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March 9, 1992

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CHEMICAL PLANT SITE REMEDIAL INVESTIGATION/FEASIBILITY STUDY DATA VALIDATION REPORT, FEBRUARY 1992

Enclosed is a copy of the Chemical Plant Site Remedial Investigation/Feasibility Study Data Validation Report. This report culminates approximately two years of intense activity by DOE to assess the validity and useability of the data in the Weldon Spring Site Remedial Action Project (WSSRAP) Remedial Investigation database.

The work associated with this effort began in December 1989 and required laboratory documentation to verify the database for transcription errors and to validate the database for useability.

The appendices associated with this document are not included due to their volume (2,296 pages). A copy of the document, including appendices, will be available in the WSSRAP public reading room.

Sincerely,

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Project Manager
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Enclosure:
As stated

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CHEMICAL PLANT SITE REMEDIAL INVESTIGATION/FEASIBILITY STUDY DATA VALIDATION REPORT

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

FEBRUARY 1992 REV. 0

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Weldon Spring Site Remedial Action Project

Chemical Plant Site
Remedial Investigation/Feasibility Study
Data Validation Report

Revision 0

February 1992

Prepared by

MK-FERGUSON COMPANY
and
JACOBS ENGINEERING GROUP
7295 Highway 94 South
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for the

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

TABLE OF CONTENTS

SECTION	PAGE
1 INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Background	1
1.3.1 Data Quality Requirements	1
1.3.2 Validation Activities	2
2 DATA VERIFICATION REVIEW	7
2.1 Introduction	7
2.2 Verification Procedures	7
2.2.1 Data Standardization	7
2.2.2 Transcription Review	8
2.3 Verification Results	9
2.3.1 Standardization of Data	11
2.3.2 Transcription Review	14
3 DATA VALIDATION	17
3.1 Validation Procedures	17
3.2 Validation Criteria	20
3.3 Validation Results	29

4 CHECK SAMPLING PROGRAM DESCRIPTION 46

4.1 Quality Assurance Sample Results 46
4.2 Check Sample Procedures 48
4.3 Check Sample Results 48

4.3.1 Groundwater 49
4.3.2 Surface Water 51
4.3.3 Sludge 51
4.3.4 Soil 54
4.3.5 Summary 57

5 CONCLUSION AND RECOMMENDATIONS 60

APPENDIXES (bound separately)

A Data Validation Summary Findings Report for Sludge Samples (5 Volumes)
B Data Validation Summary Findings Report for Groundwater Samples (3 Volumes)
C Data Validation Summary Findings Report for Soil Samples (2 Volumes)
D Data Validation Summary Findings Report for Miscellaneous Samples and Matrices (1 Volume)

ATTACHMENTS

A DATA QUALITY REQUIREMENTS
B DATA VERIFICATION PROCEDURE
C DATA VALIDATION PROCEDURE
D STANDARD DATA PRESENTATION FORMAT
E LISTING OF CHANGE INDICATORS
F LISTING OF 12000 DATA POINTS VALIDATED
G CALIBRATION CRITERIA

LIST OF FIGURES

NUMBER		PAGE
1-1	Data Verification and Validation Program	3
4-1	Monitoring Wells Resampled in Support of Data Validation	50
4-2	Springs Sampled in Support of Data Validation	52
4-3	Sludge Sample Locations in Support of Data Validation	53
4-4	Sample Locations for Sludge Resampling	55

LIST OF TABLES

NUMBERS		PAGE
1-1	Data Validation Data Point Summary	6
2-1	Distribution of Data by Verification Review Status	10
2-2	Distribution of Data by Chemical Category	12
2-3	Distribution of Database Modifications	13
3-1	Data Point Distribution for 12K Data	18
3-2	WSSRAP Data Validation Qualifier List	21
3-3	Data Validation Qualifier Summary for 12K Data Points	31
3-4	Accuracy and Precision Summary from Validation of the 12K Data Points:	35
4-1	Summary of Samples Collected to Assess Interlaboratory Variability	47
4-2	Soil Sampling Location Coordinants, Depths and Analytical Parameters	56
4-3	Summary of Check Sample Results versus Original Sample Results	59

1 INTRODUCTION

1.1 Purpose

The purpose of this report is to define the quality of the data which were used as the basis of the remedial investigation, risk assessment and feasibility study for the site operable unit at the Weldon Spring Site Remedial Action Project (WSSRAP).

1.2 Scope

This report addresses the results of the data validation program established to validate the characterization and environmental monitoring data and supporting check sample data collected by the Project Management Contractor (PMC) and analyzed by the PMC's primary subcontract laboratories, metaTRACE, Inc., and IT Analytical Services (ITAS); and the secondary subcontract laboratories, JTC Environmental Consultants, Inc. (JTC) and Accu-Labs Research, Inc. (Accu-Labs).

This report addresses the data used as the basis for the site remedial investigation and feasibility study from samples that were collected and analyzed prior to March 31, 1990, and from supporting check samples collected between July 1990 and September 1990.

1.3 Background

1.3.1 Data Quality Requirements

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that remedial action decisions be based on data of known quality so that decision makers can make informed decisions and so additional data needs can be identified.

Procedures for validating data vary considerably nationwide. At WSSRAP, the process of evaluating data quality involves establishing data quality requirements (DQRs) and verifying and validating the analytical results received from subcontract laboratories.

DQRs are quantitative statements of accuracy and precision that specify the quality of the data needed to support specified data uses. The WSSRAP DQRs used in the CERCLA decision making process and for routine environmental monitoring are shown in Attachment A.

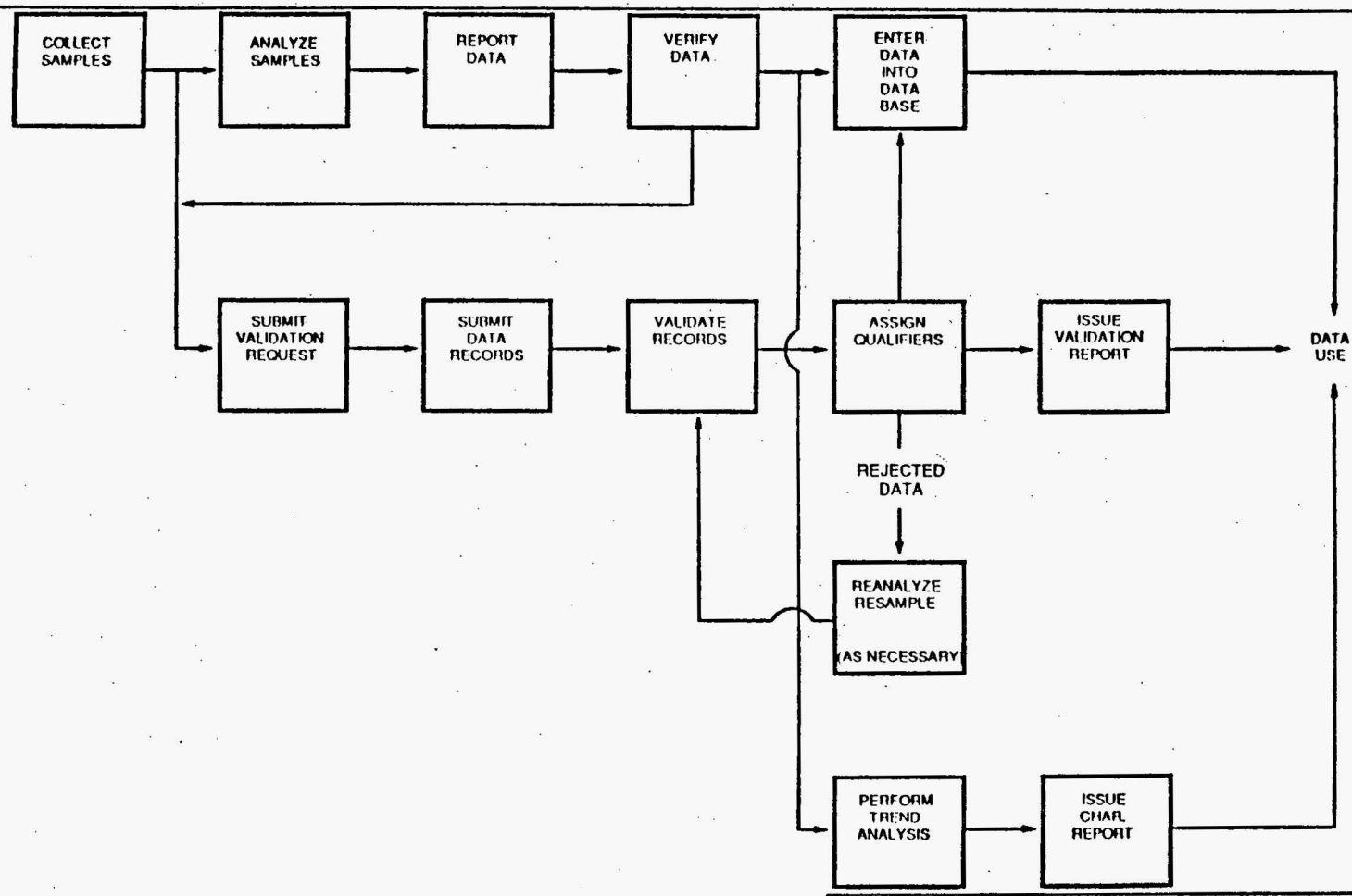
Data verification is a nonanalytical preliminary review of laboratory data and associated documentation to ensure that the samples were collected, preserved, shipped, maintained, analyzed, and reported in accordance with specified procedures. The WSSRAP data verification procedure is included in Attachment B.

Data validation involves a thorough analytical review of the data using laboratory records to assess laboratory performance relative to quality control criteria, DQRs, and other procedural and contractual requirements. Laboratories are also audited while they are analyzing the WSSRAP samples. If data quality problems or questions arise during the validation process, the PMC may require reanalysis of certain samples or may collect check samples to further define data quality. The WSSRAP procedure for the analytical review of laboratory data is shown in Attachment C.

The data verification and validation program is shown in Figure 1-1. These procedures are in-place and are routinely performed for newly acquired data, but a comprehensive and routine validation program was not performed on the data obtained prior to March 31, 1990. This report presents the results of the validation program for this previously collected data.

1.3.2 Validation Activities

In March 1989, the PMC began a formal data validation program by issuing a data validation work plan that described how the WSSRAP data would be validated. A key component of that work plan was the analytical review of approximately 4000 data points. This review included a review of the custody transfer records, a review of the laboratory's transcription of records that were merged into the WSSRAP electronic database, and of the laboratory and field quality control data. In February 1990, the final report addressing this review was submitted. The report indicated that a substantial number of data entry errors had occurred during the transcription of the data from the laboratory records into the electronic database by the subcontract laboratory. The report also indicated that a more thorough assessment of the database was necessary.



DATA VERIFICATION AND VALIDATION PROGRAM

FIGURE 1-1

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ORIGINATOR:	JJC	DRAWN BY:	GLN	DATE:	1/92

In response to this report the PMC implemented an expanded data validation program for the data collected prior to March 31, 1990. This program included:

- Establishing procedures for the verification and validation of WSSRAP data.
- Obtaining all available laboratory analytical records.
- Correcting the transcription of the data from the laboratory records into the electronic database.
- Performing a thorough analytical review of approximately 5,500 key data points from metaTRACE, JTC, and Accu-Labs.
- Performing a thorough analytical review of an additional 2,500 data points from metaTRACE to provide a more even distribution of sample matrix types included in the data population.
- Comparing the results of duplicate and split samples.
- Collecting check samples to resolve data quality questions.
- Performing a thorough analytical review of the approximate 4,000 check sample data points.
- Preparing an Environmental Data Administration Plan (EDAP).

The key data points were selected by technical specialists who prepared the site characterization reports. The initial 5,500 points are those values that were key data to the interpretation of the extent and distribution of the contaminants found at the site and were selected for all environmental media, all parameters analyzed, and the full range of contamination. Therefore the 5,500 points represent the data that are key data to preparation of the site remedial investigation and feasibility study. The initial 5,500 key data points, along with the additional 2,500 metaTRACE datapoints to even out the matrix distribution and the 4,000 check sample data points make up the 12,000 (or 12K) data points referenced in this report.

Other data validation efforts included performing trend analysis for the data from the routine water monitoring program, and validating data points specifically identified by data users. Table 1-1 shows the approximate number of data points that have been validated. As shown, WSSRAP did not validate 100% of the data points but rather validated a significant percentage of the data. This was then used to define the quality of the entire data base. This process is consistent with U.S. Environmental Protection Agency (EPA) CERCLA guidance on data validation procedures. WSSRAP had previously proposed to validate an additional 7000 data points, but based on the review of the results of the validation work on the 12K points and the recommendation of the EPA, the validation of the 7000 points was determined to be unnecessary. The results of the program are described in the following sections of this report. This data validation program was reviewed and approved in an August 16, 1990, memorandum from EPA, Region VII.

Table 1–1 Data Validation Data Point Summary

VALIDATION ACTIVITY	TYPE OF VALIDATION	APPROXIMATE NO. OF DATA POINTS	STATUS
Duplicate Samples	Sample Duplication	20,000	Complete
Initial Validation (March 1990)	Analytical Review	4,000	Complete
Key Data Points[1]	Analytical Review	5,500	Complete
Add'l metaTRACE Data Points	Analytical Review	2,500	Complete
Check Sample Data Points[2] (direct)	Analytical Review	4,000	Complete
Check Sample Data Points (reference)	Reference	4,000	Complete
Routine Water Monitoring Trend Analyses	Reference/Trend Analysis	45,000	Complete
Special Validation Requests	Analytical Review	1,000	Complete

[1] Consists of data generated from metaTRACE, JTC, and Accu–Labs.

[2] Consists of data generated from ITAS.

2 DATA VERIFICATION REVIEW

2.1 Introduction

In 1987, the effort to computerize analytical data from characterization and routine monitoring activities was initiated. Analytical data were received from metaTRACE, Inc. in hard copy and in electronic copy format. As sampling activities continued and analytical results were received, a computerized database was developed from the electronic records received from metaTRACE. The data were separated into files by sample matrix and programmatic scope such as groundwater and Phase 2 soils. The computerized Weldon Spring Site Remedial Action Project (WSSRAP) database was developed to provide an organized, retrievable format with which project personnel could utilize data for various reports and documents.

As a result of the initial inquiry into the validity of data analyzed by metaTRACE, it was determined that the electronic data records contained errors. The electronic records created by metaTRACE were not adequately verified or reviewed prior to shipment to WSSRAP and a lack of consistency in the reporting methods was noted. As a result, the review of the database records by the PMC was determined to be a requirement in the validation of data for use at WSSRAP.

2.2 Verification Procedures

The verification of records in the WSSRAP databases had two aspects. The verification review included a standardization of all data in the database sampled prior to March 31, 1990, and secondly, a transcription review of all metaTRACE data with detectable concentrations was performed. All data received for samples collected after March 31, 1990, were standardized and verified, as described in Section 2.2.1.

