I-11739-0645

DOE/OR/01-2304
FINAL-CONCURRED

Environmental Baseline Survey Report for the Title Transfer of Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

1/28/08

BJC ETTP Classification & Information Control Office — Date

07-098(E)/050708

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

United States Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth St. SW, Atlanta, GA 30303-8960

May 23, 2008

Certified Main
Return Receipt Requested

4WD-FFB

Mr. Steven Cooke
Reindustrialization and Technical
Assistance Team
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831-8540

Subject: **REQUEST FOR CONCURRENCE IN THE DEPARTMENT OF ENERGY'S CLEAN PARCEL DETERMINATION TO SUPPORT TRANSFEROF PARCEL ED-4 AT THE EAST TENNESSEE TECHNOLOGY PARK, May 12, 2008**

Dear Mr. Cooke:

The United States Environmental Protection Agency (EPA) has completed its review of the subject document. Based on information provided in the "Environmental Baseline Survey Report (EBS) for the Title Transfer of Land Parcel ED-4 at the East Tennessee Technology Park (ETTP)" (May 2008), EPA views Land Parcel ED-4 properly classified as "uncontaminated". Therefore, EPA concurs with the Department of Energy's (DOE) identification of Land Parcel ED-4 as uncontaminated property pursuant to § 120(h)(4)(B) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

If you have any questions regarding this concurrence, please contact me at (404) 562-8543.

Sincerely,

Patricia J. Goldberg Digitally signed by Patricia J. Goldberg
DN: cn=Patricia J. Goldberg, o=US, ou=USEPA, ou=FFBSFD, email=goldberg.patricia@epa.gov
Date: 2008.05.22 11:12:51 -04'00'

Patricia J. Goldberg
Sr. Remedial Project Manager
Federal Facilities Branch

cc: Roger Petrie, TDEC
Dave Adler, DOE
Oak Ridge SSAB
Tim Mott, OSWER, OAA, FFRO
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bc: Martha Brock, OEA
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Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 12, 2008

Ms. Patricia Goldberg
U.S. Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8906

Dear Ms. Goldberg:

REQUEST FOR CONCURRENCE IN THE DEPARTMENT OF ENERGY'S CLEAN PARCEL DETERMINATION TO SUPPORT TRANSFER OF PARCEL ED-4 AT THE EAST TENNESSEE TECHNOLOGY PARK

The purpose of this letter is to request that Region 4 of the Environmental Protection Agency (EPA) concur in the Clean Parcel Determination that the Department of Energy (DOE) has made with regard to Parcel ED-4 at the East Tennessee Technology Park (ETTP). In addition, this letter transmits the revised Environmental Baseline Survey (EBS) Report that has been prepared to support this determination. Included in the EBS are responses to comments that were provided by EPA on March 19, 2008.

The EBS Report includes the results of an extensive records search as well as a physical inspection of the property, interviews with current and former workers, and environmental sampling. None of the investigative efforts identified evidence that hazardous substances were released or disposed of on the subject property, and the results of the risk evaluation indicate that occupation of the property is protective of human health and the environment. As a result, DOE has made the determination that Parcel ED-4 is suitable for release as uncontaminated property pursuant to Section 120(h)(4) of CERCLA. DOE requests that EPA concur with the Department's determination that the property proposed for transfer is uncontaminated.

If you have any questions regarding DOE's Clean Parcel Determination or the enclosed information to support this determination, please contact Sue Cange, of my staff, at (865) 576-0334.

Sincerely,

Larry W. Clark
Assistant Manager
for Nuclear Fuel Supply

Enclosure
cc's on page 2

cc w/enclosure:
Sue Cange, NS-53, ORO
Steve Cooke, NS-53, ORO
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DOE/OR/01-2304
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Environmental Baseline Survey Report for the Title Transfer of Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—May 2008

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
under work release 000900

Prepared for the
U. S. Department of Energy
Office of Nuclear Fuel Supply

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

07-098(E)/050708

This report has been prepared by Science Applications International Corporation (SAIC) for the sole and exclusive use of Bechtel Jacobs Company LLC (BJC) and the U. S. Department of Energy. Any other person or entity obtaining, using, or relying on this report hereby acknowledges that they do so at their own risk, and that SAIC shall have no responsibility or liability for the consequences thereof. This report is prepared by SAIC in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) 120(h)(1) and (4) requirements.

This report is intended to be used in its entirety. Excerpts, which are taken out-of-context, run the risk of being misinterpreted and are, therefore, not representative of the findings of this assessment. Opinions and recommendations presented in this report apply only to site conditions and features as they existed at the time of SAIC's site visit, and those inferred from information observed or available at that time, and cannot be applied to conditions and features of which SAIC is unaware and has not had the opportunity to evaluate.

The results of this report are based on record reviews, site reconnaissance, interviews, and the radiological report reviewed and approved by BJC. SAIC has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information.

All sources of information on which SAIC has relied in making its conclusions are identified in Chap. 7 of this report. Any information, regardless of its source, not listed in Chap. 7 has not been evaluated or relied upon by SAIC in the context of this report.

CONTENTS

FIGURES

TABLES

ABBREVIATIONS

bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
BTEX	benzene, toluene, ethylbenzene, and xylene
C&CCC	Carbide and Carbon Chemical Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COE	U. S. Army Corps of Engineers
CPD	Clean Parcel Determination
cpm	count per minute
DCGL	derived concentration guideline level
DOE	U. S. Department of Energy
DOE-O	U. S. Department of Energy-Oversight Division
dpm	disintegrations per minute
DVS	Dynamic Verification Strategy
EBS	environmental baseline survey
EM	Environmental Management
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
HI	hazard index
HVCC	Happy Valley Construction Campsite
LAPS	large-area plastic scintillator
LSU	land survey unit
MTBE	methyl tertiary butyl ether
NaI	sodium iodide
NFI	No Further Investigation
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORO	Oak Ridge Office
ORPS	Occurrence Reporting and Processing System
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PCCR	phased construction completion report
PRG	preliminary remediation goal
QA	quality assurance
QC	quality control
RADCON	Radiation Control (organization)
RCRA	Resource Conservation and Recovery Act of 1976
ROD	Record of Decision
RSE	Remedial Site Evaluation
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TRU	transuranic
TVA	Tennessee Valley Authority
VOC	volatile organic compound

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) report documents the baseline environmental conditions of a land parcel referred to as "ED-4" (ED-4) at the U. S. Department of Energy's (DOE's) East Tennessee Technology Park (ETTP). DOE is proposing to transfer the title of this land to the Heritage Center, LLC.

Parcel ED-4 is a land parcel that consists of two noncontiguous areas comprising a total of approximately 18 acres located east of the ETTP. The western tract of ED-4 encompasses approximately 8.5 acres in the northeastern quadrant of the intersection of Boulevard Road and Highway 58. The eastern tract encompasses an area of approximately 9.5 acres in the northwestern quadrant of the intersection of Blair Road and Highway 58 (the Oak Ridge Turnpike). Aerial photographs and site maps from throughout the history of the ETTP, going back to its initial development in the 1940s as the Oak Ridge Gaseous Diffusion Plant (ORGDP), indicate that this area has been undeveloped woodland with the exception of three support facilities for workers constructing the ORGDP since federal acquisition in 1943. These three support facilities, which were located in the western tract of ED-4, included a recreation hall, the Town Hall Camp Operations Building, and the Property Warehouse. A railroad spur also formerly occupied a portion of Parcel ED-4. These former facilities only occupied approximately 5 percent of the total area of Parcel ED-4.

This report provides supporting information for the transfer of this government-owned property at ETTP to a non-federal entity. This EBS is based upon the requirements of Sect. 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). In order to support a Clean Parcel Determination (CPD) in accordance with CERCLA Sect. 120(h)(4)(d), groundwater and sediment samples were collected within, and adjacent to, the Parcel ED-4 study area. The potential for DOE to make a CPD for ED-4 is further supported by a No Further Investigation (NFI) determination made on land that adjoins ED-4 to the east (DOE 1997a) and to the south (DOE 1997b).

Preparation of this report included the detailed search of Federal Government records [in accordance with CERCLA 120(h)(4)(A)(I)], title documents, aerial photos that may reflect prior uses, and physical and visual inspections of the property and adjacent properties. Interviews with current employees[1] involved in operations on the real property were also conducted to identify any areas on the property where hazardous substances and petroleum products or their derivatives and acutely hazardous wastes were known to have been released, or disposed. In addition, a search was made of reasonably obtainable federal, state, and local government records of each adjacent facility where there has been a release of any hazardous substance or any petroleum product or their derivatives, including aviation fuel and motor oil, and which is likely to cause or contribute to a release of any hazardous substance or any petroleum product or its derivatives, including aviation fuel or motor oil on the real property proposed for transfer as a Clean Parcel (ED-4). Radiological surveys were conducted to assess the property's radiological condition, and soil sampling was also conducted to assess baseline conditions. The following is a summary of the findings of the evaluation that was performed:

- No evidence was found of a release or disposal of hazardous substances or petroleum products or their derivatives occurring on ED-4 property.

- There were and are no underground storage tanks located on ED-4.

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[1] Personal communications with S. T. Goodpasture and R. P. Prince (currently employed at the East Tennessee Technology Park).

- No potential groundwater plume has been identified within, or in proximity to, ED-4. Additionally, the study area is upgradient of, or cross gradient to, the discharge zone for groundwater flow from ETTP.

- Parcel ED-4 is not located within ETTP Zones 1 or 2, which were established to address the potentially impacted areas of ETTP (DOE 2002); thus, no cleanup levels have been established for areas outside of Zones 1 or 2, which includes the area occupied by Parcel ED-4. However, for comparison purposes, Zone 1 remediation levels (RLs) have been used for screening analytical results for soils and sediments at ED-4. In addition, residential risk-based preliminary remediation goals (PRGs) have also been used for screening the ED-4 soil and sediment data because the property is proposed for transfer as a Clean Parcel.

- Sediment and surface soil samples were collected in June of 2007 to support transfer of Parcel ED-4. The established Zone 1 RLs were not exceeded in either the sediment or soil samples collected at ED-4. Soil and sediment sampling results are discussed in Sect. 6.1 of this report.

- Results of the radiological surveys performed in the study area and the statistical tests performed on the data gathered in each survey unit indicate that all results were less than the derived concentration guideline level (DCGL), and, therefore, the survey units can be transferred from a surface contamination standpoint. The radiological survey results are discussed in Sect. 6.2 of this report.

- The ED-4 transfer area soil/sediment data were screened against established RLs for ETTP Zone 1 (though ED-4 is not within either Zone 1 or Zone 2) and residential risk-based PRGs. No RLs were exceeded by soils/sediment at Parcel ED-4, and the PRG screen indicated that adverse health effects associated with soil/sediment residential exposure are highly unlikely. The analytical results for Parcel ED-4 soils and sediment indicated the cumulative risks were within the acceptable risk range and the HI did not exceed 1 based on residential exposures. In addition, because sample collection was targeted to locations with the greatest potential for contamination (either at the location of historical operations, or from sediment accumulation areas within the parcel), it is unlikely that higher concentrations would be encountered within the parcel.

Because the risk evaluation for the residential scenario is within the U. S. Environmental Protection Agency's generally acceptable target risk range and the HI did not exceed 1, and based on the information set forth in this document, DOE has identified the property proposed for transfer as "uncontaminated property" in accordance with CERCLA Sect. 120(h)(4)(A).

CONCLUSIONS

Based on the U. S. Department of Energy's (DOE's) review of the existing information, including discussions and interviews referenced herein, and evaluation of the data gathered in preparation of the environmental baseline survey for Parcel ED-4, DOE has determined that the parcel satisfies the statutory criteria for identification of the parcel as uncontaminated and that the transfer of Parcel ED-4 can be achieved by a Clean Parcel Determination per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(4). Evidence that supports the conclusion includes the fact that no target organ hazard index exceedance occurred and the risk values are within the U. S. Environmental Protection Agency's generally acceptable risk range (i.e., E-04 to E-06).

In addition, no evidence was found that hazardous substances were released, or disposed of, on the property that would preclude its identification as an uncontaminated parcel. Also, No Further Investigation (NFI) determinations have been made on property adjacent to the eastern and southern boundaries of Parcel ED-4. The property immediately adjacent to the northern boundary of ED-4 was, and remains, undeveloped. The area bordering the eastern boundary is occupied by a paved access road to the East Tennessee Technology Park and a parking lot. Thus, there are no indications of potential impacts on ED-4 from adjacent property that would preclude its identification as a Clean Parcel under CERCLA 120(h)(4).

RESPONSES TO REGULATOR COMMENTS ON THE ENVIRONMENTAL BASELINE SURVEY REPORT FOR LAND PARCEL ED-4

DOE received comments from the U. S. Environmental Protection Agency (EPA) on the Environmental Baseline Survey (EBS) report for Parcel ED-4 on March 19, 2008. Comments and responses are noted below.

1. **Page 1-3.** The ED-4 boundary reflected in the figure is not accurate. Please modify this figure.

   DOE RESPONSE: The label for the boundary in the figure has been revised to note that it is the "ED-4 area". (It should also be noted that adjustments have been made to the proposed transfer footprints from DOE's initial notification of the intent to transfer that was issued in April 2007. The primary change to ED-4 was the reduction in the size of the footprint of the eastern parcel to avoid the wetlands. The notification letter was intended to communicate DOE's overall plan, other minor changes may occur prior to transfer, especially to accommodate the metes and bounds survey.)

2. **Page 4-2.** The hydrogeology discussed in Appendix C should be included in Section 4.3. The hydrogeologic discussion in Appendix C, 5th paragraph, discusses regional shallow groundwater flow, but not the local flow at ED-4. Shallow groundwater discharges south to the creek south of the western portion of ED-4. Groundwater discharges to the wetlands southwest of the eastern portion of ED-4 and also south to the creek. Discussion of local groundwater flow should be included in the text.

   DOE RESPONSE: The hydrogeology discussion has been added to Section 4.3, and local flow has been described in more detail as suggested.

3. **Page 6-21.** The text states that several metals "were detected at concentrations exceeding 2× the background concentration, indicating that the observed concentrations of the other metals are not significantly higher than background." It is not clear from this statement if the remaining metals are actually *less than* the 2× background screening concentrations. The text should be clarified.

DOE RESPONSE: A sentence has been added to clarify that all other metals are less than the background criteria.

4. **Page F.6-1, Section F.6.1, First Bullet.** The text says that contaminant concentrations were screened against PRGs "for the residential scenario at risk level 1E-06 and HQ of 1." This contradicts the text in other areas of the Risk Evaluation that specify an HQ of 0.1. The text should be corrected.

   DOE RESPONSE: This is a typographical error that has been corrected. In Section F.6.1 it now states "and HQ of 0.1."

5. **Page F.6-1, Section F.6.1.** The text states, "as discussed in Sect. F.1.2, as a back check the results of the screen were evaluated..." This risk evaluation does not contain a Section F.1.2. Further, the basis of the "back check" method is not referenced in the document. The text should be corrected, and additional information regarding the "back check" methodology, including a citation or reference, should be provided.

   DOE RESPONSE: The referenced section should be F.1.1 instead of F.1.2; the text has been revised accordingly. Additional discussion of the risk evaluation methodology has been added to Section F.1.1, and reference to a "back check" has been removed. The text indicates that after the initial screening of data against PRGs, the data were interpreted to evaluate the potential for ELCR > E-04 and/or HI > 1. Constituents with detected concentrations above PRGs and background criteria were evaluated in consultation with EPA and with the use of the RAIS risk calculator (http://rais.ornl.gov/cgi-bin/prg/for_ent_data) to confirm that no additional risk calculations were required for ED-4.

6. **Page F.6-1, Section F.6.1, Second Set of Bullets.** These bullets lay out the procedure that was performed to "back check" the potential risks for constituents that had concentrations that exceeded the PRGs. EPA has identified several issues with the approach used here.

   a. For constituents with a maximum detected concentration that exceeded PRGs, the average concentration was then used in the "back check" method. EPA does not support the use of an average concentration as a surrogate exposure point concentration in a screening method.

      DOE RESPONSE: Reference to the "back check" method has been removed. The analysis of constituents detected above PRGs is based on the maximum detected concentration of each constituent to provide a conservative upper-bound evaluation of risks. Based on consultation with EPA and using the RAIS risk calculator (http://rais.ornl.gov/cgi-bin/prg/for_ent_data) for confirmation, the results of the analysis of maximum detected concentrations indicates that the HI does not exceed 1, and the ELCR is within EPA's generally acceptable range of E-04 to E-06 for ED-4 soil and sediment.

   b. The back check method evaluated the average concentration against an HI of 1 and ELCR of E-04. EPA does not support the use of an ELCR of E-04 as a decision point in a screening method.

      DOE RESPONSE: Consistent with the RDR/RAWP (DOE/OR/01-2224&D3, July 2007), the ELCR is discussed relative to the EPA generally accepted target ELCR range of E-04 to E-06.

   c. The back check method used involves dividing the average concentration by the PRG "where appropriate." The text does not specify under what conditions this approach is appropriate. The method used provides a simple ratio. This may be useful for approximating a Hazard Index, but it

is not clear how the result could be used to compare against an ELCR of E-04 (or E-06). The back check method appears to be based upon misapplication of guidance described in a Region 4 memorandum from 1994, *Amended Guidance for Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease (FOSL)*. The PRE method called for use of the maximum detected concentration, which would be divided by the PRG. For carcinogens, the resulting ratio would be multiplied by 1×10^{-6} to approximate an ELCR concentration.

DOE RESPONSE: Reference to the "back check" method has been eliminated. Additional text has been added to provide interpretation of the potential risks and hazards associated with constituents above the PRG, and the text indicates that conclusions are based on consultation with EPA and confirmation using the RAIS risk calculator (http://rais.ornl.gov/cgi-bin/prg/for_ent_data). The result of the analysis for ED-4 based on maximum detected concentrations indicates that the HI does not exceed 1, and the ELCR is within EPA's generally acceptable range of E-04 to E-06.

d. The text following the bullets indicates that the HI exceeds 1, but it includes constituents that are present at concentrations below background. Metals present at concentrations below their background concentrations should be eliminated from further consideration.

DOE RESPONSE: Metals and radionuclides with maximum detected concentrations below the ETTP background criteria have been eliminated from consideration prior to the estimation of risks.

e. The text following the bullets also indicates that when constituents that are "not site-related" were eliminated, the HI was less than 1. The text does not describe how it was determined that constituents were not site related.

DOE RESPONSE: Text has been modified and the reference to "site-related" constituents has been revised.

7. **Page 6-16, Section 6.1.4.1.** Discuss the depth of the piezometers.

DOE RESPONSE: Text has been added to Section 6.1.4.1 that notes the depths of the piezometers. Note that the depths of the piezometers are also given in Table 6.11.

8. **General Comment.** The unconsolidated zone well, UNW-125, is not a downgradient well to the ED-4 property. This well is a side gradient well based on topography. Text should be modified to reflect this on page 6-17, 1st paragraph; page 6-19, last paragraph; page 6-22, last paragraph; and page 6-23, 1st paragraph.

DOE RESPONSE: The description of UNW-125 on pp. 6-17 and 6-19 has been revised from downgradient to side-gradient. However, the references to the piezometers and springs located in ED-3 on pp. 6-22 and 6-23 should remain as downgradient because they are downgradient.

1. PROPERTY IDENTIFICATION

The land referred to as Parcel ED-4, discussed in this Environmental Baseline Survey (EBS), is located in the southeastern portion of the East Tennessee Technology Park (ETTP) [formerly the Oak Ridge Gaseous Diffusion Plant (ORGDP) and later the K-25 Site] on the Oak Ridge Reservation (ORR) in Roane County, Tennessee. It consists of two noncontiguous tracts comprising a total of approximately 18 acres. The western tract of ED-4 encompasses approximately 8.5 acres in the northeastern quadrant of the intersection of Boulevard Road and Highway 58. The eastern tract encompasses an area of approximately 9.5 acres in the northwestern quadrant of the intersection of Blair Road and Highway 58. Figure 1.1 is a map showing the relationship of Parcel ED-4 to ETTP. Figure 1.2 shows the footprint of the Parcel ED-4 study area, and Fig. 1.3 is a photo (circa 1945) showing historical activities within a portion of the ED-4 footprint. Visible in this photo are several buildings associated with the Happy Valley Construction Campsite (HVCC), including a Recreation Hall, the Town Hall Camp Operations Building, and the Property Warehouse. A railroad spur used during plant construction and the former Wheat Road are also visible.

Highway 58 bounds both tracts of land to the south. The eastern boundary of the eastern tract follows Blair Road for nearly 500 ft from its intersection with Highway 58 to the point at which Blair Road turns eastward. From this point the northern boundary trends to the west for approximately 950 ft before turning to the south–southeast toward Highway 58. From the Blair Road and Highway 58 intersection, the southern boundary of the eastern tract runs approximately 1200 ft to the west along Highway 58. This tract includes a former railroad bed and a segment of the former Wheat Road. The "Haul Road," is a U.S. Department of Energy (DOE)-owned road actively used for truck transport of waste materials to the DOE Environmental Management Waste Management Facility, also bisects this tract (the Haul Road is not a part of the property to be transferred). The western boundary of the western tract is formed by the intersection of Boulevard Road and Highway 58 and runs north for a distance of approximately 600 ft across the corner of a parking lot (following the Zone 2 boundary). The boundary then turns northeast for approximately 300 ft before turning southeastward for approximately 600 ft and then to the south to Highway 58. The southern boundary of the western tract runs from the Boulevard Road and Highway 58 intersection to the east for approximately 900 ft along Highway 58. The footprint of Parcel ED-4 is outside of any Environmental Management (EM) Program areas planned for clean-up (DOE 2002).

Preparation of this report included a review of government records, title documents, and aerial photos; visual inspections of the property and adjacent properties; and interviews with current employees[2] to identify any areas on the property where hazardous substances and petroleum products or their derivatives were known to have been released, or disposed of.

[2] Personal communications with S. T. Goodpasture and R. P. Prince (currently employed at ETTP).

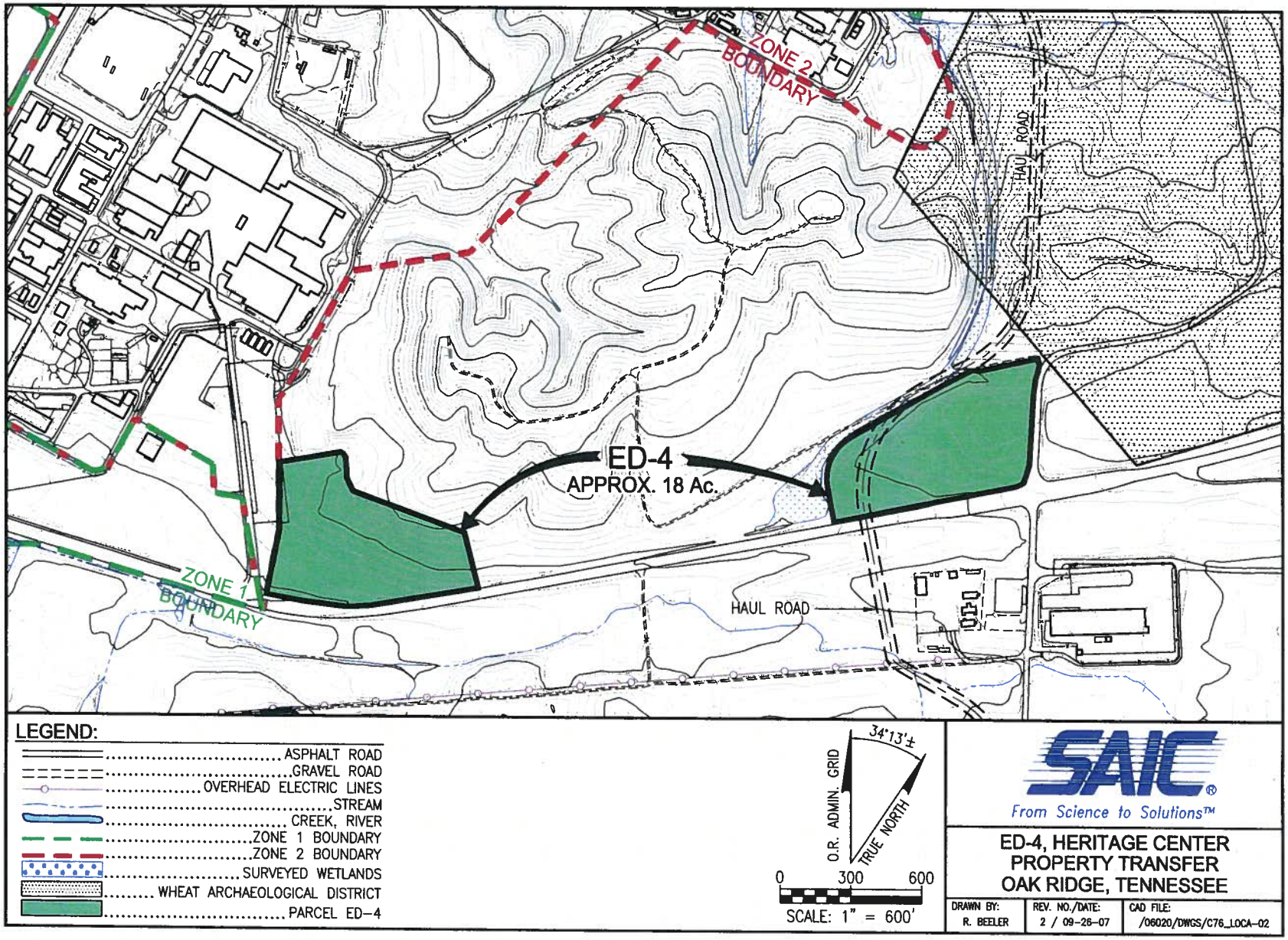

Fig. 1.1. Location map of the Parcel ED-4 study area.

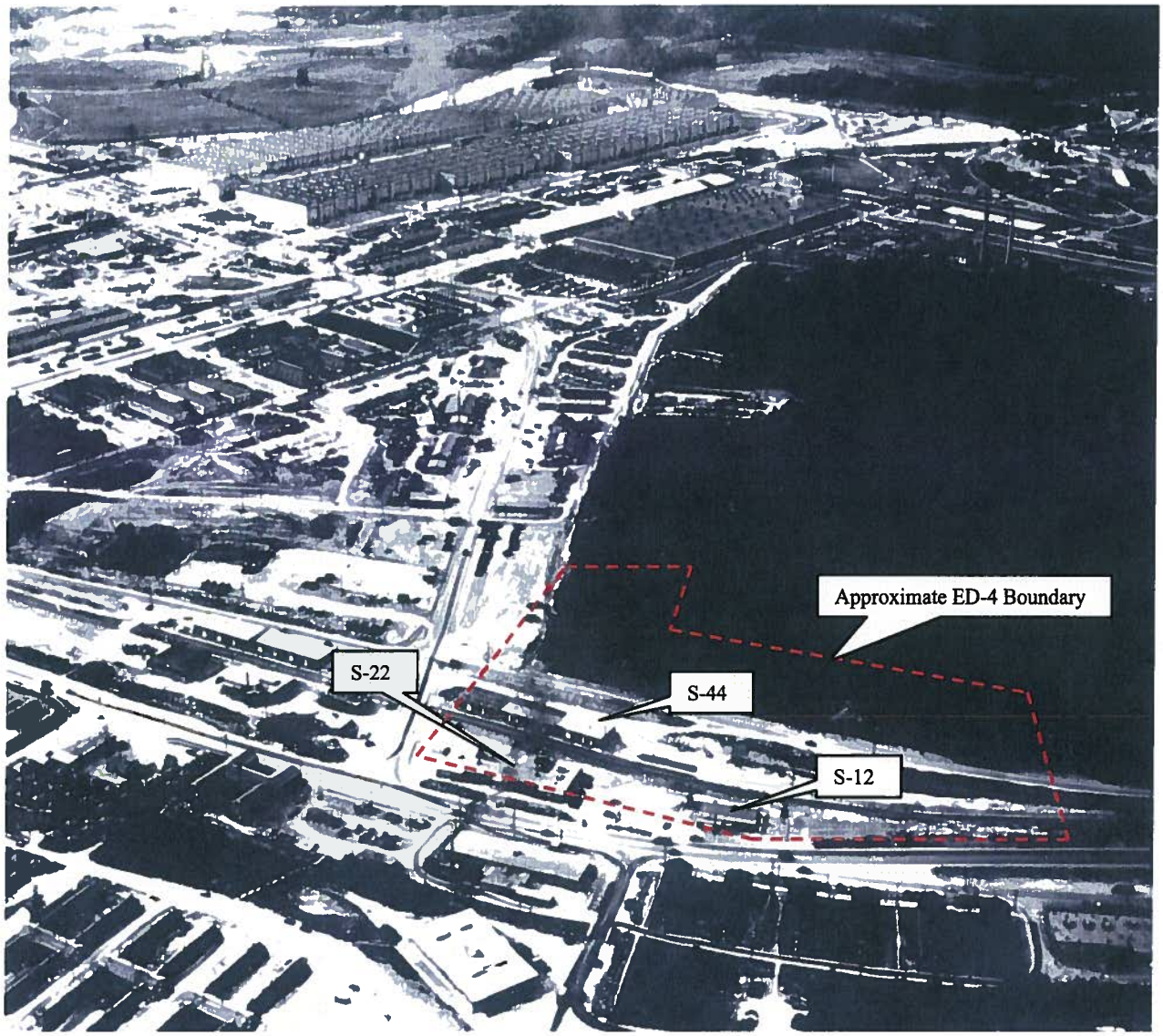

Fig. 1.2. Circa 1945 aerial photo showing historical activities within a portion of the ED-4 footprint.

2. TITLE SEARCH

On July 20, 2007 a visit was made to the state of Tennessee Roane County Registrar's Office to conduct a review of the recorded deeds documenting previous ownership of the land tract where the ED-4 study area is located.

The deeds that conveyed the property from the previous owner to the U. S. Government, and any deeds that conveyed the property to that previous owner, were reviewed as a part of the title search. Generally, the deeds from the previous two owners of a particular ORR parcel provide information that goes back to the early 1900s or even earlier. The deeds were reviewed for any references to previous land uses (e.g., homestead, farm, school, business, etc.). Also reviewed were any easements or conveyances referenced in the deeds that might indicate that portions of the land were used for pipelines, power lines, etc. Partial disposal or acquisition conveyance deeds were also reviewed because, in some instances, the land comprising a large farm had been acquired via several separate acquisitions.

In addition, property assessment records from the County Property Assessor's Office were reviewed because these documents may also contain evidence of a particular land use. Survey or subdivision maps referenced in deeds and maintained in the Register of Deeds office were also reviewed for any indications of a previous land use. Furthermore, because the Tennessee Valley Authority (TVA) was the previous owner of several large tracts of ORR land, the TVA Real Estate Office was contacted regarding their knowledge of any previous land uses. The U. S. Army Corp of Engineers (COE) was another source of information that has been contacted regarding previous land uses.[3]

[3] Energy Systems 1996. *Real Estate Section of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sect. 120(h) Review*, authored by W. W. Teer, Jr., Real Estate Manager, Lockheed Martin Energy Systems, Inc., Oak Ridge, TN, August 9, 1996.

3. FEDERAL RECORDS SEARCH AND REGULATORY SUMMARY

3.1 FEDERAL RECORDS SEARCH

The TVA in Knoxville, Tennessee, and the COE District Office in Nashville, Tennessee, were contacted in 1996, 1997, and again in 1998, to determine if they maintained any records reflecting past or present land use relative to the land presently comprising ED-4.

Page A-3 of Appendix A is a statement from the Realty Officer of the DOE Oak Ridge Office (ORO) that the real estate records contained no information or references to other recorded evidence that, prior to DOE ownership, the property was utilized for the storage of hazardous substances. Additionally, no information contained in these records would indicate that hazardous substances were released from or disposed on the property.

The pre-construction aerial photographs and maps listed below that reflect prior use of this land were also reviewed. Copies of these photographs and maps are maintained on file in the DOE-ORO Real Estate Office.

Aerial Photographs:

Photograph Nos. and Date	Flight By	Source
Nos. 820-3-20 and -21, dated September 25, 1942	Aero Service Corp. for Stone and Webster	DOE-ORO, Real Estate Office

These photographs, which were taken in 1942, show that the land on which the study area is located was predominantly used for agricultural purposes. The remaining land was wooded. A map depicting pre-World War II structures, churches, and cemeteries that were present in the area of the current ETTP is also included on page B-3 in Appendix B.

Topographic and real estate maps:

1. A November 7, 1942, topographic map identified as Section A-2 of ORR that was prepared by Aero Services Corporation for Stone and Webster.

2. A November 1940, Land Acquisition Land Map (sheet 10 N 57), prepared by the TVA, shows the boundaries of all land tracts that were acquired for the impoundment of the Watts Bar Reservoir.

3. A February 19, 1945, real estate acquisition map (sheet 9 of 16), prepared by the U. S. Army, shows the boundaries of the land tracts in Segment H of the ORR that were acquired during the early 1940s for the construction of the ORGDP.

