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ADMIN RECORD

APPENDIX K TO THE PHASE I RFI/RI WORK PLAN FOR OPERABLE UNIT 6

HUMAN HEALTH RISK ASSESSMENT TECHNICAL MEMORANDUM NO. 4 CHEMICALS OF CONCERN

FINAL

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

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LIST OF ACRONYMS

BNACLP	Base-Neutral Acid (for semi-volatiles) - Contract Laboratory Program
BRA	baseline risk assessment
CDPHE	Colorado Department of Public Health and Environment
COC	Chemical of Concern
COCTM	Chemical of Concern Technical Memorandum
CRQL	Contract required quantitation limit
DOE	U.S. Department of Energy
ECAO	Environmental Criteria and Assessment Office (U.S. EPA)
EPA	U.S. Environmental Protection Agency
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
IDL	instrument detection limit
IHSS	Individual Hazardous Substance Site
IRIS	Integrated Risk Information System
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
mg/L	milligram per liter
OU1	Operable Unit 1
OU2	Operable Unit 2
OU6	Operable Unit 6
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential chemical of concern
PERC	tetrachloroethene
PESTCLP	Pesticide Analysis - Contract Laboratory Program
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RFEDS	Rocky Flats Environmental Database System
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
SF	slope factor
SVOC	semivolatile organic compound
TCE	trichloroethene
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids

UHSU	Upper Hydrostratigraphic Unit
UTL	upper tolerance limit
VOACLP	Volatile Organic Analysis- Contract Laboratory Program
VOC	volatile organic compound
WQPL	Water Quality Parameter List

EXECUTIVE SUMMARY

This Technical Memorandum No. 4, Chemicals of Concern, is presented in support of the Baseline Risk Assessment for the Walnut Creek Priority Drainage, Operable Unit No. 6 (OU6), located at the Department of Energy Rocky Flats Environmental Technology Site (formerly Rocky Flats Plant [RFP]) in Golden, Colorado.

The technical memorandum identifies chemicals of concern (COCs) that will be included in the Human Health Risk Assessment (HHRA) to assess potential health risk from assumed exposure to the chief contaminants detected in soil, groundwater, and other media sampled in OU6. COCs are organic chemicals that are not naturally occurring and that could pose a health threat under the assumed exposure conditions and metals and radionuclides that exceed background levels, are not naturally occurring, and that could pose a health threat under the assumed exposure conditions. They are selected from all analytes detected in each medium using risk-based and other screening methods that identify chemicals that would pose the greatest risk and therefore warrant inclusion in the HHRA. COCs also provide the focus for transport modeling and remedy selection.

COCs were selected for the following media: surface soil, subsurface soil, groundwater, pond sediment, pond surface water, and stream sediment. COCs in each media were selected on an OU-wide basis; that is, data collected at Individual Hazardous Substance Sites (IHSSs) were pooled for each medium so that the chief contributors to risk could be identified for the entire OU.

The following steps were used to identify COCs:

- Metals and radionuclides above background levels were identified as potential chemicals of concern (PCOCs) and retained for further evaluation.

- The essential nutrients calcium, iron, potassium, magnesium, and sodium were eliminated from further evaluation.

- Chemicals above background levels and detected at 5 percent or greater frequency were included in concentration/toxicity screens to identify the chief

contributors to potential risk. Those chemicals that were the chief contributors to potential risk were retained as COCs for the HHRA.

- Professional judgement, such as geochemical evaluation or statistical analysis, was applied to eliminate some analytes as PCOCs.

- Chemicals detected at less than 5 percent frequency were not included in the selection of OU-wide COCs but were evaluated in a separate risk-based screen to identify special-case COCs that warrant separate evaluation in the HHRA.

Table ES-1 summarizes the COCs identified for each medium in OU6.

TABLE ES-1
OU6 SUMMARY OF CHEMICALS OF CONCERN

	Surface Soil	Subsurface Soil	Groundwater	Pond Sediment	Pond Surface Water	Stream Sediment
Chemical of Concern						
Aroclor-1254				X		
Benzo(a)anthracene						X
Benzo(a)pyrene		X		X		X
Benzo(b)fluoranthene		X		X		X
Bis(2-ethylhexyl)phthalate				X		
Di-n-butylphthalate					X	
Indeno(1,2,3-cd)pyrene						X
Chloroform			X		X	
1,2-Dichloroethene					X	
Methylene chloride			X			
Tetrachloroethene			X			
Trichloroethene			X		X	
Antimony	X			X		
Barium		X				
Cobalt						X
Silver	X			X		
Strontium						X
Vanadium	X			X		X
Zinc	X					X
Nitrate			X			
Americium-241	X	X	X	X		X
Plutonium-239/240	X	X	X	X		X
Uranium-233/234		X				
Uranium-238		X				
Radium-226			X			
Special - Case Chemicals [1]						
Vinyl chloride			X			

[1] Detected at less than 5 percent frequency, but at relatively high concentrations

1.0 INTRODUCTION

This Chemicals of Concern Technical Memorandum is presented in support of the Baseline Risk Assessment (BRA) for the Walnut Creek Priority Drainage, Operable Unit 6 (OU6), located at Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. The BRA, which consists of the Human Health Risk Assessment (HHRA) and the Environmental Evaluation, will be included in the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) report for OU6. The RFI/RI is being conducted pursuant to the U.S. Department of Energy (DOE) Environmental Restoration Program; a Compliance Agreement among DOE, the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE); and the Federal Facility Agreement and Consent Order (Interagency Agreement), signed in 1991.

This technical memorandum has been developed to select chemicals of concern (COCs) to be evaluated in the HHRA. The HHRA will evaluate potential human health risks for onsite receptors under current land use and potential future land use conditions, assuming no remedial action takes place at OU6. COCs are organic chemicals that are environmental contaminants and that could be a significant threat to human health under the exposure conditions evaluated, and metals and radionuclides that exceed background levels, are environmental contaminants, and that could be a significant threat to human health under the exposure conditions evaluated. COCs are identified on an OU-wide basis for each medium (e.g., groundwater, soil) through which exposure to contaminants could occur. The identification of COCs will also help focus the efforts of environmental transport modeling, description of the nature and extent of contamination, and remedy selection.

COCs were selected for surface soil, subsurface soil, groundwater, pond surface water, pond sediment, and stream sediment. These media were sampled during the Phase I RFI/RI in accordance with the Phase I RFI/RI Work Plan for Operable Unit 6 (DOE 1992a). COCs were identified on an OU-wide basis, by pooling sample analytical results from the various sampling locations for each medium. OU6 consists of 20 Individual Hazardous Substance Sites (IHSSs), whose locations are shown in Figure 1-1. The IHSSs or IHSS groups and the environmental media sampled at each are listed below. IHSS groups contain several individual sites; for example, IHSS 142 consists of 10 ponds in the Walnut Creek drainage, numbered 142.1 through 142.9 and 142.12.

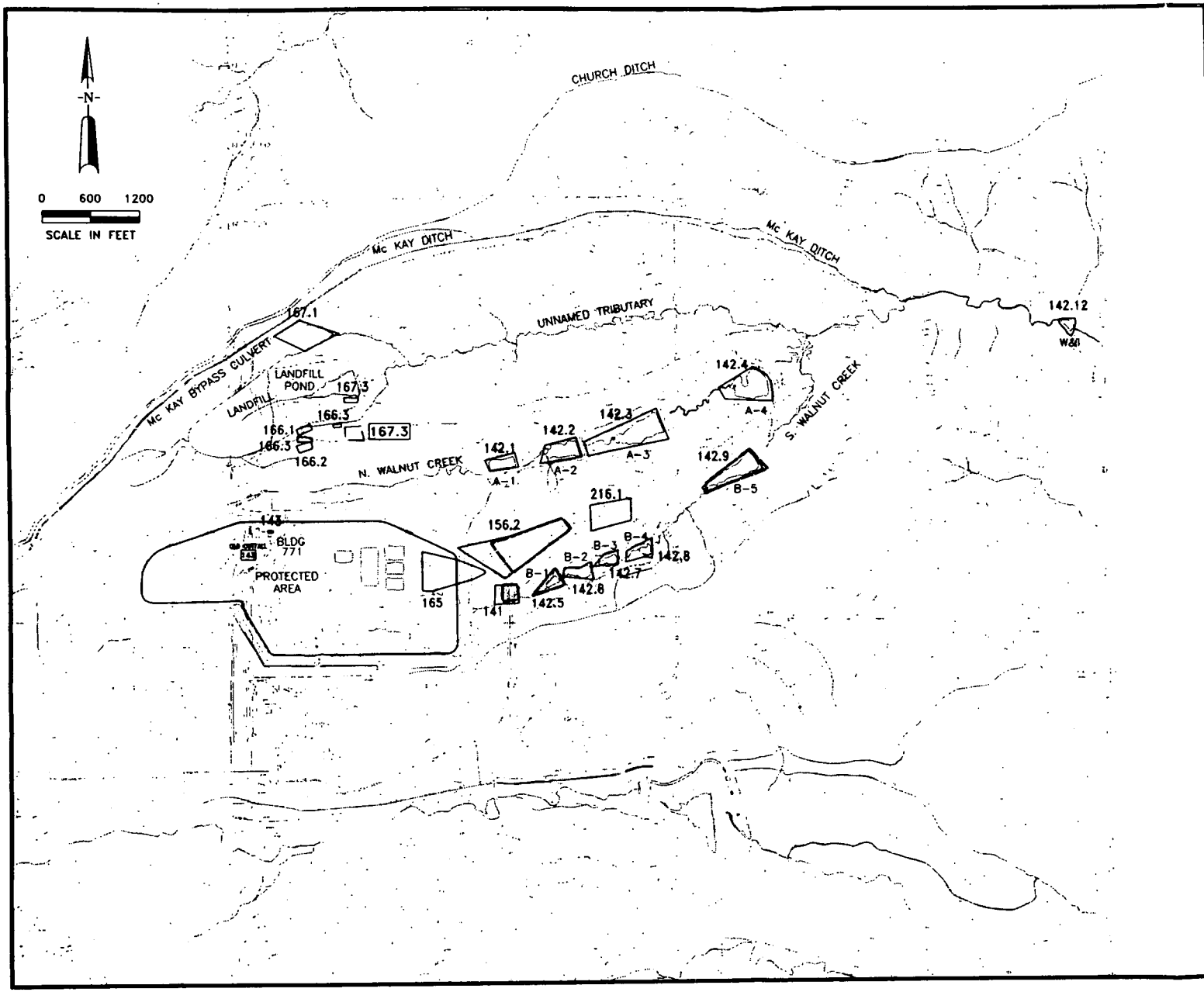
IHSS or IHSS Group	Name	Surface Soil	Subsurface Soil	Ground-water	Surface Water	Pond Sediment	Stream Sediment
141	Sludge Dispersal Area	X		X			
142	Ponds			X	X	X	
143	Old Outfall	X	X	X			
156	Soil Dump Area	X	X	X			
165	Triangle Area	X	X	X			
166	Trenches A,B,C		X	X			
167	Spray Fields	X	X	X			
216	East Spray Field	X	X	X			
--	Streams						X

This technical memorandum is divided into the following sections. Section 2.0 describes the general process used to select COCs. Sections 3.0 through 8.0 present decision criteria specific to each medium and identify the COCs selected for each medium. References are listed in Section 9.0.

Attachment A, "Background Comparison for Metals and Radionuclides," summarizes the statistical methodology used to compare OU6 data to background data and includes tables and figures showing the results of the statistical tests. Statistical tests were used to identify metals and radionuclides whose concentrations exceed background levels and which may be environmental contaminants. These metals and radionuclides were retained for further evaluation as potential chemicals of concern (PCOCs).

Attachment B, "Risk-Based Evaluation of Infrequently Detected Chemicals," presents the screening of infrequently detected compounds (<5 percent detection frequency) to identify those that merit further evaluation as special-case COCs on the basis of an extremely high concentration in a small area of localized contamination.

Attachment C, "Total Suspended and Dissolved Solids in Groundwater," is included to support the discussion of COCs in Section 5.0.



EXPLANATION

PONDS/LAKES

142.12 OU6 IHSS'S

PROTECTED AREA BOUNDARY

167.3 OU6 HISTORICAL IHSS BOUNDARY FOR IHSSs: 141,142.5, 142.9, 143, 156.2, AND 167.3

141	SLUDGE DISPERSAL AREA
142	PONDS
143	OLD OUTFALL
156.2	SOIL DUMP AREA
165	TRIANGLE AREA
166.1–166.3	TRENCHES A, B, C
167.1 AND 167.3	SPRAY FIELDS
216.1	EAST SPRAY FIELD

IHSS LOCATIONS SHOWN ARE BASED ON REVISED INTERPRETATIONS IN HISTORICAL RELEASE REPORT DOE 1992b

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO.4

INDIVIDUAL HAZARDOUS SUBSTANCE SITES WITHIN OPERABLE UNIT NO. 6

FIGURE 1-1 AUGUST 1994

OU6TM011 1=1200

2.0 CHEMICALS OF CONCERN SELECTION PROCESS

2.1 OVERVIEW

The flow chart for selecting COCs for OU6 is presented in Figure 2-1, Process for Identifying Chemicals of Concern. The process is intended to identify the chief environmental contaminants in each medium that could have adverse impacts on public health. In this way, the risk assessment is focused on OU6 constituents that are potentially significant health hazards. Inorganic analytes whose concentrations are within background range or that are essential nutrients or major cations are excluded from the risk assessment. Organic compounds that would contribute insignificantly to overall risk are identified but are not included in the quantitative risk assessment.

COCs were selected on an OU-wide basis for each medium. The individual steps shown in Figure 2-1 are listed below and described in the following sections:

- 2.2 Data Evaluation
- 2.3 Background Comparison for Inorganic Compounds
- 2.4 Essential Nutrient/Major Cation and Anion Screen
- 2.5 Frequency of Detection
- 2.6 Concentration/Toxicity Screens
- 2.7 Application of Professional Judgement
- 2.8 Risk-Based Evaluation of Infrequently Detected Compounds and Identification of Special-Case Chemicals of Concern

2.2 DATA EVALUATION

2.2.1 Media-Specific Data Sets

Analytical data from environmental samples collected during the OU6 field sampling program and the site-wide sampling programs were used to characterize potential contamination in OU6. The samples were collected from August 1992 through May 1993. Table 2-1 lists the chemical groups and media sampled at each IHSS. Table 2-2 lists the target compounds in each chemical group. Samples were collected from the following media: surface soil,

subsurface soil, groundwater, pond sediment, pond surface water, stream sediment, and dry sediment in pond basins. The number of samples, sampling locations, and other features of the sampling and analytical program are discussed in the Phase I RFI/RI Work Plan for Operable Unit 6 (DOE 1992a).

Surface Soil

Surface soil samples were collected using the RFP soil method, a composite method in which the top 2 inches of soil are collected. Samples were collected from the third quarter of 1992 though the first quarter of 1993. The analytical parameters varied among IHSSs as described below.

IHSS 141 (Sludge Dispersal Area) - Forty surface soil samples were collected. Samples were analyzed for pesticides/polychlorinated biphenyls (PCBs), metals, nitrate, and radionuclides.

IHSS 156.2 (Soil Dump Area) - Twenty-two surface soil samples were collected. Samples were analyzed for metals, radionuclides, and total organic carbon (TOC).

IHSS 165 (Triangle Area) - Fifteen surface soil samples were collected. Samples were analyzed for metals, radionuclides, and TOC.

IHSS 167.1 and the former IHSS 167.3 (North Spray Field and South Spray Field) - Thirty-two surface soil samples were collected in IHSS 167.1 and eight in an area near the South Spray Fields. Samples were analyzed for metals, radionuclides, and TOC.

IHSS 216.1 (East Spray Field) - Six surface soil samples were collected. Samples were analyzed for metals, radionuclides, and TOC.

Subsurface Soil

Subsurface soil samples were collected from the fourth quarter of 1992 through the first quarter of 1993. Subsurface soil analytical parameters and depth intervals varied among IHSSs, as described below.

IHSS 156.2 (Soil Dump Area) - Twenty-two soil borings were drilled 3 feet into the undisturbed soil beneath the fill. Samples were taken continuously in these soil borings and composited for each 6-foot interval. Samples were analyzed for volatile organic compounds (VOCs), metals, and radionuclides. The thickness of the fill is approximately 7½ feet across the site.

IHSS 165 (Triangle Area) - Nine soil borings were drilled 3 feet into weathered bedrock. Two monitoring wells, 76192 and 76292, were drilled to depths of 20 and 22½ feet, respectively. Six-foot composite samples were collected from the soil borings prior to the development of monitoring wells. Samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), metals, and radionuclides.

IHSSs 166.1-3 (Trenches A, B, C) - Twenty-six borings were drilled to 5 feet below the bottom of each trench. Eight borings were drilled in Trench A, seven borings in Trench B, six borings in the western part of Trench C, and five borings in the eastern part of Trench C. Samples were analyzed for VOCs, metals, and radionuclides.

IHSS 167.1 and the former IHSS 167.3 (North Spray Field and South Spray Field) - Twenty-three borings were drilled in the North Spray Field. Nine soil borings were also drilled in the South Spray Field area. The soil borings were sampled in 2-foot intervals to a depth of 4 feet. Samples were analyzed for metals, radionuclides, and TOC.

IHSS 216.1 (East Spray Field Area) - Six soil borings were drilled to a depth of 4 feet. The soil borings were sampled in 2-foot intervals. Samples were analyzed for metals, radionuclides, and TOC.

Groundwater

Groundwater samples were collected from onsite monitoring wells on a quarterly basis under a plant-wide groundwater sampling program. The plant-wide monitoring program included two monitoring wells installed during the OU6 Phase I investigation and wells installed during other investigations conducted from 1991 through 1993.

Samples used for evaluation of OU6 groundwater analyte concentrations were collected from the first quarter of 1991 through the fourth quarter of 1993. The number of groundwater samples collected by analyte group were: 279 samples for VOC analysis (11 analyzed by method 502.2, 22 analyzed by method 524.2, and 246 analyzed by method Volatile Organic Analysis - Contract Laboratory Program [VOACLP]), 14 samples for semivolatile organic compounds (SVOC) analysis by method Base-Neutral Acid-Contract Laboratory Program (BNACLP), 11 samples for pesticides/PCB analysis by Pesticide Analysis - Contract Laboratory Program (PESTCLP), 191 filtered samples for metals analysis, 107 unfiltered samples for metals analysis, 172 filtered samples for radionuclide analysis, 138 unfiltered samples for radionuclide analysis, and 279 samples for analysis of water quality parameters (WQPLs).

Stream Sediments

Fifteen sediment samples from the stream channels of the A and B Series Ponds were collected in May 1993 during the OU6 Phase I investigation. Two-foot composite samples were collected using a 2-inch diameter core sampler with a hand driver. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

Dry Sediments

Eighteen dry sediment samples were collected in the floodplains of the A and B series ponds in February 1993. The samples were collected using the RFP soil sampling method. The samples were analyzed for SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

Pond sediments

Pond sediment samples were collected during the fourth quarter of 1992 as part of the site-wide surface water sampling program. Each of the ponds were sampled at five locations. In each pond, one of the samples was collected within 5 feet of the inlet. The second sample was collected from the deepest part of each pond. The other three samples were collected at random locations within each pond. Composite samples were collected from 2-foot intervals. If the sediment depth was greater than 2 feet, an additional sample was collected from 2 to 4 feet. In total, seven samples were collected from the 2- to 4- foot interval

Fifty-seven pond sediment samples are included in the data set. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

Pond Surface Water

Pond surface water samples were collected in the third and fourth quarters of 1992 as part of the site-wide surface water sampling program. Five surface water samples were collected from each of the four A Series Ponds, from each of the five B Series Ponds, and from the Walnut and Indiana Pond. One of the five samples was collected from the deepest part of each pond. A second sample was collected from within 5 feet of the inlet to each pond. The third sample was collected within 5 feet of each spillway. The two remaining samples were collected randomly in each pond. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, filtered metals, unfiltered metals, filtered radionuclides, unfiltered radionuclides, and WQPLs.

2.2.2 Data Review and Editing

The OU6 Phase I field program began in August 1992 and was completed in May 1993. A total of 103,000 sample analytical results were reported for OU6. Ninety-two percent of the data (or 95,000 results) has been validated by the validation contractor. The process used to review and edit the OU6 data is described below.

Monthly data deliveries were received from the Rocky Flats Environmental Data System (RFEDS) until January 15, 1994. The data deliveries were segregated by validated and nonvalidated data. After the last delivery, it was determined which data were not received and which were received but not validated. The data identified as being received but not validated were merged with the validated data set.

In total, 95 analytical results were not received. Of these, 31 were from samples cited as having insufficient sample volume (all were for radionuclides). Fifteen were from samples received by the laboratory and not yet analyzed (all of these samples are laboratory replicates for radionuclides). Twenty-three results were missing because samples were lost during shipment to the laboratory. Fifteen of these results were associated with three radionuclide

samples. A complete data set for OU6, with the exception of results unreported as of January 15, 1994, is part of the OU6 Draft Phase I RFI/RI Report (DOE 1995a).

Quality control samples, such as equipment rinsates, field and trip blanks, spikes, and surrogates were removed from the data set. The data were then checked for multiple reported results for the same sample. When multiple records were identified, RFEDS personnel were consulted to assist in determining which results to retain in the data set. Field duplicates and the associated real sample were identified and averaged, and the average was used as the result for that sample.

After the Draft Final Chemicals of Concern Technical Memorandum (COC TM) (DOE 1994a) was issued, data were reevaluated based on the presence of laboratory contaminants in equipment rinsates and laboratory method blanks. The reevaluation resulted in changing validation codes for several results from "B" to "U" for common laboratory contaminants such as methylene chloride and acetone. This action resulted in a reevaluation of COCs and a change in COCs identified for some media subsequent to issuing the Draft Final COC TM. Table 2-3 shows the chemicals and media that were affected by the reevaluation and the number of samples for which validation codes were changed.

The following laboratory data qualifiers were applied by the analytical laboratory to some of the results:

> The B-qualifier for a metal result indicates that the reported concentration is greater than the instrument detection limit (IDL) but less than the contract required quantitation limit (CRQL) for that analyte. These data were used as reported.
>
> The B-qualifier for organics indicates the analyte was found in the method blank and in the environmental sample. Data were validated by the validation contractor in accordance with approved data validation procedures (e.g., OU6 Quality Assurance Addendum; RFETS Quality Assurance Project Plan; EPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganics and Organics), including application of the "X5 and X10 rule" for analytes also detected in laboratory method blanks. For those B-qualified sample results with concentrations less than 10 times the

concentration of a common laboratory contaminant in a method blank, the "B" laboratory qualifier was changed to a "U" validation code. For those results exceeding the X10 rule, the "B" qualifier was dropped during validation and the concentration was used as the real concentration. The same procedure was followed for application of the X5 rule for other target volatile and semivolatile compounds that are not considered to be common laboratory contaminants..

E-qualified results (exceeded the calibration range) were replaced with the associated D-qualified results (diluted to within calibration range), if the D-qualified result was received. When only the E-qualified result was reported, it was used as reported.

R-qualified (rejected) results were removed from the data set. For OU6, 555 results were rejected (radionuclides comprised 233 of the rejected results). This represents approximately one-half of 1 percent of the data.

Analytical results for organics were J-qualified if the analyte was positively identified below the quantitation limit. The result was considered an estimate because of the uncertainty associated with quantifying concentrations at low levels. Data qualified with a J were used as reported.

A U-qualifier assigned to an analytical result indicates that the analyzed chemical was not detected above the sample quantitation limit. The U-qualifier (applied by the laboratory or by the validation contractor) was the primary mechanism used for evaluating detection frequency for organic and inorganic constituents.

For radionuclides, negative values were used as reported; therefore, there were no nondetect results for radionuclides.

2.3 BACKGROUND COMPARISON FOR INORGANIC CONSTITUENTS

Analytical results for metals and radionuclides were compared to background levels derived from data for subsurface soils, groundwater, seeps/springs, and stream sediment reported in the Background Geochemical Characterization Report (DOE 1993) and from background surface soil samples collected in the Rock Creek area during the 1991 OU1 Phase III

investigation and the 1993 OU2 Phase II investigation. Metals and radionuclides whose concentrations did not exceed background levels were eliminated from further consideration as PCOCs.

Attachment A presents the background comparison methodology in detail and contains summary tables of statistical results for metals and radionuclides in all media. The criteria used to evaluate whether a metal or radionuclide exceeded background levels are summarized here:

a. Analytical results for metals and radionuclides were compared to the background data using four statistical tests: the Quantile test, Slippage test, Student's t-test, and the Gehan test as described in the letter report of Gilbert (Gilbert 1993). Test conditions and treatment of nondetect values are discussed in Attachment A. The analyte was considered to be above background if it failed any test at the $p \leq 0.05$ level.

b. $UTL_{99/99}$ comparison: Analytical results for each metal and radionuclide were compared to the 99 percent upper tolerance limit of background data calculated at the 99 percent confidence level ($UTL_{99/99}$). The $UTL_{99/99}$ test is an indicator of possible hot spots (Gilbert 1993), but with large sample sizes of one to two hundred, it is to be expected that one or two data points would exceed the $UTL_{99/99}$ value. Nevertheless, if any result exceeded the $UTL_{99/99}$, the analyte was identified as a PCOC, subject to spatial and temporal analysis.

2.4 ESSENTIAL NUTRIENT/MAJOR CATION AND ANION SCREEN

Calcium, iron, magnesium, potassium, and sodium were eliminated from further consideration as COCs because they are essential nutrients, they occur naturally in the environment, and they are toxic only at very high doses. Anions in groundwater other than nitrates were not evaluated.

2.5 FREQUENCY OF DETECTION

All metals above background levels and organic chemicals were evaluated for frequency of detection. Chemicals that were detected at a frequency of 5 percent or greater were considered OU-wide PCOCs. These chemicals were included in concentration/toxicity screens to identify chemicals that could contribute significantly to total risk (see Section 2.6). Chemicals detected at less than 5 percent frequency can be eliminated from further consideration because the compound is not characteristic of site contamination and the potential for exposure is low. Nevertheless, maximum concentrations of infrequently detected organic compounds and metals were compared to risk-based concentrations as described in Section 2.8 to identify isolated or highly localized occurrences of high concentrations of chemicals (i.e., hot spots) that could pose a health risk if routine exposure were to occur. These chemicals were retained as special-case COCs for evaluation in the risk assessment. Radionuclides were considered to be detected at 100 percent frequency.

2.6 CONCENTRATION/TOXICITY SCREEN

COCs in each medium were selected using concentration/toxicity screens for noncarcinogens, carcinogens, and radionuclides. The screens included inorganics above background levels that were detected at 5 percent frequency or greater and organic chemicals that were detected at 5 percent frequency or greater. The purpose of applying the screen is to focus the risk assessment on the chief contributors to potential risk. To perform the screen, each chemical in a medium (such as groundwater) is scored according to its maximum detected concentration and toxicity to obtain a risk factor. The risk factor for noncarcinogenic effects is the maximum detected concentration divided by the EPA Reference Dose (RfD) for that chemical. The risk factor for carcinogenic effects (and for radionuclides) is the maximum detected concentration (or activity) multiplied by the EPA cancer slope factor (SF) for that chemical (or radionuclide). The chemical-specific risk factors are summed to calculate total risk factors for the noncarcinogenic, carcinogenic, and radioactive PCOCs in each medium. The ratio of the risk factor for each chemical to the total risk factor is called a risk index; the risk index approximates the relative risk associated with each chemical in the medium. Separate concentration/toxicity screens were performed for carcinogenic and noncarcinogenic effects of organic compounds and metals and for carcinogenic effects of radionuclides.

Each chemical that comprised 1 percent or more of the total risk factor was considered a COC for evaluation in the quantitative risk assessment. This approach reduces the number of chemicals to be carried through a risk assessment. However, the approach is conservative (health protective) because it retains some chemicals that contribute as little as 1 percent of the total potential risk in that medium. In most cases, only a few chemicals contribute the majority of potential risk in each medium.

EPA-recommended toxicity factors (RfDs and cancer SFs) were used in the concentration/ toxicity screens. When toxicity values were available for both inhalation and oral exposure routes, the more conservative value was used in the screen, unless that route was negligible (these exceptions are noted in the concentration/toxicity screens). SFs and RfDs were determined from IRIS (EPA 1995), HEAST (EPA 1994a) and other EPA sources if available. The toxicity factors used in the screens are listed in Tables 2-4 and 2-5.

EPA-established toxicity factors are not available for some of the PCOCs. Therefore, these analytes cannot be included in the concentration/toxicity screens, in other toxicity-based screens, or in the quantitative risk assessment. OU6 constituents without toxicity factors were identified for each medium and are listed in each section. The potential impact of these compounds on overall risk will be addressed qualitatively in the human health risk assessment.

2.7 APPLICATION OF PROFESSIONAL JUDGEMENT

Professional judgement was used at two points in the process of selecting COCs for human health risk assessment:

1. Exclusion of some PCOCs based on lognormal $UTL_{99/99}$ comparison: The background $UTLs_{99/99}$ presented in the Background Geochemical Characterization Report (DOE 1993) were calculated assuming that the background data were normally distributed. This assumption may not be appropriate for all analytes. Concentrations of some analytes were within background range according to the formal statistical tests, but one or two results exceeded the background $UTL_{99/99}$. This resulted in identifying the analyte as a PCOC. For some of these analytes, the distribution of the

background data were tested. If the better fit was to a lognormal distribution, the $UTL_{99/99}$ was recalculated based on lognormal distribution and the site results were compared to the lognormal-based $UTL_{99/99}$. This resulted in removing some analytes as PCOC. These are noted in the tables in Attachment A.

2. Spatial/temporal and geochemical evaluation: The spatial and temporal distribution and geochemical characteristics of certain metals and radionuclides identified as being above background levels were evaluated to support a conclusion as to whether they were likely to be naturally occurring or due to environmental contamination. For example, manganese in groundwater was concluded to be naturally occurring based on spatial, temporal, and geochemical evaluation. This judgement process resulted in removing several metals and radionuclides as PCOCs in various media. All such professional judgement is described in each section, where relevant.

2.8 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS AND IDENTIFICATION OF SPECIAL-CASE CHEMICALS OF CONCERN

Chemicals detected infrequently (in less than 5 percent of all samples in the medium) can usually be eliminated from consideration as COCs because they are not characteristic of site contamination and the potential for exposure is low. However, these chemicals were further screened so as not to neglect an infrequently detected compound that could contribute significantly to risk if routine exposure to contamination in a very limited area were to occur. In this analysis, maximum measured concentrations were compared to screening levels equivalent to 1000 times risk-based concentrations (RBCs) (DOE 1995b). This analysis is summarized below and is presented in detail in Attachment B.

For screening purposes, RBCs were defined as chemical concentrations associated with an excess cancer risk of 10^{-6} (1 in 1 million) or a hazard index of one for noncarcinogenic effects, assuming residential exposure to surface soil, groundwater, pond surface water, and pond and stream sediments and assuming construction worker exposure to subsurface soil. Any infrequently detected chemical measured at a concentration greater than 1000 times the

respective RBC was identified as representing a potentially significant health threat if exposure were to occur and was included in the list of special-case COC for evaluation in the risk assessment.

In addition, to verify the frequency of detection evaluation, maximum nondetect values (i.e., the sample reporting limits) of all of the low frequency chemicals were compared to RBCs and CRQLs to test whether the reporting limits were low enough to provide adequate characterization of chemical contamination and detection frequency. If the reporting limits were not elevated above the CRQLs, the data were considered adequate to establish detection frequency. If maximum nondetect value exceeded the RBC but the CRQL did not exceed the RBC, or if the nondetect values were significantly elevated above the CRQL, then further evaluation of the data was performed on a case-by-case basis.

RBCs for chemicals in surface soil and sediment were calculated assuming multiple pathway exposure (ingestion and inhalation of particulates). RBCs for chemicals in subsurface soil were calculated assuming ingestion of soil and inhalation of particulates and VOCs. RBCs for chemicals in groundwater and pond surface water were calculated assuming ingestion of water and inhalation of VOCs. The exposure parameters used to calculate RBCs are presented in Attachment B.

TABLE 2-1
PHASE I ANALYTICAL PROGRAM

IHSS	Location	Media	Total U	Total Cr	Be	H3	Nitrate/ Nitrite as N	Gross α	Gross β	U 233/234	U 235	U 238	Pu 239/240	Am 241	Cs 137	Sr 89/90
141	Surface samples on 25' grid	Surface soil		X	X		X	X	X	X	X	X	X	X		
	Well downgradient of unit	Groundwater						X	X	X	X	X	X	X		
142	Sediment samples	Sediment		X	X	X	X	X	X	X	X	X	X	X	X	X
	Dry sediment samples	Sediment		X	X	X	X	X	X	X	X	X	X	X	X	X
	Water samples	Surface water		X	X	X	X	X	X	X	X	X	X	X	X	X
	Wells downgradient of A-4 and B-5 including the four Bedrock Wells in North Walnut Creek	Groundwater		X	X	X	X	X	X	X	X	X	X	X	X	X
143	Surface samples	Surface soil		X	X	X	X	X	X	X	X	X	X	X		
	Core samples on 20' grid	Subsurface soil		X	X	X	X	X	X	X	X	X	X	X		
	Well downgradient of unit	Groundwater		X	X	X	X	X	X	X	X	X	X	X		
156	Surface samples	Surface soil						X	X	X	X	X	X	X		
	Borings	Subsurface soil						X	X	X	X	X	X	X		
	Well within unit	Groundwater						X	X	X	X	X	X	X		
165	Surface samples from transect locations	Surface soil			X			X	X	X	X	X	X	X		
	Borings to confirm soil gas	Subsurface soil			X			X	X	X	X	X	X	X		
	Borings transecting plumes grabs from 2' intervals 6' composites	Subsurface soil			X			X	X	X	X	X	X	X		
	Wells within the site	Groundwater						X	X							
166	Borings along each trench grabs from 2' intervals 6' composites	Subsurface soil						X	X	X	X	X	X	X		
	Well downgradient of the trenches and the Bedrock Well located in unnamed tributary of North Walnut Creek	Groundwater						X	X							
167	Surface and core samples on 100' grid	Surface and Subsurface soil						X	X	X	X	X	X	X		
	Wells downgradient of units	Groundwater				X	X						X	X		
216	Surface and core samples	Surface and Subsurface soil				X		X	X	X	X	X	X	X		

TABLE 2-1
(continued)

IHSS	Location	Media	TAL Metals/ Additional Metals	TOC	TCL VOCs	TCL SVOCs	TCL Pesticides/ PCBs	WQPL	Filtered: U 233/ 234	U 235	U 238	Pu 239/240	Cs 137	Sr 89/90	Am. 241	TAL Metals	Additional Parameters for IHSS 142.1-9 & 12 Water Samples	Aquatic Toxicity
141	Surface samples on 25' grid	Surface soil	X				X											
	Well downgradient of unit	Groundwater	X		X	X												
142	Sediment samples	Sediment	X	X	X	X	X											
	Dry sediment samples	Sediment	X			X	X											
	Water samples	Surface water	X		X	X		X	X	X	X	X	X	X	X	X	X	X
	Wells downgradient of A-4 and B-5 including the four Bedrock Wells in North Walnut Creek	Groundwater	X		X	X		X	X	X	X	X	X	X	X	X		
143	Surface samples	Surface soil	X	X		X	X											
	Core samples on 20' grid	Subsurface soil	X	X	X	X	X											
	Well downgradient of unit	Groundwater	X	X	X	X	X											
156	Surface samples	Surface soil	X	X														
	Borings	Subsurface soil	X															
	Well within unit	Groundwater	X					X	X	X	X	X			X	X		
165	Surface samples from transect locations	Surface soil	X	X			X											
	Borings to confirm soil gas	Subsurface soil			X	X												
	Borings transecting plumes grabs from 2' intervals 6' composites	Subsurface soil	X		X	X												
	Wells within the site	Groundwater	X		X	X	X											
166	Borings along each trench grabs from 2' intervals 6' composites	Subsurface soil	X		X													
	Well downgradient of the trenches and the Bedrock Well located in unnamed tributary of North Walnut Creek	Groundwater	X		X	X	X											
167	Surface and core samples on 100' grid	Surface and Subsurface soil	X	X														
	Wells downgradient of units	Groundwater	X		X		X		X	X	X	X						
216	Surface and core samples	Surface and Subsurface soil	X	X														

TABLE 2-1
(continued)

													Filtered				
IHSS	Event	Media	H3	Gross α	Gross β	U 233/234	U 235	U 238	Pu 239/240	Am 241	Cs[1] 137	Sr 89/90	UISO	Pu 239/240	Cs 137	Sr 89/90	Am 241
N/A	Stream Base Flow Sampling	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
N/A	Stream Storm Event Sampling	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
N/A	Stream	Sediments	X	X	X	X	X	X	X	X	X	X					

TABLE 2-1
(concluded)

IHSS	Event	Media	GFAA Metals	TAL Metals	TCL VOCs	TCL SVOCs	Pest/ PCBs	TOC	WQPL	NH_4^+ as NH_3	Hardness	Nitrate/Nitrate as N	Acute Toxicity	Micro Toxicity	Filtered TAL Metals
N/A	Stream Base Flow Sampling	Surface Water	X	X	X	X		X	X	X	X	X	X	X	X
N/A	Stream Storm Event Sampling	Surface Water	X	X	X	X		X	X	X	X	X			X
N/A	Stream	Sediments		X	X	X	X	X				X			

• Six randomly chosen surface soil samples will be analyzed for TCL pesticides/PCBs.

α = Alpha
β = Beta
Am = Americium
Be = Beryllium
Cr = Chromium
Cs = Cesium
H3 = Tritium
N = Nitrogen
Pu = Plutonium
Sr = Strontium
SVOCs = Semivolatile Organic Compounds
TAL = Target Analyte List
TCL = Target Compound List
TDS = Total Dissolved Solids
TOC = Total Organic Carbon
U = Uranium
VOCs = Volatile Organic Compounds
UISO = Uranium Isotopes
GFAA = Graphite Furnace Atomic Absorption
WQPL = Water Quality Parameters List
NH_4^+ = Ammonium ion as NH_3
PCBs = Polychlorinated Biphenyls

TABLE 2-2
OU6 PHASE I RFI/RI ANALYTICAL PARAMETERS

TARGET ANALYTE LIST (TAL) - METALS
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Cyanide
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

ADDITIONAL - METALS
- Cesium
- Lithium
- Molybdenum
- Silicon
- Strontium
- Tin

GRAPHITE FURNACE ATOMIC ABSORPTION (GFAA) - METALS
- Cadmium
- Copper
- Iron
- Lead
- Manganese
- Silver
- Zinc

TARGET COMPOUND LIST (TCL) - VOCs
- Chloromethane
- Bromomethane
- Vinyl chloride
- Chloroethane
- Methylene chloride
- Acetone
- Carbon disulfide
- 1,1-Dichloroethene
- 1,1-Dichloroethane
- total 1,2-Dichloroethene
- Chloroform
- 1,2-Dichloroethane
- 2-Butanone
- 1,1,1-Trichloroethane
- Carbon tetrachloride
- Vinyl acetate
- Bromodichloromethane
- 1,1,2,2-Tetrachloroethane
- 1,2-Dichloropropane
- cis-1,3-Dichloropropene
- Trichloroethene
- Dibromochloromethane
- 1,1,2-Trichloroethane
- Benzene
- trans-1,3-Dichloropropene
- Bromoform
- 2-Hexanone
- 4-Methyl-2-pentanone
- Tetrachloroethene
- Toluene
- Chlorobenzene
- Ethyl benzene
- Styrene
- Total xylenes

TCL - SVOCs
- Phenol
- bis(2-Chloroethyl)ether
- 2-Chlorophenol
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- Benzyl alcohol

TABLE 2-2
(continued)

1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl)ether
4-Methylphenol
N-Nitroso-di-n-dipropylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
bis(2-Chloroethoxy)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
(para-chloro-meta-cresol)
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl phenyl ether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl phenyl ether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-butylphthalate
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

TCL - PESTICIDES/PCBs
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan sulfate
4,4'-DDT
Methoxychlor
Endrin ketone
alpha-Chlordane
gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

TABLE 2-2
(concluded)

RADIONUCLIDES
- Gross Alpha
- Gross Beta
- Uranium 233+234, 235, and 238 (each species)
- Americium 241
- Plutonium 239/240
- Tritium
- Cesium 137 Total
- Strontium 89 + 90 Total

TOTAL ORGANIC CARBON (TOC)
NITRATE/NITRITE AS N

Parameters Exclusively for Groundwater Samples

FIELD PARAMETERS
- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen
- Barometric Pressure

WATER QUALITY PARAMETER LIST (WQPL)
- Chloride
- Fluoride
- Sulfate
- Carbonate
- Bicarbonate
- Total Dissolved Solids
- Total Suspended Solids

ADDITIONAL PARAMETERS FOR IHSS 142.1-9 AND 12 WATER SAMPLES
- DOC
- Silicon
- Alkalinity

TABLE 2-3
CHANGE VALIDATION CODE FOR COMMON LABORATORY CONTAMINANTS
REVIE OF RINSATES AND METHOD BLANKS

Analyte	No. of samples changed from "B" to "U"	Total number of nondetects	Total number of samples	Eliminated as COC?(1)
Subsurface soil				
Methylene chloride	300	358	360	X
Bis (2-ethylhexyl)phthalate	2	18	25	
Groundwater				
Chloroform	1	247	270	
Pond Sediment				
Acetone	34	41	49	
Methylene chloride	44	48	49	
Bis(2-ethylhexyl)phthalate	6	11	56	
Pond Surface Water				
Acetone	17	49	51	X
Methylene chloride	25	49	51	X

B Detected in laboratory method blank
U Not detected (based on blank or rinsate contamination)

(1) X indicates that the chemical was identified as a COC in the Draft Final COC TM (DOE 1994a) but was eliminated as a contaminant based on re-evaluation of rinsate and method blank results.

TABLE 2-4
TOXICITY FACTORS FOR ORGANIC COMPOUNDS AND METALS

Analyte	Slope Factors 1/(mg/kg-day)		EPA Cancer Weight of Evidence	Reference Doses mg/kg-day		RfC
	Oral	Inhalation		Oral	Inhalation (*)	
1,1-Dichloroethane	-	-	C	1.0E-01(1)	1.4E-01	5.0E-01 (2)
1,1-Dichloroethene	6.0E-01 (3)	1.7E-01 (3)	C	9.0E-03 (3)	-	-
1,2,4-Trichlorobenzene	-	-	-	1.0E-02 (3)	3.0E-03	2.0E-01 (1)
1,2-Dichloroethane	9.1E-02 (3)	9.1E-02 (3)	B2	-	-	-
1,2-Dichloroethene	-	-	-	9.0E-03 (1)	-	-
cis-1,2-Dichloroethene	-	-	-	1.0E-02 (1)	-	-
1,2-Dichlorobenzene	2.4E-02 (1)	-	C	-	2.3E-01	2.0E-01 (2)
2-Butanone	-	-	D	6.0E-01 (3)	3.0E-01	1.0E+00 (3)
2-Chlorophenol	-	-	-	5.0E-03 (3)	-	-
4-Methyl-2-pentanone	-	-	-	8.0E-02 (1)	2.3E-02	2.0E-02 (2)
4-Methylphenol	-	-	-	5.0E-03 (1)	-	-
Acenaphthene	-	-	-	6.0E-02 (3)	-	-
Acetone	-	-	-	1.0E-01 (3)	-	-
Aldrin	1.7E+01 (3)	1.7E+01 (3)	B2	3.0E-05 (3)	-	-
Aluminum	-	-	-	2.9E+00 (4)	-	-
Anthracene	-	-	-	3.0E-01 (3)	-	-
Antimony	-	-	-	4.0E-04 (3)	-	-
Aroclor-1254	7.7E+00 (3)	-	B2	2.0E-05 (3)	-	-
Other Polychlorinated biphenyls	7.7E+00 (3)	-	B2	-	-	-
Arsenic	1.7E+00 **	1.5E+01 **	A	3.0E-04 (3)	-	-
Barium	-	-	-	7.0E-02 (3)	1.4E-04	5.0E-04 (2)
Benzene	2.9E-02 (3)	2.9E-02 (3)	A	-	-	-
Benzo(a)anthracene	7.3E-01 (5)	-	B2	-	-	-
Benzo(a)pyrene	7.3E+00 (3)	-	B2	-	-	-
Benzo(b)fluoranthene	7.3E-01 (5)	-	B2	-	-	-
Benzo(k)fluoranthene	7.3E-01 (5)	-	B2	-	-	-
Benzoic acid	-	-	-	4.0E+00 (3)	-	-
Benzyl alcohol	-	-	-	3.0E-01 (1)	-	-
Beryllium	4.3E+00 (3)	8.4E+00 (3)	B2	5.0E-03 (3)	-	-
Bis(2-ethylhexyl)phthalate	1.4E-02 (3)	-	B2	2.0E-02 (3)	-	-
Butylbenzene (sec, tert)	-	-	-	1.0E-02 (4)	-	-
Butyl benzylphthalate	-	-	C	2.0E-01 (3)	-	-
Cadmium (food)	-	6.3E+00 (3)	B1	1.0E-03 (3)	-	-
Cadmium (water)	-	-	B1	5.0E-04 (3)	-	-
Carbon disulfide	-	-	-	1.0E-01 (3)	2.9E-03	1.0E-02 (1)
Carbon tetrachloride	1.3E-01 (3)	5.2E-02 (3)	B2	7.0E-04 (3)	-	-
Chlorobenzene	-	-	-	2.0E-02 (3)	5.7E-03	2.0E-02 (2)
Chloroform	6.1E-03 (3)	8.0E-02 (3)	B2	1.0E-02 (3)	-	-
Chromium	-	-	-	1.0E+00 (3)	-	-
Chrysene	7.3E-02 (5)	-	B2	-	-	-
Cobalt	-	-	-	6.0E-02(4)	-	-
Di-n-butylphthalate	-	-	D	1.0E-01 (3)	-	-
Di-n-octylphthalate	-	-	D	2.0E-02(1)	-	-
Dibenzo(a,h)anthracene	7.3E+00 (5)	-	B2	-	-	-
Diethyl phthalate	-	-	-	8.0E-01 (3)	-	-
Ethylbenzene	-	-	D	1.0E-01 (3)	3.0E-01	1.0E+00 (3)

TABLE 2-4
(CONCLUDED)

Analyte	Slope Factors 1/(mg/kg-day) Oral	Slope Factors 1/(mg/kg-day) Inhalation	EPA Cancer Weight of Evidence	Reference Doses mg/kg-day Oral	Reference Doses mg/kg-day Inhalation (*)	RfC
Fluoranthene	-	-	-	4.0E-02 (3)	-	-
Fluorene	-	-	-	4.0E-02 (3)	-	-
gamma-BHC	1.3E+00 (3)	-	B2-C	3.0E-04 (3)	-	-
Indeno(1,2,3-cd)pyrene	7.3E-01 (5)	-	B2	-	-	-
Lithium	-	-	-	2.0E-02 (4)	-	-
Manganese (food)	-	-	D	1.4E-01 (3)	1.4E-05	4.9E-05 (3)
Manganese (water)	-	-	D	5.0E-03 (3)	-	-
Mercury	-	-	D	3.0E-04 (1)	9.0E-05	3.0E-04 (1)
Methylene chloride	7.5E-03 (3)	1.6E-03 (3)	B2	6.0E-02 (3)	9.0E-01	3.0E+00 (1)
Molybdenum	-	-	-	5.0E-03 (3)	-	-
Naphthalene	-	-	-	4.0E-02(4)	-	-
Nickel (salts)	-	-	-	2.0E-02 (3)	-	-
Nitrate	-	-	-	1.6E+00 (3)	-	-
Pentachlorophenol	1.2E-01 (3)	-	B2	3.0E-02 (3)	-	-
Phenol	-	-	D	6.0E-01 (3)	-	-
Pyrene	-	-	D	3.0E-02 (3)	-	-
Selenium	-	-	-	5.0E-03 (3)	-	-
Silver	-	-	D	5.0E-03 (3)	-	-
Strontium	-	-	-	6.0E-01 (3)	-	-
Styrene	-	-	-	2.0E-01 (3)	2.9E-01	1.0E+00 (3)
Tetrachloroethene	5.2E-02 (6)	2.0E-03 (6)	B2	1.0E-02 (3)	-	-
Thallium (sulfate)	-	-	-	8.0E-05 (3)	-	-
Tin	-	-	-	6.0E-01 (1)	-	-
Toluene	-	-	D	2.0E-01 (3)	1.1E-01	3.9E-01 (3)
Trichloroethene	1.1E-02 (6)	6.0E-03 (6)	B2	-	-	-
Xylenes	-	-	-	2.0E+00 (3)	-	-
Vanadium	-	-	-	7.0E-03 (1)	-	-
Vinyl chloride	1.9E+00 (1)	3.0E-01 (1)	A	-	-	-
Zinc	-	-	D	3.0E-01 (3)	-	-

Sources:

1 = HEAST 1994 and Supplement 2 (EPA 1994a)

2 = HEAST 1994 Table 2 (EPA 1994a)

3 = IRIS (EPA 1995).

4 = Provisional values for aluminum, butylbenzene, cobalt, lithium, and naphthalene. USEPA. ECAO

5 = EPA 1992b

6 = Joan S. Dollarhide, Superfund Health Risk Technical Support Center. "Carcinogenicity Characterization of Perchloroethylene (PERC) and Trichloroethylene (TCE) (Luke Air Force Base. Arizona)." ECAO.

Notes:

* Calculated from RfC. RfD = RfC x $20m^3$/day/70kg.

** Converted from IRIS unit risks. Oral proposed U.R. = 5.00E-05/µg/L. Inhalation U.R. = 4.30E-03/$\mu g/m^3$.
Oral SF = 5.00E-05 x 1000µg/mg x 70kg/2L. Inhalation SF = 4.30E-03/$\mu g/m^3$x1000µg/mgx70kg/$20m^3$.

EPA Cancer Weight of Evidence :

A = Human carcinogen

B1 = Probable human carcinogen (limited human data)

B2 = Probable human carcinogen (animal data only)

C = Possible human carcinogen

D = Noncarcinogenic (inadequate evidence)

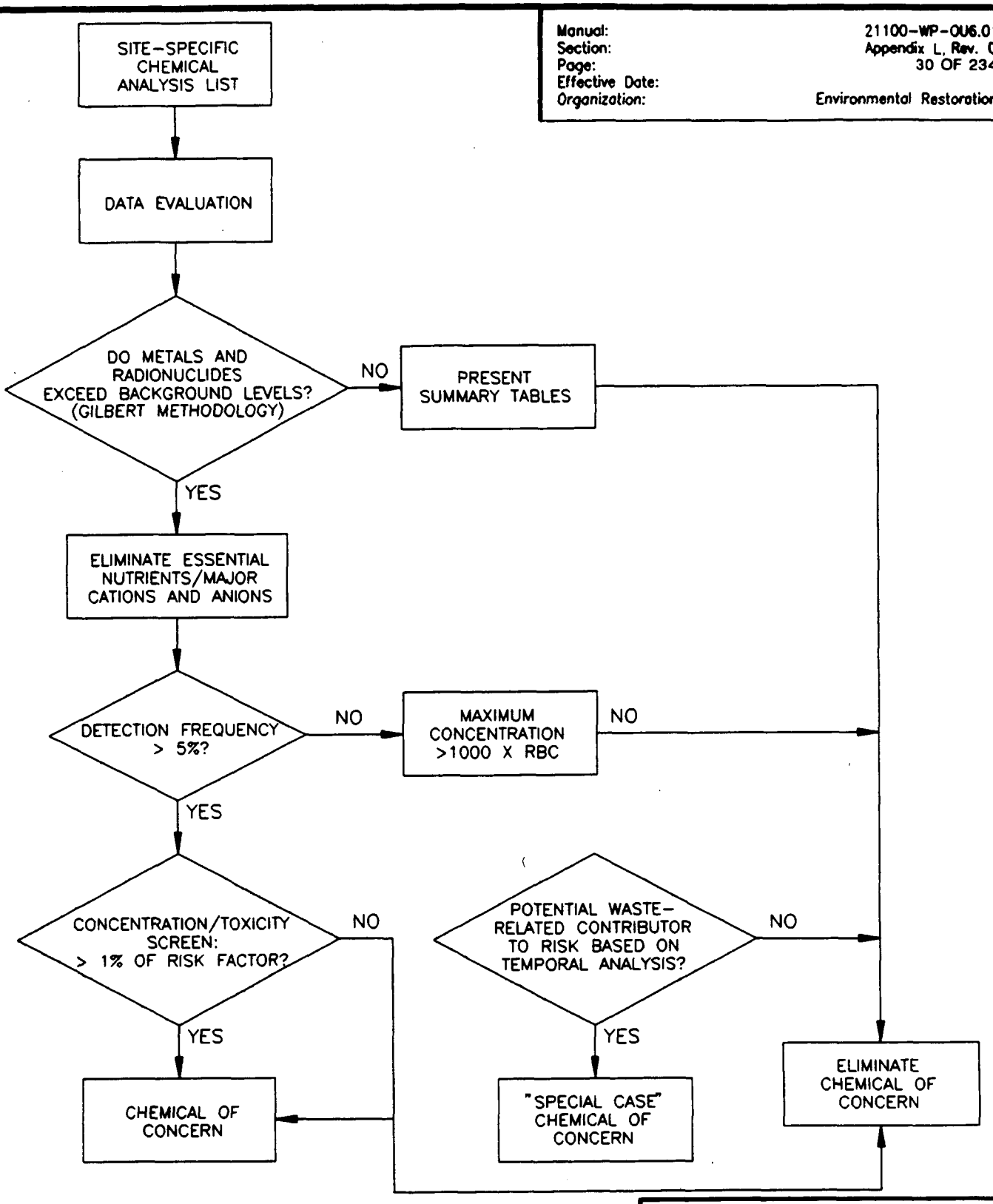
- = Not classifiable or not carcinogenic

TABLE 2-5
SLOPE FACTORS
FOR RADIONUCLIDES

Analyte	Oral (Risk/pCi)	Inhalation (Risk/pCi)	External (Risk/yr/pCi/g)	EPA Cancer Weight of Evidence
Americium-241	3.28E-10	3.85E-08	4.59E-09	A
Cesium-137 +D	3.16E-11	1.91E-11	2.09E-06	A
Plutonium-239	3.16E-10	2.78E-08	1.26E-11	A
Plutonium-240	3.15E-10	2.78E-08	1.87E-11	A
Radium-226 +D	2.96E-10	2.75E-09	6.74E-06	A
Radium-228 +D	2.48E-10	9.94E-10	3.28E-06	A
Strontium-89	1.03E-11	3.68E-12	5.38E-10	A
Strontium-90 +D	5.59E-11	6.93E-11	0.00E+00	A
Tritium	7.15E-14	9.59E-14	0.00E+00	A
Uranium-233/234*	4.44E-11	1.40E-08	2.14E-11	A
Uranium-235 +D	4.70E-11	1.30E-08	2.65E-07	A
Uranium-238 +D	6.20E-11	1.24E-08	5.25E-08	A

Source: HEAST Supplement No. 2 (EPA 1994a).

* = Slope factors shown are for U-234.
A = Class A (human) carcinogen.
+D = Risks from radioactive decay products are included.



* PROFESSIONAL JUDGEMENT
RBC RISK-BASED CONCENTRATION (DOE 1995b)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO.4

PROCESS FOR IDENTIFYING CHEMICALS OF CONCERN – OU6 HUMAN HEALTH RISK ASSESSMENT

FIGURE 2-1 JULY 1994

OU6TM148

3.0 SURFACE SOIL CHEMICALS OF CONCERN

3.1 SURFACE SOIL DATA SET

COCs in surface soil were selected using data collected at all OU6 IHSSs at which surface soil samples were collected, with the exception of samples collected at the Old Outfall (IHSS 143). The Outfall data are omitted from this OU-wide COC determination because special physical features of the Old Outfall and its location within the industrialized portion of RFETS indicate that a separate evaluation of this IHSS is warranted. The Old Outfall is a small site located approximately 10 feet below ground surface within the industrialized portion of the plant; surface and near-surface soils at this site are fill brought in for grading. All surface soil samples at the Old Outfall were collected below the asphalt that currently covers the area. As is being done for all OU6 IHSSs, the nature and extent of contamination detected in soil and groundwater samples collected at IHSS 143 will be evaluated in the OU6 RFI/RI report; and, as is being done for all OU6 contaminant source areas, maximum contaminant concentrations detected at the Old Outfall will be compared to risk-based screening concentrations to estimate potential health risk. (The risk-based screen for OU6 source areas is contained in a separate letter report [DOE 1994b]). However, if further evaluation of potential health risk at the Old Outfall is warranted based on results of the risk-based screen, the evaluation will be conducted separately from the BRA for OU6. Therefore, surface and subsurface soil sample results from IHSS 143 were not included in the selection of OU-wide COCs in soil. Maximum contaminant concentrations detected in surface and subsurface soil at IHSS 143 are shown for information purposes in Table 3-1.

The data set for selecting OU-wide COCs in surface soil includes analytical results from samples collected at IHSSs 141 (Sludge Dispersal Area), 156.2 (Soil Dump Area), 165 (Triangle Area), 167.1 (North Spray Field), and 216.1 (East Spray Field). The data set includes results from 119 surface soil samples that were analyzed for metals and anywhere from 18 to 125 samples analyzed for various radionuclides. In addition, the data set includes results from 55 surface soil samples at the Sludge Dispersal Area (IHSS 141) and the Triangle Area (IHSS 165) that were analyzed for pesticides/PCBs. The sampling and analytical program is summarized in Tables 2-1 and 2-2. The number of samples for each inorganic analyte are listed in the Background Comparison Summary Tables in Attachment A.

3.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Tables 3-2 and 3-3 summarize the maximum detected concentrations and detection frequencies for organic compounds and metals, and the results of the background comparison for metals in OU6 surface soil samples. The statistical comparisons to background data are presented in detail in Attachment A. Only molybdenum and Aroclor-1254 were detected at less than 5 percent frequency. Radionuclides are assumed to be detected at 100 percent frequency (i.e., both negative and positive results are retained in the data set). Radionuclides identified as PCOCs based on the background comparison are listed in the concentration/toxicity screen in Table 3-5.

Background surface soil data consist of analytical results from samples collected at 18 locations in the Rock Creek area. Nine of the sites were sampled in February 1992 and the remaining nine sites were sampled in March 1993. All background and OU6 surface soil samples were collected using the RFP method, a composite method in which the top 2 inches of soil are collected.

Metals and radionuclides that were detected at 5 percent or greater detection frequency and that were identified as PCOCs on the basis of the statistical background comparison or exceedances of the background $UTL_{99/99}$ and not eliminated based on professional judgement were included in concentration/toxicity screens to select OU-wide COCs.

Lead was detected above background levels in surface soil, but does not have EPA toxicity factors and, therefore, cannot be evaluated in a toxicity or risk-based screen. The potential contribution of lead to overall risk will be evaluated qualitatively in the risk. The maximum concentration of lead was relatively low (69 mg/kg) and is not expected to have adverse health effects. If the detected lead levels in soil were at a level of concern, the potential for adverse effects in lead would be estimated using EPA's Integrated Exposure Uptake Biokinetic Model for Lead (EPA 1994b). However, lead levels in surface soil do not appear to warrant quantification of adverse effects, since the maximum concentration of 69 mg/kg is well below the residential screening level of 400 mg/kg (EPA 1994c).

Copper was also detected above background levels in surface soil. Although there is not an EPA approved reference dose for copper, HEAST (EPA 1994a) does provide the current

drinking water standard (1.3 mg/L) that may be converted to an oral reference dose (0.04 mg/kg/day). However, since the standard for copper is for drinking water and since EPA has concluded that toxicity data are inadequate for calculation of an oral RfD for copper, a route-to-route extrapolation from ingestion of water to ingestion of soil may be inappropriate and would likely greatly overestimate the risk of ingestion of copper in a soil matrix. Therefore, since concentrations of copper in surface soil were low (maximum concentration 62 mg/kg) and are not likely to contribute to overall potential risk, copper in surface soil is excluded from further evaluation.

3.3 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for surface soils are presented in Table 3-4 (noncarcinogens) and Table 3-5 (radionuclides). No carcinogenic metals were among the PCOCs based on background comparison; therefore, there is no concentration/toxicity screen for carcinogens. (An inhalation cancer slope factor specific to nickel subsulfide, which occurs in nickel refinery dust, is available. However, it is considered inappropriate to apply the inhalation cancer slope factor for nickel subsulfide to nickel detected in soil at Rocky Flats because no nickel refining occurred at Rocky Flats, and nickel in soils at Rocky Flats most likely occurs in native minerals or salts or in anthropogenic salts related to industrial processes other than refining. Therefore, nickel is not evaluated as a carcinogen.)

All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs. OU-wide COCs for surface soil are listed below and in Table 3-6:

OU-Wide Chemicals of Concern
Surface Soil

Antimony
Silver
Vanadium
Zinc
Americium-241
Plutonium-239/240

The distribution of these COCs in surface soil is shown in Figures 3-1 through 3-6 (all detected results that were not rejected are shown). Antimony and zinc exceeded background

levels according to one or more of the four formal statistical tests (Quantile, Slippage, t-test, or Gehan tests) described in Attachment A. Silver and vanadium did not exceed background levels according to the formal statistical tests, but silver had one result above the background $UTL_{99/99}$ (in IHSS 141, Sludge Dispersal Area) and vanadium had four results above the UTL (in IHSS 141, Sludge Dispersal Area, and IHSS 156.2, Soil Dump Area).

Plutonium (Pu) and americium (Am) results exceeded background levels according to the formal statistical tests, and maximum concentrations at each IHSS exceeded the background $UTL_{99/99}$.

Summary data for COCs in surface soil at each IHSS are listed below:

Concentration Ranges of Chemicals of Concern in Surface Soil, mg/kg or pCi/g

IHSS		Antimony	Silver	Vanadium	Zinc	Pu	Am
	Background UTL	50	10	55.6	86.6	0.133	0.060
	Mean+2SD	35	7.1	43.7	71	0.094	0.039
141	Sludge Dispersal	-	8-53	67-76	73-650	0.14-10	0.25-1.8
156.2	Soil Dump	39-44	-	44-65	72	0.10-1.8	0.042-0.301
165	Triangle	-	-	-	75-117	0.09-15	0.061-3.24
167.1	North Spray Field	-	-	-		0.10-1.85	0.039-1.15
216.1	East Spray Field	-	-	-		0.38-0.76	0.058-0.192

- No results above background mean + 2 standard deviations (SD), which is the CDPHE criterion for background range.

3.4 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

Maximum concentrations of Aroclor-1254 and molybdenum (each detected at 1 percent frequency) were compared to values equivalent to 1000 times chemical-specific RBCs. The RBCs were calculated assuming residential exposure to surface soil and are used to identify special-case COCs that could pose a health risk if long-term exposure were to occur to the maximum concentration. The screen is discussed in Attachment B and the results for surface soil are presented in Table B-1.

None of the maximum concentrations of chemicals detected at low frequency in surface soil exceeded the 1000 times RBC value. Therefore, there are no special-case COCs in surface soils for OU6.

TABLE 3-1
MAXIMUM CONCENTRATIONS OF DETECTED ANALYSIS
IHSS 143 (OLD OUTFALL)
SURFACE AND SUBSURFACE SOIL

Surface Soil		Subsurface Soil	
Organics and Metals (mg/kg):		**Organics and Metals (mg/kg):**	
Acenaphthene	0.51	2-Butanone	0.018
Aluminum	16900	Acetone	0.17
Anthracene	0.66	Aluminum	14400
Arsenic	6.6	Arsenic	7.8
Barium	170	Barium	1150
Benzo(a)anthracene	1.8	Benzo(a)anthracene	0.2
Benzo(a)pyrene	2.3	Benzo(a)pyrene	0.17
Benzo(b)fluoranthene	3.2	Benzo(b)fluoranthene	0.21
Benzo(ghi)perylene	0.89	Benzo(k)fluoranthene	0.095
Benzo(k)fluoranthene	1.2	Benzoic acid	1.065
Benzoic acid	0.45	Beryllium	1.4
Beryllium	1.3	Bis(2-ethylhexyl)phthalate	0.41
Bis(2-ethylhexyl)phthalate	0.22	Cadmium	0.75
Cadmium	0.75	Cesium	13.6
Cesium	33.4	Chromium	13.9
Chromium	17.7	Chrysene	0.2
Chrysene	1.6	Cobalt	16.9
Cobalt	12.9	Copper	23.6
Copper	17.8	Di-n-octylphthalate	0.068
Dibenzo(a,h)anthracene	0.2	Fluoranthene	0.45
Dibenzofuran	0.085	Indeno(1,2,3-cd)pyrene	0.088
Fluoranthene	2.7	Lead	23.1
Fluorene	0.24	Lithium	16
Indeno(1,2,3-cd)pyrene	0.89	Manganese	343.5
Lead	31	Mercury	0.93
Lithium	10.8	Methylene chloride	0.013
Manganese	374	Nickel	26.1
Mercury	0.07	Phenanthrene	0.23
Naphthalene	0.12	Pyrene	0.46
Nickel	20.3	Selenium	0.61
Phenanthrene	1.8	Strontium	279
Pyrene	2.8	Thallium	0.51
Selenium	0.4	Toluene	1.055
Strontium	53.8	Vanadium	43.1
Thallium	0.28	Zinc	100.85
Vanadium	45.5		
Zinc	85.4		

TABLE 3-1
(CONCLUDED)

Surface Soil		Subsurface Soil	
Radionuclides (pCi/g):		**Radionuclides (pCi/g):**	
Plutonium-239/240	0.52	Amercium-241	0.0361
Uranium-233/234	1.25	Plutonium-239/240	0.2612
Uranium-235	0.05	Uranium-233,-234	1.843
Uranium-238	1.16	Uranium-235	0.0778
		Uranium-238	1.518

TABLE 3-2
METALS DETECTED AT 5% OR GREATER FREQUENCY
SURFACE SOIL[1]

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ?[2]
Aluminum	24100	100	No
Antimony	43.6	47	Yes
Arsenic	11	100	No
Barium	272	100	No
Beryllium	1.5	90	No
Cadmium	6.4	41	No
Cesium	35.4	86	No
Chromium	35.1	99	Yes
Cobalt	20.3	100	Yes
Copper	61.6	100	Yes
Lead	68.7	100	Yes
Lithium	18.1	95	No
Manganese	823	100	No
Mercury	0.34	41	Yes
Nickel	22.5	95	Yes
Selenium	1.3	35	No
Silver	52.7	8	Yes
Strontium	255	100	Yes
Thallium	0.55	44	No
Tin	38.7	5	No
Vanadium	75.9	100	Yes
Zinc	650	100	Yes

(1) Excluding Old Outfall (IHSS 143)
(2) Based on background comparison (Appendix A).

TABLE 3-3
METALS AND PESTICIDES/PCBs DETECTED AT LESS THAN 5% FREQUENCY SURFACE SOIL[1]

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ? [2]
Aroclor-1254	0.425	1	
Molybdenum	9.9	1	Yes

[1] Excluding Old Outfall (IHSS 143)
[2] Based on background comparison (Appendix A).

TABLE 3-4
CONCENTRATION/TOXICITY SCREEN
SURFACE SOIL[1]
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Antimony	43.6	n/a	4.0E-04	1.1E+05	8.0E-01	80.4
Vanadium	75.9	n/a	7.0E-03	1.1E+04	8.0E-02	8.0
Silver	52.7	n/a	5.0E-03	1.1E+04	7.8E-02	7.8
Zinc	650	n/a	3.0E-01	2.2E+03	1.6E-02	1.6
Mercury	0.34	n/a	3.0E-04	1.1E+03	8.4E-03	0.8
Nickel	22.5	n/a	2.0E-02	1.1E+03	8.3E-03	0.8
Strontium	255	n/a	6.0E-01	4.3E+02	3.1E-03	0.3
Cobalt	20.3	n/a	6.1E-02	3.3E+02	2.5E-03	0.2
Chromium	35.1	n/a	1.0E+00	3.5E+01	2.6E-04	0.0
Total Risk Factor				1.4E+05		

RfDs are in units of mg/kg-day.
n/a = not available.
[1] Excluding Old Outfall (IHSS 143)

TABLE 3-5
CONCENTRATION/TOXICITY SCREEN
SURFACE SOIL[1]
RADIONUCLIDES

Chemical	Maximum Detected Conc. (pCi/g)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Plutonium-239/240	15.22	2.8E-08	3.2E-10	4.3E-07	7.7E-01	77.1
Americium-241	3.243	3.9E-08	3.3E-10	1.3E-07	2.3E-01	22.9
Total Risk Factor				5.5E-07		

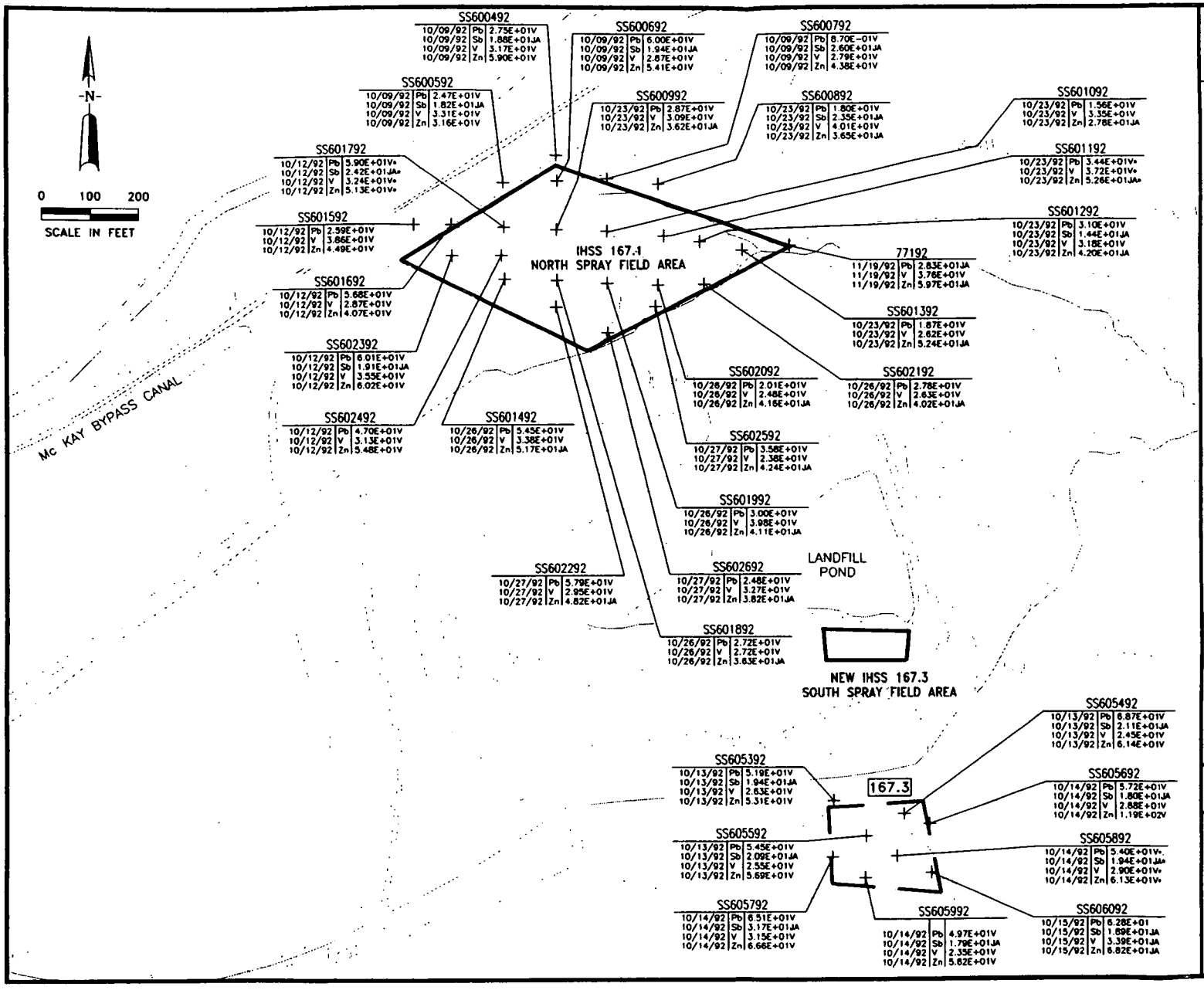
Slope factors are in units of Risk/pCi.