2.2.1 Data Standardization

The standardization of the databases included review of chemical categories, chemical parameters, units of measure, sample identification assignment, laboratory identification assignment, and format of non-detect values. Each data record was reviewed to determine if it met the standardization requirements.

These standardization requirements include a list of chemical categories, parameters and units of measure, matrix types, analytical methods and a format for the concentration value and was applied to all data (Attachment D). Unique listings of the sample identification numbers were created from the database records and reviewed by two WSSRAP personnel for accuracy according to ES&H 4.1.1, *Environmental Numbering System Procedure*. Corrections made to sample identification numbers were then checked by comparing the sample ID to the sample chain-of-custody (COC) form.

Unique laboratory identification numbers are assigned to the sample by the subcontractor laboratory when it arrives at the laboratory. This unique laboratory ID number was used throughout the course of sample analysis to identify and report sample results. A review of the accuracy of the laboratory identification number was also conducted. A unique listing of the sample identification number and laboratory identification number was produced and reviewed by two WSSRAP personnel. Corrections made to the database records based on the laboratory identification review were made by comparing database records to the laboratory's sample COC form.

The values held in the concentration field for each record were also reviewed for variation of non-detect codes. The databases contained such characters as "ND", "NA", "BQL", "----","< DL" and blank fields to represent non-detectable concentrations. The standard "ND" code was used to replace other codes.

2.2.2 Transcription Review

The transcription review was directed at verifying all detect values reported by metaTRACE and comparing the values to the records held in the database files. Copies of the original data summary sheets or raw bench sheets were recovered from metaTRACE laboratories. The sheets were reviewed for positive or detect results of the analytical test. All detectable data results were then entered into two separate databases termed DATA1 and DATA2, thus providing double-key entry of data.

After all data were entered, the two "rekeyed" databases were compared to determine the accuracy of the double-key entry effort. A compiled dBASEIII+ software program called M-COMP was used to test the exactness of the two databases. Individual records from each database were written to secondary database files based upon the results of the test. Errors in

the double-key entry databases were manually reviewed and compared to the original data summary sheets. Corrections were made to the appropriate records in the associated data file and the M_COMP program was rerun. The comparison program and data review was repeated until all records matched and a single rekeyed database was created.

The double-key entry rekeyed database was used to verify the values held in the WSSRAP database files. As each record was compared, a change indicator was used to flag the differences between data records. The records held in the WSSRAP data files were modified (if needed) to reflect the rekeyed values found in the double-key entry database. Change indicators were copied into the COMMENTS field of each modified database record to document the modification. A listing of the change indicators and their interpretation is contained in Attachment E.

The WSSRAP database was also reviewed for duplications of records as a result of data records reported by metaTRACE. A compiled dBASEIII+ program called TRUDUPS was used to identify and segregate exact duplicates from the databases. In addition, a second program (DUPS) was used to identify duplicate records based on sample ID and parameter. The DUPS program created a new file that contained any duplicated records. These records were manually reviewed and compared to the hard copy records. The records that were determined to be correct were maintained in the database files, while duplicate incorrect records were deleted. The DUPS program was rerun until all duplicate records were eliminated or corrected.

2.3 Verification Results

Prior to first quarter 1991, the WSSRAP data bases contained approximately 140,000 data records of which approximately 136,000, or 97%, are data sampled prior to March 31, 1990. Of those records, approximately 131,000, or 96%, are data analyzed by metaTRACE during the 1987 to 1989 sampling years. The majority of the records (55%) are soil samples collected during the site characterization effort in 1988. The groundwater and sludge database comprise 31% of the data; the remaining records are held in various smaller databases and include spring, lake sediment, National Pollutant Discharge Elimination System (NPDES), industrial hygiene, radiation protection and air particulate data. Table 2-1 shows the distribution of data records in the various WSSRAP databases.

Table 2–1 Distribution of Data by Verification Review Status

(prior to first quarter 1991)

DATABASE	TOTAL RECORDS[1]	% OF ALL RECORDS	RECORDS IN REVIEW[2]	% RECORDS REVIEWED	RECORDS ANALYZED BY METATRACE	% OF TOTAL RECORDS	% OF REVIEWED RECORDS
Groundwater	20,356	14.5%	18,551	91%	14,854	73%	80%
Groundwater QA	3,432	2.4%	3,028	88%	2,282	66%	75%
Surface Water	3,608	2.6%	3,493	97%	3,368	93%	96%
Surface Water QA	444	0.3%	409	92%	359	81%	88%
Springs	3,644	2.6%	3,482	96%	3,368	92%	97%
Springs QA	270	0.2%	257	95%	195	72%	76%
Sludge	15,790	11.3%	14,785	94%	14,785	94%	100%
Sludge QA	3,919	2.8%	3,919	100%	3,919	100%	100%
Lakes and Steams	4,694	3.3%	4,694	100%	4,694	100%	100%
Lakes and Steams QA	612	0.4%	612	100%	612	100%	100%
NPDES	2,453	1.8%	2,310	94%	2,238	91%	97%
NPDES QA	48	0.0%	36	75%	36	75%	100%
Phase 1 Soils	5,214	3.7%	5,214	100%	5,214	100%	100%
IRA Soils	10,812	7.7%	10,812	100%	10,812	100%	100%
Phase 2 Soils	49,653	35.4%	49,653	100%	49,653	100%	100%
Phase 2 Soils QA	11,899	8.5%	11,899	100%	11,899	100%	100%
Radiological	499	0.4%	469	94%	339	68%	72%
Radiological QA	120	0.1%	120	100%	0[3]	0%	0%
Industrial Hygiene	2,035	1.5%	1,967	97%	1,824	90%	93%
Air Particulate	664	0.5%	664	100%	594	89%	89%
Total:	**140,166**		**136,374**		**131,045**		
% of All Data:			**97%**		**93%**		
% of Reviewed Data:					**96%**		

[1] as of 12/12/90

[2] all records sampled prior to 03/31/90

[3] all radiological QA samples were analyzed by another lab besides metaTRACE. Therefore, there were no radiological QA data obtained from metatTRACE for verification review.

Concentration values were used to classify data into detectable and non-detect populations. Sixty-nine percent of the pre-March 31, 1990, records (or reviewed records) were found to be non-detect concentrations and 31% were detectable values. The majority of detects reported were metals and anions while nitroaromatics, semi-volatiles, volatiles and pesticides/PCBs contained the majority of the non-detect values. The distribution of detects and non-detect populations compared to chemical categories is shown in Table 2-2.

Change indicators, as discussed in Section 2.2, were assigned to modified data records to document the type of modifications made. The indicators were tallied by database, concentration type and chemical category to determine trends found in the verification review process. Table 2-3 summarizes the modifications made based on detect and non-detect populations.

Overall, the results of the verification review indicate that modifications to the database were due primarily to standardization of field information. Information gathered during the review process also showed that specific types of typographical errors were made in the data entry process by metaTRACE. Other modifications were attributed to the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) requirements for adjusting the concentration values of soil data for percent moisture. Percent moisture adjustments were not consistently calculated on the metaTRACE laboratory bench sheets. Percent moisture adjustments typically increased concentration values by 10% to 15% for soils.

2.3.1 Standardization of Data

The verification review showed that many modifications were attributed to the standardization test conducted. Use of computerized data requires the standardization of field information in order to consistently retrieve and present data for use at the WSSRAP. Of the total number of modifications made, the category and parameter checks resulted in a large percentage (23%) of modifications overall and they occurred in each of the databases. Differences in the use of units of measure also were noted (3%).

The use of the category "Metals" versus "EP Tox Metals" attributed to the many of the category modifications. Data records were erroneously classified into the EP Tox Metals category. Data analyzed under routine EPA CLP methods should be classified to the METALS

Table 2–2 Distribution of Data by Chemical Category[1]

DETECT Population

DATABASE	TOTAL RECORDS	# OF DETECTS	%	ANIONS	%	NITROS	%	METALS	%	RAD	%	PEST/ PCBs	%	SEMI-VOA	%	VOA	%	MISC	%
Air Particulate	664	165	25%	0	0%	0	0%	18	11%	147	89%	0	0%	0	0%	0	0%	0	0%
Groundwater	18,551	5339	29%	1,967	37%	688	13%	1,124	21%	678	13%	9	0%	25	0%	32	1%	816	15%
Groundwater QA	3,028	1063	35%	365	34%	234	22%	197	19%	116	11%	2	0%	66	6%	11	1%	72	7%
Industrial Hygiene	1,799	345	19%	5	1%	0	0%	87	25%	50	14%	120	35%	0	0%	8	2%	75	22%
IRA Soils	10,812	3649	34%	532	15%	4	0%	2,625	72%	0	0%	7	0%	71	2%	5	0%	405	11%
Lakes & Steams	4,694	929	20%	0	0%	1	0%	630	68%	178	19%	2	0%	0	0%	0	0%	118	13%
Lakes & Steams QA	610	169	28%	0	0%	12	7%	101	60%	5	3%	0	0%	43	25%	0	0%	8	5%
NPDES	2,310	1345	58%	191	14%	51	4%	169	13%	377	28%	0	0%	438	33%	0	0%	119	9%
NPDES QA	36	17	47%	2	12%	1	6%	6	35%	6	35%	0	0%	0	0%	0	0%	2	12%
Phase 1 Soils	5,214	3299	63%	509	15%	52	2%	2,589	78%	0	0%	0	0%	0	0%	0	0%	149	5%
Phase 2 Soils	49,653	14083	28%	2,287	16%	19	0%	9,818	70%	0	0%	25	0%	112	1%	304	2%	1,518	11%
Phase 2 Soils QA	11,899	4105	34%	552	13%	314	8%	2,226	54%	0	0%	69	2%	385	9%	213	5%	346	8%
Radiological	469	323	69%	0	0%	0	0%	0	0%	322	100%	0	0%	0	0%	0	0%	1	0%
Radiological QA	120	81	68%	0	0%	0	0%	0	0%	81	100%	0	0%	0	0%	0	0%	0	0%
Sludge	14,785	2847	19%	453	16%	0	0%	2,204	77%	8	0%	26	1%	12	0%	110	4%	34	1%
Sludge QA	3,919	962	25%	104	11%	42	4%	501	52%	74	8%	39	4%	84	9%	113	12%	5	1%
Springs	3,482	1011	29%	293	29%	78	8%	315	31%	136	13%	0	0%	0	0%	3	0%	186	18%
Springs QA	257	67	26%	16	24%	13	19%	21	31%	6	9%	0	0%	0	0%	3	4%	8	12%
Surface Water	3,493	1702	49%	573	34%	48	3%	311	18%	718	42%	0	0%	0	0%	0	0%	52	3%
Surface Water QA	409	194	47%	64	33%	17	9%	35	18%	71	37%	0	0%	0	0%	0	0%	7	4%
Totals:	136,204	41,695	31%	7,913	19%	1,574	4%	22,977	55%	2,973	7%	299	1%	1,236	3%	802	2%	3,921	9%

NON–DETECT Population

DATABASE	TOTAL RECORDS	# OF NON-DETECTS	%	ANIONS	%	NITROS	%	METALS	%	RAD	%	PEST/ PCBs	%	SEMI-VOA	%	VOA	%	MISC	%
Air Particulate	664	499	75%	0	0%	0	0%	0	0%	499	100%	0	0%	0	0%	0	0%	0	0%
Groundwater	18,551	13212	71%	581	4%	3,657	28%	2,115	16%	1,889	14%	1,581	12%	1,685	13%	1,082	8%	622	5%
Groundwater QA	3,028	1965	65%	137	7%	521	27%	245	12%	228	12%	293	15%	293	15%	187	10%	61	3%
Industrial Hygiene	1,799	1454	81%	0	0%	0	0%	41	3%	36	2%	1,364	94%	0	0%	4	0%	9	1%
IRA Soils	10,812	7163	66%	56	1%	878	12%	1,047	15%	0	0%	1,424	20%	3,634	51%	123	2%	1	0%
Lakes & Steams	4,694	3765	80%	0	0%	395	10%	313	8%	121	3%	264	7%	2,665	71%	0	0%	7	0%
Lakes & Steams QA	610	441	72%	0	0%	12	3%	37	8%	3	1%	42	10%	347	79%	0	0%	0	0%
NPDES	2,310	965	42%	37	4%	482	50%	183	19%	49	5%	0	0%	74	8%	0	0%	140	15%
NPDES QA	36	19	53%	0	0%	11	58%	8	42%	0	0%	0	0%	0	0%	0	0%	0	0%
Phase 1 Soils	5,214	1915	37%	87	5%	842	44%	986	51%	0	0%	0	0%	0	0%	0	0%	0	0%
Phase 2 Soils	49,653	35570	72%	1,068	3%	3,021	8%	3,112	9%	0	0%	3,026	9%	17,460	49%	7,649	22%	234	1%
Phase 2 Soils QA	11,899	7794	66%	190	2%	316	4%	618	8%	0	0%	627	8%	3,757	48%	2,239	29%	47	1%
Radiological	469	146	31%	0	0%	0	0%	0	0%	132	90%	14	10%	0	0%	0	0%	0	0%
Radiological QA	120	39	33%	0	0%	0	0%	0	0%	39	100%	0	0%	0	0%	0	0%	0	0%
Sludge	14,785	11938	81%	57	0%	423	4%	472	4%	494	4%	1,675	14%	6,483	54%	2,312	19%	22	0%
Sludge QA	3,919	2957	75%	18	1%	63	2%	147	5%	41	1%	393	13%	1,278	43%	1,015	34%	2	0%
Springs	3,482	2471	71%	39	2%	412	17%	886	36%	239	10%	702	28%	0	0%	187	8%	6	0%
Springs QA	257	190	74%	4	2%	41	22%	79	42%	10	5%	27	14%	0	0%	29	15%	0	0%
Surface Water	3,493	1791	51%	171	10%	320	18%	646	36%	627	35%	0	0%	0	0%	0	0%	27	2%
Surface Water QA	409	215	53%	20	9%	67	31%	61	28%	67	31%	0	0%	0	0%	0	0%	0	0%
Totals:	136,204	94,509	69%	2,465	3%	11,461	12%	10,996	12%	4,474	5%	11,432	12%	37,676	40%	14,827	16%	1,178	1%
Grand Totals:		136,204	100%	10,378	8%	13,035	10%	33,973	25%	7,447	5%	11,731	9%	38,912	29%	15,629	11%	5,099	4%

