug/kg,
- EU38-9C-402 6300 ug/kg,
- EU38-9C-403 370 ug/kg,
- EU38-9C-404 990 ug/kg,
- EU38-9C-405 62 ug/kg, and
- EU38-9C-406 520 ug/kg.

Fig. 12. K-895 wooden pier restoration end state.

Once contaminated soil was removed from the EU, chemical and radionuclide concentrations were at or near background concentrations in the remaining EU acreage. Following RA, there was a high probability this acreage could be released with no land use restrictions with the appropriate additional evaluation of risk.

Details of this summary are included in the Duct Island Area and K-901 Area PCCR (DOE 2006a) and formed the basis for recommending excavation of soil at the Duct Island South site. Additional data collected for WAC attainment included four soil samples collected from the soil mounds and analyzed for TCLP metals, SVOC, PCBs, TAL metals, and radiological constituents.

Results of laboratory analyses demonstrated the soil was acceptable for disposal at EMWMF.

5.8 DUCT ISLAND SOUTH SOIL MOUNDS REMEDIAL ACTION

The soil mounds were excavated (Fig. 13) to a nominal depth of 1 ft, and approximately 130 yd^3 of contaminated soil and 5 yd^3 of investigation-derived waste (10 loads) were shipped via truck to EMWMF on September 12-13 and 17-18, 2007. Six confirmatory samples were obtained from the excavation on September 20, 2007, and no contaminants above Zone 1 groundwater screening criteria or the 1×10^{-5} PRG remained. The excavated area was graded and the site end state is shown in Fig. 14.

5.9 END STATE

This section describes the end state of sites where RAs were performed and forms the basis for future land use controls.

The HVSS USTs were closed in place because there was no perceived need for future subsurface use of that land parcel. However, the average benzo(a)pyrene concentration in EU Z1-01 exceeded the 1×10^{-6} residential PRG by greater than an order of magnitude. In contrast, the K-1055 tanks were removed because such a future land use was a possibility. Metals and radionuclides at above-background concentrations and detections of PCBs, SVOCs, and VOCs remain in EU Z1-03.

Fig. 13. Duct Island South soil mounds excavation

Fig. 14. Duct Island South soil mounds restoration end state.

The remaining RL exceedances at the site were removed by RA of the K-895 cylinder destruct facility piers.

However, remaining concentrations of arsenic, cesium, radium, thorium, and uranium isotopes exceeded the 1×10^{-6} residential PRGs. Remedial action of the Duct Island soil mounds eliminated the PCB maximum RL exceedances at the site and reduced the concentrations of chemical and radionuclide contaminants to at or below background concentrations.

6. DEVIATIONS FROM GOVERNING DOCUMENTS

The RAWP for Zone 1 (DOE 2007) described the performance of pre- and post-remediation characterization activities and the Waste Handling Plan (DOE 2003b) documented the waste characterization and waste management methods to be used in Zone 1 RA. Concurrence forms that describe RA Core Team revisions to approved documents will be included in the Zone 1 RAR.

7. COSTS FOR REMEDIAL ACTION(S)

The costs for performing RAs at all sites included in this PCCR totaled $810,302 and are detailed in Table 7.

Table 7. Remedial actions costs

RA site	Cost
S-21 Happy Valley Service Station	$210,922
K-1055 gasoline/diesel station tanks	$299,316
K-895 Cylinder Destruct Facility Piers and Duct Island South Soil Mounds	$261,342
Waste disposal cost at Energy*Solutions*	$38,722
Total cost	**$810,302**

8. WASTE MANAGEMENT AND TRANSPORTATION ACTIVITIES FOR REMEDIAL ACTION(S)

Waste management and transportation activities for the RAs performed in FY 2008 and included in this PCCR are summarized in Table 8.

Table 8. Waste management and transportation summary for FY 2008 RAs

Generating site	Waste type	Transportation method	Disposal container	Disposal location	Disposal volume
S-21 HVSS	Water/aqueous liquid	Truck	Tanker truck	Clean Harbors, Chattanooga, TN	52,000 gal
	IDW[a]	Truck	Dump truck	ORR landfill	3 yd^3
K-1055 gasoline/ diesel station tanks	Tanks	Truck	Dump truck	ORR landfill	44 yd^3
	Water/aqueous liquid	Truck	Tanker truck	Clean Harbors, Chattanooga, TN	42,500 gal
	IDW	Truck	Dump truck	ORR landfill	3 yd^3
K-895 Cylinder Destruct Facility Piers	Wooden piers	Truck	B-25 boxes	Energy*Solutions*, UT	9 yd^3
	IDW	Truck	B-25 box	Energy*Solutions*, UT	1 yd^3
Duct Island South Soil Mounds	Soil	Truck	Dump truck	EMWMF Waste Lot Profile 4.8	130 yd^3
	IDW	Truck	Dump truck	EMWMF Waste Lot Profile 4.8	5 yd^3

[a]IDW was taken to K-1055 and shipped from that site.