[1] Excluding Old Outfall (IHSS 143)

TABLE 3-6
OU6 CHEMICALS OF CONCERN
SURFACE SOIL [1]

Antimony
Silver
Vanadium
Zinc
Americium-241
Plutonium-239/240

[1] Excluding Old Outfall (IHSS 143)



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

HISTORICAL IHSS BOUNDARY (DOE 1987)

167.3

+ SURFACE SOIL SAMPLE SITE

SS602592

SS602592 ← LOCATION

2/26/92

SAMPLE DATE — ANALYTE — ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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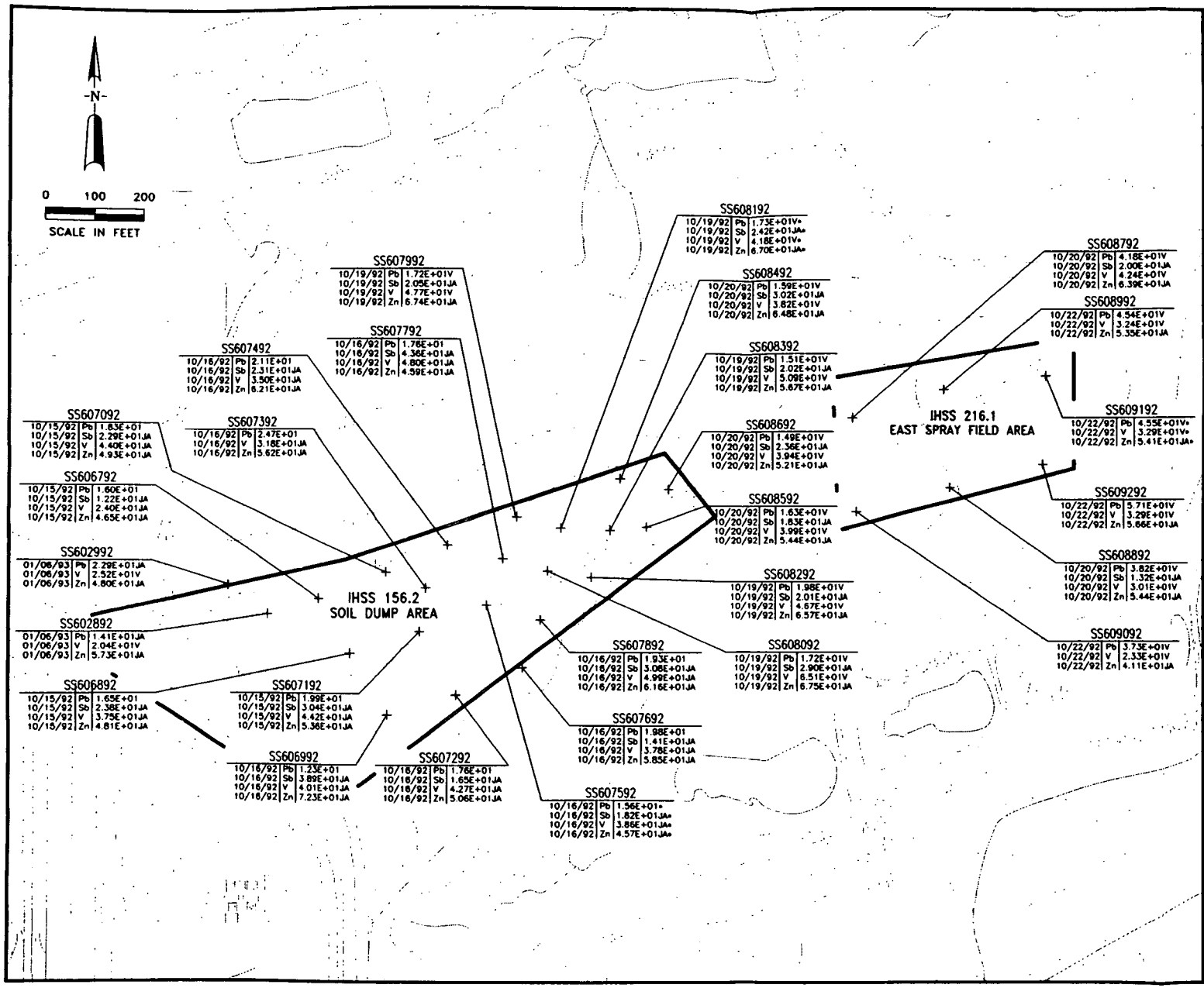
ANTIMONY, LEAD, VANADIUM, AND ZINC (IHSSs 167.1 AND 167.3) SURFACE SOILS

FIGURE 3-1 JUNE 1995

OU6TM100 1=200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

+ SURFACE SOIL SAMPLE SITE
SS602992

SS602992 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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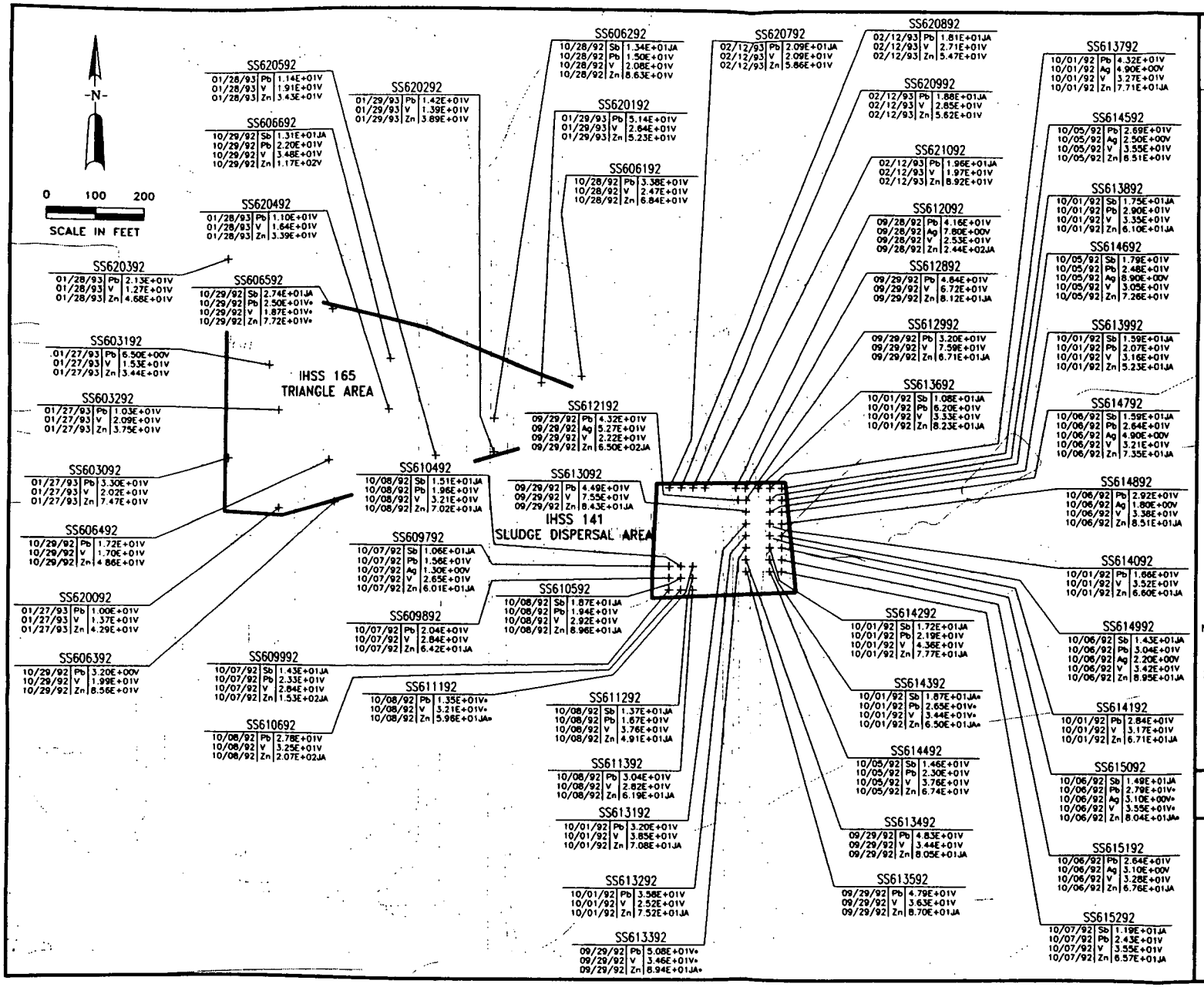
ANTIMONY, LEAD, VANADIUM, AND ZINC (IHSSs 156.2 AND 216.1) SURFACE SOILS

FIGURE 3-2 JUNE 1995

OU6TM101 1=200



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Effective Date:	
Organization:	Environmental Restoration

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

+ SURFACE SOIL SAMPLE SITE
SS612192

SS612192 ← LOCATION
2/28/92
SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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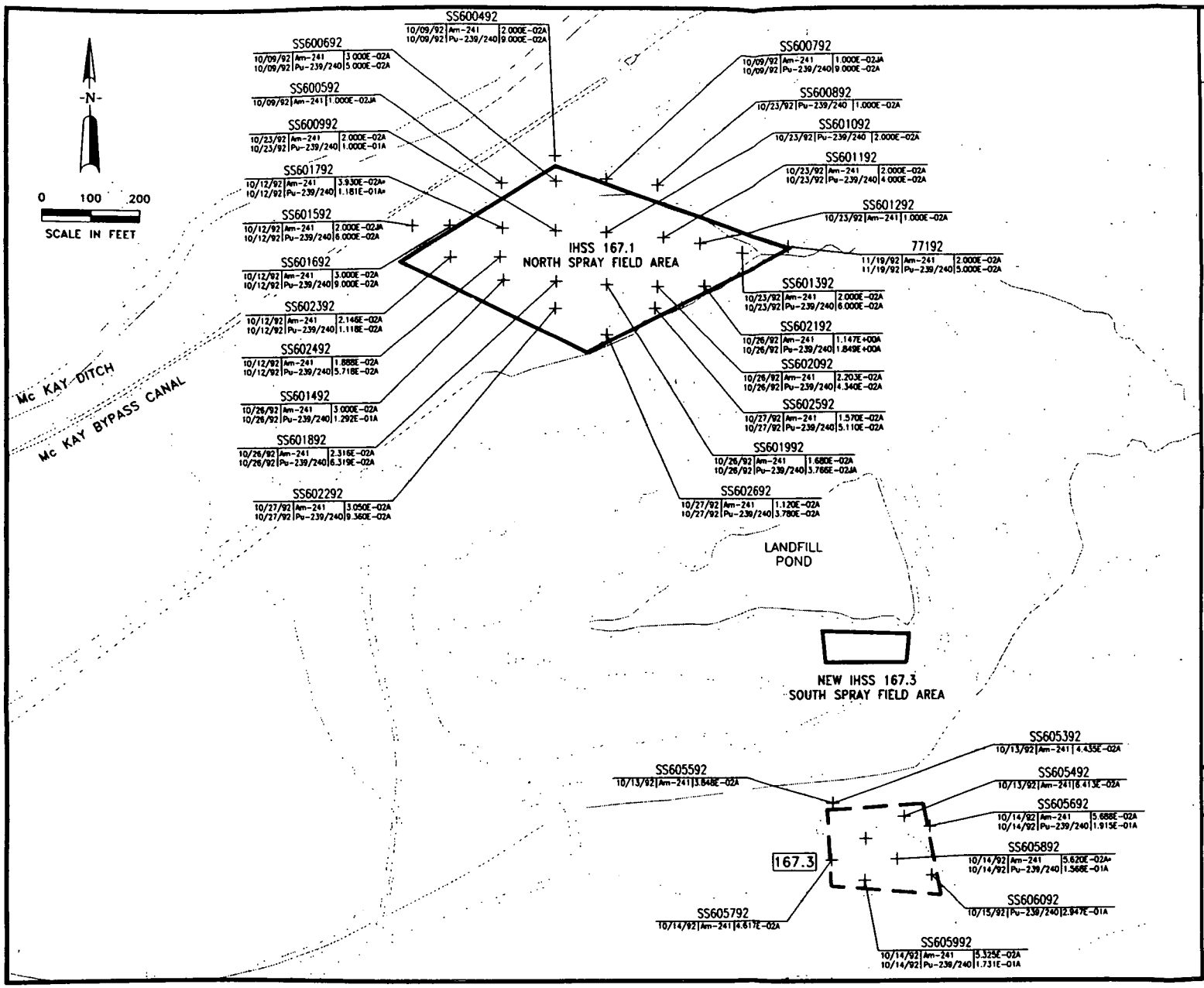
ANTIMONY, LEAD, SILVER, VANADIUM, AND ZINC (IHSSs 141 AND 165) SURFACE SOILS

FIGURE 3-3

JUNE 1995

OU6TM102 1=200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

HISTORICAL IHSS BOUNDARY (DOE 1987)

167.3

+ SURFACE SOIL SAMPLE SITE

SS602592

SS602592 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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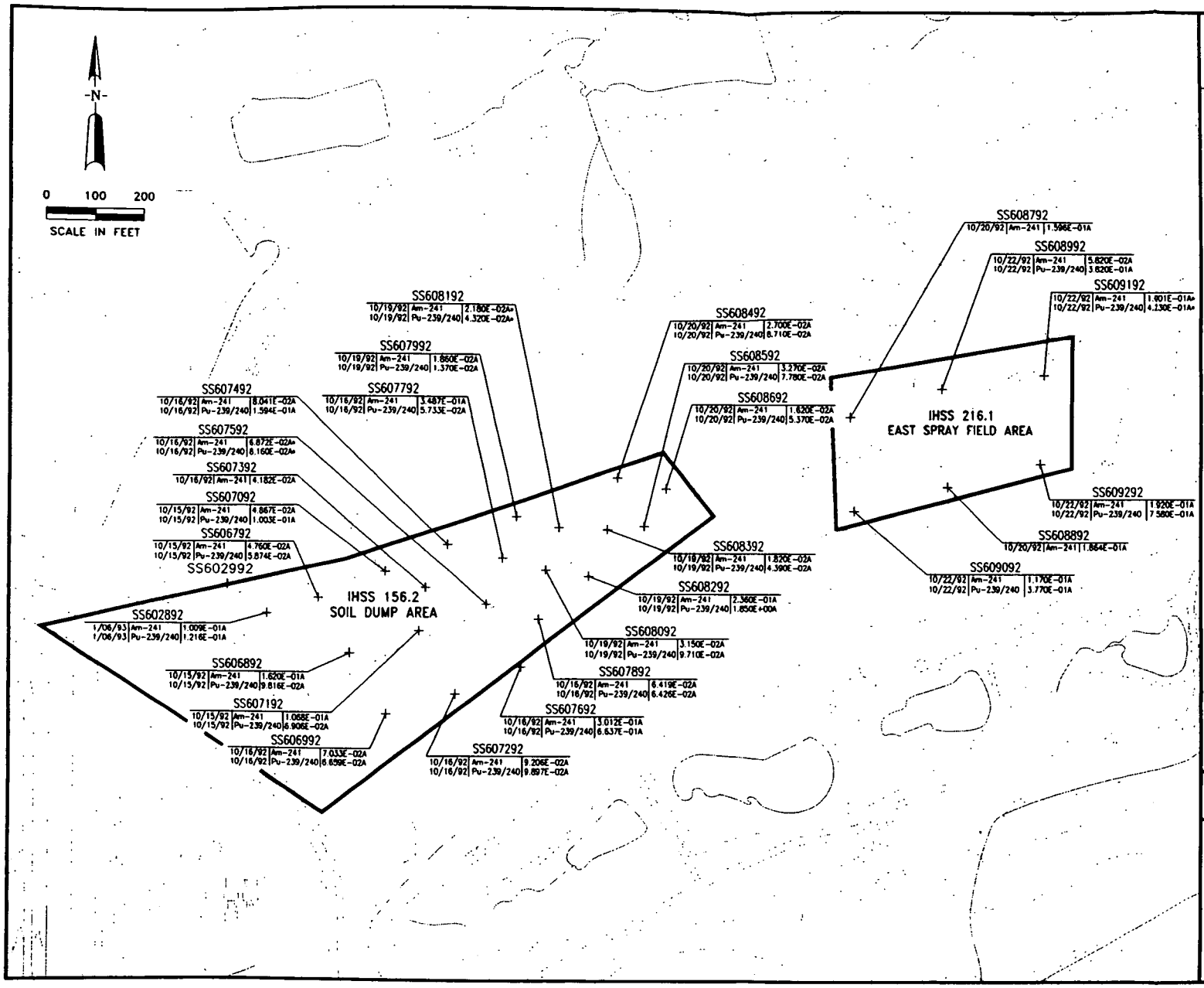
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
(IHSSs 167.1 AND 167.3)
SURFACE SOILS

FIGURE 3-4 JUNE 1995

OU6TM103 1-200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

+ SURFACE SOIL SAMPLE SITE
SS602992

SS608892 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:
1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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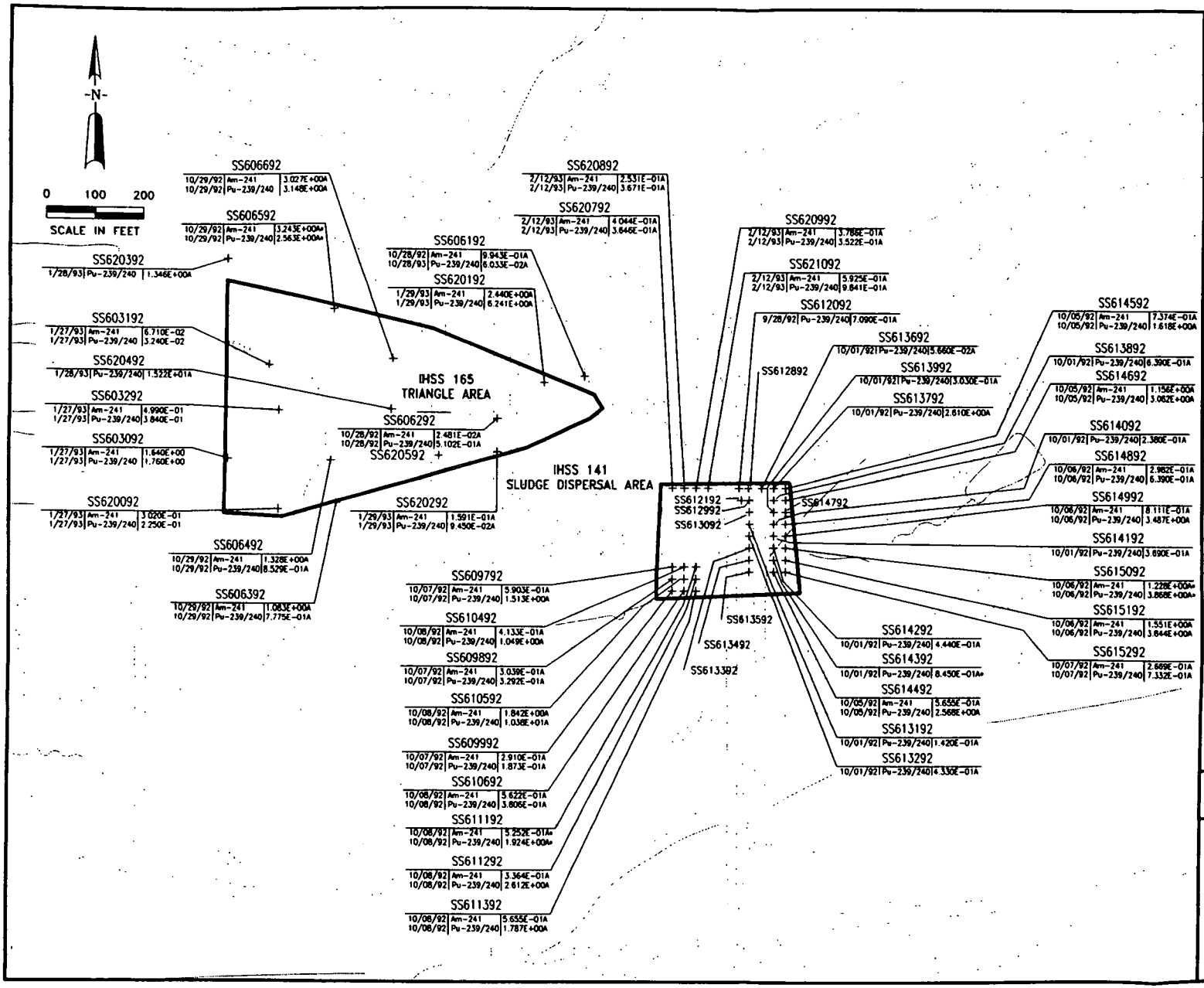
AMERICIUM-241 AND PLUTONIUM-239/240
(IHSSs 156.2 AND 216.1)
SURFACE SOILS

FIGURE 3-5 JUNE 1995

OU6TM104 1=200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

+ SURFACE SOIL SAMPLE SITE
SS612192

SS612192 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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AMERICIUM-241 AND PLUTONIUM-239/240
(IHSSs 141 AND 165)
SURFACE SOILS

FIGURE 3-6

JUNE 1995

OU6TM105 1=200

4.0 SUBSURFACE SOIL CHEMICALS OF CONCERN

4.1 SUBSURFACE SOIL DATA SET

COCs in subsurface soil were selected using data collected at all OU6 IHSSs where subsurface soil samples were collected except the Old Outfall (IHSS 143) because, as explained in Section 3.1, it is proposed to evaluate this IHSS separately from the BRA for OU6. Subsurface soil samples from the Old Outfall were therefore excluded from the data set for selecting OU-wide COCs. IHSSs included in the subsurface soil data set are IHSS 166 (Trenches A, B, and C), 156.2 (Soil Dump Area), 165 (Triangle Area), 167.1 (North Spray Field), and 216.1 (East Spray Field). All samples used for selection of COCs and in the background comparison were collected above the water table. Samples collected below the water table were not included in the data set to avoid including constituents transported by groundwater.

More than 200 subsurface soil samples were analyzed for metals and radionuclides. Approximately 380 samples were analyzed for volatile organic compounds (VOCs). SVOCs were also analyzed for in 34 samples collected at the Triangle Area (IHSS 165). The sampling and analytical program at each IHSS is summarized in Tables 2-1 and 2-2.

4.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Tables 4-1 and 4-2 summarize the maximum detected concentrations and detection frequencies for organic compounds and metals and the results of the background comparison for metals in OU6 subsurface soil samples. Background data for subsurface soils were taken from the Background Geochemical Characterization Report (DOE 1993). The statistical comparisons of inorganic results to background data are presented in detail in Attachment A.

Radionuclides were assumed to be detected at 100 percent frequency (both negative and positive results are included in the data set). Radionuclides above background levels are listed in the concentration/toxicity screen in Table 4-5.

Analytes that were detected at 5 percent or greater detection frequency and that were identified as PCOCs on the basis of the statistical background comparison or exceedances of

the background $UTL_{99/99}$ were included in concentration/toxicity screens to select OU-wide COCs in subsurface soil.

4.3 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for chemicals in subsurface soils are presented in Tables 4-3 through 4-5. All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs for quantitative risk assessment.

COCs are listed below and in Table 4-6:

OU-Wide Chemicals of Concern Subsurface Soil
Benzo(a)pyrene
Benzo(b)fluoranthene
Barium
Americium-241
Plutonium-239/240
Uranium-233/234
Uranium-238

The two PAH COCs, benzo(a)pyrene and benzo(b)fluoranthene, were detected in subsurface soils at IHSS 165 (Triangle Area) (Figure 4-1). The Triangle Area is the only IHSS at which subsurface soil samples were analyzed for SVOCs (except IHSS 143, Old Outfall, which was excluded from the determination of OU-wide COCs).

The occurrence of elevated levels of barium in subsurface soil is shown in Figures 4-1 through 4-4 (detected results that were not rejected). Barium was detected above background levels in subsurface soil at all IHSSs.

The occurrence of uranium isotopes, Pu-239/240, and Am-241 is shown in Figures 4-5 through 4-8 (results that were not U-qualified or rejected are shown).

PCOCs in subsurface soil that do not have EPA-established toxicity factors are lead and phenanthrene. These compounds cannot be evaluated in a toxicity- or risk-based screen to

select COCs. However, their potential contribution to overall risk will be evaluated qualitatively in the risk assessment for OU6. Data are inadequate to assess toxicity of phenanthrene, and at the maximum detected concentration (0.17 mg/kg) the potential for adverse effects is likely to be negligible. The maximum lead concentration of 85 mg/kg is well below EPA's screening level of 400 mg/kg for residential soil (EPA 1994c).

4.4 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

Maximum concentrations of 18 VOCs and SVOCs (detected at < 5 percent frequency) were compared to values equivalent to 1000 times chemical-specific RBCs for construction worker exposure to subsurface soil (DOE 1995b). The comparison to RBCs is used to identify special-case COCs, i.e., infrequently detected compounds that could pose a health risk if long-term exposure were to occur to the maximum detected concentration. The screen is discussed in Attachment B and the results for subsurface soil are presented in Table B-2.

None of the maximum concentrations of chemicals detected at low frequency in subsurface soil exceeded 1000 times the RBC. Therefore, no special-case COCs were identified for subsurface soils.

TABLE 4-1
ORGANIC COMPOUNDS AND METALS DETECTED AT 5% OR GREATER FREQUENCY SUBSURFACE SOIL [1]

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ? [2]
Organic Compounds:			
2-Butanone	3.7	22	
2-Chlorophenol	0.055	8	
Acetone	5.1	88	
Benzo(a)pyrene	0.13	8	
Benzo(b)fluoranthene	0.17	12	
Benzoic acid	0.26	19	
Bis(2-ethylhexyl)phthalate	0.11	27	
Fluoranthene	0.45	27	
Phenanthrene	0.17	12	
Pyrene	0.19	23	
Toluene	1.1	90	
Metals:			
Aluminum	24100	100	No
Antimony	21.65	7	No
Arsenic	10.9	99	No
Barium	2970	100	Yes
Beryllium	2.1	86	No
Cadmium	1.8	7	No
Cesium	33.7	71	No
Chromium	217	98	Yes
Cobalt	21.4	95	No
Copper	52.1	100	No
Lead	84.9	100	Yes
Lithium	29.8	89	No
Manganese	907	100	No
Mercury	0.93	28	No
Nickel	41.5	64	No
Selenium	1.3	8	No
Strontium	506	100	Yes
Thallium	0.69	34	No
Vanadium	118	100	Yes
Zinc	706	100	Yes

[1] Excluding Old Outfall (IHSS 143)
[2] Based on background comparison (Appendix A)

TABLE 4-2
ORGANIC COMPOUNDS AND METALS DETECTED AT LESS THAN 5% FREQUENCY SUBSURFACE SOIL [1]

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ? [2]
Organic Compounds:			
1,4-Dichlorobenzene	0.064	4	
4-Methyl-2-pentanone	0.004	1	
Acenaphthene	0.056	4	
Benzene	0.006	1	
Benzo(a)anthracene	0.099	4	
Benzo(k)fluoranthene	0.06	4	
Chlorobenzene	0.074	0.3	
Chloroform	0.002	0.3	
Chrysene	0.12	4	
Diethyl phthalate	0.3	4	
Di-n-octylphthalate	0.072	4	
Indeno(1,2,3-cd)pyrene	0.099	4	
Methylene chloride	0.007	3	
Pentachlorophenol	0.66	4	
Phenol	0.055	4	
Styrene	0.001	0.3	
Xylenes, total	0.002	0.3	
Trichloroethene	0.021	2	
Metals:			
Molybdenum	27.9	2	No
Silver	2.7	0.4	No
Tin	57.8	3	No

[1] Excluding Old Outfall (IHSS 143)

[2] Based on background comparison (Appendix A)

TABLE 4-3
CONCENTRATION/TOXICITY SCREEN
SUBSURFACE SOIL[1]
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Barium	2970	1.4E-04	7.0E-02	2.1E+07	1.0E+00	99.9
Vanadium	118	n/a	7.0E-03	1.7E+04	7.9E-04	0.1
Zinc	706	n/a	3.0E-01	2.4E+03	1.1E-04	0.0
Strontium	506	n/a	6.0E-01	8.4E+02	4.0E-05	0.0
Chromium	217	n/a	1.0E+00	2.2E+02	1.0E-05	0.0
Acetone	5.1	n/a	1.0E-01	5.1E+01	2.4E-06	0.0
2-Butanone	3.7	3.0E-01	6.0E-01	1.2E+01	5.8E-07	0.0
Fluoranthene	0.45	n/a	4.0E-02	1.1E+01	5.3E-07	0.0
2-Chlorophenol	0.055	n/a	5.0E-03	1.1E+01	5.2E-07	0.0
Toluene	1.1	1.1E-01	2.0E-01	1.0E+01	4.7E-07	0.0
Pyrene	0.19	n/a	3.0E-02	6.3E+00	3.0E-07	0.0
Bis(2-ethylhexyl)phthalate	0.11	n/a	2.0E-02	5.5E+00	2.6E-07	0.0
Benzoic acid	0.26	n/a	4.0E+00	6.5E-02	3.1E-09	0.0
Total Risk Factor				2.1E+07		

RfDs are in units of mg/kg-day.
n/a = not available.
[1] Excluding Old Outfall (IHSS 143)

TABLE 4-4
CONCENTRATION/TOXICITY SCREEN
SUBSURFACE SOIL[1]
CARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Benzo(a)pyrene	0.13	n/a	7.3E+00	9.5E-01	8.8E-01	88.3
Benzo(b)fluoranthene	0.17	n/a	7.3E-01	1.2E-01	1.2E-01	11.5
Bis(2-ethylhexyl)phthalate	0.11	n/a	1.4E-02	1.5E-03	1.4E-03	0.1
Total Risk Factor				1.1E+00		

Slope factors are in units of 1/(mg/kg-day).
n/a = not available.
[1] Excluding Old Outfall (IHSS 143)

TABLE 4-5
CONCENTRATION/TOXICITY SCREEN
SUBSURFACE SOIL
RADIONUCLIDES

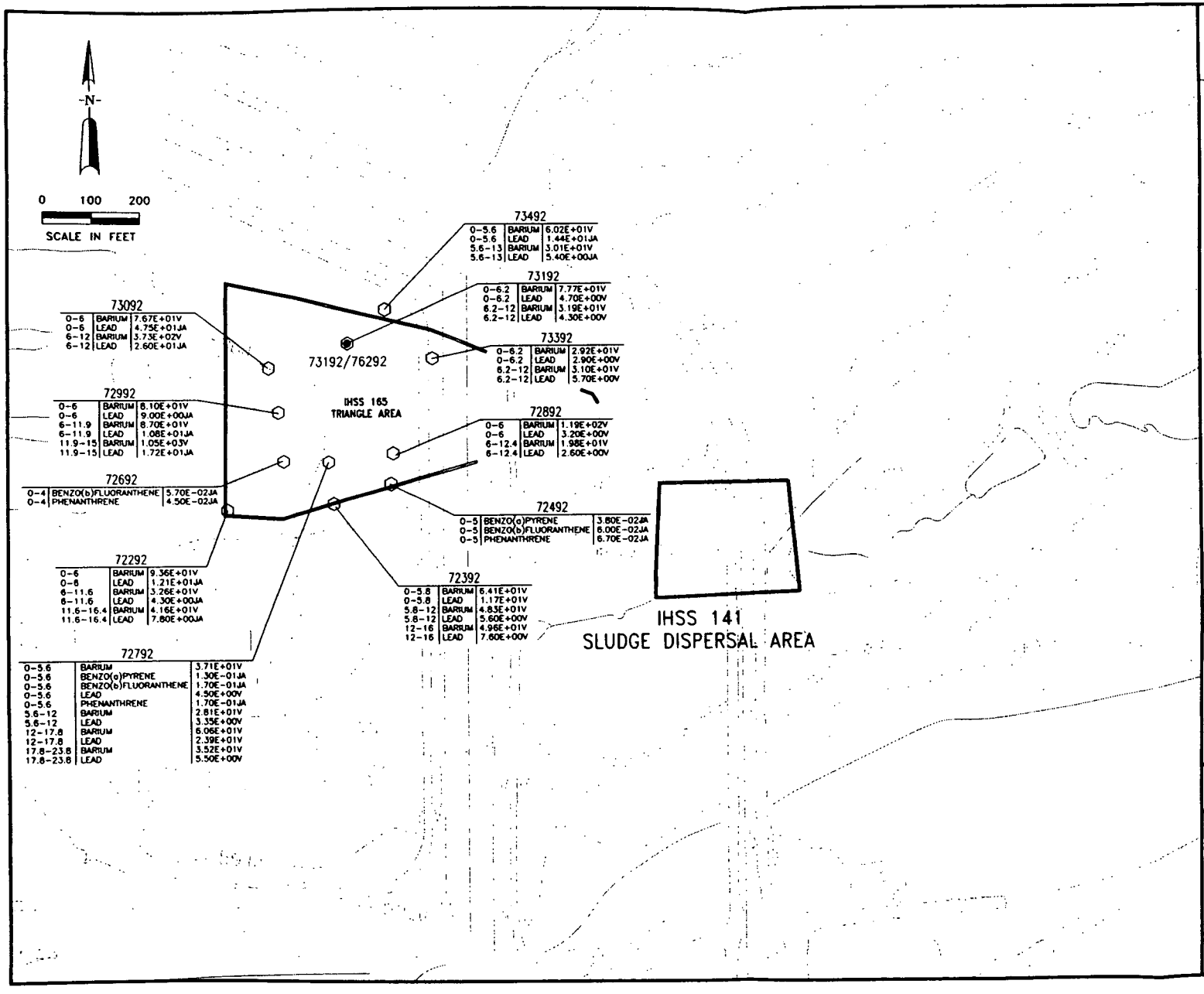
Chemical	Maximum Activity (pCi/g)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Uranium-238	141	1.2E-08	6.2E-11	1.7E-06	9.5E-01	95.1
Uranium-233/234	3.05	1.4E-08	4.4E-11	4.3E-08	2.4E-02	2.4
Plutonium-239/240	0.88	2.8E-08	3.2E-10	2.5E-08	1.4E-02	1.4
Americium-241	0.44	3.9E-08	3.3E-10	1.7E-08	9.6E-03	1.0
Uranium-235	0.16	1.3E-08	4.7E-11	2.1E-09	1.2E-03	0.1
Total Risk Factor				1.8E-06		

Slope factors are in units of 1/pCi.

TABLE 4-6
OU6 CHEMICALS OF CONCERN
SUBSURFACE SOIL[1]

Benzo(a)pyrene
Benzo(b)fluoranthene
Barium
Americium-241
Plutonium-239/240
Uranium-233/234
Uranium-238

[1] Excluding Old Outfall (IHSS 143)



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

73392 ⬡ BOREHOLE

73192/76292 ◉ MONITORING WELL & BOREHOLE (BEDROCK)

73392 ← LOCATION

0-2

SAMPLE INTERVAL (ft) | ANALYTE | ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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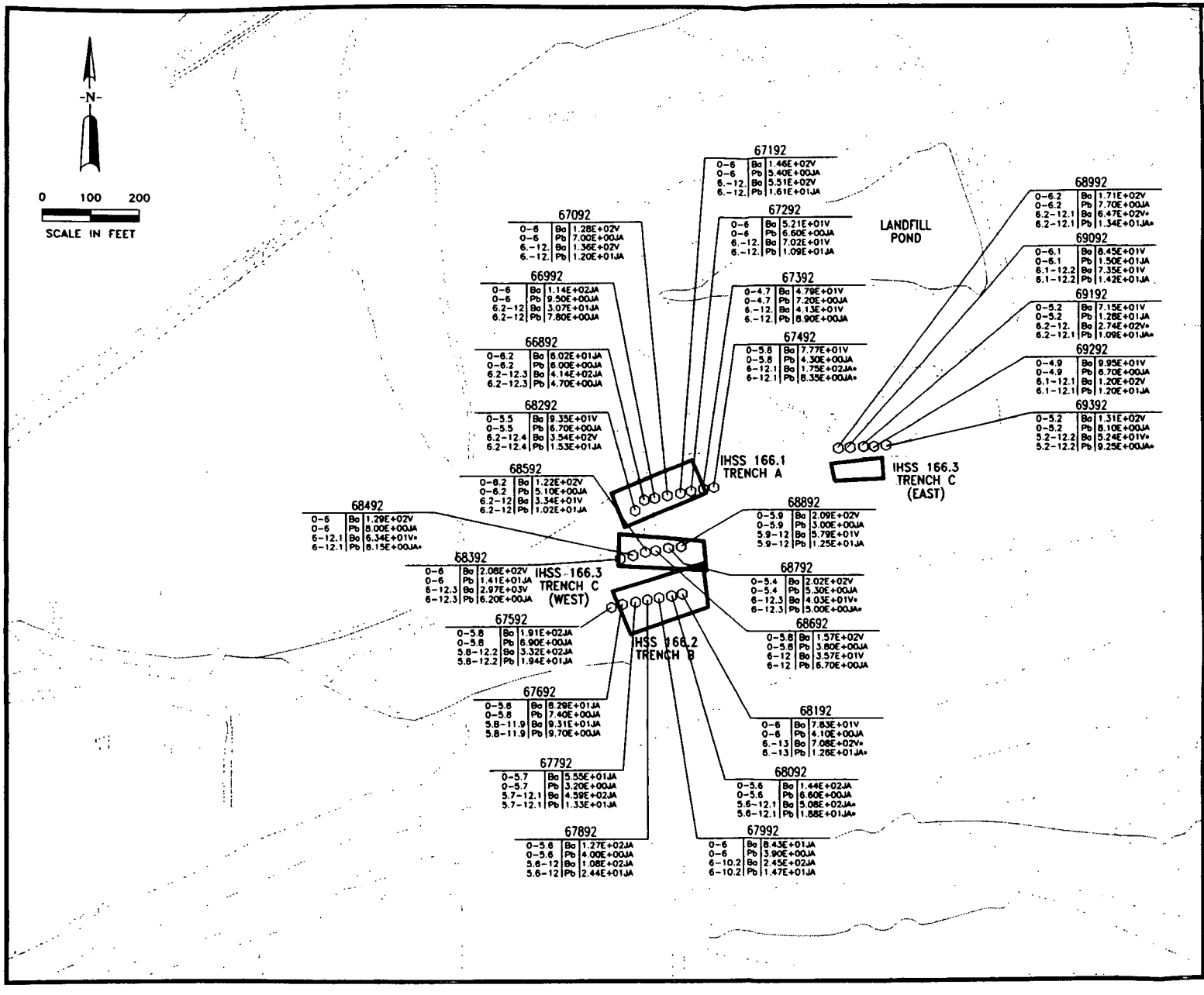
BENZO(a)PYRENE, BENZO(b)FLUORANTHENE, PHENANTHRENE, BARIUM, AND LEAD (IHSSs 141 AND 165) SUBSURFACE SOILS

FIGURE 4-1 JUNE 1995

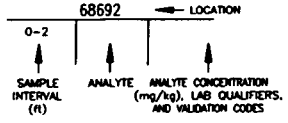
OU6TM106 1=200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

68692 ○ BOREHOLE



NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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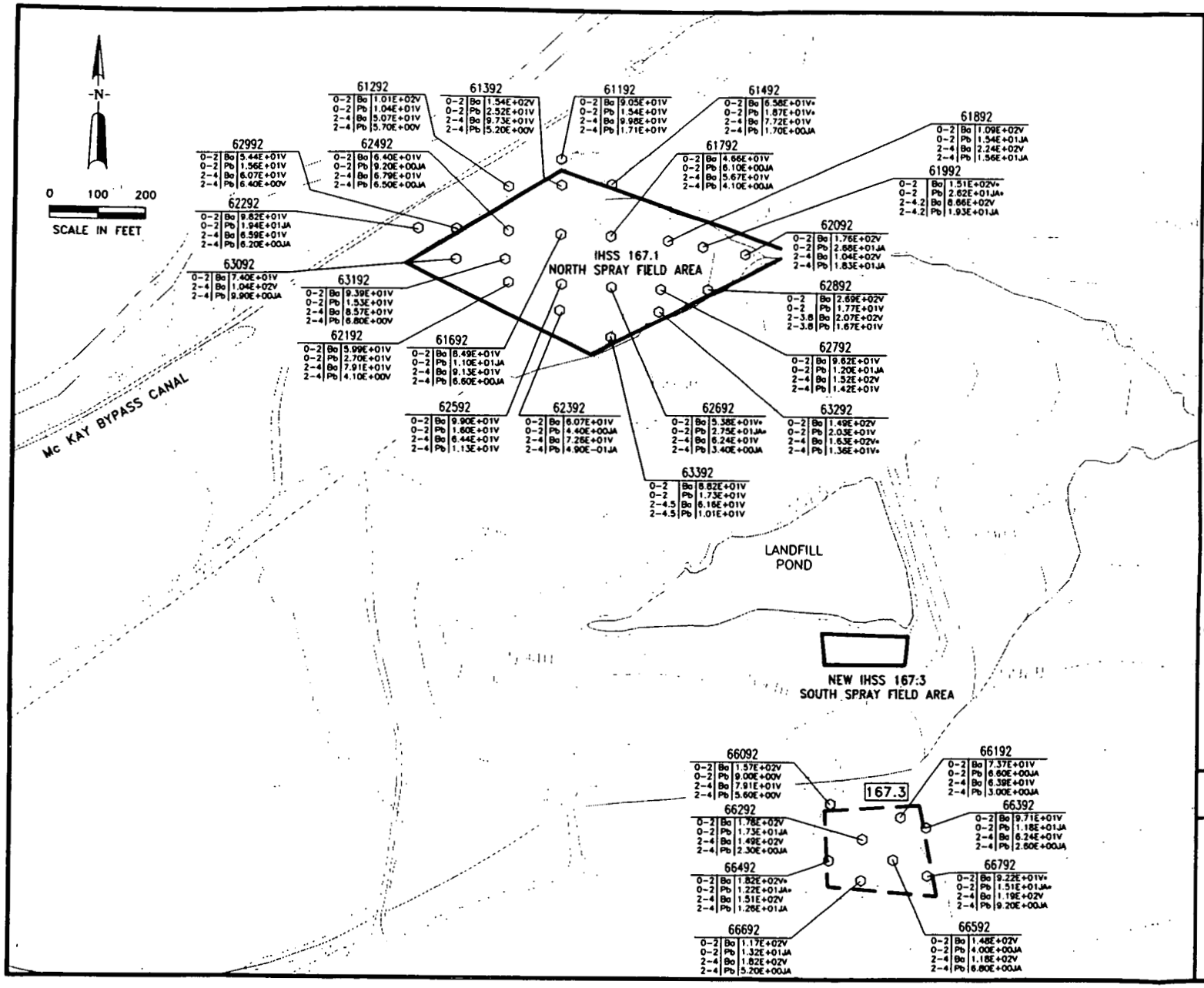
TECHNICAL MEMORANDUM NO. 4

BARIUM AND LEAD
(IHSSs 166.1 – 166.3)
SUBSURFACE SOILS

FIGURE 4-2 JUNE 1995

OU6TM107 1=200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

HISTORICAL IHSS BOUNDARIES (DOE 1987)

167.3

62892 ○ BOREHOLE

62892 ← LOCATION

0-2

SAMPLE INTERVAL (ft) | ANALYTE | ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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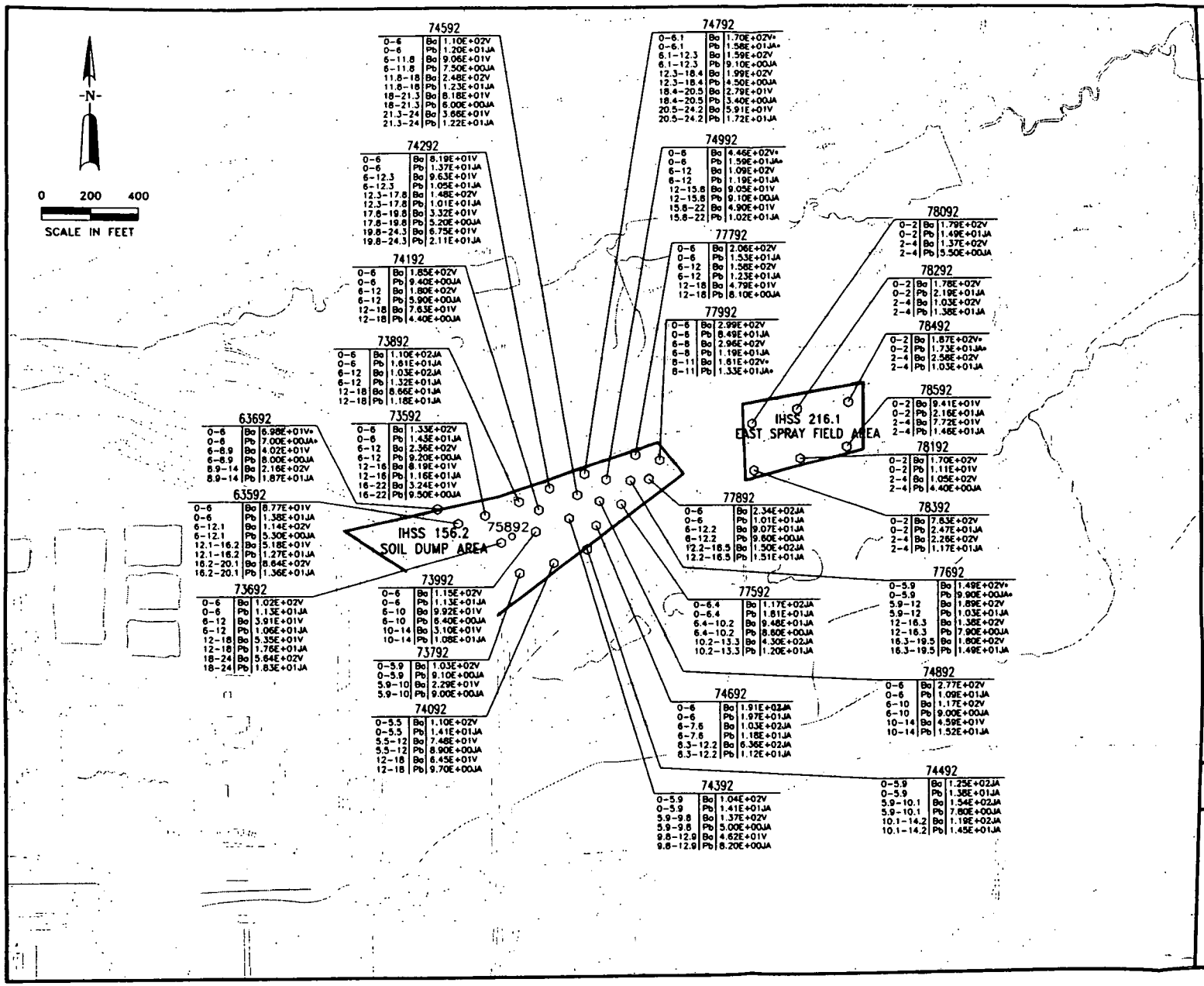
BARIUM AND LEAD
(IHSSs 167.1 AND 167.3)
SUBSURFACE SOILS

FIGURE 4-3 JUNE 1995

OU6TM108 1=200



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

73592 ○ BOREHOLE

75892 ○ MONITORING WELL (ALLUVIAL)

78392 ← LOCATION

0-2 ↑ SAMPLE INTERVAL (ft)

↑ ANALYTE

↑ ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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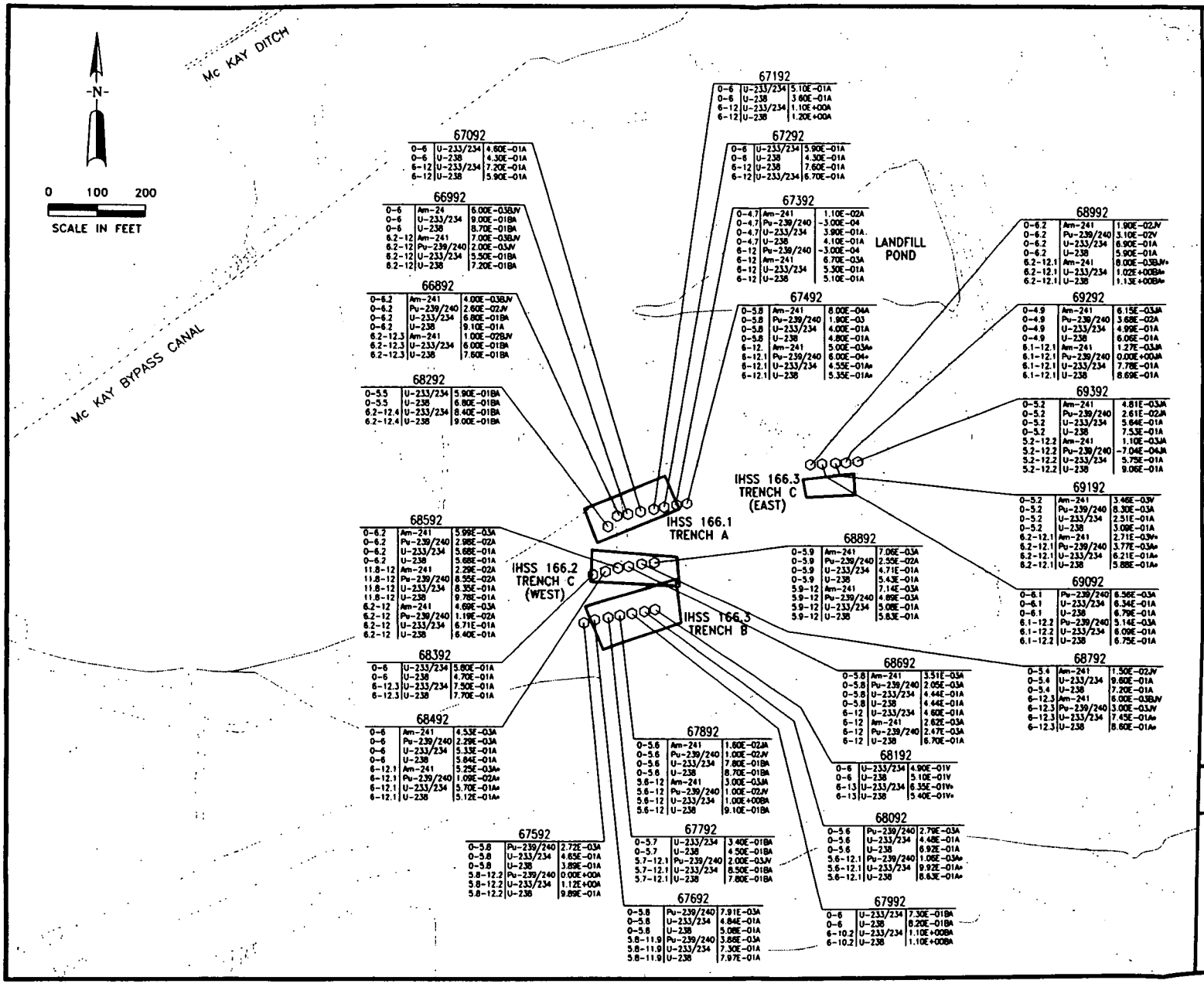
BARIUM AND LEAD
(IHSSs 156.2 AND 216.1)
SUBSURFACE SOILS

FIGURE 4-4

JUNE 1995

OU6TM109 1=400



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

68692 O BOREHOLE

68592 ← LOCATION

0-2 — SAMPLE INTERVAL (ft)

ANALYTE

ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

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2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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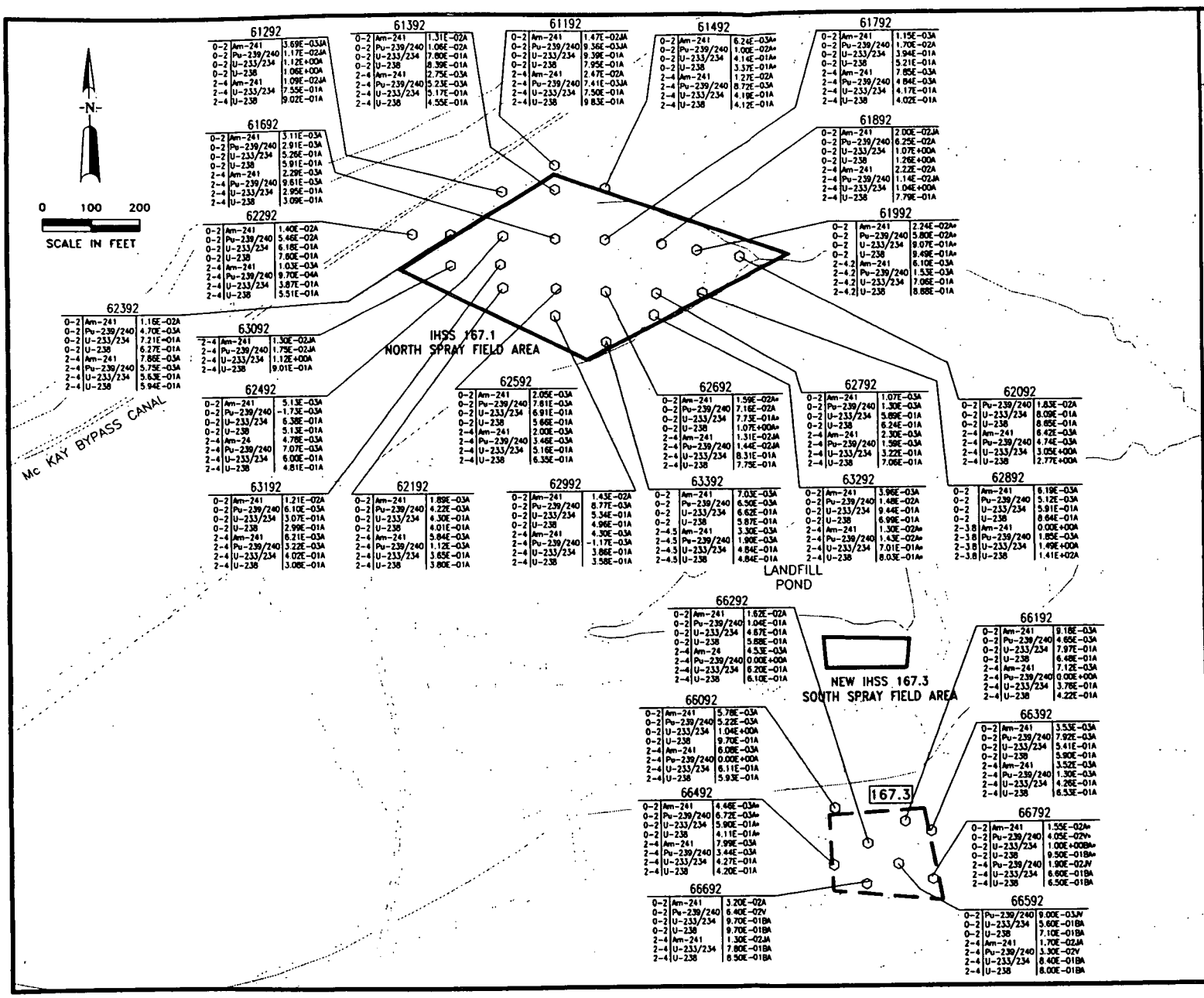
BARIUM AND LEAD
(IHSSs 166.1 - 166.3)
SUBSURFACE SOILS

FIGURE 4-5

JUNE 1995

OU6TM110 1=200



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

HISTORICAL IHSS BOUNDARIES (DOE 1987)

167.3

62892 O BOREHOLE

62892 ← LOCATION

0-2 ↑ SAMPLE INTERVAL (ft)

↑ ANALYTE

↑ ANALYTE ACTIVITIES (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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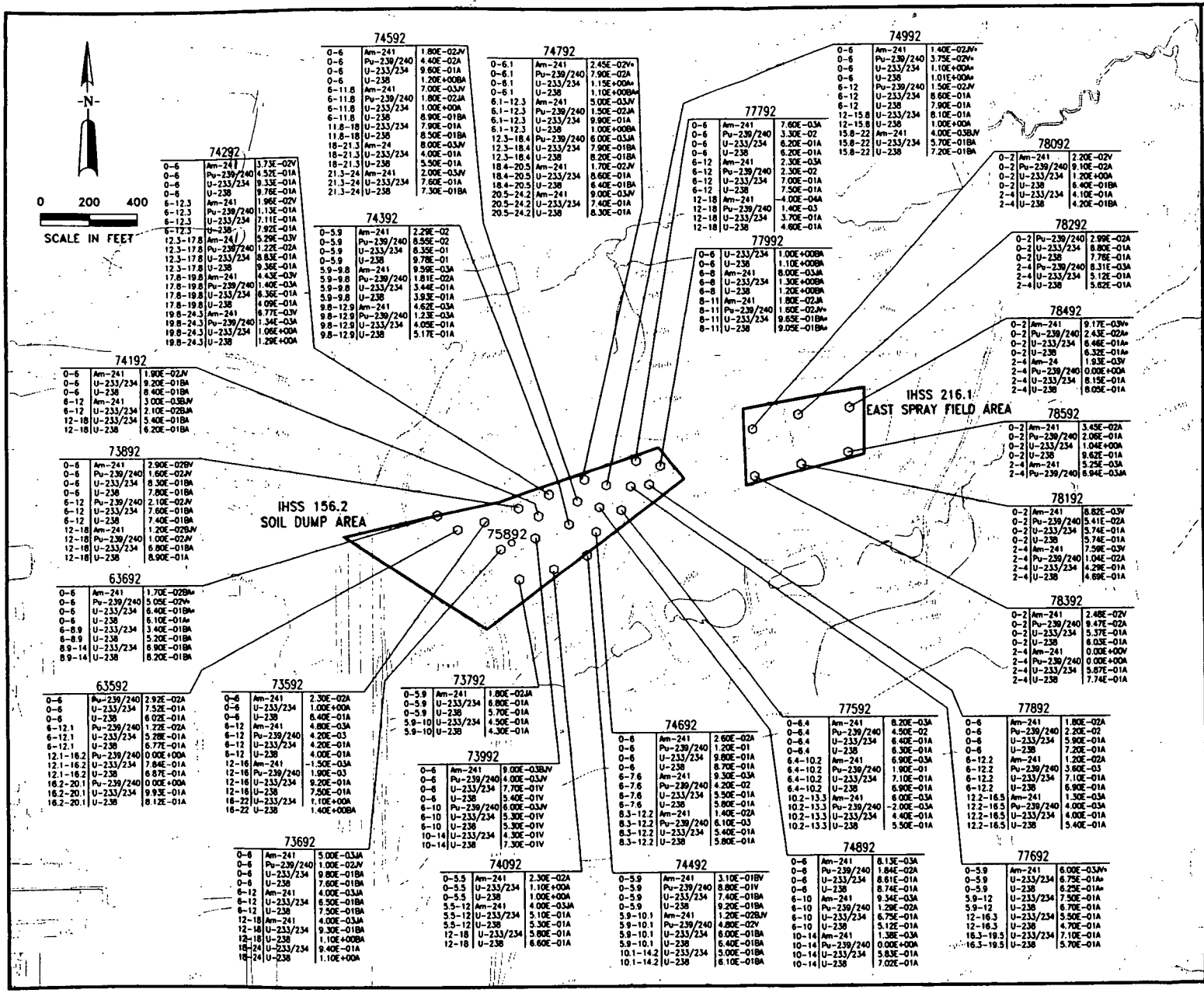
AMERICIUM-241, PLUTONIUM-239/240, URANIUM-233/234, AND URANIUM-238 (IHSSs 167.1 AND 167.3) SUBSURFACE SOILS

FIGURE 4-6 JUNE 1995

OU6TM111 1=200



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

73592 ○ BOREHOLE

75892 ○ MONITORING WELL (ALLUVIAL)

78392 ← LOCATION

0-2 SAMPLE INTERVAL (ft)

ANALYTE

ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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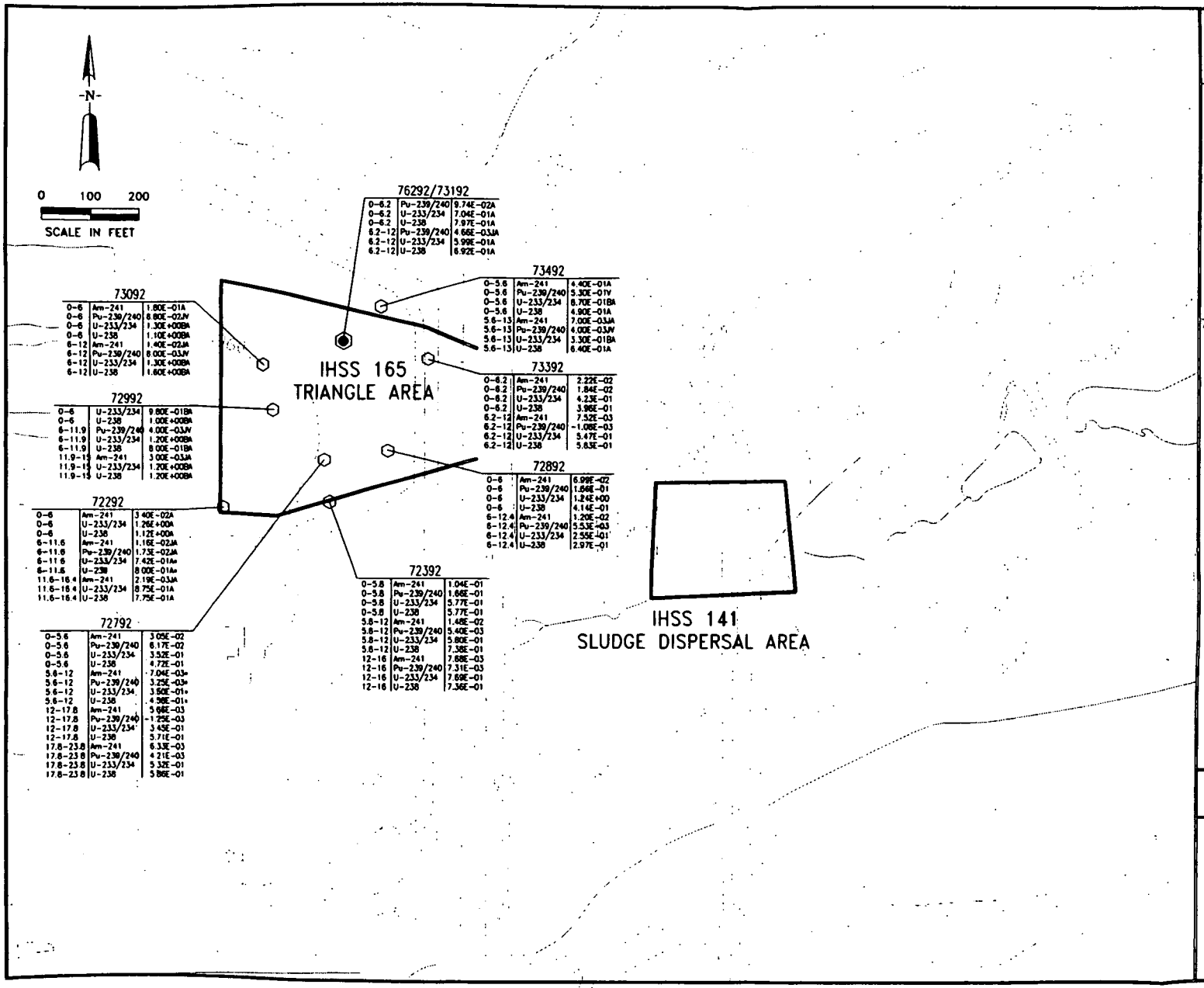
AMERICIUM-241, PLUTONIUM-239/240, URANIUM-233/234, AND URANIUM-238 (IHSSs 156.2 AND 216.1) SUBSURFACE SOILS

FIGURE 4-7 JUNE 1995

OU6TM112 1=400



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

73392 BOREHOLE

76292/73192 BEDROCK MONITORING WELL/BOREHOLE

73392 ← LOCATION

0-2

SAMPLE INTERVAL (ft) | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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AMERICIUM-241, PLUTONIUM-239/240, URANIUM-233/234, AND URANIUM-238 (IHSSs 141 AND 165) SUBSURFACE SOILS

FIGURE 4-8 JUNE 1995

OU6TM113 1=200

5.0 GROUNDWATER CHEMICALS OF CONCERN

5.1 GROUNDWATER DATA SET

Monitoring wells in OU6 were installed in the Upper Hydrostratigraphic Unit (UHSU). The UHSU consists of unconsolidated surface deposits and weathered claystones. The UHSU in OU6 is believed to exist predominantly under unconfined conditions and groundwater seepage occurs in limited areas. COCs in groundwater were selected using data collected from first quarter 1991 through fourth quarter 1993. Groundwater samples were analyzed for metals, radionuclides, volatile organic compounds, semivolatile organic compounds, and pesticides/ PCBs. The sampling and analytical programs for wells at each IHSS are summarized in Tables 2-1 and 2-2.

5.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Tables 5-1 and 5-2 summarize the maximum detected concentrations, detection frequencies, and results of background comparison for analytes detected in groundwater. The background comparison and maximum concentrations shown for metals and radionuclides are based on results from unfiltered samples. Background data for UHSU groundwater were taken from the Background Geochemical Characterization Report (DOE 1993).

The statistical background comparisons for inorganics are presented in detail in Attachment A. Inspection of Table 5-1 and the Attachment A tables for unfiltered and filtered metals in groundwater reveal that nearly all metals, including typical rock-forming elements such as aluminum, calcium, iron, and sodium, were identified as being above background levels. Metals as PCOCs are discussed further in Section 5.3.

Radionuclides are assumed to be detected at 100 percent frequency (that is, both negative and positive results are used in the data set). Radionuclides above background levels are listed in the concentration/toxicity screen in Table 5-5.

Several organic contaminants were detected at low concentrations in some groundwater samples. Maximum concentrations generally ranged from 0.1 µg/L (styrene) to 150 µg/L

(trichloroethene); vinyl chloride was detected at 860 µg/L. Detection frequencies ranged from 0.4 percent (styrene) to 21 percent (bis(2-ethylhexyl)phthalate (see Tables 5-1 and 5-2).

5.3 ELIMINATION OF METALS AS CONTAMINANTS OF CONCERN IN GROUNDWATER

As shown in Table 5-1 and Attachment A, nearly all metals analyzed for in unfiltered groundwater samples were identified as being above background levels, including aluminum, calcium, iron, potassium, and sodium, which are common rock-forming minerals and not likely to be environmental contaminants in OU6. Most metals failed the formal statistical comparison and had anywhere from 17 to 42 results above the background $UTL_{99/99}$. Only four metals (cesium, molybdenum, thallium, and tin) were found to be within background levels (see Table A-11).

Because it is unusual, even at hazardous waste sites, to see so many metals above background levels, an evaluation was conducted to ascertain whether the elevated metals concentrations in OU6 groundwater samples were due to factors other than environmental contamination. The evaluation consisted of (1) examining the spatial and temporal distribution of selected metals and (2) examining the relationship of elevated metals concentrations as a whole with organic contamination and with total suspended and total dissolved solids.

The conclusion of the evaluation was that the elevated metals concentrations are not related to environmental contamination but rather to local geochemical conditions and to suspended solids in the groundwater samples. Therefore, metals should not be considered COCs in groundwater in OU6. Evidence supporting this conclusion is presented below.

- Strong correlation of elevated metals with Total Suspended Solids (TSS) and Total Dissolved Solids (TDS): Elevated metals concentrations, and the number of elevated metals in a sample, strongly correlate with high TSS and TDS in the samples. TSS and TDS concentrations by well number are listed in Attachment C. TSS concentrations in many samples ranged as high as 1100 to 21,000 mg/L. TDS concentrations ranged as high as 1000 to 7600 mg/L. These samples had the highest metals concentrations as well. High TSS and TDS appear to be the largest factor contributing to elevated metals

concentrations in groundwater samples. High TSS is not a sign of contamination but rather of sample turbidity resulting from well development and sampling procedures. As an example, samples from well 7287, which is located at Trench A (IHSS 166.1), contained numerous elevated metals in several sampling rounds and had TSS ranging as high as 17,000 mg/L (average = 3880 mg/L). Field notes indicate all samples were cloudy, muddy, or colored. On the other hand, samples from well B206489, which is adjacent to well 7287, had TSS ranging from 9 to 81 mg/L, and had only a single occurrence of a metal result exceeding background UTL. Field notes indicate all but one sample were clear.

As examples of the correlation of elevated metals to TSS and TDS, Figures 5-1 through 5-3 show scatterplots of aluminum, arsenic, and barium to TSS and TDS. These three metals are used as examples because of their high relative risk at the maximum concentrations found in OU6.

- Presence of naturally occurring zones of high manganese and other ions: The results of the background comparison suggest that local geochemical conditions in OU6 may be different than those at the background sampling locations. The observances of elevated manganese and of elevated concentrations of iron, cobalt, lead, zinc, copper, nickel, and barium, which can associate with manganese oxides (Hem 1989), suggest the presence of naturally occurring mineralization in OU6 that is absent in the background sampling locations. Elevated metals concentrations occur in both filtered and unfiltered samples. Recent investigations at the RFETS indicate wide and irregular distribution of dissolved manganese at high concentrations in UHSU groundwater; only a few of the background wells used for the Background Characterization Report were located in the recently identified areas of elevated manganese (DOE 1995c). Therefore, it is probable that the background comparison gives misleading results and that the elevated metals in OU6 groundwater are due to local geochemical conditions.

- Wide distribution of elevated metals and absence of spatial pattern: Elevated concentrations of unfiltered and filtered metals were observed in samples

widely distributed across the OU, with no relation to contaminant sources. Figures 5-4 through 5-8 show concentrations of unfiltered metals (excluding calcium, iron, magnesium, potassium, silicon, and sodium which are essential nutrients and common rock-forming elements) in wells in several areas of OU6. For example, at wells 41691 and 0486 at Indiana Street (Figure 5-8), 19 metals--aluminum, antimony, barium, beryllium, cadmium, cobalt, chromium, copper, iron (not shown), lead, mercury, magnesium (not shown), manganese, nickel, potassium (not shown), silver, strontium, vanadium, and zinc--exceeded background levels (unfiltered results). However, in the nearest wells upgradient to 41691 and 0486, very few metals in unfiltered samples exceeded background levels. For example, in upgradient well 41091 (Figure 5-5), only barium, potassium (not shown), and manganese exceeded background levels. In well 1186, five metals exceeded background levels (Figure 5-5). In upgradient well 3886, only calcium (not shown), magnesium (not shown), sodium (not shown), and strontium exceeded background levels (Figure 5-6). As is evident in Figures 5-4 through 5-8, there are numerous other examples of erratic spatial occurrence of samples having ten or more metals with elevated concentrations. The absence of a meaningful spatial pattern (such as concentration gradients) indicates that the occurrence of elevated metals concentrations is not related to contaminant plumes and that they are not associated with identifiable contaminant sources.

- No correlation of elevated metals with VOC contamination: Elevated metals concentrations in groundwater can result from the solubilizing effects of organic contamination. However, this does not appear to be true in OU6. Low concentrations of chlorinated solvents and other VOCs such as xylenes and toluene were detected at some sampling locations. Concentrations of VOCs in wells in several areas of OU6 are show in Figures 5-9 through 5-13. Comparison of metals data shown in Figures 5-4 through 5-8 with organic data shown in Figures 5-9 through 5-13 shows that elevated metals concentrations were observed in some samples from some wells with organic contamination but not in others. Elevated metals concentrations were also observed in many wells with no VOC contamination. Therefore, it is concluded that the metals concentrations are unrelated to organic contamination.

- Absence of temporal pattern: The temporal occurrence of concentrations above background $UTL_{99/99}$ was evaluated for selected metals. For example, concentrations of total antimony exceeded the background $UTL_{99/99}$ in 10 OU6 wells at which multiple (4 to 13) sampling rounds were conducted (Figures 5-4 through 5-8). However, in seven of the wells, the $UTL_{99/99}$ was exceeded in only one sampling event, in two wells the $UTL_{99/99}$ was exceeded in two sampling events, and in one well the $UTL_{99/99}$ was exceeded in three sampling events out of ten. This pattern (i.e., temporally isolated occurrences of concentrations in excess of background $UTL_{99/99}$) was found to be true for many analytes. The temporal isolation of elevated concentrations of metals at a single sampling location is inconsistent with an assumption of contamination.

It is concluded that elevated metals concentrations in OU6 groundwater samples are related to suspended solids in the sample and to naturally occurring geochemical characteristics such as high manganese zones. Metals are therefore eliminated from further consideration as COCs in groundwater in OU6.

5.4 ELIMINATION OF BIS(2-ETHYLHEXYL)PHTHALATE, CESIUM-137, AND STRONTIUM-89,90 AS CHEMICALS OF CONCERN IN GROUNDWATER

Review of the analytical results and occurrence of bis(2-ethylhexyl)phthalate, cesium-137, and strontium-89,90 in groundwater indicates that these analytes should not be included in the selection of OU-wide COCs in groundwater. The evidence supporting this conclusion is presented below.

Bis(2-ethylhexyl)phthalate: Bis(2-ethylhexyl)phthalate is a common field and laboratory contaminant because it is a constituent of plastic products used in sampling and analysis. This compound was detected in 3 of 14 groundwater samples submitted for SVOC analysis and it is the only SVOC detected in the samples, except for one result for diethylphthalate. All results were estimated values below the quantitation limit of 0.010 mg/L. The three positive results were temporally isolated (detected in only one of multiple sampling rounds) and were from spatially distant wells:

Bis(2-ethylhexyl)phthalate Detections in Groundwater

Well No.	Location	Sample Date	Concentration, mg/L
77492	IHSS 143 (Old Outfall)	3/22/93	ND
		4/21/93	ND
		8/4/93	0.008 J
41691	Indiana Street	12/7/91	0.003 J
		4/1/92	ND
41091	North Walnut Creek, downgradient of Pond A-4	12/20/91	ND
		3/17/92	0.004 J
		8/13/93	ND

ND = Not detected (quantitation limit = 0.010 mg/L).

The few detections are temporally and spatially isolated, and the data do not support an assumption of contamination. Therefore, this compound is eliminated from further consideration as a contaminant in groundwater.

Cesium-137: Results for cesium-137 in unfiltered groundwater samples were not found to be significantly different than background levels according to the four formal statistical tests described in Attachment A. However, 2 results out of 68 exceeded the background $UTL_{99/99}$ of 1.065 pCi/L: 1.8 pCi/L in well 1786 upgradient of the A series ponds and 4.5 pCi/L at well 1286 in pond A-3. Consequently, this analyte was identified as a PCOC. However, the two exceedances of the background UTL are temporally isolated events and all other results at these locations were within background range.

Analytical results for cesium-137 at wells 1786 and 1286 are summarized below:

Cesium-137

Temporal Evaluation at Wells with Exceedances of Background $UTL_{99/99}$

Well	Sample Date	Activity, pCi/L
1786	10/10/91	0.28
	11/14/91	0.56
	1/20/92	0.40
	6/11/92	0.53
	7/12/93	1.82
1286	6/20/91	0.63
	1/10/92	0.19
	5/14/92	4.50

Background mean plus 2 standard deviation = 0.782 pCi/L; background maximum = 1.16 pCi/L; background $UTL_{99/99}$ = 1.065 pCi/L.

Because only 2 results out of 68 exceeded the background range and because they were temporally isolated events, cesium-137 is not considered a contaminant in groundwater, and it is not evaluated further.

Strontium-89,90: Only three groundwater samples were analyzed for strontium-89,90. The results were 0.19, 1.10, and 1.22 pCi/L. These results are within or slightly above background levels (the background mean plus two standard deviations is 0.95 pCi/L, the background maximum is 1.12 pCi/L (n = 32), and the background $UTL_{99/99}$ is 1.154 pCi/L). The three OU6 samples were collected from spatially distant wells (well 2691 upgradient of the B series ponds, well 1186 downgradient of pond A-4, and well 486 at Indiana Street). Because the sample size is so small and because the OU6 levels are so close to background levels, this analyte is not included in the determination of OU-wide COCs in groundwater.

5.5 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for organic contaminants and radionuclides are presented in Tables 5-3 through 5-5. With the exception of the analytes discussed in Section 5.4, all organic analytes detected at a frequency of 5 percent or greater and radionuclides identified as above background levels were included in the screens.

All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs in groundwater for quantitative risk assessment. COCs for groundwater are listed below and in Table 5-6:

OU-Wide Chemicals of Concern
Groundwater

Chemical	Maximum Result (mg/L or pCi/L)
Chloroform	0.008
Methylene chloride	0.032
Tetrachloroethene	0.013
Trichloroethene	0.150
Nitrate	1760
Plutonium-239/240	3.65
Americium-241	3.2
Radium-226	8.8

The distribution of the organic COCs in groundwater is shown in Figures 5-9 through 5-13. The maximum concentrations of volatile organics are relatively low (<0.15 mg/L) and the maximum frequency of detection was 15 percent (Table 5-1). Therefore, organic contamination of groundwater in OU6 is considered minimal.

The distribution of elevated concentrations of radionuclide COCs in groundwater is shown in Figures 5-14 through 5-18 (all detected results are shown). Most elevated results were measured in samples collected at the two wells at Indiana Street (well 486 and well 41691; Figure 5-18).

Nitrates were detected in wells upgradient of the A series ponds. They are believed to be associated with the solar ponds, which are upgradient of OU6.

PCOCs in groundwater that do not have EPA-established toxicity factors are 1,1,1-trichloroethane, 1,2,4-trimethylbenzene, and 2-hexanone. Because of the lack of toxicity factors for these chemicals, they cannot be evaluated in a toxicity or risk-based screen to

select COCs. However, their potential contribution to overall risk will be evaluated qualitatively in the risk assessment for OU6.

5.6 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

Maximum concentration of 13 VOCs (detected at <5 percent frequency) were compared to values equivalent to 1000 times the chemical-specific RBCs. The RBCs were calculated assuming residential use of groundwater and are used to identify special-case COCs that could pose a health risk if long-term exposure were to occur to maximum concentrations in a highly localized area. The screen is discussed in Attachment B and the results for groundwater are presented in Table B-3.

Vinyl chloride was the only chemical detected at low frequency that exceeded the 1000 times RBC value. Vinyl chloride will be retained for further evaluation as a special-case COC in groundwater.

TABLE 5-1
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT 5% OR GREATER FREQUENCY UHSU GROUNDWATER

Chemical	Maximum Detected Concentration (mg/L)	Detection Frequency %	Inorganic PCOC ?(1)
Organic Compounds:			
1,1,1-Trichloroethane	0.012	9	
1,1-Dichloroethane	0.062	9	
1,2-Dichloroethene	0.074	11	
1,2-Dichloroethene, cis	0.0007	6	
Acetone	0.027	5	
Bis(2-ethylhexyl)phthalate	0.008	21	
Chloroform	0.008	9	
Diethyl phthalate	0.002	7	
Methylene chloride	0.032	12	
Tetrachloroethene	0.013	15	
Toluene	0.016	6	
Trichloroethene	0.15	14	
Metals:			
Aluminum	456	95	Yes
Antimony	0.194	16	Yes
Arsenic	0.018	52	Yes
Barium	5.06	98	Yes
Beryllium	0.032	30	Yes
Cadmium	0.0329	26	Yes
Chromium	0.58	75	Yes
Cobalt	0.228	45	Yes
Copper	6.43	54	Yes
Lead	0.254	73	Yes
Lithium	0.456	93	Yes
Manganese	6.2	94	Yes
Mercury	0.0015	10	Yes
Molybdenum	0.0295	27	No
Nickel	1.07	66	Yes
Selenium	0.475	58	Yes
Silver	3.04	20	Yes
Strontium	6.96	100	Yes
Thallium	0.0027	5	No
Tin	0.267	19	No
Vanadium	0.754	74	Yes
Zinc	8	83	Yes

(1) Based on background comparison (Appendix A) prior to the application of professional judgement as discussed in Section 5.3

TABLE 5-2
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT LESS THAN 5% FREQUENCY UHSU GROUNDWATER

Chemical	Maximum Detected Concentration (mg/L)	Detection Frequency %	Inorganic PCOC ? [1]
Organic Compounds:			
1,1-Dichloroethene	0.005	1	
1,2-Dichloroethane	0.002	1	
1,2-Dichloroethene, trans	0.009	2	
1,2,4-Trimethylbenzene	0.0002	3	
2-Butanone	0.001	1	
2-Hexanone	0.005	0.4	
4-Methyl-2-pentanone	0.002	1	
Benzene	0.003	3	
Carbon disulfide	0.004	1	
Carbon tetrachloride	0.008	4	
Chloromethane	0.00025	0.4	
Ethylbenzene	0.001	2	
Styrene	0.00011	0.4	
Vinyl chloride	0.86	3	
Xylenes (total)	0.014	4	
Metals:			
Cesium	0.15	2	No

[1] Based on background comparison (Appendix A)

TABLE 5-3
CONCENTRATION/TOXICITY SCREEN
UHSU GROUNDWATER
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/L)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Nitrate	1760	n/a	1.6E+00	1.1E+03	9.9E-01	98.9
1,2-Dichloroethene	0.074	n/a	9.0E-03	8.2E+00	7.4E-03	0.7
Tetrachloroethene	0.013	n/a	1.0E-02	1.3E+00	1.2E-03	0.1
Chloroform	0.008	n/a	1.0E-02	8.0E-01	7.2E-04	0.1
1,1-Dichloroethane	0.062	1.4E-01	1.0E-01	6.2E-01	5.6E-04	0.1
Methylene chloride	0.032	9.0E-01	6.0E-02	5.3E-01	4.8E-04	0.0
Acetone	0.027	n/a	1.0E-01	2.7E-01	2.4E-04	0.0
Toluene	0.016	1.1E-01	2.0E-01	1.5E-01	1.3E-04	0.0
cis-1,2-Dichloroethene	0.0007	n/a	1.0E-02	7.0E-02	6.3E-05	0.0
Diethyl phthalate	0.002	n/a	8.0E-01	2.5E-03	2.2E-06	0.0
Total Risk Factor				1.1E+03		

RfDs are in units of mg/kg-day.
n/a = not available.

TABLE 5-4
CONCENTRATION/TOXICITY SCREEN
UHSU GROUNDWATER
CARCINOGENS

Chemical	Maximum Detected Conc. (mg/L)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Trichloroethene	0.15	6.0E-03	1.1E-02	1.7E-03	5.1E-01	51.5
Tetrachloroethene	0.013	2.0E-03	5.2E-02	6.8E-04	2.1E-01	21.1
Chloroform	0.008	8.0E-02	6.1E-03	6.4E-04	2.0E-01	20.0
Methylene chloride	0.032	1.6E-03	7.5E-03	2.4E-04	7.5E-02	7.5
Total Risk Factor				3.2E-03		

Slope factors are in units of 1/(mg/kg-day).
n/a = not available.

TABLE 5-5
CONCENTRATION/TOXICITY SCREEN
UHSU GROUNDWATER
RADIONUCLIDES

Chemical	Maximum Activity (pCi/L)	Inhalation Slope Factor		Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Radium-226[1]	8.8	2.8E-09	*	3.0E-10	2.6E-09	5.5E-01	55.1
Plutonium-239/240	3.65	2.8E-08	*	3.0E-10	1.1E-09	2.3E-01	22.9
Americium-241	3.2	3.9E-08	*	3.3E-10	1.1E-09	2.2E-01	22.0
Total Risk Factor					4.8E-09		

Slope factors are in units of Risk/pCi.

* Inhalation of radionuclides from groundwater is an incomplete pathway. Therefore oral toxicity factors were used in the screen.

[1] The maximum concentration of Radium-226 occurred at the Old Outfall (IHSS 143). Radium-226 was only analyzed for in two samples outside of the Old Outfall and the maximum concentrations was 1.2 pCi/L.