[1] as of 12/12/90

Table 2–3 Distribution of Database Modifications

DETECT Population							TYPE OF MODIFICATION															
DATABASE	TOTAL RECORDS	# OF DETECTS	%	# NOT CHANGED	%	# OF MODS	CATE-GORY	%	PARA-METER	%	CONC. VALUE	%	UNITS	%	RAD ERR. VALUE	%	DETECT. LIMIT	%	NO REVIEW	%	NEW ADD'N	%
Air Particulate	664	165	25%	18	11%	326	18	6%	113	35%	15	5%	15	5%	105	32%	0	0%	42	13%	18	6%
Groundwater	18,551	5,339	29%	2,077	39%	4,155	552	13%	747	18%	636	15%	58	1%	714	17%	15	0%	814	20%	619	15%
Groundwater QA	3,028	1,063	35%	233	22%	985	91	9%	216	22%	128	13%	2	0%	107	11%	6	1%	186	19%	249	25%
Industrial Hygiene	1,799	345	19%	21	6%	418	143	34%	58	14%	1	0%	38	9%	8	2%	0	0%	156	37%	14	3%
IRA Soils	10,812	3,649	34%	2,166	59%	1,542	293	19%	24	2%	702	46%	21	1%	7	0%	1	0%	212	14%	282	18%
Lakes & Steams	4,694	929	20%	9	1%	1,275	120	9%	168	13%	149	12%	630	49%	180	14%	17	1%	0	0%	11	1%
Lakes & Steams QA	610	169	28%	1	1%	222	8	4%	15	7%	23	10%	103	46%	41	18%	0	0%	32	14%	0	0%
NPDES	2,310	1,345	58%	197	15%	1,628	121	7%	419	26%	193	12%	29	2%	275	17%	0	0%	457	28%	134	8%
NPDES QA	36	17	47%	2	12%	20	0	0%	6	30%	2	10%	0	0%	6	30%	0	0%	0	0%	6	30%
Phase 1 Soils	5,214	3,299	63%	991	30%	2,356	159	7%	47	2%	1,719	73%	6	0%	0	0%	0	0%	425	18%	0	0%
Phase 2 Soils	49,653	14,083	28%	6,565	47%	7,999	2,681	34%	603	8%	1,711	21%	13	0%	158	2%	0	0%	590	7%	2,243	28%
Phase 2 Soils QA	11,899	4,105	34%	1,689	41%	2,521	616	24%	117	5%	578	23%	25	1%	49	2%	18	1%	644	26%	474	19%
Radiological	469	323	69%	0	0%	547	0	0%	219	40%	20	4%	0	0%	199	36%	0	0%	78	14%	31	6%
Radiological QA	120	81	68%	0	0%	81	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	81	100%	0	0%
Sludge	14,785	2,847	19%	1,255	44%	3,249	290	9%	640	20%	1,449	45%	31	1%	511	16%	176	5%	86	3%	66	2%
Sludge QA	3,919	962	25%	187	19%	1,004	86	9%	111	11%	261	26%	59	6%	122	12%	60	6%	302	30%	3	0%
Springs	3,482	1,011	29%	472	47%	672	225	33%	148	22%	68	10%	23	3%	84	13%	4	1%	62	9%	58	9%
Springs QA	257	67	26%	23	34%	51	13	25%	23	45%	9	18%	0	0%	4	8%	0	0%	1	2%	1	2%
Surface Water	3,493	1,702	49%	334	20%	2,120	204	10%	882	42%	326	15%	10	0%	479	23%	16	1%	125	6%	78	4%
Surface Water QA	409	194	47%	51	26%	224	21	9%	79	35%	39	17%	1	0%	51	23%	1	0%	21	9%	11	5%
Totals:	136,204	41,695	31%	16,291	39%	31,395	5,641	18%	4,635	15%	8,029	26%	1,064	3%	3,100	10%	314	1%	4,314	14%	4,298	14%

NON–DETECT Population							TYPE OF MODIFICATION															
DATABASE	TOTAL RECORDS	# OF NON-DETECTS	%	# NOT CHANGED	%	# OF MODS	CATE-GORY	%	PARA-METER	%	CONC. VALUE	%	UNITS	%	RAD ERR. VALUE	%	DETECT. LIMIT	%	NO REVIEW	%	NEW ADD'N	%
Air Particulate	664	499	75%	0	0%	538	0	0%	463	86%	9	2%	13	2%	17	3%	0	0%	36	7%	0	0%
Groundwater	18,551	13,212	71%	627	5%	13,154	916	7%	4,018	31%	273	2%	259	2%	287	2%	7	0%	5,138	39%	2,256	17%
Groundwater QA	3,028	1,965	65%	64	3%	1,979	90	5%	671	34%	33	2%	5	0%	76	4%	0	0%	622	31%	482	24%
Industrial Hygiene	1,799	1,454	81%	61	4%	2,187	1,342	61%	82	4%	0	0%	386	18%	32	1%	266	12%	69	3%	10	0%
IRA Soils	10,812	7,163	66%	452	6%	7,018	175	2%	653	9%	193	3%	184	3%	68	1%	3	0%	5,741	82%	1	0%
Lakes & Steams	4,694	3,765	80%	28	1%	4,890	283	6%	512	10%	25	1%	357	7%	3,188	65%	161	3%	343	7%	21	0%
Lakes & Steams QA	610	441	72%	4	1%	561	44	8%	45	8%	4	1%	41	7%	415	74%	0	0%	12	2%	0	0%
NPDES	2,310	965	42%	47	5%	1,004	37	4%	115	11%	196	20%	25	2%	18	2%	0	0%	527	52%	86	9%
NPDES QA	36	19	53%	0	0%	19	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	13	68%	6	32%
Phase 1 Soils	5,214	1,915	37%	369	19%	1,555	5	0%	149	10%	477	31%	1	0%	0	0%	0	0%	923	59%	0	0%
Phase 2 Soils	49,653	35,570	72%	697	2%	35,865	1,011	3%	3,595	10%	875	2%	399	1%	223	1%	0	0%	29,413	82%	349	1%
Phase 2 Soils QA	11,899	7,794	66%	50	1%	7,924	176	2%	815	10%	214	3%	95	1%	73	1%	71	1%	6,470	82%	10	0%
Radiological	469	146	31%	0	0%	212	14	7%	102	48%	12	6%	2	1%	32	15%	0	0%	30	14%	20	9%
Radiological QA	120	39	33%	0	0%	39	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	39	100%	0	0%
Sludge	14,785	11,938	81%	68	1%	11,898	325	3%	1,292	11%	151	1%	495	4%	139	1%	258	2%	9,185	77%	53	0%
Sludge QA	3,919	2,957	75%	10	0%	3,174	56	2%	311	10%	26	1%	477	15%	9	0%	177	6%	2,111	67%	7	0%
Springs	3,482	2,471	71%	384	16%	2,148	82	4%	418	19%	151	7%	9	0%	1	0%	21	1%	1,460	68%	6	0%
Springs QA	257	190	74%	21	11%	184	18	10%	49	27%	12	7%	0	0%	6	3%	4	2%	95	52%	0	0%
Surface Water	3,493	1,791	51%	17	1%	2,024	430	21%	931	46%	65	3%	29	1%	25	1%	12	1%	522	26%	10	0%
Surface Water QA	409	215	53%	13	6%	234	30	13%	94	40%	4	2%	1	0%	8	3%	0	0%	82	35%	15	6%
Totals:	136,204	94,509	69%	2,912	3%	96,607	5,034	5%	14,315	15%	2,720	3%	2,778	3%	4,617	5%	980	1%	62,831	65%	3,332	3%
Grand Totals:		136,204	100%	19,203	14%	128,002	10,675	8%	18,950	15%	10,749	8%	3,842	3%	7,717	6%	1,294	1%	67,145	52%	7,630	6%

category. EP Toxicity is an extraction procedure and is documented in the database in the Method field as 3010/6010 and is given the category assignment of "EP Tox Metals. Records with the EP Toxicity designation were reviewed with chain-of-custody records to confirm extraction methods requested. As a result of the review, only the industrial hygiene database contains samples extracted by the EP Tox method.

The category "Miscellaneous" is used for classification of analytical measurements such as total organic carbon, flashpoint and percent moisture. Prior to this review, each of these miscellaneous parameters carried its own category name. The grouping of these parameters into the miscellaneous category assists users in accessing data.

Modifications were also made to records for parameter or analyze misspellings. Radiological data were classified in various manners. For example, total uranium was shown as "Total Uranium," "Natural Uranium" and other variations. Again, the computerized data resulted in some difficulty in the use of data based upon misspellings and classification errors. All records were modified to the parameter standards as listed in Attachment D.

The addition of other subcontract laboratories in October of 1989 also contributed to standardization errors. Units of measure were reported differently between laboratories and accounted for 3% of the changes. MetaTRACE reported Fluoride as mg/l while other laboratories reported fluoride in μg/l. Radiological data were reported as pCi/l and mg/l. Units were standardized according to data quality requirements (DQRs) during the verification review.

2.3.2 Transcription Review

The second review of database records assessed the types of transcriptional errors made by metaTRACE during the data entry process. This review effort was directed at determining the accuracy of transcribing data results of detectable concentrations. Values for concentration, detection limits, units and radiological errors were reviewed under the transcription process.

A change indicator of "V" was used to mark database records based on changes in concentration values. Eight percent of the total modifications made (or 8% of the records held in all databases) were modified for concentration values. While the modification of concentration field was noted during the review process, the degree of change of the concentration values was not. A separate analysis was done to determine the magnitude of the

differences between values previously held in the database and those held after transcription review. The detection limit and radiological error fields were also analyzed for percent change under the screening levels. The general finding was that relatively few values were statistically significant in concentration between the re-keyed data and records held in the database.

Most of the changes made to the concentration field were attributed to extraneous characters, such as quotes, CLP qualifiers, etc. However, most numerical changes made to the concentration values were attributed to rounding and significant figures. EPA CLP protocol indicates that three significant figures should be used in reporting concentrations. MetaTRACE did not consistently report to three significant figures and/or did not round to the closest integer. Most of these changes resulted in concentration value differences of <0.5%.

Data quality requirements set for the WSSRAP designate specific reporting requirements for units of measure for each analyte. In the review of reporting units held in the databases, it was found that errors in unit conversion and appropriate sample matrix units were made. During the re-key effort, the review of laboratory bench sheets showed analytical results reported in various units for certain analytes. This was particularly true for metals analysis where data were analyzed in mg/l but reported in μg/l. For approximately 1% of all data records, the conversions of concentrations for units were either not made or were calculated erroneously by metaTRACE during the data entry process. More typical was the misuse of the proper units in the reporting of data. Most of the records with incorrect units were the site-designated quality control samples. The field and equipment water blanks were shipped to metaTRACE with soil samples for analysis. The bench sheets reflected the proper units of measure for each matrix but during the reporting phase, errors were made in reporting water blanks in weight-to-weight measurements (i.e., μg/g) instead of weight-to-volume measurements (i.e., mg/l).

Other types of transcription errors noted were caused by inappropriate data entry procedures used by metaTRACE. MetaTRACE consistently reported radiological error values as a value of 10% of the concentration instead of the calculated radiological error. During the re-key process, the calculated error values reported on the laboratory bench sheet were used to update the WSSRAP database records. Some other analytical categories show a high percentage of modifications in the error field. These changes are due to metaTRACE entering CLP qualifier values in the error field where no value was needed or expected. CLP qualifiers are

not held in the WSSRAP database and only radiological error values are held in the error field. All non-radiological records were standardized to blanks in the error field.

Detection limits were reported by metaTRACE using the standard EPA CLP CRDL values in some cases, and not provided at all in others. According to CLP protocol, detection limits should be corrected to account for dilutions and percent moisture adjustment made during the analytical testing. During manual review of the data records, some concentration values required correction to reflect dilutions and percent moisture adjustments. Adjustments to detection limits for percent moisture and dilution were only made when the WSSRAP data validation group requested changes be made based on their technical reviews.

All of the corrections described on the preceding pages were made to the database prior to use as the basis for the chemical plant remedial investigation, risk assessment, and feasibility study.

3 DATA VALIDATION

The major objectives of the data validation program are:

- To assess laboratory performance and data to quality control criteria, data quality objectives, and procedural requirements.
- To assess analytical data and qualify data for useability.
- To report data validation findings to the data users.

In support of the Weldon Spring Site Remedial Action Project (WSSRAP) remedial investigation, approximately 12,000 data points (12K data) were selected for a detailed data validation review. The samples and analyses associated with this validation effort are listed in Attachment F. Seven thousand two hundred ninety-nine data points (or 61.6%) were from analyses performed by metaTRACE, Inc.; 570 data points (4.8%) were from JTC; 101 data points (0.9%) were from Accu-Labs; and 3,878 data points (32.7%) were from ITAS. Table 3-1 provides a data point distribution of the 12K data by sample matrix and by laboratory.

3.1 Validation Procedures

The data validation process involved retracing the laboratory analyses from beginning to end and comparing the results of that validation "retracing" with those that were reported by the laboratories. In addition, sample custody transfer records and analytical holding times were reviewed to assess sample integrity. Any deviations from protocol, quality control deficiencies, compromises to sample integrity, or mathematical/transcription errors were noted and used to qualify or reject the data.

In order to accomplish the validation "retrace", the analytical documentation that pertained to the analysis (such as instrument printouts, standard preparation logs, sample preparation logs, sample data summary/calculation sheets, quality control (QC) control charts, chain-of-custody records) were reviewed for the samples of interest, instrument calibrations and tunes, and for the associated quality control samples and standards.

Table 3–1 Data Point Distribution for 12K Data

DISTRIBUTION BY SAMPLE MATRIX

MATRIX	ANIONS	METALS	MISC	NITROS	PEST/ PCBs	RAD	SEMI– VOA	VOA	TOTALS	%
Air [1]	0	0	0	0	0	18	0	0	18	0.2%
Groundwater	100	358	14	162	0	114	1,430	884	3,062	25.8%
NPDES	3	0	5	0	0	8	0	0	16	0.1%
Oil	0	0	0	0	112	0	0	0	112	0.9%
Sludge	115	649	13	144	612	100	2,470	1,530	5,633	47.5%
Soil	16	190	9	264	195	0	1,105	510	2,289	19.3%
Spring Water	0	25	0	48	0	8	0	0	81	0.7%
Surface Water	20	250	0	36	0	36	260	0	602	5.1%
Waste	0	0	1	0	0	33	0	0	34	0.3%
Total	254	1,472	42	654	919	317	5,265	2,924	11,847	100.0%

DISTRIBUTION BY LABORATORY

LAB [2]	ANIONS	METALS	MISC	NITROS	PEST/ PCBs	RAD	SEMI– VOA	VOA	TOTALS	%
metaTRACE	201	1,331	25	294	528	174	3,250	1,496	7,299	61.6%
JTC	53	113	17	114	139	0	65	68	569	4.8%
Accu–Lab [3]	0	0	0	0	0	101	0	0	101	0.9%
ITAS	0	28	0	246	252	42	1,950	1,360	3,878	32.7%
Totals	254	1,472	42	654	919	317	5,265	2,924	11,847	100.0%

[1] With the exception of a few samples analyzed for lead, all air particulate analyses were limited to radiochemical parameters.