Neither the aforementioned photographs nor maps contained any information regarding the history of the past land use that would indicate that releases of hazardous substances or petroleum products or their derivatives have occurred on the land where ED-4 is located. Copies of the 1942 topographic map and real estate map are maintained in the DOE-ORO Real Estate Office.[4]

[4] Energy Systems 1996. *Real Estate Section of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sect. 120(h) Review*, authored by W. W. Teer, Jr., Real Estate Manager, Lockheed Martin Energy Systems, Inc., Oak Ridge, TN, August 9, 1996.

3.2 REGULATORY SUMMARY

As discussed previously, prior to ownership by DOE (and its U. S. Government predecessor agencies), the property was farmland and forested land. Any DOE operations within the footprint of Parcel ED-4 occurred under DOE's own authority, without external regulation, prior to 1984. [DOE became subject to external regulations, including the Resource Conservation and Recovery Act of 1976 (RCRA), in 1984].

Based on interviews with employees and a review of records, there was no evidence of releases of hazardous substances, or petroleum products or their derivatives, that would preclude identification of Parcel ED-4 as an uncontaminated parcel.

Records (containing information about spills, permits, or permit violations) and interviews with employees or former employees[5] do not indicate that any regulatory actions have occurred within the footprint of Parcel ED-4. Therefore, no regulatory responses have been invoked.

[5] BJC 2007. Personal communications with S. T. Goodpasture and R. P. Prince (currently employed at the East Tennessee Technology Park) in August.

4. PAST AND PRESENT ACTIVITIES

4.1 PAST AND PRESENT ACTIVITIES FOR THE REAL PROPERTY PROPOSED FOR TRANSFER

Aerial photographs and site maps from throughout the history of ORGDP indicate that this area has largely been undeveloped woodland since federal acquisition. Before that time, the land where ED-4 is located consisted primarily of forests and grasslands intermixed with large and small orchards, cropland, and pastures associated with the agriculturally based and no longer extant Wheat Community. Blacksmithing, brick making, and gristmill operations also occurred in the community.

Workers building the ORGDP lived in a housing area referred to as the Happy Valley Construction Campsite (HVCC), which was located south of Highway 58(outside of ED-4). However, three support facilities for the construction workers were located in the western tract of ED-4. The three HVCC buildings located within ED-4 were designated as S-12, S-22, and S-44. Historical records indicate that these buildings were the Recreation Hall (S-12), the Town Hall Camp Operations Building (S-22), and the Property Warehouse (S-44). A railroad used during site construction passed through both tracts of ED-4, as did a segment of Wheat Road. By 1963, no remnants of these former structures, including the railroad spur, are visible on aerial photographs.

Historical maps of the ETTP area that were reviewed to determine what former DOE facilities had been located in the ED-4 footprint included the following:

- Kellex Corporation Drawing No. FD-01-AA-02, *K-25 and K-27 Plot Plan*, Rev. 9, dated March 31, 1946.

In the last two years, DOE has constructed a Haul Road used for the transport of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) waste on the Reservation, which cuts across the eastern tract. The road is gravel and is elevated above the surrounding terrain. The Haul Road property is outside of the proposed transfer footprint.

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The property to the east and immediately south of Parcel ED-4 has been designated as Parcel ED-3. Parcel ED-3 consists of two noncontiguous land areas, with the much larger area across the Oak Ridge Turnpike from ETTP and south of Parcel ED-4. Prior to federal acquisition, the land in Parcel ED-3 was mostly forest and grassland mixed with orchards, cropland, and pastures. Portions of a small agricultural community, the Wheat Community, were located on the parcel. Although the primary land use around the Wheat Community was agricultural, the community was a center for religion, education, and trade in eastern Roane County. There is no evidence that activities involving hazardous substances or petroleum products were present in the Wheat Community prior to federal acquisition.

During construction of the ORGDP, the ED-3 tract located south of Highway 58 was a portion of the campsite that provided living quarters from 1943 to 1946 for the construction workers building the ORGDP. The history of the construction camp, known as the HVCC, is described in detail in the Remedial Site Evaluation (RSE) Report (DOE 1997b).

Currently the only activities conducted at ED-3 occur at the trailers and sheds located in the northeastern corner of the HVCC tract. These facilities are used as office space and for equipment storage by Restoration Services, Inc., in support of ongoing EM activities.

The DOE EM program established the footprint reduction program in the mid-1990s as part of an incremental process to identify ORR lands that have not been impacted by activities that have resulted in hazardous substance contamination and to issue all such lands a No Further Investigation (NFI) status. The footprint reduction process followed the CERCLA 120(h) process that requires that the following information sources be used to identify the potential presence of hazardous substance contamination on government land: historical records, historical aerial photography, and field investigation/verification. As part of the DOE's footprint reduction process, the McKinney Ridge Study Area, which includes an area immediately east of Parcel ED-4, was evaluated for the purpose of an NFI determination under CERCLA. The evaluation included a review of historical records, aerial photographs, remote sensing data, and field investigation/verification. The Tennessee Department of Environment and Conservation (TDEC) DOE-Oversight Office (DOE-O) and U. S. Environmental Protection Agency (EPA) Region 4 approved the NFI status for the McKinney Ridge Study Area on May 28, 1998, and March 10, 1998, respectively.

An NFI determination has been made on the majority of both tracts of land that comprise ED-3. An NFI was approved by the EPA and TDEC in March and April of 1998, respectively, for the HVCC (DOE 1997a), which included the southern ED-3 tract. An NFI for the McKinney Ridge Study Area (DOE 1997a), which included the northern ED-3 tract, with the exception of a 150-ft-wide strip of land along Blair Road and Highway 58, was approved by TDEC and EPA in May and June of 1997, respectively.

The area to the north of ED-4 was forested prior to acquisition by the federal government and has remained forested throughout the history of operations at ETTP. The area to the west of ED-4 encompasses land and building areas that are included in both Zone 1 and Zone 2 of the ETTP. These areas are described in the Phased Construction Completion Reports (PCCRs) for the K-1007 Ponds Area (DOE 2006a) and the fiscal year 2006 PCCR for Zone 2 (DOE 2006b).

4.3 HYDROGEOLOGIC ENVIRONMENT

Parcel ED-4 is located in the southern portion of the ETTP, which is underlain by bedrock of the Chickamauga Supergroup and the Rome Formation (Fig. 4.1). Clastic bedrock of the older Rome Formation[6] has been placed over the calcareous rocks of the Chickamauga Supergroup by the K-25 thrust fault, which trends generally south to north across the western tract of ED-4 (Fig. 4.1). The Whiteoak Mountain Fault, which trends in a southwest–northeast direction along the southern boundary of Parcel ED-4 is a regional thrust fault that also places rocks of the Rome Formation in contact with rocks of the Chickamauga Supergroup.

The northeastern half of the western tract and the entire eastern tract are underlain by the Rome Formation. The lower part of the Rome Formation, which is poorly exposed in the ETTP area, generally consists of thin-bedded shale and siltstone with interbedded sandstones in variegated colors of maroon, green, and yellow-brown. The upper Rome consists of maroon sandstone, siltstone, and shale. In situ weathering of the Rome Formation yields saprolite consisting of weathered shale or siltstone, which commonly becomes more competent with depth. Available exposures of this weathered saprolite in the area north of Parcel ED-4 reveal numerous tight, highly fractured folds with widely ranging bedding orientations. This degree of variability precludes predictions of bedrock flowpaths in the Rome Formation at the ETTP.

[6] P. J. Lemiszki, 1994. *Geological Mapping of the Oak Ridge K-25 Site, Oak Ridge, Tennessee*, K/ER-11.

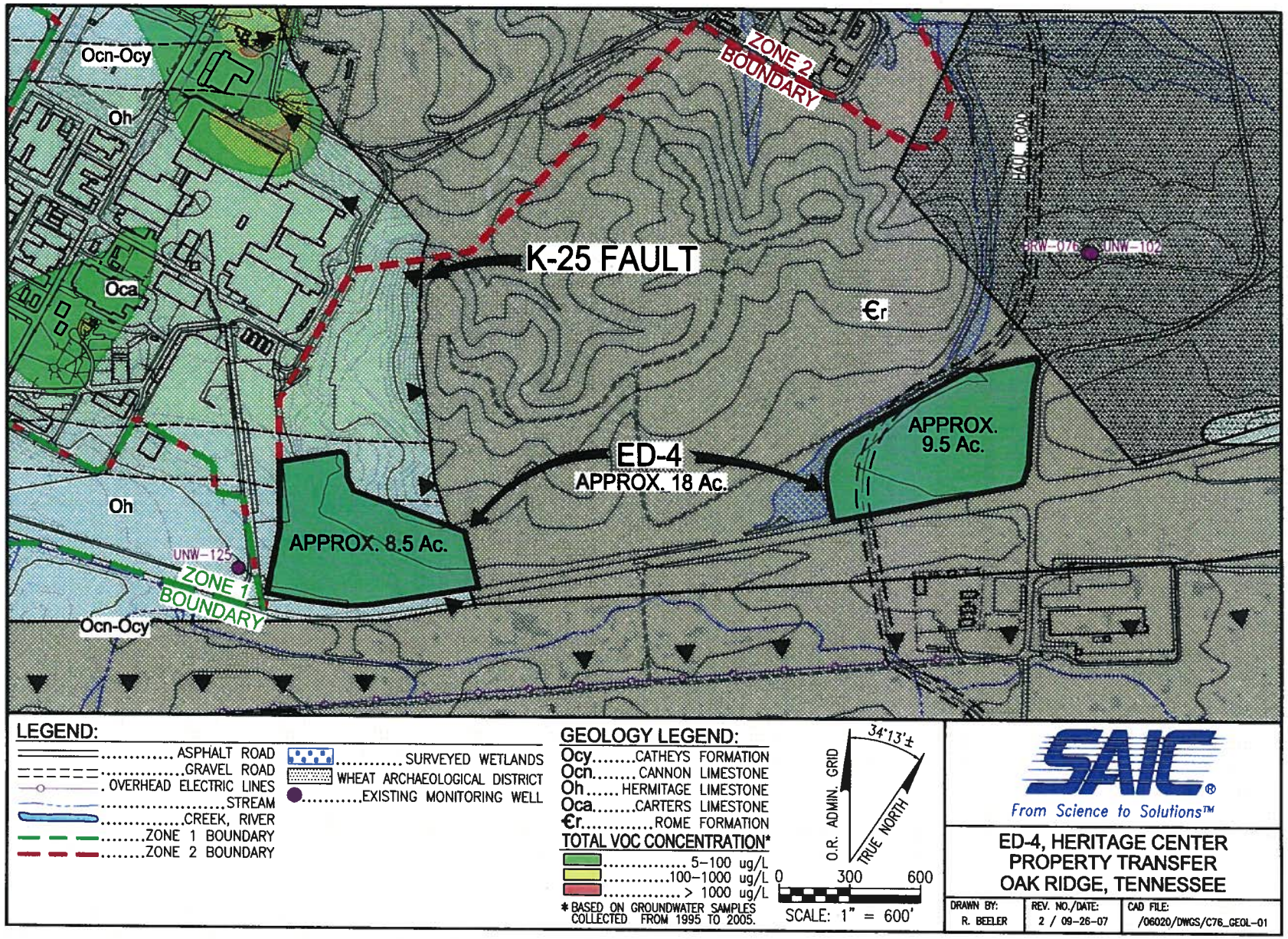

Fig. 4.1. Geologic and topographic map of the ED-4 area.

The Chickamauga Supergroup formations, which underlie the southwestern corner of the western tract of ED-4, include the Carters Limestone, the Hermitage Formation, the Cannon Limestone, and the Catheys Formation. Although less prone to karst development than the Knox Group rocks in the vicinity of the ETTP, the Chickamauga formations are nevertheless subject to the development of karst. Solutionally enlarged fractures, joints, and bedding planes are common in exposures of Chickamauga rocks in the vicinity of ETTP. Structurally, these formations have been folded into an anticline (convex upward fold) in the vicinity of Parcel ED-4 with the axis of this structure located approximately 600 ft north of the western parcel and trends southwest–northeast. Bedding in the Chickamauga generally dips northwestward on the north side of this axis and southeastward on the south side of this axis. The western tract of Parcel ED-4 is located on the south side of the anticline axis; thus, bedding is expected to dip primarily to the southeast in the vicinity of the tract. However, movement along the Whiteoak Mountain Fault may have caused significant disturbance of bedding orientations in the area of ED-4.

Depth to bedrock, interpolated from available data in the general vicinity of ED-4, is expected to be from 12 to 30 ft below ground surface (bgs). The depth to groundwater, interpolated from the available data, is expected to range from 5 to 25 ft bgs depending on topographic position within the ED-4 parcels. The water table at ETTP generally mimics topography with shallow groundwater flowing from higher topographic areas to the surrounding surface water bodies. Groundwater flow through bedrock is primarily controlled by fractures, bedding planes, and hydraulic gradient, and specific flow paths are difficult to discern. Shallow groundwater flow at ED-4 is likely to be to the southwest in the western tract of ED-4 with shallow groundwater moving from the higher topographic area in the northeast portion of this tract and discharging to the creek south of Highway 58. Groundwater flow beneath the eastern tract of ED-4 will be in a radial pattern off of the higher topographic area in the east central portion of this tract and discharging to the wetlands located to the northwest and west of the eastern portion of ED-4, with some flow also to the south toward the lower topographic area on the south side of Highway 58.

A groundwater plume has not been identified beneath or upgradient of ED-4. The nearest groundwater plume is located approximately 700 ft northwest of, and cross-gradient to, ED-4, and occurs in bedrock. The role of the K-25 fault on groundwater movement has not been determined at ETTP. However, the possibility of transport of contaminated groundwater found cross-gradient and in a different sub-watershed through bedrock flowpaths to ED-4 is not considered to be likely based on hydraulic gradients, which are anticipated to transport the groundwater plume to the southwest away from ED-4. Volatile organic compounds (VOCs) have not been detected at concentrations above a federal drinking water maximum contaminant level (MCL) or TDEC domestic water supply criteria[7] at any of the existing monitoring wells in the vicinity of ED-4. Additional information on the hydrogeology of ED-4 can be found in the approved Sampling and Analysis Plan (SAP) [Appendix C].

[7] The Tennessee Department of Environment and Conservation domestic water supply criteria are equivalent to the EPA's primary drinking water maximum contaminant levels (MCLs) indicated in Table 4.2 with the exception of chloroform, which does not have a corresponding state domestic water quality criterion.

5. RESULTS OF VISUAL AND PHYSICAL INSPECTIONS

5.1 VISUAL AND PHYSICAL INSPECTIONS OF THE PROPERTY FOR TRANSFER

A visual inspection of the property was conducted on May 3, 2007 and a walkover assessment conducted from May 8 to 14, 2007. At that time, the area was partially grass-covered and partially forested with the exception of the segment of Haul Road that transects the eastern tract of ED-4. The grass-covered areas are routinely mowed. There was no visible evidence of disposal of hazardous substances on or in the vicinity of the road during the walkover assessment. The work instruction for conducting the walkover assessment is presented in Appendix D.

A concrete pad that may be a remnant of a former structure associated with the historical railroad spur that crossed the parcel was identified during the walkover assessment. A minor amount of debris (e.g., small pieces of metal) was also present in the area of the pad. No visible evidence of disposal of hazardous substances was observed in this area.

A decision was made during development of the SAP for Parcel ED-4 that sediment accumulation areas, which would represent locations where potential contaminants may accumulate, would be targeted for sample collection to support the Clean Parcel Determination (CPD). Five sediment accumulation areas within Parcel ED-4 were identified during the walkover assessment conducted in May of 2007. These sediment accumulation areas were sampled to determine if surface soils had been impacted by historical activities at Parcel ED-4. These areas were sampled in accordance with the SAP (Appendix C), and the results are described in Chap. 6 of this report. The analytical results for the sediment samples were screened against Zone 1 soil remediation levels (RLs) and EPA preliminary remediation goals (PRGs) for evaluation. These sediment accumulation areas represent the accumulation of surface soils that have been transported by runoff from the surrounding areas.

5.2 VISUAL AND PHYSICAL INSPECTIONS OF ADJACENT PROPERTY

During the walkdown of May 3, 2007, the properties immediately adjacent to Parcel ED-4 were also visually inspected for signs of current or historical disposal of hazardous substances or petroleum products or their derivatives.

There is no evidence of any historical activities within the small northern tract of ED-3 (located to the east of ED-4's eastern tract) other than a small gravel road heading to the east from the intersection of Blair Road and Highway 58. A remnant of this road is currently gravel covered and used as a vehicle pull-off from Blair Road. The rest of this tract is either grass covered or wooded. The southern tract of ED-3 is largely forested with some grass-covered areas and a gravel-covered road. The Haul Road also transects the eastern end of the southern tract of ED-3.

A TVA power transmission right-of-way (ROW) is located south of Parcel ED-4 and a natural gas line is located in the area between the two ED-4 land tracts. No hazardous substances were observed in this area at the time of the walkdown. There was no visible evidence of disposal of hazardous substances in this area.

The area immediately west of the western tract of ED-4 is occupied by a parking lot and an open, grass-covered lawn. The former S-21 Happy Valley Service Station was located approximately 150 ft west of the western tract. This facility was in operation during the late 1940s. Four underground storage tanks (USTs) were closed in place at this former service station in the summer of 2007. Soil sampling

conducted for the Dynamic Verification Strategy (DVS) for Zone 1 of the ETTP indicated shallow surface soils had been impacted by a surface release of diesel fuel; however, subsurface soil data do not indicate past leaks from the USTs (DOE 2006a). The risk to an industrial worker from chemical and radiological exposures within the DVS exposure unit encompassing the former Happy Valley Service Station was found to be within EPA's acceptable risk range (DOE 2006a).

Closure of the Happy Valley Service Station UST site was completed on August 28, 2007, with all actions being approved by the ETTP Remedial Action Core Team (DOE 2007a), which includes EPA, TDEC, and DOE. The results of the samples were below the TDEC UST initial screening level criteria for soil with commercial use. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl tertiary butyl ether (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 initial screening level criteria (403 mg/kg). Thus, there is no evidence that hazardous substances, or petroleum products or their derivatives, from the former Happy Valley Service Station have impacted ED-4.

NFI determinations have been made on properties adjacent to the eastern and southern boundaries of Parcel ED-4. Based on the results of the walkdown, historical records research, and the approved NFIs, there are no indications of potential impacts to ED-4 from adjacent properties.

6. SAMPLING RESULTS

DOE's Reindustrialization Program has worked closely with the EM Program in an effort to realign data collection and analysis approaches to be consistent and to gain efficiencies where possible. To this end, the approach outlined in Chap. 3, "Approach to DVS," of the document titled *Remedial Action Work Plan for Dynamic Verification Strategy for Zone 1 East Tennessee Technology Park, Oak Ridge, Tennessee* (DVS), DOE/OR/01-2182&D3 (DOE 2005) is being followed to support transfers within ETTP. Because Parcel ED-4 is located outside of Zone 1, the general DVS approach has been modified to more closely resemble the footprint reduction process implemented by DOE. A process similar to the footprint reduction process was applied to ED-4 through the implementation of a walkover assessment protocol prepared to support its transfer (BJC 2007). Specifically, the walkover assessment was conducted by making foot traverses across the property and locating areas of potential anthropogenic impacts and sediment accumulation areas for subsequent sample collection. Soil and sediment samples were collected for laboratory analysis from the locations identified during the walkover (see Appendix D). In addition, because RLs do not exist for areas outside of Zones 1 and 2 at ETTP, for evaluation purposes, the sampling results have been screened against the RLs established for Zone 1 and also against EPA residential PRGs.

The SAP for Parcel ED-4 (see Appendix C) was written to address groundwater, which was excluded from the NFI for McKinney Ridge (DOE 1997a), and to address potential sediment accumulation areas and soil sampling locations within Parcel ED-4. The SAP in Appendix C, which was accepted by EPA and TDEC in May 2007, provides the analytical requirements for groundwater, sediment, and soil samples obtained from Parcel ED-4.

6.1 CHEMICAL SAMPLING

Based on discussions with EPA, it has been agreed that the need to collect soil samples to support title transfer activities will be determined on a case-by-case basis. Factors such as a facility's past operational history, if any, and geographic location will be considered. In addition, the history and knowledge of activities on adjacent properties are evaluated to see if those activities could impact the property proposed for transfer.

This section presents and discusses the results of the chemical groundwater, sediment, and soil sampling performed in the study area in 2007.

6.1.1 Data Validation

During the data validation process, laboratory data were assigned appropriate data validation flags. These flags were as described below:

"U" When the material was analyzed for but not detected above the level of the associated value.

"J" When the associated value was an estimated quantity (indicating there was cause to question the accuracy or precision of the reported data).

"UJ" When the analyte was analyzed for but not detected above the associated value; however, the reported value was an estimate and demonstrated a decreased knowledge of its accuracy or precision.

"R" When the analyte value reported was unusable. The integrity of the analyte's identification, accuracy, precision, or sensitivity raised significant questions as to the reality of the information presented.

"=" When the analyte value reported was detected. The integrity of the analyte's identification, accuracy, and precision was validated.

6.1.2 Chemical Sampling Results – Sediment

Data Validation Summary

Sediment samples were collected from the five sampling locations within the Parcel ED-4 study area (see Fig. 6.1), with 228 discrete analytes being validated for this project (EPA 1999, 2004). The samples were collected in June and July of 2007. There were 22 results rejected during validation. Note that estimated values are considered acceptable information for data interpretation.

Results

The chemical sampling results for sediments at Parcel ED-4 are summarized in Table 6.1 by analysis type and were interpreted in the risk screen (see Appendix F). The analytical results for sediment samples collected at ED-4 are being treated as soils for the purposes of the data evaluation, as these sediment accumulation areas serve as collection points for surface soils mobilized by runoff from the surrounding area. The sediment data tables include the following information:

- the frequency of detection;
- minimum and maximum detected concentrations;
- location(s) at which detected;
- if detected, concentrations that exceed the clean-up levels established for Zone 1 of the ETTP;
- PRGs for the residential scenario; and
- an indication whether the PRGs were exceeded by the maximum detected concentration.

Table 6.1. Parcel ED-4 sediment chemical analytical results summary

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)
Metals	133/150	3.0E-02	3.4E+04
PPCB	2/115	2.6E-02	4.1E-02
SVOC	37/390	4.4E-04	2.7E-01
VOC	11/288	3.9E-04	4.0E-01

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
mg/kg = milligrams chemical per kilogram soil.
PPCB = pesticides and polychlorinated biphenyls.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

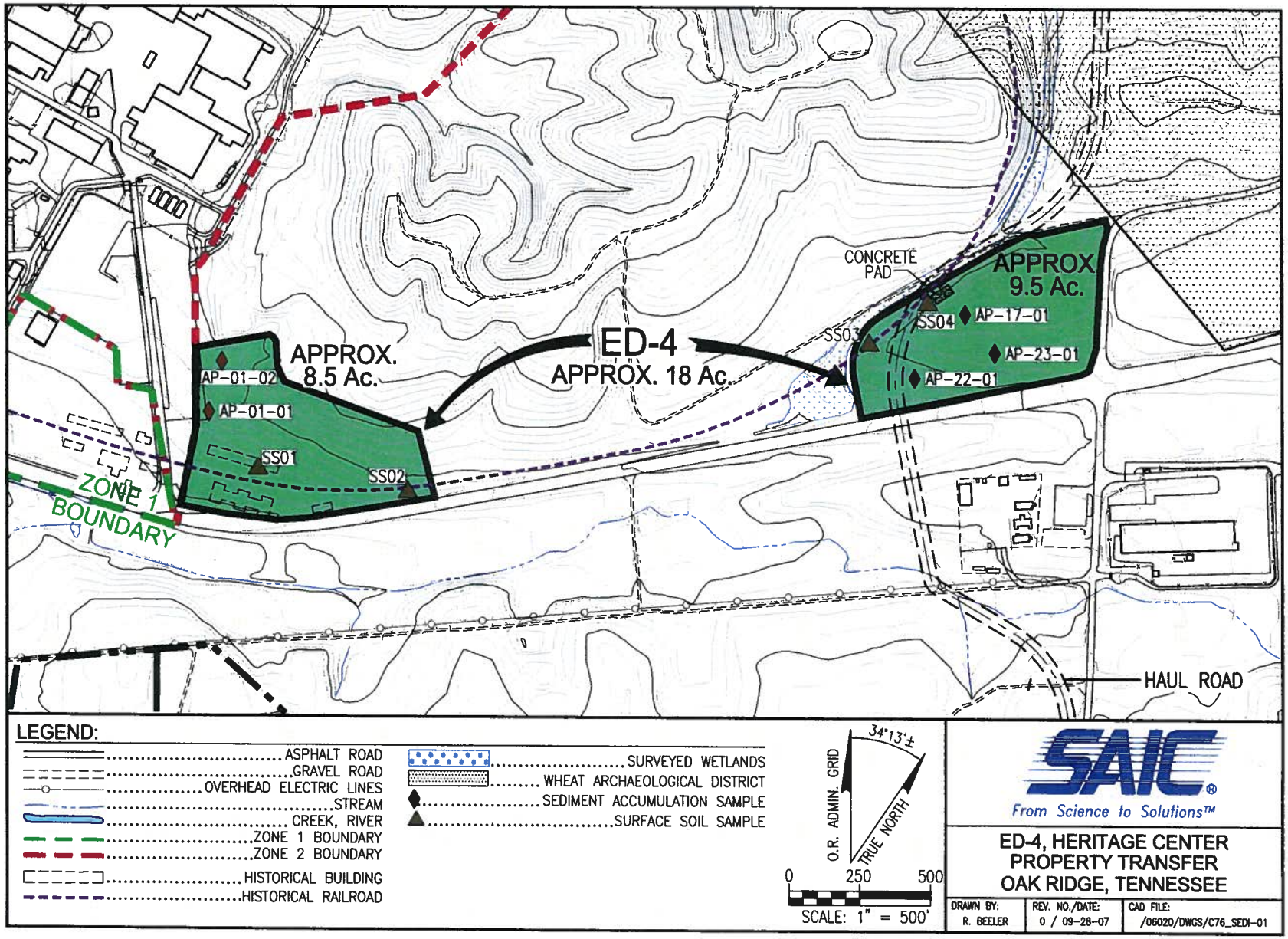

Fig. 6.1. Sediment and surface soil sampling locations at ED-4.

6.1.2.1 Sediment results analysis

The following discussion summarizes the sediment sampling results for ED-4.

PCBs

A total of 61 polychlorinated biphenyl (PCB) results were reported (Table 6.2), with 2 results (3.3%) detected. Both PCB-1254 (0.041 mg/kg) and PCB-1260 (0.026 mg/kg) were detected at location AP-01-02. This location receives runoff from a relatively large area of the hillside to the north and east of this location and from the parking lot to the west. PCBs have been used for their heat-resistant properties in oils, paints, and other materials subjected to the effects of high temperature. The detected PCB results could be due to the accumulation from runoff of small amounts of oils containing PCBs at this location. As presented in Table 6.2, none of the PCB sediment constituents had maximum detected concentrations that exceeded PRGs, indicating a low likelihood of adverse health effects.

Table 6.2. Parcel ED-4 sediment – polychlorinated biphenyls results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
PCB-1016	0/4	N/A	N/A		N/A	3.9E-01	N/A
PCB-1221	0/6	N/A	N/A		N/A	1.1E-01	N/A
PCB-1232	0/6	N/A	N/A		N/A	1.1E-01	N/A
PCB-1242	0/6	N/A	N/A		N/A	1.1E-01	N/A
PCB-1248	0/6	N/A	N/A		N/A	1.1E-01	N/A
PCB-1254	1/6	4.1E-02	4.1E-02	AP-01-02	No	1.1E-01	No
PCB-1260	1/6	2.6E-02	2.6E-02	AP-01-02	No	1.1E-01	No
PCB-1262	0/6	N/A	N/A		N/A	1.1E-01	N/A
PCB-1268	0/6	N/A	N/A		N/A	1.1E-01	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
N/A = not applicable.
PCB = polychlorinated biphenyl.
mg/kg = milligrams chemical per kilogram soil.

VOCs

A total of 288 VOC results were reported (Table 6.3), with only 11 results (3.8%) detected. Constituents were detected at AP-01-01 (1,1-DCE, acetone, 2-butanone); AP-01-02 (acetone, 2-butanone, styrene); AP-17-01 (acetone, xylenes); AP-22-01 (xylenes); and AP-23-01 (acetone, toluene) ranging from 0.004 to 0.404 mg/kg with the higher detections at AP-01-01 and AP-01-02. VOCs are typically used as industrial solvents or components of fuel. The detected VOC results could be the result of the accumulation of soil containing minor amounts of these compounds from releases related to the industrial activities conducted at ETTP. It should be noted that acetone, 2-butanone, and toluene are considered to be common laboratory contaminants. As presented in Table 6.3, none of the VOCs in sediment had maximum detected concentrations that exceeded PRGs, indicating a low likelihood of adverse health effects from these constituents.

Table 6.3. Parcel ED-4 sediment – volatile organic compounds results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
1,1,1-Trichloroethane	0/6	N/A	N/A		N/A	2.0E+02	N/A
1,1,2,2-Tetrachloroethane	0/6	N/A	N/A		N/A	4.1E-01	N/A
1,1,2-Trichloro-1,2,2-trifluoroethane	0/6	N/A	N/A		N/A	2.1E+03	N/A
1,1,2-Trichloroethane	0/6	N/A	N/A		N/A	7.3E-01	N/A
1,1-Dichloroethane	0/6	N/A	N/A		N/A	5.1E+01	N/A
1,1-Dichloroethene	1/6	1.4E-03	1.4E-03	AP-01-01	N/A	1.2E+01	No
1,2,3-Trichlorobenzene	0/6	N/A	N/A		N/A	N/A	N/A
1,2-Dibromo-3-chloropropane	0/6	N/A	N/A		N/A	2.1E-01	N/A
1,2-Dibromoethane	0/6	N/A	N/A		N/A	3.2E-02	N/A
1,2-Dichloroethane	0/6	N/A	N/A		N/A	2.8E-01	N/A
1,2-Dichloropropane	0/6	N/A	N/A		N/A	3.4E-01	N/A
1,2-Dimethylbenzene	0/6	N/A	N/A		N/A	2.7E+01	N/A
1,4-Dioxane	0/6	N/A	N/A		N/A	4.4E+01	N/A
2-Butanone	2/6	2.0E-02	3.1E-02	AP-01-01 AP-01-02	N/A	2.2E+03	No
2-Hexanone	0/6	N/A	N/A		N/A	N/A	N/A
2-Methoxy-2-methylpropane	0/6	N/A	N/A		N/A	1.7E+01	N/A
4-Methyl-2-pentanone	0/6	N/A	N/A		N/A	5.3E+02	N/A
Acetone	4/6	5.1E-03	4.0E-01	AP-01-01 AP-01-02 AP-17-01 AP-23-01	N/A	1.4E+03	No
Benzene	0/6	N/A	N/A		N/A	6.4E-01	N/A
Bromochloromethane	0/6	N/A	N/A		N/A	N/A	N/A
Bromodichloromethane	0/6	N/A	N/A		N/A	8.2E-01	N/A
Bromoform	0/6	N/A	N/A		N/A	6.2E+01	N/A
Bromomethane	0/6	N/A	N/A		N/A	3.9E-01	N/A
Carbon disulfide	0/6	N/A	N/A		N/A	3.6E+01	N/A
Carbon tetrachloride	0/6	N/A	N/A		N/A	2.2E-01	N/A
Chlorobenzene	0/6	N/A	N/A		N/A	1.5E+01	N/A
Chloroethane	0/6	N/A	N/A		N/A	3.0E+00	N/A
Chloroform	0/6	N/A	N/A		N/A	2.2E-01	N/A
Chloromethane	0/6	N/A	N/A		N/A	4.7E+00	N/A
Cumene	0/6	N/A	N/A		N/A	1.6E+01	N/A
Cyclohexane	0/6	N/A	N/A		N/A	1.4E+02	N/A
Dibromochloromethane	0/6	N/A	N/A		N/A	1.1E+00	N/A
Dichlorodifluoromethane	0/6	N/A	N/A		N/A	9.4E+00	N/A
Ethylbenzene	0/6	N/A	N/A		N/A	1.9E+02	N/A
M + P Xylene	2/6	3.9E-04	4.6E-04	AP-17-01 AP-22-01	N/A	2.7E+01	No
Methyl acetate	0/6	N/A	N/A		N/A	2.2E+03	N/A
Methylcyclohexane	0/6	N/A	N/A		N/A	2.6E+02	N/A
Methylene chloride	0/6	N/A	N/A		N/A	9.1E+00	N/A
Styrene	1/6	4.3E-02	4.3E-02	AP-01-02	N/A	4.4E+02	No
Tetrachloroethene	0/6	N/A	N/A		N/A	4.8E-01	N/A
Toluene	1/6	8.1E-04	8.1E-04	AP-23-01	N/A	6.6E+01	No

Table 6.3. Parcel ED-4 sediment – volatile organic compounds results (continued)

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Trichloroethene	0/6	N/A	N/A		N/A	5.3E-02	N/A
Trichlorofluoromethane	0/6	N/A	N/A		N/A	3.9E+01	N/A
Vinyl chloride	0/6	N/A	N/A		N/A	7.9E-02	N/A
cis-1,2-Dichloroethene	0/6	N/A	N/A		N/A	4.3E+00	N/A
cis-1,3-Dichloropropene	0/6	N/A	N/A		N/A	7.8E-01	N/A
trans-1,2-Dichloroethene	0/6	N/A	N/A		N/A	6.9E+00	N/A
trans-1,3-Dichloropropene	0/6	N/A	N/A		N/A	7.8E-01	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not applicable.