TABLE 5-6
OU6 CHEMICALS OF CONCERN
UHSU GROUNDWATER

OU-Wide	Special Case
Chloroform	Vinyl chloride
Methylene chloride	
Tetrachloroethene	
Trichloroethene	
Nitrate	
Plutonium-239/240	
Americium-241	
Radium-226	

Figure 5-1
Rocky Flats OU6
Scatter Plot of Unfiltered ALUMINUM Vs. TSS
UHSU Groundwater

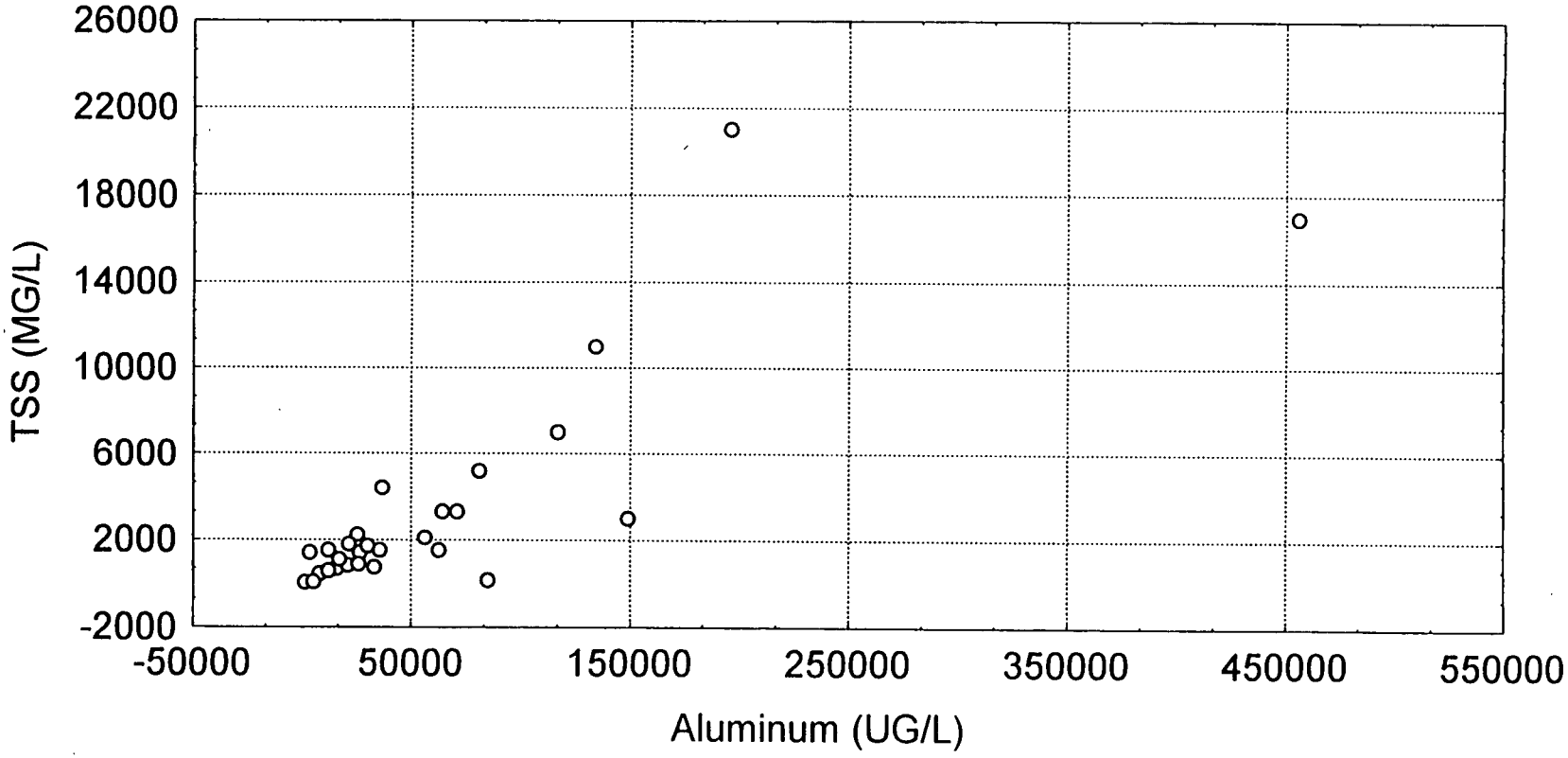


Figure 5-2
Rocky Flats OU6
Scatter Plot of Unfiltered ARSENIC Vs TSS
UHSU Groundwater

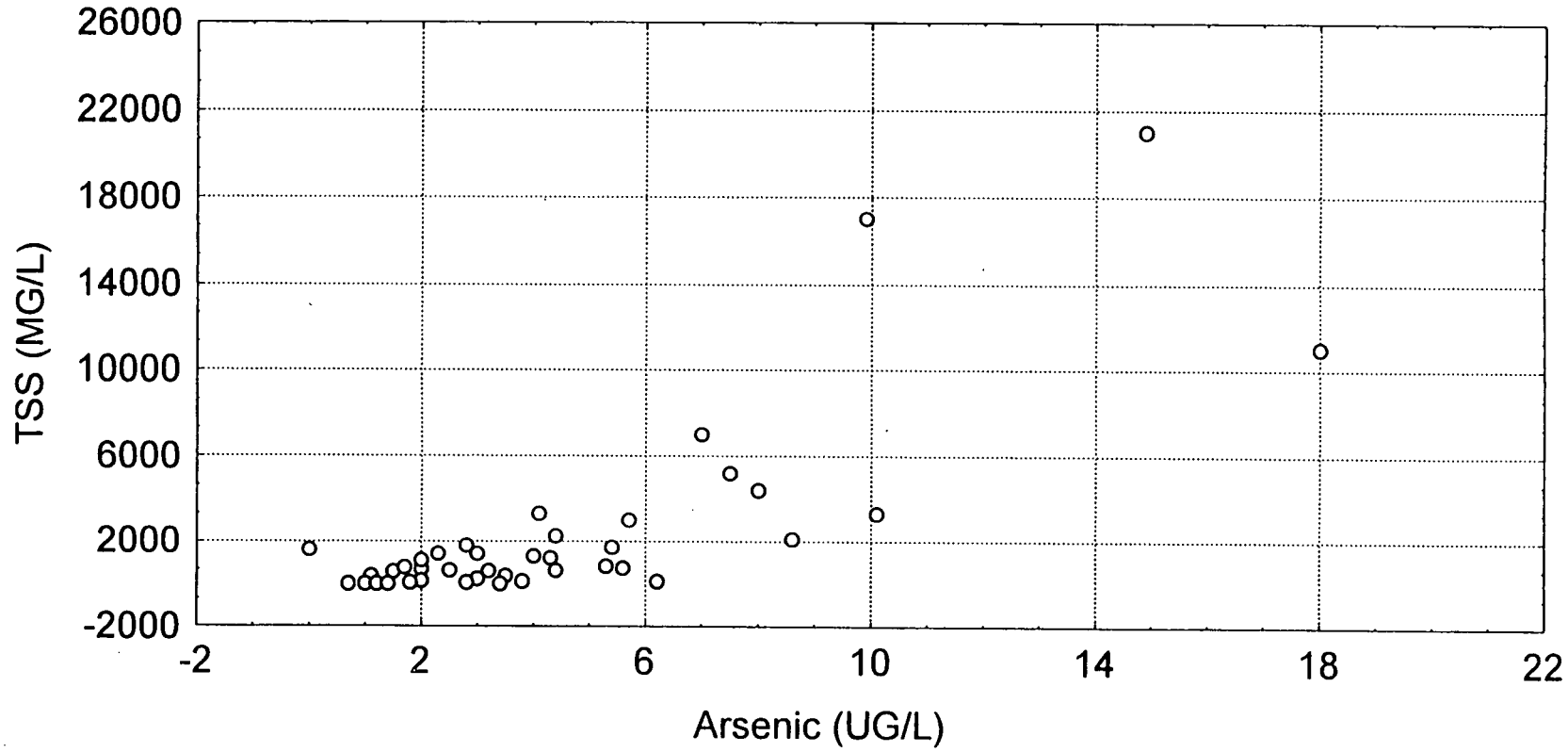
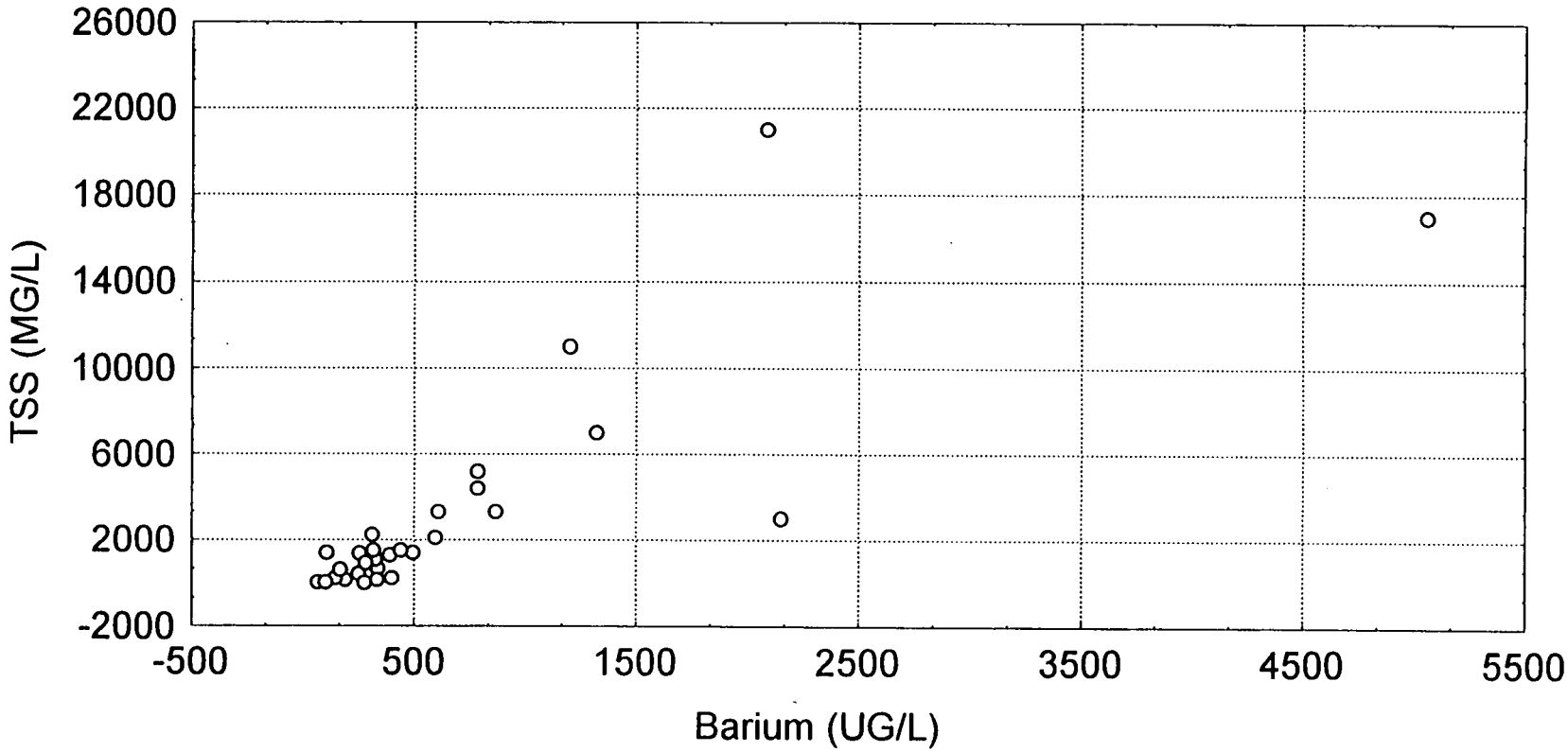
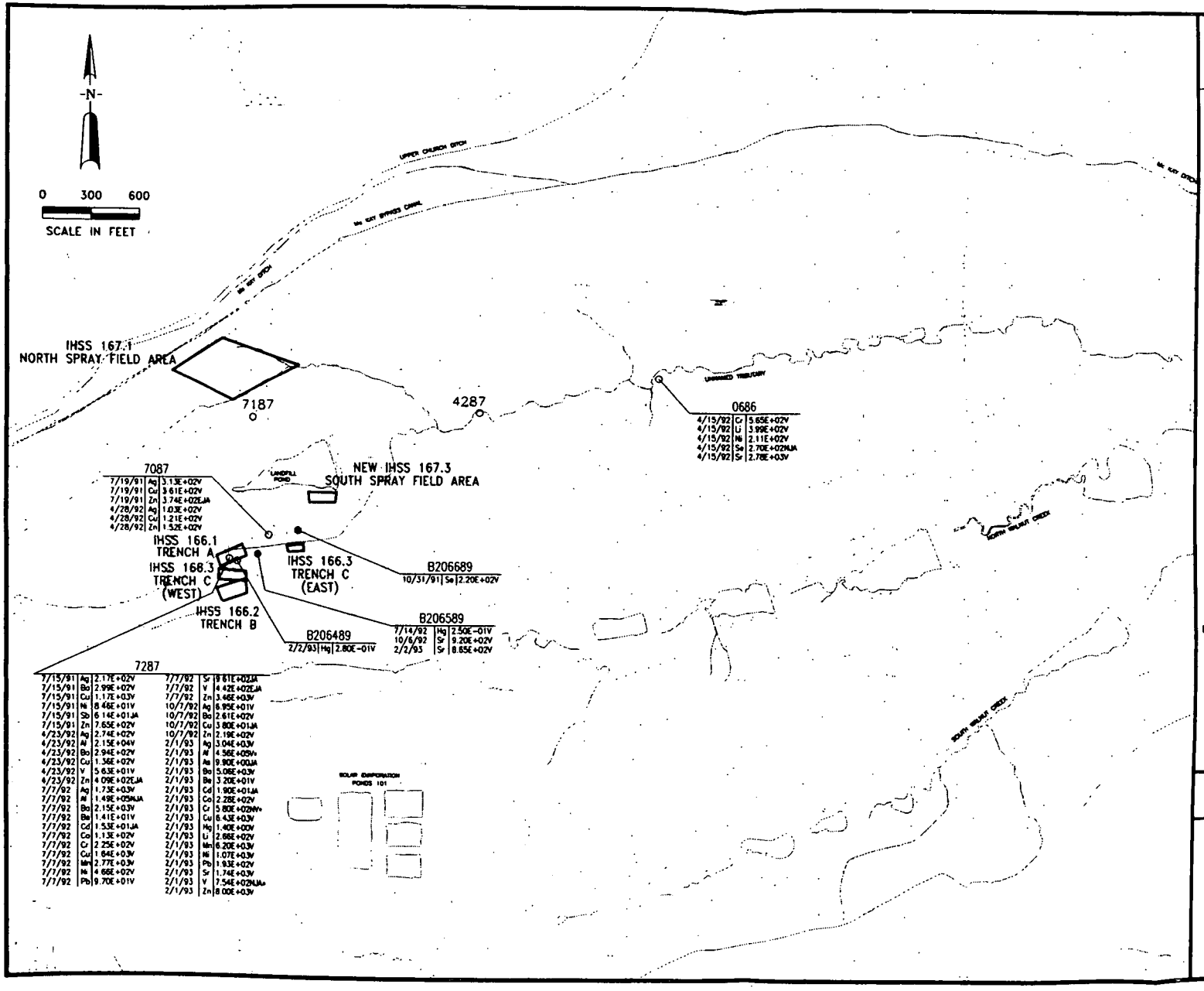


Figure 5-3
Rocky Flats OU6
Scatter Plot of Unfiltered BARIUM Vs. TSS
UHSU Groundwater





EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

0586 ○ UHSU MONITORING WELL (ALLUVIAL)

B206889 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

0686 ← LOCATION
2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

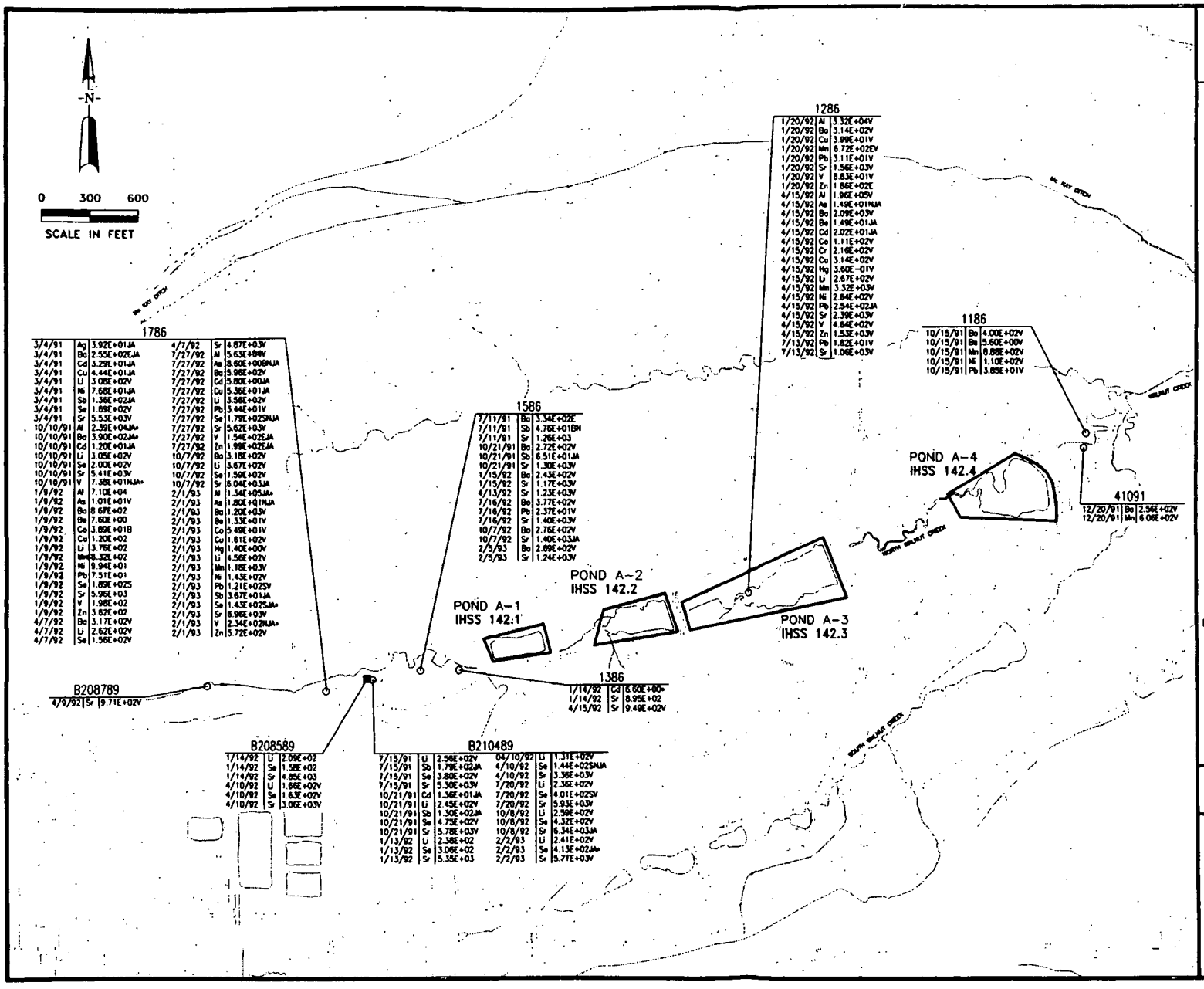
OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

UNFILTERED METALS
AREA 1 (UNNAMED TRIBUTARY DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-4

JUNE 1995

OU6TM114 1=600



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

1186 ○ UHSU MONITORING WELL (ALLUVIAL)

B208589 ■ UHSU MONITORING WELL (COLLUVIAL)

B208289 ○ UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

1186 ← LOCATION

2/26/92 — SAMPLE DATE

ANALYTE

ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

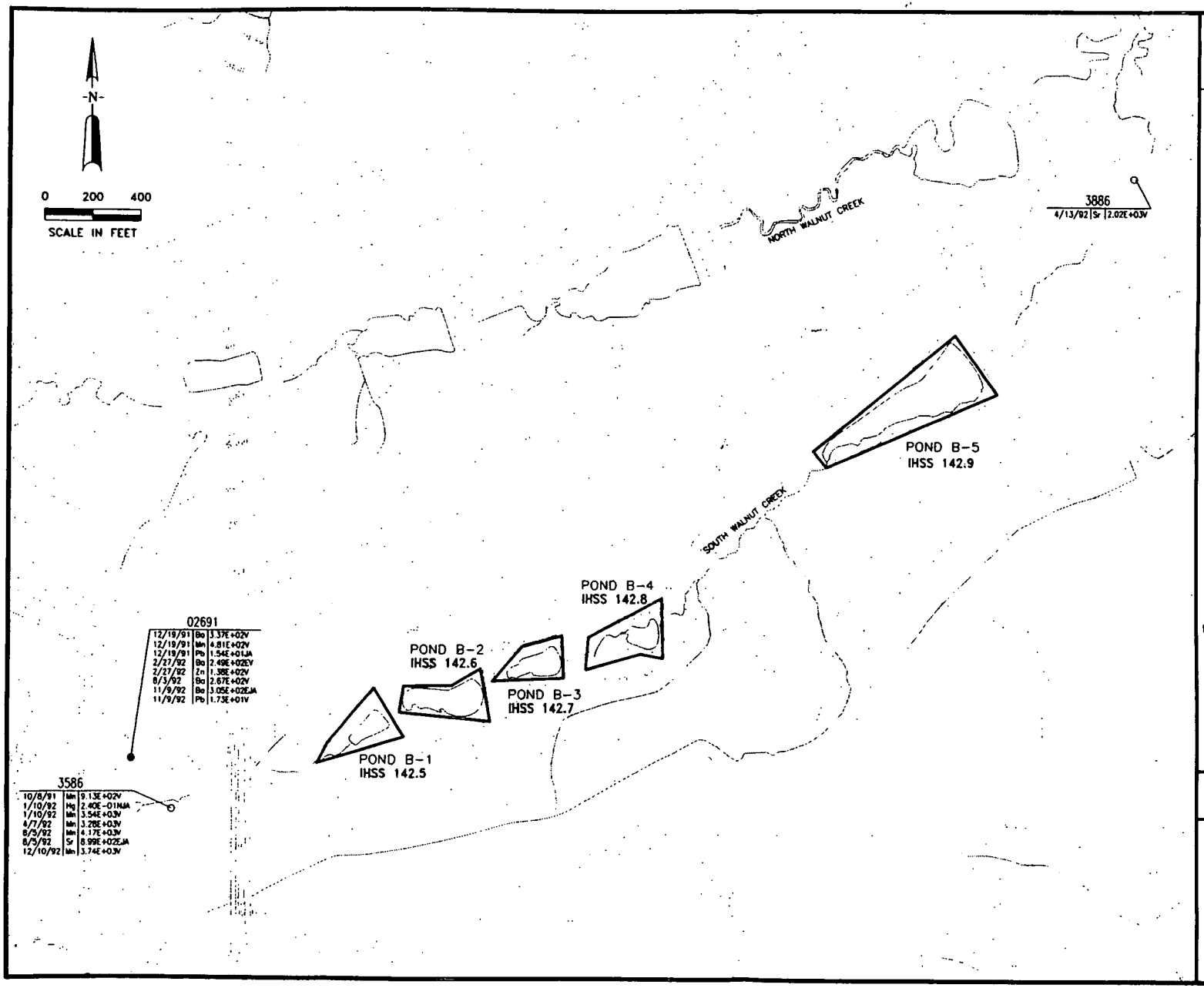
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

UNFILTERED METALS
AREA 2 (NORTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-5 JUNE 1995

OU6TM115 1=600



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

3586 ○ MONITORING WELL (ALLUVIAL)

02691 ● MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

3686 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

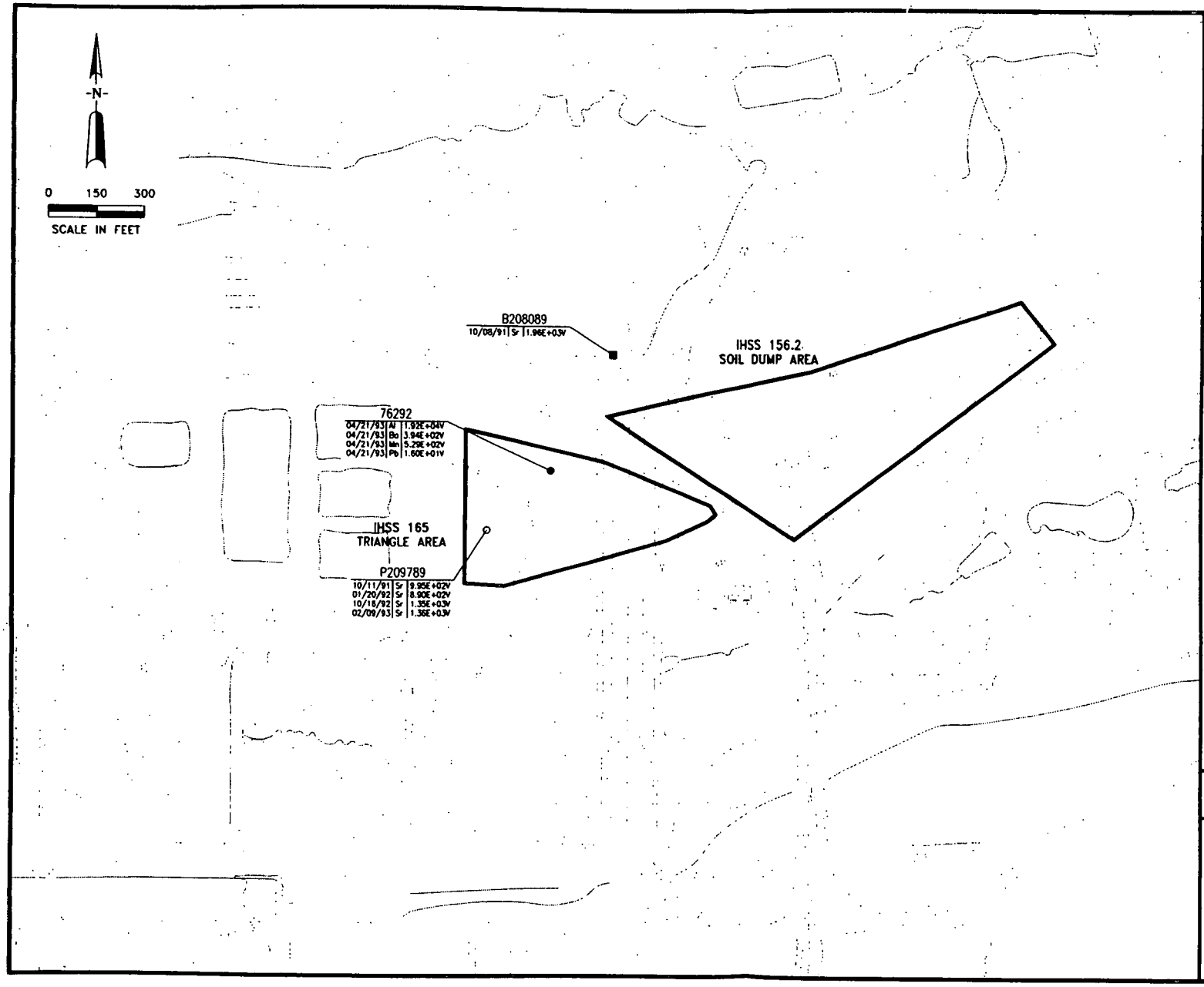
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

UNFILTERED METALS
AREA 3 (SOUTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-6 JUNE 1995

OU6TM116 1=400



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

B208089 ■ UHSU MONITORING WELL (COLLUVIAL)

2986 ○ UHSU MONITORING WELL (ALLUVIAL)

76292 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

76292 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

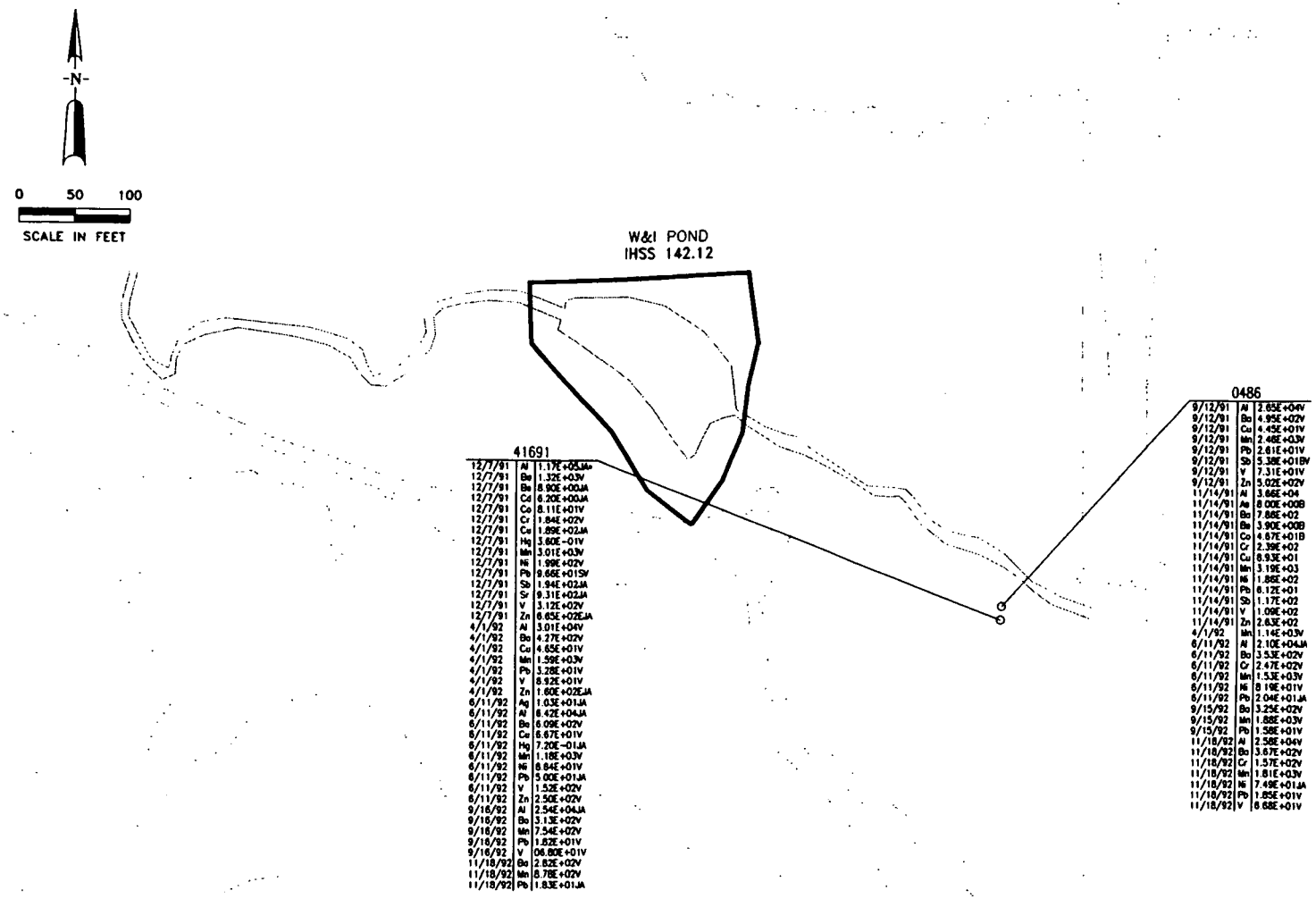
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

UNFILTERED METALS
AREA 4 (UPGRADIENT DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-7 JUNE 1995

OUSTM117 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

41691 o MONITORING WELL (ALLUVIAL)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

41691 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

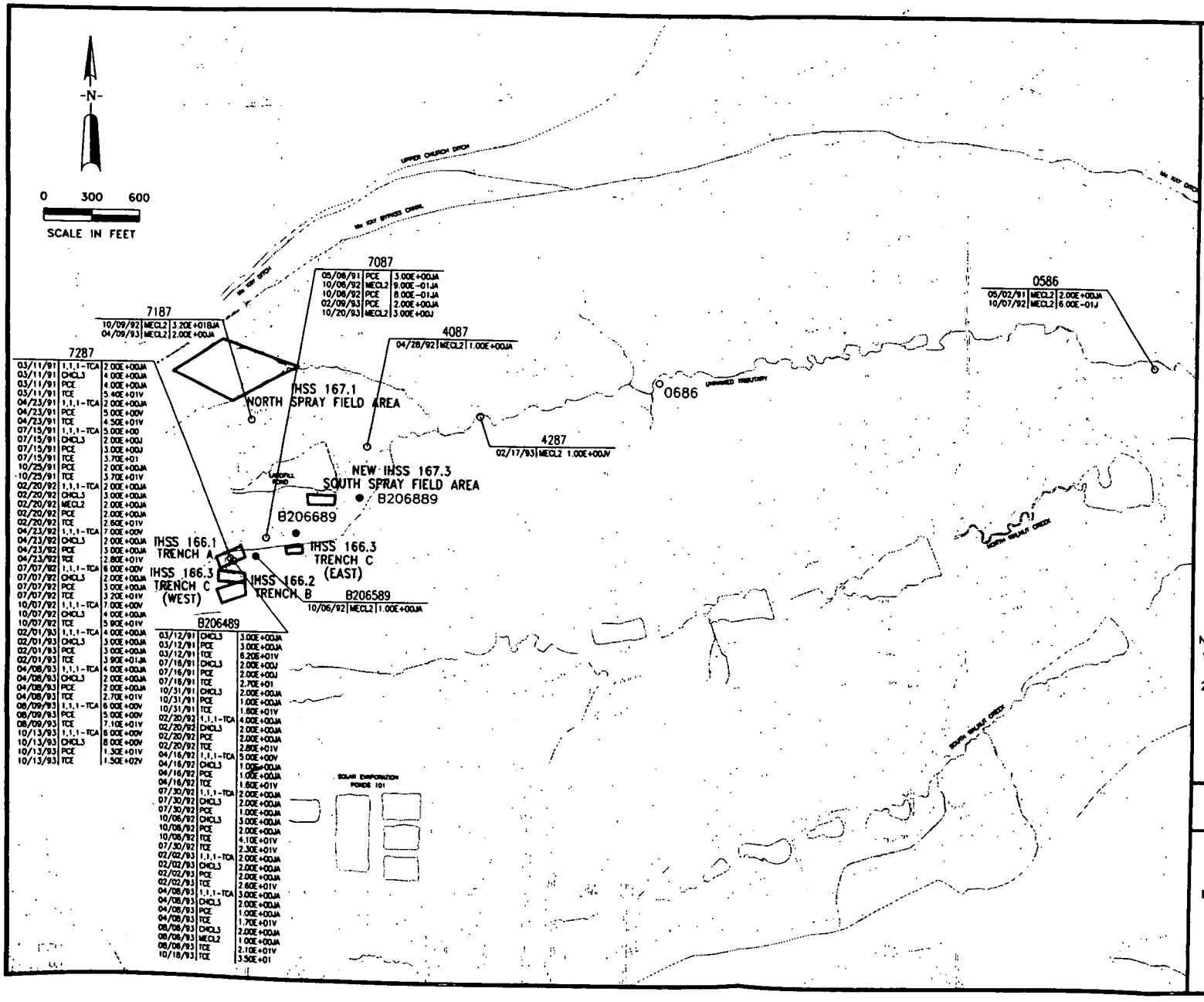
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

UNFILTERED METALS
AREA 5 (W&I DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-8 JUNE 1995

OU6TM118 1-100



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

0586 ○ UHSU MONITORING WELL (ALLUVIAL)

B206889 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

0586 ← LOCATION

2/26/92		
SAMPLE DATE	ANALYTE	ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

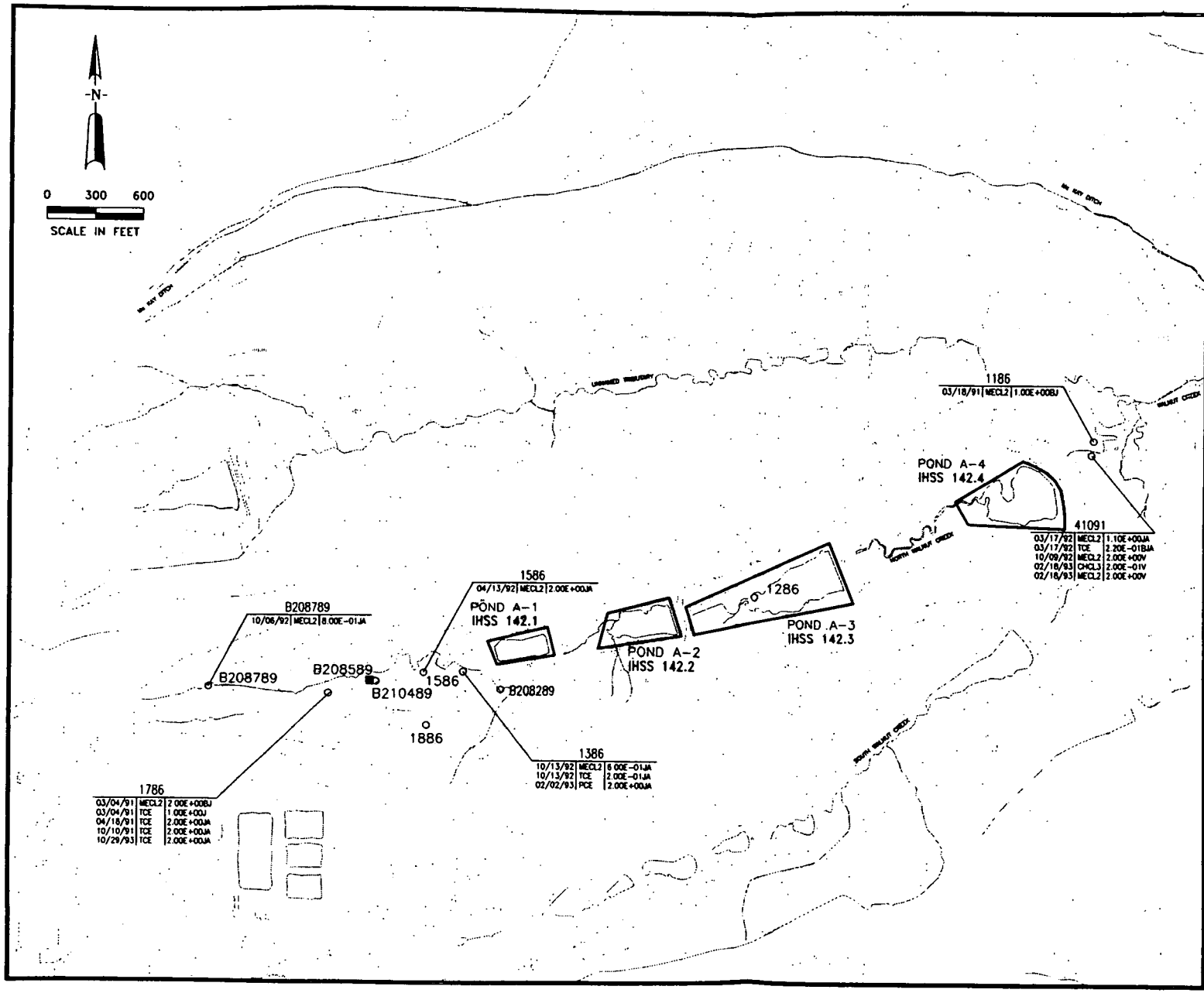
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

1,1,1-TRICHLOROETHANE, CHLOROFORM, METHYLENE CHLORIDE, TETRACHLOROETHENE, AND TRICHLOROETHENE
AREA 1 (UNNAMED TRIBUTARY DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-9 JUNE 1995

OU6TM119 1=600



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

1186 ○ UHSU MONITORING WELL (ALLUVIAL)

B208589 ■ UHSU MONITORING WELL (COLLUVIAL)

B208289 ○ UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

41091 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

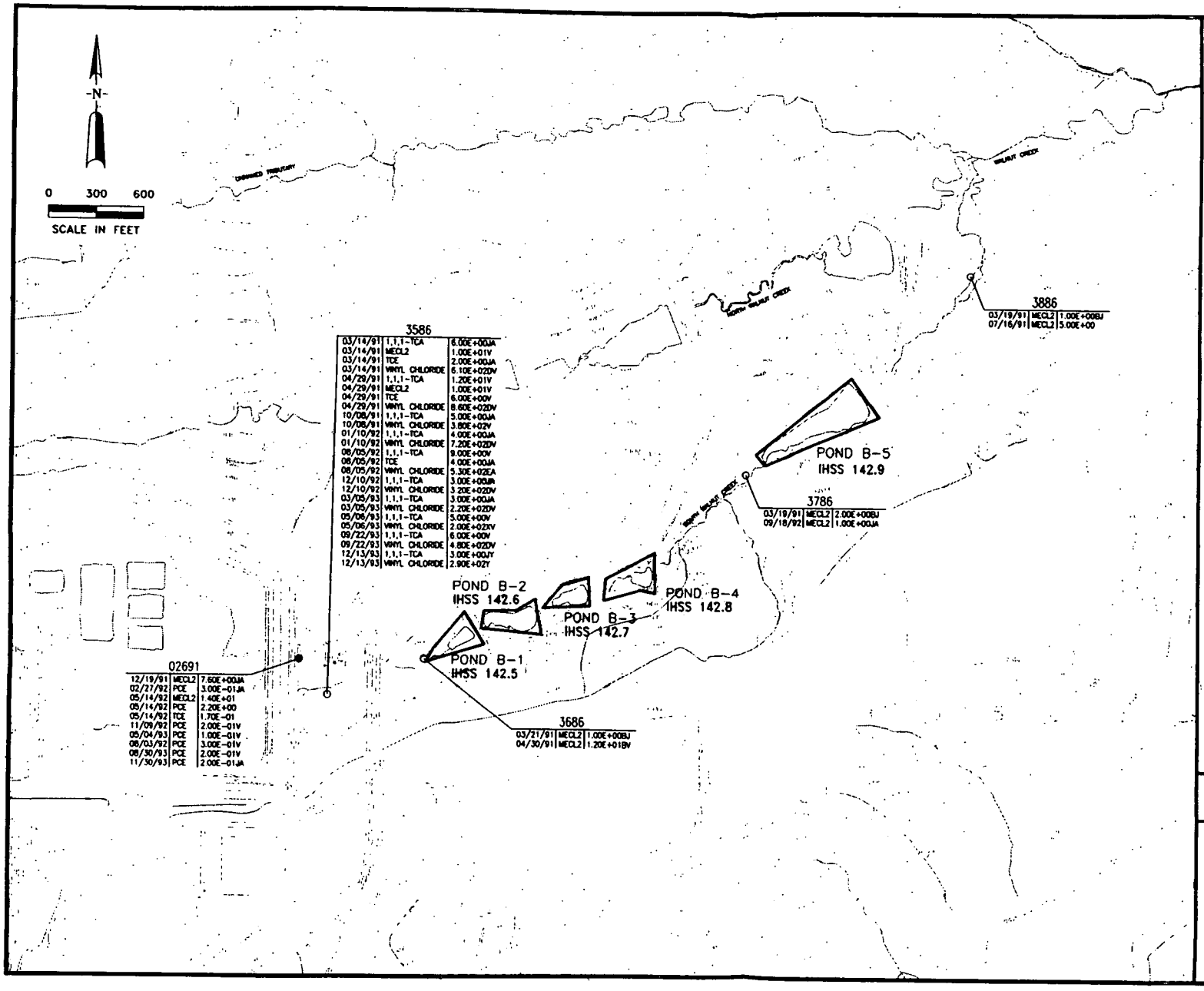
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

CHLOROFORM, METHYLENE CHLORIDE, TETRACHLOROETHENE, AND TRICHLOROETHENE AREA 2 (NORTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-10 JUNE 1995

OU6TM120 1=600



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

3586 ○ MONITORING WELL (ALLUVIAL)

02691 ● MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

3586 ← LOCATION

2/26/92

SAMPLE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

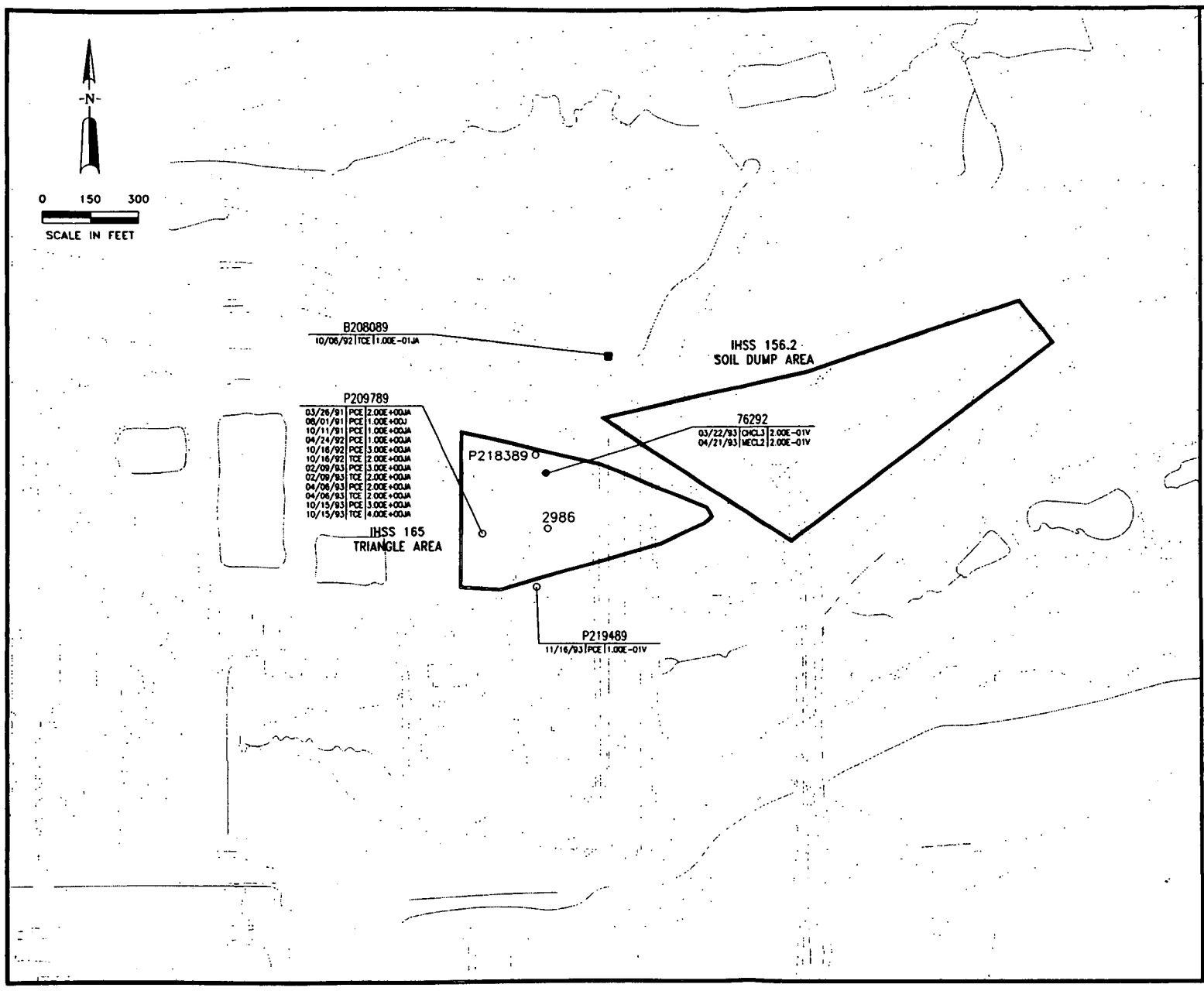
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

1,1,1-TRICHLOROETHANE, METHYLENE CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND VINYL CHLORIDE
AREA 3 (SOUTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-11 JUNE 1995

OU6TM121 1=600



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

B208089 ■ UHSU MONITORING WELL (COLLUVIAL)

75892 ○ UHSU MONITORING WELL (ALLUVIAL)

76292 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

76292 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

(V) – VOLATILE

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

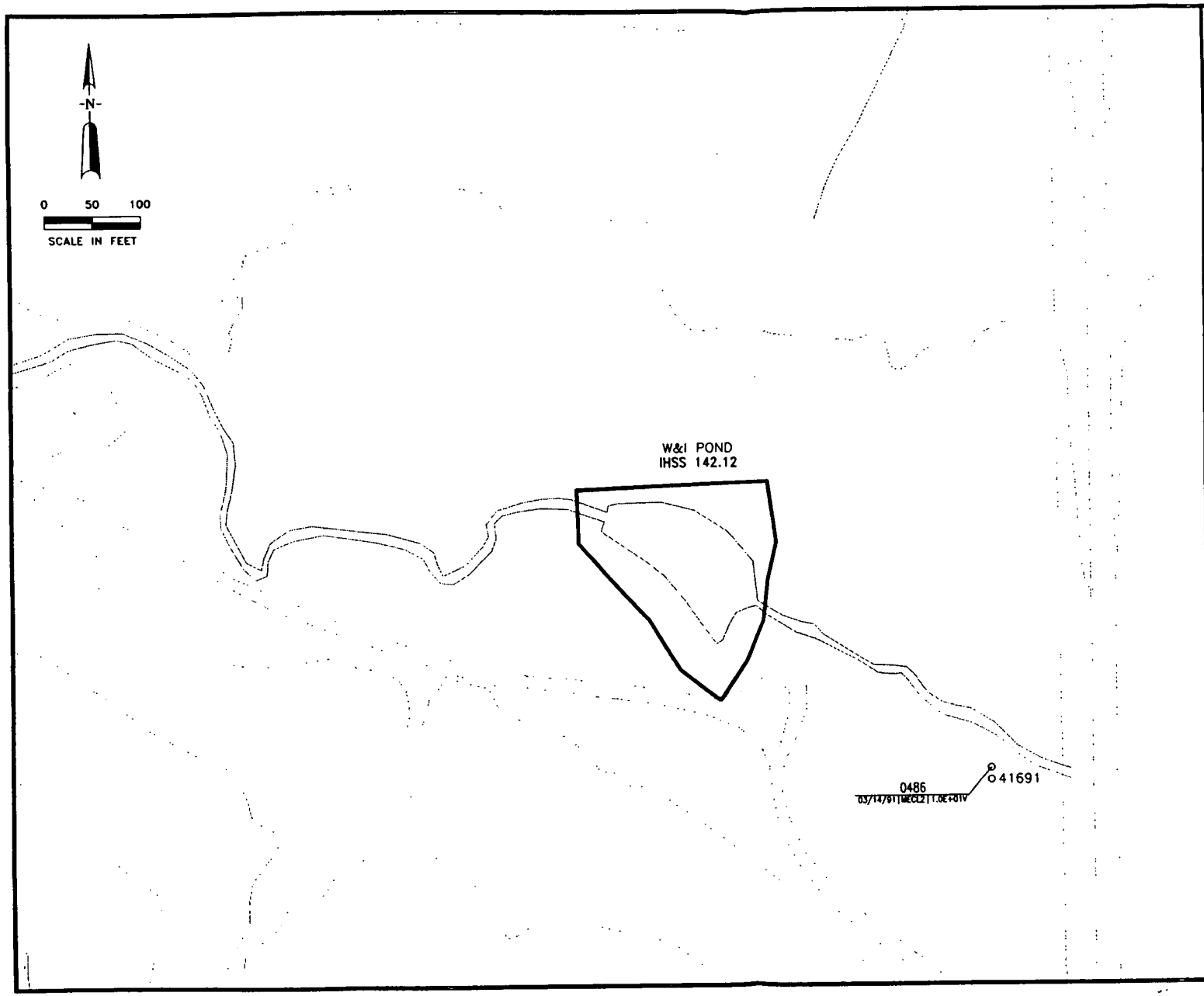
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

CHLOROFORM, METHYLENE CHLORIDE, TETRACHOROETHENE, AND TRICHLOROETHENE
AREA 4 (UPGRADIENT DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-12 JUNE 1995

OU6TM122 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

0486 o MONITORING WELL (ALLUVIAL)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

0486 ← LOCATION
2/26/92
SAMPLE DATE
ANALYTE
ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

(V) – VOLATILE

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

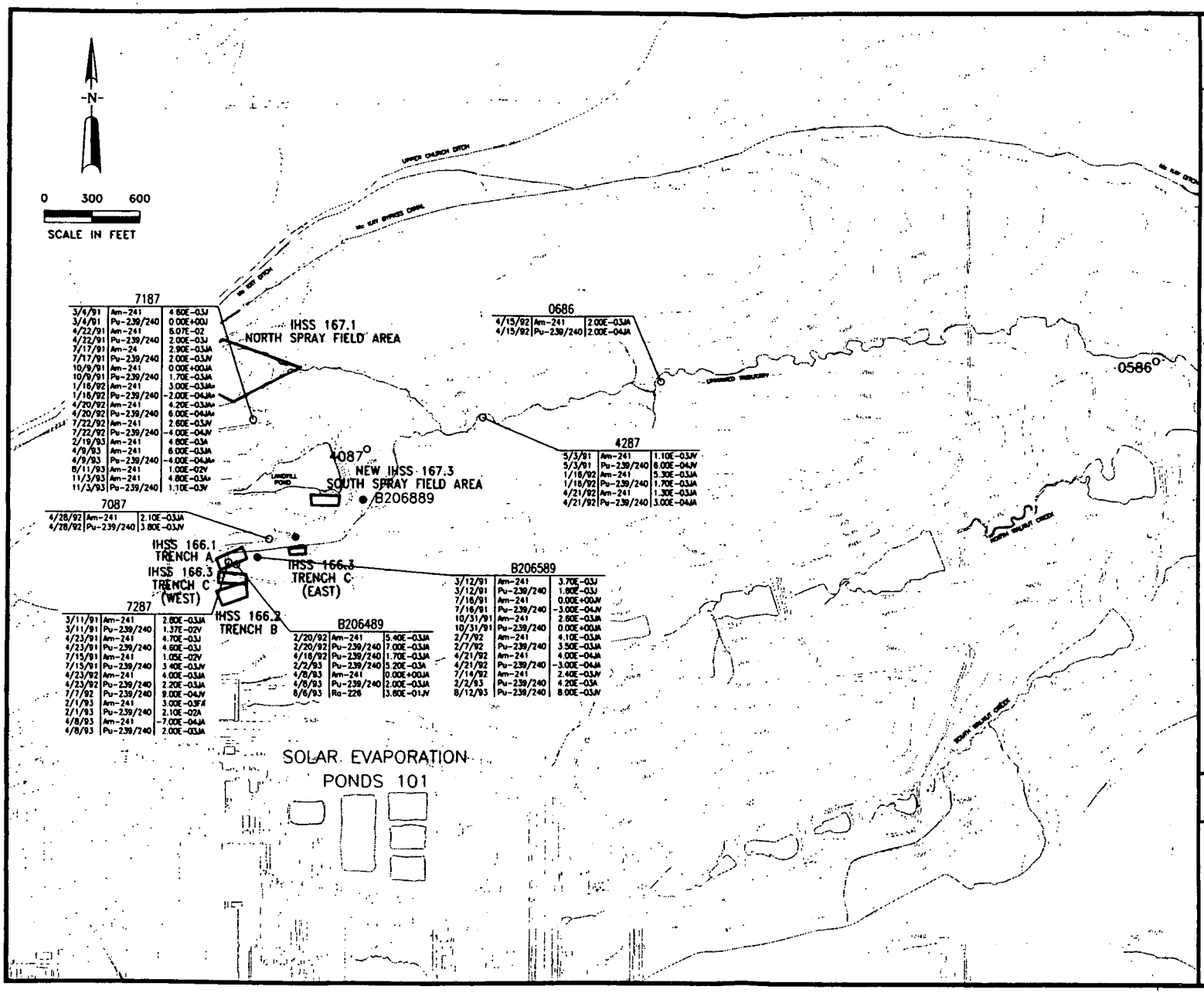
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

METHYLENE CHLORIDE
AREA 5 (W&I DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-13 JUNE 1995

OU6TM123 1=100



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

0586 ○ UHSU MONITORING WELL (ALLUVIAL)

B206889 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

78392 ← LOCATION
2/26/92

SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

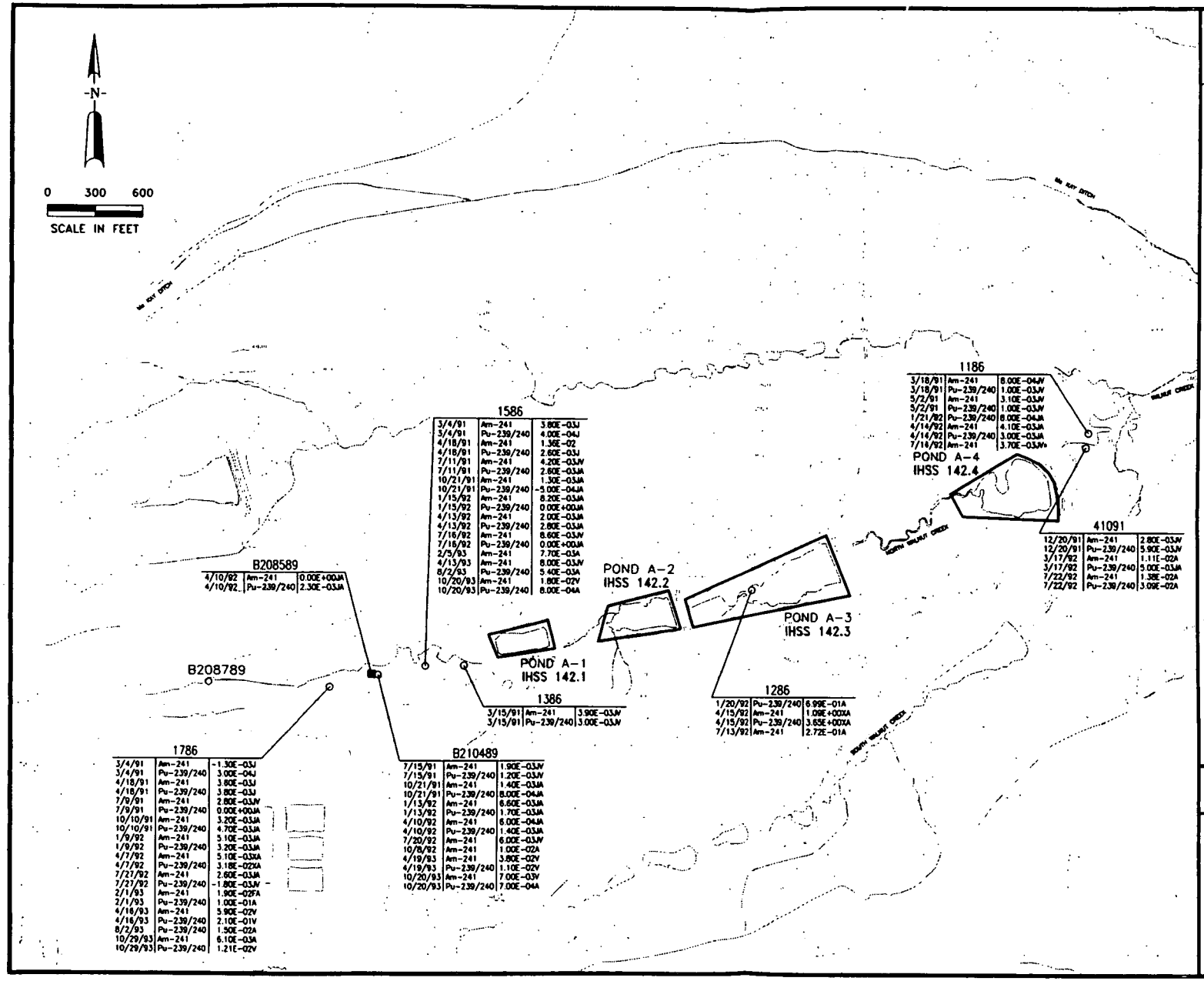
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
AREA 1 (UNNAMED TRIBUTARY DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993

FIGURE 5-14 JUNE 1995

OU6TM124 1=600



B208589		
4/10/92	Am-241	0.00E+00JA
4/10/92	Pu-239/240	2.30E-03JA

1586		
3/4/91	Am-241	3.80E-03J
3/4/91	Pu-239/240	4.00E-04J
4/18/91	Am-241	1.36E-02
4/18/91	Pu-239/240	2.60E-03J
7/11/91	Am-241	4.20E-03JV
7/11/91	Pu-239/240	2.80E-03JA
10/21/91	Am-241	1.30E-03JA
10/21/91	Pu-239/240	-5.00E-04JA
1/15/92	Am-241	8.20E-03JA
1/15/92	Pu-239/240	0.00E+00JA
4/13/92	Am-241	2.00E-03JA
4/13/92	Pu-239/240	2.80E-03JA
7/16/92	Am-241	8.60E-03JV
7/16/92	Pu-239/240	0.00E+00JA
2/5/93	Am-241	7.70E-03A
4/13/93	Am-241	8.00E-03JV
8/2/93	Pu-239/240	5.40E-03A
10/20/93	Am-241	1.80E-02V
10/20/93	Pu-239/240	8.00E-04A

1186		
3/18/91	Am-241	8.00E-04JV
3/18/91	Pu-239/240	1.00E-03JV
5/2/91	Am-241	3.10E-03JV
5/2/91	Pu-239/240	1.00E-03JV
1/21/92	Pu-239/240	8.00E-04JA
4/14/92	Am-241	4.10E-03JA
4/14/92	Pu-239/240	3.00E-03JA
7/14/92	Am-241	3.70E-03JV*

41091		
12/20/91	Am-241	2.80E-03JV
12/20/91	Pu-239/240	5.90E-03JV
3/17/92	Am-241	1.11E-02A
3/17/92	Pu-239/240	5.00E-03JA
7/22/92	Am-241	1.38E-02A
7/22/92	Pu-239/240	3.09E-02A

1386		
3/15/91	Am-241	3.90E-03JV
3/15/91	Pu-239/240	3.00E-03JV

1286		
1/20/92	Pu-239/240	6.99E-01A
4/15/92	Am-241	1.09E+00XA
4/15/92	Pu-239/240	3.65E+00XA
7/13/92	Am-241	2.72E-01A

1786		
3/4/91	Am-241	-1.30E-03J
3/4/91	Pu-239/240	3.00E-04J
4/18/91	Am-241	3.60E-03J
4/18/91	Pu-239/240	3.80E-03J
7/9/91	Am-241	2.80E-03JV
7/9/91	Pu-239/240	0.00E+00JA
10/10/91	Am-241	3.20E-03JA
10/10/91	Pu-239/240	4.70E-03JA
1/9/92	Am-241	5.10E-03JA
1/9/92	Pu-239/240	3.20E-03JA
4/7/92	Am-241	5.10E-03XA
4/7/92	Pu-239/240	3.18E-02XA
7/21/92	Am-241	2.60E-03JA
7/21/92	Pu-239/240	-1.80E-03JV
2/1/93	Am-241	1.90E-02FA
2/1/93	Pu-239/240	1.00E-01A
4/16/93	Am-241	5.90E-02V
4/16/93	Pu-239/240	2.10E-01V
8/2/93	Pu-239/240	1.50E-02A
10/29/93	Am-241	6.10E-03A
10/29/93	Pu-239/240	1.21E-02V

B210489		
7/15/91	Am-241	1.90E-03JV
7/15/91	Pu-239/240	1.20E-03JV
10/21/91	Am-241	1.40E-03JA
10/21/91	Pu-239/240	8.00E-04JA
1/13/92	Am-241	6.60E-03JA
1/13/92	Pu-239/240	1.70E-03JA
4/10/92	Am-241	6.00E-04JA
4/10/92	Pu-239/240	1.40E-03JA
7/20/92	Am-241	6.00E-03JV
10/8/92	Am-241	1.00E-02A
4/19/93	Am-241	3.80E-02V
4/19/93	Pu-239/240	1.10E-02V
10/20/93	Am-241	7.00E-03V
10/20/93	Pu-239/240	7.00E-04A

EXPLANATION

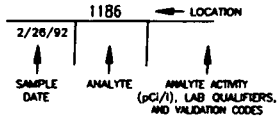
INDIVIDUAL HAZARDOUS SUBSTANCE SITES

1186 ○ UHSU MONITORING WELL (ALLUVIAL)

B208589 ■ UHSU MONITORING WELL (COLLUVIAL)

B208289 ○ UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT



NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

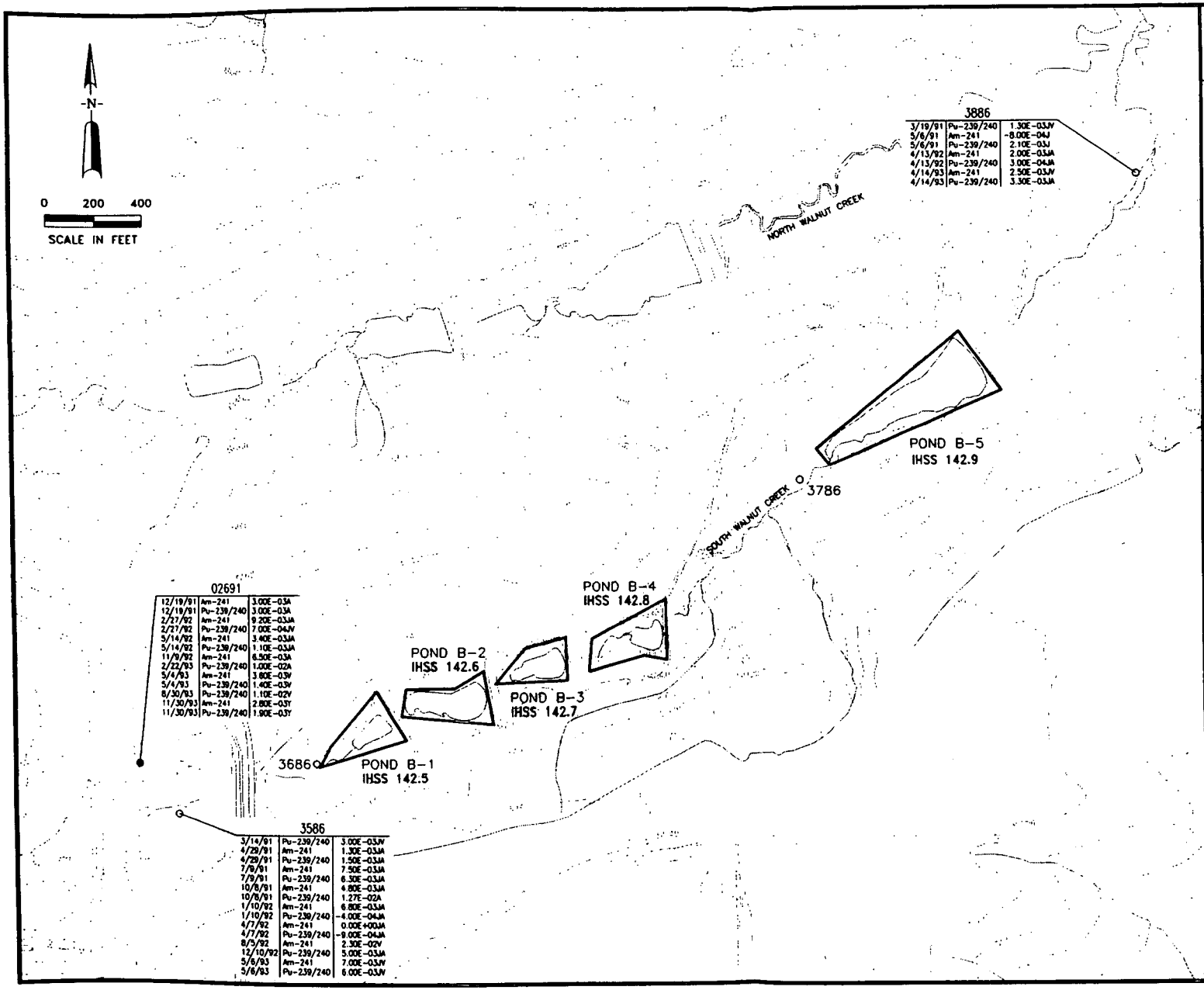
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
AREA 2 (NORTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-15 JUNE 1995

OU6TM125 1=600



3886		
3/19/91	Pu-239/240	1.30E-03JV
5/6/91	Am-241	-8.00E-04J
5/6/91	Pu-239/240	2.10E-03J
4/13/92	Am-241	2.00E-03JA
4/13/92	Pu-239/240	3.00E-04JA
4/14/93	Am-241	2.50E-03JV
4/14/93	Pu-239/240	3.30E-03JA

02691		
12/19/91	Am-241	3.00E-03A
12/19/91	Pu-239/240	3.00E-03A
2/27/92	Am-241	9.20E-03JA
2/27/92	Pu-239/240	7.00E-04JV
5/14/92	Am-241	3.40E-03JA
5/14/92	Pu-239/240	1.10E-03JA
11/9/92	Am-241	6.50E-03A
2/22/93	Pu-239/240	1.00E-02A
5/4/93	Am-241	3.80E-03V
5/4/93	Pu-239/240	1.40E-03V
8/30/93	Pu-239/240	1.10E-02V
11/30/93	Am-241	2.80E-03Y
11/30/93	Pu-239/240	1.90E-03Y

3586		
3/14/91	Pu-239/240	3.00E-03JV
4/29/91	Am-241	1.30E-03JA
4/29/91	Pu-239/240	1.50E-03JA
7/9/91	Am-241	7.50E-03JA
7/9/91	Pu-239/240	6.30E-03JA
10/8/91	Am-241	4.80E-03JA
10/8/91	Pu-239/240	1.27E-02A
1/10/92	Am-241	6.80E-03JA
1/10/92	Pu-239/240	-4.00E-04JA
4/7/92	Am-241	0.00E+00JA
4/7/92	Pu-239/240	-9.00E-04JA
8/5/92	Am-241	2.30E-02V
12/10/92	Pu-239/240	5.00E-03JA
5/6/93	Am-241	7.00E-03JV
5/6/93	Pu-239/240	6.00E-03JV

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

3586 ○ MONITORING WELL (ALLUVIAL)

02691 ● MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

02691 ← LOCATION
2/26/92
SAMPLE DATE
ANALYTE
ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

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2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

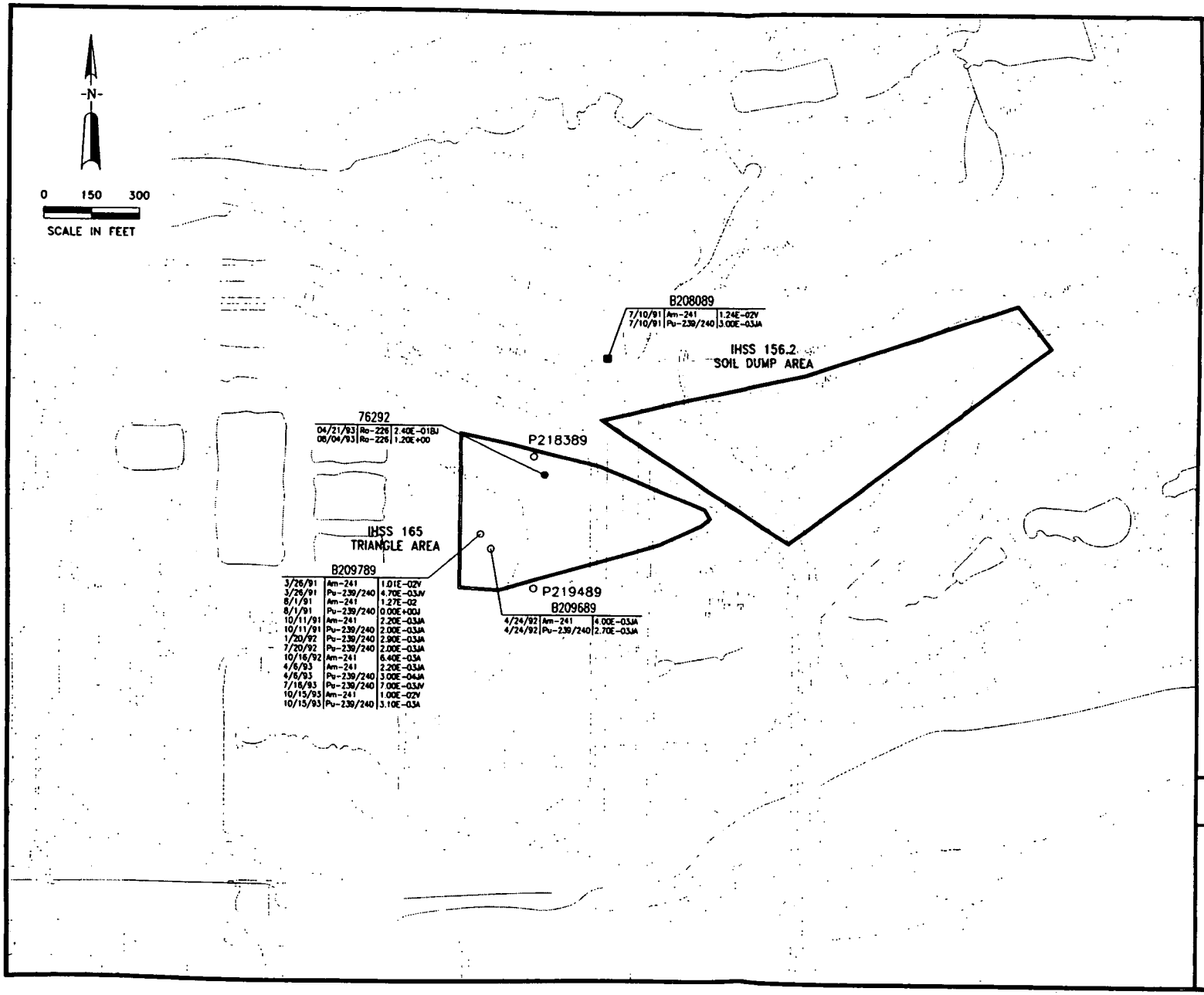
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
AREA 3 (SOUTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-16 JUNE 1995

OU6TM126 1=400



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Effective Date:	
Organization:	Environmental Restoration

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

B208089 ■ UHSU MONITORING WELL (COLLUVIAL)

2986 ○ UHSU MONITORING WELL (ALLUVIAL)

76292 ● UHSU MONITORING WELL (BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

76292 ← LOCATION

2/26/92

SAMPLE DATE — ANALYTE — ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

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• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

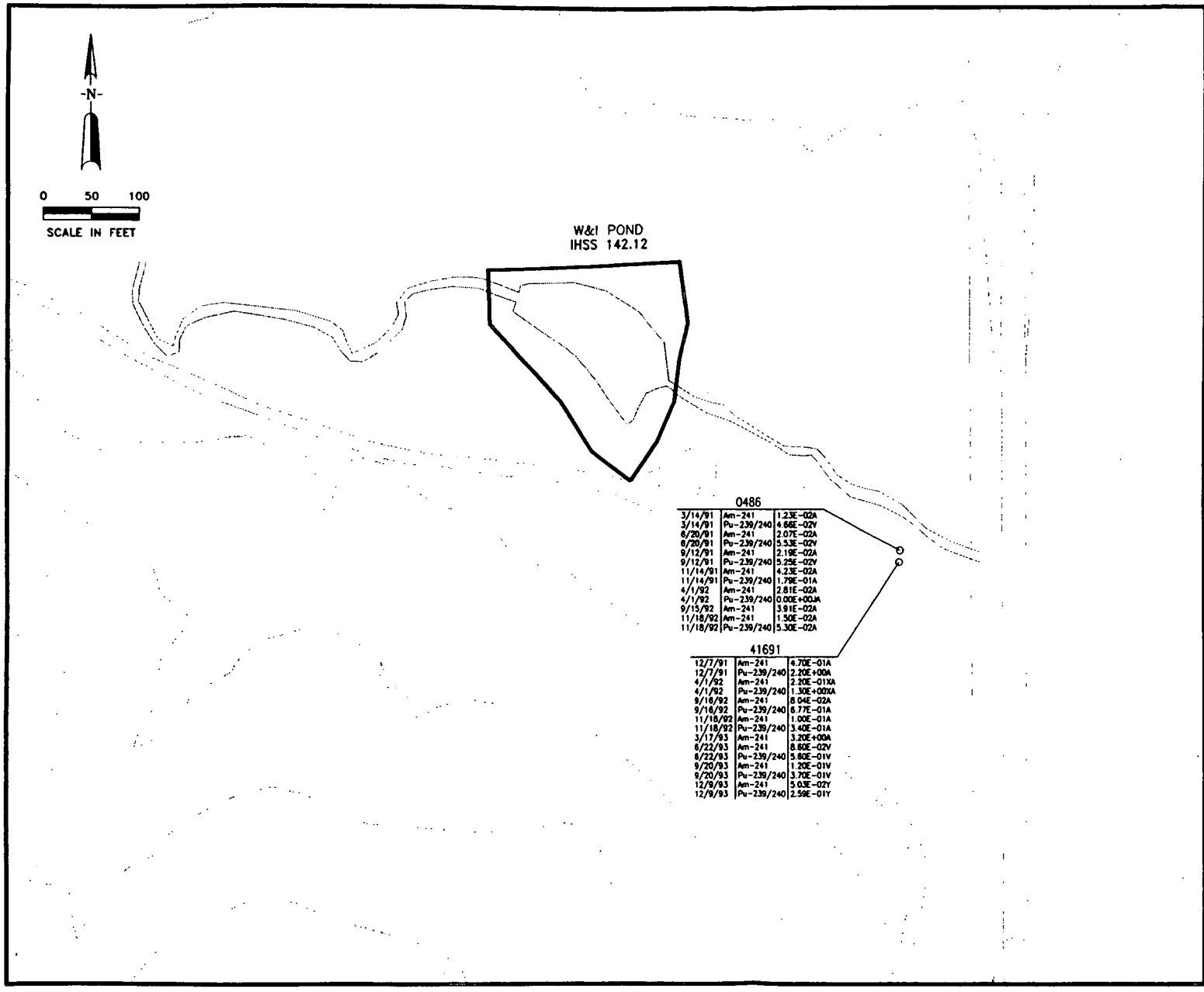
U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241, RADIUM-226, AND PLUTONIUM-239/240
AREA 4 (UPGRADIENT DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993

FIGURE 5-17 JUNE 1995

OU6TM127 1=300

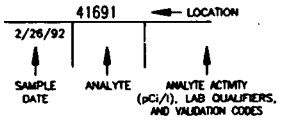


EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

41691 ○ MONITORING WELL (ALLUVIAL)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT



NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241, AND PLUTONIUM-239/240
AREA 5 (W&I DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 – 4th QUARTER 1993

FIGURE 5-18 JUNE 1995

OU5TM128 1=100

6.0 POND SEDIMENT CHEMICALS OF CONCERN

6.1 POND SEDIMENT DATA SET

Wet sediment samples were collected in the A and B series ponds in the Walnut Creek drainage, including the terminal pond at Walnut Creek and Indiana Street. Collectively the ponds are IHSS 142. The A series ponds along North Walnut Creek are numbered IHSS 142.1 through 142.4. The B series ponds along South Walnut Creek are numbered IHSS 142.5 through 142.9. The terminal pond is IHSS 142.12. Pond locations are shown in Figure 1-1. Approximately 50 samples were collected and analyzed for metals, radionuclides, volatile and semivolatile organic compounds, and pesticides/PCBs. The sampling and analytical program for pond wet sediments (IHSS 142) is summarized in Tables 2-1 and 2-2.

6.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Tables 6-1 and 6-2 summarize the maximum detected concentrations and detection frequencies for organic compounds and metals and the results of the background comparison for metals in the pond sediment samples. Background data from seeps/springs reported in the Background Geochemical Characterization Report (DOE 1993) were used for comparison to pond sediment data. Seep/spring background data were preferred to background stream sediment data for this comparison because of the similarity in flow regime (long residence time) in the seeps and ponds. The statistical comparisons of inorganic results to background data are presented in detail in Attachment A.

Radionuclides are assumed to be detected at 100 percent frequency (that is both negative and positive results are included in the data set). Radionuclides above background levels are listed in the concentration/toxicity screen in Table 6-5.

Analytes above background levels that were detected at 5 percent or greater detection frequency were included in concentration/toxicity screens to select OU-wide COCs, with the exception of manganese, which is considered to be naturally occurring as explained in Section 6.3.

