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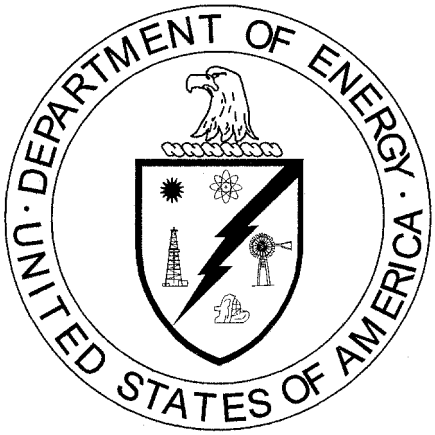
Site Evaluation Report for Addendum 1-B Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky



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Site Evaluation Report for Addendum 1-B Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—September 2010

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Managed by
LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC
managing the
Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-10CC40020

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PREFACE

This *Site Evaluation Report for Addendum 1-B Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0225&D2/R1, (SER) was prepared as a result of implementing the *Sampling and Analysis Plan for Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0015&D2/R1, (DOE 2007a) and associated *Addendum 1-B to the Sampling and Analysis Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0015/1-B&D2.

This SER is the third of four to address soil and rubble pile areas in the vicinity of the Paducah Gaseous Diffusion Plant, as identified in the notification letter submitted to U. S. Environmental Protection Agency and Kentucky Department for Environmental Protection, dated February 16, 2007 (DOE 2007b). This SER addresses soil sampling at soil piles located east and north of the Paducah Gaseous Diffusion Plant along Little Bayou Creek (excluding Soil Pile I) and the North-South Diversion Ditch. It was developed in accordance with the requirement in Section IX of the Federal Facility Agreement for submittal of an integrated removal/remedial Site Evaluation and Solid Waste Management Unit Assessment Report.

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ACRONYMS

AOC	area of concern
AL	action level
ASER	Annual Site Environmental Report
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COPC	chemical of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
HI	hazard index
ISOCS	*In Situ* Object Counting System
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
MDL	method detection limit
MQO	measurement quality objective
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NAL	no action level
NIST	National Institute of Standards and Technology
NSDD	North-South Diversion Ditch
ORPS	Occurrence Reporting and Processing System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PSS	Plant Shift Superintendent
QC	quality control
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SAR	Solid Waste Management Unit Assessment Report
SER	Site Evaluation Report
SRM	standard reference material
SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWOU	Surface Water Operable Unit
TCLP	Toxicity Characteristic Leaching Procedure
TCE	trichloroethene
VOC	volatile organic compound
WKWMA	West Kentucky Wildlife Management Area
XRF	X-ray fluorescence

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EXECUTIVE SUMMARY

This Site Evaluation Report presents the results of the comprehensive sampling effort completed for Addendum 1-B Soil Piles along Little Bayou Creek and the North-South Diversion Ditch (NSDD). Sampling and analysis were completed in accordance with the following agency-approved secondary documents:

Sampling and Analysis Plan for Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-0015&D2/R1 (SAP), 2007.

Addendum 1-B to the Sampling and Analysis Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-0015/1-B/&D2, 2008.

In December 2006, initial field reconnaissance, field radioactivity measurements, and limited sampling at Addendum 1-B Soil Piles were completed. The results of these efforts indicated radioactivity exceeding background. Addendum 1-B Soil Piles include 40 discrete piles covering an approximate area of 2.3 acres. Forty piles were identified; 34 along Little Bayou Creek east of the Paducah Gaseous Diffusion Plant (PGDP) and 6 along the NSDD north of the PGDP, and they vary in size and shape, ranging from approximately 1 to 10 ft in height. Included are Area of Concern (AOC) 492, also known as soil pile AR, and soil pile O within AOC 541 and one additional pile recently identified as K013 (for a new total of 41 piles). The field investigation was completed between October and December 2008. Additional biased sampling was conducted at six of the soil piles in March 2010.

PROJECT OBJECTIVES

The study was designed to obtain sufficient data of known quality to support the following objectives:

- Establish the nature and extent of contamination of soils in Addendum 1-B Soil Piles and adjacent soils.
- Establish the mean concentrations of contaminants in soils.
- Determine if soils pose imminent risks to human health.
- Determine if soils contamination exceeds regulatory thresholds.

INVESTIGATION SUMMARY

The following provides the planned sampling activities for Addendum 1-B Soil Piles and an accounting of the actual number and types of samples collected. Addendum 1-B to the PGDP Soil Piles SAP specified the collection and analysis of these samples:

- Sixty-three surface samples (19 at small piles, 19 at large piles and 25 at AOC 492 and soil pile O within AOC 541) to undergo field measurements and fixed laboratory analysis;
- Three hundred twenty surface samples (19 small pile locations, 53 large pile locations and 248 at AOC 492 and soil pile O within AOC 541) to undergo field measurements only;

- Sixty-five subsurface samples (19 small pile locations, 21 large pile locations and 25 at AOC 492 and soil pile O within AOC 541), where subsurface is defined as soil taken at a depth below 1 ft, to undergo field measurements and fixed laboratory analysis;

- Four hundred subsurface samples (22 small pile locations, 130 large pile locations and 248 at AOC 492 and soil pile O within 541) to undergo field measurements only; and

- A number of contingency samples (no more than 50), as determined by subject matter experts at the time of field activity.

During execution of Addendum 1-B, the total number of soil samples collected was as follows:

- Sixty-five surface samples underwent field measurements and fixed laboratory analysis

- Two hundred fifty-five surface samples underwent field measurements only

- Sixty-four subsurface samples underwent field measurements and fixed laboratory analysis

- Two hundred seventeen subsurface samples underwent field measurements only

- Twenty-eight contingency samples were collected

- In addition, 58 samples (31 surface and 27 subsurface) were collected from a new pile identified as K013 near outfall 013

- Eleven additional biased samples were collected from the surface soil of six soil piles previously sampled.

The differences between planned and actual sample numbers resulted from five factors:

- The observed differences in subsurface samples result entirely from variations in soil pile height. Because the soil pile height, on average, was less than 6 ft, fewer subsurface samples were required to reach the natural grade.

- Fewer samples were required because the pile dimensions varied in length, width, or both.

- Subsurface samples were not collected within soil pile O of AOC 541 if the surface sample did not indicate contamination and the location was not a soil pile. All soil pile locations within soil pile O of AOC 541 were sampled to grade.

- A new pile, K013, was identified after the SAP was approved (pile No. 41).

- Another deviation from the SAP includes contingency samples not being collected for all piles.

- Additional biased samples were collected for radiological constituents and polychlorinated biphenyls (PCBs) where radiological surveys indicated potential contamination.

INVESTIGATION FINDINGS

Sample results indicate 24 chemicals exceeded PGDP background values during the Addendum 1-B sampling: 17 metals and 7 radionuclides. Of those 24 chemicals, only 10 of them are recommended chemicals of potential concern (COPCs) based upon no action level exceedances: arsenic, beryllium, chromium, mercury (for the child resident scenario only), vanadium, uranium (metal), uranium-234 (for the child resident scenario only), uranium-235 (for the child resident scenario only), uranium-238, and PCBs. The seven COPCs that were found above teen recreational user no action levels in six piles (20, AT, H, J, BW, and D) as follows: arsenic, beryllium, vanadium, uranium (metal), uranium-238, and PCBs were found in pile AT; chromium was found in pile 20; uranium (metal) and uranium-238 was found in piles H and J; uranium (metal) was found in pile D; and PCBs were found in 20, J, H, BW, and D. The ten COPCs that were found above child resident no action levels as follows: arsenic, beryllium, mercury, vanadium, uranium (metal), uranium-234, uranium-235, uranium-238, and PCBs were found in pile AT; chromium, uranium (metal), uranium-238, and PCBs were found in pile 20; uranium (metal), uranium-234, uranium-235, uranium-238, and PCBs were found in pile D; uranium (metal), uranium-235, uranium-238, and PCBs were found in pile H; chromium, uranium (metal), uranium-234, uranium-235, uranium-238, and PCBs were found in pile J; chromium, uranium-238, and PCBs were found in pile BW; uranium (metal) and uranium-238 were found in piles C, F, and G; and uranium-238 in piles K013 and P.

Additional sampling indicate pile E exceeds teen recreational user no action levels for uranium-238 and PCBs and pile BV exceeds teen recreational user no action levels for uranium-238.

Uranium-238 exceeds action levels for the PGDP teen recreational user at pile E. The following detected concentrations for these COPCs exceed their action levels for the PGDP child resident: arsenic (pile AT), uranium (metal) (pile J), uranium-238 (piles D, E, and J).

Additionally, biased sampling conducted by the Commonwealth of Kentucky indicate pile K exceeds screening levels for uranium-238.

Sample results for soil pile O within AOC 541 confirm results from samples collected in 2002. Results for PCBs and uranium exceed action levels.

SUMMARY OF INVESTIGATION CONCLUSIONS

Nature and Extent of Contamination

Data of known quality were acquired in sufficient quantities to allow decision makers to formulate an informed decision as to the need for an action at any of the Addendum 1-B Soil Piles, if warranted.

Assessment of Human Health Risks

The results of the background screening indicate 17 metals above background; however, only soil piles 20, H, J, and AT exceed metal concentrations warranting further evaluation as COPCs under the teen recreational use scenario. For uranium-238, the concentrations are below the individual (teen) recreational user screening level for a 1 mrem/year dose (with the exception of soil pile O within AOC 541 and soil pile E) and, therefore, below the “walk away” level in the PGDP Risk Methods Document (DOE 2001). In addition, PCBs also were detected, warranting further evaluation as COPCs.

RECOMMENDATIONS

The following are recommendations based on the findings of the Addendum 1-B Soil Piles:

- No response action is recommended for the soil piles along Little Bayou Creek and the NSDD (Addendum 1-B Soil Piles), except for soil pile O within AOC 541. An action at soil pile O within AOC 541 is recommended. See Section 7 where the factors for an action are described in 40 *CFR* § 300.415 (b)(2).

- The presence of seven chemicals [arsenic, beryllium, chromium, vanadium, uranium (metal), uranium-238, and PCBs] in eight of the 40 Addendum 1-B soil piles (soil piles 20, AT, E, H, J, BV, BW, and D) above teen recreational use risk screening levels indicate that solid waste management unit assessment reports (SARs) should be developed for these soil piles (see Appendix A).

- The presence of 10 chemicals (arsenic, beryllium, chromium, mercury, vanadium, uranium (metal), uranium-234, uranium-235, uranium-238, and PCBs) in 14 of the 40 Addendum 1-B soil piles (soil piles 20, AT, H, J, BV, BW, CC, D, C, E, F, G, K013, and P) above child residential use risk screening levels indicate that SARs should be developed for these soil piles (see Appendix A). The soil piles D, H, J, C, E, F, G, and P (AOC 562), CC, 20 and BW (AOC 563), AT (AOC 564), and K013 (AOC 567) have been added to the Soils Operable Unit. See Appendix B for data and Appendix C for sample locations. Soil Pile BV is within the boundary of AOC 541.

- Polycyclic aromatic hydrocarbon (PAH) test kits are recommended for consideration during future sampling activities. PAH results for Addendum 1-B generally were less than detection; therefore, similar to Addendum 2, a data comparison was not performed.

1. INTRODUCTION

This Site Evaluation Report (SER) has been developed in accordance with the requirement in Section IX of the Paducah Gaseous Diffusion Plant (PGDP) Federal Facility Agreement (FFA) for the submittal of an integrated removal/remedial Site Evaluation Report/Solid Waste Management Unit (SWMU) Assessment Report. The report is organized as follows:

- Project Scope, Objectives, and Background
- Area Description
- Field and Analytical Methods
- Quality Assurance/Quality Control
- Discussion and Results
- Data Screening
- Conclusions
- Recommendations

1.1 PROJECT SCOPE

During November 2006, soil piles were discovered by U.S. Department of Energy (DOE) and the Commonwealth of Kentucky (Kentucky) along Bayou, Little Bayou Creeks and the North-South Diversion Ditch (NSDD), outside of the PGDP industrialized area. Initial field radiation surveys of some Little Bayou Creek soil piles indicated elevated levels of radioactivity. Based on these initial field results, DOE planned to determine if any of the piles pose an immediate threat to human health or public safety. A sampling plan to evaluate Addendum 1-B Soil Piles was developed and approved by the regulatory agencies. The provisions for this program are contained in two DOE secondary documents:

- *Sampling and Analysis Plan for the Soil Piles at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0015&D2/R1 (SAP), 2007.

- *Addendum 1-B to the Sampling and Analysis Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0015/1-B/&D2, 2008.

Addendum 1-B field work was implemented at Little Bayou Creek Soil Piles between October and December 2008. In March 2010, at the request of the Commonwealth of Kentucky, additional biased samples were collected at six of the soil piles. This SER presents the results of those efforts and includes the data generated from field activities, an evaluation of project data quality and usability, assessment of the potential risks to human health, and conclusions. See Figure 1 for Addendum 1-B Soil Pile locations along Little Bayou Creek.

As noted in both the SAP and Addendum 1-B, the focus of the investigation was to evaluate conditions in the soil piles along Little Bayou Creek and adjacent soils. The scope of the project was to examine conditions, evaluate potential human health risks, and compare soil pile contaminant concentrations to background, no action levels, and action levels to support future decisions.

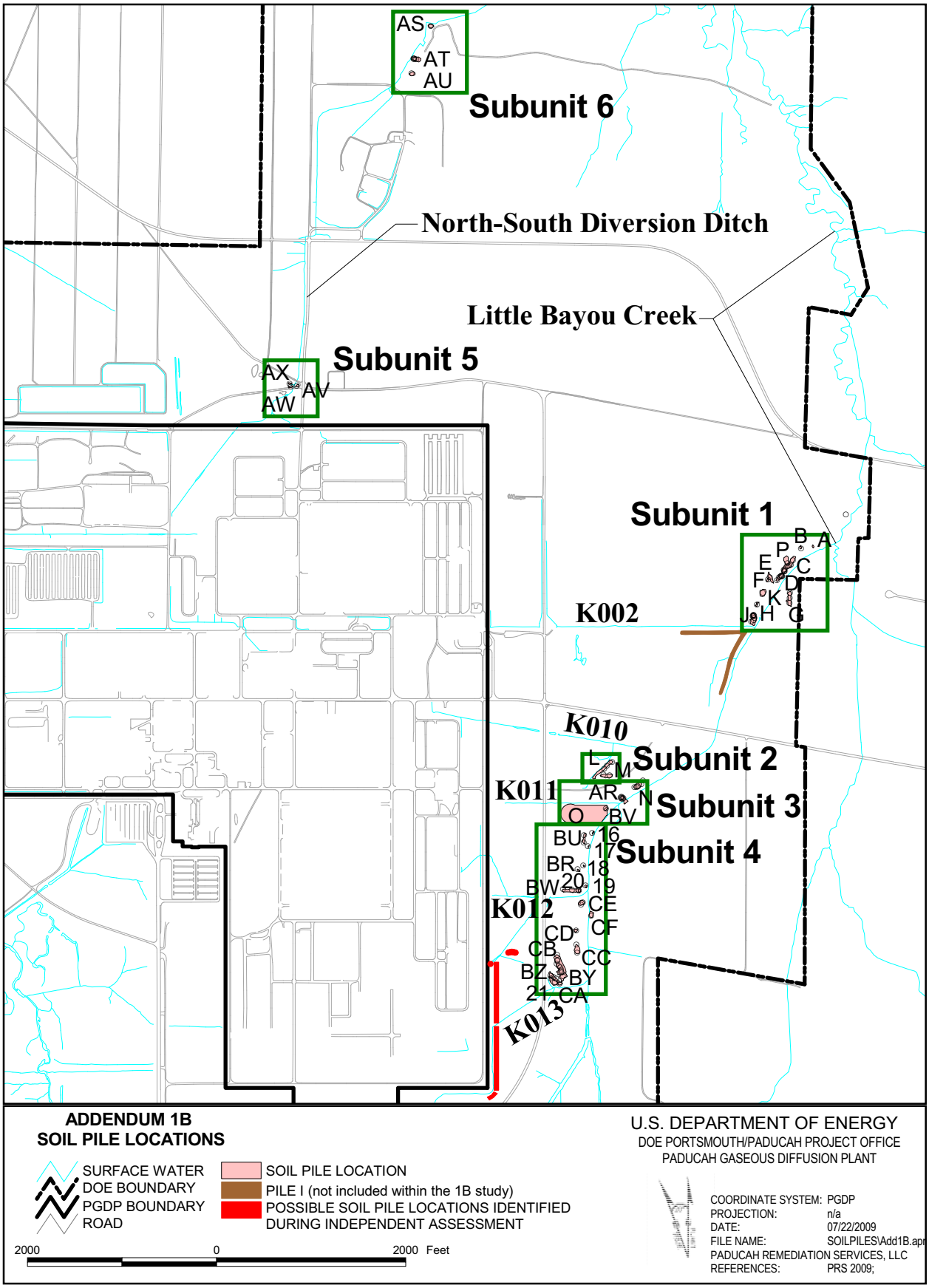

Figure 1. Addendum 1-B Soil Piles

1.2 PROJECT OBJECTIVES

The principal study objective of the Addendum 1-B Soil Piles sampling effort was to determine if contamination is present and, if so, determine the nature and extent of soil contamination in soil piles and adjoining soils. The data quality objectives (DQOs) include the following:

- Establish the nature and extent of contamination in Addendum 1-B Soil Piles and adjacent soils.
- Establish the mean concentrations of contaminants in soils.
- Determine if soils pose imminent risks to human health.
- Determine if soils contamination exceeds regulatory thresholds.

1.3 REGULATORY OVERVIEW

PGDP was placed on the National Priorities List on May 31, 1994. In accordance with Section 120 of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE entered into an FFA with U. S. Environmental Protection Agency (EPA) Region 4 and Kentucky on February 13, 1998 (EPA 1998). The FFA established one set of consistent requirements for achieving comprehensive site remediation in accordance with the Resource Conservation and Recovery Act (RCRA) and CERCLA, including stakeholder involvement.

The DOE Portsmouth/Paducah Project Office is responsible for environmental management activities associated with PGDP (CERCLIS # KY8-890-008-982) and serves as the lead agency for remedial actions at PGDP. EPA Region 4 and Kentucky Department for Environmental Protection (KDEP) serve as the regulatory oversight agencies for the facility.

Addendum 1-B Soil Piles are identified in the notification letter dated February 16, 2007 (DOE 2007b).

1.4 PROJECT BACKGROUND

Following the November 2, 2006, discovery and notifications to the regulators of Soil Pile I, field efforts were initiated to identify other piles. Once a pile was identified, the initial effort included a preliminary radiological survey of soil piles and adjoining soils. Initial reconnaissance and subsequent surveys noted radioactivity in some Addendum 1-B soil piles.

In 2002, limited soil sampling was completed at Addendum 1-B Soil Piles AR and O [Area of Concern (AOC) 492 and a portion of AOC 541] to initially assess site conditions. The results of the initial sampling effort indicated detections of polychlorinated biphenyls (PCBs) and uranium above background.

A complete gamma walkover survey was performed for Addendum 1-B Soil Piles during 2008. The results of this effort confirmed initial field effort, showing elevated radioactivity for some of the 40 Addendum 1-B Soil Piles along Little Bayou Creek, including piles AR and O (AOC 492 and a portion of AOC 541). Also of note is that Kentucky Research Consortium for Energy and Environment performed a real-time demonstration at AOC 492 during 2008 that included field sampling and removal of approximately 18 yd^3 of soil.

Historical research was performed to attempt to determine the origin of the piles and in response to EPA's previous request for soil and rubble area information pursuant to RCRA 3007. The origin of the Addendum 1-B Soil Piles remains unknown; however, available information indicates that many of the

PGDP-related soil piles may have originated from excavations associated with the creation, periodic dredging, and cleanout of the outfalls, ditches, and creeks that comprise the PGDP surface water management system. The Addendum 1-B Soil Piles are not operational.

2. AREA DESCRIPTION

2.1 ADDENDUM 1-B SOIL PILES

Field reconnaissance of Addendum 1-B Soil Piles identified 40 piles along Little Bayou Creek. The majority of the soil piles are located east of PGDP industrialized area and are on DOE-owned property. The soil piles are distributed along Little Bayou Creek and generally are bounded by PGDP industrialized area to the west, the West Kentucky Wildlife Management Association (WKWMA)/DOE boundary to the east, and the DOE boundary to the north and south. See Figure 1 in Section 1 for a map of the piles.

The Addendum 1-B Soil Piles vary in size and shape, ranging from approximately 5 to 250 ft in length and from 1 to 10 ft in height. The soil piles are widely dispersed and often occur as clusters. Vegetative regrowth on and adjacent to the piles is very dense, indicating the soil piles have been in their present locations for years. Unlike soil pile I (Addendum 1-A), improvements that may have supported the creation of soil piles (e.g., road improvements) are not visible along the Addendum 1-B Soil Piles.

2.2 GEOLOGY AND SOILS

The PGDP and Addendum 1-B Soil Piles are located in the Jackson Purchase Region of Western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain. The Jackson Purchase Region is an area of land that includes all of Kentucky west of the Tennessee River. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock.

Relative to the shallow groundwater flow system in the vicinity of the PGDP, the continental deposits and the overlying loess and alluvium are of key importance. The continental deposits locally consist of an upper silt member, with lesser sand and gravel interbeds, and a thick, basal sand and gravel member, which fills a buried river valley. A subcrop of the Porters Creek Clay, located beneath and immediately south of the PGDP marks the south extent of the buried river valley. Fine sand and clay of the McNairy Formation directly underlie the continental deposits. These continental deposits are continuous from beneath PGDP to beyond the present course of the Ohio River.

The general soil map for Ballard and McCracken counties indicates that three soil associations are found within the vicinity of the PGDP (USDA 1976): the Rosebloom-Wheeling-Dubbs association, the Grenada-Calloway association, and the Calloway-Henry association. The predominant soil association in the vicinity of the PGDP is the Calloway-Henry association, which consists of nearly level, somewhat poorly drained, medium-textured soils on upland positions.

Although the soil over most of the PGDP may be Henry silt loam with a transition to Calloway, Falaya-Collins, and Vicksburg away from the site, many of the characteristics of the original soil have been lost due to industrial activity that has occurred over the past 50+ years. Activities that have disrupted the original soil classifications include filling, mixing, and grading.

2.3 SURFACE WATER AND GROUNDWATER HYDROGEOLOGY

PGDP and Addendum 1-B Soil Piles are located in the western portion of the Ohio River drainage basin, approximately 15 miles downstream of the confluence of the Ohio River with the Tennessee River and

approximately 35 miles upstream of the confluence of the Ohio River with the Mississippi River. Locally, the PGDP is within the drainage areas of the Ohio River, Bayou Creek (also known as Big Bayou Creek), and Little Bayou Creek.

PGDP is situated on the divide between the two creeks. Surface flow is east-northeast toward Little Bayou Creek and west-northwest toward Bayou Creek. Bayou Creek is a perennial stream on the western boundary of the plant that flows generally northward, from approximately 2.5 miles south of the plant site to the Ohio River. Little Bayou Creek becomes a perennial stream at the east outfalls of PGDP. The Little Bayou Creek drainage originates within WKWMA and extends northward and joins Bayou Creek near the Ohio River. The drainage basins for both creeks are located in rural areas; however, they receive surface drainage from numerous swales that drain residential and commercial properties, including WKWMA, PGDP, and Tennessee Valley Authority Shawnee Steam Plant. The confluence of the two creeks is approximately 4.8 km (3 miles) north of the plant site, just upstream of the location at which the combined flow of the creeks discharges into the Ohio River (DOE 2006).

Most of the flow within Bayou and Little Bayou Creeks is from process effluents or surface water runoff from PGDP. Contributions from PGDP comprise approximately 85% of flow within Bayou Creek and 100% of flow within Little Bayou Creek. A network of ditches discharges effluent and surface water runoff from PGDP to the creeks. Plant discharges are monitored at the Kentucky Pollutant Discharge Elimination System (KPDES) outfalls prior to discharge into the creeks.

The local groundwater flow system at the PGDP site occurs within the sands of the Cretaceous McNairy Formation, Pliocene Terrace Gravel, Plio-Pleistocene lower continental gravel deposits and upper continental deposits, and Holocene alluvium. The primary local aquifer is the Regional Gravel Aquifer (RGA). The RGA consists of the Quaternary sand and gravel facies of the lower continental deposits and Holocene alluvium found adjacent to the Ohio River and is of sufficient thickness and saturation to constitute an aquifer. These deposits have an average thickness of 9.1 m (30 ft), and range up to 15.24 m (50 ft) along an axis that trends east–west through the plant site. The RGA is the primary local aquifer. Groundwater flow is predominantly north toward the Ohio River (Clausen 1992).

2.4 POTENTIAL SOURCES OF CONTAMINATION

The following provides an evaluation of potential transport mechanisms for contaminants found at PGDP. Figure 2 provides an overview of the PGDP industrial complex and the associated surface water management system.

2.4.1 Contaminant Transport Mechanisms

Transport mechanisms likely include both dissolved constituents and sediment in storm water runoff.

The PGDP surface water management system discharges to Little Bayou Creek through several outfalls.

Figure 2 illustrates where outfalls discharge relative to PGDP. An investigation was conducted for on-site areas for the Surface Water Operable Unit (SWOU). Transport modeling of contaminant sediment found in Outfalls 002, 010, 011, 012, and 013, completed as part of the SWOU on-site investigation, concluded that migration through surface water would not result in unacceptable risk to recreational users of Little Bayou Creek. Ongoing monitoring supports this conclusion (DOE 2006).

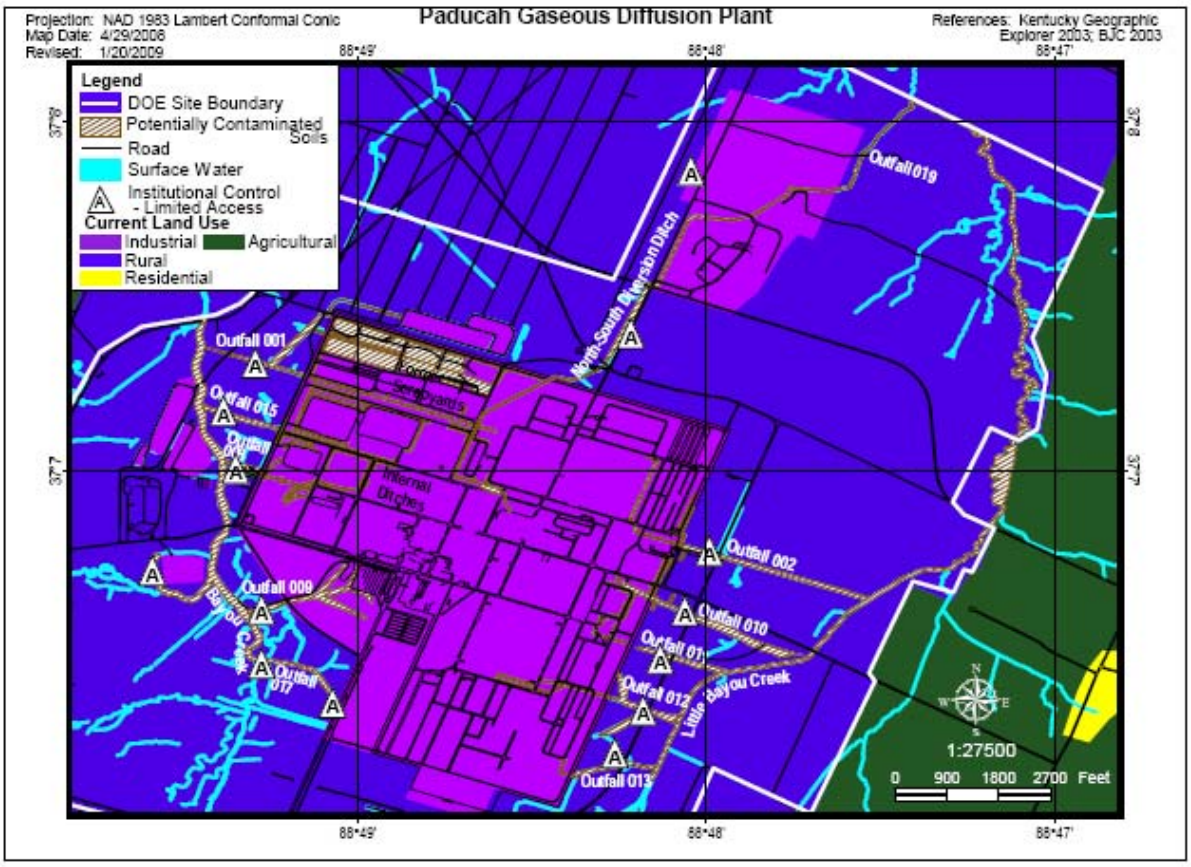

Figure 2. PGDP Outfall Locations

2.4.2 Documented Releases/Spills

Possible contaminant sources to Little Bayou Creek may include releases resulting from surface water runoff, originating at spill or release sites inside the PGDP industrial complex, prior to their remediation. These include releases documented in the following reports or logs:

- Occurrence Reporting and Processing System (ORPS) spanning from approximately 1990 to the present,
- Plant shift superintendent (PSS) logs spanning from 1984 through 1990, and
- Annual Site Environmental Reports (ASERs) from 1984 through 2006.

The RCRA 3007 request information, occurrence reports and document summary forms from the PSS logs provide a description of the spills and releases and contain pertinent information such as the date and time of release, known or suspected contaminants, estimated quantities of material(s) released, and a description of the actions taken.

The types of chemicals involved in historical spills and releases contained in the ORPS include PCBs, recirculated cooling water containing chromium, chilled chromated water, landfill leachate, gasoline and

diesel fuel, and various oils. The types of spills and releases documented in the PSS logs include PCBs, recirculated cooling water, trichloroethene (TCE), sanitary waste water, chromated water, paint pigment, gasoline, diesel, miscellaneous oil, uranium, technetium-99, and observed oil sheens in the outfall discharges. Spills and releases reported in the Annual Site Environmental Reports (ASERs) include recirculated cooling water, chilled water, TCE, battery acid, transformer oil, diesel fuel, soda ash, and landfill leachate.

2.5 SUMMARY OF RECENT ENVIRONMENTAL MONITORING RESULTS

Little Bayou Creek is subject to routine environmental monitoring under DOE Order 450.1 (previously DOE Order 5400.1). The KPDES Permit and DOE Orders, respectively, identify the discharge limits and monitoring requirements for surface water. Monitoring data indicate there have been no recent (2000 to present) releases that could result in unacceptable risk to human health and the environment through the PGDP surface water drainage system and that surface water and sediment transport presently are not acting as a source of contamination to Little Bayou Creek.

3. FIELD AND ANALYTICAL METHODS

3.1 ADDENDUM 1-B SOIL PILES SAMPLING APPROACH

The Addendum 1-B Soil Piles sampling approach was designed to accomplish the project objectives. This approach is detailed in the DOE-, EPA-, and Kentucky-approved SAP and Addendum 1-B. A summary of the sampling approach and other field activities is provided in the following sections.

3.1.1 Systematic Sampling

The Addendum 1-B Soil Piles were divided into two groups: small and large. Soil piles whose length and width are less than or equal to 30 ft were classified as small; soil piles whose length or width are greater than 30 ft were classified as large. A systematic sampling approach was implemented for small soil piles, and a systematic random sampling approach was implemented for large soil piles. Piles AR and O (AOC 492 and a portion of 541) were sampled using a systematic approach using a smaller grid spacing of 10 ft. These approaches were designed to ensure sampling results were sufficient to determine the concentration and distribution of constituents throughout the study area. Natural grade was determined in the field by noticeable differences in soil types (soil color, soil texture). This was consistently noted where the soil pile interfaces with the surrounding grade. During planning, grade typically was established by measuring the pile height to the ground surface in the field and verified by noting the increase in the number of times the sample sleeve and associated tool were driven.

Each small soil pile was sampled at a single location from the tallest portion of the pile. Each large pile was sampled using a grid with 50-ft spacing. For both small and large piles, surface samples were collected from 0-1 ft followed by subsurface samples collected vertically at 3-ft intervals starting at the 1 ft level (1-4, 4-7 if required) and extending down to the interface with natural grade.

For all piles, all samples underwent field analyses, and a minimum of one surface and one subsurface sample per pile was sent for fixed-base laboratory analyses (if fewer than 10 samples were collected from a pile, then a minimum of two samples was sent to the fixed-base laboratory). Additionally, if more than 10 samples were collected from a pile, then, at a minimum, 10% of the samples underwent fixed-base laboratory analyses. The samples undergoing fixed-base laboratory analyses subject to this 10% rule were randomly selected from all samples collected.

Field methods included RCRA metals and uranium analysis by *ex situ* X-ray fluorescence (XRF) spectrometer, *ex situ* radioactivity measurements using *In Situ* Object Counting System (ISOCS), PCBs using immunoassay/colorimetric test kits, and a demonstration of polycyclic aromatic hydrocarbon (PAH) test kits, which also employ immunoassay/colorimetric techniques.[1] The analyte list for fixed-base laboratory analyses includes the metals and radionuclides on the list of significant COPCs in the PGDP Risk Methods Document (DOE 2001), PCBs, and PAHs.[2,3]

[1] Field PAH analyses were completed on only those samples submitted for fixed laboratory analyses to determine their efficacy for deployment at PGDP on future projects.
[2] PAHs were analyzed in samples sent to the fixed-base laboratory to allow comparison with results from field test kits. The results of the PAH analyses will be used to support the use of field methods in future PGDP projects.
[3]Volatile organic compounds (VOCs) are not included in the analyte list for the fixed-base laboratory because VOCs were not detected in Soil Pile I samples at concentrations above no action risk-based screening values. Additionally, neither TCE nor trichloroethane was detected in samples collected at Soil Pile I.

3.1.2 Contingency Sampling

The Addendum 1-B Soil Piles sampling approach also included provisions for contingency sampling (up to 50 samples) to allow for the collection of data for unexpected field conditions or to augment project data based on real time results.

Based upon the data results, 28 contingency samples were collected. Consistent with the requirements of the SAP, 28 locations were identified for further sampling once data were evaluated for the soil piles and a determination was made that contamination exceeded background and no action screening levels. Contingency sample locations were spaced 20 ft from where the original contamination was identified with samples collected every 3 ft down to grade.

3.1.3 Sampling Summary and Deviations from the SAP

The following provides the planned sampling activities for Addendum 1-B Soil Piles and an accounting of the actual number and types of samples collected. Addendum 1-B to the PGDP Soil Piles SAP specified the collection and analysis of these samples:

- Sixty-three surface samples (19 at small piles, 19 at large piles and 25 at AOC 492 and soil pile O within AOC 541) to undergo field measurements and fixed laboratory analysis;
- Three hundred twenty surface samples (19 small pile locations, 53 large pile locations and 248 at AOC 492 and soil pile O within AOC 541) to undergo field measurements only;
- Sixty-five subsurface samples (19 small pile locations, 21 large pile locations and 25 at AOC 492 and soil pile O within AOC 541), where subsurface is defined as soil taken at a depth below 1 ft, to undergo field measurements and fixed laboratory analysis;
- Four hundred subsurface samples ([22 small pile locations, 130 large pile locations and 248 at AOC 492 and soil pile O within AOC 541) to undergo field measurements only;
- A number of contingency samples (no more than 50), as determined by subject matter experts at the time of field activity.

During execution of Addendum 1-B, the total number of soil samples collected was as follows:

- Sixty-five surface samples underwent field measurements and fixed laboratory analysis
- Two hundred fifty-five surface samples underwent field measurements only
- Sixty-four subsurface samples underwent field measurements and fixed laboratory analysis
- Two hundred seventeen subsurface samples underwent field measurements only
- Twenty-eight contingency samples were collected
- In addition, 58 samples (31 surface and 27 subsurface) were collected from a new pile identified as K013 near outfall 013

- Eleven additional biased samples were collected from the surface soil of six soil piles previously sampled.

The differences between planned and actual sample numbers resulted from five factors:

- The observed differences in subsurface samples result entirely from variations in soil pile height. Because the soil pile height, on average, was less than 6 ft, fewer subsurface samples were required to reach the natural grade.

- Fewer samples were required because the pile dimensions varied in length, width, or both.

- Subsurface samples were not collected within soil pile O of AOC 541 if the surface sample did not indicate contamination and the location was not a soil pile. All soil pile locations within AOC 541 were sampled to grade.

- A new pile, K013 was identified after the SAP was approved (pile No. 41).

- Another deviation from the SAP includes contingency samples not being collected for all piles.

- Additional biased samples were collected for radiological constituents and PCBs where radiological surveys indicated potential contamination.

3.1.4 Fixed Laboratory Analysis

As noted, a total of 65 surface soil samples and 64 subsurface soil samples underwent fixed laboratory analysis. Each was analyzed in accordance with the method requirements outlined in Table 1 with the exception that four samples were randomly selected for waste characterization (ignitability, reactivity, corrosivity, paint filter, and moisture) in case a removal action was required. An additional 11 surface soil samples underwent fixed laboratory analysis for radiological constituents and PCBs.

3.1.5 Field Analysis

All of the surface and subsurface samples collected for Addendum 1-B Soil Piles underwent field analysis. The total field analysis included 320 surface samples and 281 subsurface samples plus 28 contingency samples for the 40 piles. In addition, 58 total samples (31 surface and 27 subsurface samples) were collected from the recently identified K013 pile. Field measurements included the following:

- RCRA metals and uranium using an XRF spectrometer
- Gamma radionuclides using a Canberra® ISOCS (*ex situ*)
- PCBs using Hach® immunoassay sample extraction and colorimetric analysis methods
- PAHs using RaPID Assay® immunoassay sample extraction and colorimetric analysis methods

Both fixed laboratory and field results for the Addendum 1-B Soil Piles Investigation are provided on a CD in Excel format. It should be noted that field screening methods used may not always have achieved detection limits below background due to limitations of the screening method.

Table 1. Fixed Laboratory Analysis Requirements for Soils

Characterization Parameters	Analytical Method	Detection Limit/ Minimum Detectable Activity
PAHs	SW846-8270	360—990 µg/kg
PCBs (Aroclors/Total)	SW846-3540/8082	40—1,290 µg/kg
Inorganic Target Analyte List (Total Metals)	SW846-6010B or SW846-6020	
^{241}Americium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.0098—0.0669 pCi/g
^{241}Americium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0181—0.0225 pCi/g
^{137}Cesium	Gamma Spectroscopy Nitric Only Digestion (RL-7124)	0.0124—0.207 pCi/g
^{237}Neptunium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.008194—0.145 pCi/g
^{237}Neptunium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0182—0.0385 pCi/g
^{238}Plutonium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.008171—0.18 pCi/g
^{238}Plutonium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0124—0.0137 pCi/g
$^{239/240}$Plutonium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.00861—0.0431 pCi/g
$^{239/240}$Plutonium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0107—0.0139 pCi/g
^{99}Technetium	Liquid Scintillation Nitric Only Digestion (RL-7128)	0.416—2.54 pCi/g
^{228}Thorium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.02—0.208 pCi/g
^{228}Thorium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.156—0.217 pCi/g
$^{230/232}$Thorium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.003—0.236 pCi/g
^{230}Thorium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.131—0.197 pCi/g
^{232}Thorium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0713—0.149 pCi/g
Total Uranium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0—0.827 pCi/g
Total Uranium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.228—1.5 pCi/g
^{234}Uranium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.01—0.4 pCi/g
^{234}Uranium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0999—0.671 pCi/g
^{235}Uranium radioactivity	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.01094—0.26 pCi/g
^{235}Uranium radioactivity	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.0136—0.127 pCi/g
^{238}Uranium	Alpha Spectroscopy Nitric Only Digestion (RL-7128)	0.004—4 pCi/g
^{238}Uranium	Alpha Spectroscopy Hydrofluoric Acid Digestion (RL-7128)	0.114—0.701 pCi/g

Table 1. Fixed Laboratory Analysis Requirements for Soils (Continued)

Characterization Parameters	Analytical Method	Detection Limit/ Minimum Detectable Activity
Total Uranium	SW846-6020 ICP-MS	1 mg/kg
Arsenic	SW846- 6020[1]	0.848—18.9 mg/kg
Barium	SW846-6010B[1]	2—11.6 mg/kg
Cadmium	SW846- 6020[1]	0.05—2.49 mg/kg
Chromium	SW846-6010B[1]	1—5.8 mg/kg
Lead	SW846- 6020[1]	0.3—18.9 mg/kg
Mercury	SW846-7471[1]	0.011—0.099 mg/kg
Selenium	SW846- 6020[1]	0.5—18.9 mg/kg
Silver	SW846-6010B[1]	0.2—2.49 mg/kg
Ignitability	SW846-1010	
Reactivity Cyanide	SW846-9014[1]	
Reactivity Sulfide	SW846-9034[1]	
Corrosivity to Steel	SW846-1110	
Paint Filter Test	SW846-9095B	
%Moisture/%Solid	ASTM D2216-98	

ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency
[1] Toxicity Characteristic Leaching Procedure analyses will be performed only if Underlying Hazardous Constituents exceed 20 times the TCLP limit as specified in 40 *CFR* § 261.24.

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4. QUALITY ASSURANCE/QUALITY CONTROL

4.1 DATA QUALITY/DATA USABILITY

The following sections summarize the results of data verification, data validation, reconciliation of measurement quality objectives (MQOs), and the comparisons of field and laboratory data obtained from the Addendum 1-B Soil Piles investigation.

4.1.1 Precision

Precision is the measure of agreement or reproducibility between individual measurements for the same property under the same analytical conditions.

Precision for Addendum 1-B Soil Piles data was measured based on the performance of field split samples, laboratory duplicate samples, laboratory matrix spike (MS), and matrix spike duplicate (MSD) pairs.

Note: Precision does not affect the quality or usability of organic analyses whose precision is measured by MS/MSD pairs. As the SAP notes, precision results do not impact on PCBs, semivolatile organic compounds (SVOCs), or volatile organic compounds (VOCs) in terms of data quality/data usability. Where performance criteria for precision are exceeded, there is less confidence in the reported result because of error introduced from sampling or analysis caused by unequal representation of target compounds or analytes between the two sample pairs.

The SAP required that a minimum of 9 of 10 samples (90%) for each analysis type meet method prescribed precision criteria. Based on the data received from the fixed base laboratory, each analysis met their goal.

4.1.2 Accuracy

Accuracy is the comparison of a known quantity of a reference standard to the value measured during analysis. Accuracy for Addendum 1-B Soil Piles data was assessed by evaluating the performance of the following quality control standards designed to monitor accuracy during sample preparation and analysis.

- Laboratory control samples
- Radioactive tracers
- MS
- MSDs
- Surrogate compounds

The SAP required that a minimum of 9 of 10 samples (90%) for each analysis type meet method/PGDP prescribed accuracy criteria. Based on the data received from the fixed-base laboratory, each analysis met its goal.

4.1.3 Completeness

Completeness is defined as the number of valid data points obtained from a sampling effort, compared with the total number of data points obtained. Valid data are those generated when analytical systems and the resulting analytical data meet all of the quantitative measurement objectives for the project.

The SAP required that a minimum of 9 of 10 samples (90%) for each analysis type meet completeness criteria. Based on the data received from the fixed-base laboratory, each analysis met this goal.

4.1.4 Detection Limits

To ensure the fixed laboratory data acquired from Addendum 1-B Soil Piles supports the DQOs, method detection limits (MDLs), or minimum detectable concentrations (MDCs) when referring to radiological results, were pre-established for each analysis type and defined in the laboratory statement of work. The contract required detection limits in the SAP were to be attained if possible; if not, the MDLs/MDCs were to be low enough to compare to background. The MDLs/MDCs were designed to ensure that sufficiently sensitive data were obtained from the contract laboratories to enable comparison to background and other action/no action levels.

For field analytical methods, method sensitivity was a variable determined during the project. Field MDLs were determined in accordance with manufacturer analytical protocols. The field analytical methods do not achieve the same level of sensitivity as fixed-base laboratory methods; however, sufficient sensitivity was achieved for each method to support/direct field activities should actions be necessary at Addendum 1-B Soil Piles.

Reporting limits received from the laboratory were reviewed by project personnel and considered acceptable for meeting the DQOs for this project; however, it should be noted that for some field analyses (e.g., uranium-238 using ISOCs), the field instrument utilized did not achieve background levels (uranium-238 results of 2 pCi/gm versus background results near 1 pCi/gm).

4.1.5 Comparability

Comparability is the degree to which one data set can be compared to another, when both are obtained from the same sample population. Comparability can be achieved only through the use of consistent sampling procedures, experienced sampling personnel, the same or comparable analytical methods, standard field and laboratory documentation, and traceable laboratory standards.

Because the samples were collected from nearly identical locations, samplers employed similar sampling techniques, and similar analytical methods. As a result, the data are comparable.

4.1.6 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represents the characteristics of a population at a sampling point, process condition, or environmental condition. Representativeness is a qualitative term used to determine if sample measurements and physical sample locations result in data that appropriately reflect the population parameter of interest in the media and phenomenon measured or studied.

The data provides a good representation of the environmental conditions of Addendum 1-B soil piles based upon data verification, validation, and assessment.

4.1.7 Field Quality Control Summary

Field quality control (QC) samples are independently generated samples from a pre-defined sampling scheme, designed to monitor the reproducibility, cleanliness, and accuracy of the sampling and analytical process. The following are the field QC samples prescribed for the Addendum 1-B Soil Piles investigation:

- Field split samples
- Field blanks
- Equipment rinseate blanks

QC samples were required for Addendum 1-B at a frequency of 1 QC sample for every 20 samples collected or 5%. The collection frequency for QC samples applied to all samples, whether undergoing field analysis or fixed laboratory analysis.

Field split samples were collected and analyzed to evaluate the reproducibility (precision) of sampling techniques, laboratory methods, and to monitor the natural variability of the sample matrix. Field samples were submitted as separate samples with field identification numbers to the contract laboratory. The prescribed collection frequency was met with field split samples collected and analyzed at a minimum frequency of 5% for the investigation.

Field blanks were collected and analyzed to evaluate any cross contamination attributable to field methods including sample container handling. The prescribed frequency of four field blanks as required in the SAP was met.

Addendum 1-B required that field rinseate blanks be collected and analyzed where subsurface samples were collected and sampling equipment was decontaminated and reused. Field rinseate blanks provide a measure of cross-contamination attributable to field equipment decontamination procedures. The prescribed frequency of four equipment rinseates as required in the SAP was met.

In summary, field, trip, and rinseate blanks were analyzed to verify the cleanliness of the sampling, decontamination, and the overall analytical process. Each is designed to monitor at least one aspect of the process, with all providing meaningful information as to the reliability of low-level contaminant results. All field blank results were acceptable, with the exception of two samples indicating detects of PCBs. These detects were found to be from contamination within the laboratory. All equipment rinseate blank results were found to be acceptable.

4.1.8 Data Quality Summary/Fixed Laboratory Data

As stated, the DQOs for the Addendum 1-B Soil Piles investigation were to acquire sufficient data of known quality to support decision making. Experienced and properly trained field personnel were utilized to execute the sampling and operating procedures. Project samples were collected, preserved, handled, and shipped in accordance with the SAP, industry, and PGDP standard procedures, although temperature exceedances of some samples were noted and documented. Reputable analytical laboratories using industry standard analytical procedures were utilized to generate sample data that complies with the requirements of the laboratory statements(s) of work and specified protocols. No data were rejected during data validation or data assessment.

Project data underwent 10% Level C validation, with all data undergoing verification. Precision, accuracy, and completeness criteria were met for all fixed-base laboratory data indicating the data set will support decision making.

4.1.9 Data Quality Summary/Field Analytical Data

Each of the field techniques employed for the Addendum 1-B Soil Piles investigation utilized QC measures to monitor the accuracy, precision, and drift of the method during use. QC samples for PAH analyses was performed according to manufacturer instructions, which included three standards (2 ppb, 10 ppb, and 50 ppb) run in replicate, one control (blank), and one negative control that was run in replicate. The following summarizes the results of XRF, PCB, and ISOC QC analysis.

4.1.9.1 XRF

To support field XRF analysis, three types of QC samples were analyzed with each batch of 20 samples. These included (1) blanks, (2) duplicates, and (3) standard reference materials (SRMs). The XRF blank was vendor-provided, consisting of silica-certified clean for use as a blank.

Blank results for XRF analysis showed no positive detections during execution of the investigation for those parameters such as uranium. Precision for XRF duplicates was < 35% relative percent difference (RPD) for all field-laboratory duplicates.

Three SRMs were analyzed daily to monitor XRF accuracy. They represent low [National Institute of Standards and Technology (NIST) 2709], moderate (NIST 2711), and high (NIST 2710) level standards for soil analysis for metals. SRM performance was mixed for the three standards, with the low-level standard performing well for lead and barium, and moderately well for arsenic. The low concentrations for the remaining metals were outside the operating range of the XRF (below the MDL).[4] The mid-range standard performed well for barium and lead, with moderate performance for arsenic, zinc, and cadmium. The high-end standard performed very well for arsenic, barium, uranium,[5] and lead. The remaining metals concentrations were below the MDL for the XRF.

4.1.9.2 Field PCBs

To support field PCB analysis, three types of QC samples were analyzed with each batch of 20 samples: (1) blanks, (2) duplicates, and (3) calibration verification standards. The following summarizes QC performance.

- No positive detections were noted in any of the PCB method blanks.
- Precision for PCB duplicates was < 35% RPD for all field-laboratory duplicates.
- All calibration verifications had recoveries within 90–110%.

4.1.9.3 ISOCS

To support *ex situ* field ISOCS analysis, two types of QC samples were analyzed daily. Daily checks included 1) a background and 2) a NIST traceable calibration/check source.

Background results for ISOCS analysis were all within acceptable limits (i.e., 2 sigma of weekly background). In addition to daily QC checks, a chamber background count was performed weekly for

[4] Selenium was not added to any of the standards.
[5] Chromium and uranium levels for the NIST SRMs are not certified values.

a predetermined count time. The predetermined background count time was equal to or greater\ than the sample count time. The weekly background count is used for background subtraction in the activity calculation. An accurate representation of the background for the detector is necessary to produce high quality sample results.

The NIST traceable calibration/check source consists of a mixed radionuclide with gamma peaks that cover the range (i.e., low, mid, high) of detections, generally 59 keV to 2,000 keV. All daily check source results for ISOCS analysis were within acceptable limits (i.e., 2 sigma).

4.1.10 Summary

Comparison of data obtained from the Addendum 1-B soil piles investigation indicates field methods can continue to be used to support investigation planning, to identify locations where contamination is present, and to serve as a verification tool during remediation activities. The field and lab data was assessed to determine the usability of the data. A comparability analysis of field data (XRF and PCB test kits) versus lab data was performed during the Site Evaluation for Soil Pile I and established that the XRF and PCB test kits could be utilized for supporting investigations and verification sampling. Also, similar to Addendum 2 data, PAHs were mostly nondetect for Addendum 1-B soil piles.

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5. DISCUSSION AND RESULTS

The following section presents and evaluates the results for the Addendum 1-B Soil Piles investigation. It includes a discussion of the conceptual site model (CSM) as it was defined for investigation planning and a discussion of findings. This section also provides data screening versus PGDP decision levels.

5.1 CONCEPTUAL SITE MODEL

The following description of the CSM is taken from the PGDP soil piles SAP (DOE 2007a). It summarizes the expected receptors and exposures for Soil Pile I; however, it also applies to others including Addendum 1-B soil piles. See Figure 3 for the CSM representation.

Recreational activities known to take place in and around the PGDP soil piles include the following:

- Bow hunting
- Field trials (horses and dogs)
- Other recreational uses (e.g., hiking)

Recreational user exposure to surface soils is the primary exposure pathway. The recreational user could be exposed to contaminants through contact with surface soils through the following exposure routes:

- External exposure to ionizing radiation
- Dermal contact
- Incidental ingestion
- Inhalation

Recreational user exposure to surface soils through the dermal contact, incidental ingestion, and inhalation likely is limited, given that most soil piles and soils in the adjoining areas are covered by continuous vegetation. Industrial worker exposure would be similar for nonintrusive activities.

Addendum 1-B Soil Piles are located adjacent to Little Bayou Creek. This proximity to surface water drainage areas could have resulted in potential secondary exposure routes that could impact human health and the environment. The majority of the secondary routes assume the soils or contaminants they contain have been released to adjacent waterways or moved through the food chain.

Precipitation could result in contaminant migration from the soil piles if contaminated; however, PGDP historical monitoring data indicate little if any migration is occurring. Further, data presented in this SER indicate contaminants do not exist and are not migrating away from Addendum 1-B Soil Piles.

The majority of the contaminants analyzed for samples collected at Addendum 1-B Soil Piles do not bioaccumulate in plants or trees to a great degree. As a result, plant or tree uptake and corresponding accumulation in animal tissue is unlikely, but soil ingestion as part of normal feeding activities likely is a complete pathway. Ecological receptors also may be exposed to on-site contaminants; however, the primary focus of the characterization effort is to determine risks to human health.

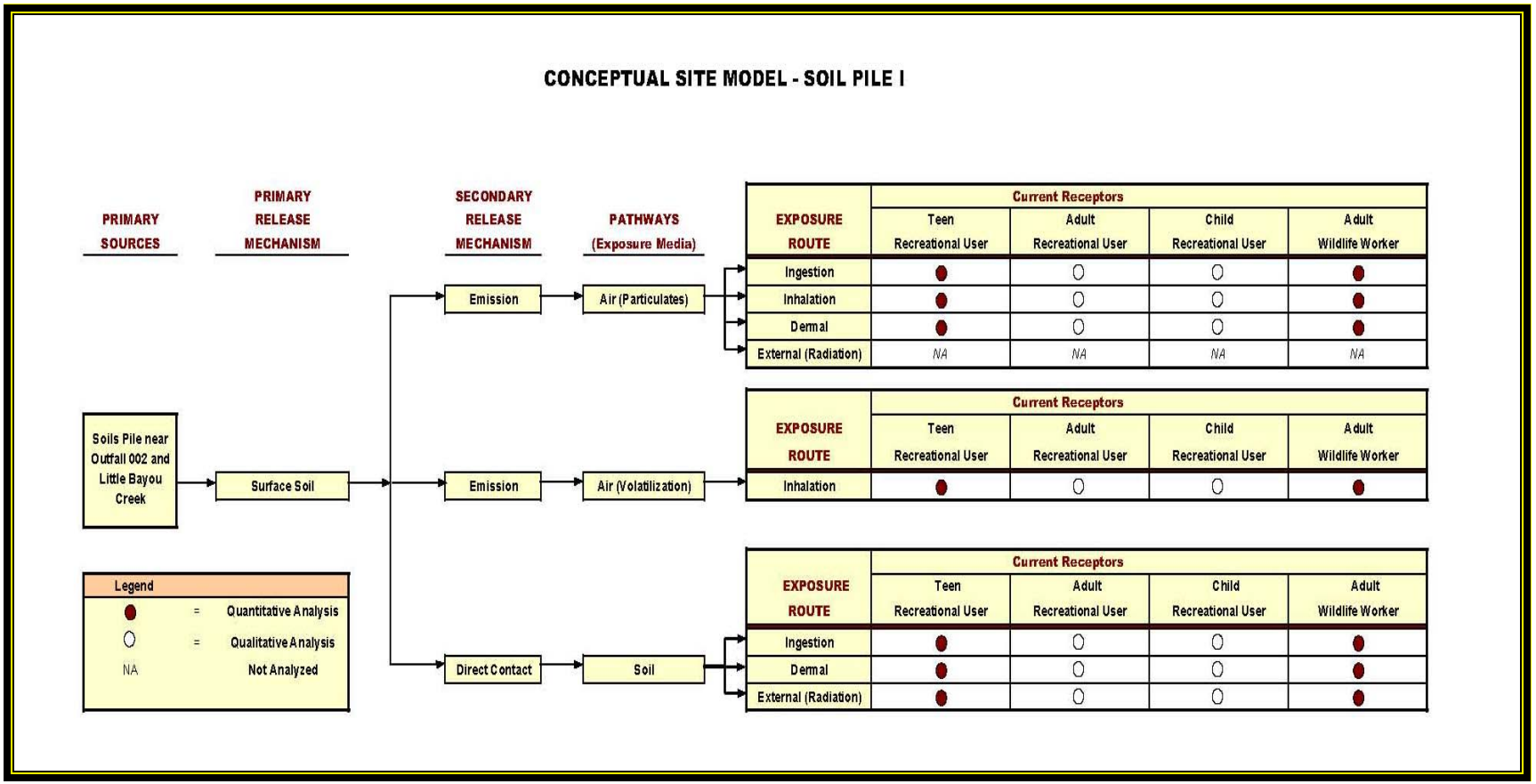

Figure 3. Conceptual Site Model for Soil Piles

5.2 EXAMINATION OF SAMPLE POPULATIONS

As part of project planning, the Addendum 1-B Soil Piles operating hypothesis for investigative purposes was that each pile likely represents a unique population, in terms of contaminant type, concentrations, and distribution. To examine this hypothesis, the data from each pile was examined to determine if individual sample populations were present. Following this examination, each pile was compared with all the other piles to determine if any/all were the same population.

The comparison indicates that likely there are three populations of piles. The first consists of those piles with levels similar to background. The second consists of those piles with levels above background (piles 20, C, D, F, G, H, J, P, AT, BW, and K013), which are included in the Appendices and have SWMU Assessment Reports presented. The third population includes soil pile O within AOC 541, which has contamination levels similar to those seen in 2002, which exceed action levels.

See Appendix B for data and Appendix C for sample locations.

5.3 SURFACE DISTRIBUTION OF CONTAMINANTS

The step in examining project data from Addendum 1-B Soil Piles was to perform a data screening, designed to establish which constituents will be retained for further consideration as COPCs. The data screening steps employed for Addendum 1-B Soil Piles include the following:

- Comparison of maximum contaminant concentrations to PGDP background levels for soils (where applicable) and
- Comparison of contaminant concentrations to established teen recreational user no action levels (NALs).[6]
- Comparison of contaminant concentrations to established child resident NALs.[6]

See Section 6 for further discussion of the data screening.

Uranium (surface soil only) field results using a sodium iodide detector were compared to fixed-base laboratory results at a select few of the piles with uranium-238 detections (see Table 2). This comparison was performed to determine variability and if there is a trend or any correlation between the field and lab results. There is variability in the results with limited correlation as noted below. Additional information is recommended to be collected for future projects to determine if there are better methodologies that can be implemented to provide better correlation.

[6] No Action Levels were taken from the PGDP Risk Methods Document (DOE 2001).

Table 2. Comparison of Uranium-238 Results

Soil Pile	Average CPM	High CPM	Low CPM	U-238 Lab Result (pCi/g)	U-238 Lab Result Contingency (pCi/g)	U-238 Lab Result Additional Sampling (pCi/g)
20	10,225	10,905	9,796	2.76		
AT	15,500	23,000	12,000	8.33	5.27	
H	9,161	10,625	7,777	10.9		
J	10,763	30,617	7,566	37.3	42.1	
BW	10,244	10,985	9,662	1.38		
D	9,488	13,673	7,529	1.67		
16	11,932	13,437	10,217	0.283		
17	12,199	13,305	10564	0.288		
18	12,208	13,229	11,052	0.258		
19	10,419	10,922	9,783	0.765		
21	17,987	19,947	15,790	0.307		
A	9,591	10,027	9,146	0.561		
AOI13	9,923	10,918	8,739	0.101 (U)		
AR	14,745	36,524	7,170	0.273		
AS	9,155	9,859	8,162	0.59		
AU	9,366	10,148	8,294	0.0842 (U)		
AV	8,148	10,290	6,129	0.137		0.509
AW	8,169	9,460	6,153	0.75		
AX	7,831	9,602	5,865	0.456		
B	9,413	9,961	8,780	0.0242 (U)		
BR	12,019	13,523	10,858	0.486		
BU	10,026	10,882	9,426	0.138		
BV	13,318	16,974	10,990	0.373		17.4
BY	15,014	17,162	9,976	0.0254 (U)		
BZ	17,319	20,362	15,225	0.222		1.17
C	9,858	23,456	6,812	2.73		
CA	15,771	16,512	14,588	0.0808 (U)		
CB	16,034	18,569	7,279	0.211		1.14
CC	10,578	13,560	6,248	0.184		1.49
CD	12,258	13,381	11,247	0.198		
CE	12,352	14,420	10,657	0.126		
CF	11,498	12,446	10,136	0.343		
E	13,922	30,446	8,998	0.0478 (U)		581
F	12,223	19,053	9,106	2.99		
G	8,859	10,803	6,346	2.24		
K	15,180	33,909	9,403	0.119		
*K013	*6,997	*14,130	*3,284	0.989		
L	9,632	10,563	8,669	0.543		
M	9,415	11,139	8,221	0.476		
N	7,659	8,763	6,528	0.336		
P	9,093	9,670	8,596	1.84		

(U) = Data is laboratory-qualified as a nondetect.
* Shielded probe was used at this location due to shine from adjacent cylinder yard.

6. DATA SCREENING

This data screening used data collected in the fall of 2008 from Addendum 1-B Soil Piles. The principal objective of this screening is to inform risk managers in support of decision making for the site. Key considerations include the following:

- Determine whether all or portions of the study area may be eliminated from concern.
- Identify where risk characterization suggest actions may be needed.
- Determine whether additional data gathering and/or risk assessments are warranted.

The data screening provides information to the stakeholders based on Commonwealth of Kentucky and nationally accepted risk assessment methods. These objectives are consistent with the goals, objectives, and requirements identified in the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant Paducah, Kentucky,* Volume 1*, Human Health* (DOE 2001).

The scope of the Addendum 1-B Soil Piles data screening is to assess risks to human receptors who, through use of the Addendum 1-B Soil Piles area, may be exposed to chemicals or radionuclides through normal use of the site. This data screening does not examine ecological risks.

6.1 METHODOLOGY

The following describes the process used to develop the data screening activity.

6.1.1 Data Screening

Following background comparisons, those contaminants retained were evaluated for comparison to other criteria as described below.

Data collected as part of Addendum 1-B Soil Piles sampling was screened first against PGDP background values. These values are documented in DOE 2001. Screening against other values representing the range of background (i.e., additional background information) also was used to determine whether a chemical exceeded background in order to better focus on chemicals presenting potential concern for the soil piles. Additional background information included the generic statewide ambient background value available in Kentucky Natural Resources and Environmental Protection Cabinet (now known as Kentucky Energy and Environment Cabinet) guidance (KNREPC 2004) for metals and values expected from global fallout for radionuclides (ANL 2007).

Secondly, maximum concentrations were compared to the PGDP Risk Methods Document and site-specific health guidelines. To complete this evaluation, NALs for the teen recreational use scenario listed in Table A-17 of the Risk Methods Document (DOE 2001) were used for comparisons with maximum concentrations. Site-specific action levels (ALs) and NALs for the teen recreational use scenario and the wildlife worker scenario were developed as part of *Site Evaluation Report for Soil Pile I at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* (DOE 2008), specifically found within Appendix Q. These values are presented in Tables 3-5.

Additionally, maximum concentrations were compared to the NALs for the child resident from the PGDP Risk Methods Document (DOE 2001). Results of this comparison are presented in Appendix D.

Figure 4 presents a data screening flow chart that was used for evaluating the results of this sampling effort.

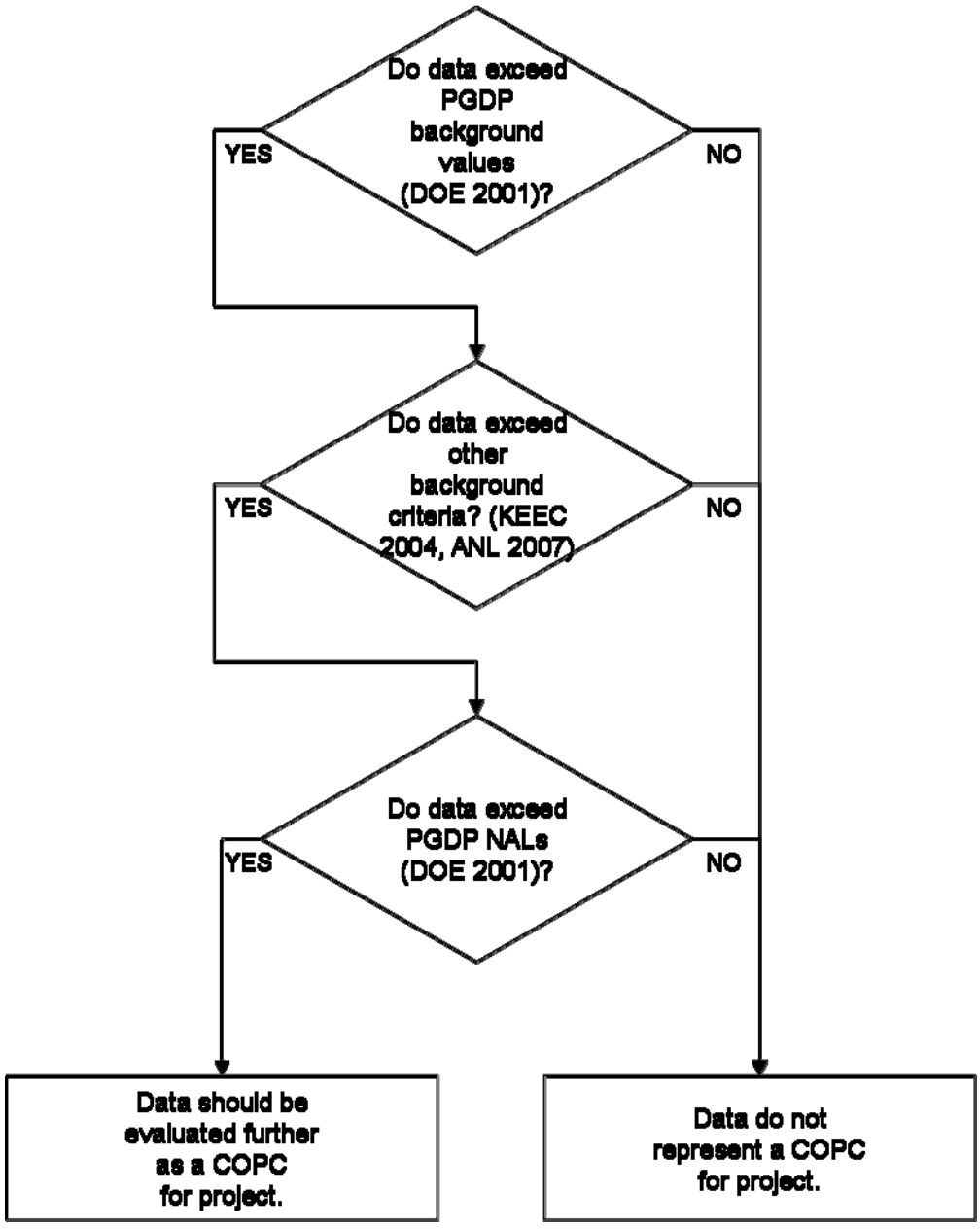

Figure 4. Data Screening Process

Table 3. Comparison of Teen Recreational Site-Specific and PGDP NALs

Contaminants	Units	Site-Specific Teen Recreational User NALs[a] Hazard	Carcinogen	NAL	PGDP Risk Methods Document Teen Recreational User NALs[b] Hazard	Carcinogen	NAL
Aluminum	mg/kg	100,000		100,000	3,010		3,010
Antimony	mg/kg	26.4		26.4	0.242		0.242
Arsenic	mg/kg	13.8	1.79	1.79	5.98	0.346	0.346
Barium	mg/kg	40,707		40,707	148		148
Beryllium	mg/kg	67.9	466,490	67.9	0.606	60,200	0.606
Chromium	mg/kg	NA	NA	NA	227	12,000	227
Iron	mg/kg	100,000		100,000	1,350		1,350
Lead[c]	mg/kg	NA	NA	1,420			400
Manganese	mg/kg	17,263		17,263	29.0		29.0
Thallium[d]	mg/kg				0.479		0.479
Uranium	mg/kg	529		529	14.7		14.7
Vanadium	mg/kg	4,036		4,036	2.12		2.12
Total PCB	mg/kg	0.436	0.636	0.436		0.127	0.127
Total PAH	mg/kg		0.066	0.066		0.0133	0.0133
Cesium-137	pCi/g		1.19	1.19		0.178	0.178
Plutonium-239	pCi/g		237	237		30.3	30.3
Thorium-230	pCi/g		302	302		39.0	39.0
Uranium-234	pCi/g		407	407		52.2	52.2
Uranium-235	pCi/g		5.53	5.53		0.826	0.826
Uranium-238	pCi/g		24.6	24.6		3.64	3.64

[a]Site-specific no action levels (NALs) were derived in a risk assessment presented in DOE 2008.
[b]No action level values are based on a risk of 1E-6 and a hazard index (HI) of 0.1 from DOE 2001, Table A.17.
[c]The value for lead is a regulatory value provided by the Commonwealth of Kentucky Risk Assessment Branch.
[d]The value for thallium chloride is used for thallium.

Table 4. Comparison of Site-Specific Action Levels and PGDP Risk Methods Action Levels

Contaminants	Units	Site-Specific Teen Recreational User ALs[a] Hazard	Carcinogen	Action	PGDP Risk Methods Document Teen Recreational User ALs[b] Hazard	Carcinogen	Action
Aluminum	mg/kg	100,000		100,000	100,000		100,000
Antimony	mg/kg	793		793	344		344
Arsenic	mg/kg	413	179	179	2,590	314	314
Barium	mg/kg	100,000		100,000	100,000		100,000
Beryllium	mg/kg	2,036	46,649,028	2,036	884	100,000	884
Chromium	mg/kg	NA	NA	NA	100,000	100,000	
Iron	mg/kg	100,000		100,000	100,000		100,000
Lead[c]	mg/kg			1,420			400
Manganese	mg/kg	100,000		100,000	39,100		39,100
Thallium[d]	mg/kg				0.479		0.479
Uranium	mg/kg	15,877		15,877	6,830		6,830
Vanadium	mg/kg	121,076		121,076	3,090		3,090
Total PCB	mg/kg	13.1	63.6	13.1		28.3	28.3
Total PAH	mg/kg		6.60	6.60		14.6	14.6
Cesium-137	pCi/g		119	119		17.8	17.8
Plutonium-239	pCi/g		23,724	23,724		3,030	3,030
Thorium-230	pCi/g		30,237	30,237		3,900	3,900

Table 4. Comparison of Site-Specific Action Levels and PGDP Risk Methods Action Levels (Continued)

		Site-Specific			PGDP Risk Methods Document		
		Teen Recreational User ALs[a]			Teen Recreational User ALs[b]		
Contaminants	**Units**	**Hazard**	**Carcinogen**	**Action**	**Hazard**	**Carcinogen**	**Action**
Uranium-234	pCi/g		40,716	40,716		5,220	5,220
Uranium-235	pCi/g		553	553		82.6	82.6
Uranium-238	pCi/g		2,461	2,461		364	364

[a]Site-specific action levels (ALs) were derived in a risk assessment presented in DOE 2008.
[b]Action level values are based on a risk of 1E-4 and a HI of 3 from DOE 2001, Table A.14.
Toxicity values for radionuclides account for short-lived daughter products, where applicable.
[c]The value for lead is a regulatory value provided by the Commonwealth of Kentucky Risk Assessment Branch.
[d]The value for thallium chloride is used for thallium.

Table 5. Site-Specific NALs for the Wildlife Worker

		Site-Specific Wildlife Worker NALs[a]		
Contaminants	**Units**	**Hazard**	**Carcinogen**	**NAL**
Aluminum	mg/kg	100,000		100,000
Antimony	mg/kg	98.0		98.0
Arsenic	mg/kg	64.3	8.22	8.22
Barium	mg/kg	62,819		62,819
Beryllium	mg/kg	374	976,375	374
Iron	mg/kg	100,000		100,000
Lead	mg/kg			50
Manganese	mg/kg	40,173		40,173
Uranium	mg/kg	211		211
Vanadium	mg/kg	3,057		3,057
Total PCB	mg/kg	11,789	3.24	3.24
Total PAH	mg/kg		0.368	0.368
Cesium-137	pCi/g		1.53	1.53
Plutonium-239	pCi/g		103	103
Thorium-230	pCi/g		137	137
Uranium-234	pCi/g		179	179
Uranium-235	pCi/g		6.93	6.93
Uranium-238	pCi/g		29.3	29.3

[a]Site-specific no action levels were derived in a risk assessment presented in DOE 2008.

6.1.2 Addendum 1-B Soil Piles Receptors

Addendum 1-B Soil Piles are located on DOE property, DOE property licensed to WKWMA, and on the WKWMA. Access to the WKWMA adjoining PGDP is controlled to the public throughout the year. In order to legally access the site, members of the public must check in with security at the main guard outpost to PGDP. Known uses of DOE lands included in the WKWMA are defined in the CSM and include a) recreational users and b) wildlife workers.[7]

[7] The receptors for Addendum 1-B soil piles are current use receptors only.

Known recreational uses of Addendum 1-B Soil Piles include field trials, which incorporate horseback riding and dog trials, bow hunting, and similar outdoor activities.

The soil piles CSM, as defined in the SAP, details the routes of exposure (as included in the derivation of the NALs and ALs shown in the previous tables) to be considered in a risk assessment and includes the following:

- Incidental ingestion of soil
- Inhalation of soil particles (i.e., dust)
- Inhalation of vapors emitted from soil
- Dermal contact with soil
- External exposure to ionizing radiation

6.1.3 Chemicals of Potential Concern

The data screening performed has identified COPCs for the Addendum 1-B soil piles. The Addendum 1-B soil piles (excluding soil pile O within AOC 541) can be divided into two categories: those with COPCs present and those without. Soil Piles 20, C, D, F, G, H, J, P, AT, BW, and K013 contain the COPCs listed in Table 6. Soil pile O within AOC 541 represents a significantly different population than the rest of the Addendum 1-B soil piles data set; therefore, data are discussed separately. Cumulative risks and hazards posed by the COPCs at these soil piles are presented in Appendix D.

Table 6. Chemicals of Potential Concern at Addendum 1-B Soil Piles, Excluding Soil Pile O within AOC 541

COPC	Depth	Soil Pile	PGDP Teen Recreator NAL[a]	PGDP Child Resident NAL[a]	PGDP Background Value[b]	Maximum Value Detected
Metals (mg/kg)						
Arsenic	Surface	AT	3.46E-01	1.32E-01	1.20E+01	4.30E+01
Beryllium	Surface	AT	6.06E-01	1.60E-01	6.70E-01	2.12E+00
Chromium	Surface	20	2.27E+02	6.05E+01	1.60E+01	2.85E+02
		J	2.27E+02	6.05E+01	1.60E+01	1.15E+02
		BW	2.27E+02	6.05E+01	1.60E+01	6.54E+01
	Subsurface	20	2.27E+02	6.05E+01	4.30E+01	3.14E+02
		J	2.27E+02	6.05E+01	4.30E+01	1.25E+02
Mercury	Surface	AT	6.34E-01	1.58E-01	2.00E-01	2.30E-01
	Subsurface	AT	6.34E-01	1.58E-01	1.30E-01	1.70E-01
Uranium	Surface	H	1.47E+01	2.16E+00	4.90E+00	5.89E+01
		J	1.47E+01	2.16E+00	4.90E+00	2.08E+02
		AT	1.47E+01	2.16E+00	4.90E+00	5.83E+01
		20	1.47E+01	2.16E+00	4.90E+00	7.96E+00
		C	1.47E+01	2.16E+00	4.90E+00	9.25E+00
		F	1.47E+01	2.16E+00	4.90E+00	9.63E+00
		G	1.47E+01	2.16E+00	4.90E+00	7.89E+00
	Subsurface	D	1.47E+01	2.16E+00	4.60E+00	5.23E+01
		AT	1.47E+01	2.16E+00	4.60E+00	5.45E+01
		J	1.47E+01	2.16E+00	4.60E+00	1.11E+02
		G	1.47E+01	2.16E+00	4.60E+00	7.88E+00
		C	1.47E+01	2.16E+00	4.60E+00	1.13E+01
		20	1.47E+01	2.16E+00	4.60E+00	9.03E+00
Vanadium	Surface	AT	2.12E+00	5.62E-01	3.80E+01	7.40E+01
	Subsurface	AT	2.12E+00	5.62E-01	3.70E+01	6.39E+01

Table 6. Chemicals of Potential Concern at Addendum 1-B Soil Piles, Excluding Soil Pile O within AOC 541 (Continued)

COPC	Depth	Soil Pile	PGDP Teen Recreator NAL[a]	PGDP Child Resident NAL[a]	PGDP Background Value[b]	Maximum Value Detected
Radionuclides (pCi/g)						
Uranium-234	Surface	AT	5.22E+01	3.81E+00	2.5E+00	6.58E+00
		E	5.22E+01	3.81E+00	2.5E+00	5.34E+01
		J	5.22E+01	3.81E+00	2.5E+00	4.05E+00
	Subsurface	AT	5.22E+01	3.81E+00	2.4E+00	6.70E+00
		D	5.22E+01	3.81E+00	2.4E+00	4.68E+00
Uranium-235	Surface	AT	8.26E-01	5.91E-02	1.40E-01	3.37E-01
		BV	8.26E-01	5.91E-02	1.40E-01	2.95E-01
		E	8.26E-01	5.91E-02	1.40E-01	8.96E+00
		H	8.26E-01	5.91E-02	1.40E-01	1.63E-01
		J	8.26E-01	5.91E-02	1.40E-01	5.68E-01
	Subsurface	AT	8.26E-01	5.91E-02	1.40E-01	3.48E-01
		D	8.26E-01	5.91E-02	1.40E-01	5.91E-01
		J	8.26E-01	5.91E-02	1.40E-01	4.35E-01
Uranium-238	Surface	AT	3.64E+00	2.61E-01	1.20E+00	8.33E+00
		H	3.64E+00	2.61E-01	1.20E+00	1.09E+01
		J	3.64E+00	2.61E-01	1.20E+00	3.73E+01
		BV	3.64E+00	2.61E-01	1.20E+00	1.74E+01
		BW	3.64E+00	2.61E-01	1.20E+00	1.38E+00
		CC	3.64E+00	2.61E-01	1.20E+00	1.49E+00
		D	3.64E+00	2.61E-01	1.20E+00	1.67E+00
		E	3.64E+00	2.61E-01	1.20E+00	5.81E+02
		P	3.64E+00	2.61E-01	1.20E+00	1.84E+00
		G	3.64E+00	2.61E-01	1.20E+00	2.24E+00
		C	3.64E+00	2.61E-01	1.20E+00	2.73E+00
		20	3.64E+00	2.61E-01	1.20E+00	2.76E+00
		F	3.64E+00	2.61E-01	1.20E+00	2.99E+00
	Subsurface	D	3.64E+00	2.61E-01	1.20E+00	4.42E+01
		J	3.64E+00	2.61E-01	1.20E+00	3.04E+01
		AT	3.64E+00	2.61E-01	1.20E+00	8.54E+00
		K013	3.64E+00	2.61E-01	1.20E+00	1.72E+00
		BW	3.64E+00	2.61E-01	1.20E+00	1.13E+00
		P	3.64E+00	2.61E-01	1.20E+00	2.13E+00
		F	3.64E+00	2.61E-01	1.20E+00	2.13E+00
		G	3.64E+00	2.61E-01	1.20E+00	2.42E+00
		20	3.64E+00	2.61E-01	1.20E+00	2.96E+00
		C	3.64E+00	2.61E-01	1.20E+00	2.94E+00
Total PCBs (mg/kg)						
	Surface	20	1.27E-01	5.74E-02	n/a	7.40E-01
		E	1.27E-01	5.74E-02	n/a	1.58E+00
		J	1.27E-01	5.74E-02	n/a	6.20E-01
		H	1.27E-01	5.74E-02	n/a	2.40E-01
		AT	1.27E-01	5.74E-02	n/a	1.15E+00
		BW	1.27E-01	5.74E-02	n/a	5.90E-01
	Subsurface	20	1.27E-01	5.74E-02	n/a	3.54E+00
		D	1.27E-01	5.74E-02	n/a	2.01E+00
		J	1.27E-01	5.74E-02	n/a	6.90E-01
		AT	1.27E-01	5.74E-02	n/a	7.40E-01
		BW	1.27E-01	5.74E-02	n/a	4.40E-01

[a] No action level values are based on a risk of 1E-6 and a HI of 0.1 from DOE 2001, Table A.17.
[b] PGDP Background Values from DOE 2001, Table A.12.

There are no known primary sources of PAHs at the site and are considered ubiquitous. As a result, PAHs are not considered COPCs for this SER; however, PAHs may be considered during subsequent investigative activities.

6.1.3.1 Radiation Dose Comparison

The PGDP Risk Methods Document provides radionuclide screening concentrations derived for human health based target doses for 1, 15, and 25 mrem/year. Of the two known receptors (recreational user and wildlife worker) at Addendum 1-B Soil Piles, screening concentrations for the teen recreational user are considered for this analysis since the recreational user is a more sensitive receptor than the wildlife worker. The target dose of 25 mrem/year is based on criteria in DOE Order 5400.5, Chapter II. The target dose of 15 mrem/year is based on the EPA memorandum dated August 22, 1997. The PGDP Risk Methods Document describes a screening level from the target dose of 1 mrem/year as the "walk away" level.

Concentrations of radionuclides are below the individual teen recreational user screening levels for a 1 mrem/year dose with the exception of soil pile E and, therefore, below the "walk away" level in the PGDP Risk Methods Document. Comparisons of Addendum 1-B Soil Piles Radionuclide Concentrations with these screening levels are presented in Table 7.