SVOCs

A total of 390 semivolatile organic compound (SVOC) results were reported (Table 6.4), with 37 results (10%) detected. SVOCs are used in various industries and found in lubricants and as components of fuel and asphalt. Detections ranged from 0.0004 mg/kg for 1,2,4-trichlorobenzene at AP-02-01 to 0.269 mg/kg for benzo(*a*)pyrene at AP-17-01, with detections at all locations except AP-23-01 and generally higher detections found at location AP-17-01. The detected SVOC results could be the result of runoff from adjoining asphalt areas or the use of diesel fuel and/or lubricating oils associated with activities along the former railroad.

As indicated in Table 6.4, benzo(*a*)pyrene had a maximum detected sediment concentration in excess of the residential soil PRG. The potential for adverse health effects associated with concentrations exceeding the PRG is discussed in the risk evaluation (Appendix F).

Table 6.4. Parcel ED-4 sediment – semivolatile organic compounds results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
1,2,4,5-Tetrachlorobenzene	0/6	N/A	N/A		N/A	1.8E+00	N/A
1,2,4-Trichlorobenzene	2/6	4.4E-04	4.5E-04	AP-01-01 AP-01-02	N/A	6.2E+00	No
1,2-Dichlorobenzene	0/6	N/A	N/A		N/A	1.1E+02	N/A
1,3-Dichlorobenzene	0/6	N/A	N/A		N/A	5.3E+01	N/A
1,4-Dichlorobenzene	0/6	N/A	N/A		N/A	3.4E+00	N/A
2,3,4,6-Tetrachlorophenol	0/6	N/A	N/A		N/A	1.8E+02	N/A
2,4,5-Trichlorophenol	0/6	N/A	N/A		N/A	6.1E+02	N/A
2,4,6-Trichlorophenol	0/6	N/A	N/A		N/A	6.1E-01	N/A
2,4-Dichlorophenol	0/6	N/A	N/A		N/A	1.8E+01	N/A

Table 6.4. Parcel ED-4 sediment – semivolatile organic compounds results (continued)

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
2,4-Dimethylphenol	0/6	N/A	N/A		N/A	1.2E+02	N/A
2,4-Dinitrophenol	0/6	N/A	N/A		N/A	1.2E+01	N/A
2,4-Dinitrotoluene	0/6	N/A	N/A		N/A	7.2E-01	N/A
2,6-Dinitrotoluene	0/6	N/A	N/A		N/A	7.2E-01	N/A
2-Chloronaphthalene	0/6	N/A	N/A		N/A	4.9E+02	N/A
2-Chlorophenol	0/6	N/A	N/A		N/A	6.3E+00	N/A
2-Methyl-4,6-dinitrophenol	0/6	N/A	N/A		N/A	6.1E-01	N/A
2-Methylnaphthalene	0/6	N/A	N/A		N/A	5.6E+00	N/A
2-Methylphenol	0/6	N/A	N/A		N/A	3.1E+02	N/A
2-Nitrobenzenamine	0/6	N/A	N/A		N/A	1.8E+01	N/A
2-Nitrophenol	0/6	N/A	N/A		N/A	N/A	N/A
3-Nitrobenzenamine	0/6	N/A	N/A		N/A	1.8E+00	N/A
4-Bromophenyl phenyl ether	0/6	N/A	N/A		N/A	N/A	N/A
4-Chloro-3-methylphenol	0/6	N/A	N/A		N/A	N/A	N/A
4-Chlorobenzenamine	0/6	N/A	N/A		N/A	2.4E+01	N/A
4-Chlorophenyl phenyl ether	0/6	N/A	N/A		N/A	N/A	N/A
4-Nitrobenzenamine	0/6	N/A	N/A		N/A	1.8E+01	N/A
4-Nitrophenol	0/6	N/A	N/A		N/A	N/A	N/A
Acenaphthene	0/6	N/A	N/A		N/A	3.7E+02	N/A
Acenaphthylene	0/6	N/A	N/A		N/A	3.7E+02	N/A
Acetophenone	0/6	N/A	N/A		N/A	N/A	N/A
Anthracene	2/6	9.9E-03	1.5E-02	AP-17-01	N/A	2.2E+03	No
Benz(*a*)anthracene	3/6	2.8E-02	1.1E-01	AP-17-01 AP-22-01	N/A	6.2E-01	No
Benzo(*a*)pyrene	4/6	1.4E-01	2.7E-01	AP-01-02 AP-17-01 AP-22-01	N/A	6.2E-02	Yes
Benzo(*b*)fluoranthene	2/6	1.9E-01	2.4E-01	AP-01-02 AP-22-01	N/A	6.2E-01	No
Benzo(*g,h,i*)perylene	3/6	7.5E-02	1.7E-01	AP-01-02 AP-17-01	N/A	2.3E+02	No
Benzo(*k*)fluoranthene	3/6	4.2E-02	1.2E-01	AP-01-02 AP-17-01	N/A	6.2E+00	No
Bis(2-chloroethoxy)methane	0/6	N/A	N/A		N/A	N/A	N/A
Bis(2-chloroethyl) ether	0/6	N/A	N/A		N/A	2.2E-01	N/A
Bis(2-ethylhexyl)phthalate	0/6	N/A	N/A		N/A	3.5E+01	N/A
Butyl benzyl phthalate	0/6	N/A	N/A		N/A	1.2E+03	N/A
Carbazole	0/6	N/A	N/A		N/A	2.4E+01	N/A
Chrysene	4/6	1.9E-02	1.7E-01	AP-01-02 AP-17-01 AP-22-01	N/A	6.2E+01	No
Di-n-butyl phthalate	0/6	N/A	N/A		N/A	6.1E+02	N/A
Di-n-octylphthalate	0/6	N/A	N/A		N/A	2.4E+02	N/A
Dibenz(*a,h*)anthracene	0/6	N/A	N/A		N/A	6.2E-02	N/A
Dibenzofuran	0/6	N/A	N/A		N/A	1.5E+01	N/A
Diethyl phthalate	0/6	N/A	N/A		N/A	4.9E+03	N/A
Dimethyl phthalate	0/6	N/A	N/A		N/A	6.1E+04	N/A
Diphenylamine	0/6	N/A	N/A		N/A	1.5E+02	N/A
Fluoranthene	4/6	2.7E-02	1.2E-01	AP-01-02 AP-17-01 AP-22-01	N/A	2.3E+02	No
Fluorene	0/6	N/A	N/A		N/A	2.7E+02	N/A
Hexachlorobenzene	0/6	N/A	N/A		N/A	3.0E-01	N/A

Table 6.4. Parcel ED-4 sediment – semivolatile organic compounds results (continued)

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Hexachlorobutadiene	0/6	N/A	N/A		N/A	1.8E+00	N/A
Hexachlorocyclopentadiene	0/6	N/A	N/A		N/A	3.7E+01	N/A
Hexachloroethane	0/6	N/A	N/A		N/A	6.1E+00	N/A
Indeno(*1,2,3-cd*)pyrene	2/6	5.7E-02	1.2E-01	AP-17-01	N/A	6.2E-01	No
Isophorone	0/6	N/A	N/A		N/A	5.1E+02	N/A
N-Nitroso-di-n-propylamine	0/6	N/A	N/A		N/A	6.9E-02	N/A
Naphthalene	0/6	N/A	N/A		N/A	5.6E+00	N/A
Nitrobenzene	0/6	N/A	N/A		N/A	2.0E+00	N/A
Pentachlorophenol	0/6	N/A	N/A		N/A	3.0E+00	N/A
Phenanthrene	3/6	2.2E-02	2.6E-02	AP-01-02 AP-17-01	N/A	2.3E+02	No
Phenol	0/6	N/A	N/A		N/A	1.8E+03	N/A
Pyrene	5/6	1.5E-02	1.8E-01	AP-01-01 AP-01-02 AP-17-01 AP-22-01	N/A	2.3E+02	No
m+p Methylphenol	0/6	N/A	N/A		N/A	N/A	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not available.

Pesticides

A total of 61 pesticide results were reported, with no detections.

Herbicides

A total of 7 herbicide results were reported, with no detections.

Metals

A total of 150 metals results were reported, with 133 results (90%) detected. The detected concentrations ranged from 0.03 mg/kg for mercury at AP-17-01 to 34,100 mg/kg for iron at AP-01-01 (Table 6.5). All sample locations were found to have detected metals results, which is to be expected because soil generally has a measurable content of metals in nature. There is no evident correlation between sample location and elevated metals results. The highest metals results were for the macronutrient elements calcium, iron, manganese, magnesium, aluminum, and potassium, which are all naturally occurring. As indicated in Table 6.5, several of the metals had a maximum detected sediment concentration in excess of the residential soil PRG. However, the established ETTP background soil concentrations for six of these eight metals are higher than the PRG, and only the maximum concentrations of selenium and thallium exceed both the PRG and background concentrations. The potential for adverse health effects associated with concentrations exceeding the PRG is discussed in the risk evaluation (Appendix F).

Table 6.5. Parcel ED-4 study area sediment – metals results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Residential soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Aluminum	6/6	3.9E+03	2.6E+04	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	7.6E+03	Yes
Antimony	1/6	1.7E+00	1.7E+00	AP-23-01	N/A	3.1E+00	No
Arsenic	6/6	1.7E+00	1.3E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	No	3.9E-01	Yes
Barium	6/6	2.6E+01	9.4E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	5.4E+02	No
Beryllium	6/6	3.3E-01	1.6E+00	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	No	1.5E+01	No
Boron	5/6	2.4E+00	4.6E+00	AP-01-01 AP-01-02 AP-17-01 AP-23-01	N/A	1.6E+03	No
Cadmium	0/6	N/A	N/A		N/A	3.7E+00	N/A
Calcium	6/6	2.5E+03	1.5E+04	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	N/A	N/A
Chromium	6/6	3.3E+00	3.1E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	2.2E+01	Yes
Cobalt	6/6	1.6E+00	2.1E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	1.4E+02	No
Copper	6/6	5.7E+00	2.7E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	3.1E+02	No
Iron	6/6	1.3E+04	3.4E+04	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	2.3E+03	Yes
Lead	6/6	6.0E+00	5.2E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	4.0E+02	No
Magnesium	6/6	4.0E+02	1.0E+04	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	N/A	N/A
Manganese	6/6	6.1E+01	1.3E+03	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	1.8E+02	Yes
Mercury	6/6	3.0E-02	1.4E-01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	No	2.3E+00	No
Nickel	6/6	8.6E+00	2.5E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	1.6E+02	No
Potassium	6/6	3.5E+02	1.9E+03	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	N/A	N/A
Selenium	6/6	6.6E+01	1.3E+02	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	3.9E+01	Yes
Silicon	6/6	1.1E+03	1.8E+03	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	N/A	N/A
Silver	6/6	2.8E+00	6.2E+00	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	3.9E+01	No
Sodium	6/6	9.5E+00	3.4E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	N/A	N/A
Thallium	1/6	1.5E+00	1.5E+00	AP-17-01	N/A	5.2E-01	Yes
Vanadium	6/6	6.3E+00	4.4E+01	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	7.8E+00	Yes
Zinc	6/6	1.3E+01	1.2E+02	AP-01-01 AP-01-02 AP-17-01 AP-22-01 AP-23-01	N/A	2.3E+03	No

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not available.

Asbestos

Asbestos was analyzed in selected sediment samples collected at ED-4. The purpose was to determine if this substance may have been disposed in the area due to the common use of asbestos-containing building materials during that period of time. A total of two (2) asbestos samples and one (1) duplicate sample were collected from sediment accumulation areas identified during the walkover assessment. The sediment samples analyzed for asbestos included the 02-SD-ED4 and 04-SD-ED4, locations. A duplicate sample was collected from the 02-SD-ED4 location. All sediment sample analysis results were negative for the presence of asbestos.

6.1.3 Chemical Sampling Results – Soil

Data Validation Summary

Soil samples were collected from four locations within the Parcel ED-4 study area (see Fig. 6.1), with 1236 discrete analytes being validated for this project (EPA 1999, 2004). There were 22 results rejected during validation. Note that estimated values are considered acceptable information for data interpretation. The samples were collected in June 2007.

Results

The chemical sampling results for soil at Parcel ED-4 are summarized in Table 6.6 by analysis type and were interpreted in the risk screen (see Appendix F). The soil data tables include the following information:

- the frequency of detection;
- minimum and maximum detected concentrations;
- location(s) at which detected;
- if detected, concentrations that exceed the clean-up levels established for Zone 1 of the ETTP;
- PRGs for the residential scenario;
- and an indication whether the PRGs were exceeded by the maximum detected concentration.

Table 6.6. Parcel ED-4 soil chemical analytical results summary

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)
METAL	112/125	5.3E-02	5.6E+04
OTHER	4/4	1.0E+00	1.0E+00
PPCB	4/129	2.0E-03	5.3E-03
RADS	332/332	-2.6E+00	5.1E+01
SVOC	32/313	4.0E-04	2.2E-01
VOC	4/240	3.3E-03	6.5E-03

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
mg/kg = milligrams chemical per kilogram soil.
PPCB = pesticides and polychlorinated biphenyls.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

6.1.3.1 Soil results analysis

The following discussion summarizes the soil sampling results for ED-4.

PCBs

A total of 45 PCB results were reported (Table 6.7), with 4 results (9%) detected. Three of the constituents: PCB-1248 (0.0053 mg/kg), PCB-1254 (0.0036 mg/kg), and PCB-1260 (0.002 mg/kg); were detected at location NS-SS01, while PCB-1254 was also detected at NS-SS03. As mentioned previously, PCBs have been used for their heat-resistant properties in oils, paints, and other materials subjected to the effects of high temperature. The detected PCB results could be due to the past use of oils or paints containing PCBs in the vicinity of this location, which is located between the former warehouse and the railroad spur. As presented in Table 6.7, none of the PCBs in soil had maximum detected concentrations that exceeded PRGs, indicating a low likelihood of adverse health effects from these constituents.

Table 6.7. Parcel ED-4 soil - polychlorinated biphenyls results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
PCB-1016	0/5	N/A	N/A		N/A	3.9E-01	N/A
PCB-1221	0/5	N/A	N/A		N/A	1.1E-01	N/A
PCB-1232	0/5	N/A	N/A		N/A	1.1E-01	N/A
PCB-1242	0/5	N/A	N/A		N/A	1.1E-01	N/A
PCB-1248	1/5	5.3E-03	5.3E-03	NS-SS01-ED4	No	1.1E-01	No
PCB-1254	2/5	2.7E-03	3.6E-03	NS-SS01-ED4 NS-SS03-ED4	No	1.1E-01	No
PCB-1260	1/5	2.0E-03	2.0E-03	NS-SS01-ED4	No	1.1E-01	No
PCB-1262	0/5	N/A	N/A		N/A	1.1E-01	N/A
PCB-1268	0/5	N/A	N/A		N/A	1.1E-01	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not available.

VOCs

A total of 240 VOC results were reported, with only 4 results (1.7%) detected (Table 6.8). Constituents were detected at NS-SS01 (acetone, carbon disulfide) and NS-SS02 (acetone). VOCs are typically industrial solvents or components of fuel. Although the detected VOC results could be the result of releases related to former operations in this area, acetone is a common laboratory contaminant, and it is not uncommon for carbon disulfide to also be reported by laboratories in the absence of the detection of other VOCs. As presented in Table 6.8, none of the VOCs in soil had maximum detected concentrations that exceeded PRGs, indicating a low likelihood of adverse health effects from these constituents.

Table 6.8. Parcel ED-4 soil - volatile organic compounds results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
1,1,1-Trichloroethane	0/5	N/A	N/A		N/A	2.0E+02	N/A
1,1,2,2-Tetrachloroethane	0/5	N/A	N/A		N/A	4.1E-01	N/A
1,1,2-Trichloro-1,2,2-trifluoroethane	0/5	N/A	N/A		N/A	2.1E+03	N/A
1,1,2-Trichloroethane	0/5	N/A	N/A		N/A	7.3E-01	N/A
1,1-Dichloroethane	0/5	N/A	N/A		N/A	5.1E+01	N/A
1,1-Dichloroethene	0/5	N/A	N/A		N/A	1.2E+01	N/A
1,2,3-Trichlorobenzene	0/5	N/A	N/A		N/A	N/A	N/A
1,2-Dibromo-3-chloropropane	0/5	N/A	N/A		N/A	2.1E-01	N/A
1,2-Dibromoethane	0/5	N/A	N/A		N/A	3.2E-02	N/A
1,2-Dichloroethane	0/5	N/A	N/A		N/A	2.8E-01	N/A
1,2-Dichloropropane	0/5	N/A	N/A		N/A	3.4E-01	N/A
1,2-Dimethylbenzene	0/5	N/A	N/A		N/A	2.7E+01	N/A
1,4-Dioxane	0/5	N/A	N/A		N/A	4.4E+01	N/A
2-Butanone	0/5	N/A	N/A		N/A	2.2E+03	N/A
2-Hexanone	0/5	N/A	N/A		N/A	N/A	N/A
2-Methoxy-2-methylpropane	0/5	N/A	N/A		N/A	1.7E+01	N/A
4-Methyl-2-pentanone	0/5	N/A	N/A		N/A	5.3E+02	N/A
Acetone	3/5	3.3E-03	5.0E-03	NS-SS01-ED4 NS-SS02-ED4	N/A	1.4E+03	No
Benzene	0/5	N/A	N/A		N/A	6.4E-01	N/A
Bromochloromethane	0/5	N/A	N/A		N/A	N/A	N/A
Bromodichloromethane	0/5	N/A	N/A		N/A	8.2E-01	N/A
Bromoform	0/5	N/A	N/A		N/A	6.2E+01	N/A
Bromomethane	0/5	N/A	N/A		N/A	3.9E-01	N/A
Carbon disulfide	1/5	6.5E-03	6.5E-03	NS-SS01-ED4	N/A	3.6E+01	No
Carbon tetrachloride	0/5	N/A	N/A		N/A	2.2E-01	N/A
Chlorobenzene	0/5	N/A	N/A		N/A	1.5E+01	N/A
Chloroethane	0/5	N/A	N/A		N/A	3.0E+00	N/A
Chloroform	0/5	N/A	N/A		N/A	2.2E-01	N/A
Chloromethane	0/5	N/A	N/A		N/A	4.7E+00	N/A
Cumene	0/5	N/A	N/A		N/A	1.6E+01	N/A
Cyclohexane	0/5	N/A	N/A		N/A	1.4E+02	N/A
Dibromochloromethane	0/5	N/A	N/A		N/A	1.1E+00	N/A
Dichlorodifluoromethane	0/5	N/A	N/A		N/A	9.4E+00	N/A
Ethylbenzene	0/5	N/A	N/A		N/A	1.9E+02	N/A
M + P Xylene	0/5	N/A	N/A		N/A	2.7E+01	N/A
Methyl acetate	0/5	N/A	N/A		N/A	2.2E+03	N/A
Methylcyclohexane	0/5	N/A	N/A		N/A	2.6E+02	N/A
Methylene chloride	0/5	N/A	N/A		N/A	9.1E+00	N/A
Styrene	0/5	N/A	N/A		N/A	4.4E+02	N/A
Tetrachloroethene	0/5	N/A	N/A		N/A	4.8E-01	N/A
Toluene	0/5	N/A	N/A		N/A	6.6E+01	N/A
Trichloroethene	0/5	N/A	N/A		N/A	5.3E-02	N/A
Trichlorofluoromethane	0/5	N/A	N/A		N/A	3.9E+01	N/A
Vinyl chloride	0/5	N/A	N/A		N/A	7.9E-02	N/A
cis-1,2-Dichloroethene	0/5	N/A	N/A		N/A	4.3E+00	N/A
cis-1,3-Dichloropropene	0/5	N/A	N/A		N/A	7.8E-01	N/A
trans-1,2-Dichloroethene	0/5	N/A	N/A		N/A	6.9E+00	N/A
trans-1,3-Dichloropropene	0/5	N/A	N/A		N/A	7.8E-01	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not applicable.

SVOCs

A total of 313 SVOC results were reported (Table 6.9), with 32 results (10%) detected. SVOCs are used in various industries and found in lubricants and as components of fuel. Detections ranged from 0.0004 mg/kg for 1,4-dichlorobenzene at NS-SS03 to 0.222 mg/kg for benzo(*a*)anthracene at NS-SS01, with detections at all locations. The detected SVOC results could be the result of runoff from adjoining asphalt areas or the use of diesel fuel and/or lubricating oils associated with activities along the former railroad. As indicated in Table 6.9, benzo(*a*)pyrene had a maximum detected soil concentration in excess of the residential soil PRG. The potential for adverse health effects associated with concentrations exceeding the PRG is discussed in the risk evaluation (Appendix F).

Table 6.9. Parcel ED-4 soil – semivolatile organic compounds results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
1,2,4,5-Tetrachlorobenzene	0/5	N/A	N/A		N/A	1.8E+00	N/A
1,2,4-Trichlorobenzene	0/5	N/A	N/A		N/A	6.2E+00	N/A
1,2-Dichlorobenzene	0/5	N/A	N/A		N/A	1.1E+02	N/A
1,3-Dichlorobenzene	0/5	N/A	N/A		N/A	5.3E+01	N/A
1,4-Dichlorobenzene	2/5	4.0E-04	6.5E-04	NS-SS02-ED4 NS-SS03-ED4	N/A	3.4E+00	No
2,3,4,6-Tetrachlorophenol	0/5	N/A	N/A		N/A	1.8E+02	N/A
2,4,5-Trichlorophenol	0/5	N/A	N/A		N/A	6.1E+02	N/A
2,4,6-Trichlorophenol	0/5	N/A	N/A		N/A	6.1E-01	N/A
2,4-Dichlorophenol	0/5	N/A	N/A		N/A	1.8E+01	N/A
2,4-Dimethylphenol	0/5	N/A	N/A		N/A	1.2E+02	N/A
2,4-Dinitrophenol	0/5	N/A	N/A		N/A	1.2E+01	N/A
2,4-Dinitrotoluene	0/5	N/A	N/A		N/A	7.2E-01	N/A
2,6-Dinitrotoluene	0/5	N/A	N/A		N/A	7.2E-01	N/A
2-Chloronaphthalene	0/5	N/A	N/A		N/A	4.9E+02	N/A
2-Chlorophenol	0/5	N/A	N/A		N/A	6.3E+00	N/A
2-Methyl-4,6-dinitrophenol	0/5	N/A	N/A		N/A	6.1E-01	N/A
2-Methylnaphthalene	0/5	N/A	N/A		N/A	5.6E+00	N/A
2-Methylphenol	0/5	N/A	N/A		N/A	3.1E+02	N/A
2-Nitrobenzenamine	0/5	N/A	N/A		N/A	1.8E+01	N/A
2-Nitrophenol	0/5	N/A	N/A		N/A	N/A	N/A
3-Nitrobenzenamine	0/5	N/A	N/A		N/A	1.8E+00	N/A
4-Bromophenyl phenyl ether	0/5	N/A	N/A		N/A	N/A	N/A
4-Chloro-3-methylphenol	0/5	N/A	N/A		N/A	N/A	N/A
4-Chlorobenzenamine	0/5	N/A	N/A		N/A	2.4E+01	N/A
4-Chlorophenyl phenyl ether	0/5	N/A	N/A		N/A	N/A	N/A
4-Nitrobenzenamine	0/5	N/A	N/A		N/A	1.8E+01	N/A
4-Nitrophenol	0/5	N/A	N/A		N/A	N/A	N/A
Acenaphthene	0/5	N/A	N/A		N/A	3.7E+02	N/A
Acenaphthylene	0/5	N/A	N/A		N/A	3.7E+02	N/A
Acetophenone	0/5	N/A	N/A		N/A	N/A	N/A
Anthracene	0/5	N/A	N/A		N/A	2.2E+03	N/A
Benz(*a*)anthracene	2/5	3.0E-02	3.6E-02	NS-SS01-ED4	N/A	6.2E-01	No
Benzo(*a*)pyrene	4/4	1.6E-01	1.7E-01	NS-SS01-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	6.2E-02	Yes

Table 6.9. Parcel ED-4 soil – semivolatile organic compounds results (continued)

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Benzo(*b*)fluoranthene	2/4	2.1E-01	2.2E-01	NS-SS01-ED4 NS-SS03-ED4	N/A	6.2E-01	No
Benzo(*g,h,i*)perylene	3/3	6.9E-02	8.0E-02	NS-SS01-ED4 NS-SS04-ED4	N/A	2.3E+02	No
Benzo(*k*)fluoranthene	1/3	3.2E-02	3.2E-02	NS-SS01-ED4	N/A	6.2E+00	No
Bis(2-chloroethoxy)methane	0/5	N/A	N/A		N/A	N/A	N/A
Bis(2-chloroethyl) ether	0/5	N/A	N/A		N/A	2.2E-01	N/A
Bis(2-ethylhexyl)phthalate	0/5	N/A	N/A		N/A	3.5E+01	N/A
Butyl benzyl phthalate	0/5	N/A	N/A		N/A	1.2E+03	N/A
Carbazole	0/5	N/A	N/A		N/A	2.4E+01	N/A
Chrysene	4/5	1.8E-02	3.9E-02	NS-SS01-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	6.2E+01	No
Di-n-butyl phthalate	0/5	N/A	N/A		N/A	6.1E+02	N/A
Di-n-octylphthalate	0/3	N/A	N/A		N/A	2.4E+02	N/A
Dibenz(*a,h*)anthracene	0/3	N/A	N/A		N/A	6.2E-02	N/A
Dibenzofuran	0/5	N/A	N/A		N/A	1.5E+01	N/A
Diethyl phthalate	0/5	N/A	N/A		N/A	4.9E+03	N/A
Dimethyl phthalate	0/5	N/A	N/A		N/A	6.1E+04	N/A
Diphenylamine	0/5	N/A	N/A		N/A	1.5E+02	N/A
Fluoranthene	4/5	2.5E-02	5.7E-02	NS-SS01-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	2.3E+02	No
Fluorene	0/5	N/A	N/A		N/A	2.7E+02	N/A
Hexachlorobenzene	0/5	N/A	N/A		N/A	3.0E-01	N/A
Hexachlorobutadiene	0/5	N/A	N/A		N/A	1.8E+00	N/A
Hexachlorocyclopentadiene	0/5	N/A	N/A		N/A	3.7E+01	N/A
Hexachloroethane	0/5	N/A	N/A		N/A	6.1E+00	N/A
Indeno(*1,2,3-cd*)pyrene	3/3	1.6E-02	2.3E-02	NS-SS01-ED4 NS-SS04-ED4	N/A	6.2E-01	No
Isophorone	0/5	N/A	N/A		N/A	5.1E+02	N/A
N-Nitroso-di-n-propylamine	0/5	N/A	N/A		N/A	6.9E-02	N/A
Naphthalene	0/5	N/A	N/A		N/A	5.6E+00	N/A
Nitrobenzene	0/5	N/A	N/A		N/A	2.0E+00	N/A
Pentachlorophenol	0/5	N/A	N/A		N/A	3.0E+00	N/A
Phenanthrene	2/5	1.2E-02	3.0E-02	NS-SS01-ED4 NS-SS04-ED4	N/A	2.3E+02	No
Phenol	0/5	N/A	N/A		N/A	1.8E+03	N/A
Pyrene	5/5	1.9E-02	9.0E-02	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	2.3E+02	No
m+p Methylphenol	0/5	N/A	N/A		N/A	N/A	N/A

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not applicable.

Pesticides

A total of 84 pesticide results were reported, with no detections.

Herbicides

A total of 24 herbicide results were reported, with no detections.

Metals

A total of 125 metals results were reported, with 112 results (90%) detected. The detected concentrations ranged from 0.09 mg/kg for mercury at NS-SS02 to 56,000 mg/kg for calcium at NS-SS02-01 (Table 6.10). All sample locations were found to have detected metals results, which is to be expected because soil generally has a measurable content of metals in nature. There is no evident correlation between sample location and elevated metals results. The highest metals results were for the macronutrient elements calcium, iron, manganese, magnesium, aluminum, and potassium, which are all naturally occurring. As indicated in Table 6.10, several metals had a maximum detected soil concentration in excess of the residential soil PRG. However, the established ETTP background soil concentrations for six of these seven metals are higher than the PRG, and only the maximum concentration of selenium exceeded both the PRG and background concentrations. The potential for adverse health effects associated with concentrations exceeding the PRG is discussed in the risk evaluation (Appendix F).

Table 6.10. Parcel ED-4 study area soil – metals results

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Aluminum	5/5	8.1E+03	1.2E+04	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	7.6E+03	Yes
Antimony	2/5	1.3E+00	1.5E+00	NS-SS01-ED4 NS-SS04-ED4	N/A	3.1E+00	No
Arsenic	5/5	3.0E+00	6.5E+00	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	No	3.9E-01	Yes
Barium	5/5	3.4E+01	2.9E+02	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	5.4E+02	No
Beryllium	5/5	2.9E-01	1.2E+00	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	No	1.5E+01	No
Boron	5/5	1.4E+00	7.5E+00	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	1.6E+03	No
Cadmium	2/5	1.6E-01	2.4E-01	NS-SS02-ED4 NS-SS04-ED4	N/A	3.7E+00	No
Calcium	5/5	2.9E+03	5.6E+04	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	N/A	N/A
Chromium	5/5	1.2E+01	3.1E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	2.2E+01	Yes
Cobalt	5/5	4.0E+00	1.6E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	1.4E+02	No
Copper	5/5	1.1E+01	3.0E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	3.1E+02	No
Iron	5/5	1.7E+04	2.6E+04	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	2.3E+03	Yes
Lead	5/5	1.2E+01	3.1E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	4.0E+02	No
Magnesium	5/5	9.5E+02	3.2E+04	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	N/A	N/A
Manganese	5/5	1.7E+02	9.7E+02	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	1.8E+02	Yes
Mercury	5/5	5.3E-02	8.5E-02	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	No	2.3E+00	No
Nickel	5/5	6.8E+00	4.7E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	1.6E+02	No
Potassium	5/5	6.8E+02	1.7E+03	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	N/A	N/A

Table 6.10. Parcel ED-4 study area soil – metals results (continued)

Analysis type	Frequency of detections	Minimum concentration (mg/kg)	Maximum concentration (mg/kg)	Locations where detected	Exceeds Zone 1 remediation level?	Resident soil preliminary remediation goal (mg/kg)	Maximum detect exceeds preliminary remediation goal ?
Selenium	5/5	4.0E+01	9.5E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	3.9E+01	Yes
Silicon	5/5	1.0E+03	1.7E+03	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	N/A	N/A
Silver	3/5	3.5E+00	4.8E+00	NS-SS01-ED4 NS-SS03-ED4	N/A	3.9E+01	No
Sodium	5/5	1.2E+01	5.4E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	N/A	N/A
Thallium	0/5	N/A	N/A		N/A	5.2E-01	N/A
Vanadium	5/5	2.3E+01	3.6E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	7.8E+00	Yes
Zinc	5/5	2.0E+01	6.0E+01	NS-SS01-ED4 NS-SS02-ED4 NS-SS03-ED4 NS-SS04-ED4	N/A	2.3E+03	No

Dataset from sampling conducted in 2007 includes duplicate analysis collected for quality control.
Residential soil PRG at a risk level of 1E-06 and a hazard index of 0.1.
mg/kg = milligrams chemical per kilogram soil.
N/A = not available.

Asbestos

Asbestos was analyzed in selected surface soil samples collected at ED-4. A total of three (3) asbestos samples and one (1) duplicate sample were collected from surface soils and submitted for laboratory analysis. The samples analyzed for asbestos included the SS01-ED4, SS02-ED4, and SS04-ED4 locations. A duplicate sample was collected from the SS01-ED4 location. All sample analysis results for the surface soil samples were negative for the presence of asbestos.

6.1.4 Chemical Sampling Results – Groundwater

6.1.4.1 Groundwater results analysis

In accordance with the approved SAP for Land Parcel ED-4,[8] groundwater samples were to be collected using temporary drive-point piezometers and existing monitoring wells. Five temporary piezometers were installed for the purpose of groundwater sample collection at ED-4. Installation took place on July 19, 2007. Locations of the temporary piezometers and the existing monitoring wells in the vicinity of ED-4 are indicated on Fig. 6.2. Table 6.11 indicates the total depths of the completed piezometers and existing wells sampled at ED-4, the formation monitored by the piezometers and wells, the date sample collection was attempted, and whether or not a sample was successfully collected.