EMWMF = Environmental Management Waste Management Facility
FY = fiscal year
HVSS = Happy Valley Service Station
ORR = Oak Ridge Reservation
RA = remedial action
IDW = investigation-derived waste

9. OPERATIONS AND MAINTENANCE

There are no active systems requiring ongoing operations and maintenance at locations in Zone 1 where RAs were performed in FY 2008.

10. MONITORING SCHEDULE AND/OR EXPECTATIONS

Based on information obtained under the DVS characterization program and RAs documented in this PCCR, there is no residual contaminant mass that poses a threat to an industrial worker or groundwater. Therefore, no environmental or radiological monitoring is required for EUs Z1-01, Z1-03, Z1-38, and Z1-49.

11. LAND USE CONTROLS

This section discusses the general land use controls for EUs in ETTP Zone 1. Details of the controls will be presented in the RAR. An assessment of EUs that may be available for possible unrestricted use is presented in Sect. 11.2.

11.1 LAND USE CONTROLS UNDER THE ZONE 1 ROD

DVS characterization of the EUs presented in this PCCR was conducted in accordance with the requirements of the Zone 1 ROD and Zone 1 RAWP. The characterization goal was to gather sufficient information to evaluate the EUs against the four decision rules developed in the DVS DQOs (see Table 5), and identify an action/NFA decision for each EU. The decision rule evaluation process used in this PCCR is described in Sect. 3. Consistent with the Zone 2 ROD, a NFA decision means an EU is available for unrestricted industrial use to 10 ft bgs.

11.2 POSSIBLE LIFTING OF LAND USE CONTROLS

Although not required by the Zone 1 ROD, this section presents an evaluation of the EUs assessed in this PCCR for possible lifting of land use controls. This section will consider the possibility of lifting the following different land use controls:

- The need for industrial land use controls below 10 ft bgs, and
- Designating certain EUs available for unrestricted land use.

Based on the RAs performed, DVS process, and EU DVS status assessments presented in this PCCR, each EU was assigned a high, medium, or low probability of lifting land use controls.

11.2.1 Definitions

High probability. This designation indicated there were no identified areas of contaminated soils and no significant disposal or landfill operations were observed in the EU. Dynamic Verification Strategy evaluations indicated there was no identified impact within the EU and there was a high probability the acreage could be released with no land use controls following appropriate evaluation.

Medium probability. This designation indicated there was an identifiable impact from facility operations to some portion of the EU acreage. The impact may have been visible rubbish and debris, and/or concentrations of several metals, and/or radionuclides above background levels, and/or the detection of organic compounds in a few samples within the EU. Based on observations and sample results, the impact appeared to be minor and limited in extent. There was a moderate probability that the acreage could be released following appropriate evaluation.

Low Probability. This designation indicated there was a clearly identified impact to substantial portions of the EU acreage. Metals and radionuclides were commonly above background levels and organic compounds may have been present in several samples within the EU at levels above 1×10^{-6} residential PRGs. The probability of unrestricted use of the acreage in the EU was low.

11.2.2 Industrial Controls at Depth

An evaluation was performed to determine which EUs would require industrial controls below 10 ft bgs. The DVS program was designed to assure the top 10 ft met industrial criteria. However, sufficient information existed to make reasonable conclusions regarding the need for land use controls below 10 ft. For those EUs where the top 10 ft met industrial criteria pre- or post-RA and it was determined that waste was not buried, there was no mechanism to transport contaminants to depths below 10 ft and, therefore, those EUs could be considered good candidates to lift industrial controls below 10 ft.

For those EUs where waste was buried, sufficient data was gathered to determine the vertical distribution of contaminants. All EUs that had been cleared for industrial use to a depth of 10 ft bgs had a high probability of being cleared for industrial use to all depths. All EUs evaluated in this PCCR are proposed for unrestricted use below 10 ft (see Table 9).