[2] metaTRACE = metaTRACE, Inc. JTC = JTC Environmental Consultants, Inc. Accu–Lab = Accu–Labs Research, Inc. ITAS = IT Analytical Services, Inc.

[3] Accu–Labs provided only radiochemical services to WSSRAP.

Calculations were repeated; accuracy and precision were measured; and the analytical process (preparatory and instrumental) was reviewed.

The analytical documentation was grouped and cataloged into data sets synonymous to the laboratory analytical lot and assigned a unique data set number. Within each data set, all analyses or injections were further cataloged chronologically and assigned a sequence number. Using this approach, each analysis or injection could be referenced by the combined data set and sequence numbers. No two analyses or injections would have the same combined numbers. An analysis-specific worksheet was maintained with each data set and was used for maintaining validation notes and comments, and as a checklist to ensure critical items for each analysis were reviewed. Calculation checks for each data set were performed and documented by computerized spreadsheet and were maintained with each data set.

The results from each validation review were compared with those that have been reported by the laboratories and/or were maintained in the WSSRAP database. This comparison included not only the reported parameter concentration values, but also the reported error values (for radiochemical analyses only), the units, and the detection limits. Discrepancies associated with these comparisons were noted.

The analyses were evaluated for useability based on the requirements established for the analytical protocol or method (i.e., U.S. Environmental Protection Agency (EPA), Contract Laboratory Program (CLP), U.S. Army Toxic and Hazardous Materials Agency (USATHAMA)) used to obtain the resulting data. However, there are numerous accepted protocols available for a given parameter, and a simple deviation from the intended protocol would not necessarily lessen the degree of confidence to a level where the data would not be usable. As such, if a sufficient amount of quality control and analytical checks were performed during an analysis (which is standard analytical practice), then the accuracy and precision for the analysis could be measured, the degree of confidence assessed, and an informed decision about the analysis and its data could be made. Such data would not be automatically rejected as unusable, but would be flagged as data from an analysis not following the intended protocol.

The results from the data validation review were summarized in the form of validation qualifiers. The use of qualifiers is similar to the technique used by the EPA with its CLP program, and provide a means for incorporating validation results into the WSSRAP database. The list of qualifiers adopted for WSSRAP and their meaning is provided in Table 3-2.

For each parameter in a given data set, the analytical accuracy and precision was calculated. In general, accuracy was calculated from the recovery of the parameter of interest in the laboratory control spike sample (or blank spike) or from the matrix spike sample. In cases were several control samples were available per data set, the recoveries were averaged. For volatiles, semi-volatiles, and pesticide/PCBs, accuracy was measured from the recovery of the analytical surrogate compounds included in each sample for analysis. Precision was measured as the relative percent difference between duplicate analyses of the same sample for the same parameters. Such precision measurements were made from laboratory duplicates, field duplicates, or matrix spike duplicates. In cases where duplicates or control samples were not available, no accuracy and/or precision determinations could be made and the resulting data were qualified accordingly. In as much as duplicate data are often matrix specific and such precision measurements are not used as a rejection criteria in the EPA CLP program, poor or missing precision measurements were not automatically taken as cause for rejection of the WSSRAP data.

3.2 Validation Criteria

Listed below are the evaluation criteria that were used during data validation. Several evaluation criteria were general and were applied to all analyses. These general criteria were:

- Reject data if the analyte of interest was present in the associated analytical blank at a level that was within 10 times the level of that analyte present in the sample (per CLP).

- Accept but flag data if the analyte of interest was present in the associated analytical blank and the level in the sample of interest exceeded the level present in the blank by a factor of ten or more (per CLP).

- Accept data if the analyte of interest was present in the associated blank but was not detected in the sample of interest.

Table 3–2 WSSRAP Data Validation Qualifier List

QUALIFIER

4 (or A+)	Data meeting all QA/QC requirements.
3	Good quantitative data not meeting all objective QA/QC requirements, but are generally valid.
2	Data that are adequate for semi–quantitative comparisons (i.e. the order of magnitude of the reported value is credible, but the exactness of the value is questionable).
1	Data that are adequate for a qualitative assessment (ie. the target analyte is a real artifact, not contamination), but have no quantitative validity.
A	Acceptable, but has restrictions (has attached flags).
V	Data that appear to be valid based on good comparison to data from identical sampling locations or to data from historical records.
R	Data that are not valid.
N	Data not petitioned for validation; or validation documentation not yet received from the laboratory.
O	Validation Technical Review ON–HOLD.
P	Validation Technical Review IN–PROGRESS or PENDING.
X	Data Not Validatable.

FLAGS[1]

>	High Bias (i.e. accuracy > DQR limit)
<	Low Bias (i.e. accuracy < DQR limit)
C	Calibration/Quantitation Deficiencies
Q	Quality Control Deficiencies
I	Qualitative Deficiencies or Instrument Interferences Present
B	Contamination or High Background Present
H(#/#)	Holding Time(s) Exceeded (# days exceeded for prep/analysis)
F	Matrix–Related Interferences Present
J	Estimated Value (may be linked with other flags)
Y	Custody Deficiencies
T	Typographical or Mathematical Error Present
M	Poor Matrix Spike Recoveries (matrix accuracy)
D	Poor Duplicate RPD (precision)
?	Other (see applicable validation report)

[1] To be used in conjunction with any of the above qualifiers, except for qualifier 4 or A+, which by definition shall stand alone.

- Reject data if any analytical condition or circumstance suggested low analytical confidence (i.e. spectral interferences, poor spectral match, faulty calibrations etc.).

- Accept but flag data if any associated precision measurement exceeded the CLP 20% criteria (no flag is necessary where the analyte concentration is less than or equal to five times the applicable detection limit).

- Accept but flag any data associated with a matrix spike or matrix spike duplicate where the CLP criteria were not met (±25% recovery was used for non-CLP parameters).

- Accept but flag data if expected quality control samples (which are protocol requirements) were missing from the analytical run; reject data if the missing quality control requirements could be interpreted as standard analytical practice (i.e. control spikes, analytical blanks).

- Place on-hold any data value mismatches or omissions in the WSSRAP database that were due to transcription errors[1]. The on-hold status would be changed when the transcription error was corrected.

- Declare any data non-validatable if documentation critical to supporting the data and the analysis (i.e. instrument print-outs) were not available.

The additional analysis-specific evaluation criteria are as described in the following sections.

Anions

There were 74 samples or 254 data points involved in this validation effort for anions. These data were grouped into 66 data sets for validation purposes.

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[1] If another situation existed that would reject the data or make the data non-validatable even after the transcription error or omission was corrected, the data would be rejected or declared non-validatable.

The analytical method employed by metaTRACE, Inc. was EPA 300.0, Ion Chromatography. The analytical methods employed by JTC were the EPA 300 series wet chemistry methods for the individual anions.

An analytical value for anions was accepted or rejected by data validation based on the following criteria:

- Reject data if the associated initial calibration curve was non-linear (as determined by a correlation coefficient of < 0.995).

- Reject data if the percent recovery of the daily calibration verification checks that bracket the sample of interest were <85% and the sample was non-detect (or within 10 X DL), otherwise flag. Flag if the calibration check exceeds 115%.

- Reject data if the associated analytical accuracy exceeded the WSSRAP data quality requirement (DQR) limits.

- Accept but flag data if the accuracy exceeded the laboratory control limits, as determined by QC control charts provided. If control charts are not available, use control limits of ±20%.

- Accept but flag data if the holding time was exceeded and the sample was positive for the analyte of interest.

- Reject data if the holding time was exceeded by seven days and the sample was negative.

Metals

There were 85 samples or 1472 data points involved in this validation effort for metals. These data were grouped into 148 data sets for validation purposes.

The analytical methods employed by the laboratories were the EPA CLP inductively coupled plasma (ICAP), graphite furnace (GFAA), and cold vapor (CV) methods. Sample

preparation was in accordance with the applicable EPA CLP procedure for each particular sample matrix type.

An analytical value for metals was accepted or rejected by data validation based on the following criteria:

- Reject data if the associated initial calibration curve was non-linear (as determined by a correlation coefficient of < 0.995).
- Reject data if the daily calibration verification checks that bracket the sample of interest exceeded recovery limits of 85% to 115%; accept but flag if the checks exceeded the CLP limits of 90% to 110%.
- Reject data if the analytical accuracy exceeded the WSSRAP DQR limits or the laboratory control limits (whichever are greater).
- Accept but flag data if the accuracy exceeded the WSSRAP DQR limits or the laboratory warning limits (whichever are greater).
- Accept but flag data if the precision exceeded the DQR (and CLP) limits of 20% (or 35% for non-aqueous samples).
- Accept but flag data if the holding time was exceeded.

Miscellaneous

There were 33 samples or 42 data points in this validation effort for the miscellaneous parameters (cyanide, total organic carbon, total organic halides, grease & oil). These data were grouped into 27 data sets for validation purposes.

EPA approved methods were employed by the laboratories for these analyses. An analytical value for the miscellaneous parameters was accepted or rejected by data validation based on the following criteria:

- Reject data if the associated initial calibration curve (if applicable) was non-linear (as determined by a correlation coefficient of < 0.995).

- Reject data if the daily calibration verification checks (if applicable) that bracket the sample of interest exceeded recovery limits of 85% to 115%.

- Reject data if the associated analytical accuracy exceeded the WSSRAP DQR limits.

- Accept but flag data if the holding time was exceeded and the sample was positive for the analyte of interest.

- Reject data if the holding time was exceeded by seven days and the sample is negative.

Nitroaromatics

There were 108 samples or 654 data points involved in this validation effort for nitroaromatics. These data were grouped into 47 data sets for validation purposes.

The analytical methods employed by the laboratory were based on procedures certified by the USATHAMA, which involved sample preparation[2] and analysis by high performance liquid chromatography (HPLC).

An analytical value for nitroaromatics was accepted or rejected by data validation based on the following criteria:

- Reject data if the associated initial calibration curve is non-linear (as determined by a correlation coefficient of <0.995).

- Reject data if the daily calibration verification checks associated with the sample of interest exceeded recovery limits of 80% to 120%; accept but flag if the checks exceeded recovery limits of 85% to 115%.

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2 A solid phase extraction sample preparation method was used by metaTRACE, Inc.; JTC used a "dilute and shoot" method, while ITAS used a solvent "shake-out."

- Reject data if the associated analytical accuracy exceeded the laboratory control limits, as determined by QC control charts provided. If control charts are not available, use control limits of ±50%.

- Accept but flag data if the accuracy exceeded the laboratory warning limits, as determined by QC control charts provided. If control charts are not available, use warning limits of ±25%.

- Accept but flag data if the holding time was exceeded by 30 days or less[3].

- Reject data if the holding time is exceeded by more than 30 days.

Pesticides/PCBs

There were 77 samples or 919 data points involved in this validation effort for pesticides/PCBs. These data were grouped into 24 data sets for validation purposes.

The analytical methods employed by the laboratory were the EPA CLP procedures for sample preparation and analysis by gas chromatography (GC). Several PCB-only samples were analyzed in accordance with EPA Method 608 or SW846 Method 8080.

An analytical value for pesticides/PCBs was accepted or rejected by data validation based on the following criteria:

- Accept but flag data if the relative standard deviation of the calibration factors in the three evaluation standard mixes exceeded the CLP 10% criteria.

- Accept but flag data if the percent breakdown for endrin or DDT exceeded the CLP 20% criteria.

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3 The 30 day holding time cut-off is based on a USATHAMA/EPA holding time study performed by Martin-Marietta which demonstrated parameter stability for up to 30 days if the samples are maintained at a temperature of 4° C.

- Accept but flag data if the percent difference of the calibration factors for each standard in the individual mixes A and B exceeded the CLP 15% criteria during the analytical run.

- Accept but flag data if the dibutylchlorendate (DBC) surrogate recoveries (accuracy) exceeded the CLP advisory limits.

- Reject data if a reported positive compound did not confirm during the conformational analysis.

- Reject data if the holding times were exceeded by more than 15 days; flag otherwise.

- Reject data if a reported positive multi-peak compound did not match the peak pattern from the compound's associated standard in the analytical run.

Radiochemical

There were 122 samples or 317 data points involved in this validation effort for radiochemical parameters. These data were grouped into 103 data sets for validation purposes.

The analytical method employed by the laboratories were from the EPA 900 series methods utilizing alpha, beta, or gamma spectrometry, as appropriate. Fluorometry (EPA 908.1) was employed by Accu-Labs for natural uranium.

An analytical value for radiochemical parameters was accepted or rejected by data validation based on the following criteria:

- Reject data if the associated analytical accuracy exceeded the WSSRAP DQR limits or laboratory control limits (whichever are greater). If control limits are not available use ±25%.

- Accept but flag data if the accuracy exceeded the WSSRAP DQR limits or laboratory warning limits (whichever are greater). If limits are not available, use ±20%.

Semi-Volatile Organics

There were 81 samples or 5,265 data points involved in this validation effort for semi-volatile organics. These data were grouped into 39 data sets for validation purposes.

The analytical methods employed by the laboratories were the EPA CLP procedures for sample preparation and analysis by gas chromatography/mass spectrometry (GC/MS).

An analytical value for semi-volatile organics was accepted or rejected by data validation based on the following criteria:

- Initial and continuing (or daily) calibrations were evaluated and qualified as described in Appendix G.
- Reject all acid compounds if the acid surrogate recoveries did not meet the CLP criteria.
- Reject all base/neutral compounds if the base/neutral surrogate recoveries did not meet the CLP criteria.
- Reject all compounds associated with an internal standard if the CLP criteria for that internal standard were not met.
- Accept but flag all associated compounds if the surrogate compounds in the associated blank were low and did not meet the CLP criteria.
- Accept but flag all associated compounds if the internal standard area counts in the associated blank exceeded the CLP upper limits.
- Reject all data if the CLP instrument tuning criteria were not met.
- Reject all data if the holding times were exceeded by more than 15 days; flag otherwise.

Volatile Organics

There were 81 samples or 2,924 data points involved in this validation effort for volatile organics. These data were grouped into 27 data sets for validation purposes.

The analytical methods employed by the laboratories were the EPA CLP procedures for sample preparation and analysis by gas chromatography/mass spectrometry (GC/MS).

An analytical value for volatile organics was accepted or rejected by data validation based on the following criteria:

- Initial and continuing (or daily) calibrations were evaluated and qualified as described in Appendix G.
- Reject all compounds if the surrogate recoveries did not meet the CLP criteria.
- Reject all compounds associated with an internal standard if the CLP criteria for that internal standard were not met.
- Accept but flag all compounds if the surrogate compounds in the associated blank were low and did not meet the CLP criteria.
- Accept but flag all associated compounds if the internal standard area counts in the associated blank exceeded the CLP upper limits.
- Reject all data if the CLP instrument tuning criteria were not met.
- Reject all data if the holding times were exceeded by more than 15 days; flag otherwise.