The collection of groundwater samples from the drive-point piezometers was attempted on July 23, 2007. On that date, four of the five piezometers were dry [NS-01-GW-ED4 (18.5 ft bgs), NS-03-GW-ED4 (12.9 ft bgs), NS-04-GW-ED4 (10.1 ft bgs), and NS-05-GW-ED4 (9.29 ft bgs)]. The piezometers were checked periodically for water levels, and a groundwater sample was collected from piezometer NS-02-GW-ED4 (12.8 ft bgs) on July 30, 2007. In addition to four of the five drive-point piezometers, one existing upgradient monitoring well (UNW-102, 31.5 ft bgs) was also found to be dry during the

[8] BJC 2007. *Sampling and Analysis Plan for Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-2809, May, Oak Ridge, TN.

period that sample collection was attempted. Well UNW-102 continued to be dry on the date that the paired well, BRW-076 (60.5 ft bgs), was sampled on July 30, 2007. The side-gradient unconsolidated zone well (UNW-125, 20 ft bgs) was sampled on August 2, 2007. Groundwater samples collected from the bedrock well BRW-076 were analyzed for herbicides, pesticides, metals, VOCs, SVOCs, and radiological parameters. Groundwater samples collected from well UNW-125 were analyzed for herbicides, pesticides, metals, VOCs, and radiological parameters. Groundwater samples collected from temporary piezometer 02 were analyzed for herbicides, pesticides, metals, VOCs, and radiological parameters. Samples for SVOC analysis were not collected at UNW-125 and the temporary piezometer 02 due to the limited water volume obtained from these shallow monitoring locations. The temporary piezometer samples were not filtered at the time of collection, and due to questionable radiological results, subsequent analyses for radiological parameters were conducted on a subsample filtered in the laboratory. The results of the radiological re-analysis are discussed below in Sect. 6.2.2.4. Figure 6.2 indicates the piezometer and well locations that were dry and summarizes the analytical results for VOCs in groundwater samples collected at Parcel ED-4.

Table 6.11. Groundwater sample collection locations for Parcel ED-4

Location	Formation monitored	Total depth (ft)	Date sampling attempted	Date sample collected
NS-01-GW-ED4	Unconsolidated zone	18.5	7/19/07	NA
			7/23/07	
			7/24/07	
			7/30/07	
NS-02-GW-ED4	Unconsolidated zone	12.8	7/19/07	7/30/07
			7/23/07	
			7/24/07	
			7/30/07	
NS-03-GW-ED4	Unconsolidated zone	12.9	7/19/07	NA
			7/23/07	
			7/24/07	
			7/30/07	
NS-04-GW-ED4	Unconsolidated zone	10.1	7/19/07	NA
			7/23/07	
			7/24/07	
			7/30/07	
NS-05-GW-ED4	Unconsolidated zone	9.29	7/19/07	NA
			7/23/07	
			7/24/07	
			7/30/07	
BRW-076	Bedrock	60.5	July 30, 2007	7/30/07
UNW-102	Unconsolidated zone	31.5	7/19/07	NA
			7/23/07	
			7/24/07	
			7/30/07	
UNW-125	Unconsolidated zone	20.0	August 2, 2007	8/01/07

NA = groundwater sample could not be collected due to insufficient water.

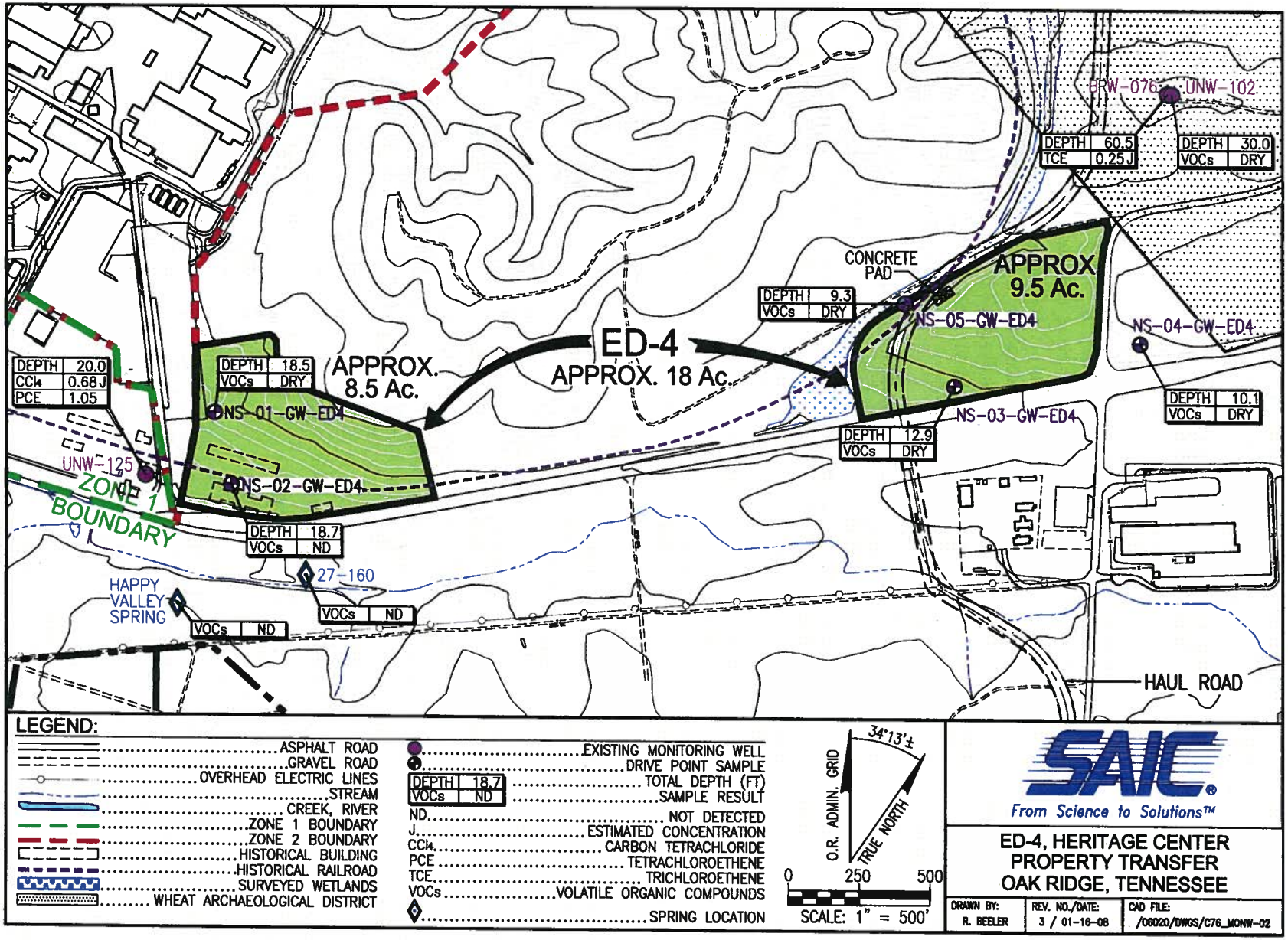

Fig. 6.2. Groundwater sampling locations and results for VOCs at ED-4.

Table 6.12 provides a summary of the sample collection history and analytical results for VOCs, including July 2007 results, for the existing wells in the vicinity of ED-4. Table 6.12 includes the well identification, the date sampled, the VOCs detected for each sampling event, and the concentration of the VOCs detected. VOCs had not been detected at the upgradient bedrock well BRW-076 in any historical sampling results until the July 2007 sample collection event. Trichloroethene (TCE) was detected at an estimated concentration of 0.25 μg/L at well BRW-076. However, due to the absence of TCE in historical samples and the low concentration reported in July 2007, this result may be questionable and is well below the MCL of 5 μg/L established for this compound.[9]

Table 6.12. Analytical results for VOCs in groundwater at Parcel ED-4

Well	Date sampled	VOCs detected	Concentration (μg/L)
BRW-076 upgradient	September 1994	ND	NA
	February 1995	ND	NA
	September 1995	ND	NA
	February 2005	ND	NA
	March 2005	ND	NA
	July 2007	Trichloroethene	0.25 J
UNW-102 upgradient	September 1994	Toluene 1,1,1-Trichloroethane	38 2 J
	February 1995	ND	NA
	September 1995	2-Butanone	10
	December 2004	ND	NA
	March 2005	1,1,1-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene	0.56 J 0.33 J 0.19 J
	July 2007	Dry – no sample collected	NA
UNW-125 side-gradient	April 1998	1,1,2-Trichloro-1,2,2-trifluoroethane Acetone Toluene Trichloroethene	8 5 J 1 J 3 J
	September 1999	Methylene chloride	4 J
	February 2000	ND	NA
	August 2000	ND	NA
	August 2007	Carbon tetrachloride Tetrachloroethene	0.68 J 1.05
NS-02-GW-E04 downgradient	July 2007	ND	NA

BRW = bedrock well.
GW = groundwater.
J = estimated concentration.
NA = not applicable.
ND = not detected.
UNW = unconsolidated zone well.
VOC = volatile organic compound.

Carbon tetrachloride and tetrachloroethene were detected at side-gradient well UNW-125 at low concentrations (0.68 J and 1.05 μg/L, respectively) during the July sampling event. However, although VOCs have been reported sporadically at this side-gradient well, none of the reported compounds have

[9] Maximum contaminant levels (MCLs) for drinking water have been established by the EPA (http://www.epa.gov/safewater/consumer/pdf/mcl.pdf) and the Tennessee Department of Environment and Conservation (Rule 1200-1-15-.06, 12, and 25). Comparisons to MCLs are made to be consistent with EM's groundwater program at ETTP.

been detected in more than one sampling event at this well. The reported concentrations of carbon tetrachloride and tetrachloroethene at well UNW-125 during the July 2007 sampling event do not exceed the MCL of 5 μg/L established for these compounds.[10]

VOCs have been reported during three of five historical sampling events at the upgradient unconsolidated zone monitoring well UNW-102, which was dry during the attempted sampling event in July 2007. However, with the exception of 1,1,1-trichloroethane, no other VOCs have been reported in more than one sampling event at this well. The VOC 1,1,1-trichloroethane was reported at low estimated concentrations in the 1994 and 2005 sampling events.

Analytical results for the single temporary piezometer (NS-02-GW-E04) that was not dry during the July 2007 sampling event indicate that no VOCs are present in groundwater at this location.

Herbicides and pesticides were not detected in groundwater samples collected from the existing wells (BRW-076 and UNW-125) and the temporary piezometer (02) at Parcel ED-4. In addition, SVOCs were not detected in the sample where analyzed for at bedrock well BRW-076.

The analytical results for metals are summarized in Table 6.13. This table also includes background concentrations established for ETTP for the Sitewide Remedial Investigation (DOE 2007b) and applicable MCLs. Metals exceeding established MCLs were only detected in groundwater samples collected from the temporary piezometer (02) installed at ED-4. However, samples collected from this piezometer were not filtered prior to preservation of the sample, and significant suspended solids were present in the sample obtained from the piezometer. The required acid preservation of water samples may release metals bound to the surface of the suspended solids or dissolve some of the solids altogether, thus resulting in higher metals concentrations in the sample (Giles and Story 1997). There were no exceedances of MCLs in the groundwater samples collected from the existing monitoring wells.

Table 6.13. Analytical results for metals in groundwater at Parcel ED-4

Analyte	Background	MCL	Well identification		
			BRW-076 (upgradient)	UNW-125 (side-gradient)	Temporary piezometer 02
Aluminum	1.018		1.030	0.049 U	420
Antimony	0.00095	0.006	0.008 U	0.008 U	NA
Arsenic	0.0019	0.01	0.007 U	0.007 U	0.0961
Barium	0.249	2	0.197	0.122	2.89
Beryllium	0.00025	0.004	0.0002 U	0.0002 U	0.0381
Boron	0.0252		0.025 J	0.0235	0.265 J
Cadmium	0.0016	0.005	0.001 U	0.001 U	0.005 U
Calcium	72.5		30.9	101	642
Chromium	0.011	0.1	0.016	0.0049 J	0.435
Cobalt	0.0067		0.0019 U	0.001 U	0.303
Copper	0.007	1.3	0.106 J	0.111 J	0.474
Iron	1.63		1.9	0.054 U	545
Lead	0.0045	0.015	0.004 U	0.004 U	0.537
Magnesium	24.7		10.2	22.5	98.5
Manganese	0.14		0.268	0.009 J	24.4

[10] Ibid.

Table 6.13. Analytical results for metals in groundwater at Parcel ED-4 (continued)

Analyte	Background	MCL	Well identification		
			BRW-076 (upgradient)	UNW-125 (side-gradient)	Temporary piezometer 02
Mercury	0.00013	0.002	0.00003 UJ	0.00003 U	0.0016 J
Nickel	0.023		0.204	0.0031 J	0.627
Potassium	5.62		4.03	1.38	58.2 J
Selenium	0.0012	0.05	0.005 U	0.005 U	0.0428 J
Silicon	15.7		18.8	2.16	111
Silver	0.0023		0.002 U	0.002 U	0.002 U
Sodium	12.06		19.1	3.24	2.91
Thallium	0.0021	0.002	0.008 U	0.008 U	0.04 U
Vanadium	0.008		0.0021 J	0.002 U	0.475
Zinc	0.032		0.102 J	0.918 J	1.5

Note: All concentrations are in mg/L.
BRW = bedrock monitoring well.
J = estimated concentration.
MCL = maximum contaminant level.
U = not detected at or above indicated concentration.
UJ = not detected at or above indicated concentration and concentration is estimated.
UNW = unconsolidated monitoring well.

Concentrations of metals in existing monitoring wells that exceeded groundwater background concentrations established for ETTP[11] include aluminum, calcium, chromium, copper, iron, manganese, nickel, silicon, sodium, and zinc. However, only copper, nickel, and zinc were detected at concentrations exceeding the background criteria, with all other metals below their background criteria. The elevated concentrations of copper, nickel, and zinc may be, in part, due to the unfiltered samples collected from these wells and the fact that these wells have not been re-developed since their installation in 1993 (BRW-076) and 1998 (UNW-125).

The groundwater sample collected from the temporary piezometer 02 indicates that MCLs for several metals were exceeded. The metals exceeding MCLs included arsenic, barium, beryllium, chromium, lead, and mercury. However, as mentioned previously, this sample was unfiltered and the acid preservation of the sample, which contained a significant suspended solids content, likely has impacted the results from this location (Giles and Story 1997).

Due to the uncertainty of the results for the ED-4 groundwater samples obtained from the temporary piezometer, discussions with EPA were held in November 2007 to determine an appropriate path forward with respect to groundwater at ED-4. Based on discussions with the EPA, it was agreed that groundwater quality results from springs located across Highway 58 on Parcel ED-3 could be used as being representative of groundwater quality discharging from ED-4. Two springs located within Parcel ED-3 have been sampled more than once as noted below. These include the Happy Valley Spring and spring 27-160 (Fig. 6.2).

TDEC conducts routine sampling of selected springs around the ORR, including the Happy Valley Spring, which is located approximately 300 ft south of the western tract of ED-4. Analytical results for the period from 1998 through 2002 are available for samples collected from this spring. Samples from this spring, which represents a discharge point for groundwater on the south side of Highway 58

[11] Background concentrations for groundwater at ETTP are presented in the ETTP Sitewide RI/FS (DOE/OR/01-2279&D2).

(Oak Ridge Turnpike), have been analyzed for radiological parameters, metals, VOCs, and general water quality parameters (e.g., alkalinity, chloride, nitrate/nitrite, and sulfate). The results for the chemical constituents are summarized in Table 6.14.

Table 6.14. Summary of analytical results for the Happy Valley Spring

Analyte	Frequency of detects	Minimum detected concentration	Maximum detected concentration	Drinking water MCL (μg/L)	Frequency of detects exceeding MCL
Arsenic (μg/L)	2/9	1.0	1.1	10	0/2
Cadmium (μg/L)	0/8	NA	NA	5	NA
Chromium (μg/L)	3/8	1.0	1.0	100	0/3
Iron (μg/L)	1/1	113	113	300[a]	NA
Lead (μg/L)	1/8	1.0	1.0	15	0/1
Magnesium (μg/L)	1/1	20,300	20,300	NA	NA
Mercury (μg/L)	0/5	NA	NA	2	NA
Nickel (μg/L)	1/4	14	14	NA	NA
Selenium (μg/L)	0/8	NA	NA	50	NA
Thallium (μg/L)	0/8	NA	NA	2	NA
Zinc (μg/L)	8/8	2	8	5,000[a]	NA
VOCs (μg/L)	0/8	NA	NA	NA*	NA

[a] Represents secondary non-enforceable drinking water standard.
MCL = maximum contaminant level.
NA = not applicable.
VOCs = volatile organic compounds.
* MCLs apply only to specific VOCs.

Based on the results for the Happy Valley Spring, no metals or VOCs have been detected above an MCL. Thus, there is no evidence of contamination in groundwater at this spring.

Spring 27-160 was identified by the U. S. Geological Survey (USGS) during a spring and seep survey of the ETTP conducted in 1994 and 1995. Samples were collected from this spring to support the Groundwater Remedial Site Evaluation Report for ETTP (DOE 1996) in 1995. The analytical results for samples collected in April and October of 1995 at the 27-160 spring, located approximately 450 ft northeast of the Happy Valley Spring, are summarized in Table 6.15.

Results for samples collected from the 27-160 spring indicate there is no evidence of groundwater contamination at this spring. No organic compounds were detected. All concentrations of the only metal detected that has a corresponding MCL (barium) were well below the MCL.

In addition, groundwater samples have been collected from two temporary piezometers installed within the adjacent and downgradient Parcel ED-3. One piezometer was located approximately 200 ft north of the Happy Valley Spring and the second piezometer was located on the south side of Highway 58, approximately halfway between the two ED-4 tracts. Results for these piezometers indicate that the only VOCs detected have been benzene (maximum of 1.36 μg/L) and xylene (maximum of 1.02 μg/L). The detected concentrations are below the MCLs for these compounds.

Table 6.15. Summary of analytical results for Spring 27-160

Constituent	Frequency of detects	Minimum detected concentration	Maximum detected concentration	Drinking water MCL (µg/L)	Frequency of detects exceeding MCL
Arsenic (µg/L)	0/4	NA	NA	10	NA
Barium (µg/L)	4/4	46.3	49.5	2000	0/4
Cadmium (µg/L)	0/4	NA	NA	5	NA
Chromium (µg/L)	0/4	NA	NA	100	NA
Lead (µg/L)	0/2	NA	NA	15	NA
Selenium (µg/L)	0/4	NA	NA	50	NA
Thallium (µg/L)	0/4	NA	NA	2	NA
VOCs (µg/L)	0/2	NA	NA	NA*	NA
SVOCs (µg/L)	0/2	NA	NA	NA*	NA
Herbicides (µg/L)	0/2	NA	NA	NA*	NA
Pesticides (µg/L)	0/2	NA	NA	NA*	NA
PCBs (µg/L)	0/2	NA	NA	NA*	NA

* MCLs are only applicable to specific compounds.
MCL = maximum contaminant level.
NA = not applicable.
PCBs = polychlorinated biphenyls.
SVOCs = semivolatile organic compounds.
VOCs = volatile organic compounds.

Based on discussions with the EPA, groundwater data collected at springs and temporary piezometers located south and downgradient of ED-4 (in ED-3) have been included in this report to support a CPD. The results of these groundwater samples and those collected at existing monitoring wells and temporary piezometers within Parcel ED-4 indicate that there is no evidence of groundwater contamination from chemical constituents at this parcel.

6.2 RADIOLOGICAL SURVEYS AND SAMPLING

This section presents and discusses both historical and recent radiological survey data and the radiological soil sampling results collected from the study area. The availability of historical survey data is discussed, followed by a discussion of the survey methodology and results used to supplement the historical data. The final subsection presents a summary of the 2007 soil sample data.

The process history of the ETTP indicates uranium (natural, depleted, and/or enriched) is the most prominent radiological contaminant potentially present in the ED-4 land parcel as a result of tracking contamination from on-site buildings or from environmental release. Uranium-235 enrichment levels of contamination from operations since the early 1960s are expected between 0.2 and 5.0%. Most on-site facilities were potentially contaminated from enrichments of less than 3%.[12]

Other radionuclides detected on-site at ETTP are ^{60}Co, ^{137}Cs, $^{89/90}Sr$, ^{237}Np, ^{99}Tc, and $^{238/239/240}Pu$. These other radionuclides originated from the introduction of contaminated materials from Oak Ridge National Laboratory and/or from the Hanford and Savannah River reactor returns uranium-reprocessing program.

[12] Contracted Health Physics Technician Training handouts, K-25 Site, 1993.

6.2.1 Radiological Surveys

6.2.1.1 Historical surveys

No historical radiological survey data were found for this land parcel. However, the eastern tract is bisected by DOE's Haul Road. The Haul Road is being surveyed monthly using a large-area plastic scintillator (LAPS) detector that can be compared to the established management limits. It will be assumed that any contamination identified in connection with monitoring the Haul Road will be remediated prior to transfer; Haul Road activities are outside the scope of this survey plan.

6.2.1.2 2007 Exterior survey units

As the survey teams were performing the land survey units (LSUs) walkover scans, a concrete pad and other concrete debris were identified in ED-4. The pad was probably an old building foundation and measured approximately 36 ft by 80 ft (2880 ft^2). The pad was surveyed with the sodium iodide (NaI) probe in order to detect elevated readings. None were detected. The pad was classified as a Class 3 exterior survey unit (ESU) for further survey.

One exterior radiological surface survey was conducted (survey number 07-AREAC-1377) for the concrete pad. The survey was performed on May 18, 2007, in accordance with ETTP Radiation Control (RADCON) procedures[13] and the survey design document[14] (hereafter referred to as the "design document") and the survey plan (see Appendix E). The concrete pad was scan-surveyed over the accessible area that was not covered by moss, weeds, or vegetation (available pad area was less than 20 ft^2). The accessible locations for survey were isolated to multiple small areas of exposed concrete across the entire surface of the pad. Twenty-one measurements of total and removable activity were taken (alpha and beta-gamma) at locations having the highest activities, as determined during the scan survey. A summary of the survey results is shown in Table 6.16.

All readings taken in the ESU were less than 1250 dpm/100 cm^2 total activity. Because all results were well below the respective screening levels, no further statistical analysis was performed. Based on an inspection of the individual surveys, including quality assurance/quality control (QA/QC) surveys, all total activities were less than 24 dpm/100 cm^2 total alpha and 375 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 19 dpm/100 cm^2 removable alpha and 56 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 8 μrem/hour.

[13] Primarily EH-4516, "Radioactive Contamination Control and Monitoring," found in BJC-EH-4000, *Radiation Protection Program Description for Bechtel Jacobs Company LLC, Oak Ridge, Tennessee.*

[14] *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation,* BJC/OR-554-R1, Bechtel Jacobs Company LLC, Oak Ridge, TN, August 2006.

Table 6.16. Summary of contamination and dose rates

Location	Alpha total				Alpha removable				Beta-gamma total				Beta-gamma removable				Dose equivalent rate (mrem/h)
	Min.		Max.		Min.		Max.		Min.		Max.		Min.		Max.		
Exterior survey units – Class 3																	
ESU 1	<	24	<	44	<	19	<	19	<	375	<	375	<	56	<	56	0.005 to 0.008
DOE contamination limits				5000				1000				5000				1000	20

Notes: All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
This table does not include results from quality assurance/quality control surveys.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
mrem/h = millirem per hour.

6.2.1.3 Land survey units

A separate sampling plan was prepared to evaluate soil contamination and is discussed below. Surveys of the soils are conducted to identify possible additional sampling locations. Many of the radionuclides found on the ORR have natural background concentrations; therefore, background subtraction is required for all direct field measurements and laboratory analyses. Some comparison to background levels is required for the scanning because only a gross signal was measured.

The ED-4 land parcel consisted of two LSUs, LSU 1 is the western tract while LSU 2 is the eastern tract. Both ED-4 tracts were classified as Class 3.

A total of six radiological land surveys were conducted in the proposed transfer footprint. The survey numbers are listed in Table 6.17. The surveys of the fixed-grid assessment points were performed from May 8, 2007, to May 14, 2007, and the surveys of the biased assessment points were performed on June 14, 2007, in accordance with ETTP RADCON procedures,[2] the survey design document,[3] and the survey plan (see Appendix E). Fixed measurements were made at the predetermined fixed-grid locations in the LSUs per Appendix E, Fig. E.2. Biased measurements were made at locations of anthropogenic disturbances or sediment accumulation areas determined from the walkover survey.

Table 6.17. Current ETTP land radiological surveys

07-AREAC-1416
07-AREAC-1417
07-AREAC-1418
07-AREAC-1419
07-AREAC-1420
200706152AKDESK001

NaI walkover survey scans were performed according to the survey plan (Appendix E). Emphasis was placed on roadbed areas, areas of soil or vegetation discoloration, and other areas based on professional judgment. NaI survey measurements were performed at the fixed-grid assessment points; any anthropogenic, groundwater runoff, and sediment collection areas recognized during the NaI walkover; and any scan areas determined to have elevated readings. A 10-ft-diameter surface area was to be scanned at each of these points with the NaI detector; however, a 20-ft-diameter surface area was actually scanned. The measurements at each point, to include only timed, 1-min-count NaI and dose-rate measurements at the location of the highest scan reading, were recorded. The fixed-grid and biased NaI radiological survey assessment locations were to be marked for biased sampling for laboratory analysis by pin-flagging any location having an NaI survey reading greater than three times the established background or two times the established background if a background specific to the geology and topography for the area can be obtained.

Because the derived concentration guideline levels (DCGLs) for surface measurements do not apply to soil areas, direct readings are not used in the dose and risk assessments for soil areas. Instead, soil samples were collected for dose and risk assessment purposes. Upgrades of any LSUs were not made based on the timed NaI measurements. However, upgrades could have been necessary based on the results of the soil sampling and analysis discussed below.

As a result of the walkover survey, five additional discretionary locations were chosen for sampling and fixed, timed measurements based on them either being recognized as a sediment collection area or due to the NaI count rate (see Fig. 6.1). Location AP-01-01 is located in a parking lot drainage ditch

where a culvert running under the parking lot empties into the ditch. Location AP-01-02 is located in the woods adjacent to the parking lot near some rock outcroppings where there was a large, depressed sediment collection area. Location AP-17-01 is located in a drainage area on the east side of the concrete pad. Location AP-18-01 is chosen due to the NaI count rate [total count rate of approximately 11,000 counts per minute (cpm)] being elevated above the average background more than the other measurements. However, it was still less than twice the background of approximately 8000 cpm. Location AP-22-01 is located in a drainage area on the east side of the Haul Road near where the area drains into a culvert that goes under Highway 58.

The results of the fixed, timed NaI measurements are shown in Table 6.18. A total of 17 NaI measurements were made at fixed-grid locations in LSU 1 and LSU 2. In addition, as described above, five measurements were made in LSU 1 and LSU 2 based on the walkover survey results. No NaI measurements were greater than two times a field-determined background appropriate for the geological and topographical conditions. NaI background count rates ranged from 5,004 cpm to 10,578 cpm. Based on an inspection of the individual surveys, all NaI readings were less than 11,323 cpm. The maximum tissue-equivalent dose rate was 15 μrem/hour.

Results of the surveys performed in the study area and the statistical tests performed on the data gathered in each survey unit indicate that the concrete surfaces are below the DOE surface contamination limits and within the acceptable dose-equivalent rate range for exterior surfaces. Because all results were less than the DCGL, no statistical analysis of the data for each survey unit was required, and, therefore, the survey units can be released from a surface contamination standpoint.

Table 6.18. Fixed-timed radiological survey measurements of ED-4

Location	No. of Measurements	NaI Min. cpm	NaI Max. cpm	Dose equivalent (mrem/h)
LSU 1 Grid APs Locations	8	6,733	10,140	0.006 to 0.009
LSU 2 Grid AP Locations	9	7,194	10,521	0.008 to 0.015
LSU 1 Biased Sample Locations	2	7,645	7,911	0.006
LSU 2 Biased Sample Locations	3	9,059	11,323	0.005 to 0.008

Note: Sodium iodide (NaI) fixed, timed measurements are reported in counts per minute (cpm) and are not background-corrected.
AP = assessment point.
LSU =land survey unit.
mrem/h = millirem per hour.

6.2.2 Radiological Sampling

6.2.2.1 Historical samples

No historical radiological sampling data were found for this land parcel.

6.2.2.2 2007 Soil and Sediment Samples

Soil samples were collected in the vicinity of anthropogenic features identified from historical aerial photographs and maps, and features identified during a walkover assessment of the parcel. The operation with the greatest potential to contribute radiological contamination was transport of materials over the former railroad spur and over the existing Haul Road. The walkover assessment of the parcel identified a concrete pad and debris in the eastern tract of ED-4. Biased samples of surface soils were collected in the vicinity of the former warehouse and from the concrete pad. All soil samples were collected to a depth of 0 to 0.5 ft below ground surface (bgs). These samples (SS01, SS02, SS03, and SS04) were analyzed for baseline radionuclides. In addition, location SS01 was analyzed for transuranic (TRU) radionuclides. Sediment samples were also collected from five locations identified during the radiological walkover survey as sediment collection or drainage areas as discussed in Sect. 6.2.1.3. The sediment samples were analyzed for baseline radionuclides and total activity. Samples were collected in accordance with the SAP included in Appendix C. The sample locations are discussed in the SAP.

A total of four soil and five sediment locations were sampled in the study area for radiological analysis during this effort. One field duplicate was also collected at soil sample location SS01 and one at sediment location 02. During the data validation process, laboratory data were assigned appropriate data validation flags. Refer to Sect. 6.1.1 for the validation flags and their definitions.

6.2.2.3 2007 Groundwater Samples

In accordance with the final SAP for Land Parcel ED-4,[15] groundwater samples were to be collected using temporary drive-point piezometers and existing monitoring wells. As prescribed in the SAP, five temporary piezometers were installed for the purpose of groundwater sample collection at ED-4. Section 6.1.4 describes the attempts made to collect samples, and Fig. 6.2 indicates the piezometer and well locations that were dry and which locations were able to be sampled as part of the ED-4 investigation.

6.2.2.4 Sample data analysis

Data Validation Summary

Four surface soil samples and five sediment samples from ED-4 were validated. During the data validation process, laboratory data were assigned appropriate data validation flags. Refer to Sect. 6.1.1 for the validation flags and their definitions. The original analyses showed that the detection limits required to evaluate the data in comparison to the 1E-6 residential PRG screening levels were not achieved for ^{90}Sr, ^{99}Tc, ^{228Th}, ^{235}U, ^{238}U, and ^{237}Np. Therefore, the original results were rejected and reanalyses were requested. This resulted in duplication of valid results for some of the other uranium and thorium isotopes. In these cases, the higher valid result was used for the statistical summary and risk assessment. Duplicate analyte results from gamma spectroscopy were also rejected in favor of more sensitive alpha spectroscopy results when available. Also, all fission and activation products reported from gamma spectroscopy, except for ^{137}Cs, were undetected and were eliminated from the final data set. In the final data set for soil samples, nine ^{234}U results were qualified as estimated due to method blank contamination, all thorium isotopic results were qualified as estimated due to uncertainty in the chemical recovery, and the ^{90}Sr results were qualified as estimated due to duplicate results being out of limits and due to a background subtraction bias.

[15] BJC 2007. *Sampling and Analysis Plan for Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-2809, May, Oak Ridge, TN.

For the groundwater samples, all gross beta were qualified as estimated due to the semi-quantitative nature of the analysis that does not include volatile radionuclides (e.g., ^{3}H and ^{99}Tc), the ^{234}U results for three samples were qualified as estimated and undetected due to blank contamination, and the gross alpha results for three samples were qualified as estimated due to blank contamination. The gross alpha/beta result for the groundwater sample collected from the temporary piezometer was greater than the sum of the alpha emitters by a factor of 8.3/18.5, respectively, indicating possible missing alpha and beta emitters not analyzed for in the individual alpha and beta analyses. However, it was judged that the difference was most likely due to the natural decay chain products in the soil—the sample contained undissolved solids because the samples were not filtered.

As the results for the temporary piezometer were greater than the screening values for adjusted gross alpha and gross beta, the sample was reanalyzed for gross alpha/beta, uranium isotopes, and ^{226}Ra after filtering at the laboratory. The results of the second analysis showed minimum uranium and ^{226}Ra, but the gross alpha/beta results were qualified as unusable (R) due to very high detection limits. Therefore, another analysis for gross alpha/beta was performed on a second sub-sample taken from the same location. Since the results were still elevated, further analyses (alpha spectroscopy, gamma spectroscopy, and total activity) were requested for qualitative purposes to help identify the nature of the activity. The total activity results were qualified as unusable (R) due to very high detection limits.

The sum of the analytical results, including daughters assumed in equilibrium, was compared with the total activity result for each sample. The comparison showed reasonable agreement with all samples.