11.2.3 Potential Unrestricted Use

To conduct the evaluation and determine the probability of lifting land use controls, EU analytical data were compared to background concentrations and 1×10^{-6} residential PRGs. A qualitative assessment of the applicability of the comparison results to the whole EU then was made. DVS sampling was biased to areas with relatively high probabilities of being contaminated (i.e., DVS systematic sampling is focused on Class 1 and Class 2 SUs and DVS biased sampling is conducted in all SUs based on a determination from visual and screening assessments that there is a likelihood of contamination). As a result, the presence of background or 1×10^{-6} residential use PRG concentration exceedances in the data set for a particular EU did not automatically preclude the EU from the possibility of lifting industrial land use controls. Instead, given the relatively non-impacted nature of Zone 1, it was likely that localized background or PRG concentration exceedances would not be extrapolated across an EU during the qualitative assessment of the background and PRG comparison results.

Because the DVS process was designed around the requirements of the Zone 1 ROD, which specifies an unrestricted industrial land use, further evaluation was recommended before a final conclusion was made concerning lifting industrial land use controls.

To evaluate the EUs for unrestricted use, appropriate DQOs were developed that considered but were not limited to the following:

- Calculated RLs consistent with the risk management requirements of an unrestricted land use scenario;
- RLs for chemicals and radionuclides whose background concentrations were greater than residential PRGs (i.e., aluminum, arsenic, iron, manganese, K-40, Ra-226, Th-228, and Th-232);
- RL for Cs-137, a ubiquitous fallout radionuclide that does not have a determined background concentration but which typically exceeded its residential PRG whenever detected; and the size of the EU.

With these considerations in mind, results of the evaluation process identified the EUs assessed in this PCCR that had a high, medium, and low probability of meeting further considerations for lifting the land use restrictions. Results of the evaluation are presented in Table 10.

Table 9. EUs with restricted/unrestricted land use below 10 ft bgs in Zone 1 EUs[a]

EU	Proposed restricted/unrestricted land use below 10 ft	EU	Proposed restricted/unrestricted land use below 10 ft
Z1-01	Unrestricted	Z1-38	Unrestricted
Z1-03	Unrestricted	Z1-49	Unrestricted

[a]Only EUs assessed in this PCCR were considered.

EU = exposure unit
PCCR = Phased Construction Completion Report

Table 10. Probability of lifting land use restrictions from Zone 1 EUs[a]

EU	Probability of lifting land use restrictions	Rationale/caveats
Z1-01	Low	UST RA completed but average benzo(a)pyrene concentration exceeds 1×10^{-6} residential PRG by greater than an order of magnitude
Z1-03	Low	UST RA completed but presence of metals and radionuclides at above-background concentrations and detections of PCBs, SVOCs, and VOCs indicate additional information is required to make an evaluation regarding unrestricted use
Z1-38	High	RA of contaminated soils reduces chemical and radionuclide concentrations to at or near background concentrations
Z1-49	Low	Arsenic detected at below background levels but above its 1×10^{-6} residential PRG; several samples reported radioisotopes of cesium, radium, thorium, and uranium above 1×10^{-6} residential PRGs

[a]Only EUs assessed in this PCCR were considered.

EU = exposure unit
PRG = preliminary remediation goal
RA = remedial action
SVOC = semivolatile organic compound
UST = underground storage tank
VOC = volatile organic compound

12. REMAINING ACTIVITIES

This section summarizes activities remaining to be completed in Zone 1. The rationale for these activities falls into the following four categories:

- Remaining activity is an action to be performed,
- Remaining activity awaits a risk management decision,
- Remaining activity is part of a larger infrastructure investigation to be conducted at a later time, or
- Remaining activity awaits decontamination and decommissioning to make soils accessible.

The status of Zone 1 EUs and soil characterization, appropriateness of NFA for soils in the EU, appropriateness of NFA for infrastructure in the EU, documentation for EU action and closure, required action based on DVS characterization, and explanatory comments is presented in Table 11. The status of each Zone 1 EU as of the publication of this PCCR is shown in Fig. 15.