Table 7. Comparison of Addendum 1-B Soil Piles Radionuclide Concentrations and Radiation Dose/Concentration Limits, Excluding Soil Pile O within AOC 541 and Soil Pile E

Radionuclide	Range of Concentration (pCi/g)	Screening Level (pCi/g)[a]			Residual Concentration Limit for Release of DOE Property (pCi/g)
		1 mrem/year	15 mrem/year	25 mrem/year	
Cesium-137	-0.0239—0.647	4.58E+00	6.88E+01	1.15E+02	
Thorium-230	0.0967—1.69	5.91E+02	8.86E+03	1.48E+04	5/15[b]
Thorium-232	0.142—1.2	1.24E+02	1.86E+03	3.09E+03	5/15[b]
Uranium-234	0.0257—6.7	1.17E+03	1.75E+04	2.91E+04	
Uranium-238	0.0198—44.2	1.05E+02	1.57E+03	2.62E+03	

[a] From Table A.8, Teen Recreator, of the PGDP Risk Methods Document (DOE 2001). All Risk Methods Document values are presented for comparison purposes; however, not all of these values may be appropriate for response action decision making.
[b] 5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.

6.1.3.2 PCB Comparison

Addendum 1-B soil piles (20, J, H, AT, BW, E, and D) show total PCBs exceed the NAL for the default PGDP teen recreational user in 6 of 55 surface samples and 8 of 48 subsurface samples. The maximum value detected in the Addendum 1-B soil piles was 3.54 mg/kg. The maximum risk posed by total PCBs to the teen recreational user is less than 1E-4 (see Appendix D).

6.1.4 Chemicals of Potential Concern for Soil Pile O within AOC 541

As a result of the 2008 sampling event, additional areas within the AOC were determined to have similar levels of PCBs and uranium as did the original five samples from 2002. Table 8 provides a summary of COPCs associated with soil pile O within AOC 541, excluding PAHs, which are considered ubiquitous.

Table 8. Chemicals of Potential Concern Retained for Additional Evaluation at Soil Pile O within AOC 541

COPC	Depth	Maximum Value Detected	PGDP Teen Recreational User	
			No Action Levels*	Action Level*
Metals (mg/kg)				
Aluminum	Surface	1.64E+04	3.01E+03	1.00E+05
	Subsurface	1.51E+04	3.01E+03	1.00E+05
Arsenic	Subsurface	2.33E+01	3.46E-01	3.14E+02
Beryllium	Subsurface	9.57E-01	6.06E-01	8.84E+02
Chromium	Surface	2.31E+02	2.27E+02	1.00E+05
Iron	Subsurface	2.87E+04	1.35E+03	1.00E+05
Uranium	Surface	3.60E+03	1.47E+01	6.83E+03
	Subsurface	3.43E+03	1.47E+01	6.83E+03
Vanadium	Subsurface	5.17E+01	2.12E+00	3.09E+03
Radionuclides (pCi/g)				
Cesium-137	Surface	9.62E-01	1.78E-01	1.78E+01
	Subsurface	5.06E-01	1.78E-01	1.78E+01
Uranium-234	Surface	8.47E+01	5.22E+01	5.22E+03
	Subsurface	7.96E+01	5.22E+01	5.22E+03
Uranium-235	Surface	4.30E+01	8.26E-01	8.26E+01
	Subsurface	5.48E+01	8.26E-01	8.26E+01
Uranium-238	Surface	1.02E+03	3.64E+00	3.64E+02
	Subsurface	1.66E+03	3.64E+00	3.64E+02
Total PCBs (mg/kg)				
	Surface	3.11E+01	1.27E-01	2.83E+01
	Subsurface	3.82E+01	1.27E-01	2.83E+01

n/a = value not available

* No Action Levels and Action Levels are taken from the 2001 Risk Methods Document, Tables A.17 and A.14, respectively (DOE 2001).

Results for PCBs and uranium exceed action levels at soil pile O within AOC 541.

7. CONCLUSIONS

The following provides a summary of the major findings and conclusions for the Addendum 1-B soil piles evaluation.

Consistent with Section 40 *CFR* § 300.415(b)(2) of the National Contingency Plan, the factors that should be considered for determining whether a removal action is appropriate for Addendum 1-B soil piles are discussed below.

(i) **Actual or potential exposure to nearby human populations, animals, or food chain from hazardous substances or pollutants or contaminants.**
See Section 7.2.

(ii) **Actual or potential contamination of drinking water supplies or sensitive ecosystem.**
There is no known use of groundwater for drinking water, feedstock watering, or crop irrigation from the Addendum 1-B soil piles area.

(iii) **Hazardous substances or pollutants or contaminants in drums, barrels, banks, or other bulk storage containers that may pose a threat of release.**
There are no containers or tanks associated with the Addendum 1-B soil piles.

(iv) **High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate.**
PGDP historical monitoring data indicate little if any migration is occurring.

(v) **Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.**
PGDP historical monitoring data indicate little if any migration is occurring.

(vi) **Threat of fire or explosion.**
The Addendum 1-B soil piles do not present a threat of fire or explosion.

(vii) **The availability of other appropriate federal or state response mechanisms to respond to the release.**
This factor is not applicable to the Addendum 1-B soil piles.

(viii) **Other situations or factors that may pose threats to public health or welfare of the United States or the environment.**
There are no other situations or factors at Addendum 1-B soil piles that would pose a threat to public health or the environment.

7.1 NATURE AND EXTENT OF CONTAMINATION

Sample results indicate 24 chemicals exceeded PGDP background values during the Addendum 1-B sampling (excluding soil pile O within AOC 541): 17 metals and 7 radionuclides. Of those 24 chemicals, only 10 of them are recommended COPCs based upon teen recreational use and child resident NAL

exceedances of arsenic, beryllium, chromium, mercury (for the child resident scenario only), uranium (metal), vanadium, uranium-234 (for the child resident scenario only), uranium-235 (for the child resident scenario only), uranium-238, and PCBs.

The remaining chemicals were not recommended COPCs due to levels similar to background or the chemicals are considered ubiquitous (e.g., PAHs). Table 9 summarizes the 10 COPCs that were above child resident NALs in addition to COPCs for soil pile O within AOC 541. Also see Appendices D and E for specific information related to nature and extent of contamination.

None of these COPCs for piles excluding soil pile O within AOC 541 and soil pile E exceed action levels for the PGDP teen recreational user. The following detected concentrations for these COPCs exceed their action levels for the PGDP child resident in piles excluding soil pile O within AOC 541: arsenic (pile AT), uranium (metal) (pile J), and uranium-238 (piles D, E, and J).

Findings for AOC 541 indicate additional areas of contamination within the AOC (i.e., soil pile BV); therefore, the SAR for AOC 541 requires revision (see Appendix A).

Findings for AOC 492 are similar to previous findings; therefore, the SAR for AOC 492 does not require revision.

Table 9. Chemicals of Potential Concern at Addendum 1-B Soil Piles

COPC	Depth	Soil Pile	PGDP Teen Recreator NAL[a]	PGDP Child Resident NAL[a]	PGDP Background Value[b]	Maximum Value Detected
Metals (mg/kg)						
Aluminum	Surface	O (AOC 541)	3.01E+03	[c]	1.30E+04	1.64E+04
	Subsurface	O (AOC 541)	3.01E+03	[c]	1.20E+04	1.51E+04
Arsenic	Surface	AT	3.46E-01	1.32E-01	1.20E+01	4.30E+01
	Subsurface	O (AOC 541)	3.46E-01	[c]	1.20E+01	2.33E+01
Beryllium	Surface	AT	6.06E-01	1.60E-01	6.70E-01	2.12E+00
	Subsurface	O (AOC 541)	6.06E-01	[c]	6.70E-01	9.57E-01
Chromium	Surface	20	2.27E+02	6.05E+01	1.60E+01	2.85E+02
		J	2.27E+02	6.05E+01	1.60E+01	1.15E+02
		BW	2.27E+02	6.05E+01	1.60E+01	6.54E+01
		O (AOC 541)	2.27E+02	[c]	1.60E+01	2.31E+02
	Subsurface	20	2.27E+02	6.05E+01	4.30E+01	3.14E+02
		J	2.27E+02	6.05E+01	4.30E+01	1.25E+02
Iron	Subsurface	O (AOC 541)	1.35E+03	[c]	2.80E+04	2.87E+04
Mercury	Surface	AT	6.34E-01	1.58E-01	2.00E-01	2.30E-01
	Subsurface	AT	6.34E-01	1.58E-01	1.30E-01	1.70E-01

Table 9. Chemicals of Potential Concern at Addendum 1-B Soil Piles (Continued)

COPC	Depth	Soil Pile	PGDP Teen Recreator NAL[a]	PGDP Child Resident NAL[a]	PGDP Background Value[b]	Maximum Value Detected
Uranium	Surface	H	1.47E+01	2.16E+00	4.90E+00	5.89E+01
		J	1.47E+01	2.16E+00	4.90E+00	2.08E+02
		AT	1.47E+01	2.16E+00	4.90E+00	5.83E+01
		20	1.47E+01	2.16E+00	4.90E+00	7.96E+00
		C	1.47E+01	2.16E+00	4.90E+00	9.25E+00
		F	1.47E+01	2.16E+00	4.90E+00	9.63E+00
		G	1.47E+01	2.16E+00	4.90E+00	7.89E+00
		O (AOC 541)	1.47E+01	[c]	4.90E+00	3.60E+03
	Subsurface	D	1.47E+01	2.16E+00	4.60E+00	5.23E+01
		AT	1.47E+01	2.16E+00	4.60E+00	5.45E+01
		J	1.47E+01	2.16E+00	4.60E+00	1.11E+02
		G	1.47E+01	2.16E+00	4.60E+00	7.88E+00
		C	1.47E+01	2.16E+00	4.60E+00	1.13E+01
		20	1.47E+01	2.16E+00	4.60E+00	9.03E+00
		O (AOC 541)	1.47E+01	[c]	4.60E+00	3.43E+03
Vanadium	Surface	AT	2.12E+00	5.62E-01	3.80E+01	7.40E+01
	Subsurface	AT	2.12E+00	5.62E-01	3.70E+01	6.39E+01
		O (AOC 541)	2.12E+00	[c]	3.70E+01	5.17E+01
Radionuclides (pCi/g)						
Cesium-137	Surface	O (AOC 541)	1.78E-01	[c]	4.90E-01	9.62E-01
	Subsurface	O (AOC 541)	1.78E-01	[c]	2.80E-01	5.06E-01
Uranium-234	Surface	AT	5.22E+01	3.81E+00	2.5E+00	6.58E+00
		E	5.22E+01	3.81E+00	2.5E+00	5.34E+01
		J	5.22E+01	3.81E+00	2.5E+00	4.05E+00
		O (AOC 541)	5.22E+01	[c]	2.50E+00	8.47E+01
	Subsurface	AT	5.22E+01	3.81E+00	2.4E+00	6.70E+00
		D	5.22E+01	3.81E+00	2.4E+00	4.68E+00
		O (AOC 541)	5.22E+01	[c]	2.40E+00	7.96E+01
Uranium-235	Surface	AT	8.26E-01	5.91E-02	1.40E-01	3.37E-01
		BV	8.26E-01	5.91E-02	1.40E-01	2.95E-01
		E	8.26E-01	5.91E-02	1.40E-01	8.96E+00
		H	8.26E-01	5.91E-02	1.40E-01	1.63E-01
		J	8.26E-01	5.91E-02	1.40E-01	5.68E-01
		O (AOC 541)	8.26E-01	[c]	1.40E-01	4.30E+01
	Subsurface	AT	8.26E-01	5.91E-02	1.40E-01	3.48E-01
		D	8.26E-01	5.91E-02	1.40E-01	5.91E-01
		J	8.26E-01	5.91E-02	1.40E-01	4.35E-01
		O (AOC 541)	8.26E-01	[c]	1.40E-01	5.48E+01

Table 9. Chemicals of Potential Concern at Addendum 1-B Soil Piles (Continued)

COPC	Depth	Soil Pile	PGDP Teen Recreator NAL[a]	PGDP Child Resident NAL[a]	PGDP Background Value[b]	Maximum Value Detected
Uranium-238	Surface	AT	3.64E+00	2.61E-01	1.20E+00	8.33E+00
		H	3.64E+00	2.61E-01	1.20E+00	1.09E+01
		J	3.64E+00	2.61E-01	1.20E+00	3.73E+01
		BV	3.64E+00	2.61E-01	1.20E+00	1.74E+01
		BW	3.64E+00	2.61E-01	1.20E+00	1.38E+00
		CC	3.64E+00	2.61E-01	1.20E+00	1.49E+00
		D	3.64E+00	2.61E-01	1.20E+00	1.67E+00
		E	3.64E+00	2.61E-01	1.20E+00	5.81E+02
		P	3.64E+00	2.61E-01	1.20E+00	1.84E+00
		G	3.64E+00	2.61E-01	1.20E+00	2.24E+00
		C	3.64E+00	2.61E-01	1.20E+00	2.73E+00
		20	3.64E+00	2.61E-01	1.20E+00	2.76E+00
		F	3.64E+00	2.61E-01	1.20E+00	2.99E+00
		O (AOC 541)	3.64E+00	[c]	1.20E+00	1.02E+03
Uranium-238	Subsurface	D	3.64E+00	2.61E-01	1.20E+00	4.42E+01
		J	3.64E+00	2.61E-01	1.20E+00	3.04E+01
		AT	3.64E+00	2.61E-01	1.20E+00	8.54E+00
		K013	3.64E+00	2.61E-01	1.20E+00	1.72E+00
		BW	3.64E+00	2.61E-01	1.20E+00	1.13E+00
		P	3.64E+00	2.61E-01	1.20E+00	2.13E+00
		F	3.64E+00	2.61E-01	1.20E+00	2.13E+00
		G	3.64E+00	2.61E-01	1.20E+00	2.42E+00
		20	3.64E+00	2.61E-01	1.20E+00	2.96E+00
		C	3.64E+00	2.61E-01	1.20E+00	2.94E+00
		O (AOC 541)	3.64E+00	[c]	1.20E+00	1.66E+03
Total PCBs (mg/kg)						
	Surface	20	1.27E-01	5.74E-02	n/a	7.40E-01
		E	1.27E-01	5.74E-02	n/a	1.58E+00
		J	1.27E-01	5.74E-02	n/a	6.20E-01
		H	1.27E-01	5.74E-02	n/a	2.40E-01
		AT	1.27E-01	5.74E-02	n/a	1.15E+00
		BW	1.27E-01	5.74E-02	n/a	5.90E-01
		O (AOC 541)	1.27E-01	[c]	n/a	3.11E+01
	Subsurface	20	1.27E-01	5.74E-02	n/a	3.54E+00
		D	1.27E-01	5.74E-02	n/a	2.01E+00
		J	1.27E-01	5.74E-02	n/a	6.90E-01
		AT	1.27E-01	5.74E-02	n/a	7.40E-01
		BW	1.27E-01	5.74E-02	n/a	4.40E-01
		O (AOC 541)	1.27E-01	[c]	n/a	3.82E+01

n/a = value not available

[a] No action level values are based on a risk of 1E-6 and a HI of 0.1 from DOE 2001, Table A.17.

[b] PGDP Background Values from DOE 2001, Table A.12.

[c] Information for the child residential scenario at soil pile O within AOC 541 is provided in Appendix E.

7.2 HUMAN HEALTH RISKS

7.2.1 Metals

The results of the background screening indicate 17 metals above background; however, only soil within soil piles 20, H, J, and AT exceed metal concentrations greater than teen recreational user NALs, therefore, warranting further evaluation as COPCs. Metal concentrations above the full range of background and greater than child resident NALs warrant further evaluation as COPCs at the following soil piles: AT, 20, D, H, J, BW, C, F, and G.

7.2.2 Radiation Dose Limits

Concentrations of radiological parameters detected in Addendum 1-B soil piles are below teen recreational user screening levels for a 1 mrem/year dose (with the exception of soil pile O within AOC 541 and soil pile E) and, therefore, are below the "walk away" level in the PGDP Risk Methods Document.

Based upon risk screening, the results of the background screening for radionuclides indicate seven radionuclides above background. Only soil within soil piles H, J, E, BV, and AT exceed the full range of background and have radionuclide concentrations greater than teen recreational user NALs, therefore, warranting further evaluation as COPCs. Radionuclides exceeding child resident NALs and warranting further evaluation as COPCs are found in soil piles AT, 20, D, E, H, J, BV, BW, CC, C, F, G, K013, and P.

Additionally, biased sampling conducted by the Commonwealth of Kentucky indicate pile K exceeds screening levels for uranium-238.

7.2.3 PCB Remediation Waste

PCBs were detected in soil pile O within AOC 541 and 7 of the remaining 40 soil pile samples and warrant further evaluation as COPCs.

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8. RECOMMENDATIONS

The following provides recommendations for future activities at Addendum 1-B Soil Piles. The recommendations are based on the findings of the investigation and lessons learned during the planning and execution of study efforts at Addendum 1-B Soil Piles.

Future activities

The following are recommendations based on the findings of the Addendum 1-B Soil Piles:

- No early response action is recommended, with the exception of soil pile E, for the soil piles along Little Bayou Creek (Addendum 1-B Soil Piles). An early action at soil pile E is recommended for consideration. See Appendix D. An early action at soil pile O within AOC 541 is recommended for consideration. See Appendix E.

- The soil piles C, D, E, F, G, H, J, K, and P (AOC 562), 20 and BW and CC (AOC 563), AT (AOC 564), and K013 (AOC 567) have been added to the Soils Operable Unit. The soil pile BV is within the boundary of AOC 541. See Appendix B for data and Appendix C for sample locations.

- PAH test kits are recommended for consideration during future sampling activities. PAH results for Addendum 1-B generally were less than detection; therefore, similar to Addendum 2, a data comparison was not performed. A comparison should be performed on future projects when ample data are above detection limits.

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APPENDIX A

SWMU/AOC PRELIMINARY ASSESSMENT/SITE INSPECTION REPORTS AND REVISED SOLID WASTE MANAGEMENT UNIT ASSESSMENT REPORTS

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Contaminated Soil Area South of Outfall 011
Solid Waste Management Unit (SWMU) Assessment Report

SWMU/AOC NUMBER: 541

DATE OF ORIGINAL SAR: 01/15/03

DATE OF SAR REVISIONS: 06/10/09; 8/31/10

REGULATORY STATUS: Area of Concern (AOC)

LOCATION: South of Outfall 011 near Little Bayou Creek. See enclosed map.

APPROXIMATE DIMENSION OR CAPACITY: Approximately 480 ft by 210 ft

FUNCTION: No known use.

BRIEF HISTORY: This area was discovered on April 16, 2002, during routine radiological surveys in support of sampling activities when an area with elevated radiological readings was identified. The area contained soil piles that were likely generated as a result of past construction activities at the Paducah Gaseous Diffusion Plant. This area was sampled on September 30, 2002. Upon receipt of preliminary results, DOE categorized this area as an AOC. This area was further characterized in December 2008 and March 2010, during the Soil Pile Addendum 1-B investigation.

PRESENT OPERATIONAL STATUS: Inactive

DATES OPERATED: Unknown

SITE/PROCESS DESCRIPTION: Unknown

WASTE DESCRIPTION: Contaminated Soils

WASTE QUANTITY: The waste quantity is estimated to be between 1,900 yd^3 (the volume estimated based on 2002 samples) and 4,300 yd^3 (the volume estimated assuming the entire volume of the soil pile is contaminated). The waste quantity will be updated as additional data become available.

SUMMARY OF ENVIRONMENTAL SAMPLING DATA: During 2002, the area was surveyed upon initial discovery. Fixed beta/gamma measurements ranging from approximately 26,000 dpm/100 cm2 to over 300,000 dpm/100 cm2 were recorded. Highest readings were obtained in a significantly small, localized area (approximately 1 acre) with several small mounds of soil. Data from locations sampled in the AOC were reviewed. Metals, polychlorinated biphenyls (PCBs), semivolatiles, volatiles, and radionuclides were analyzed in soils. Analytical results indicate the presence of metals, PCBs, semivolatiles, and radionuclides. No metals results exceeded the Resource Conservation and Recovery Act (RCRA) Bulk Metals levels (401 *KAR* 31:030 § 4 incorporating 40 *CFR* § 261.24). All samples had detectable PCB. Some sampling points exceeded the Toxic Substances Control Act limit of 50 ppm. Significant levels of uranium (greater than 1,000 pCi/g) were measured at five sampling points. All other sampling points showed uranium greater than background. There were some points with detectable technetium-99, plutonium-239/240, and radium-226. There were no RCRA issues identified with the semivolatile results.

In December 2008, 242 soil samples were collected for field screening with 24 samples being sent to a fixed-base laboratory for analysis. As a result of the 2008 sampling event (see SER for Addendum 1-B DOE/LX/07-0225&D2/R1), additional areas within the AOC were determined to have similar levels of PCBs and uranium, as did the original five sample results collected in 2002. The most elevated Total PCB concentration was 38.2 mg/kg from the subsurface sample at location LBCSOOB162. The surface soil sample with the most elevated concentration of Total PCBs (31.1 mg/kg) was from location LBCSOOB55.The most elevated concentration of uranium in a surface soil sample (3,600 mg/kg as a metal and 1,020 pCi/g as uranium-238) was from location LBCSOOB169 and the most elevated concentration of uranium in a subsurface soil sample (3,430 mg/kg as a metal and 1,660 pCi/g as uranium-238) was from location LBCSOOB162. Additional sampling was conducted in March 2010 for PCBs and radionuclides. Sampling results were consistent with those found in December 2008.

DESCRIPTION OF RELEASE AND MEDIA AFFECTED:

GROUNDWATER:	None known
SURFACE WATER:	None known
SOIL:	See Above
ECOLOGY AFFECTED (i.e., threatened/endangered species):	None known

DOCUMENTATION OF NO RELEASE: No documentation identified.

IMPACT ON OR BY OTHER SWMU/AOC: There is no evidence that this AOC impacts or is being impacted by other SWMUs/AOCs.

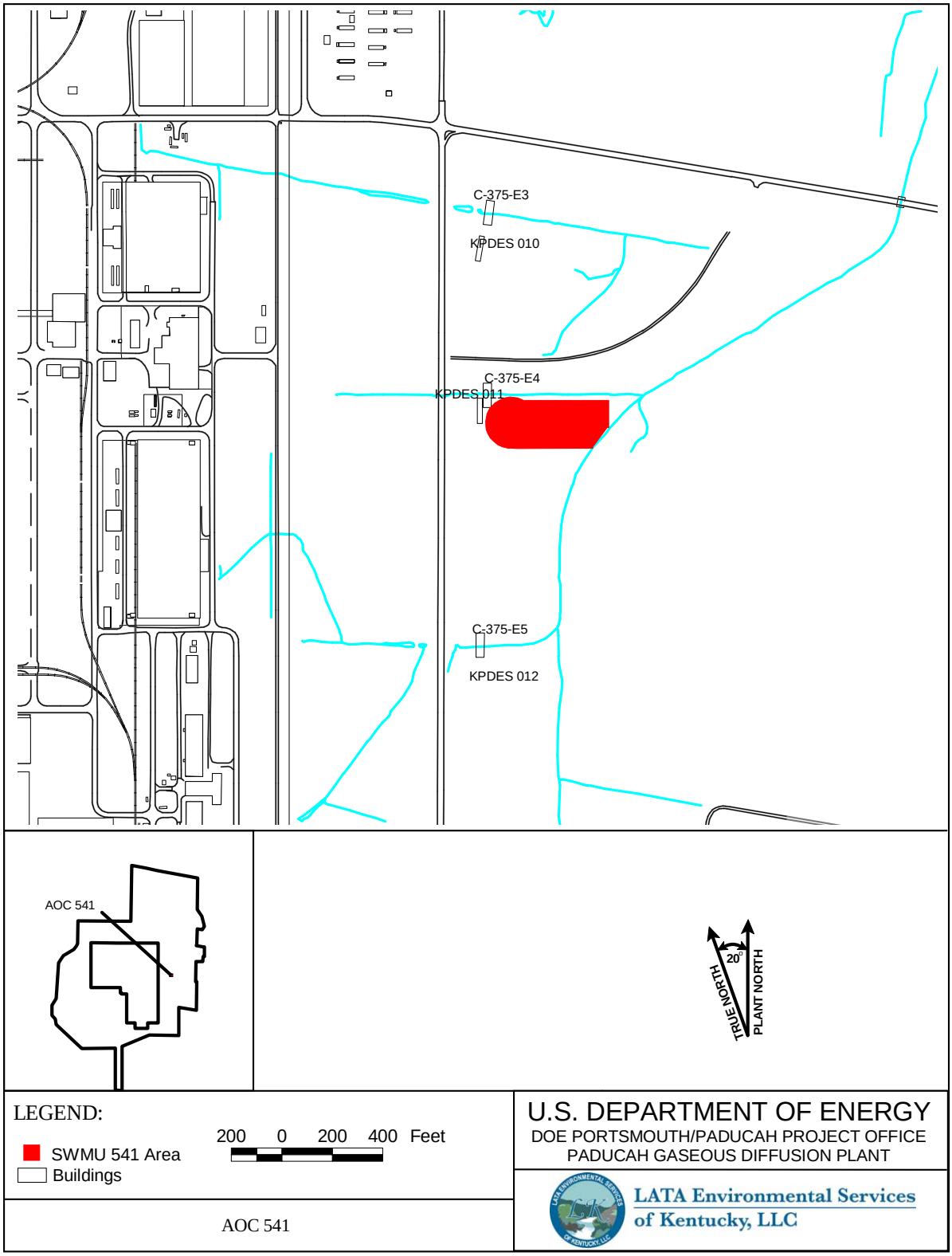
PRG COMPARISON: N/A

RFI NECESSARY: Yes, as identified in the Hazardous Waste Facility Permit (KY8-890-008-982).

OPERABLE UNIT ASSIGNMENT: Soils Operable Unit

PHOTOGRAPH OF SOIL PILES AOC 541

AOC 541: April 16, 2009


C-375-E3
KPDES 010
C-375-E4
KPDES 011
C-375-E5
KPDES 012
AOC 541
TRUE NORTH
20°
PLANT NORTH
LEGEND:
SWMU 541 Area
Buildings
200 0 200 400 Feet
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
LATA Environmental Services of Kentucky, LLC
AOC 541
FIGURE No. 541_545_SAR_MAP.apr
DATE 04-28-09

Contaminated Soil Area North of Soil Pile I on the West Bank of Little Bayou Creek
Solid Waste Management Unit (SWMU) Assessment Report

SWMU/AOC NUMBER: 562

DATE OF SAR: 06/10/09

DATE OF SAR REVISIONS: 08/31/10

REGULATORY STATUS: Area of Concern (AOC)

LOCATION: Soil Piles C, D, E, F, G, H, J, K, and P in subunit 1 are north of soil pile I on the west bank of Little Bayou Creek. See enclosed map.

APPROXIMATE DIMENSION OR CAPACITY: Soil Pile C is designated as a large soil pile with dimensions of approximately 223 ft by 25 ft by 10 ft high. Soil Pile D consists of two soil piles separated by a distance of 8 ft. The larger of the two piles is shaped like a saddle having two peaks, one at either end and is approximately 60 ft long by 30 ft wide. The first peak represents an approximate cone-shaped sub-pile that is 45 ft by 30 ft by 12 ft high. The second peak represents an approximate cone-shaped sub-pile that is 15 ft by 30 ft by 8 ft high. The second discrete pile is approximately 7.5 ft by 7.5 ft by 4 ft high. Soil Pile E is designated as a small soil pile with dimensions of approximately 6 ft by 6 ft by 2 ft high. Soil Pile F is designated as a small soil pile with dimensions of approximately 14 ft by 8 ft by 3 ft high. Soil Pile G is designated as a large soil pile with dimensions of approximately 117 ft by 19 ft by 4 ft high. Soil Pile H consists of one small pile approximately 8 ft by 2 ft by 1 ft high. Soil Pile J consists of two soil piles. The first pile is approximately cone shaped and is 25 ft by 25 ft by 6 ft high. The second pile is shaped like an "L" on the ground and a saddle vertically, having two peaks, one at either end of the "L" covering an area of approximately 62.5 ft by 37.5 ft with a maximum height at both high points of 5 ft. Soil Pile K is designated as a small soil pile with dimensions of approximately 26 ft by 14 ft by 3 ft high. Soil Pile P is designated as a large soil pile with dimensions of approximately 16 ft by 9 ft by 2 ft high.

FUNCTION: No known use.

BRIEF HISTORY: This area was discovered between November 2006 and March 2007, when soil piles with elevated radiological readings were identified. The area contained soil piles that likely were generated as a result of past construction activities at Paducah Gaseous Diffusion Plant. This area was characterized in October 2008 during the Soil Pile Addendum 1-B investigation. Soil Piles C, D, E, F, G, H, J, and P are grouped as one AOC because of their proximity to one other and similarities in contaminant content possibly indicating a common source.

PRESENT OPERATIONAL STATUS: Inactive

DATES OPERATED: Unknown

SITE/PROCESS DESCRIPTION: Unknown

WASTE DESCRIPTION: Contaminated Soil

WASTE QUANTITY: Soil Pile D waste quantity is estimated to be 795 yd^3, Soil Pile H waste quantity is estimated to be 1 yd^3, and Soil Pile J waste quantity is estimated to be 295 yd^3; therefore, the total waste quantity estimated for the AOC is approximately 1,091 yd^3.

SUMMARY OF ENVIRONMENTAL SAMPLING DATA: The area was surveyed upon initial discovery in 2006. Gamma measurements were recorded at greater than twice the background levels in Soil Piles D and J and less than twice the background levels in Soil Pile H. Alpha, beta and gamma scans were performed during the October 2008 soil sampling event and all readings were less than detectable levels. As a result of the December 2008 sampling event and additional sampling performed in March 2010 (see SER for Addendum 1-B DOE/LX/07-0225&D2/R2), risk screening determined the following chemicals of potential concern in the soil piles:

Soil Pile C

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Uranium	Surface	C	9.25E+00
	Subsurface	C	1.13E+01
Radionuclides (pCi/g)			
Uranium-238	Surface	C	2.73E+00
	Subsurface	C	2.94E+00

Soil Pile D

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Uranium	Subsurface	D	5.23E+01
Total PCBs (mg/kg)			
	Subsurface	D	2.01E+00
Radionuclides (pCi/g)			
Uranium-234	Subsurface	D	4.68E+00
Uranium-235	Subsurface	D	5.91E-01
Uranium-238	Surface	D	1.67E+00
	Subsurface	D	4.42E+01

Soil Pile E

COPC	Depth	Soil Pile	Maximum Value Detected
Total PCBs (mg/kg)			
	Surface	E	1.58E+00
Radionuclides (pCi/g)			
Uranium-234	Surface	E	5.34E+01
Uranium-235	Surface	E	8.96E+00
Uranium-238	Surface	E	5.81E+02

Soil Pile F

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Uranium	Surface	F	9.63E+00
Radionuclides (pCi/g)			
Uranium-238	Surface	F	2.99E+00
	Subsurface	F	2.13E+00

Soil Pile G

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Uranium	Surface	G	7.89E+00
	Subsurface	G	7.88E+00
Radionuclides (pCi/g)			
Uranium-238	Surface	G	2.24E+00
	Subsurface	G	2.42E+00

Soil Pile H

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Uranium	Surface	H	5.89E+01
Radionuclides (pCi/g)			
Uranium-235	Surface	H	1.63E-01
Uranium-238	Surface	H	1.09E+01
Total PCBs (mg/kg)			
	Surface	H	2.40E-01

Soil Pile K (sampled by the Commonwealth of Kentucky)

COPC	Depth	Soil Pile	Maximum Value Detected
Radionuclides (pCi/g)			
Uranium-238	Surface	K	3.62E+02

Soil Pile J

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Chromium	Surface	J	1.15E+02
	Subsurface	J	1.25E+02
Uranium	Surface	J	2.08E+02
	Subsurface	J	1.11E+02
Radionuclides (pCi/g)			
Uranium-234	Surface	J	4.05E+00
Uranium-235	Surface	J	5.68E-01
	Subsurface	J	4.35E-01
Uranium-238	Surface	J	3.73E+01
	Subsurface	J	3.04E+01
Total PCBs (mg/kg)			
	Surface	J	6.20E-01
	Subsurface	J	6.90E-01

Soil Pile P

COPC	Depth	Soil Pile	Maximum Value Detected
Radionuclides (pCi/g)			
Uranium-238	Surface	P	1.84E+00
	Subsurface	P	2.13E+00

DESCRIPTION OF RELEASE AND MEDIA AFFECTED:

GROUNDWATER:	None known
SURFACE WATER:	None known
SOIL:	See Above
ECOLOGY AFFECTED (i.e., threatened/endangered species):	None known

DOCUMENTATION OF NO RELEASE: No documentation identified.

IMPACT ON OR BY OTHER SWMU/AOC: There is no evidence that this AOC impacts or is being impacted by other SWMUs/AOCs.

PRG COMPARISON: Screening indicated that uranium, chromium, and Total polychlorinated biphenyls (PCBs) are the contaminants present.

RFI NECESSARY: Yes, as identified in the Hazardous Waste Facility Permit (KY8-890-008-982).

OPERABLE UNIT ASSIGNMENT: Soils Operable Unit

PHOTOGRAPHS OF SOIL PILES AOC 562

Soil Pile C: December 17, 2009

Soil Pile D: May 19, 2009

Soil Pile D: May 19, 2009

Soil Pile D: May 19, 2009

Soil Pile E: June 1, 2010

Soil Pile F: December 17, 2009

Soil Pile G: December 17, 2009

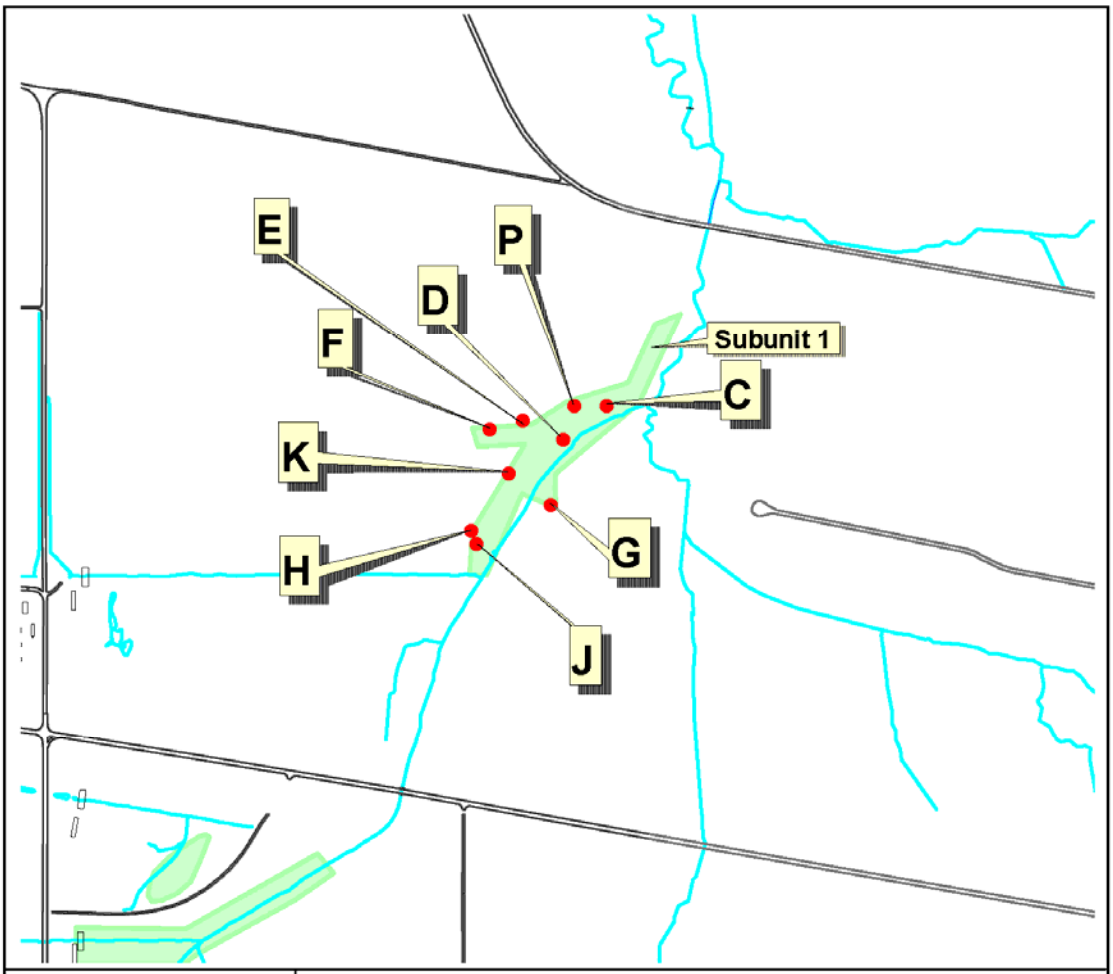
Soil Pile H: May 19, 2009

Soil Pile J: May 19, 2009

Soil Pile J: May 19, 2009

Soil Pile K: December 17, 2009

Soil Pile P: December 17, 2009


E
P
D
F
Subunit 1
C
K
G
H
J
AOC 562
TRUE NORTH
20°
PLANT NORTH
LEGEND:
SWMU 562 Area
Buildings
200 0 200 400 Feet
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
LATA Environmental Services
of Kentucky, LLC
AOC 562
FIGURE No. 562_SAR_MAPg.apr
DATE 05-25-10

Contaminated Soil Area North of Outfall 012 West of Little Bayou Creek
Solid Waste Management Unit (SWMU) Assessment Report

SWMU/AOC NUMBER: 563

DATE OF SAR: 06/10/09

DATE OF SAR REVISIONS: 08/31/10

REGULATORY STATUS: Area of Concern (AOC)

LOCATION: Soil Piles CC, 20 and BW in subunit 4 are north of outfall 012 west of Little Bayou Creek See enclosed map.

APPROXIMATE DIMENSION OR CAPACITY: Soil Pile 20 consists of one conically-shaped small pile approximately 25 ft by 25 ft by 6 ft high. Soil Pile BW consists of one rectangular-shaped pile approximately 150 ft by 25 ft generally uniform in height, approximately 5 ft, with an irregular surface. Soil Pile CC is a large soil pile approximately 75 ft by 25 ft by 3 ft high.

FUNCTION: No known use.

BRIEF HISTORY: This area was discovered between November 2006 and March 2007, when an area with elevated radiological readings above background was identified. The area contained soil piles that likely were generated as a result of past construction activities at Paducah Gaseous Diffusion Plant. This area was characterized in October 2008 during the Soil Pile Addendum 1-B investigation. Soil Piles CC, 20, and BW are grouped as one AOC because of their proximity to each other and similarities in physiology and contaminant content possibly indicating a common source.

PRESENT OPERATIONAL STATUS: Inactive

DATES OPERATED: Unknown

SITE/PROCESS DESCRIPTION: Unknown

WASTE DESCRIPTION: Contaminated Soils

WASTE QUANTITY: Soil Pile CC waste quantity is estimated to be 200 yd^3, Soil Pile 20 waste quantity is estimated to be 40 yd^3, and Soil Pile BW waste quantity is estimated to be 275 yd^3; therefore, the total waste quantity estimated for the AOC is approximately 515 yd^3.

SUMMARY OF ENVIRONMENTAL SAMPLING DATA: The area was surveyed upon initial discovery and the radiological scan indicated readings less than twice the background gamma scan. During the October 2008 sampling event, alpha and beta/gamma measurements were recorded at less than detectable. As a result of the December 2008 sampling event (see SER for Addendum 1-B DOE/LX/07-0225&D2/R1), risk screening determined the following chemicals of potential concern in the soil piles:

Soil Pile CC

COPC	Depth	Soil Pile	Maximum Value Detected
Radionuclides (pCi/g)			
Uranium-238	Surface	CC	1.49E+00

Soil Pile 20

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Chromium	Surface	20	2.85E+02
	Subsurface	20	3.14E+02
Total PCBs (mg/kg)			
	Surface	20	7.40E-01
	Subsurface	20	3.54E+00

Soil Pile BW

COPC	Depth	Soil Pile	Maximum Value Detected
Total PCBs (mg/kg)			
	Surface	BW	5.90E-01
	Subsurface	BW	4.40E-01

DESCRIPTION OF RELEASE AND MEDIA AFFECTED:

GROUNDWATER: None known
SURFACE WATER: None known
SOIL: See Above
ECOLOGY AFFECTED (i.e., threatened/endangered species): None known

DOCUMENTATION OF NO RELEASE: No documentation identified.

IMPACT ON OR BY OTHER SWMU/AOC: There is no evidence that this AOC impacts or is being impacted by other SWMUs/AOCs.

PRG COMPARISON: Screening indicated that chromium and Total polychlorinated biphenyls (PCBs) are the contaminants present.

RFI NECESSARY: Yes, as identified in the Hazardous Waste Facility Permit (KY8-890-008-982).

OPERABLE UNIT ASSIGNMENT: Soils Operable Unit

PHOTOGRAPHS OF SOIL PILES AOC 563

Soil Pile CC: June 1, 2010

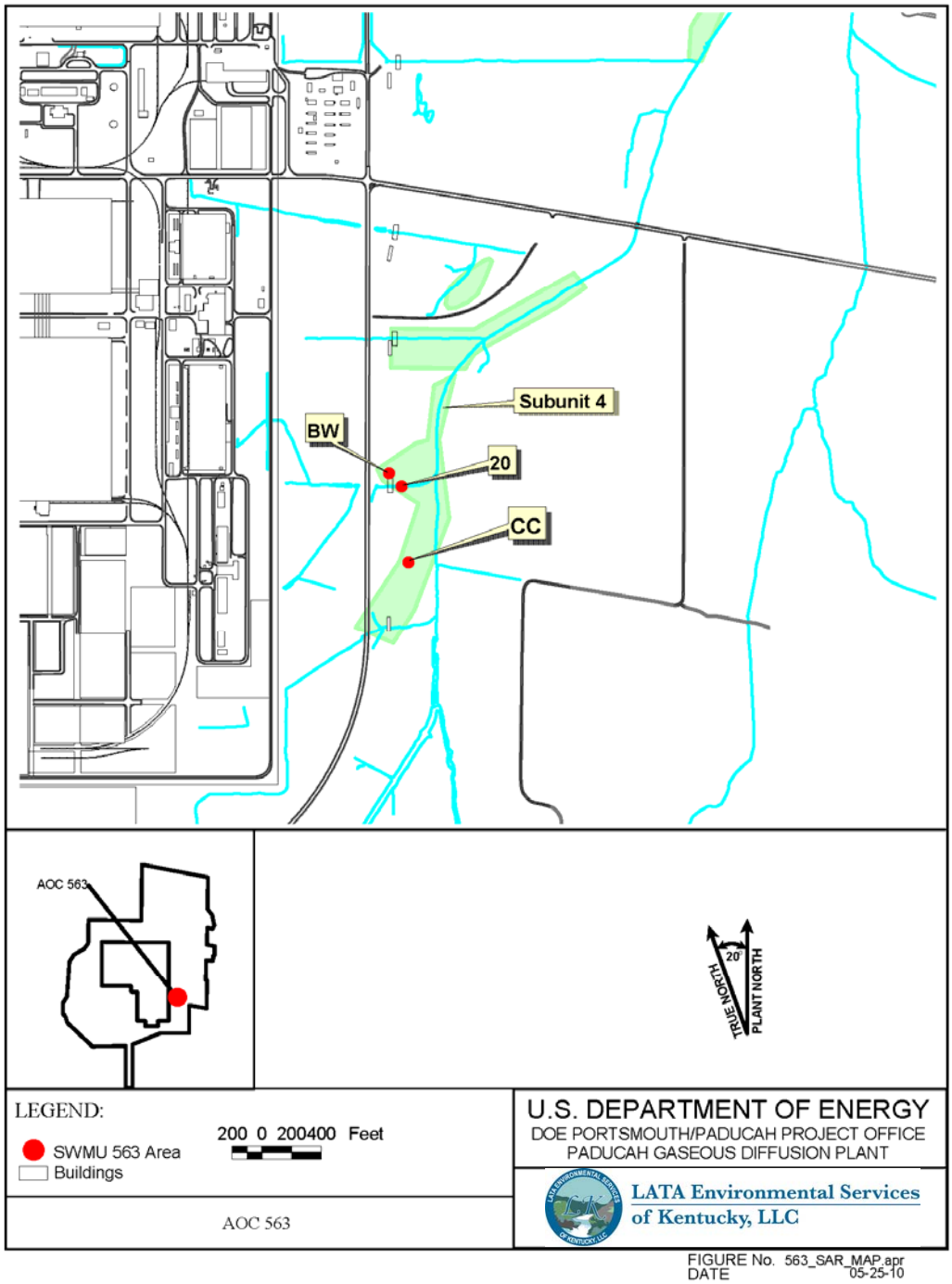
Soil Pile CC: June 1, 2010

Soil Pile 20: May 19, 2009

Soil Pile 20: May 19, 2009

Soil Pile BW: May 19, 2009

Soil Pile BW: May 19, 2009


Subunit 4
BW
20
CC
AOC 563
TRUE NORTH
20°
PLANT NORTH
LEGEND:
SWMU 563 Area
Buildings
200 0 200400 Feet
AOC 563
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
LATA Environmental Services
of Kentucky, LLC
FIGURE No. 563_SAR_MAP.apr
DATE 05-25-10

Contaminated Soil Areas on the East side of the North-South Diversion Ditch North of the P-, S-, and T-Landfills.
Solid Waste Management Unit (SWMU) Assessment Report

SWMU/AOC NUMBER: 564

DATE OF SAR: 06/01/09

DATE OF SAR REVISIONS: 08/31/10

REGULATORY STATUS: Area of Concern (AOC)

LOCATION: Soil Pile AT in subunit 5 consists of 3 soil areas on the east side of the North-South Diversion Ditch north of the P-, S-, and T-Landfills. See enclosed map.

APPROXIMATE DIMENSION OR CAPACITY: This consists of two discrete, small soil areas (sub-piles) with low relief in close proximity. The first sub-pile is approximately 7.5 ft by 5 ft by 1 ft high and the second sub-pile is approximately 5 ft by 3 ft by 1 ft high.

FUNCTION: No known use.

BRIEF HISTORY: This area was discovered between November 2006 and March 2007, when an area with elevated radiological readings was identified. The area contained soil piles that likely were generated as a result of past construction activities at the Paducah Gaseous Diffusion Plant. This area was characterized in December 2008 during the Soil Pile Addendum 1-B investigation.

PRESENT OPERATIONAL STATUS: Inactive

DATES OPERATED: Unknown

SITE/PROCESS DESCRIPTION: Unknown

WASTE DESCRIPTION: Contaminated Soils

WASTE QUANTITY: Soil Pile AT waste quantity is estimated to be 2 yd^3 each sub-pile being less than 1 yd^3 each.

SUMMARY OF ENVIRONMENTAL SAMPLING DATA: The area was surveyed upon initial discovery and the radiological scan indicated readings less than twice the background gamma scan. During the October 2008 sampling event, alpha and beta/gamma measurements were recorded at less than detectable. As a result of the December 2008 sampling event (see SER for Addendum 1-B DOE/LX/07-0225&D2/R1), risk screening determined the following chemicals of potential concern in the soil piles:

Soil Pile AT

COPC	Depth	Soil Pile	Maximum Value Detected
Metals (mg/kg)			
Arsenic	Surface	AT	4.30E+01
Beryllium	Surface	AT	2.12E+00
Mercury	Surface	AT	2.30E-01
	Subsurface	AT	1.70E-01
Uranium	Surface	AT	5.83E+01
	Subsurface	AT	5.45E+01
Vanadium	Surface	AT	7.40E+01
	Subsurface	AT	6.39E+01
Radionuclides (pCi/g)			
Uranium-234	Surface	AT	6.58E+00
	Subsurface	AT	6.70E+00
Uranium-235	Surface	AT	3.37E-01
	Subsurface	AT	3.48E-01
Uranium-238	Surface	AT	8.33E+00
	Subsurface	AT	8.54E+00
Total PCBs (mg/kg)			
	Surface	AT	1.15E+00
	Subsurface	AT	7.40E-01

DESCRIPTION OF RELEASE AND MEDIA AFFECTED:

GROUNDWATER: None known
SURFACE WATER: None known
SOIL: See Above
ECOLOGY AFFECTED (i.e., threatened/endangered species): None known

DOCUMENTATION OF NO RELEASE: No documentation identified.

IMPACT ON OR BY OTHER SWMU/AOC: There is no evidence that this AOC impacts or is being impacted by other SWMUs/AOCs.

PRG COMPARISON: Screening indicated that arsenic, beryllium, uranium, vanadium, and Total polychlorinated biphenyls (PCBs) are the contaminants present.

RFI NECESSARY: Yes, as identified in the Hazardous Waste Facility Permit (KY8-890-008-982).

OPERABLE UNIT ASSIGNMENT: Soils Operable Unit

PHOTOGRAPHS OF SOIL PILES AOC 564

Soil Pile AT: May 19, 2009

Soil Pile AT: May 19, 2009

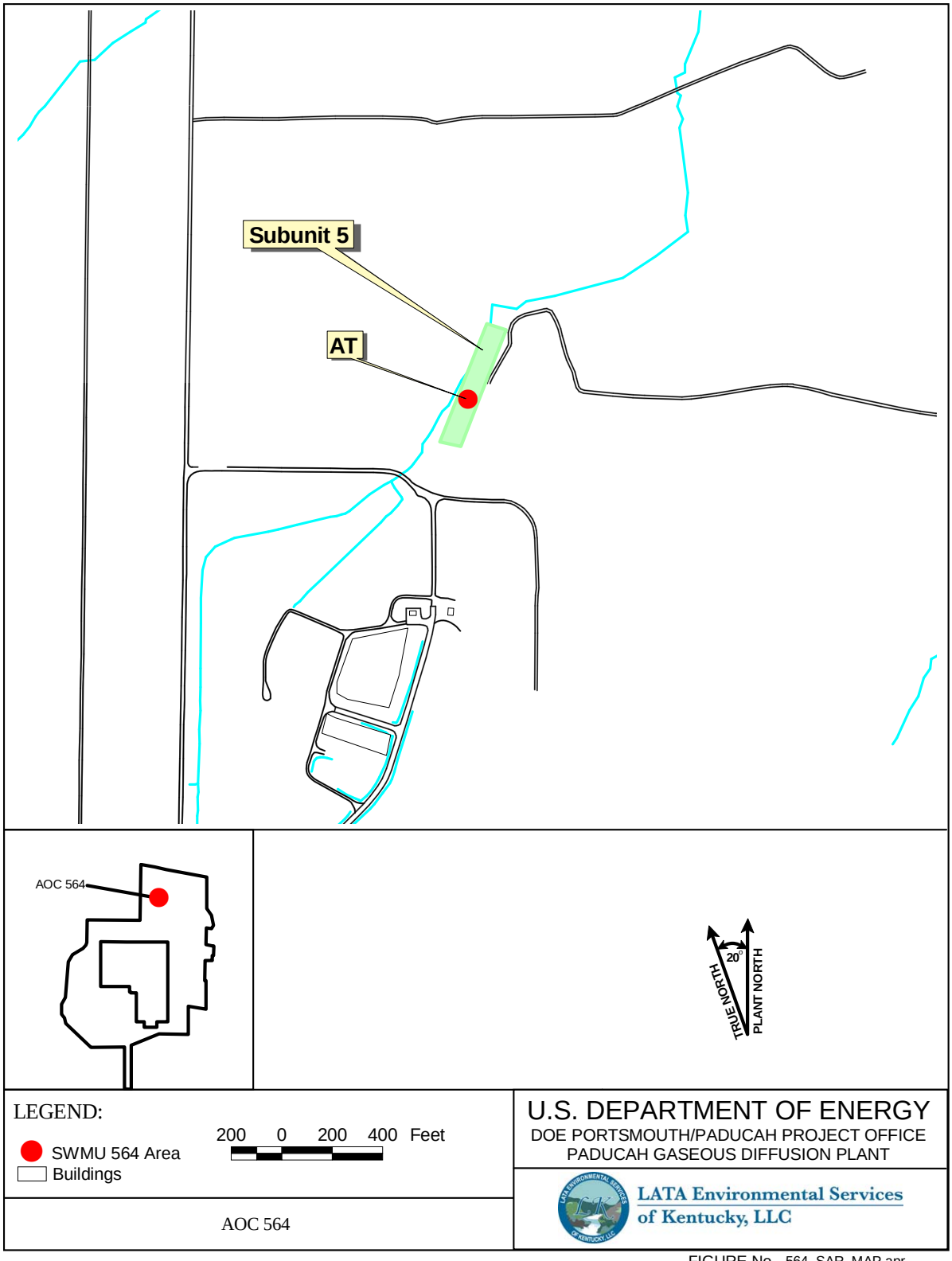


FIGURE No. 564_SAR_MAP.apr
DATE 05-26-09

Contaminated Soil Area near Outfall 013 West of Little Bayou Creek
Solid Waste Management Unit (SWMU) Assessment Report

SWMU/AOC NUMBER: 567

DATE OF SAR: 12/23/09

DATE OF SAR REVISIONS: 08/31/10

REGULATORY STATUS: Area of Concern (AOC)

LOCATION: Soil Pile K013 are near outfall 013 west of Little Bayou Creek. See enclosed map.

APPROXIMATE DIMENSION OR CAPACITY: The K013 soil pile consists of 5 individual piles with the following approximate areas: 2,500 ft^2; 6,300 ft^2; 30,400 ft^2; 31,800 ft^2; and 3,800 ft^2. The soil piles are approximately 3 ft high.

FUNCTION: No known use.

BRIEF HISTORY: This area was discovered between June 2008, when a sampling and analysis plan for other soil piles in the area was approved. The area contained soil piles that likely were generated as a result of past construction activities at Paducah Gaseous Diffusion Plant. This area was characterized with the other soil piles in the area in October 2008 during the Soil Pile Addendum 1-B investigation. The soil piles is not grouped with other soil piles because it is not in close proximity to another.

PRESENT OPERATIONAL STATUS: Inactive

DATES OPERATED: Unknown

SITE/PROCESS DESCRIPTION: Unknown

WASTE DESCRIPTION: Contaminated Soils

WASTE QUANTITY: Soil Pile K013 waste quantity is estimated to be 8,300 yd^3.

SUMMARY OF ENVIRONMENTAL SAMPLING DATA: As a result of the December 2008 sampling event (see SER for Addendum 1-B DOE/LX/07-0225&D2/R1), risk screening determined the following chemicals of potential concern in the soil pile:

Soil Pile K013

COPC	Depth	Soil Pile	Maximum Value Detected
Radionuclides (pCi/g)			
Uranium-238	Subsurface	K013	1.72 pCi/g

DESCRIPTION OF RELEASE AND MEDIA AFFECTED:

GROUNDWATER: None known
SURFACE WATER: None known

SOIL:	See Above
ECOLOGY AFFECTED (i.e., threatened/endangered species):	None known

DOCUMENTATION OF NO RELEASE: No documentation identified.

IMPACT ON OR BY OTHER SWMU/AOC: There is no evidence that this AOC impacts or is being impacted by other SWMUs/AOCs.

PRG COMPARISON: Screening indicated that uranium-238 is the contaminant present.

RFI NECESSARY: Yes, as identified in the Hazardous Waste Facility Permit (KY8-890-008-982).

OPERABLE UNIT ASSIGNMENT: Soils Operable Unit

PHOTOGRAPH OF SOIL PILE AOC 567

AOC 567: December 17, 2009

AOC 567: December 17, 2009

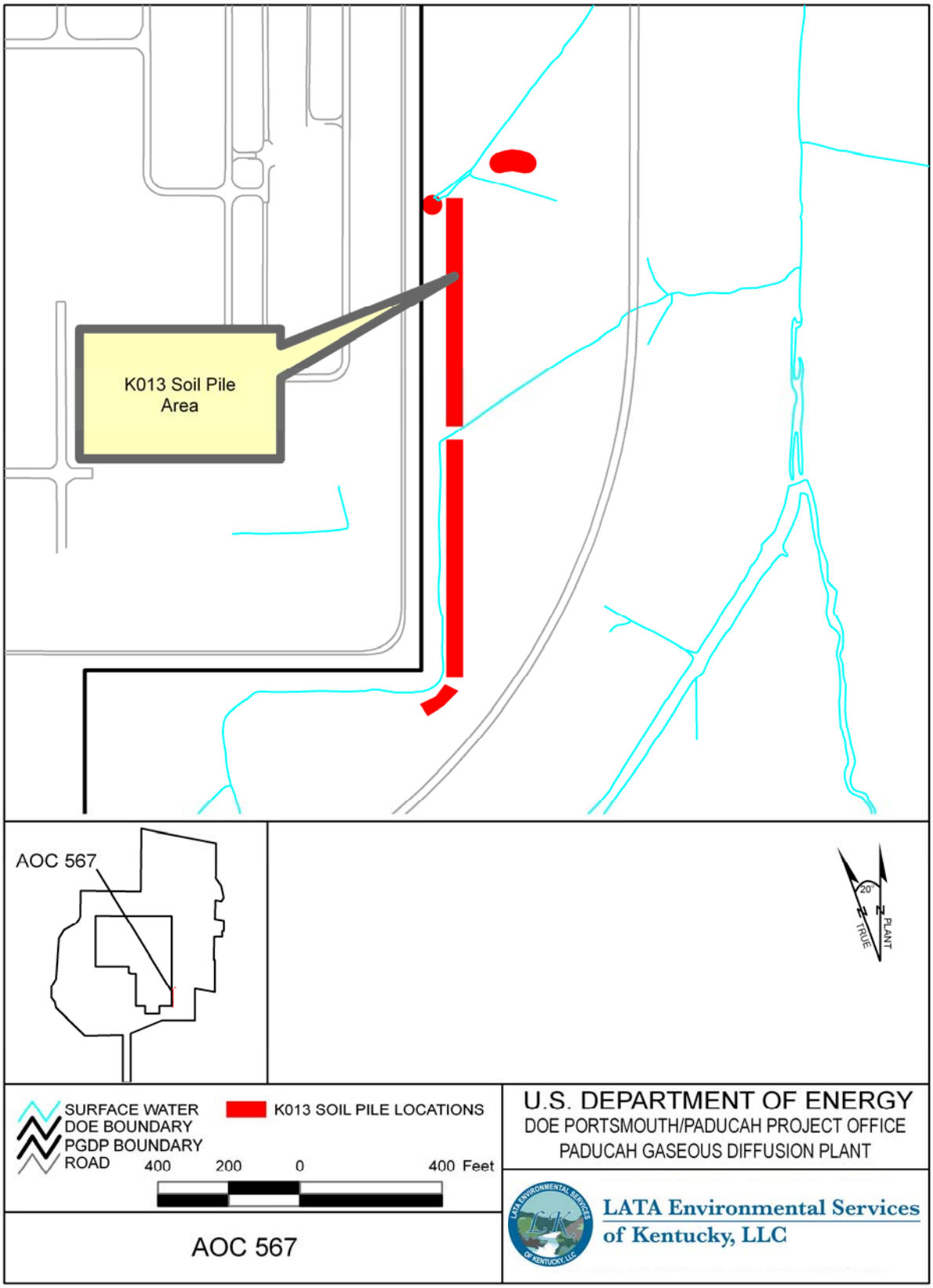


Figure No.SoilPiles/Addendum 1B/567_SAR_MAP.mxd
Date 12-09-2009

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APPENDIX B

SER ADDENDUM 1-B DATA (CD)

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(CD)
FIXED AND FIELD LABORATORY RESULTS

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APPENDIX C

SAMPLE LOCATION FIGURES

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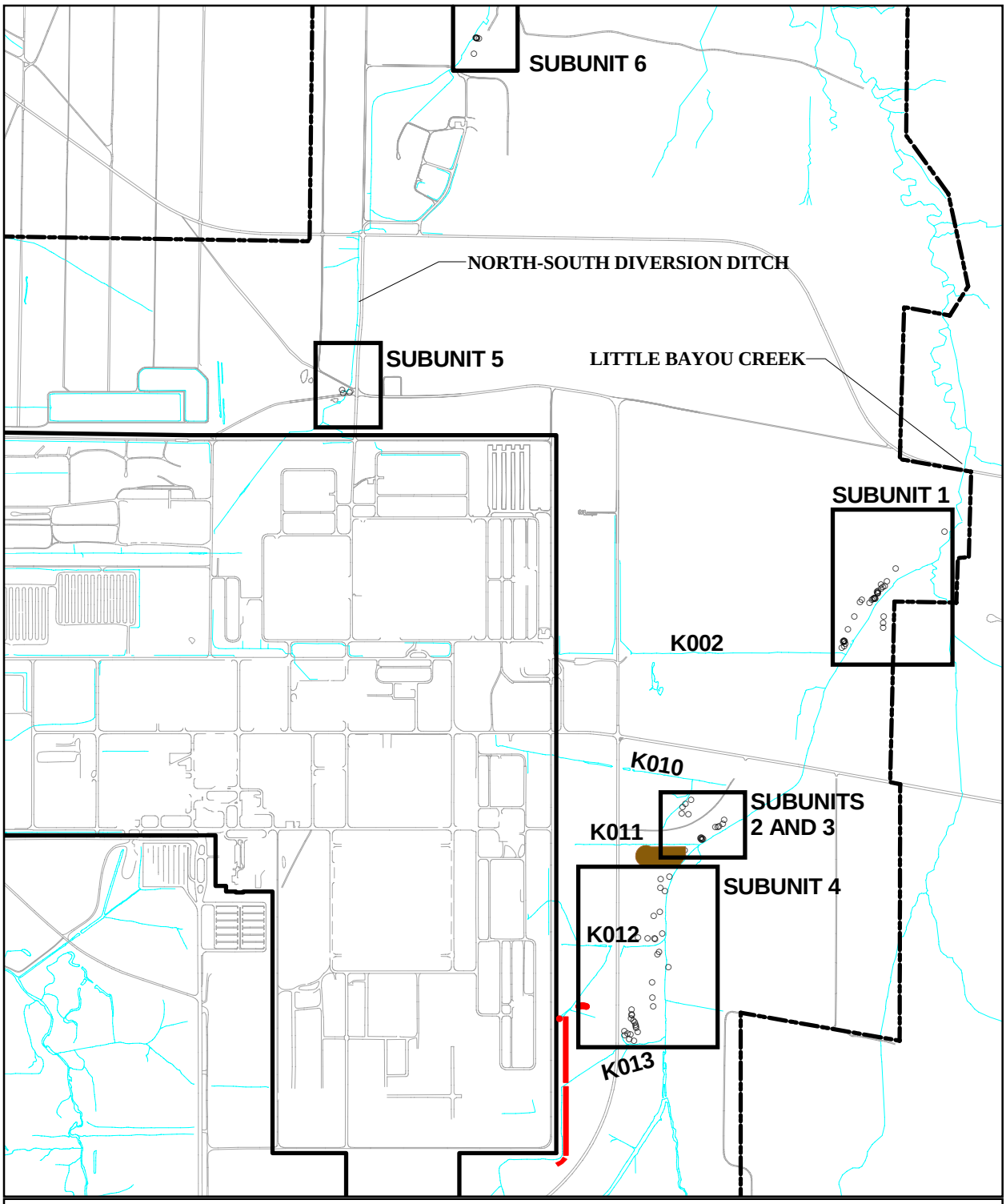
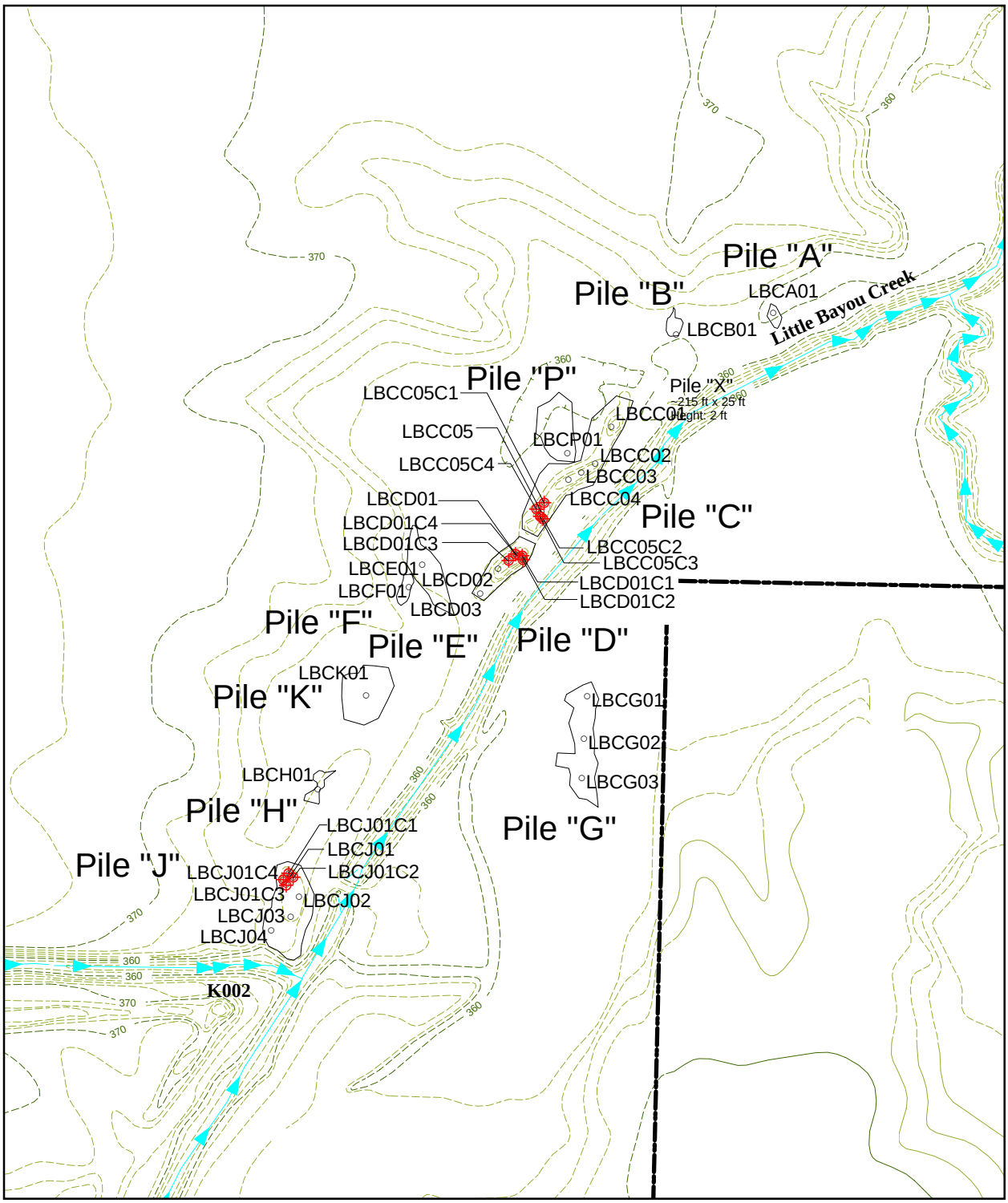
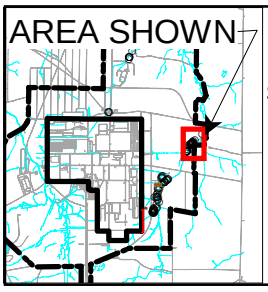

SUBUNIT 6
NORTH-SOUTH DIVERSION DITCH
SUBUNIT 5
LITTLE BAYOU CREEK
SUBUNIT 1
K002
K010
SUBUNITS
2 AND 3
K011
SUBUNIT 4
K012
K013
ADDENDUM 1B SOIL PILE AND
SUBSURFACE SAMPLE LOCATIONS
SURFACE WATER
DOE BOUNDARY
PGDP BOUNDARY
ROAD
POSSIBLE SOIL PILE LOCATIONS
IDENTIFIED DURING INDEPENDENT
ASSESSMENT
LOCATION OF AOC 541 (Pile "O")
1500 0 1500 Feet
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
COORDINATE SYSTEM: PGDP
PROJECTION: n/a
DATE: 07/22/2009
FILE NAME: SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC
REFERENCES: PRS 2009;





ADDENDUM 1B SOIL PILE AND SUBSURFACE SAMPLE LOCATIONS

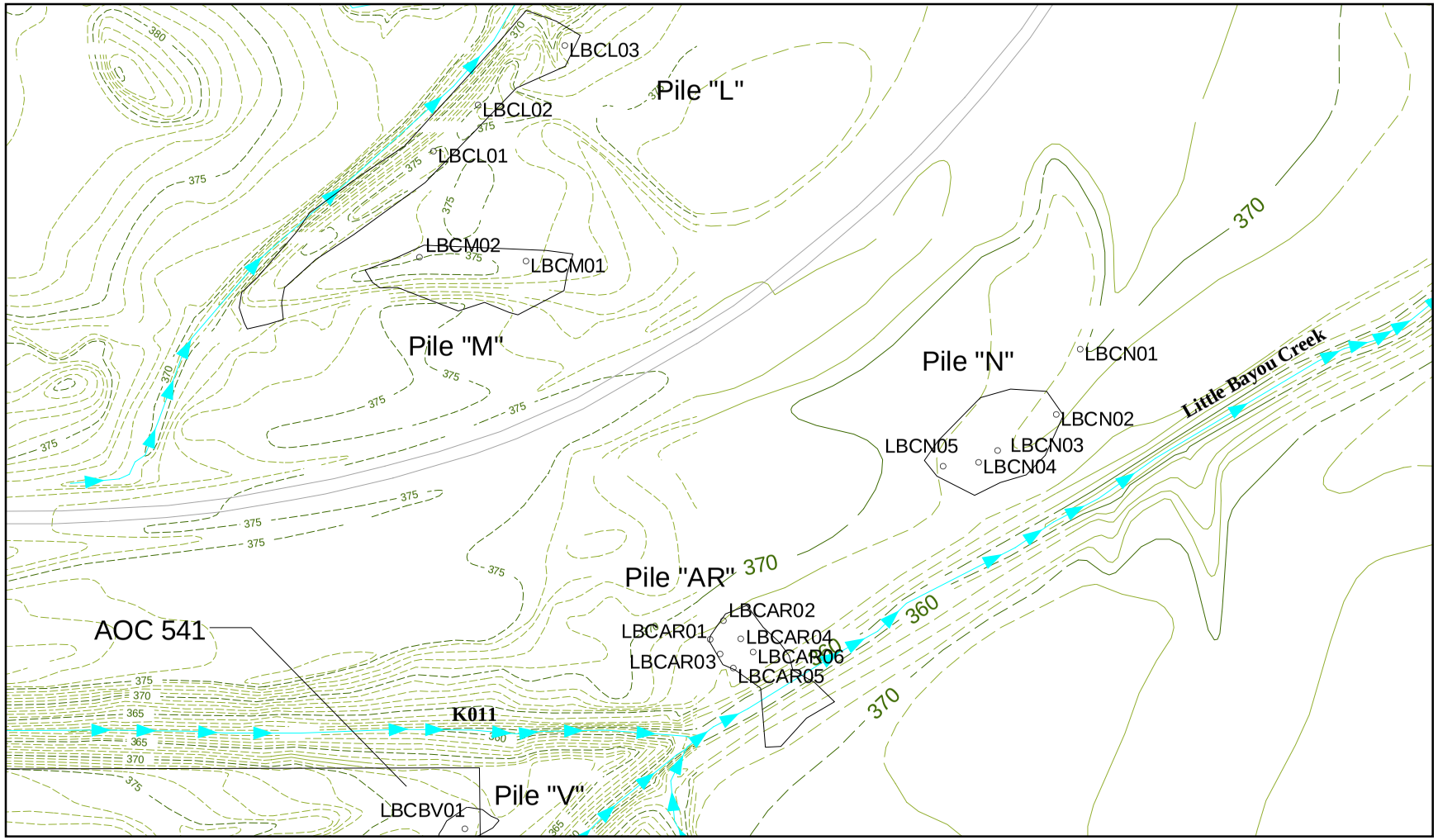
SUBUNIT 1

SURFACE WATER (direction of flow shown)
DOE BOUNDARY
PGDP BOUNDARY
ROAD
SURFACE CONTOUR (5 ft)
SURFACE CONTOUR (10 ft)
SAMPLE LOCATION
CONTINGENCY SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM: PGDP
PROJECTION: n/a
DATE: 09/09/2009
FILE NAME: SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC
REFERENCES: PRS 2009;

200 0 200 Feet



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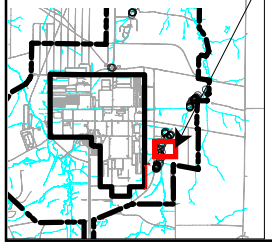


ADDENDUM 1B SOIL PILE AND SUBSURFACE SAMPLE LOCATIONS

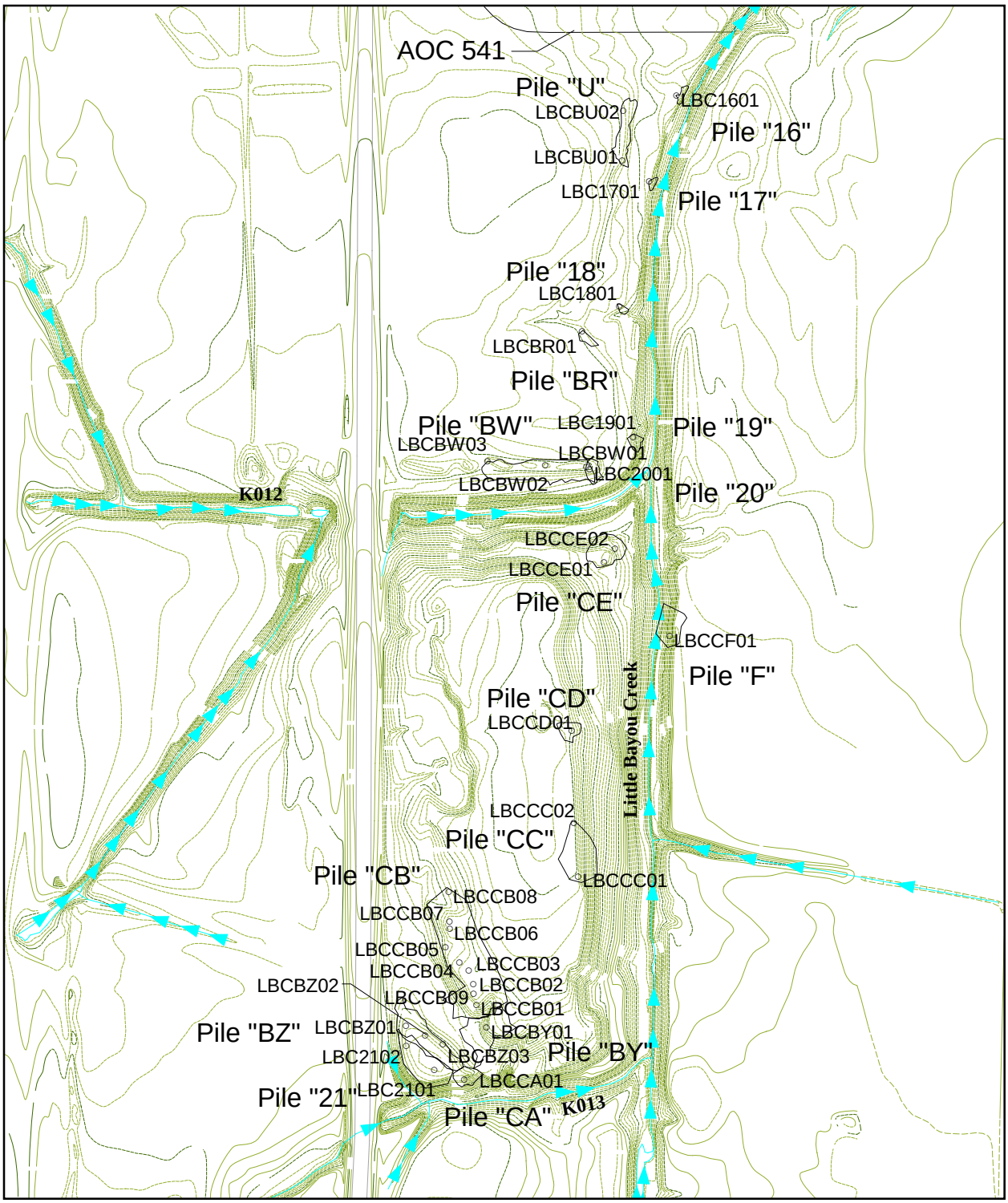
SUBUNITS 2 and 3

SURFACE WATER (direction of flow shown)
DOE BOUNDARY
PGDP BOUNDARY
ROAD
SURFACE CONTOUR (1 ft)
SURFACE CONTOUR (5 ft)
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	07/22/2009
FILE NAME:	SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

100 0 100 Feet



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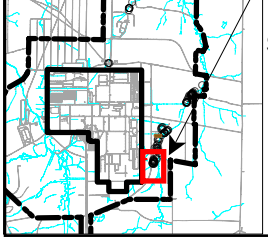


ADDENDUM 1B SOIL PILE AND SUBSURFACE SAMPLE LOCATIONS

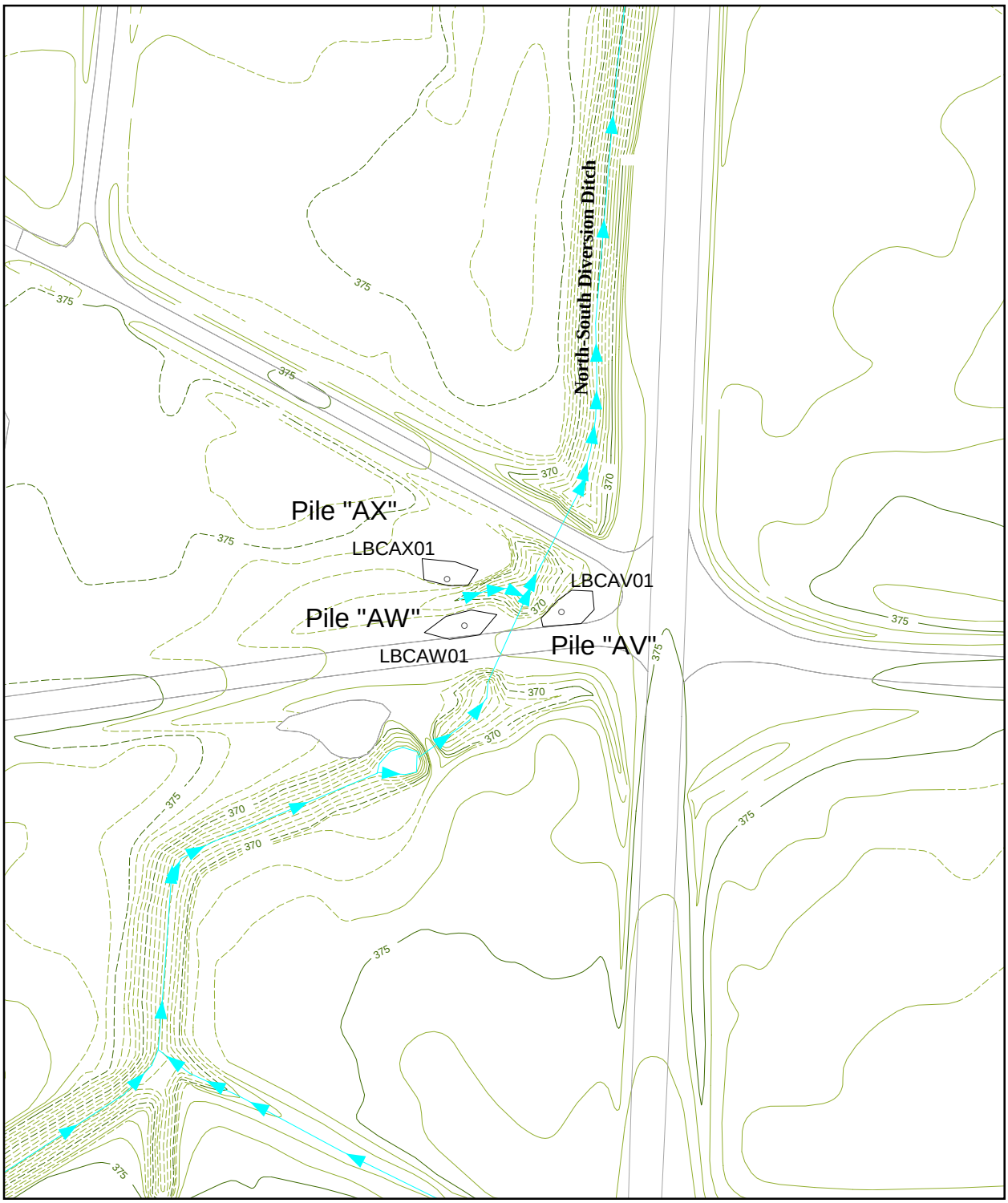
SUBUNIT 4

SURFACE WATER (direction of flow shown)
DOE BOUNDARY
PGDP BOUNDARY
ROAD
SURFACE CONTOUR (1 ft)
SURFACE CONTOUR (5 ft)
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM: PGDP
PROJECTION: n/a
DATE: 07/22/2009
FILE NAME: SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC
REFERENCES: PRS 2009;

250 0 250 Feet



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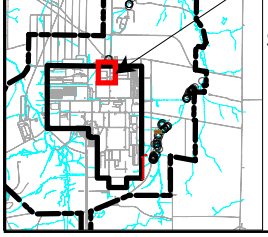