3.3 Validation Results

Table 3-3 summarizes the validation qualifiers that were assigned to the data points associated with the 12K data point validation project. These qualifiers are presented for all laboratories associated with these data, and independently for metaTRACE, Inc., JTC/Accu-labs, and ITAS.

Of the 11,847 total data points referenced in Table 3-3, 80.5% are accepted, 10.4% rejected, 5.9% validated by reference, and 3.2% are not validatable. The data points that were "validated by reference" consist of 486 pesticide/PCB and 217 nitroaromatic data points that were judged for useability by comparison to similar samples collected in the check sample program (discussed in Section 4 of this report). The non-validatable percentage represents analyses where essential laboratory documentation (i.e., instrument printouts associated with the analyses) could not be located. These analyses were not rejected (unless other circumstances associated with the analysis were present that would have rejected the analysis even if the missing documentation was present), but were not accepted since the supporting documentation was missing.

Table 3-4 summarizes the accuracy and precision for each parameter in the 12K data points. The accuracy and precision values are the average from all data sets for each parameter, where n is equal to each data population size. The accuracy values for aqueous, non-aqueous, and total samples are listed as a ± percentage from 100% (where 100% or ±0% represents the best accuracy). The precision values for aqueous, non-aqueous, and total samples are listed as a percentage from 0% (where 0% represents the best precision). In cases where a sample of a particular matrix was not included with the 12K data points, a "None" is listed. In cases where precision or accuracy measurements are not available (i.e. due to missing analytical QC) a "****" is listed.

In general, the accuracy and precision values listed in Table 3-4 were within the DQR limits and within the range expected for the types of analyses and matrices involved. However, a number of values are worth discussion:

1. The 51% precision for nitrate in non-aqueous samples (with a data population of 17) was influenced by the 121.5% precision for five samples in dataset 41 and the 141.7%

Table 3–3 Data Validation Qualifier Summary

All Labs

# of datapoints	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	208	1073	33	240	369	235	4649	2724	**9531**
Valid by Ref. (V)	0	0	0	215	486	0	0	0	**701**
On–Hold (O)	0	0	0	0	0	0	0	0	**0**
Non–Validatable (X)	5	159	3	60	22	63	32	34	**378**
Rejected (R)	41	240	6	139	42	19	584	166	**1237**
Total	**254**	**1472**	**42**	**654**	**919**	**317**	**5265**	**2924**	**11847**

Percentages	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	81.9%	72.9%	78.6%	36.7%	40.2%	74.1%	88.3%	93.2%	**80.5%**
Valid by Ref. (V)	0.0%	0.0%	0.0%	32.9%	52.9%	0.0%	0.0%	0.0%	**5.9%**
On–Hold (O)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Non–Validatable (X)	2.0%	10.8%	7.1%	9.2%	2.4%	19.9%	0.6%	1.2%	**3.2%**
Rejected (R)	16.1%	16.3%	14.3%	21.3%	4.6%	6.0%	11.1%	5.7%	**10.4%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

% Completeness	**83.5%**	**81.7%**	**84.6%**	**76.6%**	**95.3%**	**92.5%**	**88.8%**	**94.3%**	**89.2%**

Table 3–3 Data Validation Qualifier Summary (cont'd)

metaTRACE, Inc.

# of datapoints	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	172	941	22	0	0	105	2639	1380	**5259**
Valid by Ref. (V)	0	0	0	215	486	0	0	0	**701**
On–Hold (O)	0	0	0	0	0	0	0	0	**0**
Non–Validatable (X)	4	157	2	12	0	60	32	0	**267**
Rejected (R)	25	233	1	67	42	9	579	116	**1072**
Total	**201**	**1331**	**25**	**294**	**528**	**174**	**3250**	**1496**	**7299**

Percentages	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	85.6%	70.7%	88.0%	0.0%	0.0%	60.3%	81.2%	92.2%	**72.1%**
Valid by Ref. (V)	0.0%	0.0%	0.0%	73.1%	92.0%	0.0%	0.0%	0.0%	**9.6%**
On–Hold (O)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Non–Validatable (X)	2.0%	11.8%	8.0%	4.1%	0.0%	34.5%	1.0%	0.0%	**3.7%**
Rejected (R)	12.4%	17.5%	4.0%	22.8%	8.0%	5.2%	17.8%	7.8%	**14.7%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

% Completeness	**87.3%**	**80.2%**	**95.7%**	**76.2%**	**92.0%**	**92.1%**	**82.0%**	**92.2%**	**84.8%**

Table 3–3 Data Validation Qualifier Summary (cont'd)

JTC / Accu–Labs

# of datapoints	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	36	104	11	6	124	88	64	33	**466**
Valid by Ref. (V)	0	0	0	0	0	0	0	0	**0**
On–Hold (O)	0	0	0	0	0	0	0	0	**0**
Non–Validatable (X)	1	2	1	48	15	3	0	34	**104**
Rejected (R)	16	7	5	60	0	10	1	1	**100**
Total	**53**	**113**	**17**	**114**	**139**	**101**	**65**	**68**	**670**

Percentages	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	67.9%	92.0%	64.7%	5.3%	89.2%	87.1%	98.5%	48.5%	**69.6%**
Valid by Ref. (V)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
On–Hold (O)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Non–Validatable (X)	1.9%	1.8%	5.9%	42.1%	10.8%	3.0%	0.0%	50.0%	**15.5%**
Rejected (R)	30.2%	6.2%	29.4%	52.6%	0.0%	9.9%	1.5%	1.5%	**14.9%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

% Completeness	**69.2%**	**93.7%**	**68.8%**	**9.1%**	**100.0%**	**89.8%**	**98.5%**	**97.1%**	**82.3%**

Table 3–3 Data Validation Qualifier Summary (cont'd)

IT Analytical Services

# of datapoints	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	0	28	0	234	245	42	1946	1311	3806
Valid by Ref. (V)	0	0	0	0	0	0	0	0	0
On–Hold (O)	0	0	0	0	0	0	0	0	0
Non–Validatable (X)	0	0	0	0	7	0	0	0	7
Rejected (R)	0	0	0	12	0	0	4	49	65
Total	0	28	0	246	252	42	1950	1360	3878

Percentages	Anions	Metals	Misc.	Nitros	Pest/ PCB	Radio– chem.	Semi– VOA	VOA	Total
Accepted (A)	0.0%	100.0%	0.0%	95.1%	97.2%	100.0%	99.8%	96.4%	98.1%
Valid by Ref. (V)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On–Hold (O)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Non–Validatable (X)	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%	0.0%	0.2%
Rejected (R)	0.0%	0.0%	0.0%	4.9%	0.0%	0.0%	0.2%	3.6%	1.7%
Total	0.0%	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

% Completeness		100.0%		95.1%	100.0%	100.0%	99.8%	96.4%	98.3%

Table 3–4 Accuracy & Precision Summary from Validation of the 12K Data Points[1]

	Aqueous				Non–Aqueous				Total			
ANIONS	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n
CHLORIDE	± 0.4	33	1.3	17	± 7.4	21	20.7	11	± 2.6	54	8.9	28
FLUORIDE	± 3.4	28	2.7	17	± 0.5	24	6.3	15	± 2.1	52	4.4	32
NITRATE	± 5.5	31	6.4	18	± 2.0	22	51.0	17	± 2.4	53	28.0	35
NITRITE	± 11.1	2	****	2	± 11.1	24	8.6	14	± 11.1	26	8.6	14
SULFATE	± 1.4	33	8.7	17	± 3.6	25	15.6	16	± 2.4	58	12.0	33
METALS												
ALUMINUM	± 0.7	26	1.9	9	± 4.2	20	14.0	17	± 1.4	46	9.8	26
ANTIMONY	± 3.6	26	0.0	9	± 10.2	20	0.6	17	± 6.5	46	0.4	26
ARSENIC	± 2.2	29	0.0	11	± 0.6	23	20.2	19	± 1.0	52	12.8	30
BARIUM	± 3.1	26	0.5	10	± 3.1	11	14.8	11	± 3.1	37	8.0	21
BERYLLIUM	± 1.7	27	0.0	10	± 2.0	18	8.0	15	± 1.8	45	4.8	25
CADMIUM	± 1.1	26	0.0	9	± 2.2	18	6.5	10	± 1.5	44	3.4	19
CALCIUM	± 1.9	26	5.0	9	± 4.9	18	10.1	14	± 0.9	44	8.1	23
CHROMIUM	± 2.2	33	8.3	16	± 0.5	19	54.8	15	± 1.2	52	30.8	31
COBALT	± 2.6	26	0.0	9	± 1.9	18	0.0	10	± 0.8	44	0.0	19
COPPER	± 0.6	26	0.0	9	± 5.0	18	16.6	15	± 1.7	44	10.3	24
IRON	± 0.6	26	4.1	6	± 4.7	20	39.3	17	± 1.7	46	30.1	23
LEAD	± 4.9	25	4.0	8	± 3.9	29	29.6	20	± 0.2	54	22.3	28
LITHIUM	± 10.3	26	0.0	10	± 35.3	12	0.0	19	± 18.2	38	0.0	29
MAGNESIUM	± 0.2	26	5.4	9	± 2.8	20	9.6	16	± 1.3	46	8.1	25
MANGANESE	± 0.8	26	1.3	9	± 1.6	20	33.7	17	± 0.2	46	22.5	26
MERCURY	± 2.3	8	7.0	21	± 4.0	26	2.1	15	± 2.5	34	5.0	36
MOLYBDENUM	± 2.1	26	0.0	9	± 0.9	15	22.4	12	± 1.7	41	12.8	21
NICKEL	± 1.1	33	0.0	16	± 5.3	19	15.4	14	± 2.7	52	7.2	30
POTASSIUM	± 6.5	26	0.8	9	± 6.9	9	0.0	10	± 3.1	35	0.4	19
SELENIUM	± 3.8	23	4.6	7	± 7.8	30	9.0	28	± 6.1	53	8.1	35
SILVER	± 52.6	25	0.0	9	± 12.6	31	0.0	15	± 30.4	56	0.0	24
SODIUM	± 1.0	26	5.4	9	± 2.1	9	5.8	15	± 0.2	35	5.6	24
THALLIUM	± 6.5	25	0.0	9	± 0.4	24	6.4	20	± 3.5	49	4.4	29
VANADIUM	± 4.9	26	0.0	9	± 6.2	18	17.5	14	± 5.4	44	10.6	23
ZINC	± 4.1	26	0.6	8	± 1.3	18	12.7	15	± 1.9	44	8.5	23
ZIRCONIUM	± 16.3	1	****	1	± 18.4	24	12.4	16	± 18.3	25	12.4	16
MISCELLANEOUS												
BIOCHEMICAL OXYGEN DEMAND	None	0	None	0	None	0	None	0	None	0	None	0
CYANIDE	None	0	None	0	± 1.5	3	0.0	2	± 1.5	3	0.0	2
OIL & GREASE	None	0	None	0	± 3.3	4	****	4	± 3.3	4	****	4
PERCENT SOLID	NA	0	NA	0	****	4	1.6	4	****	4	1.6	4
PH	None	0	None	0	± 1.8	2	0.8	2	± 1.8	2	0.8	2
TOTAL DISSOLVED SOLIDS	None	0	None	0	± 2.0	1	1.2	1	± 2.0	1	1.2	1
TOTAL ORGANIC CARBON	± 1.6	14	9.1	9	± 4.7	3	0.0	2	± 2.2	17	7.4	11
TOTAL SUSPENDED SOLIDS	± 7.4	5	0.0	5	NA	0	NA	0	± 7.4	5	0.0	5
TOX	None	0	None	0	± 5.3	5	0.0	4	± 5.3	5	0.0	4

Table 3–4 Accuracy & Precision Summary from Validation of the 12K Data Points[1] (cont'd)

	Aqueous				Non–Aqueous				Total			
NITROAROMATICS	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n
1,3,5–TRINITROBENZENE	± 22.8	33	0.8	13	± 8.3	61	6.5	17	± 13.4	94	4.0	30
1,3–DINITROBENZENE	± 22.3	35	0.9	15	± 1.7	61	10.2	17	± 9.2	96	5.8	32
2,4,6–TNT	± 19.2	36	0.9	16	± 1.2	61	15.4	17	± 7.9	97	8.4	33
2,4–DNT	± 15.6	36	2.9	16	± 1.6	61	4.2	17	± 4.8	97	3.5	33
2,6–DNT	± 19.5	36	2.7	16	± 11.6	61	5.7	17	± 0.1	97	4.2	33
NITROBENZENE	± 19.5	36	1.9	16	± 2.1	55	1.8	11	± 6.5	91	1.8	27
RADIOCHEMICAL												
GROSS ALPHA	± 14.5	7	34.9	4	None	0	None	0	± 14.5	7	34.9	4
GROSS BETA	± 7.3	1	28.9	1	None	0	None	0	± 7.3	1	28.9	1
LEAD–210	± 58.9	4	9.2	4	± 4.0	2	8.0	2	± 40.6	6	8.8	6
RADIUM–226	± 6.3	22	3.9	14	± 32.7	12	38.1	11	± 7.5	34	18.9	25
RADIUM–228	± 27.5	5	28.9	5	± 24.9	2	21.0	2	± 26.8	7	26.6	7
THORIUM–228	± 15.6	5	****	5	± 0.9	8	88.3	6	± 6.6	13	88.3	6
THORIUM–230	± 4.9	24	28.8	19	± 40.8	9	17.5	24	± 14.7	33	22.5	43
THORIUM–232	± 11.3	22	55.3	16	± 15.2	13	36.6	11	± 1.5	35	47.7	27
URANIUM, TOTAL	± 11.8	69	12.1	54	± 9.7	11	8.9	7	± 11.5	80	11.7	61
URANIUM–234	None	0	None	0	± 18.9	27	33.2	13	± 18.9	27	33.2	13
URANIUM–235	None	0	None	0	± 9.2	18	34.5	11	± 9.2	18	34.5	11
URANIUM–238	None	0	None	0	± 19.8	27	39.7	13	± 19.8	27	39.7	13
PESTICIDES/PCBs												
4,4'–DDD	± 104.0	1	****	1	± 31.4	13	0.5	8	± 36.6	14	0.5	8
4,4'–DDE	± 104.0	1	****	1	± 31.4	13	0.0	15	± 36.6	14	0.0	15
4,4'–DDT	± 104.0	1	****	1	± 31.4	13	11.8	14	± 36.6	14	11.8	14
ALDRIN	± 104.0	1	****	1	± 31.4	13	37.9	15	± 36.6	14	37.9	15
ALPHA–BHC	± 104.0	1	****	1	± 31.4	13	0.0	14	± 36.6	14	0.0	14
ALPHA–CHLORDANE	± 104.0	1	****	1	± 31.4	13	0.0	14	± 36.6	14	0.0	14
AROCLOR–1016	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1221	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1232	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1242	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1248	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1254	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
AROCLOR–1260	± 104.0	1	****	1	± 8.1	67	8.1	58	± 9.5	68	8.1	58
BETA–BHC	± 104.0	1	****	1	± 31.4	13	2.4	12	± 36.6	14	2.4	12
DELTA–BHC	± 104.0	1	****	1	± 31.4	13	0.0	15	± 36.6	14	0.0	15
DIELDRIN	± 104.0	1	****	1	± 31.4	13	13.1	14	± 36.6	14	13.1	14
ENDOSULFAN I	± 104.0	1	****	1	± 31.4	13	0.0	9	± 36.6	14	0.0	9
ENDOSULFAN II	± 104.0	1	****	1	± 31.4	13	0.0	14	± 36.6	14	0.0	14
ENDOSULFAN SULFATE	± 104.0	1	****	1	± 31.4	13	10.4	15	± 36.6	14	10.4	15
ENDRIN	± 104.0	1	****	1	± 31.4	13	10.3	14	± 36.6	14	10.3	14
ENDRIN KETONE	± 104.0	1	****	1	± 31.4	13	0.0	12	± 36.6	14	0.0	12
GAMMA–BHC (LINDANE)	± 104.0	1	****	1	± 31.4	13	39.8	15	± 36.6	14	39.8	15
GAMMA–CHLORDANE	± 104.0	1	****	1	± 31.4	13	1.3	10	± 36.6	14	1.3	10
HEPTACHLOR	± 104.0	1	****	1	± 31.4	13	38.3	15	± 36.6	14	38.3	15
HEPTACHLOR EPOXIDE	± 104.0	1	****	1	± 31.4	13	0.0	15	± 36.6	14	0.0	15
METHOXYCHLOR	± 104.0	1	****	1	± 31.4	13	0.0	15	± 36.6	14	0.0	15
TOXAPHENE	± 104.0	1	****	1	± 31.4	13	0.0	15	± 36.6	14	0.0	15