Table 11. Status of Zone 1 EUs

EU	Characterization complete?	NFA for soil appropriate?	NFA for infrastructure appropriate?[a]	Action required?	Closure documentation?	Comments/explanation
1	✓	✓	✓		FY 2008 Zone 1 PCCR	UST RAs complete
2	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
3	✓	✓	✓		FY 2008 Zone 1 PCCR	UST RAs complete
4	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
5	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
6	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
7	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
8A	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
8B	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
9	✓			✓	Future PCCR or Zone 1 RAR	K-1085 soils action required
10	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
11					Future PCCR or Zone 1 RAR	
12	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
13	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
14	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
15	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
16	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
17					Future PCCR or Zone 1 RAR	
18					Future PCCR or Zone 1 RAR	
19					Future PCCR or Zone 1 RAR	
20					Future PCCR or Zone 1 RAR	
21					Future PCCR or Zone 1 RAR	
22					Future PCCR or Zone 1 RAR	
23	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
24	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
25	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
26					Future PCCR or Zone 1 RAR	
27					Future PCCR or Zone 1 RAR	
28					Future PCCR or Zone 1 RAR	
29					Future PCCR or Zone 1 RAR	
30					Future PCCR or Zone 1 RAR	

Table 11. (continued)

EU	Characterization complete?	NFA for soil appropriate?	NFA for infrastructure appropriate?[a]	Action required?	Closure documentation?	Comments/explanation
31					Future PCCR or Zone 1 RAR	
32					Future PCCR or Zone 1 RAR	
33					Future PCCR or Zone 1 RAR	
34	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
35	✓	✓	✓		K-1007 Ponds/Powerhouse PCCR	
36	✓	✓	✓		Duct Island/K-901 PCCR	
37	✓	✓	✓		Duct Island/K-901 PCCR	
38	✓	✓	✓		FY 2008 Zone 1 PCCR	Soil mounds RA complete
39	✓	✓			Future PCCR or Zone 1 RAR	Address ducts as part of larger infrastructure investigation
40	✓	✓			Future PCCR or Zone 1 RAR	Address ducts as part of larger infrastructure investigation
41	✓	✓	✓		Duct Island/K-901 PCCR	
42	✓	✓	✓		Duct Island/K-901 PCCR	
43	✓	✓	✓		Duct Island/K-901 PCCR	
44	✓	✓	✓		Duct Island/K-901 PCCR	
45	✓	✓	✓		Duct Island/K-901 PCCR	
46	✓	✓	✓		Duct Island/K-901 PCCR	
47	✓	✓	✓		Duct Island/K-901 PCCR	
48	✓	✓	✓		Duct Island/K-901 PCCR	
49	✓	✓	✓		FY 2008 Zone 1 PCCR	K-895 Piers RA complete
50	✓	✓		✓	Future PCCR or Zone 1 RAR	K-1066-K concrete pad action required
51	✓	✓	✓		Future PCCR or Zone 1 RAR	
52	✓	✓	✓		Future PCCR or Zone 1 RAR	
53	✓	✓	✓		Duct Island/K-901 PCCR	
54	✓	✓	✓		Duct Island/K-901 PCCR	
55	✓	✓	✓		Duct Island/K-901 PCCR	
56	✓	✓	✓		Duct Island/K-901 PCCR	
57	✓	✓	✓		Duct Island/K-901 PCCR	
58	✓	✓	✓		Duct Island/K-901 PCCR	
59	✓	✓	✓		Duct Island/K-901 PCCR	
60	✓	✓	✓		Duct Island/K-901 PCCR	
61	✓	✓	✓		Duct Island/K-901 PCCR	
62	✓	✓	✓		Duct Island/K-901 PCCR	
63	✓	✓	✓		Duct Island/K-901 PCCR	
64	✓	✓	✓		Duct Island/K-901 PCCR	
65	✓	✓	✓		Duct Island/K-901 PCCR	

Table 11. (continued)

EU	Characterization complete?	NFA for soil appropriate?	NFA for infrastructure appropriate?[a]	Action required?	Closure documentation?	Comments/explanation
66			✓		Future PCCR or Zone 1 RAR	Risk evaluation ongoing to determine action/NFA decision
67	✓	✓	✓		Duct Island/K-901 PCCR	
68	✓	✓	✓		Duct Island/K-901 PCCR	
69	✓	✓	✓		Duct Island/K-901 PCCR	
70			✓		Future PCCR or Zone 1 RAR	Risk evaluation ongoing to determine action/NFA decision
71	✓	✓	✓		Duct Island/K-901 PCCR	
72	✓	✓	✓		Duct Island/K-901 PCCR	
73	✓	✓	✓		Duct Island/K-901 PCCR	
74	✓	✓	✓		Duct Island/K-901 PCCR	
75	✓	✓	✓		Duct Island/K-901 PCCR	
76	✓	✓	✓		Duct Island/K-901 PCCR	
77	✓	✓	✓		Duct Island/K-901 PCCR	
78	✓	✓	✓		Duct Island/K-901 PCCR	
79	✓	✓	✓		Duct Island/K-901 PCCR	

[a]Check mark in this column indicates either the infrastructure has been evaluated or there is no infrastructure requiring evaluation.