Results

The radiological results were interpreted in a risk evaluation (Appendix F). The surface soil sampling results are shown in Table 6.19, the sediment sampling results are shown in Table 6.20, and the groundwater sampling results are shown in Table 6.21 by analysis type. The results are summarized along with historical data in Table 6.22 for soil samples and in Table 6.23 for sediment samples. The results for groundwater are presented in Table 6.24.

For each analysis type, the following information is listed:

- frequency of detection above background screening level,
- minimum and maximum concentrations,
- arithmetic mean,
- comparison to Zone 1 RLs, and
- comparison to residential PRGs calculated for a 1E-06 risk level.

The current background evaluation method is based on DOE (2003) and EPA (2002b). Backgrounds for ^{232}Th and ^{226}Ra and ^{238}U decay chain progeny are assumed to be equal to those established for their parents due to equilibrium in nature.

Although some individual sample results for all radionuclide analytes exceeded their background values and some (^{137}Cs, ^{99}Tc, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{232}Th, and ^{238}U) exceeded their PRGs, as shown in Tables 6.22 and 6.23 for soil and sediment respectively, no individual results were greater than the Zone 1 maximum RLs and no averages were above average RLs. All survey units were found to have no residual contamination in excess of the Zone 1 remediation goals.

Table 6.19. Radiological soil sample data from Parcel ED-4

Sample ID	Sample depth (ft)	^{241}Am (pCi/g)	^{137}Cs (pCi/g)	^{237}Np (pCi/g)	^{238}Pu (pCi/g)	$^{239/240}$Pu (pCi/g)	^{226}Ra (pCi/g)	^{228}Ra (pCi/g)	$^{89/90}$Sr (pCi/g)	^{99}Tc (pCi/g)	^{228}Th (pCi/g)	^{230}Th (pCi/g)	^{232}Th (pCi/g)	^{234}U (pCi/g)	^{235}U (pCi/g)	^{238}U (pCi/g)
NS-SS01D-ED4-03	0–0.5	-0.0829 U	0.356	0.0183 U	NA	0.0919 U	0.766	1.1	0.00492 UJ	0.0715 U	NA	0.954 J	NA	**1.72**	**0.0964**	1.09 J
NS-SS01-ED4-03	0–0.5	-0.123 U	0.253	-0.0116 U	NA	0.0514 U	0.833	1.36	-0.0162 UJ	0.034 U	1.23 J	0.991 J	1.13 J	**2.49**	**0.0773**	1.07 J
NS-SS02-ED4-03	0–0.5	-0.0152 U	0.298	NA	NA	NA	0.803	0.913	0.0102 UJ	0.0205 U	NA	NA	NA	1.4	**0.0683**	**1.5 J**
NS-SS03-ED4-03	0–0.5	-0.0026 U	0.787	NA	NA	NA	1.05	1.01	0.0186 UJ	0.06 U	NA	NA	NA	**2.89**	**0.142**	**3.18**
NS-SS04-ED4-03	0–0.5	0.0612 U	0.096	NA	NA	NA	0.688	1.12	-0.0172 UJ	0.0265 U	NA	NA	NA	1.3	**0.0872**	1.45 J

NA = Data not available.

Bold = detected value exceeds radionuclide background data set. Background concentration as defined by Bechtel Jacobs Company LLC in DOE 2003. The background data set that EM is using has values for only ^{40}K, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and ^{238}U. However, the U. S. Environmental Protection Agency (EPA) report on the September 2001 sampling of the Scarboro community (SESD Project No. 01-1222, April 2003) denotes that, in some cases, the PRG values are far below the background values and, as an example, the EPA report mentions that the ^{137}Cs background is approximately 1 pCi/g, but the PRG is far lower. For this report, a background of 1.0 pCi/g is used for ^{137}Cs. In addition, a background for ^{228}Ra has been assumed based on equilibrium with ^{228}Th and for ^{234}U based on equilibrium with ^{238}U. Background values for other radionuclides for which data is not available are assumed to be zero.

Validation qualifier definitions:

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.

U denotes the analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ denotes the analyte was not detected above the reported detection limit, which is approximated due to quality deficiency.

Table 6.20. Radiological sediment sample data from Parcel ED-4

Sample ID	Sample depth (ft)	^{241}Am (pCi/g)	^{137}Cs (pCi/g)	^{237}Np (pCi/g)	^{238}Pu (pCi/g)	$^{239/240}$Pu (pCi/g)	^{226}Ra (pCi/g)	^{228}Ra (pCi/g)	$^{89/90}$Sr (pCi/g)	^{99}Tc (pCi/g)	^{228}Th (pCi/g)	^{230}Th (pCi/g)	^{232}Th (pCi/g)	^{234}U (pCi/g)	^{235}U (pCi/g)	^{238}U (pCi/g)
NS-01-SD-ED4-03	0–0.5	0.193 U	0.158	NA	NA	NA	**1.47**	1.12	-0.00235 UJ	-0.0305 U	NA	NA	NA	1.39 J	**0.125**	1.4
NS-02-D1-ED4-03	0–0.5	0.0799 U	0.112	NA	NA	NA	1.07	1.47	-0.00549 UJ	0.0403	NA	NA	NA	**1.99**	**0.144**	**1.48**
NS-02-SD-ED4-03	0–0.5	0.162 U	0.178	NA	NA	NA	1.06	1.39	-0.00819 UJ	0.0262 U	NA	NA	NA	**1.99**	**0.0897**	**1.48**
NS-03-SD-ED4-03	0–0.5	0.211 U	0.416	NA	NA	NA	0.701	0.935	-0.00969 UJ	0.387	NA	NA	NA	**2.41**	**0.165**	**1.92 J**
NS-04-SD-ED4-03	0–0.5	0.101 U	0.0961	NA	NA	NA	1.05	1.51	-0.0208 UJ	0.0388	NA	NA	NA	1.1 J	**0.0944**	1.36 J
NS-05-SD-ED4-03	0–0.5	0.0971 U	0.149	NA	NA	NA	1.07	1.85	0.00436 UJ	0.0119 U	NA	NA	NA	**1.68**	**0.131**	**1.98 J**

NA = Data not available.

Bold = detected value exceeds radionuclide background data set. Background concentration as defined by Bechtel Jacobs Company LLC in DOE 2003. The background data set that EM is using has values for only ^{40}K, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and ^{238}U. However, the U. S. Environmental Protection Agency (EPA) report on the September 2001 sampling of the Scarboro community (SESD Project No. 01-1222, April 2003) denotes that, in some cases, the PRG values are far below the background values and, as an example, the EPA report mentions that the ^{137}Cs background is approximately 1 pCi/g, but the PRG is far lower. For this report, a background of 1.0 pCi/g is used for ^{137}Cs. In addition, a background for ^{228}Ra has been assumed based on equilibrium with ^{228}Th and for ^{234}U based on equilibrium with ^{238}U. Background values for other radionuclides for which data is not available are assumed to be zero.

Validation qualifier definitions:

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.

U denotes the analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ denotes the analyte was not detected above the reported detection limit, which is approximated due to quality deficiency.

Table 6.21. Radiological groundwater sample data from Parcel ED-4

Sample ID	Sample Fraction	$^{233/234}U$ (pCi/L)	$^{235/236}U$ (pCi/L)	^{238}U (pCi/L)	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{226}Ra (pCi/L)	Total activity (pCi/L)	^{40}K (pCi/L)	^{214}Bi (pCi/L)	^{214}Pb (pCi/L)
BRW-076	Original Analysis Unfiltered	0.045 UJ	0.0324 U	0.03 U	0.881 J	4.41 J					
BRW-076D	Original Analysis Unfiltered	0.098 UJ	-0.016 U	0.07	0.876 J	3.75 J					
UNW-125	Original Analysis Unfiltered	0.92	0.0233 U	0.65	1.28	2.49 J					
NS-02-GW-ED4-04	Original Analysis Unfiltered	9.8	0.7	9.6	166.0	355 J					
NS-02-GW-ED4-04	Reanalysis Filtered	2.8	0.241 U	2.2	-54.1 R	-65.9 R	4.6				
NS-02-GW-ED4-04	Second Subsample Filtered				177.0	496.0					
NS-02-GW-ED4-04	Third Subsample Filtered							26.3 R	122.0	32.9	19.2

Validation qualifier definitions:

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.
U denotes the analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ denotes the analyte was not detected above the reported detection limit, which is approximated due to quality deficiency.
R denotes the analysis result was qualified as unusable due to high uncertainty or error.

Table 6.22. Parcel ED-4 summary statistics for radionuclides in soil

Analyte	Frequency of detections	Minimum detected concentration (pCi/g)	Maximum detected concentration (pCi/g)	Average detected concentration (pCi/g)	Background reference level[a] (pCi/g)	Frequency of detections exceeding background reference	Maximum RL	Frequency of detects exceeding maximum RL	Average Zone 1 remediation level (pCi/g)	Exceed Zone 1 average remediation level?	Residential preliminary remediation goal (pCi/g)	Frequency of detects exceeding preliminary remediation goal
Americium-241	0/4	-0.0152	0.0612	0.02	0	0/4		NA		NA	1.87	0/4
Cesium-137	4/4	0.096	0.787	0.38	1	0/4	20	0/4	2	No	0.0597	4/4
Neptunium-237	0/1	ND	ND	ND	0	0/1	50	0/1	5	No	0.13	0/1
Plutonium-239	0/1	ND	ND	ND	0	0/1		NA		NA	2.6	0/1
Radium-226	4/4	0.688	1.05	0.84	1.25	0/4	15	0/4	5	No	0.0124	4/4[b]
Radium-228	4/4	0.913	1.36	1.1	1.95	0/4		NA		NA	0.07681899	4/4[b]
Strontium-90	1/4	0.0186 J	0.0186 J	0.02	0	1/4		NA		NA	0.231	0/4
Technetium-99	2/4	0.06	0.0715	0.07	0	2/4		NA		NA	0.25	0/4
Thorium-228	1/1	1.23 J	1.23 J	1.23	1.86	0/1		NA		NA	0.07681899	1/1[b]
Thorium-230	1/1	0.991 J	0.991 J	0.99	1.2	0/1		NA		NA	3.5	0/1
Thorium-232	1/1	1.12 J	1.12 J	1.12	1.95	0/1	15	0/1	5	No	0.07681899	1/1[b]
Uranium-234	4/4	0.939 J	2.12	1.31	1.47	1/4	7,000	0/4	700	No	4.02	0/4
Uranium-235	4/4	0.0683	0.142	0.1	0	4/4	80	0/4	8	No	0.195	0/4
Uranium-238	4/4	1.95	2.89	2.38	1.47	4/4	500	0/4	50	No	0.743	4/4

[a] The background data set that EM is using (Bechtel Jacobs Company LLC in DOE 2003) has values for only ^{40}K, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and ^{238}U. However, the U. S. Environmental Protection Agency (EPA) report on the September 2001 sampling of the Scarboro community (SESD Project No. 01-1222, April 2003) denotes that, in some cases, the PRG values are far below the background values and, as an example, the EPA report mentions that the ^{137}Cs background is approximately 1 pCi/g, but the PRG is far lower. For this report, a background of 1.0 pCi/g is used for ^{137}Cs. In addition, a background for ^{228}Ra has been assumed based on equilibrium with ^{228}Th and for ^{234}U based on equilibrium with ^{238}U. Background values for other radionuclides for which data is not available are assumed to be zero.

[b] PRG not applicable for this radionuclide, due to an exception in the Zone 1 ROD. The exception takes background levels for these radionuclides into consideration.

ND = None Detected

NA = Not applicable, not available or insufficient data to calculate the statistic.

pCi/g = picocuries per gram.

RL = remediation level.

Table 6.23. Parcel ED-4 summary statistics for radionuclides in sediment

Analyte	Frequency of detections	Minimum detected concentration (pCi/g)	Maximum detected concentration (pCi/g)	Average detected concentration (pCi/g)	Background reference level[a] (pCi/g)	Frequency of detections exceeding background reference	Maximum RL	Frequency of detects exceeding maximum RL	Average Zone 1 remediation level (pCi/g)	Exceed Zone 1 average remediation level?	Residential preliminary remediation goal (pCi/g)	Frequency of detects exceeding preliminary remediation goal
Americium-241	5/5	0.0971	0.211	0.15	0	5/5		NA		NA	1.87	0/5
Cesium-137	5/5	0.0961	0.416	0.2	1	0/5	20	0/5	2	No	0.0597	5/5
Radium-226	5/5	0.701	1.47	1.07	1.25	1/5	15	0/5	5	No	0.0124	5/5[b]
Radium-228	5/5	0.935	1.85	1.38	1.95	0/5		NA		NA	0.07681899	5/5[b]
Strontium-90	0/5	ND	ND	ND	0	0/5		NA		NA	0.231	0/5
Technetium-99	3/5	0.0388	0.387	0.16	0	3/5		NA		NA	0.25	1/5
Uranium-234	5/5	1.1 J	1.81	1.45	1.47	2/5	7,000	0/5	700	No	4.02E+00	0/5
Uranium-235	5/5	0.0944	0.165	0.13	0	5/5	80	0/5	8	No	0.195	0/5
Uranium-238	5/5	1.4	3.08	1.94	1.47	4/5	500	0/5	50	No	0.743	5/5

[a] The background data set that EM is using (Bechtel Jacobs Company LLC in DOE 2003) has values for only ^{40}K, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and ^{238}U. However, the U. S. Environmental Protection Agency (EPA) report on the September 2001 sampling of the Scarboro community (SESD Project No. 01-1222, April 2003) denotes that, in some cases, the PRG values are far below the background values and, as an example, the EPA report mentions that the ^{137}Cs background is approximately 1 pCi/g, but the PRG is far lower. For this report, a background of 1.0 pCi/g is used for ^{137}Cs. In addition, a background for ^{228}Ra has been assumed based on equilibrium with ^{228}Th and for ^{234}U based on equilibrium with ^{238}U. Background values for other radionuclides for which data is not available are assumed to be zero.

[b] PRG not applicable for this radionuclide, due to an exception in the Zone 1 ROD. The exception takes background levels for these radionuclides into consideration.

ND = None Detected

NA = Not applicable, not available or insufficient data to calculate the statistic.

pCi/g = picocuries per gram.

RL = remediation level.

Table 6.24. Radionuclides summary for groundwater from Parcel ED-4

Analyte	Frequency of detections	Minimum detected concentration (pCi/L)	Maximum detected concentration (pCi/L)	Average detected concentration (pCi/L)	Drinking water screening level (pCi/L)	Frequency of detects exceeding drinking water screening level
$^{233/234}U$	2/3	0.92	2.8	1.9	30	0/3
$^{235/236}U$	1/3	0.7	0.7	0.7	30	0/3
^{238}U	2/3	0.07	2.2	1.1	30	0/3
Gross Alpha	3/3	.88	177	59.7	15	1/3
Gross Beta	3/3	2.5	4.96	167	50	1/3
^{226}Ra	1/1	4.6	4.6	4.6	20	0/3

pCi/L = picocuries per liter.
RL = remediation level.

For each groundwater analysis type, the following information is listed:

- frequency of detection,
- arithmetic mean, and
- comparison to EPA drinking water screening values.

The results for the groundwater sample collected from the newly installed piezometer NS-02-GW-ED4 showed high gross alpha and gross beta results. The high result could not be accounted for by the uranium and radium measured in the sample. The alpha spectra did not confirm the presence of significant alpha activity in the sample. The gamma spectra provided some clues and showed that naturally occurring ^{40}K could account for over 100 pCi/L of beta activity. Also, ^{214}Bi and ^{214}Pb were detected at levels close to 20 pCi/L. These are ^{226}Ra daughters and would indicate the presence of the entire ^{226}Ra decay chain since all ^{226}Ra daughters have a relatively short half-life. That could account for five or six times the activity of the measured ^{214}Bi or ^{214}Pb (20 to 30 pCi/L) for the gross alpha activity and the gross beta activity. The fact that ^{226}Ra was not detected might be explained by the fact that the ^{222}Rn daughter is a gas and could have been absorbed in the liquid phase of the sample if ^{226}Ra is in the solids that were filtered away. It is also possible that ^{222}Rn could have been drawn into the liquid sample from the air during filtering since vacuum suction was used. The measured values do not seem to be consistent between the different analyses. This may be due to variations in how the sample is preserved and handled, which can influence how much activity in the solids is dissolved or in a colloidal form that would pass through the filter.

EPA has suggested that the data collected by the state of Tennessee for the Happy Valley Spring in ED-3 may be used to evaluate the groundwater for this area of ED-4. The radiological data from that data set are shown in Table 6.25. While the gross alpha and gross beta results are consistently less than 10 pCi/L, results for ^{214}Bi and ^{214}Pb are consistently around 60 to 70 pCi/L for each and with one sample showing approximately 200 pCi/L for each. From the evaluation of all data, it is apparent that the elevated alpha and beta activity is likely due to naturally occurring radionuclides in the solids or absorbed into the liquid and is not from process-related radionuclides. Although ^{214}Bi and ^{214}Pb are ^{238}U decay chain daughters, they are not process related due to the long half-life intermediate isotopes in the decay chain between the chemically separated process uranium and these daughters.

Table 6.25. Radiological spring sample data from Happy Valley collected by the state of Tennessee

Date	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	^{214}Bi (pCi/L)	^{214}Pb (pCi/L)
1/13/97	0.7	2.3	203	198
11/2/98	1.8	5.7	20	ND
5/25/99	-0.4	3.3	67	60
11/15/99	-0.5	1.9	35	25
3/14/00	0.5	6	62	54
10/23/00	2.8	10.2	73	68
2/7/01	0.9	3.6	42	24
3/25/02	0.8	3.8	ND	ND
10/16/02	-0.06	1.4	56	71

Validation qualifier definitions:

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.

U denotes the analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ denotes the analyte was not detected above the reported detection limit, which is approximated due to quality deficiency.

R denotes the analysis result was qualified as unusable due to high uncertainty or error.

ND denotes not detected.

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APPENDIX A

REAL ESTATE ACQUISITION LETTER

PROPOSED REAL ESTATE ACTION, OAK RIDGE RESERVATION, TN
FILES RESEARCH FOR HAZARDOUS SUBSTANCE ACTIVITY

The following statement is provided in support of guidance promulgated under Section 120(h) of the Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA) 42 U.S.C 9620(h) and in support of regulations issued by the Environmental Protection Agency at 40 CFR part 373.

The undersigned has made a complete search of existing and available Department of Energy (DOE) records, documentation, and data within the real estate files relating to the property that is subject to the proposed fee transfer action of Parcel ED-4 at the East Tennessee Technology Park (ETTP) within the Oak Ridge Reservation, Tennessee. The proposed action would result in transfer to the Heritage Center, LLC, under a 10 CFR 770 Proposal. The search conducted was considered reasonable with a good faith effort expended to identify whether any hazardous substances were known to have been released or disposed of on the property. The available real estate records of this office do not reflect any determinable reference that hazardous substance activity as defined by Section 101(14) of CERCLA took place on or in the property during the time the property was owned by the United States of America.

Lands affected by this action are identified as portions of the following original acquisition tracts in which the United States of America acquired title, (having been acquired for the Atomic Energy Commission as a forerunner of the Department of Energy) by Civil Action No. 429 filed in the United States District Court for the Eastern District of Tennessee, Northern Division:

Parcel ED-4 is located on a portion of Tract H-720. Title to this land was vested in the United States of America by Declaration of Taking No. 19. Judgment on Declaration of Taking was filed for public record on February 23, 1943, in Vol. Y-5, page 138 in the Roane County Register's Office, Tennessee.

Parcel ED-4 is located on a portion of Tract H-729. Title to this land was vested in the United States of America by Declaration of Taking No. 24. Judgment on Declaration of Taking was filed for public record on March 24, 1943, in Vol. Y-5, page 438 in the Roane County Register's Office, Tennessee.

Parcel ED-4 is located on a portion of Tract H-732. Title to this land was vested in the United States of America by Declaration of Taking No. 19. Judgment on Declaration of Taking was filed for public record on February 23, 1943, in Vol. Y-5, page 139 in the Roane County Register's Office, Tennessee.

Parcel ED-4 is located on a portion of Tract H-736. Title to this land was vested in the United States of America by Declaration of Taking No. 20. Judgment on Declaration of Taking was filed for public record on February 23, 1943, in Vol. Y-5, page 170 in the Roane County Register's Office, Tennessee.

This record shall be made a part of the CERCLA report currently being prepared.

Cindy Hunter 11/13/07

Cindy Hunter, Realty Officer
Oak Ridge Office
U. S. Department of Energy

Attachment
Plat Exhibit


H-724
H-728
H-729
ED-4
H-720
ED-4
H-732
H-736
TN GRID NORTH
Acquisition Tract Number
Acquisition Tract
Transfer Footprint ED-4
Tract H-720: Acquired from W. F. Elzey et ux, DB/Page Y-5/138 Declaration of Taking No. 19
Tract H-729: Acquired from Mattie E. Thomas et vir, DB/Page Y-5/438 Declaration of Taking No. 24
Tract H-732: Acquired from Edgar W. Arnold et ux, DB/Page Y-5/139 Declaration of Taking No. 19
Tract H-736: Acquired from Josie Robinette et al, DB/Page Y-5/170 Declaration of Taking No. 20
500' 0 500' 1000' 1500'
SCALE: 1" = 500'

APPENDIX B

STUDY AREA MAP FROM RECORDS SEARCH

Location of Pre–World War II Structures
and Cemeteries in or near the
East Tennessee Technology Park

LEGEND

- Pre–World War II Structures
- Cemeteries
- Buildings
- Roads
- Water Bodies
- Streams

N
W E
S

DATA COMPLIED BY GRID IS NAD 83 FEET
ER REMOTE SENSING PROGRAM
ENVIRONMENTAL INFORMATION MANAGEMENT PROGRAM
GEOGRAPHIC INFORMATION SCIENCES AND TECHNOLOGY GROUP
ORIGINAL BY: BARGE, WAGGONER, SUMNER AND CANNON, INC.
REVISED BY: TETRA TECH, INC. 2/1001

KMAPS ORO HISTORIC MAP GSL

APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR LAND PARCEL ED-4 AT THE EAST TENNESSEE TECHNOLOGY PARK

BJC/OR-2809
FINAL

Sampling and Analysis Plan for Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

P. J. Kortman/dw 5/1/2007

BJC ETTP Classification and Information Control Office — Date

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/OR-2809

Sampling and Analysis Plan for Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—May 2007

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
under work release 000700

Prepared for the
U. S. Department of Energy
Office of Nuclear Fuel Supply

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

07-069(E)/051007

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FIGURES

TABLES

ACRONYMS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CPD	Clean Parcel Determination
DOE	U. S. Department of Energy
DPT	direct-push technology
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
GPS	Global Positioning System
HVCC	Happy Valley Construction Campsite
ID	inside diameter
µg/L	micrograms per liter
NFI	No Further Investigation
ORGDP	Oak Ridge Gaseous Diffusion Plant
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QC	quality control
RI	remedial investigation
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
SVOC	semivolatile organic compound
TDEC	Tennessee Department of Environment and Conservation
VOA	volatile organic analysis
VOC	volatile organic compound

C.1. INTRODUCTION

This Sampling and Analysis Plan (SAP) presents the objectives, rationale, and the protocols for conducting groundwater, soil, and sediment sampling at a piece of land referred to as Parcel ED-4 at the East Tennessee Technology Park (ETTP), formerly known as the Oak Ridge Gaseous Diffusion Plant (ORGDP). The study area addressed by this SAP consists of two noncontiguous areas comprising a total of approximately 18 acres located east of the ETTP.

In order to support a Clean Parcel Determination (CPD) in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(4)(d), groundwater, soil, and sediment samples will be collected at, and adjacent to, the Parcel ED-4 study area. The potential for the U. S. Department of Energy (DOE) to make a CPD for ED-4 is supported by a No Further Investigation (NFI) determination made on land that adjoins ED-4 to the east (DOE 1997a) and to the south (DOE 1997b).

Groundwater monitoring wells have not been installed in the vicinity of Parcel ED-4, and, therefore, site-specific hydrogeologic characterization data are not available. Groundwater samples will be collected in the vicinity of Parcel ED-4, soil samples will be collected from anthropogenic features, and sediment samples will be collected from sediment accumulation areas identified during the radiological survey. These samples will be quantified for volatile organic compounds (VOCs) and other potential contaminants that would be expected from historical operations at ETTP.

C.2. SITE DESCRIPTION AND HISTORY

The study area addressed by this SAP consists of two noncontiguous tracts comprising a total of approximately 18 acres. The western tract of ED-4 encompasses approximately 8.5 acres in the northeastern quadrant of the intersection of Boulevard Road and Highway 58. The eastern tract encompasses an area of approximately 9.5 acres in the northwestern quadrant of the intersection of Blair Road and Highway 58. Highway 58 bounds both tracts of land to the south. The eastern boundary of the eastern tract follows Blair Road for nearly 500 ft from its intersection with Highway 58 to the point at which Blair Road turns eastward. From this point the northern boundary trends to the west for approximately 300 ft before turning to the southwest toward Highway 58 parallel to the Haul Road described below. From the Blair Road and Highway 58 intersection, the southern boundary of the eastern tract runs approximately 800 ft to the west along Highway 58. This tract includes a former railroad bed and a segment of the former Wheat Road, and the wetlands area near the headwaters of Mitchell Branch. The "Haul Road," actively used for truck transport of waste materials from ETTP to the Environmental Management Waste Management Facility, also bisects this tract. The western boundary of the western tract is formed by the intersection of Boulevard Road and Highway 58 and runs north for a distance of approximately 600 ft across the corner of a parking lot. The boundary then turns northeast for approximately 300 ft before turning southeastward for approximately 600 ft and then to the south to Highway 58. The southern boundary of the western tract runs from the Boulevard Road and Highway 58 intersection to the east for approximately 900 ft along Highway 58. The locations of the two ED-4 tracts are depicted in Fig. C.2.1.

Aerial photographs and site maps from throughout the history of ORGDP indicate that this area has largely been undeveloped woodland since federal acquisition. Before that time, the land where ED-4 is located consisted primarily of forests and grasslands intermixed with large and small orchards, cropland, and pastures associated with the agriculturally based and no longer extant Wheat Community. Blacksmithing, brick making, and gristmill operations also occurred in the community.

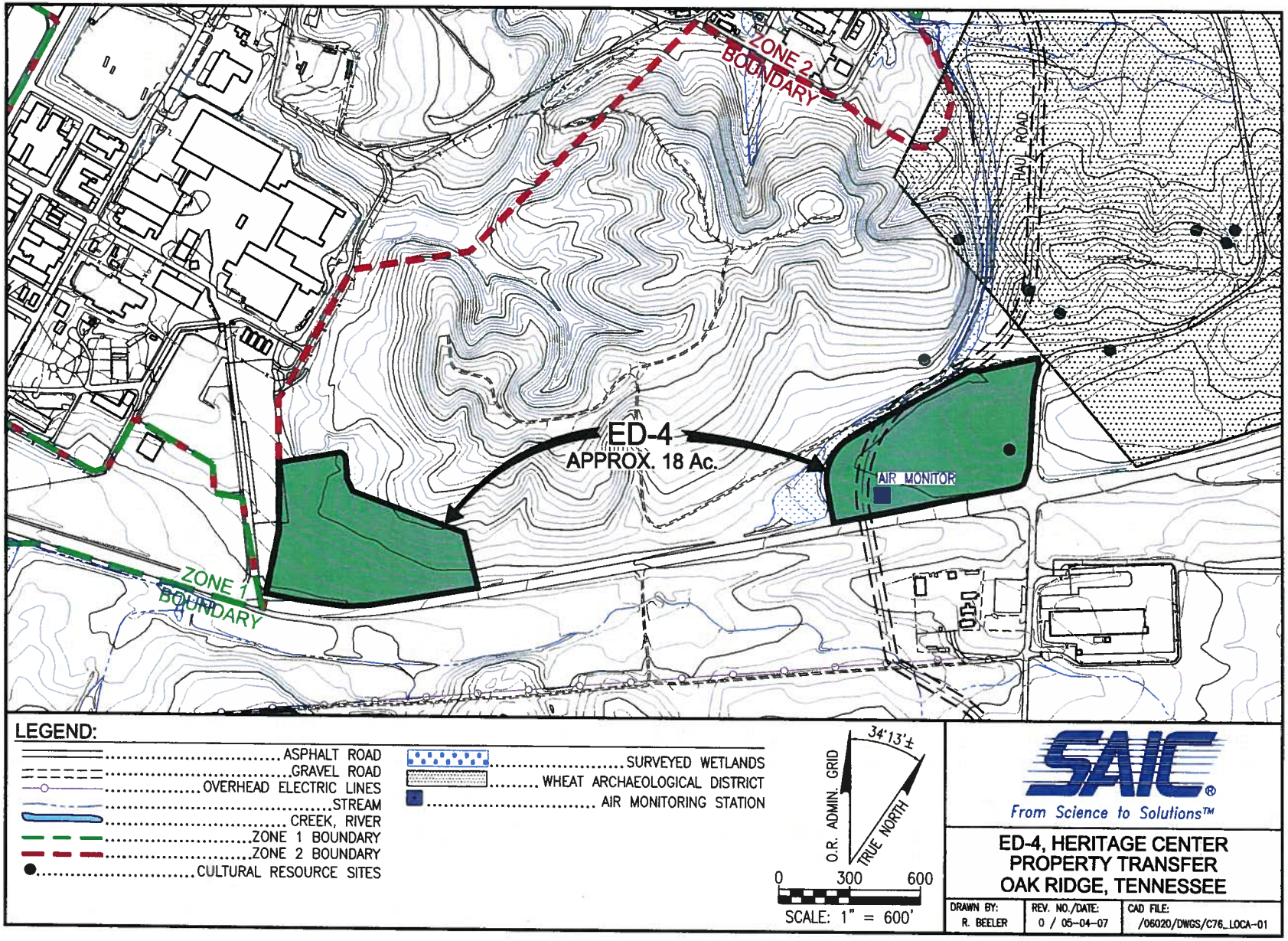

Fig. C.2.1. Location of the study area.

Workers building the ORGDP lived in a housing area referred to as the Happy Valley Construction Campsite (HVCC), which was located south of Highway 58. Several of the supporting facilities for the construction workers building the ORGDP were located in the western tract of ED-4. The three HVCC buildings located within ED-4 were designated as S-12, S-22, and S-44. Historical records indicate that these buildings were the Recreation Hall (S-12), the Town Hall Camp Operations Building (S-22), and the Property Warehouse (S-44). A railroad used during site construction passed through both tracts of ED-4, as did a segment of Wheat Road. By 1963, no remnants of these former structures, including the railroad spur, are visible on aerial photographs.

C.3. HISTORICAL DATA

No soil samples have been collected from Parcel ED-4. Historical sampling has been conducted in the vicinity of Parcel ED-4 and has included the collection of surface soil, surface water, sediment, and groundwater from areas adjacent to ED-4. The ETTP Sitewide Remedial Investigation (RI) conducted in 1998 (DOE 1999) included the collection of two surface soil samples and two surface water samples from adjacent areas (see Fig. C.3.1). A groundwater monitoring well (UNW-125) was also installed and sampled under the activities conducted for the RI. The Remedial Site Investigation of the HVCC (DOE 1997) included the collection of 13 sediment samples, of which six were collected within 300 ft of the southern boundary of ED-4. The area formerly occupied by the HVCC (ED-3) is also proposed for transfer as a separate action. Additional data collection is planned for the ED-3 parcel in the future. A separate SAP will be prepared in the future to address the proposed data collection effort for ED-3.

As part of the DOE's footprint reduction process, the McKinney Ridge Study Area, which includes an area immediately east of Parcel ED-4, was evaluated for the purpose of an NFI determination under CERCLA. The evaluation included a review of historical records, aerial photographs, remote sensing data, and field investigation/verification. The Tennessee Department of Environment and Conservation (TDEC) DOE-Oversight Office and U. S. Environmental Protection Agency (EPA) Region 4 approved the NFI status for the McKinney Ridge Study Area on May 28, 1998, and March 10, 1998, respectively.

Parcel ED-4 is underlain by bedrock of the Rome Formation and the Chickamauga Supergroup. Clastic bedrock of the older Rome Formation[1] has been placed over the calcareous rocks of the Chickamauga Supergroup by the K-25 thrust fault, which trends generally south to north across the western tract of ED-4 (Fig. C.3.1). The Whiteoak Mountain Fault, which trends in a southwest-northeast direction along the southern boundary of Parcel ED-4 is a regional thrust fault that also places rocks of the Rome Formation in contact with rocks of the Chickamauga Supergroup.

The northeastern half of the western tract and the entire eastern tract are underlain by the Rome Formation. The lower part of the Rome Formation, which is poorly exposed in the ETTP area, generally consists of thin-bedded shale and siltstone with interbedded sandstones in variegated colors of maroon, green, and yellow-brown. The upper Rome consists of maroon sandstone, siltstone, and shale. In situ weathering of the Rome Formation yields saprolite consisting of weathered shale or siltstone, which commonly becomes more competent with depth. Available exposures of this weathered saprolite in the area north of Parcel ED-4 reveal numerous tight, highly fractured folds with widely ranging bedding orientations. This degree of variability precludes predictions of bedrock flowpaths in the Rome Formation at the ETTP.