ADDENDUM 1B SOIL PILE AND SUBSURFACE SAMPLE LOCATIONS

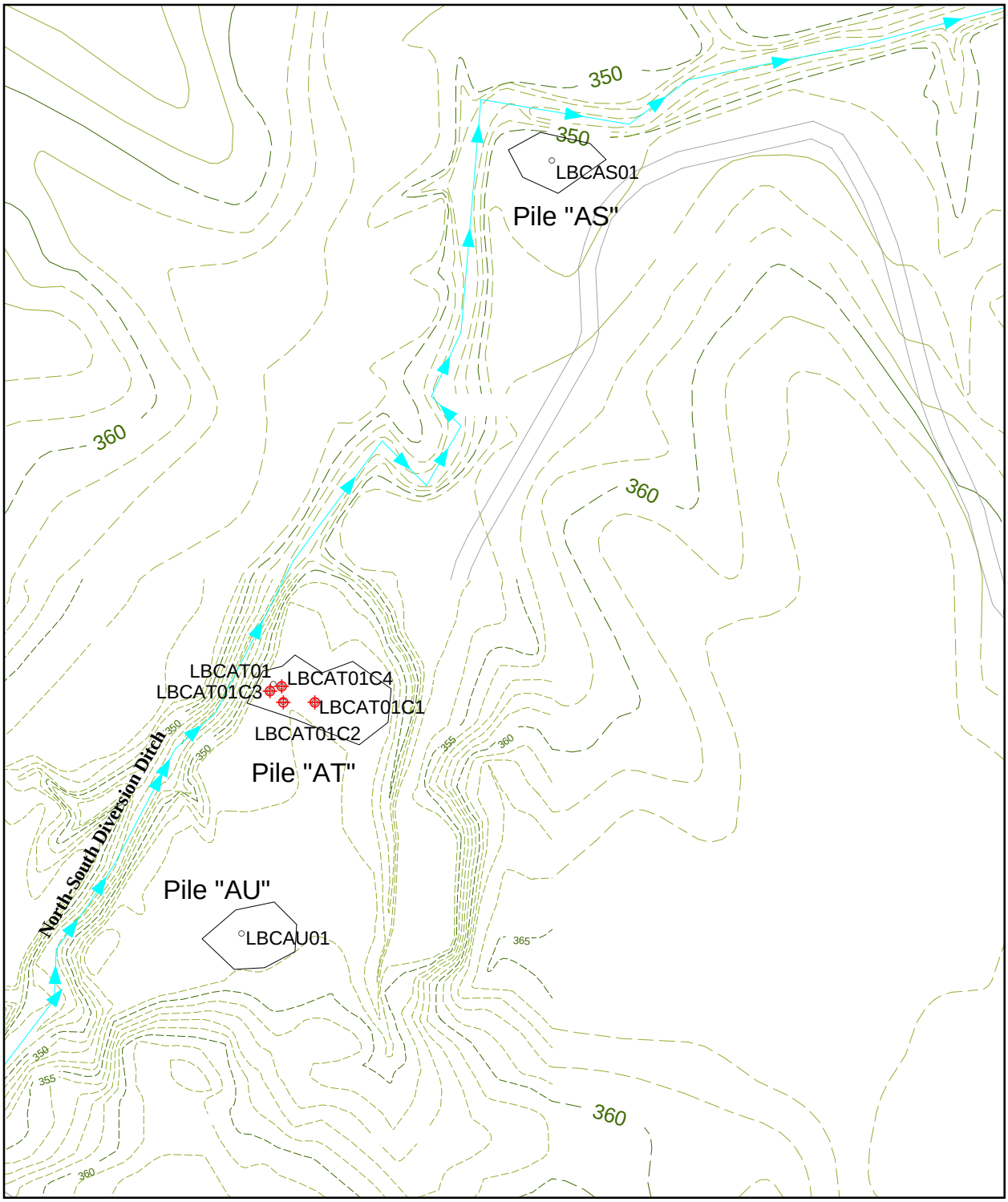
SUBUNIT 5

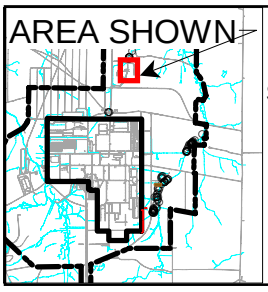
SURFACE WATER (direction of flow shown)
DOE BOUNDARY
PGDP BOUNDARY
ROAD
SURFACE CONTOUR (1 ft)
SURFACE CONTOUR (5 ft)
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM: PGDP
PROJECTION: n/a
DATE: 07/22/2009
FILE NAME: SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC
REFERENCES: PRS 2009;

100 0 100 Feet





ADDENDUM 1B SOIL PILE AND SUBSURFACE SAMPLE LOCATIONS

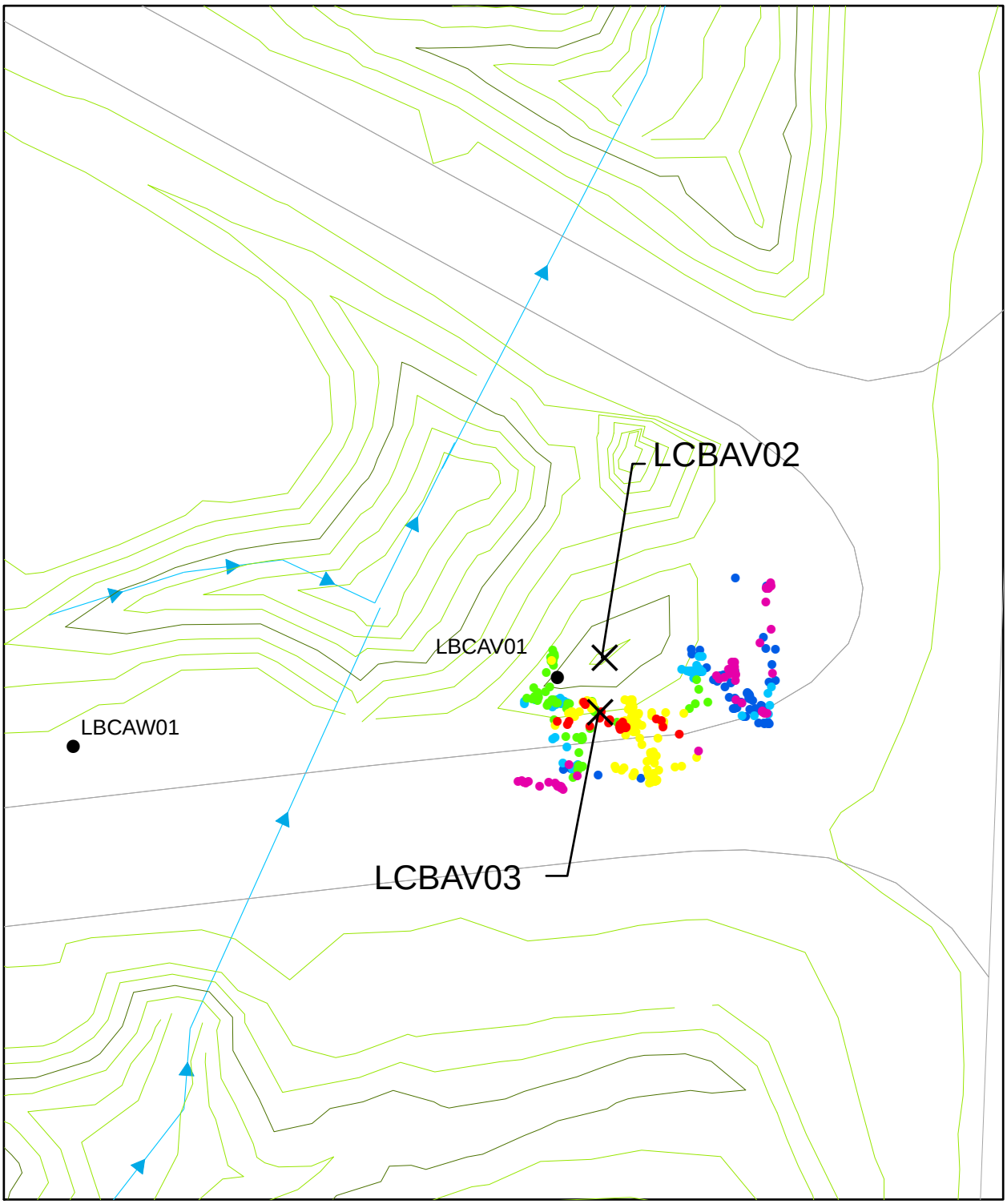
SUBUNIT 6

SURFACE WATER (direction of flow shown)
DOE BOUNDARY
PGDP BOUNDARY
ROAD
SURFACE CONTOUR (1 ft)
SURFACE CONTOUR (5 ft)
SAMPLE LOCATION
CONTINGENCY SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM: PGDP
PROJECTION: n/a
DATE: 09/09/2009
FILE NAME: SOILPILES\Add1B.apr
PADUCAH REMEDIATION SERVICES, LLC
REFERENCES: PRS 2009;

100 0 100 Feet



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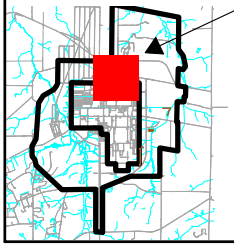


ADDENDUM 1B SOIL PILES

SOIL PILE AV

SURVEY RESULTS (CPM)

- 6129 - 6822
- 6822 - 7516
- 7516 - 8209
- 8209 - 8903
- 8903 - 9596
- 9596 - 10290

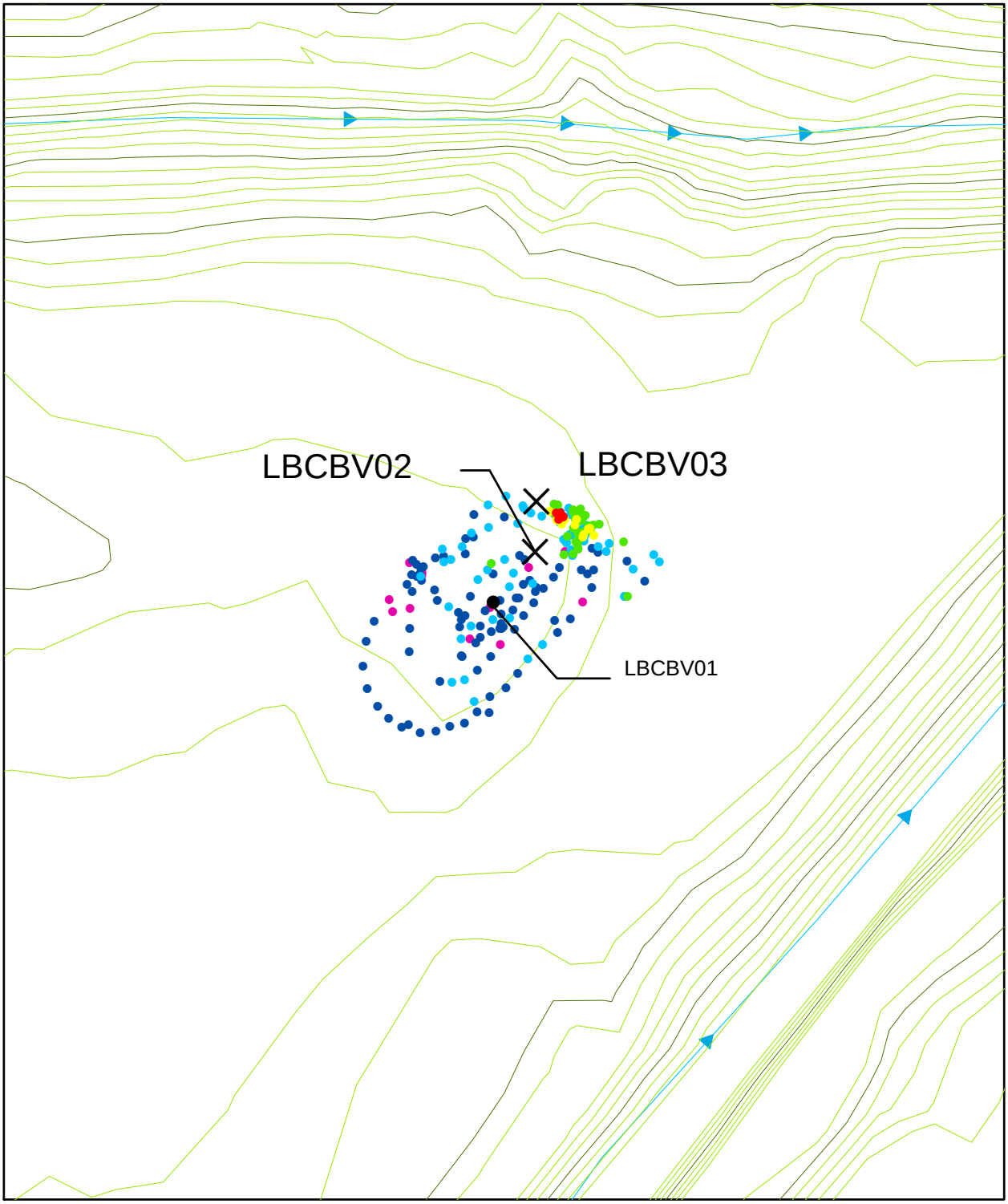
- SURFACE CONTOUR (5-ft interval)
- SURFACE CONTOUR (1-ft interval)
- PGDP AND DOE BOUNDARIES
- ROAD
- SURFACE WATER (direction of flow shown)
- SOIL PILE
- FIXED-BASE SAMPLE LOCATION MARCH 2010
- SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_AV.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

TRUE NORTH
PLANT NORTH

20 10 0 20 Feet



AREA SHOWN

ADDENDUM 1B SOIL PILES

SOIL PILE BV

SURVEY RESULTS (CPM)

- 10990 - 11987
- 11987 - 12985
- 12985 - 13982
- 13982 - 14979
- 14979 - 15977
- 15977 - 16974

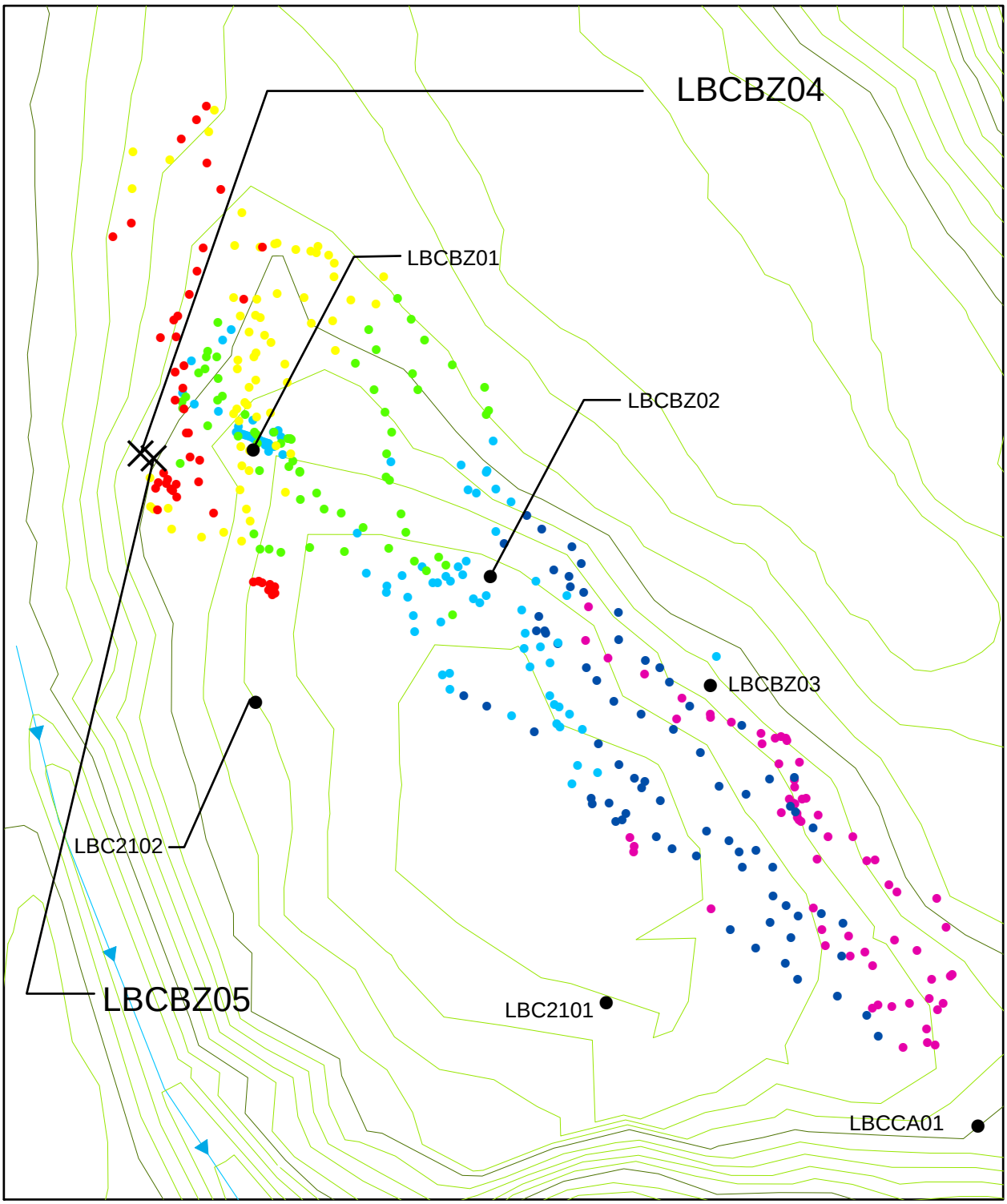
SURFACE CONTOUR (5-ft interval)
SURFACE CONTOUR (1-ft interval)
PGDP AND DOE BOUNDARIES
ROAD
SURFACE WATER (direction of flow shown)
SOIL PILE
FIXED-BASE
SAMPLE LOCATION MARCH 2010
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

TRUE NORTH
PLANT NORTH

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_BV.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

20 10 0 20 Feet



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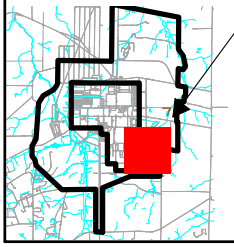


ADDENDUM 1B SOIL PILES

SOIL PILE BZ

SURVEY RESULTS (CPM)

- 15225 - 15966
- 15966 - 16668
- 16668 - 17314
- 17314 - 18153
- 18153 - 19098
- 19098 - 20362

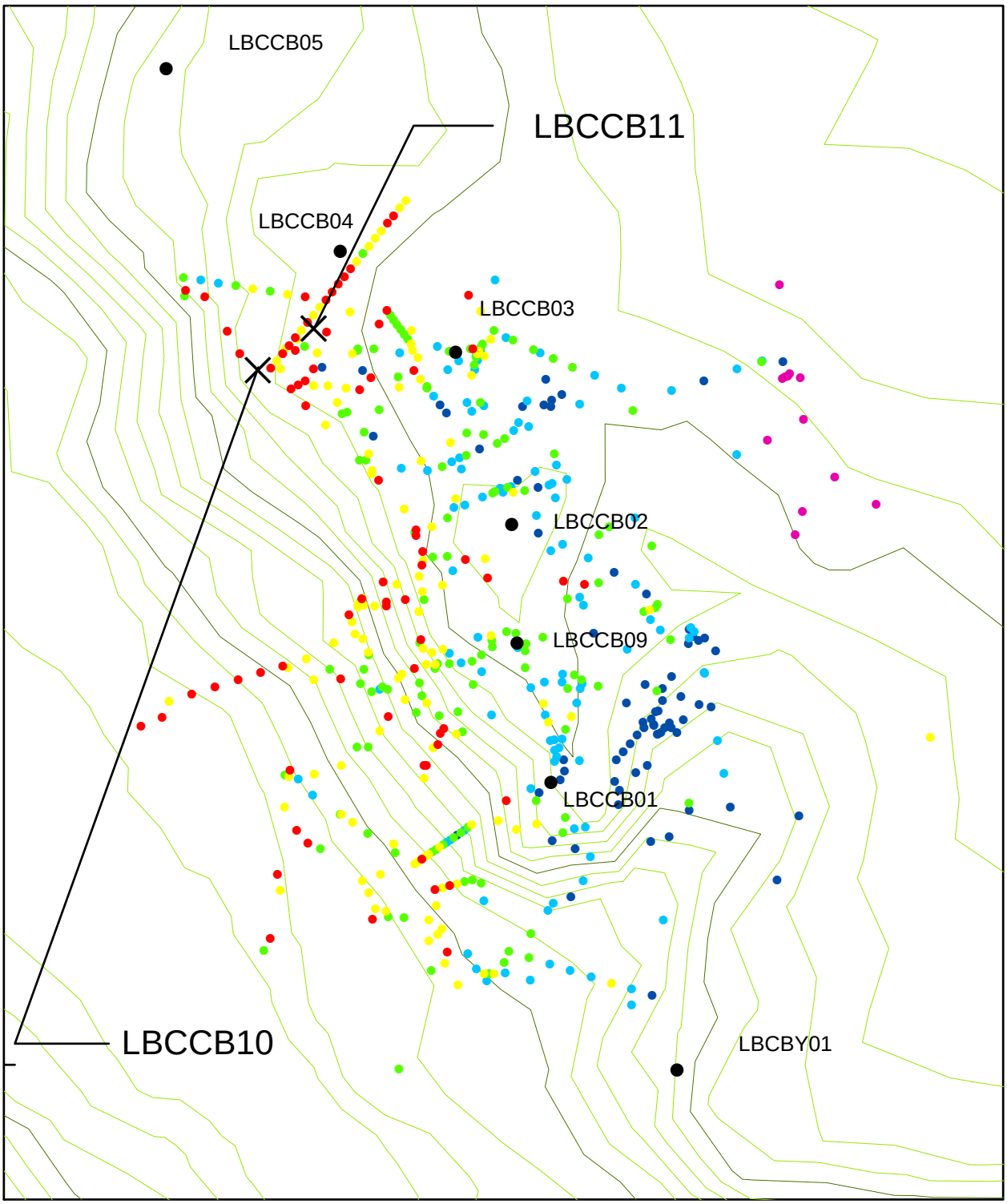
SURFACE CONTOUR (5-ft interval)
SURFACE CONTOUR (1-ft interval)
PGDP AND DOE BOUNDARIES
ROAD
SURFACE WATER (direction of flow shown)
SOIL PILE
FIXED-BASE
SAMPLE LOCATION MARCH 2010
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

TRUE NORTH
PLANT NORTH

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_BZ.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

20 10 0 20 Feet



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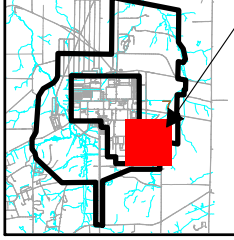


ADDENDUM 1B SOIL PILES

SOIL PILE CB

SURVEY RESULTS (CPM)

- 7279 - 10832
- 10832 - 15034
- 15034 - 15870
- 15870 - 16595
- 16595 - 17321
- 17321 - 18569

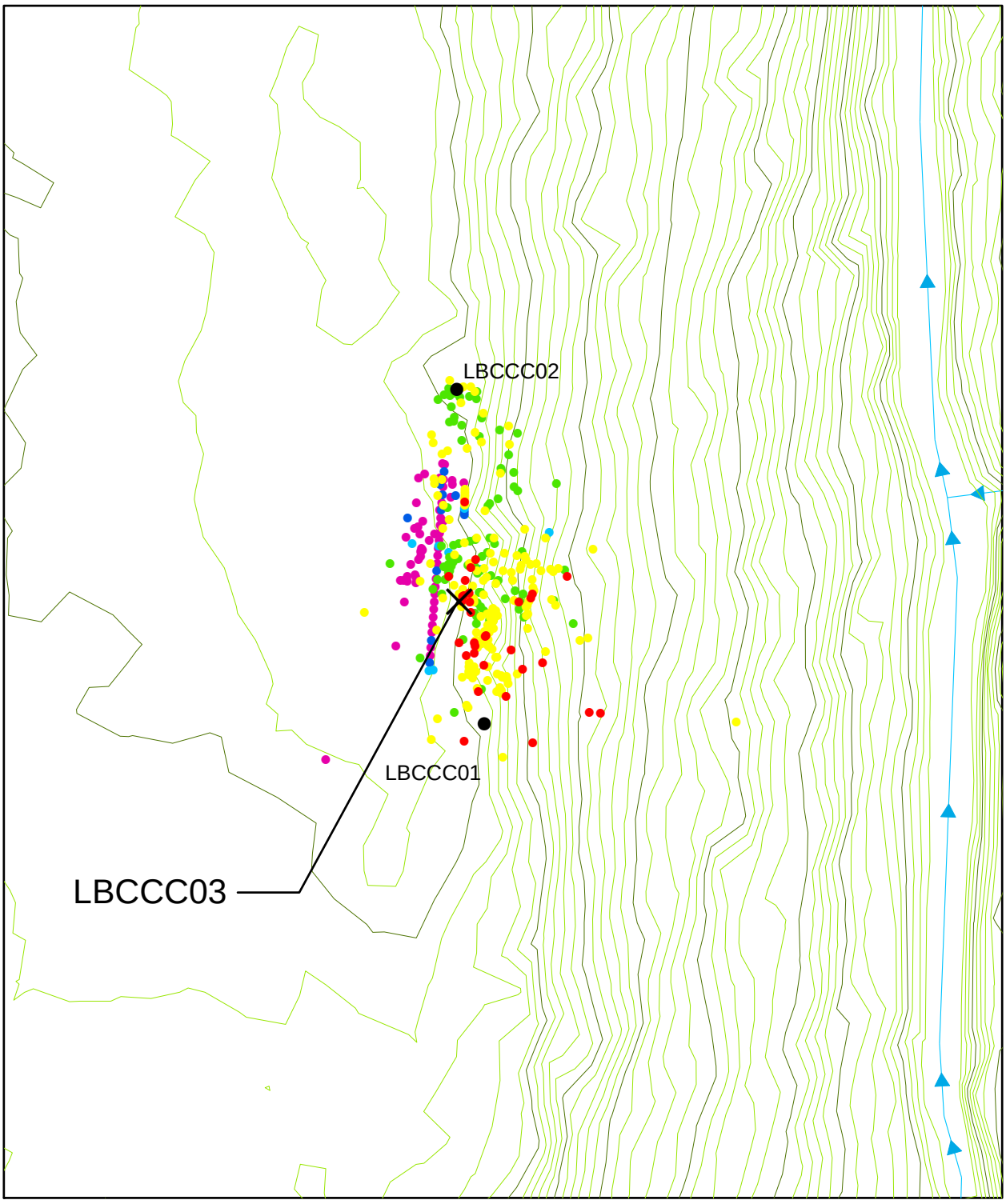
SURFACE CONTOUR (5-ft interval)
SURFACE CONTOUR (1-ft interval)
PGDP AND DOE BOUNDARIES
ROAD
SURFACE WATER (direction of flow shown)
SOIL PILE
FIXED-BASE
SAMPLE LOCATION MARCH 2010
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

TRUE NORTH
PLANT NORTH

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_CB.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

20 10 0 20 Feet



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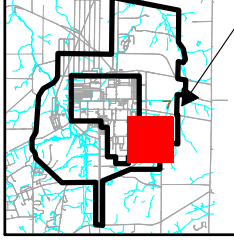


ADDENDUM 1B SOIL PILES

SOIL PILE CC

SURVEY RESULTS (CPM)
- 6248 - 7466
- 7466 - 8685
- 8685 - 9904
- 9904 - 11122
- 11122 - 12341
- 12341 - 14000

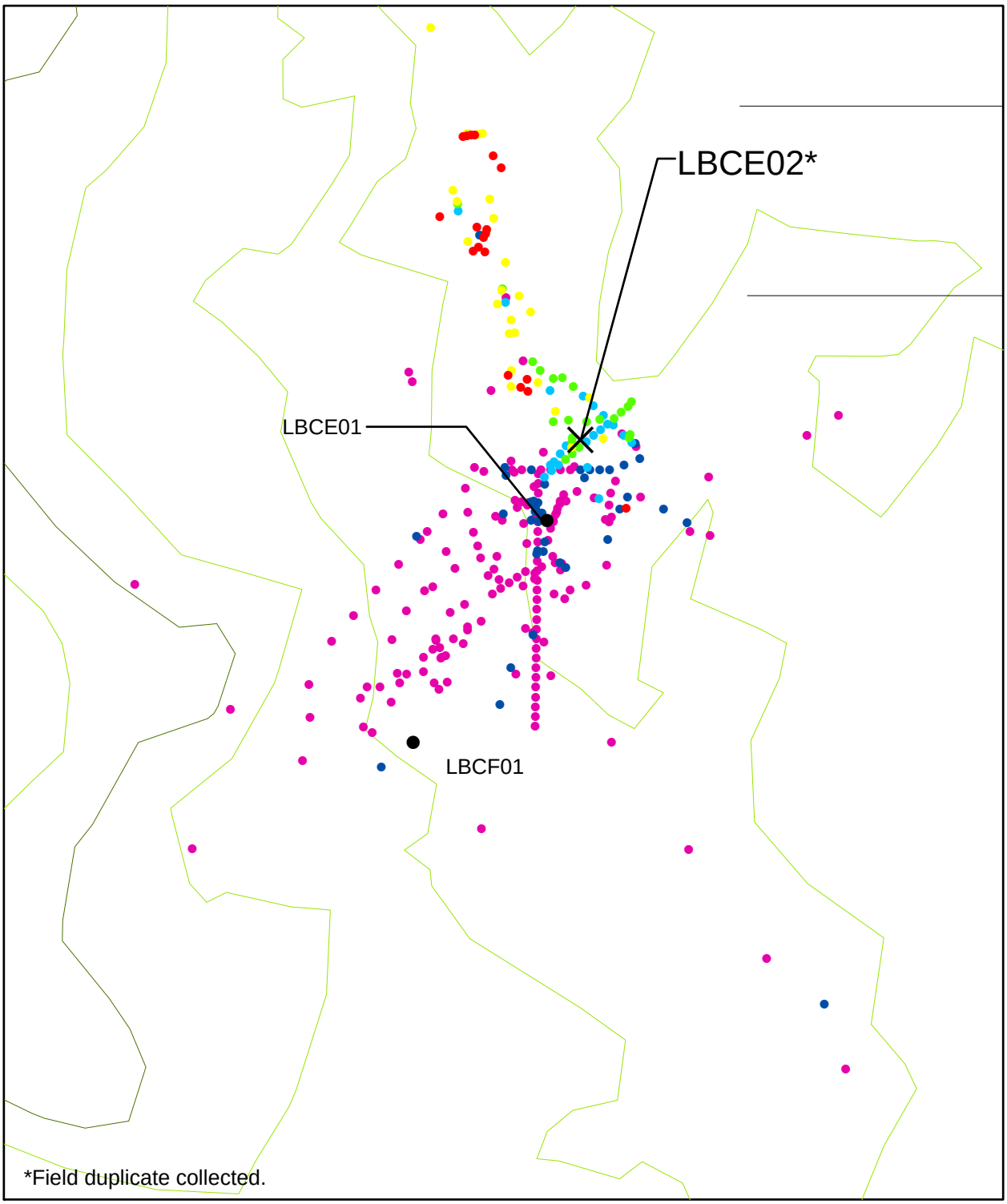
SURFACE CONTOUR (5-ft interval)
SURFACE CONTOUR (1-ft interval)
PGDP AND DOE BOUNDARIES
ROAD
SURFACE WATER (direction of flow shown)
SOIL PILE
FIXED-BASE
SAMPLE LOCATION MARCH 2010
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

TRUE NORTH
PLANT NORTH

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_CC.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

40 20 0 40 Feet



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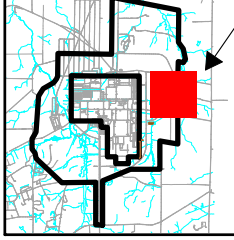

ADDENDUM 1B SOIL PILES

SOIL PILE E

SURVEY RESULTS (CPM)

- 8998 - 11119
- 11119 - 13343
- 13343 - 17025
- 17025 - 21112
- 21112 - 25648
- 25648 - 30446

SURFACE CONTOUR (5-ft interval)
SURFACE CONTOUR (1-ft interval)
PGDP AND DOE BOUNDARIES
ROAD
SURFACE WATER (direction of flow shown)
SOIL PILE
FIXED-BASE
SAMPLE LOCATION MARCH 2010
SAMPLE LOCATION

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

TRUE NORTH
PLANT NORTH

COORDINATE SYSTEM:	PGDP
PROJECTION:	n/a
DATE:	05/10/2010
FILE NAME:	SoilPiles Pile_E.mxd
PADUCAH REMEDIATION SERVICES, LLC	
REFERENCES:	PRS 2009;

20 10 0 20 Feet

APPENDIX D

SCREENING OF DETECTED CHEMICALS EXCEEDING BACKGROUND, EXCLUDING SOIL PILE O WITHIN AOC 541

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SCREENING OF DETECTED CHEMICALS EXCEEDING BACKGROUND, EXCLUDING SOIL PILE O WITHIN AOC 541

The summary of data collected for the Addendum 1-B Soil Pile Sampling and Addendum 1B Soil Piles Additional Evaluation, excluding those samples collected for soil pile O within Area of Concern (AOC) 541, is presented on Table D.1. This table summarizes fixed laboratory data and shows only those analyses that exceeded background values or one of the no action level (NAL) criteria if no background value is available. All screening reported in this appendix excludes data from soil pile O within AOC 541. A summary of the screening for AOC 541 data is included in DOE/LX/07-0246 (Appendix A) and in Appendix E.

Table D.1. presents minimum, maximum, and average summaries of detected concentrations of chemicals. Additionally the table shows the frequencies of detection and exceedance of screening criteria. An incremental adjustment was used in comparing detected uranium isotope results with screening values. Additional information regarding uranium isotope results is included in the uncertainties section.

Background Exceedances for Addendum 1-B Soil Pile Sampling, excluding Soil Pile O within AOC 541

Twenty-four chemicals exceeded Paducah Gaseous Diffusion Plant (PGDP) background values[1] during the Addendum 1-B sampling, excluding sampling of soil pile O within AOC 541: 17 metals and 7 radionuclides. Seventeen of those chemicals exceeded background in both surface and subsurface sampling. The 24 chemicals are listed in Table D.2. The locations of these background exceedances are shown in Attachment D1, Figures D1.1 through D1.41. Additionally, locations of total polychlorinated biphenyl (PCB) and total polycyclic aromatic hydrocarbon (PAH) detections are shown in Figures D1.42 and D1.43. Plots of results from Addendum 1-B sampling together with evaluation criteria values are presented in Attachment D2, Figures D2.1 through D2.41.

Of the soil piles with results exceeding background, Soil Pile AT has the most background exceedances with 30 (16 surface exceedances and 14 subsurface exceedances). The next highest ranking soil pile is J, having 20 background exceedances (7 surface exceedances and 13 subsurface exceedances). Soil Pile 20 has 12 background exceedances (5 surface exceedances and 7 subsurface exceedances); Soil Pile D has 16 background exceedances (2 surface and 14 subsurface); and the soil pile at Outfall K013 has 15 background exceedances (5 surface and 10 subsurface). Thirty other soil piles have fewer than 10 background exceedances.

Five soil piles have no background exceedances. Those soil piles are 17, AR (AOC 492), AU, BU, and K.

The following text describes and illustrates the spatial distribution of the soil piles having background and/or NAL exceedances, with accompanying charts of results compared to background. The 2001 Risk Methods Document (DOE 2001) was the primary source used for comparing Addendum 1-B results with background and NALs; however, in order to better focus on chemicals presenting potential concern for the soil piles, additional screening values were considered. These screening values used for comparison are the draft site background values and NALs for PGDP published for review in 2009 and the generic statewide ambient background values published by the Kentucky Natural Resources and Environmental Protection Cabinet [now called the Kentucky Energy and Environment Cabinet (KEEC)] (KEEC 2004)

[1] Background values are taken from the 2001 Risk Methods Document (DOE 2001).

Table D.1. Data Exceeding Screening Criteria, excluding Soil Pile O within AOC 541

Analysis	Units	Detected Results			Frequency of Detection[a]	Exceeds Background[b]	Exceedances of No Action Levels[c]				Detection Limit Range
		Minimum	Maximum	Average			Site-Specific Teen Recreational User[d]	PGDP Teen Recreational User[e]	Site-Specific Wildlife Worker[d]	PGDP Child Resident[e]	
SURFACE SAMPLES											
Metals											
Aluminum	mg/kg	3.89E+03	1.34E+04	7.67E+03	45/45	1/45	0/45	45/45	0/45	45/45	17.8 - 200
Arsenic	mg/kg	2.00E+00	4.30E+01	5.99E+00	44/45	1/45	44/45	44/45	6/45	44/45	0.893 - 9.7
Beryllium	mg/kg	4.55E-01	2.12E+00	7.41E-01	7/45	3/45	0/45	3/45	0/45	7/45	0.444 - 0.499
Cadmium	mg/kg	4.84E-01	1.96E+00	6.92E-01	12/45	12/45	n/a	0/45	n/a	0/45	0.446 - 2.48
Chromium	mg/kg	5.27E+00	2.85E+02	2.20E+01	45/45	10/45	n/a	1/45	n/a	3/45	2.22 - 2.49
Copper	mg/kg	4.31E+00	4.63E+01	9.29E+00	39/45	1/45	n/a	0/45	n/a	0/45	2.23 - 24.3
Lead	mg/kg	6.41E+00	6.16E+01	1.30E+01	45/45	3/45	n/a	2/45	2/45	2/45	0.893 - 9.79
Mercury	mg/kg	1.50E-02	2.30E-01	2.85E-02	38/45	1/45	n/a	0/45	n/a	1/45	0.013 - 0.017
Selenium	mg/kg	2.82E+00	2.82E+00	2.82E+00	1/45	1/45	n/a	0/45	n/a	0/45	0.893 - 4.96
Thallium	mg/kg	2.36E+00	2.36E+00	2.36E+00	1/45	1/45	n/a	1/45	n/a	1/45	1.79 - 9.93
Uranium	mg/kg	9.77E-01	2.08E+02	1.14E+01	32/45	10/45	0/45	3/45	0/45	15/45	0.897 - 47.6
Vanadium	mg/kg	8.45E+00	7.40E+01	1.89E+01	45/45	1/45	0/45	45/45	0/45	45/45	2.22 - 2.49
Zinc	mg/kg	1.91E+01	1.98E+02	3.44E+01	42/45	4/45	n/a	0/45	n/a	0/45	17.8 - 20
PCBs											
PCB, Total	mg/kg	2.40E-01	1.58E+00	9.29E-01	6/55	n/a	5/55	6/55	0/55	6/55	0.1 - 0.13
PCB-1254	mg/kg	1.00E-01	8.70E-01	4.98E-01	5/55	n/a	n/a	4/55	n/a	5/55	0.07 - 0.09
PCB-1260	mg/kg	8.00E-02	1.15E+00	4.49E-01	7/55	n/a	n/a	6/55	n/a	7/55	0.07 - 0.1
Radionuclides											
Cesium-137	pCi/g	3.42E-02	6.47E-01	2.20E-01	34/55	2/55	0/55	14/55	0/55	34/55	0.0199 - 0.118
Plutonium-239/240	pCi/g	1.77E-02	2.94E-02	2.31E-02	4/55	1/55	0/55	0/55	0/55	0/55	0.0107 - 0.0142
Technetium-99	pCi/g	5.71E-01	8.75E+00	3.19E+00	22/55	11/55	0/55	0/55	0/55	0/55	0.536 - 2.35
Thorium-230	pCi/g	1.50E-01	1.69E+00	4.44E-01	54/55	1/55	0/55	0/55	0/55	0/55	0.0555 - 0.197
Uranium	pCi/g	2.46E-01	6.43E+02	2.98E+01	41/55	n/a	n/a	n/a	n/a	n/a	0.224 - 1.5
Uranium-234[f]	pCi/g	1.15E-01	5.34E+01	2.52E+00	46/55	3/55	0/55	1/55	0/55	3/55	0.0999 - 0.671
Uranium-235[f]	pCi/g	1.77E-02	8.96E+00	6.96E-01	26/55	5/55	1/55	1/55	1/55	18/55	0.0113 - 0.133
Uranium-238[f]	pCi/g	1.19E-01	5.81E+02	2.24E+01	49/55	24/55	2/55	6/55	2/55	49/55	0.0983 - 0.701
Semivolatile Organics											
Benzo(a)anthracene	mg/kg	5.20E-01	7.20E-01	6.07E-01	3/45	n/a	n/a	3/45	n/a	3/45	0.46 - 0.5
Benzo(a)pyrene	mg/kg	6.10E-01	6.10E-01	6.10E-01	1/45	n/a	n/a	1/45	n/a	1/45	0.46 - 0.5
Benzo(b)fluoranthene	mg/kg	5.10E-01	9.80E-01	7.28E-01	5/45	n/a	n/a	5/45	n/a	5/45	0.46 - 0.5
Total PAHs[g]	mg/kg	5.10E-02	7.81E-01	2.32E-01	5/45	n/a	4/45	5/45	1/45	5/45	n/a

Table D.1. Data Exceeding Screening Criteria, excluding Soil Pile O within AOC 541 (Continued)

Analysis	Units	Detected Results					Exceedances of No Action Levels[c]				
		Minimum	Maximum	Average	Frequency of Detection[a]	Exceeds Background[b]	Site-Specific Teen Recreational User[d]	PGDP Teen Recreational User[e]	Site-Specific Wildlife Worker[d]	PGDP Child Resident[e]	Detection Limit Range
SUBSURFACE SAMPLES											
Metals											
Aluminum	mg/kg	4.17E+03	1.29E+04	7.90E+03	48/48	3/48	0/48	48/48	0/48	48/48	17.9 - 199
Arsenic	mg/kg	1.75E+00	1.91E+01	5.62E+00	47/48	6/48	46/48	47/48	6/48	47/48	0.895 - 4.9
Beryllium	mg/kg	4.68E-01	1.78E+00	7.29E-01	9/48	2/48	0/48	4/48	0/48	9/48	0.442 - 0.499
Cadmium	mg/kg	4.98E-01	1.66E+00	6.66E-01	15/48	15/48	n/a	0/48	n/a	0/48	0.447 - 2.45
Calcium	mg/kg	1.58E+02	3.53E+04	4.60E+03	47/48	9/48	n/a	n/a	n/a	n/a	88.3 - 99.8
Chromium	mg/kg	5.97E+00	3.14E+02	3.13E+01	48/48	6/48	n/a	1/48	n/a	3/48	2.21 - 2.5
Copper	mg/kg	4.09E+00	4.42E+01	9.60E+00	42/48	1/48	n/a	0/48	n/a	0/48	2.24 - 24.2
Iron	mg/kg	5.42E+03	3.14E+04	1.21E+04	48/48	1/48	0/48	48/48	0/48	48/48	17.7 - 20
Lead	mg/kg	6.50E+00	4.06E+01	1.23E+01	48/48	2/48	n/a	0/48	0/48	0/48	0.895 - 9.68
Magnesium	mg/kg	4.77E+02	2.28E+03	1.01E+03	48/48	3/48	n/a	n/a	n/a	n/a	4.42 - 4.99
Manganese	mg/kg	1.44E+02	1.13E+03	4.50E+02	48/48	2/48	0/48	48/48	0/48	48/48	2.21 - 2.5
Mercury	mg/kg	1.50E-02	1.70E-01	2.64E-02	37/48	1/48	n/a	0/48	n/a	1/48	0.012 - 0.017
Selenium	mg/kg	2.74E+00	2.74E+00	2.74E+00	1/48	1/48	n/a	0/48	n/a	0/48	0.895 - 4.9
Uranium	mg/kg	9.71E-01	1.11E+02	1.24E+01	33/48	14/48	0/48	6/48	0/48	18/48	0.895 - 47.5
Vanadium	mg/kg	9.08E+00	6.39E+01	1.85E+01	48/48	1/48	0/48	48/48	0/48	48/48	2.21 - 2.5
Zinc	mg/kg	1.93E+01	2.37E+02	4.15E+01	43/48	4/48	n/a	0/48	n/a	0/48	17.7 - 20
PCBs											
PCB, Total[h]	mg/kg	1.30E-01	3.54E+00	1.31E+00	8/48	n/a	6/48	8/48	1/48	8/48	0.12 - 0.13
PCB-1248	mg/kg	1.95E+00	1.95E+00	1.95E+00	1/48	n/a	n/a	1/48	n/a	1/48	0.1 - 0.1
PCB-1254	mg/kg	1.20E-01	1.23E+00	6.02E-01	7/48	n/a	n/a	6/48	n/a	7/48	0.09 - 0.09
PCB-1260	mg/kg	1.60E-01	7.80E-01	4.22E-01	7/48	n/a	n/a	7/48	n/a	7/48	0.1 - 0.1
Radionuclides											
Cesium-137	pCi/g	6.84E-02	4.91E-01	2.09E-01	18/48	4/48	0/48	7/48	0/48	18/48	0.0268 - 0.138
Technetium-99	pCi/g	5.47E-01	3.13E+00	1.45E+00	9/48	1/48	0/48	0/48	0/48	0/48	0.536 - 0.707
Uranium	pCi/g	2.45E-01	4.95E+01	4.80E+00	34/48	n/a	n/a	n/a	n/a	n/a	0.224 - 0.328
Uranium-234[f]	pCi/g	1.13E-01	6.70E+00	6.68E-01	41/48	4/48	0/48	0/48	0/48	3/48	0.112 - 0.151
Uranium-235[f]	pCi/g	2.13E-02	5.91E-01	1.19E-01	19/48	6/48	0/48	0/48	0/48	19/48	0.0116 - 0.0518
Uranium-238[f]	pCi/g	1.03E-01	4.42E+01	3.34E+00	42/48	19/48	2/48	9/48	2/48	42/48	0.0984 - 0.125

Table D.1. Data Exceeding Screening Criteria, excluding Soil Pile O within AOC 541 (Continued)

		Detected Results					Exceedances of No Action Levels[c]				
Analysis	Units	Minimum	Maximum	Average	Frequency of Detection[a]	Exceeds Background[b]	Site-Specific Teen Recreational User[d]	PGDP Teen Recreational User[e]	Site-Specific Wildlife Worker[d]	PGDP Child Resident[e]	Detection Limit Range
Semivolatile Organics											
Benzo(a)anthracene	mg/kg	1.70E+00	1.70E+00	1.70E+00	1/48	n/a	n/a	1/48	n/a	1/48	0.48 - 0.5
Benzo(a)pyrene	mg/kg	7.80E-01	7.80E-01	7.80E-01	1/48	n/a	n/a	1/48	n/a	1/48	0.48 - 0.5
Benzo(b)fluoranthene	mg/kg	5.60E-01	1.80E+00	1.19E+00	3/48	n/a	n/a	3/48	n/a	3/48	0.48 - 0.5
Total PAHs[g]	mg/kg	5.60E-02	1.14E+00	5.98E-01	3/48	n/a	1/48	3/48	1/48	3/48	n/a

[a] Frequency of Detection was determined from the number of detected samples over the entire number of samples. Field duplicates were not counted in the total. The maximum result was used between the duplicate and original sample.

[b] Background Values from DOE 2001. Samples whose bottom depth less than or equal to 1 ft screened against surface values; those with bottom depth greater than 1 ft screened against subsurface values.

[c] Frequency of Exceedance of No Action Levels does not consider exceedances of background level.

[d] Site-Specific Teen Recreational User and Site-Specific Wildlife Worker No Action Levels from DOE 2008.

[e] PGDP Teen Recreational User and Child Resident No Action Levels from DOE 2001. Values for thallium screened against No Action Levels for thallium chloride.

[f] Isotopic uranium results were compared to screening values using incremental adjustments, as appropriate.

[g] Total PAHs calculated using the toxicity equivalence factors according to DOE 2001.

[h] PCB, Total minimum subsurface value is lower than the PCB-1248 minimum subsurface value because the sample containing the minimum PCB, Total value did not detect PCB-1248. Its value is from PCB-1254.

n/a = not applicable or not available.

Table D.2. Addendum 1-B Chemicals Exceeding Background [a]

Analysis	Depth	Frequency Exceeding Background[a]
Aluminum	Surface	1/45
	Subsurface	3/48
Arsenic	Surface	1/45
	Subsurface	6/48
Beryllium	Surface	3/45
	Subsurface	2/48
Cadmium	Surface	12/45
	Subsurface	15/48
Calcium	Subsurface	9/48
Chromium	Surface	10/45
	Subsurface	6/48
Copper	Surface	1/45
	Subsurface	1/48
Iron	Subsurface	1/48
Lead	Surface	3/45
	Subsurface	2/48
Magnesium	Subsurface	3/48
Manganese	Subsurface	2/48
Mercury	Surface	1/45
	Subsurface	1/48
Selenium	Surface	1/45
	Subsurface	1/48
Thallium	Surface	1/45
Uranium	Surface	10/45
	Subsurface	14/48
Vanadium	Surface	1/45
	Subsurface	1/48
Zinc	Surface	4/45
	Subsurface	4/48
Cesium-137	Surface	2/55
	Subsurface	4/48
Plutonium-239/240	Surface	1/55
Technetium-99	Surface	11/55
	Subsurface	1/48
Thorium-230	Surface	1/55
Uranium-234	Surface	3/55
	Subsurface	4/48
Uranium-235	Surface	5/55
	Subsurface	6/48
Uranium-238	Surface	24/55
	Subsurface	19/48

[a] Background values for this analysis were taken from the provisional background values provided in DOE 2001. Isotopic uranium results were compared to screening values using incremental adjustments, as appropriate. Material presented later in this section considers estimates of background concentrations from other sources.

and values expected from global fallout (ANL 2007). The background screen is not meant necessarily to screen against the most conservative of the background values available, but to screen results that are below values that reasonably could be expected to occur naturally.

To apply the guidance established by KEEC, the criteria used are listed below:

1. The mean site concentration for inorganic constituents must be below the 95% upper confidence limit (UCL) of the mean concentrations of background for inorganic constituents.

2. At least half of the data points should be less than the 60th percentile.

3. No data points should be above the upper bound value (95th percentile).

Aluminum–Surface. Aluminum values in surface soil samples exceed the background value of 13,000 mg/kg in only one of 45 samples (see Figures D1.1 and D2.1). The exceeding value is 13,400 mg/kg from the soil pile at Outfall K013. This value is below the draft background value of 16,045 mg/kg and should not be considered a chemical of potential concern (COPC) (DOE 2009).

Aluminum–Subsurface. Aluminum values in subsurface soil samples exceed the background value of 12,000 mg/kg in three of 48 samples (see Figures D1.2 and D2.2). The exceeding values range from 12,100 to 12,900 mg/kg. All of these values are from samples collected within soil piles at Outfall K013. The mean site concentration for subsurface aluminum is 7,904 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 11,314 mg/kg, and 42 of the 48 results (more than half) were not detected or less than the 60th percentile of 10,800 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These aluminum values are below the 95th percentile of the generic statewide ambient background value (21,000 mg/kg) (KEEC 2004); therefore, aluminum is not present in the Addendum 1-B soil piles in the subsurface as a COPC.

Arsenic–Surface. Arsenic values in surface soil samples exceed the background value of 12 mg/kg in only one of 45 samples (see Figures D1.3 and D2.3). The exceeding value is 43 mg/kg. The soil pile from which this sample was collected is Soil Pile AT. Since this value is above all available criteria for background for arsenic, this value will be retained for additional evaluation. All other arsenic values are below background and are not present in the Addendum 1-B soil piles on the surface as a COPC.

Arsenic–Subsurface. Arsenic values in subsurface soil samples exceed the background value of 7.9 mg/kg in six of 48 samples (see Figures D1.4 and D2.4). The exceeding values range from 7.96 to 19.1 mg/kg. The criteria for applying ambient background values established by KEEC were met [the mean site concentration for subsurface arsenic is 5.62 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 9.4 mg/kg, and 42 of the 48 results (more than half) were not detected or less than the 60th percentile of 8.3 mg/kg]. All subsurface arsenic values are below the 95th percentile of the generic statewide ambient background value (21.2 mg/kg) (KEEC 2004); therefore, arsenic is not present in the Addendum 1-B soil piles in the subsurface as a COPC, though it is a COPC for surface soil at Soil Pile AT. It should be noted, however, that one of the soil piles showing a background exceedance in subsurface soil for arsenic, Soil Pile AT, also showed a background exceedance in the surface soil for arsenic. The remaining locations from which the exceeding samples were collected are from different soil piles and are not related.

Beryllium–Surface. Beryllium values in surface soil samples exceed the background value of 0.67 mg/kg in three of 45 samples. The exceeding values are 0.677, 0.685, and 2.12 mg/kg. The locations from which the exceeding samples were collected are from different soil piles and are not related (Figure D1.5). As

shown in Figure D2.5, two of the three exceedances are below the draft surface beryllium value for PGDP background of 0.9 mg/kg and are well below the 95th percentile of the generic statewide ambient background value (1.8 mg/kg) (DOE 2009; KEEC 2004). The criteria for applying ambient background values established by KEEC were met [the mean site concentration for surface beryllium is 0.741 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.83 mg/kg, and 44 of the 45 results (more than half) were not detected or less than the 60th percentile of 0.75 mg/kg].

The remaining exceeding value, 2.12 mg/kg was collected from Soil Pile AT. Since this value is above all available criteria for evaluating background values for beryllium, this value will be retained for additional evaluation. No other beryllium values are present in the Addendum 1-B soil piles on the surface as a COPC.

Beryllium–Subsurface. Beryllium values in subsurface soil samples exceed the background value of 0.69 mg/kg in two of 48 samples. The exceeding values are 1.15 and 1.78 mg/kg. The locations from which the exceeding samples were collected are from different soil piles and are not related (Figure D1.6). The mean site concentration for subsurface beryllium is 0.729 mg/kg which is below Kentucky's 95% UCL of the mean concentrations of background of 0.83 mg/kg, and 46 of the 48 results (more than half) were not detected or less than the 60th percentile of 0.75 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These 1.15 and 1.78 mg/kg exceedances are below the 95th percentile of the generic statewide ambient background value of 1.8 mg/kg (See Figure D2.6) (KEEC 2004).

Beryllium values are not present in the subsurface of Addendum 1-B soil piles as a COPC, though it is a COPC for surface soil at Soil Pile AT. It should be noted that Soil Pile AT reported values above site-specific background in both surface and subsurface soil for beryllium.

Cadmium–Surface. Cadmium values in surface soil samples exceed the background value of 0.21 mg/kg in 12 of 45 samples. The exceeding values were the only detects of cadmium in surface samples because the background value is lower than the detection limit for cadmium. Detected values in the samples range from 0.484 to 1.96 mg/kg. The locations from which the exceeding samples were collected are from different soil piles and are not related (Figure D1.7). The criteria for applying ambient background values established by KEEC were met [the mean site concentration for surface cadmium is 0.692 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.78 mg/kg, and 33 of the 45 results (more than half) were not detected or less than the 60th percentile of 0.27 mg/kg]. All detected values, however, are below the 95th percentile of the generic statewide ambient background value (3.9 mg/kg) (KEEC 2004), as shown on Figure D2.7; therefore, cadmium is not present in the Addendum 1-B soil piles as a COPC on the surface.

Cadmium–Subsurface. Cadmium values in subsurface soil samples exceed the background value of 0.21 mg/kg in 15 of 48 samples. The exceeding values were the only detects of cadmium in the subsurface because the background value is lower than the detection limit for cadmium. Detected values in the samples range from 0.498 to 1.66 mg/kg. The mean site concentration for subsurface cadmium is 0.666 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.78 mg/kg, and 33 of the 48 results (more than half) were not detected or less than the 60th percentile of 0.27 mg/kg, which meets the criteria for applying ambient background values established by KEEC. All detected values, however, are below the 95th percentile of the generic statewide ambient background value (3.9 mg/kg) (KEEC 2004) therefore, cadmium is not present in the Addendum 1-B soil piles as a COPC in the subsurface.

Figure D1.8 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.8 graphically shows the results with the background value and other comparison

values. It should be noted that the highest reported values for cadmium in both surface and subsurface were collected from Soil Pile AT.

Calcium–Subsurface. Calcium values in subsurface soil samples exceed the background value of 6,100 mg/kg in nine of 48 samples. The exceeding values range from 6,350 to 35,300 mg/kg. Although the exceeding values are primarily located within close proximity, calcium does not have risk-based action and no-action levels because it is an essential element (DOE 2001). Further, calcium is not listed with a generic statewide ambient background value; therefore, though calcium is present in the Addendum 1-B soil piles above background, it is not considered a COPC.

Figure D1.9 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.9 graphically shows the results with the background value and other comparison values.

Chromium–Surface. Chromium values in surface soil samples exceed the background value of 16 mg/kg in ten of 45 samples. The samples exceeding background ranged from 17.7 to 285 mg/kg. All values except three were below the 95th percentile of the generic statewide ambient background value (40 mg/kg) (KEEC 2004). Excluding the three values exceeding statewide ambient background, the mean site concentration for surface chromium is 14.4 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 21.3 mg/kg, and 36 of the remaining 42 results (more than half) were not detected or less than the 60th percentile of 19.3 mg/kg.

The exceeding values, 65.4, 115, and 285 mg/kg were collected from Soil Piles BW, J, and 20, respectively. The current PGDP teen recreational user NAL for chromium is 227 mg/kg, and the proposed, updated PGDP teen recreational user NAL for chromium if 501 mg/kg (DOE 2001; DOE 2009). Although chromium is present in the Addendum 1-B soil piles above all available background criteria for three of the soil piles, it should not be considered a COPC at Soil Pile BW and J since it is below the NAL screening criteria. The value for Soil Pile 20, however, will be retained for additional evaluation.

These values exceeding background also exceed the current PGDP child resident NAL of 60.5 mg/kg. Two of the three values exceed the updated PGDP child resident NAL of 109 mg/kg. Chromium in surface soil from Soil Piles BW, J, and 20 should be further evaluated as a COPC since they exceed the current child resident NAL.

Figure D1.10 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.10 graphically shows the results with the background value and other comparison values.

Chromium–Subsurface. Chromium values in subsurface soil samples exceed the background value of 43 mg/kg in only six of 48 samples (ranging 45 to 314 mg/kg). These samples were collected from Soil Piles K013, BW, D, J, and 20, as shown on Figure D1.11.

The current PGDP teen recreational user NAL for chromium is 227 mg/kg, and the proposed, updated PGDP teen recreational user NAL for chromium if 501 mg/kg (DOE 2001; DOE 2009). Although chromium is present in the Addendum 1-B soil piles above all available background criteria for five samples from four of the soil piles, it should not be considered a COPC at Soil Piles K013, BW, D, and J since it is below the NAL screening criteria at those locations (see Figure D2.11). The value for the sample collected at Soil Pile 20 (314 mg/kg) will be retained for additional evaluation.

NAL values for the PGDP child resident are 60.5 mg/kg (current value) and 109 mg/kg (updated value) (DOE 2001; DOE 2009). Chromium in subsurface soil from Soil Piles J and 20 should be further evaluated as a COPC, as chromium was detected in these piles at 122 and 125 mg/kg and 314 mg/kg, respectively. The remaining values above background are less than the proposed, updated child resident NAL.

Copper–Surface. Copper values in surface soil samples exceed the background value of 19 mg/kg in one of the 45 samples. The exceeding value (46.3 mg/kg) was collected from Soil Pile AT, as shown on Figure D1.12. Although copper is present in the surface soil of Soil Pile AT above all available background criteria, it is below the current PGDP teen recreational user NAL of 331 mg/kg and the proposed, updated PGDP teen recreational user NAL of 1,130 mg/kg (DOE 2001; DOE 2009) (Figure D2.12); therefore, copper should not be considered a COPC in surface soils at soil piles from Addendum 1-B sampling. Copper in surface soil is also below the child resident NALs of 68.1 mg/kg and 184 mg/kg (DOE 2001; DOE 2009). Copper in surface soil should not be considered a COPC in surface soils.

Copper–Subsurface. Copper values in subsurface soil samples exceed the background value of 25 mg/kg in one of the 48 samples. The exceeding value (44.2 mg/kg) was collected from Soil Pile AT, as shown on Figure D1.13. Although copper is present in the subsurface soil of Soil Pile AT above all available background criteria, it is below the current PGDP teen recreational user NAL of 331 mg/kg and the proposed, updated PGDP teen recreational user NAL of 1,130 mg/kg (DOE 2001; DOE 2009) (Figure D2.13). Copper should not be considered a COPC in subsurface soils at soil piles from Addendum 1-B sampling. Copper in surface soil is also below the child resident NALs of 68.1 mg/kg and 184 mg/kg (DOE 2001; DOE 2009). Copper in subsurface soil should not be considered a COPC.

Iron–Subsurface. Iron values in subsurface soil samples exceed the background value of 28,000 mg/kg in one of the 48 samples. The exceeding value (31,400 mg/kg) was collected from Soil Pile CB (Figure D1.14). The mean site concentration for subsurface iron is 12,084 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 23,284 mg/kg, and 46 of the 48 results (more than half) were not detected or less than the 60^{th} percentile of 22,000 mg/kg, which meets the criteria for applying ambient background values established by KEEC. As shown on Figure D2.14, the exceeding iron value is below the 95^{th} percentile of the generic statewide ambient background value (47,600 mg/kg) (KEEC 2004); therefore, iron is not present in the Addendum 1-B soil piles in the subsurface as a COPC.

Lead–Surface. As shown in Figure D1.15, lead values in surface soil samples exceed the background value of 36 mg/kg in three of 45 samples. The exceeding values were 40.9, 50.3, and 61.6 mg/kg from Soil Piles AT, 19, and BR, respectively. The criteria for applying ambient background values established by KEEC were met [the mean site concentration for surface lead is 13.03 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 33 mg/kg and 42 of the 45 results (more than half) were not detected or less than the 60^{th} percentile of 20.9 mg/kg]. The exceedances, displayed on Figure D2.15, are below the 95^{th} percentile of the generic statewide ambient background value (84.6 mg/kg) (KEEC 2004). The values from Soil Piles 19 and BR (50.3 and 61.6 mg/kg) are greater than the current NAL for lead [50 mg/kg (though lower than the proposed, updated NAL of 400 mg/kg)]; however, since lead is not present in the surface soils above the statewide ambient background value, it will not be included for Addendum 1-B soil piles as a COPC.

Lead–Subsurface. As shown in Figure D1.16, lead values in subsurface soil samples exceed the background value of 23 mg/kg in two of 48 samples (values of 40.1 and 40.6 mg/kg). The exceeding samples were collected from Soil Pile AX and from Soil Pile AT. The mean site concentration for subsurface lead is 12.28 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 33 mg/kg, and 46 of the 48 results (more than half) were not detected or less than the 60^{th} percentile of 20.9 mg/kg, which meets the criteria for applying ambient background values established by

KEEC. The exceedances, displayed on Figure D2.16, are below the 95th percentile of the generic statewide ambient background value (84.6 mg/kg) (KEEC 2004); therefore, lead is not present in the subsurface soils of Addendum 1-B soil piles as a COPC.

Magnesium–Subsurface. Magnesium values in subsurface soil samples exceed the background value of 2,100 mg/kg in three of 48 samples (ranging 2,110 to 2,280 mg/kg). These samples were collected from Soil Piles BZ, 19, and N, as shown on Figures D1.17 and D2.17. Magnesium is not listed with a generic statewide ambient 21 background value, nor does the chemical have risk-based action and no-action levels because magnesium is an essential element (DOE 2001). Though magnesium is present in the Addendum 1-B soil piles above background, it is not considered a COPC.

Manganese–Subsurface. Manganese values in subsurface soil samples exceed the background value of 820 mg/kg in two of 48 samples (960 and 1,130 mg/kg). The mean site concentration for subsurface manganese is 450.4 mg/kg which is below Kentucky's 95% UCL of the mean concentrations of background of 1,071 mg/kg, and 46 of the 48 results (more than half) were not detected or less than the 60th percentile of 948 mg/kg, which meets the criteria for applying ambient background values established by KEEC. The exceedances are well below the 95th percentile of the generic statewide ambient background value (2,620 mg/kg) (KEEC 2004); therefore, manganese is not present in the Addendum 1-B soil piles as a COPC.

Figure D1.18 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.18 graphically shows the results with the background value and other comparison values.

Mercury–Surface. Mercury values in surface soil samples exceed the background value of 0.2 mg/kg in one of the 45 samples. The exceeding value (0.23 mg/kg) was collected from Soil Pile AT (Figure D1.19). Although mercury is present in the surface soil of Soil Pile AT above all available background criteria, it is below the current PGDP teen recreational user NAL of 0.634 mg/kg and the proposed, updated PGDP teen recreational user NAL of 0.625 mg/kg (DOE 2001; DOE 2009) (Figure D2.19); therefore, mercury should not be considered a COPC in surface soils at soil piles from Addendum 1-B sampling.

The mercury present above background at Soil Pile AT is greater than the current PGDP child residential NAL of 0.158 mg/kg and the proposed, updated PGDP child residential NAL of 0.213 mg/kg (DOE 2001; DOE 2009). Mercury in surface soil from Soil Pile AT should be further evaluated as a COPC.

Mercury–Subsurface. Mercury values in subsurface soil samples exceed the background value of 0.13 mg/kg in one of the 48 samples. The exceeding value (0.17 mg/kg) was collected from Soil Pile AT (Figure D1.20). Although mercury is present in the subsurface soil of Soil Pile AT above DOE 2001 PGDP background value, it is below the draft background value of 0.2 (DOE 2009). Further, mercury is below the current PGDP teen recreational user NAL of 0.634 mg/kg and the proposed, updated PGDP teen recreational user NAL of 0.625 mg/kg (DOE 2001; DOE 2009) (Figure D2.20); therefore, mercury should not be considered a COPC in subsurface soils at soil piles from Addendum 1-B sampling.

The mercury present above background at Soil Pile AT is greater than the current PGDP child residential NAL of 0.158 mg/kg, but is less than the proposed, updated PGDP child residential NAL of 0.213 mg/kg (DOE 2001; DOE 2009). Since mercury is present above child resident NALs in the surface soil, mercury in subsurface soil from Soil Pile AT also should be further evaluated as a COPC.

Selenium–Surface. As shown on Figure D1.21, selenium values in surface soil samples exceed the background value of 0.8 mg/kg in only one of 45 samples, the only detected value (2.82 mg/kg from Soil

Pile AT). Although all background criteria for selenium are exceeded by this sample, neither the current PGDP teen recreational user NAL of 65 mg/kg nor the proposed, updated PGDP teen recreational user NAL of 142 mg/kg is exceeded (DOE 2001; DOE 2009). Further, laboratory detection limits for selenium were greater than the background value, but less than the NAL. Since selenium is within NAL screening criteria, it should not be considered a COPC for surface soils at soil piles from Addendum 1-B sampling.

PGDP child resident NALs for selenium are 12.1 mg/kg (current) and 23 mg/kg (proposed, updated) (DOE 2001; DOE 2009). Selenium also should not be considered a COPC in surface soil.

Figure D2.21 graphically shows the results with the background values and other comparison values.

Selenium–Subsurface. As shown on Figure D1.22, selenium values in subsurface soil samples exceed the background value of 0.7 mg/kg in only one of 48 samples (2.74 mg/kg from Soil Pile AT). Although all background criteria for selenium are exceeded by this sample, neither the current PGDP teen recreational user NAL of 65 mg/kg nor the proposed, updated PGDP teen recreational user NAL of 142 mg/kg is exceeded (DOE 2001; DOE 2009). Further, laboratory detection limits for selenium were greater than the background value, but less than the NAL. Since selenium is within NAL screening criteria, it should not be considered a COPC for subsurface soils at soil piles from Addendum 1-B sampling.

PGDP child resident NALs for selenium are 12.1 mg/kg (current) and 23 mg/kg (proposed, updated) (DOE 2001; DOE 2009). Selenium also should not be considered a COPC in subsurface soil.

Figure D2.22 graphically shows the results with the background values and other comparison values.

Thallium–Surface. Thallium values in surface soil samples exceed the background value of 0.21 mg/kg in only one of 45 samples. The exceeding value was the only detection of thallium in surface samples because the background value is lower than the detection limit for thallium. The detected value in the samples was 2.36 mg/kg from Soil Pile AT (Figure D1.23). The criteria for applying ambient background values established by KEEC, Kentucky's 95% UCL of the mean concentrations of background and the 60^{th} percentile are not established. The detected value, however, is below the 95^{th} percentile of the generic statewide ambient background value (7.95 mg/kg) (KEEC 2004), as shown on Figure D2.23; therefore, thallium is not present in the Addendum 1-B soil piles as a COPC on the surface. It should be noted, however, that six results were not detected, though the laboratory detection limit was greater than the statewide ambient background value. These nondetect results were from samples collected near K013.

Uranium–Surface. Uranium values in surface soil samples exceed the background value of 4.9 mg/kg in ten of 45 samples (ranging from 5.66 to 208 mg/kg), as shown on Figure D1.24. The values from three of these soil piles, 5.66 mg/kg from Soil Pile P, 5.96 mg/kg from Soil Pile D, and 6.05 mg/kg from Soil Pile BW, are below the background value presented in the revised Risk Methods Document (7.6 mg/kg) and, therefore, be considered less than background (DOE 2009). Seven samples remain above background values.

The current and proposed, updated PGDP teen recreational user NALs for uranium are 14.7 mg/kg and 17.0 mg/kg, respectively (DOE 2001; DOE 2009). Although uranium is present in the Addendum 1-B soil piles above background criteria for these samples, it is below the NAL screening criteria at four of the remaining of those locations (see Figure D2.24) and should not be considered a COPC there. Samples at Soil Piles AT, H, and J, however, detected 58.3, 58.9, and 208 mg/kg in surface soils, respectively. The values for the samples collected at these soil piles will be retained for additional evaluation.

The current and proposed, updated PGDP child resident NALs for uranium are 2.16 mg/kg and 2.76 mg/kg, respectively (DOE 2001; DOE 2009). Uranium metal in surface soil from the seven piles

exceeding background should be considered a COPC and retained for further evaluation. These piles are the following: G (7.89 mg/kg), 20 (7.96 mg/kg), C (9.25 mg/kg), F (9.63 mg/kg), AT (58.3 mg/kg), H (58.9 mg/kg), and J (208 mg/kg).

Uranium–Subsurface. Uranium values in subsurface soil samples exceed the background value of 4.6 mg/kg in 14 of 48 samples (ranging from 4.62 to 111 mg/kg), as shown on Figure D1.25. Four of these samples, however, are below the draft background value of 7.2 mg/kg (DOE 2009).

The current and proposed, updated PGDP teen recreational user NALs for uranium are 14.7 mg/kg and 17.0 mg/kg, respectively (DOE 2001; DOE 2009). Uranium is present in the Addendum 1-B soil piles above both the 2001 and the draft 2009 background criteria for four samples, but it is below the NAL screening criteria at those locations (see Figure D2.25) and should not be considered a COPC there. A total of six samples (three from Soil Pile D, one from Soil Pile AT, and two from Soil Pile J), however, detected 16.4, 45.9, and 52.3; 54.5; and 78.8 and 111 mg/kg in subsurface soils, respectively. These values for the samples collected at these soil piles will be retained for additional evaluation.

Uranium from a total of ten samples from six different piles, all of those above background screening criteria, would be considered a COPC and retained for further evaluation since they are above both the current PGDP child resident NAL and proposed, updated PGDP child resident NAL for uranium 2.16 mg/kg and 2.76 mg/kg, respectively (DOE 2001; DOE 2009). These sample results were the following: 7.88 mg/kg from Soil Pile G; 7.95 and 11.3 mg/kg from Soil Pile C; 9.03 mg/kg from Soil Pile 20; 16.4, 45.9, and 52.3 mg/kg from Soil Pile D; 54.5 mg/kg from Soil Pile AT; and 78.8 and 111 mg/kg from Soil Pile J.

Vanadium–Surface. Vanadium values in surface soil samples exceed the background value of 38 mg/kg in only one of 45 samples (see Figures D1.26 and D2.26). The exceeding value is 74 mg/kg. The soil pile from which this sample was collected is Soil Pile AT. Since this value is above all available criteria for evaluating background values for vanadium and is above both the current PGDP teen recreational user NAL of 2.12 mg/kg and the proposed, updated PGDP teen recreational user NAL of 5.43 mg/kg, this value will be retained for additional evaluation (DOE 2001; DOE 2009). All other vanadium values are below background and are not present in the Addendum 1-B soil piles on the surface as a COPC.

Vanadium from the surface sample collected at Soil Pile AT also would be retained for further evaluation as a COPC since it is above both the current PGDP child resident NAL of 0.562 mg/kg and the proposed, updated PGDP child resident NAL of 1.96 mg/kg (DOE 2001; DOE 2009).

Vanadium–Subsurface. Vanadium values in subsurface soil samples exceed the background value of 37 mg/kg in one of 48 samples (63.9 mg/kg from Soil Pile AT). Since this value is above all available criteria for evaluating background values for vanadium and is above both the current PGDP teen recreational user NAL of 2.12 mg/kg and the proposed, updated PGDP teen recreational user NAL of 5.43 mg/kg, this value will be retained for additional evaluation (DOE 2001; DOE 2009). All other vanadium values are below background and are not present in the Addendum 1-B soil piles in the subsurface as a COPC.

Figure D1.27 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.27 graphically shows the results with the background value and other comparison values.

Vanadium from the subsurface sample collected at Soil Pile AT also would be retained for further evaluation as a COPC since it is above both the current PGDP child resident NAL of 0.562 mg/kg and the proposed, updated PGDP child resident NAL of 1.96 mg/kg (DOE 2001; DOE 2009).

Zinc–Surface. As shown in Figure D1.28, zinc values in surface soil samples exceed the background value of 65 mg/kg in four of 45 samples. The exceeding values are 82.5, 83.6, 106, and 198 mg/kg from Soil Piles BW, J, AT, and 20, respectively. The criteria for applying ambient background values established by KEEC were met [the mean site concentration for surface zinc is 34.4 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 57 mg/kg and 41 of the 45 results (more than half) were not detected or less than the 60^{th} percentile of 48.6 mg/kg]. Three of the four exceedances, displayed on Figure D2.28, are below the 95^{th} percentile of the generic statewide ambient background value (115 mg/kg) (KEEC 2004).

The remaining value, 198 mg/kg at Soil Pile 20, is well below the current PGDP teen recreational user NAL of 1,800 mg/kg and the proposed, updated PGDP teen recreational user NAL of 8,500 mg/kg (DOE 2001; DOE 2009); therefore, zinc is not present in the surface soils of Addendum 1-B soil piles as a COPC.

Further, zinc present above background at Soil Pile 20 also is below the current PGDP child resident NAL of 401 mg/kg and the proposed, updated PGDP child resident NAL of 1,380 mg/kg (DOE 2001; DOE 2009); therefore, zinc is not present in the surface soils of Addendum 1-B soil piles as a COPC.

Zinc–Subsurface. As shown in Figure D1.29, zinc values in subsurface soil samples exceed the background value of 60 mg/kg in four of 48 samples. The exceeding values range from 62.9 to 237 mg/kg from Soil Piles J, AT, and 20. The mean site concentration for subsurface zinc is 41.5 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 57 mg/kg and 42 of the 48 results (more than half) were not detected or less than the 60^{th} percentile of 48.6 mg/kg, which meets the criteria for applying ambient background values established by KEEC. Three of the four exceedances, displayed on Figure D2.29, are below the 95^{th} percentile of the generic statewide ambient background value (115 mg/kg) (KEEC 2004).

The remaining value, 237 mg/kg, from Soil Pile 20, is well below the current PGDP teen recreational user NAL of 1,800 mg/kg and the proposed, updated PGDP teen recreational user NAL of 8,500 mg/kg (DOE 2001; DOE 2009); therefore, zinc is not present in the subsurface soils of Addendum 1-B soil piles as a COPC.

Further, zinc present above background at Soil Pile 20 also is below the current PGDP child resident NAL of 401 mg/kg and the proposed, updated PGDP child resident NAL of 1,380 mg/kg (DOE 2001; DOE 2009); therefore, zinc is not present in the subsurface soils of Addendum 1-B soil piles as a COPC under the child residential scenario.

Cesium-137–Surface. Cesium-137 values in surface soil samples exceed the background value of 0.49 pCi/g in two of 55 samples. The samples exceeding background are 0.598 and 0.647 pCi/g from Soil Piles AS and CC, respectively. Although the cesium-137 concentration exceeds the site-specific background for PGDP, the concentration of cesium-137 in samples exceeding background are below the concentrations associated with fall-out. Cesium-137 is a major contributor to global fall-out due to atmospheric testing of nuclear weapons in the 1950s to the early 1960s. A summary from Argonne National Lab (ANL 2007) states that concentrations up to 1 pCi/g are expected from fall-out. Further, earlier monitoring studies at PGDP (from 1988 to 1993) revealed background levels of cesium-137 ranging from 0.11 to 4.0 pCi/g (DOE 1997); therefore, cesium-137 should not be considered in the Addendum 1-B soil piles as a COPC.

Figure D1.30 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.30 graphically shows the results with the background value and other comparison values.

Cesium-137–Subsurface. Cesium-137 values in subsurface soil samples exceed the background value of 0.28 pCi/g in four of 48 samples (ranging 0.288 to 0.491 pCi/g). Although the cesium-137 concentration exceeds the site-specific background for PGDP, the concentration of cesium-137 in samples exceeding background is below levels seen in 1988 to 1993 surface soil monitoring studies at PGDP. Cesium-137 levels in these studies ranged from 0.11 to 4.0 pCi/g (DOE 1997). One possible explanation for these cesium-137 results is the association with fall-out. Cesium-137 is a major contributor to global fall-out due to atmospheric testing of nuclear weapons in the 1950s to the early 1960s. A summary from Argonne National Lab (ANL 2007) states that concentrations up to 1 pCi/g are expected from fall-out. Although cesium-137 as a result of fall-out would not be expected to be found at depth, the material from the soil piles is thought once to have been surface soil or sediment and could have been subject to the results of global fall-out at that time.

The cesium-137 activities present are below reasonably what could be expected as a result of global fall-out and should not be considered in the Addendum 1-B soil piles as a COPC.

Figure D1.31 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.31 graphically shows the results with the background value and other comparison values.

Plutonium-239/240–Surface. Plutonium-239/240 values in surface soil samples exceed the background value of 0.025 pCi/g in one of the 55 samples. The exceeding value is 0.0294 pCi/g. Although the plutonium-239/240 concentration exceeds the site-specific background for PGDP, the concentration of plutonium-239/240 in samples exceeding background are below the concentrations associated with fall-out. Plutonium-239/240 is a major contributor to global fall-out due to atmospheric testing of nuclear weapons in the 1950s to the early 1960s. A summary from Argonne National Lab (ANL 2007) states that concentrations up to 0.1 pCi/g are expected from fall-out; therefore, plutonium-239/240 should not be considered in the Addendum 1-B soil piles as a COPC.

Figure D1.32 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.32 graphically shows the results with the background value and other comparison values.

Technetium-99–Surface. Technetium-99 values in surface soil samples exceed the background value of 2.5 pCi/g in 11 of the 55 samples. The exceeding values range from 2.92 to 8.75 pCi/g from Soil Piles 16, 18, A, E, F, M, AS, AV, BZ, CB, and CC. These concentrations in surface soil likely are not applicable to fall-out since fall-out concentrations are very low (0.0001 pCi/g) (ANL 2007). The current PGDP teen recreational user NAL for technetium-99 is 926 pCi/g, and the proposed, updated PGDP teen recreational user NAL is 1,110 pCi/g (DOE 2001; DOE 2009). Although technetium-99 is present in the Addendum 1-B soil piles above background criteria for 11 of the soil piles, it should not be considered a COPC since it is below the NAL screening criteria.

The current PGDP child resident NAL for technetium-99 is 67.4 pCi/g, and the proposed, updated PGDP child resident NAL is 101 pCi/g (DOE 2001; DOE 2009). Since technetium-99 is below the child residential NAL screening criteria, it should not be considered a COPC under a child residential scenario.

Figure D1.33 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.33 graphically shows the results with the background value and other comparison values.

Technetium-99–Subsurface. Technetium-99 values in subsurface soil samples exceed the background value of 2.8 pCi/g in one of the 48 subsurface samples (3.13 pCi/g from Soil Pile 20). The current PGDP teen recreational user NAL for technetium-99 is 926 pCi/g, and the proposed, updated PGDP teen recreational user NAL is 1,110 pCi/g (DOE 2001; DOE 2009). The current PGDP child resident NAL for technetium-99 is 67.4 pCi/g, and the proposed, updated PGDP child resident NAL is 101 pCi/g (DOE 2001; DOE 2009). Although technetium-99 is present in the Addendum 1-B soil piles above background criteria at one location, it should not be considered a COPC since it is below all of the NAL screening criteria. Figure D1.34 illustrates the sampling location in which the background value was exceeded. Figure D2.34 graphically shows the results with the background values and other comparison values.

Thorium-230–Surface. Thorium-230 values in surface soil samples exceed the background value of 1.5 pCi/g in one of the 55 surface samples (1.69 pCi/g from Soil Pile AT). The current and proposed, updated PGDP teen recreational user NALs for thorium-230 are 39 pCi/g and 44.9 pCi/g, respectively (DOE 2001; DOE 2009). The current and proposed, updated PGDP child resident NALs for thorium-230 are 2.85 pCi/g and 4.09 pCi/g, respectively (DOE 2001; DOE 2009). Although thorium-230 is present in the Addendum 1-B soil piles above background criteria at one location, it should not be considered a COPC since it is below all of the NAL screening criteria. Figure D1.35 illustrates the sampling location in which the background value was exceeded. Figure D2.35 graphically shows the results with the background values and other comparison values.

Uranium-234–Surface. Incrementally adjusted uranium-234 values (if appropriate) in surface soil samples exceed the background value of 2.5 pCi/g in three of the 55 samples. The exceeding values are 4.05 pCi/g from Soil Pile J, 6.58 pCi/g from Soil Pile AT, and 53.4 pCi/g from Soil Pile E. The current and proposed updated PGDP teen recreational user NALs for uranium-234 are 52.2 pCi/g and 62.4 pCi/g, respectively (DOE 2001; DOE 2009). Although uranium-234 is present in the Addendum 1-B soil piles above background criteria for three of the soil piles, it should not be considered a COPC since it is below the 2009 revised NAL screening criteria.

The current and proposed updated PGDP child resident NALs are 3.81 and 5.47 pCi/g, respectively (DOE 2001; DOE 2009). The uranium-234 from surface soil in Soil Pile J is above the current child resident NAL, but below the updated, proposed NAL. The uranium-234 from surface soil in Soil Piles AT and E, however, is above both the current and proposed, updated PGDP child resident NALs. Uranium-234 in surface soil would be considered a COPC for further evaluation under the child residential scenario at Soil Piles J, AT, and E.

Figure D1.36 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.36 graphically shows the results with the background value and other comparison values.