Table 3–4 Accuracy & Precision Summary from Validation of the 12K Data Points[1] (cont'd)

SEMI–VOLATILES	Aqueous				Non–Aqueous				Total			
	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n
1,2,4–TRICHLOROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
1,2–DICHLOROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
1,3–DICHLOROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
1,4–DICHLOROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2,4,5–TRICHLOROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2,4,6–TRICHLOROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2,4–DICHLOROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2,4–DIMETHYLPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2,4–DINITROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2,4–DINITROTOLUENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2,6–DINITROTOLUENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2–CHLORONAPHTHALENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2–CHLOROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2–METHYLNAPHTHALENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2–METHYLPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
2–NITROANILINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
2–NITROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
3,3'–DICHLOROBENZIDINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
3–NITROANILINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
4,6–DINITRO–2–METHYLPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
4–BROMOPHENYL PHENYL ETHER	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
4–CHLORO–3–METHYL PHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
4–CHLOROANILINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
4–CHLOROPHENYL PHENYL ETHER	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
4–METHYLPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
4–NITROANILINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
4–NITROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
ACENAPHTHENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
ACENAPHTHYLENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
ANTHRACENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZO(A)ANTHRACENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZO(A)PYRENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZO(B)FLUORANTHENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZO(G,H,I)PERYLENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZO(K)FLUORANTHENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BENZOIC ACID	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
BENZYL ALCOHOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
BIS(2–CHLOROETHOXY)METHANE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BIS(2–CHLOROETHYL)ETHER	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BIS(2–CHLOROISOPROPYL)ETHER	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
BIS(2–ETHYLHEXYL)PHTHALATE	± 9.9	27	17.1	7	± 33.8	54	5.9	16	± 25.8	81	9.3	23
BUTYLBENZYLPHTHALATE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
CHRYSENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
DI–N–BUTYLPHTHALATE	± 9.9	27	17.1	7	± 33.8	54	4.1	16	± 25.8	81	8.1	23
DI–N–OCTYLPHTHALATE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
DIBENZO(A,H)ANTHRACENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
DIBENZOFURAN	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
DIETHYLPHTHALATE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
DIMETHYLPHTHALATE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
FLUORANTHENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25

Table 3-4 Accuracy & Precision Summary from Validation of the 12K Data Points[1] (cont'd)

SEMI-VOLATILES (cont'd)	Aqueous				Non-Aqueous				Total			
	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n
FLUORENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
HEXACHLOROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
HEXACHLOROBUTADIENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
HEXACHLOROCYCLOPENTADIENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
HEXACHLOROETHANE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
INDENO(1,2,3-CD)PYRENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
ISOPHORONE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
N-NITROSO-DI-N-PROPYLAMINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
N-NITROSODIPHENYLAMINE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
NAPHTHALENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
NITROBENZENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
PENTACHLOROPHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
PHENANTHRENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25
PHENOL	± 53.2	27	17.1	7	± 33.3	54	3.4	18	± 39.9	81	7.3	25
PYRENE	± 9.9	27	17.1	7	± 33.8	54	3.7	18	± 25.8	81	7.4	25

Table 3-4 Accuracy & Precision Summary from Validation of the 12K Data Points[1] (cont'd)

VOLATILES	Aqueous				Non-Aqueous				Total			
	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n	% Acc.	n	% Prec.	n
1,1,1-TRICHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,1,2,2-TETRACHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,1,2-TRICHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,1-DICHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,1-DICHLOROETHENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,2-DICHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,2-DICHLOROETHENE (TOTAL)	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
1,2-DICHLOROPROPANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
2-BUTANONE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
2-HEXANONE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
4-METHYL-2-PENTANONE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
ACETONE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
BENZENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
BROMODICHLOROMETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
BROMOFORM	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
BROMOMETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CARBON DISULFIDE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CARBON TETRACHLORIDE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CHLOROBENZENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CHLOROETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CHLOROFORM	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CHLOROMETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
CIS-1,3-DICHLOROPROPENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
DIBROMOCHLOROMETHANE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
ETHYL BENZENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
METHYLENE CHLORIDE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
STYRENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
TETRACHLOROETHENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
TOLUENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
TRANS-1,3-DICHLOROPROPENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
TRICHLOROETHENE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
VINYL ACETATE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
VINYL CHLORIDE	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44
XYLENES, TOTAL	± 0.2	27	2.5	17	± 1.8	59	4.0	27	± 1.3	86	3.4	44

**** – Value not available due to missing analytical QC (ie. analytical duplicates, control sample)
None – No samples of this matrix in the data group.
NA – Analysis not applicable to this matrix.
n – Data Population.
% Acc. – Based on percent recovery (subtracted from 100%) of the target compound or surrogate compounds in the control sample, matrix spike or target sample (surrogates).
% Prec. – Based on % difference of the target compound concentration or surrogate recoveries from analytical duplicates or MS/MSD pair.

[1] All accuracy and precision values relating to CLP parameters are within the acceptance range as defined by EPA CLP protocols, except for those discussed in Section 3 of this report. Attachment A contains the WSSRAP Data Quality Requirments (DQRs) for comparison to the accuracy and precision values in this table.

precision for one sample in dataset 42. These two occurrences (datasets) may reflect sample non-homogeneity that is typically seen in non-aqueous samples.

2. The 54.8% precision for chromium in non-aqueous samples (with a data population of 15) was influenced by the 124% precision for three samples and a matrix spike/matrix spike duplicate (MS/MSD) pair in dataset 277 and the 71.4% precision for one sample in dataset 273. The 39.3% precision for iron in non-aqueous samples (with a data population of 17) was influenced by the 72.7% precision for four samples and one field duplicate in dataset 278 and the 114.6% precision for one sample in dataset 1,016. In each of these cases, sample non-homogeneity is suspected.

3. The ±35.3% accuracy for lithium in non-aqueous samples (with a data population of 12) was influenced by the 23.8% recovery of the control sample for five samples in dataset 269. This probably reflects poor sample preparation and the lithium datapoints for those five samples in the dataset have been rejected by data validation.

4. The ±52.6% accuracy for silver in aqueous samples (with a data population of 25) was influenced by the 52% control sample recovery for three samples in dataset 259, by the 6.0% control sample recovery for one sample in dataset 307, and by the 4.0% control sample recovery for 10 samples in dataset 297. The poor recoveries of these control samples probably reflect poor sample preparation (i.e., loss of silver as AgCl during digestion) or reflects inductively coupled plasma (ICP) spectral interferences. All 14 data points have been rejected by data validation.

5. The ±58.9% accuracy for Lead-210 in aqueous samples (with a data population of four) was influenced by the 158.9% control spike recovery for four samples in dataset 119. Control charts were not available for this analysis and the quality of the resulting recovery is uncertain. Due to this uncertainty and the fact that the 158.9% recovery may reflect poor sample preparation, the four datapoints have been rejected by data validation.

6. The ±32.7% accuracy for Radium-226 in non-aqueous samples (with a data population of 12) was influenced by the 57% control sample recovery for two samples in dataset 91; by the 48.2% control sample recovery for two samples in dataset 87; by the 56.4% control sample recovery for one sample in dataset 89; by the 59.3% control sample

recovery for one sample in dataset 90; and by the 77.9% control sample recovery for one sample in dataset 86. All five sets of analyses were done by radon-emanation, which according to the control charts provided by the laboratory, has lower recoveries compared to gas proportional counting. All associated datapoints have been properly flagged by data validation.

7. The ±27.5% accuracy for Radium-228 in aqueous samples (with a data population of five) was influenced by the 125.6% control sample recovery for one sample in dataset 914 and the 128% control sample recovery for four samples in dataset 99. All associated datapoints have been properly flagged by data validation.

8. The 28.9% precision for Radium-228 in aqueous samples (with a data population of five) was influenced by the 144.5% precision for one sample in dataset 914. This datapoint has been properly flagged by data validation.

9. The 88.3% precision for Thorium-228 in non-aqueous samples (with a data population of six) was influenced by the 88.3% precision for two samples in dataset 919. This may reflect sample non-homogeneity; both datapoints have been properly flagged.

10. The 28.8% precision for Thorium-230 in aqueous samples (with a data population of 19) was influenced by the 285% precision for one sample in dataset 941 and by the 52.4% precision for five samples in dataset 928. Sample preparation is suspect; all six datapoints have been properly flagged by data validation.

11. The ±40.8% accuracy for Thorium-230 in non-aqueous samples (with a data population of nine) was influenced by the 179.6% control sample recovery for one sample in dataset 100, and by the 78.1% control sample recovery for two samples in dataset 919. These recoveries probably reflect the efficiency of the sample preparation for the analysis. Due to the large deviation in recovery of the control sample in dataset 100, the target Thorium-230 datapoint in that dataset had been rejected by data validation. All three associated datapoints in the discussion have been properly flagged by data validation.

12. The 55.3% precision for Thorium-232 in aqueous samples (with a data population of 16) was influenced by the 177.0% precision for five samples in dataset 928. Sample preparation is suspect; all five datapoints have been properly flagged.

13. The ±104% accuracy for pesticides and polychlorinated biphenyls (PCBs) in aqueous samples is influenced by the 204% DBC surrogate recovery in the single target sample in the aqueous population. Due to the lack of available aqueous pesticide and PCB samples, or to the lack of available complete laboratory documentation, a larger data population was not possible. For the single sample in question (from dataset 196), the DBC surrogate recovery exceeds the CLP advisory upper limit of 175%; the data for this sample have been properly flagged by data validation.

For the volatile and semi-volatile parameters, the accuracy and precision values are within the ranges typically seen for the type of analysis. For example, the accuracies listed for the acid parameters (±53.2% for aqueous and ±33.3% for non-aqueous) and for the base/neutral parameters (±9.9% for aqueous and ±33.8% for non-aqueous) are within the acceptance ranges established from CLP (which averages ±86% for acid compounds and ±63% for base neutral compounds).

During the validation of the 12K data points, numerous problems surfaced; however, most of these problems were resolved. The most widespread problem related to missing laboratory documentation. A major effort was undertaken by the PMC to gather all WSSRAP documentation from the contract laboratories, and most of this documentation was collected. However, several pieces were not located, which has resulted in some of the data points (3.2%) being declared non-validatable (X). Listed below are several other problems that were analysis-specific:

1. Numerous <u>manual</u> integrations were observed with the volatile and semi-volatile data. Manual integrations occurred when the instrument operator over-rode the instrument's software integration technique which could have allowed calibration bias to enter into the analysis. However, "pictures" of these manual integrations were obtained from the laboratory, which allowed the validation team to determine which integrations were acceptable and which were not. Corrections to the data were made for the improper integrations and evaluations of the data were based on the corrected analyses.

2. Only one nitroaromatic initial calibration curve was used for compound quantitation by metaTRACE for a period of at least 13 months. This single calibration curve was applied to all but two of the metaTRACE nitroaromatic data sets. Instrument stability over that span of time is extremely unusual. According to USATHAMA protocol, a new

initial calibration is required at instrument start-up, after any instrument or column maintenance, or when the daily calibration check fails to meet the laboratory established limits. For several of the affected data sets, the daily calibration checks did not meet the acceptance criteria, and instrument maintenance by a service representative was noted during that 13 month period. Since a new calibration curve was not established, the sensitivity or ability of the instrument to detect nitroaromatic compounds at the reported detection limits was uncertain to the validation team. As such, the reliability of the nitroaromatic data (and particularly the "non-detects") in 31 of 33 metaTRACE data sets were in question.

To resolve this uncertainty, additional nitroaromatic samples were collected in a check sample program that is discussed further in Section 4 of this report, and the resulting data were validated and compared to the metaTRACE data. Except for two data points, there was complete agreement among the data. The non-detects reported by metaTRACE remained as non-detects from the check sample program, thus adding confidence and support to the viability and sensitivity of the single metaTRACE initial calibration curve used over the 13 month period. The nitroaromatic data in the affected metaTRACE data sets have been validated by reference (V) to the check sample data. The qualifier summary on Table 3-3 reflects these reference approvals.

Of the two conflicting data points, both were associated with sample S2-051280, 100890-2.0,4.0. MetaTRACE reported 1.21 μg/g for 1,3,5-TNT while the check sample was a non-detect. Since the 1.21 μg/g value is on the low end of the calibration curve, this value has been determined to be too unreliable and has been rejected by the validation team. For 2,4,6-TNT, metaTRACE reported 647 μg/g while the check sample yielded a non-detect. The metaTRACE instrument chromatogram was reviewed again by the validation team, and again confirmed the presence of 2,4,6-TNT. This discrepancy may suggest sample non-homogeneity. However, due to the poor comparison to the check sample data and the qualitative uncertainty of the chromatographic peak being 2,4,6-TNT, the metaTRACE data point has been rejected by the validation team.