EU = exposure unit
NFA = no further action
PCCR = Phased Construction Completion Report
RA = remedial action
RAR = Remedial Action Report
UST = underground storage tank

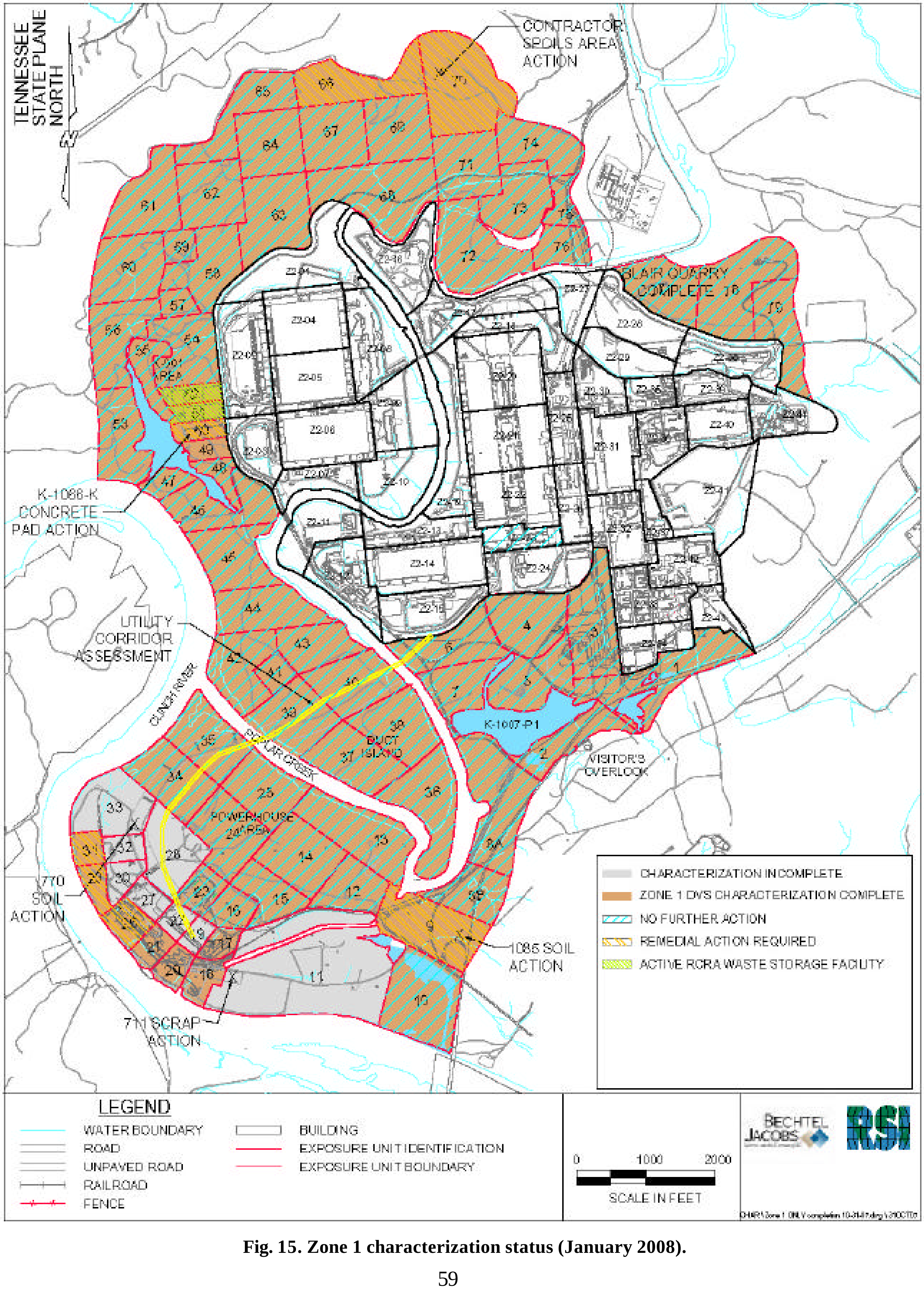

Fig. 15. Zone 1 characterization status (January 2008).

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