Uranium-234–Subsurface. As shown on Figure D1.37, incrementally adjusted uranium-234 values in subsurface soil samples exceed the background value of 2.4 pCi/g in four of the 48 subsurface samples [3.33 pCi/g from Soil Pile J, 1.84 (as adjusted) and 4.68 pCi/g from Soil Pile D, and 6.7 pCi/g from Soil Pile AT].

The current and proposed, updated PGDP teen recreational user NALs for uranium-234 are 52.2 pCi/g and 62.4 pCi/g, respectively (DOE 2001; DOE 2009). Although uranium-234 is present in the Addendum 1-B soil piles above background criteria at three locations, it is below the NAL screening criteria. Figure

D2.37 graphically shows the results with the background values and other comparison values. Uranium-234 should not be considered a COPC in the subsurface soils of Addendum 1-B soil piles, since it is below screening criteria.

Under a child residential scenario, the uranium-234 from subsurface soil exceeding background values, as adjusted, would be compared to the current and proposed, updated PGDP child resident NALs (3.81 and 5.47 pCi/g, respectively) (DOE 2001; DOE 2009). Of these four sample results, the subsurface uranium-234 from Soil Pile J and one of the values from Soil Pile D are below at least one of the adjusted NAL criteria. Uranium-234 results found in these samples should not be considered a COPC. The uranium-234 found in Soil Pile AT, however, is above both child residential NALs, and should be considered a COPC for further evaluation under the child residential scenario. Additionally, since the maximum value from Soil Pile D is greater than the current PGDP child resident NAL, is should be considered a COPC for further evaluation.

Uranium-235–Surface. Incrementally adjusted uranium-235 values (if appropriate) in surface soil samples exceed the background value of 0.14 pCi/g in five of the 55 samples. The exceeding values are 0.163 pCi/g from Soil Pile H; 0.295 pCi/g from Soil Pile BV; 0.337 pCi/g from Soil Pile AT; 0.568 pCi/g from Soil Pile J; and 8.96 from Soil Pile E. The current PGDP teen recreational user NAL for uranium-235 is 0.826 pCi/g, and the proposed, updated PGDP teen recreational user NAL for uranium-235 is 0.913 pCi/g (DOE 2001; DOE 2009). Although uranium-235 is present in the Addendum 1-B soil piles above background criteria for five of the soil piles, it should not be considered a COPC at four of the soil piles since it is below the NAL screening criteria.

The current and proposed, updated PGDP child resident NALs are 0.0591 and 0.122 pCi/g, respectively (DOE 2001; DOE 2009). The uranium-235 from surface soil in Soil Piles H, BV, AT, J, and E are above the child resident NALs and should be considered a COPC for further evaluation under the child residential scenario at these locations. It should be noted that if incrementally adjusted, surface soil from additional piles exceed child resident NALs; however, risk estimates are calculated here without incremental adjustment and, as such, uranium-235 at these soil piles is not considered a COPC.

Figure D1.38 illustrates the spatial distribution of the sampling locations in which the background value was exceeded. Figure D2.38 graphically shows the results with the background value and other comparison values.

Uranium-235–Subsurface. As shown on Figure D1.39, incrementally adjusted uranium-235 values in subsurface soil samples exceed the background value of 0.14 pCi/g in six of the 48 subsurface samples from three different soil piles. The exceeding values are 0.218 and 0.435 pCi/g from Soil Pile J, 0.104 (as adjusted), 0.274, and 0.591 pCi/g from Soil Pile D, and 0.348 pCi/g from Soil Pile AT.

The current PGDP teen recreational user NAL for uranium-235 is 0.826 pCi/g, and the proposed, updated PGDP teen recreational user NAL for uranium-235 is 0.913 pCi/g (DOE 2001; DOE 2009). Although uranium-235 is present in the Addendum 1-B soil piles above background criteria at the three soil piles previously mentioned, it is below the adjusted NAL screening criteria at all of these locations. Figure D2.39 graphically shows the results with the background values and other comparison values. Uranium-235 should not be considered a COPC in the subsurface soils of Addendum 1-B soil piles, since it is below screening criteria.

The uranium-235 from subsurface soil exceeding background values, as adjusted, would be compared to the current and proposed, updated PGDP child resident NALs (0.0591 and 0.122 pCi/g, respectively) (DOE 2001; DOE 2009). All of these six sample results, as adjusted, exceed NAL criteria. Since risk estimates are calculated here without incremental adjustment, only subsurface soil from Soil Pile D, J, and

AT should be considered a COPC for further evaluation under the child residential scenario at these locations.

Uranium-238–Surface. Incrementally adjusted uranium-238 values (if appropriate) in surface soil samples exceed the background value of 1.2 pCi/g in 24 of the 55 samples from 22 different soil piles (Figure D1.40). The maximum exceeding value from each pile are the following:

- 0.456 pCi/g (as adjusted) from Soil Pile AX;
- 0.476 pCi/g (as adjusted) from Soil Pile M;
- 0.486 pCi/g (as adjusted) from Soil Pile BR;
- 0.543 pCi/g (as adjusted) from Soil Pile L;
- 0.561 pCi/g (as adjusted) from Soil Pile A;
- 0.59 pCi/g (as adjusted) from Soil Pile AS;
- 0.75 pCi/g (as adjusted) from Soil Pile AW;
- 0.765 pCi/g (as adjusted) from Soil Pile 19;
- 0.989 pCi/g (as adjusted) from Soil Pile K013;
- 1.38 pCi/g from Soil Pile BW;
- 1.49 pCi/g from Soil Pile CC;
- 1.67 pCi/g from Soil Pile D;
- 1.84 pCi/g from Soil Pile P;
- 2.24 pCi/g from Soil Pile G;
- 2.73 pCi/g from Soil Pile C;
- 2.76 pCi/g from Soil Pile 20;
- 2.99 pCi/g from Soil Pile F;
- 8.33 pCi/g from Soil Pile AT;
- 10.9 pCi/g from Soil Pile H;
- 17.4 pCi/g from Soil Pile BV;
- 37.3 pCi/g from Soil Pile J; and
- 581 pCi/g from Soil Pile E.

The draft background value for uranium-238 in surface soil is 1.9 pCi/g, which indicate the adjusted values from soil piles AX, M, BR, L, A, AS, AW, 19, and K013, should not be considered above the range of background.

The current and proposed, updated PGDP teen recreational user NALs for uranium-238 are 3.64 pCi/g and 4.02 pCi/g, respectively (DOE 2001; DOE 2009). Although uranium-238 is present in 25 Addendum 1-B soil piles above background criteria, these values are below the adjusted (proposed, updated) NAL screening criteria for all except five of these soil piles. Figure D2.40 graphically shows the results with the background value and other comparison values. For all except the Soil Piles AT, H, BV, J, and E, uranium-238 should not be considered a COPC since it is below the screening criteria. Uranium-238 in surface soil should be further evaluated, however, for Soil Piles AT, H, BV, J, and E.

The current and proposed, updated PGDP child resident NALs are 0.261 and 0.517 pCi/g, respectively (DOE 2001; DOE 2009). Uranium-238 from surface soil exceeding the range of background (BW, CC, D, P, G, C, 20, F, AT, H, BV, J, and E) also exceeds adjusted NALs. Uranium-238 in surface soil should be further evaluated for these soil piles.

Uranium-238–Subsurface. As shown on Figure D1.41, uranium-238 values in subsurface soil samples exceed the background value of 1.2 pCi/g in 19 of the 48 subsurface samples. The soil piles with exceeding values and their maximum results are the following:

- 0.411 pCi/g (as adjusted) from Soil Pile L;
- 0.579 pCi/g (as adjusted) from Soil Pile AX;
- 0.973 pCi/g (as adjusted) from Soil Pile AW;
- 1.13 pCi/g (as adjusted) from Soil Pile BW;
- 1.72 pCi/g from a soil pile at Outfall K013;
- 2.13 pCi/g from Soil Pile P;
- 2.13 pCi/g from Soil Pile F;
- 2.42 pCi/g from Soil Pile G;
- 2.94 pCi/g from Soil Pile C;
- 2.96 pCi/g from Soil Pile 20;
- 8.54 pCi/g from Soil Pile AT;
- 30.4 pCi/g from Soil Pile J; and
- 44.2 pCi/g from Soil Pile D.

The draft background value for uranium-238 in subsurface soil is 1.8 pCi/g, which indicate the adjusted values from soil piles L, AX, and AW should not be considered above the range of background.

The current and proposed, updated PGDP teen recreational user NALs for uranium-238 are 3.64 pCi/g and 4.02 pCi/g, respectively (DOE 2001; DOE 2009). Although uranium-238 is present in the Addendum 1-B soil piles above background criteria at several locations, it is below the adjusted NAL screening criteria at all except five of these soil piles. For these soil piles with subsurface soil values either below background or below the NAL screening criteria, uranium-238 should not be considered a COPC in the subsurface soils of Addendum 1-B soil piles. Figure D2.41 graphically shows the results with the background values and other comparison values. Uranium-238 in the subsurface at Soil Piles AT, J, and D should be evaluated further. It also should be noted that uranium-238 in subsurface soil at Soil Pile C and 20 are above the adjusted NAL screening criteria, but would not be evaluated further under the teen recreational scenario.

Under a child residential scenario, the uranium-238 from subsurface soil exceeding background values, as adjusted, would be compared to the adjusted current and proposed, updated PGDP child resident NALs (0.261 and 0.517 pCi/g, respectively) (DOE 2001; DOE 2009). Uranium-238 in subsurface soil should be further evaluated as a COPC, however, for the following soil piles that exceed background screening criteria (as adjusted): BW, K013, P, F, G, C, 20, AT, J, and D.

NAL Exceedances for Addendum 1-B Soil Pile PCB and PAH Sampling, Excluding Soil Pile O within AOC 541

Total PCBs and total PAHs exceeded the current default PGDP teen recreational user NAL during the Addendum 1-B sampling, excluding sampling of soil pile O within AOC 541. [The congeners PCB-1248, PCB-1254, and PCB-1260 and the individual PAH compounds of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene also exceeded their NAL (teen recreational user scenario); however, only total PCBs and total PAHs will be considered for this screening.] The chemicals and their frequencies of exceedance are listed in Table D.3.

Table D.3. Addendum 1-B Total PCBs and Total PAHs Exceeding PGDP Teen Recreational User and Child Resident NAL[a]

Analysis	Depth	Frequency Exceeding Teen Recreational User NAL[a]	Frequency Exceeding Child Resident NAL[a]
Total PCBs	Surface	6/55	6/55
	Subsurface	8/48	8/48
Total PAHs[b]	Surface	5/45	5/45
	Subsurface	3/48	3/48

[a] NAL values for this analysis were taken from DOE 2001.
[b] Total PAHs calculated using the toxicity equivalence factors according to DOE 2001.

The locations of the PCB NAL exceedances are shown in Attachment D1, Figures D1.42 and D1.43.

The current and proposed, updated PGDP teen recreational user NALs for total PCBs (highest risk) are 0.127 mg/kg and 0.179 mg/kg, respectively (DOE 2001; DOE 2009). Of the soil piles with total PCB results exceeding the current default risk-based PGDP teen recreational user NAL [for highest risk (i.e., 0.127 mg/kg)], Soil Piles D and J have three exceedances [Soil Pile J with two exceedances from the subsurface (0.69 mg/kg and 0.28 mg/kg) and one from the surface (0.62) and Soil Pile D all from the subsurface [0.13 mg/kg, 1.31 mg/kg, and 2.01 mg/kg)]. Soil Piles 20, AT, and BW have two exceedances each (one surface and one subsurface (0.74 mg/kg and 3.54 mg/kg, 1.15 mg/kg and 0.74 mg/kg, and 0.59 mg/kg and 0.44 mg/kg), respectively], and Soil Piles H and E each have one exceedance (surface at 0.24 mg/kg and 1.58 mg/kg). These soil piles will be evaluated further to determine whether total PCBs should be considered a COPC. The remaining soil piles do not exceed the current PGDP teen recreational user NAL for total PCBs. All PCB detections are well below the 25 mg/kg Toxic Substances Control Act clean-up standard for low occupancy areas.

The current and proposed, updated PGDP child resident NALs for total PCBs (highest risk) are 0.0574 mg/kg and 0.0624 mg/kg, respectively (DOE 2001; DOE 2009). The same soil piles exceeding PGDP teen recreational user NALs also exceed PGDP child resident NALs. All samples with a detection exceeded both sets of values.

The current and proposed, updated PGDP teen recreational user NALs for total PAHs are 0.0133 mg/kg and 0.0557 mg/kg, respectively (DOE 2001; DOE 2009). Locations with total PAH NAL exceedances for current default risk-based PGDP teen recreational user are depicted in Attachment D1, Figure D1.44. Surface exceedances were found at Soil Piles 19, H, J, N, and BY. Subsurface exceedances were found at Soil Piles N, BU, and BZ.

PGDP child resident NALs for total PAHs are 0.0067 mg/kg (current) and 0.0197 mg/kg (proposed, updated), respectively (DOE 2001; DOE 2009). The same soil piles exceeding PGDP teen recreational user NALs also exceed PGDP child resident NALs. All samples with a detection exceeded both sets of values. Locations with total PAH NAL exceedances for current default risk-based PGDP child resident are depicted in Attachment D1, Figure D1.45.

CHEMICALS WITHIN SOIL PILES FOR FURTHER EVALUATION

Table D.4 lists the COPCs associated with specific Addendum 1-B soil piles, as noted in the previous sections. All of these chemicals exceeded background values where applicable and NALs for the current PGDP teen recreational user.

Table D.4. Chemicals of Potential Concern Retained for Additional Evaluation under the Teen Recreational Use Scenario

COPC	Depth	Soil Pile	Maximum Value Detected	PGDP Teen Recreational User No Action Levels* Hazard	No Action Levels* Cancer	Action Level*
Metals (mg/kg)						
Arsenic	Surface	AT	4.30E+01	5.98E+00	3.46E-01	3.14E+02
Beryllium	Surface	AT	2.12E+00	6.06E-01	6.02E+04	8.84E+02
Chromium	Surface	20	2.85E+02	2.27E+02	1.20E+04	n/a
	Subsurface	20	3.14E+02	2.27E+02	1.20E+04	n/a
Uranium	Surface	H	5.89E+01	1.47E+01	n/a	6.83E+03
		J	2.08E+02			
		AT	5.83E+01			
	Subsurface	D	5.23E+01	1.47E+01	n/a	6.83E+03
		AT	5.45E+01			
		J	1.11E+02			
Vanadium	Surface	AT	7.40E+01	2.12E+00	n/a	3.09E+03
	Subsurface	AT	6.39E+01	2.12E+00	n/a	3.09E+03
Radionuclides (pCi/g)						
Uranium-238	Surface	AT	8.33E+00		3.64E+00	3.64E+02
		BV	1.74E+01			
		E	5.81E+02			
		H	1.09E+01			
		J	3.73E+01			
	Subsurface	D	4.42E+01		3.64E+00	3.64E+02
		J	3.04E+01			
		AT	8.54E+00			
Total PCBs (mg/kg)						
	Surface	20	7.40E-01	n/a	1.27E-01	2.83E+01
		E	1.58E+00			
		J	6.20E-01			
		H	2.40E-01			
		AT	1.15E+00			
		BW	5.90E-01			
	Subsurface	20	3.54E+00	n/a	1.27E-01	2.83E+01
		D	2.01E+00			
		J	6.90E-01			
		AT	7.40E-01			
		BW	4.40E-01			
Total PAHs (mg/kg)						
	Surface	19	5.10E-02	n/a	1.33E-02	1.46E+01
		H	1.26E-01			
		J	7.05E-02			
		N	1.31E-01			
		BY	7.81E-01			
	Subsurface	N	1.14E+00	n/a	1.33E-02	1.46E+01
		BU	6.10E-02			
		BZ	5.60E-02			

n/a = value not available

* No Action Levels and Action Levels are taken from the 2001 Risk Methods Document, Tables A.17 and A.14, respectively (DOE 2001).

Of the detected concentrations for these COPCs, only uranium-238 in surface soil (Soil Pile E) exceeds its action level for the PGDP teen recreational user.

Table D.5 lists the COPCs associated with specific Addendum 1-B soil piles, as noted in the previous sections. All of these chemicals exceeded background values where applicable and NALs for the current PGDP child resident.

Table D.5. Chemicals of Potential Concern Retained for Additional Evaluation under the Child Residential Use Scenario

COPC	Depth	Soil Pile	Maximum Value Detected	PGDP Child Resident No Action Levels* Hazard	Cancer	Action Level*
Metals (mg/kg)						
Arsenic	Surface	AT	4.30E+01	9.59E-01	1.32E-01	3.50E+01
Beryllium	Surface	AT	2.12E+00	1.60E-01	1.55E+04	1.58E+02
Chromium	Surface	20	2.85E+02	6.05E+01	3.10E+03	7.19E+04
		J	1.15E+02			
		BW	6.54E+01			
	Subsurface	20	3.14E+02	6.05E+01	3.10E+03	7.19E+04
		J	1.25E+02			
Mercury	Surface	AT	2.30E-01	1.58E-01	n/a	5.37E+01
	Subsurface	AT	1.70E-01	1.58E-01	n/a	5.37E+01
Uranium	Surface	20	7.96E+00	2.16E+00	n/a	1.33E+02
		AT	5.83E+01			
		C	9.25E+00			
		F	9.63E+00			
		G	7.89E+00			
		H	5.89E+01			
		J	2.08E+02			
	Subsurface	G	7.88E+00	2.16E+00	n/a	1.33E+02
		C	1.13E+01			
		20	9.03E+00			
		D	5.23E+01			
		AT	5.45E+01			
		J	1.11E+02			
Vanadium	Surface	AT	7.40E+01	5.62E-01	n/a	5.54E+02
	Subsurface	AT	6.39E+01	5.62E-01	n/a	5.54E+02
Radionuclides (pCi/g)						
Uranium-234	Surface	AT	6.58E+00	n/a	3.81E+00	3.81E+02
		E	5.34E+01			
		J	4.05E+00			
	Subsurface	AT	6.70E+00	n/a	3.81E+00	3.81E+02
		D	4.68E+00			
Uranium-235	Surface	AT	3.37E-01	n/a	5.91E-02	5.91E+00
		BV	2.95E-01			
		E	8.96E+00			
		H	1.63E-01			
		J	5.68E-01			
	Subsurface	AT	3.48E-01	n/a	5.91E-02	5.91E+00
		D	5.91E-01			
		J	4.35E-01			

Table D.5. Chemicals of Potential Concern Retained for Additional Evaluation under the Child Residential Use Scenario (Continued)

COPC	Depth	Soil Pile	Maximum Value Detected	PGDP Child Resident No Action Levels* Hazard	Cancer	Action Level*
Uranium-238	Surface	AT	8.33E+00	n/a	2.61E-01	2.61E+01
		H	1.09E+01			
		BV	1.74E+01			
		BW	1.38E+00			
		CC	1.49E+00			
		D	1.67E+00			
		E	5.81E+02			
		P	1.84E+00			
		G	2.24E+00			
		C	2.73E+00			
		20	2.76E+00			
		F	2.99E+00			
		J	3.73E+01			
	Subsurface	K013	1.72E+00	n/a	2.61E-01	2.61E+01
		BW	1.13E+00			
		P	2.13E+00			
		F	2.13E+00			
		G	2.42E+00			
		20	2.96E+00			
		C	2.94E+00			
		AT	8.54E+00			
		J	3.04E+01			
		D	4.42E+01			
Total PCBs (mg/kg)						
	Surface	20	7.40E-01	n/a	5.74E-02	1.05E+01
		E	1.58E+00			
		J	6.20E-01			
		H	2.40E-01			
		AT	1.15E+00			
		BW	5.90E-01			
	Subsurface	20	3.54E+00	n/a	5.74E-02	1.05E+01
		D	2.01E+00			
		J	6.90E-01			
		AT	7.40E-01			
		BW	4.40E-01			
Total PAHs (mg/kg)						
	Surface	19	5.10E-02	n/a	6.70E-03	4.24E+00
		H	1.26E-01			
		J	7.05E-02			
		N	1.31E-01			
		BY	7.81E-01			
	Subsurface	N	1.14E+00	n/a	6.70E-03	4.24E+00
		BU	6.10E-02			
		BZ	5.60E-02			

n/a = value not available

* No Action Levels and Action Levels are taken from the 2001 Risk Methods Document, Tables A.17 and A.14, respectively (DOE 2001).

The following detected concentrations for these COPCs exceed their action levels for the PGDP child resident: arsenic in surface (Soil Pile AT), uranium metal in surface (Soil Pile J), uranium-238 in surface (Soil Piles E and J), and uranium-238 in subsurface (Soil Piles J and D).

DERIVATION OF RISK ESTIMATES FOR COPCs

For each COPC, the exposure concentration was the maximum detected concentration, since fewer than five results typically were available per soil pile. Exposure concentrations were compared to risk-based concentrations to determine an estimate of risk for the teen recreational user scenario (direct contact with soil and sediment for 140 days per year over a 40-year period) and for the child resident scenario (direct contact with soil and sediment for 350 days per year). These risk-based concentrations were taken from Table A.17 in DOE 2001.

The equation used to derive the risk estimate for each COPC (i.e., chemical-specific cancer risk or hazard) is as follows:

$$\textbf{Risk} = \frac{\textbf{Exposure Concentration}}{\textbf{Screening Value}} \times \textbf{Target Risk Value}$$

where:
Risk = calculated chemical-specific cancer risk or hazard value.
Exposure Concentration = Maximum concentration taken from Table D.4 for the teen recreational user scenario and from Table D.5 for the child residential scenario.
Screening Value = Cancer and Hazard concentrations taken from Table D.4 for the teen recreational user scenario and from Table D.5 for the child residential scenario.
Target Risk Value = Cancer risk (1×10^{-6}) or hazard (0.1) upon which the screening value is based.

Results of the application of this equation are presented in Tables D.6 and D.8. The cumulative hazard and cancer risk for applicable soil piles are listed in Tables D.7 and D.9.

Additionally, risk estimates for each COPC were calculated for the site-specific recreational user. These screening values are presented in Table D.10. The results are presented in Tables D.11 through D.12.

UNCERTAINTIES IN DERIVATION OF RISK ESTIMATES FOR COPCs

Several uncertainties should be taken into account when considering the risk estimates for COPCs at the Addendum 1-B Soil Piles. These uncertainties include the fact that the default PGDP scenarios were used for calculations, not values that were derived specifically for the Addendum 1-B Soil Piles.

Additionally, the laboratory-reported results for uranium isotopes near background values may be low based on the laboratory's extraction method. Due to this method, an incremental adjustment is necessary prior to comparison of the data to screening values. To simplify the comparison, the adjustment was made to the data results and not the screening values themselves. The incremental adjustments (0.77 pCi/g, 0.04 pCi/g, and 0.8 pCi/g for uranium-234, uranium-235, and uranium-238, respectively) were applied to results less than 10 pCi/g within the dataset. Screening is conducted upon detected values only, thus the incremental adjustment did not affect results qualified by the laboratory as not detected.

The variance of the incremental adjustment due to the magnitude of the uranium isotope concentration is uncertain, but likely the comparison of the adjusted data to screening values is biased toward identifying a potential health effect at the risk and hazard targets used to derive the NALs, when a health effect may not

occur. These incremental adjustments were applied to screening only. In determining a risk estimate, incremental adjustments were not applied.

Further, only risk and hazard contributed by chemicals considered COPCs were included in the calculation.

Table D.6. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles

COPC	Depth	Soil Pile	Hazard	Cancer
Metals (mg/kg)				
Arsenic	Surface	AT	0.72	***1.24E-04***
Beryllium	Surface	AT	0.35	3.52E-11
Chromium	Surface	20	0.13	2.38E-08
	Subsurface	20	0.14	2.62E-08
Uranium	Surface	H	0.40	n/a
		J	**1.41**	n/a
		AT	0.40	n/a
	Subsurface	D	0.36	n/a
		AT	0.37	n/a
		J	0.76	n/a
Vanadium	Surface	AT	***3.49***	n/a
	Subsurface	AT	***3.01***	n/a
Radionuclides (pCi/g)				
Uranium-238	Surface	AT	n/a	**2.29E-06**
		BV	n/a	**4.78E-06**
		E	n/a	***1.60E-04***
		H	n/a	**2.99E-06**
		J	n/a	**1.02E-05**
Uranium-238	Subsurface	D	n/a	**1.21E-05**
		J	n/a	**8.35E-06**
		AT	n/a	**2.35E-06**
Total PCBs (mg/kg)				
	Surface	20	n/a	**5.83E-06**
		E	n/a	**1.24E-05**
		J	n/a	**4.88E-06**
		H	n/a	**1.89E-06**
		AT	n/a	**9.06E-06**
		BW	n/a	**4.65E-06**
	Subsurface	20	n/a	**2.79E-05**
		D	n/a	**1.58E-05**
		J	n/a	**5.43E-06**
		AT	n/a	**5.83E-06**
		BW	n/a	**3.46E-06**

Table D.6. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles (Continued)

COPC	Depth	Soil Pile	Hazard	Cancer
Total PAHs (mg/kg)				
	Surface	19	n/a	**3.83E-06**
		H	n/a	**9.47E-06**
		J	n/a	**5.30E-06**
		N	n/a	**9.85E-06**
		BY	n/a	**5.87E-05**
	Subsurface	N	n/a	**8.57E-05**
		BU	n/a	**4.59E-06**
		BZ	n/a	**4.21E-06**

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table D.7. Cumulative Hazard and Cancer Risk Posed to the PGDP Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles

Soil Pile	Depth	Hazard	Cancer
19	Surface	n/a	**3.83E-06**
20	Surface	0.13	**5.85E-06**
	Subsurface	0.14	**2.79E-05**
D	Subsurface	0.36	**2.79E-05**
E	Surface	n/a	***1.72E-04***
H	Surface	0.40	**1.44E-05**
J	Surface	**1.41**	**2.04E-05**
	Subsurface	0.76	**1.38E-05**
N	Surface	n/a	**9.85E-06**
	Subsurface	n/a	**8.57E-05**
AT	Surface	***4.96***	***1.35E-04***
	Subsurface	***3.38***	**8.18E-06**
BU	Subsurface	n/a	**4.59E-06**
BV	Surface	n/a	**4.78E-06**
BW	Surface	n/a	**4.65E-06**
	Subsurface	n/a	**3.46E-06**
BY	Surface	n/a	**5.87E-05**
BZ	Subsurface	n/a	**4.21E-06**

n/a = value not available
Cancer risk above 1E-6 and hazards above 1 shown in bold.
Cancer risk above 1E-4 and hazards above 3 shown in bold italics.

Table D.8. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Child Resident by COPCs Found in Addendum 1-B Soil Piles

COPC	Depth	Soil Pile	Hazard	Cancer
Metals (mg/kg)				
Arsenic	Surface	AT	***4.48***	***3.26E-04***
Beryllium	Surface	AT	**1.33**	1.37E-10
Chromium	Surface	20	0.47	9.19E-08
		J	0.19	3.71E-08
	Subsurface	20	0.52	1.01E-07
		J	0.21	4.03E-08
Mercury	Surface	AT	0.15	n/a
	Subsurface	AT	0.11	n/a
Uranium	Surface	20	0.37	n/a
		AT	**2.70**	n/a
		C	0.43	n/a
		F	0.45	n/a
		G	0.37	n/a
		H	**2.73**	n/a
		J	***9.63***	n/a
	Subsurface	G	0.36	n/a
		C	0.52	n/a
		20	0.42	n/a
		D	**2.42**	n/a
		AT	**2.52**	n/a
		J	***5.14***	n/a
Vanadium	Surface	AT	***13.17***	n/a
	Subsurface	AT	***11.37***	n/a
Radionuclides (pCi/g)				
Uranium-234	Surface	AT	n/a	**1.73E-06**
		E	n/a	**1.40E-05**
		J	n/a	**1.06E-06**
	Subsurface	AT	n/a	**1.76E-06**
		D	n/a	**1.23E-06**
Uranium-235	Surface	AT	n/a	**5.70E-06**
		BV	n/a	**4.99E-06**
		E	n/a	***1.52E-04***
		H	n/a	**2.76E-06**
		J	n/a	**9.61E-06**
	Subsurface	AT	n/a	**5.89E-06**
		D	n/a	**1.00E-05**
		J	n/a	**7.36E-06**

Table D.8. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Child Resident by COPCs Found in Addendum 1-B Soil Piles (Continued)

COPC	Depth	Soil Pile	Hazard	Cancer
Uranium-238	Surface	AT	n/a	**3.19E-05**
		H	n/a	**4.18E-05**
		BV	n/a	**6.67E-05**
		BW	n/a	**5.29E-06**
		CC	n/a	**5.71E-06**
		D	n/a	**6.40E-06**
		E	n/a	***2.23E-03***
		P	n/a	**7.05E-06**
		G	n/a	**8.58E-06**
		C	n/a	**1.05E-05**
		20	n/a	**1.06E-05**
		F	n/a	**1.15E-05**
		J	n/a	***1.43E-04***
	Subsurface	K013	n/a	**6.59E-06**
		BW	n/a	**4.33E-06**
		P	n/a	**8.16E-06**
		F	n/a	**8.16E-06**
		G	n/a	**9.27E-06**
		20	n/a	**1.13E-05**
		C	n/a	**1.13E-05**
		AT	n/a	**3.27E-05**
		J	n/a	***1.16E-04***
		D	n/a	***1.69E-04***
Total PCBs (mg/kg)				
	Surface	20	n/a	**5.83E-06**
		E	n/a	**1.24E-05**
		J	n/a	**4.88E-06**
		H	n/a	**1.89E-06**
		AT	n/a	**9.06E-06**
		BW	n/a	**4.65E-06**
	Subsurface	20	n/a	**2.79E-05**
		D	n/a	**1.58E-05**
		J	n/a	**5.43E-06**
		AT	n/a	**5.83E-06**
		BW	n/a	**3.46E-06**
Total PAHs (mg/kg)				
	Surface	19	n/a	**3.83E-06**
		H	n/a	**9.47E-06**
		J	n/a	**5.30E-06**
		N	n/a	**9.85E-06**
		BY	n/a	**5.87E-05**
	Subsurface	N	n/a	**8.57E-05**
		BU	n/a	**4.59E-06**
		BZ	n/a	**4.21E-06**

n/a = value not available Cancer risks above 1E-6 and hazards above 1 shown in bold. Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table D.9. Cumulative Hazard and Cancer Risk Posed to the PGDP Child Resident by COPCs Found in Addendum 1-B Soil Piles

Soil Pile	Depth	Hazard	Cancer
19	Surface	n/a	**3.83E-06**
20	Surface	0.84	**1.65E-05**
	Subsurface	0.94	**3.93E-05**
AT	Surface	***21.82***	***3.74E-04***
	Subsurface	***14.00***	**4.62E-05**
BU	Subsurface	n/a	**4.59E-06**
BV	Surface	n/a	**7.17E-05**
BW	Surface	n/a	**9.93E-06**
	Subsurface	n/a	**7.79E-06**
BY	Surface	n/a	**5.87E-05**
BZ	Subsurface	n/a	**4.21E-06**
C	Surface	0.43	**1.05E-05**
	Subsurface	0.52	**1.13E-05**
CC	Surface	n/a	**5.71E-06**
D	Surface	n/a	**6.40E-06**
	Subsurface	**2.42**	***1.96E-04***
E	Surface	n/a	***2.40E-03***
F	Surface	0.45	**1.15E-05**
	Subsurface	n/a	**8.16E-06**
G	Surface	0.37	**8.58E-06**
	Subsurface	0.36	**9.27E-06**
H	Surface	**2.73**	**5.59E-05**
J	Surface	***9.82***	***1.64E-04***
	Subsurface	***5.35***	***1.29E-04***
K013	Subsurface	n/a	**6.59E-06**
N	Surface	n/a	**9.85E-06**
	Subsurface	n/a	**8.57E-05**
P	Surface	n/a	**7.05E-06**
	Subsurface	n/a	**8.16E-06**

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table D.10. Additional Screening Criteria for COPCs Found in Addendum 1-B Soil Piles

COPC	Site-Specific Teen Recreation User[a] No Action Levels	
	Hazard	Cancer
Metals (mg/kg)		
Arsenic	1.38E+01	1.79E+00
Beryllium	6.79E+01	4.66E+05
Chromium	n/a	n/a
Uranium	5.29E+02	n/a
Vanadium	4.04E+03	n/a
Radionuclides (pCi/g)		
Uranium-235	n/a	5.53E+00
Uranium-238	n/a	2.46E+01
Total PCBs (mg/kg)		
	4.36E-01	6.36E-01
Total PAHs (mg/kg)		
	n/a	6.60E-02

n/a = value not available
[a]Site-Specific Teen Recreational User No Action Levels are taken from the Site Evaluation Report for Soil Pile I (DOE 2008).

Table D.11. Chemical-Specific Hazards and Cancer Risk Posed to the Site-Specific Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles

COPC	Depth	Soil Pile	Hazard	Cancer
Metals (mg/kg)				
Arsenic	Surface	AT	0.31	**2.40E-05**
Beryllium	Surface	AT	0.00	4.54E-12
Uranium	Surface	H	0.01	n/a
		J	0.04	n/a
		AT	0.01	n/a
	Subsurface	D	0.01	n/a
		AT	0.01	n/a
		J	0.02	n/a
Vanadium	Surface	AT	0.00	n/a
	Subsurface	AT	0.00	n/a
Radionuclides (pCi/g)				
Uranium-235	Surface	E	n/a	**1.62E-06**
Uranium-238	Surface	AT	n/a	3.39E-07
		E	n/a	**2.36E-05**
		H	n/a	4.43E-07
		J	n/a	**1.52E-06**
	Subsurface	D	n/a	**1.80E-06**
		J	n/a	**1.24E-06**
		AT	n/a	**3.47E-07**

Table D.11. Chemical-Specific Hazards and Cancer Risk Posed to the Site-Specific Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles (Continued)

COPC	Depth	Soil Pile	Hazard	Cancer
Total PCBs (mg/kg)				
	Surface	20	0.17	**1.16E-06**
		E	0.36	**2.48E-06**
		J	0.14	9.75E-07
		H	0.06	3.77E-07
		AT	0.26	**1.81E-06**
		BW	0.14	9.28E-07
	Subsurface	20	0.81	**5.57E-06**
		D	0.46	**3.16E-06**
		J	0.16	**1.08E-06**
		AT	0.17	**1.16E-06**
		BW	0.10	6.92E-07
Total PAHs (mg/kg)				
	Surface	19	n/a	7.73E-07
		H	n/a	**1.91E-06**
		J	n/a	**1.07E-06**
		N	n/a	**1.98E-06**
		BY	n/a	**1.18E-05**
	Subsurface	N	n/a	**1.73E-05**
		BU	n/a	9.24E-07
		BZ	n/a	8.48E-07

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table D.12. Cumulative Hazard and Cancer Risk Posed to the Site-Specific Teen Recreational User by COPCs Found in Addendum 1-B Soil Piles

Soil Pile	Depth	Hazard	Cancer
19	Surface		7.73E-07
20	Surface	0.17	**1.16E-06**
	Subsurface	0.81	**5.57E-06**
D	Subsurface	0.47	**4.96E-06**
E	Surface	0.36	**2.77E-05**
H	Surface	0.07	**2.73E-06**
J	Surface	0.18	**3.56E-06**
	Subsurface	0.18	**2.32E-06**
N	Surface		**1.98E-06**
	Subsurface		**1.73E-05**
AT	Surface	0.59	**2.62E-05**
	Subsurface	0.18	**1.51E-06**
BU	Subsurface		9.24E-07
BW	Surface		9.28E-07
	Subsurface		6.92E-07
BY	Surface		**1.18E-05**
BZ	Subsurface		8.48E-07

n/a = value not available
Cancer risk above 1E-6 and hazards above 1 shown in bold.
Cancer risk above 1E-4 and hazards above 3 shown in bold italics.

RESULTS OF DERIVATION OF RISK ESTIMATES FOR COPCs

Teen Recreational Use Scenario. These estimates indicate arsenic in surface soil provides an unacceptable cancer risk and unacceptable cumulative hazards and cumulative cancer risks to the teen recreator at Soil Pile AT under the default scenario. Further evaluation using the site-specific scenario indicate no unacceptable cumulative hazards or cumulative cancer risks to the teen recreator.

Child Residential Use Scenario. These estimates indicate unacceptable cumulative hazards and cumulative cancer risks to the child resident are present in soil at Soil Pile AT and at Soil Pile J. Additionally, unacceptable cumulative hazard to the child resident is present in soil at Soil Pile AT and unacceptable cancer risk is present in soil at Soil Pile D.

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Attachment D1
Exceedance Locations

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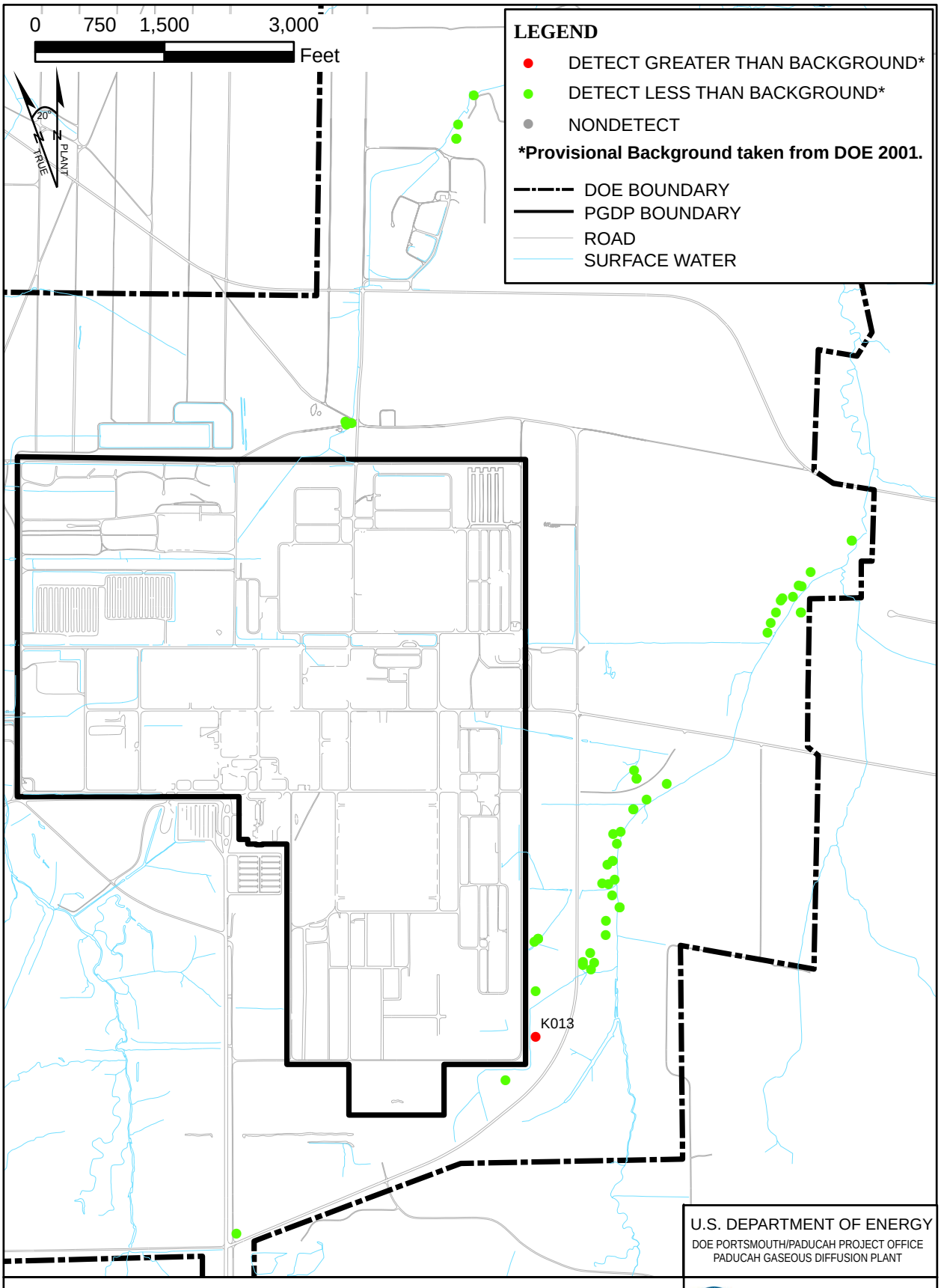