3. Instrument calibration and sensitivity for the metaTRACE pesticide/PCB analyses were uncertain. To resolve this uncertainty, additional samples for PCB analysis were collected in the check sample program and the resulting data validated and compared with the metaTRACE PCB data. For all sample matrices except soils, the comparisons

matched. As such, the data from the associated metaTRACE data sets have been validated by reference to the check sample data. Table 3-3 reflects these reference approvals. However for soils, the data comparisons were poor in approximately 50% of the soil samples analyzed for PCBs in the check sample program. Significant quantities (ranging from 50 μg/kg to 38,000 μg/kg) of Aroclors 1260 and/or 1254 were observed in the check samples where non-detects were reported by metaTRACE in corresponding samples. The significant quantities of PCBs and the 50% poor match does not lend support to the uncertainty associated with the metaTRACE calibrations. The poor comparison could possibly reflect sample non-homogeneity, but this fact is uncertain. As such, the metaTRACE pesticide/PCB data associated with the soils in the 12K data points have been rejected by the validation team.

4. A large percentage of the laboratory documentation needed for validating the isotopic thorium analyses by metaTRACE was not located during the documentation search performed by both metaTRACE and the PMC. In particular, most of the Thorium-229 tracer counts were missing, which directly impacts validating the efficiency of the isotopic thorium analyses. Though these data points are not validatable, their rejection is not certain since the percent acceptance of the validatable data population for isotopic thorium is high (82%).

5. For many of the metals analyses, some of the CLP required QC samples (i.e. serial dilutions, end-of-run interference check samples, post-digestion spikes) were not included in the analytical runs. Though important, their absence has not hindered evaluation of the data. These data were evaluated, but flagged as not following CLP protocol.

6. For anions, all metaTRACE analyses were done by ion chromatography which requires an unpreserved sample. The holding time for nitrate on an unpreserved sample is 48 hours (as opposed to 28 days for a preserved sample). For this reason, the holding time was generally exceeded for all nitrate analyses. In addition, the routine end-of-run calibration verification check was not always included. Those data have been flagged accordingly.

Detailed print-outs of the 12K data point validation findings are available in appendixes A through D under separate cover. These findings have been arranged by WSSRAP ID and by analytical category. For each data point, the following information has been provided.

a. WSSRAP sample ID.
b. Sample percent solids (if applicable).
c. Validation dataset number and sequence number.
d. Laboratory code and analysis request number (if available).
e. Laboratory sample ID number.
f. Parameter.
g. Analytical category.
h. Analytical concentration (±Rad. error) in WSSRAP GURU database.
i. Analytical concentration (±Rad. error) from validation review.
j. Analytical detection limit in WSSRAP GURU database.
k. Analytical detection limit from validation review.
l. Validation qualifier and flags.
m. Validation comments (if any).
n. Analytical accuracy and precision.

4 CHECK SAMPLING PROGRAM DESCRIPTION

This section contains a discussion of the results of quality assurance (QA) samples collected and analyzed by secondary laboratories as well as the rationale, procedures, and results of the check sampling program.

4.1 Quality Assurance Sample Results

Quality assurance (QA) samples were collected throughout all site characterization and routine environmental monitoring activities at the Weldon Spring Site Remedial Action Project (WSSRAP). Two types of QA samples were used to support data validation activities; duplicate samples, which were analyzed by the same laboratory as the original sample, and replicate samples which were analyzed by a different laboratory.

Duplicate and replicate samples were collected at the same time and in the same manner as regular samples. Generally, both duplicate and replicate samples were collected at the frequency of one sample per 20 regular samples. Replicate samples were not collected for raffinate sludges due to constraints on the analysis of radioactive materials. The results of QA samples were generally presented in the data reports. Numerous reports generically summarize the QA sample results by stating the general agreement between QA samples and regular samples and present the QA sample results in an appendix or table. The number of samples collected and analyzed to evaluate interlaboratory variability is summarized in Table 4-1. QA sample results were statistically evaluated in the Phase II Chemical Soil Investigation. The results are discussed in detail in the following paragraphs.

Duplicate and replicate samples were collected during the Phase II Chemical Soil Investigation. A detailed analysis was performed for those compounds with sufficient detected concentrations. Duplicate samples from this investigation yielded an average relative percent difference of 23.6% for metals analyses and 21.1% for inorganic anions. This general agreement indicates that the primary laboratory performed analyses in a consistent manner. The average relative percent difference for replicate samples was 25%. This general agreement between laboratories indicates that the analyses were performed consistent with the required analytical methods. Also, a combined total of 65 volatile organic, semi-volatile organic and pesticide and polychlorinated biphenyl (PCB) analyses performed by the secondary laboratory

Table 4-1 Summary of Samples Collected to Assess Interlaboratory Variability

WATER SAMPLES

Analytical Category	Number of Samples
Volatile Organics	0
Semivolatile Organics	0
Pest/PCBs	0
Metals	1
Nitroaromatics	24
Anions	24
Radiological	38
Misc.	4

SOIL SAMPLES

Analytical Category	Number of Samples
Volatile Organics	22
Semivolatile Organics	32
Pest/PCBs	11
Metals	68
Nitroaromatics	31
Anions	70
Radiological	12
Misc.	74

agreed completely (except for laboratory contaminants) with the results from the primary laboratory.

4.2 Check Sample Procedures

The purpose of the check sampling program was to collect and analyze samples from media and locations for which the existing data were not of documentable quality to support the Remedial Investigation/Feasibility Study (RI/FS) process (see Section 3.3). This effort focused on documenting the absence of specific contaminants as well as confirming the presence and concentrations of contaminants previously detected. A sampling plan was prepared and submitted to the U.S. Environmental Protection Agency (EPA). Samples were collected from the raffinate pit sludges, on-site soils, groundwater, and surface water. The analytical parameters included volatile organic compounds, semivolatile organic compounds, PCBs, nitroaromatic compounds and radiological species.

Check samples were collected according to site-specific procedures. Samples were preserved as appropriate prior to shipment to the analytical laboratory. Chain of custody was maintained for all samples according to the site-specific chain of custody procedure. The rational for sampling locations and analytical parameters is discussed by media in the respective sections.

Samples collected under this check sampling program were analyzed according to standard EPA Contract Laboratory Program (CLP) methods for volatile organic, semivolatile organic, and PCB compounds. Samples requiring nitroaromatic compound analyses were analyzed using EPA SW846 Method 8330. Radiological analyses were performed using methods consistent with the EPA 900 series procedures.

4.3 Check Sample Results

Results from the check sampling program are discussed by medium in the following sections. The data from this program have been used to validate previous analytical results and to confirm the absence of groups of compounds. The data collected as a result of this program have been entered into the WSSRAP database.

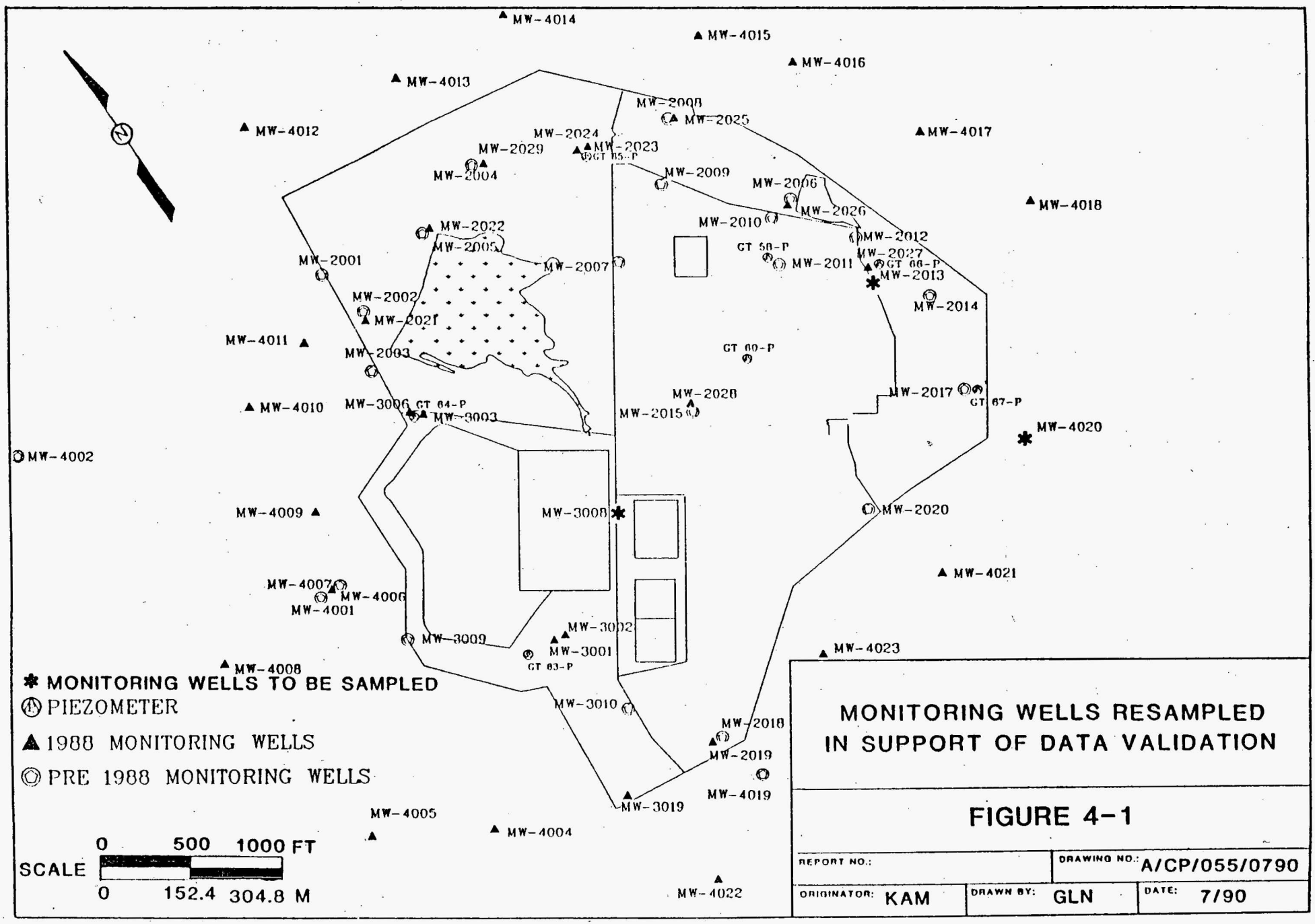
4.3.1 Groundwater

Data quality problems with the groundwater portion of the database included the inability to completely validate volatile and semivolatile organic compound results and the infrequent calibration of laboratory instruments used to perform nitroaromatic analyses. The check sampling program for groundwater consisted of resampling to provide data confirming the previous volatile and semivolatile organic results and comparing historical nitroaromatic results (performed by metaTRACE) with current environmental monitoring data performed by the U.S. Army Environmental Hygiene Agency (AEHA).

Three groundwater monitoring wells were sampled to confirm the absence of volatile and semivolatile organic compounds. These wells, MW-2013, MW-3008 and MW-4020, are located in the nitroaromatic and raffinate pit plumes and in an area not impacted by either area of contaminated groundwater. The location of these wells is shown in Figure 4-1.

Samples were collected using dedicated bladder pumps from three monitoring wells on site and analyzed for volatile and semivolatile organic compounds. The results of the check samples from these wells confirm that the groundwater is not contaminated with these compounds.

In addition to the check sampling program, nitroaromatic compound results from routine environmental monitoring performed in 1990 were compared to the historical metaTRACE results. This comparison indicates that the historical nitroaromatic concentrations observed in groundwater are consistent with the concentrations observed during recent environmental monitoring. A direct, statistical comparison is not practical due to the dynamic nature of the groundwater system. However, in 1989, 44 of 89 wells contained detectable concentrations of nitroaromatic compounds with seven wells exhibiting nitroaromatic concentrations above 10 μg/l. During the first half of 1990, 31 of 89 wells contained detectable concentrations of nitroaromatic compounds with 12 wells exhibiting concentrations above 10 μg/l. These minor differences between 1989 and 1990 are due to the fact that the 1990 numbers are based on a single sampling event, while the 1989 numbers are based on at least two sampling events. Wells with low concentrations of nitroaromatic compounds have historically varied between detecting and not detecting concentrations near the detection limit. The increase in the number of wells with



MONITORING WELLS RESAMPLED IN SUPPORT OF DATA VALIDATION

FIGURE 4-1

REPORT NO.:		DRAWING NO.: A/CP/055/0790
ORIGINATOR: KAM	DRAWN BY: GLN	DATE: 7/90

higher concentration is consistent with recent trend analyses and may be partially attributed to slight concentration fluctuations. This is supported by variation in nitroaromatic concentrations between 1987 and 1989. Overall, 1990 AEHA nitroaromatic results are consistent with 1987, 1988, and 1989 metaTRACE results.