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[1] P. J. Lemiszki, 1994. *Geological Mapping of the Oak Ridge K-25 Site, Oak Ridge, Tennessee*, K/ER-11.

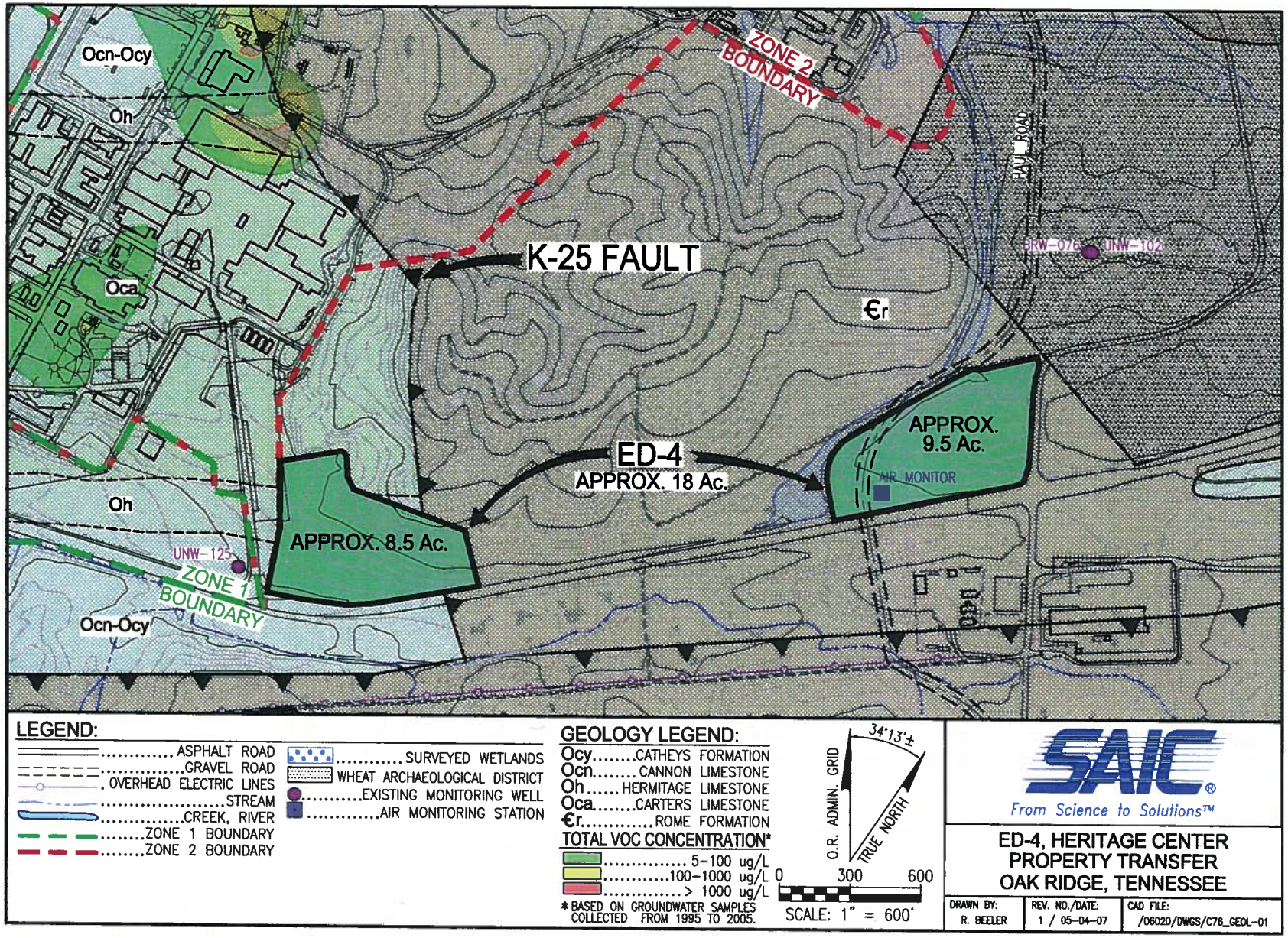

Fig. C.3.1. Geologic map of the study area.

The Chickamauga Supergroup formations, which underlie the southwestern corner of the western tract of ED-4, include the Carters Limestone, the Hermitage Formation, the Cannon Limestone, and the Catheys Formation. Although less prone to karst development than the Knox Group rocks in the vicinity of the ETTP, the Chickamauga formations are nevertheless subject to the development of karst. Solutionally enlarged fractures, joints, and bedding planes are common in exposures of Chickamauga rocks in the vicinity of ETTP. Structurally, these formations have been folded into an anticline (convex upward fold) in the vicinity of Parcel ED-4 with the axis of this structure located approximately 600 ft north of the western parcel and trends southwest-northeast. Bedding in the Chickamauga generally dips northwestward on the north side of this axis and southeastward on the south side of this axis. The western tract of Parcel ED-4 is located on the south side of the anticline axis; thus, bedding is expected to dip primarily to the southeast in the vicinity of the tract. However, movement along the Whiteoak Mountain Fault may have caused significant disturbance of bedding orientations in the area of ED-4.

The Carters Limestone generally consists of thick to massive beds of limestone with some medium beds and occasional interbedded argillaceous limestone and calcareous shale. Some pods and lenses of chert are present in the lower and middle parts of the formation. Although exposures were not observed during the geologic mapping of ETTP, the middle part of the Carters Limestone also contains two distinctive apple-green metabentonite beds, which range from 1 to 3 ft in thickness. Irregular, cobbly, and fossiliferous beds characterize the overlying Hermitage Formation.

Due to lack of exposures, the Cannon Limestone and Catheys Formation have been mapped as one unit at ETTP (Lemiszki 1994). The Cannon-Catheys Formation, which is poorly exposed at ETTP, generally consists of dark-gray, thick to massive beds of limestone with some thin to medium beds and shale seams and partings. Chert and siltstone fragments are common in soil developed above the Catheys Formation (Lemiszki 1994).

The water table at ETTP generally mimics topography with shallow groundwater flowing from higher topographic areas to the surrounding surface water bodies. Groundwater flow through bedrock is primarily controlled by fractures, bedding planes, and hydraulic gradient, and specific flow paths are difficult to discern. Hydrogeologic characterization data for ED-4 are limited because the property was not involved in ETTP operational activities and no contamination history exists. No groundwater monitoring wells exist in the immediate vicinity of the study area either. The nearest monitoring well (UNW-125), which is completed in the unconsolidated materials, is located approximately 150 ft west of the western ED-4 parcel (Fig. C.3.1). In addition, a well pair consisting of an unconsolidated zone well and a bedrock well (BRW-076/UNW-102) have been installed within 500 ft to northeast of the eastern ED-4 parcel. This well pair was installed in 1993 to provide background groundwater quality data for the ETTP. The hydrogeologic characterization data presented below for ED-4 are partly based on the data from these wells and partly based on interpolation from available ETTP sitewide information.

Because no monitoring points exist in the immediate vicinity of the study area, depth to bedrock and depth to groundwater can only be interpolated from available data. Depth to bedrock, interpolated from data in the general vicinity of ED-4, is expected to be from 12 to 30 ft below ground surface (bgs). The depth to groundwater, interpolated from the available data, is expected to range from 5 to 25 ft bgs depending on topographic position within the ED-4 parcels. Shallow groundwater flow is anticipated to be generally to the southwest toward the primary surface water bodies (K-1007-P Ponds and Poplar Creek) in this area of the ETTP.

A groundwater plume has not been identified beneath or upgradient of ED-4. The nearest groundwater plume is located approximately 700 ft northwest of, and cross-gradient to, ED-4, and occurs in bedrock. The role of the K-25 fault on groundwater movement has not been determined at ETTP. However, the possibility of transport of contaminated groundwater found cross-gradient and in a

different sub-watershed through bedrock flowpaths to ED-4 is not considered to be likely based on hydraulic gradients, which are anticipated to transport the groundwater plume to the southwest away from ED-4. Table C.3.1 summarizes the analytical results for the VOCs detected in groundwater samples collected from the three monitoring wells located downgradient and upgradient of ED-4. The data included in Table C.3.1 represent all of the analytical results for these wells. It should be noted that these concentrations do not represent groundwater beneath ED-4 but have been included to provide characterization data for the groundwater monitoring wells located nearest to ED-4.

VOCs have not been detected at concentrations above a federal drinking water maximum contaminant level (MCL) or TDEC domestic water supply criteria[2] at any of the existing monitoring wells.

C.4. OBJECTIVES

The overall scope or objective of this SAP is to obtain data that demonstrate the absence of chemical and radiological groundwater, soil, and sediment contamination at ED-4 to support a CPD.

C.5. SAMPLING DESIGN

The overall objectives of this SAP are to obtain data for the two study areas comprising ED-4 that demonstrate the absence of groundwater, soil, and sediment contamination. In order to meet this overall objective, the following sampling will be required:

- groundwater samples will be collected from temporary piezometers installed within the study areas;
- groundwater samples will be collected from existing monitoring wells adjacent to the study areas;
- surface soil samples will be collected in the vicinity of historical anthropogenic features; and
- sediment samples will be collected from accumulation areas identified during the radiological walkover survey.

Although groundwater impacts are not expected based on the history of the ED-4 area, groundwater samples will be collected to support a CPD for ED-4. The proposed groundwater sample locations have been selected based on inferred groundwater flow directions and potential release sites in the ED-4 area.

Groundwater samples will be collected from five (5) temporary piezometers, constructed using drive-point technology (DPT) such as Geoprobe® or a similar technique, and three (3) existing monitoring wells. The temporary piezometers have been located to determine groundwater quality beneath ED-4 and the quality of groundwater being transported to ED-4 from upgradient areas. Piezometer 01 will provide groundwater quality in the northwestern portion of the western tract, and piezometer 02 will provide groundwater quality data for the area downgradient of the former warehouse and in the vicinity of the former railroad. Piezometer 03 will provide groundwater quality data in the downgradient portion of

[2] The Tennessee Department of Environment and Conservation domestic water supply criteria are equivalent to the EPA's primary drinking water maximum contaminant levels (MCLs) indicated in Table 4.2 with the exception of chloroform, which does not have a corresponding state domestic water quality criterion.

Table C.3.1. Summary of VOCs detected in groundwater samples from monitoring wells in the vicinity of Parcel ED-4

Analyte (µg/L)	MCL	BRW-076					UNW-102					UNW-125				
		Oct-94	Feb-95	Sep-95	Feb-05	Mar-05	Oct-94	Feb-95	Sep-95	Dec-04	Mar-05	Apr-98	Apr-99	Sep-99	Feb-00	Aug-00
1,1,1-Trichloroethane	200	5 U	5 U	5 U	1 U	0.5 U	2 J	5 U	5 U	0.5 U	0.56	5 U	5 U	5 U	2 U	2 U
1,1-Dichloroethane	NA	5 U	5 U	5 U	1 U	0.5 U	5 U	5 U	5 U	0.5 U	0.33 J	5 U	5 U	5 U	2 U	2 U
1,1-Dichloroethene	7	5 U	5 U	5 U	1 U	0.5 U	5 U	5 U	5 U	0.5 U	0.19 J	5 U	5 U	5 U	2 U	2 U
2-butanone	NA	10 UJ	10 U	10 U	5 U	5 U	10 UJ	10 U	10	5 UJ	5 U	NA	10 U	10 U	50 U	50 U
Methylene chloride	5	5 U	5 U	5 U	1 U	0.5 U	5 U	5 U	5 U	0.5 UJ	0.5 U	5 U	11 U	4 J	2 U	2 U
Toluene	1000	5 U	5 U	5 U	1 U	0.5 U	38	5 U	5 U	0.5 U	0.5 U	1 J	5 U	5 U	2 U	2 U
Trichloroethene	5	5 U	5 U	5 U	1 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	3 J	5 U	5 U	2 U	2 U

BRW = bedrock well.
J = estimated concentration.
MCL = maximum contaminant level.
NA = Not applicable or not available.
U = analyte not detected at indicated concentration.
UJ = analyte not detected at indicated concentration and concentration is estimated.
UNW = unconsolidated zone well.
VOC = volatile organic compound.
µg/L = micrograms per liter.

the eastern tract, and piezometer 05 provides groundwater quality data for the area near the wetlands and former railroad in the northwestern portion of the eastern tract. The 04 location will provide data for groundwater upgradient of the eastern tract. The existing monitoring wells will provide additional upgradient and downgradient groundwater quality data for ED-4. Collection of samples from the temporary piezometers will be accomplished using non-dedicate mini-bailers or peristaltic pumps one to two days after piezometer installation. The existing wells will be sampled using micropurge, low-flow sample collection techniques using non-dedicated bladder pumps. The temporary piezometers will be designated 01 to 05 and the existing monitoring wells to be sampled will include BRW-076, UNW-102, and UNW-125. The groundwater sampling locations are presented in Fig. C.5.1. The locations for the proposed temporary piezometers in latitude/longitude and Tennessee State Plane coordinates are indicated in Table C.5.1.

Table C.5.1. Coordinates for Parcel ED-4 groundwater sample locations

Sample station number	Latitude	Longitude	Easting State Plane	Northing State Plane
NS-01-GW-ED4	35°55'40.32"	84°22'59.12"	2447191.41	584372.83
NS-02-GW-ED4	35°55'38.59"	84°22'56.82"	24477358.69	5844195.34
NS-03-GW-ED4	35°55'55.75"	84°22'33.60"	2449263.39	585968.19
NS-04-GW-ED4	35°56'00.64"	84°22'28.08"	2449709.33	586470.39
NS-05-GW-ED4	35°55'57.14"	84°22'37.32"	2448930.28	586097.12

Samples collected from the temporary piezometers and existing monitoring wells will be analyzed for VOCs, semivolatile organic compounds (SVOCs), metals, herbicides/pesticides, gross alpha activity, gross beta activity, and uranium isotopes. Table C.5.2 provides a summary of the sampling requirements for ED-4 and a summary of the total number of groundwater samples, and the analytical parameters, to be collected from the temporary piezometers and existing monitoring wells is presented in Table C.5.3.

Table C.5.2. Summary of sampling requirements for groundwater at Parcel ED-4

Sample number	Uranium isotopes[a]	Gross alpha and beta activity	TAL Metals	TCL VOCs	TCL SVOCs	Herbicides/ Pesticides
NS-01-GW-ED4	X	X	X	X	X	X
NS-02-GW-ED4	X	X	X	X	X	X
NS-03-GW-ED4	X	X	X	X	X	X
NS-04-GW-ED4	X	X	X	X	X	X
NS-102-GW-ED4	X	X	X	X	X	X
NS-125-GW-ED4	X	X	X	X	X	X
NS-076-GW-ED4	X	X	X	X	X	X
NS-TB1-GW-ED4				X		
NS-TB2-GW-ED4				X		
NS-01D-GW-ED4	X	X	X	X	X	X
NS-76D-GW-ED4	X	X	X	X	X	X
NS-ER1-GW-ED4	X	X	X	X	X	X
NS-ER2-GW-ED4	X	X	X	X	X	X

[a] Uranium isotopes to be reported are ^{234}U, ^{235}U, and ^{238}U.
SVOC = semivolatile organic compound.
TAL = Target Analyte List.
TCL = Target Compound List.
VOC = volatile organic compound.

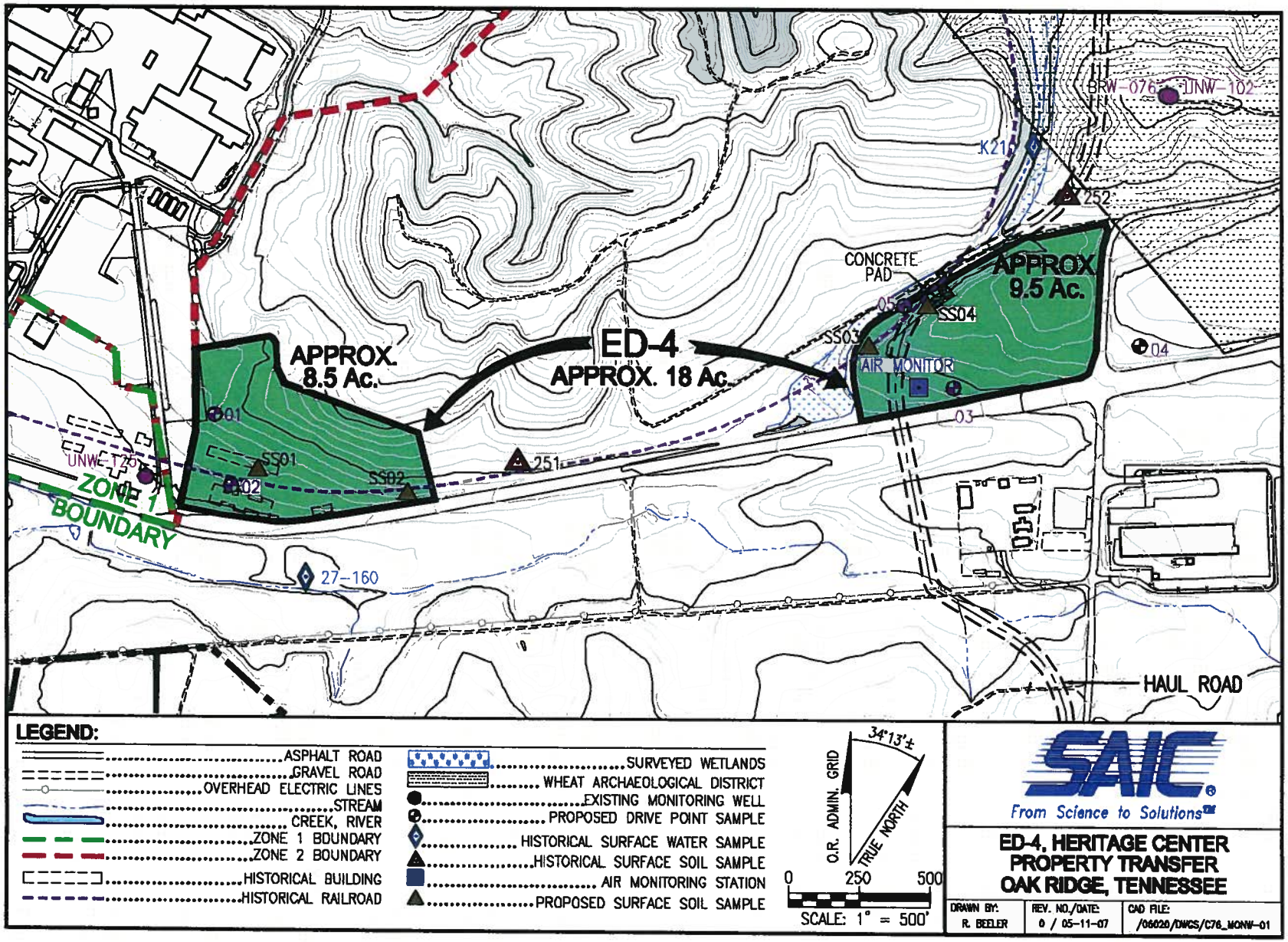

Fig. C.5.1. Proposed soil and groundwater sampling locations for ED-4.

Table C.5.3. Summary of groundwater sampling activities for Parcel ED-4

		Quantity of samples				Required analysis					
		Groundwater	QC Duplicates	QC Rinsates	QA Trip Blanks	VOCs: SW-846, 8260B	SVOCs: SW-846, 8270C	Metals: SW-846, 6010/7470A	Gross alpha and beta: EPA, 900.0	Uranium isotopes: alpha spectroscopy	Herbicides/Pesticides: SW-846, 8081A/8151A
DPT (Temporary piezometers)	Parcel ED-4	5	1	1	1	8	7	7	7	7	7
Existing monitoring wells	BRW-076, UNW-102, and UNW-125	3	1	1	1	6	5	5	5	5	5

BRW = bedrock well.
DPT = direct-push technology.
EPA = U. S. Environmental Protection Agency.
QA = quality assurance.
QC = quality control.
SVOC = semivolatile organic compound.
UNW = unconsolidated zone well.
VOC = volatile organic compound.

Soil samples will be collected from the vicinity of anthropogenic features identified from historical aerial photographs and maps, and features identified during a walkover assessment of the parcel. As indicated in Chap. C.2, limited historical operations were located in the ED-4 area. The operations with the greatest potential to contribute contamination are likely to be incidental spills and leaks related to the storage and handling of materials at the former HVCC warehouse, and transport of materials over the former railroad spur. A walkover assessment of the parcel has also identified a concrete pad and debris in the eastern tract of ED-4. The contaminants most likely to have resulted from activities in these areas include VOCs, SVOCs, metals, and radionuclides. Asbestos may also be of concern due to its use in building materials at that time. These contaminants, if present, would be expected primarily in surface soils.

Biased sampling of surface soils will be performed in the vicinity of the former warehouse, at selected locations along the railroad, and from the concrete pad. The proposed sample locations are indicated in Fig. C.5.1. All samples will be collected to a depth of 0 to 0.5 ft bgs. These samples (SS01, SS02, SS03, and SS04) will be analyzed for VOCs, SVOCs, polychlorinated biphenyls (PCBs), metals, and baseline radionuclides. In addition, locations SS01, SS02, and SS04 will also undergo analysis for pesticides/herbicides and asbestos, and SS01 will also be analyzed for transuranic radionuclides. Table C.5.4 summarizes the soil sampling requirements for Parcel ED-4. Table C.5.5 provides coordinates for the surface soil sample locations to allow the field sampling crew to locate them using Global Positioning System instrumentation.

Table C.5.4. Summary of analyses for surface soil samples for Parcel ED-4

Sample station	Metals	VOCs	SVOCs	PCBs	Pesticides/ Herbicides	Asbestos	Baseline radionuclides[a]	TRU isotopes[b]
NS-SS01-ED4	X	X	X	X	X	X	X	X
NS-SS02-ED4	X	X	X	X	X	X	X	
NS-SS03-ED4	X	X	X	X			X	
NS-SS04-ED4	X	X	X	X	X	X	X	
NS-SS01D-ED4	X	X	X	X	X	X	X	X
NS-SSER1-ED4	X	X	X	X	X		X	
NS-SSTB1-ED4		X						
NS-SSFB1-ED4		X						

[a] Baseline radionuclides include uranium isotopes ($^{233/234}U$, ^{235}U, and ^{238}U), ^{99}Tc, ^{90}Sr, and gamma-emitting isotopes, including but not limited to, ^{60}Co, ^{137}Cs, ^{234m}Pa, and ^{234Th}. These samples shall also be quantitated for total alpha/beta and gamma activity.

[b] Transuranic (TRU) isotopes include plutonium isotopes ($^{239/240}Pu$), ^{241}Am, and ^{237}Np. Thorium isotopes (^{228Th}, ^{230Th}, and ^{232}Th) shall also be quantitated in these samples.

PCB = polychlorinated biphenyl.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Table C.5.5. Coordinates for surface soil sampling stations at Parcel ED-4

Sample ID	Latitude	Longitude	State Planar East	State Planar North
NS-SS01-ED4	35°55'39.58"	84°22'56.28"	2447401.20	584296.35
NS-SS02-ED4	35°55'41.86"	84°22'50.42"	2447879.18	584534.73
NS-SS03-ED4	35°55'55.25"	84°22'37.60"	2448910.99	585906.01
NS-SS04-ED4	35°55'57.57"	84°22'36.48"	2449023.86	586147.92

One field duplicate will be collected at sampling location SS01. The field duplicate will be designated by the sample identifier NS-SS01D-ED4. One equipment rinsate will also be collected and designated by the identifier NS-SSER1-ED4. A trip blank will accompany each rigid container (ice chest) used to ship samples for volatile organic analysis. The trip blank will be designated as NS-SSTB1-ED4.

Sediment samples will be collected from a maximum of five locations to be identified during the radiological walkover survey. Sediment samples will be submitted to a laboratory for analysis for VOCs, SVOCs, metals, PCBs, total radioactivity, and radionuclides. Selected samples will also be analyzed for herbicides, pesticides, and asbestos. Table C.5.6 provides a summary of the analyses to be performed on the sediment samples.

Table C.5.6. Summary of analyses for sediment samples at ED-4

Sample Number	Metals[a]	VOCs[b]	SVOCs[b]	PCBs	Asbestos	Total activity	Herbicide/ Pesticide[c]	Baseline radionuclides[d]
NS-01-SD-ED4	X	X[e]	X	X		X	X	X
NS-02-SD-ED4	X	X[e]	X	X	X	X	X	X
NS-03-SD-ED4	X	X[e]	X	X		X		X
NS-04-SD-ED4	X	X[e]	X	X	X	X		X
NS-05-SD-ED4	X	X[e]	X	X		X		X
NS-02-D1-ED4	X	X[e]	X	X	X	X	X	X
NS-ER-01-ED4[f]	X	X	X	X		X	X	X
NS-TB-00-ED4[f]		X						
NS-FB-00-ED4[f]		X						

[a] Total metals include Al, As, Sb, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Na, Si, Se, Ag, Tl, V, and Zn.

[b] Target Compound List (TCL)–volatile organic compounds (VOCs) and TCL–semivolatile organic compounds (SVOCs) are to be quantified.

[c] Herbicides and pesticides include chlorinated herbicides and organochlorine pesticides.

[d] Baseline radionuclides include uranium isotopes (^{234}U, ^{235}U, and ^{238}U), ^{99}Tc, ^{90}Sr, and gamma-emitting isotopes, including but not limited to, ^{60}Co, ^{137}Cs, ^{234m}Pa, and ^{234}Th. Uranium-235 shall also be quantified by gamma spectroscopy.

[e] VOC sample shall be an aliquot collected prior to compositing remaining sample material. The aliquot shall be collected from the portion of the coring with the most elevated PID reading.

[f] Samples designated NS-ER, NS-TB, and NS-FB are equipment rinsates, trip blanks, and field blanks, respectively.

C.6. FIELD SAMPLING PLAN

The various types of samples specified in Chap. C.5 of this SAP will be obtained by the sampling subcontractor (SSC) in accordance with their contract specifications. Therefore, the descriptions of the field sampling methodologies provided in the following sections are provided only as a general synopsis of the procedures and do not supercede the SSC's contract requirements.

The groundwater investigation shall be accomplished using DPT to install temporary piezometers, which will subsequently be sampled. In addition, three existing monitoring wells will be sampled. Groundwater samples shall be collected in accordance with the sampling subcontractor's contract specifications, "Exhibit E, Standard Specifications for Environmental Sampling." The following description of the field sampling method is provided only as a general synopsis of the sampling procedure and does not supercede the contract requirements.

Groundwater samples will be collected from five (5) temporary piezometers, constructed using DPT, and three (3) existing monitoring wells. The temporary piezometers will be placed to determine groundwater quality beneath ED-4 and the quality of groundwater being transported to ED-4 from upgradient areas. The existing monitoring wells will provide additional upgradient and downgradient groundwater quality data for ED-4. Collection of samples from temporary piezometers will be accomplished using non-dedicated mini-bailers or peristaltic pumps one to two days after piezometer installation. The existing wells will be sampled using micropurge, low-flow sample collection techniques using non-dedicated bladder pumps. The temporary piezometers will be designated 01 to 05 and the existing monitoring wells to be sampled will include BRW-076, UNW-102, and UNW-125. The groundwater sampling locations are presented in Fig. C.5.1. Samples collected from the temporary piezometers and monitoring wells will be analyzed for VOCs, SVOCs, metals, herbicides/pesticides, gross alpha activity, gross beta activity, and uranium isotopes.

Temporary piezometers will be installed using a DPT drill rig. Boreholes will be drilled using the DPT until refusal of the drill rods is obtained. The temporary piezometers will be constructed in the borehole using 1-in. inside diameter (ID) schedule 40, polyvinyl chloride (PVC) riser casing equipped with a 5-ft PVC screen. The screens shall be manufactured with a 0.010-in. slot size. A fine-grained silica sand (20/40 grade), to serve as a filter, shall be placed around the screen to a point at least 1 ft above the top of the screen. Bentonite shall be placed above the sand to serve as a temporary seal until sampling is complete. At the completion of sample collection from the temporary piezometers, the PVC casing and screen shall be removed from the borehole and the borehole backfilled to the ground surface with bentonite.

Groundwater samples shall be collected from the temporary piezometers as soon as a sufficient amount of water for sample collection has entered the piezometer. Groundwater samples shall be collected from the temporary piezometers using a stainless steel mini-bailer or Teflon-lined polyethylene tubing attached to a peristaltic pump.

As discussed in Chap. C.3, groundwater sampling has previously been performed at the selected monitoring wells between October 1994 and March 2005. The most recent groundwater data at well UNW-102 indicated low estimated concentrations of chlorinated VOCs, which were not detected in the four previous sampling events at this well. Therefore, additional monitoring data will be obtained for this well to determine the validity of the March 2005 results. The bedrock well, BRW-076, paired with UNW-102 will also be sampled to provide contemporaneous data with UNW-102. Although VOCs have never been detected at BRW-076, because of the placement of the shallow well, UNW-102, on a topographic high point, a bedrock transport pathway is the most likely mechanism to explain the possibility of VOCs at UNW-102, if they are actually present and not a sampling or laboratory artifact. Monitoring well UNW-125 is located downgradient of the western parcel of ED-4 and this well has not been sampled since August 2000. Thus, a groundwater sample will be collected from this well to determine current groundwater quality conditions immediately downgradient of the parcel. Groundwater samples from the existing wells will be collected using non-dedicated bladder pumps and micropurge, low-flow sample collection techniques. The discharge line of the bladder pumps shall be equipped with Teflon-lined polyethylene tubing.

Groundwater samples collected for chemical analyses from each temporary piezometer and monitoring well shall be field-analyzed for temperature, pH, Redox, DO, turbidity, and specific conductance. Purging of the existing monitoring wells should continue until stabilization of the field parameters has been obtained.

Samples shall be placed into appropriate laboratory containers for submittal to the laboratory for analysis immediately upon sample collection. Sample containers will be labeled to include the sample location, sample number, sampling data and time, sampler's name, and requested analyses. Chain-of-custody procedures shall be maintained throughout the sample collection effort. Sample container preservation and holding time requirements are provided in Table C.6.1.

Table C.6.1. Container, preservation, and holding time requirements for ED-4 groundwater samples

Sample location	Parameters of concern	Container type/volume	Preservation	Holding time
Temporary piezometers (01 to 05) and existing wells (BRW-076, UNW-102, and UNW-125)	Volatile organics[a]	(3) 40-mL VOA vials	pH <2, Cool 4°C[b]	14 days
	Semivolatile organics[c]	(2) 1-L A-glass – Teflon™[c]	Cool 4°C	7 days[d]
	Total metals[e]	1-L Polybottle	pH <2, Cool 4°C[f]	180 days
	Herbicides/pesticides	(2) 1-L A-glass – Teflon™	Cool 4°C	7 days[d]
	Uranium isotopes	2 × 1-gal Polybottle	pH <2, Cool to 4°C[f]	180 days
	Gross alpha and beta	Taken from above	pH <2, Cool 4°C[f]	180 days
Trip blanks	Volatile organics	(3) 40-mL VOA vials	Pre-preserved	14 days

[a]Analytes to be quantified are Target Compound List (TCL)–volatile organic compounds (VOCs).
[b]Preservation requirement for water samples for volatile organic compound analysis is addition of HCl to pH <2 and cool 4°C.
[c]Analytes to be quantified are TCL–semivolatile organic compounds (SVOCs). A-glass = amber glass.
[d]Holding time is 7 days to extraction and 40 days from extraction to analyses.
[e]Total metals include Al, As, Sb, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Na, Se, Si, Ag, Tl, V, and Zn. Holding time for mercury is 28 days.
[f]Preservation requirement for water samples for metals and radionuclides is addition of HNO_3 to pH<2 and cool 4°C.
VOA = volatile organic analysis.

Surface soil samples at each of the locations specified in Fig. C.5.1 shall be manually collected using a hand-held auger or scoop to obtain a soil sample (core) from 0.0- to 0.5-ft below ground surface. Upon collection of the soil sample, it shall be scanned using a PID. Samples for VOC analysis from these intervals shall be collected from the portion of the sample that exhibits elevated PID readings from the center of the sample core. If no portion of the sample exhibits an elevated reading, the VOC sample shall be selected randomly from the collected material at the center of the sample core. Samples for VOC analyses may be obtained using Encore®[3] samplers or Method 8260B sampling tubes.

After collection of the VOC samples, the remainder of the collected soil mass shall be homogenized in a stainless steel bowl and transferred to appropriate sample containers. Requirements for sample containers, preservation, and holding times for all analytes of concern from soil sampling are summarized in Table C.6.2. All sample containers shall be sealed, cleaned, and secured in accordance with the SSC's standard operating procedures (SOPs). After filling, containers will be transferred to ice chests with ice packs and a temperature check bottle. Sampling equipment (e.g., auger, mixing bowls, etc.) shall be decontaminated in accordance with the SSC's SOPs prior to reuse at other sampling stations.