Figure D1.1. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Aluminum

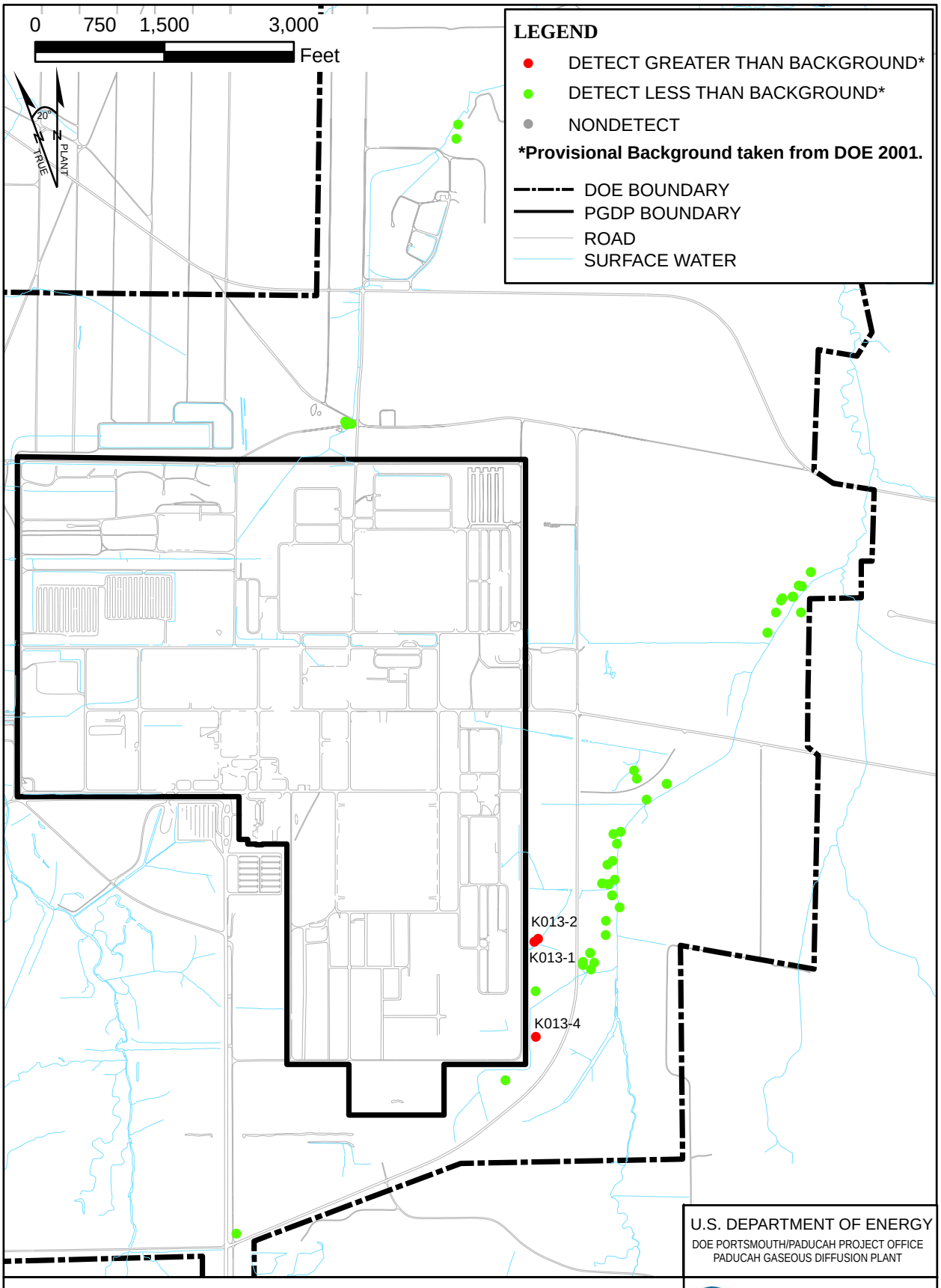

Figure D1.2. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Aluminum

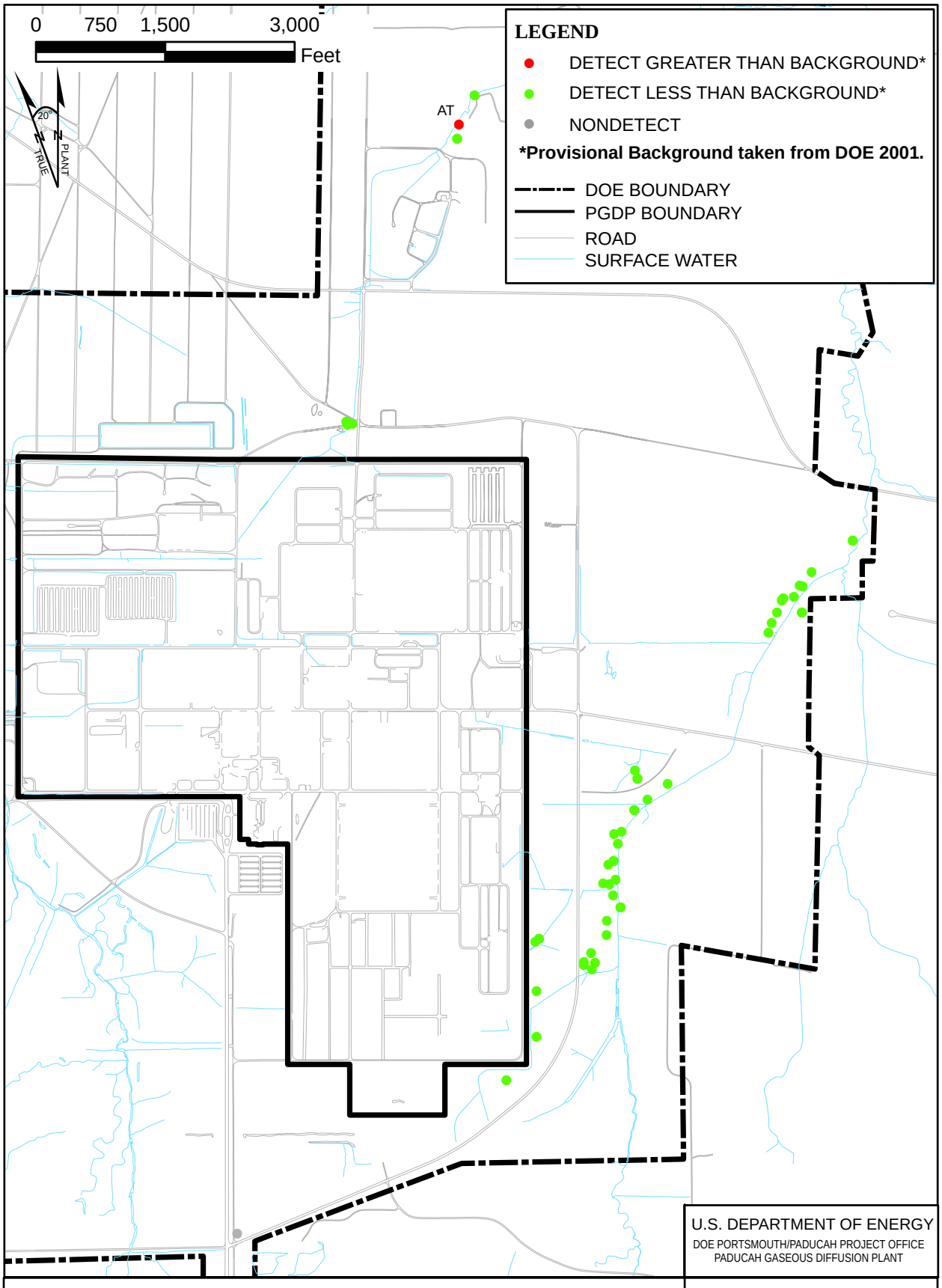

Figure D1.3. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Arsenic

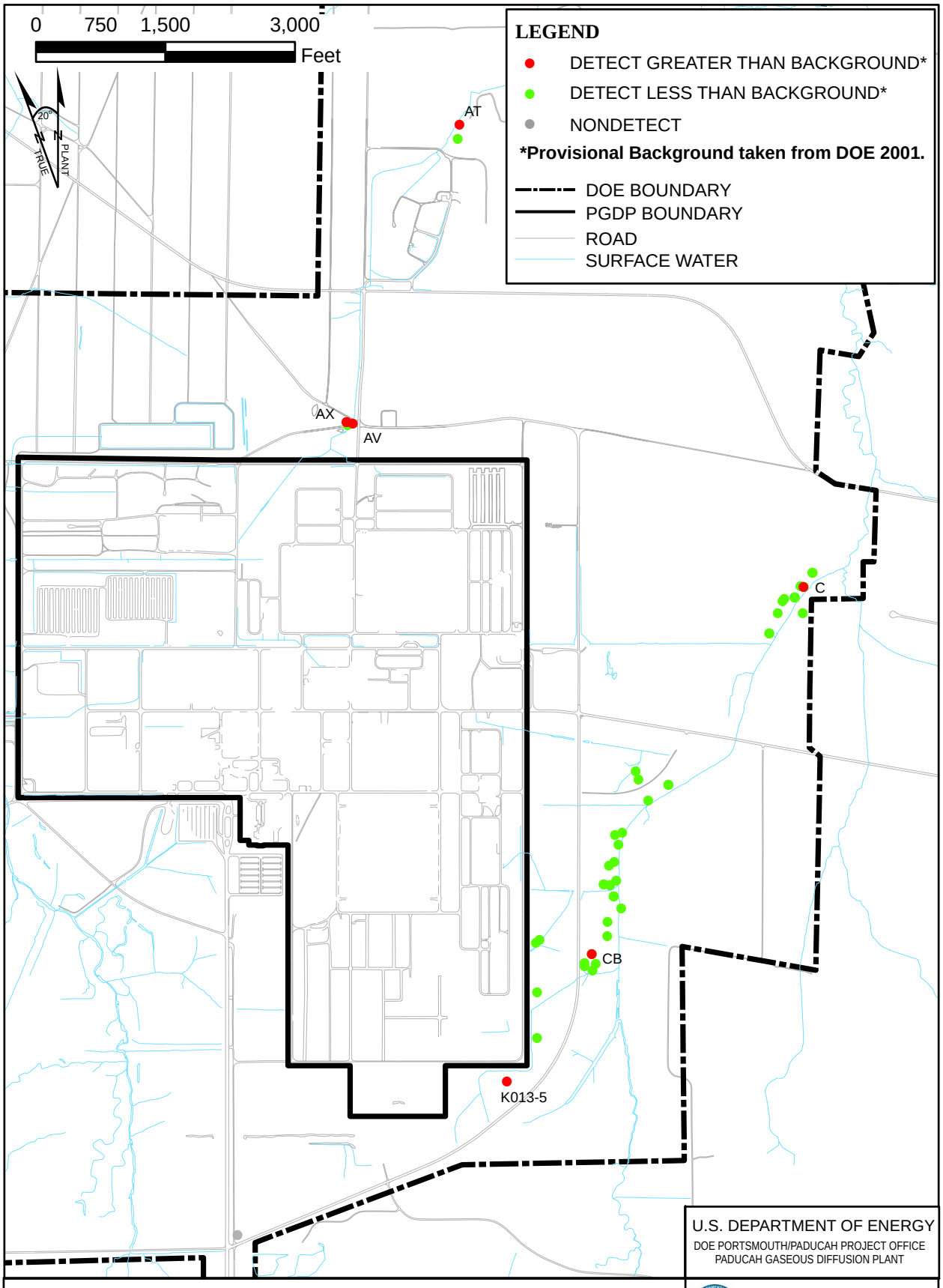

Figure D1.4. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Arsenic

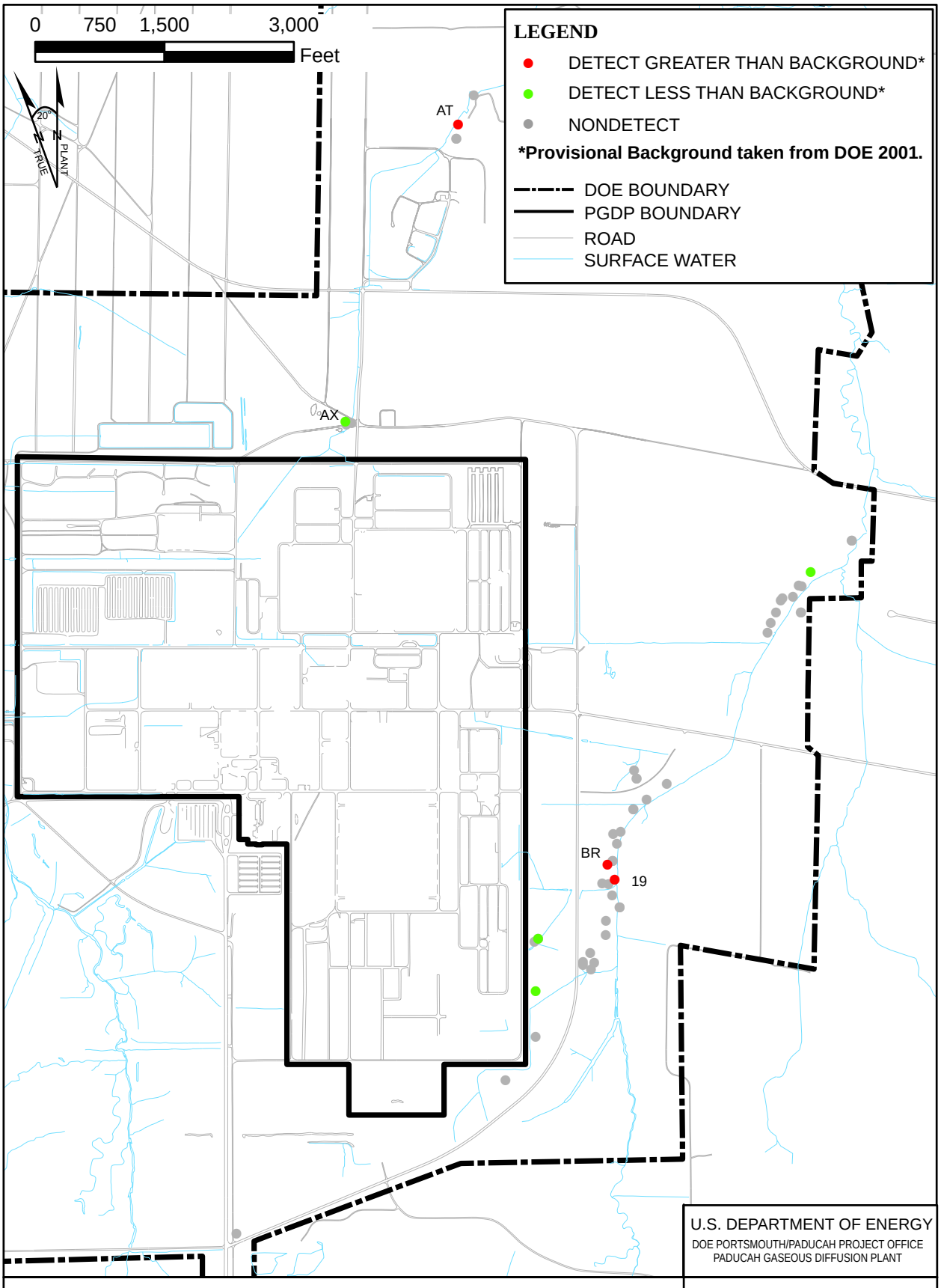

Figure D1.5. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Beryllium

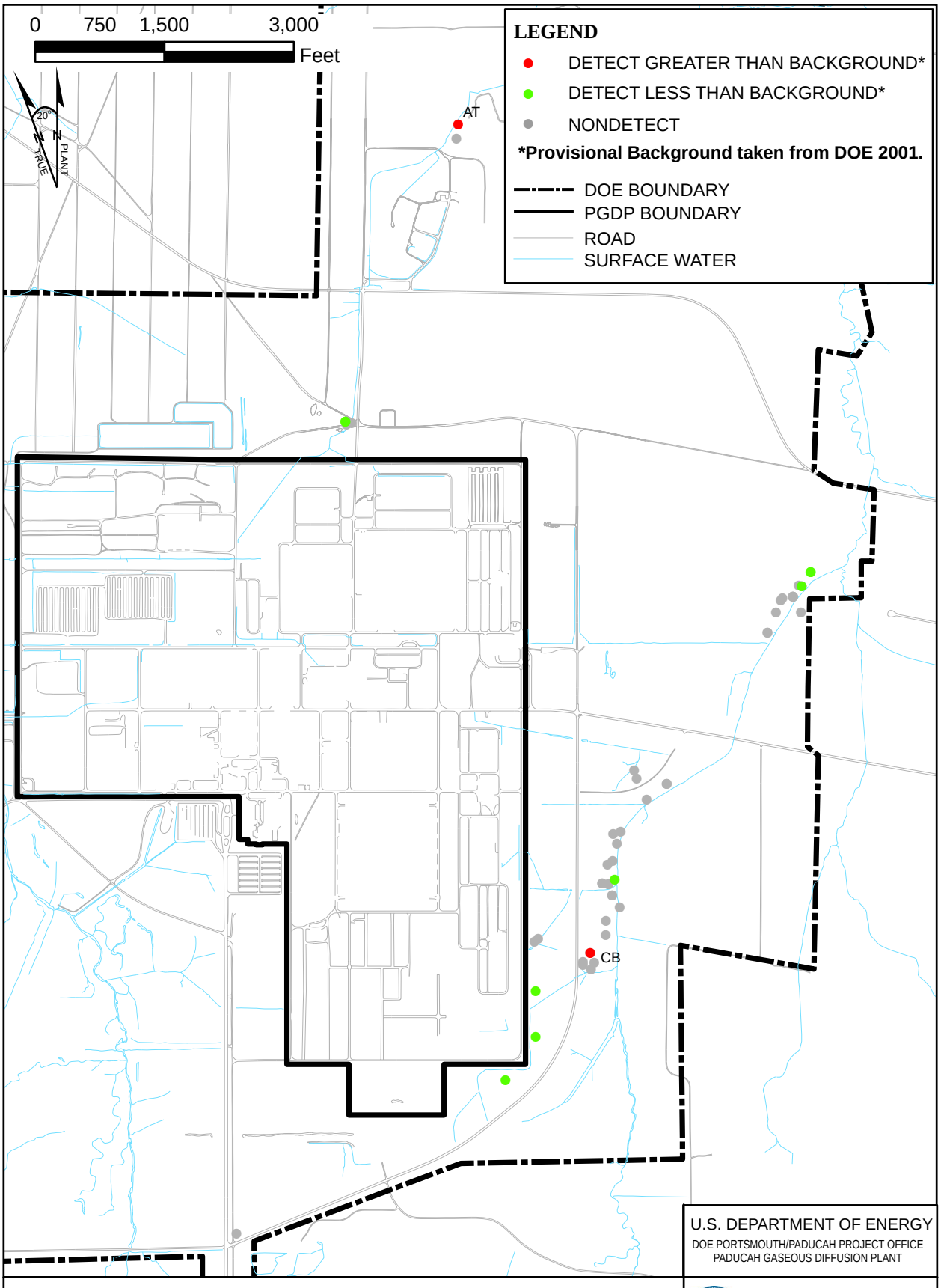

Figure D1.6. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Beryllium

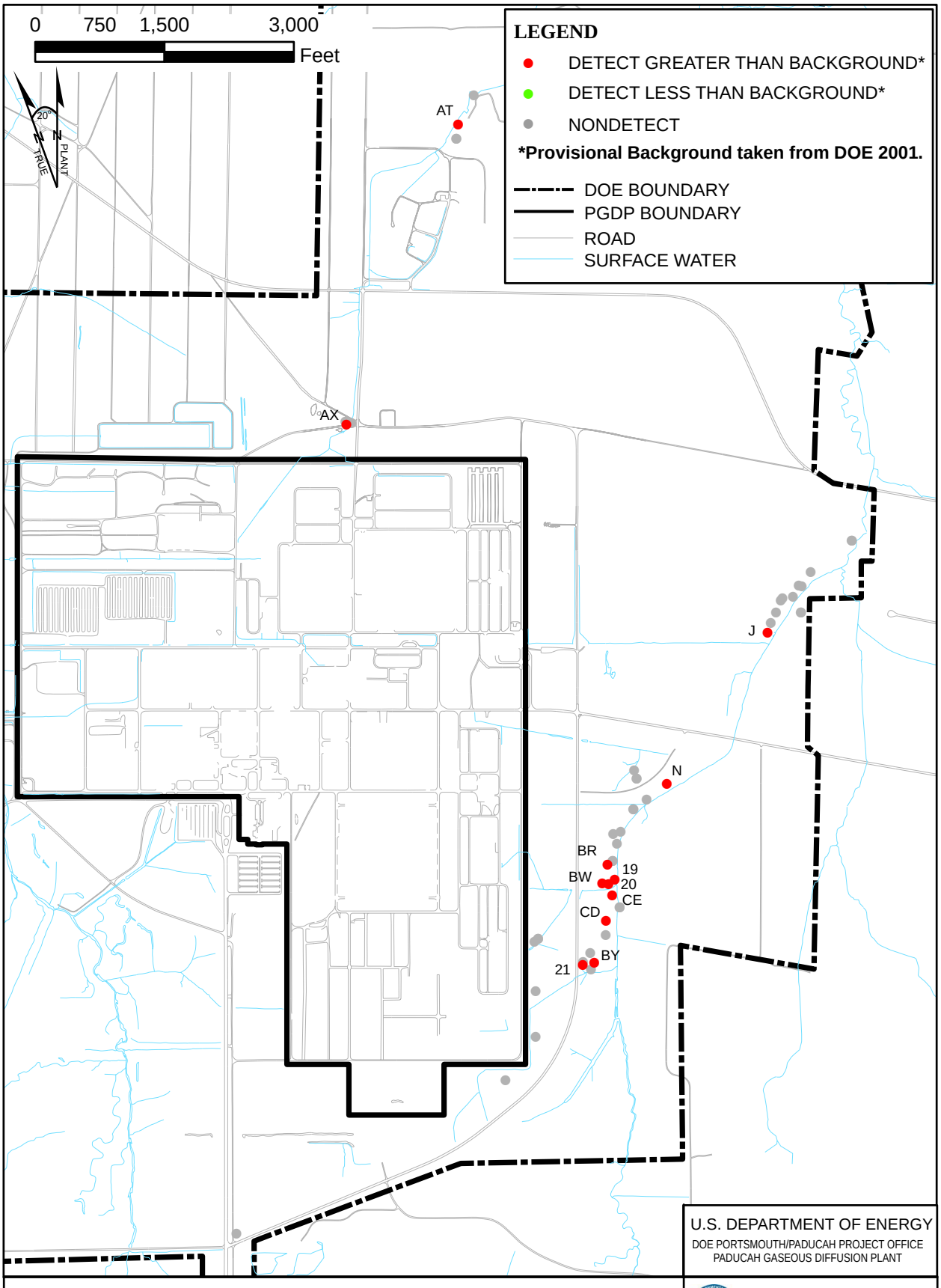

Figure D1.7. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Cadmium

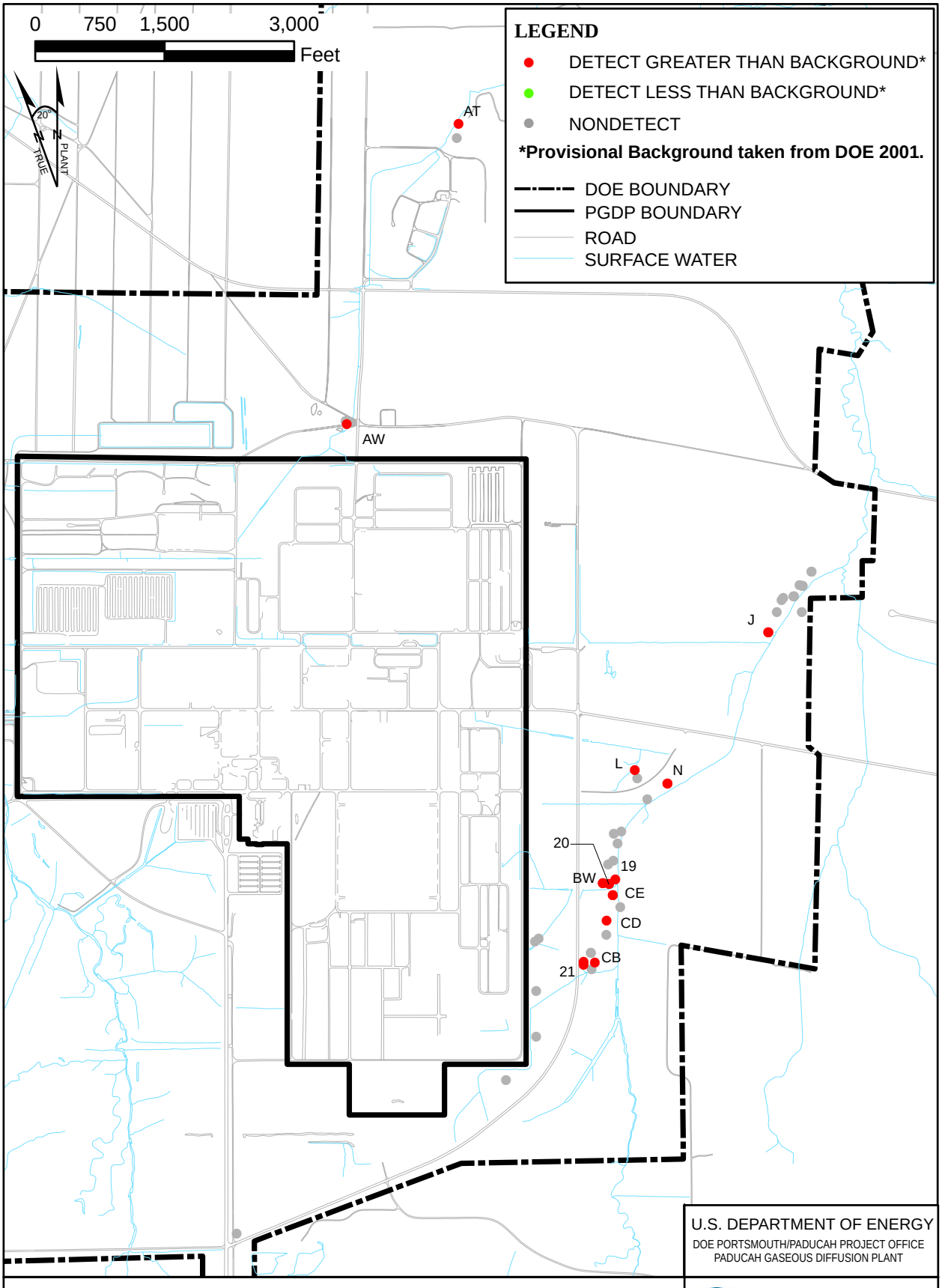

Figure D1.8. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Cadmium

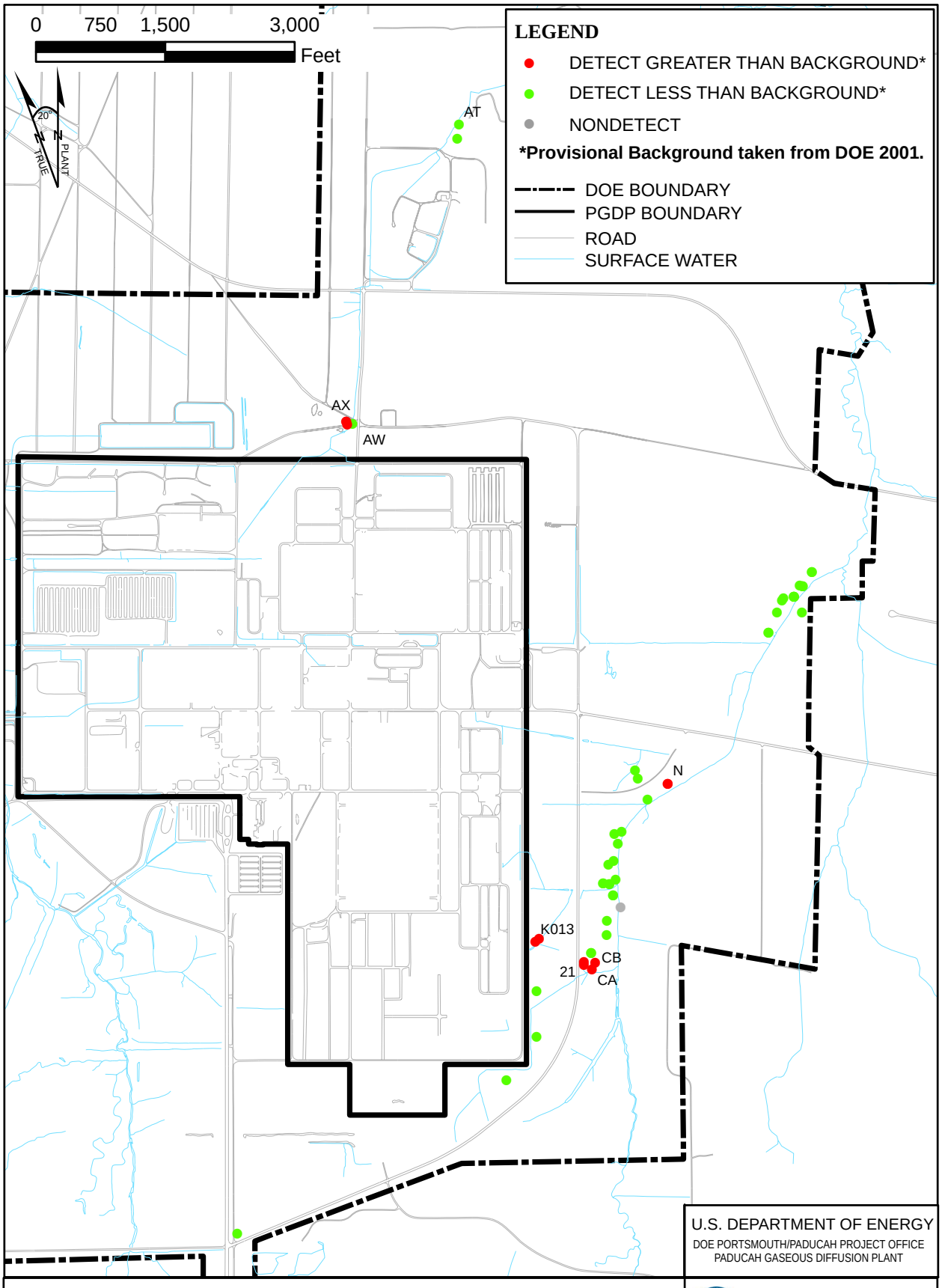

Figure D1.9. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Calcium

LATA Environmental Services of Kentucky, LLC

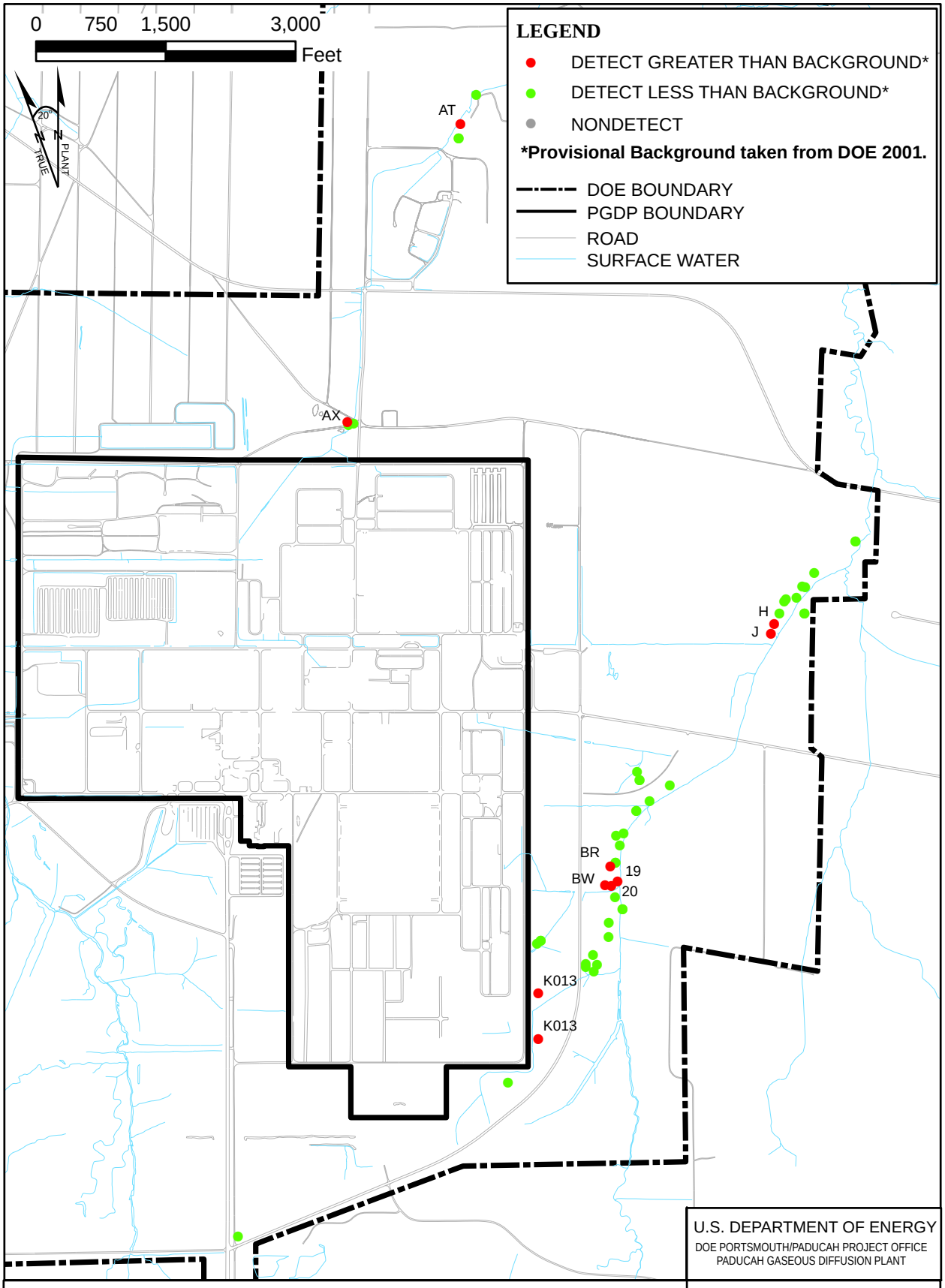

Figure D1.10. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Chromium

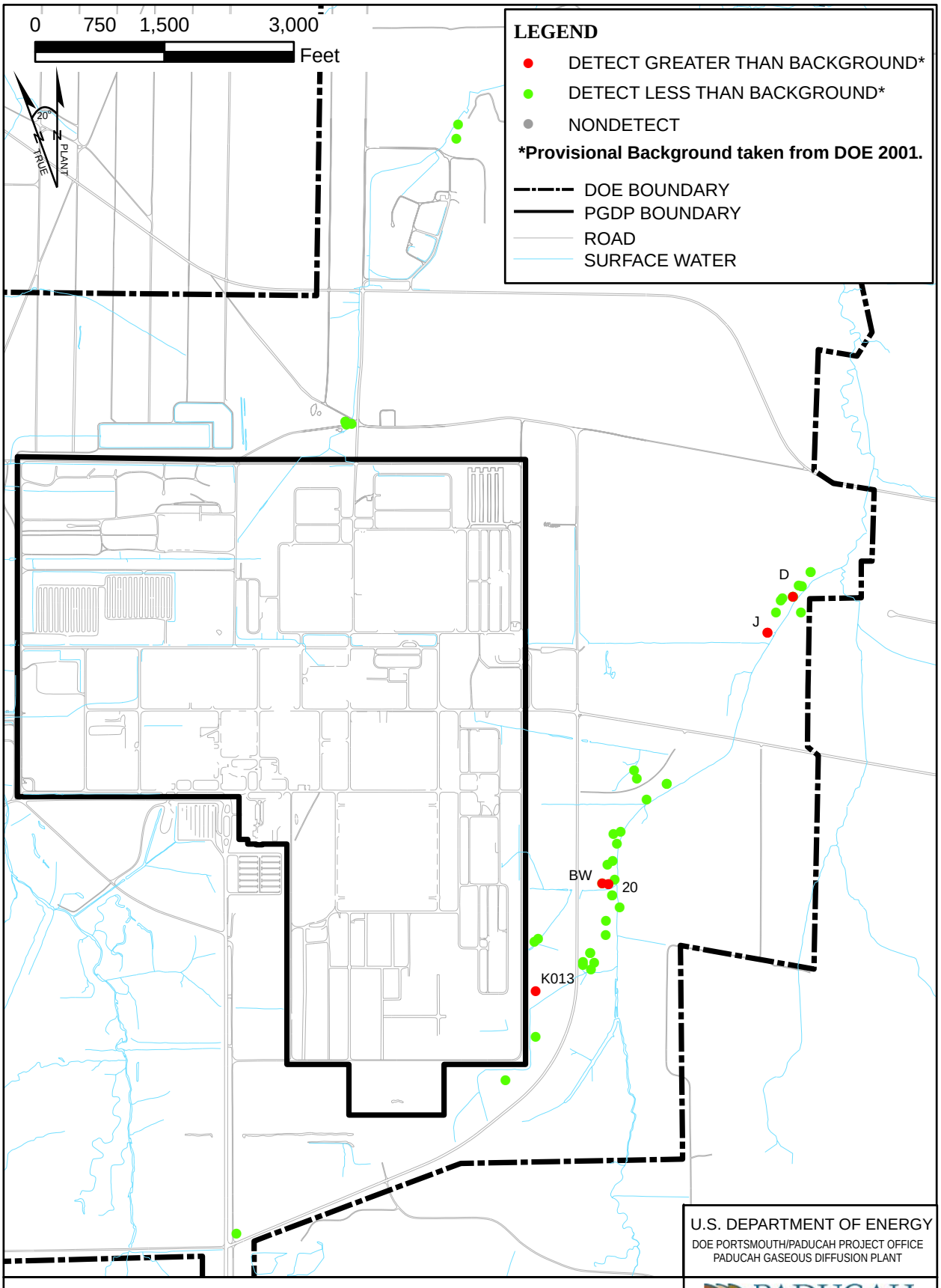

Figure D1.11. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Chromium

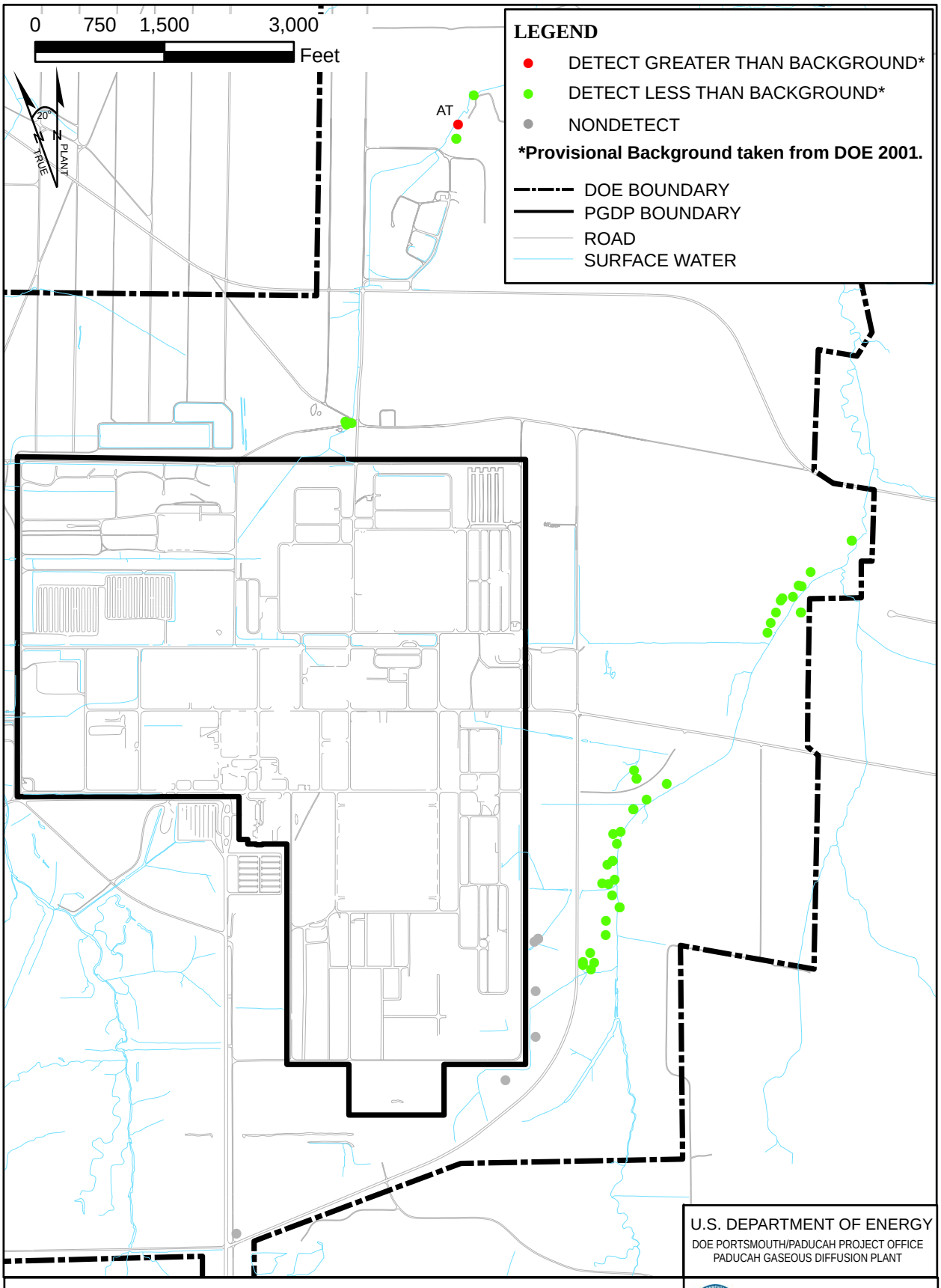

Figure D1.12. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Copper

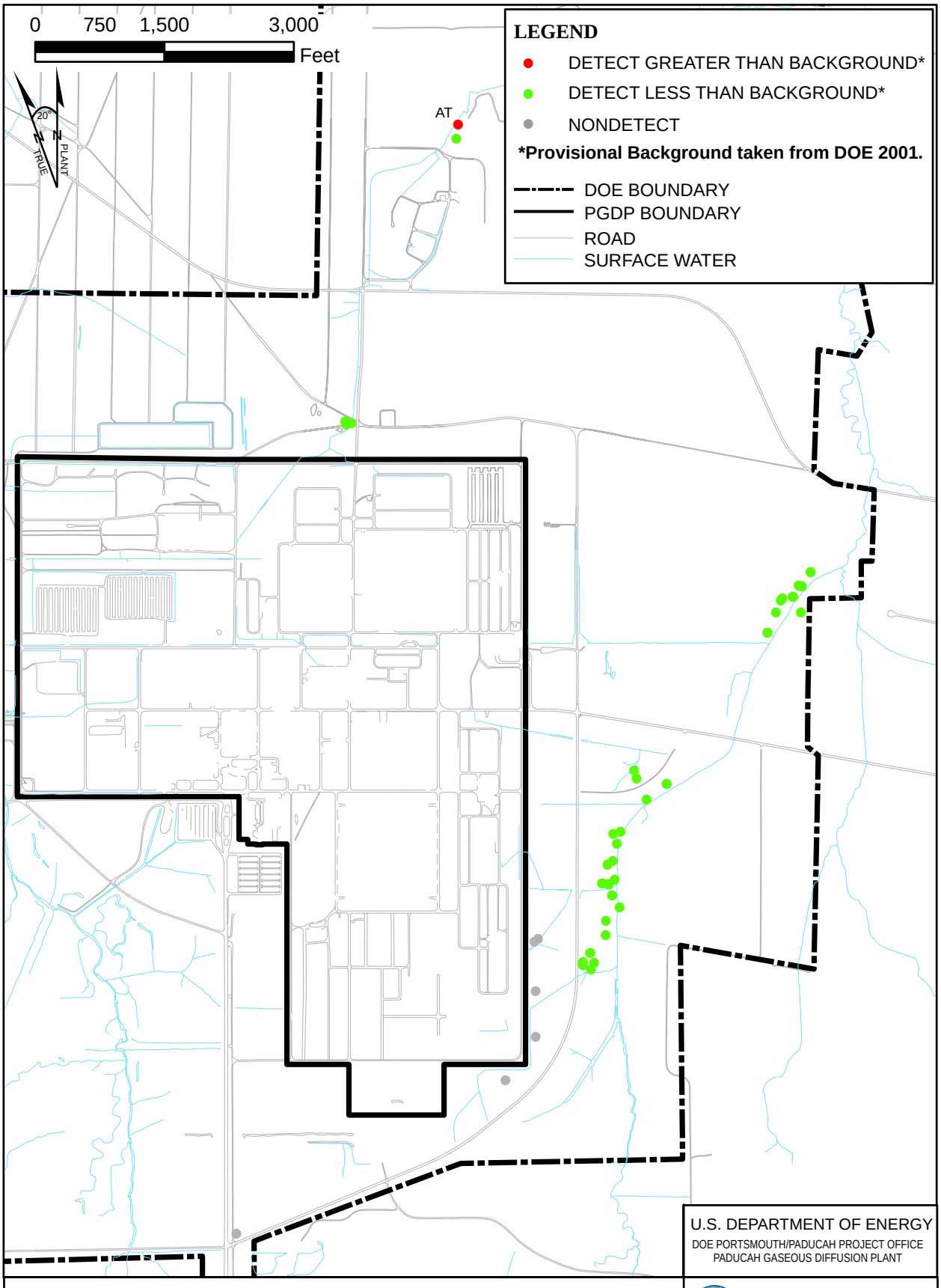

Figure D1.13. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Copper

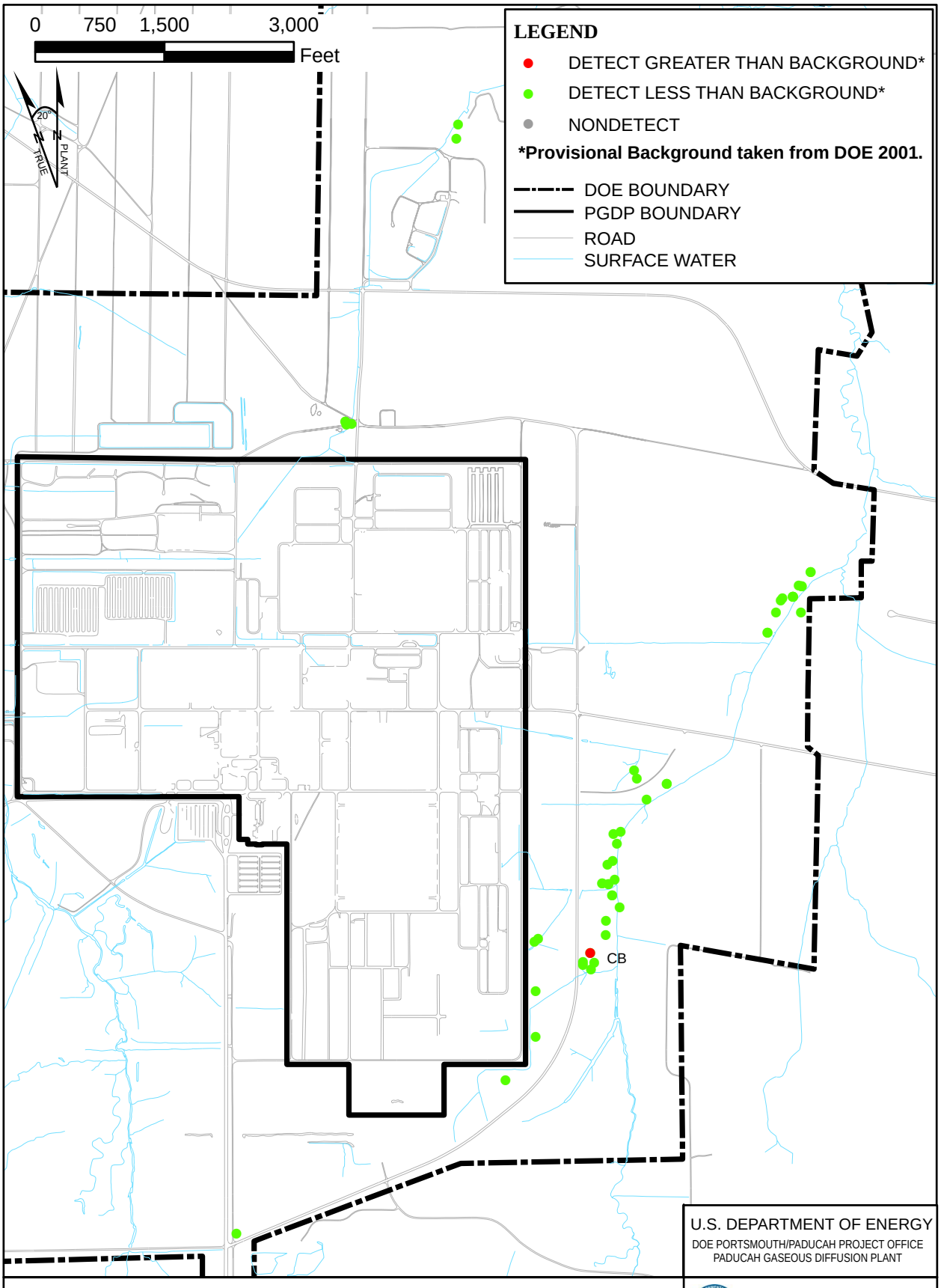

Figure D1.14. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Iron

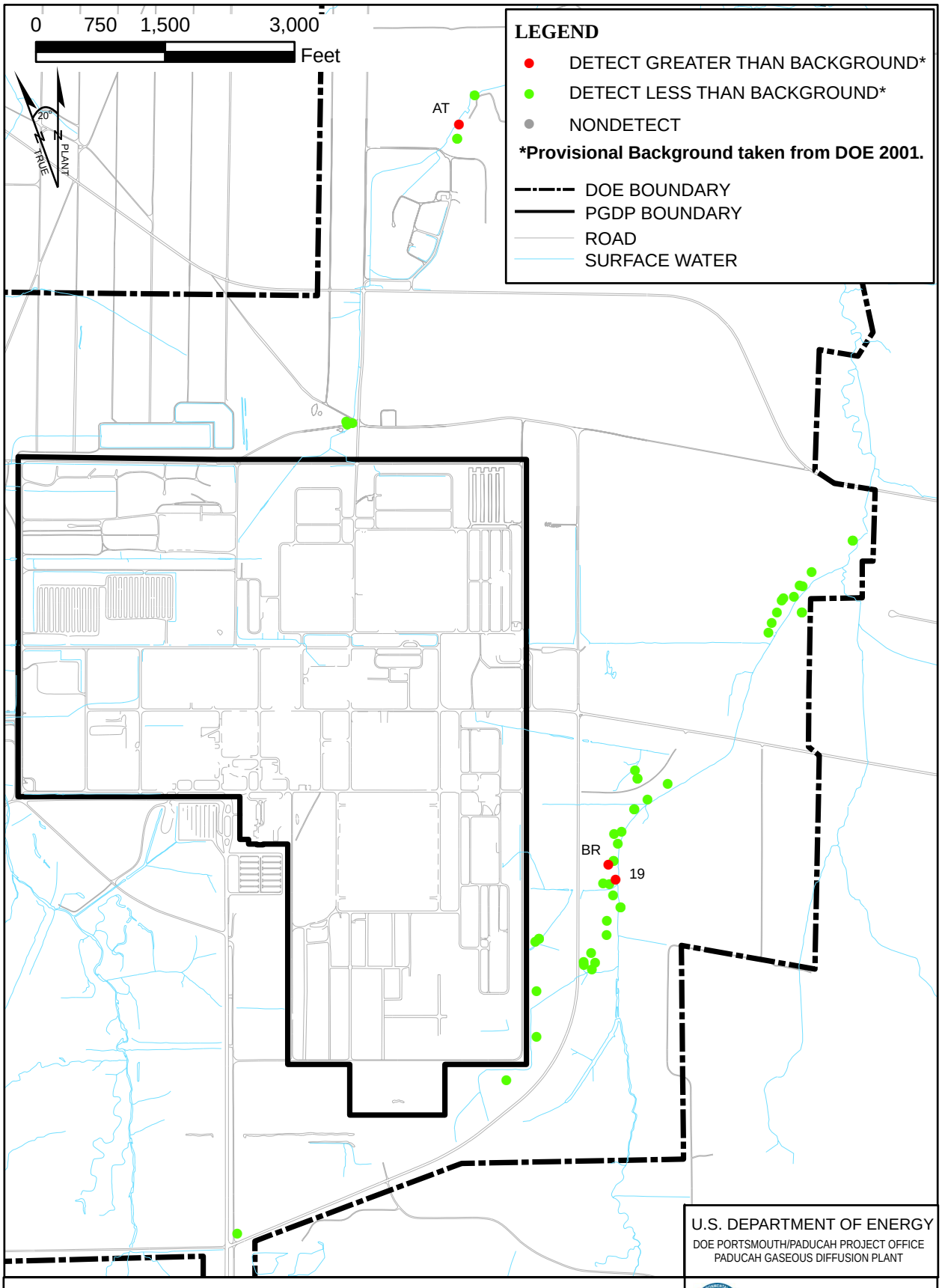

Figure D1.15. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Lead

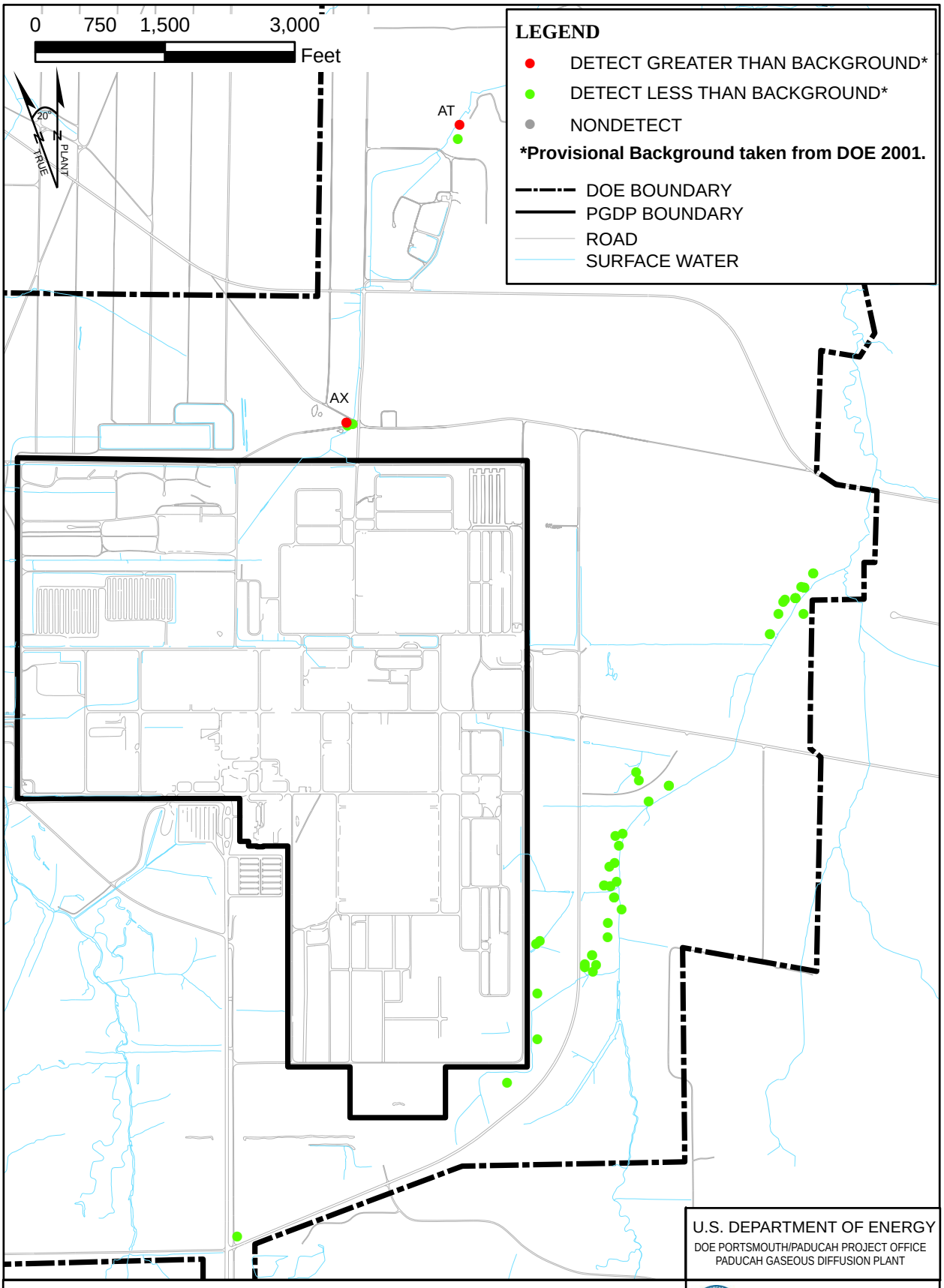

Figure D1.16. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Lead

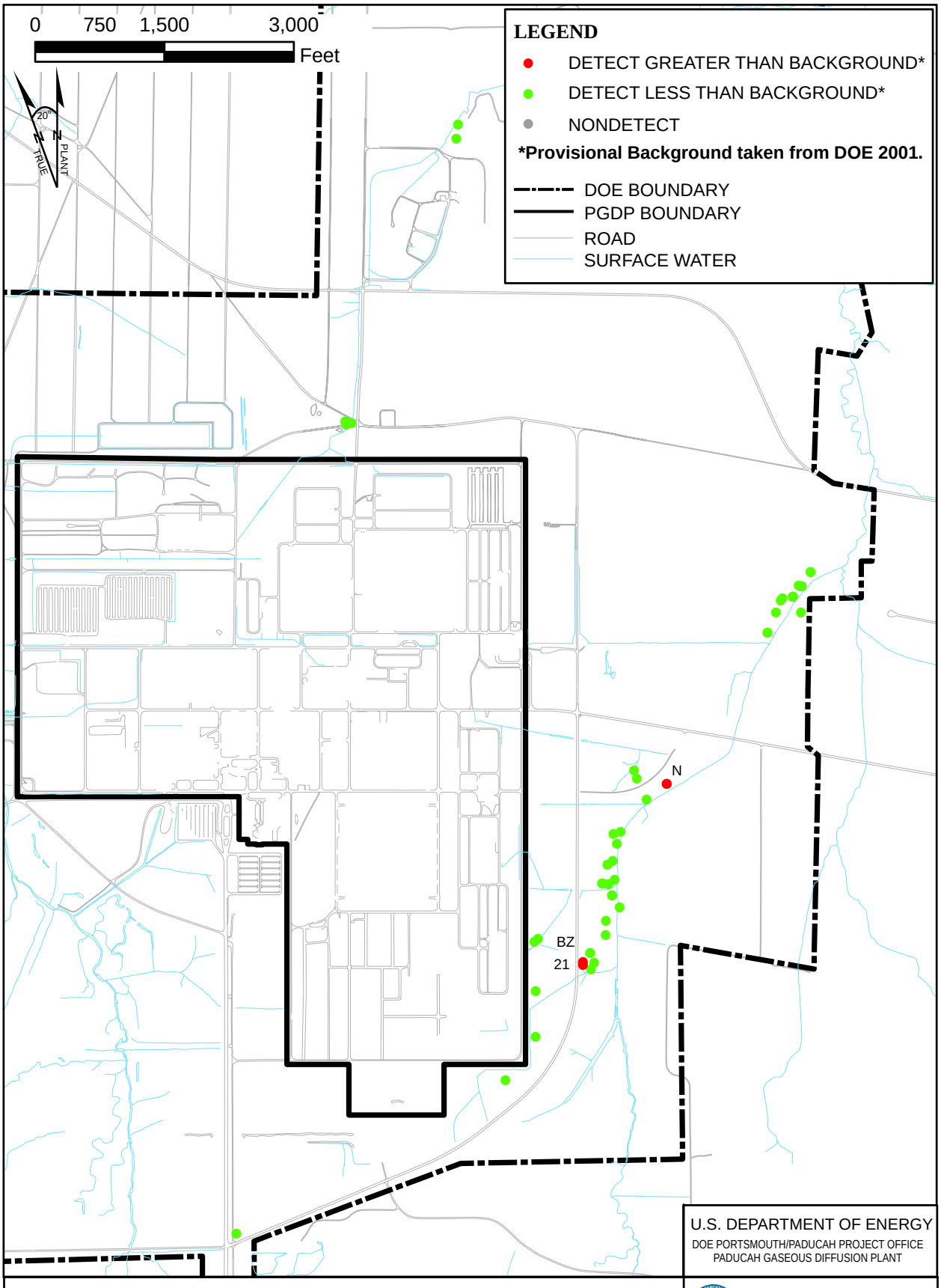

Figure D1.17. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Magnesium

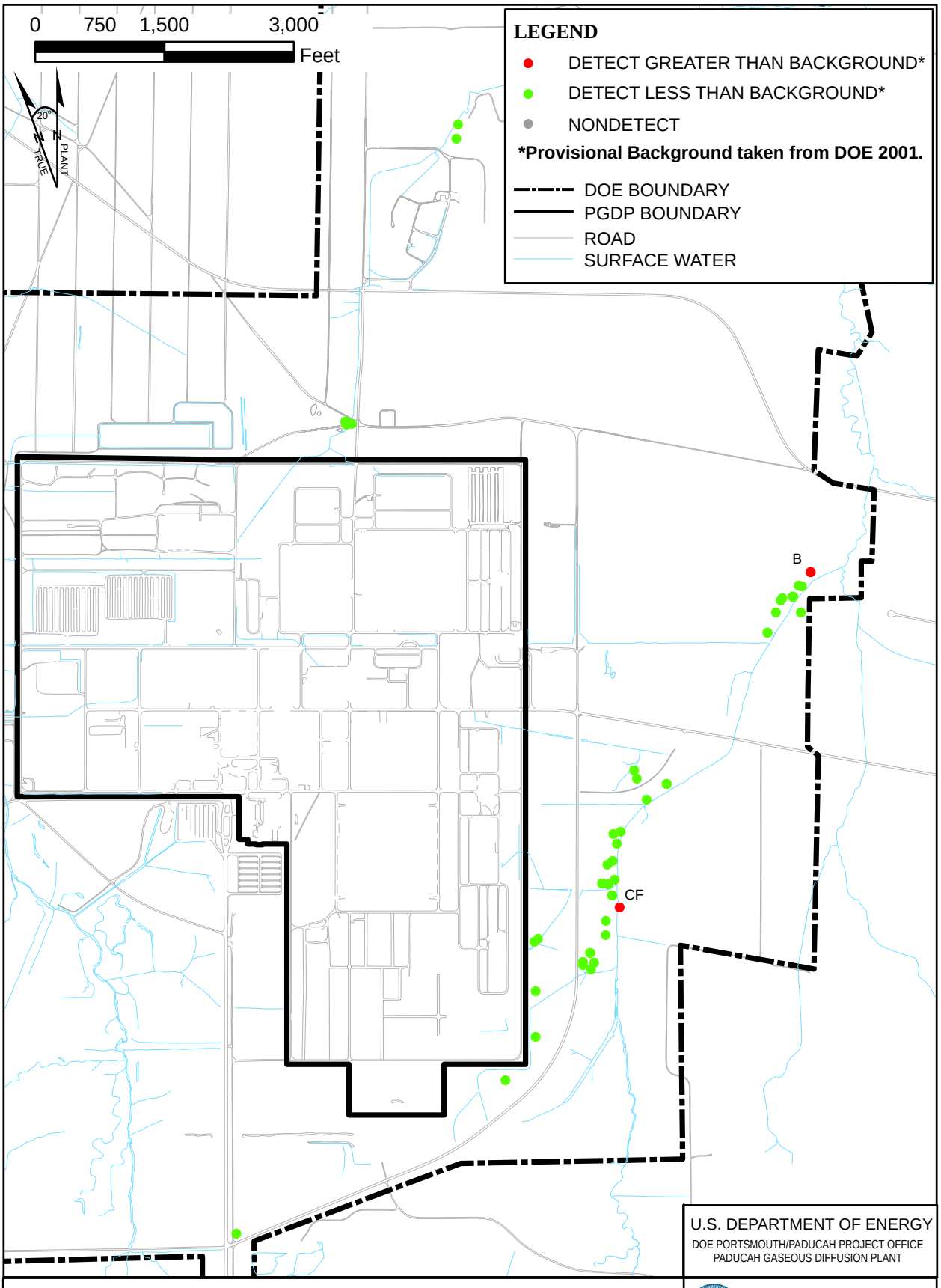

Figure D1.18. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Manganese

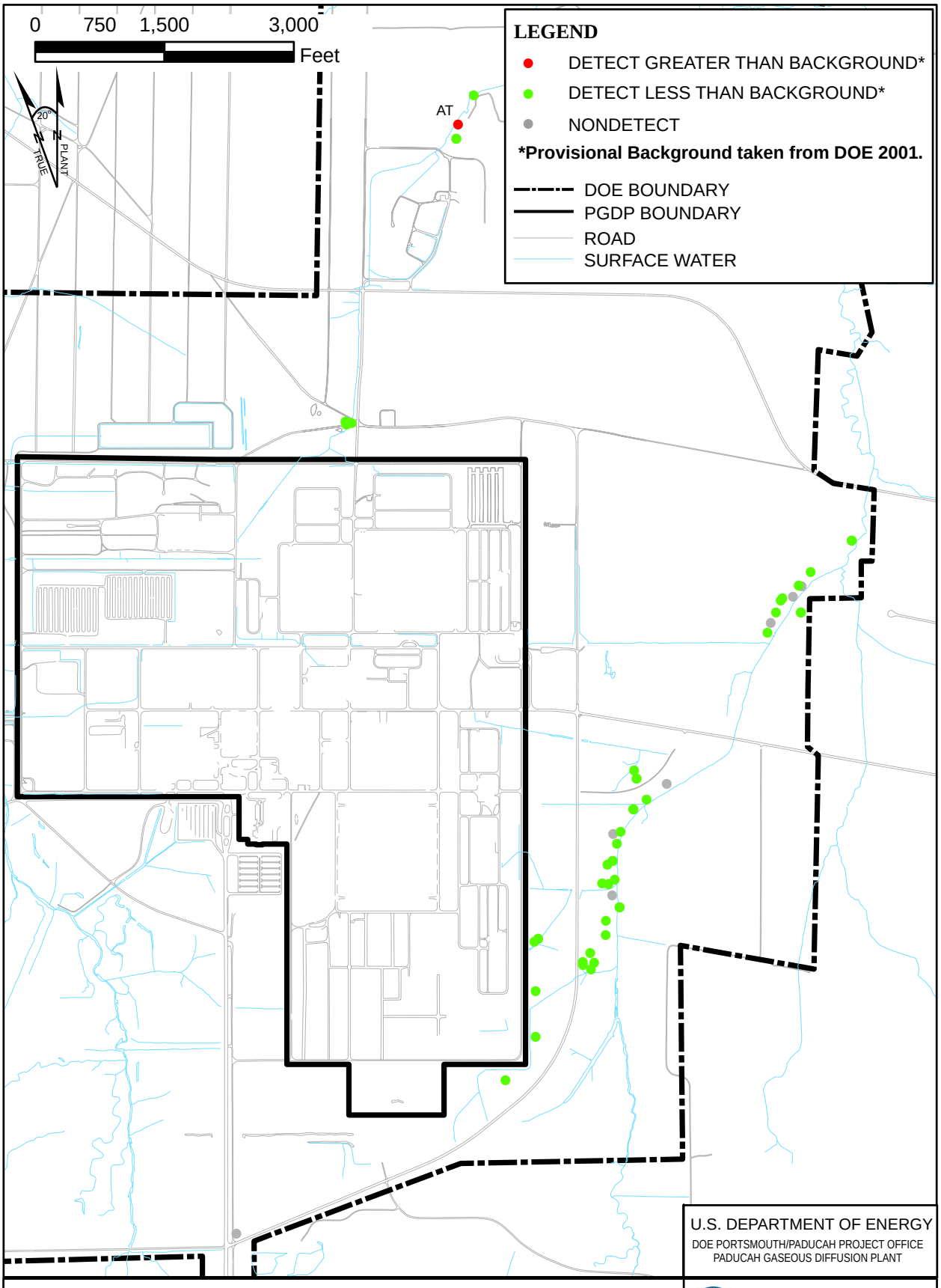

Figure D1.19. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Mercury

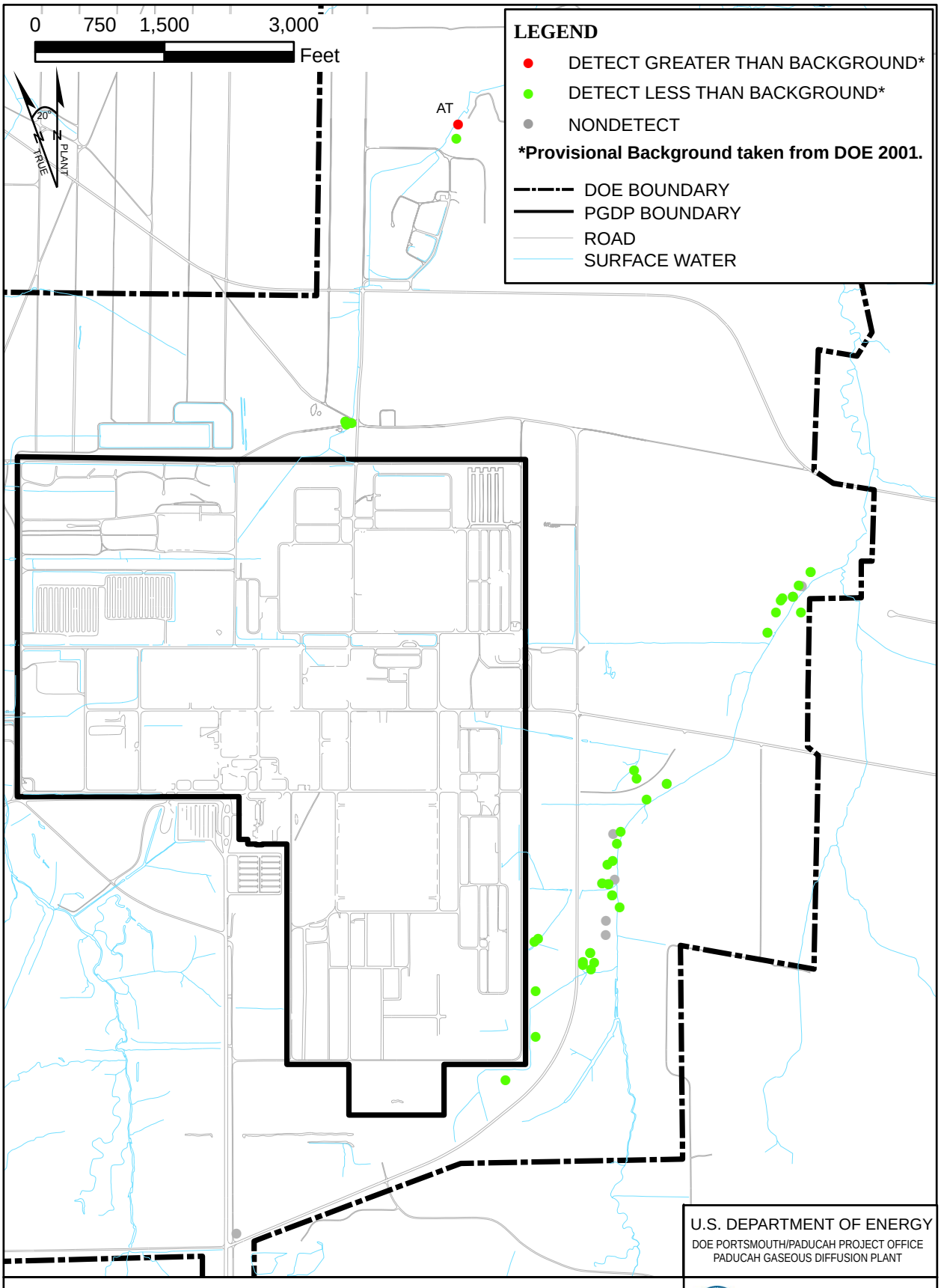

Figure D1.20. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Mercury

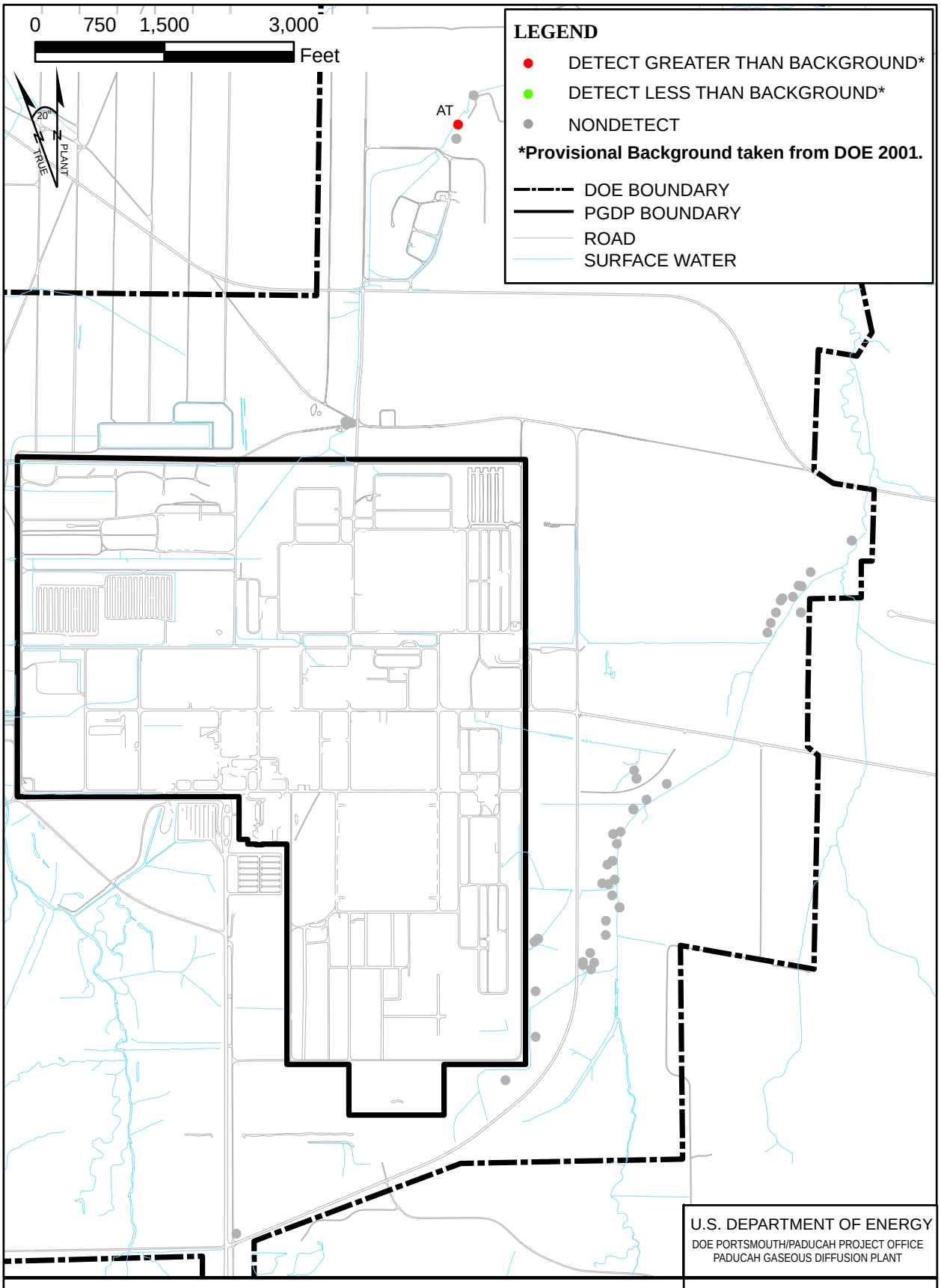

Figure D1.21. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Selenium

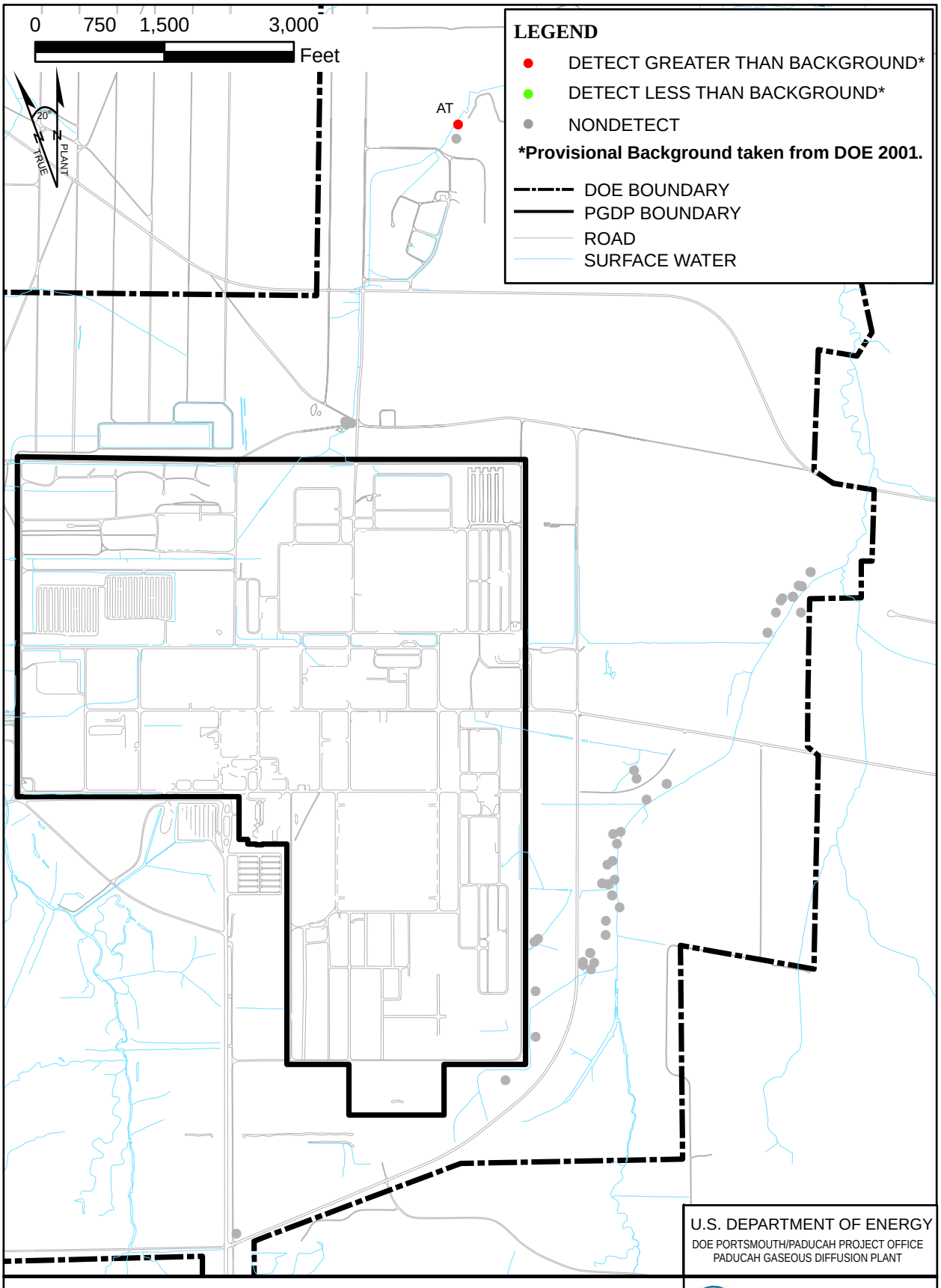

Figure D1.22. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Selenium

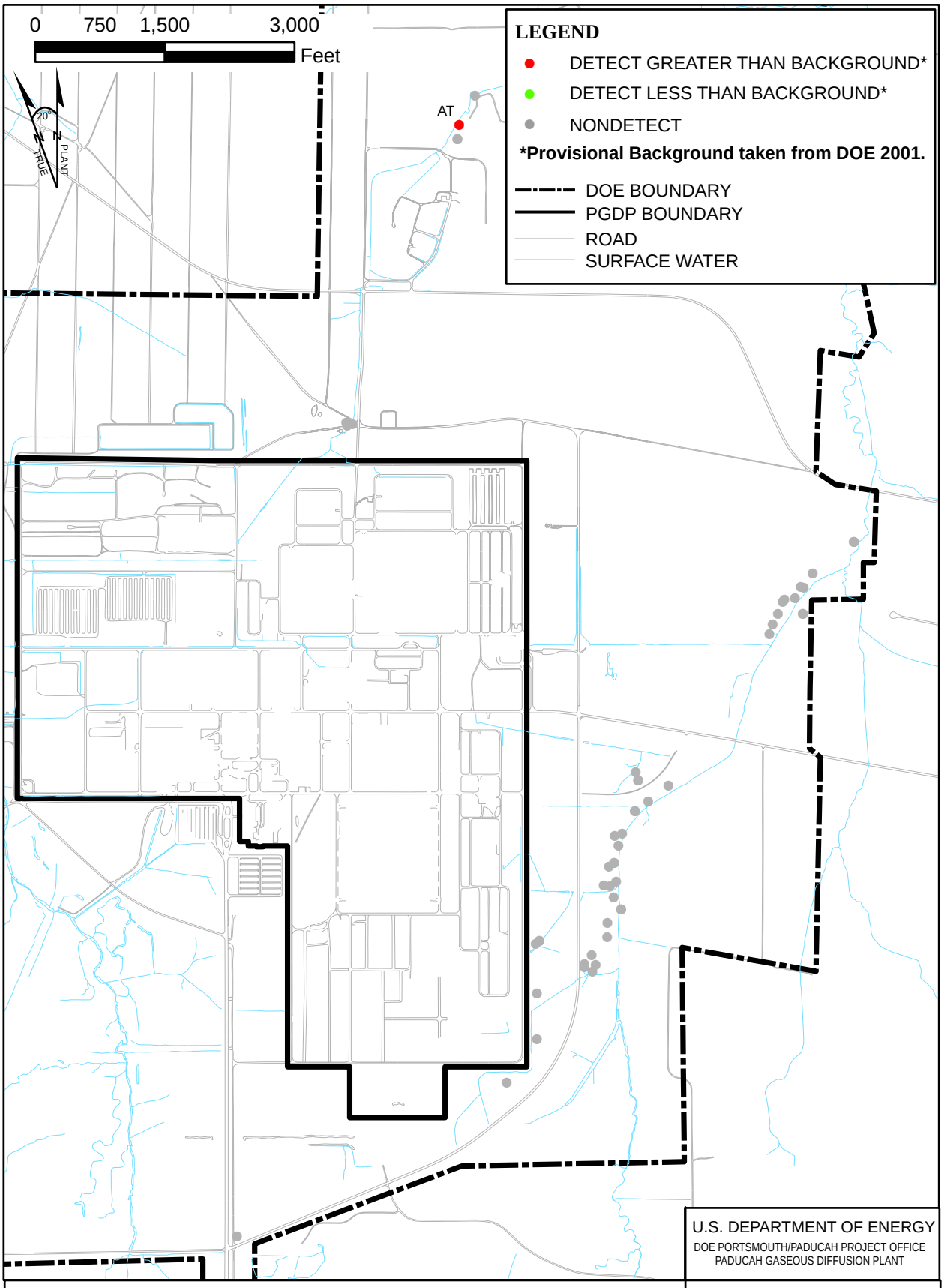

Figure D1.23. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Thallium

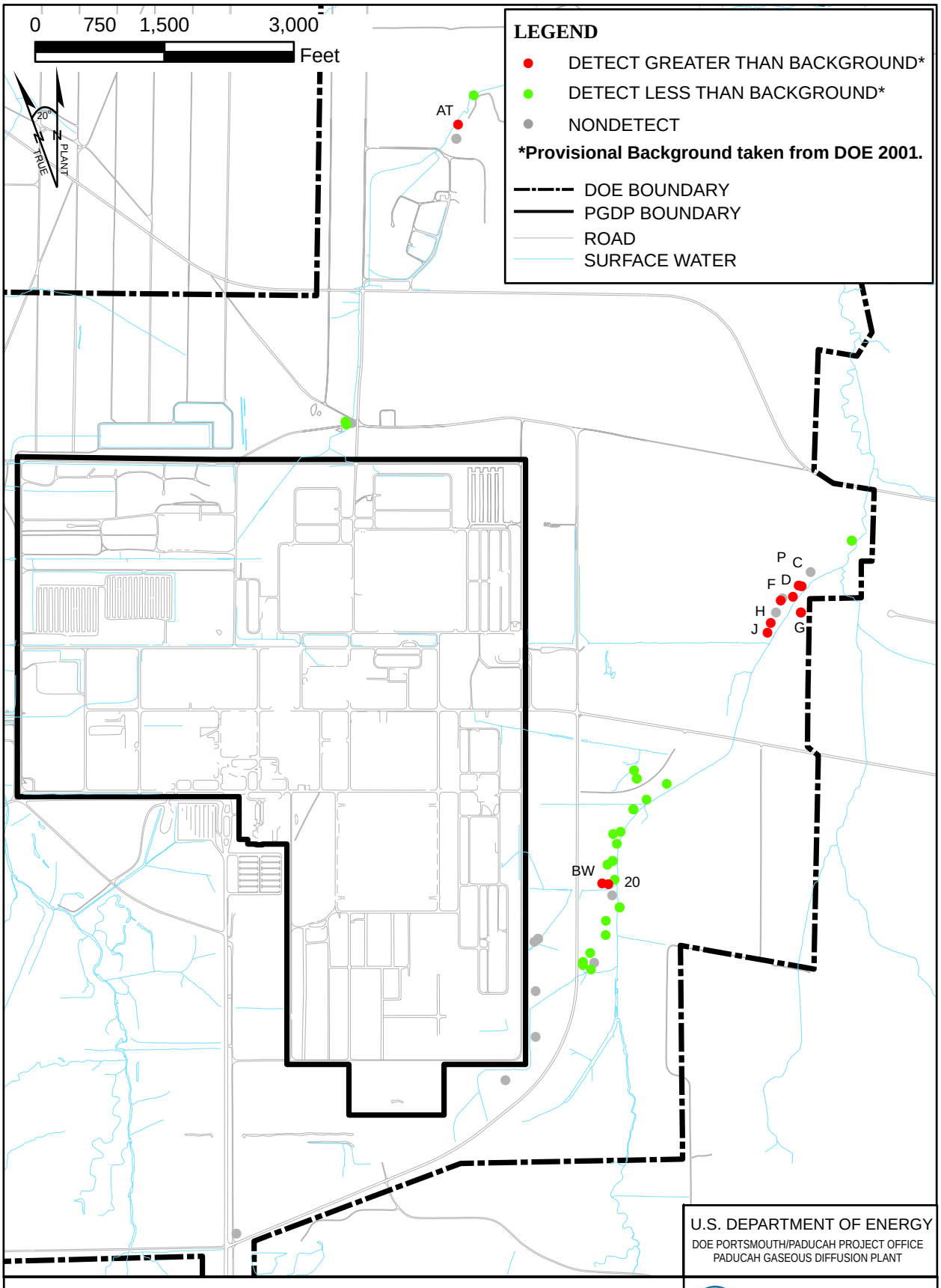

Figure D1.24. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Uranium

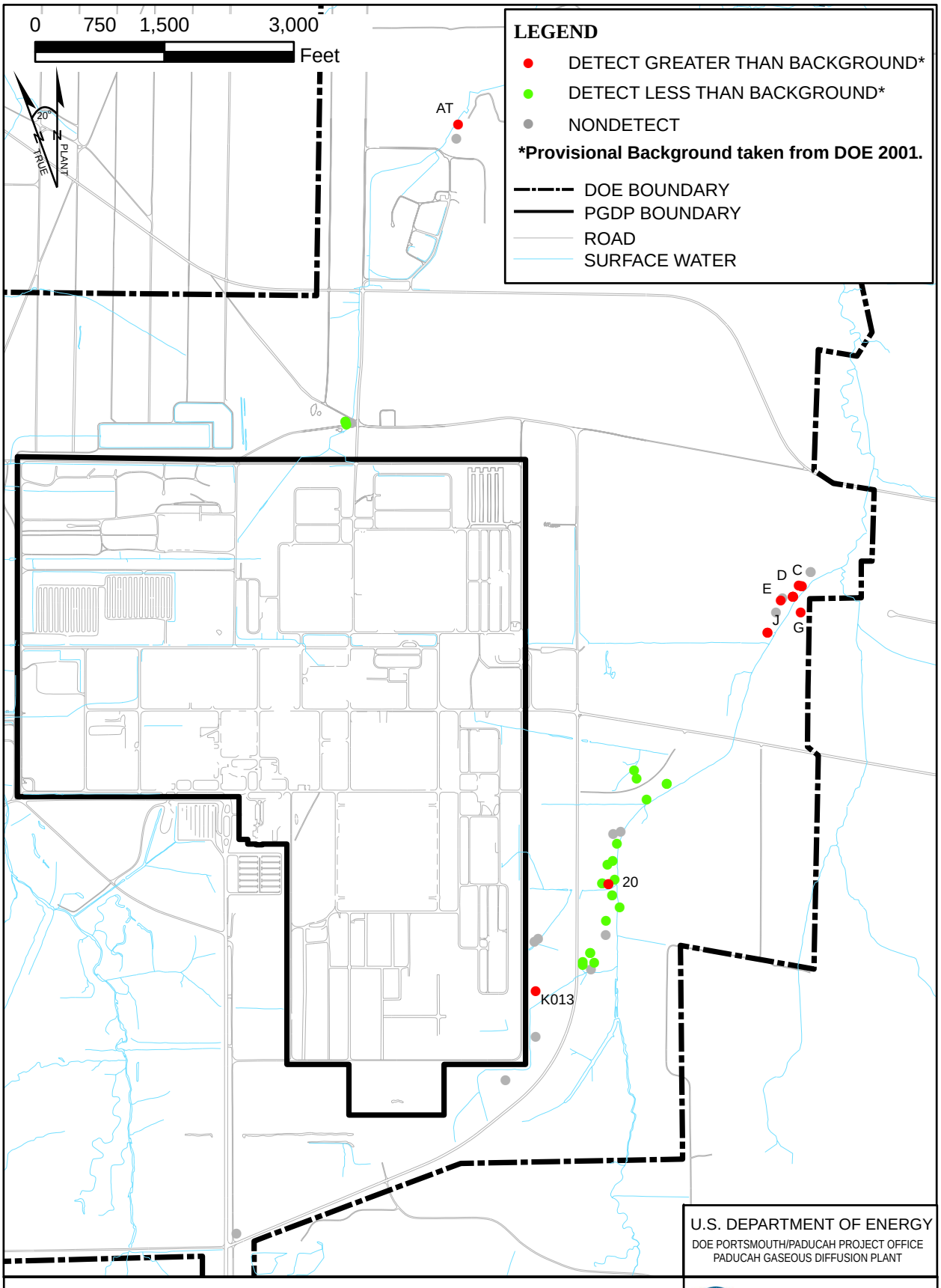

Figure D1.25. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Uranium

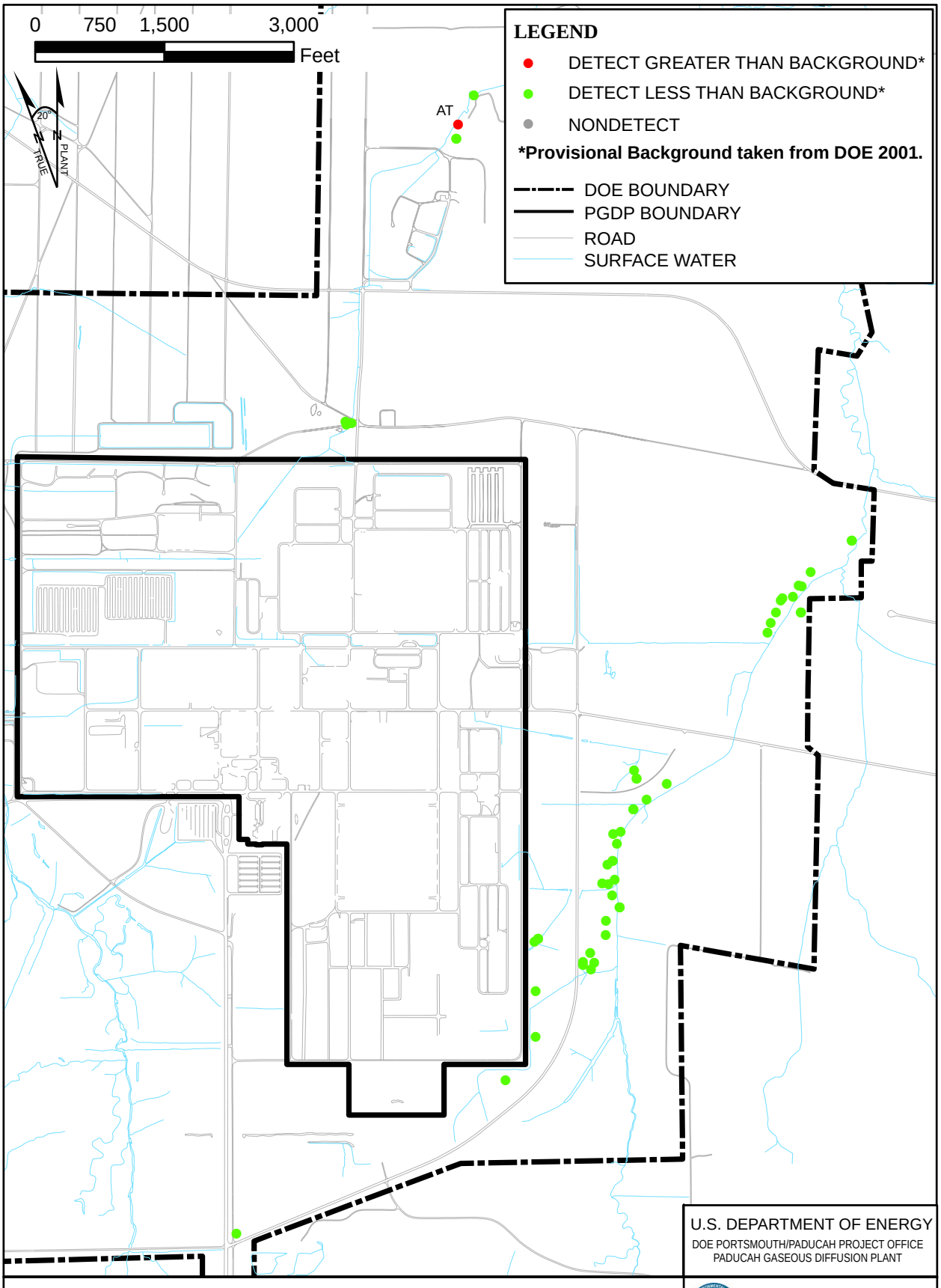

Figure D1.26. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Vanadium

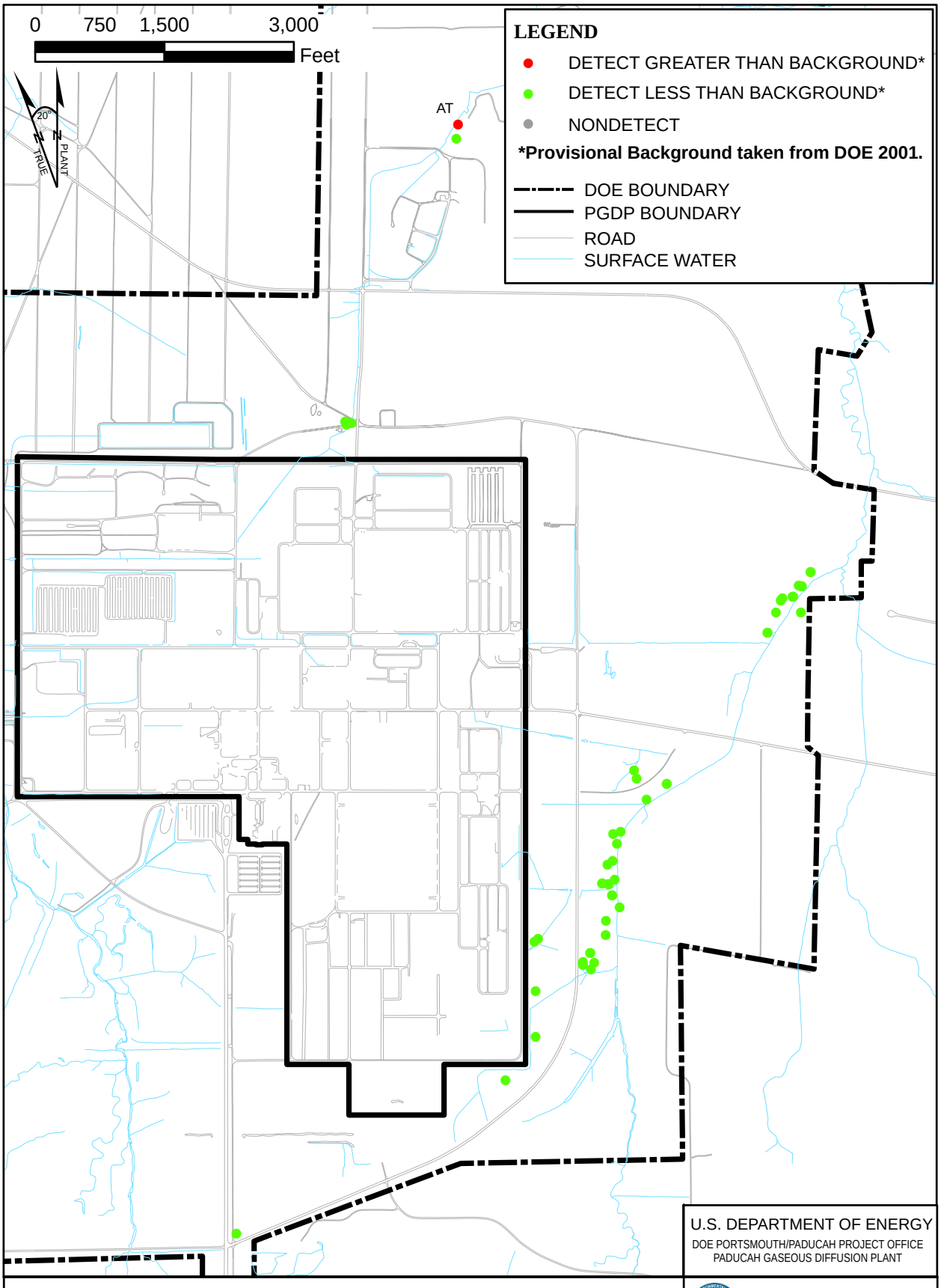

Figure D1.27. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Vanadium

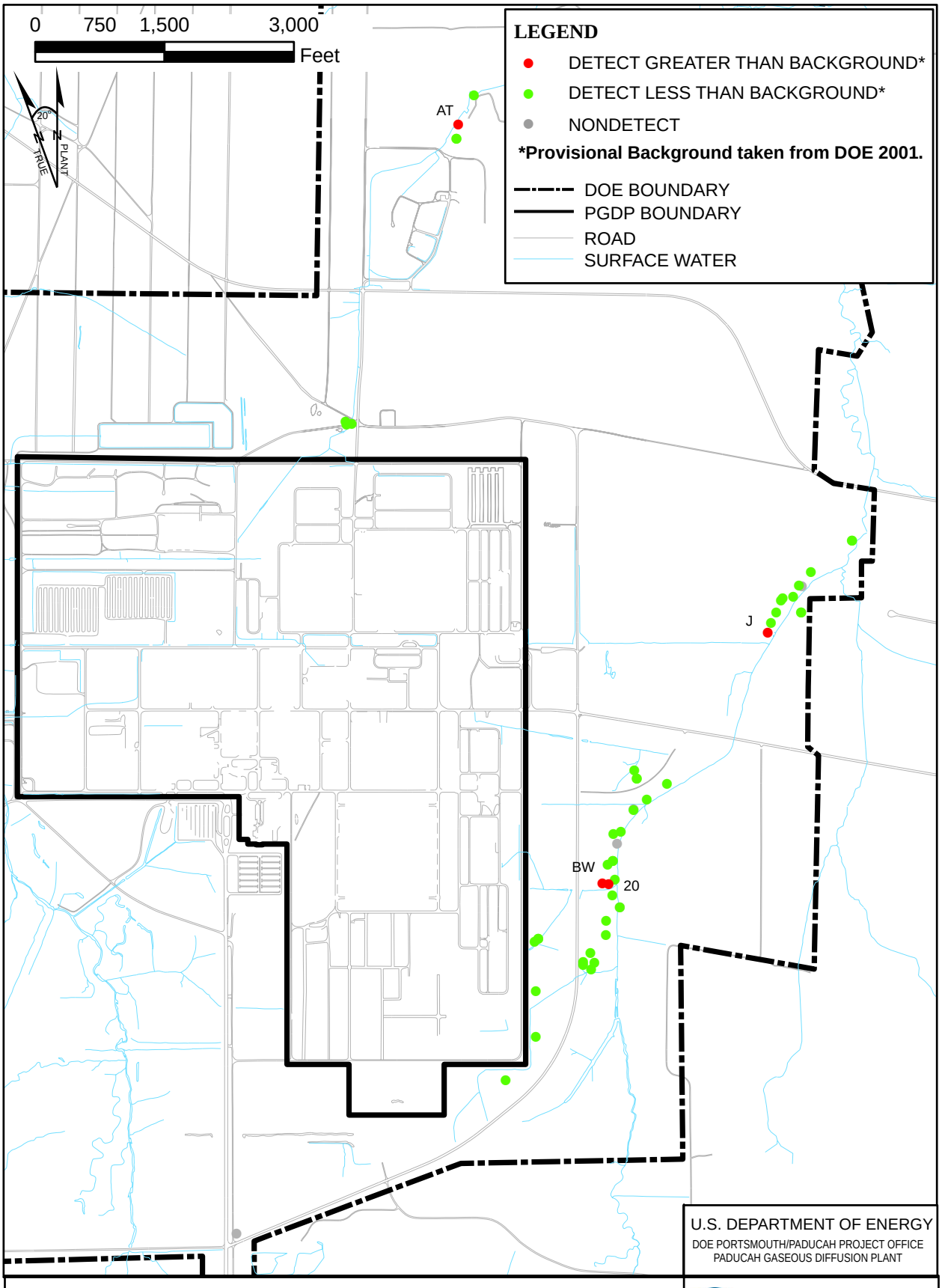

Figure D1.28. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Zinc

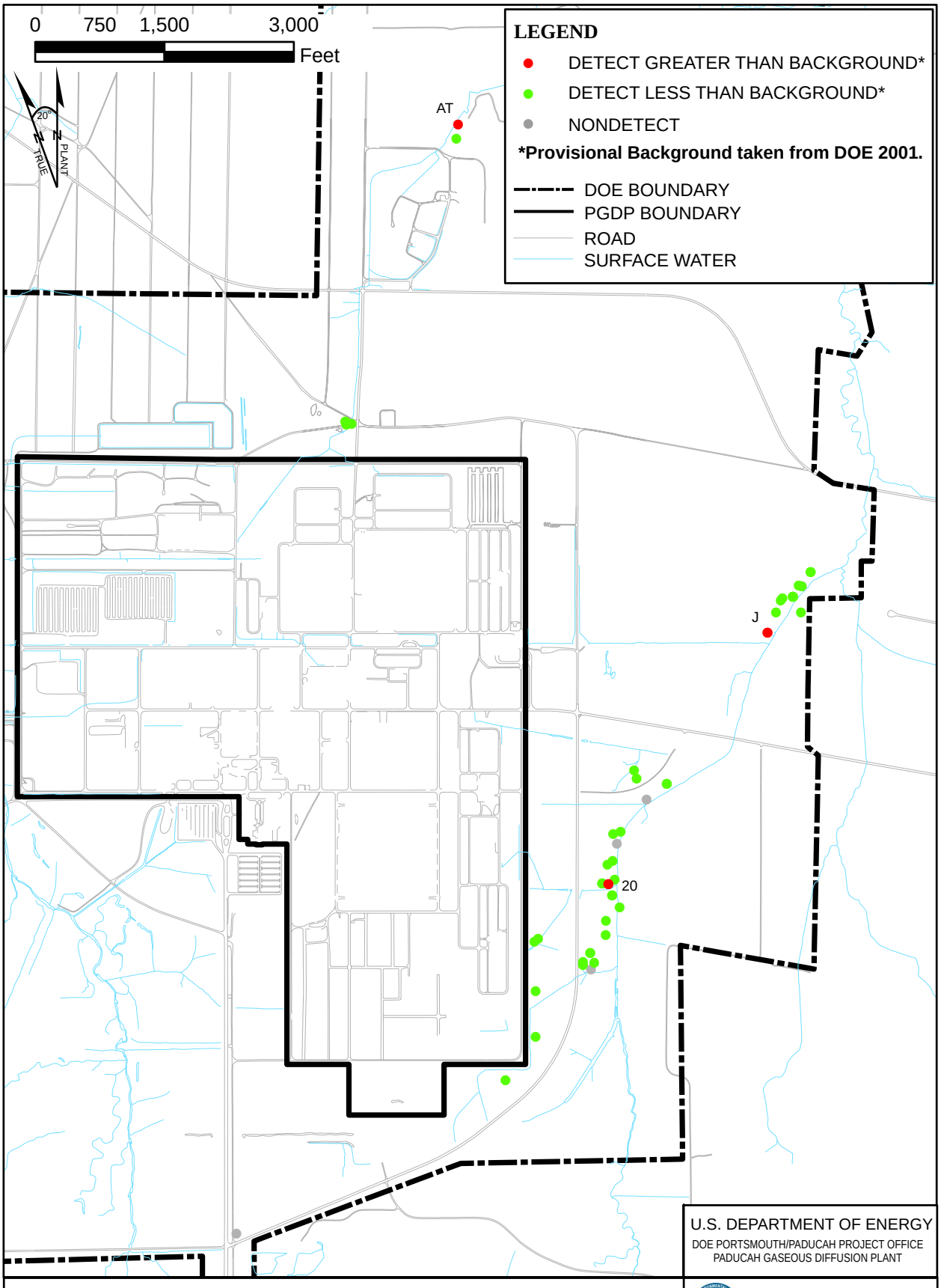

Figure D1.29. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Zinc

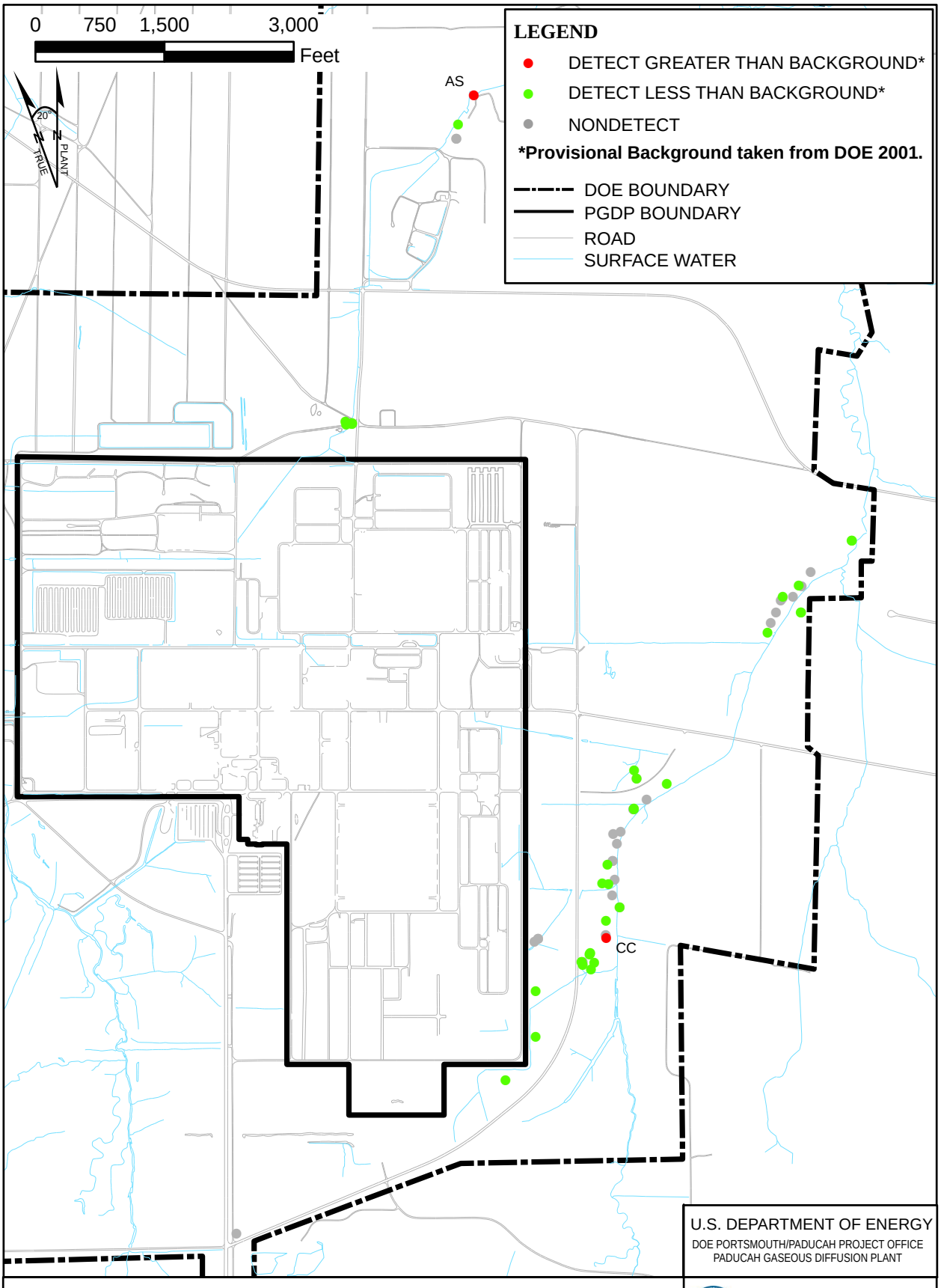

Figure D1.30. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Cesium-137

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
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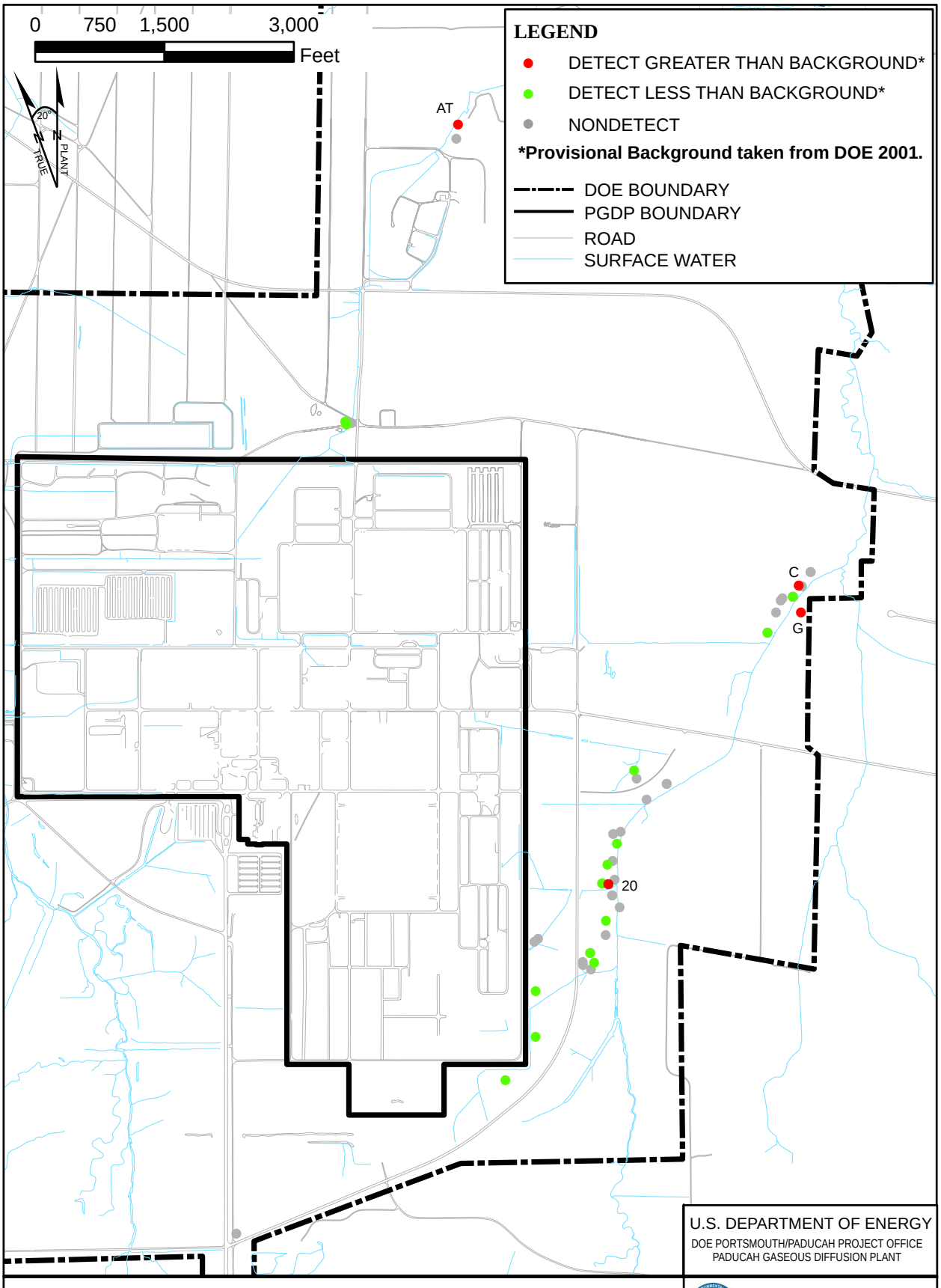

Figure D1.31. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Cesium-137

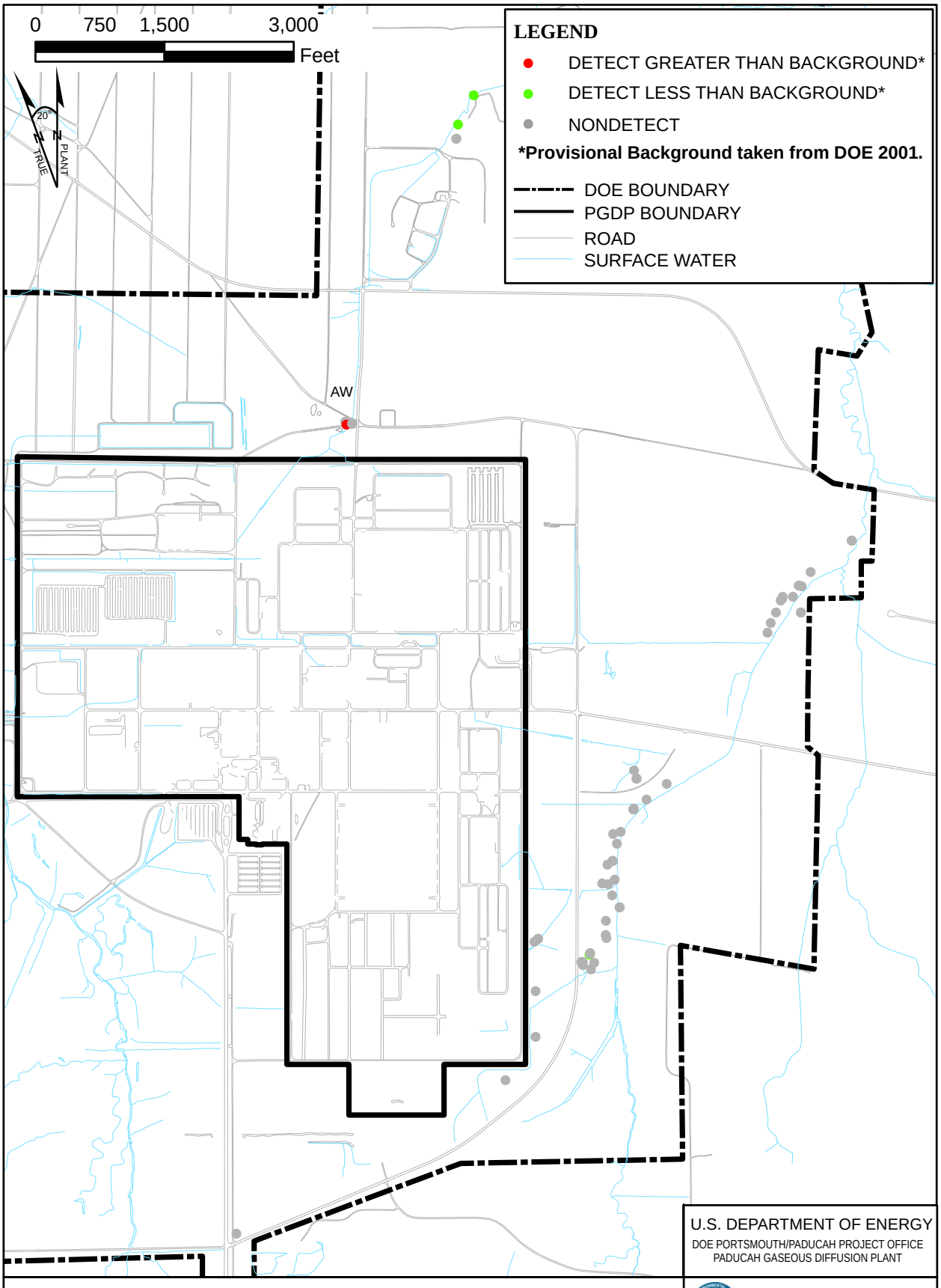

Figure D1.32. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Plutonium-239/240