6.3 EXCLUSION OF MANGANESE AS A CHEMICAL OF CONCERN IN POND SEDIMENT

Manganese was identified as a PCOC in pond sediment because it failed the Gehan test when compared to background seep/spring data (see Table A-21). (The Gehan test ranks the values in the combined background and site data sets.) However, further review of the data indicates that manganese should not be considered a contaminant in this medium. Mean and maximum concentrations of manganese in background and OU6 pond sediments are summarized in the table below:

Manganese in Background and OU6 Sediment Samples

Location	Sample Size	Mean mg/kg	Maximum mg/kg	Std Dev mg/kg
Background	20	318	1740	437
OU6	57	283	558	86

Histograms and box plots comparing background and OU6 sediment data are shown in Figures 6-1 and 6-2. Review of the histograms shows that the majority of the OU6 pond sediment data falls between 177 and 400 mg/kg, with a maximum of 558 mg/kg, and that these values fall well within the range of values for the background data. In fact, the background data set includes higher values than detected in pond sediment. The box plot (Figure 6-2) also demonstrates that the OU6 measurements are similar to background. Furthermore, no OU6 measurement exceeded the background mean plus two standard deviations of 1192 mg/kg, which is the CDPHE criterion for identifying source areas of contamination. In addition, manganese is not a contaminant in surface soil, subsurface soil, or groundwater, and therefore it would not be expected to be a contaminant in sediment. Concentrations of manganese in sediment are comparable to those measured in background and OU6 surface soils samples (Figure 6-3).

6.4 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for pond sediments are presented in Tables 6-3 through 6-5. All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs for quantitative risk assessment.

COCs are listed below and in Table 6-6:

OU-Wide Chemicals of Concern
Pond Sediments

Benzo(a)pyrene
Benzo(b)fluoranthene
Bis(2-ethylhexyl)phthalate
Aroclor-1254
Antimony
Silver
Vanadium
Americium-241
Plutonium-239/240

The distribution of organic COCs in pond sediments is shown in Figures 6-4 through 6-7. PAHs and PCBs were widely detected in pond sediments. Bis(2-ethylhexyl)phthalate was detected in low concentrations in the A series ponds and in higher concentrations in the B series ponds.

Detected concentrations of metal COCs are shown in Figure 6-8 through 6-11. Silver was detected in the highest concentrations in the B series ponds, especially pond B-1. Antimony was identified as a PCOC because 1 sample out of 57 (68 mg/kg in pond B-3) exceeded the background $UTL_{99/99}$ of 55 mg/kg; however, antimony did not exceed background by any of the four formal statistical tests (see Attachment A, Table A-21). Therefore, although antimony at its maximum detected concentration represented 23 percent of the total risk factor (Table 6-3), it is questionable whether antimony should be considered an OU-wide COC. However, it is retained as a COC because it met the following criteria for selecting COCs: it was detected at greater than 5 percent frequency, 1 sample exceeded the background UTL, and the elevated concentration is located in an IHSS (i.e., cannot be excluded on the basis of spatial or temporal evaluation).

Plutonium-239/240 and americium-241 are also widely detected in pond sediments, especially in the B series ponds (Figures 6-12 through 6-15; results were detected and not rejected are shown).

PCOCs in pond sediments that do not have EPA-established toxicity factors are 2-methylnaphthalene, benzo(ghi)perylene, phenanthrene, and dibenzofuran. Because of the lack of toxicity factors for these chemicals, they cannot be evaluated in a toxicity- or risk-based screen to select COCs. However, their potential contribution to overall risk will be evaluated qualitatively in the risk assessment for OU6.

Copper was also a PCOC in pond sediment because the background comparison demonstrated that copper was significantly different than background levels. Copper does not have an EPA-established toxicity factor and route-to-route extrapolation of the drinking water standard to ingestion of pond sediment may be inappropriate and would likely overestimate risk (see Section 3.2). In addition, the maximum concentration of copper in pond sediment (125 mg/kg) is less than the background maximum (175 mg/kg) and the site mean and background means were of similar magnitude (30 mg/kg and 27 mg/kg, respectively). Therefore, copper is not likely to contribute to overall potential risk and copper in pond sediments is excluded from further evaluation.

6.5 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

Maximum concentrations of eleven VOCs, SVOCs, and pesticides/PCBs (detected at <5 percent frequency) were compared to values equivalent to 1000 times chemical-specific RBCs (DOE 1995b). Although these chemicals were detected in pond sediment where exposure potential is limited, the RBCs used in this screening evaluation were calculated assuming long-term residential exposure to soil (sediment). This approach is extremely conservative, since it assumes a daily exposure to chemicals in pond sediment, including inhalation of particulate matter. The comparison to 1000 times the RBCs is used to identify special-case COCs; that is, infrequently detected chemicals that could pose a health risk if long-term exposure were to occur to the maximum concentration. The screen is discussed in Attachment B and the results for pond sediment are presented in Table B-4.

None of the chemicals detected at low frequency in pond sediments exceeded 1000 times the RBC. Therefore, no special-case COCs were identified in pond sediments.

TABLE 6-1
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT 5% OR GREATER FREQUENCY POND SEDIMENT

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ?[1]
Organic Compounds:			
2-Butanone	0.13	53	
Acenaphthene	0.59	9	
Acetone	0.81	25	
Anthracene	0.8	20	
Aroclor-1254	10	44	
Benzene	0.01	6	
Benzo(a)anthracene	1.1	38	
Benzo(a)pyrene	0.87	41	
Benzo(b)fluoranthene	3.1	45	
Benzo(ghi)perylene	0.66	11	
Benzo(k)fluoranthene	1	32	
Benzoic acid	4.6	27	
Bis(2-ethylhexyl)phthalate	88	80	
Butyl benzylphthalate	0.12	5	
Chrysene	1.9	52	
Di-n-octylphthalate	0.25	11	
Fluoranthene	3.5	66	
Indeno(1,2,3-cd)pyrene	0.66	14	
Phenanthrene	2.6	54	
Pyrene	3.8	66	
Toluene	1.1	90	
Metals:			
Aluminum	27400	100	No
Antimony	68.5	39	Yes
Arsenic	10.2	100	No
Barium	254	100	No
Beryllium	15.2	98	No
Cadmium	9.9	39	No
Cesium	5.8	93	No
Chromium	96.1	100	Yes
Cobalt	15.5	100	Yes

TABLE 6-1
(CONCLUDED)

Chemical	Maximum Detected Concentration (mg/L)	Detection Frequency %	Inorganic PCOC ?[1]
Copper	125	100	Yes
Lead	155	100	No
Lithium	16.6	98	No
Manganese	558	100	Yes
Mercury	1.5	43	No
Nickel	58.1	70	No
Selenium	1.9	5	No
Silver	345	39	Yes
Strontium	307	100	No
Thallium	0.85	39	No
Vanadium	62.7	100	Yes
Zinc	1270	100	Yes

(1) Based on background comparison (Appendix A).

TABLE 6-2
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT LESS THAN 5% FREQUENCY POND SEDIMENT

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ? [1]
Organic Compounds:			
1,2,4-Trichlorobenzene	0.13	2	
2-Methylnaphthalene	0.17	2	
4-Methyl-2-pentanone	0.006	2	
Aldrin	0.054	2	
Aroclor-1260	0.86	4	
Dibenzo(ah)anthracene	0.15	2	
Dibenzofuran	0.18	2	
Fluorene	0.46	4	
gamma-BHC (Lindane)	0.025	2	
Heptachlor	0.039	1	
Methylene chloride	0.009	2	
Naphthalene	0.39	2	
Phenol	0.29	4	
Metals:			
Tin	39.5	2	No

[1] Based on background comparison (Appendix A)

TABLE 6-3
CONCENTRATION/TOXICITY SCREEN
POND SEDIMENT
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD		Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Aroclor-1254	10	n/a		2.0E-05	5.0E+05	6.6E-01	65.9
Antimony	68.5	n/a		4.0E-04	1.7E+05	2.3E-01	22.6
Silver	345	n/a		5.0E-03	6.9E+04	9.1E-02	9.1
Vanadium	62.7	n/a		7.0E-03	9.0E+03	1.2E-02	1.2
Bis(2-ethylhexyl)phthalate	88	n/a		2.0E-02	4.4E+03	5.8E-03	0.6
Zinc	1270	n/a		3.0E-01	4.2E+03	5.6E-03	0.6
Cobalt	15.5	n/a		6.0E-02	2.6E+02	3.4E-04	0.0
Pyrene	3.8	n/a		3.0E-02	1.3E+02	1.7E-04	0.0
Chromium	96.1	n/a		1.0E+00	9.6E+01	1.3E-04	0.0
Fluoranthene	3.5	n/a		4.0E-02	8.8E+01	1.2E-04	0.0
Di-n-octyl phthalate	0.25	n/a		2.0E-02	1.3E+01	1.6E-05	0.0
Acenaphthene	0.59	n/a		6.0E-02	9.8E+00	1.3E-05	0.0
Acetone	0.81	n/a		1.0E-01	8.1E+00	1.1E-05	0.0
Toluene	1.1	1.1E-01	*	2.0E-01	5.5E+00	7.3E-06	0.0
Anthracene	0.8	n/a		3.0E-01	2.7E+00	3.5E-06	0.0
Benzoic acid	4.6	n/a		4.0E+00	1.2E+00	1.5E-06	0.0
Butyl benzylphthalate	0.12	n/a		6.0E-01	2.0E-01	2.6E-07	0.0
2-Butanone	0.13	3.0E-01	*	2.2E-01	5.9E-01	7.8E-07	0.0
Total Risk Factor					7.6E+05		

RfDs are in units of mg/kg-day.
n/a = not available.
* Inhalation is an incomplete pathway because pond sediments are assumed to remain saturated and contaminants are not released to air. Therefore, oral toxicity factors were used in this screen.

TABLE 6-4
CONCENTRATION/TOXICITY SCREEN
POND SEDIMENT
CARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation Slope Factor		Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Aroclor-1254	10	n/a		7.7E+00	7.7E+01	8.7E-01	87.2
Benzo(a)pyrene	0.87	n/a		7.3E+00	6.4E+00	7.2E-02	7.2
Benzo(b)fluoranthene	3.1	n/a		7.3E-01	2.3E+00	2.6E-02	2.6
Bis(2-ethylhexyl)phthalate	88	n/a		1.4E-02	1.2E+00	1.4E-02	1.4
Benzo(a)anthracene	1.1	n/a		7.3E-01	8.0E-01	9.1E-03	0.9
Indeno(1,2,3-cd)pyrene	0.66	n/a		7.3E-01	4.8E-01	5.5E-03	0.5
Chrysene	1.9	n/a		7.3E-02	1.4E-01	1.6E-03	0.2
Benzo(k)fluoranthene	1	n/a		7.3E-02	7.3E-02	8.3E-04	0.1
Benzene	0.01	2.9E-02	*	2.9E-02	2.9E-04	3.3E-06	0.0
Total Risk Factor					8.8E+01		

Slope factors are in units of Risk/(mg/kg-day).

n/a = not available.

* Inhalation is an incomplete pathway because pond sediments are assumed to remain saturated and contaminants are not released to air. Therefore, oral toxicity factors were used in this screen.

TABLE 6-5
CONCENTRATION/TOXICITY SCREEN
POND SEDIMENT
RADIONUCLIDES

Chemical	Maximum Activity (pCi/L)	Inhalation Slope Factor		Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Plutonium-239/240	1174	2.8E-08	*	3.2E-10	3.8E-07	8.3E-01	82.5
Americium-241	230.53	3.9E-08	*	3.3E-10	7.6E-08	1.7E-01	16.7
Uranium-238	26.445	1.2E-08	*	6.2E-11	1.6E-09	3.6E-03	0.4
Uranium-233/234	15.935	1.4E-08	*	4.4E-11	7.0E-10	1.5E-03	0.2
Radium-228	2.3	9.9E-10	*	2.5E-10	5.8E-10	1.3E-03	0.1
Radium-226	1.25	2.8E-09	*	3.0E-10	3.8E-10	8.2E-04	0.1
Strontium-89,90	1.8	6.9E-11	*	5.6E-11	1.0E-10	2.2E-04	0.0
Uranium-235	0.854	1.3E-08	*	4.7E-11	4.0E-11	8.8E-05	0.0
Total Risk Factor					4.6E-07		

Slope factors are in units of Risk/pCi.

* Inhalation is an incomplete pathway because pond sediments are assumed to remain saturated and contaminants are not released to air. Therefore, oral toxicity factors were used in the screen.

TABLE 6-6
OU6 CHEMICALS OF CONCERN
POND SEDIMENT

Aroclor-1254
Benzo(a)pyrene
Benzo(b)fluoranthene
Bis(2-ethylhexyl)phthalate
Antimony
Silver
Vanadium
Americium-241
Plutonium-239/240

FIGURE 6-1
HISTOGRAMS FOR MANGANESE IN BACKGROUND SEEP/SPRING SEDIMENT AND OU6 POND SEDIMENT

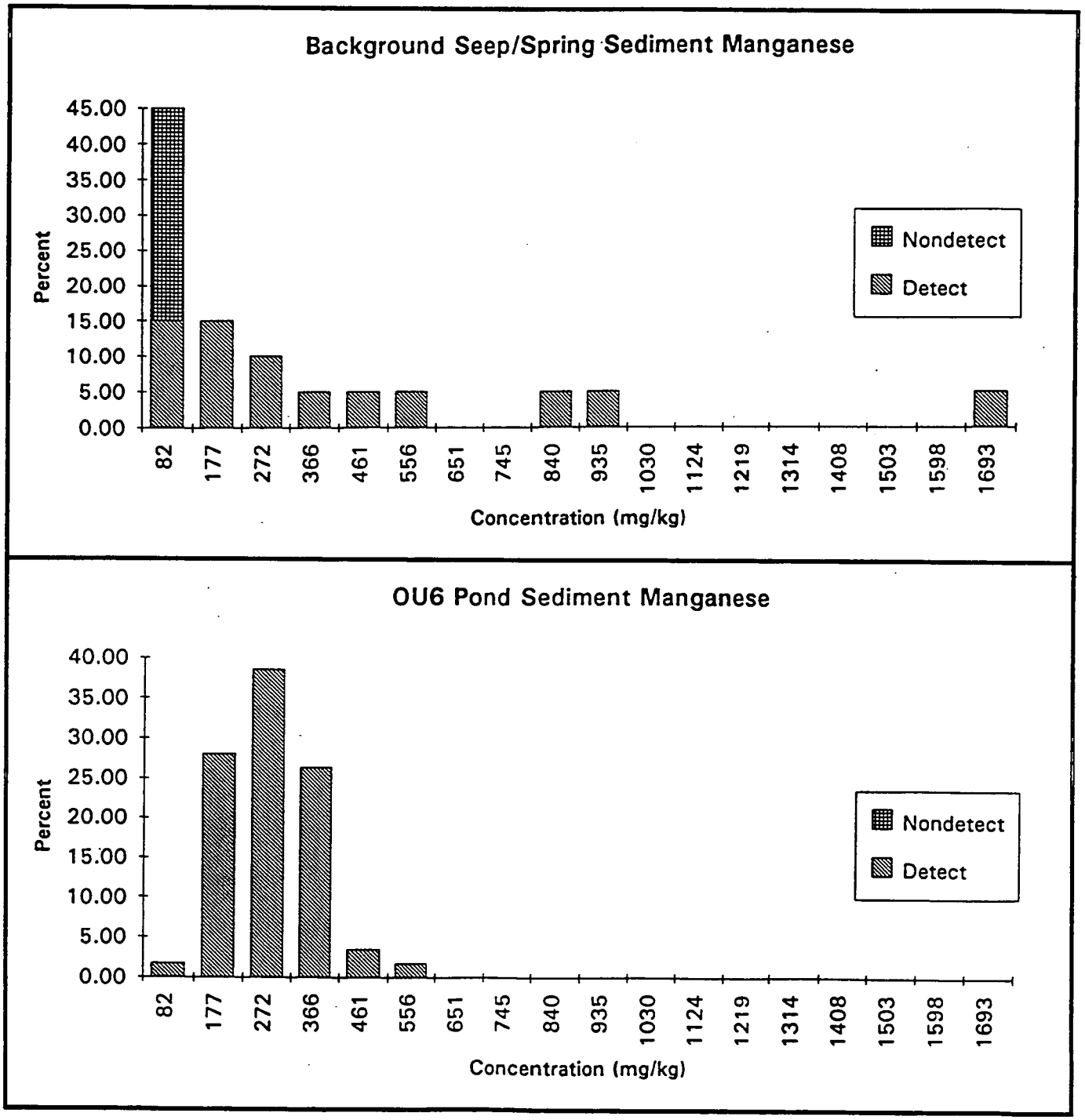


FIGURE 6-2
BOX PLOTS FOR MANGANESE IN BACKGROUND SEEP/SPRING SEDIMENT AND OU6 POND SEDIMENT

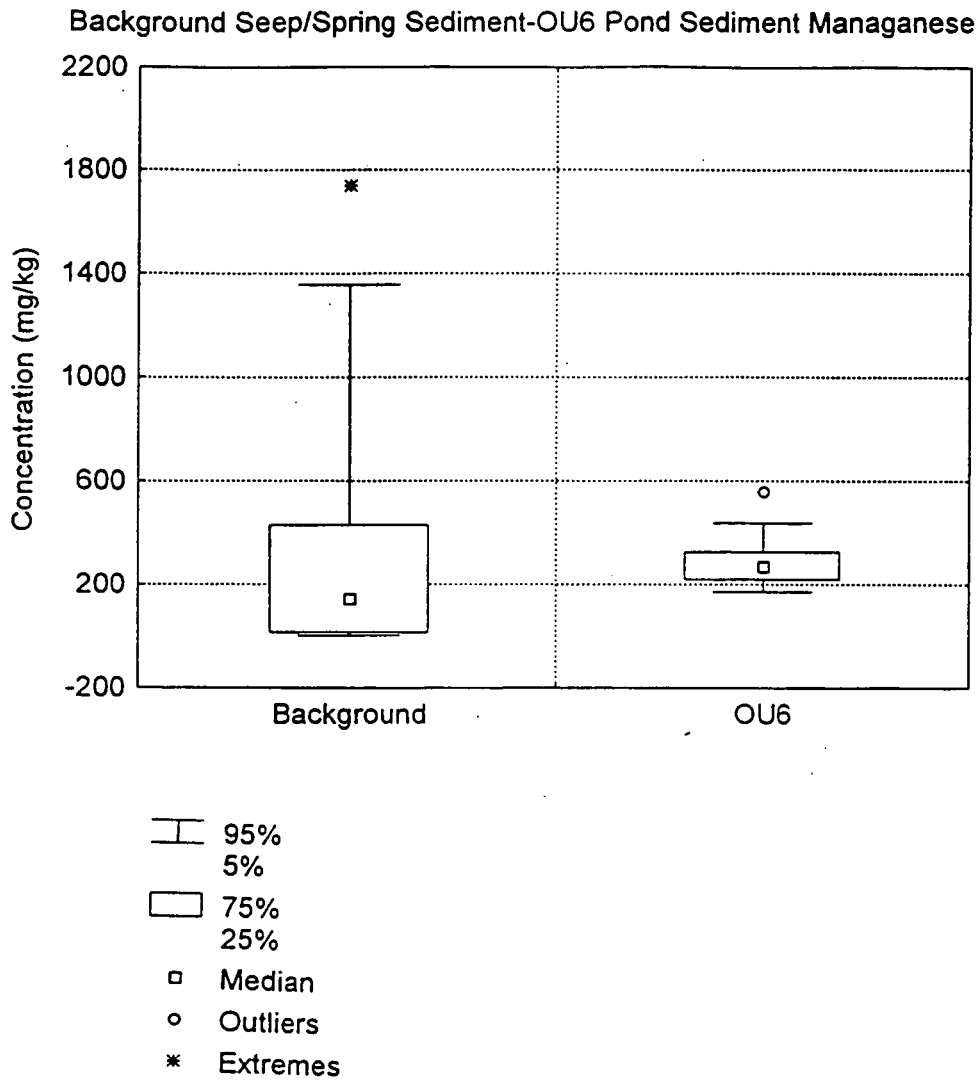
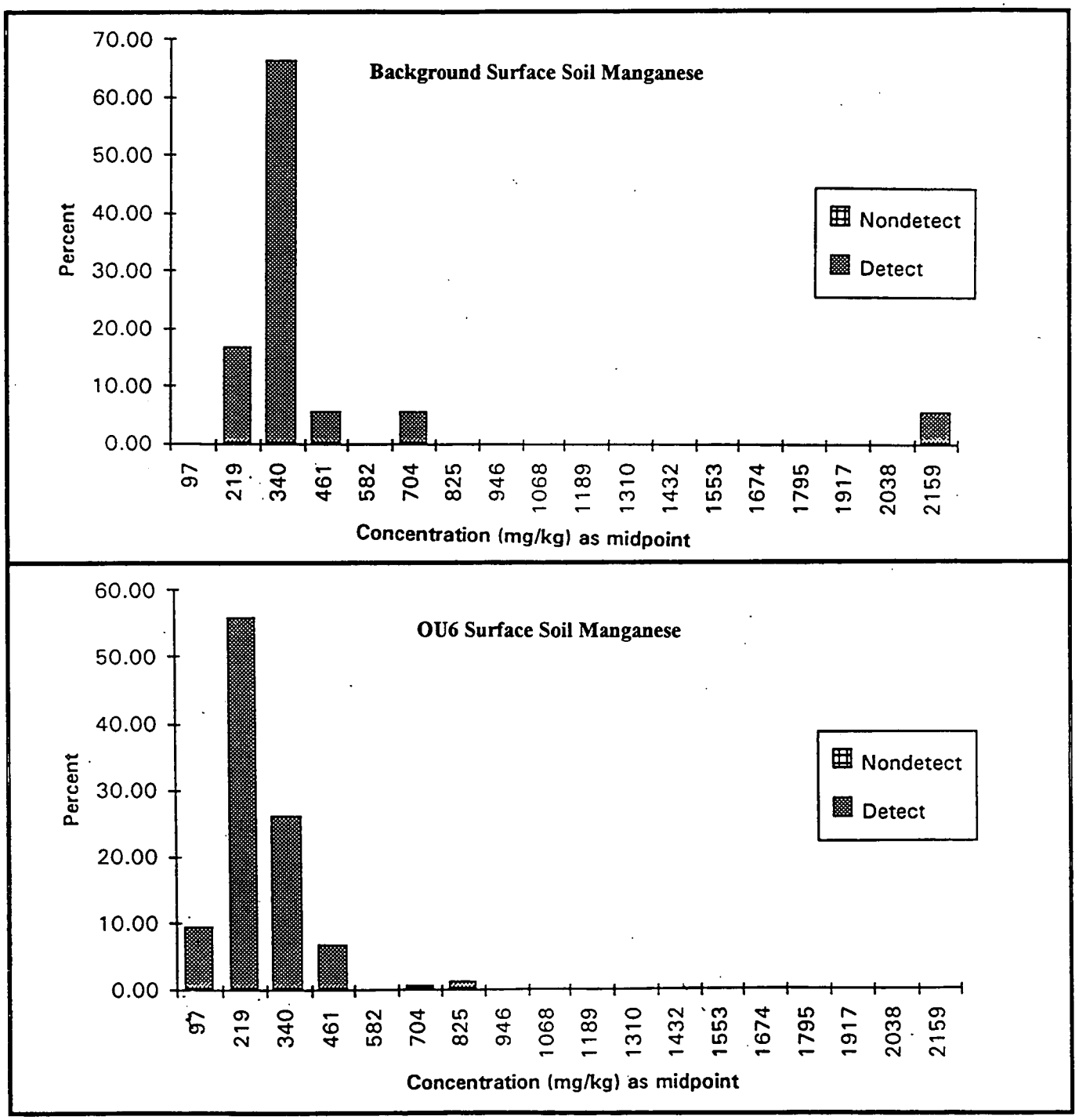
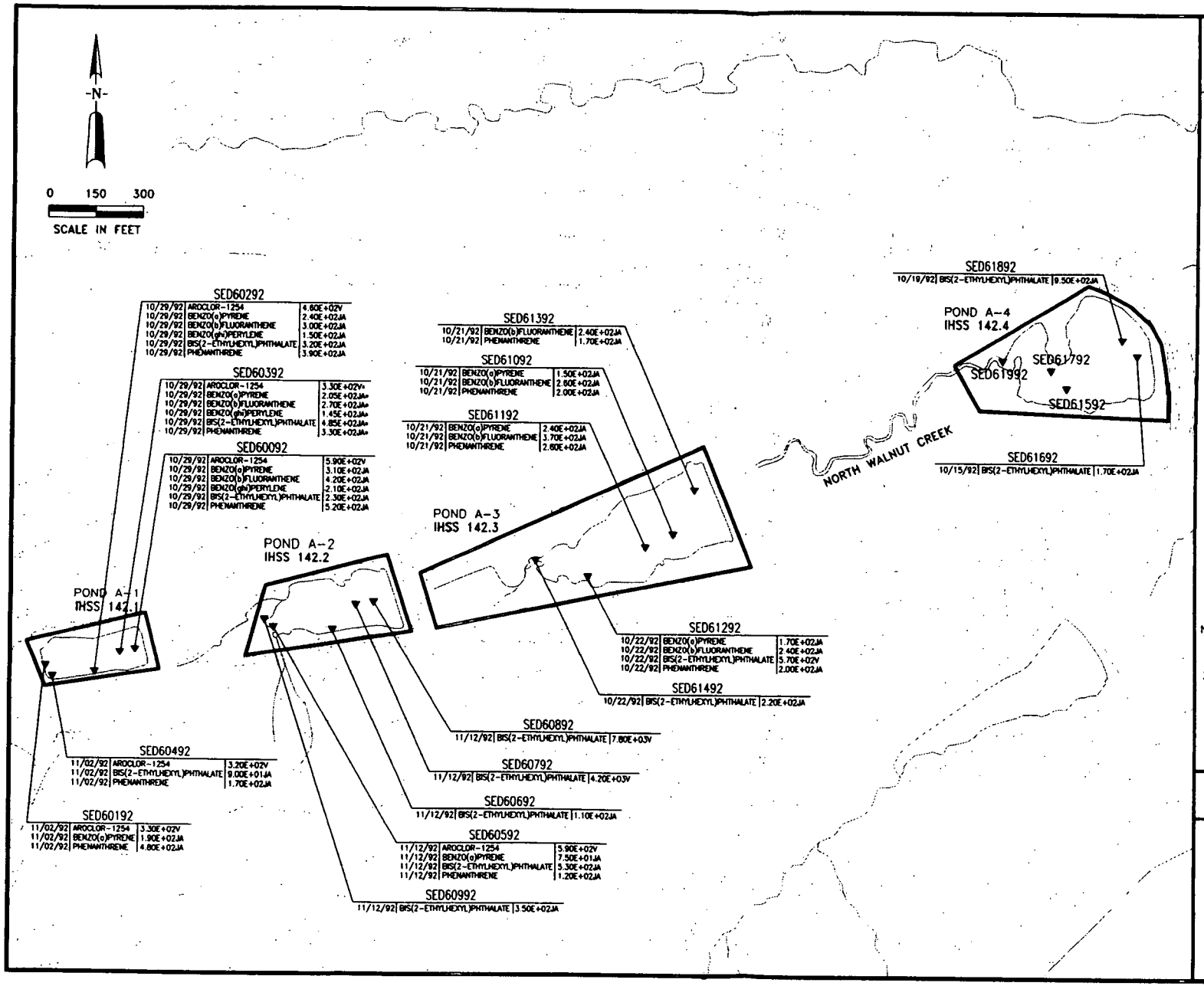


FIGURE 6-3
HISTOGRAMS FOR MANGANESE IN BACKGROUND AND OU6 SURFACE SOIL





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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ SED61892 POND SEDIMENT SAMPLE SITE

SED61692 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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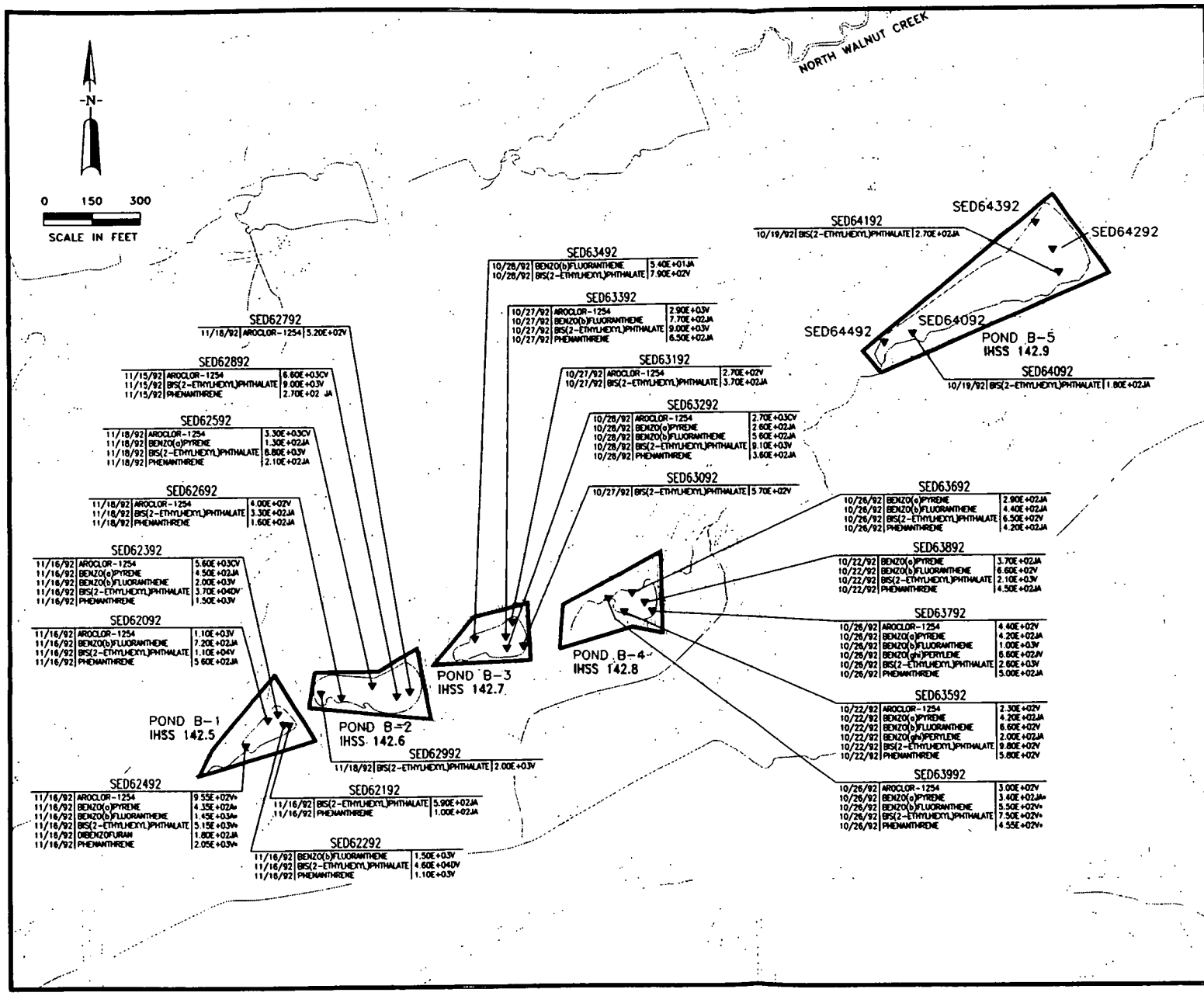
AROCLOR-1254, PAHs, AND BIS(2-ETHYLHEXYL)PHTHALATE (IHSSs 142.1 - 142.4) POND SEDIMENTS

FIGURE 6-4 JUNE 1995

OU6TM129 1=300



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE

SED63692

SED64392 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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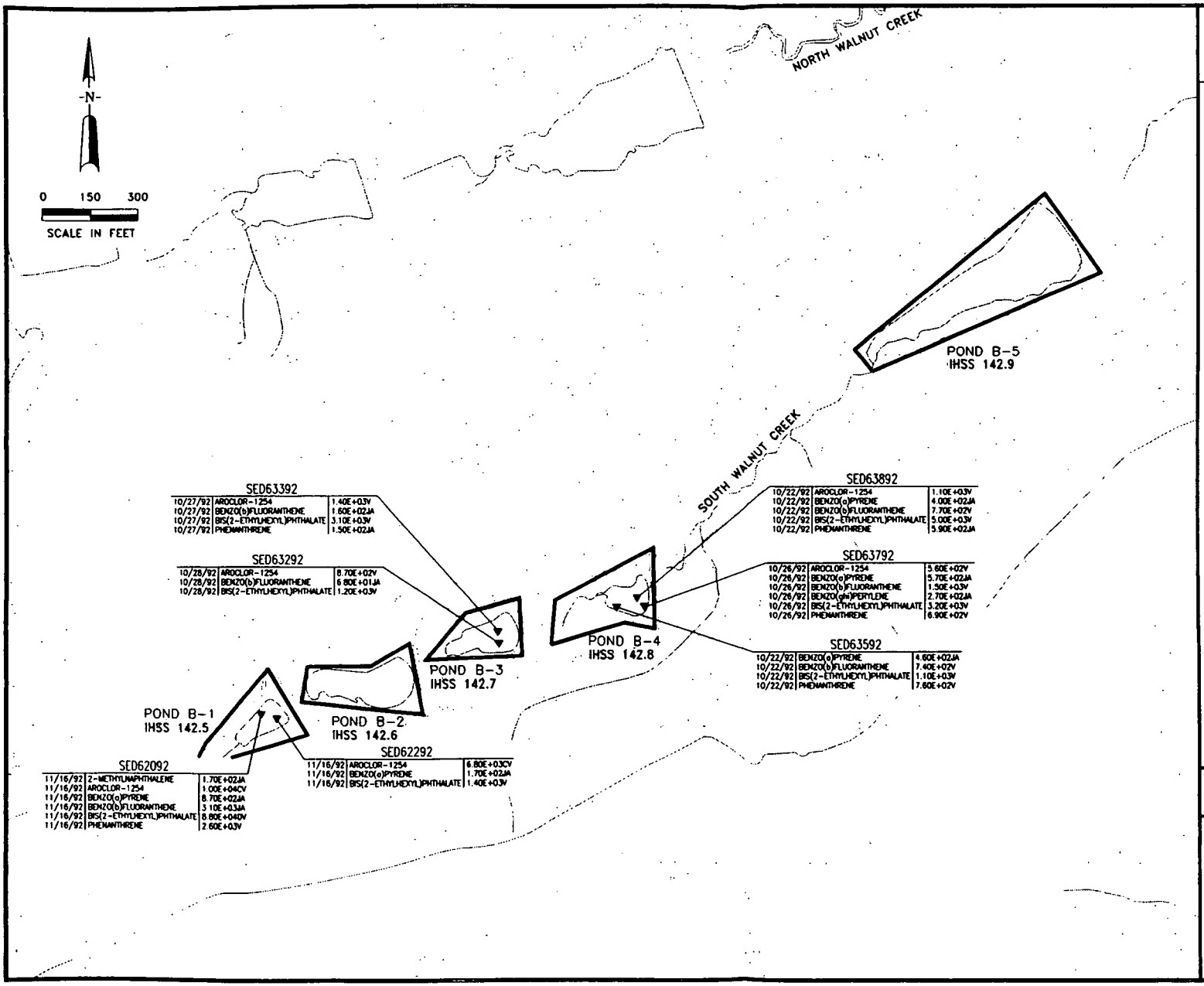
AROCLOR-1254, PAHs, AND BIS(2-ETHYLHEXYL)PHTHALATE (IHSSs 142.5 - 142.9) POND SEDIMENTS 0'-2' DEPTH

FIGURE 6-5 JUNE 1995

OU6TM130 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED64292

SED64892 ← LOCATION
2/26/92
SAMPLE DATE
ANALYTE
ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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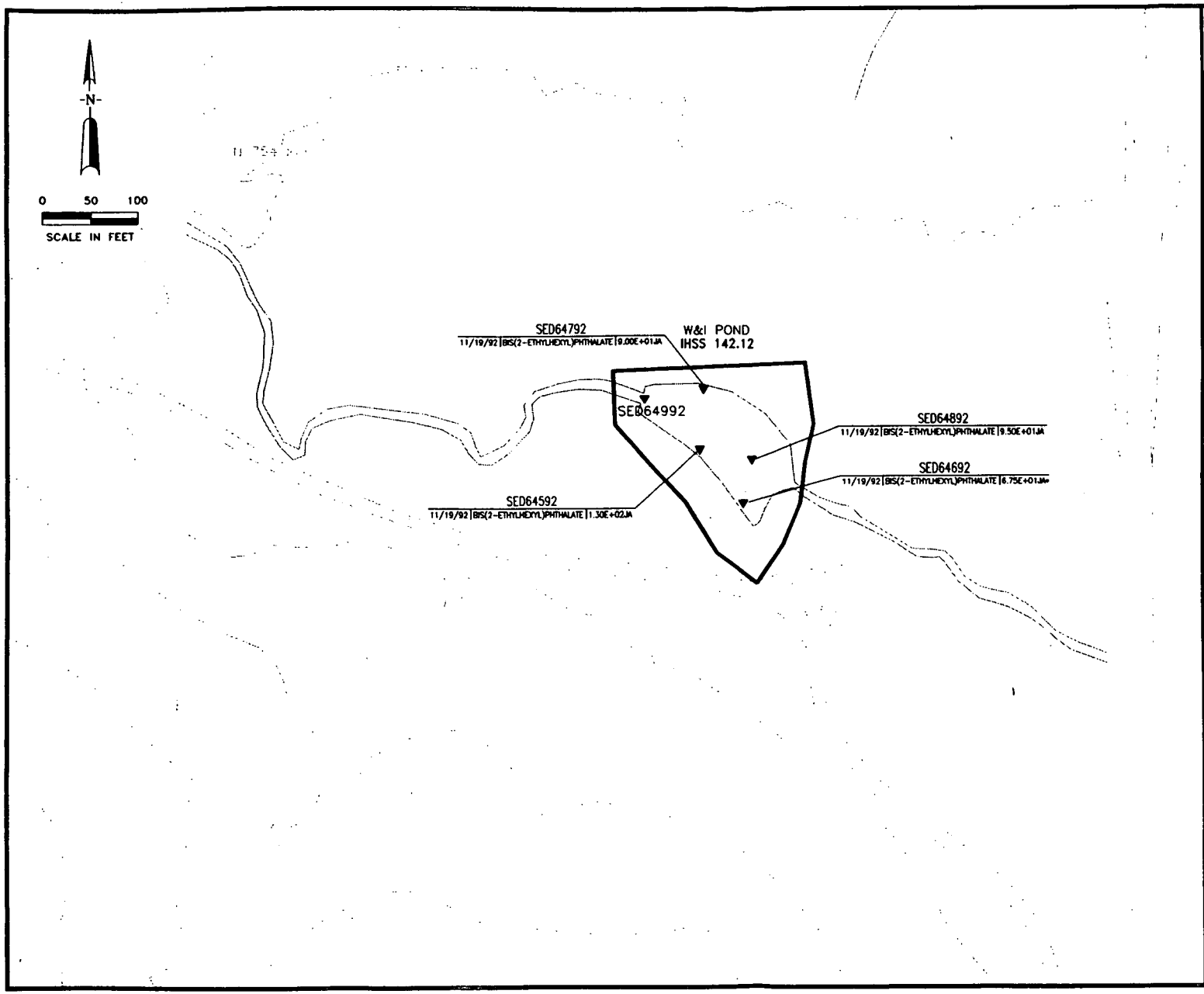
AROCLOR-1254, PAHs, 2-METHYLNAPHTHALENE, AND BIS(2-ETHYLHEXYL)PHTHALATE
(IHSSs 142.5 - 142.9)
POND SEDIMENTS
2'-4' DEPTH

FIGURE 6-6 JUNE 1995

OU6TM131 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED64592

SED64592 ← LOCATION
2/26/92
SAMPLE DATE
ANALYTE
ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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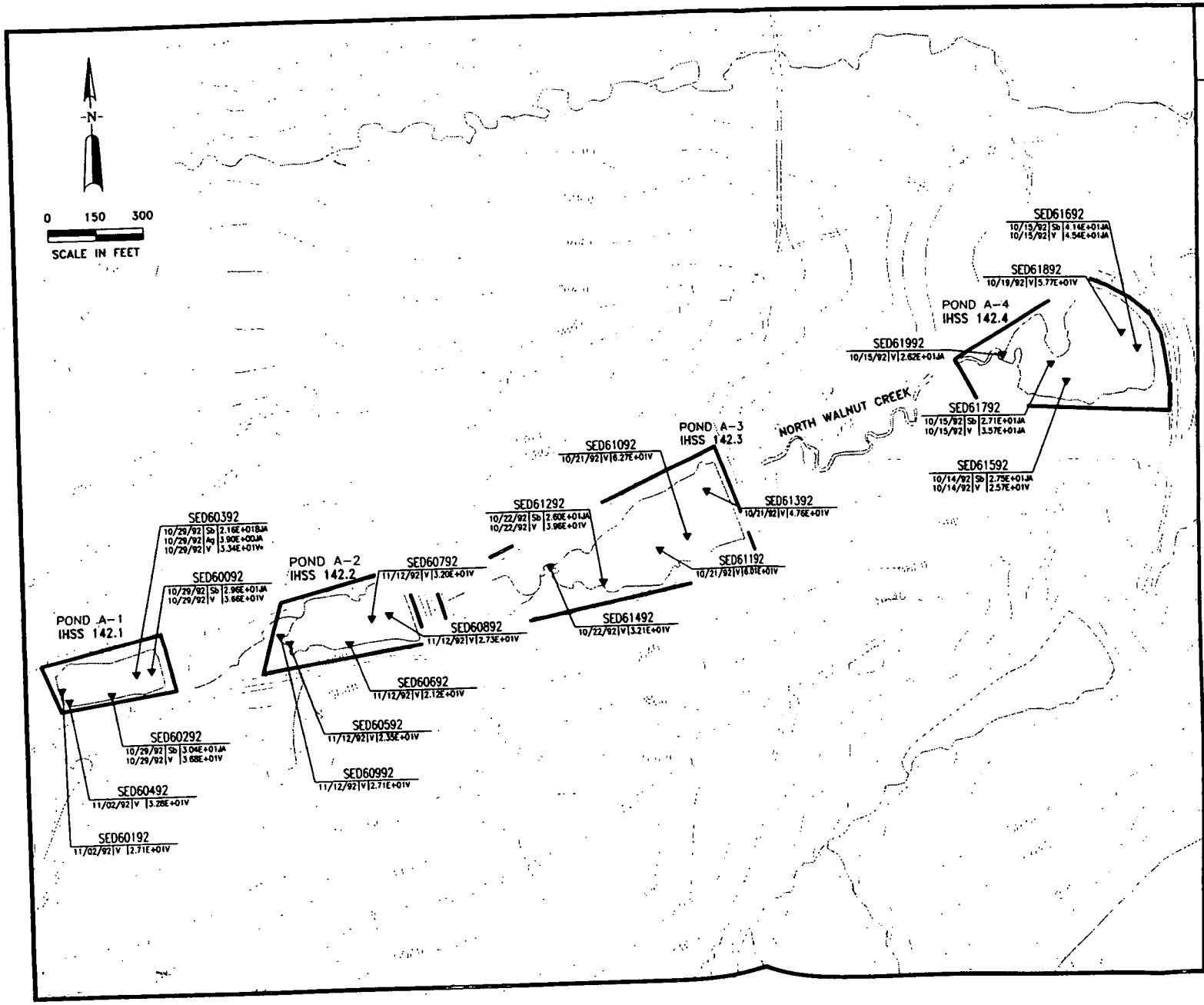
BIS(2-ETHYLHEXYL)PHTHALATE
(IHSS 142.12)
POND SEDIMENTS

FIGURE 6-7 JUNE 1995

OU6TM132 1=100



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SED61792 — POND SEDIMENT SAMPLE SITE

SED61692 ← LOCATION
2/28/92 — SAMPLE DATE
ANALYTE
ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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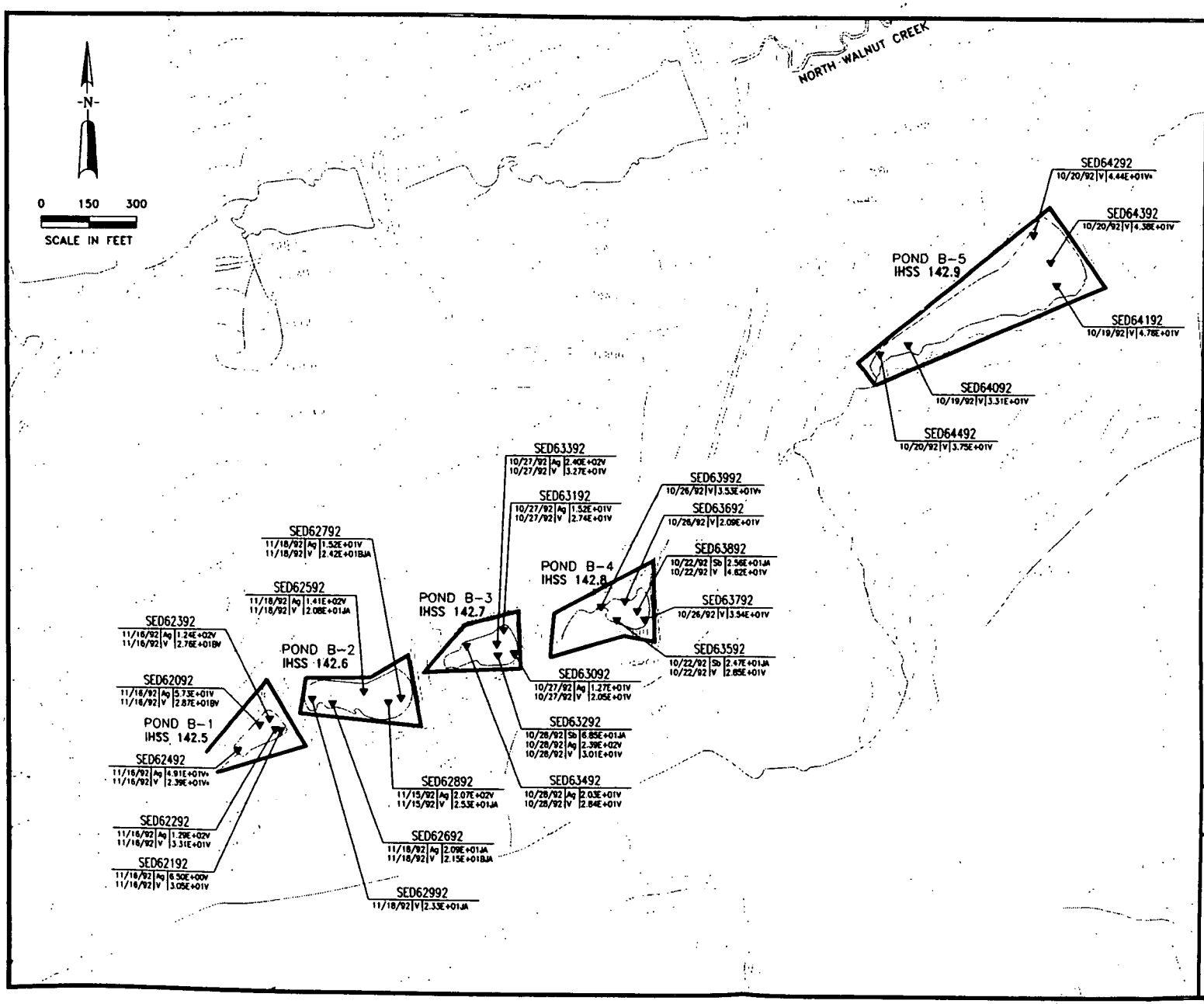
ANTIMONY, SILVER, AND VANADIUM
(IHSSs 142.1 – 142.4)
POND SEDIMENTS

FIGURE 6-8 JUNE 1995

OU6TM133 1-300



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SED63892 — POND SEDIMENT SAMPLE SITE

SED64392 ← LOCATION

2/26/92 — SAMPLE DATE

ANALYTE

ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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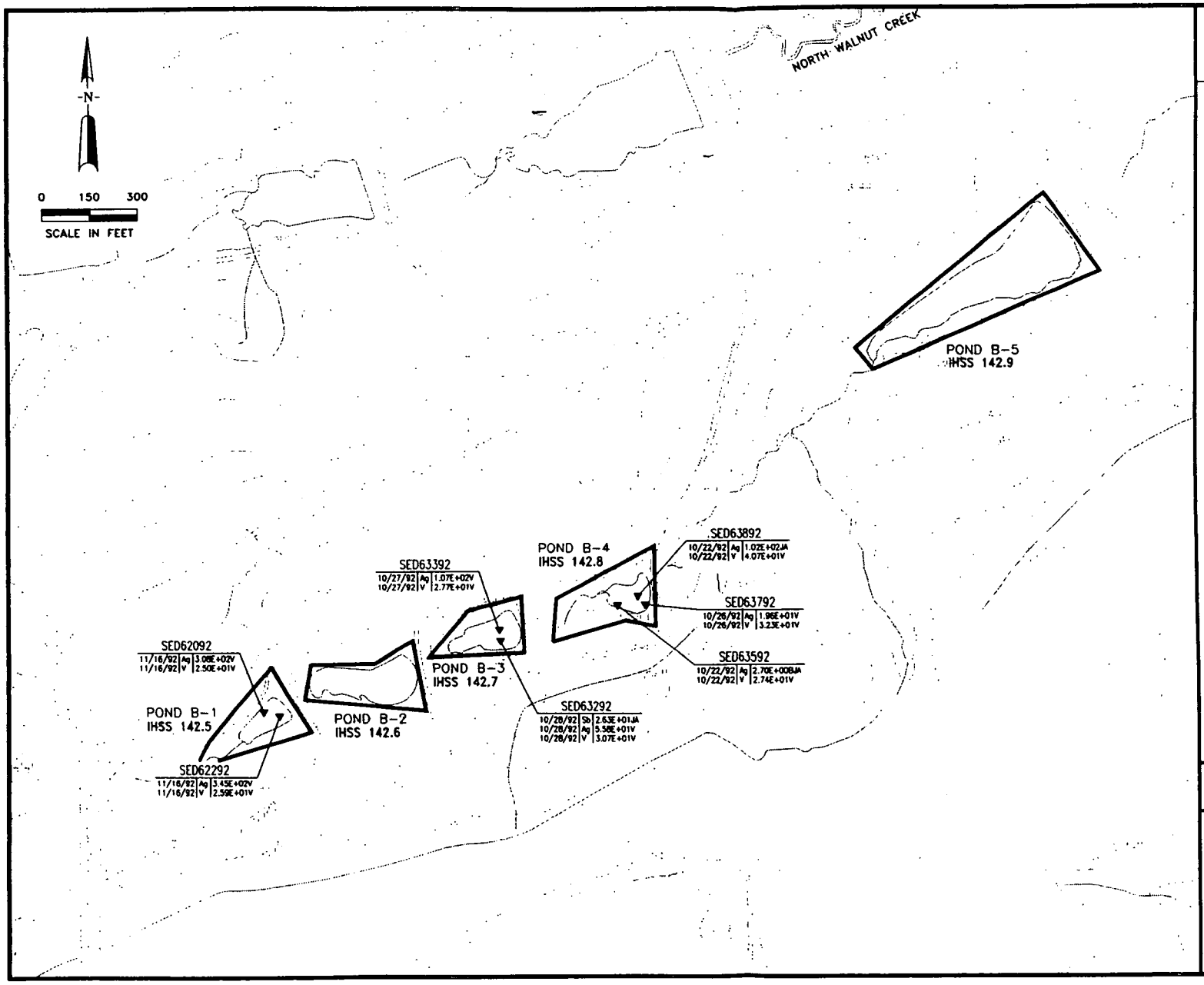
ANTIMONY, SILVER, AND VANADIUM
(IHSSs 142.5 - 142.9)
POND SEDIMENTS
0'-2' DEPTH

FIGURE 6-9

JUNE 1995

OU6TM134 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SED63892 POND SEDIMENT SAMPLE SITE

SED64392 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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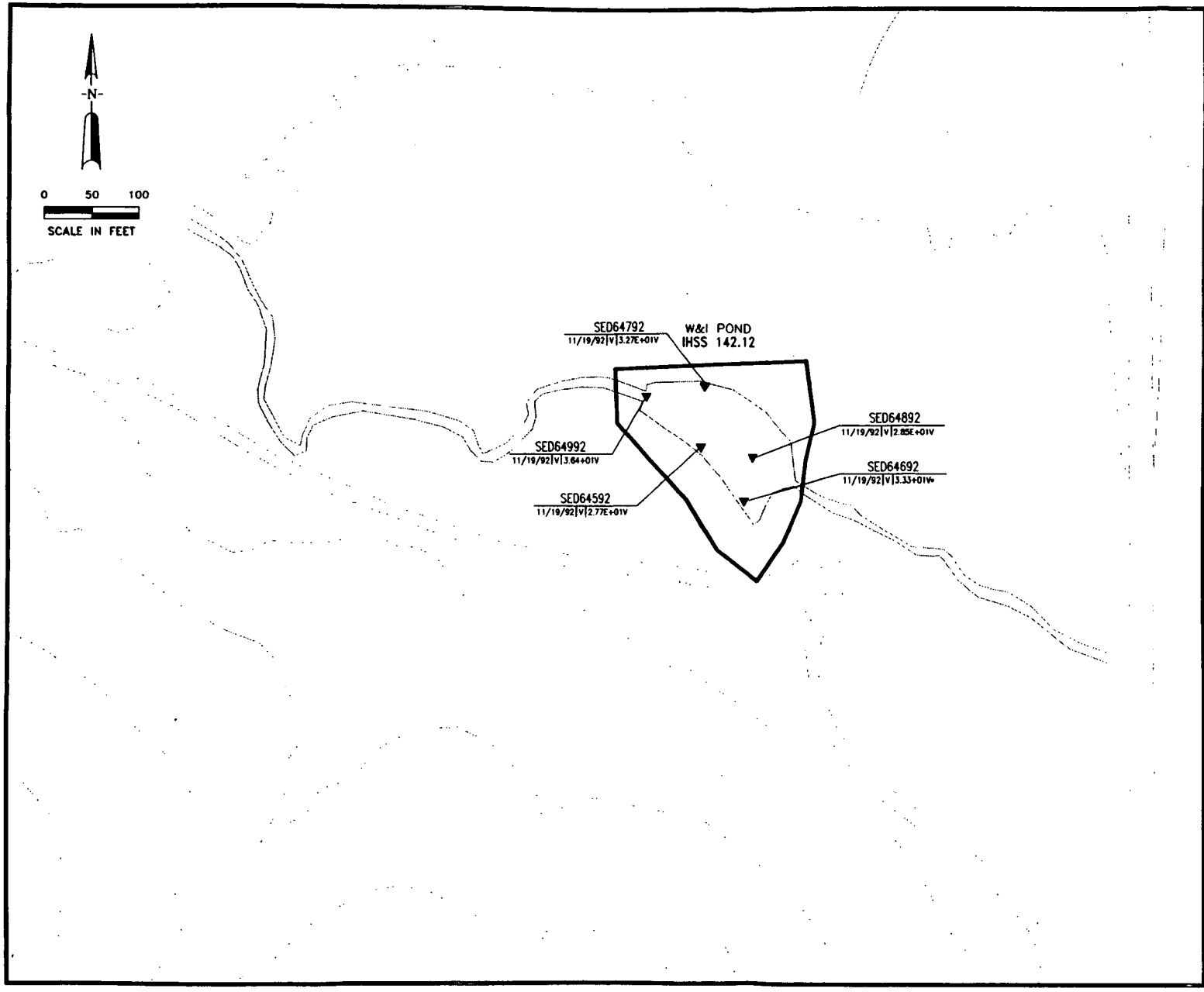
ANTIMONY, SILVER, AND VANADIUM
(IHSSs 142.5 – 142.9)
POND SEDIMENTS
2'-4' DEPTH

FIGURE 6-10 JUNE 1995

OU6TM135 1=300



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED64592

SED64592 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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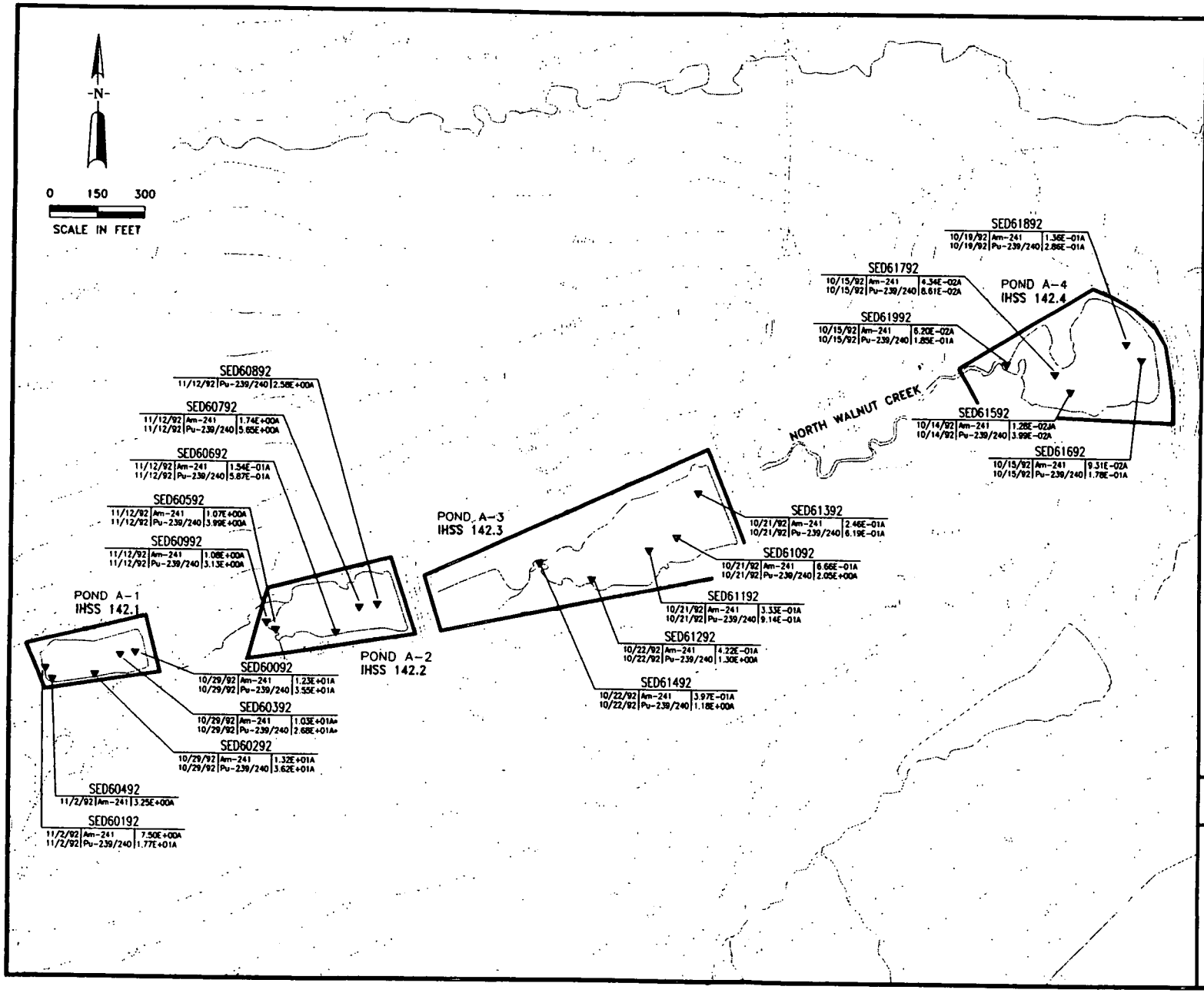
VANADIUM
(IHSS 142.12)
POND SEDIMENTS

FIGURE 6-11 JUNE 1995

OU6TM136 1=100



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED61492

SED61492 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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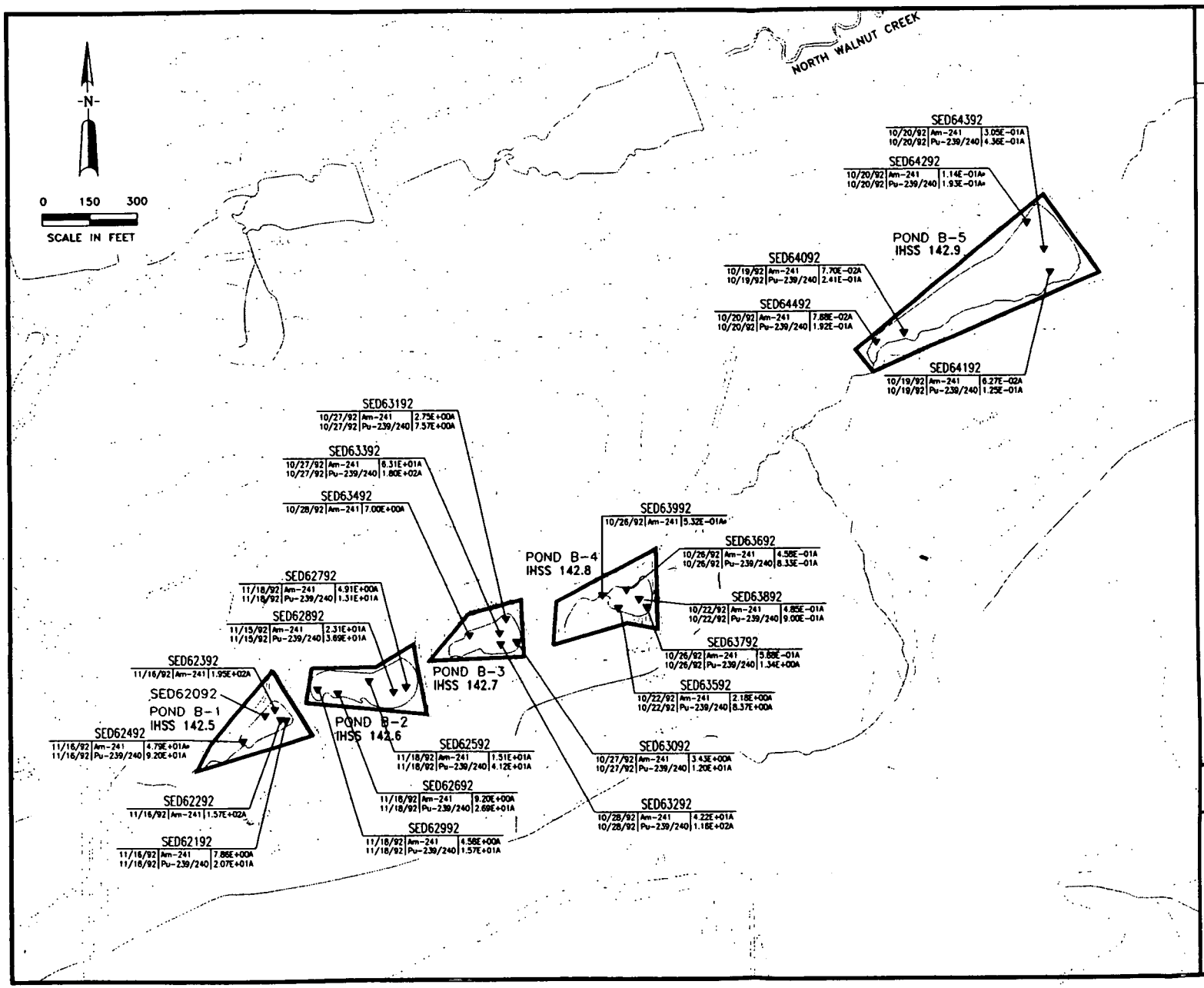
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
(IHSSs 142.1 - 142.4)
POND SEDIMENTS

FIGURE 6-12 JUNE 1995

OU6TM137 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED63892

SED63892 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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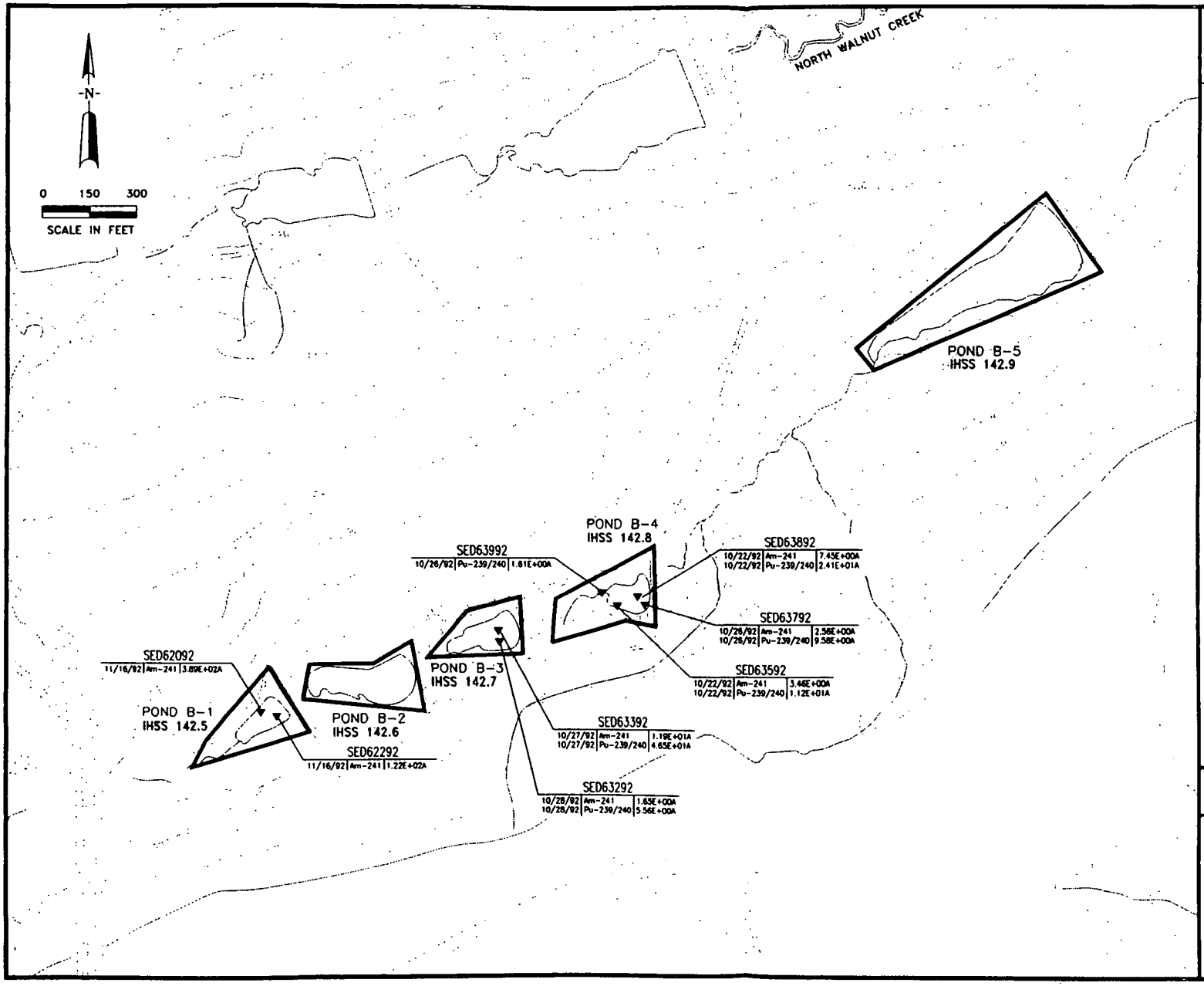
AMERICIUM-241 AND PLUTONIUM-230/240
(IHSSs 142.5 – 142.9)
POND SEDIMENTS
0'-2' DEPTH

FIGURE 6-13 JUNE 1995

OU6TM138 1=300



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INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED63892

SED63892 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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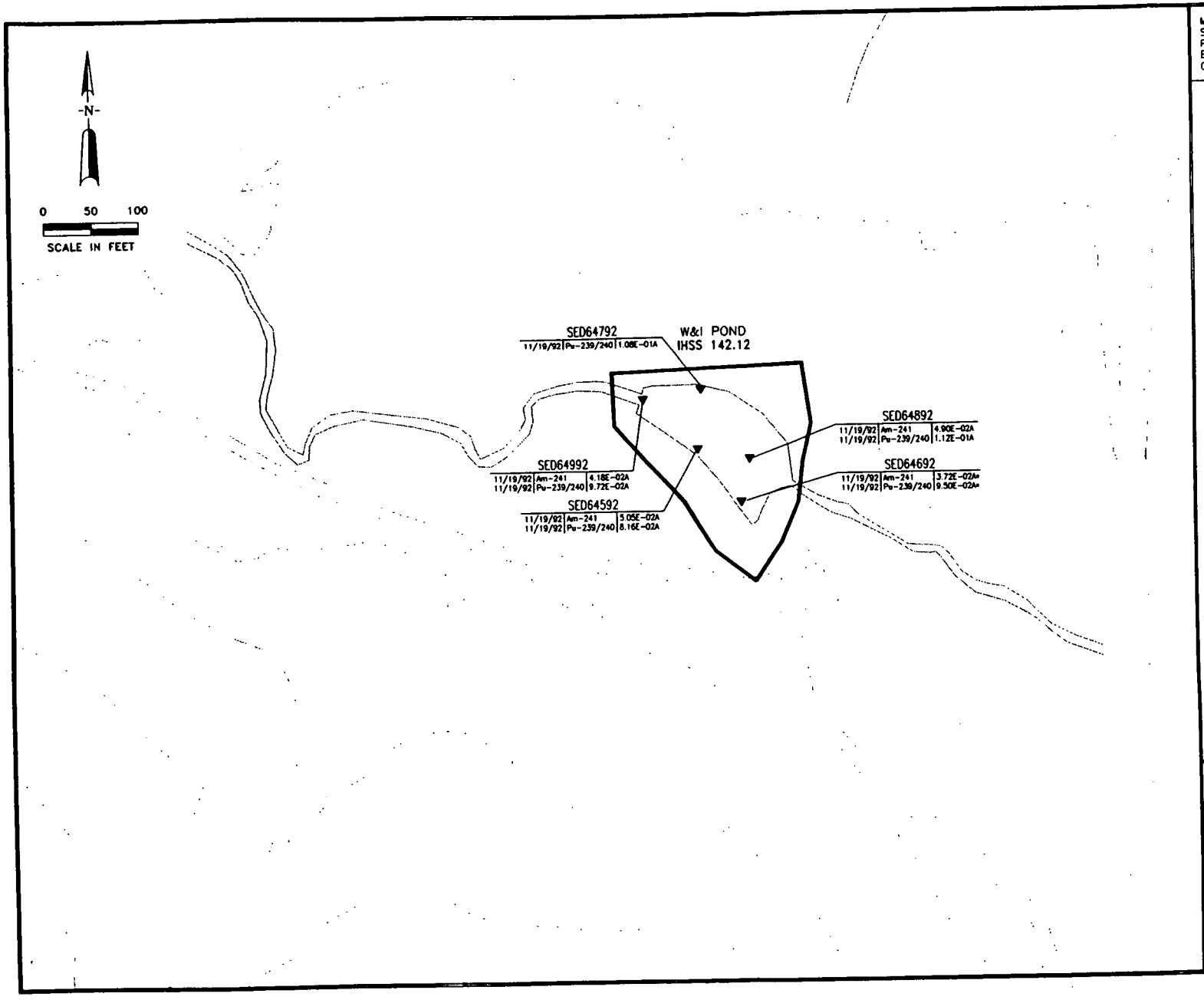
AMERICIUM-241 AND PLUTONIUM-239/240
(IHSSs 142.5 - 142.9)
POND SEDIMENTS
2'-4' DEPTH

FIGURE 6-14 JUNE 1995

OU6TM139 1=300



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EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED64592

SED64592 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:
1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

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AMERICIUM-241 AND PLUTONIUM-239/240
(IHSS 142.12)
POND SEDIMENTS

FIGURE 6-15 JUNE 1995

OU6TM140 1=100

7.0 POND SURFACE WATER CHEMICALS OF CONCERN

7.1 POND SURFACE WATER DATA SET

Approximately 50 surface water samples were collected in the A and B series ponds in the Walnut Creek drainage, including the terminal pond at Walnut Creek and Indiana Street. Samples were analyzed for metals, radionuclides, and volatile and semivolatile organic compounds. The sampling and analytical program for pond surface water (IHSS 142) is summarized in Tables 2-1 and 2-2.

7.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Tables 7-1 and 7-2 summarize the maximum detected concentrations and detection frequencies for organic compounds and metals and the results of the background comparison for metals in pond surface water. Background data from seeps/springs reported in the Background Geochemical Characterization Report (DOE 1993) were used for comparison to pond surface water data. Seep/spring background data were preferred to background stream data for this comparison because of the similarity in flow regime (long residence time) in the seeps and ponds. The statistical comparisons of metals and radionuclide results to background data are presented in detail in Attachment A.

As shown in Tables 7-1 and 7-2 (for metals) and Attachment A (for radionuclides), no metals or radionuclides exceeded background levels, except for uranium isotopes. However, uranium in pond surface water is considered to be naturally occurring, for the reasons presented in Section 7.3. Therefore, only organic compounds were included in risk-based screens to identify COCs. Organic chemicals that were detected at 5 percent or greater detection frequency were included in concentration/toxicity screens to select OU-wide COCs. Compounds detected at less than 5 percent frequency were evaluated in the risk-based screen to identify special-case COCs (see Attachment B).

7.3 EXCLUSION OF URANIUM ISOTOPES AS CHEMICALS OF CONCERN IN POND SURFACE WATER

Uranium isotopes (U-233/234, U-235, and U-238) were the only radionuclides in unfiltered pond water that exceeded background levels (based on comparison to seep/spring water; Table A-31). The detections of uranium isotope activities are shown in Figures 7-1 through 7-3. The uranium isotopes in pond water are likely to be naturally occurring. The ratio of U-233/234 to U-238 activity is close to one in naturally occurring uranium (DOE 1992c). In all ponds except B-4 (where nondetect results for U-238 prevented an adequate analysis), the ratio of U-233/234 activity to U-238 activity ranged from 0.7 to 1.3 (overall average = 0.99). Because the ratios in individual ponds and the overall average are so close to one, it is concluded that the uranium detected in pond water samples results from naturally occurring uranium in the environment. Furthermore, uranium isotopes did not exceed background levels in OU6 surface soil or in groundwater, which supports a conclusion that these isotopes are not contaminants but rather are naturally occurring. Therefore, uranium isotopes are eliminated from further evaluation as COCs.

7.4 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for organic compounds detected in pond surface water are presented in Tables 7-3 and 7-4. All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs for quantitative risk assessment. COCs are listed below and in Table 7-5:

OU-Wide Chemicals of Concern Pond Surface Water
Chloroform
1,2-Dichloroethene
Trichloroethene
Di-n-butylphthalate

Figures 7-4 and 7-5 show the occurrence of semivolatile and volatile organic COCs in pond surface water. The organic COCs were reported in trace concentrations (0.0008J to 0.006 mg/L) in some samples collected in the B series ponds. Di-n-butylphthalate was also reported in four samples collected in the A series ponds. Most results for chloroform, di-n-

butylphthalate, trichloroethene, and 1,2-dichloroethene were J-qualified, indicating estimated quantities below the sample quantitation limit. The very low reported concentrations and the occurrence of other organic compounds in the laboratory method blanks suggest that some or all of these compounds may not be environmental contaminants in surface water but rather sampling or laboratory artifacts or naturally occurring (chloroform). It is not uncommon to detect halogenated methanes such as chloroform in surface waters (Tchobanoglous 1985).

On the other hand, chloroform and trichloroethene were reported in groundwater samples from OU6, and these and other organic compounds detected in pond surface water cannot be conclusively excluded as environmental contaminants based on the available evidence. Therefore, these four chemicals are retained as COCs in pond surface water.

7.5 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

Maximum concentrations of acetone, methylene chloride, tetrachloroethene, and 1,2-dichloroethane (detected at <5 percent frequency) were compared to values equivalent to 1000 times chemical-specific RBCs (DOE 1994b). Although these chemicals were detected in pond surface water, the RBCs used in this screening evaluation were calculated assuming residential exposure to groundwater. This approach is extremely conservative, since it assumes daily ingestion of pond surface water as drinking water. The RBCs are used to identify special-case COCs; that is, infrequently detected compounds that could pose a health risk if long-term exposure were to occur to maximum concentrations. The screen is discussed in Attachment B and the results for pond surface water are presented in Table B-5.

None of the chemicals detected at low frequency in pond surface water exceeded 1000 times the RBC. Therefore, no special-case COCs were identified in pond surface water.

TABLE 7-1
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT 5% OR GREATER FREQUENCY POND SURFACE WATER

Chemical	Maximum Detected Concentration (mg/L)	Detection Frequency %	Inorganic PCOC ?[1]
Organic Compounds:			
1,2-Dichloroethene	0.003	7	
Chloroform	0.002	20	
Di-n-butylphthalate	0.002	12	
Trichloroethene	0.006	12	
Metals:			
Aluminum	1.02	98	No
Antimony	0.0205	6	No
Arsenic	0.0066	41	No
Barium	0.12	100	No
Cadmium	0.0022	22	No
Cesium	0.06	12	No
Chromium	0.0043	16	No
Cobalt	0.0036	35	No
Copper	0.0047	19	No
Lead	0.0158	78	No
Lithium	0.0545	100	No
Manganese	0.293	100	No
Mercury	0.00096	33	No
Molybdenum	0.0176	75	No
Nickel	0.0063	47	No
Selenium	0.0083	22	No
Silver	0.0027	6	No
Strontium	0.568	100	No
Tin	0.0119	20	No
Vanadium	0.0056	49	No
Zinc	0.0748	76	No

(1) Based on background comparison (Appendix A).

TABLE 7-2
ORGANIC COMPOUNDS AND TOTAL METALS DETECTED AT LESS THAN 5% FREQUENCY POND SURFACE WATER

Chemical	Maximum Detected Concentration (mg/L)	Detection Frequency %	Inorganic PCOC ? [1]
Organic Compounds:			
1,2-Dichloroethane	0.001	2	
Acetone	0.018	4	
Methylene chloride	0.034	4	
Tetrachloroethene	0.012	4	
Metals:			
Beryllium	0.00034	4	No

[1] Based on background comparison (Appendix A)

TABLE 7-3
CONCENTRATION/TOXICITY SCREEN
POND SURFACE WATER
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/L)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
1,2-Dichloroethene	0.003	n/a	9.0E-03	3.3E-01	6.0E-01	60.2
Chloroform	0.002	n/a	1.0E-02	2.0E-01	3.6E-01	36.1
Di-n-butylphthalate	0.002	n/a	1.0E-01	2.0E-02	3.6E-02	3.6
Total Risk Factor				5.5E-01		

RfDs are in units of mg/kg-day.
n/a = not available.