Sediment samples shall be collected at locations identified during the radiological walkover survey. Sediment samples at each identified location shall be manually collected using either a shovel or hand-held auger. Upon retrieval of the sediment material, it shall be scanned using a PID. Samples for VOC analyses shall be collected from the portion of the sediment material that exhibits the highest PID reading. If no portion of the material exhibits elevated PID readings, the sample shall be collected from the center of the material. Samples for VOC analyses may be collected using three Encore® samplers that are pushed into the sample material until the sampler is completely filled. After collection of the sample material, the Encore® samplers shall be capped and placed in a plastic bag that is subsequently securely closed. The plastic bag containing the Encore® samplers shall be immediately transferred to an ice chest with ice packs. The holding time for VOC samples collected using Encore® samplers is 48 hrs.

[3] Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof of its contractors of subcontractors.

Alternately, the VOC samples may be collected using three laboratory pre-marked sampling tubes that are pushed into the material to the indicated interval. The sample material collected using each sampling tube shall be extruded to a laboratory pre-preserved, 40-mL volatile organic analysis (VOA) vial. As required for Method 8260B, two of these VOA vials shall be pre-preserved with methanol. The third VOA vial shall be pre-preserved using sodium bisulfate solution as required by Method 8260B. Holding times for VOC samples collected in this fashion are 14 days.

After collection of the VOC samples, the remaining sample material shall be transferred to a stainless steel mixing bowl, homogenized, and transferred to the appropriate sample containers. Requirements for sample containers, preservation, and holding times for sediment samples are provided in Table C.6.2. Care shall be taken to prevent sediment from remaining in the lid threads prior to closure to prevent contaminant migration into or from the sample. Upon filling each sample container, it shall be sealed, wiped clean, and the lid secured in accordance with the SSC's SOPs. After filling, the sample containers shall be transferred to an ice chest with ice packs and a temperature check bottle. Sampling equipment shall be decontaminated in accordance with the SSC's SOPs between each sampling location.

Table C.6.2. Container, preservation, and holding time requirements for ED-4 soil and sediment samples

Sample location	Parameters of concern	Container type/volume	Preservation	Holding time
Locations 01 through 05 and SS01 through SS04	Total metals[a]	8-oz glass – Teflon™ closure	Cool 4°C	180 days[a]
	Mercury[a]	Taken from above	Cool 4°C	28 days[a]
	Volatile organics[b]	Three pre-marked sample tubes extruded to 3- × 40-mL pre-preserved VOA vials or 3 Encore® samplers	One vial Methanol – Cool 4°C One vial Methanol – Cool 4°C One vial $NaHSO_3$ – Cool 4°C	14 days
	Semivolatile organics[c]	8-oz A-glass – Teflon™ closure[c]	Cool 4°C	14 days[d]
	PCBs (Aroclors)	Taken from above	Cool 4°C	14 days[d]
	Herbicides/pesticides	Taken from above	Cool 4°C	14 days[d]
	Asbestos	50-mL plastic vial	None	None
	Uranium isotopes	1500-g glass – Teflon™ closure	Cool 4°C	180 days
	^{235}U	Taken from above	Cool 4°C	180 days
	Gamma-emitting isotopes[e]	Taken from above	Cool 4°C	180 days
	^{90}Sr	Taken from above	Cool 4°C	180 days
	^{99}Tc	Taken from above	Cool 4°C	180 days
	TRU isotopes[f]	Taken from above	Cool 4°C	180 days
	Total alpha/beta activity	Taken from above	Cool 4°C	180 days
	Total gamma activity	Taken from above	Cool 4°C	180 days
Equipment rinsates	Volatile organics	(3) 40-mL VOA vials	pH<2, Cool to 4°C[g]	14 days
	Semivolatile organics	(2) 1-L A-glass – Teflon™[c]	Cool 4°C	7 days[h]
	PCBs	Taken from above	Cool 4°C	7 days
	Herbicides/pesticides	Taken from above	Cool 4°C	7 days[d]
	Total metals	1-L Polybottle	pH<2, Cool 4°C[i]	180 days
	Uranium isotopes	(2) 1-gal Polybottles	pH<2, Cool 4°C[i]	180 days
	^{99}Tc	Taken from above	pH<2, Cool 4°C[i]	180 days
	^{90}Sr	Taken from above	pH<2, Cool 4°C[i]	180 days

Table C.6.2. Container, preservation, and holding time requirements for ED-4 soil and sediment samples

Sample location	Parameters of concern	Container type/volume	Preservation	Holding time
	TRU isotopes[f]	Taken from above	Cool 4°C	180 days
	Gamma Isotopes	Taken from above	pH<2, Cool 4°C[h]	180 days
	Total activity	Taken from above	pH<2, Cool 4°C[h]	180 days
Trip blanks	Volatile organics	(3) 40-mL VOA vials	Pre-preserved	14 days
Field blanks	Volatile organics	(3) 40-mL VOA vials	Pre-preserved	14 days

[a] Total metals include Al, As, Sb, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Na, Se, Si, Ag, Tl, V, and Zn. Holding time for mercury is 28 days.

[b] Volatile organic sample shall be an aliquot – collected before compositing material from the specific depth interval. Analytes to be quantified are Target Compound List (TCL)–volatile organic compounds (VOCs).

[c] Analytes to be quantified are TCL–semivolatile organic compounds (SVOCs). A-glass = amber glass.

[d] Holding time is 14 days to extraction and 40 days from extraction to analyses.

[e] Gamma isotopes include ^{234}Th, ^{234m}Pa, ^{137}Cs, ^{60}Co, and other gamma-emitting radionuclides detected above the minimum detectable activity. Uranium-235 shall also be quantified by both alpha and gamma spectroscopy.

[f] TRU isotopes include plutonium isotopes (^{238}Pu, ^{239}Pu, and ^{241}Pu), 237Np, and 241Am. Thorium isotopes (^{228}Th, ^{230}Th, and ^{232}Th) shall also be quantified in these samples.

[g] Preservation requirement for water samples for volatile organic compound analysis is addition of HCl to pH<2 and cool 4°C.

[h] Holding time is 7 days to extraction and 40 days from extraction to analyses.

[i] Preservation requirement for water samples for metals and radionuclides is addition of HNO_3 to pH<2 and cool 4°C.

PCB = polychlorinated biphenyl.

TRU = transuranic.

VOA = volatile organic analysis (or analyte).

C.7. ANALYTICAL REQUIREMENTS

Analytical protocols for the analyte groups specified for the samples collected under this SAP are indicated in Table C.7.1. Samples for chemical analyses will be measured by the relevant SW-846 Methods. Uranium isotopes will be analyzed by alpha spectroscopy except that ^{235}U will also be measured by gamma spectroscopy.

Table C.7.1. Analytical requirements for Parcel ED-4 groundwater, soil, and sediment samples

Parameters of concern	Analytical protocols
Total metals[a]	6010
Mercury	7471
Total volatile organics	8260B
Total semivolatile organics	8250/8270
Herbicides/pesticides	8151A/8081
PCBs	8082
Asbestos	NIOSH 9002
Gamma-emitting isotopes	Gamma spectroscopy
Total alpha/beta activity	Radiochemical counting method
Total gamma activity	Gamma scan non-destructive, spectrum method
Gross alpha and beta	900.0/9310
Uranium isotopes	Alpha spectroscopy
Plutonium isotopes	Alpha spectroscopy
^{241}Am, ^{237}Np	Alpha spectroscopy

[a] Total metals include Al, As, Sb, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Na, Si, Se, Ag, Tl, V, and Zn.

C.8. DATA MANAGEMENT AND REPORTING

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee* (BJC/OR-865). Results will be provided to EPA Region 4 and to the TDEC DOE-Oversight Office.

C.9. REFERENCES

DOE (U. S. Department of Energy) 1997a. *Evaluation of McKinney Ridge Study Area, Environmental Restoration Footprint Reduction Process*, DOE/OR/01-1511&D1/R1, Office of Environmental Management, Oak Ridge, TN.

DOE 1997b. *Remedial Site Evaluation Report for the Happy Valley Campsite at the Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/02-1654&D1, Office of Environmental Management, Oak Ridge, TN.

DOE 1999. *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/01-1778&D1, Office of Environmental Management, Oak Ridge, TN.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1995. *Site Descriptions of Environmental Restoration Units at the Oak Ridge K-25 Site*, K/ER-47/R1, Lockheed Martin Energy Systems, Inc., Environmental Restoration Division, Oak Ridge, TN, November.

EPA (U. S. Environmental Protection Agency) 1993. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition (November 1986; Rev. 1, July 1992; Rev. 2, November 1992; and Update 1, August 1993), Office of Solid Waste, Washington, D.C., August.

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APPENDIX D

WALKOVER ASSESSMENT WORK INSTRUCTION

BJC/OR-2808
FINAL

Walkover Assessment Instruction for Heritage Center Property Transfers at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

P. J. Hartman/dw 5/1/2007

BJC/ETTP Classification and Information Control Office **Date**

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/OR-2808

Walkover Assessment Instruction for Heritage Center Property Transfers at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—May 2007

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
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Prepared for the
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BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
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07-069(NE)/050107

INTRODUCTION

The area to be addressed by this walkover assessment instruction includes any land parcels outside of Zone 1 and 2 at the East Tennessee Technology Park (ETTP). Potential areas of interest for walkover assessments shall be identified from a review of available records. The available records to be reviewed shall include aerial photographs, historical maps, and other readily available records, including employee process knowledge.

PURPOSE AND OBJECTIVE

This walkover assessment is being performed to support Clean Parcel Determinations under CERCLA 120(h)(4). Potential areas of interest identified during this assessment may be designated for soil sample collection, if deemed to be warranted. The objective of this assessment is to conduct thorough walkovers to identify areas of possible anthropogenic sources of contamination that could potentially impact the release of the property by DOE.

GENERAL METHODOLOGY

The walkover assessment shall be performed in a manner similar to the Department of Energy (DOE) Footprint Reduction Process which was employed in the late 1990's on other land areas potentially suitable for exclusion from the CERCLA clean-up "footprint".

The walkover assessment shall be performed by conducting observational surveys of the land parcels. The survey shall focus on areas exhibiting anthropogenic impacts, such as former roads, areas of soil discoloration, areas of stressed vegetation, and areas that appear to have been previously disturbed. Professional judgment shall be used to identify other potential areas to be assessed during the walkover. Roads and trails are investigated to determine if materials may have been dumped along these routes. In addition to areas of interest identified from the record reviews and former roads and trails, additional assessment shall be performed on unique parcel features. Routes for the foot traverses shall be selected that ensure maximum coverage of the area to be assessed.

Observational information gathered during walkdowns shall be supplemented with radiological survey, groundwater sampling and the collection of sediment samples from any sediment accumulation areas, as appropriate and based on existing data needs. Separate survey and sampling plans for these activities are prepared for implementation.

Walkover teams are equipped with field notebooks or field forms, writing instruments, maps showing the area to be assessed, Global Positioning System (GPS) instrument, and survey pin flags. Areas of interest identified during the walkover assessment will be located using GPS instruments. Locations for potential sample collection shall be marked using pin flags. The coordinate system used for identifying locations of areas of interest or potential sampling locations shall be the Tennessee State Plane, 1983 North American Datum.

All activities conducted during the walkover shall be documented in field logbooks or on appropriate field forms. A report shall be prepared following completion of the assessment that describes the assessment methods, the activities performed, and the results of the assessment, including any soil sampling conducted. The rationale for the type of analyses requested and the analytical results for any

sediment samples collected during this assessment shall be reported and evaluated in the environmental documentation prepared for the lease/transfer of the property.

METHODOLOGY FOR PARCELS ED-3 AND ED-4

The first two parcels to be assessed using this instruction are designated as ED-3 and ED-4, and consist of four separate tracts located adjacent to Highway 58 (Fig. 1). The two separate tracts comprising ED-3 are bounded by Highway 58 on the north for the large tract and on the south for the smaller tract. The larger tract occupies the area formerly known as the Happy Valley Construction campsite (HVCC). The two ED-4 tracts occupy an area bounded by Highway 58 on the south and by Blair Road to the east and Boulevard Road to the west. This walkover assessment is being performed in conjunction with a radiological survey and groundwater and sediment sampling efforts for these parcels, which will be conducted under efforts separate from this assessment.

Emphasis for the observational survey walkover of land parcels ED-3 and ED-4 shall be placed on any anthropogenic features such as the former railroad bed and the path of the former Wheat Road, which transected parcel ED-4, and other former roads that traversed both of the parcels. Existing features such as the Haul Road, which transects portions of both ED-3 and ED-4 (Fig. 1) shall also be assessed along with any other roads and trails that are identified. Additional assessment shall be performed by conducting foot traverses at a minimum of 300-ft intervals beginning near Highway 58 and proceeding perpendicular to Highway 58 in either a northwest or southeast direction depending on the land parcel being surveyed.

The initial walkover assessment shall be conducted for the ED-4 parcel with a subsequent assessment of ED-3. A SAP has been prepared for ED-4 for the collection of groundwater samples and the collection of sediment samples from sediment accumulation areas[1]. The SAP also provides sampling and analytical requirements for sediment samples obtained at ED-4. A radiological survey to be conducted at ED-4 will identify sediment accumulation areas for sample collection[2]. A radiological survey plan and groundwater SAP for the small area of ED-3 not already included within the existing clean parcel determination[3] will also be prepared. Soil samples shall be collected at areas of interest that are determined to warrant sample collection during the walkover assessment. Soil sample collection may be warranted if evidence, such as soil discoloration, is found indicating that soils may have been impacted by activities on the parcel.

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[1] BJC 2007. *Sampling and Analysis Plan for Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee (in preparation).*

[2] BJC 2007. *Radiological Survey Plan for the Transfer of Land Parcel ED-4 at the East Tennessee Technology Park, Oak Ridge, Tennessee (in preparation).*

[3] DOE 1997. *Environmental Restoration Footprint Reduction Process – Evaluation of West Pine Ridge Study Area*, DOE/OR/01-1568&D1, September.

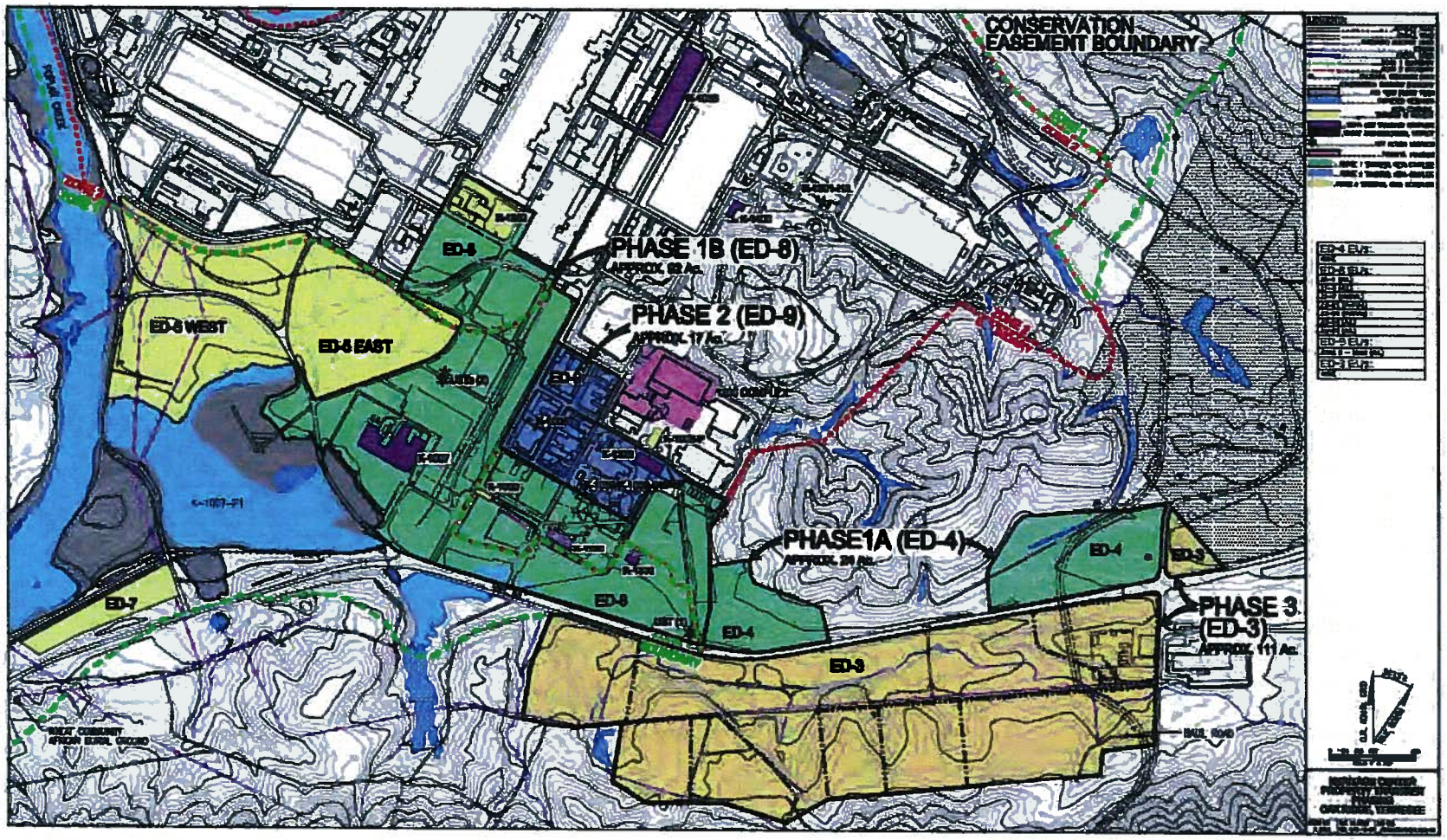

Fig. 1. Location of land parcels for Heritage Center Property Transfer

APPENDIX E

RADIOLOGICAL SURVEY PLAN FOR PARCEL ED-4

E.1. AREA TO BE SURVEYED

Parcel ED-4, a land parcel shown in Fig. E.1, is proposed for transfer to the Community Reuse Organization of East Tennessee (CROET). Parcel ED-4 encompasses approximately 24 acres of partially wooded land that is located east of the former gas centrifuge complex at the Oak Ridge Gaseous Diffusion Plant (ORGDP) in two separate tracts. Highway 58 bounds both tracts of land to the south. The eastern boundary of the eastern tract follows Blair Road for nearly 500 ft from its intersection with Highway 58 to the point at which Blair Road turns eastward. The southern boundary of the eastern tract runs approximately 1000 ft along Highway 58. This tract includes a former railroad bed and the wetlands area near the headwaters of Mitchell Branch. The western boundary of the western tract is formed by the intersection of Boulevard Road and Highway 58 and runs north for a distance of approximately 600 ft across the corner of a parking lot. The southern boundary of the western tract runs approximately 900 ft along Highway 58. The combined area comprises approximately 24 acres. Refer to Fig. E.1 for the complete footprint of the survey area.

E.2. HISTORY OF THE AREA

Aerial photographs and site maps from throughout the history of ORGDP indicate that this area has largely been undeveloped woodland since federal acquisition. Before that time, the land in Parcel ED-4 consisted primarily of forests and grasslands intermixed with large and small orchards, cropland, and pastures associated with the Wheat Community. Blacksmithing, brick making, and gristmill operations also occurred in the community.

During the Manhattan Project, the area south of Highway 58 was a portion of the campsite that provided living quarters for the construction workers building the ORGDP. Several of the supporting facilities were located in the western tract of ED-4. The three Happy Valley Construction Camp (HVCC) buildings located within ED-4 were designated as S-12, S-22, and S-44. Historical records indicate that these buildings were the Recreation Hall (S-12), the Town Hall Camp Operations Building (S-22), and the Property Warehouse (S-44). A railroad used during site construction passed through both tracts of ED-4, as did a segment of Wheat Road. By 1963, no remnants of these former structures, including the railroad spur, are visible on aerial photographs.

In the last two years, the U. S. Department of Energy (DOE) has constructed and is using a Haul Road for the transport of radiological waste on the Reservation, which cuts across the eastern tract. The road is gravel and is elevated above the surrounding terrain.

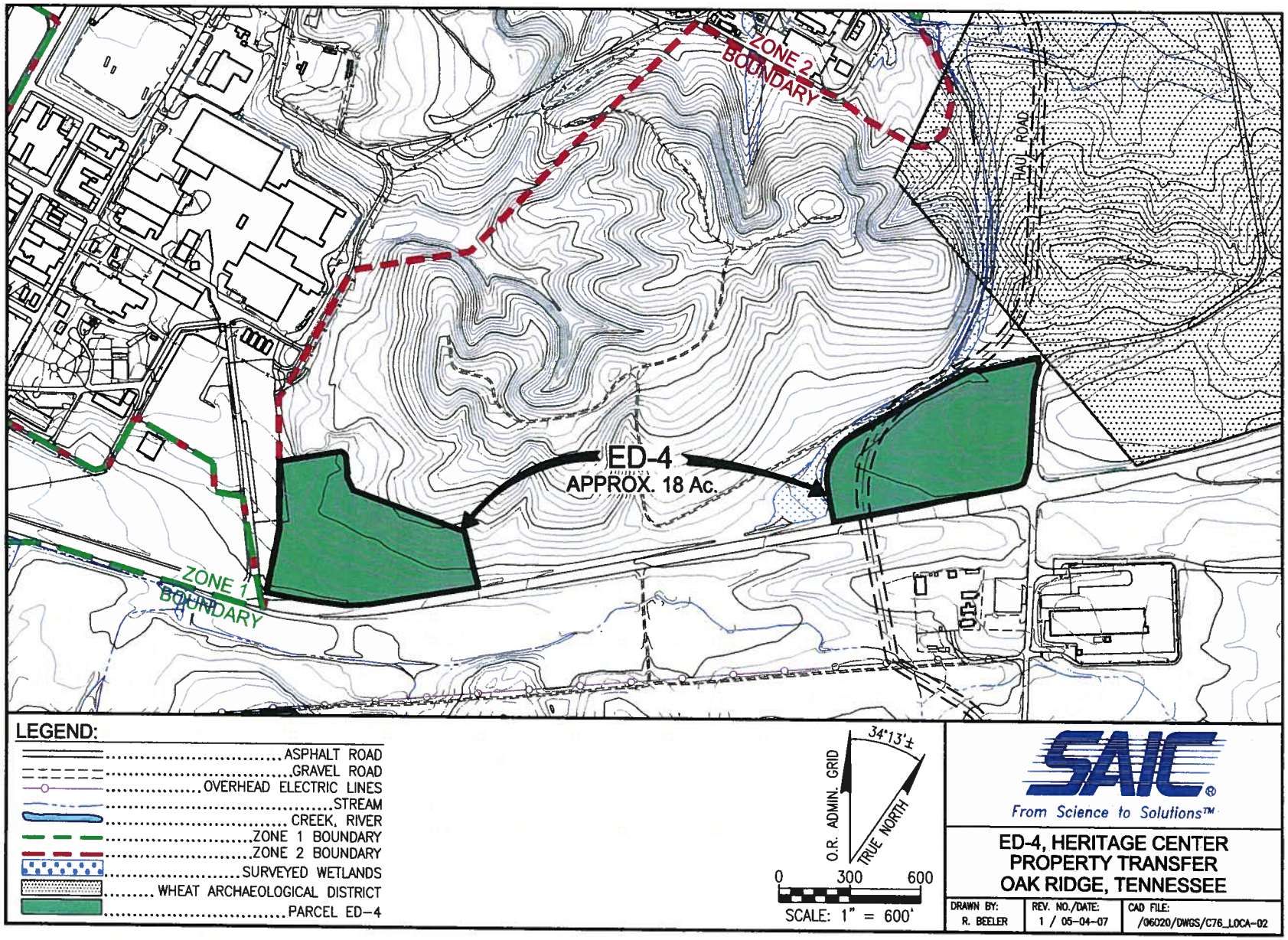

Fig. E.1. Footprint for Land Parcel ED-4.

E.3. EXISTING SURVEY AND SAMPLING DATA SUMMARY

No survey or sampling data have been found for this land parcel. However, the eastern tract is bisected by DOE's Haul Road (used by DOE for the transport of radiological waste on the Reservation). The Haul Road footprint is currently being monitored. Any areas exceeding 200 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) removable beta, 1000 dpm/100 cm^2 total beta, 20 dpm/100 cm^2 removable alpha, and 100 dpm/100 cm^2 total alpha are to be remediated.

The 2-in. × 2-in. sodium iodide (NaI) Gamma Scintillator detector is the instrument of choice for these Haul Road surveys but can only be used to locate areas for survey with other instruments that can be compared to the above limits. It will be assumed that any contamination identified in connection with monitoring the Haul Road will be remediated prior to transfer; Haul Road activities are outside the scope of this survey plan.

E.4. DATA QUALITY OBJECTIVES PURPOSE

The purpose of this survey plan is to obtain radiological survey data through the use of a scoping survey. The data gathered, combined with process knowledge, will be used to support a clean parcel determination (CPD) for title transfer of the ED-4 land parcel. The data quality objectives (DQOs) are detailed in the Design of Radiological Surveys (DRS) document[1] found in Appendix A. However, since this parcel is outside the site boundaries and clean-up areas, the protocols have been modified to more closely match those that have previously been used for footprint reduction efforts as noted below.

Surface contamination limits do not apply to soil-covered land parcels such as ED-4. Therefore, there are no applicable limits that apply to the data collected during the walkover survey. The purpose of this walkover survey is to visually inspect the area to collect observations and screening data that will be used to support a CPD. The inspections will focus on identifying any anthropogenic features, delineating the boundaries of the features, and determining if sampling of the feature is warranted. For volumetric or mass measurements, DOE Order 5400.5 mandates the use of generic guidelines for thorium and radium of 5 pCi/g. For other radionuclides, guidelines must be based on specific survey unit modeling and meet a dose limit of 25 mrem modified by as low as reasonably achievable considerations. Derived concentration guideline levels (DCGLs) will be calculated in the Sampling and Analysis Plan (SAP) for individual isotopes based on that dose limit. Therefore, it is the objective of the walkover inspection to be able to detect areas for sampling that could possibly exceed the DCGLs. Surface water run-off and sediment accumulation areas will also be identified for sampling.

E.5. MEASUREMENT TECHNIQUES/SURVEY APPROACH

E.5.1 RADIONUCLIDES OF INTEREST

The process history of the East Tennessee Technology Park (ETTP) site indicates that uranium (natural, depleted, and/or enriched) would be the most prominent radiological contaminant potentially present in Parcel ED-4 as a result of emissions or tracking of contamination from on-site buildings.

[1] *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation*, BJC/OR-554-R1, August 2006.

Uranium-235 enrichment levels from operations since the early 1960s would be expected to be between 0.2 and 5.0%. Most ETTP areas would have potentially been contaminated by tracking from enrichments of less than 3%.[2]

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}Sr$, ^{237}Np, ^{99}Tc, and $^{238/239/240}Pu$) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from the Oak Ridge National Laboratory and/or from the Hanford and Savannah River reactor returns uranium-reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in this area. If radionuclides are present, it is assumed that they will be present at ratios of 1140:1 for uranium to transuranic and 350:1 for uranium to technetium-99 (both ratios are process-building weighted averages).[3]

E.5.2 IDENTIFICATION OF SURVEY UNITS AND CLASSIFICATIONS

Under the DRS protocols that are based on *Multi-Agency Radiation Survey and Site Investigation Manual* (*MARSSIM*) guidance, survey units are classified as either non-impacted, or Class 3, 2, or 1 based upon historical data and process knowledge. Non-impacted areas have no reasonable potential for residual contamination and require no further evidence to demonstrate compliance with the release criterion. An area is considered a Class 3 survey unit if it is not expected to have residual radioactivity levels above 25% of the DCGL. A Class 2 survey unit is expected to have, or has had, residual radioactivity levels less than the DCGL but above the criteria for Class 3. A Class 1 survey unit is expected to have, or has had, residual radioactivity levels above the DCGL.

The ED-4 land parcel will consist of two land survey units (LSUs), as shown in Table E.1. Though contamination is considered unlikely in ED-4, its proximity to the former ORDGP precludes its classification as non-impacted. Because of the parcel's dormant status and lack of development, except during the construction of the plant site and the current Haul Road, contamination in the eastern tract (LSU 2) is not expected, and if present, should be at levels well below the DCGL. It has been judged that some potential for low levels of contamination exists in LSU 1, since its western boundary's proximity to the former ORGDP area increases the potential for contamination of this localized area from groundwater runoff because the property slopes in that direction. However, it is not expected that the levels would exceed 25% of the DCGL. Therefore, both ED-4 tracts will be classified as Class 3.

Table E.1. Land survey units

Survey unit	Class
LSU 1 – western tract	Class 3
LSU 2 – eastern tract	Class 3

E.5.3 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES

Refer to the DRS in Appendix A for details on instrumentation selection. NaI meters and Bicron MicroRem® meters will be used, as specified in this survey plan.

[2] Contracted Health Physics Technician Training handouts, K-25 Site, 1993.

[3] *Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, Science Applications International Corporation, BJC/OR-257, October 1999.

The Walkover team should be equipped with the following:

- field notebook and writing instruments,
- maps showing the LSU and assessment locations,
- Global Positioning System (GPS) instrument for in-field locating of the assessment locations and for documenting locations of notable field observations,
- survey pin-flags,
- Bicron MicroRem® meter, and
- 2-in.-diameter × 2-mm-thick NaI detector for surveying assessment locations and possible anthropogenic features, and sediment collection area. If a 2-in.-diameter × 2-mm-thick NaI detector is not available, a 2-in. × 2-in. NaI detector may be substituted.

If necessary, the visual inspections and locations of assessment points using a GPS unit may be performed by a separate team prior to the survey measurements. If so, the assessment points and any other locations to be measured (anthropogenic, groundwater runoff, and sediment collection areas) will need to be marked in such a way that the locations can be found by the survey team.

For the Class 3 areas, NaI walkover survey judgment scans will be performed. Emphasis will be placed on road bed areas, suspect areas of discoloration, and other areas based on professional judgment. Any anthropogenic, groundwater runoff, and sediment collection areas recognized during the NaI walkover, and any scan areas determined to have elevated readings, will be marked, and timed-fixed NaI and dose-rate measurements will be taken at the specifically identified locations of highest scan readings. A fixed NaI and dose-rate measurements will also be taken at randomly generated points based on a supplied grid.

All surveys will be performed in accordance with established Bechtel Jacobs Company LLC (BJC) Radiation Control Organization (RADCON) procedures (e.g., scan rate, probe distance, source checks).

E.5.4 AREA PREPARATION

All areas will be surveyed in an "as-found" condition. Materials may be rearranged or moved to allow for survey access to areas covered by debris. Clearing of some areas by bushhog or other means may be necessary for access to some points.

E.5.5 REFERENCE COORDINATE SYSTEM FOR SURVEY

The DRS normally requires random points to be generated for timed measurements for Class 3 survey units. However, due to the modified DQOs discussed above, a sample grid with systematic measurements taken based upon a random starting point will be used. These survey grids are based upon the LSU's area such that there is approximately one assessment point per acre. A reference coordinate system will be used in each survey unit to reference measurements so they can be relocated/verified as needed. The reference coordinate system used for the anticipated transects will be the state plane coordinates.

E.6. SURVEY DESIGN

E.6.1 DETERMINATION OF THE NUMBER OF DATA POINTS

LSUs have a prescribed number of data points (samples), at a minimum, to gather, which is based upon the protocols described in the MARSSIM. However, there is no set number of survey measurements required for soil areas, as the determination of the LSU's contamination level, as compared to the DCGL, is done using soil sample data, not hand-held instrumentation data. It is desired to make timed NaI and dose rate measurements in order to identify possible locations for representative sampling. Therefore, assessment points for timed NaI and dose rate measurements will be located at intersects of a survey grid whose size is based upon the LSU's area, such that there is approximately one point per acre. In addition, anthropogenic, groundwater runoff, and sediment collection areas will be identified by visual inspection for biased, timed NaI and dose rate measurements.

E.6.2 SURVEY PROCEDURES

All surveys are to be performed in accordance with this survey plan, the DRS, and BJC RADCON procedures.[4] *Note:* The survey technique is covered in the DRS and will not be repeated in this plan; however, variations from, or clarifications of, the design document protocols are included below.

Many of the radionuclides found on the Oak Ridge Reservation have natural background concentrations; therefore, background subtraction will be required for all direct field measurements. Some comparison to background levels will also be required for the scanning because only a gross signal will be measured. Material-specific backgrounds might be necessary for materials such as tile, brick, and cinderblock because these materials contain elevated levels of naturally occurring radionuclides.