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
DATE 05-20-10

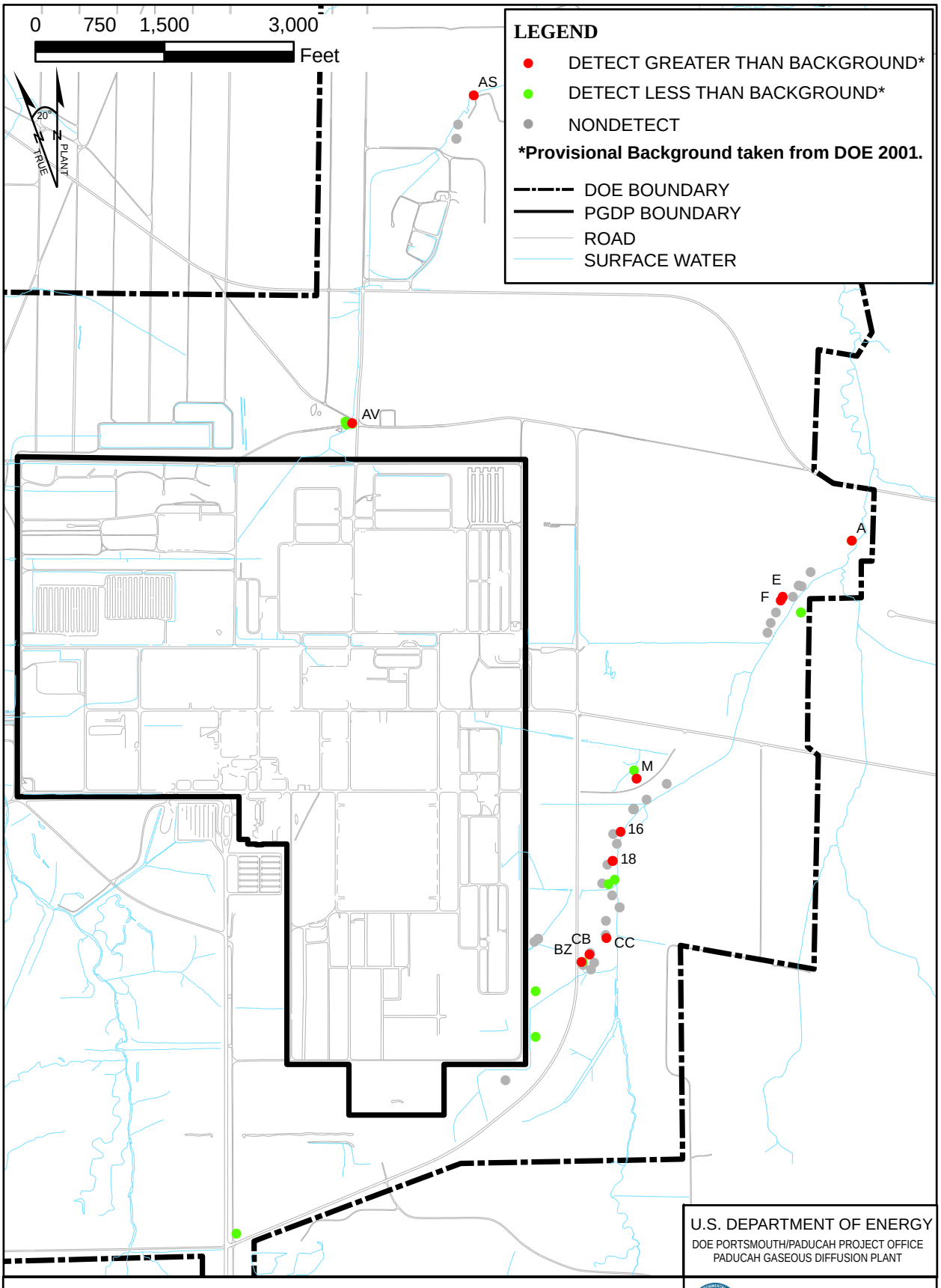

Figure D1.33. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Technetium-99

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
DATE 05-20-10

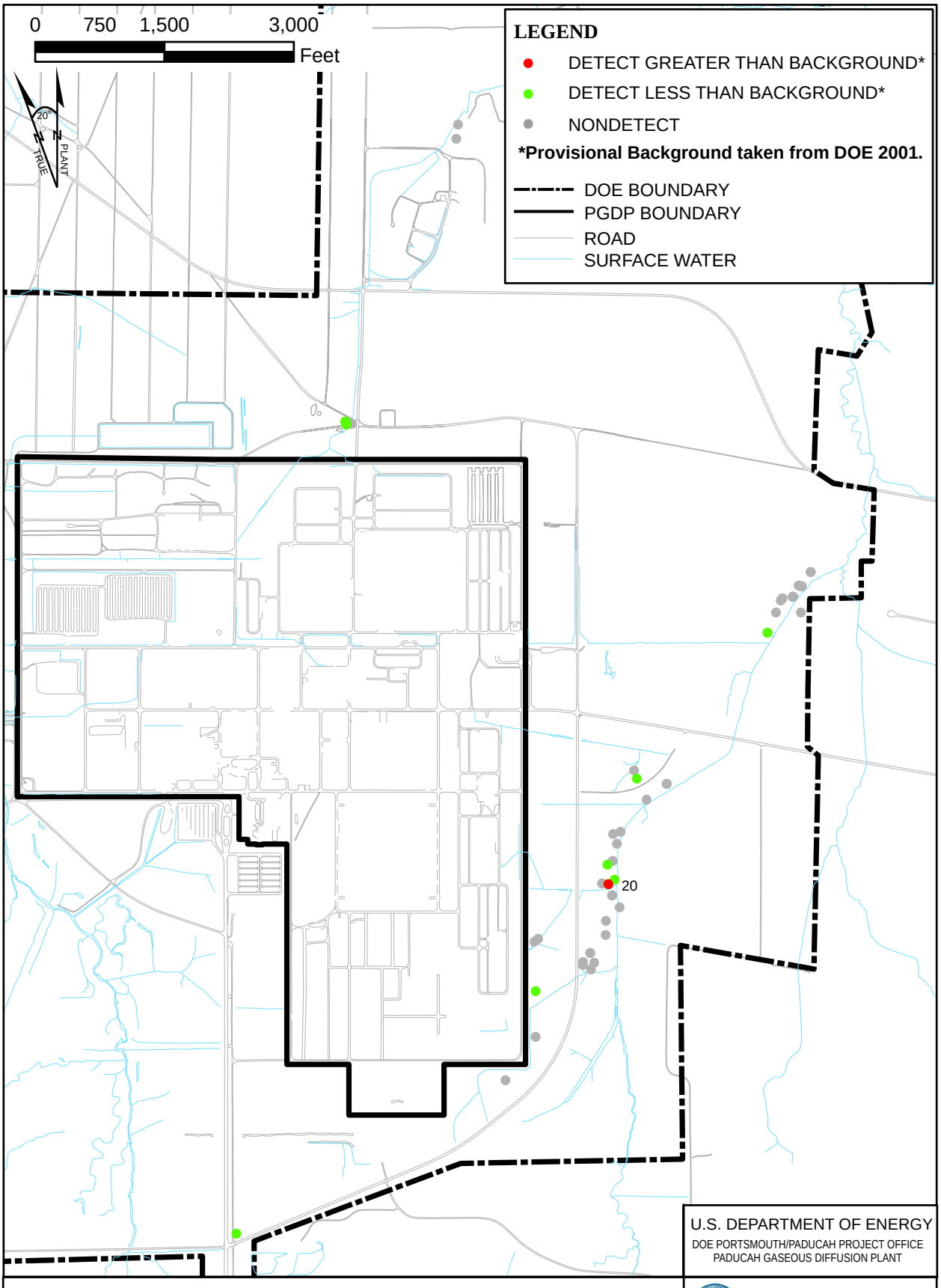

Figure D1.34. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Technetium-99

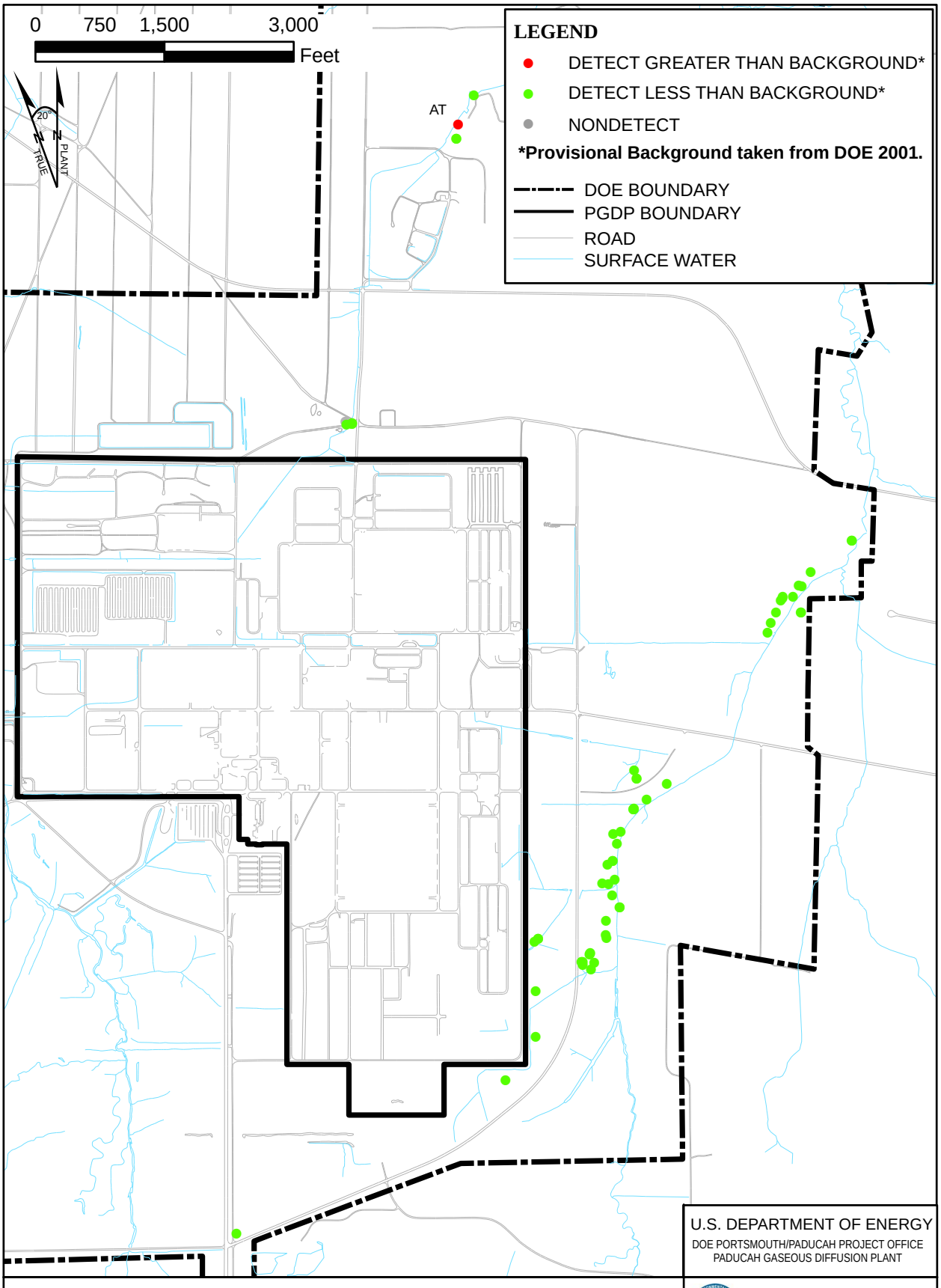

Figure D1.35. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Thorium-230

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
DATE 05-20-10

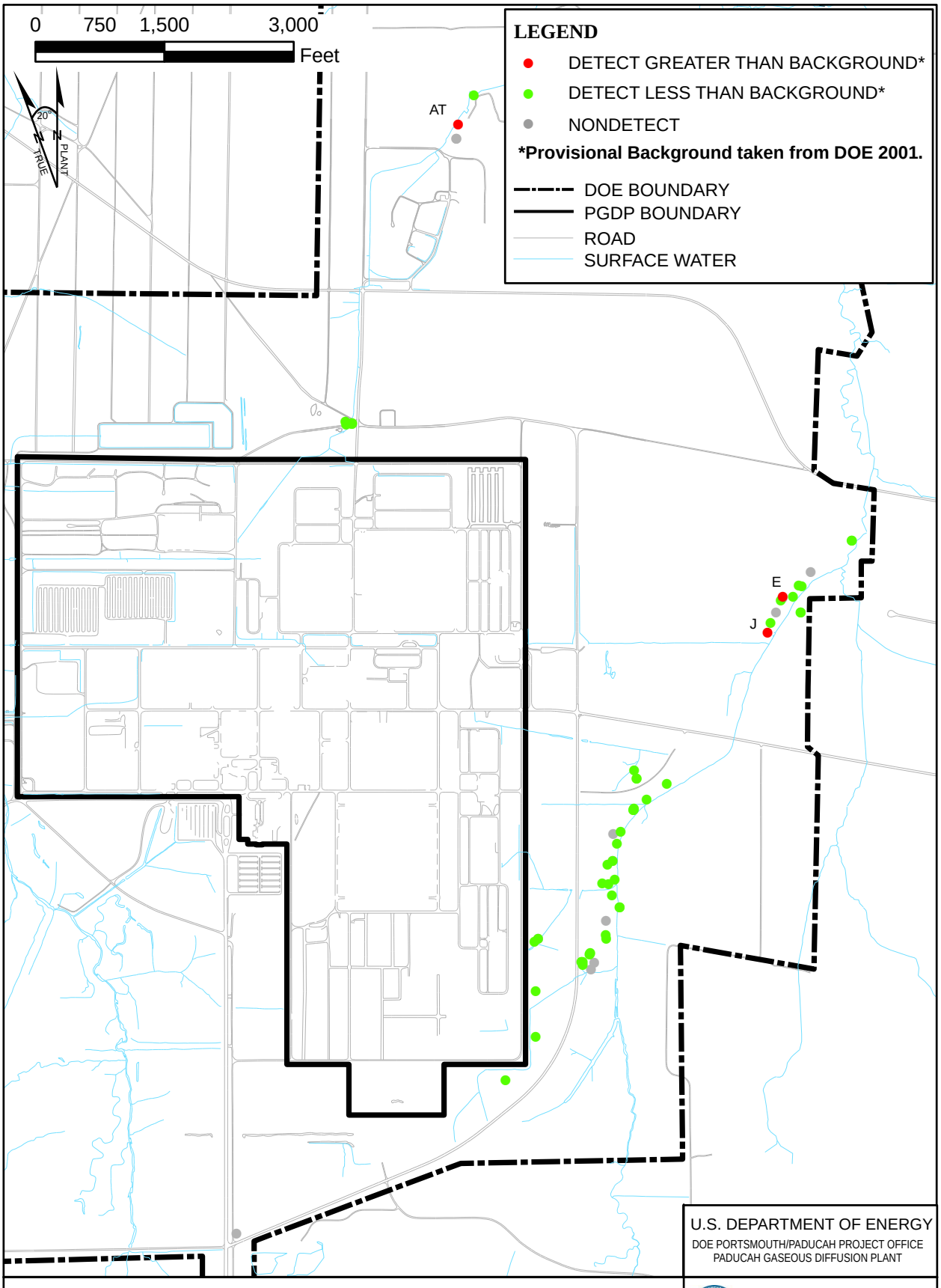

Figure D1.36. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Uranium-234

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
DATE 05-20-10

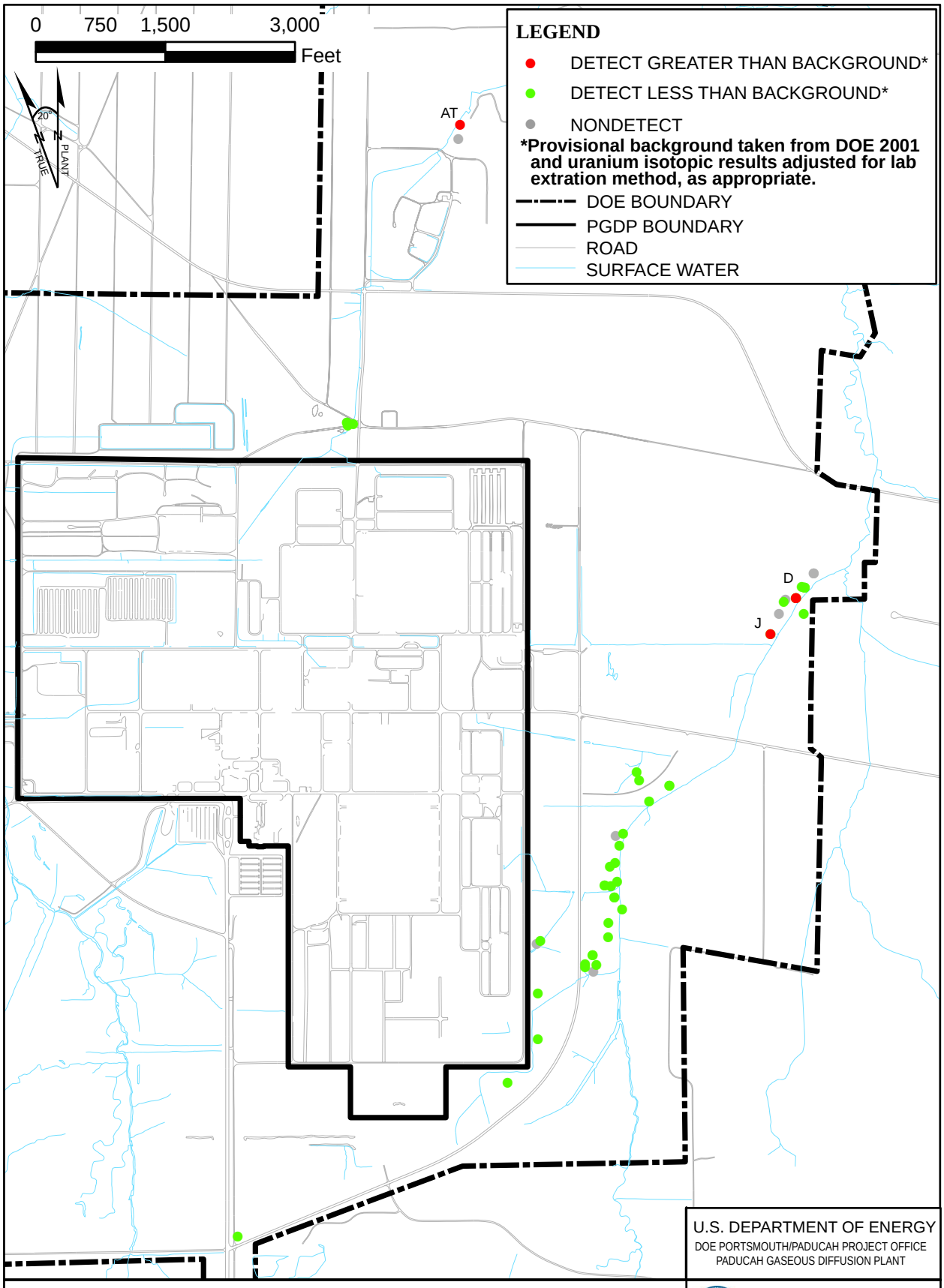

Figure D1.37. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Uranium-234

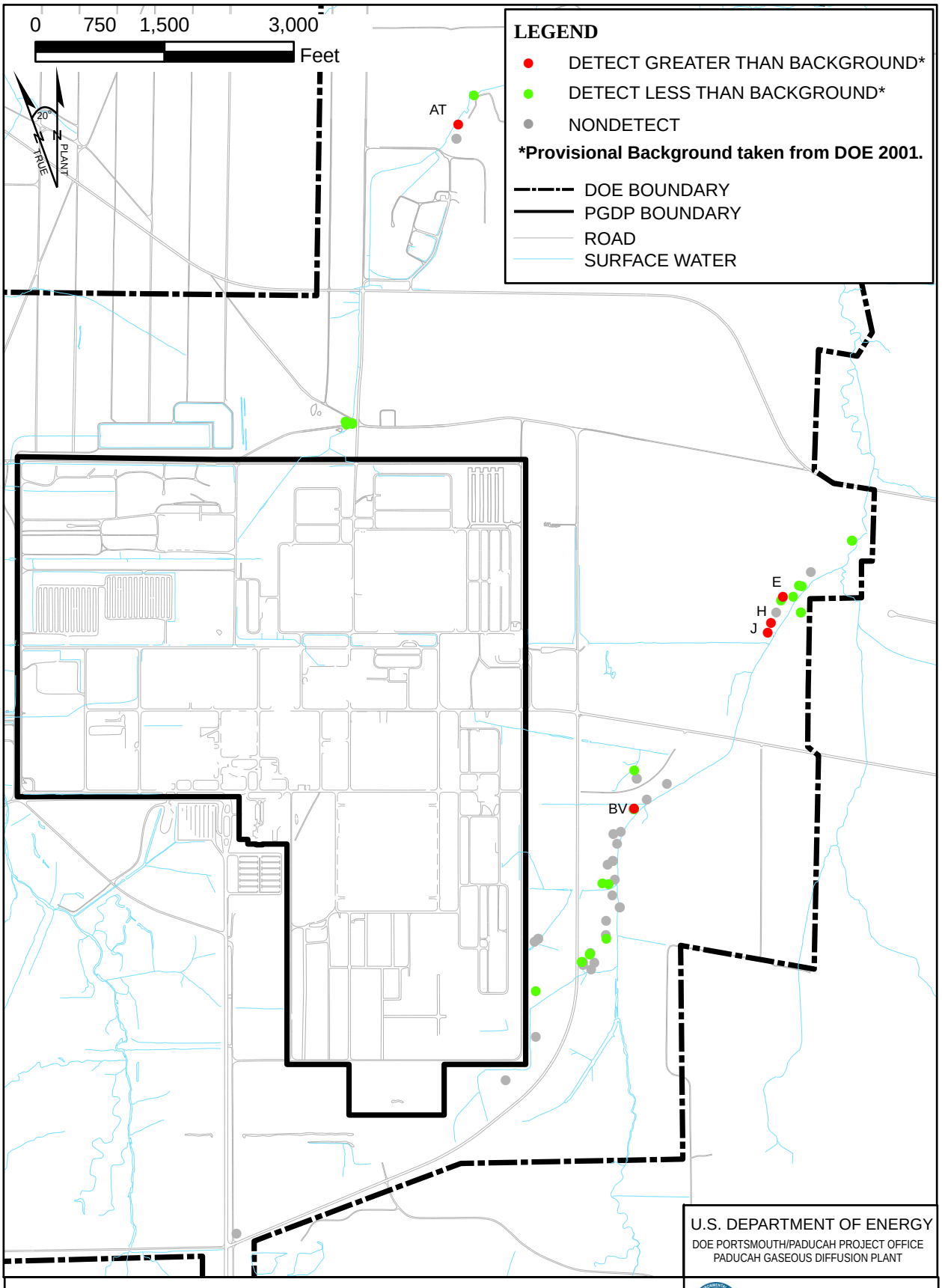

Figure D1.38. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Uranium-235

Figure No. SoilPiles|Addendum 1Br2 May2010Errata.mxd
DATE 05-20-10

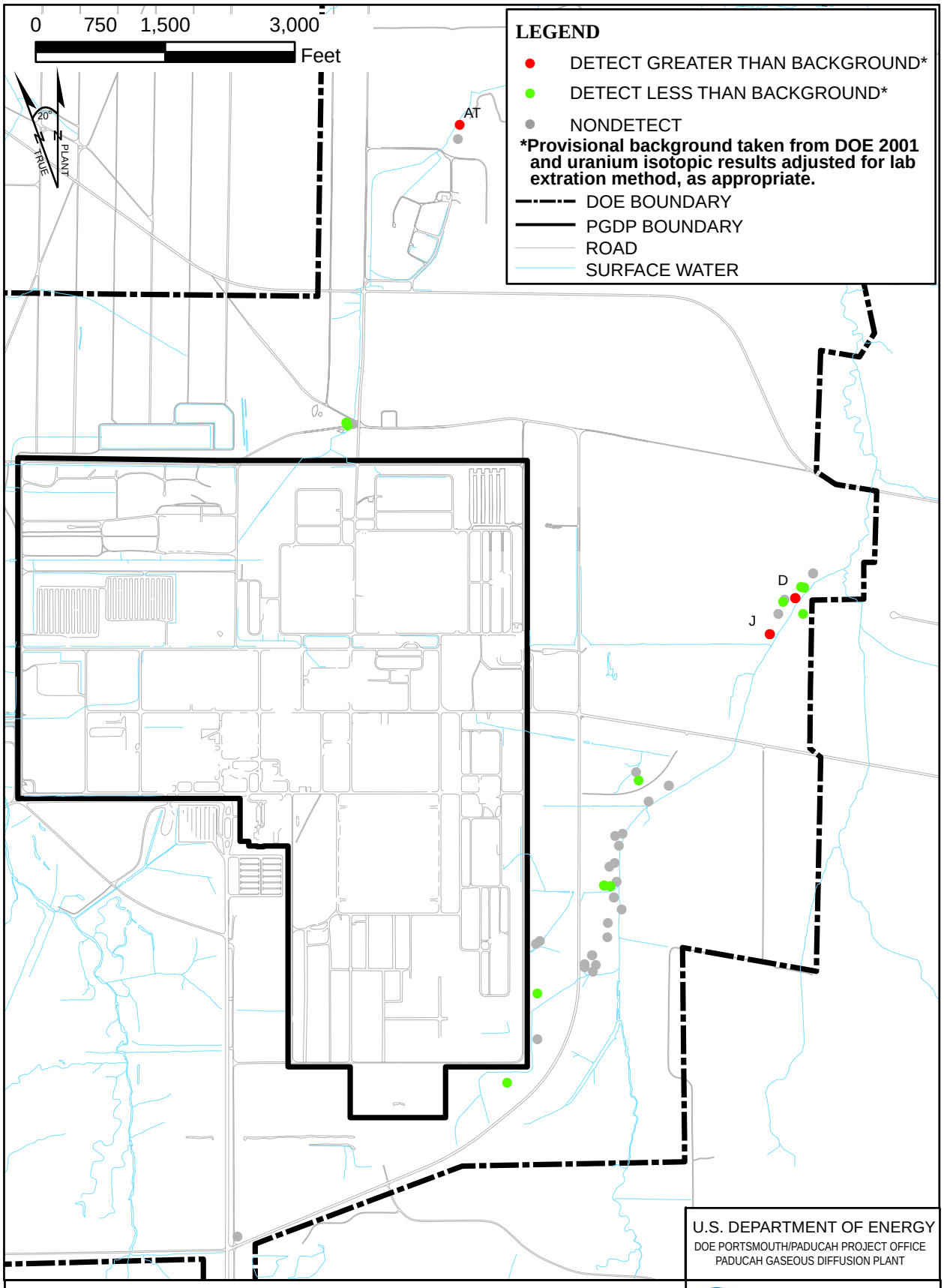

Figure D1.39. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Uranium-235

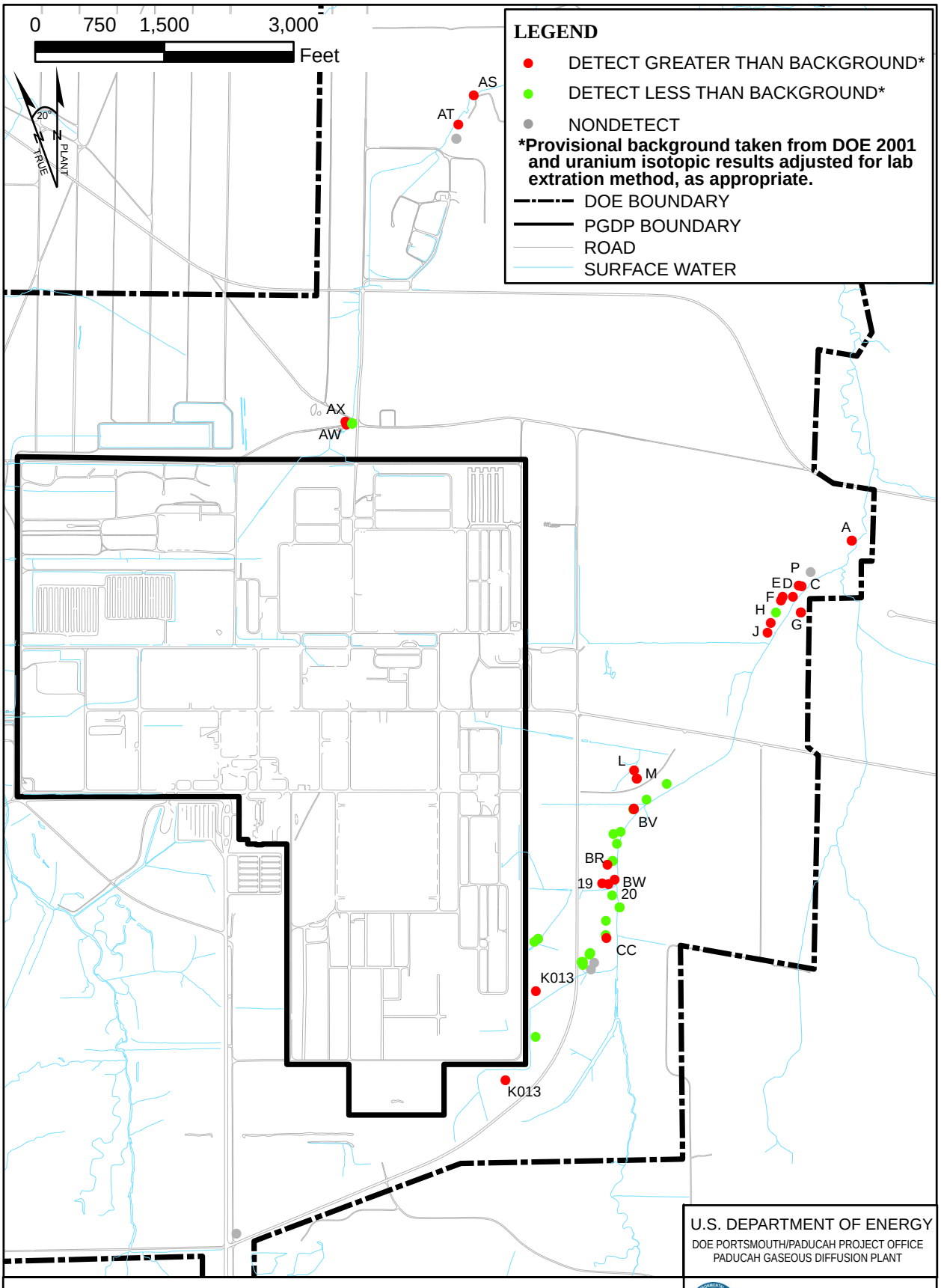

Figure D1.40. Addendum 1B Soil Pile Sampling (excluding AOC 541) Surface Uranium-238

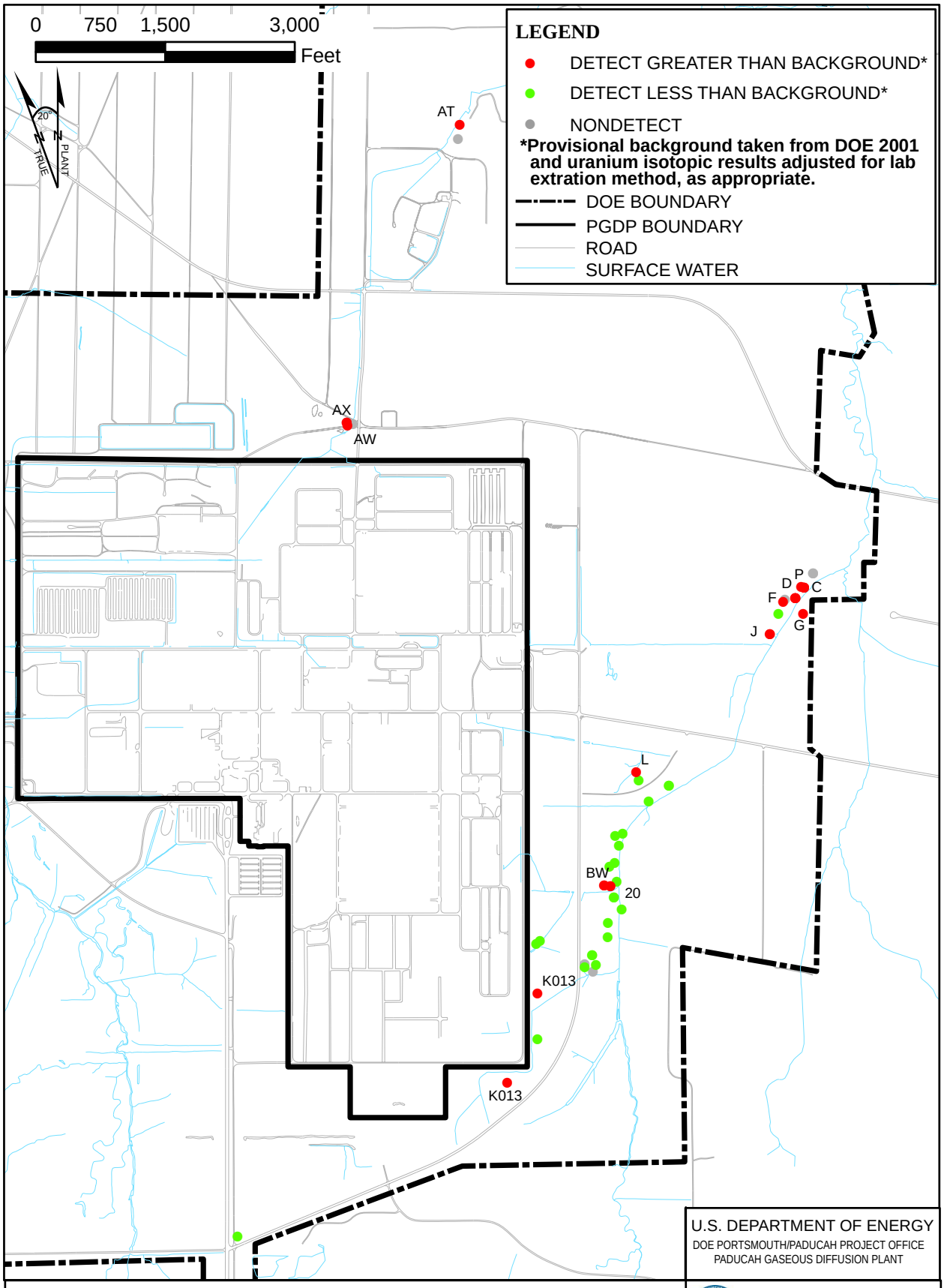

Figure D1.41. Addendum 1B Soil Pile Sampling (excluding AOC 541) Subsurface Uranium-238

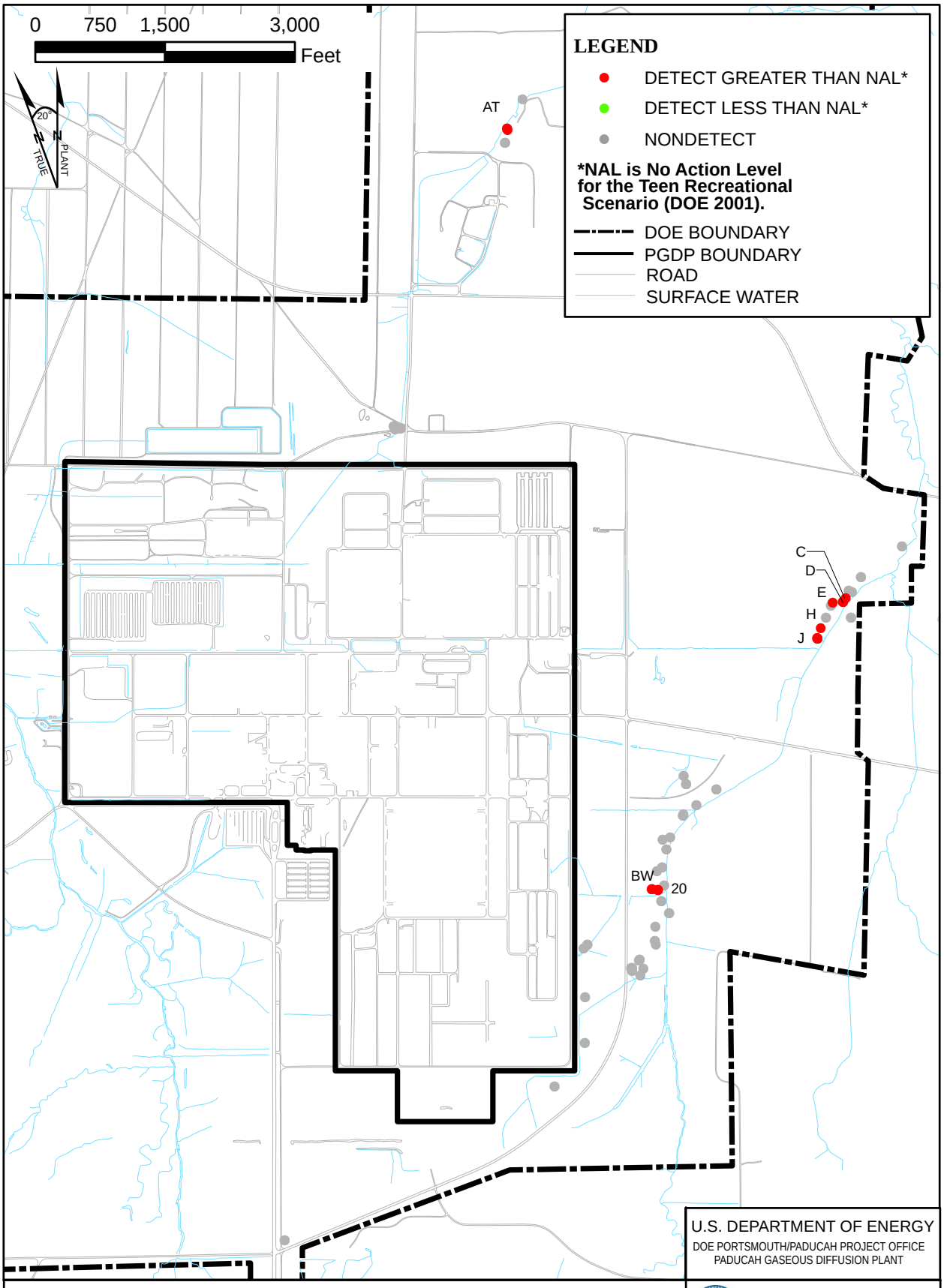

Figure D1.42. Addendum 1B Soil Pile Sampling (excluding AOC 541) Total PCBs

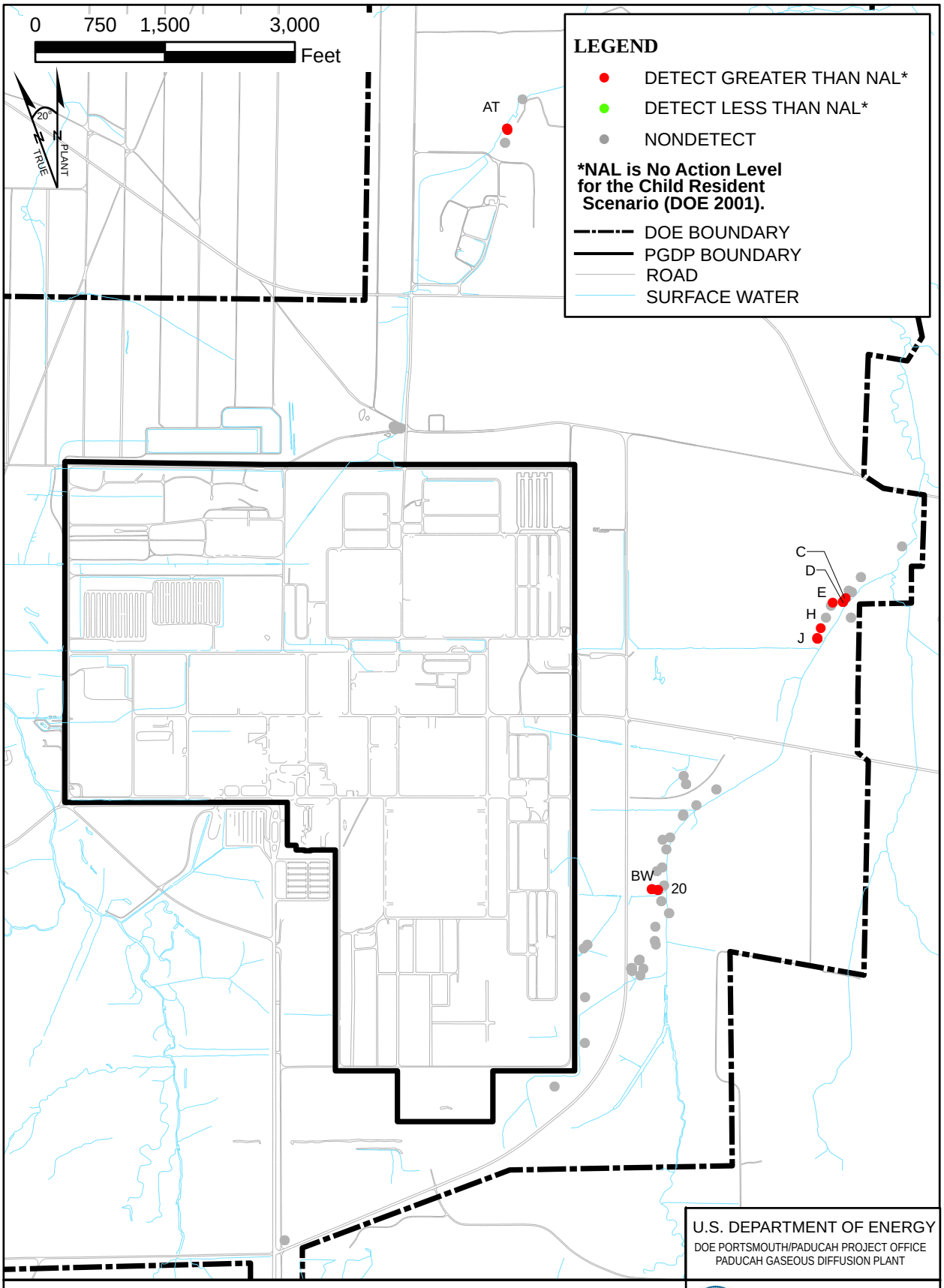

Figure D1.43. Addendum 1B Soil Pile Sampling (excluding AOC 541) Total PCBs

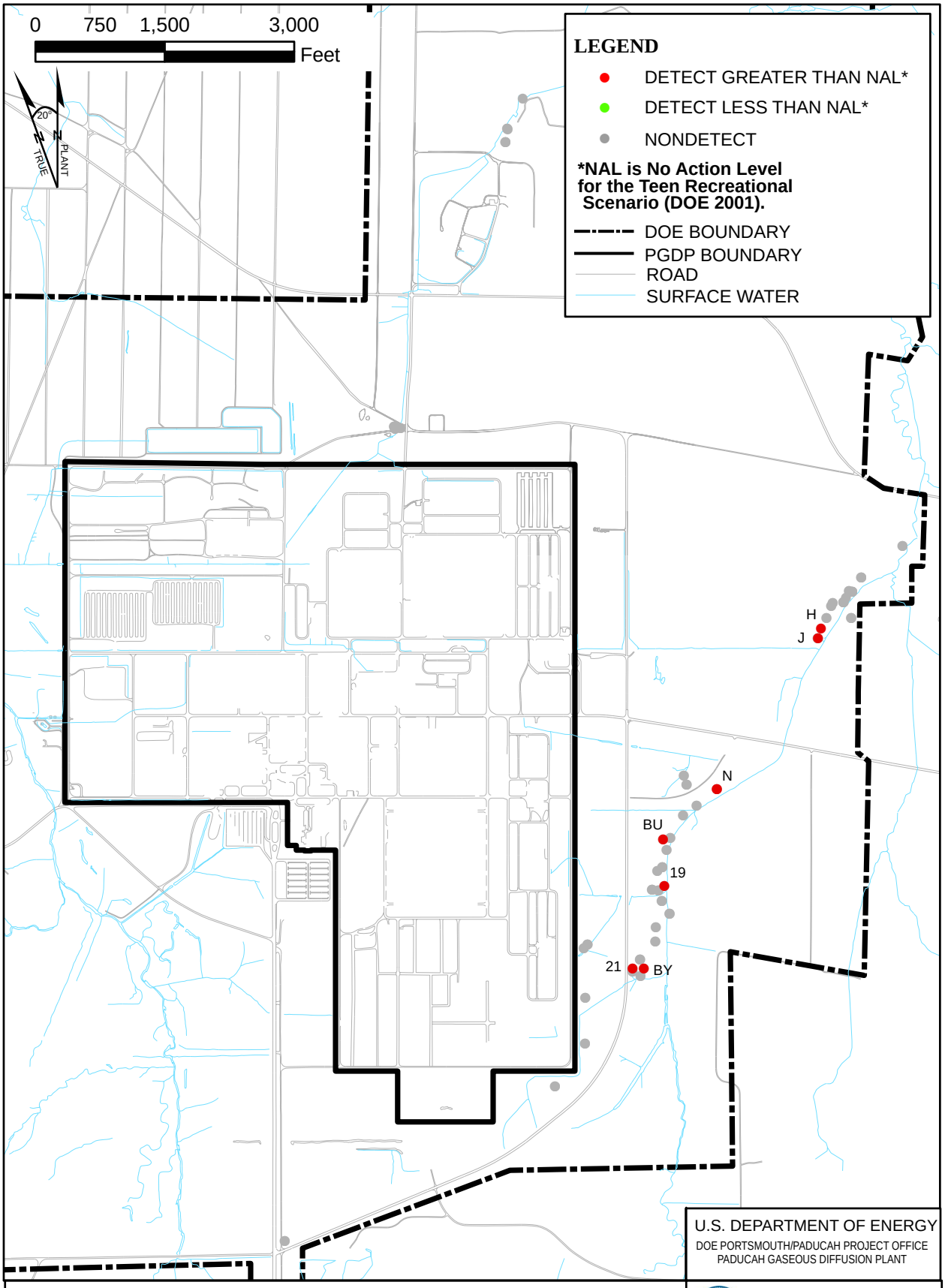

Figure D1.44. Addendum 1B Soil Pile Sampling (excluding AOC 541) Total PAHs

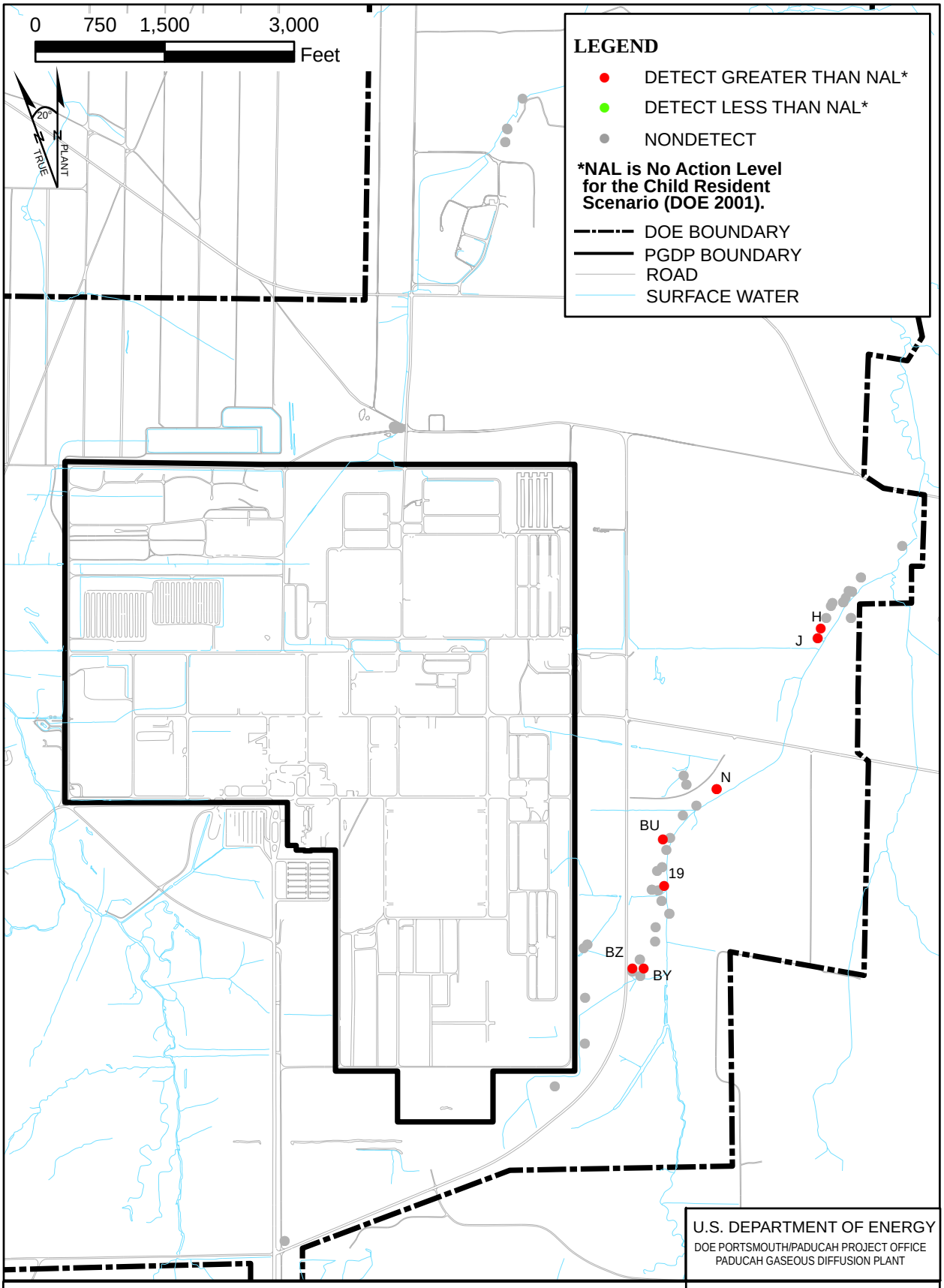

Figure D1.45. Addendum 1B Soil Pile Sampling (excluding AOC 541) Total PAHs

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Attachment D2
Background Graphs

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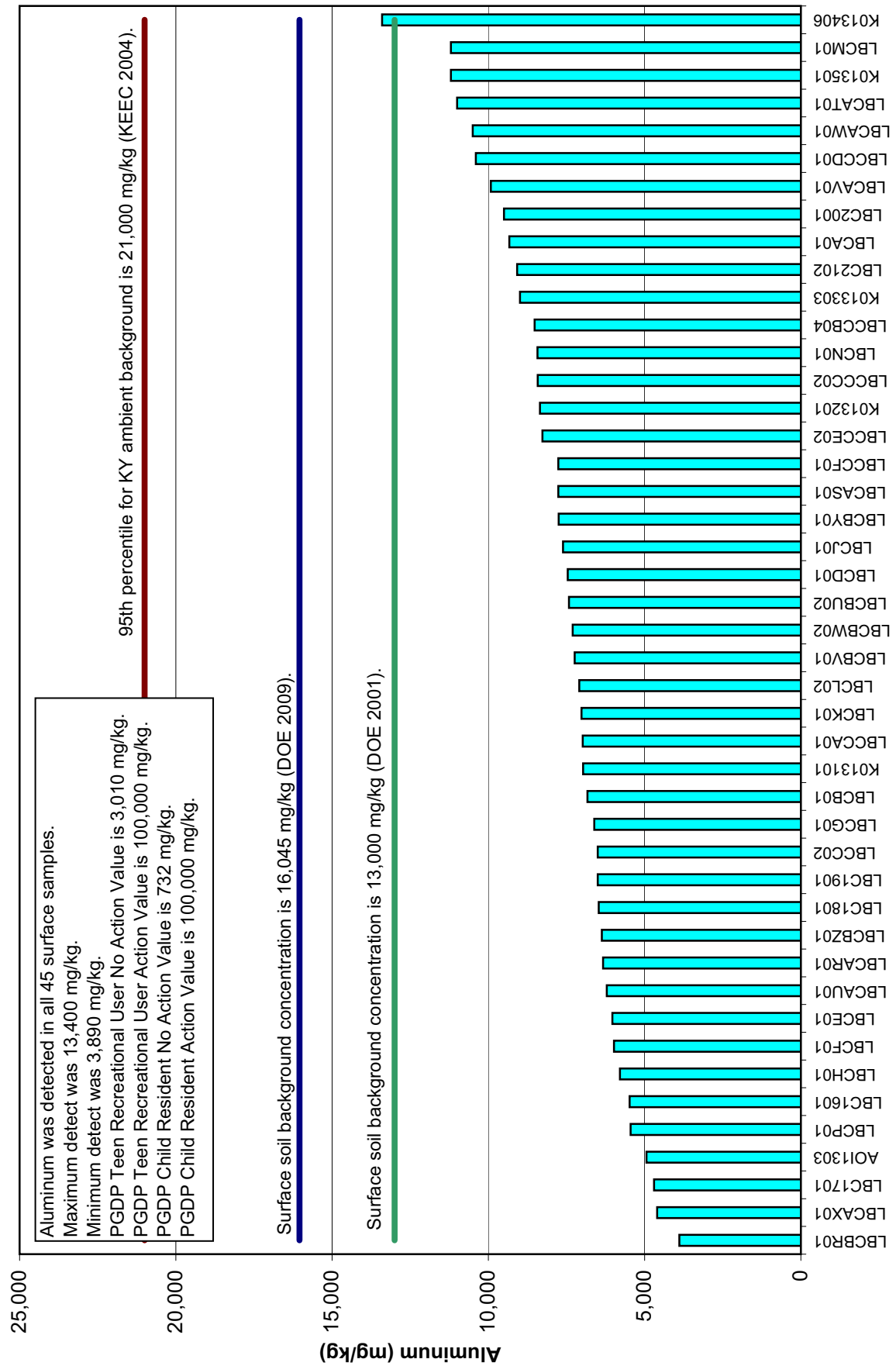

Figure D2.1. Comparison between Aluminum Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

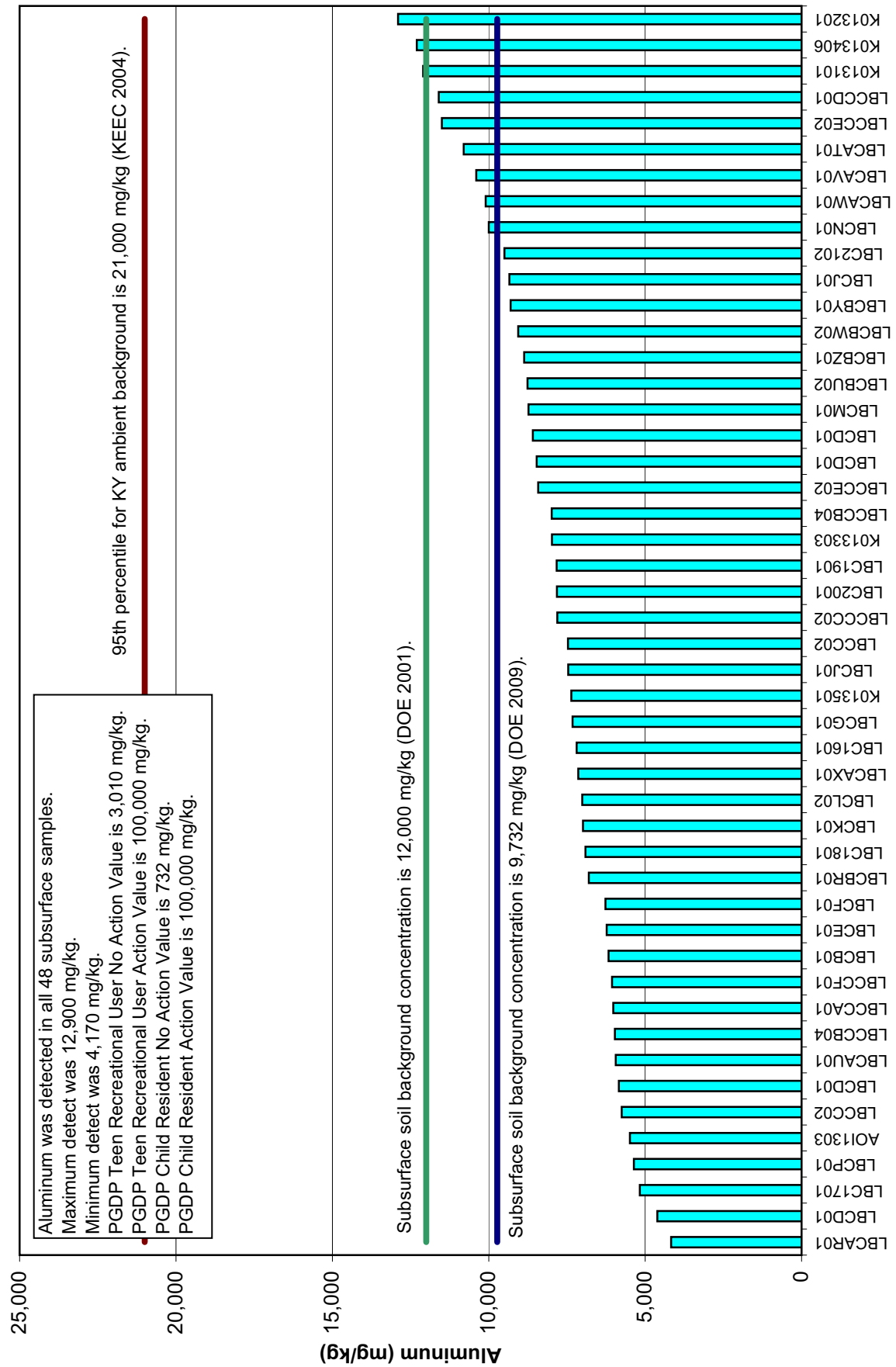

Figure D2.2. Comparison between Aluminum Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

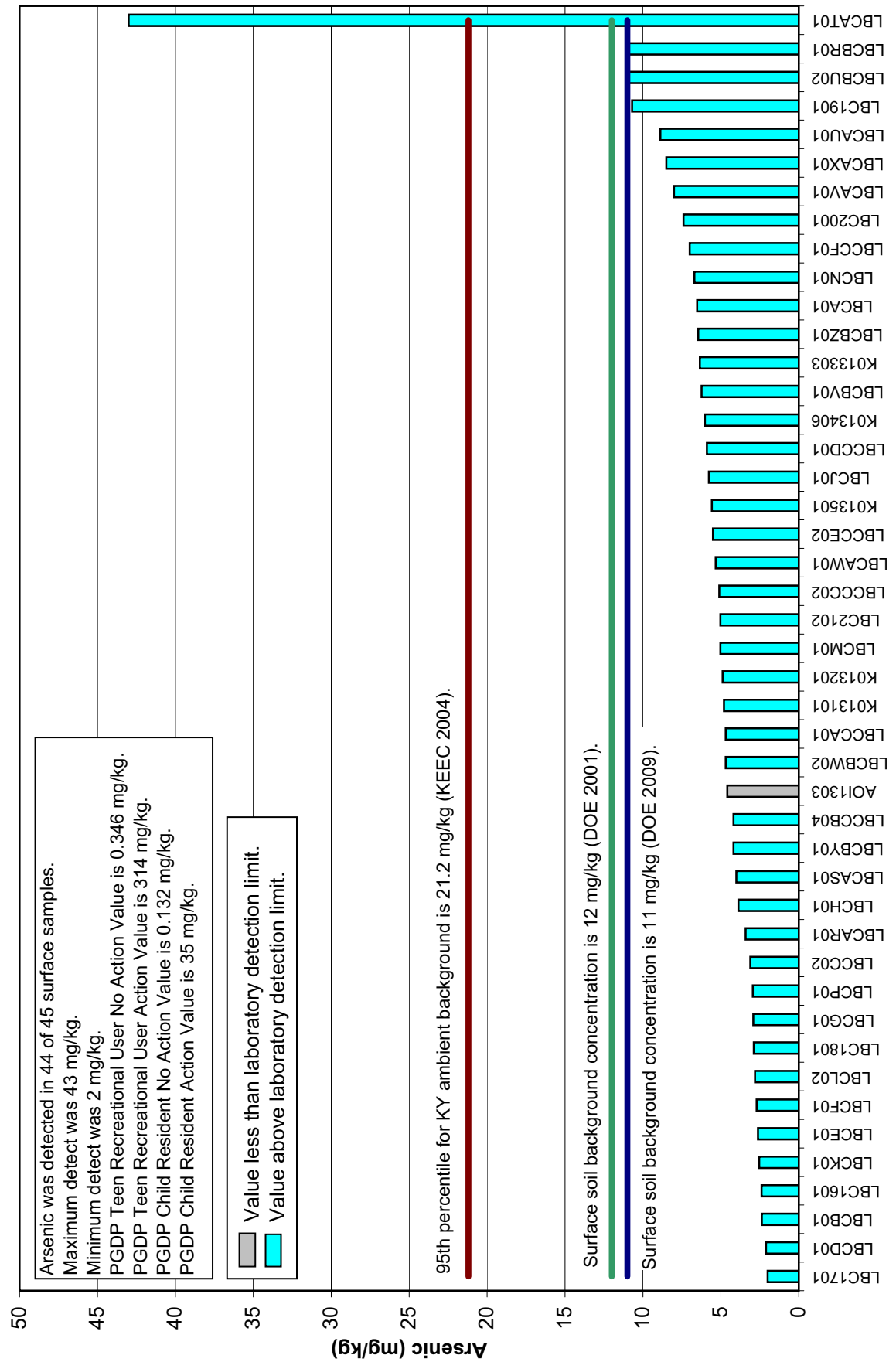

Figure D2.3. Comparison between Arsenic Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

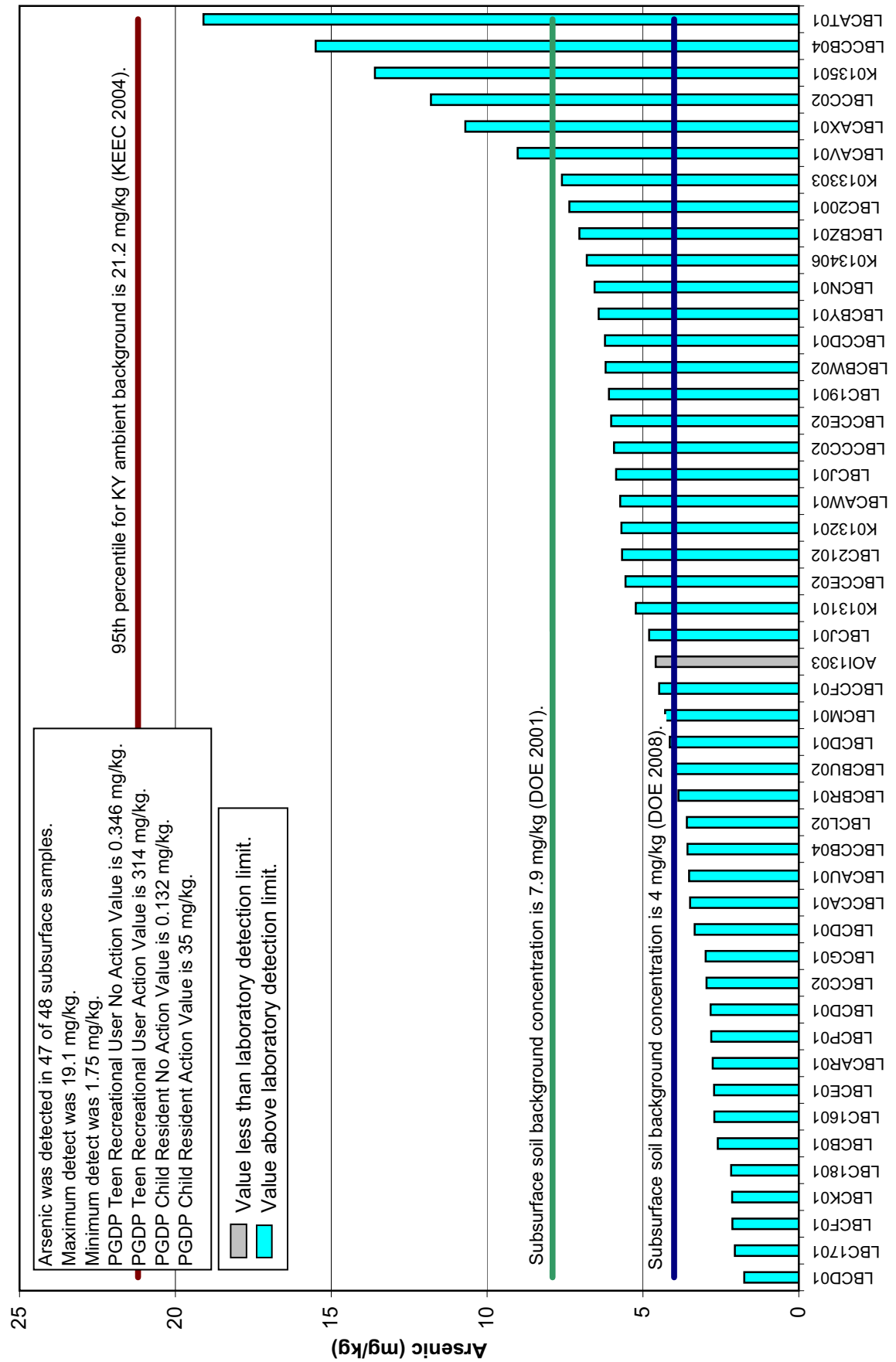

Figure D2.4. Comparison between Arsenic Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

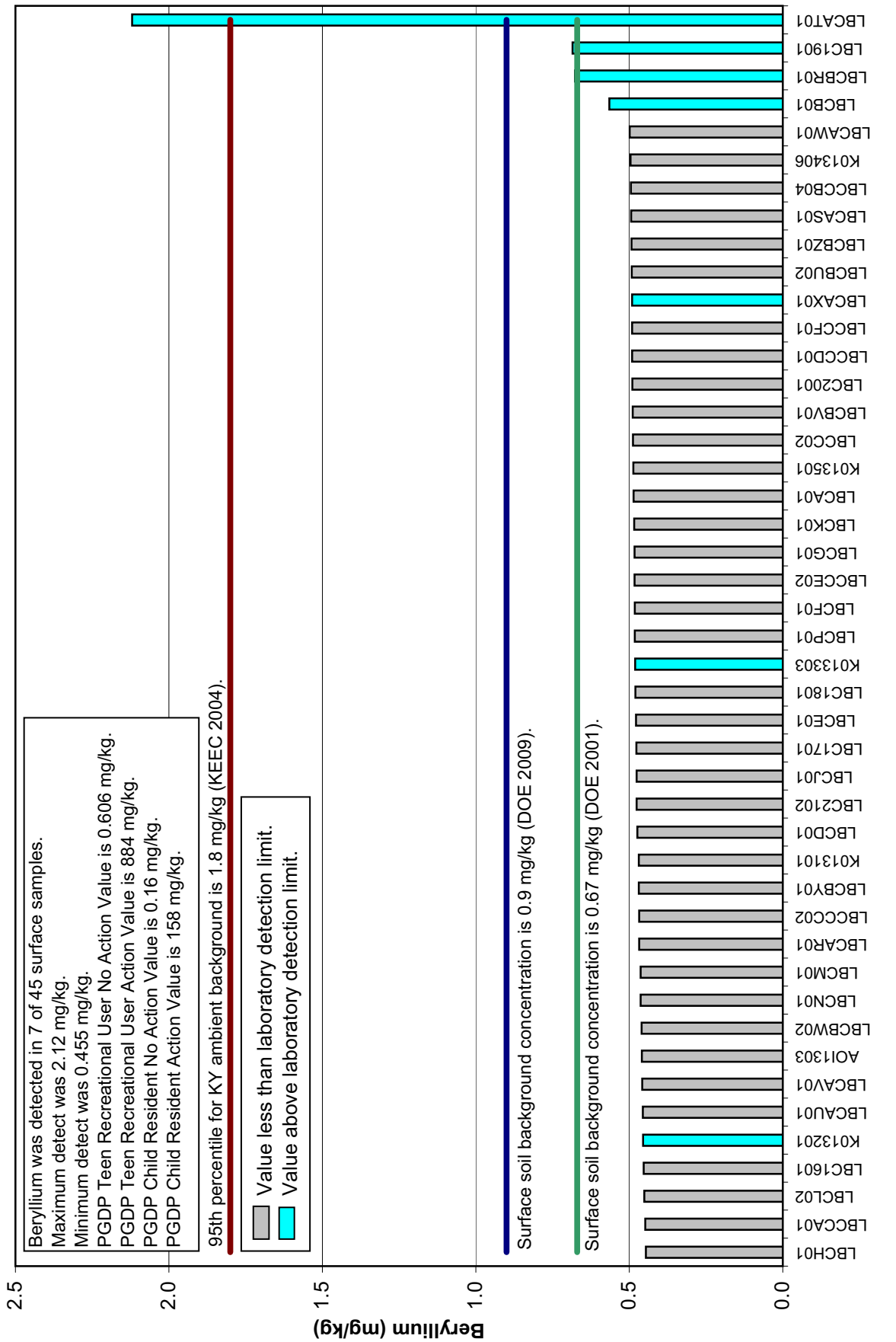

Figure D2.5. Comparison between Beryllium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

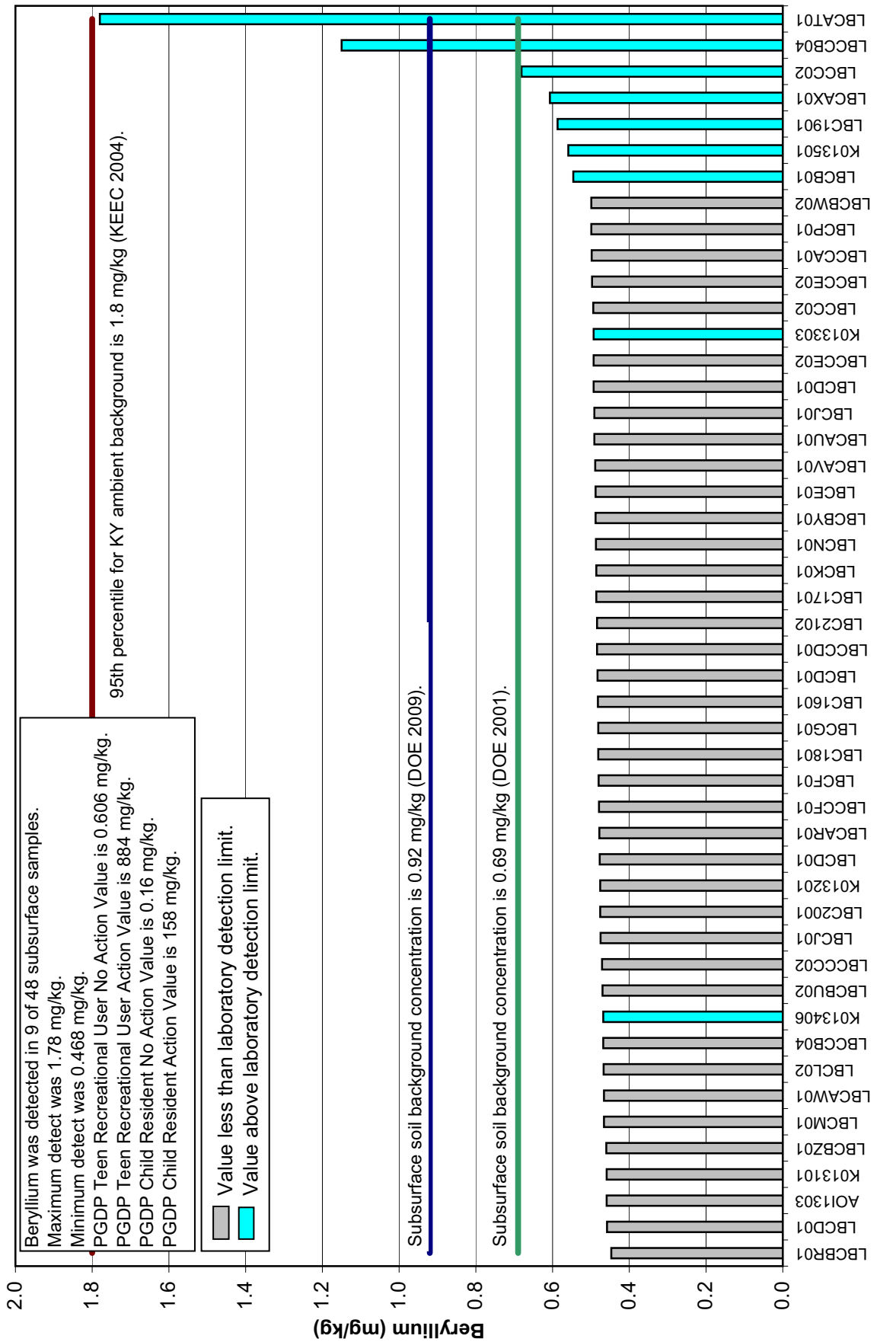

Figure D2.6. Comparison between Beryllium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

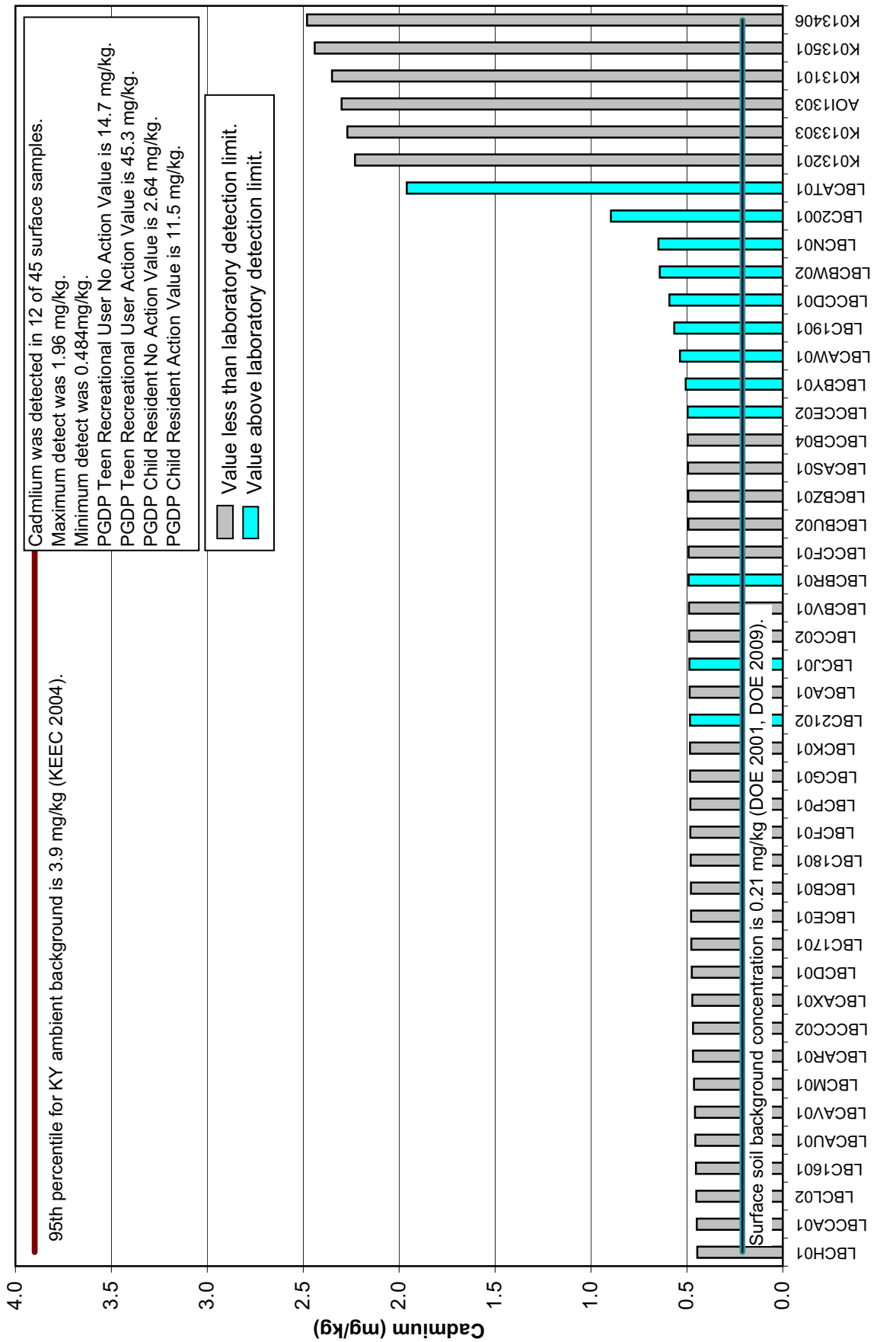

Figure D2.7. Comparison between Cadmium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

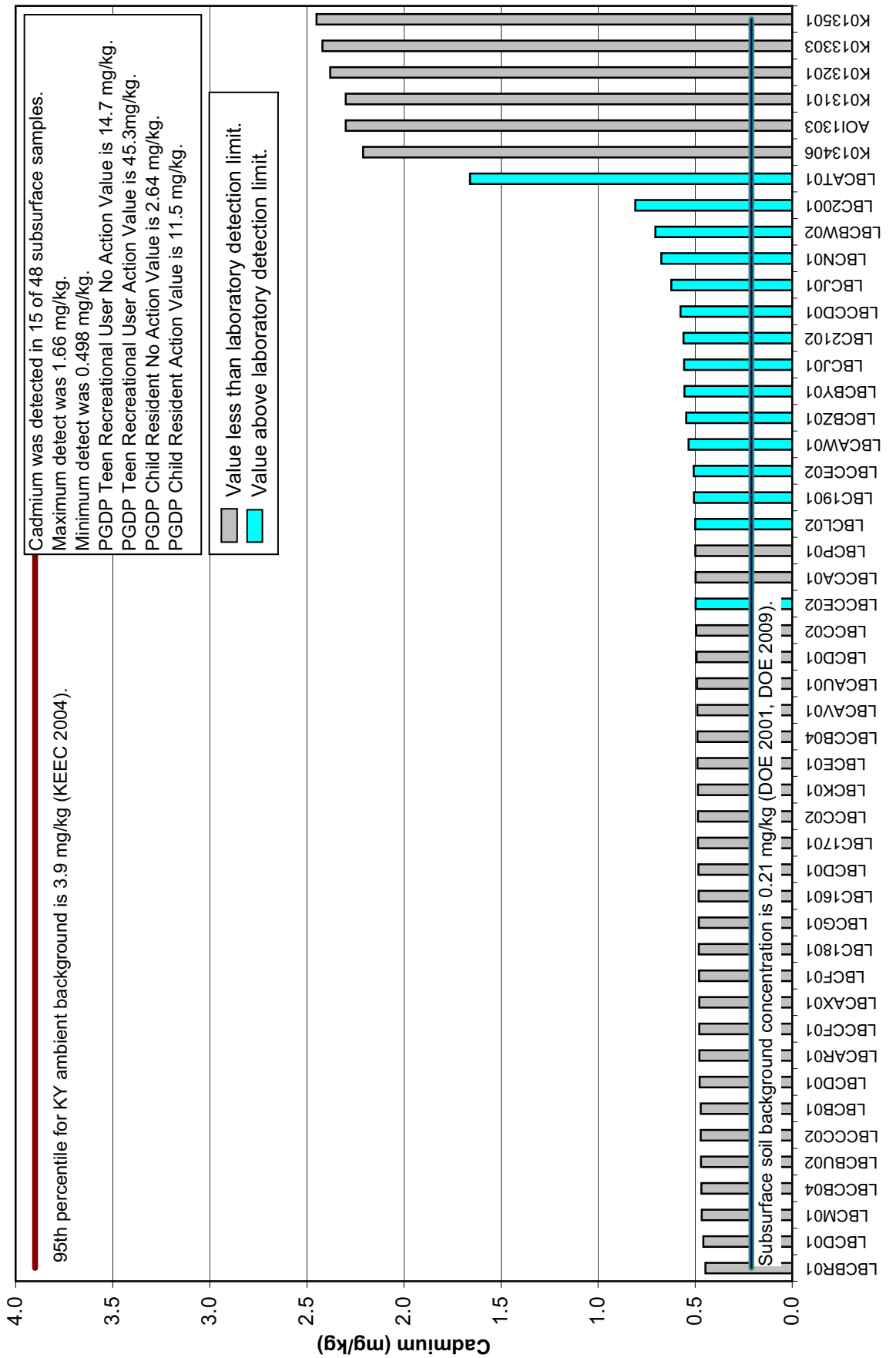

Figure D2.8. Comparison between Cadmium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

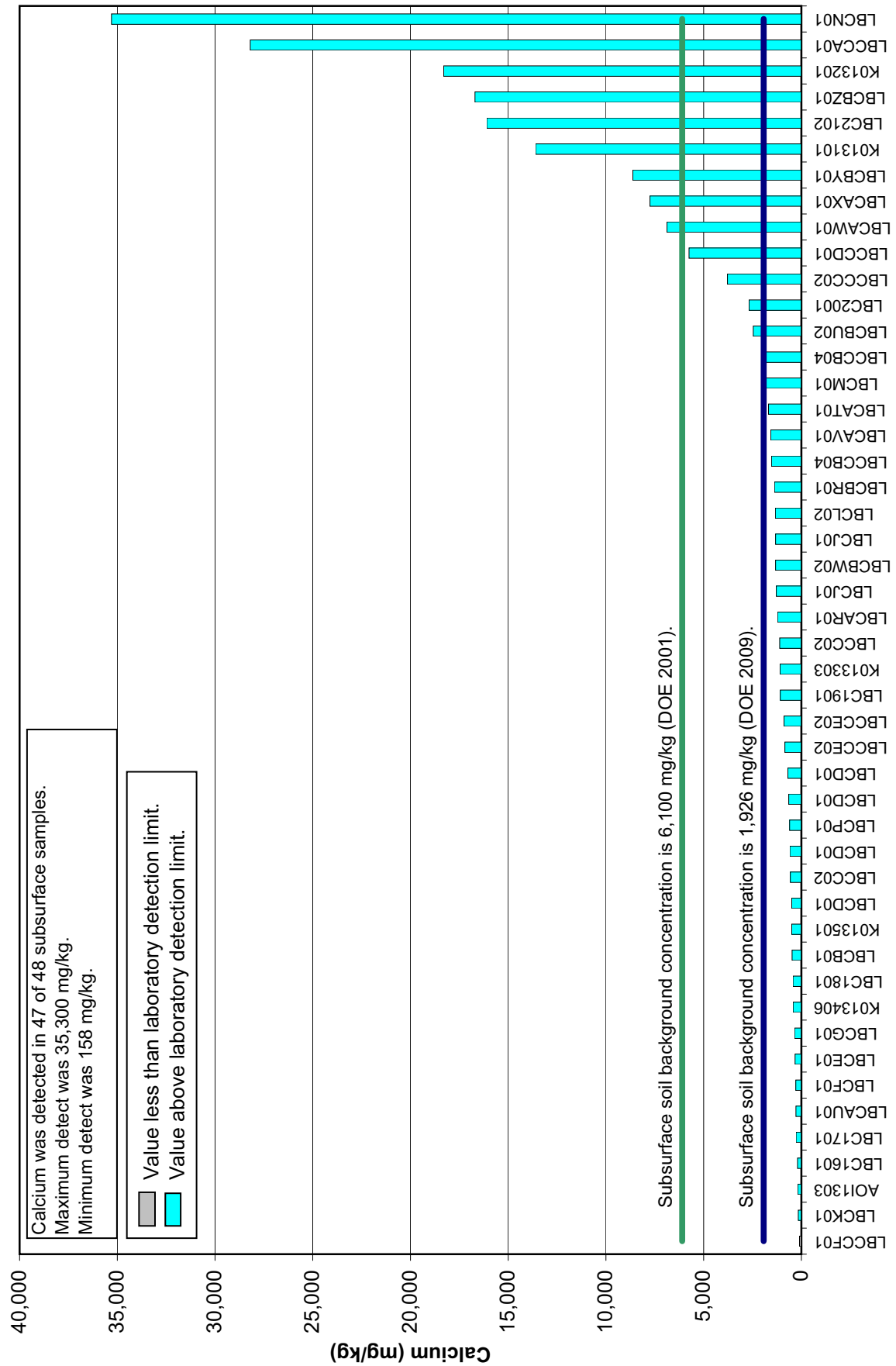

Figure D2.9. Comparison between Calcium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

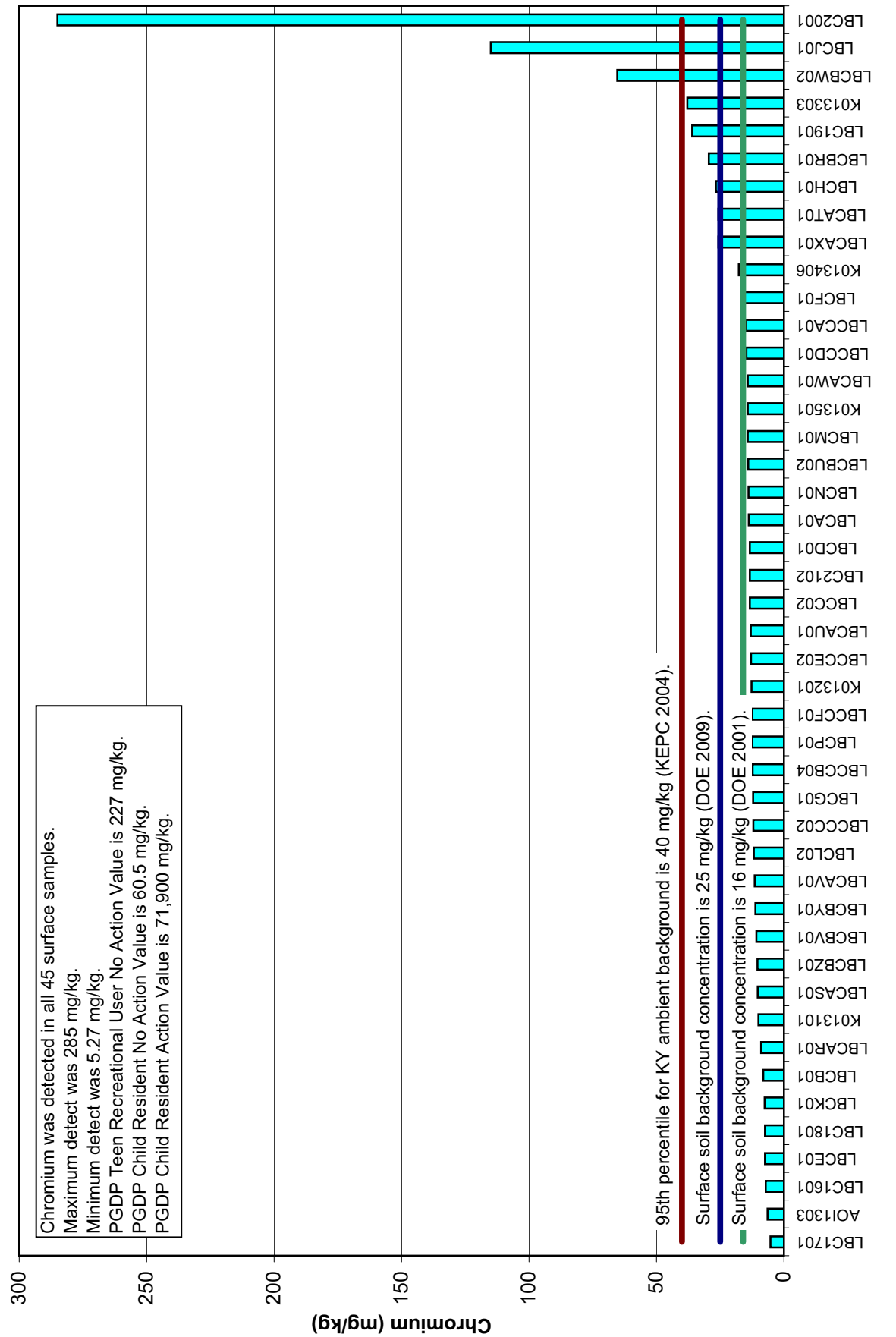

Figure D2.10. Comparison between Chromium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