TABLE 7-4
CONCENTRATION/TOXICITY SCREEN
POND SURFACE WATER
CARCINOGENS

Chemical	Maximum Detected Conc. (mg/L)	Inhalation Slope Factor		Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Trichloroethene	0.006	6.0E-03	*	1.1E-02	6.6E-05	8.4E-01	84.4
Chloroform	0.002	8.0E-02	*	6.1E-03	1.2E-05	1.6E-01	15.6
Total Risk Factor					7.8E-05		

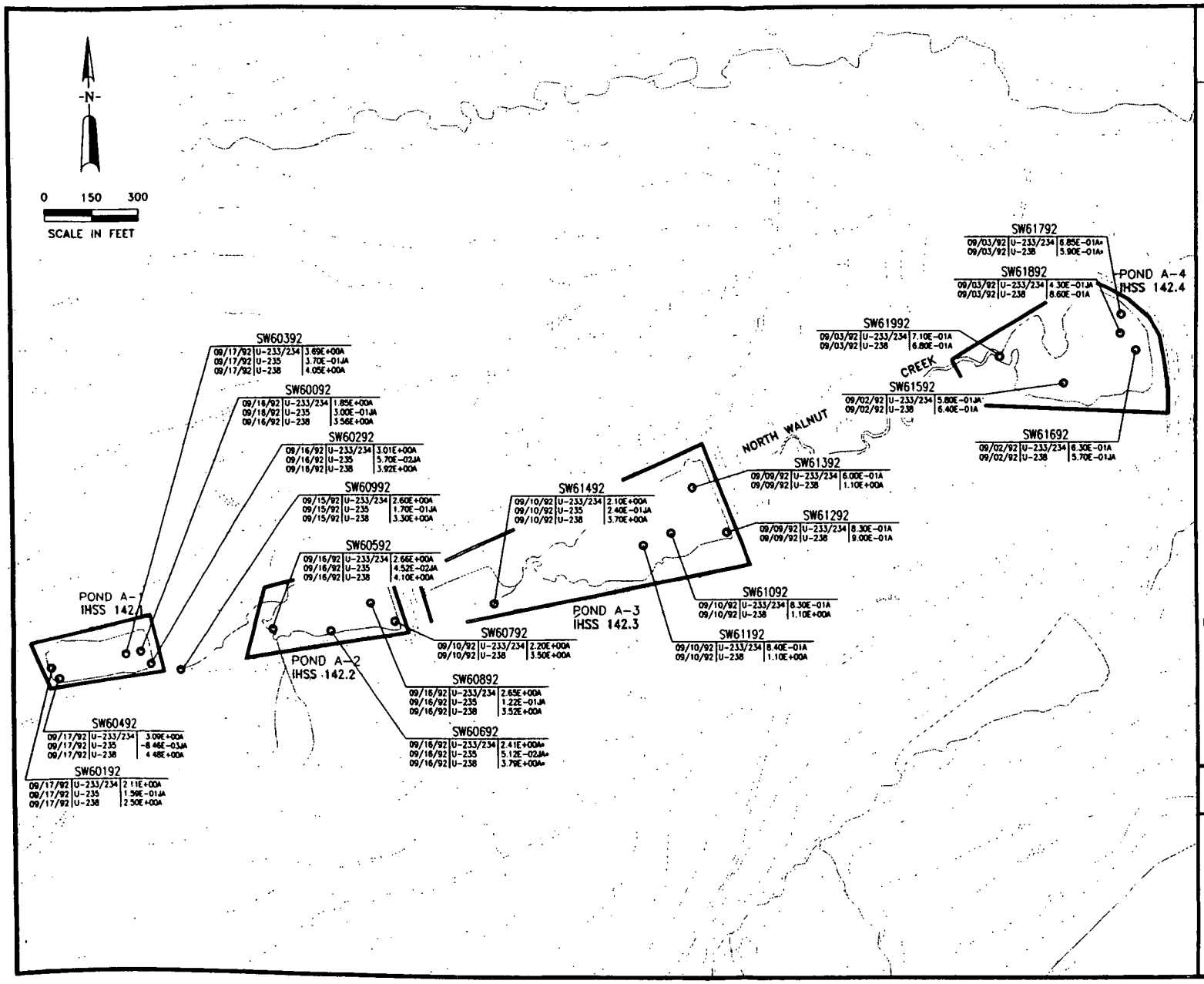
Slope factors are in units of Risk/(mg/kg-day).

n/a = not available.

* Inhalation of volatile organic compounds released to air in the outdoors is a negligible pathway. Therefore, oral toxicity factors were used in the screen.

TABLE 7-5
OU6 CHEMICALS OF CONCERN
POND SURFACE WATER

1,2-Dichloroethene
Chloroform
Di-n-butylphthalate
Trichloroethene



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

POND SURFACE WATER SAMPLE SITE

SW61892

SW78392 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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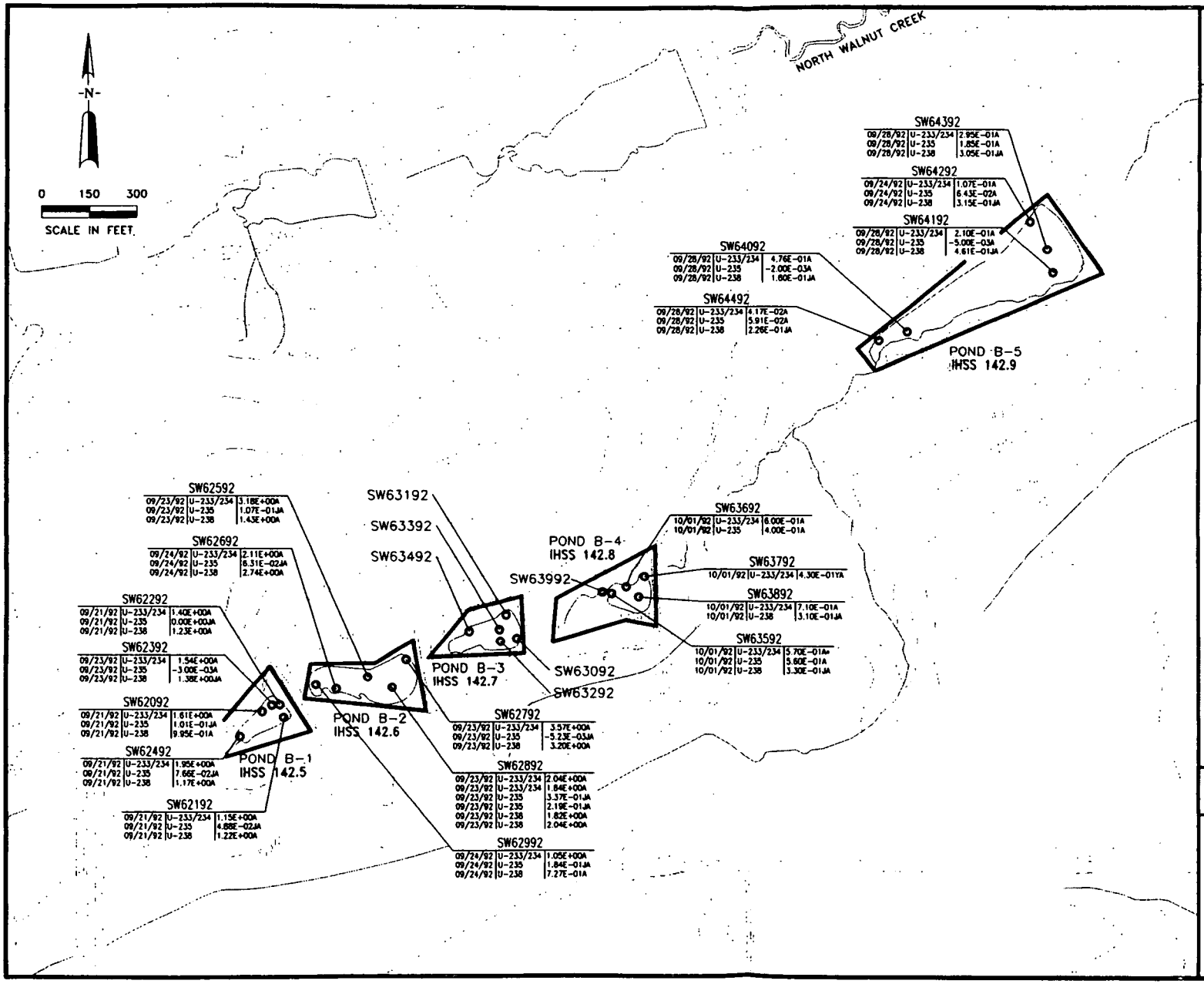
URANIUM-233/234,
URANIUM-235, AND URANIUM-238
(IHSSs 142.1 - 142.4)
POND SURFACE WATER

FIGURE 7-1 JUNE 1995

OU6TM141 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

POND SURFACE WATER SAMPLE SITE
SW64392

SW64392 ← LOCATION
2/28/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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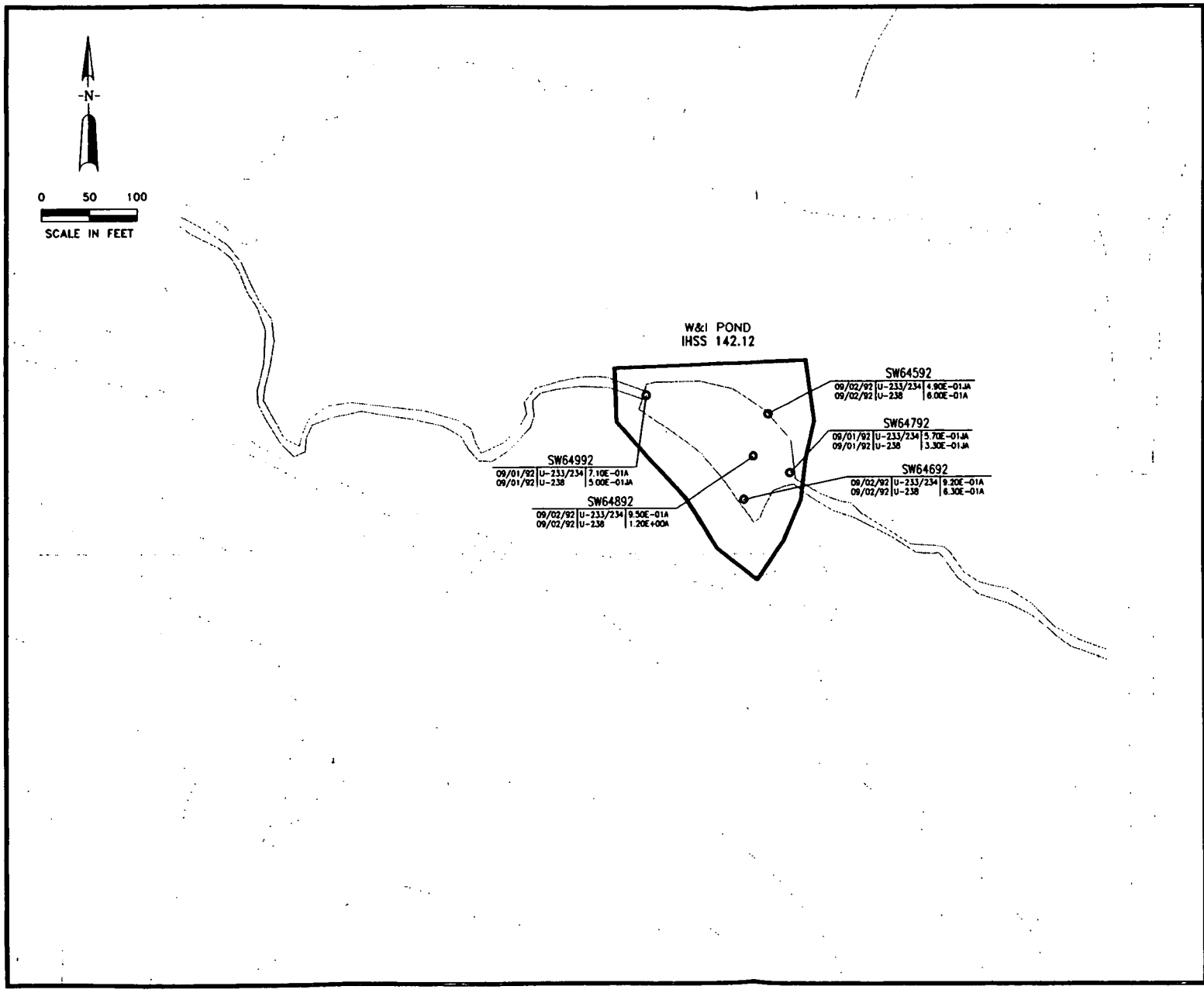
URANIUM-233/234,
URANIUM-235, AND URANIUM-238
(IHSSs 142.5 - 142.9)
POND SURFACE WATER

FIGURE 7-2 JUNE 1995

OU6TM142 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

POND SURFACE WATER SAMPLE SITE

SW64792

SW64792 ← LOCATION

2/26/92

SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE ACTIVITIES ARE REPORTED IN pCi/l.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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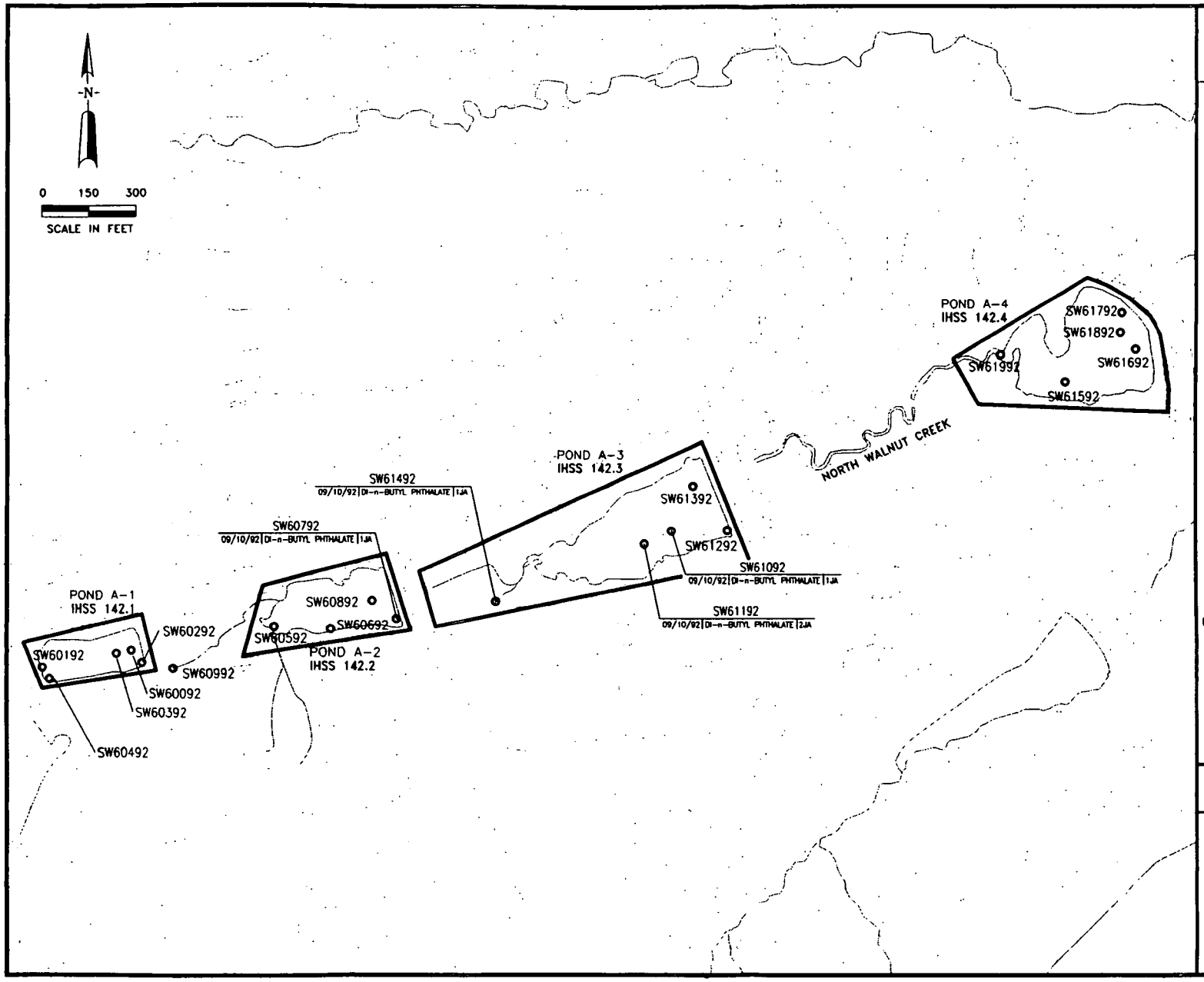
URANIUM-233/234 AND URANIUM-238
(IHSS 142.12)
POND SURFACE WATER

FIGURE 7-3 JUNE 1995

OU6TM143 1=100



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SW60892 — SURFACE WATER SAMPLE SITE (POND WATER)

SW64892 ← LOCATION

2/26/92		
SAMPLE DATE	ANALYTE	ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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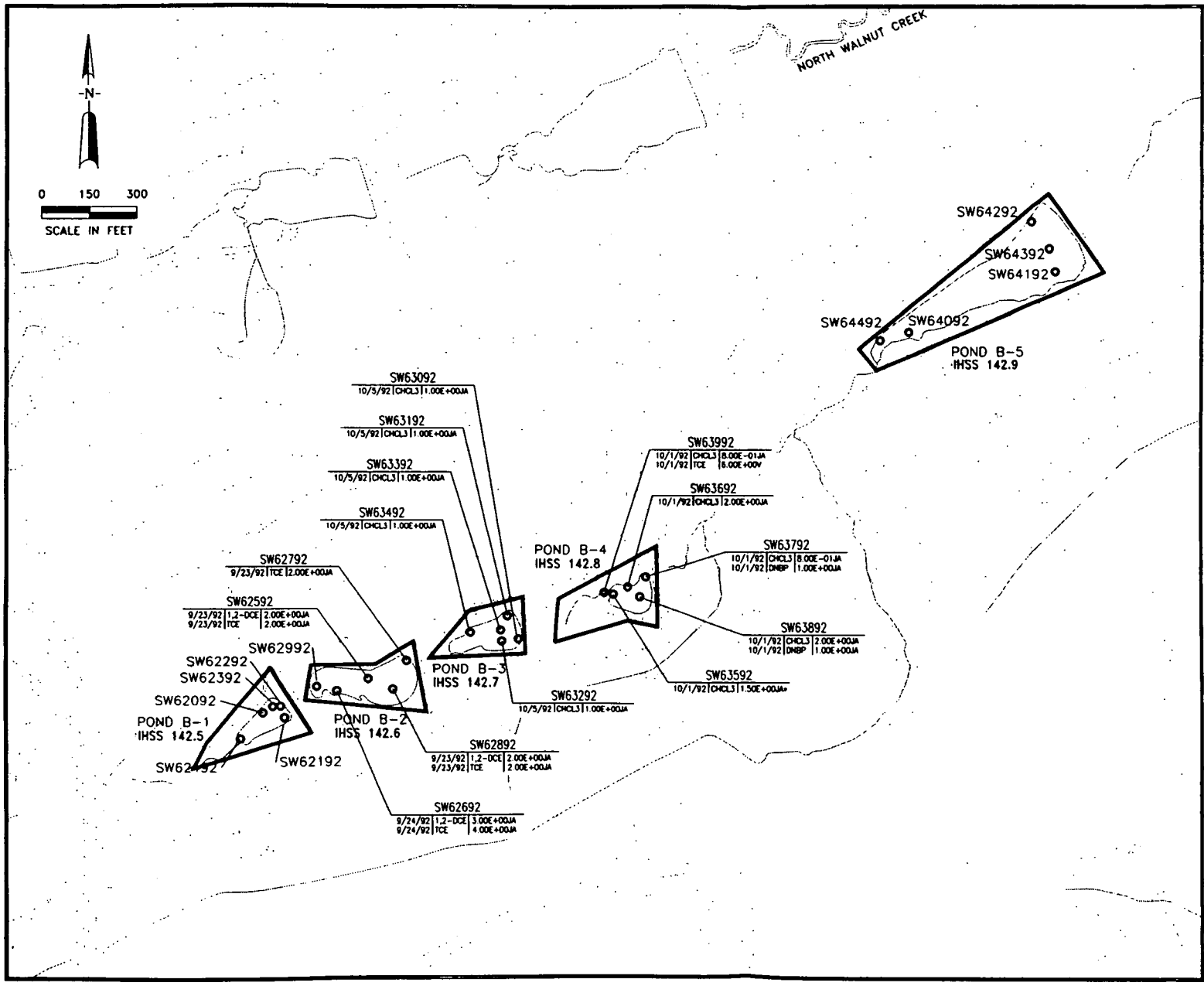
DI-N-BUTYL PHTHALATE
(IHSSs 142.1 - 142.4)
POND SURFACE WATER

FIGURE 7-4 JUNE 1995

OU6TM144 1=300



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SW64192 — POND SURFACE WATER SAMPLE SITE

SW64892 ← LOCATION

2/26/92		
SAMPLE DATE	ANALYTE	ANALYTE CONCENTRATION (ug/l), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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1,2-DICHLOROETHENE, CHLOROFORM, Di-n-BUTYL PHTHALATE, AND TRICHLOROETHENE (IHSSs 142.5 - 142.9) POND SURFACE WATER

FIGURE 7-5 JUNE 1995

OU6TM145 1=300

8.0 STREAM SEDIMENT CHEMICALS OF CONCERN

8.1 STREAM SEDIMENT DATA SET

Fifteen stream sediment samples were collected in the North and South Walnut Creeks including locations upgradient of the A and B series ponds to help characterize potential contaminant transport through surface water/sediment pathways. Samples were analyzed for metals, radionuclides, volatile and semivolatile organic compounds, and pesticides/PCBs. The sampling and analytical program for stream sediments is summarized in Tables 2-1 and 2-2.

8.2 BACKGROUND COMPARISON AND FREQUENCY OF DETECTION

Table 8-1 summarizes the maximum detected concentrations and detection frequencies for organic compounds and metals, and the results of the background comparison for metals detected in the stream sediment samples. All analytes were detected at greater than 5 percent frequency. Background data from streambeds reported in the Background Geochemical Characterization Report (DOE 1993) were used for comparison. The statistical comparisons of metals and radionuclide results to background data are presented in detail in Attachment A.

Radionuclides are assumed to be detected at 100 percent frequency (that is, both negative and positive results were used in the data set). Radionuclides above background levels are listed in the concentration/toxicity screen in Table 8-4.

Inorganic analytes above background levels and organic compounds were included in concentration/toxicity screens to select OU-wide COCs, with the exception of arsenic, manganese, and barium. These metals are considered to be naturally occurring, for the reasons explained in Section 8.3. Other metals included in the concentration/toxicity screens may also be naturally occurring but were not evaluated in detail.

8.3 ELIMINATION OF ARSENIC, MANGANESE, AND BARIUM AS CHEMICALS OF CONCERN IN STREAM SEDIMENT

8.3.1 Arsenic

The statistical background evaluation of arsenic in stream sediments indicated that, because of failure of the Gehan test, arsenic in stream sediments was statistically different from background and should be retained as a PCOC. However, a more in-depth review of the data supports the conclusion that arsenic in stream sediments is naturally occurring and is not an environmental contaminant.

Summary statistics for arsenic in surface soil and stream sediment are shown in the table below. Arsenic concentrations in surface soil did not exceed background levels (see Attachment A). The rationale for concluding that arsenic is not a contaminant in stream sediment follow.

	Arsenic in Surface Soil, mg/kg		Arsenic in Stream Sediment, mg/kg	
	Background	OU6	Background	OU6
Mean	5.8	5.3	2.4	3.6
Std Dev	1.8	1.9	2.5	1.3
Maximum	8.5	11.0	17.3	5.8
N	18	119	59	15
Det. Freq.	100%	100%	49%	93%

- No significant sources or uses of arsenic in past RFETS activities were identified during review of historical release reports and sitewide databases.

- The distribution of arsenic concentrations in stream sediment, pond sediment, and surface soil at RFETS indicates that arsenic is widely distributed onsite at levels below background mean plus two standard deviations.

- The OU6 stream sediment maximum (5.8 mg/kg) is approximately three times lower than the background maximum (17.3 mg/kg). The two highest detected values (7.3 and 17.3 mg/kg) were in the background samples.

- The OU6 stream sediment maximum of 5.8 mg/kg is well below the $UTL_{99/99}$ of background (10 mg/kg) and below the background mean plus two standard deviations (7.4 mg/kg).

- Surface soil is the largest source of sediment in stream beds. Arsenic in OU6 surface soil did not differ significantly from background. The maximum arsenic concentration in stream sediments is equivalent to the mean background concentration in surface soil.

- A review of numerous literature sources suggests that arsenic concentrations detected at RFETS are well within background for the region.

After presenting the above information to EPA and CDPHE, it was concluded that the presence of arsenic in the OU6 stream sediments was likely due to natural processes. It was also agreed that, although arsenic would not be considered a potential chemical of concern, a comparative human health risk assessment would be conducted between arsenic in background stream sediments and arsenic in OU6 stream sediments (EPA Region VIII 1995, CDPHE 1995). This comparison will be presented in the Uncertainty Section of the OU6 HHRA.

8.3.2 Manganese

The statistical background evaluation of manganese in stream sediments indicated that, because of failure of the Gehan test, manganese in stream sediments was statistically different from background levels and should be retained as a PCOC. However, a more in-depth review of the data supports the conclusion that manganese in stream sediments is naturally occurring and is not an environmental contaminant.

Summary statistics for manganese in surface soil and stream sediment are shown in the table below. Manganese in surface soil did not exceed background levels (see Attachment A). The reasons for concluding manganese is not a contaminant in stream sediment follow.

	Manganese in Surface Soil, mg/kg		Manganese in Stream Sediment, mg/kg	
	Background	OU6	Background	OU6
Mean	443	265	217	366
Std Dev	457	114	225	240
Maximum	2220	823	1280	1000
N	18	119	59	15
Det. Freq.	100%	100%	80%	100%

- The OU6 stream sediment maximum (1000 mg/kg) is lower than the background maximum (1280 mg/kg). The next highest OU6 stream sediment concentration was 639 mg/kg, which is below the maximum values detected in background and OU6 surface soils.

- Surface soil is the largest source of sediment in stream beds. Manganese in OU6 surface soils did not exceed background levels. The mean manganese concentration in stream sediments (366 mg/kg) is below the mean background concentration in surface soil (443 mg/kg).

In conclusion, manganese is not considered a contaminant in stream sediments in OU6 but is considered to be the result of naturally occurring manganese in native geologic materials.

8.3.3 Barium

The statistical background evaluation of barium in stream sediments indicated that, because of failure of the Gehan test, barium in OU6 stream sediments was statistically different from background and should be retained as a PCOC. However, a more in-depth review of the data supports the conclusion that barium in stream sediments is naturally occurring and is not an environmental contaminant.

Summary statistics for barium in surface soil and stream sediment are shown in the table below. Barium did not exceed background levels in surface soil. The reasons for concluding barium is not a contaminant in stream sediment follow.

	Barium in Surface Soil, mg/kg		Barium in Stream Sediment, mg/kg	
	Background	OU6	Background	OU6
Mean	194	147	78	107
Std Dev	84	52	56	32
Maximum	470	272	244	177
N	18	119	57	15
Det. Freq.	100%	100%	100%	100%

- The OU6 sediment maximum (177 mg/kg) is lower than the background maximum (244 mg/kg).

- The OU6 sediment maximum of 177 mg/kg is below the background $UTL_{99/99}$ of 251 mg/kg and below the background mean plus two standard deviations (190 mg/kg).

- Surface soil is the largest source of sediment in stream beds. Barium in OU6 surface soils was not statistically different from background. Since the maximum barium concentration in stream sediments is comparable to the mean concentration in surface soil, and barium in surface soil does not exceed background levels, barium is not considered a contaminant in stream sediments in OU6.

8.4 CONCENTRATION/TOXICITY SCREENS

Concentration/toxicity screens for COCs in stream sediments are presented in Tables 8-2 through 8-4. All analytes that contribute at least 1 percent of the total risk factor are retained as OU-wide COCs for quantitative risk assessment. The metal COCs in sediment were also

identified as being above background levels in surface soil. COCs are listed below and in Table 8-5:

OU-Wide Chemicals of Concern
Stream Sediments

Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(a)anthracene
Indeno(123-cd)pyrene
Cobalt
Strontium
Vanadium
Zinc
Americium-241
Plutonium-239/240

The occurrence of COCs in stream sediments are shown in Figures 8-1 through 8-3.

PCOCs detected in stream sediments that do not have EPA-established toxicity factor are benzo(ghi)perylene, dibenzofuran, and phenanthrene. Because of the lack of toxicity factors, these compounds cannot be evaluated in a toxicity- or risk-based screen to select COCs. However, their potential contribution to overall risk will be evaluated qualitatively in the risk assessment for OU6.

8.5 RISK-BASED EVALUATION OF INFREQUENTLY DETECTED COMPOUNDS

There were no compounds detected in stream sediments at less than 5 percent frequency, so the RBC screening evaluation for infrequently detected compounds was not performed.

TABLE 8-1
ORGANIC COMPOUNDS AND METALS DETECTED AT 5% OR GREATER FREQUENCY[1] STREAM SEDIMENT

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC ? [2]
Organic Compounds:			
Acenaphthene	0.13	7	
Acetone	0.063	7	
Anthracene	0.15	20	
Benzo(a)anthracene	0.43	27	
Benzo(a)pyrene	0.48	33	
Benzo(b)fluoranthene	0.65	27	
Benzo(g,h,i)perylene	0.16	13	
Benzo(k)fluoranthene	0.23	20	
Benzoic acid	0.51	33	
Benzyl alcohol	0.041	7	
Bis(2-ethylhexyl)phthalate	0.19	27	
Butyl benzylphthalate	0.12	7	
Chrysene	0.51	33	
Di-n-butylphthalate	0.075	33	
Dibenzofuran	0.037	7	
Fluoranthene	1	47	
Fluorene	0.089	7	
Indeno(1,2,3-cd)pyrene	0.18	20	
Methylene chloride	0.007	7	
Naphthalene	0.046	7	
Phenanthrene	0.75	33	
Pyrene	0.96	33	
Metals:			
Aluminum	11600	100	No
Antimony	26.3	13	No
Arsenic	5.8	93	Yes
Barium	177	100	Yes
Beryllium	1	53	No
Cadmium	0.8	7	No
Cesium	18.1	47	No
Chromium	12.3	100	No
Cobalt	12.4	100	Yes
Copper	17.7	60	No
Lead	94.8	100	No
Lithium	15.2	93	No

TABLE 8-1
(Concluded)

Chemical	Maximum Detected Concentration (mg/kg)	Detection Frequency %	Inorganic PCOC? [2]
Manganese	1000	100	Yes
Mercury	0.13	27	No
Nickel	19.2	47	No
Selenium	0.45	13	No
Silver	1.4	7	No
Strontium	95.8	100	Yes
Thallium	0.46	33	No
Vanadium	33.9	100	Yes
Zinc	178	100	Yes

[1] All detected analytes were detected at a frequency greater than 5 percent.
[2] Based on background comparison (Appendix A)

TABLE 8-2
CONCENTRATION/TOXICITY SCREEN
STREAM SEDIMENT
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Vanadium	33.9	n/a	7.0E-03	4.8E+03	8.2E-01	82.4
Zinc	178	n/a	3.0E-01	5.9E+02	1.0E-01	10.1
Cobalt	12.4	n/a	6.0E-02	2.1E+02	3.5E-02	3.5
Strontium	95.8	n/a	6.0E-01	1.6E+02	2.7E-02	2.7
Pyrene	0.96	n/a	3.0E-02	3.2E+01	5.4E-03	0.5
Fluoranthene	1	n/a	4.0E-02	2.5E+01	4.3E-03	0.4
Bis(2-ethylhexyl)phthalate	0.19	n/a	2.0E-02	9.5E+00	1.6E-03	0.2
Fluorene	0.089	n/a	4.0E-02	2.2E+00	3.8E-04	0.0
Acenaphthene	0.13	n/a	6.0E-02	2.2E+00	3.7E-04	0.0
Naphthalene	0.046	n/a	4.0E-02	1.2E+00	2.0E-04	0.0
Di-n-butylphthalate	0.075	n/a	1.0E-01	7.5E-01	1.3E-04	0.0
Acetone	0.063	n/a	1.0E-01	6.3E-01	1.1E-04	0.0
Butyl benzylphthalate	0.12	n/a	2.0E-01	6.0E-01	1.0E-04	0.0
Anthracene	0.15	n/a	3.0E-01	5.0E-01	8.5E-05	0.0
Benzyl alcohol	0.041	n/a	3.0E-01	1.4E-01	2.3E-05	0.0
Benzoic acid	0.51	n/a	4.0E+00	1.3E-01	2.2E-05	0.0
Methylene chloride	0.007	9.0E-01	6.0E-02	1.2E-01	2.0E-05	0.0
Total Risk Factor				5.9E+03		

RfDs are in units of mg/kg-day.
n/a = not available.

TABLE 8-3
CONCENTRATION/TOXICITY SCREEN
STREAM SEDIMENT
CARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Benzo(a)pyrene	0.48	n/a	7.3E+00	3.5E+00	7.8E-01	78.2
Benzo(b)fluoranthene	0.65	n/a	7.3E-01	4.7E-01	1.1E-01	10.6
Benzo(a)anthracene	0.43	n/a	7.3E-01	3.1E-01	7.0E-02	7.0
Indeno(1,2,3-cd)pyrene	0.18	n/a	7.3E-01	1.3E-01	2.9E-02	2.9
Chrysene	0.51	n/a	7.3E-02	3.7E-02	8.3E-03	0.8
Benzo(k)fluoranthene	0.23	n/a	7.3E-02	1.7E-02	3.7E-03	0.4
Bis(2-ethylhexyl)phthalate	0.19	n/a	1.4E-02	2.7E-03	5.9E-04	0.1
Methylene chloride	0.007	1.6E-03	7.5E-03	5.3E-05	1.2E-05	0.0
Total Risk Factor				4.5E+00		

Slope factors are in units of Risk/(mg/kg-day).
n/a = not available.

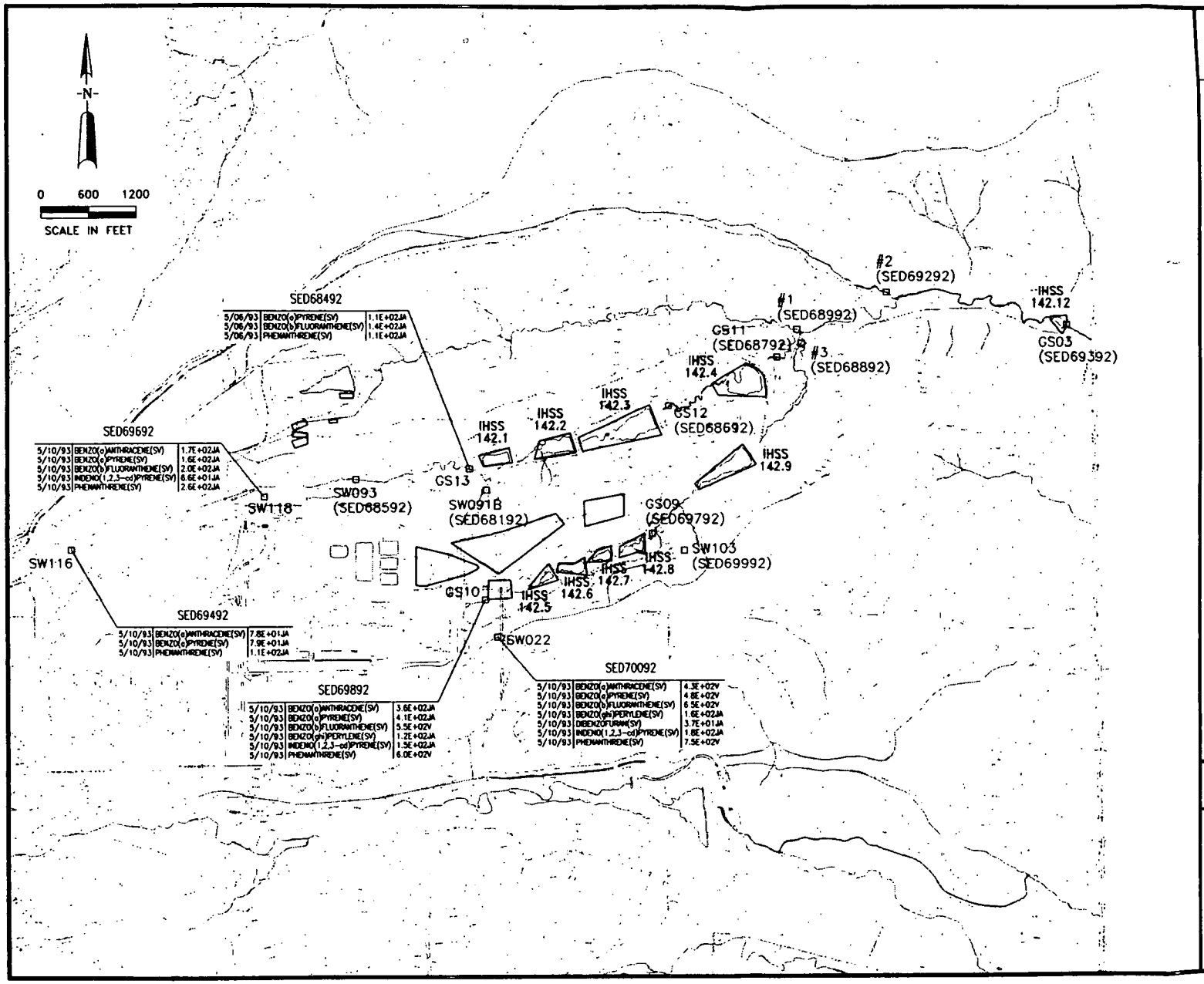
TABLE 8-4
CONCENTRATION/TOXICITY SCREEN
STREAM SEDIMENT
RADIONUCLIDES

Chemical	Maximum Activity (pCi/g)	Inhalation Slope Factor	Oral Slope Factor	Risk Factor	Risk Index	% of Total Risk Factor
Plutonium-239/240	1.95	2.8E-08	3.2E-10	5.5E-08	6.5E-01	65.1
Americium-241	0.75	3.9E-08	3.3E-10	2.9E-08	3.5E-01	34.9
Total Risk Factor				8.4E-08		

Slope factors are in units of Risk/pCi.

TABLE 8-5
OU6 CHEMICALS OF CONCERN
STREAM SEDIMENT

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluroanthene
Indeno(1,2,3-cd)pyrene
Cobalt
Strontium
Vanadium
Zinc
Americum-241
Plutonium-239/240



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

GS03 STREAM SEDIMENT SAMPLING SITE (SED68492)

SED68492 ← LOCATION

5/06/93 | BENZO(a)PYRENE(SV) | 1.1E+02JA

SAMPLE DATE — ANALYTE — ANALYTE CONCENTRATION (ug/kg), LAB QUALIFIERS, AND VALIDATION CODES

(SV) – SEMIVOLATILE

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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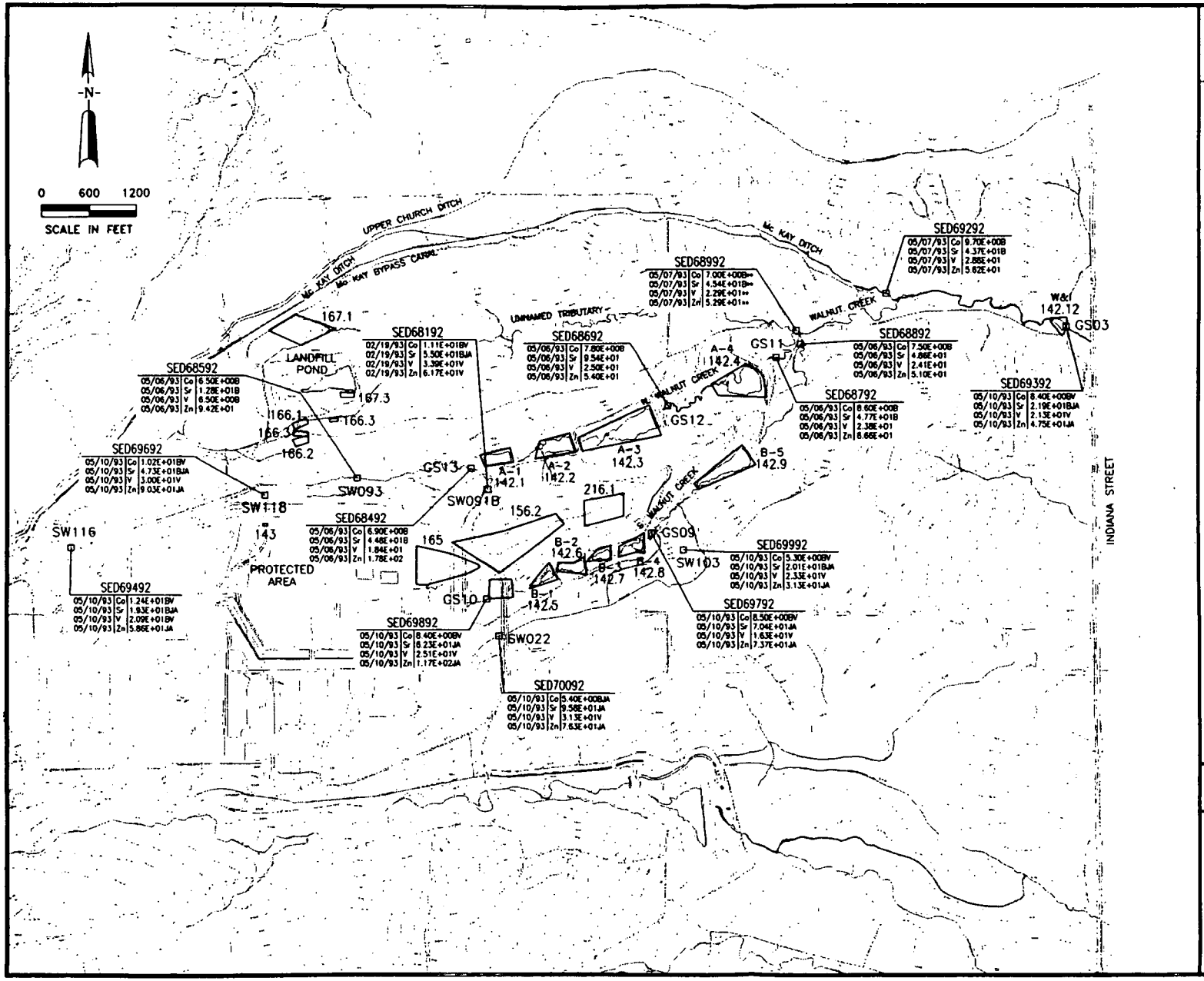
PAH COCs
OU6 DRAINAGES
STREAM SEDIMENTS

FIGURE 8-1 JUNE 1995

OU6TM081 1=1200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

GS03 — STREAM SEDIMENT SAMPLING SITE (SED68492)

GS10 — GS10 – GAUGING STATION #10

SW118 — SURFACE WATER #118

SED69392 ← LOCATION

2/26/92 — SAMPLE DATE

ANALYTE

ANALYTE CONCENTRATION (mg/kg), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN mg/kg (parts per million).
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

* INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

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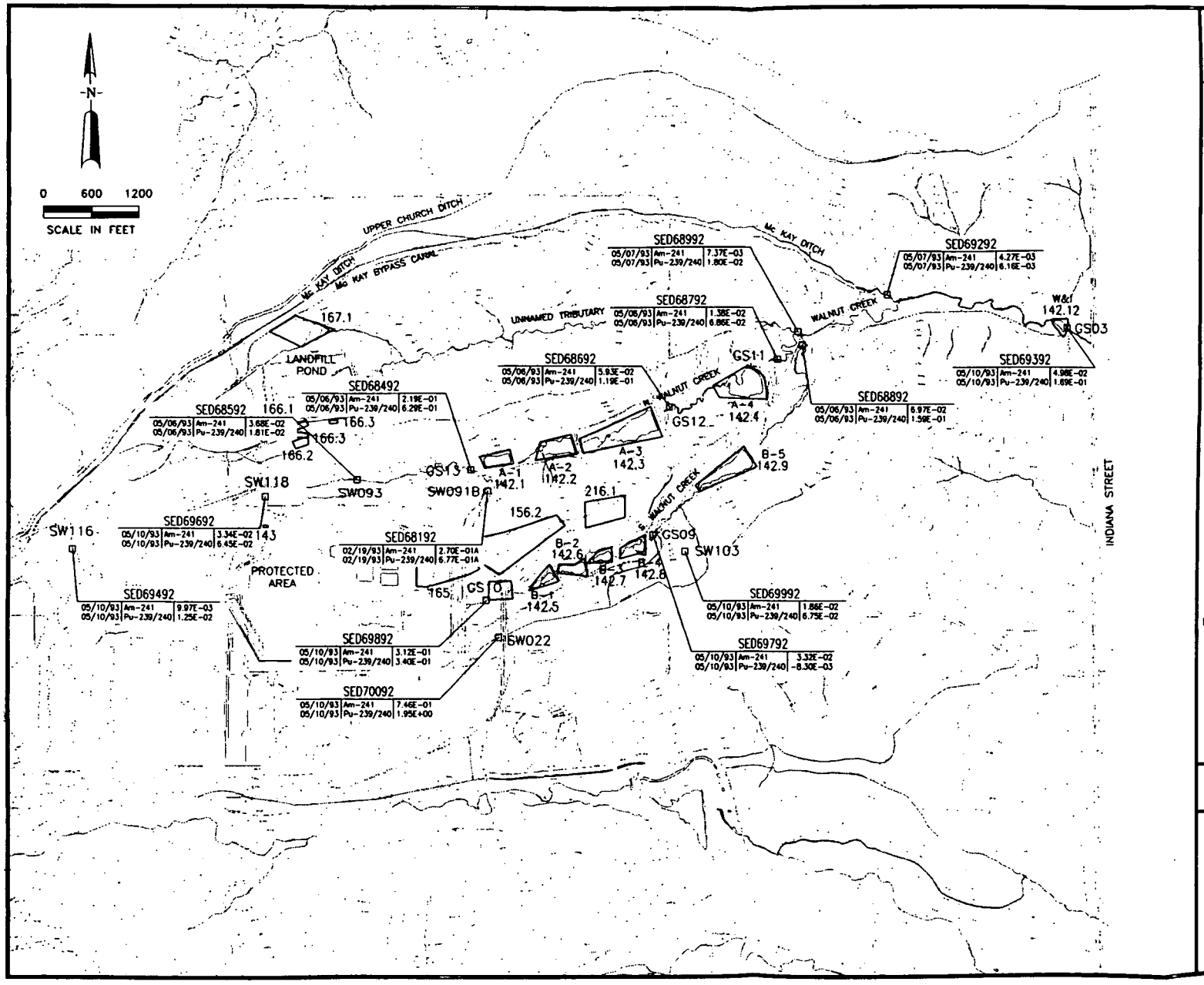
COBALT, STRONTIUM, VANADIUM, AND ZINC
OU6 DRAINAGES
STREAM SEDIMENTS

FIGURE 8-2 JUNE 1995

OU6TM146 1=1200



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

GS03 — STREAM SEDIMENT SAMPLING SITE (SED68492)

GS10 — GS10 - GAUGING STATION #10

SW118 — SURFACE WATER #118

SED69992 ← LOCATION
2/26/92
SAMPLE DATE | ANALYTE | ANALYTE ACTIVITY (pCi/g), LAB QUALIFIERS, AND VALIDATION CODES

NOTES:

1. ALL ANALYTE CONCENTRATIONS ARE REPORTED IN pCi/g.
2. ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE ANALYSIS WAS COMPLETED AND THE CHEMICALS WERE DETECTED AND NOT REJECTED.

• INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS.

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO. 4

AMERICIUM-241 AND PLUTONIUM-239/240
OU6 DRAINAGES
STREAM SEDIMENTS

FIGURE 8-3 JUNE 1995

OU6TM147 1=1200

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ATTACHMENT A
BACKGROUND COMPARISON FOR METALS AND RADIONUCLIDES

Concentrations of metals and radionuclides measured in soil, groundwater, surface water, and sediment in OU6 were compared to background concentrations in order to identify OU6 analytes whose concentrations are statistically higher than background levels. These analytes are then identified as potential chemicals of concern for further evaluation. The background data used for comparison were reported in the Background Geochemical Characterization Report (DOE 1993), except for the surface soil data, which were not available in the 1993 report. The background surface soil data were collected in the Rock Creek area during the 1991 OU1 Phase III investigation and the 1993 OU2 Phase II investigation. Analytical results from each medium sampled were pooled, and the background comparison was performed on an OU-wide basis.

The procedures applied in the background comparisons are shown in the flow chart in Figure A-1. Three major steps were involved: (1) data aggregation, (2) statistical background comparisons, and (3) professional judgement of statistical results. Each of these steps is discussed below.

A.1 DATA AGGREGATION

The chemical data were grouped by medium into seven categories:

- Subsurface soil in the upper hydrostratigraphic unit (UHSU)
- Surface soil
- Pond sediment
- Stream sediment
- Groundwater (UHSU)
- Pond surface water
- Baseflow stream surface water.

In general, each medium has 29 analytes for metals and 13 analytes for radionuclides, as unfiltered or filtered concentrations. Soil media (surface soil, subsurface soil, pond sediment, and stream sediment) were each analyzed for metals and radionuclides, totaling eight media-

analyte groups. Liquid media (groundwater and pond surface water) were each analyzed for filtered and unfiltered metals and filtered and unfiltered radionuclides. Therefore, there are a total of 16 media-analyte groups to be evaluated in the background comparisons, as shown in Table A-1.

Most of OU6 media-analyte groups were compared directly to the corresponding background groups. Exceptions were pond sediment and pond surface water due to the lack of background pond data. Background data from seep/spring sampling locations (rather than from background stream locations) were adopted for comparison to OU6 pond data because of the similarity of the flow conditions for ponds and seeps/springs (both have relatively long residence time).

A.2 STATISTICAL BACKGROUND COMPARISON

Background comparisons were performed according to the procedures given in the "Guidance Document, Statistical Comparisons of Site-To-Background Data in Support of RFI/RI Investigations" (EG&G 1994), which was primarily based on the methodology proposed by Gilbert (Gilbert 1993). The formal statistical tests were the Gehan test, Slippage test, Quantile test, and t-test. Analytical results were also compared to the upper tolerance limit ($UTL_{99/99}$) of background to identify high concentrations above a reasonable estimate of the upper limit of background. The conditions for applying each of the tests are briefly discussed below.

A.2.1 Formal Statistical Tests

Four formal statistical tests were performed to test the difference between the background and site populations. If any of the four statistical tests was significant, the analyte was considered to be a potential chemical of concern. Significance was defined as a p value less than or equal to 0.05, the Type I (false positive) error rate. Non-detects of metals were treated as described below for each test. All the radionuclide results were treated as detects.

1. Gehan Test

The Gehan test (Gehan 1965, explained in Gilbert 1993) is a nonparametric ranking test. It was performed for all the media-analyte groups. For non-detects, the reporting limits were used for ranking purposes.

2. Slippage Test

The slippage test (Rosenbaum 1954), a nonparametric test, was performed by comparing the OU6 measurements to the maximum background measurement (detect or non-detect). The p-value for the probability of the number of site measurements greater than the maximum background measurement was calculated. Reporting limits were used for non-detects.

3. Quantile Test

The Quantile test (Gilbert and Simpson 1992), a nonparametric test, was performed by first ranking the combined background and OU6 measurements from largest to smallest. If there were no non-detects among the top 20% of the combined background and OU6 measurements, the probability of the number of site measurements within the top 20% of the data set was calculated. If there were any non-detects among the top 20% of the measurements, no Quantile test was performed.

4. t-Test

The t-test, a parametric statistical test, was performed under these conditions: that (1) the non-detects in each of the data sets represent less than 20% of the measurements; and (2) <u>EITHER</u> each of the data sets contains at least 20 data points, <u>OR</u> both of the data sets are normally distributed.

For simplicity, the t-test was only performed when condition (1) and the first option of condition (2) were met. Non-detect results for metals were replaced by one-half the reporting limits.

The homogeneity of the variance was tested following Levene's test (EPA 1992). If the variances from both data sets were the same, the standard t-test was performed. If the variances were not the same, the unequal variance t-test (Helsel and Hirsch 1992) was performed.

A.2.2 Upper Tolerance Limit ($UTL_{99/99}$) Comparison

For each media-analyte in the background data, an upper tolerance limit with 99% confidence and 99% coverage ($UTL_{99/99}$) was calculated, assuming the background data were normally distributed (EG&G 1994). In calculating the UTL, if non-detects were less than 80% of the data, one-half the reporting limit was used as the result for non-detect samples. Otherwise, the maximum background measurement, instead of the $UTL_{99/99}$, was used in the comparisons. For the radionuclides, all the results were treated as detects (EG&G 1994).

Each of the OU6 measurements was compared to the $UTL_{99/99}$. If one or more OU6 measurements exceed the background $UTL_{99/99}$, the analyte was considered as a potential chemical of concern for further evaluation, even if the analyte did not exceed background levels according to the formal statistical evaluation.

A.3 BACKGROUND COMPARISON RESULTS

The number of inorganic potential chemicals of concern in each media-analyte group resulting from the background comparisons is summarized in Table A-1. Out of 374 media-analytes, 142 media-analytes were identified as above background based on the formal statistical tests. An additional 32 media-analytes were identified as above background based on the $UTL_{99/99}$ comparison alone.

The summary tables for the background comparisons for each media-analyte group are presented in the remaining tables in Appendix A.

A.4 PROFESSIONAL JUDGEMENT FOR STATISTICAL RESULTS

Statistical professional judgement was applied for those media-analytes that were below background according to the formal statistical tests but failed the $UTL_{99/99}$ comparisons. The professional judgement consisted of performing a lognormal $UTL_{99/99}$ comparison if the background data were lognormally distributed.

According to the background comparison methodology (EG&G 1994), the $UTL_{99/99}$ was calculated assuming a normal distribution of background data. However, lognormal distribution may better describe some geochemical data, as indicated in the Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities (EPA 1992). Lognormal-based $UTL_{99/99}$s were calculated for media-analytes that passed the formal statistical tests but failed to pass the normal-based $UTL_{99/99}$ comparison. If a media-analyte passed the lognormal-based $UTL_{99/99}$ comparison, probability plots (Figures A-2 through A-11) were generated for both normal and lognormal distributions. If the probability plots indicated that the data better fit a lognormal distribution, the media-analyte was eliminated from the potential chemical of concern list.

The results of the lognormal-based $UTL_{99/99}$ comparisons are presented in the remark column in the summary tables. Based on the results of the lognormal $UTL_{99/99}$ comparison, the following ten analytes were eliminated as potential chemicals of concern:

Medium	Analyte
Surface Soil	Aluminum Cadmium Uranium-233,234
Subsurface Soil	Copper
Groundwater	Total (unfiltered) Tin Filtered Radium-228
Pond Sediment	Beryllium Cadmium Nickel Tritium

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ATTACHMENT A
TABLE LEGEND

N_B	Number of background samples
N_S	Number of site samples
DTF_B	Detection frequency in background samples
DTF_S	Detection frequency in site samples
P_SLIP	p-value, Slippage test
P_QUAN	p-value, Quantile test
P_GEHAN	p-value, Gehan test
P_T_1	p-value, Student's t-test
UTL99	99 percent upper tolerance limit of background data at the 99 percent confidence level
PCOC	Potential chemical of concern
MEAN_B	Arithmetic mean of background data
MEAN_S	Arithmetic mean of site data
STD_B	Standard deviation of background data
STD_S	Standard deviation of site data
NGUTL	Number of site sample results > UTL99
MAX_B	Maximum background value
MAX_S	Maximum site value
NGM	Number of site sample results > background maximum
NDT20	Number of non-detect results in the top 20% of measurements of the combined data set (Quantile test)
N_T20	Number of results that comprise the top 20% of measurements of the combined data set (Quantile test)
N_SITE	Number of site measurements in the top 20% of the combined data set (Quantile test)
Z_CAL	Z-value calculated from the Gehan test
Z_95	Z-value from statistical tables at the 95% confidence level
P-VAL	p-value for the Gehan test

TABLE A-1
OU6 Background Comparison Summary

Media	Background Data	OU6 Data	Analyte Group	No. of Analytes in Comparison	No. of Analytes Significant in Tests	No. of Analytes Greater than UTL 99/99	No. of PCOCs
Surface Soil	Rock Creek Surface Soil	Surface Soil	Metals	28	9	15	16
			Rads	7	2	5	4
Subsurface Soil	UHSU Subsurface Soil	Subsurface Soil	Metals	28	3	8	7
			Rads	8	5	6	6
Groundwater	UHSU* Groundwater	Historic and New Wells	Unfiltered Metals	29	25	26	25
			Filtered Metals	28	13	17	17
	UHSU Groundwater	Historic and New Wells	UnfilteredRads	11	4	5	5***
			Filtered Rads	11	7	6	8***
Pond Sediment	Seep/Spring Sediment	Pond Sediment	Metals	27	11	7	12
			Rads	12	10	8	10
Pond Surface Water	Seep/Spring* Surface Water	Pond Surface Water	Unfiltered Metals	29	3	1	3
			Filtered Metals	28	4	4	4
	Seep/Spring Surface Water	Pond Surface Water	Unfiltered Rads	10	4	2	4
			Filtered Rads	7	2	2	3***
Stream Sediment	Stream Sediment	Stream Sediment	Metals	26	11	2	11
			Rads	12	3	1	3***

* In these background data files, non-detect records with extremely high reporting limits were not used.

** Background data files are from "1993 Background Geochemical Characterization Report," except for surface soil (DOE 1993).

*** Some sample sizes too small to draw conclusion.

TABLE A-2
OU6 Background Comparison Summary of Surface Soil Metals
(Concentration Unit:MG/KG)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
ALUMINUM	18	119	1.00	1.00	0.2320	0.7081	0.9976	1.0000	N	21915.4	3	NO	Not a PCOC by PJ (1)
ANTIMONY	18	103	0.00	0.54	1.0000		0.0174		Y	50.0	0	YES	
ARSENIC	18	119	1.00	1.00	0.4222	0.8522	0.8614	0.7828	N	12.9	0	NO	
BARIUM	18	119	1.00	1.00	1.0000	0.9975	0.9914	0.9912	N	528.0	0	NO	
BERYLLIUM	18	119	0.50	0.87	1.0000		0.4654		N	5.2	0	NO	
CADMIUM	17	119	0.35	0.47	0.8750		0.3602		N	5.0	1	NO	Not a PCOC by PJ (1)
CALCIUM	18	119	1.00	1.00	0.0001	0.0119	0.0001	0.0001	Y	13573.3	24	YES	
CESIUM	18	114	0.50	0.91	1.0000		0.2843		N	630.8	0	NO	
CHROMIUM	18	119	1.00	0.99	0.6532	0.9848	0.9998	1.0000	N	24.8	1	YES	
COBALT	18	119	1.00	1.00	1.0000	0.1921	0.0028	0.0057	Y	24.8	0	YES	
COPPER	18	119	1.00	1.00	0.0099	0.0119	0.0007	0.0001	Y	27.3	7	YES	
IRON	18	119	1.00	1.00	0.6532	0.4417	0.9190	0.8919	N	28160.4	3	YES	
LEAD	18	119	1.00	1.00	0.0909	0.4743	0.9995	1.0000	N	61.4	4	YES	
LITHIUM	18	119	1.00	0.97	0.1707		0.9889	0.9997	N	20.0	0	NO	
MAGNESIUM	18	119	1.00	1.00	0.4222	0.7081	0.3266	0.2969	N	7011.5	3	YES	
MANGANESE	18	119	1.00	1.00	1.0000	0.9557	0.9998	0.9999	N	2253.5	0	NO	
MERCURY	18	119	0.00	0.41	0.8686		0.0303		Y	0.2	1	YES	
MOLYBDENUM	18	119	0.06	0.01	1.0000		0.0185		Y	40.0	0	YES	
NICKEL	18	118	1.00	0.95	0.1228	0.4348	0.0308	0.1363	Y	26.9	0	YES	
POTASSIUM	18	119	1.00	0.92	0.8686	1.0000	1.0000	1.0000	N	5256.8	0	NO	
SELENIUM	18	119	0.72	0.27	1.0000		0.2903		N	1.4	0	NO	
SILICON	0	0	0.00	0.00									NO site measurement
SILVER	18	119	0.00	0.09	0.8686		0.2388		N	10.0	1	YES	
SODIUM	18	119	0.50	1.00	0.6532		0.0547		N	1108.0	3	YES	
STRONTIUM	18	119	1.00	1.00	0.2320	0.0769	0.0714	0.0397	Y	90.1	6	YES	
THALLIUM	18	118	0.28	0.42	1.0000		0.6887		N	2.0	0	NO	
TIN	18	119	0.50	0.03	1.0000		1.0000		N	75.9	0	NO	
VANADIUM	18	119	1.00	1.00	0.2700	0.2375	0.4443	0.5916	N	55.6	4	YES	
ZINC	18	119	1.00	1.00	0.0099	0.0119	0.1244	0.0028	Y	86.6	11	YES	

(1) Professional judgment based on lognormal UTL comparison

TABLE A-3
OU6 Background Comparison Statistical Test Results of Surface Soil Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	ND_B	ND_S	TF_B	TF_S	EAN_B	EAN_S	STD_B	STD_S	UTL99	GUTL	AX_B	MAX_S	NGM	P_SLP	N_T20	_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	18	119	0	0	1.00	1.00	12886.1	10843.3	2279.9	4325.1	21915.4	3	17950.0	24100.0	10	0.2320	28	24	0.7081	-2.826	1.645	0.9976
ANTIMONY	18	103	18	47	0.00	0.54	15.5	13.6	9.8	8.5	50.0	0	50.0	43.6	0	1.0000	999	999	999.0000	2.111	1.645	0.0174
ARSENIC	18	119	0	0	1.00	1.00	5.8	5.3	1.8	1.9	12.9	0	8.5	11.0	6	0.4222	29	24	0.8522	-1.087	1.645	0.8614
BARIUM	18	119	0	0	1.00	1.00	194.3	147.4	84.3	51.5	528.0	0	470.0	272.0	0	1.0000	28	20	0.9975	-2.383	1.645	0.9914
BERYLLIUM	18	119	9	15	0.50	0.87	1.6	0.8	0.9	0.3	5.2	0	5.0	1.5	0	1.0000	999	999	999.0000	0.087	1.645	0.4654
CADMIUM	17	119	11	63	0.35	0.47	1.4	0.9	0.9	0.7	5.0	1	5.0	6.4	1	0.8750	999	999	999.0000	0.358	1.645	0.3602
CALCIUM	18	119	0	0	1.00	1.00	5022.2	11383.1	2159.2	9689.8	13573.3	24	8810.0	59800.0	59	0.0001	28	28	0.0119	4.078	1.645	0.0001
CESIUM	18	114	9	10	0.50	0.91	126.2	11.6	127.4	27.7	630.8	0	500.0	33.4	0	1.0000	999	999	999.0000	0.570	1.645	0.2843
CHROMIUM	18	119	0	1	1.00	0.99	15.0	11.8	2.5	4.6	24.8	1	20.2	35.1	3	0.6532	29	22	0.9848	-3.562	1.645	0.9998
COBALT	18	119	0	0	1.00	1.00	7.8	8.7	4.3	2.7	24.8	0	24.0	20.3	0	1.0000	30	28	0.1921	2.775	1.645	0.0028
COPPER	18	119	0	0	1.00	1.00	13.0	17.9	3.6	8.0	27.3	7	18.5	61.6	29	0.0099	28	28	0.0119	3.189	1.645	0.0007
IRON	18	119	0	0	1.00	1.00	15381.7	14451.3	3226.6	4460.8	28160.4	3	24900.0	34600.0	3	0.6532	29	26	0.4417	-1.399	1.645	0.9190
LEAD	18	119	0	0	1.00	1.00	37.5	29.2	6.0	15.4	61.4	4	51.0	68.7	16	0.0909	28	25	0.4743	-3.269	1.645	0.9995
LITHIUM	18	119	0	4	1.00	0.97	11.0	9.2	2.3	3.4	20.0	0	15.0	18.1	12	0.1707	999	999	999.0000	-2.288	1.645	0.9889
MAGNESIUM	18	119	0	0	1.00	1.00	2853.3	3078.3	1049.9	1571.8	7011.5	3	5195.0	11400.0	6	0.4222	28	24	0.7081	0.449	1.645	0.3266
MANGANESE	18	119	0	0	1.00	1.00	443.5	265.0	457.0	114.5	2253.5	0	2220.0	823.0	0	1.0000	28	22	0.9557	-3.546	1.645	0.9998
MERCURY	18	119	18	70	0.00	0.41	0.1	0.1	0.0	0.0	0.2	1	0.2	0.3	1	0.8686	999	999	999.0000	1.877	1.645	0.0303
MOLYBDENUM	18	119	17	118	0.06	0.01	14.0	19.9	5.7	0.9	40.0	0	40.0	9.9	0	1.0000	999	999	999.0000	2.085	1.645	0.0185
NICKEL	18	118	0	6	1.00	0.95	12.3	14.0	3.7	4.2	26.9	0	18.7	22.5	14	0.1228	29	26	0.4348	1.869	1.645	0.0308
POTASSIUM	18	119	0	9	1.00	0.92	2977.9	2103.5	575.4	844.0	5256.8	0	4205.0	4430.0	1	0.8686	28	17	1.0000	-4.155	1.645	1.0000
SELENIUM	18	119	5	87	0.72	0.27	0.6	0.5	0.2	0.1	1.4	0	2.0	1.3	0	1.0000	999	999	999.0000	0.553	1.645	0.2903
SILICON(1)																						
SILVER	18	119	18	108	0.00	0.09	3.0	1.7	2.1	4.8	10.0	1	10.0	52.7	1	0.8686	999	999	999.0000	0.710	1.645	0.2388
SODIUM	18	119	9	0	0.50	1.00	305.6	197.2	202.6	216.7	1108.0	3	1000.0	1650.0	3	0.6532	999	999	999.0000	1.601	1.645	0.0547
STRONTIUM	18	119	0	0	1.00	1.00	35.3	45.8	13.8	29.9	90.1	6	79.1	255.0	10	0.2320	28	27	0.0769	1.465	1.645	0.0714
THALLIUM	18	118	13	69	0.28	0.42	0.8	0.7	0.3	0.3	2.0	0	2.0	0.6	0	1.0000	999	999	999.0000	-0.492	1.645	0.6887
TIN	18	119	9	116	0.50	0.03	31.4	20.2	11.2	1.8	75.9	0	100.0	38.7	0	1.0000	999	999	999.0000	-4.620	1.645	1.0000
VANADIUM	18	119	0	0	1.00	1.00	31.6	32.5	6.0	10.7	55.6	4	45.6	75.9	9	0.2700	28	26	0.2375	0.140	1.645	0.4443
ZINC	18	119	0	0	1.00	1.00	55.8	68.5	7.8	60.7	86.6	11	70.6	650.0	29	0.0099	28	28	0.0119	1.153	1.645	0.1244

(1) No site measurement.

TABLE A-4
OU6 Background Comparison Summary of Surface Soil Radionuclides
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	DTF_B	TF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFIC	UTL99	GUTL	PCO	REMARK
AMERICIUM-241	15	91	1.00	1.00	0.0001	0.0228	0.0001		Y	0.060	49	YES	
CESIUM-137	12	0	0.00	0.00									NO site measurement
GROSS ALPHA	9	116	1.00	1.00	0.4239	0.7427	0.9694		N	42.220	3	YES	
GROSS BETA	18	116	1.00	1.00	0.2613	0.7199	0.9345		N	54.120	2	YES	
PLUTONIUM-239/240	18	101	1.00	1.00	0.0001	0.0120	0.0001		Y	0.133	56	YES	
RADIUM-226	10	0	0.00	0.00									NO site measurement
RADIUM-228	10	0	0.00	0.00									NO site measurement
STRONTIUM-89,90	9	0	0.00	0.00									NO site measurement
TRITIUM (1)	0	9	0.00	0.00									NO BKGD measurement
URANIUM,TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233/234	13	107	1.00	1.00	0.3027	0.7558	0.9911		N	1.826	1	NO	Not a PCOC by PJ (2)
URANIUM-235	13	107	1.00	1.00	0.3879	0.7558	0.4148		N	0.179	0	NO	
URANIUM-238	13	107	1.00	1.00	0.6282	0.9721	0.9933		N	2.086	0	NO	

(1) Concentration unit: pCi/L
(2) Professional judgment based on lognormal UTL comparison

TABLE A-5
OU6 Background Comparison Statistical Test Results of
Surface Soil Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/g)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGMAXB	P_SLP	NDT20	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	15	91	0	0	1.00	1.00	0.019	0.361	0.010	0.625	0.060	49	0.040	3.243	58	0.0001	0	22	22	0.0228	4.275	1.645	0.0001
CESIUM-137 (1)	12	0	0	0																			
GROSS ALPHA	9	116	0	0	1.00	1.00	20.833	20.795	3.969	20.786	42.220	3	28.000	186.000	11	0.4239	0	25	23	0.7427	-1.872	1.645	0.9694
GROSS BETA	18	116	0	0	1.00	1.00	32.231	30.903	5.527	7.696	54.120	2	40.000	71.700	9	0.2613	0	27	23	0.7199	-1.510	1.645	0.9345
PLUTONIUM-239/240	18	101	0	0	1.00	1.00	0.054	0.919	0.020	2.036	0.133	56	0.100	15.220	61	0.0001	0	24	24	0.0120	4.480	1.645	0.0001
RADIUM-226 (1)	10	0	0	0																			
RADIUM-228 (1)	10	0	0	0																			
STRONTIUM-89,90 (1)	9	0	0	0																			
TRITIUM(2,3)	0	9	0	0																			
URANIUM,TOTAL (4)	0	0	0	0																			
URANIUM-233/234	13	107	0	0	1.00	1.00	1.167	1.031	0.147	0.284	1.826	1	1.470	2.020	10	0.3027	0	24	21	0.7558	-2.369	1.645	0.9911
URANIUM-235	13	107	0	0	1.00	1.00	0.047	0.049	0.030	0.031	0.179	0	0.100	0.160	8	0.3879	0	24	21	0.7558	0.215	1.645	0.4148
URANIUM-238	13	107	0	0	1.00	1.00	1.200	1.044	0.198	0.271	2.086	0	1.520	2.082	4	0.6282	0	25	20	0.9721	-2.474	1.645	0.9933

(1) No site measurement
(2) Concentration Unit : pCi/L
(3) No detections measured from the site
(4) No background measurement

TABLE A-6
OU6 Background Comparison Summary of Subsurface Soil Metals
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
ALUMINUM	98	231	1.00	1.00	1.0000	1.0000	1.0000	1.0000	N	45083.1	0	NO	
ANTIMONY	66	210	0.18	0.07	1.0000		0.1658		N	47.0	0	NO	
ARSENIC	99	231	0.81	0.99	1.0000	0.8480	0.3116	0.7957	N	17.0	0	NO	
BARIUM	99	231	0.92	1.00	0.1153	0.0006	0.0001	0.0004	Y	371.1	17	YES	
BERYLLIUM	99	231	0.91	0.84	1.0000	1.0000	1.0000	1.0000	N	18.2	0	NO	
CADMIUM	81	211	0.48	0.08	1.0000		1.0000		N	2.0	0	NO	
CALCIUM	99	231	0.90	1.00	0.0385	0.0001	0.0001	0.0001	Y	53248.1	52	YES	
CESIUM	95	221	0.78	0.68	1.0000		1.0000		N	1014.9	0	NO	
CHROMIUM	99	231	1.00	0.98	0.7000	1.0000	1.0000	0.9998	N	89.1	3	YES	
COBALT	99	231	0.34	0.95	1.0000		0.9996		N	38.1	0	NO	
COPPER	99	231	0.97	1.00	1.0000	0.9931	0.9998	0.9978	N	49.0	1	NO	Not a PCOC by PJ (1)
IRON	99	231	1.00	1.00	1.0000	0.9999	1.0000	0.9999	N	52385.2	0	NO	
LEAD	99	231	1.00	1.00	0.4894	0.9548	0.1262	0.2347	N	31.0	2	YES	
LITHIUM	99	209	0.48	0.87	1.0000		1.0000		N	41.9	0	NO	
MAGNESIUM	99	231	0.71	1.00	1.0000	0.8663	0.5539		N	12147.1	0	NO	
MANGANESE	99	231	1.00	1.00	1.0000	0.9998	0.9998	0.9813	N	1194.0	0	NO	
MERCURY	86	231	0.38	0.31	1.0000		1.0000		N	2.1	0	NO	
MOLYBDENUM	99	231	0.18	0.02	1.0000		0.9848		N	67.6	0	NO	
NICKEL	96	231	0.96	0.66	1.0000	1.0000	1.0000		N	79.9	0	NO	
POTASSIUM	98	230	0.40	0.60	1.0000		1.0000		N	8362.3	0	NO	
SELENIUM	82	211	0.27	0.09	1.0000		1.0000		N	7.1	0	NO	
SILICON													NO site measurement
SILVER	83	230	0.43	0.00	1.0000		1.0000		N	33.1	0	NO	
SODIUM	99	231	0.18	1.00	1.0000		0.9989		N	3680.0	0	NO	
STRONTIUM	99	231	0.43	1.00	0.7000		0.0003		Y	269.9	6	YES	
THALLIUM	75	223	0.05	0.29	1.0000		0.8231		N	20.0	0	NO	
TIN	92	231	0.23	0.03	1.0000		1.0000		N	383.7	0	NO	
VANADIUM	99	231	0.98	1.00	1.0000	0.9998	1.0000	0.9982	N	112.8	1	YES	
ZINC	98	231	1.00	1.00	0.7021	0.9259	0.8970	0.6826	N	182.9	4	YES	

(1) Professional judgment based on lognormal UTL comparison

TABLE A-7
OU6 Background Comparison Statistical Test Results of Subsurface Soil Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	ND_B	ND_S	TF_B	TF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	GUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	98	231	0	0	1.00	1.00	12752.0	7249.3	11310.6	3521.4	45083.1	0	102000.0	24100.0	0	1.000	66	26	1.0000	-7.040	1.645	1.0000
ANTIMONY	66	210	54	195	0.18	0.07	7.0	6.7	5.4	2.7	47.0	0	47.0	21.7	0	1.000	999	999	999.0000	0.971	1.645	0.1658
ARSENIC	99	231	19	2	0.81	0.99	4.0	3.6	4.6	1.8	17.0	0	41.8	10.9	0	1.000	70	46	0.8480	0.491	1.645	0.3116
BARIUM	99	231	8	0	0.92	1.00	97.0	160.8	96.0	246.5	371.1	17	777.0	2970.0	6	0.115	66	57	0.0006	3.979	1.645	0.0001
BERYLLIUM	99	231	9	37	0.91	0.84	4.8	0.7	4.7	0.3	18.2	0	23.5	2.1	0	1.000	68	0	1.0000	-13.704	1.645	1.0000
CADMIUM	81	211	42	195	0.48	0.08	0.9	0.5	0.4	0.2	2.0	0	2.4	1.8	0	1.000	999	999	999.0000	-8.903	1.645	1.0000
CALCIUM	99	231	10	0	0.90	1.00	6995.8	36724.9	16198.9	45552.6	53248.1	52	157000.0	203000.0	9	0.039	66	65	0.0001	8.752	1.645	0.0001
CESIUM	95	221	21	71	0.78	0.68	230.7	34.5	273.4	44.9	1014.9	0	2830.0	33.7	0	1.000	999	999	999.0000	-14.089	1.645	1.0000
CHROMIUM	99	231	0	4	1.00	0.98	19.6	10.8	24.3	18.6	89.1	3	176.0	217.0	1	0.700	66	23	1.0000	-8.558	1.645	1.0000
COBALT	99	231	65	12	0.34	0.95	8.6	6.4	10.3	3.0	38.1	0	93.9	21.4	0	1.000	999	999	999.0000	-3.366	1.645	0.9996
COPPER	99	231	3	0	0.97	1.00	12.7	9.7	12.7	5.9	49.0	1	123.0	52.1	0	1.000	67	39	0.9931	-3.567	1.645	0.9998
IRON	99	231	0	0	1.00	1.00	14532.0	9171.4	13257.3	5212.0	52385.2	0	132000.0	42000.0	0	1.000	67	34	0.9999	-6.646	1.645	1.0000
LEAD	99	231	0	1	1.00	1.00	10.9	11.5	7.0	7.8	31.0	2	39.8	84.9	2	0.489	66	41	0.9548	1.145	1.645	0.1262
LITHIUM	99	209	51	27	0.48	0.87	14.7	9.5	9.5	5.6	41.9	0	83.2	29.8	0	1.000	999	999	999.0000	-4.607	1.645	1.0000
MAGNESIUM	99	231	29	0	0.71	1.00	2706.5	2450.4	3306.4	970.5	12147.1	0	32500.0	6090.0	0	1.000	66	43	0.8663	-0.135	1.645	0.5539
MANGANESE	99	231	0	0	1.00	1.00	217.6	143.4	342.0	119.8	1194.0	0	3330.0	907.0	0	1.000	67	35	0.9998	-3.546	1.645	0.9998
MERCURY	86	231	53	159	0.38	0.31	0.3	0.1	0.6	0.1	2.1	0	5.9	0.9	0	1.000	999	999	999.0000	-5.743	1.645	1.0000
MOLYBDENUM	99	231	81	227	0.18	0.02	18.3	19.8	7.6	1.9	67.6	0	67.6	27.9	0	1.000	999	999	999.0000	-2.164	1.645	0.9848
NICKEL	96	231	4	79	0.96	0.66	20.9	10.5	20.6	6.7	79.9	0	193.0	41.5	0	1.000	67	28	1.0000	-7.444	1.645	1.0000
POTASSIUM	98	230	59	93	0.40	0.60	1627.4	913.8	2356.1	473.2	8362.3	0	18700.0	3030.0	0	1.000	999	999	999.0000	-4.488	1.645	1.0000
SELENIUM	82	211	60	192	0.27	0.09	1.5	0.5	1.9	0.1	7.1	0	13.7	1.3	0	1.000	999	999	999.0000	-7.883	1.645	1.0000
SILICON(1)																						
SILVER	83	230	47	229	0.43	0.00	5.8	1.0	9.4	0.1	33.1	0	40.9	2.7	0	1.000	999	999	999.0000	-10.074	1.645	1.0000
SODIUM	99	231	81	0	0.18	1.00	866.8	158.0	441.1	129.3	3680.0	0	3680.0	970.0	0	1.000	999	999	999.0000	-3.069	1.645	0.9989
STRONTIUM	99	231	56	1	0.43	1.00	69.2	81.3	70.3	74.8	269.9	6	484.0	506.0	1	0.700	999	999	999.0000	3.395	1.645	0.0003
THALLIUM	75	223	71	158	0.05	0.29	1.3	0.8	1.2	0.3	20.0	0	20.0	0.7	0	1.000	999	999	999.0000	-0.927	1.645	0.8231
TIN	92	231	71	223	0.23	0.03	66.6	20.4	110.2	3.4	383.7	0	441.0	57.8	0	1.000	999	999	999.0000	-6.293	1.645	1.0000
VANADIUM	99	231	2	0	0.98	1.00	31.5	22.7	28.5	11.8	112.8	1	283.0	118.0	0	1.000	67	35	0.9998	-4.486	1.645	1.0000
ZINC	98	231	0	0	1.00	1.00	36.9	33.9	51.1	53.5	182.9	4	486.0	706.0	1	0.702	66	42	0.9259	-1.265	1.645	0.8970

(1)No site measurement.