NaI walkover survey judgment scans will be performed. Emphasis will be placed on road bed areas, suspect areas of soil or vegetation discoloration, and other areas based on professional judgment. NaI survey measurements will be performed at the fixed grid assessment points, any anthropogenic, groundwater runoff, and sediment collection areas recognized during the NaI walkover, and any scan areas determined to have elevated readings. (Sediment accumulation areas are those areas where overland flow and surface drainage gradients decrease and sediment may accumulate. These accumulation areas will generally be flat or low-lying areas that would tend to accumulate run-off and any sediments.) A 10-ft-diameter surface area will be scanned at each of these points with the NaI detector, and the location of the highest reading will be counted for 1 minute and the results recorded. Biased samples will be collected for laboratory analysis from any location that has a timed NaI survey reading greater than three times the established background. The basis for the "three times rule" stems from the fact that natural backgrounds vary by up to a factor of three, depending on geology, topography, and other geometric factors. However, the data for each LSU will be reviewed to determine if other areas exist where there is a clear elevation in count rate as compared to surrounding areas but less than three times the established background. Professional judgment will be used to evaluate if the specific geology, topography, and matrix (e.g., rock outcroppings, pavement, severe slopes, and brick buildings) could have caused the elevated readings. If a background specific to the geology and topography for the area can be obtained, a lower trigger level (e.g., two times the background or the 99% decision level for the NaI meter) may be used based on professional judgment.

[4] Primarily EH-4516, "Radioactive Contamination Control and Monitoring," found in BJC-EH-4000, Radiation Protection Program Description for Bechtel Jacobs Company LLC, Oak Ridge, Tennessee.

A summary of the requirements for each survey unit is found in Table E.2.

Table E.2. Summary of survey unit requirements

Survey unit type	Class 3
Land (LSU)	• Judgmental NaI walkover survey in/on each survey unit will be performed with emphasis placed on road bed areas, suspect areas of soil or vegetation discoloration, and other areas based on professional judgment. Areas elevated above background will be identified for assessment. • Anthropogenic, groundwater runoff, and sediment collection areas will be identified for assessment during the walkover. • Specified number of systematic points based upon grid coordinates will be identified for assessment using a GPS unit. • At each systematic and biased assessment location identified above, a 10-ft-diameter surface area will be scanned with the NaI detector, and the location of the highest reading will be counted for 1 minute and the results recorded. • Any assessment point found to be greater than three times the background or other appropriate threshold will be pin-flagged for sampling. • One dose-rate reading will be made per every systematic and biased sample point.

GPS = Global Positioning Unit.
LSU = land survey unit.
NaI = sodium iodide.

E.6.3 SPECIFICATION OF ASSESSMENT POINT LOCATIONS

Systematic assessment points will be based on the survey grid as shown on Fig. E.2. The state plane system coordinates and longitude/latitude for each assessment point for LSU 1 are shown in Table E.3; those for LSU 2 are shown in Table E.4 and correspond to the locations shown on Fig. E.2. In addition, the walkover inspection team will identify anthropogenic, groundwater runoff, and sediment accumulation areas, and any other areas scanned above background in the LSUs, as biased assessment points.

Table E.3. Assessment point locations for LSU 1

Assessment point number	Oak Ridge administrative grid easting	Oak Ridge administrative grid northing	Tennessee State grid easting	Tennessee State grid northing	Latitude	Longitude
AP-01	14975.00	33675.00	2447125.66	584403.53	842259.9097	355540.6293
AP-02	15196.22	33716.04	2447282.68	584564.65	842257.9683	355542.1969
AP-03	15016.04	33453.78	2447286.79	584246.51	842257.9823	355539.0503
AP-04	15237.27	33494.82	2447443.81	584407.63	842256.0410	355540.6179
AP-05	15458.49	33535.87	2447600.83	584568.76	842254.0995	355542.1855
AP-06	15278.31	33273.60	2447604.93	584250.61	842254.1136	355539.0389
AP-07	15499.54	33314.64	2447761.95	584411.74	842252.1722	355540.6065
AP-08	15715.97	33360.47	2447912.30	584574.00	842250.3117	355542.1864

LSU = land survey unit.

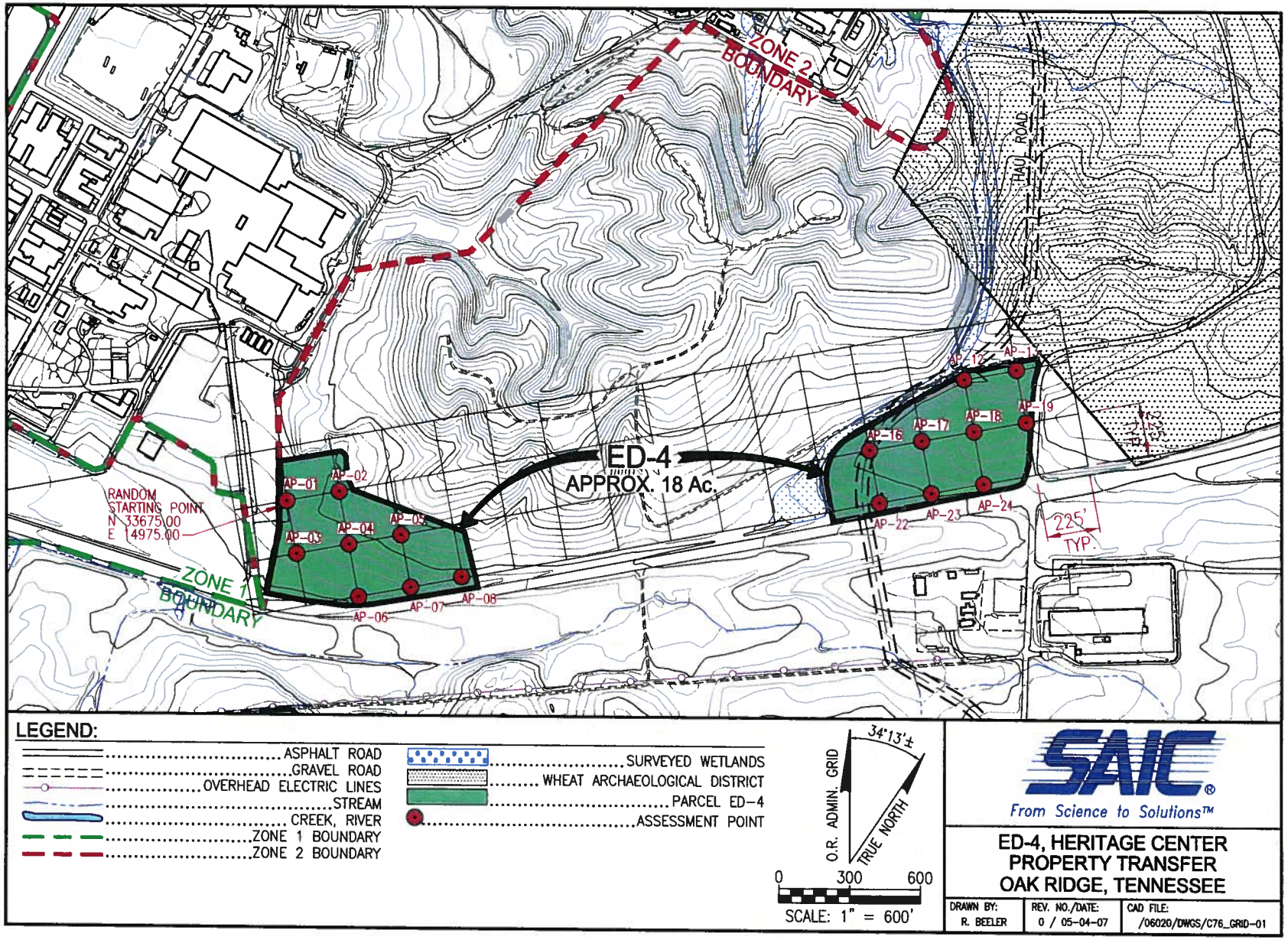

Fig. E.2. LSU assessment point locations.

Table E.4. Assessment point locations for LSU 2

Assessment point number	Oak Ridge administrative grid easting	Oak Ridge administrative grid northing	Tennessee State grid easting	Tennessee State grid northing	Latitude	Longitude
AP-12	17850.92	34208.58	2449166.93	586498.15	842234.6699	355601.0075
AP-13	18072.14	34249.63	2449323.95	586659.28	842232.7282	355602.5750
AP-16	17449.52	33905.27	2449014.01	586018.88	842236.6258	355556.2934
AP-17	17670.74	33946.31	2449171.04	586180.01	842234.6842	355557.8609
AP-18	17891.96	33987.36	2449328.06	586341.13	842232.7425	355559.4284
AP-19	18113.19	34028.40	2449485.08	586502.26	842230.8009	355600.9959
AP-22	17490.56	33684.04	2449175.14	585861.86	842234.6985	355554.7143
AP-23	17711.78	33725.09	2449332.16	586022.99	842232.7568	355556.2818
AP-24	17933.01	33766.13	2449489.18	586184.11	842230.8152	355557.8493

LSU = land survey unit.

E.7. DOCUMENTATION

Survey data will be documented in accordance with the procedures and reviews required by the DOE Contractor. A report will be prepared that describes the survey methods, results, and evaluation. The report will include the findings of the assessment, describe the materials surveyed and their condition, and justify the contamination-potential classification assigned. The data evaluation will be included, along with the assessment of the quality assurance (QA)/quality control (QC) documentation. This report, or a summary of it, will also be included and referenced in the facility's baseline environmental conditions documentation.

E.8. QUALITY ASSURANCE

All appropriate QA/QC reviews to ensure the quality of the data gathered will be performed and documented. Survey instruments and methods specified in applicable RADCON operating and technical procedures have been documented as to their ability to provide a 95% confidence level in detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form.

A DOE Contractor RADCON-Certified Health Physicist, or another designated health physicist, will review, evaluate, and validate the survey results, including assessment of the QA/QC information and data, before generation of the radiological survey report. The final radiological survey report will include the details of this assessment. It will be provided to the DOE Contractor project QA manager, project manager, and site project health physicist for approval before its inclusion in the Environmental Baseline Survey report.

APPENDIX F

RISK EVALUATION FOR PARCEL ED-4

CONTENTS

FIGURES

TABLES

ACRONYMS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COPC	contaminant of potential concern
CPD	Clean Parcel Determination
DOE	U. S. Department of Energy
EBS	Environmental Baseline Survey
EPA	U. S. Environmental Protection Agency
EPC	exposure point concentration
ETTP	East Tennessee Technology Park
HI	hazard index
HQ	hazard quotient
PRG	preliminary remediation goal
RAGS	*Risk Assessment Guidance for Superfund*
RL	remediation level
ROD	Record of Decision
TDEC	Tennessee Department of Environment and Conservation

EXECUTIVE SUMMARY

The goal of this risk evaluation is to determine the potential for adverse health effects associated with Parcel ED-4. The U. S. Department of Energy (DOE) is proposing to transfer title of this land parcel to the Heritage Center, LLC under a Clean Parcel Determination (CPD). The intended land use for the property is industrial/commercial. However, to support a CPD, a residential scenario was evaluated.

The methodology followed in performing this risk evaluation included screening the site data against nationally available preliminary remediation goals (PRGs), as well as remediation levels (RLs) developed for the East Tennessee Technology Park (ETTP) Zone 1 soils Record of Decision (ROD), to determine the need for a full risk calculation. The full risk calculation is conducted only when the constituents exceeding PRGs indicate the potential for elevated risks [cumulative excess lifetime cancer risk (ELCR) exceeding EPA's generally acceptable risk range or a hazard index (HI) above 1], or where no nationally recognized PRGs are available for the exposure scenario being considered.

The U. S. Environmental Protection Agency has established a generally acceptable target risk range of E-04 to E-06 (also expressed as 10^{-4} to 10^{-6}) and a generally acceptable HI of 1. The ELCR is a value that represents the excess cancer incidence that might be expected due to the exposure scenario evaluated. The HI is a value that represents the potential for toxic effects to an exposed individual.

The analytical results for Parcel ED-4 soils and sediment indicated the cumulative risks were within the acceptable risk range and the HI did not exceed 1; therefore, a full risk calculation was not necessary. As stated above, because the risk estimate did not exceed the generally acceptable risk range or exceed a HI of 1, the risk evaluation was considered indicative of the low likelihood of adverse health effects associated with residential exposure to the Parcel ED-4 soils and sediments. The land parcel, therefore, is considered suitable for transfer as a Clean Parcel per the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(4).

F.1. INTRODUCTION

The goal of this risk evaluation is to determine the potential for adverse health effects associated with Parcel ED-4, which is proposed for transfer by the U. S. Department of Energy (DOE). Specifically, the objectives of this evaluation are: (1) to determine exposure to constituents based on available data for the soils and sediment, and (2) to use these data to provide an estimate of the potential for adverse effects to human health. The risk calculations utilized in this evaluation are based on the document *Risk Assessment Guidance for Superfund* (RAGS) [EPA 1989]. The following sections describe the process used to provide a quantitative analysis of the risks to human health from exposure to Parcel ED-4.

F.1.1 RISK EVALUATION METHODOLOGY

The risk evaluation methodology utilizes a step-wise process in order to more efficiently determine if the property under consideration is suitable (from a health perspective) for transfer. As detailed below, the site data are screened against trigger levels first to determine if further examination of the data is necessary. By virtue of the decision needed to be made when examining the data (i.e., health protection), the screening process is conservative.

The risk evaluation method to support the title transfer of Parcel ED-4 includes analysis of both soil and sediment. A process agreed to by both DOE and the regulators [i.e., U. S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC)] is utilized in order to be consistent with other programs (e.g., Environmental Management). Soil and sediment sampling results are compared with Preliminary Remediation Goals (PRGs) and/or site-specific remediation levels (RLs). PRGs are health-protective concentrations that have been developed by EPA Region 9 for the purpose of screening chemical concentrations to identify chemicals of potential concern. RLs are health-protective concentrations that have been established in the site Records of Decision (RODs).

PRGs are developed based on a specific exposure scenario (i.e. residential) and exposure pathways (soil ingestion, inhalation, and/or dermal contact) for a given level of risk and hazard [i.e., risk of 1E-06 and hazard quotient (HQ) of 0.1]. The risk represents the estimated probability of increased cancer incidences for the exposed population (i.e., risk of 1E-06 means a 1-in-1,000,000 increased chance). The HQ is a measure of the potential for toxic effects from an individual contaminant, and the sum of HQs for multiple constituents is referred to as the hazard index (HI). An HI that exceeds 1 indicates the possibility that toxic effects may occur in the exposed population. The RLs use site-specific data to develop health-protective concentrations for contaminants that are site-related and considered widespread. Because site-specific data are used to develop RLs, they are higher in concentration than the PRGs.

As indicated above, the evaluation of risk and hazards is based on comparing soil and sediment sample results with PRGs or RLs. If there are constituents with concentrations in excess of the PRGs or RLs, further evaluation is conducted to ensure that cumulative risks are within the acceptable risk range and the overall HI is below 1 for the facility. If the site data indicate the potential for elevated risks and/or hazards, a full risk calculation is conducted. The full risk calculation is based on an exposure assessment and identified exposure parameters (e.g., soil ingestion rate, exposure frequency, body weight, etc.) for the anticipated receptors. The results of the full risk calculation are then compared to the acceptable risk and hazard levels to determine the potential for adverse health effects associated with soils and sediment in order to determine if the property is suitable for transfer. The following sections describe the process used to provide a quantitative analysis of the potential risks to human health while occupying Parcel ED-4.

F.2. DESCRIPTION AND HISTORY

A full description and history of Parcel ED-4, as well as site maps, are presented in Chaps. 1 through 4 of the draft Environmental Baseline Survey (EBS) report for the ED-4 study area (DOE 2007, in progress).

F.3. AVAILABLE DATA

The data available for the Parcel ED-4 study area consist of soil and sediment results from nine total sampling locations. Chapter 6 of the EBS provides a detailed evaluation of all available data, which are summarized in the following sections.

F.4. DATA DISCUSSION

The available data for ED-4 are discussed in detail in Chap. 6 of the EBS and are summarized below. Duplicate analyses were conducted at some locations for quality assurance purposes. For the risk assessment, duplicate analyses were reduced to a single result (for each location, sample depth, and sampling date) in order to avoid biasing the dataset toward locations with duplicate analyses available. Where the original sample and duplicate were both detections, the larger detection was selected as the representative result. Where both the original and duplicate were non-detections, the sample with the lower detection limit was selected as the representative result. Additionally, the risk evaluation considered soil and sediment data as a single media in the analysis of potential residential exposures.

F.4.1 PARCEL ED-4 SOIL DATA

Field sampling was conducted in June 2007 and generated soil analytical results from four locations (Fig. 4.1). Samples were collected from 0 to 0.5 ft below ground surface (bgs) and analyzed for metals, organics, and radionuclides.

F.4.2 PARCEL ED-4 SEDIMENT DATA

The June 2007 sampling event also generated sediment analytical results from five locations and analyzed for metals, organics, and radionuclides (Fig. 4.1).

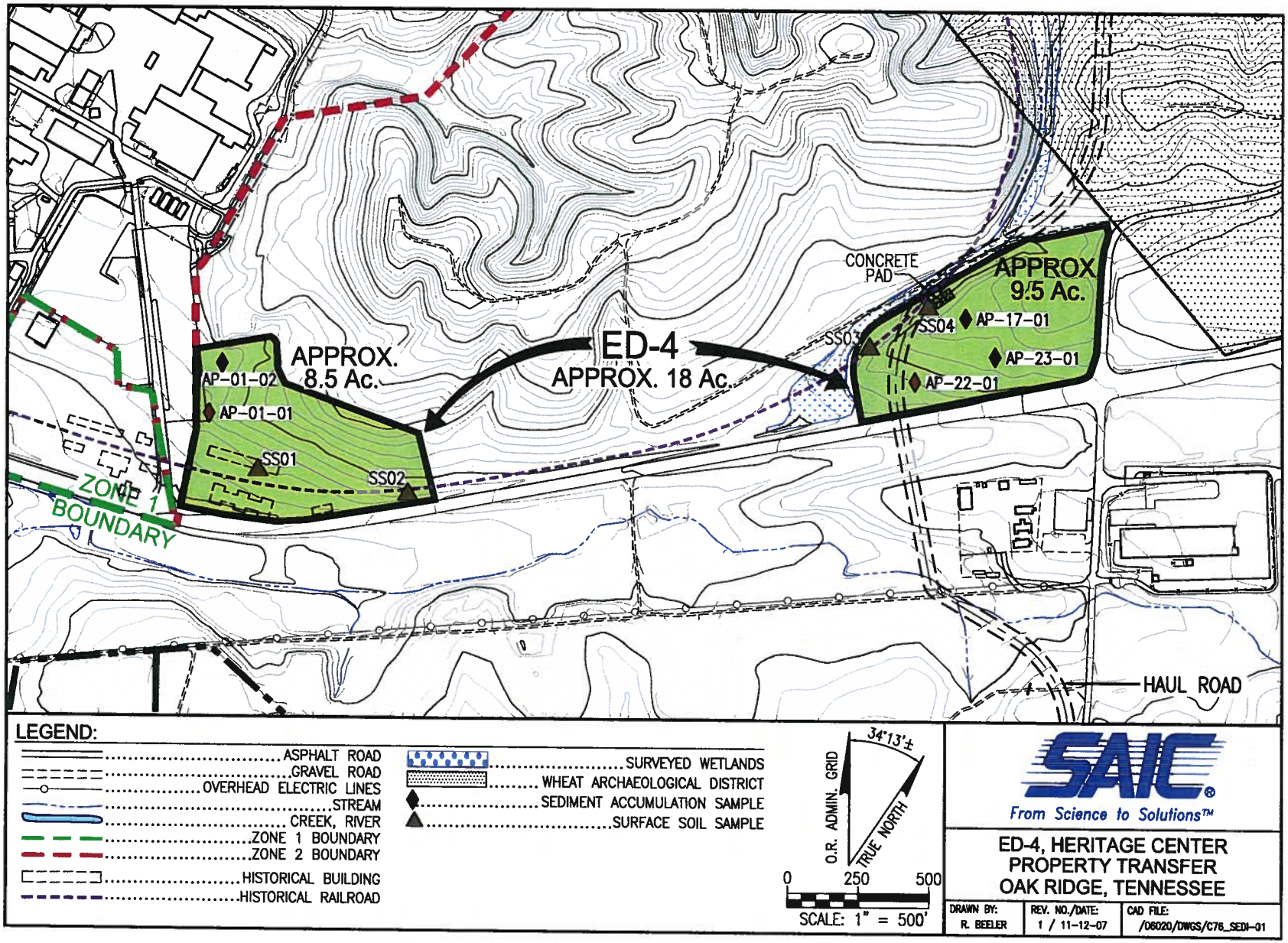

Fig. F.4.1. Parcel ED-4 soil and sediment sampling locations.

F.5. EXPOSURE ASSESSMENT

An exposure assessment combines information about site characteristics and site-related data with exposure assumptions in order to quantify the intake of contaminants by a hypothetically exposed individual. The estimated exposure is based on the following:

- characterizing the exposure scenario based on site surveys,
- identifying complete exposure pathways based on assumed receptor activities and site-specific information, and
- quantifying receptor exposure based on exposure assumptions and chemical-specific data.

The steps in the exposure assessment are discussed in detail in the following sections.

F.5.1 EXPOSURE SCENARIO EVALUATION

Exposure scenarios are selected based on site surveys and anticipated uses of Parcel ED-4. ED-4 is being transferred for industrial uses. However, a residential scenario was considered for this land parcel to support a Clean Parcel Determination (CPD).

Exposures to the resident, while spending time outside and within the transfer area, were evaluated using soil and sediment sampling results. Uncertainties associated with the exposure scenario evaluation are presented in Chap. F.7.

F.5.1.1 Residential Scenario

The hypothetical residential scenario assumes that a resident may be present on Parcel ED-4 in the future.[1] It is assumed that the resident is exposed to soils from 0 to 2 ft bgs as well as sediment, while hypothetically living in the area. Details associated with this theoretical residential scenario are presented in the following section.

F.5.2 EXPOSURE PATHWAY IDENTIFICATION

Evaluating the exposure pathways requires describing the mechanism by which an individual may become exposed to contaminants associated with Parcel ED-4 transfer area soils and sediment. A complete exposure pathway requires the following:

- a source of contamination,
- a pathway of migration from the source of contamination to the exposure point,
- a receptor present at the exposure point, and
- an exposure mechanism at the exposure point.

If any one component of a complete exposure pathway is missing, then the pathway is considered incomplete. Only complete exposure pathways were evaluated in the risk screen.

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[1] It should be noted that the Quitclaim deed prohibits residential use.

Complete exposure pathways associated with Parcel ED-4 soils and sediment include ingestion, inhalation, dermal contact, and external exposure to ionizing radiation. The ingestion pathway is complete because contaminated media may be present, a receptor may be present on the parcel, and a receptor may contact and ingest contaminants from the media. The inhalation pathway is complete because contaminated media may be present, contaminants may become airborne, a receptor may be present on the parcel, and an individual may inhale contaminants that are in the air. The dermal pathway is complete because contaminated media may be present, a receptor may be present on the parcel, and a receptor may contact and dermally absorb contaminants from the media. External exposure to ionizing radiation is a complete exposure pathway because radionuclides may be present in media, ionizing radiation may be emitted, and a receptor may be present to absorb the radiation. The following section describes how each of these exposure pathways was quantified in the risk screen.

F.5.3 QUANTIFICATION OF EXPOSURE

The evaluation of the ED-4 residential scenario included a comparison of detected concentrations with EPA Region 9 residential PRGs adjusted to a risk level of 10E-6 and an HQ of 0.1.

The residential exposure scenario assumes the following:

- the resident is present on Parcel ED-4 for 30 years as an adult, and for 6 years as a child;
- the resident is on-site for 350 d/year;
- the resident is outdoors exposed to soils for 1.5 h/d as an adult, and 2.25 h/d as a child;
- the resident ingests 100 mg/d and 200 mg/d of contaminated soil as an adult and child, respectively; and
- the resident inhales 20 m^3/d as an adult and 15 m^3/d as a child.

As described in the risk evaluation methodology in Sect. F.1.1, for the Parcel ED-4 study area soils and sediment, detected concentrations were compared with EPA Region 9 residential PRGs adjusted to a risk level of 1E-06 and an HQ of 0.1, as well as site-specific RLs. Because the comparison indicated a low potential for adverse health effects, a full risk calculation was not required, as discussed in Chap. F.6.

F.6. RISK RESULTS

The EPA has established a generally acceptable target risk range of E-04 to E-06 (also expressed as 10^{-4} to 10^{-6}) and a target HI of 1. The following sections present the evaluation of site analytical data collected from the Parcel ED-4 study area

F.6.1 RESIDENTIAL SCENARIO

Hypothetical residential exposures associated with Parcel ED-4 soils and sediment may occur via ingestion, inhalation, dermal contact, and external exposure. As discussed in the previous section, EPA Region 9 residential PRGs and ETTP RLs were used to screen the soils and sediment as follows:

- each detected result was compared with EPA Region 9 PRGs for the residential scenario adjusted to a risk level of 1E-06 and an HQ of 0.1;
- detected results were compared with the RLs developed for the ETTP Zone 1 ROD; and
- detected results were compared with background levels.

As discussed in Sect. F.1.1, the dataset was evaluated to determine if the generally acceptable risk range and HI of 1 were exceeded as follows:

- constituents with maximum detected concentrations above the RLs and/or PRGs were evaluated to determine the potential for a cumulative risk exceeding the acceptable risk range or an HI exceeding 1.
- constituents with a maximum detected concentration below background were eliminated.

Table F.6.1 presents the results of the Parcel ED-4 risk evaluation based on residential exposures and indicates the following:

- No constituents were determined to exceed the RLs.
- Constituents exceeding the PRG and/or background values were selenium, thallium, benzo(*a*)pyrene, radium-226, technetium-99, and uranium-238.
- Selenium analytical results included laboratory qualifiers indicating that matrix interference and sample dilution hindered accurate quantification of media concentrations. Process knowledge at ED-4 does not indicate a likely source of selenium to account for these elevated levels above background criteria; however, selenium is included in the evaluation for completeness.
- Radium-226 is a site-wide contaminant based on background considerations (DOE 2002a) and is not considered site-specific to ED-4.
- Based on consultation with EPA and verification utilizing the RAIS risk estimator (http://rais.ornl.gov/cgi-bin/prg/for_ent_data), site concentrations with maximum concentrations that exceeded the residential PRG were evaluated to determine the potential for adverse health effects associated with exposure to maximum detected concentrations. The results indicate a cumulative

ELCR within the acceptable risk range and HI < 1 associated with constituents detected in ED-4 soils and sediment.

Because the potential residential risks associated with ED-4 soil and sediment did not exceed the generally acceptable risk range of E-04 to E-06 or HI of 1, no further evaluation was needed, and a full risk calculation was not conducted. The screening was considered indicative of the low likelihood of adverse health effects associated with residential exposure to Parcel ED-4 soils and sediment. Parcel ED-4 is, therefore, considered suitable for transfer as a Clean Parcel per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(4).

Table F.6.1. Results of residential risk screen for ED-4 soils and sediment

Constituent	Frequency of detect	Minimum detect	Maximum detect	Average detected result	Background concentration	Frequency of detects exceeding background	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	Residential PRG (Risk = 1E-06, HQ = 0.1)	Frequency of detects exceeding PRG limit
Selenium	9/9	39.5 J	126 J	86.46	1.47	9/9	NA	NA	NA	NA	39.1	9/9
Thallium	1/9	1.46 J	1.46 J	1.46	0.4 U	1/9	NA	NA	NA	NA	0.516	1/9
Benzo(*a*)pyrene	6/8	0.143	0.269 J	0.18	NA	NA	NA	NA	NA	NA	0.0621	6/8
Radium-226	9/9	0.688	1.47	0.97	1.25	1/9	15	0/9	5	0/9	0.0124	9/9**
Technetium-99	5/9	0.0388	0.387	0.12	NA	NA	NA	NA	NA	NA	0.25	1/9
Uranium-238	9/9	1.4	3.08	2.13	1.47	8/9	500	0/9	50	0/9	0.743	9/9

NA = not applicable or not available.

** - Constituent is considered a site-wide contaminant based on background considerations and is not site specific to ED-4 (DOE 2002a).

PRG = preliminary remediation goal. Values presented here are from U. S. Environmental Protection Agency Region 9 for residential exposure adjusted for a risk level of 1E-06 and hazard quotient of 0.1.

RL = remedial level from ETTP Zone1 ROD (DOE 2002a).

F.7. EVALUATION OF UNCERTAINTIES

The estimation of uncertainty, whether quantitative or qualitative, is fundamental to scientific activities that involve measured or assessed quantities. Estimates of risk are conditional based on a number of assumptions concerning exposure. Generation of a point estimate of risk, as has been done in this screening-level assessment, has the potential to yield under- or overestimates of the actual value and can lead to improper decisions. Therefore, it is necessary to specify the assumptions and uncertainties inherent in the screening-level evaluation process to place the risk estimates in perspective and ensure that anyone making risk-management decisions is well informed.

Uncertainty about environmental risk estimates is known to be at least an order of magnitude or greater (EPA 1989). The evaluation of uncertainties for the assessment is qualitative, since the resource requirements necessary to provide a quantitative statistical uncertainty analysis for this study area would generally outweigh the benefits. The focus of the discussion in this section will be on the important variables and assumptions that contribute most to the overall uncertainty.

F.7.1 UNCERTAINTY IN THE SOURCE TERM

Several uncertainties are associated with the data set and the data evaluation process. These uncertainties include the selection of COPCs and the determination of the EPC.

Although the data evaluation process used to select COPCs adheres to established procedures and guidance, it also requires making decisions and developing assumptions on the basis of historical information, process knowledge, and best professional judgment about the data. Uncertainties are associated with all such assumptions. The background concentrations and PRGs used to screen analytes are also subject to uncertainty. The toxicity values used in the derivation of PRGs are subject to change; as additional information (from scientific research) becomes available, these periodic changes in toxicity values may cause the PRG values to change as well, causing increased uncertainty in the data screening process.

Representative concentrations and other statistics are calculated in this risk screen based on the assumption that the samples collected are truly random samples. Some of the data may not have been taken randomly, but rather may have come from biased sampling, aimed at identifying high contaminant concentration locations.

This evaluation has been performed using only the COPCs with available toxicity data. Radionuclides that are short-lived isotopes were eliminated from the dataset, along with daughter products of isotopes that include the contribution of the daughter in the PRG calculation to overestimating their contribution to the overall risks.

F.7.2 UNCERTAINTY IN THE EXPOSURE ASSESSMENT

For each exposure pathway, assumptions are made concerning the parameters, the routes of exposure, the amount of contaminated media an individual can be exposed to, and intake rates for different routes of exposure. In the absence of site-specific data, the assumptions used in this assessment are consistent with EPA-approved parameters and default values. When several of these upper-bound values are combined in estimating exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and, therefore, outside the range that may be reasonably expected.

The guidance values for intake rates and exposure parameters are assumed to be representative of the hypothetical populations evaluated. All contaminant exposures and intakes are assumed to be from the site-related exposure media (i.e., no other sources contribute to the receptor's risk). Even if these assumptions are true, other areas of uncertainty may apply. Selected intake rates and population characteristics (i.e., weight, life span, and activities) are assumed to be representative of the exposed population. The consistent conservatism used in the estimation of these parameters generally leads to overestimation of the potential risk to the postulated receptors.

F.7.3 UNCERTAINTY IN TOXICITY VALUES AND RISK PREDICTIONS

Uncertainty in the values used to represent the dose-response relationship will highly impact the risk estimates. These uncertainties are contaminant-specific and are embedded in the toxicity value. The factors that are incorporated to represent sources of uncertainty include the source of the data, duration of the study, extrapolations from short- to long-term exposures, intrahuman or interspecies variability, and other special considerations. In addition, toxicity varies with the chemical form.

Uncertainties related to the summation of carcinogenic risk and non-carcinogenic hazard estimates across contaminants and pathways are a primary uncertainty in the risk characterization process. In the absence of information on the toxicity of specific chemical mixtures, additive (cumulative) risks are assumed (EPA 1989).

Limitations of the additive risk approach for exposure to multiple chemicals include the following:

1. The slope factors may represent the mean but often represent the upper 95th percentile estimate of potency (the central estimate on the mean for radionuclides), so the summation can result in an excessively conservative estimate of lifetime risk.

2. The reference doses do not have equal accuracy or precision and are not based on the same severity of effects.

3. The effects of a mixture of carcinogens are unknown, and possible interactions could be synergistic or antagonistic.

Despite these limitations and the general unavailability of data on these interactions, summations were performed for the carcinogenic risks and chemical hazards presented in the risk screen. This approach is consistent with RAGS (EPA 1989).

In order to avoid double-counting the short-lived daughters of specific isotopes, the daughters were excluded from the COPC list if analytical results for the parent were available; only daughters as defined by EPA (2001) were excluded. As a special case, the ^{232}Th decay chain was evaluated as "^{232}Th+D" (which combines the slope factors for ^{232}Th, ^{228}Ra+D, and ^{228}Th+D) when calculating risks. When evaluating data for "^{232}Th+D," a conservative approach was used, whereby the largest concentration among ^{232}Th, ^{228}Ra, and ^{228}Th was used to determine the maximum detected concentration and to estimate all summary statistics. Another special consideration for radioisotopes was to eliminate ^{40}K from the COPC list, as it was considered to be naturally occurring and, therefore, was not considered to be a COPC.

F.8. REFERENCES

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