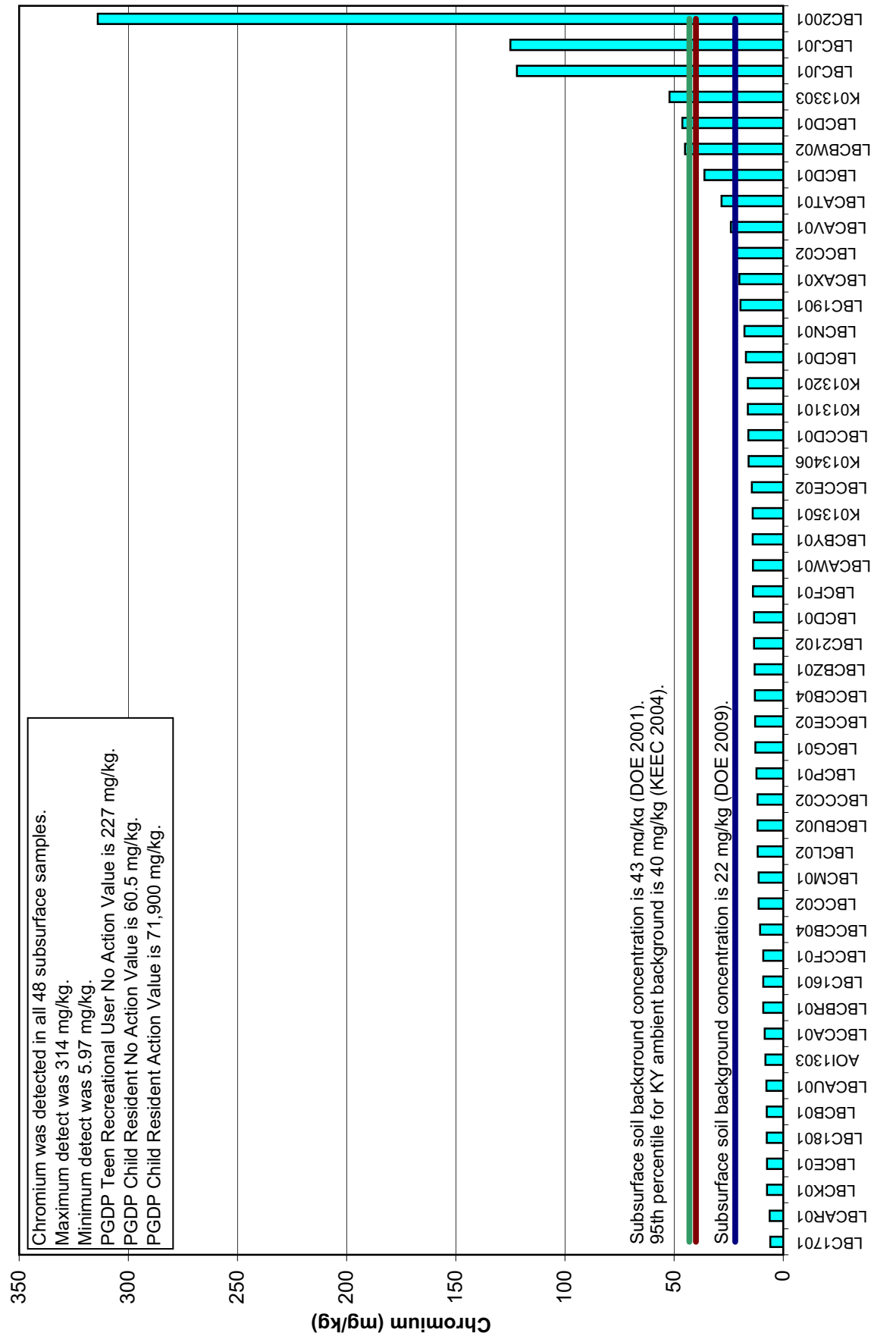

Figure D2.11. Comparison between Chromium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

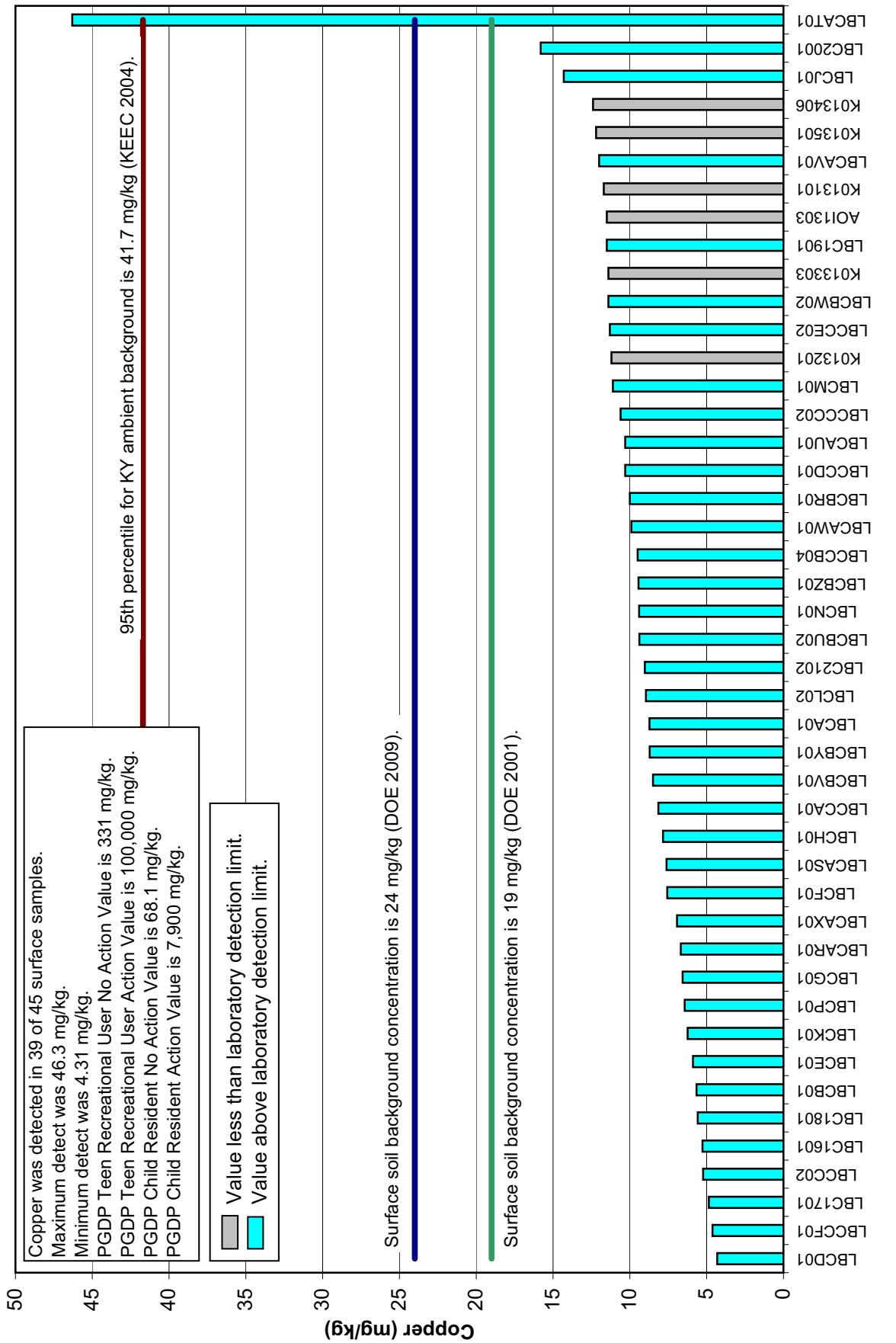

Figure D2.12. Comparison between Copper Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

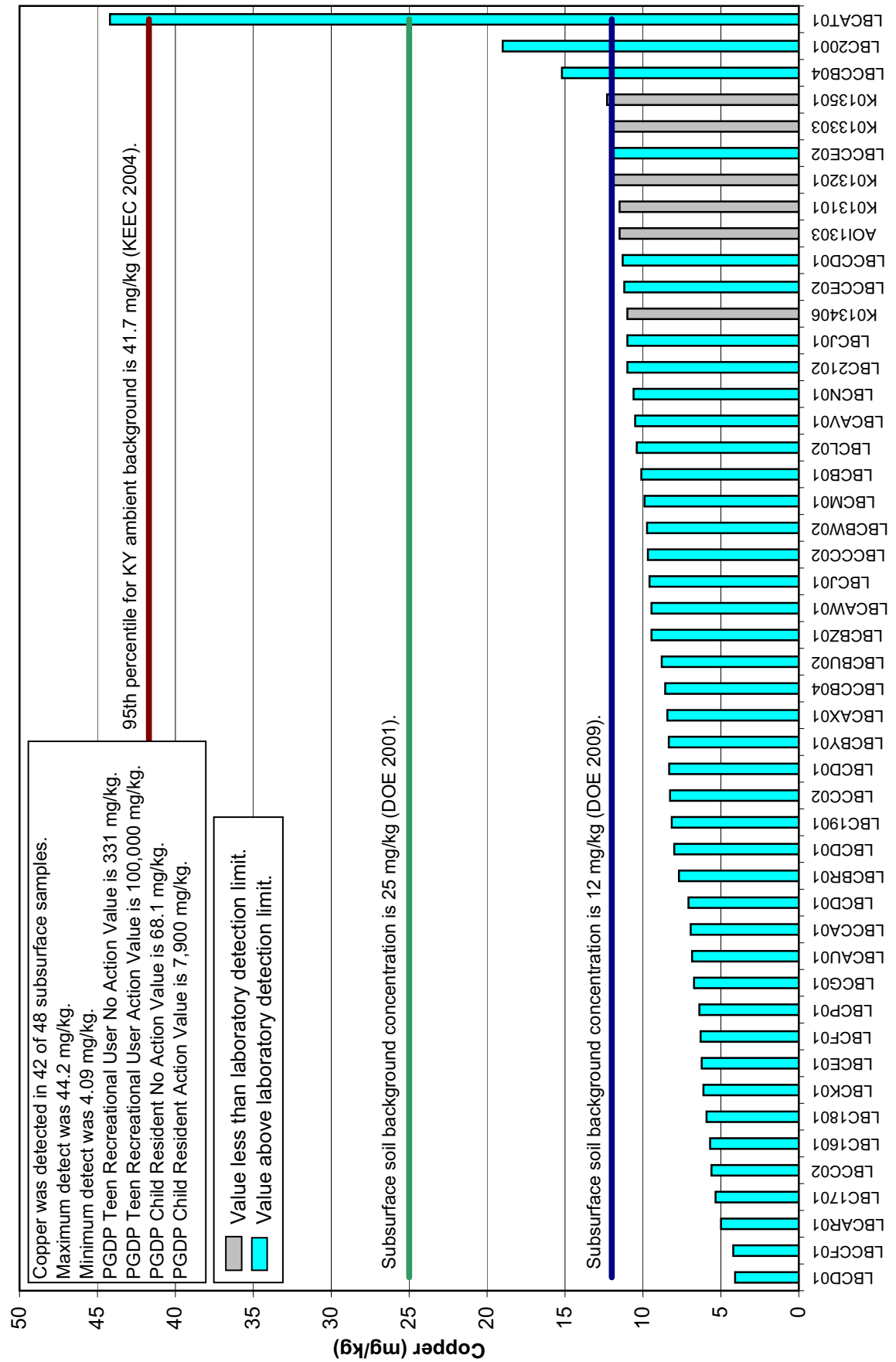

Figure D2.13. Comparison between Copper Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

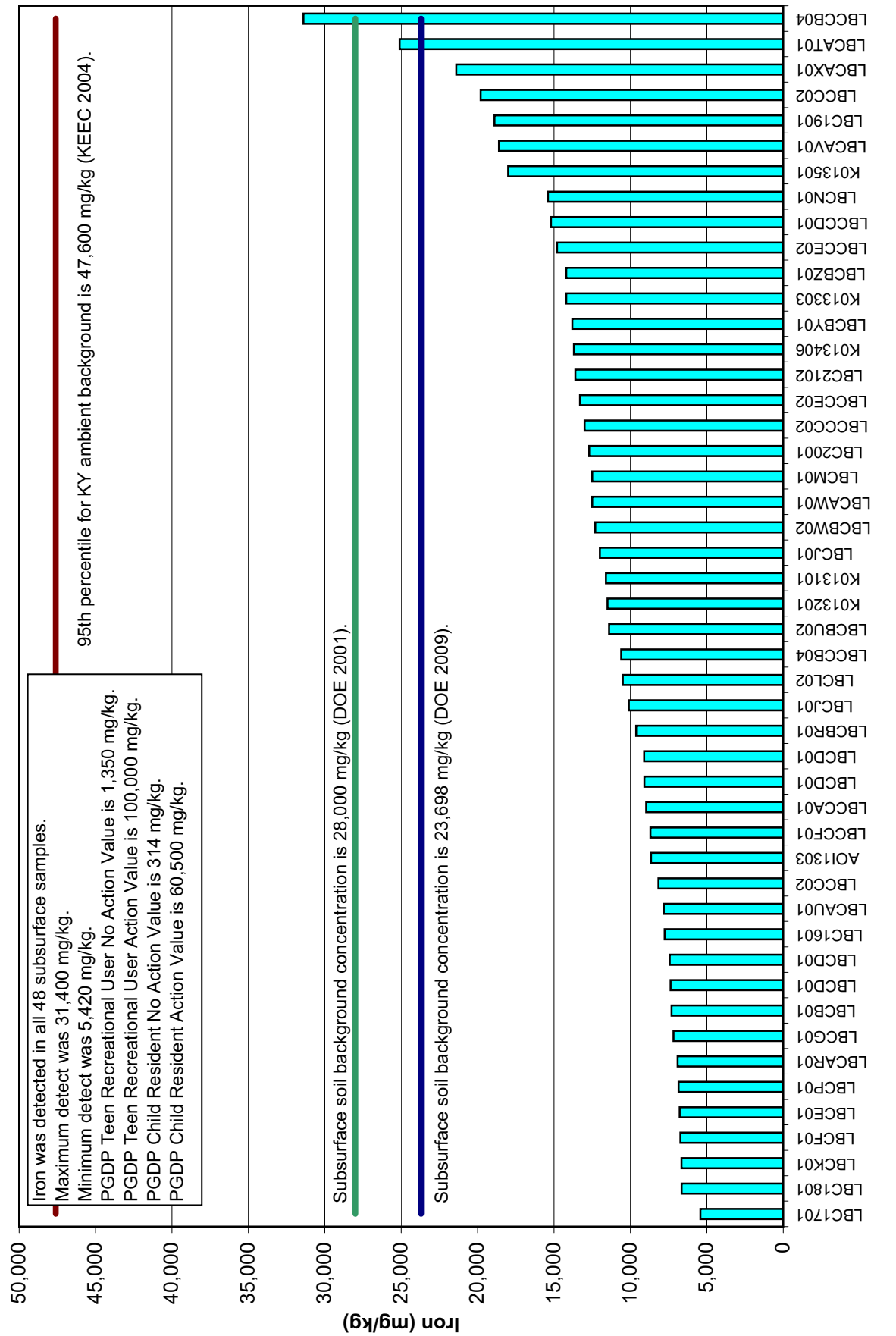

Figure D2.14. Comparison between Iron Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

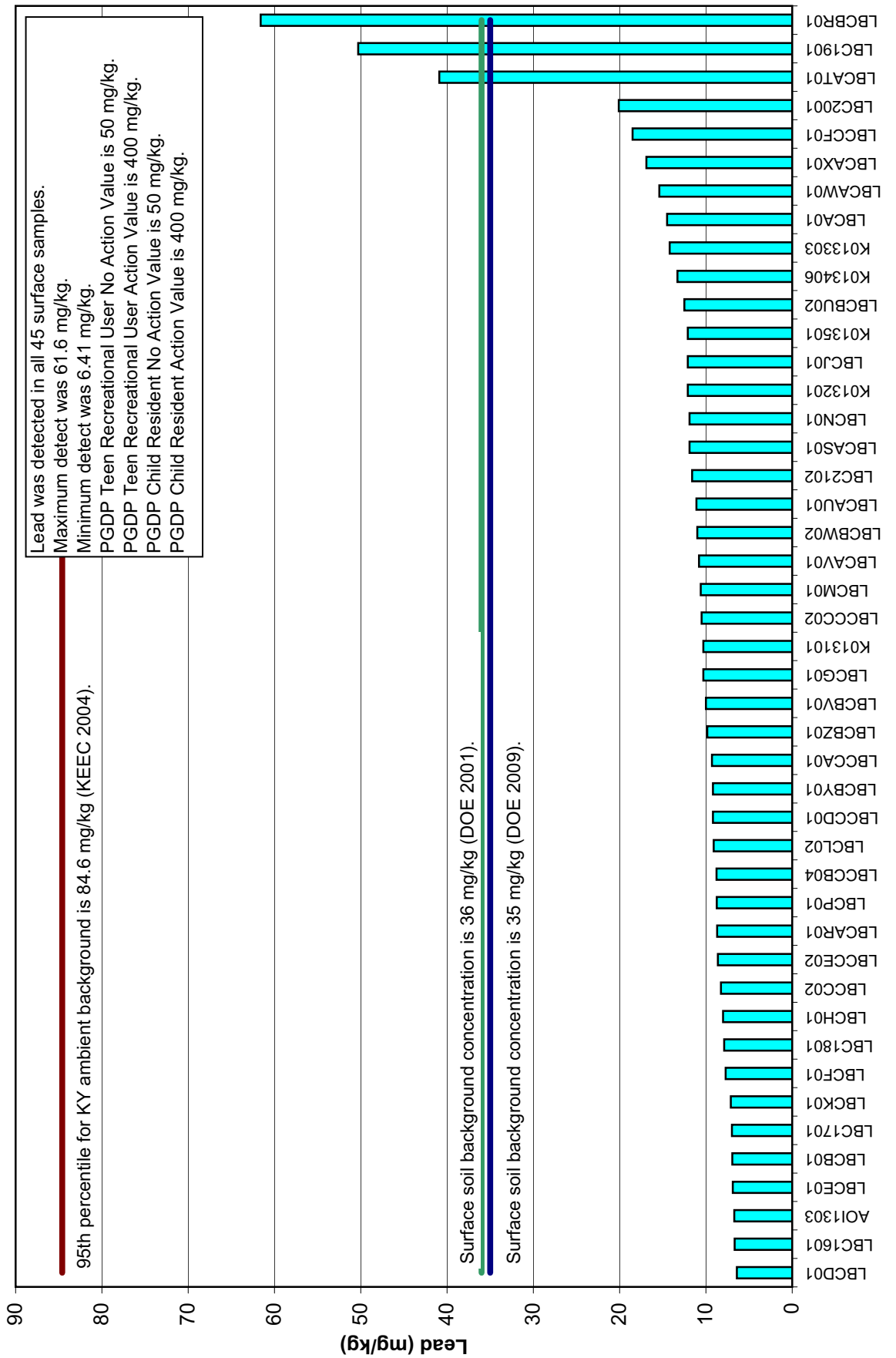

Figure D2.15. Comparison between Lead Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

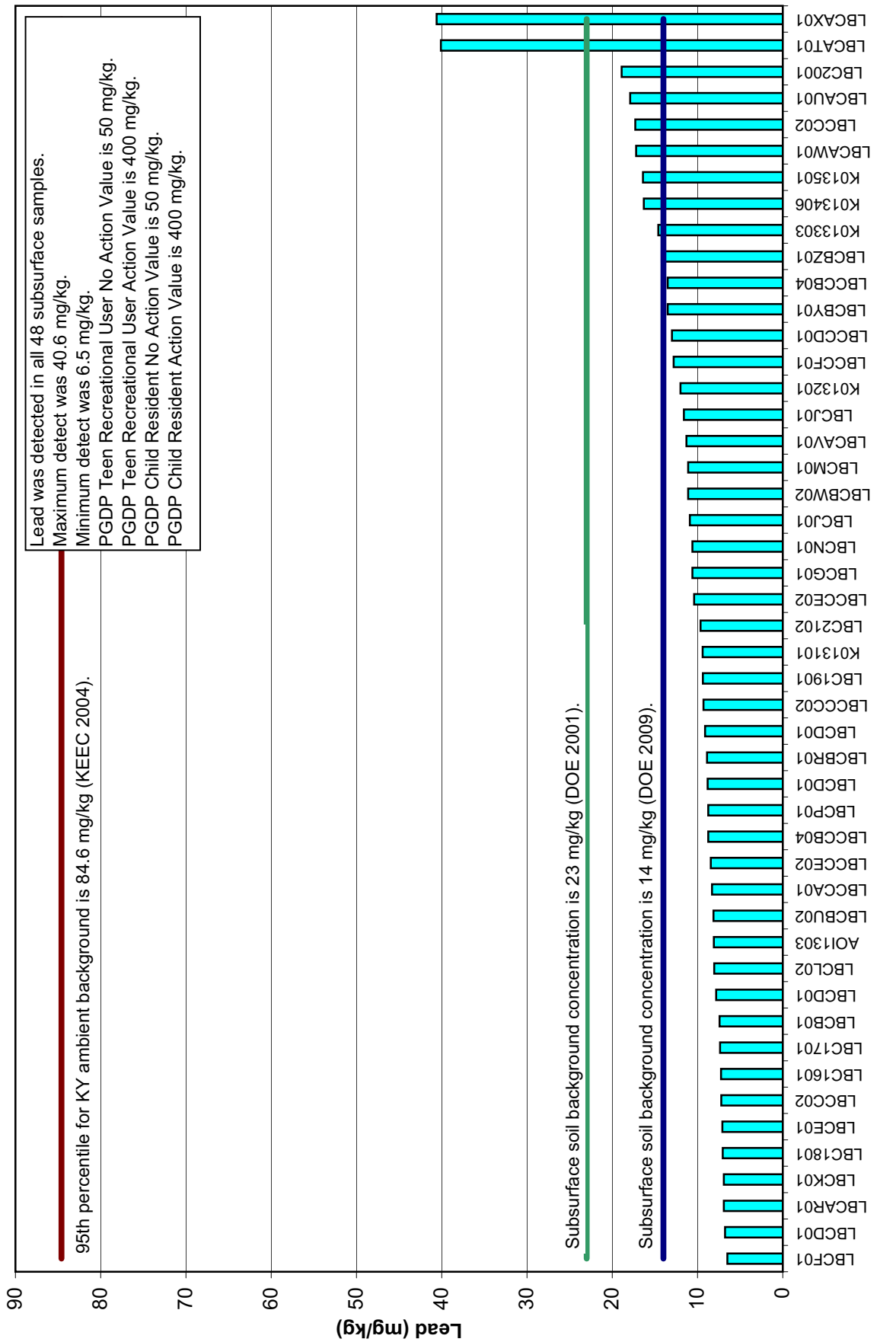

Figure D2.16. Comparison between Lead Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

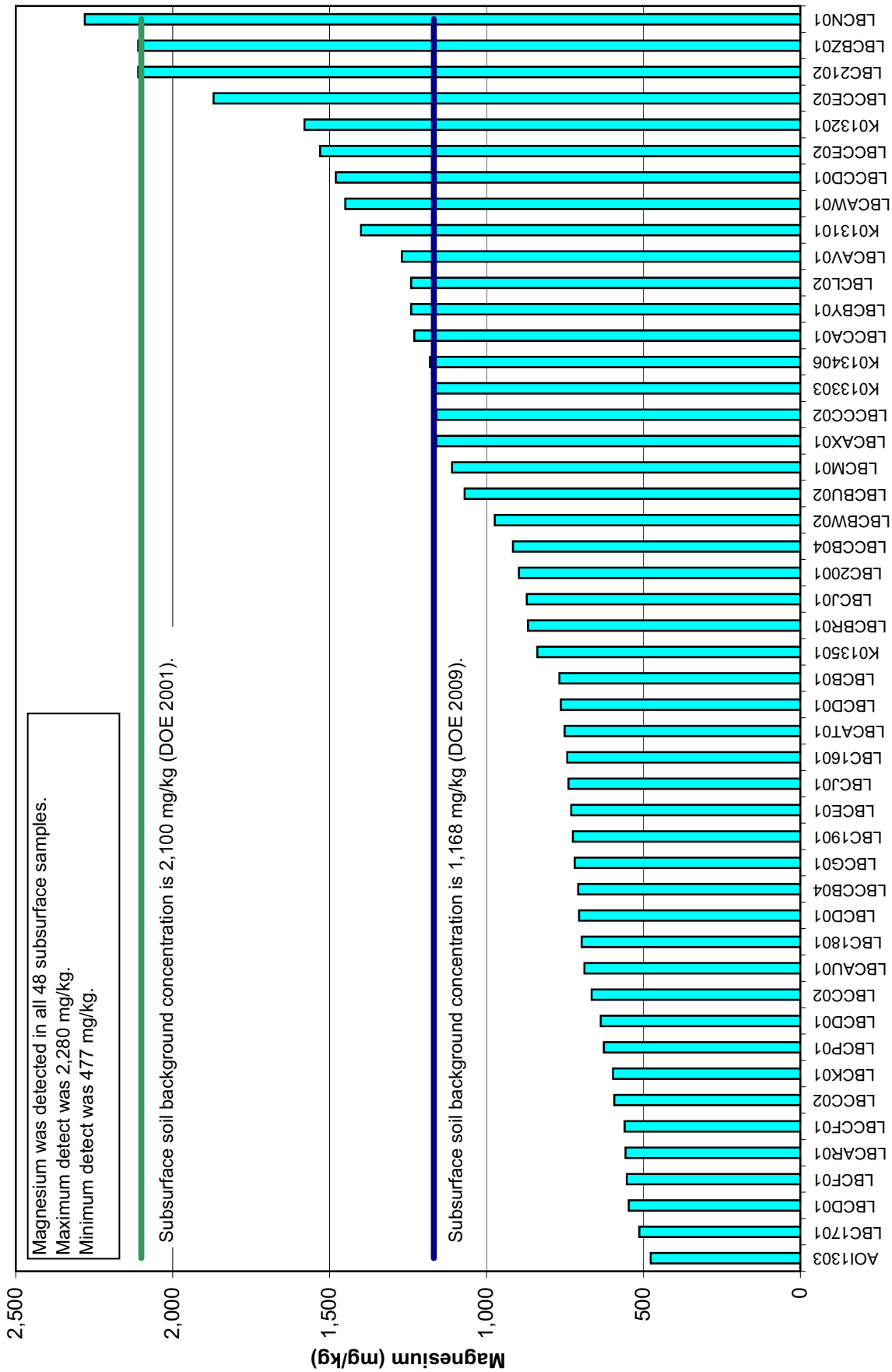

Figure D2.17. Comparison between Magnesium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

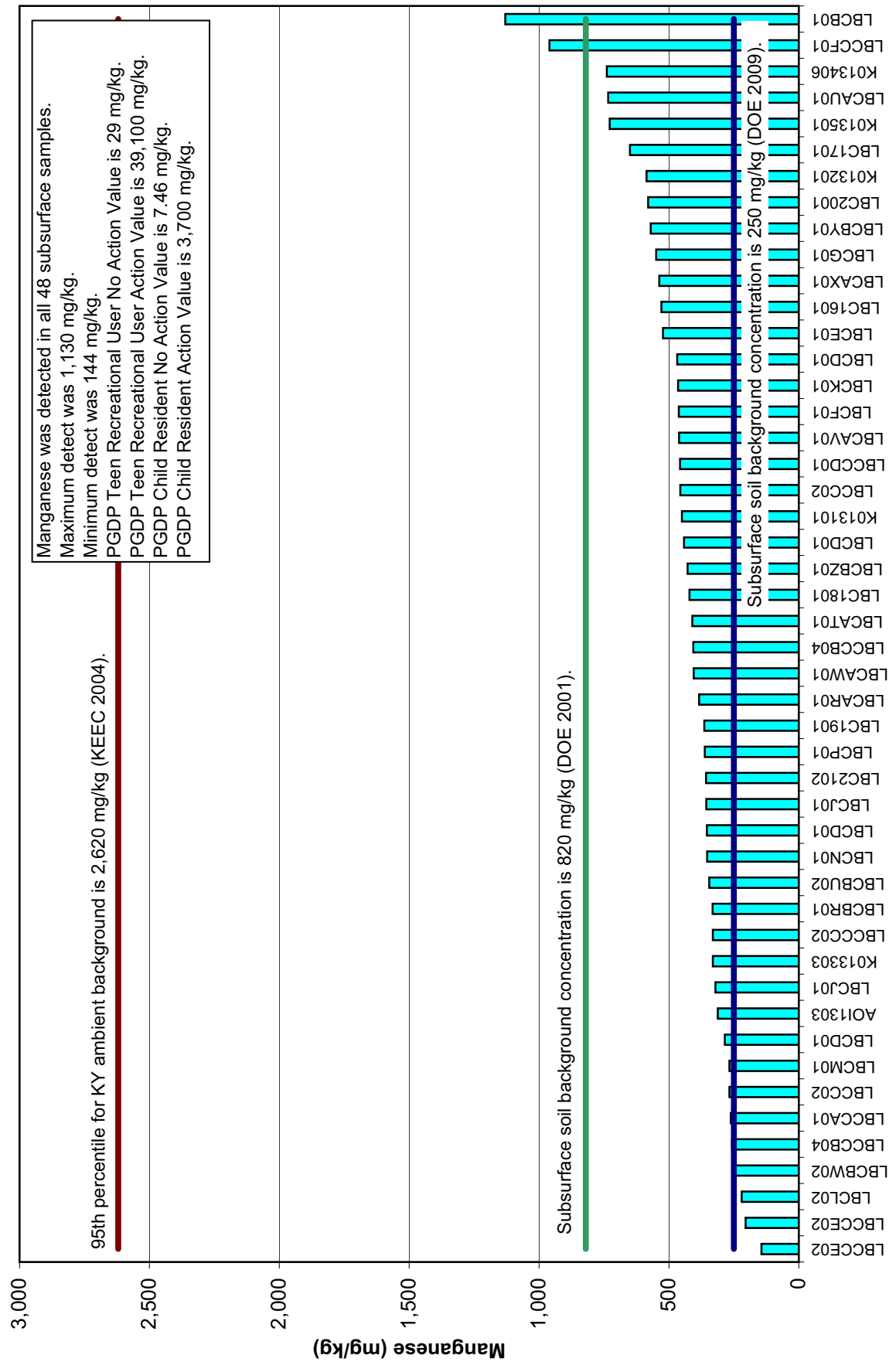

Figure D2.18. Comparison between Manganese Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

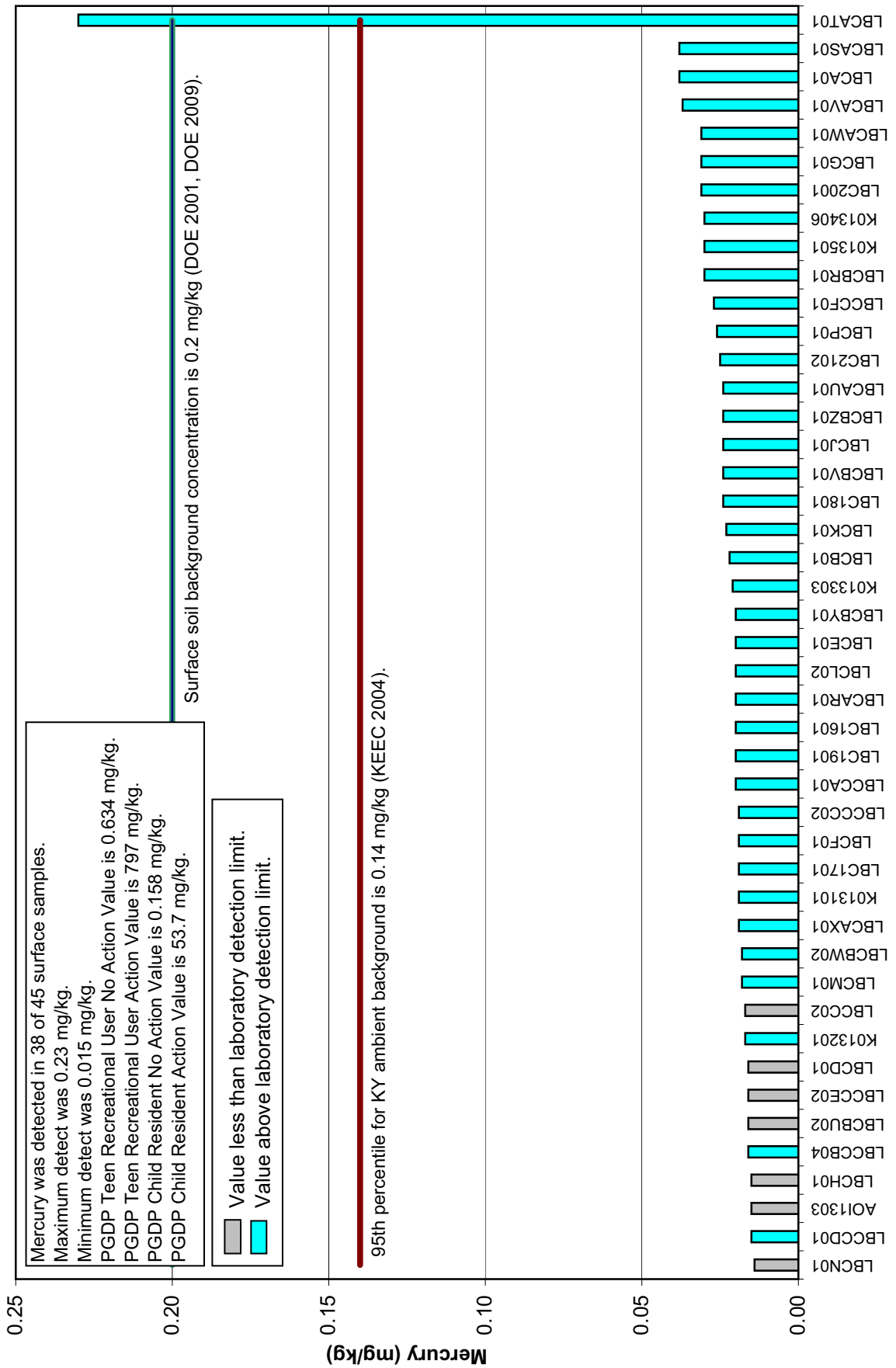

Figure D2.19. Comparison between Mercury Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

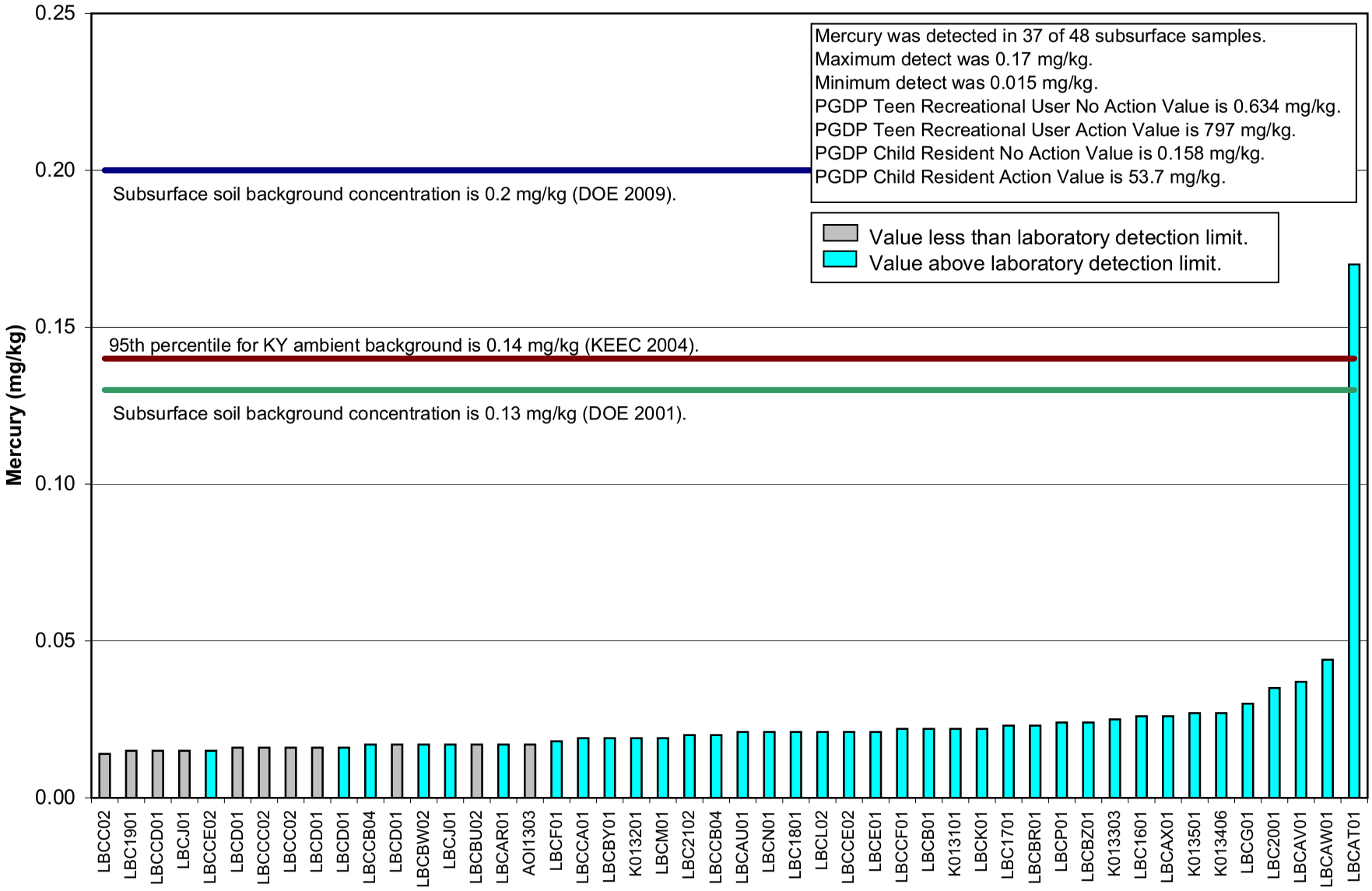

Figure D2.20. Comparison between Mercury Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

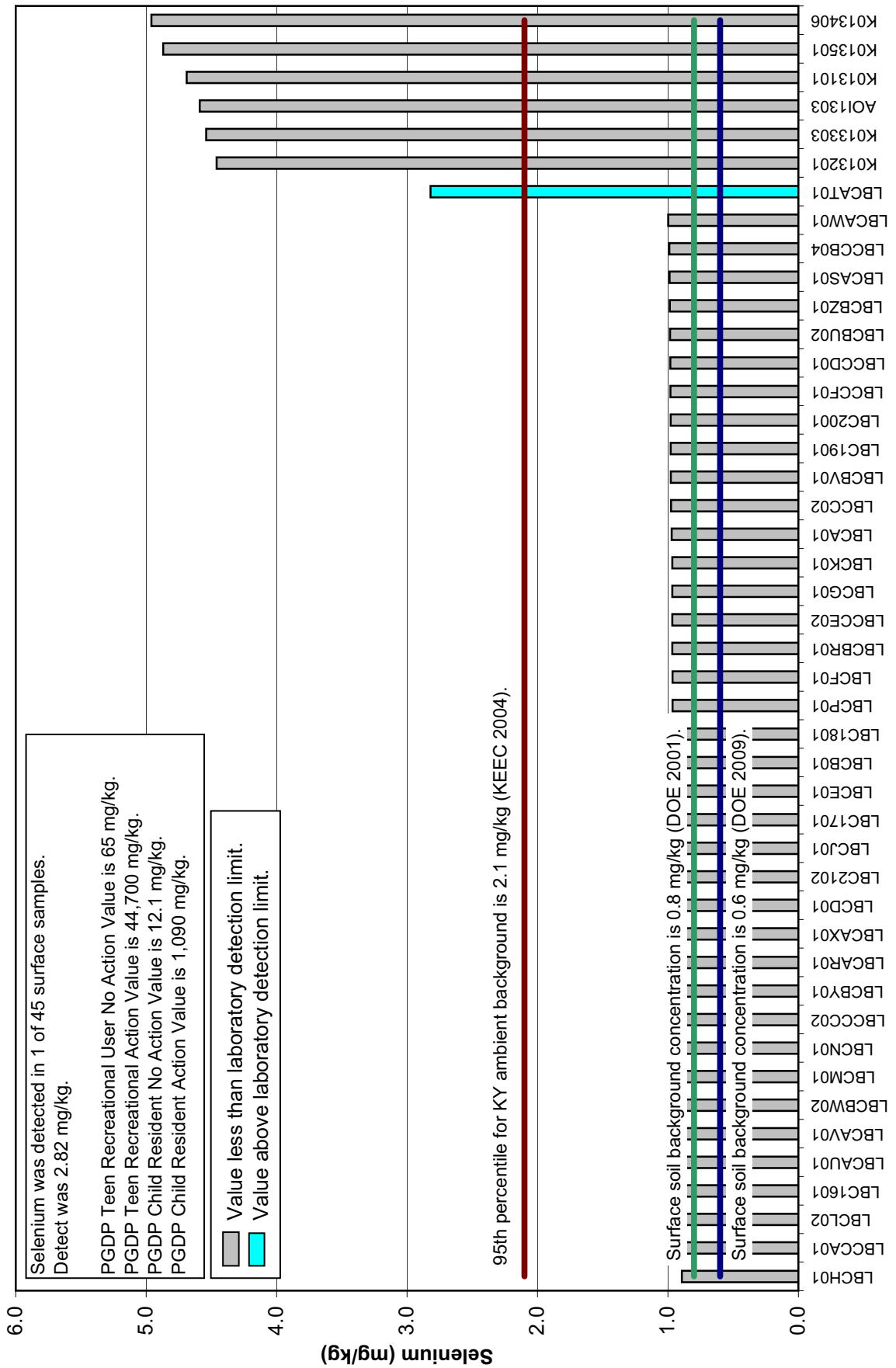

Figure D2.21. Comparison between Selenium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

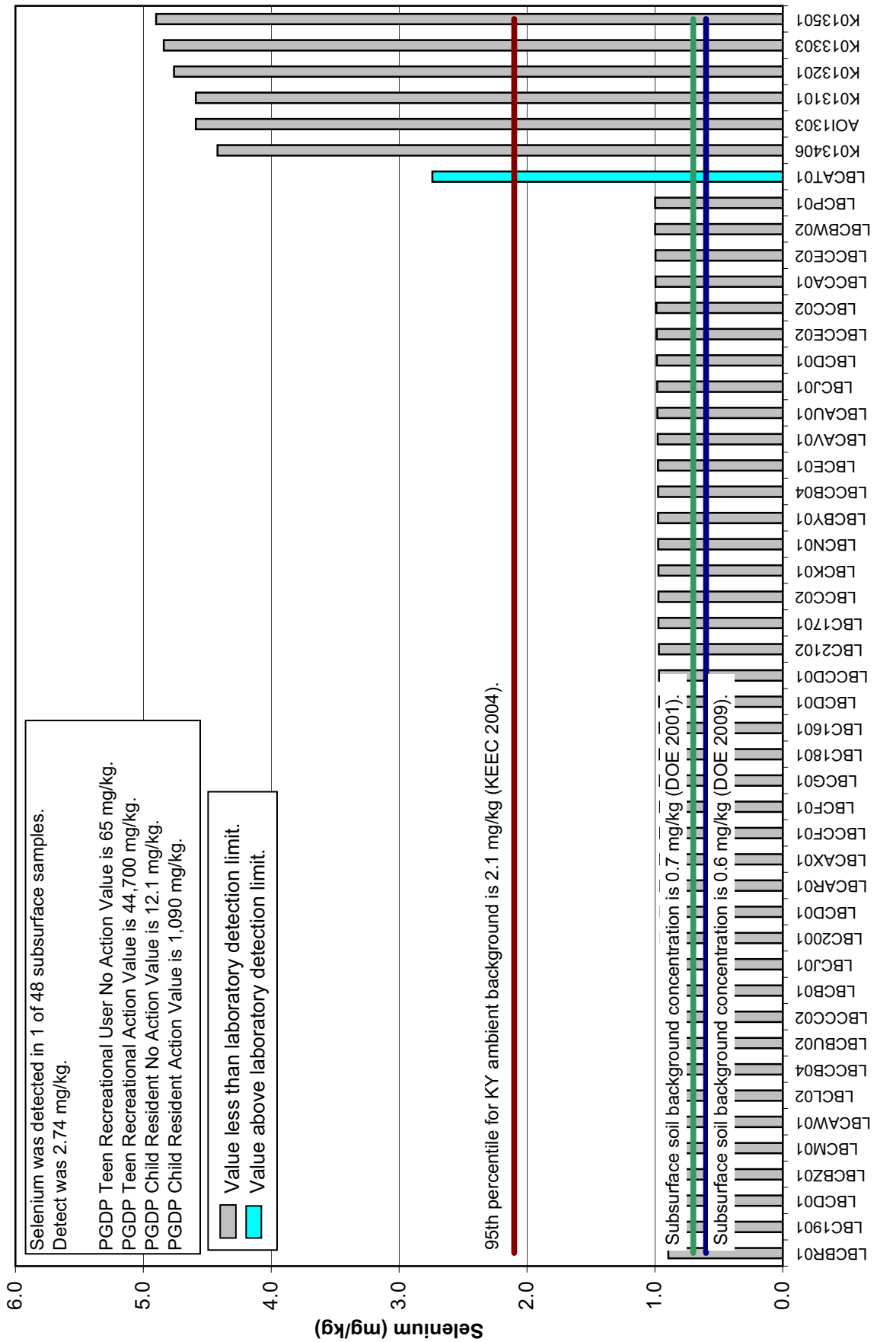

Figure D2.22. Comparison between Selenium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

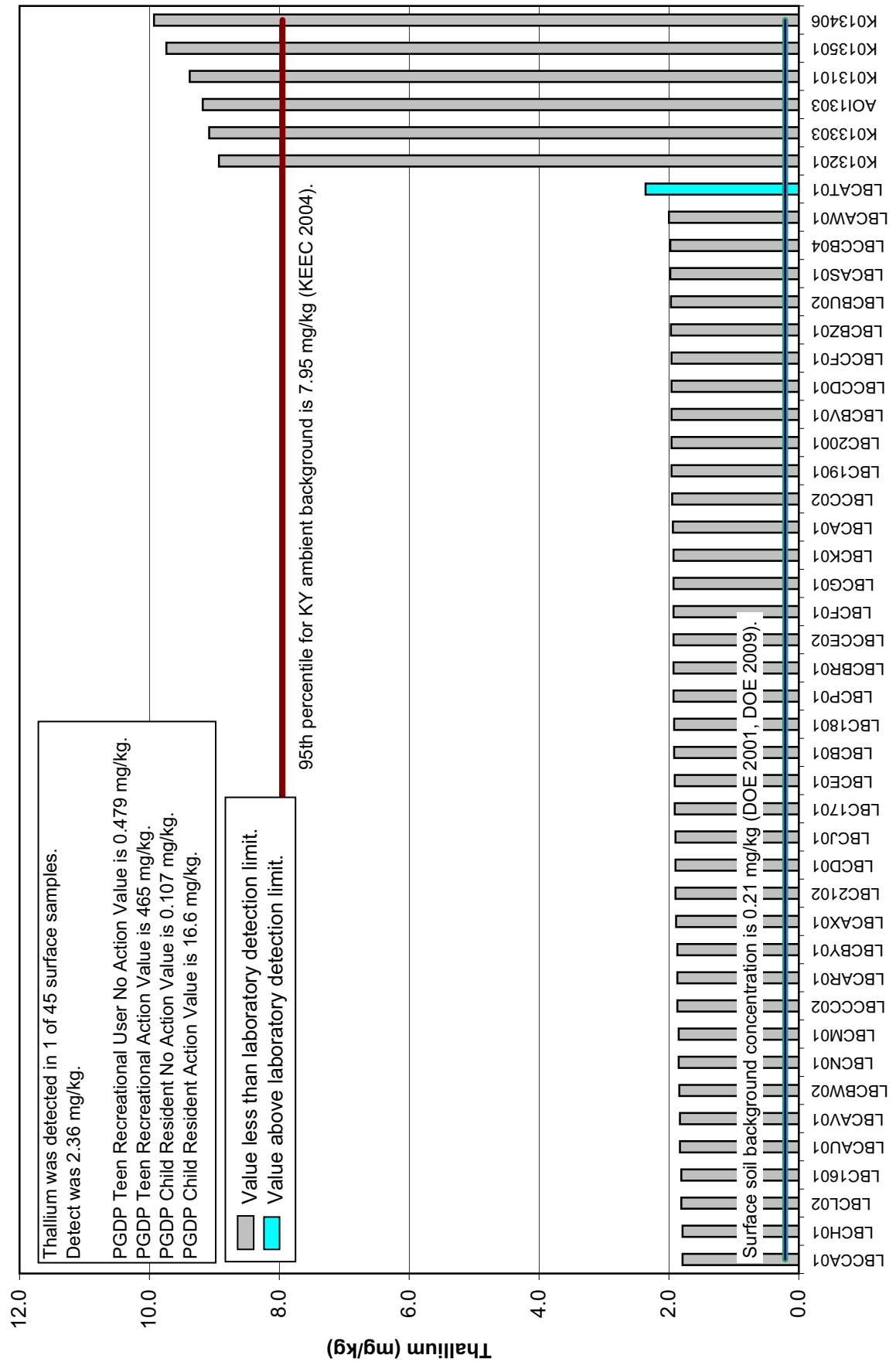

Figure D2.23. Comparison between Thallium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

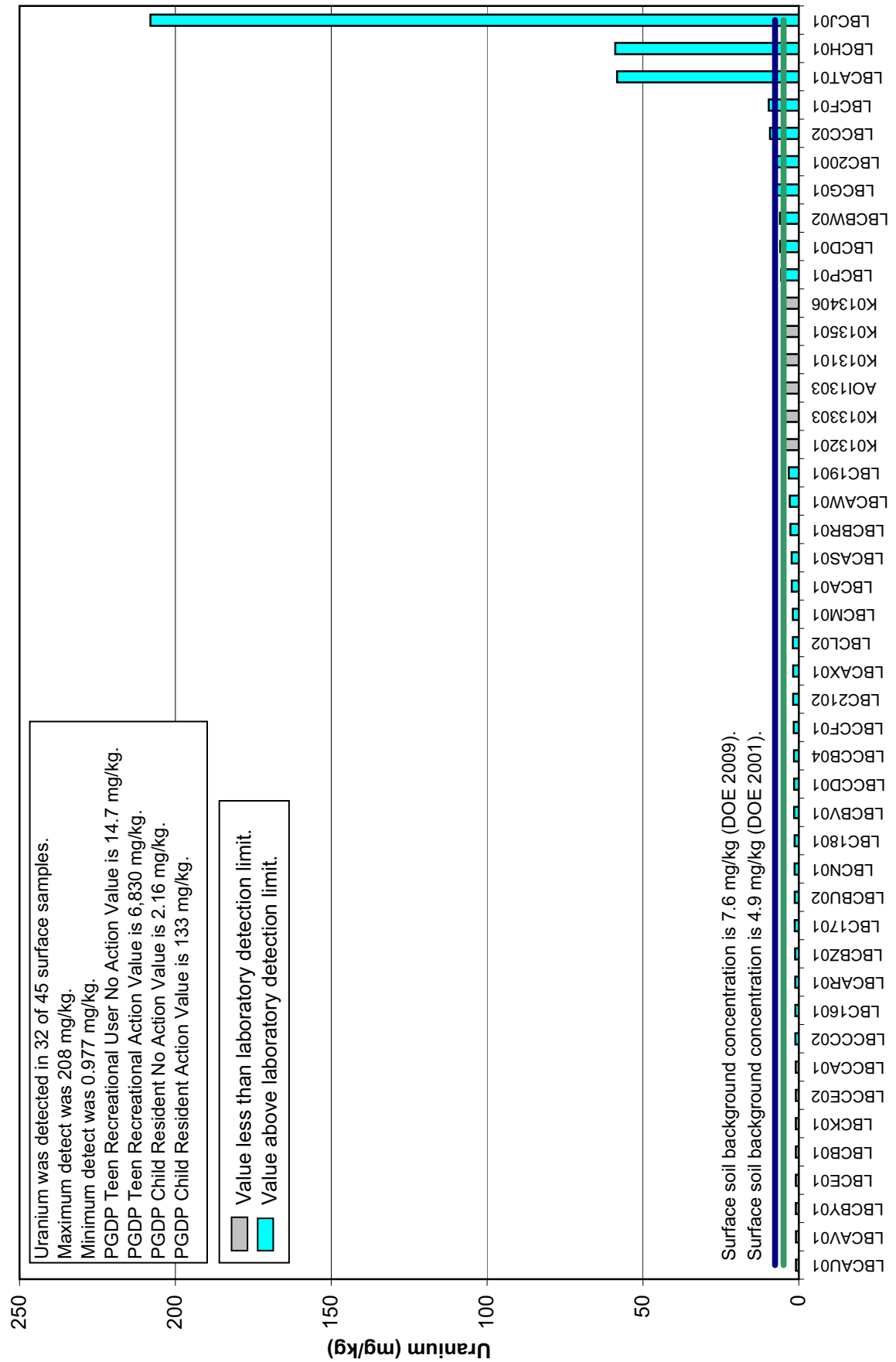

Figure D2.24. Comparison between Uranium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

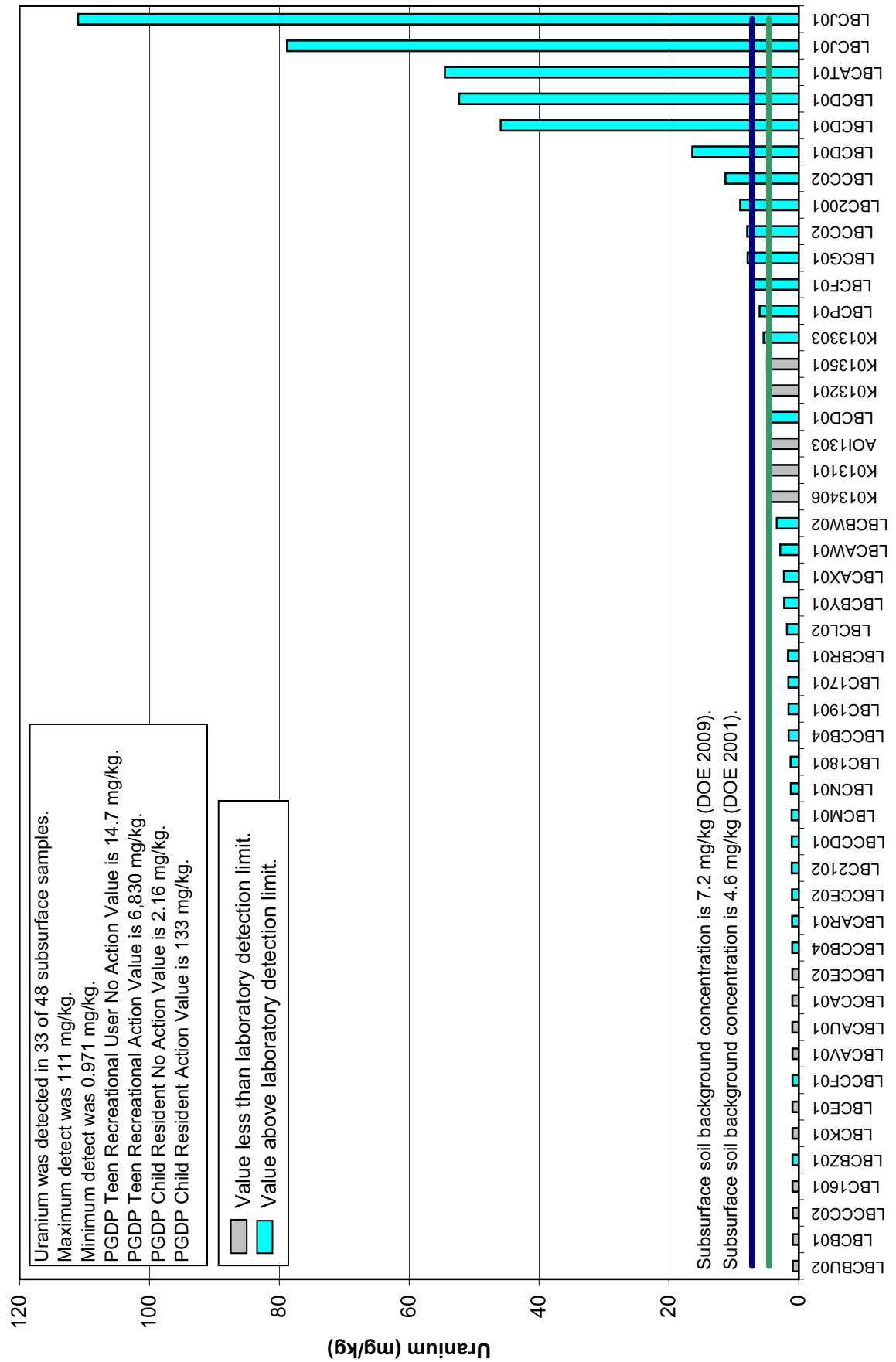

Figure D2.25. Comparison between Uranium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

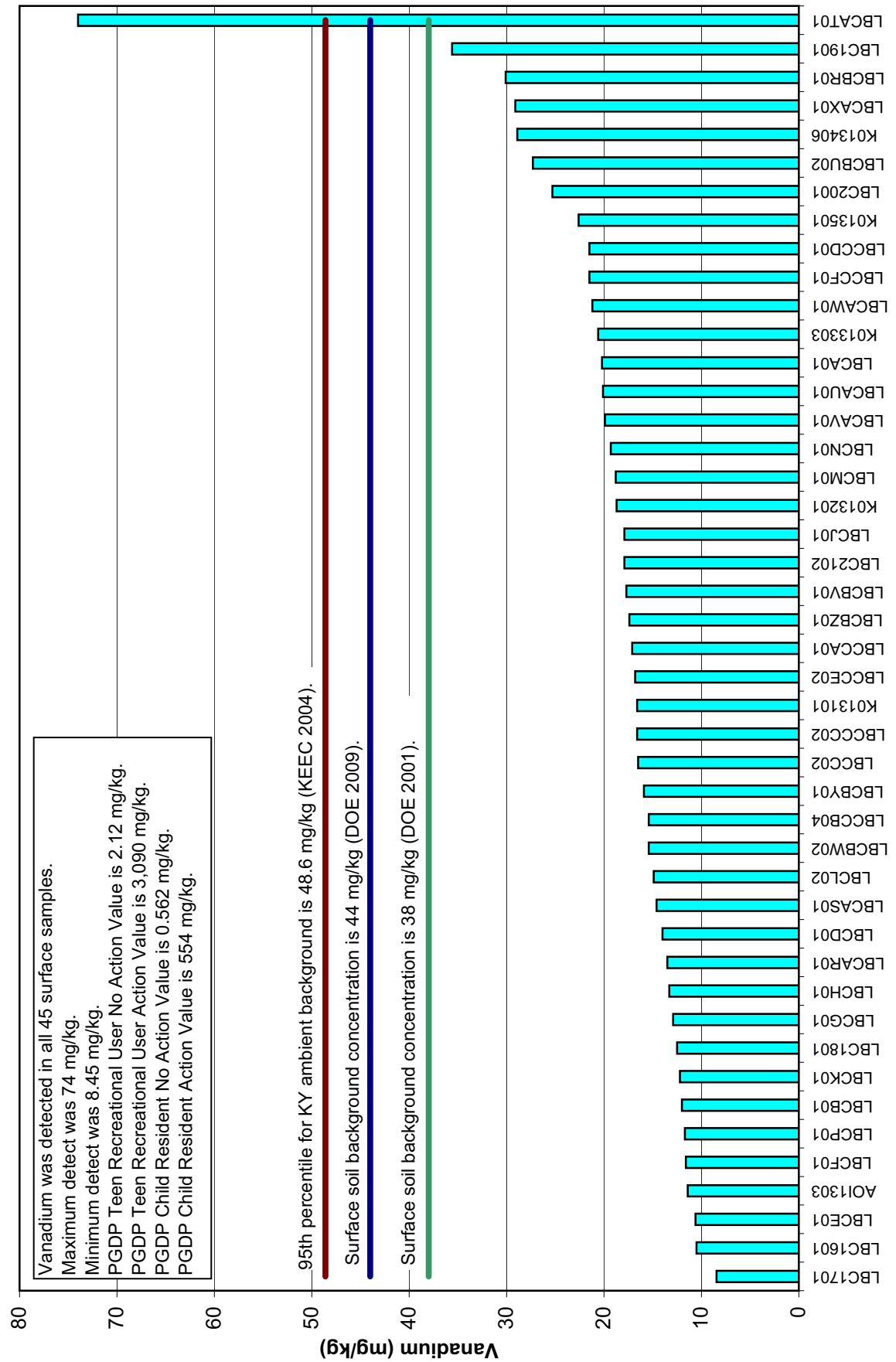

Figure D2.26. Comparison between Vanadium Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

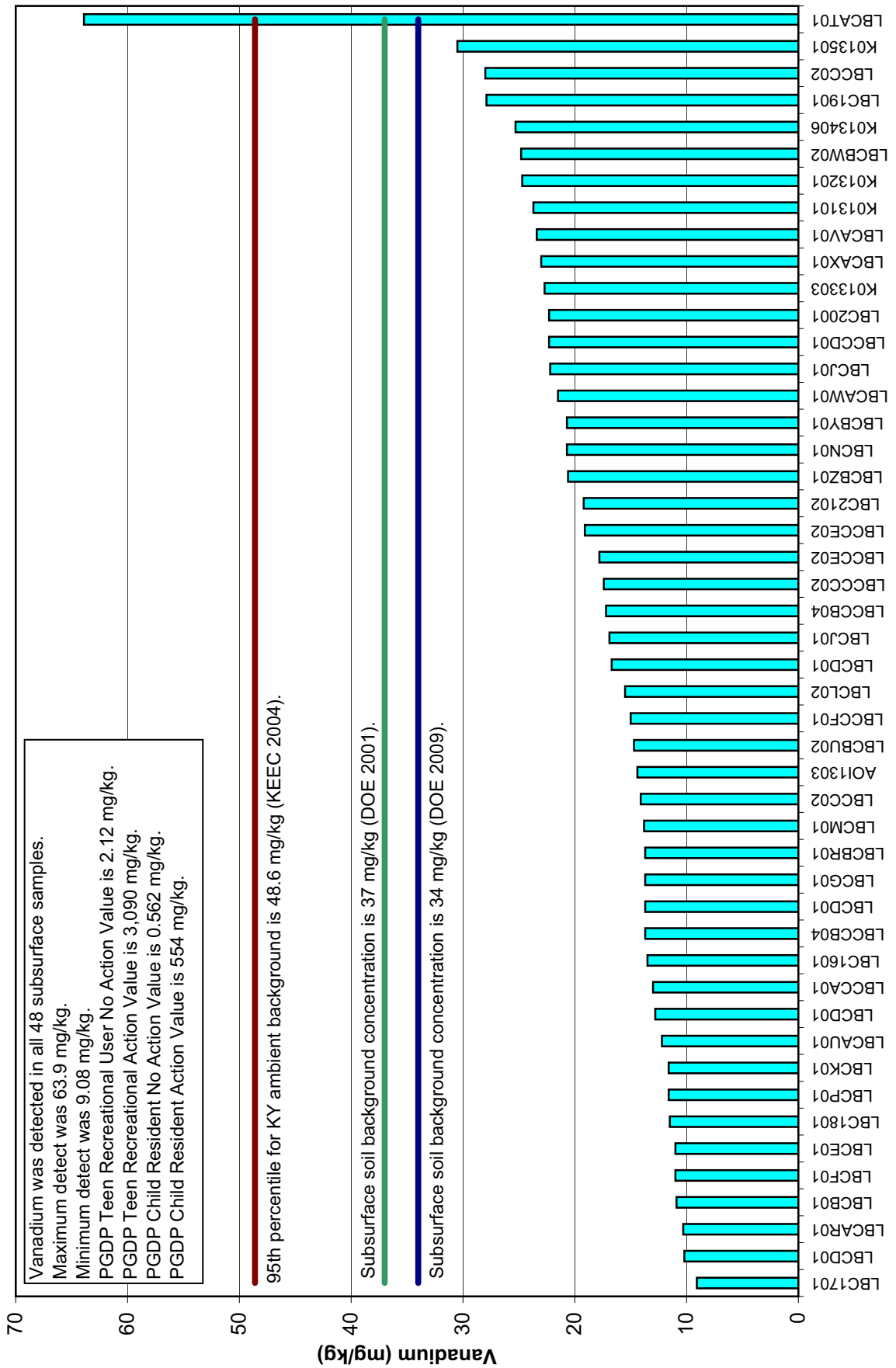

Figure D2.27. Comparison between Vanadium Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

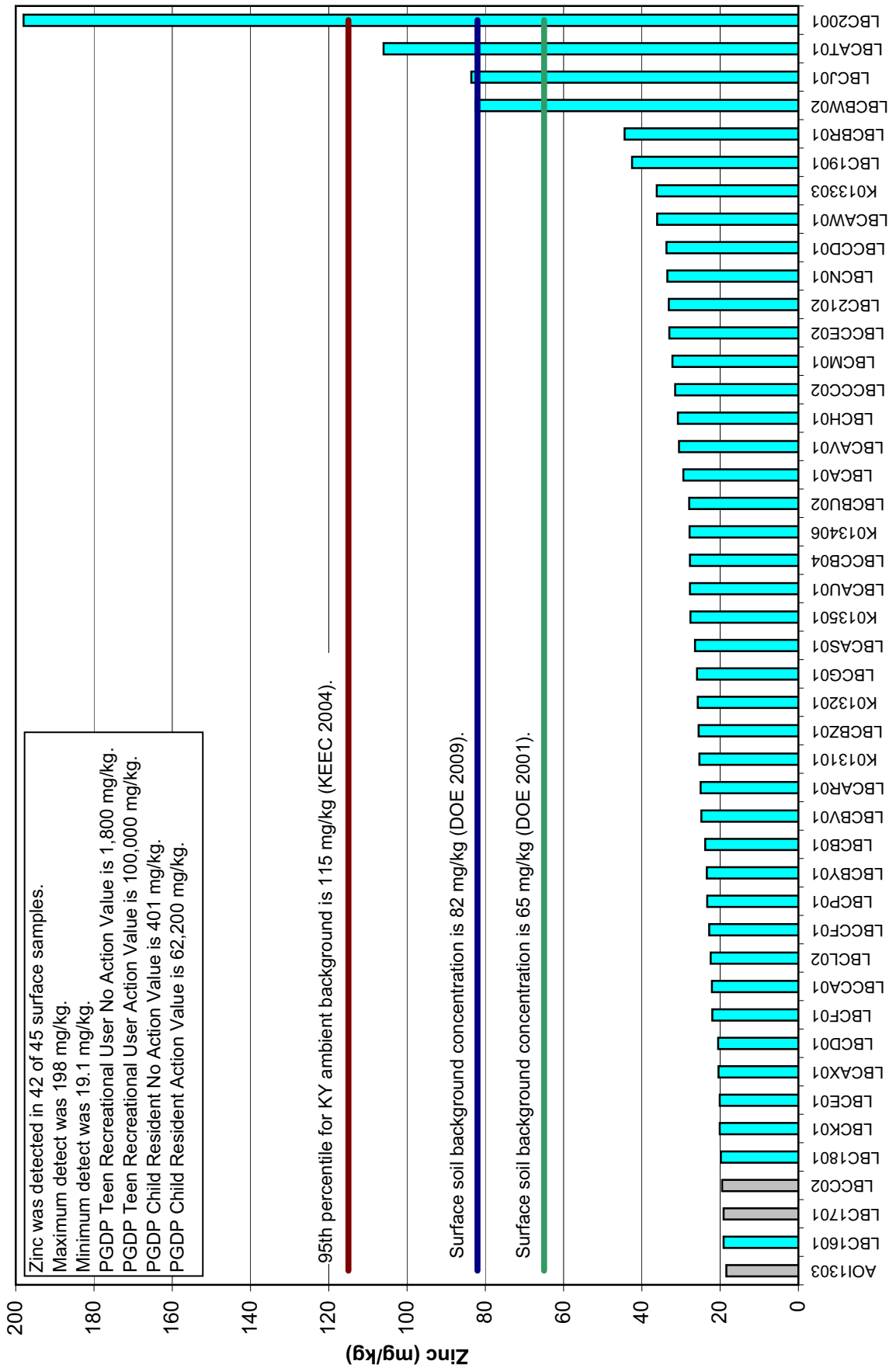

Figure D2.28. Comparison between Zinc Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

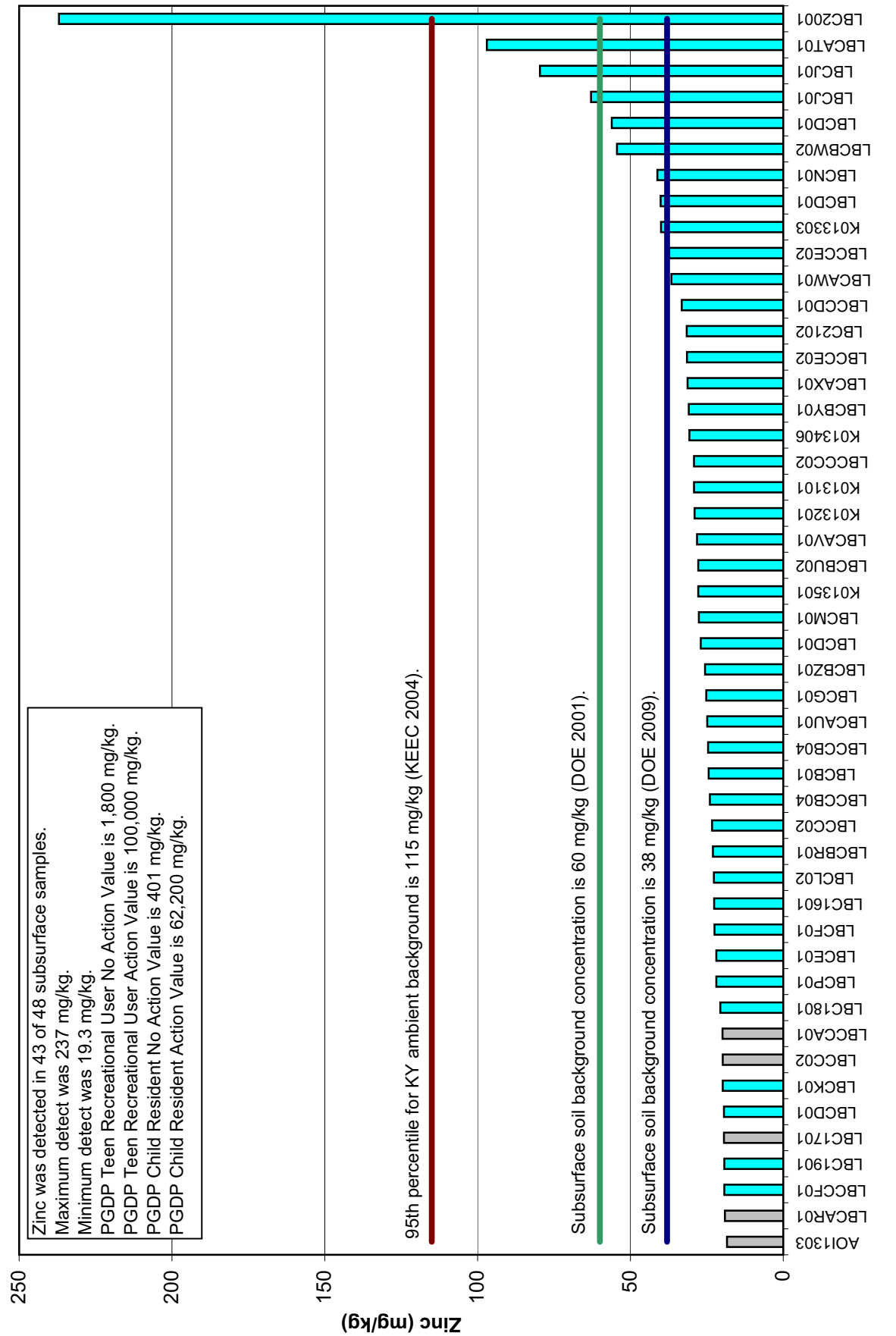

Figure D2.29. Comparison between Zinc Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

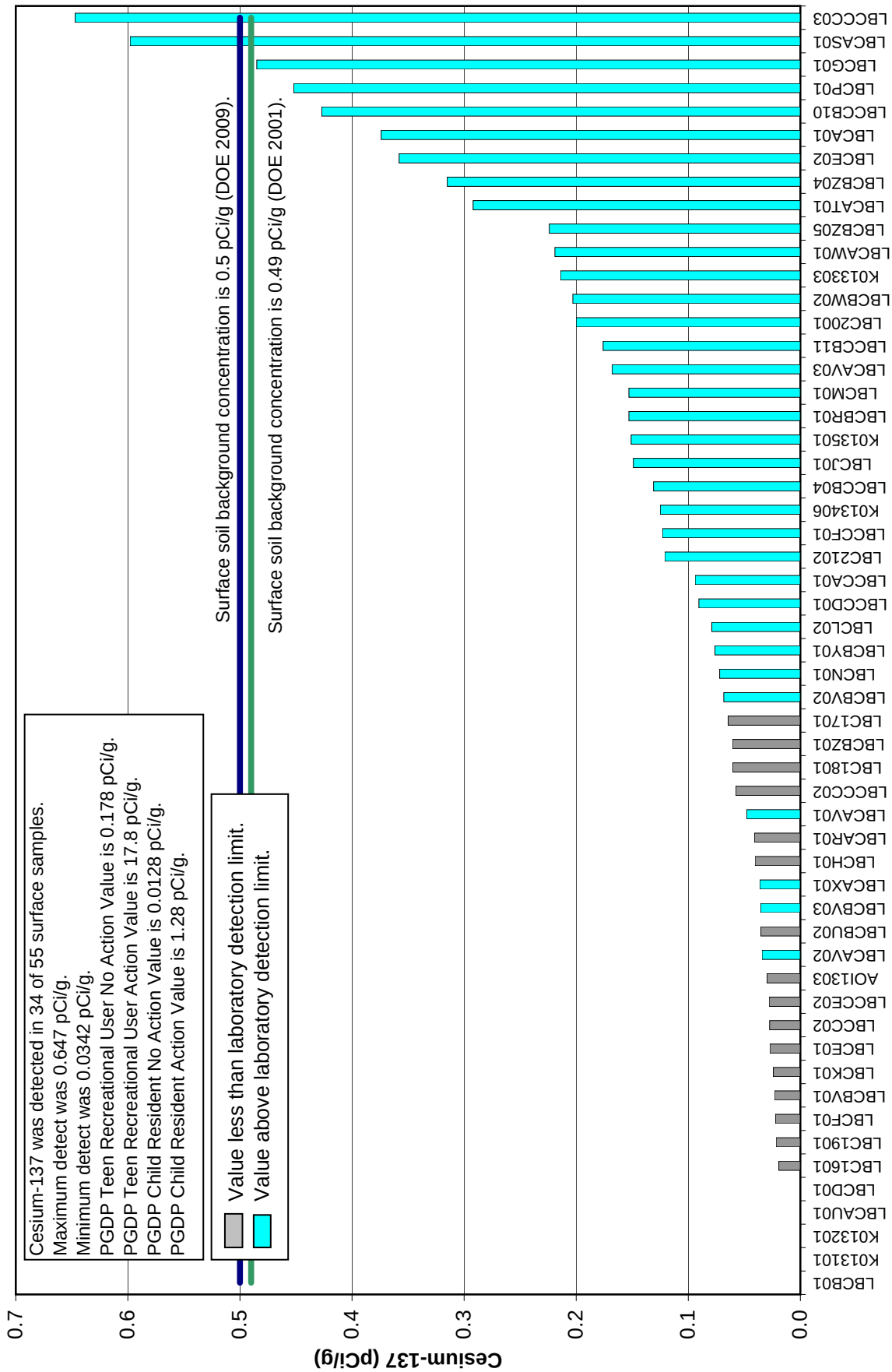

Figure D2.30. Comparison between Cesium-137 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

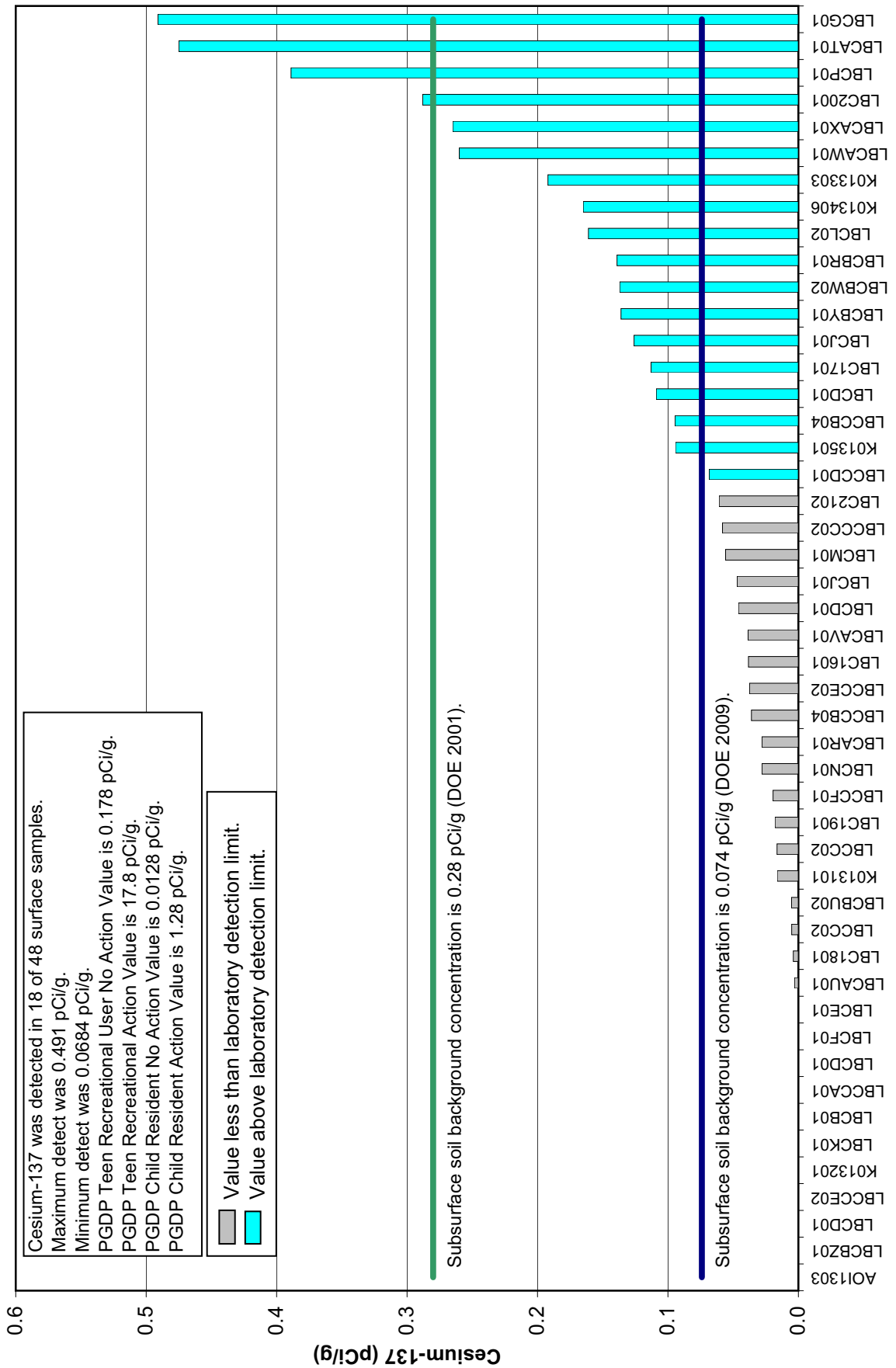

Figure D2.31. Comparison between Cesium-137 Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