TABLE A-8
OU6 Background Comparison t-Test Results of Subsurface Soil Metals
(Concentration Unit: MG/KG)

ANALYTE	N_B	_S	D_B	ND_S	EAN_B	EAN_S	STD_B	STD_S	_CAL	F_TAB	DF	T_CAL	T_1_95	P_T_1	REMARK
ALUMINUM	98	231	0	0	12752.0	7249.3	11310.6	3521.4	25.7	3.8	105	-4.720	1.66	1.0000	
ANTIMONY	66	210	54	195	7.0	6.7	5.4	2.7							NNDT more than 20%
ARSENIC	99	231	19	2	4.0	3.6	4.6	1.8	9.4	3.8	111	-0.829	1.66	0.7957	
BARIUM	99	231	8	0	97.0	160.8	96.0	246.5	6.7	3.8	326	3.382	1.65	0.0004	
BERYLLIUM	99	231	9	37	4.8	0.7	4.7	0.3	182.2	3.8	98	-8.613	1.66	1.0000	
CADMIUM	81	211	42	195	0.9	0.5	0.4	0.2							NNDT more than 20%
CALCIUM	99	231	10	0	6995.8	36724.9	16198.9	45552.6	78.1	3.8	320	8.716	1.65	0.0001	
CESIUM	95	221	21	71	230.7	34.5	273.4	44.9							NNDT more than 20%
CHROMIUM	99	231	0	4	19.6	10.8	24.3	18.6	2.6	3.8	328	-3.570	1.65	0.9998	
COBALT	99	231	65	12	8.6	6.4	10.3	3.0							NNDT more than 20%
COPPER	99	231	3	0	12.7	9.7	12.7	5.9	3.6	3.8	328	-2.874	1.65	0.9978	
IRON	99	231	0	0	14532.0	9171.4	13257.3	5212.0	5.9	3.8	111	-3.896	1.66	0.9999	
LEAD	99	231	0	1	10.9	11.5	7.0	7.8	1.5	3.8	328	0.724	1.65	0.2347	
LITHIUM	99	209	51	27	14.7	9.5	9.5	5.6							NNDT more than 20%
MAGNESIUM	99	231	29	0	2706.5	2450.4	3306.4	970.5							NNDT more than 20%
MANGANESE	99	231	0	0	217.6	143.4	342.0	119.8	6.7	3.8	108	-2.107	1.66	0.9813	
MERCURY	86	231	53	159	0.3	0.1	0.6	0.1							NNDT more than 20%
MOLYBDENUM	99	231	81	227	18.3	19.8	7.6	1.9							NNDT more than 20%
NICKEL	96	231	4	79	20.9	10.5	20.6	6.7							NNDT more than 20%
POTASSIUM	98	230	59	93	1627.4	913.8	2356.1	473.2							NNDT more than 20%
SELENIUM	82	211	60	192	1.5	0.5	1.9	0.1							NNDT more than 20%
SILICON	0	0	0	0											NO BKGD measurement
SILVER	83	230	47	229	5.8	1.0	9.4	0.1							NNDT more than 20%
SODIUM	99	231	81	0	866.8	158.0	441.1	129.3							NNDT more than 20%
STRONTIUM	99	231	56	1	69.2	81.3	70.3	74.8							NNDT more than 20%
THALLIUM	75	223	71	158	1.3	0.8	1.2	0.3							NNDT more than 20%
TIN	92	231	71	223	66.6	20.4	110.2	3.4							NNDT more than 20%
VANADIUM	99	231	2	0	31.5	22.7	28.5	11.8	6.3	3.8	113	-2.979	1.66	0.9982	
ZINC	98	231	0	0	36.9	33.9	51.1	53.5	0.1	3.8	327	-0.475	1.65	0.6826	

NNDT = Number of non-detects

TABLE A-9
OU6 Background Comparison Summary of Subsurface Soil Radionuclides
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	28	208	1.00	1.00	0.0001	0.0009	0.0001	0.0228	Y	0.022	21	YES	
CESIUM-137	99	0											NO site measurement
GROSS ALPHA	99	209	1.00	1.00	0.4597	1.0000	1.0000	1.0000	N	51.423	2	YES	
GROSS BETA	99	223	1.00	1.00	1.0000	1.0000	1.0000	1.0000	N	42.022	0	NO	
PLUTONIUM-239/240	99	206	1.00	1.00	0.0001	0.0001	0.0001	0.0001	Y	0.025	43	YES	
RADIUM-226	83	0											NO site measurement
RADIUM-228	83	0											NO site measurement
STRONTIUM-89,90	99	0											NO site measurement
TRITIUM (1)	99	12	1.00	1.00	1.0000	0.9479	0.9564		N	503.616	0	NO	
URANIUM,TOTAL	0	0											NO site measurement
URANIUM-233/234	99	230	1.00	1.00	1.0000	0.0256	0.0344	0.2701	Y	3.441	0	YES	
URANIUM-235	99	230	1.00	1.00	1.0000	0.4617	0.0001	0.0009	Y	0.153	1	YES	
URANIUM-238	99	230	1.00	1.00	0.6991	0.8497	0.3157	0.2637	N	1.807	2	YES	

(1) Concentration Unit: pCi/L

TABLE A-10
OU6 Background Comparison Statistical Test Results of Subsurface Soil Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	ND_B	ND_S	TF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	28	208	0	0	1.00	1.00	-0.002	0.013	0.007	0.040	0.022	21	0.010	0.440	63	0.0001	49	49	0.0009	6.390	1.645	0.0001
CESIUM-137(1)	99	0	0	0	1.00		0.012		0.041													
GROSS ALPHA	99	209	0	0	1.00	1.00	24.915	14.138	9.284	10.768	51.423	2	48.000	143.000	2	0.4597	64	9	1.0000	-10.266	1.645	1.0000
GROSS BETA	99	223	0	0	1.00	1.00	24.717	20.794	6.061	5.275	42.022	0	44.000	36.560	0	1.0000	67	28	1.0000	-5.530	1.645	1.0000
PLUTONIUM-239/240	99	206	0	0	1.00	1.00	0.004	0.029	0.007	0.085	0.025	43	0.030	0.880	37	0.0001	61	53	0.0001	5.355	1.645	0.0001
RADIUM-226(1)	83	0	0	0	1.00		0.746		0.231													
RADIUM-228(1)	83	0	0	0	1.00		1.402		0.318													
STRONTIUM-89,90(1)	99	0	0	0	1.00		0.031		0.358													
TRITIUM (2)	99	12	0	0	1.00	1.00	141.717	79.093	126.747	101.881	503.616	0	440.000	250.500	0	1.0000	23	1	0.9479	-1.710	1.645	0.9564
URANIUM,TOTAL(3)	0	0	0	0																		
URANIUM-233/234	99	230	0	0	1.00	1.00	0.779	0.715	0.932	0.302	3.441	0	8.900	3.050	0	1.0000	66	53	0.0256	1.819	1.645	0.0344
URANIUM-235	99	230	0	0	1.00	1.00	0.022	0.037	0.046	0.032	0.153	1	0.200	0.160	0	1.0000	66	47	0.4617	7.487	1.645	0.0001
URANIUM-238	99	230	0	0	1.00	1.00	0.733	1.333	0.376	9.254	1.807	2	3.200	141.000	1	0.6991	76	50	0.8497	0.480	1.645	0.3157

(1) No site measurement

(2)Concentration Unit: pCi/L

(3) No background measurement

TABLE A-11
OU6 Background Comparison Summary of Groundwater Unfiltered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99_	NGUTL_	PCOC	REMARK
ALUMINUM	149	98	0.95	0.95	0.0005	0.0001	0.0001	0.0029	Y	25624.6	14	YES	
ANTIMONY	141	84	0.38	0.15	0.0067		0.0167		Y	55.8	7	YES	
ARSENIC	138	98	0.28	0.50	0.0116		0.0001		Y	8.8	6	YES	
BARIUM	149	99	0.74	0.98	0.0002	0.0001	0.0001		Y	300.4	27	YES	
BERYLLIUM	148	92	0.12	0.27	0.0001		0.0001		Y	5.0	9	YES	
CADMIUM	148	98	0.20	0.28	0.0036		0.0112		Y	11.1	6	YES	
CALCIUM	149	99	1.00	1.00	0.0001	0.0001	0.0001	0.0001	Y	145353.0	32	YES	
CESIUM													NO HIT
CHROMIUM	145	99	0.48	0.74	1.0000	0.0001	0.0001		Y	186.4	7	YES	
COBALT	148	99	0.16	0.40	0.0038		0.0004		Y	50.0	6	YES	
COPPER	148	99	0.74	0.51	0.0001		0.0005		Y	45.3	16	YES	
IRON	149	98	0.98	0.95	0.0092	0.0001	0.0001	0.0043	Y	31518.5	13	YES	
LEAD	141	99	0.70	0.72	0.0007	0.0001	0.0001		Y	19.3	17	YES	
LITHIUM	149	99	0.77	0.92	0.0005		0.0001		Y	172.3	17	YES	
MAGNESIUM	149	99	0.97	1.00	0.0001	0.0001	0.0001	0.0001	Y	33005.6	42	YES	
MANGANESE	149	99	0.89	0.94	0.0001	0.0001	0.0001	0.0001	Y	626.4	25	YES	
MERCURY	148	99	0.20	0.10	0.0006		0.9548		Y	0.2	9	YES	
MOLYBDENUM	150	99	0.34	0.24	1.0000		0.2314		N	195.1	0	NO	
NICKEL	146	99	0.38	0.65	0.1623		0.0001		Y	97.5	10	YES	
POTASSIUM	150	99	0.71	0.94	0.0001		0.0001		Y	5178.8	32	YES	
SELENIUM	145	98	0.30	0.61	0.4033	0.0001	0.0001		Y	127.5	18	YES	
SILICON	84	58	0.99	1.00	0.0040	0.0025	0.1502	0.0043	Y	61390.0	9	YES	
SILVER	147	96	0.16	0.20	0.0002		0.0009		Y	10.0	9	YES	
SODIUM	149	99	0.99	1.00	0.0001	0.0001	0.0001	0.0001	Y	144226.0	26	YES	
STRONTIUM	146	98	0.89	1.00	0.0001	0.0001	0.0001	0.0001	Y	1085.4	33	YES	
THALLIUM	146	99	0.24	0.05	1.0000		0.5107		N	9.0	0	NO	
TIN	149	98	0.35	0.18	0.1564		0.3374		N	179.2	3	NO	Not a PCOC by PJ (1)
VANADIUM	149	99	0.77	0.72	0.0014		0.0001		Y	68.2	15	YES	
ZINC	149	99	0.91	0.82	0.0005	0.0001	0.0010	0.0199	Y	179.2	17	YES	

(1) Professional judgement based on lognormal UTL comparison

TABLE A-12
OU6 Background Comparison Statistical Test Results of
UHSU Groundwater Unfiltered Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit UG/L)

ANALYTE	_B	N_S	D_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	GUTL	MAX_B	MAX_S	NGM	_SLP	N_T20	N_SITE	_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	149	98	8	5	0.95	0.95	3496.5	19344.2	7758.2	55179.0	25624.6	14	63900.0	456000.0	8	0.001	50	32	0.000	4.027	1.645	0.0001
ANTIMONY	141	84	87	71	0.38	0.15	26.8	35.8	10.2	31.6	55.8	7	86.6	194.0	5	0.007	999	999	999.000	2.127	1.645	0.0167
ARSENIC	138	98	99	49	0.28	0.50	3.9	4.5	1.7	3.1	8.8	6	10.0	18.0	5	0.012	999	999	999.000	4.999	1.645	0.0001
BARIUM	149	99	39	2	0.74	0.98	105.9	348.4	68.2	628.8	300.4	27	752.0	5060.0	9	0.000	50	45	0.000	8.076	1.645	0.0001
BERYLLIUM	148	92	130	67	0.12	0.27	2.3	3.4	0.6	4.6	5.0	9	5.0	32.0	9	0.000	999	999	999.000	4.027	1.645	0.0001
CADMIUM	148	98	119	71	0.20	0.28	2.5	3.5	1.0	4.4	11.1	6	11.1	32.9	6	0.004	999	999	999.000	2.284	1.645	0.0112
CALCIUM	149	99	0	0	1.00	1.00	55030.2	185482.8	31667.8	176922.0	145353.0	32	186000.0	715000.0	24	0.000	50	41	0.000	10.479	1.645	0.0001
CESIUM	142	89	107	89	0.25	0.00																
CHROMIUM	145	99	75	26	0.48	0.74	13.5	46.5	60.6	94.1	186.4	7	729.0	580.0	0	1.000	49	38	0.000	5.804	1.645	0.0001
COBALT	148	99	124	59	0.16	0.40	21.9	24.0	7.4	28.4	50.0	6	50.0	228.0	6	0.004	999	999	999.000	3.331	1.645	0.0004
COPPER	148	99	39	49	0.74	0.51	11.4	123.4	11.9	672.4	45.3	16	105.0	6430.0	11	0.000	999	999	999.000	3.320	1.645	0.0005
IRON	149	98	3	5	0.98	0.95	3909.1	25037.1	9680.1	77620.4	31518.5	13	97000.0	656000.0	5	0.009	50	32	0.000	4.078	1.645	0.0001
LEAD	141	99	43	28	0.70	0.72	3.8	17.9	5.4	40.2	19.3	17	52.5	254.0	8	0.001	48	34	0.000	4.058	1.645	0.0001
LITHIUM	149	99	34	8	0.77	0.92	34.0	89.1	48.5	104.3	172.3	17	266.0	456.0	8	0.001	999	999	999.000	8.162	1.645	0.0001
MAGNESIUM	149	99	4	0	0.97	1.00	10317.4	54419.8	7954.6	58253.5	33005.6	42	47900.0	235000.0	25	0.000	50	46	0.000	11.274	1.645	0.0001
MANGANESE	149	99	17	6	0.89	0.94	92.4	676.1	187.2	1241.7	626.4	25	1950.0	6200.0	12	0.000	50	37	0.000	3.774	1.645	0.0001
MERCURY	148	99	118	89	0.20	0.10	0.1	0.2	0.0	0.2	0.2	9	0.3	1.5	8	0.001	999	999	999.000	-1.694	1.645	0.9548
MOLYBDENU	150	99	99	75	0.34	0.24	66.0	62.9	45.3	45.6	195.1	0	200.0	29.5	0	1.000	999	999	999.000	0.734	1.645	0.2314
NICKEL	146	99	91	35	0.38	0.65	18.7	51.7	27.6	122.2	97.5	10	334.0	1070.0	2	0.162	999	999	999.000	6.407	1.645	0.0001
POTASSIUM	150	99	44	6	0.71	0.94	1843.2	5439.7	1169.5	6632.4	5178.8	32	8370.0	38900.0	17	0.000	999	999	999.000	7.682	1.645	0.0001
SELENIUM	145	98	101	38	0.30	0.61	8.5	52.7	41.7	107.6	127.5	18	456.0	475.0	1	0.403	49	35	0.000	5.703	1.645	0.0001
SILICON	84	58	1	0	0.99	1.00	16575.3	37010.7	15401.0	55921.1	61390.0	9	116000.0	288000.0	6	0.004	29	19	0.003	1.035	1.645	0.1502
SILVER	147	96	123	77	0.16	0.20	4.7	64.3	1.0	356.5	10.0	9	10.0	3040.0	9	0.000	999	999	999.000	3.111	1.645	0.0009
SODIUM	149	99	2	0	0.99	1.00	30081.9	115715.5	40019.7	115938.0	144226.0	26	194000.0	549000.0	18	0.000	50	38	0.000	9.109	1.645	0.0001
STRONTIUM	146	98	16	0	0.89	1.00	312.9	1569.2	270.9	1790.6	1085.4	33	1770.0	6960.0	21	0.000	49	42	0.000	10.669	1.645	0.0001
THALLIUM	146	99	111	94	0.24	0.05	3.9	4.1	1.8	1.7	9.0	0	10.0	2.7	0	1.000	999	999	999.000	-0.027	1.645	0.5107
TIN	149	98	97	80	0.35	0.18	70.4	81.9	38.2	45.7	179.2	3	200.0	267.0	2	0.156	999	999	999.000	0.420	1.645	0.3374
VANADIUM	149	99	35	28	0.77	0.72	15.1	54.1	18.6	109.1	68.2	15	167.0	754.0	7	0.001	999	999	999.000	6.158	1.645	0.0001
ZINC	149	99	14	18	0.91	0.82	37.1	222.3	49.8	883.3	179.2	17	498.0	8000.0	8	0.001	50	36	0.000	3.093	1.645	0.0010

TABLE A-13
OU6 Background Comparison t-Test Results of UHSU Groundwater Unfiltered Metals
(Concentration Unit: UG/L)

ANALYTE	_B	_S	D_B	D_S	MEAN_B	MEAN_S	STD_B	STD_S	F_CAL	F_TAB	DF_	T_CAL	T_1_95	P_T_1	REMARK
ALUMINUM	149	106	8	5	3496.5	20830.0	7758.2	53968.8	32.4	3.8	108	3.283	1.66	0.0007	
ANTIMONY	141	92	87	77	26.8	35.1	10.2	30.3							NNDT more than 20%
ARSENIC	138	106	99	51	3.9	4.6	1.7	3.0							NNDT more than 20%
BARIUM	149	107	39	2	105.9	353.7	68.2	608.5							NNDT more than 20%
BERYLLIUM	148	100	130	70	2.3	3.4	0.6	4.4							NNDT more than 20%
CADMIUM	148	106	119	78	2.5	3.4	1.0	4.2							NNDT more than 20%
CALCIUM	149	107	0	0	55030.2	177129.9	31667.8	172674.0	110.9	3.8	111	7.228	1.66	0.0001	
CESIUM	142	97	107	95	378.2	448.6	195.1	101.5							NNDT more than 20%
CHROMIUM	145	107	75	27	13.5	46.9	60.6	91.2							NNDT more than 20%
COBALT	148	107	124	59	21.9	24.1	7.4	27.7							NNDT more than 20%
COPPER	148	107	39	49	11.4	117.8	11.9	646.9							NNDT more than 20%
IRON	149	106	3	5	3909.1	26939.2	9680.1	75639.4	29.7	3.8	107	3.117	1.66	0.0012	
LEAD	141	107	43	29	3.8	18.5	5.4	39.3							NNDT more than 20%
LITHIUM	149	107	34	8	34.0	85.9	48.5	101.1							NNDT more than 20%
MAGNESIUM	149	107	4	0	10317.4	52059.5	7954.6	56654.4	121.4	3.8	109	7.568	1.66	0.0001	
MANGANESE	149	107	17	6	92.4	697.3	187.2	1204.1	106.2	3.8	110	5.152	1.66	0.0001	
MERCURY	148	107	118	96	0.1	0.2	0.0	0.2							NNDT more than 20%
MOLYBDENUM	150	107	99	78	66.0	61.4	45.3	45.7							NNDT more than 20%
NICKEL	146	107	91	36	18.7	52.5	27.6	118.0							NNDT more than 20%
POTASSIUM	150	107	44	6	1843.2	5797.4	1169.5	6613.6							NNDT more than 20%
SELENIUM	145	106	101	44	8.5	48.9	41.7	104.3							NNDT more than 20%
SILICON	84	66	1	0	16575.3	40453.3	15401.0	55239.6	39.1	3.9	73	3.409	1.67	0.0005	
SILVER	147	104	123	83	4.7	59.7	1.0	342.8							NNDT more than 20%
SODIUM	149	107	2	0	30081.9	110537.7	40019.7	113020.3	79.6	3.8	125	7.053	1.65	0.0001	
STRONTIUM	146	106	16	0	312.9	1492.2	270.9	1742.5	104.7	3.8	109	6.908	1.66	0.0001	
THALLIUM	146	107	111	102	3.9	4.1	1.8	1.6							NNDT more than 20%
TIN	149	106	97	86	70.4	82.0	38.2	44.7							NNDT more than 20%
VANADIUM	149	107	35	28	15.1	57.5	18.6	107.6							NNDT more than 20%
ZINC	149	107	14	18	37.1	219.9	49.8	850.0	15.8	3.8	107	2.222	1.66	0.0142	

NNDT = Number of non-detects

TABLE A-14
OU6 Background Comparison Summary of UHSU Groundwater Filtered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
ALUMINUM	248	178	0.77	0.42	1.0000		0.5506		N	1816.5	0	NO	
ANTIMONY	248	176	0.48	0.22	0.0008		0.1688		Y	51.2	8	YES	
ARSENIC	219	178	0.07	0.12	1.0000		0.6220		N	15.0	0	NO	
BARIUM	256	178	0.71	0.97	0.0001		0.0001		Y	176.5	30	YES	
BERYLLIUM	212	178	0.10	0.05	1.0000		0.9996		N	5.0	0	NO	
CADMIUM	240	176	0.22	0.11	0.1784		0.9832		N	5.1	4	YES	
CALCIUM	257	178	1.00	1.00	0.0001	0.0001	0.0001	0.0001	Y	148383.0	49	YES	
CESIUM	211	161	0.21	0.04	1.0000		0.9988		N	1122.4	0	NO	
CHROMIUM	250	176	0.36	0.28	0.0019		0.1864		Y	15.0	15	YES	
COBALT	231	178	0.18	0.15	1.0000		0.9717		N	50.0	0	NO	
COPPER	250	177	0.39	0.28	1.0000		0.6438		N	53.8	4	YES	
IRON	256	175	0.76	0.43	1.0000		0.6368		N	1682.7	5	YES	
LEAD	250	178	0.23	0.03	1.0000		1.0000		N	15.8	0	NO	
LITHIUM	250	178	0.74	0.90	0.0001		0.0001		Y	190.7	24	YES	
MAGNESIUM	254	178	0.94	1.00	0.0001	0.0001	0.0001	0.0001	Y	33721.2	63	YES	
MANGANESE	256	178	0.61	0.64	0.0001	0.0010	0.0088		Y	282.1	35	YES	
MERCURY	206	178	0.10	0.01	1.0000		1.0000		N	0.7	0	NO	
MOLYBDENU	241	176	0.37	0.20	1.0000		0.4405		N	188.1	0	NO	
NICKEL	236	178	0.33	0.35	0.0060		0.0001		Y	35.4	6	YES	
POTASSIUM	252	178	0.72	0.84	0.4140		0.0001		Y	4683.9	20	YES	
SELENIUM	219	178	0.32	0.60	1.0000	0.0001	0.0001		Y	136.8	28	YES	
SILICON													NO BKGD measurement
SILVER	236	177	0.29	0.10	1.0000		0.9962		N	2586.6	0	NO	
SODIUM	255	178	0.99	1.00	0.0001	0.0001	0.0001	0.0001	Y	156322.0	46	YES	
STRONTIUM	253	178	0.92	1.00	1.0000	0.0001	0.0001	0.0001	Y	1968.2	30	YES	
THALLIUM	213	178	0.22	0.04	1.0000		0.9960		N	72.1	0	NO	
TIN	236	177	0.43	0.19	1.0000		0.9623		N	1734.3	0	NO	
VANADIUM	249	178	0.65	0.37	1.0000		0.9034		N	40.7	0	NO	
ZINC	256	178	0.79	0.51	0.0277		0.9934		Y	64.8	11	YES	

TABLE A-15
OU6 Background Comparison Statistical Test Results of UHSU Groundwater Filtered Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	TF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	248	191	56	109	0.77	0.43	113.0	94.3	597.3	347.2	1816.5	1	8610.0	4830.0	0	1.000	999	999	999.0000	-0.123	1.645	0.5488
ANTIMONY	248	189	128	151	0.48	0.20	24.5	28.1	9.4	19.1	51.2	8	60.0	162.0	8	0.001	999	999	999.0000	0.936	1.645	0.1747
ARSENIC	219	191	203	168	0.07	0.12	4.4	3.9	1.6	1.7	15.0	0	15.0	4.0	0	1.000	999	999	999.0000	-0.324	1.645	0.6269
BARIUM	256	191	73	6	0.71	0.97	87.4	120.0	31.2	63.6	176.5	30	203.0	286.0	26	0.000	999	999	999.0000	7.171	1.645	0.0001
BERYLLIUM	212	191	190	181	0.10	0.05	2.3	2.1	0.6	0.8	5.0	0	5.0	2.0	0	1.000	999	999	999.0000	-3.231	1.645	0.9994
CADMIUM	240	189	187	169	0.22	0.11	2.6	2.4	0.9	1.3	5.1	4	8.6	13.9	2	0.194	999	999	999.0000	-2.274	1.645	0.9885
CALCIUM	257	191	1	0	1.00	1.00	55208.7	161556.0	32667.6	157988.0	148383.0	50	184000.0	659000.0	36	0.000	90	71	0.0001	12.955	1.645	0.0001
CESIUM	211	174	167	166	0.21	0.05	443.8	407.9	237.9	159.6	1122.4	0	2500.0	160.0	0	1.000	999	999	999.0000	-3.094	1.645	0.9990
CHROMIUM	250	189	160	139	0.36	0.26	6.0	6.7	3.1	6.7	15.0	15	23.2	46.0	7	0.003	999	999	999.0000	0.614	1.645	0.2697
COBALT	231	191	189	164	0.18	0.14	20.9	17.7	8.4	10.2	50.0	0	50.0	13.3	0	1.000	999	999	999.0000	-1.865	1.645	0.9689
COPPER	250	190	152	134	0.39	0.29	10.7	10.9	15.1	10.6	53.8	4	175.0	81.9	0	1.000	999	999	999.0000	-0.539	1.645	0.7052
IRON	256	188	62	103	0.76	0.45	93.7	193.0	557.1	597.9	1682.7	6	8790.0	5500.0	0	1.000	999	999	999.0000	-0.195	1.645	0.5773
LEAD	250	191	192	184	0.23	0.04	2.4	1.4	4.7	0.5	15.8	0	64.0	3.4	0	1.000	999	999	999.0000	-3.767	1.645	0.9999
LITHIUM	250	191	64	18	0.74	0.91	38.0	75.2	53.6	107.2	190.7	25	250.0	650.0	20	0.000	999	999	999.0000	8.450	1.645	0.0001
MAGNESIUM	254	191	15	0	0.94	1.00	9991.4	47941.6	8319.8	56083.1	33721.2	65	46300.0	257000.0	41	0.000	89	83	0.0001	14.199	1.645	0.0001
MANGANESE	256	191	101	66	0.61	0.65	32.7	344.5	87.4	892.1	282.1	42	934.0	4520.0	17	0.000	90	55	0.0001	3.026	1.645	0.0012
MERCURY	206	191	186	190	0.10	0.01	0.1	0.1	0.1	0.0	0.7	0	0.7	0.3	0	1.000	999	999	999.0000	-4.063	1.645	1.0000
MOLYBDENUM	241	189	151	149	0.37	0.21	56.1	60.5	46.3	46.1	188.1	0	200.0	48.4	0	1.000	999	999	999.0000	0.444	1.645	0.3284
NICKEL	236	191	159	120	0.33	0.37	15.4	21.5	7.0	38.1	35.4	7	40.0	295.0	7	0.003	999	999	999.0000	4.587	1.645	0.0001
POTASSIUM	252	191	70	28	0.72	0.85	1574.3	2608.0	1090.3	1666.3	4683.9	25	8110.0	9450.0	1	0.431	999	999	999.0000	8.413	1.645	0.0001
SELENIUM	219	191	149	79	0.32	0.59	9.2	46.2	44.8	96.0	136.8	29	607.0	460.0	0	1.000	82	66	0.0001	6.376	1.645	0.0001
SILICON(1)	0	122	0	0		1.00																
SILVER	236	190	168	171	0.29	0.10	62.5	4.4	885.0	1.4	2586.6	0	13600.0	10.2	0	1.000	999	999	999.0000	-2.696	1.645	0.9965
SODIUM	255	191	3	0	0.99	1.00	31887.5	117400.0	43627.7	127532.0	156322.0	47	252000.0	897000.0	29	0.000	90	74	0.0001	12.142	1.645	0.0001
STRONTIUM	253	191	21	0	0.92	1.00	353.8	1407.5	566.0	1718.7	1968.2	31	7930.0	7000.0	0	1.000	89	73	0.0001	13.344	1.645	0.0001
THALLIUM	213	191	166	184	0.22	0.04	5.9	4.0	23.2	1.7	72.1	0	328.0	2.4	0	1.000	999	999	999.0000	-2.662	1.645	0.9961
TIN	236	190	135	156	0.43	0.18	102.3	70.8	572.2	39.9	1734.3	0	8830.0	129.0	0	1.000	999	999	999.0000	-1.830	1.645	0.9664
VANADIUM	249	191	88	122	0.65	0.36	11.8	13.8	10.1	10.4	40.7	0	50.0	27.3	0	1.000	999	999	999.0000	-0.986	1.645	0.8380
ZINC	256	191	54	93	0.79	0.51	14.4	18.2	17.7	37.8	64.8	11	137.0	314.0	4	0.033	999	999	999.0000	-2.052	1.645	0.9799

(1) No background measurement

TABLE A-16
OU6 Background Comparison t-Test Results of UHSU Groundwater Filtered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	MEAN_B	MEAN_S	STD_B	STD_S	F_CAL	F_TAB	F_	T_CAL	T_1_95	P_T_1	REMARK
ALUMINUM	248	191	56	109	113.0	94.3	597.3	347.2							NNDT more than 20%
ANTIMONY	248	189	128	151	24.5	28.1	9.4	19.1							NNDT more than 20%
ARSENIC	219	191	203	168	4.4	3.9	1.6	1.7							NNDT more than 20%
BARIUM	256	191	73	6	87.4	120.0	31.2	63.6							
BERYLLIUM	212	191	190	181	2.3	2.1	0.6	0.8							NNDT more than 20%
CADMIUM	240	189	187	169	2.6	2.4	0.9	1.3							NNDT more than 20%
CALCIUM	257	191	1	0	55208.7	161556.0	32667.6	157987.7	132.0	3.8	202	9.159	1.65	0.0001	
CESIUM	211	174	167	166	443.8	407.9	237.9	159.6							NNDT more than 20%
CHROMIUM	250	189	160	139	6.0	6.7	3.1	6.7							NNDT more than 20%
COBALT	231	191	189	164	20.9	17.7	8.4	10.2							NNDT more than 20%
COPPER	250	190	152	134	10.7	10.9	15.1	10.6							NNDT more than 20%
IRON	256	188	62	103	93.7	193.0	557.1	597.9							NNDT more than 20%
LEAD	250	191	192	184	2.4	1.4	4.7	0.5							NNDT more than 20%
LITHIUM	250	191	64	18	38.0	75.2	53.6	107.2							
MAGNESIUM	254	191	15	0	9991.4	47941.6	8319.8	56083.1	162.3	3.8	196	9.275	1.65	0.0001	
MANGANESE	256	191	101	66	32.7	344.5	87.4	892.1							NNDT more than 20%
MERCURY	206	191	186	190	0.1	0.1	0.1	0.0							NNDT more than 20%
MOLYBDENUM	241	189	151	149	56.1	60.5	46.3	46.1							NNDT more than 20%
NICKEL	236	191	159	120	15.4	21.5	7.0	38.1							NNDT more than 20%
POTASSIUM	252	191	70	28	1574.3	2608.0	1090.3	1666.3							
SELENIUM	219	191	149	79	9.2	46.2	44.8	96.0							NNDT more than 20%
SILICON	0	122	0	0		7186.0		1896.1							
SILVER	236	190	168	171	62.5	4.4	885.0	1.4							NNDT more than 20%
SODIUM	255	191	3	0	31887.5	117400.0	43627.7	127532.2	99.9	3.8	223	8.885	1.65	0.0001	
STRONTIUM	253	191	21	0	353.8	1407.5	566.0	1718.7	116.6	3.8	221	8.146	1.65	0.0001	
THALLIUM	213	191	166	184	5.9	4.0	23.2	1.7							NNDT more than 20%
TIN	236	190	135	156	102.3	70.8	572.2	39.9							NNDT more than 20%
VANADIUM	249	191	88	122	11.8	13.8	10.1	10.4							NNDT more than 20%
ZINC	256	191	54	93	14.4	18.2	17.7	37.8							NNDT more than 20%

NNDT = Number of non-detects

TABLE A-17
OU6 Background Comparison Summary of UHSU Groundwater Unfiltered Radionuclides
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFIC	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	183	131	1.00	1.00	0.0020	0.0018	0.0151		Y	0.037	16	YES	
CESIUM-137	156	68	1.00	1.00	0.0912	0.3756	0.1002		N	1.065	2	YES	
GROSS ALPHA	23	7	1.00	1.00	1.0000	0.1201	0.0775		N	390.578	0	NO	
GROSS BETA	23	7	1.00	1.00	1.0000	0.1201	0.1056		N	221.307	0	NO	
PLUTONIUM-239/240	194	138	1.00	1.00	0.0003	0.0001	0.0001		Y	0.064	12	YES	
RADIUM-226	6	6	1.00	1.00	0.0303	0.0909	0.0547		Y	1.295	1	YES	
RADIUM-228	0	3	0.00	0.00									NO BKGD measurement
STRONTIUM-89,90(1)	32	3	1.00	1.00	0.0857	0.0952	0.0259		Y	1.154	1	YES	
TRITIUM	84	238	1.00	1.00	1.0000	0.3271	0.1193		N	12982.300	0	NO	
URANIUM,TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233/234(1)	35	4	1.00	1.00	1.0000	1.0000	0.3730		N	144.836	0	NO	
URANIUM-235(1)	35	4	1.00	1.00	1.0000	1.0000	0.7981		N	5.233	0	NO	
URANIUM-238(1)	22	4	1.00	1.00	1.0000	0.6759	0.1776		N	114.171	0	NO	

(1) Sample size is too small

TABLE A-18

OU6 Background Comparison Statistical Test Results of UHSU Groundwater Unfiltered Radionuclides

(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)

(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	ND_B	ND_S	TF_B	TF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	183	131	0	0	1.00	1.00	0.006	0.050	0.011	0.297	0.037	16	0.097	3.200	7	0.0020	63	37	0.0018	2.166	1.645	0.0151
CESIUM-137	156	68	0	0	1.00	1.00	0.120	0.231	0.331	0.628	1.065	2	1.160	4.499	2	0.0912	45	15	0.3756	1.280	1.645	0.1002
GROSS ALPHA	23	7	0	0	1.00	1.00	43.497	64.329	94.285	99.739	390.578	0	362.000	280.000	0	1.0000	6	3	0.1201	1.422	1.645	0.0775
GROSS BETA	23	7	0	0	1.00	1.00	24.945	40.003	53.342	55.787	221.307	0	220.000	160.000	0	1.0000	6	3	0.1201	1.251	1.645	0.1056
PLUTONIUM-239/240	194	138	0	0	1.00	1.00	0.004	0.081	0.021	0.388	0.064	12	0.224	3.650	9	0.0003	67	44	0.0001	5.104	1.645	0.0001
RADIUM-226	6	6	0	0	1.00	1.00	0.355	2.070	0.128	3.319	1.295	1	0.520	8.800	4	0.0303	3	3	0.0909	1.601	1.645	0.0547
RADIUM-228(1)	0	3	0	0																		
STRONTIUM-89,90	32	3	0	0	1.00	1.00	0.215	0.837	0.276	0.563	1.154	1	1.120	1.220	1	0.0857	7	2	0.0952	1.945	1.645	0.0259
TRITIUM	84	238	0	0	1.00	1.00	624.852	216.280	4246.750	260.340	12982.300	0	39030.000	1088.650	0	1.0000	65	50	0.3271	1.179	1.645	0.1193
URANIUM,TOTAL(2)	0	0	0	0																		
URANIUM-233/234	35	4	0	0	1.00	1.00	15.618	4.313	38.753	3.982	144.836	0	164.000	9.700	0	1.0000	8	0	1.0000	0.324	1.645	0.3730
URANIUM-235	35	4	0	0	1.00	1.00	0.617	0.095	1.384	0.050	5.233	0	6.290	0.170	0	1.0000	8	0	1.0000	-0.835	1.645	0.7981
URANIUM-238	22	4	0	0	1.00	1.00	10.840	3.985	27.727	3.849	114.171	0	108.000	9.400	0	1.0000	6	1	0.6759	0.925	1.645	0.1776

(1) No detect record from site

(2)No background measurement

TABLE A-19
OU6 Background Comparison Summary of UHSU Groundwater Filtered Radionuclides
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	2	4	1.00	1.00	0.4000	0.4000	0.3217		N	10.068	0	NO(1)	
CESIUM-137	38	12	1.00	1.00	1.0000	0.7636	0.6161		N	2.143	0	NO	
GROSS ALPHA	213	167	1.00	1.00	1.0000	0.0001	0.0001		Y	100.522	0	YES	
GROSS BETA	196	177	1.00	1.00	1.0000	0.0001	0.0001		Y	39.774	4	YES	
PLUTONIUM-239/240	1	4	1.00	1.00	0.8000	0.8000	0.7602		N	0.011	1	YES(1)	
RADIUM-226	36	85	1.00	1.00	0.0001	0.0001	0.0001		Y	0.626	18	YES	
RADIUM-228	6	18	1.00	1.00	0.5543	0.8609	0.9713		N	5.935	1	NO	Not a PCOC by PJ (2)
STRONTIUM-89,90	180	128	1.00	1.00	0.4156	0.0004	0.0007		Y	1.210	4	YES	
TRITIUM	165	0	0.00	0.00									NO site measurement
URANIUM,TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233/234	207	172	1.00	1.00	1.0000	0.0001	0.0001		Y	79.470	0	YES	
URANIUM-235	207	172	1.00	1.00	1.0000	0.0001	0.0001		Y	2.006	2	YES	
URANIUM-238	177	172	1.00	1.00	1.0000	0.0001	0.0001		Y	55.240	0	YES	

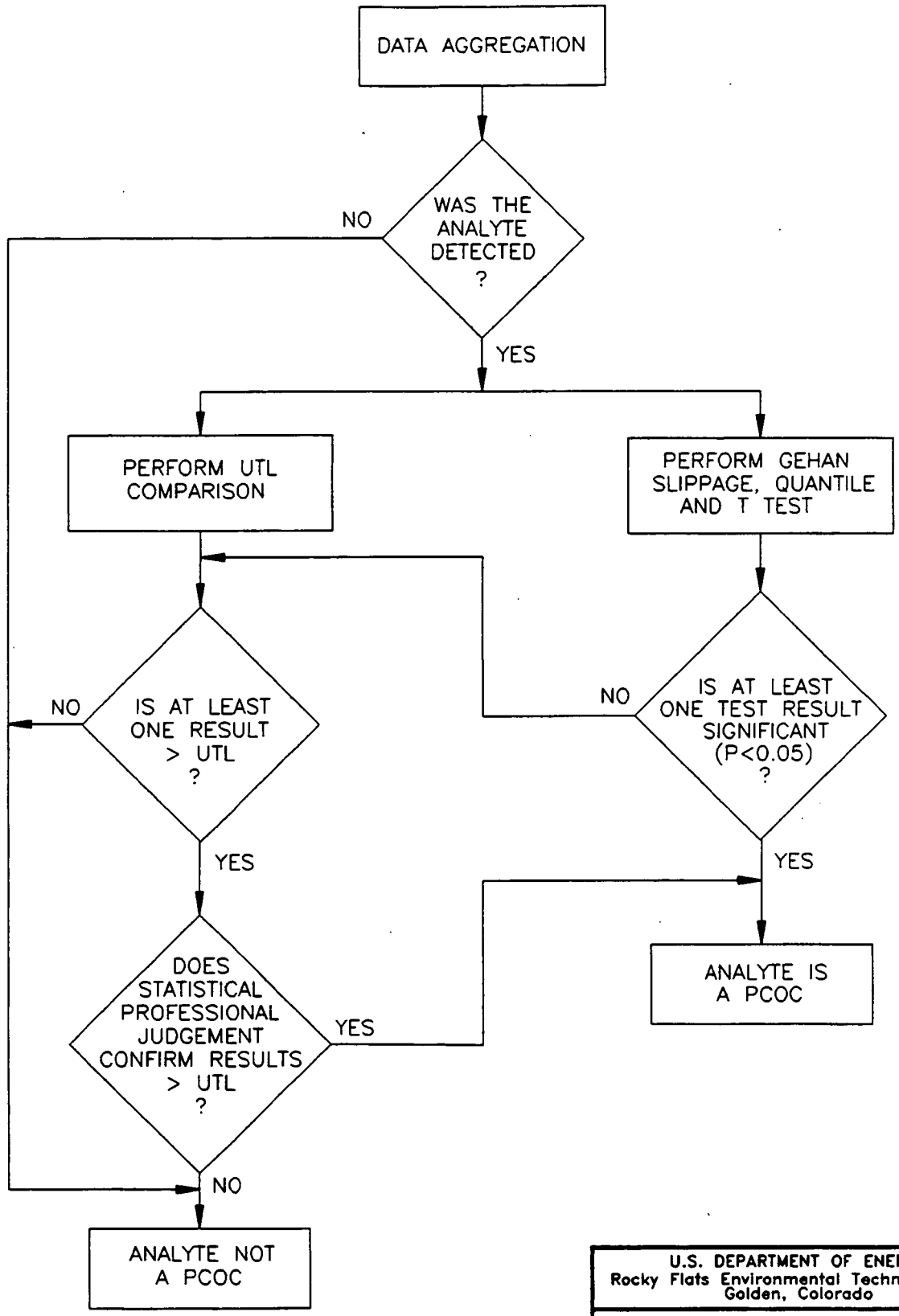
(1) Sample size is too small
(2) Professional judgment based on lognormal UTL comparison

TABLE A-20
OU6 Background Comparison Statistical Test Results of UHSU Groundwater Filtered Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	EAN_B	EAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	2	4	0	0	1.00	1.00	0.011	0.129	0.011	0.228	10.068	0	0.019	0.471	2	0.4000	2	2	0.4000	0.463	1.645	0.3217
CESIUM-137	38	12	0	0	1.00	1.00	0.420	0.348	0.525	0.389	2.143	0	2.600	1.160	0	1.0000	10	2	0.7636	-0.295	1.645	0.6161
GROSS ALPHA	213	167	0	0	1.00	1.00	8.354	16.928	32.315	17.208	100.522	0	312.700	74.490	0	1.0000	76	62	0.0001	9.523	1.645	0.0001
GROSS BETA	196	177	0	0	1.00	1.00	4.892	10.299	12.230	10.858	39.774	4	135.900	90.000	0	1.0000	75	62	0.0001	8.790	1.645	0.0001
PLUTONIUM-239/240	1	4	0	0	1.00	1.00	0.011	0.035		0.067	0.011	1	0.011	0.136	1	0.8000	1	1	0.8000	-0.707	1.645	0.7602
RADIUM-226	36	85	0	0	1.00	1.00	0.258	0.475	0.111	0.225	0.626	18	0.530	1.199	29	0.0001	25	25	0.0001	5.355	1.645	0.0001
RADIUM-228	6	18	0	0	1.00	1.00	2.122	1.614	0.520	1.888	5.935	1	3.000	7.700	2	0.5543	6	4	0.8609	-1.901	1.645	0.9713
STRONTIUM-89,90	180	128	0	0	1.00	1.00	0.338	0.449	0.306	0.359	1.210	4	1.800	1.804	1	0.4156	62	38	0.0004	3.196	1.645	0.0007
TRITIUM(1)	165	0	0	0																		
URANIUM,TOTAL(2)	0	0	0	0																		
URANIUM-233/234	207	172	0	0	1.00	1.00	6.914	12.997	25.439	13.602	79.470	0	199.500	63.000	0	1.0000	76	61	0.0001	9.997	1.645	0.0001
URANIUM-235	207	172	0	0	1.00	1.00	0.195	0.438	0.635	0.491	2.006	2	4.803	2.100	0	1.0000	76	60	0.0001	8.501	1.645	0.0001
URANIUM-238	177	172	0	0	1.00	1.00	4.832	9.395	17.673	9.620	55.240	0	135.600	39.000	0	1.0000	70	61	0.0001	9.916	1.645	0.0001

(1) No site measurement

(2) No background measurement



UTL UPPER TOLERANCE LIMIT OF BACKGROUND DATA (99/99)

PCOC POTENTIAL CHEMICAL OF CONCERN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

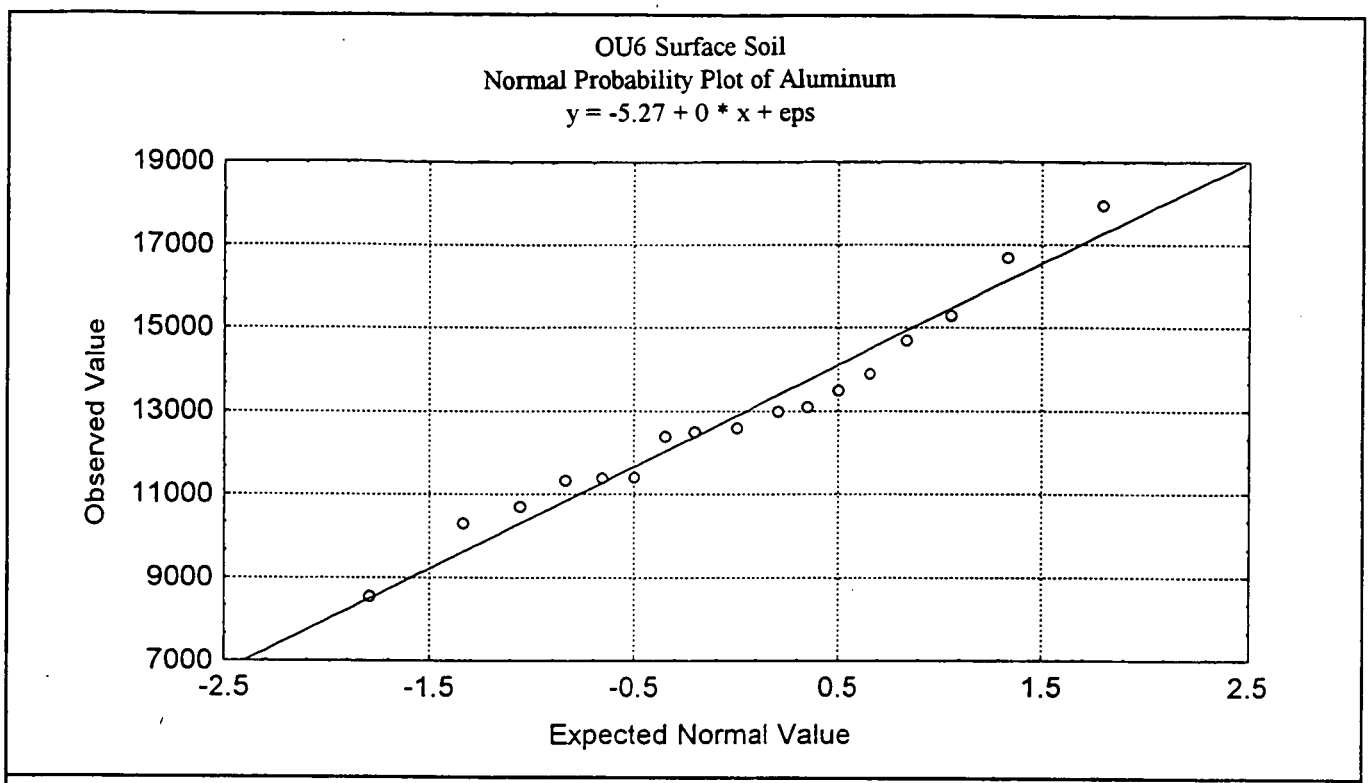
OPERABLE UNIT NO. 6
TECHNICAL MEMORANDUM NO.4

BACKGROUND COMPARISON PROCESS

FIGURE A-1 JULY 1994

OU6TMA1

FIGURE A-2


OU6 Surface Soil
Normal Probability Plot of Aluminum
y = -5.27 + 0 * x + eps
Observed Value
19000
17000
15000
13000
11000
9000
7000
-2.5
-1.5
-0.5
0.5
1.5
2.5
Expected Normal Value

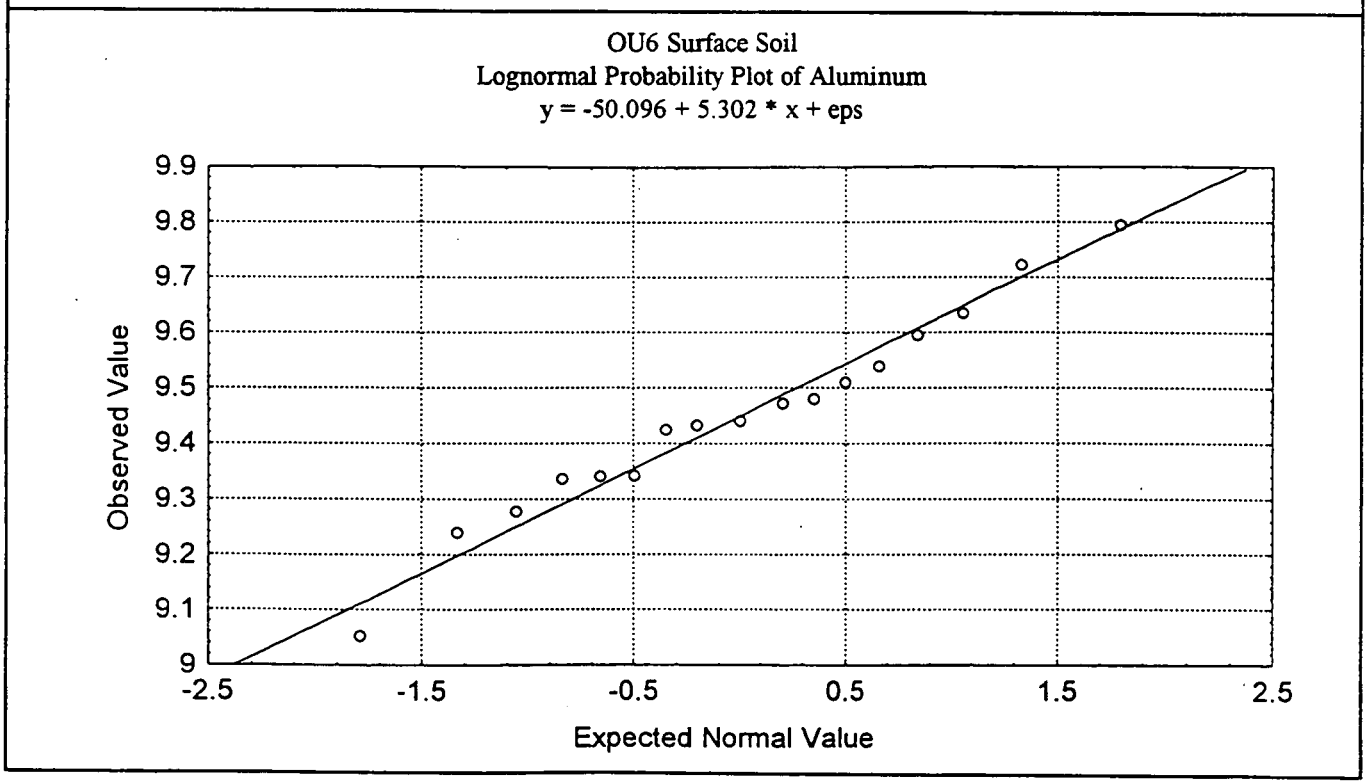

OU6 Surface Soil
Lognormal Probability Plot of Aluminum
y = -50.096 + 5.302 * x + eps
Observed Value
9.9
9.8
9.7
9.6
9.5
9.4
9.3
9.2
9.1
9
-2.5
-1.5
-0.5
0.5
1.5
2.5
Expected Normal Value

FIGURE A-3

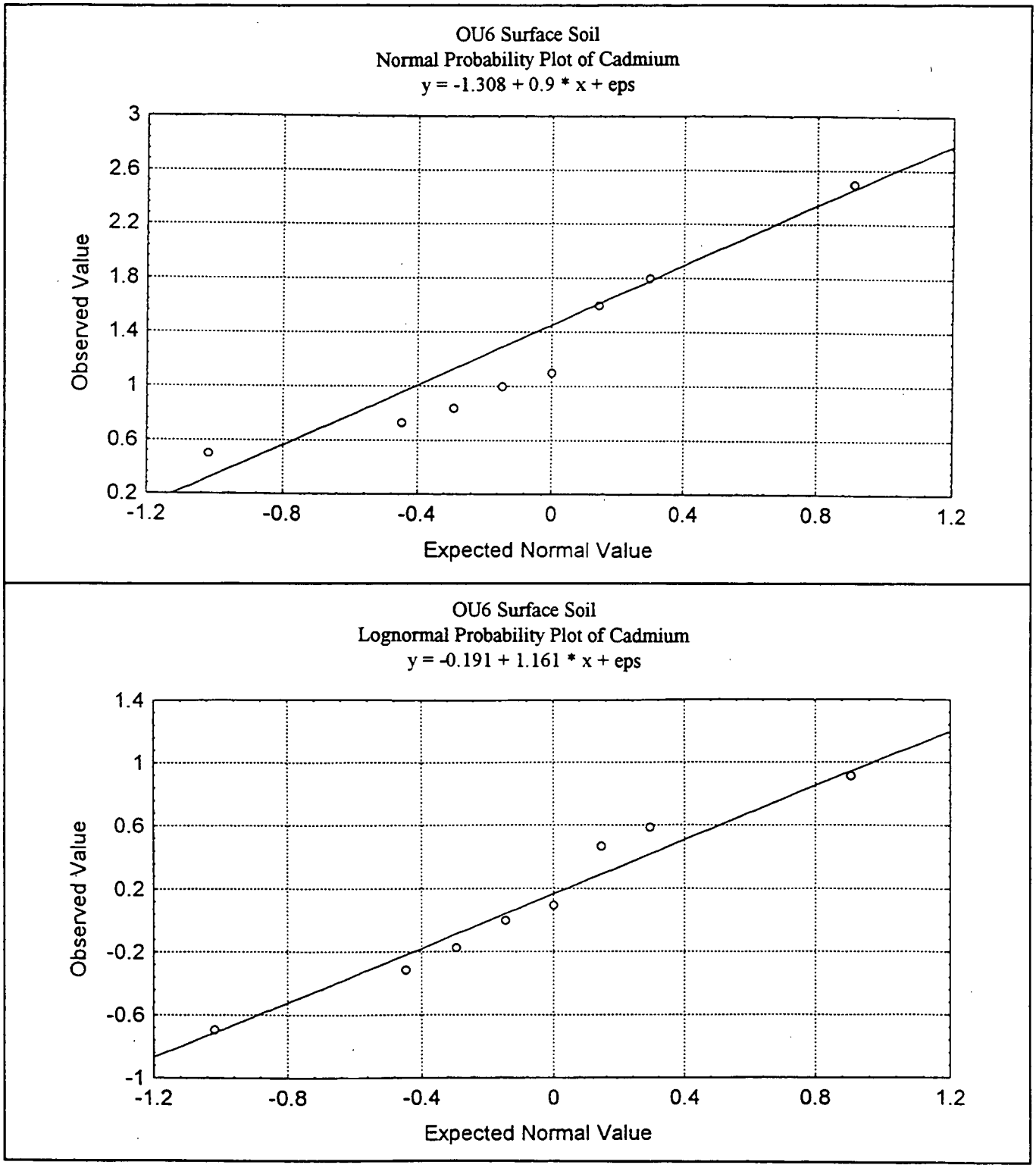
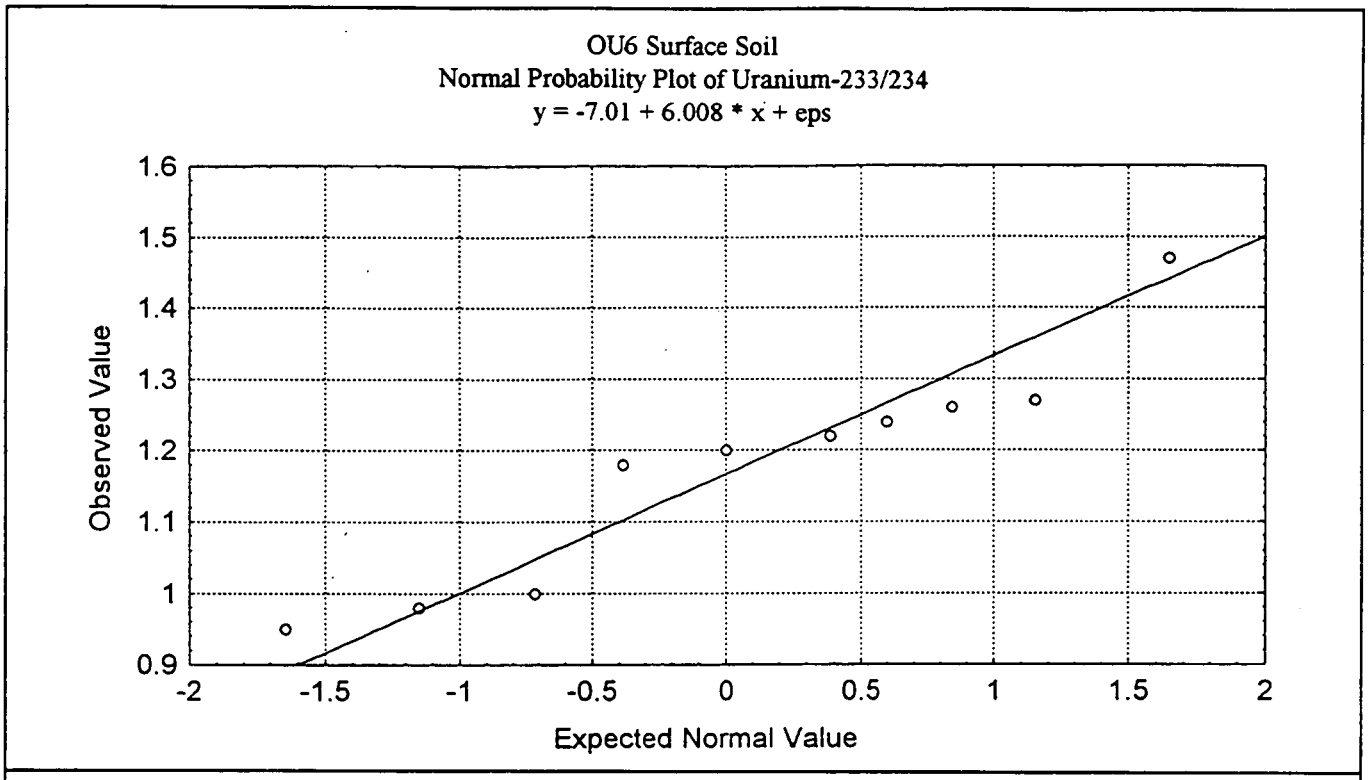

OU6 Surface Soil
Normal Probability Plot of Cadmium
y = -1.308 + 0.9 * x + eps
Observed Value
3
2.6
2.2
1.8
1.4
1
0.6
0.2
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
Expected Normal Value
OU6 Surface Soil
Lognormal Probability Plot of Cadmium
y = -0.191 + 1.161 * x + eps
Observed Value
1.4
1
0.6
0.2
-0.2
-0.6
-1
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
Expected Normal Value

FIGURE A-4


OU6 Surface Soil
Normal Probability Plot of Uranium-233/234
y = -7.01 + 6.008 * x + eps
Observed Value
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Expected Normal Value

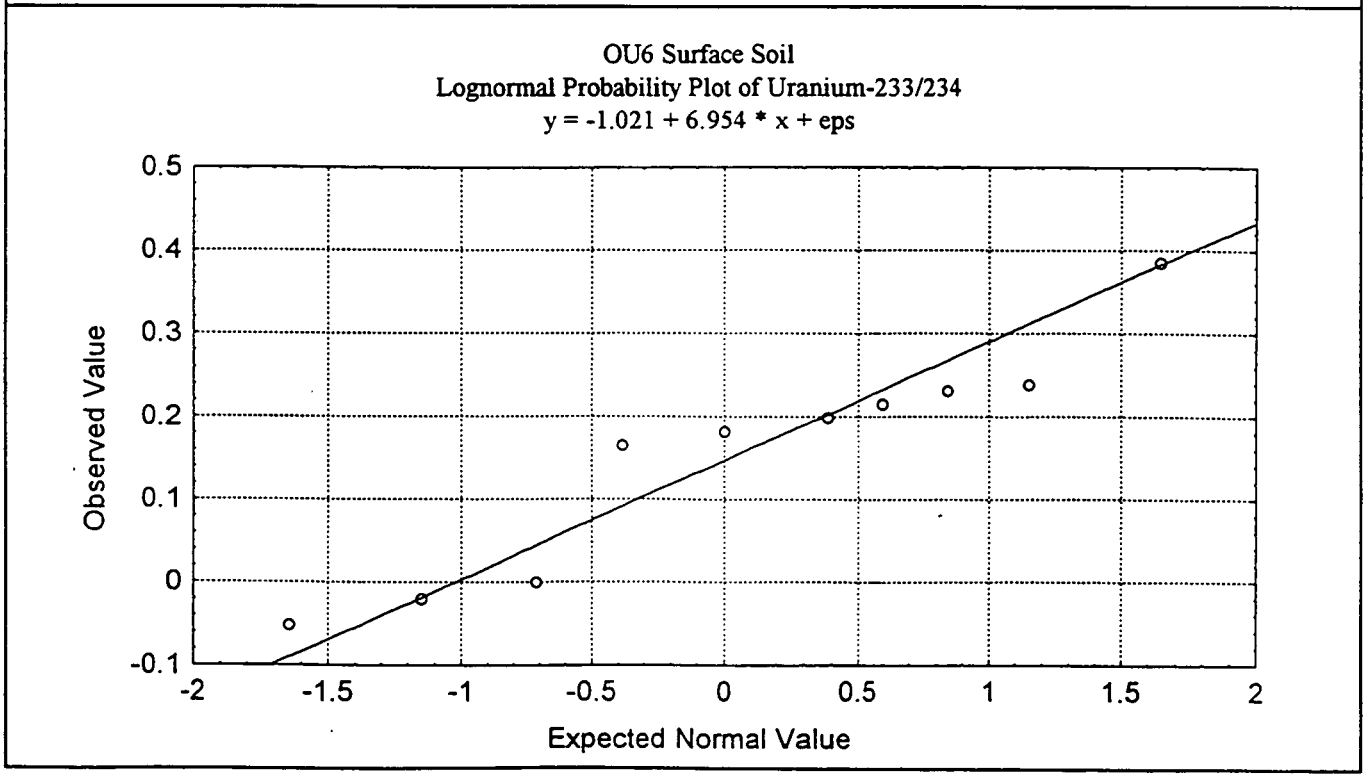

OU6 Surface Soil
Lognormal Probability Plot of Uranium-233/234
y = -1.021 + 6.954 * x + eps
Observed Value
0.5
0.4
0.3
0.2
0.1
0
-0.1
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Expected Normal Value

FIGURE A-5

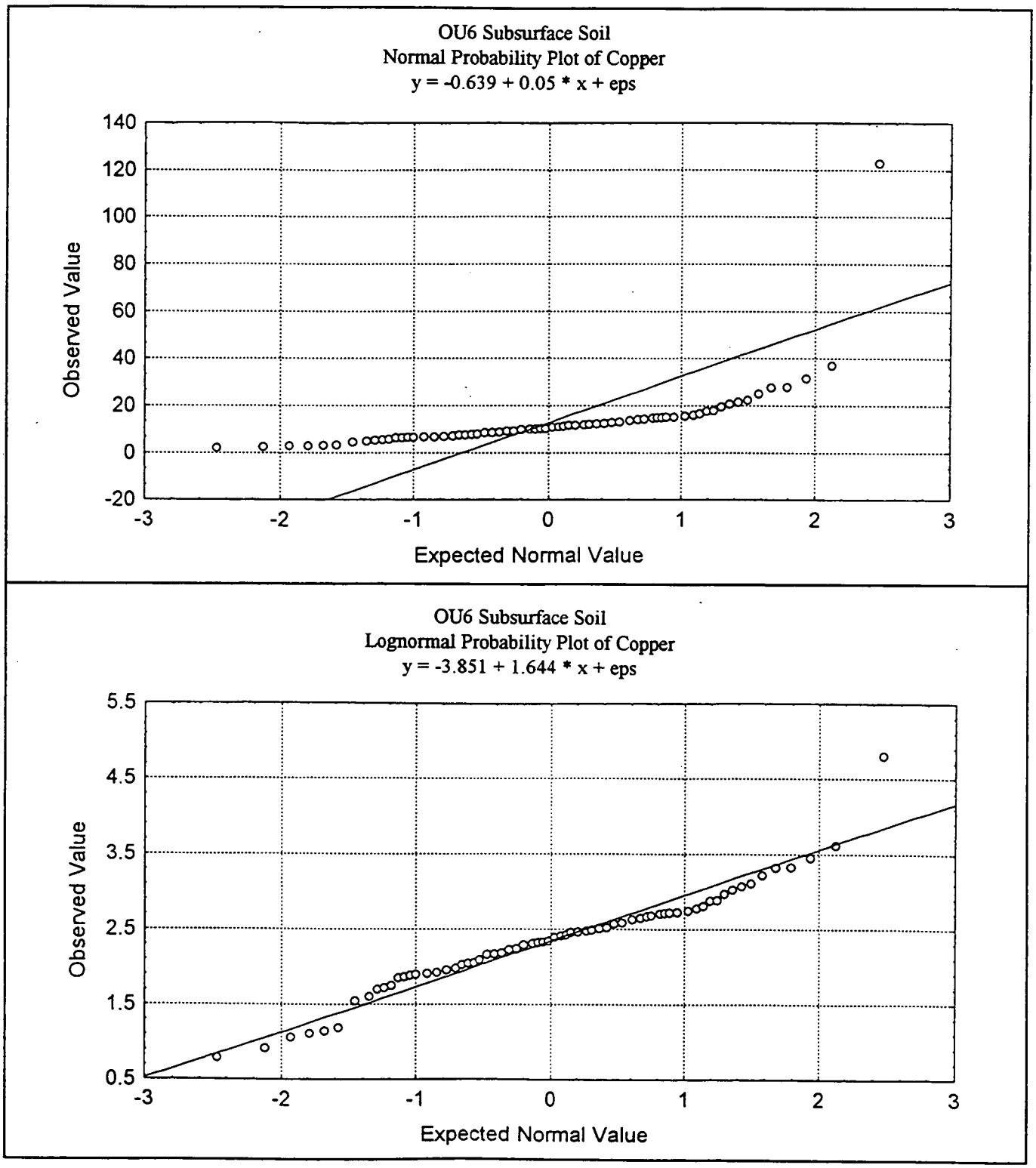

OU6 Subsurface Soil
Normal Probability Plot of Copper
y = -0.639 + 0.05 * x + eps
Observed Value
Expected Normal Value
140
120
100
80
60
40
20
0
-20
-3
-2
-1
0
1
2
3
OU6 Subsurface Soil
Lognormal Probability Plot of Copper
y = -3.851 + 1.644 * x + eps
Observed Value
Expected Normal Value
5.5
4.5
3.5
2.5
1.5
0.5
-3
-2
-1
0
1
2
3

FIGURE A-6

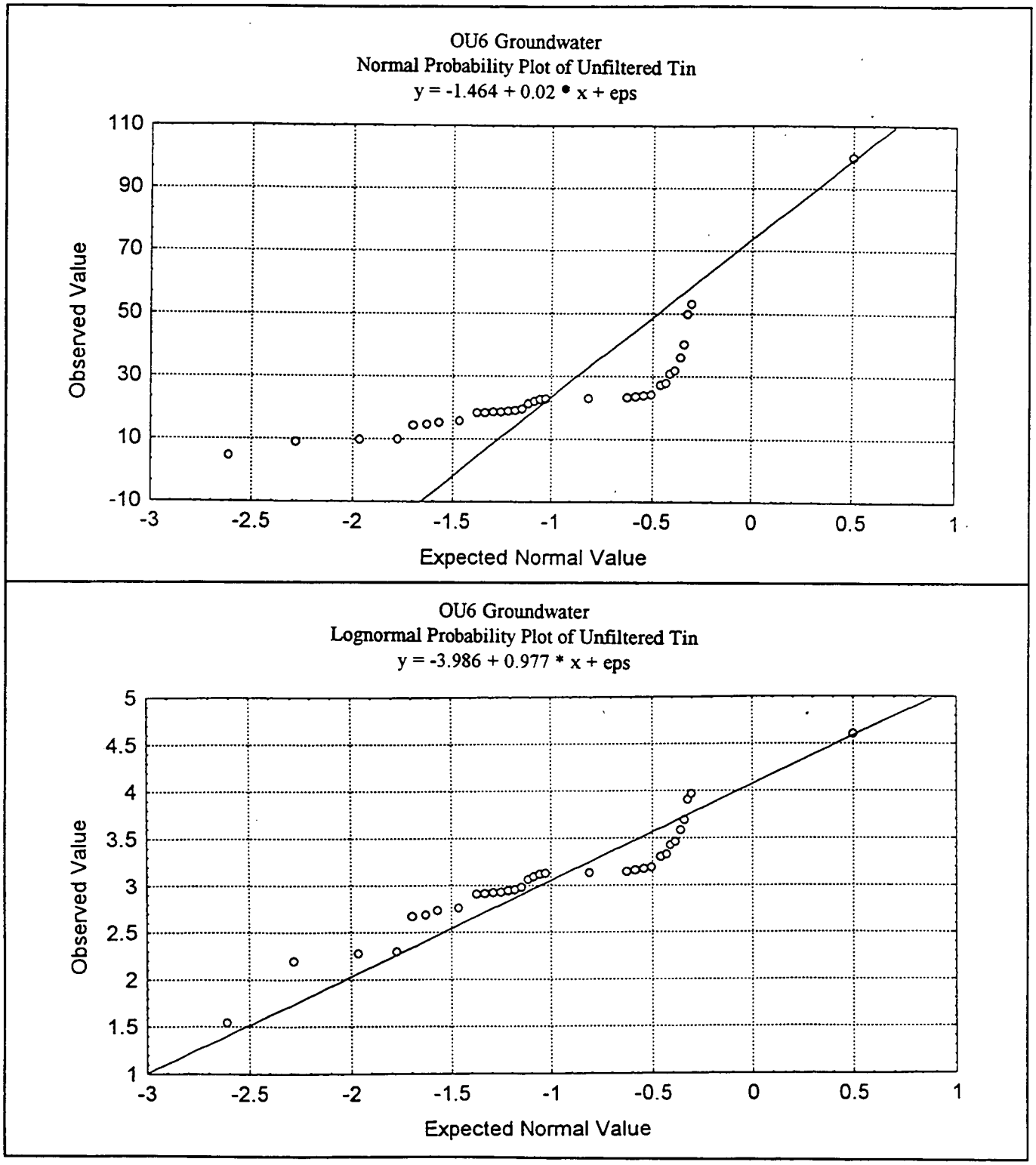

OU6 Groundwater
Normal Probability Plot of Unfiltered Tin
y = -1.464 + 0.02 • x + eps
Observed Value
110
90
70
50
30
10
-10
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
Expected Normal Value
OU6 Groundwater
Lognormal Probability Plot of Unfiltered Tin
y = -3.986 + 0.977 * x + eps
Observed Value
5
4.5
4
3.5
3
2.5
2
1.5
1
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
Expected Normal Value

FIGURE A-7

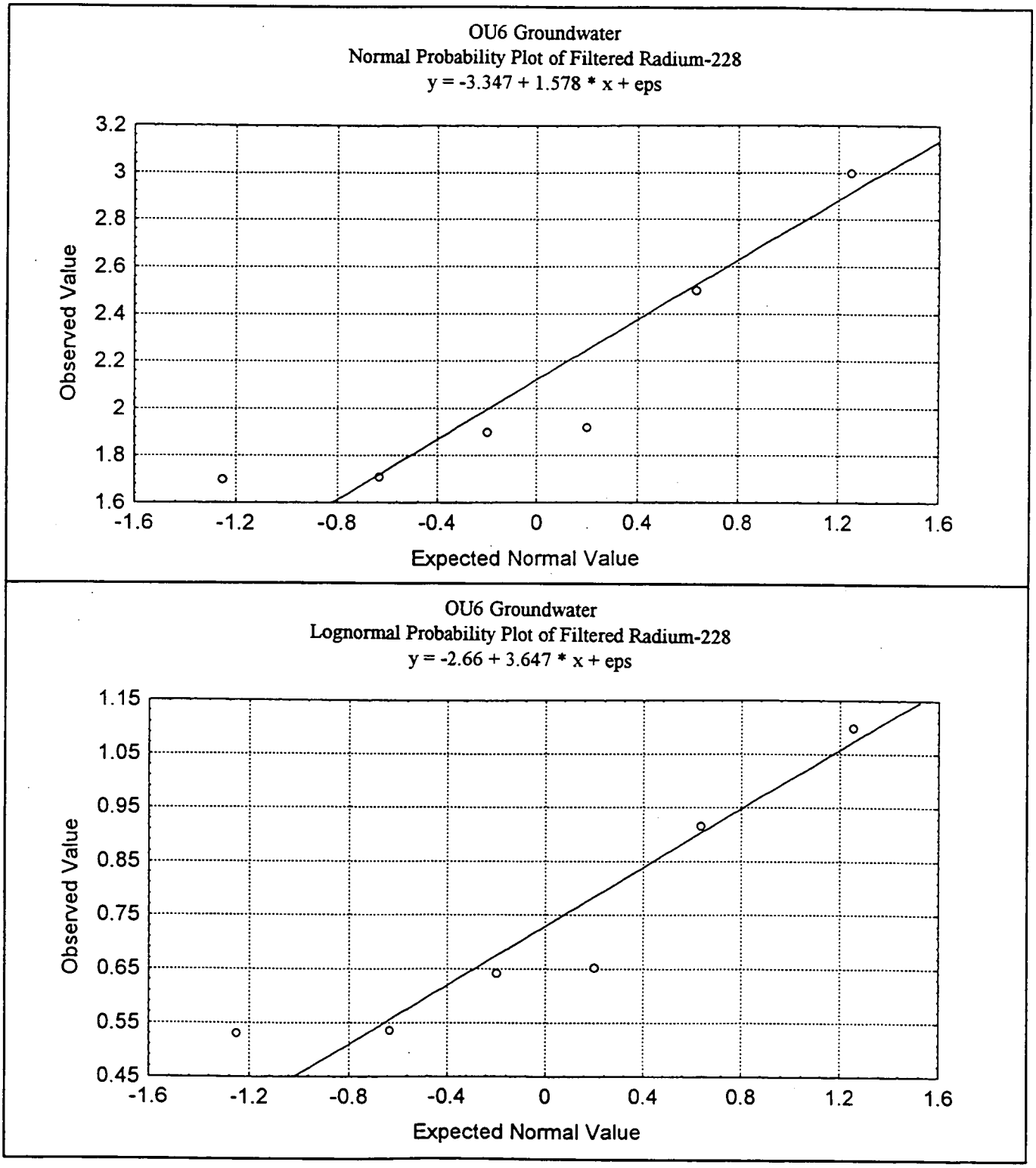

OU6 Groundwater
Normal Probability Plot of Filtered Radium-228
y = -3.347 + 1.578 * x + eps
Observed Value
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
-1.6
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
1.6
Expected Normal Value
OU6 Groundwater
Lognormal Probability Plot of Filtered Radium-228
y = -2.66 + 3.647 * x + eps
Observed Value
1.15
1.05
0.95
0.85
0.75
0.65
0.55
0.45
-1.6
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
1.6
Expected Normal Value

TABLE A-21
OU6 Background Comparison Summary of Pond Sediments Metals
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99_	NGUTL_	PCOC	REMARK
ALUMINUM	20	57	1.00	1.00	0.4000	0.3476	0.1135	0.2025	N	29553.4	0	NO	
ANTIMONY	18	28	0.44	0.39	0.6087		0.3327		N	55.0	1	YES	
ARSENIC	20	57	0.90	1.00	1.0000		0.5749	0.9802	N	66.7	0	NO	
BARIUM	20	57	1.00	1.00	1.0000	0.9300	0.5577	0.8872	N	794.9	0	NO	
BERYLLIUM	16	57	0.81	0.98	0.3629		0.1331		N	5.6	4	NO	Not a PCOC by PJ (1)
CADMIUM	16	56	0.88	0.39	0.6025		0.9911		N	8.8	1	NO	Not a PCOC by PJ (1)
CALCIUM	20	57	1.00	1.00	0.7403	0.9300	0.4400	0.7545	N	80941.3	0	NO	
CESIUM	17	57	1.00	0.93	1.0000		1.0000		N	1259.1	0	NO	
CHROMIUM	18	57	1.00	1.00	0.0377	0.0704	0.0172		Y	31.2	6	YES	
COBALT	19	57	0.95	1.00	1.0000	0.8358	0.0340	0.3018	Y	35.1	0	YES	
COPPER	19	57	1.00	1.00	1.0000	0.6377	0.0047	0.3555	Y	174.7	0	YES	
IRON	19	57	1.00	1.00	1.0000	0.9440	0.0235	0.8936	Y	143862.0	0	YES	
LEAD	19	57	1.00	1.00	1.0000	0.9859	0.7115	0.8849	N	261.1	0	NO	
LITHIUM	18	57	1.00	0.98	1.0000		0.9875		N	106.7	0	NO	
MAGNESIUM	20	57	1.00	1.00	0.0785	0.0365	0.0001	0.0001	Y	6328.5	0	YES	
MANGANESE	20	57	0.70	1.00	1.0000	0.9300	0.0238		Y	1993.1	0	YES	
MERCURY	15	56	1.00	0.43	0.7887	0.9467	0.9994		N	1.7	0	NO	
MOLYBDENUM													NO site measurement
NICKEL	17	56	1.00	0.70	0.7671	0.5169	0.1637		N	44.3	1	NO	Not a PCOC by PJ (1)
POTASSIUM	18	56	1.00	0.89	0.0496	0.0662	0.0008		Y	3872.2	0	YES	
SELENIUM	19	57	0.89	0.05	1.0000		1.0000		N	5.3	0	NO	
SILICON													NO site measurement
SILVER	15	57	0.87	0.39	0.0054	0.0191	0.3114		Y	11.5	19	YES	
SODIUM	20	57	0.85	1.00	1.0000	0.5983	0.0119	0.5326	Y	2610.3	0	YES	
STRONTIUM	20	57	1.00	1.00	1.0000	0.9962	0.8340	0.9479	N	621.7	0	NO	
THALLIUM	13	56	0.69	0.39	1.0000		1.0000		N	13.6	0	NO	
TIN	19	56	0.95	0.02	1.0000		0.9953		N	103.3	0	NO	
VANADIUM	19	57	1.00	1.00	0.7500	0.6377	0.0028	0.0762	Y	83.0	0	YES	
ZINC	20	57	1.00	1.00	0.0001	0.0042	0.0001	0.0001	Y	143.0	19	YES	

(1) Professional judgment based on lognormal UTL comparison.