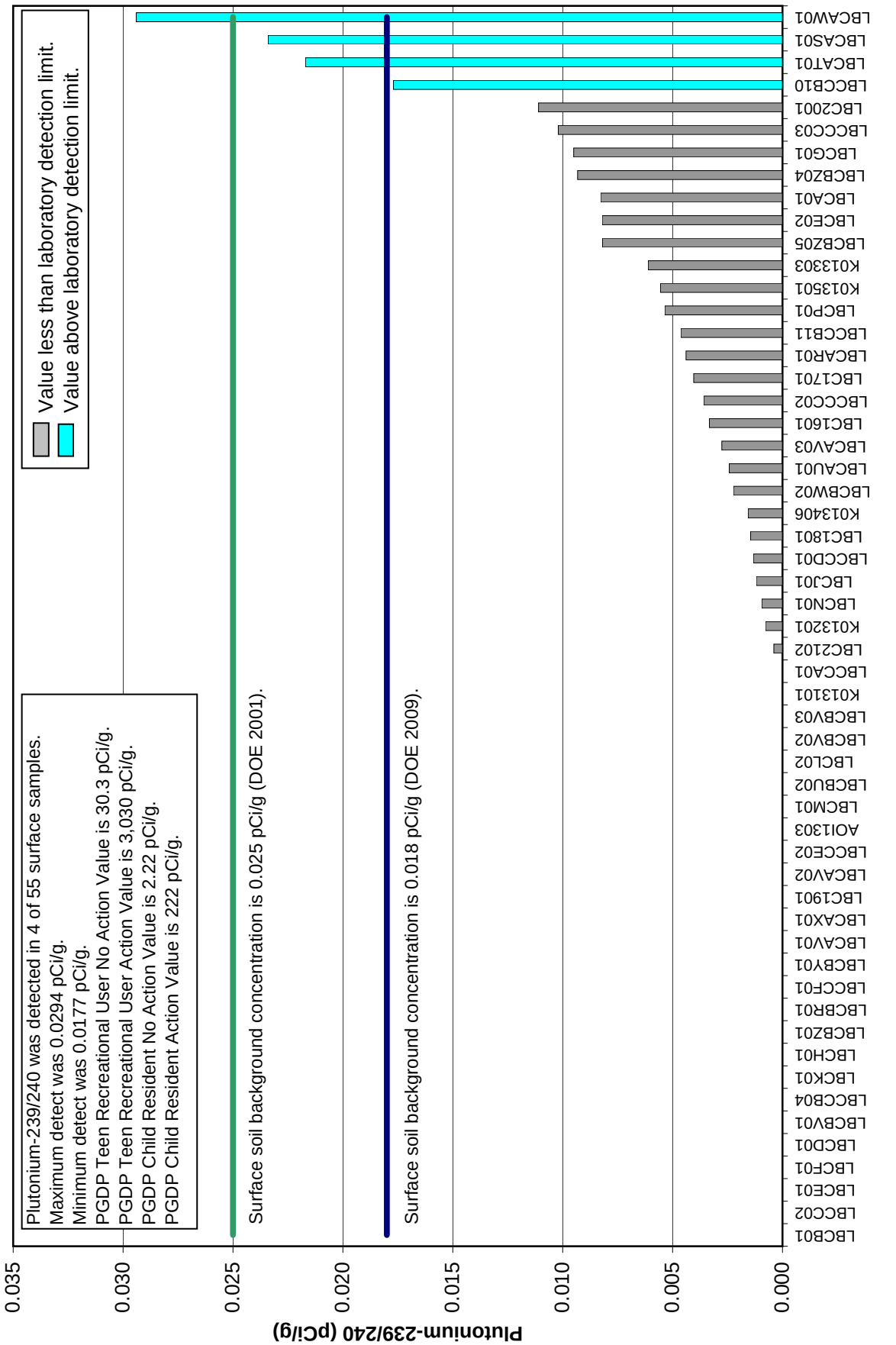

Figure D2.32. Comparison between Plutonium-239/240 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

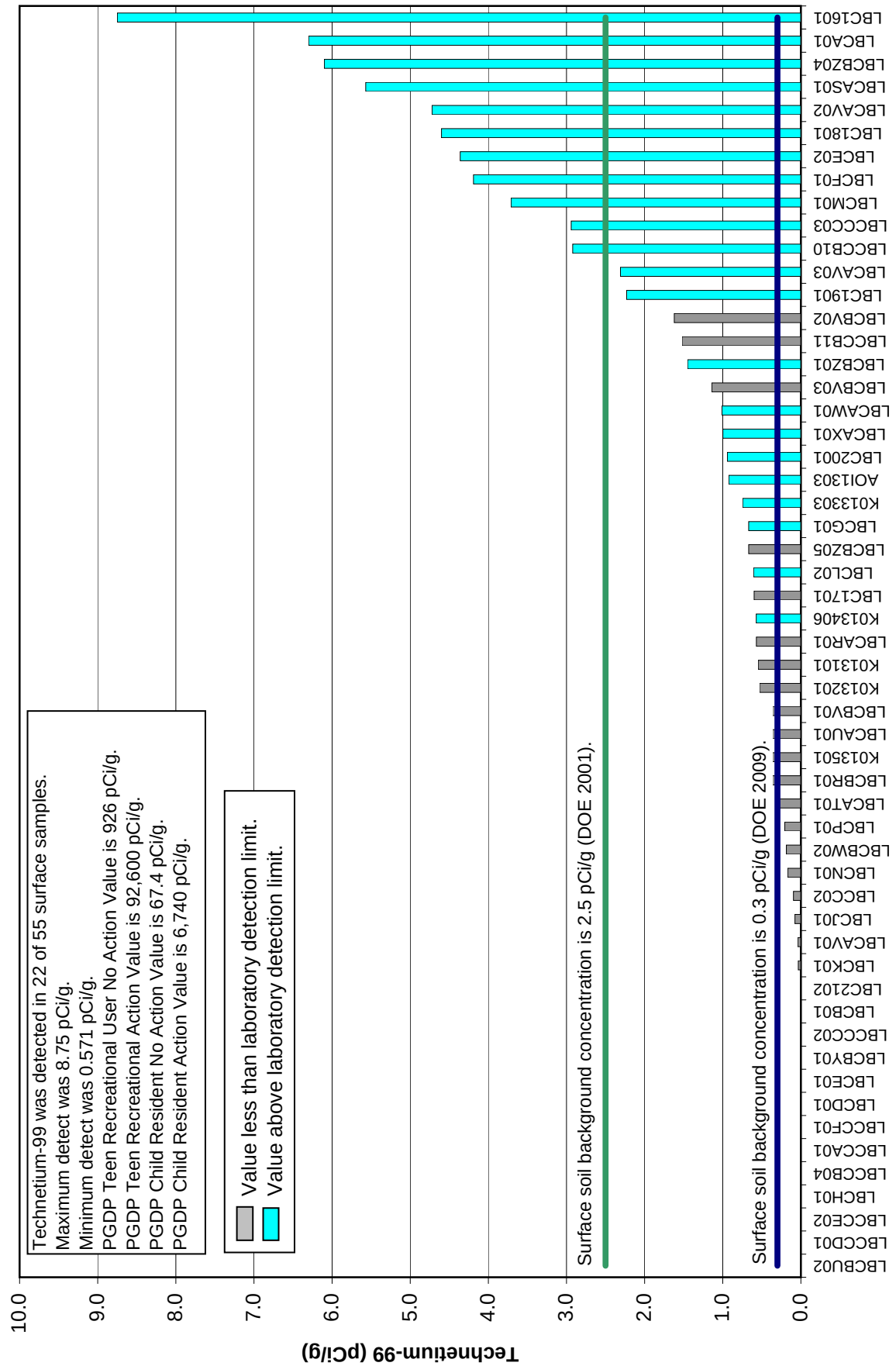

Figure D2.33. Comparison between Technetium-99 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

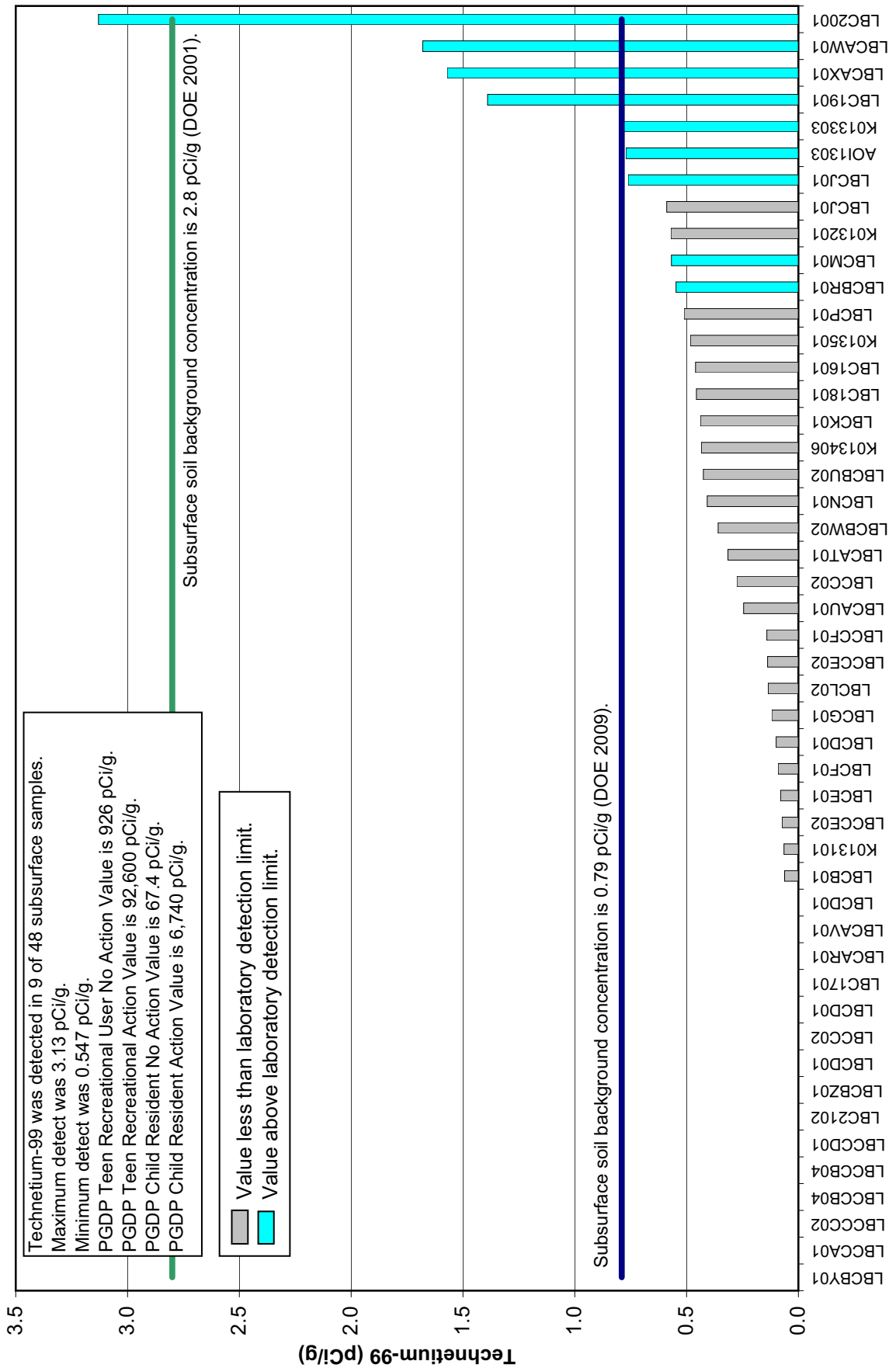

Figure D2.34. Comparison between Technetium-99 Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

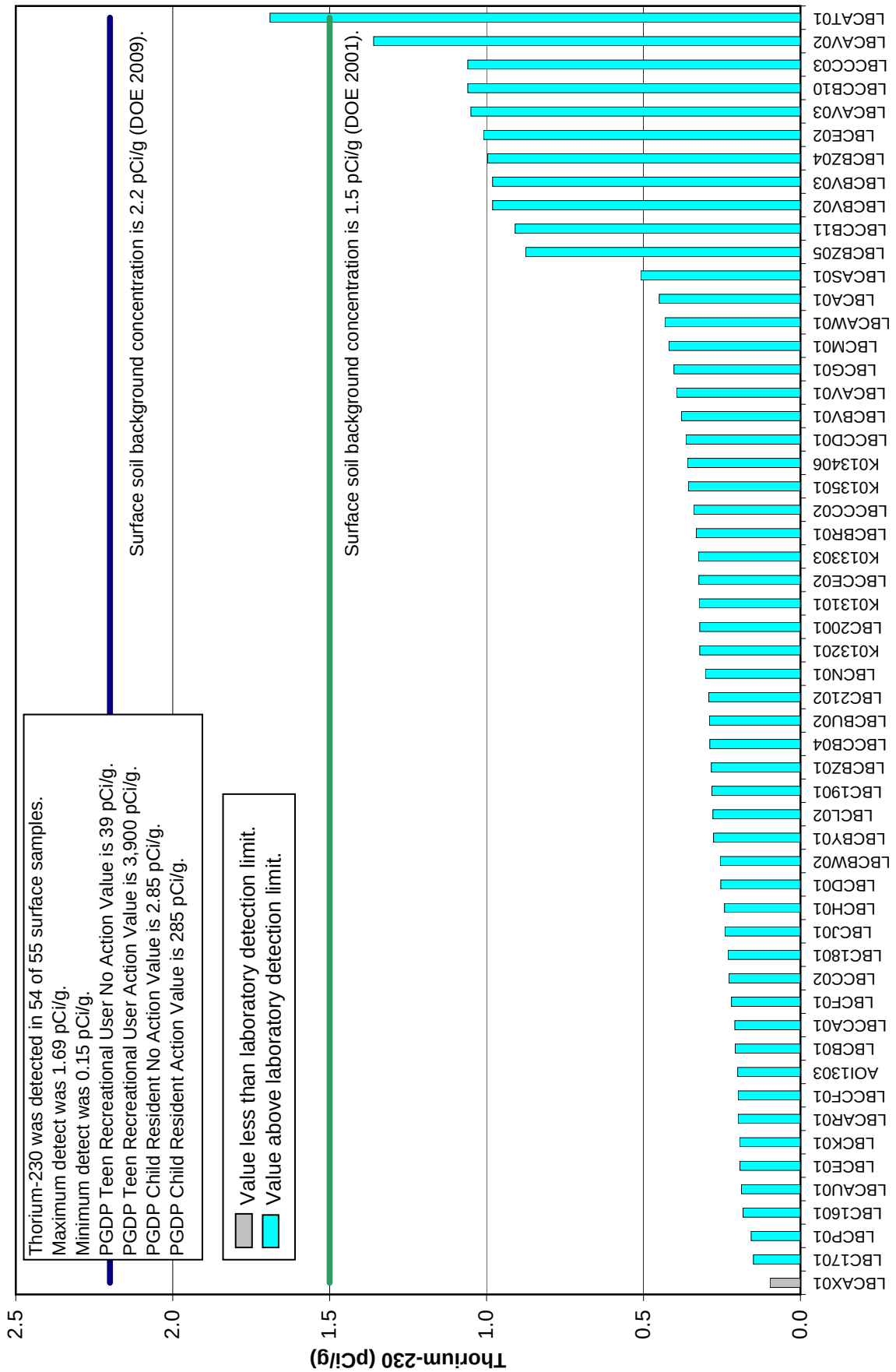

Figure D2.35. Comparison between Thorium-230 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

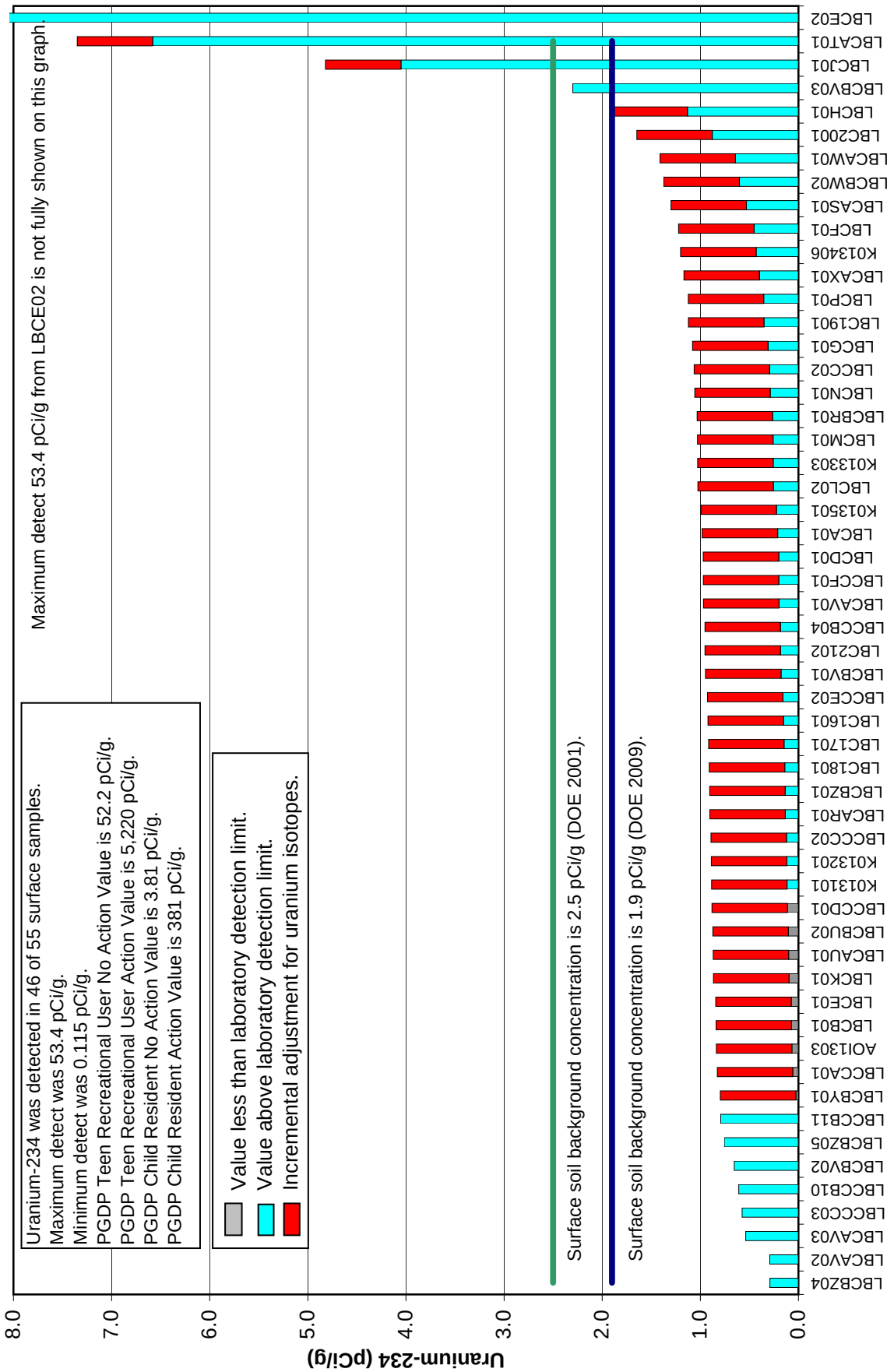

Figure D2.36. Comparison between Uranium-234 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

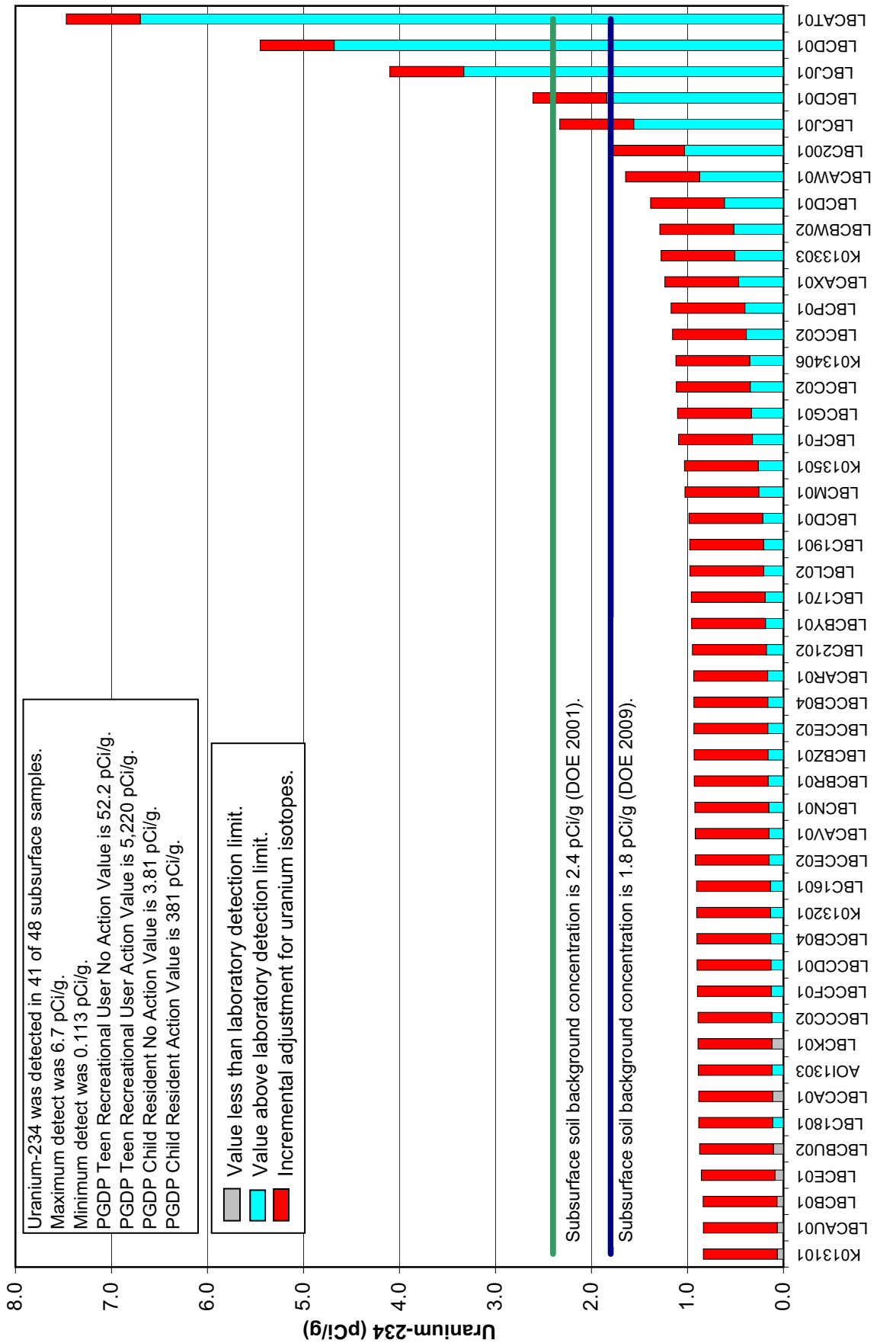

Figure D2.37. Comparison between Uranium-234 Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

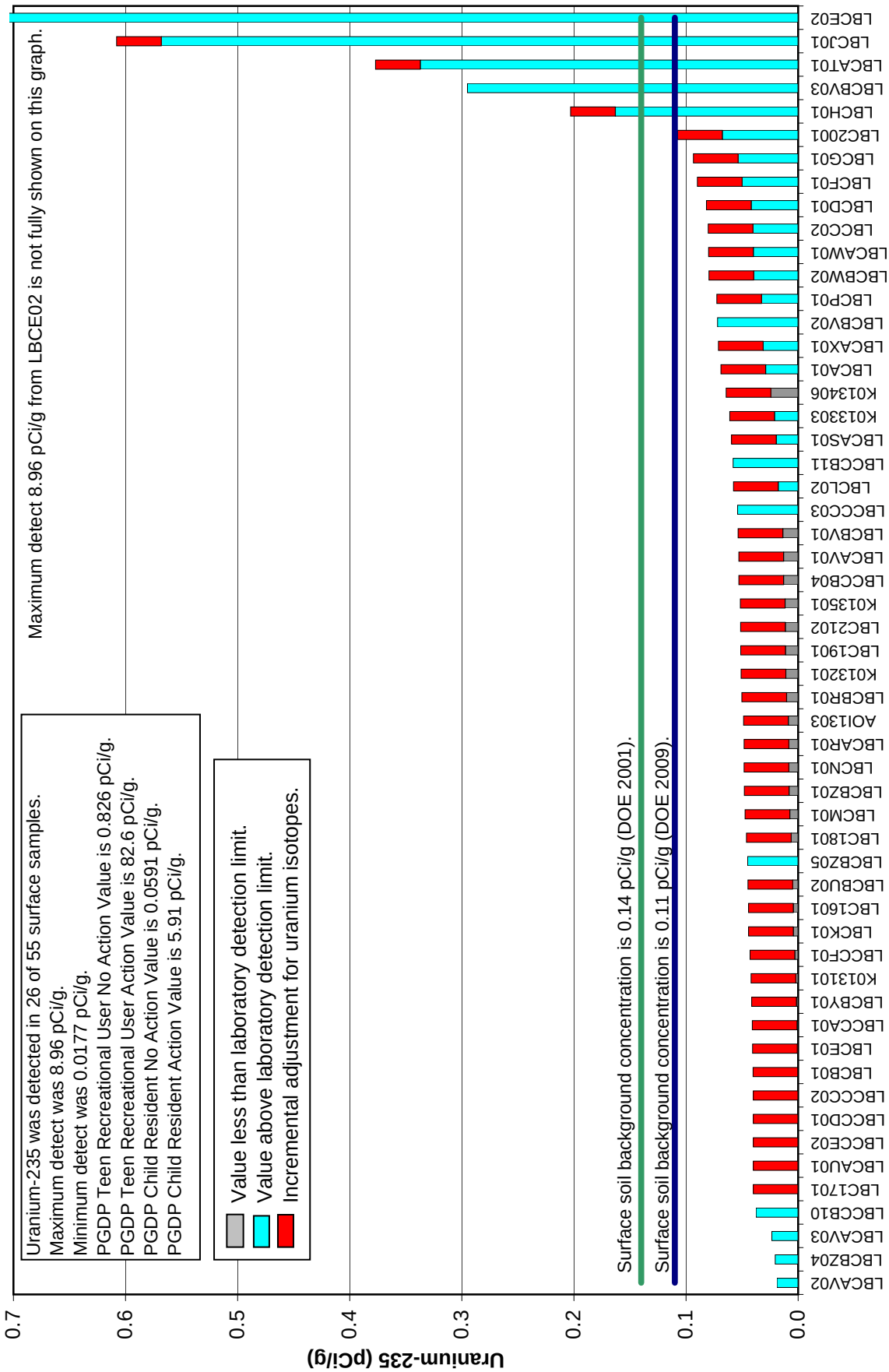

Figure D2.38. Comparison between Uranium-235 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

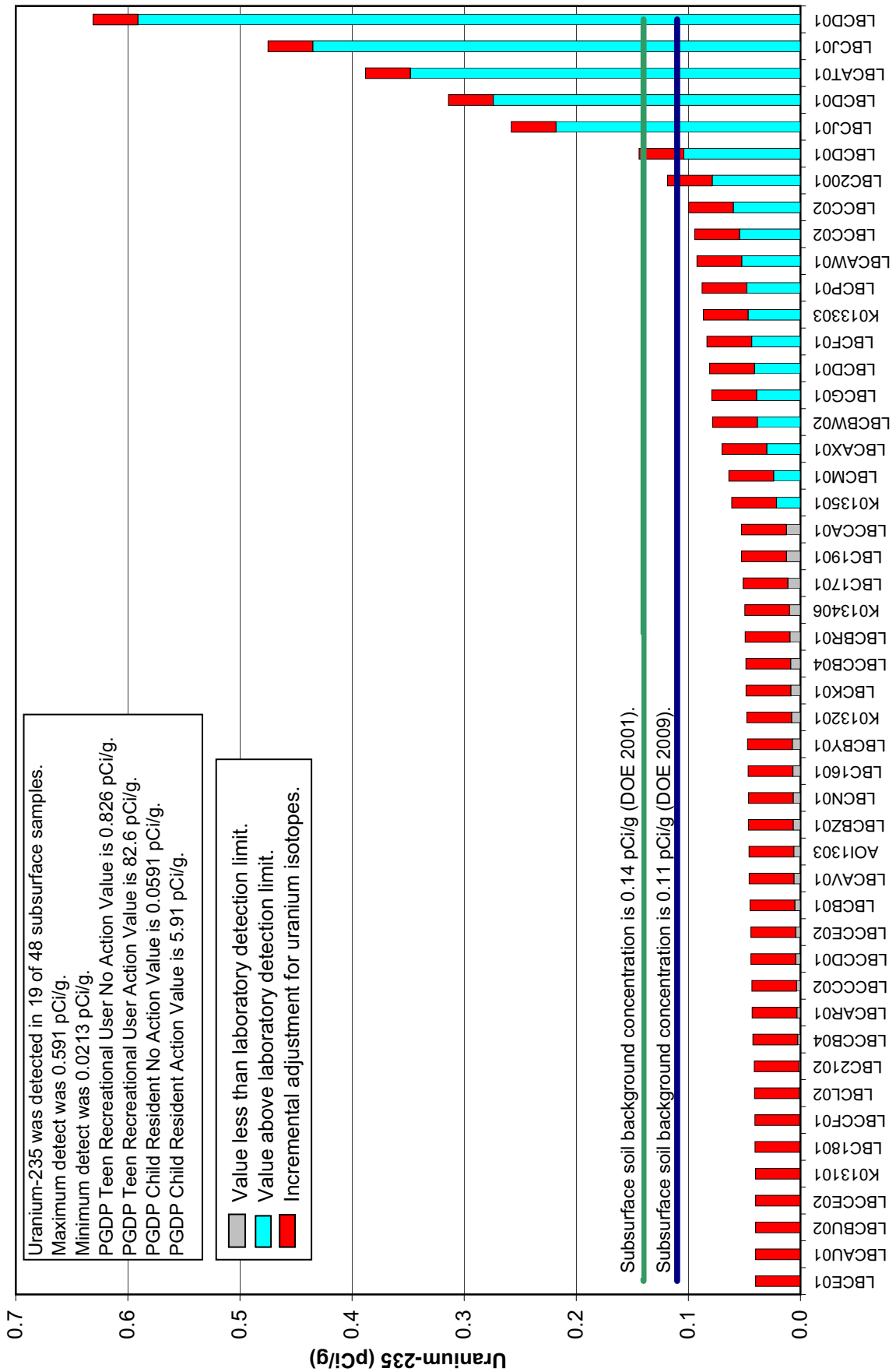

Figure D2.39. Comparison between Uranium-235 Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

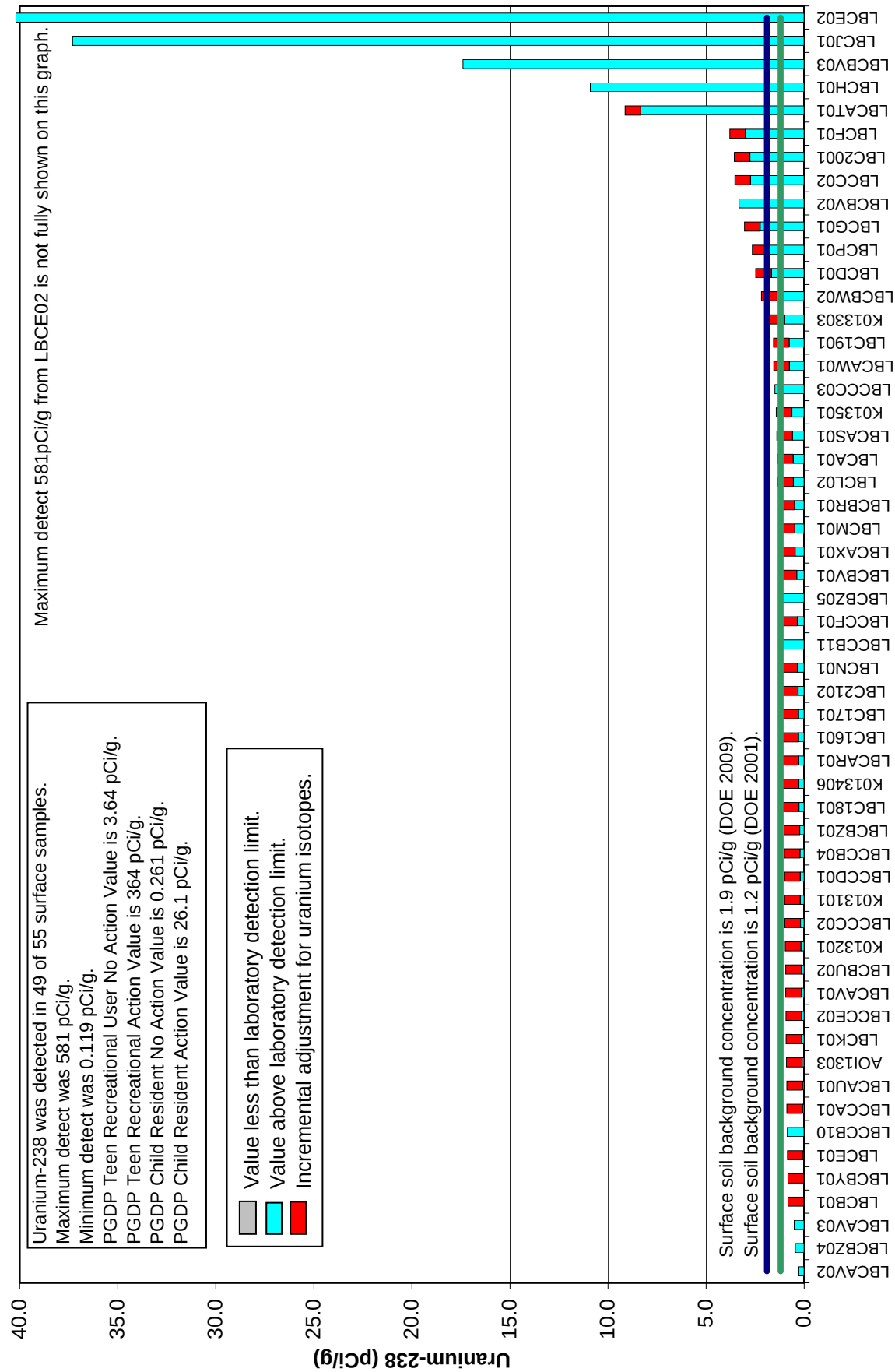

Figure D2.40. Comparison between Uranium-238 Concentrations in Samples from Soil Piles Addendum 1B and Surface Soil Background Concentrations

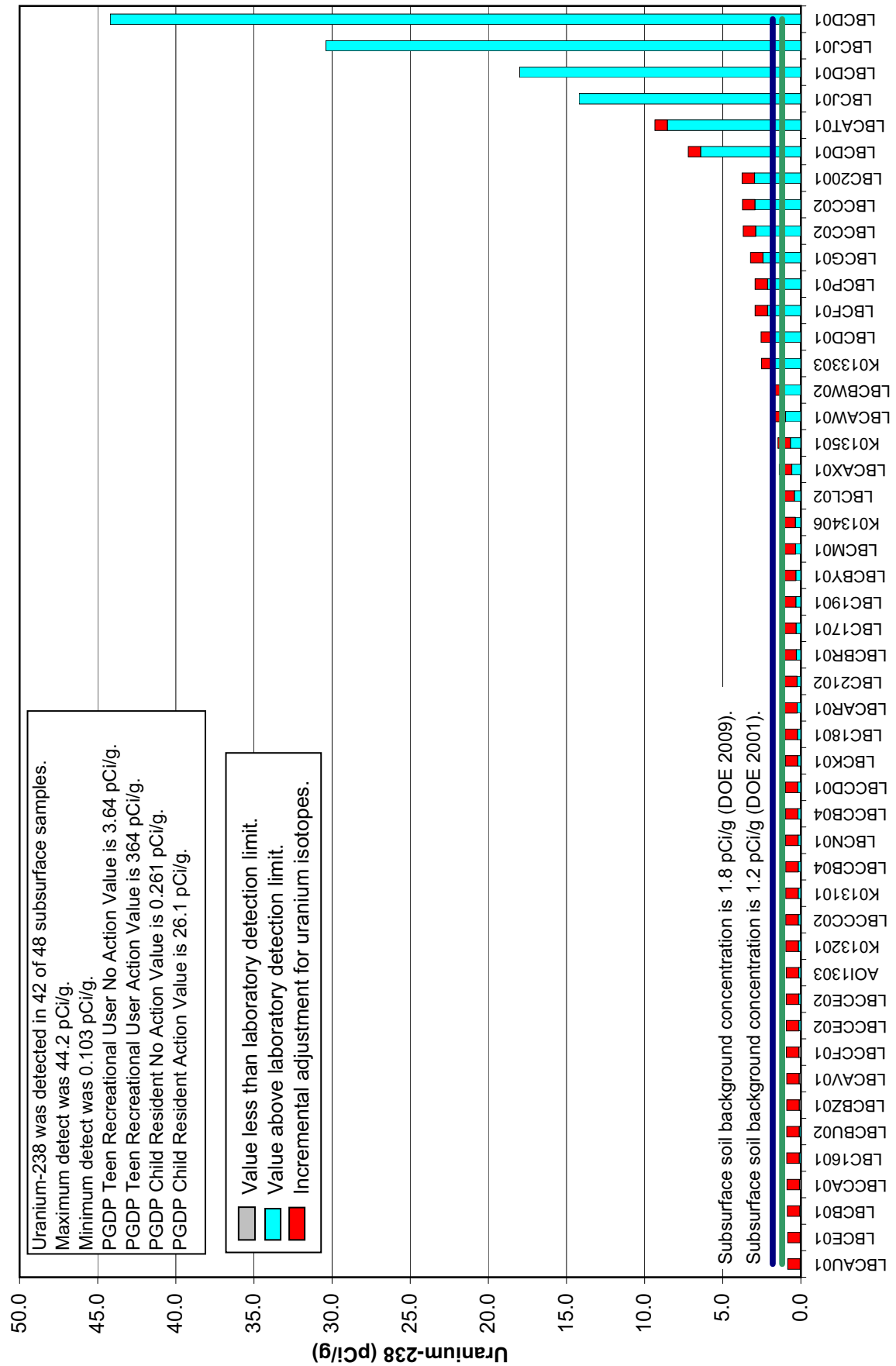

Figure D2.41. Comparison between Uranium-238 Concentrations in Samples from Soil Piles Addendum 1B and Subsurface Soil Background Concentrations

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APPENDIX E

SCREENING OF DETECTED CHEMICALS EXCEEDING BACKGROUND, SOIL PILE O WITHIN AOC 541

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SCREENING OF DETECTED CHEMICALS EXCEEDING BACKGROUND, SOIL PILE O

The summary of data collected for the Addendum 1-B Soil Pile Sampling, for those samples collected for soil pile O within Area of Concern (AOC) 541 is presented on Table E.1. This table summarizes laboratory data and shows only those analyses that exceeded background values or one of the no action level (NAL) criteria if no background value is available. All screening reported in this appendix includes data only from soil pile O within AOC 541 collected during the Soil Piles Addendum 1-B sampling effort. Historical data is not included in this appendix. A summary of screening for all AOC 541 data is included in DOE/LX/07-0246 (Appendix A).

Background Exceedances for Addendum 1-B Soil Pile Sampling, AOC 541

Nineteen chemicals exceeded Paducah Gaseous Diffusion Plant (PGDP) background values[1] during the Addendum 1-B sampling of soil pile O within AOC 541: 13 metals and 6 radionuclides. Eleven of those chemicals exceeded background in both surface and subsurface sampling. The 19 chemicals are listed in Table E.2.

[1] Background values are taken from the 2001 Risk Methods Document (DOE 2001).

Table E.1. Data Exceeding Screening Criteria, Soil Pile O within AOC 541

		Detected Results					Exceedances of No Action Levels[c]				
Analysis	Units	Minimum	Maximum	Average	Frequency of Detection[a]	Exceeds Background[b]	Site-Specific Teen Recreational User[d]	PGDP Teen Recreational User[e]	Site-Specific Wildlife Worker[d]	PGDP Child Resident[e]	Detection Limit Range
SURFACE SAMPLES											
Metals											
Aluminum	mg/kg	7.88E+03	1.64E+04	1.22E+04	24/24	9/24	0/24	24/24	0/24	24/24	17 - 199
Cadmium	mg/kg	5.02E-01	1.13E+00	7.08E-01	14/24	14/24	n/a	0/24	n/a	0/24	0.424 - 2.49
Chromium	mg/kg	1.18E+01	2.31E+02	5.89E+01	24/24	19/24	n/a	1/24	n/a	5/24	2.12 - 2.5
Copper	mg/kg	5.80E+00	3.66E+01	1.48E+01	23/24	5/24	n/a	0/24	n/a	0/24	2.12 - 12.5
Uranium	mg/kg	2.63E+00	3.60E+03	5.35E+02	24/24	22/24	7/24	20/24	12/24	24/24	0.889 - 214
Zinc	mg/kg	2.01E+01	2.48E+02	7.13E+01	24/24	7/24	n/a	0/24	n/a	0/24	17 - 20
PCBs											
PCB, Total[h]	mg/kg	3.40E-01	3.11E+01	9.53E+00	18/24	n/a	17/24	18/24	14/24	18/24	0.12 - 0.65
PCB-1248	mg/kg	1.60E-01	1.24E+01	3.59E+00	18/24	n/a	n/a	18/24	n/a	18/24	0.09 - 0.5
PCB-1254	mg/kg	1.80E-01	9.81E+00	3.16E+00	18/24	n/a	n/a	18/24	n/a	18/24	0.09 - 0.45
PCB-1260	mg/kg	1.20E-01	1.03E+01	2.72E+00	18/24	n/a	n/a	17/24	n/a	18/24	0.09 - 0.5
Radionuclides											
Cesium-137	pCi/g	8.90E-02	9.62E-01	2.24E-01	20/24	1/24	0/24	9/24	0/24	20/24	0.0545 - 0.207
Plutonium-239/240	pCi/g	1.56E-02	5.80E-02	3.51E-02	4/24	3/24	0/24	0/24	0/24	0/24	0.0124 - 0.0407
Technetium-99	pCi/g	5.95E-01	9.41E+00	2.21E+00	19/24	5/24	n/a	0/24	n/a	0/24	0.548 - 0.663
Uranium	pCi/g	4.46E+00	1.15E+03	1.96E+02	22/24	n/a	n/a	22/24	n/a	22/24	0.233 - 0.558
Uranium-234[f]	pCi/g	3.53E-01	8.47E+01	1.62E+01	23/24	17/24	0/24	2/24	0/24	15/24	0.102 - 0.211
Uranium-235[f]	pCi/g	5.26E-02	4.30E+01	4.36E+00	22/24	20/24	3/24	14/24	3/24	22/24	0.0121 - 0.0876
Uranium-238[f]	pCi/g	3.49E-01	1.02E+03	1.60E+02	24/24	23/24	16/24	22/24	15/24	24/24	0.107 - 0.288
Semivolatile Organics											
Benzo(a)anthracene	mg/kg	5.20E-01	6.40E+00	2.45E+00	4/24	n/a	0/24	4/24	0/24	4/24	0.46 - 0.5
Benzo(a)pyrene	mg/kg	5.70E-01	5.10E+00	2.04E+00	4/24	n/a	0/24	4/24	0/24	4/24	0.46 - 0.5
Benzo(b)fluoranthene	mg/kg	1.10E+00	1.10E+01	4.08E+00	4/24	n/a	0/24	4/24	0/24	4/24	0.46 - 0.97
Benzo(k)fluoranthene	mg/kg	5.30E-01	3.30E+00	1.64E+00	3/24	n/a	0/24	1/24	0/24	2/24	0.46 - 0.5
Dibenz(a,h)anthracene	mg/kg	5.20E-01	5.20E-01	5.20E-01	1/23	n/a	0/23	1/23	0/23	1/23	0.46 - 0.5
Indeno(1,2,3-cd)pyrene	mg/kg	1.20E+00	2.30E+00	1.75E+00	2/24	n/a	0/24	2/24	0/24	2/24	0.46 - 0.5
Total PAHs[g]	mg/kg	7.33E-01	7.63E+00	2.92E+00	4/24	n/a	4/24	4/24	4/24	4/24	-

Table E.1. Data Exceeding Screening Criteria, Soil Pile O within AOC 541 (Continued)

		Detected Results					Exceedances of No Action Levels[c]				
Analysis	Units	Minimum	Maximum	Average	Frequency of Detection[a]	Exceeds Background[b]	Site-Specific Teen Recreational User[d]	PGDP Teen Recreational User[e]	Site-Specific Wildlife Worker[d]	PGDP Child Resident[e]	Detection Limit Range
SUBSURFACE SAMPLES											
Metals											
Aluminum	mg/kg	8.59E+03	1.51E+04	1.27E+04	22/22	14/22	0/22	22/22	0/22	22/22	17.1 - 197
Arsenic	mg/kg	1.87E+00	2.33E+01	6.67E+00	20/22	4/22	20/22	20/22	3/22	20/22	0.853 - 4.92
Beryllium	mg/kg	4.60E-01	9.57E-01	5.76E-01	7/22	1/22	0/22	1/22	0/22	7/22	0.427 - 0.499
Cadmium	mg/kg	4.96E-01	9.90E-01	7.18E-01	14/22	14/22	n/a	0/22	0/22	0/22	0.427 - 2.46
Calcium	mg/kg	6.82E+02	5.92E+04	5.22E+03	22/22	2/22	n/a	n/a	n/a	n/a	85.3 - 877
Chromium	mg/kg	1.60E+01	1.99E+02	5.28E+01	22/22	7/22	n/a	0/22	0/22	5/22	2.13 - 2.5
Copper	mg/kg	8.34E+00	3.46E+01	1.51E+01	22/22	2/22	n/a	0/22	0/22	0/22	2.13 - 12.3
Iron	mg/kg	9.91E+03	2.87E+04	1.40E+04	22/22	1/22	0/22	22/22	0/22	22/22	17.1 - 20
Lead	mg/kg	7.05E+00	2.78E+01	1.34E+01	22/22	2/22	0/22	0/22	0/22	0/22	0.853 - 4.92
Magnesium	mg/kg	9.98E+02	2.28E+03	1.52E+03	22/22	2/22	n/a	n/a	n/a	n/a	4.27 - 4.99
Uranium	mg/kg	1.66E+01	3.43E+03	4.79E+02	22/22	22/22	6/22	22/22	12/22	22/22	0.951 - 243
Vanadium	mg/kg	1.63E+01	5.17E+01	2.64E+01	22/22	2/22	0/22	22/22	0/22	22/22	2.13 - 2.5
Zinc	mg/kg	2.36E+01	1.82E+02	6.40E+01	22/22	8/22	n/a	0/22	n/a	0/22	17.1 - 20
PCBs											
PCB, Total[h]	mg/kg	5.10E-01	3.82E+01	7.06E+00	19/22	n/a	19/22	19/22	10/22	19/22	0.13 - 1.29
PCB-1248	mg/kg	1.50E-01	2.05E+01	2.96E+00	19/22	n/a	0/22	19/22	0/22	19/22	0.1 - 1
PCB-1254	mg/kg	1.60E-01	1.12E+01	2.27E+00	19/22	n/a	0/22	19/22	0/22	19/22	0.09 - 0.9
PCB-1260	mg/kg	2.00E-01	9.59E+00	1.84E+00	19/22	n/a	0/22	19/22	0/22	19/22	0.1 - 1
Radionuclides											
Cesium-137	pCi/g	6.01E-02	5.06E-01	1.87E-01	15/22	2/22	0/22	7/22	0/22	15/22	0.0124 - 0.182
Technetium-99	pCi/g	5.98E-01	4.21E+00	1.54E+00	18/22	1/22	n/a	0/22	n/a	0/22	0.536 - 0.663
Uranium	pCi/g	6.23E+00	1.79E+03	1.90E+02	21/22	n/a	n/a	21/22	n/a	21/22	0.237 - 0.551
Uranium-234[f]	pCi/g	3.09E-01	7.96E+01	1.27E+01	22/22	16/22	0/22	1/22	0/22	16/22	0.102 - 0.21
Uranium-235[f]	pCi/g	1.06E-01	5.48E+01	4.27E+00	21/22	21/22	3/22	12/22	1/22	21/22	0.0137 - 0.0758
Uranium-238[f]	pCi/g	1.24E+00	1.66E+03	1.65E+02	22/22	22/22	16/22	21/22	15/22	22/22	0.107 - 0.287
Semivolatile Organics											
Benzo(a)anthracene	mg/kg	8.70E-01	4.40E+00	2.64E+00	2/22	n/a	0/22	2/22	0/22	2/22	0.46 - 0.5
Benzo(a)pyrene	mg/kg	7.20E-01	3.70E+00	2.21E+00	2/22	n/a	0/22	2/22	0/22	2/22	0.46 - 0.5
Benzo(b)fluoranthene	mg/kg	1.20E+00	7.10E+00	4.15E+00	2/22	n/a	0/22	2/22	0/22	2/22	0.46 - 0.5
Benzo(k)fluoranthene	mg/kg	5.00E-01	2.10E+00	1.30E+00	2/22	n/a	0/22	1/22	0/22	1/22	0.46 - 0.5
Indeno(1,2,3-cd)pyrene	mg/kg	1.60E+00	1.60E+00	1.60E+00	1/22	n/a	0/22	1/22	0/22	1/22	0.46 - 0.5
Total PAHs[g]	mg/kg	9.33E-01	5.04E+00	2.98E+00	2/22	n/a	2/22	2/22	2/22	2/22	-

Table E.1. Data Exceeding Screening Criteria, Soil Pile O within AOC 541 (Continued)

[a] Frequency of Detection was determined from the number of detected samples over the entire number of samples. Field duplicates were not counted in the total. The maximum result was used between the duplicate and original sample.
[b] Background Values from DOE 2001. Samples whose bottom depth less than or equal to 1 ft screened against surface values; those with bottom depth greater than 1 ft screened against subsurface values.
[c] Frequency of Exceedances of No Action Levels does not consider exceedances of background level.
[d] Site-Specific Teen Recreational User and Site-Specific Wildlife Worker No Action Levels from DOE 2008.
[e] PGDP Teen Recreational User and Child Resident No Action Levels from DOE 2001. Values for Total Uranium reported as a radionuclide screened against No Action Levels for Uranium-238 from DOE 2001.
f Isotopic uranium results were compared to screening values using incremental adjustments, as appropriate.
[g] Total PAHs calculated using the toxicity equivalence factors according to DOE 2001.
[h] PCB, Total minimum subsurface value is lower than the PCB-1248 minimum subsurface value because the sample containing the minimum PCB, Total value did not detect PCB-1248. Its value is from PCB-1254.
n/a = not applicable or not available.

Table E.2. Addendum 1-B Chemicals Exceeding Background [a]

Analysis	Depth	Frequency Exceeding Background[a]
Aluminum	Surface	9/24
Aluminum	Subsurface	14/22
Arsenic	Subsurface	4/22
Beryllium	Subsurface	1/22
Cadmium	Surface	14/24
Cadmium	Subsurface	14/22
Calcium	Subsurface	2/22
Chromium	Surface	19/24
Chromium	Subsurface	7/22
Copper	Surface	5/24
Copper	Subsurface	2/22
Iron	Subsurface	1/22
Lead	Subsurface	2/22
Magnesium	Subsurface	2/22
Uranium	Surface	22/24
Uranium	Subsurface	22/22
Vanadium	Subsurface	2/22
Zinc	Surface	7/24
Zinc	Subsurface	8/22
Cesium-137	Surface	1/24
Cesium-137	Subsurface	2/22
Plutonium-239/240	Surface	3/24
Technetium-99	Surface	5/24
Technetium-99	Subsurface	1/22
Uranium-234	Surface	17/24
Uranium-234	Subsurface	16/22
Uranium-235	Surface	20/24
Uranium-235	Subsurface	21/22
Uranium-238	Surface	23/24
Uranium-238	Subsurface	22/22

[a] Background values for this analysis were taken from the provisional background values provided in DOE 2001. Isotopic uranium results were compared to screening values using incremental adjustments, as appropriate. Material presented later in this section considers estimates of background concentrations from other sources.

NAL Exceedances for Addendum 1-B Soil Pile PCB and PAH Sampling, Soil Pile O within AOC 541

Total PCBs and total PAHs exceeded the default PGDP teen recreational user NAL during the Addendum 1-B sampling of soil pile O within AOC 541. [The congeners PCB-1248, PCB-1254, and PCB-1260 and the individual PAH compounds of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene also exceeded their NAL (teen recreational user scenario); however, only total PCBs and total PAHs will be considered for this screening.] The chemicals and their frequencies of exceedance are listed in Table E.3.

Table E.3. Addendum 1-B Total PCBs and Total PAHs Exceeding PGDP Teen Recreational User and Child Resident NAL[a]

Analysis	Depth	Frequency Exceeding Teen Recreational User NAL [a]	Frequency Exceeding Child Resident NAL [a]
Total PCBs	Surface	18/24	18/24
	Subsurface	19/22	19/22
Total PAHs[b]	Surface	4/24	4/24
	Subsurface	2/22	2/22

[a] NAL values for this analysis were taken from DOE 2001.
[b] Total PAHs calculated using the toxicity equivalence factors according to DOE 2001.

The locations of the Total PCB and Total PAH NAL exceedances are shown in Figures E.1 through E.4.

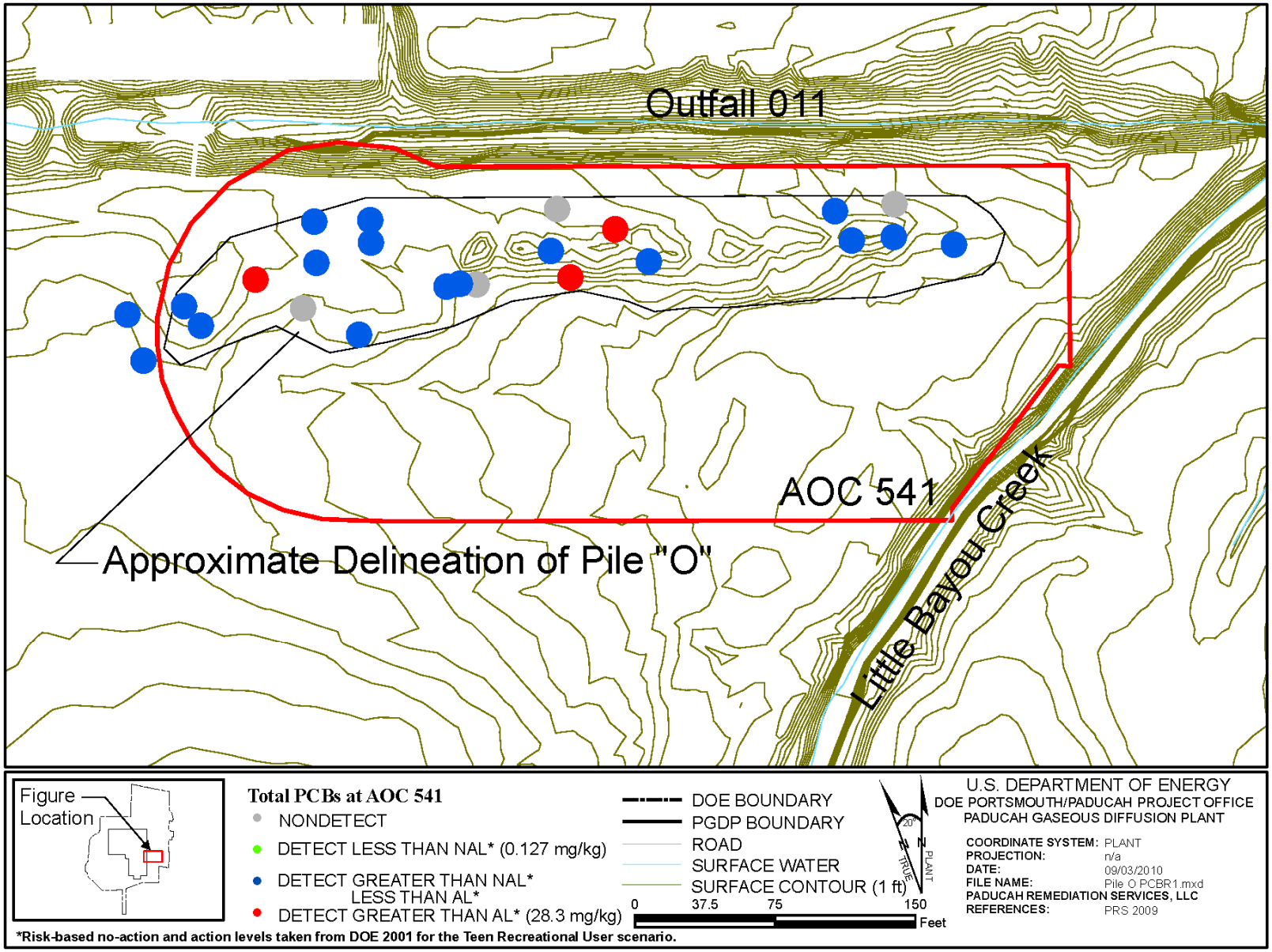

Figure E.1. Teen Recreational User NAL Exceedances for Total PCBs at Soil Pile O within AOC 541

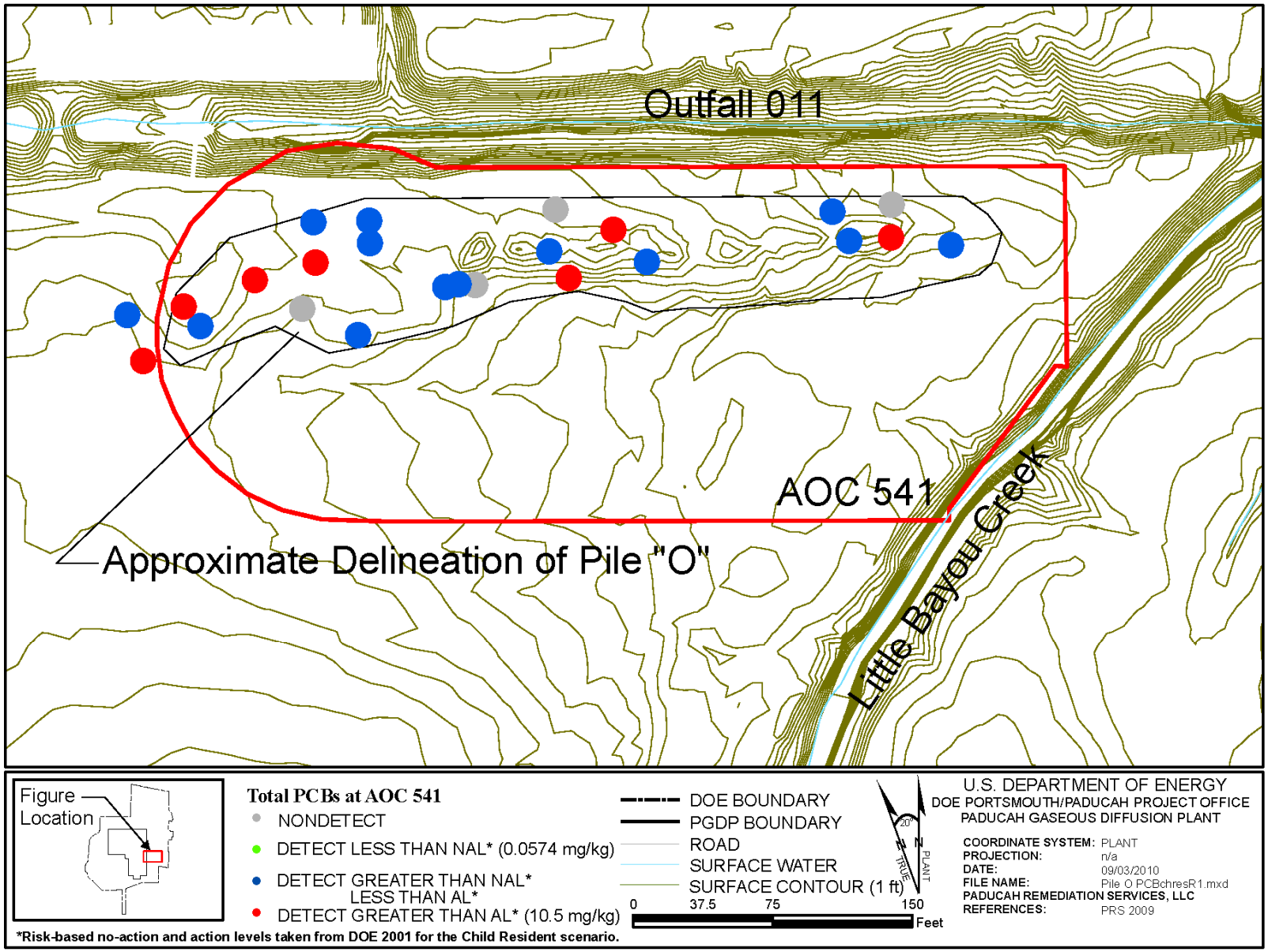

Figure E.2. Child Resident NAL Exceedances for Total PCBs at Soil Pile O within AOC 541

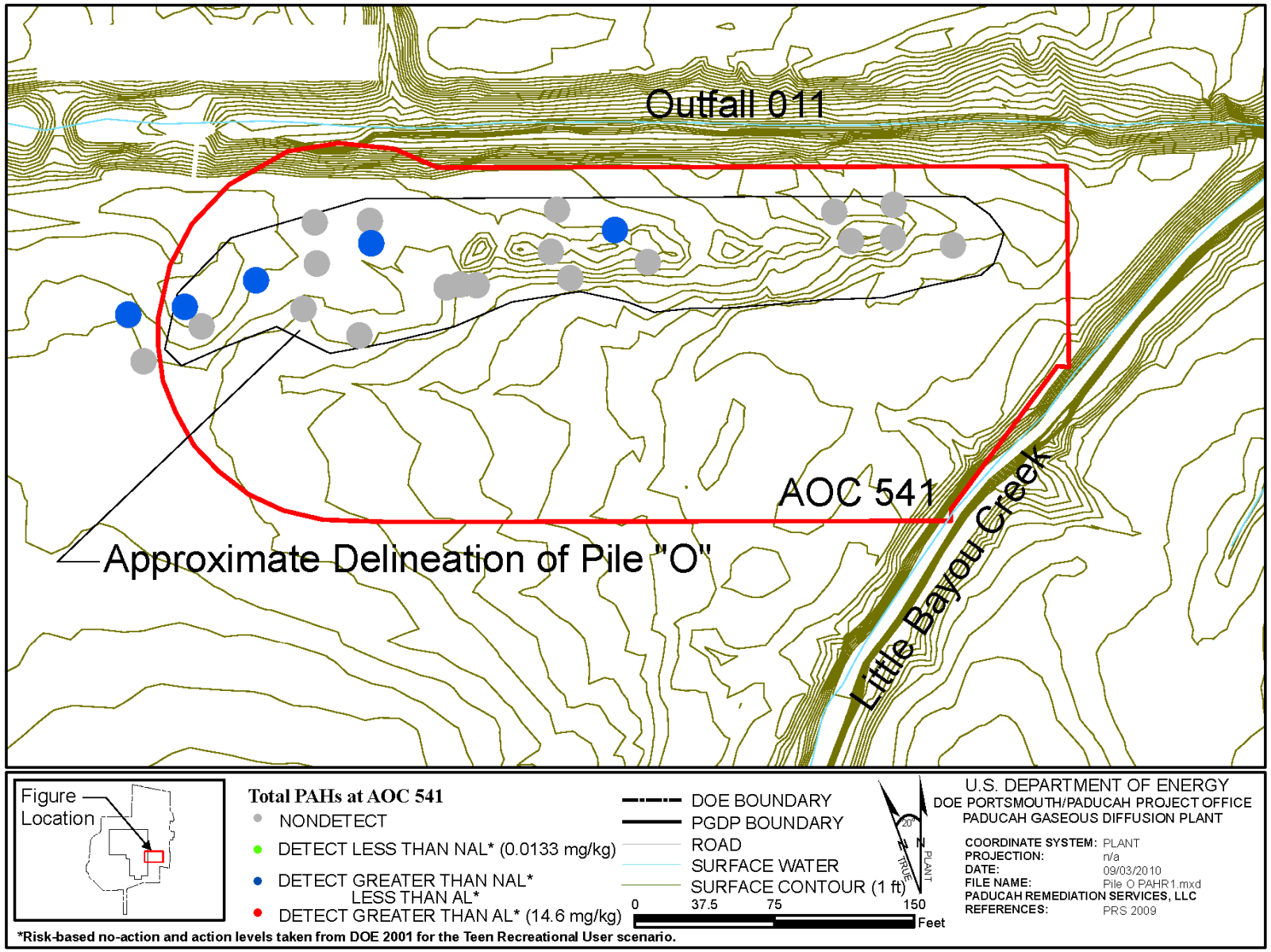

Figure E.3. Teen Recreational User NAL Exceedances for Total PAHs at Soil Pile O within AOC 541

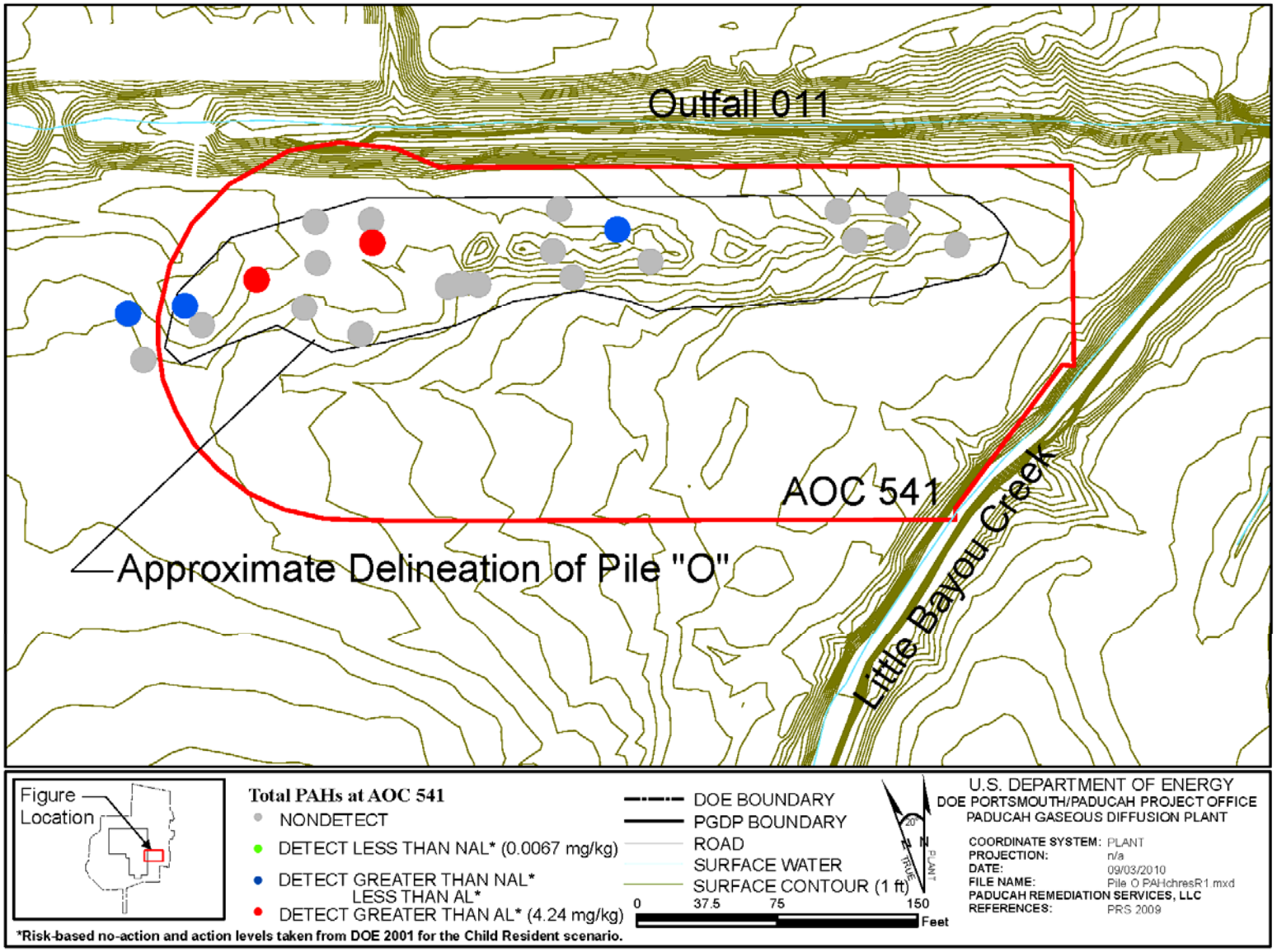

Figure E.4. Child Resident NAL Exceedances for Total PAHs at Soil Pile O within AOC 541

CHEMICALS WITHIN SOIL PILES FOR FURTHER EVALUATION

Tables E.4 and E.5 list the COPCs associated with soil pile O within AOC 541, as noted in the previous sections. All of these chemicals exceeded background values where applicable and NALs for the PGDP teen recreational user and the PGDP child resident, respectively. Those metals and radionuclides that exceeded background values but did not exceed the appropriate PGDP no action level were not evaluated further.

Table E.4. Chemicals of Potential Concern Retained for Additional Evaluation under the Teen Recreational Use Scenario

COPC	Depth	Maximum Value Detected	PGDP Teen Recreational User No Action Levels* Hazard	Cancer	Action Level*
Metals (mg/kg)					
Aluminum	Surface	1.64E+04	3.01E+03	n/a	1.00E+05
	Subsurface	1.51E+04	3.01E+03	n/a	1.00E+05
Arsenic	Subsurface	2.33E+01	5.98E+00	3.46E-01	3.14E+02
Beryllium	Subsurface	9.57E-01	6.06E-01	6.02E+04	8.84E+02
Chromium	Surface	2.31E+02	2.27E+02	1.20E+04	1.00E+05
Iron	Subsurface	2.87E+04	1.35E+03	n/a	1.00E+05
Uranium	Surface	3.60E+03	1.47E+01	n/a	6.83E+03
	Subsurface	3.43E+03	1.47E+01	n/a	6.83E+03
Vanadium	Subsurface	5.17E+01	2.12E+00	n/a	3.09E+03
Radionuclides (pCi/g)					
Cesium-137	Surface	9.62E-01	n/a	1.78E-01	1.78E+01
	Subsurface	5.06E-01	n/a	1.78E-01	1.78E+01
Uranium-234	Surface	8.47E+01	n/a	5.22E+01	5.22E+03
	Subsurface	7.96E+01	n/a	5.22E+01	5.22E+03
Uranium-235	Surface	4.30E+01	n/a	8.26E-01	8.26E+01
	Subsurface	5.48E+01	n/a	8.26E-01	8.26E+01
Uranium-238	Surface	1.02E+03	n/a	3.64E+00	3.64E+02
	Subsurface	1.66E+03	n/a	3.64E+00	3.64E+02
Total PCBs (mg/kg)					
	Surface	3.11E+01	n/a	1.27E-01	2.83E+01
	Subsurface	3.82E+01	n/a	1.27E-01	2.83E+01
Total PAHs (mg/kg)					
	Surface	7.63E+00	n/a	1.33E-02	1.46E+01
	Subsurface	5.04E+00	n/a	1.33E-02	1.46E+01

n/a = value not available

* No Action Levels and Action Levels are taken from the 2001 Risk Methods Document, Tables A.17 and A.14, respectively (DOE 2001).

Uranium-238 and total PCBs exceed action levels for the PGDP teen recreational user.

Table E.5. Chemicals of Potential Concern Retained for Additional Evaluation under the Child Resident Scenario

COPC	Depth	Maximum Value Detected	PGDP Child Resident No Action Levels* Hazard	No Action Levels* Cancer	Action Level*
Metals (mg/kg)					
Aluminum	Surface	1.64E+04	7.32E+02	n/a	1.00E+05
	Subsurface	1.51E+04	7.32E+02	n/a	1.00E+05
Arsenic	Subsurface	2.33E+01	9.59E-01	1.32E-01	3.50E+01
Beryllium	Subsurface	9.57E-01	1.60E-01	1.55E+04	1.58E+02
Chromium	Surface	2.31E+02	6.05E+01	3.10E+03	7.19E+04
	Subsurface	1.99E+02	6.05E+01	3.10E+03	7.19E+04
Iron	Subsurface	2.87E+04	3.14E+02	n/a	6.05E+04
Uranium	Surface	3.60E+03	2.16E+00	n/a	1.33E+02
	Subsurface	3.43E+03	2.16E+00	n/a	1.33E+02
Vanadium	Subsurface	5.17E+01	5.62E-01	n/a	5.54E+02
Radionuclides (pCi/g)					
Cesium-137	Surface	9.62E-01	n/a	1.28E-02	1.28E+00
	Subsurface	5.06E-01	n/a	1.28E-02	1.28E+00
Uranium-234	Surface	8.47E+01	n/a	3.81E+00	3.81E+02
	Subsurface	7.96E+01	n/a	3.81E+00	3.81E+02
Uranium-235	Surface	4.30E+01	n/a	5.91E-02	5.91E+00
	Subsurface	5.48E+01	n/a	5.91E-02	5.91E+00
Uranium-238	Surface	1.02E+03	n/a	2.61E-01	2.61E+01
	Subsurface	1.66E+03	n/a	2.61E-01	2.61E+01
Total PCBs (mg/kg)					
	Surface	3.11E+01	n/a	5.74E-02	1.05E+01
	Subsurface	3.82E+01	n/a	5.74E-02	1.05E+01
Total PAHs (mg/kg)					
	Surface	7.63E+00	n/a	6.70E-03	4.24E+00
	Subsurface	5.04E+00	n/a	6.70E-03	4.24E+00

n/a = value not available

* No Action Levels and Action Levels are taken from the 2001 Risk Methods Document, Tables A.17 and A.14, respectively (DOE 2001).

Uranium metal, uranium-235, uranium-238, total PCBs, and total PAHs exceed action levels for the PGDP child resident.

DERIVATION OF RISK ESTIMATES FOR COPCs

For each COPC, the exposure concentration was the maximum detected concentration. Exposure concentrations were compared to risk-based concentrations to determine an estimate of risk for the teen recreational user scenario (direct contact with soil and sediment for 140 days per year) and the child resident scenario (direct contact with soil and sediment for 350 days per year). These risk-based concentrations were taken from Table A.17 in DOE 2001.

The equation used to derive the risk estimate for each COPC (i.e., chemical-specific cancer risk or hazard) is as follows:

$$\textbf{Risk} = \frac{\textbf{Exposure Concentration}}{\textbf{Screening Value}} \times \textbf{Target Risk Value}$$

where:
Risk = calculated chemical-specific cancer risk or hazard value.
Exposure Concentration = Maximum concentration taken from Tables E.4 and E.5.
Screening Value = Cancer and Hazard concentrations taken from Tables E.4 and E.5.
Target Risk Value = Cancer risk (1×10^{-6}) or hazard (0.1) upon which the screening value is based.

Results of the application of this equation are presented in Tables E.6 and E.8. The cumulative hazard and cancer risk for soil pile O within AOC 541 for the PGDP teen recreational user and the PGDP child resident are listed in Tables E.7 and E.9, respectively. Table E.10 presents additional screening criteria for the soil piles and Tables E.11 through E.12 presents application of the above equation and cumulative hazard and cancer risks for the site-specific teen recreational user.

UNCERTAINTIES IN DERIVATION OF RISK ESTIMATES FOR COPCs

Several uncertainties should be taken into account when considering the risk estimates for COPCs at soil pile O within AOC 541. These uncertainties include the fact that the default PGDP scenarios were used for calculations, not values that were derived specifically for the soil piles.

Additionally, the laboratory-reported results for uranium isotopes near background values may be low based on the laboratory's extraction method. Due to this method, an incremental adjustment is necessary prior to comparison of the data to screening values. To simplify the comparison, the adjustment was made to the data results and not the screening values themselves. The incremental adjustments (0.77 pCi/g, 0.04 pCi/g, and 0.8 pCi/g for uranium-234, uranium-235, and uranium-238, respectively) were applied to results less than 10 pCi/g within the dataset. Screening is conducted upon detected values only; thus, the incremental adjustment did not affect results qualified by the laboratory as not detected.

The variance of the incremental adjustment due to the magnitude of the uranium isotope concentration is uncertain, but likely the comparison of the adjusted data to screening values is biased toward identifying a potential health effect at the risk and hazard targets used to derive the NALs, when a health effect may not occur. These incremental adjustments were applied to screening only. In determining a risk estimate, incremental adjustments were not applied.

Further, only risk and hazard contributed by chemicals considered COPCs and only results from the current sampling (not historical data) were included in the calculation.

RESULTS OF DERIVATION OF RISK ESTIMATES FOR COPCs

These estimates indicate uranium metal, uranium-238, total PCBs, and total PAHs in soil provide unacceptable hazards and cancer risks to the PGDP teen recreator at soil pile O within AOC 541 under the default scenario.

Additionally, unacceptable hazards and/or cancer risks would be posed to a resident from arsenic, iron, and vanadium in subsurface soil and unacceptable hazards and/or cancer risks from uranium (metal), uranium-235, uranium-238, total PCBs, and total PAHs in both surface and subsurface soil at soil pile O within AOC 541.

Table E.6. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Teen Recreational User by COPCs Found in Soil Pile O within AOC 541

COPC	Depth	Hazard	Cancer
Metals (mg/kg)			
Aluminum	Surface	0.54	
	Subsurface	0.50	
Arsenic	Subsurface	0.39	**6.73E-05**
Beryllium	Subsurface	0.16	1.59E-11
Chromium	Surface	0.10	1.93E-08
Iron	Subsurface	**2.13**	
Uranium	Surface	***24.49***	
	Subsurface	***23.33***	
Vanadium	Subsurface	**2.44**	
Radionuclides (pCi/g)			
Cesium-137	Surface		**5.40E-06**
	Subsurface		**2.84E-06**
Uranium-234	Surface		**1.62E-06**
	Subsurface		**1.52E-06**
Uranium-235	Surface		**5.21E-05**
	Subsurface		**6.63E-05**
Uranium-238	Surface		***2.80E-04***
	Subsurface		***4.56E-04***
Total PCBs (mg/kg)			
	Surface		***2.45E-04***
	Subsurface		***3.01E-04***
Total PAHs (mg/kg)			
	Surface		***5.74E-04***
	Subsurface		***3.79E-04***

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table E.7. Cumulative Hazard and Cancer Risk Posed to the PGDP Teen Recreational User by COPCs Found in Soil Pile O within AOC 541

Depth	Hazard	Cancer
Surface	***25.14***	***1.16E-03***
Subsurface	***28.95***	***1.27E-03***

n/a = value not available
Cancer risk above 1E-6 and hazards above 1 shown in bold.
Cancer risk above 1E-4 and hazards above 3 shown in bold italics.

Table E.8. Chemical-Specific Hazards and Cancer Risk Posed to the PGDP Child Resident by COPCs Found in Soil Pile O within AOC 541

COPC	Depth	Hazard	Cancer
Metals (mg/kg)			
Aluminum	Surface	**2.24**	
	Subsurface	**2.06**	
Arsenic	Subsurface	**2.43**	***1.77E-04***
Beryllium	Subsurface	0.60	6.17E-11
Chromium	Surface	0.38	7.45E-08
	Subsurface	0.33	
Iron	Subsurface	***9.14***	
Uranium	Surface	***166.67***	
	Subsurface	***158.80***	
Vanadium	Subsurface	***9.20***	
Radionuclides (pCi/g)			
Cesium-137	Surface		**7.52E-05**
	Subsurface		**3.95E-05**
Uranium-234	Surface		**2.22E-05**
	Subsurface		**2.09E-05**
Uranium-235	Surface		***7.28E-04***
	Subsurface		***9.27E-04***
Uranium-238	Surface		***3.91E-03***
	Subsurface		***6.36E-03***
Total PCBs (mg/kg)			
	Surface		***5.42E-04***
	Subsurface		***6.66E-04***
Total PAHs (mg/kg)			
	Surface		***1.14E-03***
	Subsurface		***7.52E-04***

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table E.9. Cumulative Hazard and Cancer Risk Posed to the PGDP Child Resident by COPCs Found in Soil Pile O within AOC 541

Depth	Hazard	Cancer
Surface	***169.29***	***6.41E-03***
Subsurface	***182.56***	***8.94E-03***

n/a = value not available
Cancer risk above 1E-6 and hazards above 1 shown in bold.
Cancer risk above 1E-4 and hazards above 3 shown in bold italics.

Table E.10. Additional Screening Criteria for COPCs Found in Soil Pile O within AOC 541

COPC	Site-Specific Teen Recreation User[b] No Action Levels	
	Hazard	**Cancer**
Metals (mg/kg)		
Aluminum	1.00E+05	n/a
Arsenic	1.38E+01	1.79E+00
Beryllium	6.79E+01	4.66E+05
Chromium	n/a	n/a
Iron	1.00E+05	n/a
Uranium	5.29E+02	n/a
Vanadium	4.04E+03	n/a
Radionuclides (pCi/g)		
Cesium-137	n/a	1.19E+00
Uranium-234	n/a	4.07E+02
Uranium-235	n/a	5.53E+00
Uranium-238	n/a	2.46E+01
Total PCBs (mg/kg)		
	4.36E-01	6.36E-01
Total PAHs (mg/kg)		
	n/a	6.60E-02

n/a = value not available

[a]PGDP Resident No Action Levels are taken from the 2001 Risk Methods Document, Table A.17, as the child resident (DOE 2001).

[b]Site-Specific Teen Recreational User No Action Levels are taken from the Site Evaluation Report for Soil Pile I (DOE 2008).

Table E.11. Chemical-Specific Hazards and Cancer Risk Posed to the Site-Specific Teen Recreational User by COPCs Found in Soil Pile O within AOC 541

COPC	Depth	Hazard	Cancer
Metals (mg/kg)			
Aluminum	Surface	0.02	
	Subsurface	0.02	
Arsenic	Subsurface	0.17	**1.30E-05**
Beryllium	Subsurface	0.00	2.05E-12
Iron	Subsurface	0.03	
Uranium	Surface	0.68	
	Subsurface	0.65	
Vanadium	Subsurface	0.00	
Radionuclides (pCi/g)			
Cesium-137	Surface		8.08E-07
	Subsurface		4.25E-07
Uranium-234	Surface		2.08E-07
	Subsurface		1.96E-07
Uranium-235	Surface		**7.78E-06**
	Subsurface		**9.91E-06**
Uranium-238	Surface		**4.15E-05**
	Subsurface		**6.75E-05**
Total PCBs (mg/kg)			
	Surface	***7.13***	**4.89E-05**
	Subsurface	***8.76***	**6.01E-05**
Total PAHs (mg/kg)			
	Surface		***1.16E-04***
	Subsurface		**7.63E-05**

n/a = value not available
Cancer risks above 1E-6 and hazards above 1 shown in bold.
Cancer risks above 1E-4 and hazards above 3 shown in bold italics.

Table E.12. Cumulative Hazard and Cancer Risk Posed to the Site-Specific Teen Recreational User by COPCs Found in Soil Pile O within AOC 541

Depth	Hazard	Cancer
Surface	***7.8***	***2.15E-04***
Subsurface	***9.6***	***2.27E-04***

n/a = value not available
Cancer risk above 1E-6 and hazards above 1 shown in bold.
Cancer risk above 1E-4 and hazards above 3 shown in bold italics.

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