TABLE A-22

OU6 Background Comparison Statistical Test Results of Pond Sediment Metals

(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	20	57	0	0	1.00	1.00	10354.3	11428.5	5010.7	4909.6	29553.4	0	21600.0	27400.0	3	0.4000	16	13	0.3476	1.208	1.645	0.1135
ANTIMONY	18	28	10	17	0.44	0.39	12.6	16.1	10.7	15.1	55.0	1	60.0	68.5	1	0.6087	999	999	999.0000	0.432	1.645	0.3327
ARSENIC	20	57	2	0	0.90	1.00	12.9	6.0	14.0	1.6	66.7	0	49.2	10.2	0	1.0000	999	999	999.0000	-0.189	1.645	0.5749
BARIUM	20	57	0	0	1.00	1.00	207.9	164.7	153.2	31.7	794.9	0	706.0	254.0	0	1.0000	16	10	0.9300	-0.145	1.645	0.5577
BERYLLIUM	16	57	3	1	0.81	0.98	1.4	1.8	1.0	2.5	5.6	4	5.0	15.2	4	0.3629	999	999	999.0000	1.112	1.645	0.1331
CADMIUM	16	56	2	34	0.88	0.39	2.3	1.7	1.6	2.0	8.8	1	6.1	9.9	2	0.6025	999	999	999.0000	-2.371	1.645	0.9911
CALCIUM	20	57	0	0	1.00	1.00	19407.5	16698.9	16059.6	11030.5	80941.3	0	61000.0	68100.0	1	0.7403	16	10	0.9300	0.151	1.645	0.4400
CESIUM	17	57	0	4	1.00	0.93	341.6	9.6	227.3	25.1	1259.1	0	725.0	5.8	0	1.0000	999	999	999.0000	-6.426	1.645	1.0000
CHROMIUM	18	57	0	0	1.00	1.00	11.2	17.8	5.0	15.3	31.2	6	22.5	96.1	11	0.0377	15	14	0.0704	2.115	1.645	0.0172
COBALT	19	57	1	0	0.95	1.00	9.5	10.3	6.6	1.8	35.1	0	27.3	15.5	0	1.0000	16	11	0.8358	1.825	1.645	0.0340
COPPER	19	57	0	0	1.00	1.00	27.5	30.1	37.8	21.5	174.7	0	178.0	125.0	0	1.0000	16	12	0.6377	2.597	1.645	0.0047
IRON	19	57	0	0	1.00	1.00	25565.8	16540.2	30391.4	3541.4	143861.5	0	112000.0	26500.0	0	1.0000	16	10	0.9440	1.985	1.645	0.0235
LEAD	19	57	0	0	1.00	1.00	47.9	36.4	54.8	27.0	261.1	0	255.0	155.0	0	1.0000	16	9	0.9859	-0.558	1.645	0.7115
LITHIUM	18	57	0	1	1.00	0.98	21.6	8.3	21.5	3.1	106.7	0	70.2	16.6	0	1.0000	999	999	999.0000	-2.240	1.645	0.9875
MAGNESIUM	20	57	0	0	1.00	1.00	2446.8	3536.0	1013.1	846.5	6328.5	0	4730.0	5650.0	8	0.0785	16	15	0.0365	4.235	1.645	0.0001
MANGANESE	20	57	6	0	0.70	1.00	318.0	283.2	437.2	85.6	1993.1	0	1740.0	558.0	0	1.0000	16	10	0.9300	1.981	1.645	0.0238
MERCURY	15	56	0	32	1.00	0.43	0.3	0.2	0.3	0.3	1.7	0	1.3	1.5	1	0.7887	15	10	0.9467	-3.261	1.645	0.9994
MOLYBDENUM(1)																						
NICKEL	17	56	0	17	1.00	0.70	13.9	15.4	7.5	10.0	44.3	1	29.9	58.1	1	0.7671	15	12	0.5169	0.979	1.645	0.1637
POTASSIUM	18	56	0	6	1.00	0.89	1299.8	1924.1	649.5	784.6	3872.2	0	2730.0	3540.0	10	0.0496	15	14	0.0662	3.175	1.645	0.0008
SELENIUM	19	57	2	54	0.89	0.05	1.5	0.5	1.0	0.2	5.3	0	3.5	1.9	0	1.0000	999	999	999.0000	-5.405	1.645	1.0000
SILICON(1)																						
SILVER	15	57	2	35	0.87	0.39	2.7	39.6	2.1	80.9	11.5	19	6.8	345.0	19	0.0054	15	15	0.0191	0.492	1.645	0.3114
SODIUM	20	57	3	0	0.85	1.00	370.6	359.7	584.5	157.9	2610.3	0	2730.0	761.0	0	1.0000	16	12	0.5983	2.260	1.645	0.0119
STRONTIUM	20	57	0	0	1.00	1.00	129.7	80.0	128.4	41.1	621.7	0	546.0	307.0	0	1.0000	16	8	0.9962	-0.970	1.645	0.8340
THALLIUM	13	56	4	34	0.69	0.39	2.0	0.8	2.6	0.2	13.6	0	9.2	0.9	0	1.0000	999	999	999.0000	-4.156	1.645	1.0000
TIN	19	56	1	55	0.95	0.02	27.6	20.3	19.4	2.6	103.3	0	70.2	39.5	0	1.0000	999	999	999.0000	-2.599	1.645	0.9953
VANADIUM	19	57	0	0	1.00	1.00	27.6	32.8	14.2	9.5	83.0	0	61.2	62.7	1	0.7500	16	12	0.6377	2.765	1.645	0.0028
ZINC	20	57	0	0	1.00	1.00	56.1	165.8	22.7	181.1	143.0	19	112.0	1270.0	30	0.0001	16	16	0.0042	5.321	1.645	0.0001

(1) No site measurement

TABLE A-23
OU6 Background Comparison Summary of Pond Sediment Radionuclides
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	14	55	1.00	1.00	0.0001	0.0282	0.0001		Y	1.472	29	YES	
CESIUM-137	13	57	1.00	1.00	0.8143	0.9827	0.9960		N	3.510	0	NO	
GROSS ALPHA	15	57	1.00	1.00	0.0054	0.0191	0.0012		Y	78.829	10	YES	
GROSS BETA	14	57	1.00	1.00	0.0552	0.3854	0.0005		Y	45.966	4	YES	
PLUTONIUM-239/240	16	50	1.00	1.00	0.0012	0.0121	0.0001		Y	7.678	19	YES	
RADIUM-226	9	9	1.00	1.00	1.0000	0.2882	0.0121		Y	1.973	0	YES	
RADIUM-228	9	9	1.00	1.00	0.0147	0.0412	0.0035		Y	2.884	0	YES	
STRONTIUM-89,90	14	25	1.00	1.00	0.6410	0.7033	0.0188		Y	2.649	0	YES	
TRITIUM (1)	13	50	1.00	1.00	0.3014	0.1847	0.7777		N	769.750	3	NO	Not a PCOC by PJ (2)
URANIUM,TOTAL	0	0	0.00	0.00									NO HIT
URANIUM-233/234	16	56	1.00	1.00	0.0001	0.0141	0.0001		Y	2.389	13	YES	
URANIUM-235	17	56	1.00	1.00	0.0573	0.0790	0.0004		Y	0.248	10	YES	
URANIUM-238	14	56	1.00	1.00	0.0004	0.0300	0.0001		Y	2.540	13	YES	

(1) Concentration Unit: pCi/L
(2) Professional judgment based on lognormal UTL comparison.

TABLE A-24
OU6 Background Comparison Statistical Test Results of Pond Sediment Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	14	55	0	0	1.00	1.00	0.127	23.184	0.307	63.598	1.472	29	1.072	389.400	30	0.0001	14	14	0.0282	4.864	1.645	0.0001
CESIUM-137	13	57	0	0	1.00	1.00	0.812	0.447	0.603	0.512	3.510	0	2.300	2.810	1	0.8143	14	9	0.9827	-2.651	1.645	0.9960
GROSS ALPHA	15	57	0	0	1.00	1.00	19.709	106.743	14.002	261.135	78.829	10	47.600	1735.000	19	0.0054	15	15	0.0191	3.030	1.645	0.0012
GROSS BETA	14	57	0	0	1.00	1.00	23.728	31.807	5.080	12.186	45.966	4	32.500	98.170	12	0.0552	15	13	0.3854	3.281	1.645	0.0005
PLUTONIUM-239/240	16	50	0	0	1.00	1.00	0.613	16.252	1.713	32.798	7.678	19	6.667	180.200	20	0.0012	14	14	0.0121	4.893	1.645	0.0001
RADIUM-226	9	9	0	0	1.00	1.00	0.705	0.879	0.235	0.086	1.973	0	1.100	1.016	0	1.0000	4	3	0.2882	2.253	1.645	0.0121
RADIUM-228	9	9	0	0	1.00	1.00	1.179	1.622	0.316	0.147	2.884	0	1.600	1.835	5	0.0147	4	4	0.0412	2.693	1.645	0.0035
STRONTIUM-89,90	14	25	0	0	1.00	1.00	0.353	0.446	0.525	0.441	2.649	0	1.727	1.800	1	0.6410	8	5	0.7033	2.079	1.645	0.0188
TRITIUM	13	50	0	0	1.00	1.00	198.538	220.083	127.731	325.297	769.750	3	540.000	1729.000	5	0.3014	13	12	0.1847	-0.764	1.645	0.7777
URANIUM,TOTAL(1)	0	0	0	0																		
URANIUM-233/234	16	56	0	0	1.00	1.00	0.822	3.232	0.380	4.618	2.389	13	1.427	25.220	34	0.0001	15	15	0.0141	4.727	1.645	0.0001
URANIUM-235	17	56	0	0	1.00	1.00	0.039	0.153	0.052	0.250	0.248	10	0.212	1.302	10	0.0573	15	14	0.0790	3.328	1.645	0.0004
URANIUM-238	14	56	0	0	1.00	1.00	0.733	4.331	0.413	7.736	2.540	13	1.610	43.090	27	0.0004	14	14	0.0300	5.066	1.645	0.0001

(1) No Background measurement

TABLE A-25
OU6 Background Comparison Summary of Pond Surface Water Unfiltered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	IGNIFICT	UTL99_	NGUTL_	PCOC	REMARK
ALUMINUM	44	49	0.91	0.98	1.0000	1.0000	1.0000	0.9937	N	176057.0	0	NO	
ANTIMONY	30	51	0.37	0.06	1.0000		0.9952		N	448.7	0	NO	
ARSENIC	40	51	0.65	0.41	1.0000		0.9996		N	727.5	0	NO	
BARIUM	40	51	0.83	1.00	1.0000	1.0000	1.0000	0.9992	N	6697.9	0	NO	
BERYLLIUM	34	51	0.38	0.04	1.0000		0.9983		N	14.6	0	NO	
CADMIUM	29	51	0.34	0.22	1.0000		1.0000		N	73.2	0	NO	
CALCIUM	48	51	1.00	1.00	1.0000	1.0000	1.0000	0.9997	N	521669.0	0	NO	
CESIUM	29	51	0.28	0.12	1.0000		0.9735		N	1942.1	0	NO	
CHROMIUM	36	51	0.44	0.16	1.0000		1.0000		N	196.6	0	NO	
COBALT	31	51	0.39	0.35	1.0000		0.9999		N	375.2	0	NO	
COPPER	40	47	0.58	0.19	1.0000		1.0000		N	385.9	0	NO	
IRON	46	51	0.98	1.00	1.0000	1.0000	1.0000	0.9900	N	1915387.0	0	NO	
LEAD	41	50	0.71	0.78	1.0000	1.0000	0.9995		N	796.4	0	NO	
LITHIUM	31	51	0.55	1.00	1.0000		0.8200		N	125.0	0	NO	
MAGNESIUM	46	51	0.87	1.00	1.0000	0.0657	0.0655	0.0188	Y	35266.9	0	YES	
MANGANESE	47	51	0.87	1.00	1.0000	0.9756	0.3282	0.9898	N	18404.9	0	NO	
MERCURY	29	51	0.21	0.33	1.0000	0.5002	0.3482		N	1.1	0	NO	
MOLYBDENUM	29	51	0.31	0.75	1.0000		0.9538		N	197.2	0	NO	
NICKEL	31	51	0.42	0.47	1.0000		1.0000		N	476.0	0	NO	
POTASSIUM	37	51	0.54	1.00	1.0000	0.0478	0.0002		Y	13719.0	0	YES	
SELENIUM	32	49	0.38	0.22	1.0000		0.9575		N	16.6	0	NO	
SILICON	11	51	1.00	1.00	1.0000	1.0000	1.0000		N	23029.6	0	NO	
SILVER	28	47	0.36	0.06	1.0000		0.9996		N	107.1	0	NO	
SODIUM	48	51	0.98	1.00	0.0001	0.0001	0.0001	0.0001	Y	27145.6	30	YES	
STRONTIUM	37	51	0.70	1.00	1.0000		0.9900		N	2167.9	0	NO	
THALLIUM	35	51	0.11	0.00									NO HIT
TIN	31	51	0.42	0.20	1.0000		0.9996		N	794.7	0	NO	
VANADIUM	37	51	0.57	0.49	1.0000		1.0000		N	1096.5	0	NO	
ZINC	46	51	0.89	0.76	1.0000	1.0000	1.0000		N	1625.9	0	NO	

TABLE A-26

OU6 Background Comparison Statistical Test Results of Pond Surface Water Unfiltered Metals

(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)

(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	44	49	4	1	0.91	0.98	19493.4	259.2	49035.1	219.6	176057.0	0	293000.0	1020.0	0	1.000	19	0	1.0000	-4.890	1.645	1.0000
ANTIMONY	30	51	19	48	0.37	0.06	52.5	29.4	114.9	2.6	448.7	0	643.0	20.5	0	1.000	999	999	999.0000	-2.588	1.645	0.9952
ARSENIC	40	51	14	30	0.65	0.41	76.3	4.7	200.5	0.8	727.5	0	1030.0	6.6	0	1.000	999	999	999.0000	-3.331	1.645	0.9996
BARIUM	40	51	7	0	0.83	1.00	993.7	47.5	1755.9	27.1	6697.9	0	7070.0	120.0	0	1.000	19	0	1.0000	-5.974	1.645	1.0000
BERYLLIUM	34	51	21	49	0.38	0.04	3.2	2.4	3.4	0.4	14.6	0	14.0	0.3	0	1.000	999	999	999.0000	-2.930	1.645	0.9983
CADMIUM	29	51	19	40	0.34	0.22	10.2	2.3	18.1	0.3	73.2	0	68.4	2.2	0	1.000	999	999	999.0000	-3.925	1.645	1.0000
CALCIUM	48	51	0	0	1.00	1.00	101452.1	31122.5	133216.0	14175.5	521669.0	0	803000.0	83600.0	0	1.000	20	3	1.0000	-6.438	1.645	1.0000
CESIUM	29	51	21	45	0.28	0.12	445.9	447.3	430.8	145.9	1942.1	0	2530.0	60.0	0	1.000	999	999	999.0000	-1.935	1.645	0.9735
CHROMIUM	36	51	20	43	0.44	0.16	26.1	4.7	51.4	0.6	196.6	0	275.0	4.3	0	1.000	999	999	999.0000	-4.862	1.645	1.0000
COBALT	31	51	19	33	0.39	0.35	49.5	16.9	95.2	11.0	375.2	0	489.0	3.6	0	1.000	999	999	999.0000	-3.879	1.645	0.9999
COPPER	40	47	17	38	0.58	0.19	47.9	10.7	104.0	3.7	385.9	0	607.0	4.7	0	1.000	999	999	999.0000	-4.301	1.645	1.0000
IRON	46	51	1	0	0.98	1.00	193560.4	303.3	543454.0	250.3	1915387.0	0	3220000.0	1210.0	0	1.000	20	0	1.0000	-5.788	1.645	1.0000
LEAD	41	50	12	11	0.71	0.78	99.5	3.5	215.5	2.5	796.4	0	950.0	15.8	0	1.000	19	1	1.0000	-3.279	1.645	0.9995
LITHIUM	31	51	14	0	0.55	1.00	35.2	19.1	26.2	15.5	125.0	0	140.0	54.5	0	1.000	999	999	999.0000	-0.915	1.645	0.8200
MAGNESIUM	46	51	6	0	0.87	1.00	10943.0	14360.1	7677.2	8272.6	35266.9	0	30300.0	27500.0	0	1.000	20	14	0.0657	1.510	1.645	0.0655
MANGANESE	47	51	6	0	0.87	1.00	1940.6	112.0	5215.5	84.5	18404.9	0	27700.0	293.0	0	1.000	20	7	0.9756	0.445	1.645	0.3282
MERCURY	29	51	23	34	0.21	0.33	0.2	0.2	0.3	0.2	1.1	0	1.3	1.0	0	1.000	18	12	0.5002	0.390	1.645	0.3482
MOLYBDENU	29	51	20	13	0.31	0.75	41.6	29.4	44.8	41.8	197.2	0	203.0	17.6	0	1.000	999	999	999.0000	-1.682	1.645	0.9538
NICKEL	31	51	18	27	0.42	0.47	57.0	12.4	122.5	8.2	476.0	0	646.0	6.3	0	1.000	999	999	999.0000	-4.237	1.645	1.0000
POTASSIUM	37	51	17	0	0.54	1.00	3764.9	6120.2	3018.7	2804.2	13719.0	0	13500.0	11200.0	0	1.000	18	14	0.0478	3.494	1.645	0.0002
SELENIUM	32	49	20	38	0.38	0.22	3.7	2.9	3.8	1.0	16.6	0	16.5	8.3	0	1.000	999	999	999.0000	-1.722	1.645	0.9575
SILICON	11	51	0	0	1.00	1.00	8408.2	2897.6	3027.8	1934.0	23029.6	0	12700.0	6880.0	0	1.000	13	3	1.0000	-4.524	1.645	1.0000
SILVER	28	47	18	44	0.36	0.06	11.5	4.8	27.3	0.6	107.1	0	148.0	2.7	0	1.000	999	999	999.0000	-3.379	1.645	0.9996
SODIUM	48	51	1	0	0.98	1.00	12565.0	61372.5	4622.3	53891.2	27145.6	30	26100.0	178000.0	34	0.000	20	20	0.0001	8.388	1.645	0.0001
STRONTIUM	37	51	11	0	0.70	1.00	531.2	239.3	496.3	81.5	2167.9	0	2100.0	568.0	0	1.000	999	999	999.0000	-2.327	1.645	0.9900
THALLIUM(1)	35	51	31	51	0.11	0.00																
TIN	31	51	18	41	0.42	0.20	108.9	82.1	200.4	36.6	794.7	0	969.0	11.9	0	1.000	999	999	999.0000	-3.348	1.645	0.9996
VANADIUM	37	51	16	26	0.57	0.49	128.9	14.6	293.4	10.8	1096.5	0	1650.0	5.6	0	1.000	999	999	999.0000	-4.593	1.645	1.0000
ZINC	46	51	5	12	0.89	0.76	209.4	15.6	447.1	12.2	1625.9	0	2680.0	74.8	0	1.000	20	1	1.0000	-5.351	1.645	1.0000

(1) No detect record from site

TABLE A-27
OU6 Background Comparison t-Test Results of Pond Surface Water Unfiltered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	MEAN_B	MEAN_S	STD_B	STD_S	F_CAL	F_TAB	DF_	T_CAL	T_1_95	P_T_1	REMARK
ALUMINUM	44	49	4	1	19493.4	259.2	49035.1	219.6	18.7	3.9	43	-2.602	1.68	0.9937	
ANTIMONY	30	51	19	48	52.5	29.4	114.9	2.6							NNDT more than 20%
ARSENIC	40	51	14	30	76.3	4.7	200.5	0.8							NNDT more than 20%
BARIUM	40	51	7	0	993.7	47.5	1755.9	27.1	52.5	4.0	39	-3.408	1.69	0.9992	
BERYLLIUM	34	51	21	49	3.2	2.4	3.4	0.4							NNDT more than 20%
CADMIUM	29	51	19	40	10.2	2.3	18.1	0.3							NNDT more than 20%
CALCIUM	48	51	0	0	101452.1	31122.5	133216.1	14175.5	22.2	3.9	48	-3.638	1.68	0.9997	
CESIUM	29	51	21	45	445.9	447.3	430.8	145.9							NNDT more than 20%
CHROMIUM	36	51	20	43	26.1	4.7	51.4	0.6							NNDT more than 20%
COBALT	31	51	19	33	49.5	16.9	95.2	11.0							NNDT more than 20%
COPPER	40	47	17	38	47.9	10.7	104.0	3.7							NNDT more than 20%
IRON	46	51	1	0	193560.4	303.3	543454.4	250.3	22.7	3.9	45	-2.412	1.68	0.9900	
LEAD	41	50	12	11	99.5	3.5	215.5	2.5							NNDT more than 20%
LITHIUM	31	51	14	0	35.2	19.1	26.2	15.5							NNDT more than 20%
MAGNESIUM	46	51	6	0	10943.0	14360.1	7677.2	8272.6	6.0	3.9	95	2.110	1.66	0.0188	
MANGANESE	47	51	6	0	1940.6	112.0	5215.5	84.5	23.2	3.9	46	-2.403	1.68	0.9898	
MERCURY	29	51	23	34	0.2	0.2	0.3	0.2							NNDT more than 20%
MOLYBDENUM	29	51	20	13	41.6	29.4	44.8	41.8							NNDT more than 20%
NICKEL	31	51	18	27	57.0	12.4	122.5	8.2							NNDT more than 20%
POTASSIUM	37	51	17	0	3764.9	6120.2	3018.7	2804.2							NNDT more than 20%
SELENIUM	32	49	20	38	3.7	2.9	3.8	1.0							NNDT more than 20%
SILICON	11	51	0	0	8408.2	2897.6	3027.8	1934.0							
SILVER	28	47	18	44	11.5	4.8	27.3	0.6							NNDT more than 20%
SODIUM	48	51	1	0	12565.0	61372.5	4622.3	53891.2	60.4	3.9	51	6.443	1.68	0.0001	
STRONTIUM	37	51	11	0	531.2	239.3	496.3	81.5							NNDT more than 20%
THALLIUM	35	51	31	51	4.0	5.0	1.7	0.0							NNDT more than 20%
TIN	31	51	18	41	108.9	82.1	200.4	36.6							NNDT more than 20%
VANADIUM	37	51	16	26	128.9	14.6	293.4	10.8							NNDT more than 20%
ZINC	46	51	5	12	209.4	15.6	447.1	12.2							NNDT more than 20%

NNDT = Number of non-detects

TABLE A-28
OU6 Background Comparison Summary of Pond Surface Water Filtered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99_	NGUTL_	PCOC	REMARK
ALUMINUM	42	48	0.26	0.67	1.0000		0.6986		N	185.1	0	NO	
ANTIMONY	29	51	0.31	0.18	1.0000		0.9963		N	123.9	0	NO	
ARSENIC	34	51	0.18	0.37	1.0000		0.1529		N	18.0	0	NO	
BARIUM	46	51	0.43	1.00	1.0000		1.0000		N	188.6	0	NO	
BERYLLIUM	21	51	0.00	0.06	1.0000		0.5000		N	5.0	0	NO	
CADMIUM	26	51	0.00	0.10	1.0000		0.5000		N	5.0	0	NO	
CALCIUM	49	51	1.00	1.00	1.0000	1.0000	1.0000	0.9997	N	159463.0	0	NO	
CESIUM	30	51	0.13	0.18	1.0000		0.9959		N	2500.0	0	NO	
CHROMIUM	27	51	0.07	0.08	1.0000		0.8954		N	14.8	0	NO	
COBALT	30	51	0.07	0.33	1.0000		0.8347		N	50.0	0	NO	
COPPER	40	44	0.25	0.02	1.0000		0.8546		N	26.0	0	NO	
IRON	48	50	0.71	0.96	1.0000	1.0000	1.0000		N	14947.5	0	NO	
LEAD	41	50	0.22	0.46	0.5495		0.0143		Y	4.7	2	YES	
LITHIUM	42	51	0.33	1.00	1.0000		0.3195		N	96.2	0	NO	
MAGNESIUM	46	51	0.74	1.00	0.0721	0.0001	0.0001		Y	23399.8	14	YES	
MANGANESE	43	51	0.88	1.00	1.0000	0.9968	0.6805	0.9943	N	728.6	0	NO	
MERCURY	22	51	0.27	0.22	1.0000		0.9575		N	4.4	0	NO	
MOLYBDENUM	33	51	0.21	0.69	1.0000		0.8586		N	213.8	0	NO	
NICKEL	23	51	0.13	0.53	1.0000		0.9178		N	40.0	0	NO	
POTASSIUM	38	51	0.42	1.00	0.0001	0.0001	0.0001		Y	6911.4	28	YES	
SELENIUM	27	48	0.19	0.15	1.0000		0.8495		N	19.0	0	NO	
SILICON	0	51		1.00									NO BKGD measurement
SILVER	31	50	0.16	0.02	1.0000		0.8868		N	12.5	0	NO	
SODIUM	49	51	1.00	1.00	0.0001	0.0001	0.0001	0.0001	Y	29793.3	28	YES	
STRONTIUM	44	51	0.80	1.00	1.0000	1.0000	0.9745		N	1763.4	0	NO	
THALLIUM	26	51	0.04	0.00									NO HIT
TIN	35	51	0.17	0.16	1.0000		0.9964		N	200.0	0	NO	
VANADIUM	37	51	0.16	0.45	1.0000		0.9821		N	50.0	0	NO	
ZINC	45	51	0.47	0.55	1.0000		0.8665		N	82.9	0	NO	

TABLE A-29
OU6 Background Comparison Statistical Test Results of Pond Surface Water Filtered Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	42	48	31	16	0.26	0.67	77.5	53.9	33.4	38.0	185.1	0	200.0	154.0	0	1.000	999	999	999.0000	-0.520	1.645	0.6986
ANTIMONY	29	51	20	42	0.31	0.18	35.5	27.8	25.5	4.7	123.9	0	104.0	20.3	0	1.000	999	999	999.0000	-2.675	1.645	0.9963
ARSENIC	34	51	28	32	0.18	0.37	4.7	4.8	2.8	0.9	18.0	0	18.0	7.4	0	1.000	999	999	999.0000	1.024	1.645	0.1529
BARIUM	46	51	26	0	0.43	1.00	97.7	43.9	28.7	25.4	188.6	0	211.0	125.0	0	1.000	999	999	999.0000	-4.148	1.645	1.0000
BERYLLIUM	21	51	21	48	0.00	0.06	2.3	2.4	0.6	0.5	5.0	0	5.0	0.3	0	1.000	999	999	999.0000	0.000	1.645	0.5000
CADMIUM	26	51	26	46	0.00	0.10	2.4	2.4	0.3	0.2	5.0	0	5.0	2.2	0	1.000	999	999	999.0000	0.000	1.645	0.5000
CALCIUM	49	51	0	0	1.00	1.00	50869.4	31813.7	34547.7	14541.1	159463.0	0	216000.0	86600.0	0	1.000	20	3	1.0000	-4.651	1.645	1.0000
CESIUM	30	51	26	42	0.13	0.18	750.0	423.7	701.0	166.6	2500.0	0	2500.0	120.0	0	1.000	999	999	999.0000	-2.646	1.645	0.9959
CHROMIUM	27	51	25	47	0.07	0.08	5.0	4.9	2.2	0.5	14.8	0	14.8	3.4	0	1.000	999	999	999.0000	-1.256	1.645	0.8954
COBALT	30	51	28	34	0.07	0.33	22.3	17.4	7.2	10.9	50.0	0	50.0	4.1	0	1.000	999	999	999.0000	-0.973	1.645	0.8347
COPPER	40	44	30	43	0.25	0.02	11.3	12.3	4.5	1.3	26.0	0	27.8	3.7	0	1.000	999	999	999.0000	-1.056	1.645	0.8546
IRON	48	50	14	2	0.71	0.96	1974.3	44.3	4112.7	106.6	14947.5	0	16700.0	765.0	0	1.000	20	1	1.0000	-6.083	1.645	1.0000
LEAD	41	50	32	27	0.22	0.46	2.1	2.2	0.8	1.1	4.7	2	5.4	6.5	1	0.550	999	999	999.0000	2.188	1.645	0.0143
LITHIUM	42	51	28	0	0.33	1.00	37.5	19.2	18.2	16.0	96.2	0	100.0	57.3	0	1.000	999	999	999.0000	0.469	1.645	0.3195
MAGNESIUM	46	51	12	0	0.74	1.00	7202.0	14718.8	5112.5	8523.8	23399.8	14	27400.0	29500.0	4	0.072	20	18	0.0001	4.608	1.645	0.0001
MANGANESE	43	51	5	0	0.88	1.00	130.8	53.3	186.5	55.8	728.6	0	760.0	262.0	0	1.000	20	6	0.9968	-0.469	1.645	0.6805
MERCURY	22	51	16	40	0.27	0.22	0.4	0.1	1.1	0.1	4.4	0	5.1	0.6	0	1.000	999	999	999.0000	-1.723	1.645	0.9575
MOLYBDENUM	33	51	26	16	0.21	0.69	77.6	35.3	40.4	44.3	213.8	0	200.0	18.8	0	1.000	999	999	999.0000	-1.074	1.645	0.8586
NICKEL	23	51	20	24	0.13	0.53	17.6	12.1	5.0	8.4	40.0	0	40.0	30.3	0	1.000	999	999	999.0000	-1.390	1.645	0.9178
POTASSIUM	38	51	22	0	0.42	1.00	2442.4	6289.9	1362.3	2972.7	6911.4	28	7073.0	12000.0	28	0.000	18	18	0.0001	5.797	1.645	0.0001
SELENIUM	27	48	22	41	0.19	0.15	3.3	2.7	3.7	0.5	19.0	0	19.0	4.5	0	1.000	999	999	999.0000	-1.034	1.645	0.8495
SILICON(1)	0	51	0	0		1.00																
SILVER	31	50	26	49	0.16	0.02	4.8	5.0	1.8	0.3	12.5	0	12.5	3.2	0	1.000	999	999	999.0000	-1.210	1.645	0.8868
SODIUM	49	51	0	0	1.00	1.00	12466.2	63372.5	5512.4	55702.2	29793.3	28	35200.0	192000.0	27	0.000	20	20	0.0001	8.354	1.645	0.0001
STRONTIUM	44	51	9	0	0.80	1.00	494.8	245.1	397.3	83.2	1763.4	0	1000.0	597.0	0	1.000	19	1	1.0000	-1.951	1.645	0.9745
THALLIUM(2)	26	51	25	51	0.04	0.00																
TIN	35	51	29	43	0.17	0.16	81.2	85.5	35.3	33.9	200.0	0	200.0	11.8	0	1.000	999	999	999.0000	-2.690	1.645	0.9964
VANADIUM	37	51	31	28	0.16	0.45	20.1	15.3	8.9	10.8	50.0	0	50.0	4.8	0	1.000	999	999	999.0000	-2.099	1.645	0.9821
ZINC	45	51	24	23	0.47	0.55	17.4	12.1	20.6	5.9	82.9	0	105.0	29.2	0	1.000	999	999	999.0000	-1.110	1.645	0.8665

(1) No background measurement
(2) No detect records from site

TABLE A-30
OU6 Background Comparison t-Test Results of Pond Surface Water Filtered Metals
(Concentration Unit: UG/L)

ANALYTE	N_B	N_S	ND_B	ND_S	MEAN_B	MEAN_S	STD_B	STD_S	F_CAL	F_TAB	DF_	T_CAL	T_1_95	P_T_1	REMARK
ALUMINUM	42	48	31	16	77.5	53.9	33.4	38.0							NNDT more than 20%
ANTIMONY	29	51	20	42	35.5	27.8	25.5	4.7							NNDT more than 20%
ARSENIC	34	51	28	32	4.7	4.8	2.8	0.9							NNDT more than 20%
BARIUM	46	51	26	0	97.7	43.9	28.7	25.4							NNDT more than 20%
BERYLLIUM	21	51	21	48	2.3	2.4	0.6	0.5							NNDT more than 20%
CADMIUM	26	51	26	46	2.4	2.4	0.3	0.2							NNDT more than 20%
CALCIUM	49	51	0	0	50869.4	31813.7	34547.7	14541.1	6.4	3.9	64	-3.569	1.67	0.9997	
CESIUM	30	51	26	42	750.0	423.7	701.0	166.6							NNDT more than 20%
CHROMIUM	27	51	25	47	5.0	4.9	2.2	0.5							NNDT more than 20%
COBALT	30	51	28	34	22.3	17.4	7.2	10.9							NNDT more than 20%
COPPER	40	44	30	43	11.3	12.3	4.5	1.3							NNDT more than 20%
IRON	48	50	14	2	1974.3	44.3	4112.7	106.6							NNDT more than 20%
LEAD	41	50	32	27	2.1	2.2	0.8	1.1							NNDT more than 20%
LITHIUM	42	51	28	0	37.5	19.2	18.2	16.0							NNDT more than 20%
MAGNESIUM	46	51	12	0	7202.0	14718.8	5112.5	8523.8							NNDT more than 20%
MANGANESE	43	51	5	0	130.8	53.3	186.5	55.8	31.7	3.9	48	-2.629	1.68	0.9943	
MERCURY	22	51	16	40	0.4	0.1	1.1	0.1							NNDT more than 20%
MOLYBDENUM	33	51	26	16	77.6	35.3	40.4	44.3							NNDT more than 20%
NICKEL	23	51	20	24	17.6	12.1	5.0	8.4							NNDT more than 20%
POTASSIUM	38	51	22	0	2442.4	6289.9	1362.3	2972.7							NNDT more than 20%
SELENIUM	27	48	22	41	3.3	2.7	3.7	0.5							NNDT more than 20%
SILICON	0	51	0	0		2939.5		1878.5							NO BKGD measurement
SILVER	31	50	26	49	4.8	5.0	1.8	0.3							NNDT more than 20%
SODIUM	49	51	0	0	12466.2	63372.5	5512.4	55702.2	60.1	3.9	51	6.494	1.68	0.0001	
STRONTIUM	44	51	9	0	494.8	245.1	397.3	83.2							NNDT more than 20%
THALLIUM	26	51	25	51	5.3	5.0	3.2	0.0							NNDT more than 20%
TIN	35	51	29	43	81.2	85.5	35.3	33.9							NNDT more than 20%
VANADIUM	37	51	31	28	20.1	15.3	8.9	10.8							NNDT more than 20%
ZINC	45	51	24	23	17.4	12.1	20.6	5.9							NNDT more than 20%

NNDT = Number of non-detects

TABLE A-31
OU6 Background Comparison Summary of Pond Surface Water Unfiltered Radionuclides
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	DTF_B	TF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	37	49	1.00	1.00	1.0000	0.5703	0.1674		N	0.080	0	NO	
CESIUM-137	37	18	1.00	1.00	1.0000	1.0000	0.9796		N	7.157	0	NO	
GROSS ALPHA	36	48	1.00	1.00	1.0000	1.0000	0.9284		N	340.129	0	NO	
GROSS BETA	10	51	1.00	1.00	0.0001	0.0725	0.0001		Y	9.742	13	YES	
PLUTONIUM-239/240	33	51	1.00	1.00	1.0000	0.9825	0.9268		N	2.849	0	NO	
RADIUM-226	12	0	0.00	0.00									NO site measurement
RADIUM-228	5	0	0.00	0.00									NO site measurement
STRONTIUM-89,90	32	51	1.00	1.00	0.2267	0.4931	0.1420		N	1.614	0	NO	
TRITIUM	31	46	1.00	1.00	1.0000	0.5178	0.4917		N	4277.820	0	NO	
URANIUM,TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233/234	33	51	1.00	1.00	1.0000	0.0352	0.0001		Y	4.988	0	YES	
URANIUM-235	32	51	1.00	1.00	0.0161	0.0266	0.0032		Y	0.307	4	YES	
URANIUM-238	28	51	1.00	1.00	1.0000	0.0995	0.0008		Y	4.885	0	YES	

TABLE A-32
OU6 Background Comparison Statistical Test Results of Pond Surface Water Unfiltered Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/l)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	AX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	37	49	0	0	1.00	1.00	0.013	0.010	0.020	0.010	0.080	0	0.100	0.038	0	1.0000	19	11	0.5703	0.964	1.645	0.1674
CESIUM-137	37	18	0	0	1.00	1.00	0.584	-0.033	1.993	0.295	7.157	0	12.000	0.331	0	1.0000	12	0	1.0000	-2.045	1.645	0.9796
GROSS ALPHA	36	48	0	0	1.00	1.00	42.517	3.078	89.767	1.634	340.129	0	440.000	7.879	0	1.0000	17	2	1.0000	-1.464	1.645	0.9284
GROSS BETA	10	51	0	0	1.00	1.00	2.149	7.715	1.496	3.038	9.742	13	4.300	15.000	44	0.0001	13	13	0.0725	4.784	1.645	0.0001
PLUTONIUM-239/240	33	51	0	0	1.00	1.00	0.214	0.015	0.781	0.019	2.849	0	4.400	0.076	0	1.0000	17	7	0.9825	-1.452	1.645	0.9268
RADIUM-226(1)	12	0	0	0																		
RADIUM-228(1)	5	0	0	0																		
STRONTIUM-89,90	32	51	0	0	1.00	1.00	0.317	0.412	0.382	0.376	1.614	0	1.100	1.541	3	0.2267	17	11	0.4931	1.071	1.645	0.1420
TRITIUM	31	46	0	0	1.00	1.00	-87.722	126.463	1275.950	134.620	4277.820	0	475.000	430.000	0	1.0000	16	10	0.5178	0.021	1.645	0.4917
URANIUM,TOTAL(2)	0	0	0	0																		
URANIUM-233/234	33	51	0	0	1.00	1.00	0.637	1.244	1.289	1.040	4.988	0	6.900	3.688	0	1.0000	17	14	0.0352	3.907	1.645	0.0001
URANIUM-235	32	51	0	0	1.00	1.00	0.022	0.104	0.084	0.120	0.307	4	0.190	0.560	8	0.0161	18	15	0.0266	2.723	1.645	0.0032
URANIUM-238	28	51	0	0	1.00	1.00	0.642	1.393	1.212	1.395	4.885	0	5.930	4.475	0	1.0000	16	13	0.0995	3.147	1.645	0.0008

(1) No site measurement

(2) No background measurement

TABLE A-33
OU6 Background Comparison Summary of Pond Surface Water Filtered Radionuclides
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	8	51	1.00	1.00	1.0000	0.9904	0.8733		N	1.755	0	NO	
CESIUM-137	3	18	1.00	1.00	0.0075	0.4211	0.0104		Y	4.708	0	YES(1)	
GROSS ALPHA	13	0	0.00	0.00									NO site measurement
GROSS BETA	14	0	0.00	0.00									NO site measurement
PLUTONIUM-239/240	8	51	1.00	1.00	1.0000	0.9539	0.9662		N	1.016	0	NO	
RADIUM-226	2	0	0.00	0.00									NO site measurement
RADIUM-228	1	0	0.00	0.00									NO site measurement
STRONTIUM-89,90	20	49	1.00	1.00	0.1697	0.9761	0.9430		N	2.013	1	YES	
TRITIUM	13	0	0.00	0.00									NO site measurement
URANIUM,TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233/234	13	49	1.00	1.00	0.1013	0.1760	0.0640		N	4.192	0	NO	
URANIUM-235	12	49	1.00	1.00	0.8033	0.9861	0.8972		N	0.716	0	NO	
URANIUM-238	13	48	1.00	1.00	0.0155	0.0294	0.0091		Y	3.032	7	YES	

(1) Sample size is too small

TABLE A-34
OU6 Background Comparison Statistical Test Results of Pond Surface Water Filtered Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/L)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	TF_S	MEAN_B	EAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	8	51	0	0	1.00	1.00	0.128	0.007	0.280	0.013	1.755	0	0.800	0.077	0	1.0000	13	9	0.9904	-1.142	1.645	0.8733
CESIUM-137	3	18	0	0	1.00	1.00	-0.267	0.183	0.208	0.263	4.708	0	-0.100	0.610	16	0.0075	5	5	0.4211	2.312	1.645	0.0104
GROSS ALPHA(1)	13	0	0	0																		
GROSS BETA(1)	14	0	0	0																		
PLUTONIUM-239/240	8	51	0	0	1.00	1.00	0.099	0.016	0.158	0.024	1.016	0	0.400	0.100	0	1.0000	12	9	0.9539	-1.828	1.645	0.9662
RADIUM-226(1)	2	0	0	0																		
RADIUM-228(1)	1	0	0	0																		
STRONTIUM-89,90	20	49	0	0	1.00	1.00	0.515	0.406	0.391	0.470	2.013	1	1.000	2.502	5	0.1697	15	8	0.9761	-1.581	1.645	0.9430
TRITIUM(1)	13	0	0	0																		
URANIUM,TOTAL(2)	0	0	0	0																		
URANIUM-233/234	13	49	0	0	1.00	1.00	0.906	1.378	0.735	0.995	4.192	0	2.600	3.391	9	0.1013	13	12	0.1760	1.522	1.645	0.0640
URANIUM-235	12	49	0	0	1.00	1.00	0.124	0.066	0.128	0.079	0.716	0	0.300	0.370	1	0.8033	13	8	0.9861	-1.266	1.645	0.8972
URANIUM-238	13	48	0	0	1.00	1.00	0.605	1.401	0.543	1.205	3.032	7	1.700	4.310	15	0.0155	13	13	0.0294	2.360	1.645	0.0091

(1) No site measurement

(2) No background measurement

TABLE A-35
OU6 Background Comparison Summary of Stream Sediment Metals
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	DTF_B	DTF_S	_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99_	NGUTL_	PCOC	REMARK
ALUMINUM	59	15	1.00	1.00	1.0000	0.6358	0.0705		N	20880.1	0	NO	
ANTIMONY	52	15	0.17	0.13	1.0000		0.4121		N	60.0	0	NO	
ARSENIC	59	15	0.49	0.93	1.0000		0.0007		Y	10.1	0	YES	
BARIUM	57	15	1.00	1.00	1.0000	0.8810	0.0197		Y	250.8	0	YES	
BERYLLIUM	57	15	0.53	0.53	1.0000		0.5367		N	11.6	0	NO	
CADMIUM	51	15	0.29	0.07	1.0000		0.9908		N	3.5	0	NO	
CALCIUM	59	15	1.00	1.00	0.2027	0.0092	0.0001		Y	17888.3	1	YES	
CESIUM	56	15	0.86	0.47	1.0000	1.0000	0.9998		N	513.5	0	NO	
CHROMIUM	59	15	0.83	1.00	1.0000	0.8947	0.4866		N	31.1	0	NO	
COBALT	59	15	0.88	1.00	1.0000		0.0021		Y	19.3	0	YES	
COPPER	59	15	0.80	0.60	1.0000	0.6871	0.7164		N	36.0	0	NO	
IRON	59	15	1.00	1.00	1.0000	0.1471	0.0001		Y	27966.4	0	YES	
LEAD	59	15	1.00	1.00	1.0000	0.6358	0.0602		N	134.3	0	NO	
LITHIUM	57	15	0.91	0.93	1.0000		0.7018		N	41.3	0	NO	
MAGNESIUM	59	15	1.00	1.00	1.0000	0.0436	0.0014		Y	5262.0	0	YES	
MANGANESE	59	15	0.80	1.00	1.0000	0.0436	0.0024		Y	905.0	1	YES	
MERCURY	49	15	0.86	0.27	1.0000		1.0000		N	0.5	0	NO	
MOLYBDENUM	0	0	0.00	0.00									NO site measurement
NICKEL	57	15	0.88	0.47	1.0000		0.3626		N	24.2	0	NO	
POTASSIUM	58	15	1.00	0.93	1.0000	0.0100	0.0002		Y	3112.5	0	YES	
SELENIUM	58	15	0.40	0.13	1.0000		0.8914		N	3.5	0	NO	
SILICON	0	0	0.00	0.00									NO site measurement
SILVER	54	15	0.48	0.07	1.0000		0.9170		N	12.0	0	NO	
SODIUM	59	15	0.69	0.87	1.0000		0.0806		N	1745.1	0	NO	
STRONTIUM	58	15	0.88	1.00	1.0000		0.0079		Y	294.8	0	YES	
THALLIUM	50	15	0.40	0.33	1.0000		0.8391		N	2.3	0	NO	
TIN	0	0	0.00	0.00									NO site measurement
VANADIUM	57	15	0.70	1.00	1.0000		0.0128		Y	63.4	0	YES	
ZINC	59	15	0.95	1.00	1.0000	0.0144	0.0005		Y	307.8	0	YES	

TABLE A-36
OU6 Background Comparison Statistical Test Results of Stream Sediment Metals
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: MG/KG)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
ALUMINUM	59	15	0	0	1.00	1.00	5887.6	6922.3	4912.7	2881.1	20880.1	0	25200.0	11600.0	0	1.0000	15	3	0.6358	1.472	1.645	0.0705
ANTIMONY	52	15	43	13	0.17	0.13	7.4	8.1	7.9	5.9	60.0	0	60.0	26.3	0	1.0000	999	999	999.0000	0.222	1.645	0.4121
ARSENIC	59	15	30	1	0.49	0.93	2.4	3.6	2.5	1.3	10.1	0	17.3	5.8	0	1.0000	999	999	999.0000	3.198	1.645	0.0007
BARIUM	57	15	0	0	1.00	1.00	77.9	106.6	56.4	32.5	250.8	0	244.0	177.0	0	1.0000	15	2	0.8810	2.059	1.645	0.0197
BERYLLIUM	57	15	27	7	0.53	0.53	1.2	0.6	3.4	0.2	11.6	0	26.0	1.0	0	1.0000	999	999	999.0000	-0.092	1.645	0.5367
CADMIUM	51	15	36	14	0.29	0.07	0.9	0.5	0.8	0.1	3.5	0	5.0	0.8	0	1.0000	999	999	999.0000	-2.359	1.645	0.9908
CALCIUM	59	15	0	0	1.00	1.00	3659.8	13263.7	4662.4	23046.1	17888.3	1	17100.0	95700.0	1	0.2027	15	7	0.0092	4.054	1.645	0.0001
CESIUM	56	15	8	8	0.86	0.47	139.9	60.3	121.4	43.9	513.5	0	621.0	18.1	0	1.0000	15	0	1.0000	-3.499	1.645	0.9998
CHROMIUM	59	15	10	0	0.83	1.00	8.3	6.9	7.5	3.5	31.1	0	29.7	12.3	0	1.0000	16	2	0.8947	0.034	1.645	0.4866
COBALT	59	15	7	0	0.88	1.00	6.5	8.2	4.2	2.0	19.3	0	50.0	12.4	0	1.0000	999	999	999.0000	2.859	1.645	0.0021
COPPER	59	15	12	6	0.80	0.60	11.0	9.5	8.2	6.6	36.0	0	36.7	17.7	0	1.0000	16	3	0.6871	-0.572	1.645	0.7164
IRON	59	15	0	0	1.00	1.00	8852.6	13810.0	6263.2	3237.4	27966.4	0	31400.0	21500.0	0	1.0000	15	5	0.1471	3.812	1.645	0.0001
LEAD	59	15	0	0	1.00	1.00	22.0	20.9	36.8	21.8	134.3	0	244.0	94.8	0	1.0000	15	3	0.6358	1.553	1.645	0.0602
LITHIUM	57	15	5	1	0.91	0.93	11.0	7.0	9.9	3.0	41.3	0	45.8	15.2	0	1.0000	999	999	999.0000	-0.529	1.645	0.7018
MAGNESIUM	59	15	0	0	1.00	1.00	1494.7	2317.0	1234.5	848.3	5262.0	0	5850.0	3580.0	0	1.0000	15	6	0.0436	2.978	1.645	0.0014
MANGANESE	59	15	12	0	0.80	1.00	216.9	366.5	225.5	240.4	905.0	1	1280.0	1000.0	0	1.0000	15	6	0.0436	2.816	1.645	0.0024
MERCURY	49	15	7	11	0.86	0.27	0.1	0.1	0.1	0.0	0.5	0	0.6	0.1	0	1.0000	999	999	999.0000	-4.175	1.645	1.0000
MOLYBDENUM(1)																						
NICKEL	57	15	7	8	0.88	0.47	8.1	8.3	5.3	5.4	24.2	0	40.0	19.2	0	1.0000	999	999	999.0000	0.352	1.645	0.3626
POTASSIUM	58	15	0	1	1.00	0.93	909.7	1492.4	720.0	559.1	3112.5	0	3770.0	2660.0	0	1.0000	15	7	0.0100	3.489	1.645	0.0002
SELENIUM	58	15	35	13	0.40	0.13	0.9	0.5	0.8	0.0	3.5	0	5.0	0.5	0	1.0000	999	999	999.0000	-1.234	1.645	0.8914
SILICON(1)																						
SILVER	54	15	28	14	0.48	0.07	2.3	1.0	3.1	0.1	12.0	0	25.0	1.4	0	1.0000	999	999	999.0000	-1.385	1.645	0.9170
SODIUM	59	15	18	2	0.69	0.87	303.9	258.0	472.3	135.4	1745.1	0	5000.0	483.0	0	1.0000	999	999	999.0000	1.401	1.645	0.0806
STRONTIUM	58	15	7	0	0.88	1.00	50.8	48.7	79.8	25.1	294.8	0	421.0	95.8	0	1.0000	999	999	999.0000	2.412	1.645	0.0079
THALLIUM	50	15	30	10	0.40	0.33	0.7	0.8	0.5	0.3	2.3	0	2.6	0.5	0	1.0000	999	999	999.0000	-0.991	1.645	0.8391
TIN(1)																						
VANADIUM	57	15	17	0	0.70	1.00	18.7	23.4	14.6	6.7	63.4	0	73.0	33.9	0	1.0000	999	999	999.0000	2.232	1.645	0.0128
ZINC	59	15	3	0	0.95	1.00	54.3	75.3	83.0	35.9	307.8	0	639.0	178.0	0	1.0000	16	7	0.0144	3.268	1.645	0.0005

(1) No site measurement

TABLE A-37
OU6 Background Comparison Summary of Stream Sediment Radionuclides
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	DTF_B	DTF_S	P_SLIP	P_QUAN	P_GEHAN	P_T_1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	37	15	1.00	1.00	1.0000	0.3923	0.0031		Y	1.770	0	YES	
CESIUM-137	35	15	1.00	1.00	1.0000	0.9821	0.5551		N	1.541	0	NO	
GROSS ALPHA	45	15	1.00	1.00	1.0000	1.0000	0.6776		N	88.058	0	NO	
GROSS BETA	43	15	1.00	1.00	1.0000	1.0000	1.0000		N	67.337	0	NO	
PLUTONIUM-239/24	45	15	1.00	1.00	1.0000	0.0355	0.0059		Y	5.658	0	YES	
RADIUM-226	21	1	1.00	1.00	1.0000	1.0000	0.3466		N	2.216	0	NO(1)	
RADIUM-228	20	1	1.00	1.00	1.0000	1.0000	0.4344		N	4.547	0	NO(1)	
STRONTIUM-89,90	43	8	1.00	1.00	1.0000	0.5572	0.6464		N	1.087	0	NO	
TRITIUM(2)	42	15	1.00	1.00	0.2632	0.0460	0.5576		Y	1047.685	1	YES	
URANIUM,TOTAL	0	0											NO site measurement
URANIUM-233/234	47	15	1.00	1.00	1.0000	1.0000	0.9942		N	5.293	0	NO	
URANIUM-235	49	15	1.00	1.00	1.0000	1.0000	0.9351		N	0.212	0	NO	
URANIUM-238	36	15	1.00	1.00	1.0000	1.0000	0.9530		N	4.817	0	NO	

(1) Sample size is too small
(2) Concentration Unit: pCi/L

TABLE A-38
OU6 Background Comparison Statistical Test Results of Stream Sediment Radionuclides
(Slippage Test, Quantile Test, Gehan Test, UTL Comparison)
(Concentration Unit: pCi/G)

ANALYTE	N_B	N_S	ND_B	ND_S	DTF_B	DTF_S	MEAN_B	MEAN_S	STD_B	STD_S	UTL99	NGUTL	MAX_B	MAX_S	NGM	P_SLP	N_T20	N_SITE	P_QUAN	Z_CAL	Z_95	P_VAL
AMERICIUM-241	37	15	0	0	1.00	1.00	0.173	0.125	0.484	0.200	1.770	0	2.526	0.75	0	1.0000	11	4	0.3923	2.738	1.645	0.0031
CESIUM-137	35	15	0	0	1.00	1.00	0.262	0.141	0.383	0.107	1.541	0	1.500	0.44	0	1.0000	10	1	0.9821	-0.138	1.645	0.5551
GROSS ALPHA	45	15	0	0	1.00	1.00	22.976	13.065	20.463	3.446	88.058	0	72.000	18.00	0	1.0000	12	0	1.0000	-0.461	1.645	0.6776
GROSS BETA	43	15	0	0	1.00	1.00	35.349	24.608	9.978	2.202	67.337	0	59.000	27.80	0	1.0000	12	0	1.0000	-4.271	1.645	1.0000
PLUTONIUM-239/240	45	15	0	0	1.00	1.00	0.537	0.287	1.610	0.509	5.658	0	8.933	1.95	0	1.0000	12	6	0.0355	2.519	1.645	0.0059
RADIUM-226	21	1	0	0	1.00	1.00	0.849	0.930	0.362		2.216	0	1.800	0.93	0	1.0000	5	0	1.0000	0.395	1.645	0.3466
RADIUM-228	20	1	0	0	1.00	1.00	1.701	1.600	0.743		4.547	0	3.453	1.60	0	1.0000	5	0	1.0000	0.165	1.645	0.4344
STRONTIUM-89,90	43	8	0	0	1.00	1.00	0.206	0.190	0.275	0.171	1.087	0	1.165	0.49	0	1.0000	11	2	0.5572	-0.376	1.645	0.6464
TRITIUM (1)	42	15	0	0	1.00	1.00	194.297	977.603	265.068	2844.995	1047.685	1	1770.000	11200.00	1	0.2632	12	6	0.0460	-0.145	1.645	0.5576
URANIUM,TOTAL(2)	0	0	0	0																		
URANIUM-233/234	47	15	0	0	1.00	1.00	1.677	0.904	1.145	0.301	5.293	0	4.500	1.64	0	1.0000	13	0	1.0000	-2.523	1.645	0.9942
URANIUM-235	49	15	0	0	1.00	1.00	0.062	0.040	0.048	0.026	0.212	0	0.191	0.08	0	1.0000	13	0	1.0000	-1.515	1.645	0.9351
URANIUM-238	36	15	0	0	1.00	1.00	1.399	0.868	1.031	0.260	4.817	0	3.820	1.42	0	1.0000	11	0	1.0000	-1.675	1.645	0.9530

(1) Concentration Unit: pCi/L

(2) No background measurement

FIGURE A-8

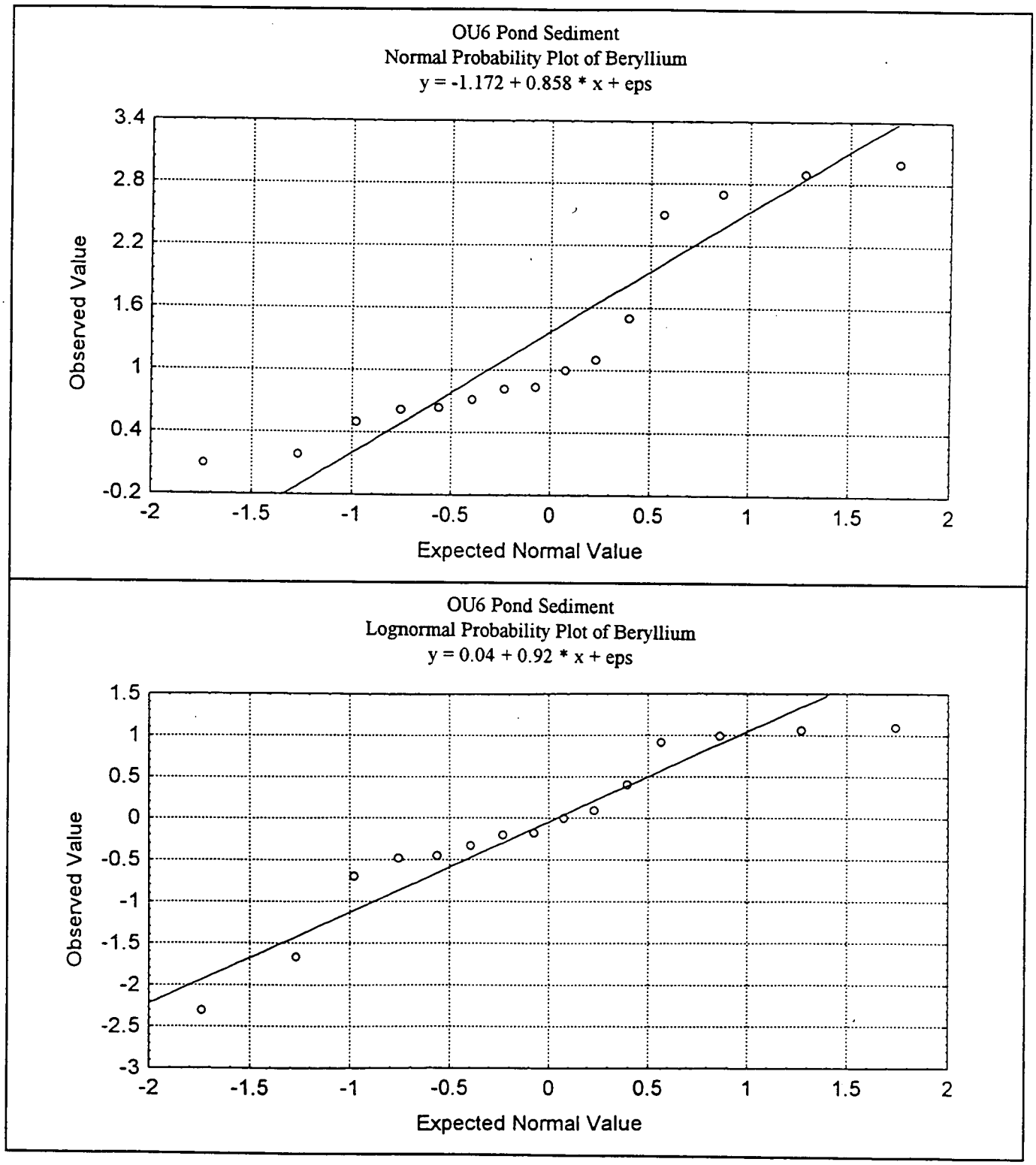
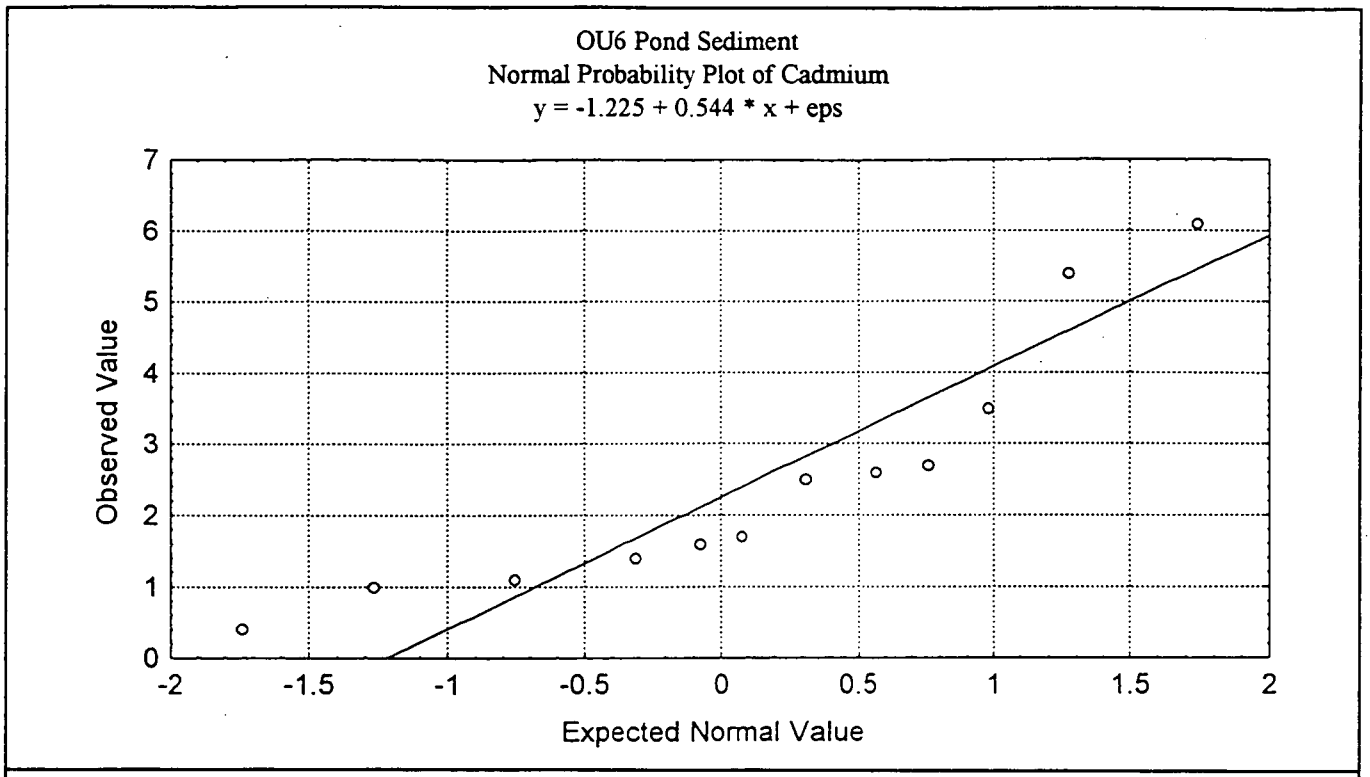

OU6 Pond Sediment
Normal Probability Plot of Beryllium
y = -1.172 + 0.858 * x + eps
Observed Value
Expected Normal Value
3.4
2.8
2.2
1.6
1
0.4
-0.2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
OU6 Pond Sediment
Lognormal Probability Plot of Beryllium
y = 0.04 + 0.92 * x + eps
Observed Value
Expected Normal Value
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

FIGURE A-9


OU6 Pond Sediment
Normal Probability Plot of Cadmium
y = -1.225 + 0.544 * x + eps
Observed Value
Expected Normal Value
0
1
2
3
4
5
6
7
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

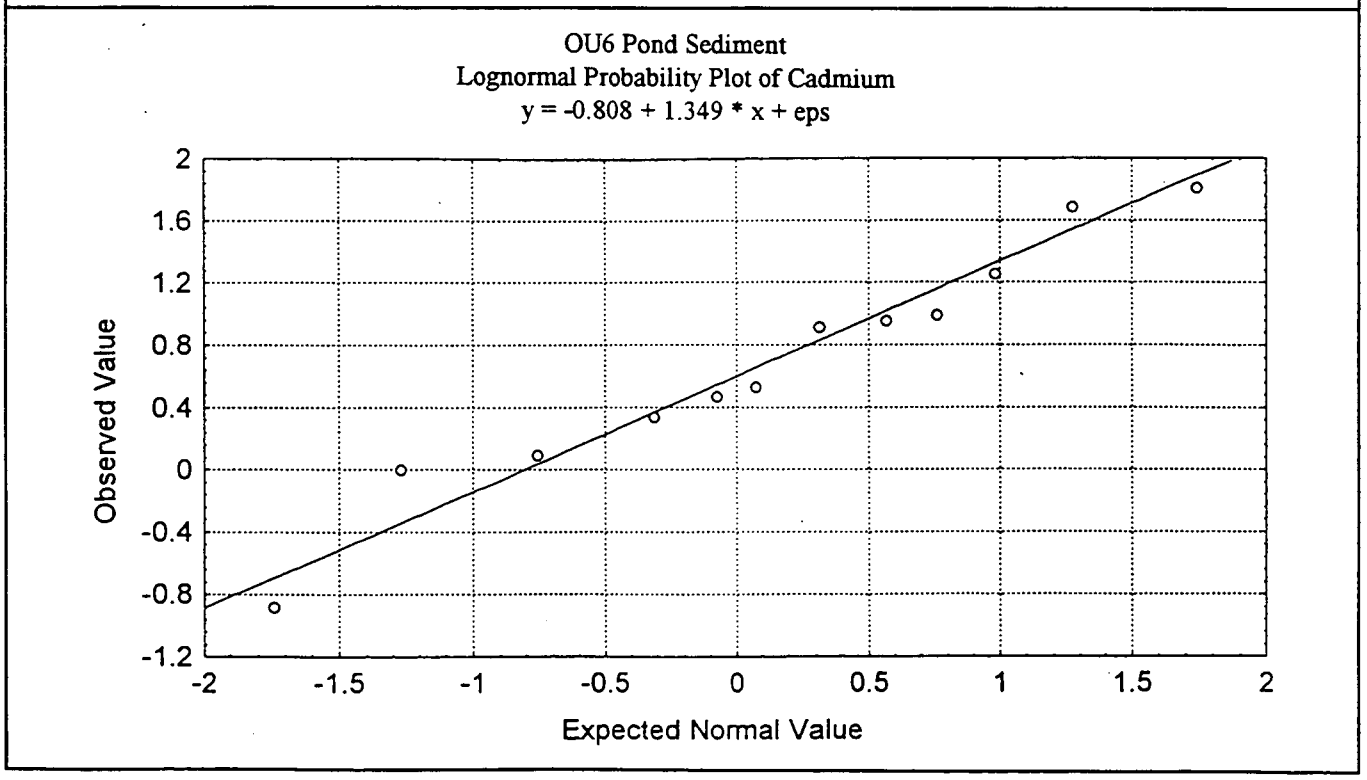
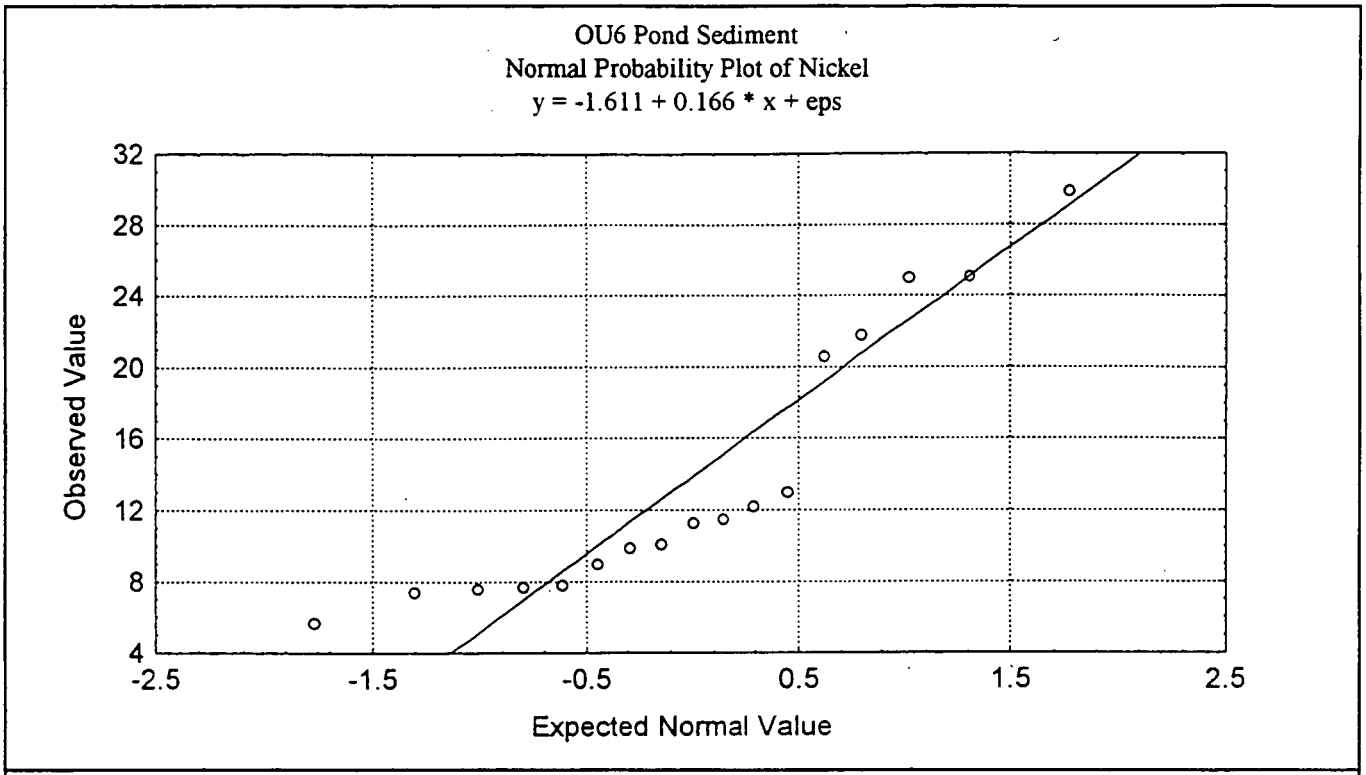

OU6 Pond Sediment
Lognormal Probability Plot of Cadmium
y = -0.808 + 1.349 * x + eps
Observed Value
Expected Normal Value
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
1.6
2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

FIGURE A-10


OU6 Pond Sediment
Normal Probability Plot of Nickel
y = -1.611 + 0.166 * x + eps
Observed Value
32
28
24
20
16
12
8
4
-2.5
-1.5
-0.5
0.5
1.5
2.5
Expected Normal Value

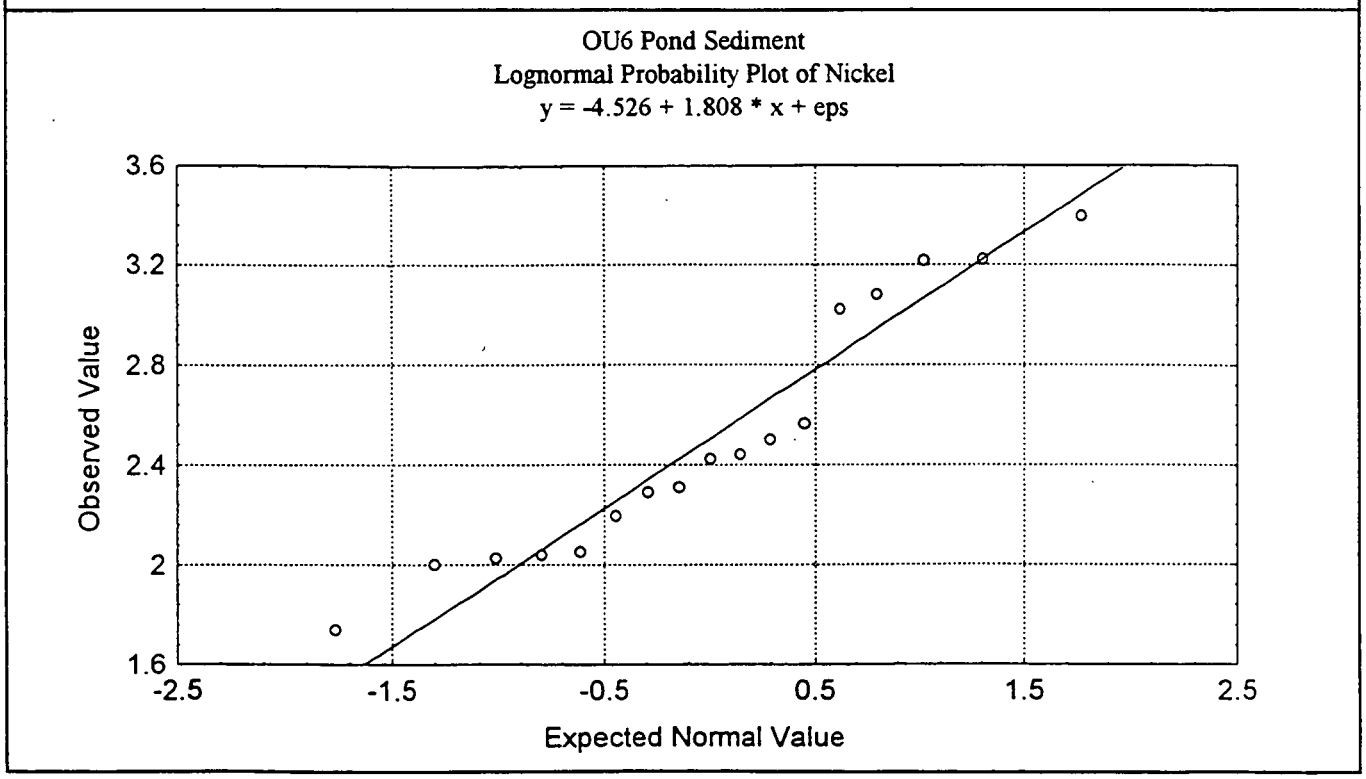
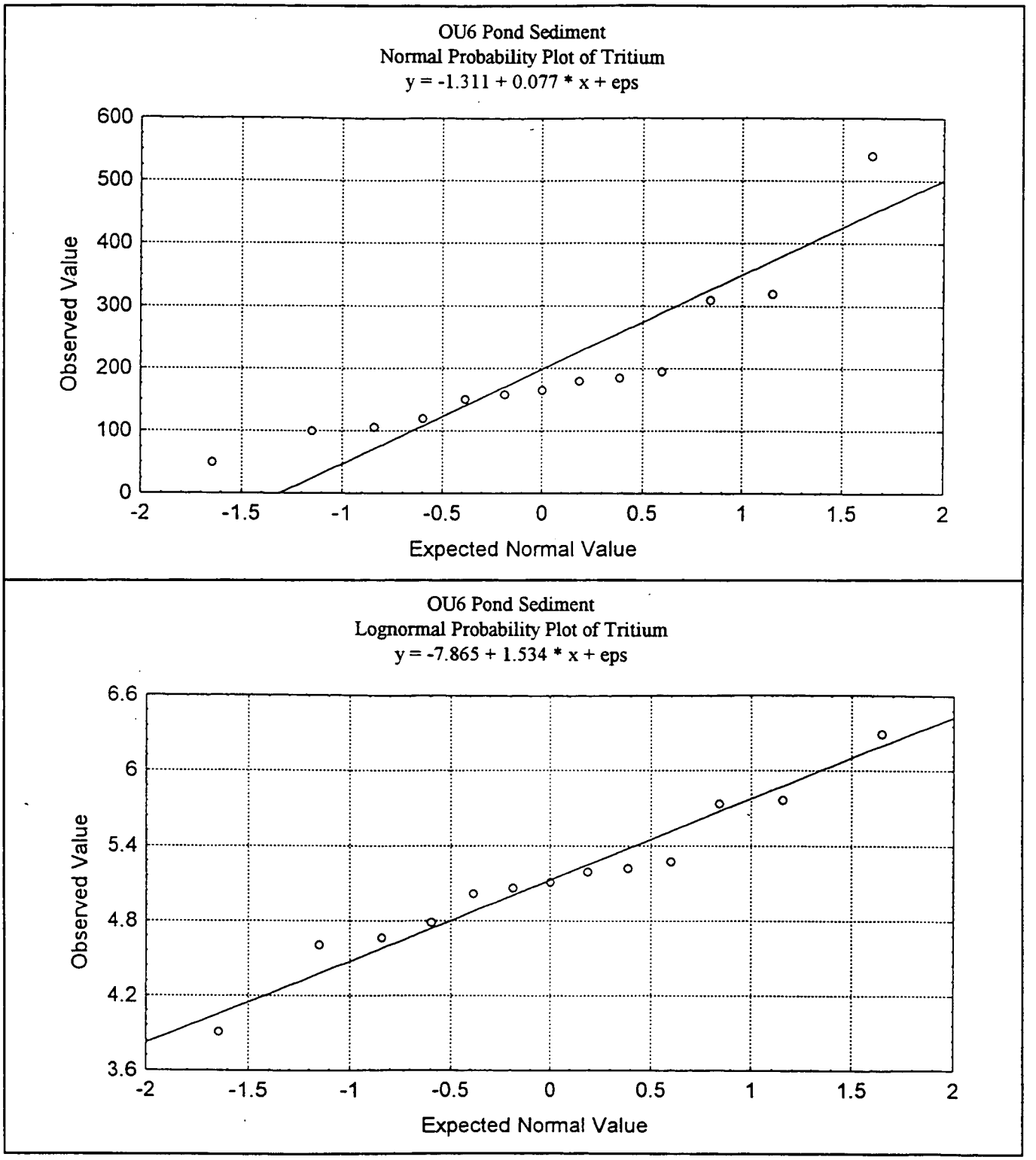

OU6 Pond Sediment
Lognormal Probability Plot of Nickel
y = -4.526 + 1.808 * x + eps
Observed Value
3.6
3.2
2.8
2.4
2
1.6
-2.5
-1.5
-0.5
0.5
1.5
2.5
Expected Normal Value

FIGURE A-11


OU6 Pond Sediment
Normal Probability Plot of Tritium
y = -1.311 + 0.077 * x + eps
Observed Value
600
500
400
300
200
100
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Expected Normal Value
OU6 Pond Sediment
Lognormal Probability Plot of Tritium
y = -7.865 + 1.534 * x + eps
Observed Value
6.6
6
5.4
4.8
4.2
3.6
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Expected Normal Value

ATTACHMENT B
RISK-BASED EVALUATION OF INFREQUENTLY DETECTED CHEMICALS

B.1 PURPOSE AND APPROACH

The chemicals of concern (COCs) evaluated in a quantitative human health risk assessment are the subset of all site-related chemicals that are thought to pose the greatest potential risk to human health. The determination that these chemicals may pose the greatest potential risk is generally based on an evaluation of the following three criteria:

- The inherent toxicity of the chemical
- The concentrations of the chemical found on-site
- The potential for human exposure to the chemical (e.g., whether or not the chemical is widely distributed across the site or could readily migrate from the site)

In general, compounds found at low frequency (<5% of all samples for a particular media) are not included as chemicals of concern because the potential for human exposure is limited. However, all infrequently detected compounds were evaluated according to the procedures shown in Figure 2-1 so as not to neglect infrequently detected chemicals that could contribute significantly to risk if they were co-located with other potentially hazardous compounds at source areas or locations where routine exposure could occur.

This evaluation examines those metals (detected in concentrations above background levels) and organic chemicals that were initially excluded as COCs based on low frequency of detection, using a health-based screening approach. A screening evaluation was performed using risk-based concentrations (RBCs) calculated in guidance provided by DOE (1995). The screening evaluation was performed for all low-frequency chemicals for which RBCs were available. As a benchmark, it was assumed that any infrequently detected chemical whose maximum concentration was greater than 1000 times the RBC warrants further evaluation. The purpose is to identify those infrequently detected chemicals that may pose an unacceptable health risk (cancer or non-cancer) if chronic exposure were to occur to the

maximum detected concentration. These chemicals are retained for separated evaluation as special case chemicals of concern in the risk assessment. Since they are not characteristic of contamination in OU6, risk will be assessed separately at the locations where the special case chemicals are found.

In addition, to verify the frequency of detection evaluation, the range of reporting limits for nondetect results were reviewed. In the review, maximum nondetect values (i.e., the sample reporting limits) of all of the low frequency chemicals were compared to RBCs to test whether the reporting limits were low enough to provide adequate characterization of chemical contamination and detection frequency. The percentage of nondetect values that exceeded the RBC was also determined. The nondetect values were also compared to the contract required quantitation limits (CRQLs) for the analytical method used for each chemical to determine if the reporting limits were elevated above the CRQLs. The CRQLs are levels at which chemicals can be reliably quantified by the specified analytical method. Therefore, analytical results with reporting limits at or near the CRQL are considered adequate for characterizing chemical contamination and detection frequency. If the CRQL exceeded the RBC and the reporting limits were not significantly elevated above the CRQL, the data were considered adequate to perform the low frequency risk characterization. If the CRQL does not exceed the RBC and the reporting limits were elevated above the CRQL, then further evaluation of the data was performed on a case-by-case basis and is discussed in the medium-specific sections below.

RBCs for all media except subsurface soil were calculated assuming a residential exposure scenario, using standard toxicity values established by EPA, and using the exposure assumptions outlined below (DOE 1995). This is a conservative approach because residential use is not expected in future at RFETS. For surface soils, pond sediments, and stream sediments, multiple pathway exposure was assumed (ingestion and inhalation of particulates) in calculating RBCs. The RBC for residential soil (surface soil) is used for surface soil, pond sediment, and stream sediment in this evaluation. For carcinogenic effects, the target excess lifetime cancer risk is 10^{-6} (1 in 1,000,000), the exposure frequency is 350 days/year, exposure duration is 30 years, averaging time is 70 years, daily inhalation rate is 20 m^3/day, the particulate emission factor (for non-volatile organics and inorganics) is 4.63 x 10^9 m^3/kg, body weight is 70 kg, and the age-adjusted soil ingestion factor is 114 mg-yr/kg-day. All exposure factors are EPA standard default values for adult residents, except for soil ingestion,

which is a time-weighted average for child and adult exposures. For noncarcinogenic effects, all of the exposure factors are the same as the carcinogenic exposure factors except the averaging time is 30 years and, instead of a target excess lifetime cancer risk, the target hazard index is 1.

RBCs for subsurface soil were calculated assuming a construction worker exposure scenario and assuming multiple pathway exposure (ingestion and inhalation of particulates). For carcinogenic effects, the target excess lifetime cancer risk is 10^{-6} (1 in 1,000,000), the exposure frequency is 30 days/year, exposure duration is 1 year, averaging time is 70 years, the daily inhalation rate is 10 m^3/day (based on an hourly inhalation rate of 1.25 m^3/hour over an 8-hour workday), the particulate emission factor (for non-volatile organics and inorganics) is 4.63 x 10^9 m^3/kg, body weight is 70 kg, and the daily soil ingestion rate is 480 mg/day. All exposure factors are EPA standard default values for construction workers except the exposure frequency of 30 days which is site-specific. For noncarcinogenic effects, all of the exposure factors are the same as the carcinogenic exposure factors except the averaging time is 1 year and, instead of a target excess lifetime cancer risk, the target hazard index is 1.

The RBCs for groundwater assume residential exposure via ingestion and inhalation of volatile organic chemicals released during use. The residential groundwater RBCs were also used in the evaluation of chemicals detected in pond surface water, even though surface water is not expected to be used for domestic drinking water. The RBCs for residential groundwater are more conservative than the RBCs for residential surface water (based on swimming exposures), therefore providing more stringent screening criteria for chemicals found in pond surface water. The exposure factors for groundwater are: target excess lifetime cancer risk of 10^{-6} (1 in 1,000,000), body weight of 70 kg, averaging time of 70 years, exposure frequency of 350 days/yr, exposure duration of 30 years, daily indoor inhalation rate of 15 m^3/day, a volatilization factor (for volatile organic chemicals) of 0.5 L/m^3, and a daily ingestion rate or 2 L/day. All exposure factors are EPA standard default values for adult residents. For noncarcinogenic effects, all of the exposure factors are the same as the carcinogenic exposure factors except the averaging time is 30 years and, instead of a target excess lifetime cancer risk, the target hazard index is 1.

B.2 SURFACE SOIL

One metal (molybdenum) and one PCB (Aroclor-1254) were detected at low frequency (<5% detection) in surface soil samples. Table B-1 presents a comparison of the maximum detected concentrations and the maximum nondetect value to the health-based screening criteria (both cancer and non-cancer). Chemicals whose maximum detected concentration were greater than 1000 times either the cancer or non-cancer RBCs will be retained for further evaluation as special case chemicals of concern. Table B-1 shows that neither molybdenum nor Aroclor-1254 had concentrations above the 1000 times the RBC, and therefore they will not require further evaluation in the risk assessment.

Chemicals whose maximum nondetect value exceeds the RBC may also require additional evaluation (if the CRQL for that chemical is less than the RBC). The maximum nondetect value for Aroclor-1254 (0.25 mg/kg) exceeded the RBC (0.083 mg/kg) by a factor of 3, and 100 percent of the nondetect values exceeded the RBC by factors of 3 or less. All surface soil samples analyzed for PCBs were analyzed by the pesticide/PCB contract laboratory program method (PESTCLP), which has a CRQL of 0.16 mg/kg for Aroclor-1254. Since the CRQL exceeds the RBC, and the maximum nondetect value exceeded the CRQL by only a factor of 2, the data are adequate for use in the risk characterization and frequency determination.

B.3 SUBSURFACE SOIL

Eighteen organic compounds and 3 metals were reported at less than 5 percent frequency in subsurface soils. These are listed in Table B-2. None of the 18 organic chemicals exceeded 1000 times the RBC, and therefore they will not require further evaluation in the risk assessment. Since the three metals did not exceed background levels, they did not require evaluation in the RBC screen. Maximum nondetect values for all 18 chemicals and 3 metals were also below RBCs and no further evaluation of detection limits was required.

B.4 GROUNDWATER

Table B-3 lists 15 organic chemicals and 1 metal detected at less than 5 percent frequency in groundwater. Cesium did not exceed background levels and therefore did not require evaluation in the RBC screen. Of the organic chemicals, 1,2,4-trimethylbenzene and 2-hexanone do not have RBCs. Vinyl chloride exceeded 1000 times the RBC and will be retained as a special-case COC in the risk assessment. None of the remaining chemicals had maximum concentrations above 1000 times the RBC and they will not require further evaluation in the risk assessment.

The maximum nondetect values were compared to RBCs. Five chemicals (excluding vinyl chloride, which was already determined to be a special-case COC) had a high percentage of nondetect values that exceeded the RBC. These five chemicals are 1,1-dichloroethene, 1,2-dichloroethane, benzene, carbon tetrachloride, and chloromethane. The majority (83%) of the samples were analyzed using the Volatile Organic Analyte Contract Laboratory Program (VOACLP) analysis. The CRQLs are 0.005 mg/L for 1,1-dichloroethene, 1,2-dichloroethane, benzene, and carbon tetrachloride, and 0.01 mg/L for chloromethane. Maximum nondetect values, which ranged from 0.01 to 0.02 mg/L for these chemicals, exceeded the CRQLs by only a factor of 2. All of the CRQLs for these chemicals exceed the RBC, and the nondetect values were not significantly higher than the CRQLs. Therefore, the data are adequate for risk characterization and frequency determination.

B.5 POND SEDIMENT

Thirteen organic compounds and 1 metal (tin) were detected at less than 5 percent frequency in pond sediments. Tin did not exceed background levels and therefore did not require evaluation in the RBC screen. Dibenzofuran and 2-methylnaphthalene were detected at low frequency, but do not have RBCs. The remaining eleven organic chemicals are listed on Table B-4. None of them were detected at concentrations exceeding 1000 times the RBC, and they will not require further evaluation in the risk assessment.

The maximum nondetect values were also compared to RBCs. All nondetect values of Aroclor-1260 and dibenzo(a,h)anthracene exceeded RBCs. The PESTCLP and Base Neutral Acid Contract Laboratory Program (BNACLP) methods were used for analysis of pond sediment. The CRQLs for Aroclor-1260 and dibenzo(a,h)anthracene are 0.16 mg/kg and 0.33 mg/kg, respectively. Both CRQLs exceed RBCs, and the nondetect values exceeded the CRQLs by only a factor of 3. Therefore the data are adequate for risk characterization and frequency determination.

B.6 POND SURFACE WATER

Table B-5 lists the four VOCs and one metal detected at low frequency in pond surface water. Beryllium did not exceed background levels based on statistical comparison to background data. None of the chemicals were detected at concentrations that exceeded the 1000 times the RBC, and they do not require further evaluation in the risk assessment.

The maximum nondetect values for these chemicals, including beryllium, were also compared to RBCs. Beryllium, 1,2-dichloroethene, methylene chloride, and tetrachloroethene all had nondetect values that exceeded RBCs. All of the samples were analyzed using the respective CLP method. Beryllium, 1,2-dichloroethene, and tetrachloroethene all had CRQLs of 0.005 mg/L, which exceeds the respective RBCs. However, since their respective maximum nondetect values were equal to the CRQLs, the data for these analytes are considered adequate for risk characterization and frequency determination.

The CRQL for methylene chloride (also 0.005 mg/L) does not exceed the RBC. Furthermore, all nondetect values for methylene chloride that exceeded the RBC were B-qualified (detected in laboratory method blanks). Therefore, the reporting limits are considered adequate for identifying the frequency of detection of methylene chloride as an environmental contaminant.

B.7 STREAM SEDIMENT

No chemicals were detected at low frequency in stream sediments. Therefore, a risk-based screening of infrequently detected chemicals was not applicable to this medium.

References

DOE. 1995. Programmatic Risk-Based Preliminary Remediation Goals. Final, Revision 2. Rocky Flats Environmental Technology Site. Golden, CO. February 1995.

EPA. 1992. Guidance for Data Useability in Risk Assessment (Part A). Final. Office of Emergency and Remedial Response. Washington, D.C. 9285.7-09A. April.

TABLE B-1
ROCKY FLATS OU6
COMPARISON TO RBCs
FOR INFREQUENTLY DETECTED COMPOUNDS
SURFACE SOIL

Chemical	Range of Detected Concentrations (mg/kg)	Detection Frequency %	Reporting Limit (mg/kg)	Minimum Nondetect Value (mg/kg)	Maximum Nondetect Value (mg/kg)	Residential Soil RBC (mg/kg)	Max. Detected Concentration> RBC?	Max. Detected Concentration> 1000 x RBC?	Max Nondetect> RBC?	Percent of Nondetects > RBC
Organic Compounds:										
Aroclor-1254 [1]	0.425	1	0.16	0.17	0.25	8.32E-02	YES	NO	YES	100
Metals:										
Molybdenum	9.9	1	40	2.5	5.3	1.37E+03	NO	NO	NO	0

Note: If the Contract Required Quantitation Limit (CRQL) exceeds the RBC, the data were considered adequate for chemical characterization and frequency determination.

[1] The CRQL for Aroclor-1254 (0.16 mg/kg) exceeds the RBC (0.083 mg/kg) by a factor of 2.

TABLE B-2
ROCKY FLATS OU6
COMPARISON TO RBCs
FOR INFREQUENTLY DETECTED COMPOUNDS
SUBSURFACE SOIL

Chemical	Range of Detected Concentrations (mg/kg)	Detection Frequency %	Reporting Limit (mg/kg)	Minimum Nondetect Value (mg/kg)	Maximum Nondetect Value (mg/kg)	Construction Worker Soil RBC (mg/kg)	Max. Detected Concentration> RBC?	Max. Detected Concentration > 1000 x RBC?	Max Nondetect> RBC?	Percent of Nondetects > RBC
Organic Compounds:										
1,4-Dichlorobenzene	0.064	4	0.33	0.35	0.41	5.17E+03	NO	NO	NO	0
4-Methyl-2-pentanone	0.001-0.004	1	0.01	0.01	1.5	1.42E+05	NO	NO	NO	0
Acenaphthene	0.056	4	0.33	0.35	0.41	1.06E+05	NO	NO	NO	0
Benzene	0.001-0.006	1	0.005	0.005	0.77	1.43E+03	NO	NO	NO	0
Benzo(a)anthracene	0.099	4	0.33	0.35	0.41	1.70E+02	NO	NO	NO	0
Benzo(k)fluoranthene	0.06	4	0.33	0.35	0.41	1.70E+03	NO	NO	NO	0
Chlorobenzene	0.074	0.3	0.005	0.005	0.77	9.96E+03	NO	NO	NO	0
Chloroform	0.002	0.3	0.005	0.005	0.77	6.34E+02	NO	NO	NO	0
Chrysene	0.12	4	0.33	0.35	0.41	1.70E+04	NO	NO	NO	0
Diethyl phthalate	0.3	4	0.33	0.35	0.41	1.00E+06	NO	NO	NO	0
Di-n-octyl-phthalate	0.072	4	0.33	0.35	0.41	8.87E+03	NO	NO	NO	0
Indeno(1,2,3-cd)pyrene	0.099	4	0.33	0.35	0.41	1.70E+02	NO	NO	NO	0
Methylene chloride	0.001-0.007	0.3	0.005	0.005	3.75	1.66E+04	NO	NO	NO	0
Pentachlorophenol	0.66	4	1.6	1.7	2	1.03E+03	NO	NO	NO	0
Phenol	0.055	4	0.33	0.35	0.41	1.00E+06	NO	NO	NO	0
Styrene	0.001	0.3	0.005	0.005	0.77	2.13E+05	NO	NO	NO	0
Trichloroethene	0.006-0.021	2	0.005	0.005	0.77	5.44E+03	NO	NO	NO	0
Xylenes, total	0.002	0.3	0.005	0.005	0.77	1.00E+06	NO	NO	NO	0
Metals:										
Molybdenum	-[1]	2	40	2.4	4.9	8.87E+03	-	-	NO	0
Silver	-[1]	0.4	2	0.73	1.5	8.87E+03	-	-	NO	0
Tin	-[1]	3	40	10.2	23.4	1.00E+06	-	-	NO	0

[1] These analytes are not potential chemicals of concern based on the statistical comparison to background levels.

TABLE B-3
ROCKY FLATS OU6
COMPARISON TO RBCs
FOR INFREQUENTLY DETECTED COMPOUNDS
UHSU GROUNDWATER

Chemical	Range of Detected Concentrations (mg/l)	Detection Frequency %	Reporting Limit (mg/l)	Minimum Nondetect Value (mg/l)	Maximum Nondetect Value (mg/l)	Residential Groundwater RBC (mg/l)	Max. Detected Concentration> RBC?	Max. Detected Concentration> 1000 x RBC?	Max. Nondetect> RBC?	Percent of Nondetects > RBC
Organic Compounds:										
1,1-Dichloroethene [1]	0.0002-0.005	1	0.0002-0.01	0.0001	0.01	6.77E-05	YES	NO	YES	100
1,2-Dichloroethane [2]	0.001-0.002	1	0.0004-0.01	0.0007	0.01	1.97E-04	YES	NO	YES	100
1,2-Dichloroethene, trans	0.009	2	0.00003-0.005	0.0001	0.005	3.28E-01	NO	NO	NO	0
1,2,4-Trimethylbenzene	0.0002	3	0.00002-0.0005	0.0002	0.0005	-	-	-	-	0
2-Butanone	0.001	1	0.01	0.01	0.02	2.47E+00	NO	NO	NO	0
2-Hexanone	0.005	0.4	0.01	0.01	0.02	-	-	-	-	0
4-Methyl-2-pentanone	0.001-0.002	1	0.01	0.01	0.02	2.03E-01	NO	NO	NO	0
Benzene [3]	0.0002-0.003	3	0.00001-0.01	0.0001	0.01	6.17E-04	YES	NO	YES	88
Carbon disulfide	0.0004-0.004	1	0.0005-0.01	0.005	0.01	2.76E-02	NO	NO	NO	0
Carbon tetrachloride [4]	0.002-0.008	4	0.0002-0.01	0.0001	0.01	2.60E-04	YES	NO	YES	87
Chloromethane [5]	0.00025	0.4	0.0002-0.01	0.002	0.02	2.32E-03	NO	NO	YES	98
Ethylbenzene	0.0002-0.001	2	0.0001-0.01	0.0001	0.01	1.58E+00	NO	NO	NO	0
Styrene	0.00011	0.4	0.0001-0.01	0.0001	0.01	2.01E+00	NO	NO	NO	0
Vinyl chloride[6]	0.22-0.86	3	0.00001-0.01	0.0002	0.01	2.81E-05	YES	YES	YES	100
Xylenes (total)	0.0007-0.014	4	0.0003-0.01	0.003	0.01	7.30E+01	NO	NO	NO	0
Metals:										
Cesium	-[7]	2	0.5-1	0.002-0.617	0.617	-	-	-	-	0

Note: If the Contract Required Quantitation Limit (CRQL) exceeds the RBC, the data were considered adequate for chemical characterization and frequency determination.

[1] The CRQL for 1,1-dichloroethene (0.005 mg/l) exceeds the RBC.
[2] The CRQL for 1,2-dichloroethane (0.005 mg/l) exceeds the RBC.
[3] The CRQL for benzene (0.005 mg/l) exceeds the RBC.
[4] The CRQL for carbon tetrachloride (0.005 mg/l) exceeds the RBC.
[5] The CRQL for chloromethane (0.01 mg/l) exceeds the RBC.
[6] The CRQL for vinyl chloride (0.01) exceeds the RBC.
[7] This analyte is not a potential chemical of concern based on the statistical comparison to background levels..

TABLE B-4
ROCKY FLATS OU6
COMPARISON TO RBCs
FOR INFREQUENTLY DETECTED COMPOUNDS
POND SEDIMENT

Chemical	Range of Detected Concentrations (mg/kg)	Detection Frequency %	Reporting Limit (mg/kg)	Minimum Nondetect Value (mg/kg)	Maximum Nondetect Value (mg/kg)	Residential Soil RBC (mg/kg)	Max. Detected Concentration> RBC?	Max. Detected Concentration> 1000 x RBC?	Max Nondetect> RBC?	Percent of Nondetects > RBC
Organic Compounds:										
1,2,4-Trichlorobenzene	0.13	2	0.33	0.46	0.99	2.74E+03	NO	NO	NO	0
2-Methylnaphthalene	0.17	2	0.33	0.46	0.99	-	-	-	-	0
4-Methyl-2-pentanone	0.006	2	0.01	0.014	3.1	1.37E+04	NO	NO	NO	0
Aldrin	0.054	2	0.008	0.011	0.024	3.77E-02	YES	NO	NO	0
Aroclor-1260 [1]	0.62-0.86	4	0.16	0.22	0.48	8.32E-02	YES	NO	YES	100
Dibenzo(a,h)anthracene [2]	0.15	2	0.33	0.46	0.99	8.77E-02	YES	NO	YES	100
Dibenzofuran	0.18	2	0.33	0.46	0.99	-	-	-	-	0
Fluorene	0.31-0.46	4	0.33	0.46	0.99	1.10E+04	NO	NO	NO	0
gamma-BHC (Lindane)	0.025	2	0.008	0.011	0.024	4.93E-01	NO	NO	NO	0
Heptachlor	0.039	1	0.008	0.011	0.024	1.42E-01	NO	NO	NO	0
Methylene chloride	0.009	2	0.005	0.008	8.3	8.54E+01	NO	NO	NO	0
Naphthalene	0.39	2	0.33	0.46	0.99	1.10E+04	NO	NO	NO	0
Phenol	0.11-0.29	4	0.33	0.46	0.99	1.65E+05	NO	NO	NO	0
Metals:										
Tin	-[3]	2	40	19.1	61.9	-	-	-	-	0

Note: If the Contract Required Quantitation Limit (CRQL) exceeds the RBC, the data were considered adequate for chemical characterization and frequency determination.

[1] The CRQL for Aroclor-1254 (0.16 mg/kg) exceeds the RBC.
[2] The CRQL for dibenzo(a,h)anthracene (0.33 mg/kg) exceeds the RBC.
[3] This analyte is not a potential chemical of concern based on the statistical comparison.

TABLE B-5
ROCKY FLATS OU6
COMPARISON TO RBCs
FOR INFREQUENTLY DETECTED COMPOUNDS
POND SURFACE WATER

Chemical	Range of Detected Concentrations (mg/l)	Detection Frequency %	Reporting Limit (mg/l)	Minimum Nondetect Value (mg/l)	Maximum Nondetect Value (mg/l)	Residential Groundwater RBC (mg/l)	Max. Detected Concentration> RBC?	Max. Detected Concentration> 1000 x RBC?	Max Nondetect> RBC?	Percent of Nondetects > RBC
Organic Compounds:										
1,2-Dichloroethane [1]	0.001	2	0.005	0.005	0.005	1.97E-04	YES	NO	YES	100
Acetone	0.009-0.018	4	0.01	0.01	0.14	3.65E+00	NO	NO	NO	0
Methylene chloride [2]	0.002-0.034	4	0.005	0.005	0.046	6.22E-03	YES	NO	YES	49
Tetrachloroethene [3]	0.006-0.012	4	0.005	0.005	0.005	1.43E-03	YES	NO	YES	100
Metals:										
Beryllium [4]	- [5]	4	0.005	0.0003	0.0004	1.98E-05	YES	NO	YES	100

Note: If the Contract Required Quanitation Limit (CRQL) exceeds the RBC, the data were considered adequate for chemical characterization and frequency determination.

[1] The CRQL for 1,2-dichloroethane (0.005 mg/l) exceeds the RBC.
[2] All of the nondetect values for methylene chloride that exceeded the RBC were B-qualified.
[3] The CRQL for tetrachloroethene (0.005 mg/l) exceeds the RBC.
[4] The CRQL for beryllium (0.005 mg/l) exceeds the RBC.
[5] This analyte is not a potential chemical of concern based on the statistical comparison.

ATTACHMENT C

TOTAL SUSPENDED AND DISSOLVED SOLIDS IN GROUNDWATER

ROCKY FLATS OU6
TOTAL DISSOLVED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
02691	GW02172IT	12/19/91	TOTAL DISSOLVED SOLIDS	450.00	10.00	MG/L		V
02691	GW02513IT	2/27/92	TOTAL DISSOLVED SOLIDS	440.00	10.00	MG/L		V
02691	GW02856IT	5/14/92	TOTAL DISSOLVED SOLIDS	330.00	10.00	MG/L		V
02691	GW03215IT	8/3/92	TOTAL DISSOLVED SOLIDS	500.00	10.00	MG/L		V
02691	GW03826IT	11/9/92	TOTAL DISSOLVED SOLIDS	470.00	10.00	MG/L		V
02691	GW00260WC	2/22/93	TOTAL DISSOLVED SOLIDS	450.00	14.00	MG/L		V
02691	GW00693WC	5/4/93	TOTAL DISSOLVED SOLIDS	440.00	14.00	MG/L		JA
02691	GW01218WC	8/30/93	TOTAL DISSOLVED SOLIDS	396.00	14.00	MG/L		V
02691	GW01630WC	11/30/93	TOTAL DISSOLVED SOLIDS	440.00	10.00	MG/L		V
0486	GW01456IT	6/20/91	TOTAL DISSOLVED SOLIDS	370.00	10.00	MG/L		V
0486	GW01763IT	9/12/91	TOTAL DISSOLVED SOLIDS	370.00	10.00	MG/L		V
0486	GW02027IT	11/14/91	TOTAL DISSOLVED SOLIDS	440.00	10.00	MG/L		V
0486	GW02613IT	4/1/92	TOTAL DISSOLVED SOLIDS	400.00	10.00	MG/L		V
0486	GW02957IT	6/11/92	TOTAL DISSOLVED SOLIDS	510.00	5.00	MG/L		
0486	GW03391IT	9/15/92	TOTAL DISSOLVED SOLIDS	350.00	14.00	MG/L		V
0486	GW03807IT	11/18/92	TOTAL DISSOLVED SOLIDS	410.00	14.00	MG/L		V
0586	GW01538IT	7/18/91	TOTAL DISSOLVED SOLIDS	5100.00	10.00	MG/L		V
0586	GW02670IT	4/23/92	TOTAL DISSOLVED SOLIDS	4300.00	10.00	MG/L		V
0586	GW00549WC	4/15/93	TOTAL DISSOLVED SOLIDS	4700.00	14.00	MG/L		V
0686	GW02671IT	4/15/92	TOTAL DISSOLVED SOLIDS	1900.00	10.00	MG/L		V
0686	GW03150IT	7/16/92	TOTAL DISSOLVED SOLIDS	3600.00	10.00	MG/L		V
1186	GW00998IT	3/18/91	TOTAL DISSOLVED SOLIDS	490.00	10.00	MG/L		
1186	GW01225IT	5/2/91	TOTAL DISSOLVED SOLIDS	510.00	10.00	MG/L		V
1186	GW01539IT	7/19/91	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		V
1186	GW01902IT	10/15/91	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		V
1186	GW02242IT	1/21/92	TOTAL DISSOLVED SOLIDS	520.00	10.00	MG/L		V
1186	GW02669IT	4/14/92	TOTAL DISSOLVED SOLIDS	500.00	10.00	MG/L		V
1186	GW03152IT	7/14/92	TOTAL DISSOLVED SOLIDS	580.00	10.00	MG/L		V
1186	GW03618IT	10/7/92	TOTAL DISSOLVED SOLIDS	530.00	14.00	MG/L		V
1286	GW02245IT	1/20/92	TOTAL DISSOLVED SOLIDS	1600.00	10.00	MG/L		V
1286	GW02677IT	4/15/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
1286	GW03095IT	7/13/92	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V
1386	GW00972IT	3/15/91	TOTAL DISSOLVED SOLIDS	690.00	10.00	MG/L		
1386	GW01210IT	4/24/91	TOTAL DISSOLVED SOLIDS	690.00	10.00	MG/L		V
1386	GW01482IT	7/16/91	TOTAL DISSOLVED SOLIDS	770.00	10.00	MG/L		
1386	GW01880IT	10/22/91	TOTAL DISSOLVED SOLIDS	720.00	10.00	MG/L		V
1386	GW02237IT	1/14/92	TOTAL DISSOLVED SOLIDS	710.00	10.00	MG/L		V
1386	GW02659IT	4/15/92	TOTAL DISSOLVED SOLIDS	690.00	10.00	MG/L		V
1386	GW03232IT	7/30/92	TOTAL DISSOLVED SOLIDS	760.00	10.00	MG/L		V
1386	GW03621IT	10/13/92	TOTAL DISSOLVED SOLIDS	690.00	14.00	MG/L		V
1386	GW00145WC	2/2/93	TOTAL DISSOLVED SOLIDS	780.00	14.00	MG/L		V
1386	GW00562WC	4/13/93	TOTAL DISSOLVED SOLIDS	740.00	14.00	MG/L		V
1386	GW01132WC	8/4/93	TOTAL DISSOLVED SOLIDS	770.00	10.00	MG/L		V
1386	GW01421WC	10/28/93	TOTAL DISSOLVED SOLIDS	751.00	14.00	MG/L		V
1386	GW00046GA	1/20/94	TOTAL DISSOLVED SOLIDS	700.00	10.00	MG/L		Y
1586	GW00904IT	3/4/91	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		
1586	GW01120IT	4/18/91	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
1586	GW01509IT	7/11/91	TOTAL DISSOLVED SOLIDS	1200.00	10.00	MG/L		
1586	GW01882IT	10/21/91	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V

ROCKY FLATS OU6
TOTAL DISSOLVED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
1586	GW02240IT	1/15/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
1586	GW02676IT	4/13/92	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V
1586	GW03182IT	7/16/92	TOTAL DISSOLVED SOLIDS	1200.00	10.00	MG/L		V
1586	GW03627IT	10/7/92	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V
1586	GW00136WC	2/5/93	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
1586	GW00555WC	4/13/93	TOTAL DISSOLVED SOLIDS	1100.00	14.00	MG/L		V
1586	GW01125WC	8/2/93	TOTAL DISSOLVED SOLIDS	1097.00	14.00	MG/L		JA
1586	GW01415WC	10/20/93	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V
1786	GW00905IT	3/4/91	TOTAL DISSOLVED SOLIDS	4420.00		MG/L		V
1786	GW01116IT	4/18/91	TOTAL DISSOLVED SOLIDS	5000.00	10.00	MG/L		V
1786	GW01474IT	7/9/91	TOTAL DISSOLVED SOLIDS	5000.00	10.00	MG/L		
1786	GW01878IT	10/10/91	TOTAL DISSOLVED SOLIDS	4100.00	10.00	MG/L		V
1786	GW02640IT	4/7/92	TOTAL DISSOLVED SOLIDS	3700.00	10.00	MG/L		V
1786	GW03190IT	7/27/92	TOTAL DISSOLVED SOLIDS	4900.00	10.00	MG/L		V
1786	GW03630IT	10/7/92	TOTAL DISSOLVED SOLIDS	4360.00	10.00	MG/L		V
1786	GW00138WC	2/1/93	TOTAL DISSOLVED SOLIDS	4400.00	14.00	MG/L		V
1786	GW00557WC	4/16/93	TOTAL DISSOLVED SOLIDS	4600.00	10.00	MG/L		
1786	GW01127WC	8/2/93	TOTAL DISSOLVED SOLIDS	4331.00	14.00	MG/L		JA
1786	GW01416WC	10/29/93	TOTAL DISSOLVED SOLIDS	3900.00	10.00	MG/L		V
3586	GW00976IT	3/14/91	TOTAL DISSOLVED SOLIDS	950.00	10.00	MG/L		
3586	GW01221IT	4/29/91	TOTAL DISSOLVED SOLIDS	920.00	10.00	MG/L		V
3586	GW01461IT	7/9/91	TOTAL DISSOLVED SOLIDS	950.00	10.00	MG/L		
3586	GW01818IT	10/8/91	TOTAL DISSOLVED SOLIDS	980.00	10.00	MG/L		V
3586	GW02195IT	1/10/92	TOTAL DISSOLVED SOLIDS	920.00	10.00	MG/L		V
3586	GW02631IT	4/7/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
3586	GW03217IT	8/5/92	TOTAL DISSOLVED SOLIDS	1000.00	14.00	MG/L		V
3586	GW03828IT	12/10/92	TOTAL DISSOLVED SOLIDS	950.00	10.00	MG/L		V
3586	GW00262WC	3/5/93	TOTAL DISSOLVED SOLIDS	810.00	10.00	MG/L		V
3586	GW00695WC	5/6/93	TOTAL DISSOLVED SOLIDS	900.00	10.00	MG/L		V
3586	GW01244WC	9/22/93	TOTAL DISSOLVED SOLIDS	930.00	10.00	MG/L		V
3586	GW01701WC	12/13/93	TOTAL DISSOLVED SOLIDS	900.00	10.00	MG/L		Y
3686	GW01222IT	4/30/91	TOTAL DISSOLVED SOLIDS	1400.00	10.00	MG/L		V
3686	GW02632IT	4/8/92	TOTAL DISSOLVED SOLIDS	1200.00	10.00	MG/L		V
3786	GW00995IT	3/19/91	TOTAL DISSOLVED SOLIDS	2200.00	10.00	MG/L		
3786	GW01223IT	4/30/91	TOTAL DISSOLVED SOLIDS	1900.00	10.00	MG/L		V
3786	GW01521IT	7/17/91	TOTAL DISSOLVED SOLIDS	2100.00	10.00	MG/L		V
3786	GW01899IT	10/15/91	TOTAL DISSOLVED SOLIDS	1900.00	10.00	MG/L		V
3786	GW02656IT	4/14/92	TOTAL DISSOLVED SOLIDS	2300.00	10.00	MG/L		V
3786	GW03233IT	9/18/92	TOTAL DISSOLVED SOLIDS	2450.00	10.00	MG/L		V
3786	GW03641IT	10/13/92	TOTAL DISSOLVED SOLIDS	2500.00	14.00	MG/L		V
3786	GW01362WC	9/23/93	TOTAL DISSOLVED SOLIDS	2400.00	10.00	MG/L		V
3786	GW01685WC	12/13/93	TOTAL DISSOLVED SOLIDS	2300.00	10.00	MG/L		Y
3786	GW00155GA	1/27/94	TOTAL DISSOLVED SOLIDS	2200.00	10.00	MG/L		Y
3886	GW01224IT	5/6/91	TOTAL DISSOLVED SOLIDS	1400.00	10.00	MG/L		V
3886	GW02657IT	4/13/92	TOTAL DISSOLVED SOLIDS	1600.00	10.00	MG/L		V
3886	GW00128WC	3/2/93	TOTAL DISSOLVED SOLIDS	1600.00	14.00	MG/L		V
3886	GW00552WC	4/14/93	TOTAL DISSOLVED SOLIDS	1900.00	14.00	MG/L		V
4087	GW01529IT	7/17/91	TOTAL DISSOLVED SOLIDS	1400.00	10.00	MG/L		
4087	GW02313IT	2/21/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V

ROCKY FLATS OU6
TOTAL DISSOLVED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
4087	GW02790IT	4/28/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
4087	GW00501WC	4/20/93	TOTAL DISSOLVED SOLIDS	850.00	14.00	MG/L		V
41091	GW02171IT	12/20/91	TOTAL DISSOLVED SOLIDS	530.00	10.00	MG/L		V
41091	GW02609IT	3/17/92	TOTAL DISSOLVED SOLIDS	550.00	10.00	MG/L		V
41091	GW03050IT	6/11/92	TOTAL DISSOLVED SOLIDS	600.00	5.00	MG/L		
41091	GW03153IT	7/22/92	TOTAL DISSOLVED SOLIDS	440.00	10.00	MG/L		V
41091	GW03616IT	10/9/92	TOTAL DISSOLVED SOLIDS	632.00	10.00	MG/L		V
41091	GW00125WC	2/18/93	TOTAL DISSOLVED SOLIDS	430.00	10.00	MG/L		V
41091	GW00550WC	5/11/93	TOTAL DISSOLVED SOLIDS	520.00	14.00	MG/L		V
41091	GW01172WC	8/13/93	TOTAL DISSOLVED SOLIDS	480.00	10.00	MG/L		V
41091	GW01286WC	9/16/93	TOTAL DISSOLVED SOLIDS	520.00	10.00	MG/L		V
41091	GW01475WC	11/8/93	TOTAL DISSOLVED SOLIDS	524.00	14.00	MG/L		Y
41691	GW02090IT	12/7/91	TOTAL DISSOLVED SOLIDS	430.00	10.00	MG/L		V
41691	GW02615IT	4/1/92	TOTAL DISSOLVED SOLIDS	680.00	10.00	MG/L		V
41691	GW02953IT	6/11/92	TOTAL DISSOLVED SOLIDS	560.00	5.00	MG/L		
41691	GW03396IT	9/16/92	TOTAL DISSOLVED SOLIDS	528.00	10.00	MG/L		V
41691	GW03806IT	11/18/92	TOTAL DISSOLVED SOLIDS	410.00	10.00	MG/L		V
41691	GW00440WC	3/17/93	TOTAL DISSOLVED SOLIDS	310.00	10.00	MG/L		V
41691	GW01010WC	6/22/93	TOTAL DISSOLVED SOLIDS	540.00	10.00	MG/L		V
41691	GW01357WC	9/20/93	TOTAL DISSOLVED SOLIDS	396.00	14.00	MG/L		V
41691	GW01549WC	12/9/93	TOTAL DISSOLVED SOLIDS	400.00	14.00	MG/L		Y
41691	GW00247GA	2/16/94	TOTAL DISSOLVED SOLIDS	410.00	10.00	MG/L		Y
41691	GW00248GA	2/16/94	TOTAL DISSOLVED SOLIDS	490.00	10.00	MG/L		Y
41691	GW00274GA	2/18/94	TOTAL DISSOLVED SOLIDS	388.00	10.00	MG/L		Y
41691	GW00275GA	2/18/94	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		Y
41691	GW00290GA	2/21/94	TOTAL DISSOLVED SOLIDS	830.00	10.00	MG/L		Y
41691	GW00291GA	2/24/94	TOTAL DISSOLVED SOLIDS	640.00	10.00	MG/L		Y
41691	GW00400GA	3/3/94	TOTAL DISSOLVED SOLIDS	460.00	10.00	MG/L		Y
4287	GW01231IT	5/3/91	TOTAL DISSOLVED SOLIDS	350.00	10.00	MG/L		V
4287	GW02246IT	1/16/92	TOTAL DISSOLVED SOLIDS	330.00	10.00	MG/L		V
4287	GW02672IT	4/21/92	TOTAL DISSOLVED SOLIDS	310.00	10.00	MG/L		V
4287	GW00122WC	2/17/93	TOTAL DISSOLVED SOLIDS	280.00	10.00	MG/L		V
4287	GW00548WC	5/11/93	TOTAL DISSOLVED SOLIDS	360.00	14.00	MG/L		V
4287	GW00031GA	1/18/94	TOTAL DISSOLVED SOLIDS	374.00	14.00	MG/L		Y
7087	GW01540IT	7/19/91	TOTAL DISSOLVED SOLIDS	500.00	10.00	MG/L		V
7087	GW01957IT	10/31/91	TOTAL DISSOLVED SOLIDS	510.00	10.00	MG/L		V
7087	GW02303IT	2/21/92	TOTAL DISSOLVED SOLIDS	500.00	10.00	MG/L		V
7087	GW02776IT	4/28/92	TOTAL DISSOLVED SOLIDS	450.00	10.00	MG/L		V
7087	GW03094IT	7/23/92	TOTAL DISSOLVED SOLIDS	520.00	10.00	MG/L		V
7087	GW03608IT	10/6/92	TOTAL DISSOLVED SOLIDS	550.00	14.00	MG/L		V
7087	GW00523WC	4/12/93	TOTAL DISSOLVED SOLIDS	520.00	14.00	MG/L		V
7087	GW01117WC	8/10/93	TOTAL DISSOLVED SOLIDS	527.00	14.00	MG/L		V
7087	GW00037GA	1/20/94	TOTAL DISSOLVED SOLIDS	470.00	10.00	MG/L		Y
7187	GW00903IT	3/4/91	TOTAL DISSOLVED SOLIDS	260.00	10.00	MG/L		
7187	GW01183IT	4/22/91	TOTAL DISSOLVED SOLIDS	270.00	10.00	MG/L		V
7187	GW01541IT	7/17/91	TOTAL DISSOLVED SOLIDS	300.00	10.00	MG/L		V
7187	GW01886IT	10/9/91	TOTAL DISSOLVED SOLIDS	300.00	10.00	MG/L		V
7187	GW02279IT	1/16/92	TOTAL DISSOLVED SOLIDS	235.00	10.00	MG/L		V
7187	GW02681IT	4/20/92	TOTAL DISSOLVED SOLIDS	275.00	10.00	MG/L		V

ROCKY FLATS OU6
TOTAL DISSOLVED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
7187	GW03148IT	7/22/92	TOTAL DISSOLVED SOLIDS	290.00	10.00	MG/L		V
7187	GW03580IT	10/9/92	TOTAL DISSOLVED SOLIDS	302.00	10.00	MG/L		V
7187	GW00091WC	2/19/93	TOTAL DISSOLVED SOLIDS	255.00	10.00	MG/L		V
7187	GW00502WC	4/9/93	TOTAL DISSOLVED SOLIDS	260.00	10.00	MG/L		V
7187	GW01094WC	8/11/93	TOTAL DISSOLVED SOLIDS	281.50	14.00	MG/L		V
7187	GW01434WC	11/3/93	TOTAL DISSOLVED SOLIDS	275.00	10.00	MG/L		V
7287	GW00944IT	3/11/91	TOTAL DISSOLVED SOLIDS	300.00	10.00	MG/L		
7287	GW01212IT	4/23/91	TOTAL DISSOLVED SOLIDS	300.00	10.00	MG/L		V
7287	GW01524IT	7/15/91	TOTAL DISSOLVED SOLIDS	360.00	10.00	MG/L		
7287	GW02309IT	2/20/92	TOTAL DISSOLVED SOLIDS	340.00	10.00	MG/L		V
7287	GW02783IT	4/23/92	TOTAL DISSOLVED SOLIDS	400.00	10.00	MG/L		V
7287	GW03089IT	7/7/92	TOTAL DISSOLVED SOLIDS	220.00	10.00	MG/L		V
7287	GW03604IT	10/7/92	TOTAL DISSOLVED SOLIDS	380.00	10.00	MG/L		V
7287	GW00113WC	2/1/93	TOTAL DISSOLVED SOLIDS	350.00	14.00	MG/L		V
7287	GW00519WC	4/8/93	TOTAL DISSOLVED SOLIDS	340.00	10.00	MG/L		V
7287	GW01113WC	8/9/93	TOTAL DISSOLVED SOLIDS	307.00	14.00	MG/L		V
7287	GW01391WC	10/13/93	TOTAL DISSOLVED SOLIDS	380.00	10.00	MG/L		V
76292	GW00467WC	3/22/93	TOTAL DISSOLVED SOLIDS	430.00	14.00	MG/L		
76292	GW00533WC	4/21/93	TOTAL DISSOLVED SOLIDS	380.00	14.00	MG/L		
77492	GW00469WC	3/22/93	TOTAL DISSOLVED SOLIDS	760.00	14.00	MG/L		
77492	GW00534WC	4/21/93	TOTAL DISSOLVED SOLIDS	740.00	14.00	MG/L		
B206489	GW00956IT	3/12/91	TOTAL DISSOLVED SOLIDS	308.00	10.00	MG/L		V
B206489	GW01525IT	7/16/91	TOTAL DISSOLVED SOLIDS	370.00	10.00	MG/L		
B206489	GW01959IT	10/31/91	TOTAL DISSOLVED SOLIDS	360.00	10.00	MG/L		V
B206489	GW02310IT	2/20/92	TOTAL DISSOLVED SOLIDS	320.00	10.00	MG/L		V
B206489	GW02720IT	4/16/92	TOTAL DISSOLVED SOLIDS	430.00	10.00	MG/L		V
B206489	GW03246IT	7/30/92	TOTAL DISSOLVED SOLIDS	420.00	10.00	MG/L		V
B206489	GW00116WC	2/2/93	TOTAL DISSOLVED SOLIDS	340.00	14.00	MG/L		V
B206489	GW00522WC	4/8/93	TOTAL DISSOLVED SOLIDS	330.00	10.00	MG/L		V
B206589	GW00943IT	3/12/91	TOTAL DISSOLVED SOLIDS	504.00	10.00	MG/L		V
B206589	GW01526IT	7/16/91	TOTAL DISSOLVED SOLIDS	1500.00	10.00	MG/L		
B206589	GW01961IT	10/31/91	TOTAL DISSOLVED SOLIDS	520.00	10.00	MG/L		V
B206589	GW02311IT	2/7/92	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		V
B206589	GW02721IT	4/21/92	TOTAL DISSOLVED SOLIDS	580.00	10.00	MG/L		V
B206589	GW03091IT	7/14/92	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		V
B206589	GW03609IT	10/6/92	TOTAL DISSOLVED SOLIDS	570.00	14.00	MG/L		V
B206589	GW00118WC	2/2/93	TOTAL DISSOLVED SOLIDS	580.00	14.00	MG/L		V
B206589	GW00524WC	4/16/93	TOTAL DISSOLVED SOLIDS	600.00	10.00	MG/L		
B206589	GW01118WC	8/12/93	TOTAL DISSOLVED SOLIDS	590.00	10.00	MG/L		V
B206589	GW01406WC	11/5/93	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		V
B206589	GW00038GA	1/20/94	TOTAL DISSOLVED SOLIDS	560.00	10.00	MG/L		Y
B206689	GW00953IT	3/12/91	TOTAL DISSOLVED SOLIDS	592.00	10.00	MG/L		V
B206689	GW01527IT	7/16/91	TOTAL DISSOLVED SOLIDS	520.00	10.00	MG/L		
B206689	GW01962IT	10/31/91	TOTAL DISSOLVED SOLIDS	510.00	10.00	MG/L		V
B206689	GW02312IT	2/22/92	TOTAL DISSOLVED SOLIDS	580.00	10.00	MG/L		V
B206689	GW02722IT	4/23/92	TOTAL DISSOLVED SOLIDS	480.00	10.00	MG/L		V
B206689	GW03092IT	7/16/92	TOTAL DISSOLVED SOLIDS	500.00	10.00	MG/L		V
B206689	GW03610IT	10/6/92	TOTAL DISSOLVED SOLIDS	570.00	14.00	MG/L		V
B206689	GW00119WC	2/11/93	TOTAL DISSOLVED SOLIDS	700.00	10.00	MG/L		V

ROCKY FLATS OU6
TOTAL DISSOLVED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
B206689	GW00525WC	4/21/93	TOTAL DISSOLVED SOLIDS	550.00	14.00	MG/L		V
B206689	GW01119WC	8/10/93	TOTAL DISSOLVED SOLIDS	511.00	14.00	MG/L		V
B206689	GW01407WC	10/18/93	TOTAL DISSOLVED SOLIDS	600.00	14.00	MG/L		V
B206689	GW00040GA	1/25/94	TOTAL DISSOLVED SOLIDS	590.00	10.00	MG/L		Y
B206889	GW00951IT	3/12/91	TOTAL DISSOLVED SOLIDS	3560.00	10.00	MG/L		JA
B206889	GW00527WC	4/22/93	TOTAL DISSOLVED SOLIDS	3700.00	10.00	MG/L		V
B208089	GW01472IT	7/10/91	TOTAL DISSOLVED SOLIDS	700.00	10.00	MG/L		
B208089	GW01820IT	10/8/91	TOTAL DISSOLVED SOLIDS	550.00	10.00	MG/L		V
B208089	GW02197IT	1/10/92	TOTAL DISSOLVED SOLIDS	610.00	10.00	MG/L		V
B208089	GW02635IT	4/10/92	TOTAL DISSOLVED SOLIDS	510.00	10.00	MG/L		V
B208089	GW03133IT	7/15/92	TOTAL DISSOLVED SOLIDS	550.00	10.00	MG/L		V
B208089	GW03632IT	10/6/92	TOTAL DISSOLVED SOLIDS	620.00	14.00	MG/L		V
B208089	GW00558WC	4/23/93	TOTAL DISSOLVED SOLIDS	600.00	10.00	MG/L		V
B208089	GW01128WC	7/28/93	TOTAL DISSOLVED SOLIDS	680.00	10.00	MG/L		V
B208589	GW02227IT	1/14/92	TOTAL DISSOLVED SOLIDS	4800.00	10.00	MG/L		V
B208589	GW02654IT	4/10/92	TOTAL DISSOLVED SOLIDS	2800.00	10.00	MG/L		V
B208789	GW02208IT	1/14/92	TOTAL DISSOLVED SOLIDS	780.00	10.00	MG/L		V
B208789	GW02638IT	4/9/92	TOTAL DISSOLVED SOLIDS	930.00	10.00	MG/L		V
B208789	GW03132IT	7/21/92	TOTAL DISSOLVED SOLIDS	1000.00	10.00	MG/L		V
B208789	GW03623IT	10/6/92	TOTAL DISSOLVED SOLIDS	930.00	14.00	MG/L		V
B210489	GW01516IT	7/15/91	TOTAL DISSOLVED SOLIDS	7600.00	10.00	MG/L		
B210489	GW01883IT	10/21/91	TOTAL DISSOLVED SOLIDS	4900.00	10.00	MG/L		V
B210489	GW02228IT	1/13/92	TOTAL DISSOLVED SOLIDS	4600.00	10.00	MG/L		V
B210489	GW02655IT	4/10/92	TOTAL DISSOLVED SOLIDS	2600.00	10.00	MG/L		V
B210489	GW03185IT	7/20/92	TOTAL DISSOLVED SOLIDS	4800.00	10.00	MG/L		V
B210489	GW03639IT	10/8/92	TOTAL DISSOLVED SOLIDS	5720.00	10.00	MG/L		V
B210489	GW00144WC	2/2/93	TOTAL DISSOLVED SOLIDS	4600.00	14.00	MG/L		V
B210489	GW00637WC	4/19/93	TOTAL DISSOLVED SOLIDS	4000.00	14.00	MG/L		JA
B210489	GW01131WC	8/4/93	TOTAL DISSOLVED SOLIDS	4516.00	14.00	MG/L		V
B210489	GW01420WC	10/20/93	TOTAL DISSOLVED SOLIDS	4700.00	10.00	MG/L		V
B210489	GW00045GA	1/20/94	TOTAL DISSOLVED SOLIDS	4400.00	10.00	MG/L		Y
P209789	GW01025IT	3/26/91	TOTAL DISSOLVED SOLIDS	690.00	10.00	MG/L		V
P209789	GW01610IT	8/1/91	TOTAL DISSOLVED SOLIDS	660.00	10.00	MG/L		
P209789	GW01837IT	10/11/91	TOTAL DISSOLVED SOLIDS	740.00	10.00	MG/L		V
P209789	GW02239IT	1/20/92	TOTAL DISSOLVED SOLIDS	610.00	10.00	MG/L		V
P209789	GW02789IT	4/24/92	TOTAL DISSOLVED SOLIDS	600.00	10.00	MG/L		V
P209789	GW03186IT	7/20/92	TOTAL DISSOLVED SOLIDS	590.00	10.00	MG/L		V
P209789	GW03551IT	10/16/92	TOTAL DISSOLVED SOLIDS	1030.00	10.00	MG/L		V
P209789	GW00021WC	2/9/93	TOTAL DISSOLVED SOLIDS	950.00	14.00	MG/L		V
P209789	GW00493WC	4/6/93	TOTAL DISSOLVED SOLIDS	1000.00	14.00	MG/L		V
P209789	GW01048WC	7/16/93	TOTAL DISSOLVED SOLIDS	670.00	10.00	MG/L		V
P209789	GW01379WC	10/15/93	TOTAL DISSOLVED SOLIDS	1100.00	10.00	MG/L		V
P218389	GW01522WC	11/16/93	TOTAL DISSOLVED SOLIDS	405.00	14.00	MG/L		V
P219489	GW01523WC	11/16/93	TOTAL DISSOLVED SOLIDS	509.00	14.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
02691	GW02172IT	12/19/91	TOTAL SUSPENDED SOLIDS	660.00	4.00	MG/L		V
02691	GW02513IT	2/27/92	TOTAL SUSPENDED SOLIDS	410.00	4.00	MG/L		V
02691	GW02856IT	5/14/92	TOTAL SUSPENDED SOLIDS	350.00	4.00	MG/L		V
02691	GW03215IT	8/3/92	TOTAL SUSPENDED SOLIDS	564.00	5.00	MG/L		V
02691	GW03826IT	11/9/92	TOTAL SUSPENDED SOLIDS	830.00	4.00	MG/L		V
02691	GW00260WC	2/22/93	TOTAL SUSPENDED SOLIDS	420.00	5.00	MG/L		V
02691	GW00693WC	5/4/93	TOTAL SUSPENDED SOLIDS	360.00	5.00	MG/L		JA
02691	GW01218WC	8/30/93	TOTAL SUSPENDED SOLIDS	411.00	5.00	MG/L		V
02691	GW01630WC	11/30/93	TOTAL SUSPENDED SOLIDS	100.00	4.00	MG/L		V
0486	GW01456IT	6/20/91	TOTAL SUSPENDED SOLIDS	950.00	4.00	MG/L		V
0486	GW01763IT	9/12/91	TOTAL SUSPENDED SOLIDS	1400.00	4.00	MG/L		V
0486	GW02027IT	11/14/91	TOTAL SUSPENDED SOLIDS	4400.00	4.00	MG/L		V
0486	GW02613IT	4/1/92	TOTAL SUSPENDED SOLIDS	150.00	4.00	MG/L		V
0486	GW02957IT	6/11/92	TOTAL SUSPENDED SOLIDS	820.00	5.00	MG/L		
0486	GW03391IT	9/15/92	TOTAL SUSPENDED SOLIDS	1100.00	5.00	MG/L		V
0486	GW03807IT	11/18/92	TOTAL SUSPENDED SOLIDS	860.00	5.00	MG/L		V
0586	GW01538IT	7/18/91	TOTAL SUSPENDED SOLIDS	19.00	4.00	MG/L		V
0586	GW02670IT	4/23/92	TOTAL SUSPENDED SOLIDS	50.00	4.00	MG/L		V
0586	GW00549WC	4/15/93	TOTAL SUSPENDED SOLIDS	15.00	5.00	MG/L		V
0686	GW02671IT	4/15/92	TOTAL SUSPENDED SOLIDS	36.00	4.00	MG/L		V
0686	GW03150IT	7/16/92	TOTAL SUSPENDED SOLIDS	40.00	4.00	MG/L		V
1186	GW00998IT	3/18/91	TOTAL SUSPENDED SOLIDS	400.00	4.00	MG/L		
1186	GW01225IT	5/2/91	TOTAL SUSPENDED SOLIDS	290.00	4.00	MG/L		V
1186	GW01539IT	7/19/91	TOTAL SUSPENDED SOLIDS	60.00	4.00	MG/L		V
1186	GW01902IT	10/15/91	TOTAL SUSPENDED SOLIDS	210.00	4.00	MG/L		V
1186	GW02242IT	1/21/92	TOTAL SUSPENDED SOLIDS	220.00	4.00	MG/L		V
1186	GW02669IT	4/14/92	TOTAL SUSPENDED SOLIDS	580.00	4.00	MG/L		V
1186	GW03152IT	7/14/92	TOTAL SUSPENDED SOLIDS	750.00	4.00	MG/L		V
1186	GW03618IT	10/7/92	TOTAL SUSPENDED SOLIDS	150.00	5.00	MG/L		V
1286	GW02245IT	1/20/92	TOTAL SUSPENDED SOLIDS	730.00	4.00	MG/L		V
1286	GW02677IT	4/15/92	TOTAL SUSPENDED SOLIDS	21000.00	4.00	MG/L		V
1286	GW03095IT	7/13/92	TOTAL SUSPENDED SOLIDS	1400.00	4.00	MG/L		V
1386	GW00972IT	3/15/91	TOTAL SUSPENDED SOLIDS	28.00	4.00	MG/L		
1386	GW01210IT	4/24/91	TOTAL SUSPENDED SOLIDS	12.00	4.00	MG/L		V
1386	GW01482IT	7/16/91	TOTAL SUSPENDED SOLIDS	33.00	4.00	MG/L		
1386	GW01880IT	10/22/91	TOTAL SUSPENDED SOLIDS	35.00	4.00	MG/L		V
1386	GW02237IT	1/14/92	TOTAL SUSPENDED SOLIDS	38.00	4.00	MG/L		V
1386	GW02659IT	4/15/92	TOTAL SUSPENDED SOLIDS	15.00	4.00	MG/L		V
1386	GW03232IT	7/30/92	TOTAL SUSPENDED SOLIDS	6.00	4.00	MG/L		V
1386	GW03621IT	10/13/92	TOTAL SUSPENDED SOLIDS	44.00	5.00	MG/L		V
1386	GW00145WC	2/2/93	TOTAL SUSPENDED SOLIDS	20.00	5.00	MG/L		V
1386	GW00562WC	4/13/93	TOTAL SUSPENDED SOLIDS	14.00	5.00	MG/L		V
1386	GW01132WC	8/4/93	TOTAL SUSPENDED SOLIDS	58.00	4.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
1386	GW01421WC	10/28/93	TOTAL SUSPENDED SOLIDS	27.00	5.00	MG/L		V
1386	GW00046GA	1/20/94	TOTAL SUSPENDED SOLIDS	37.00	4.00	MG/L		Y
1586	GW00904IT	3/4/91	TOTAL SUSPENDED SOLIDS	760.00	4.00	MG/L		
1586	GW01120IT	4/18/91	TOTAL SUSPENDED SOLIDS	130.00	4.00	MG/L		V
1586	GW01509IT	7/11/91	TOTAL SUSPENDED SOLIDS	130.00	4.00	MG/L		
1586	GW01882IT	10/21/91	TOTAL SUSPENDED SOLIDS	100.00	4.00	MG/L		V
1586	GW02240IT	1/15/92	TOTAL SUSPENDED SOLIDS	170.00	4.00	MG/L		V
1586	GW02676IT	4/13/92	TOTAL SUSPENDED SOLIDS	110.00	4.00	MG/L		V
1586	GW03182IT	7/16/92	TOTAL SUSPENDED SOLIDS	360.00	4.00	MG/L		V
1586	GW03627IT	10/7/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
1586	GW00136WC	2/5/93	TOTAL SUSPENDED SOLIDS	280.00	4.00	MG/L		V
1586	GW00555WC	4/13/93	TOTAL SUSPENDED SOLIDS	47.00	5.00	MG/L		V
1586	GW01125WC	8/2/93	TOTAL SUSPENDED SOLIDS	504.00	5.00	MG/L		V
1586	GW01415WC	10/20/93	TOTAL SUSPENDED SOLIDS	250.00	4.00	MG/L		V
1786	GW00905IT	3/4/91	TOTAL SUSPENDED SOLIDS	1380.00		MG/L		V
1786	GW01116IT	4/18/91	TOTAL SUSPENDED SOLIDS	1200.00	4.00	MG/L		V
1786	GW01474IT	7/9/91	TOTAL SUSPENDED SOLIDS	2100.00	4.00	MG/L		
1786	GW01878IT	10/10/91	TOTAL SUSPENDED SOLIDS	1300.00	4.00	MG/L		V
1786	GW02210IT	1/9/92	TOTAL SUSPENDED SOLIDS	3300.00	4.00	MG/L		V
1786	GW02640IT	4/7/92	TOTAL SUSPENDED SOLIDS	1500.00	4.00	MG/L		V
1786	GW03190IT	7/27/92	TOTAL SUSPENDED SOLIDS	2100.00	4.00	MG/L		V
1786	GW03630IT	10/7/92	TOTAL SUSPENDED SOLIDS	1590.00	5.00	MG/L		V
1786	GW00138WC	2/1/93	TOTAL SUSPENDED SOLIDS	11000.00	5.00	MG/L		V
1786	GW00557WC	4/16/93	TOTAL SUSPENDED SOLIDS	6700.00	4.00	MG/L		
1786	GW01127WC	8/2/93	TOTAL SUSPENDED SOLIDS	1274.00	5.00	MG/L		V
1786	GW01416WC	10/29/93	TOTAL SUSPENDED SOLIDS	1500.00	4.00	MG/L		V
3586	GW00976IT	3/14/91	TOTAL SUSPENDED SOLIDS	130.00	4.00	MG/L		
3586	GW01221IT	4/29/91	TOTAL SUSPENDED SOLIDS	170.00	4.00	MG/L		V
3586	GW01461IT	7/9/91	TOTAL SUSPENDED SOLIDS	54.00	4.00	MG/L		
3586	GW01818IT	10/8/91	TOTAL SUSPENDED SOLIDS	160.00	4.00	MG/L		V
3586	GW02195IT	1/10/92	TOTAL SUSPENDED SOLIDS	100.00	4.00	MG/L		V
3586	GW02631IT	4/7/92	TOTAL SUSPENDED SOLIDS	62.00	4.00	MG/L		V
3586	GW03217IT	8/5/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
3586	GW03828IT	12/10/92	TOTAL SUSPENDED SOLIDS	120.00	4.00	MG/L		V
3586	GW00262WC	3/5/93	TOTAL SUSPENDED SOLIDS	69.00	4.00	MG/L		V
3586	GW00695WC	5/6/93	TOTAL SUSPENDED SOLIDS	69.00	4.00	MG/L		V
3586	GW01244WC	9/22/93	TOTAL SUSPENDED SOLIDS	32.00	4.00	MG/L		V
3586	GW01701WC	12/13/93	TOTAL SUSPENDED SOLIDS	42.00	4.00	MG/L		Y
3686	GW01222IT	4/30/91	TOTAL SUSPENDED SOLIDS	38.00	4.00	MG/L		V
3686	GW02632IT	4/8/92	TOTAL SUSPENDED SOLIDS	33.00	4.00	MG/L		V
3786	GW00995IT	3/19/91	TOTAL SUSPENDED SOLIDS	23.00	4.00	MG/L		
3786	GW01223IT	4/30/91	TOTAL SUSPENDED SOLIDS	60.00	4.00	MG/L		V
3786	GW01521IT	7/17/91	TOTAL SUSPENDED SOLIDS	26.00	4.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
3786	GW01899IT	10/15/91	TOTAL SUSPENDED SOLIDS	22.00	4.00	MG/L		V
3786	GW02656IT	4/14/92	TOTAL SUSPENDED SOLIDS	32.00	4.00	MG/L		V
3786	GW03233IT	9/18/92	TOTAL SUSPENDED SOLIDS	25.00	5.00	MG/L		V
3786	GW03641IT	10/13/92	TOTAL SUSPENDED SOLIDS	49.00	5.00	MG/L		V
3786	GW01362WC	9/23/93	TOTAL SUSPENDED SOLIDS	50.00	4.00	MG/L		V
3786	GW01685WC	12/13/93	TOTAL SUSPENDED SOLIDS	19.00	4.00	MG/L		Y
3786	GW00155GA	1/27/94	TOTAL SUSPENDED SOLIDS	44.00	4.00	MG/L		Y
3886	GW01224IT	5/6/91	TOTAL SUSPENDED SOLIDS	40.00	4.00	MG/L		V
3886	GW02657IT	4/13/92	TOTAL SUSPENDED SOLIDS	28.00	4.00	MG/L		V
3886	GW00128WC	3/2/93	TOTAL SUSPENDED SOLIDS	20.00	5.00	MG/L		V
3886	GW00552WC	4/14/93	TOTAL SUSPENDED SOLIDS	61.00	5.00	MG/L		V
4087	GW01529IT	7/17/91	TOTAL SUSPENDED SOLIDS	32.00	4.00	MG/L		
4087	GW02313IT	2/21/92	TOTAL SUSPENDED SOLIDS	39.00	4.00	MG/L		V
4087	GW02790IT	4/28/92	TOTAL SUSPENDED SOLIDS	19.00	4.00	MG/L		V
4087	GW00501WC	4/20/93	TOTAL SUSPENDED SOLIDS	34.00	5.00	MG/L		V
41091	GW02171IT	12/20/91	TOTAL SUSPENDED SOLIDS	330.00	4.00	MG/L		V
41091	GW02609IT	3/17/92	TOTAL SUSPENDED SOLIDS	250.00	4.00	MG/L		V
41091	GW03050IT	6/11/92	TOTAL SUSPENDED SOLIDS	130.00	5.00	MG/L		
41091	GW03153IT	7/22/92	TOTAL SUSPENDED SOLIDS	660.00	4.00	MG/L		V
41091	GW03616IT	10/9/92	TOTAL SUSPENDED SOLIDS	287.00	5.00	MG/L		V
41091	GW00125WC	2/18/93	TOTAL SUSPENDED SOLIDS	190.00	4.00	MG/L		V
41091	GW00550WC	5/11/93	TOTAL SUSPENDED SOLIDS	42.00	5.00	MG/L		V
41091	GW01172WC	8/13/93	TOTAL SUSPENDED SOLIDS	110.00	4.00	MG/L		V
41091	GW01286WC	9/16/93	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
41091	GW01475WC	11/8/93	TOTAL SUSPENDED SOLIDS	80.00	5.00	MG/L		Y
41691	GW02090IT	12/7/91	TOTAL SUSPENDED SOLIDS	7000.00	4.00	MG/L		V
41691	GW02615IT	4/1/92	TOTAL SUSPENDED SOLIDS	1700.00	4.00	MG/L		V
41691	GW02953IT	6/11/92	TOTAL SUSPENDED SOLIDS	3300.00	5.00	MG/L		
41691	GW03396IT	9/16/92	TOTAL SUSPENDED SOLIDS	2240.00	5.00	MG/L		V
41691	GW03806IT	11/18/92	TOTAL SUSPENDED SOLIDS	910.00	4.00	MG/L		V
41691	GW00440WC	3/17/93	TOTAL SUSPENDED SOLIDS	860.00	4.00	MG/L		V
41691	GW01010WC	6/22/93	TOTAL SUSPENDED SOLIDS	1600.00	4.00	MG/L		V
41691	GW01357WC	9/20/93	TOTAL SUSPENDED SOLIDS	434.00	5.00	MG/L		V
41691	GW01549WC	12/9/93	TOTAL SUSPENDED SOLIDS	663.00	5.00	MG/L		Y
41691	GW00247GA	2/16/94	TOTAL SUSPENDED SOLIDS	140.00	4.00	MG/L		Y
41691	GW00248GA	2/16/94	TOTAL SUSPENDED SOLIDS	3000.00	4.00	MG/L		Y
41691	GW00275GA	2/18/94	TOTAL SUSPENDED SOLIDS	1500.00	4.00	MG/L		Y
41691	GW00274GA	2/18/94	TOTAL SUSPENDED SOLIDS	1860.00	5.00	MG/L		Y
41691	GW00290GA	2/21/94	TOTAL SUSPENDED SOLIDS	5200.00	4.00	MG/L		Y
41691	GW00291GA	2/24/94	TOTAL SUSPENDED SOLIDS	1200.00	4.00	MG/L		Y
41691	GW00400GA	3/3/94	TOTAL SUSPENDED SOLIDS	610.00	4.00	MG/L		Y
4287	GW01231IT	5/3/91	TOTAL SUSPENDED SOLIDS	140.00	4.00	MG/L		V
4287	GW02246IT	1/16/92	TOTAL SUSPENDED SOLIDS	95.00	4.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
4287	GW02672IT	4/21/92	TOTAL SUSPENDED SOLIDS	88.00	4.00	MG/L		V
4287	GW00122WC	2/17/93	TOTAL SUSPENDED SOLIDS	310.00	4.00	MG/L		V
4287	GW00548WC	5/11/93	TOTAL SUSPENDED SOLIDS	320.00	5.00	MG/L		V
4287	GW00031GA	1/18/94	TOTAL SUSPENDED SOLIDS	175.00	5.00	MG/L		Y
7087	GW01540IT	7/19/91	TOTAL SUSPENDED SOLIDS	600.00	4.00	MG/L		V
7087	GW01957IT	10/31/91	TOTAL SUSPENDED SOLIDS	700.00	4.00	MG/L		V
7087	GW02303IT	2/21/92	TOTAL SUSPENDED SOLIDS	1100.00	4.00	MG/L		V
7087	GW02776IT	4/28/92	TOTAL SUSPENDED SOLIDS	250.00	4.00	MG/L		V
7087	GW03094IT	7/23/92	TOTAL SUSPENDED SOLIDS	1200.00	4.00	MG/L		V
7087	GW03608IT	10/6/92	TOTAL SUSPENDED SOLIDS	420.00	5.00	MG/L		V
7087	GW00523WC	4/12/93	TOTAL SUSPENDED SOLIDS	1100.00	5.00	MG/L		V
7087	GW01117WC	8/10/93	TOTAL SUSPENDED SOLIDS	836.00	5.00	MG/L		V
7087	GW00037GA	1/20/94	TOTAL SUSPENDED SOLIDS	480.00	4.00	MG/L		Y
7187	GW00903IT	3/4/91	TOTAL SUSPENDED SOLIDS	26.00	4.00	MG/L		
7187	GW01183IT	4/22/91	TOTAL SUSPENDED SOLIDS	57.00	4.00	MG/L		V
7187	GW01541IT	7/17/91	TOTAL SUSPENDED SOLIDS	53.00	4.00	MG/L		V
7187	GW01886IT	10/9/91	TOTAL SUSPENDED SOLIDS	97.00	4.00	MG/L		V
7187	GW02279IT	1/16/92	TOTAL SUSPENDED SOLIDS	18.50	4.00	MG/L		V
7187	GW02681IT	4/20/92	TOTAL SUSPENDED SOLIDS	26.00	4.00	MG/L		V
7187	GW03148IT	7/22/92	TOTAL SUSPENDED SOLIDS	92.00	4.00	MG/L		V
7187	GW03580IT	10/9/92	TOTAL SUSPENDED SOLIDS	51.00	5.00	MG/L		V
7187	GW00091WC	2/19/93	TOTAL SUSPENDED SOLIDS	45.50	4.00	MG/L		V
7187	GW00502WC	4/9/93	TOTAL SUSPENDED SOLIDS	79.50	4.00	MG/L		V
7187	GW01094WC	8/11/93	TOTAL SUSPENDED SOLIDS	227.00	5.00	MG/L		V
7187	GW01434WC	11/3/93	TOTAL SUSPENDED SOLIDS	16.00	4.00	MG/L		V
7287	GW00944IT	3/11/91	TOTAL SUSPENDED SOLIDS	580.00	4.00	MG/L		
7287	GW01212IT	4/23/91	TOTAL SUSPENDED SOLIDS	640.00	4.00	MG/L		V
7287	GW01524IT	7/15/91	TOTAL SUSPENDED SOLIDS	360.00	4.00	MG/L		
7287	GW02309IT	2/20/92	TOTAL SUSPENDED SOLIDS	1800.00	4.00	MG/L		V
7287	GW02783IT	4/23/92	TOTAL SUSPENDED SOLIDS	1800.00	4.00	MG/L		V
7287	GW03089IT	7/7/92	TOTAL SUSPENDED SOLIDS	3000.00	4.00	MG/L		V
7287	GW03604IT	10/7/92	TOTAL SUSPENDED SOLIDS	619.00	5.00	MG/L		V
7287	GW00113WC	2/1/93	TOTAL SUSPENDED SOLIDS	17000.00	5.00	MG/L		V
7287	GW00519WC	4/8/93	TOTAL SUSPENDED SOLIDS	2500.00	4.00	MG/L		V
7287	GW01113WC	8/9/93	TOTAL SUSPENDED SOLIDS	9382.00	5.00	MG/L		V
7287	GW01391WC	10/13/93	TOTAL SUSPENDED SOLIDS	5000.00	4.00	MG/L		V
76292	GW00467WC	3/22/93	TOTAL SUSPENDED SOLIDS	20.00	5.00	MG/L		
76292	GW00533WC	4/21/93	TOTAL SUSPENDED SOLIDS	700.00	5.00	MG/L		
77492	GW00469WC	3/22/93	TOTAL SUSPENDED SOLIDS	1300.00	5.00	MG/L		
77492	GW00534WC	4/21/93	TOTAL SUSPENDED SOLIDS	3500.00	5.00	MG/L		
B206489	GW00956IT	3/12/91	TOTAL SUSPENDED SOLIDS	81.00	5.00	MG/L		JA
B206489	GW01525IT	7/16/91	TOTAL SUSPENDED SOLIDS	19.00	4.00	MG/L		
B206489	GW01959IT	10/31/91	TOTAL SUSPENDED SOLIDS	20.00	4.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
B206489	GW02310IT	2/20/92	TOTAL SUSPENDED SOLIDS	14.00	4.00	MG/L		V
B206489	GW02720IT	4/16/92	TOTAL SUSPENDED SOLIDS	21.00	4.00	MG/L		V
B206489	GW03246IT	7/30/92	TOTAL SUSPENDED SOLIDS	9.00	4.00	MG/L		V
B206489	GW00116WC	2/2/93	TOTAL SUSPENDED SOLIDS	9.00	5.00	MG/L		V
B206489	GW00522WC	4/8/93	TOTAL SUSPENDED SOLIDS	31.00	4.00	MG/L		V
B206589	GW00943IT	3/12/91	TOTAL SUSPENDED SOLIDS	8.00	5.00	MG/L		JA
B206589	GW01526IT	7/16/91	TOTAL SUSPENDED SOLIDS	340.00	4.00	MG/L		
B206589	GW01961IT	10/31/91	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206589	GW02311IT	2/7/92	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L		V
B206589	GW02721IT	4/21/92	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206589	GW03091IT	7/14/92	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206589	GW03609IT	10/6/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
B206589	GW00118WC	2/2/93	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
B206589	GW00524WC	4/16/93	TOTAL SUSPENDED SOLIDS	35.00	4.00	MG/L		
B206589	GW01118WC	8/12/93	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206589	GW01406WC	11/5/93	TOTAL SUSPENDED SOLIDS	5.00	4.00	MG/L		V
B206589	GW00038GA	1/20/94	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	Y
B206689	GW00953IT	3/12/91	TOTAL SUSPENDED SOLIDS	6.00	5.00	MG/L		JA
B206689	GW01527IT	7/16/91	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	
B206689	GW01962IT	10/31/91	TOTAL SUSPENDED SOLIDS	5.00	4.00	MG/L		V
B206689	GW02312IT	2/22/92	TOTAL SUSPENDED SOLIDS	5.00	4.00	MG/L		V
B206689	GW02722IT	4/23/92	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206689	GW03092IT	7/16/92	TOTAL SUSPENDED SOLIDS	4.00	4.00	MG/L	U	V
B206689	GW03610IT	10/6/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
B206689	GW00119WC	2/11/93	TOTAL SUSPENDED SOLIDS	11.00	4.00	MG/L		V
B206689	GW00525WC	4/21/93	TOTAL SUSPENDED SOLIDS	23.00	5.00	MG/L		V
B206689	GW01119WC	8/10/93	TOTAL SUSPENDED SOLIDS	9.00	5.00	MG/L	U	JA
B206689	GW01407WC	10/18/93	TOTAL SUSPENDED SOLIDS	6.80	5.00	MG/L	U	V
B206689	GW00040GA	1/25/94	TOTAL SUSPENDED SOLIDS	9.00	4.00	MG/L		Y
B206889	GW00951IT	3/12/91	TOTAL SUSPENDED SOLIDS	29.00	5.00	MG/L		JA
B206889	GW00527WC	4/22/93	TOTAL SUSPENDED SOLIDS	29.00	4.00	MG/L		V
B208089	GW01472IT	7/10/91	TOTAL SUSPENDED SOLIDS	6.00	4.00	MG/L		
B208089	GW01820IT	10/8/91	TOTAL SUSPENDED SOLIDS	21.00	4.00	MG/L		V
B208089	GW02197IT	1/10/92	TOTAL SUSPENDED SOLIDS	28.00	4.00	MG/L		V
B208089	GW02635IT	4/10/92	TOTAL SUSPENDED SOLIDS	54.00	4.00	MG/L		V
B208089	GW03133IT	7/15/92	TOTAL SUSPENDED SOLIDS	24.00	4.00	MG/L		V
B208089	GW03632IT	10/6/92	TOTAL SUSPENDED SOLIDS	43.00	5.00	MG/L		JA
B208089	GW00558WC	4/23/93	TOTAL SUSPENDED SOLIDS	22.00	4.00	MG/L		V
B208089	GW01128WC	7/28/93	TOTAL SUSPENDED SOLIDS	15.00	4.00	MG/L		V
B208589	GW02227IT	1/14/92	TOTAL SUSPENDED SOLIDS	10.00	4.00	MG/L		V
B208589	GW02654IT	4/10/92	TOTAL SUSPENDED SOLIDS	22.00	4.00	MG/L		V
B208789	GW02208IT	1/14/92	TOTAL SUSPENDED SOLIDS	21.00	4.00	MG/L		V
B208789	GW02638IT	4/9/92	TOTAL SUSPENDED SOLIDS	9.00	4.00	MG/L		V

ROCKY FLATS OU6
TOTAL SUSPENDED SOLIDS

location	fieldid	date sampled	analyte	result	rep_lim	units	qual_lab	qual_wc
B208789	GW03132IT	7/21/92	TOTAL SUSPENDED SOLIDS	8.00	4.00	MG/L		V
B208789	GW03623IT	10/6/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
B210489	GW01516IT	7/15/91	TOTAL SUSPENDED SOLIDS	1200.00	4.00	MG/L		
B210489	GW01883IT	10/21/91	TOTAL SUSPENDED SOLIDS	20.00	4.00	MG/L		V
B210489	GW02228IT	1/13/92	TOTAL SUSPENDED SOLIDS	66.00	4.00	MG/L		V
B210489	GW02655IT	4/10/92	TOTAL SUSPENDED SOLIDS	34.00	4.00	MG/L		V
B210489	GW03185IT	7/20/92	TOTAL SUSPENDED SOLIDS	44.00	4.00	MG/L		V
B210489	GW03639IT	10/8/92	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
B210489	GW00144WC	2/2/93	TOTAL SUSPENDED SOLIDS	13.00	5.00	MG/L		V
B210489	GW00637WC	4/19/93	TOTAL SUSPENDED SOLIDS	7.00	5.00	MG/L		JA
B210489	GW01131WC	8/4/93	TOTAL SUSPENDED SOLIDS	102.00	5.00	MG/L		V
B210489	GW01420WC	10/20/93	TOTAL SUSPENDED SOLIDS	12.00	4.00	MG/L		V
B210489	GW00045GA	1/20/94	TOTAL SUSPENDED SOLIDS	7.00	4.00	MG/L		Y
P209789	GW01025IT	3/26/91	TOTAL SUSPENDED SOLIDS	140.00	4.00	MG/L		V
P209789	GW01610IT	8/1/91	TOTAL SUSPENDED SOLIDS	26.00	4.00	MG/L		
P209789	GW01837IT	10/11/91	TOTAL SUSPENDED SOLIDS	15.00	4.00	MG/L		V
P209789	GW02239IT	1/20/92	TOTAL SUSPENDED SOLIDS	420.00	4.00	MG/L		V
P209789	GW02789IT	4/24/92	TOTAL SUSPENDED SOLIDS	12.00	4.00	MG/L		V
P209789	GW03186IT	7/20/92	TOTAL SUSPENDED SOLIDS	14.00	4.00	MG/L		V
P209789	GW03551IT	10/16/92	TOTAL SUSPENDED SOLIDS	54.50	5.00	MG/L		V
P209789	GW00021WC	2/9/93	TOTAL SUSPENDED SOLIDS	8.00	5.00	MG/L		V
P209789	GW00493WC	4/6/93	TOTAL SUSPENDED SOLIDS	5.00	5.00	MG/L	U	V
P209789	GW01048WC	7/16/93	TOTAL SUSPENDED SOLIDS	81.00	4.00	MG/L		V
P209789	GW01379WC	10/15/93	TOTAL SUSPENDED SOLIDS	5.00	4.00	MG/L		V
P218389	GW01522WC	11/16/93	TOTAL SUSPENDED SOLIDS	224.00	5.00	MG/L		V
P219489	GW01523WC	11/16/93	TOTAL SUSPENDED SOLIDS	52.00	5.00	MG/L		V