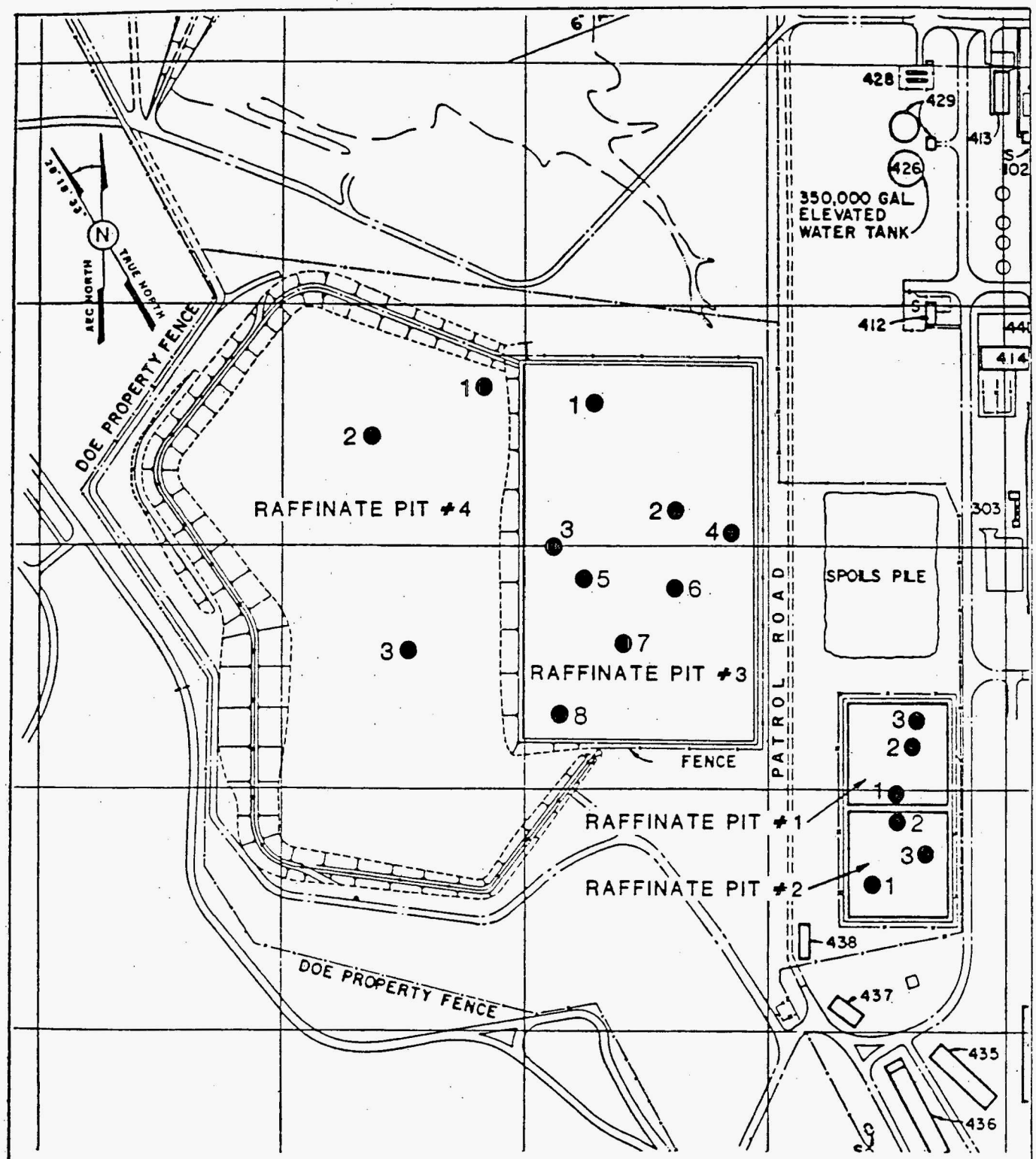
4.3.2 Surface Water

The rational for the surface water check sampling program was similar to the groundwater check sample program. Routine monitoring confirmed the levels of contaminants present. The check sampling program was designed to confirm previous characterization efforts which documented the absence of contamination. The check sampling program consisted of sampling a spring north and a spring south of the site for both volatile and semivolatile organic compounds. The springs sampled are shown in Figure 4-2. These springs were selected because they are impacted by the WSSRAP and would indicate whether a significant problem existed. No volatile or semivolatile organic compounds were detected, confirming previous characterization data.

4.3.3 Sludge

The sludge check sampling program consisted of collecting a total of 17 samples from the four raffinate pits. The locations of these samples are presented in Figure 4-3. Analytical parameters for raffinate sludge included volatile and semivolatile organic compounds, PCBs, and nitroaromatic compounds. These analytical parameters were selected because the initial characterization indicated that these compounds were not present in the raffinate sludge. Sludge samples were also analyzed for silver and zirconium to provide data to compare with the initial results.

Sludge samples were collected using a ponar dredge from all four raffinate pits. The check samples collected confirmed the previous data which indicated that the raffinate sludges do not contain nitroaromatic, volatile organic, semivolatile organic, or PCB compounds. The check samples did detect small amounts of acetone and methylene chloride. These compounds are common laboratory solvents and their detection indicates laboratory contamination and does not represent actual values.



●-SAMPLE LOCATION

0 300 600 FT

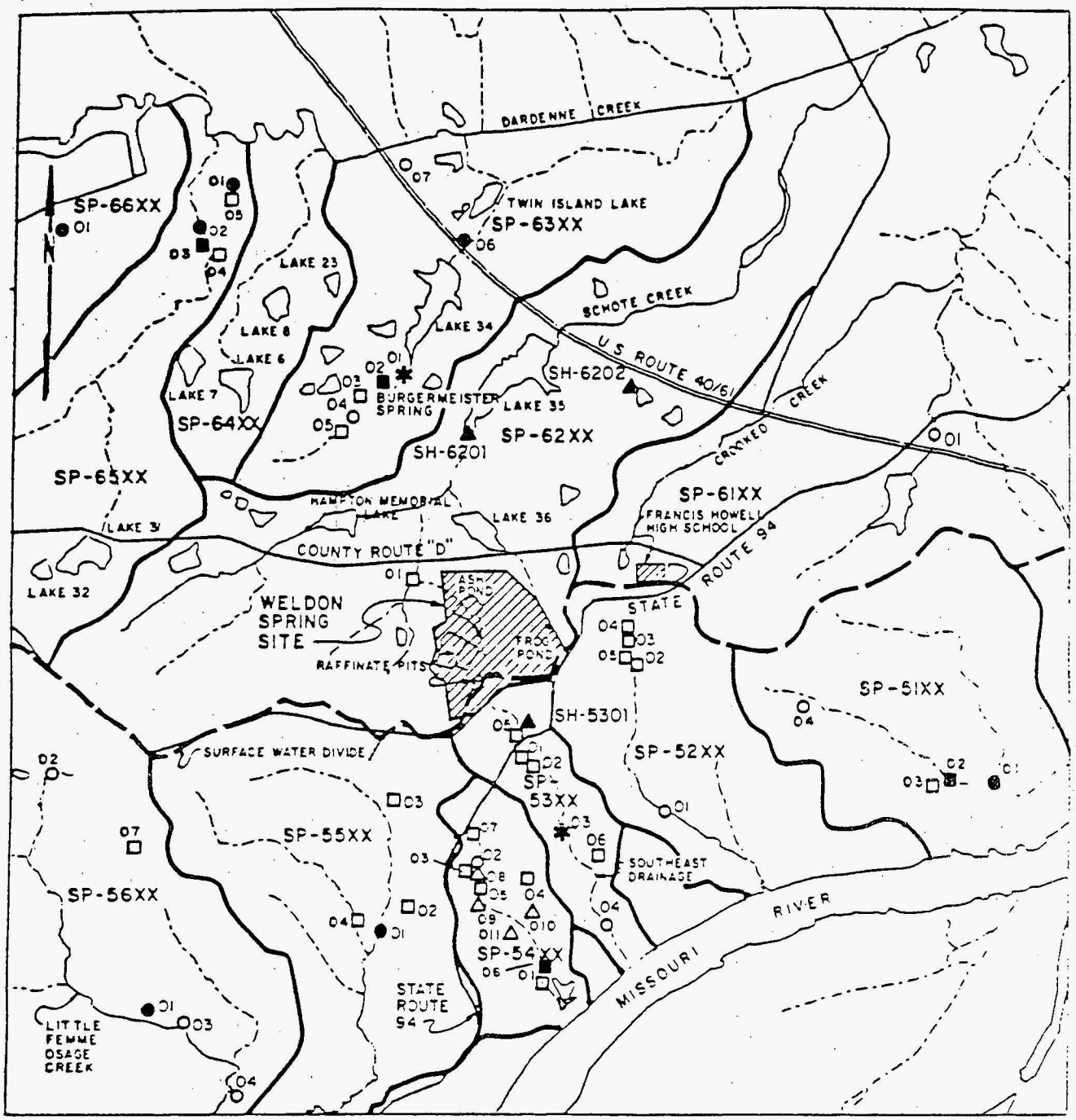
0 91.4 182.4 M

SCALE

SLUDGE SAMPLING LOCATIONS
FOR DATA VALIDATION

FIGURE 4-3

REPORT NO.: NA		DRAWING NO.: A/RP/001/0790	
ORIGINATOR: KAM	DRAWN BY: GLN	DATE: 7/90	



SOURCE: MDNR, 1989

LEGEND:

- SURFACE WATER DIVIDE BETWEEN MISSISSIPPI RIVER AND MISSOURI RIVER
- DRAINAGE BOUNDARY
- CREEK OR SURFACE DRAINAGE
- POND OR LAKE
- ● PERENNIAL SPRING WITH LARGE MAXIMUM FLOW
- ○ PERENNIAL SPRING WITH SMALL MAXIMUM FLOW
- ■ WET WEATHER SPRING WITH LARGE MAXIMUM FLOW
- □ WET WEATHER SPRING WITH SMALL MAXIMUM FLOW
- ▲ SHALLOW HOLE (SH)
- △ SEEP
- SP-63XX SPRING OR SEEP IN DESIGNATED DRAINAGE AREA NUMBER 63. XX REPRESENTS THE DESIGNATED SPRING NUMBER IN DRAINAGE 63.
- ✱ SPRINGS TO BE SAMPLED

SCALE 0 3200 6400 FT
0 975.4 1950.7 M

SPRINGS SAMPLED IN SUPPORT OF DATA VALIDATION

FIGURE 4-2

REPORT NO.:		DRAWING NO.: A/VP/036/0790
ORIGINATOR: KAM	DRAWN BY: GLN	DATE: 7/90

Check sample results from Raffinate Pit 3 indicate that silver results in the original data set may be biased low since all check sample results for silver were above the maximum observed concentration. Zirconium results were within the expected range.

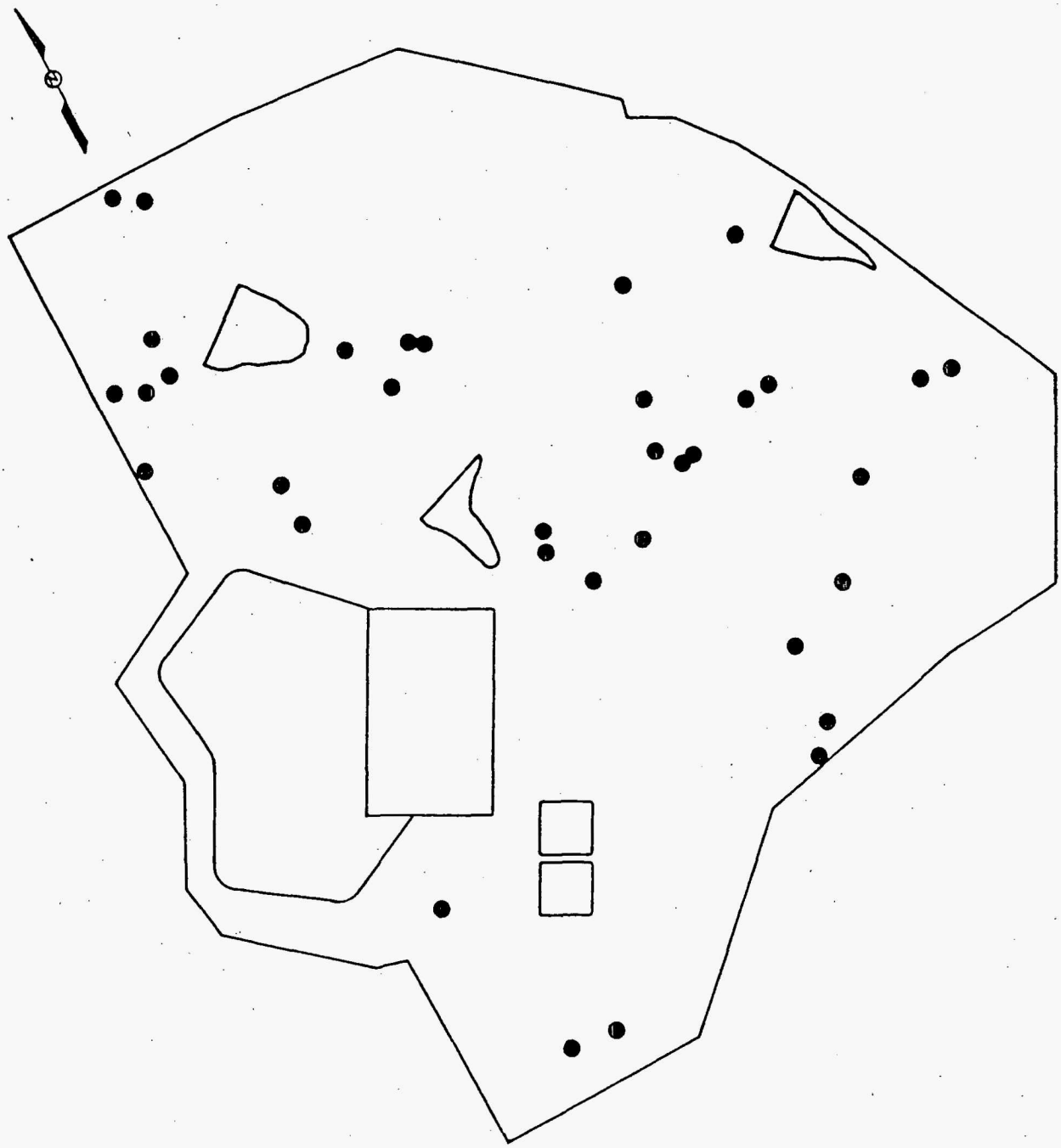
4.3.4 Soil

The check sampling program for soils focused on confirming the absence of significant volatile organic, semivolatile organic, and PCB compound contamination. Samples were also collected and analyzed for nitroaromatic compounds to confirm the presence of contamination, and to confirm that the concentrations observed accurately reflect site conditions. Samples were collected from the locations shown on Figure 4-4. The coordinates, depths, and analytical parameters are presented in Table 4-2.

All soil sampling locations were surveyed prior to sample collection. Soil samples were collected using a bucket auger. Soil from the desired location and interval was placed in a clean stainless steel pan and homogenized (except for sample aliquot used for volatiles) prior to filling the samples containers. Sampling equipment was decontaminated between samples.

Thirteen soil samples from 10 locations were collected and analyzed for volatile organic compounds. The locations sampled during this effort were selected because past known practices indicated the highest probability of volatiles contamination. No detected concentrations of volatile organic compounds were detected during the resampling effort, confirming the absence of these compounds. No tentatively identified compounds other than those related to the analysis (Aldol condensation products) or those present in laboratory blanks were detected.

Thirteen soil samples were collected from 10 locations and analyzed for semivolatile organic compounds. The only compounds detected during the check sample program were common phthalate esters and low concentrations of polyaromatic hydrocarbons (PAH). Phthalates were detected during previous investigations and generally reflect laboratory contamination. The PAHs were detected in the fire training pit as originally observed during the Phase II Chemical Soil Investigation. PAHs were also observed at concentrations below the contract required quantitation limits (CRQL) at site coordinates 50040 East and 100700 North in the 2 ft to 2.5 ft depth interval. No tentatively identified compounds other than those related to the analysis (Aldol condensation products) or those present in laboratory blanks were detected.



● - SOIL SAMPLE LOCATION

0 500 1000 FT
0 152.4 304.8 M
SCALE

SAMPLING LOCATIONS FOR SOIL RESAMPLING

FIGURE 4-4

REPORT NO.: DOE/OR/21548-256		EXHIBIT NO.: A/CP/004/0192	
ORIGINATOR: JJC	DRAWN BY: GLN	DATE: 1/92	

TABLE 4-2 Soil Sampling Location Coordinants, Depths and Analytical Parameters

EAST	NORTH	DEPTH	PARAMETERS
52400	100700	0 - 1	NITROAROMATICS
52300	100700	0 - 1	"
51300	100850	0 - 1	"
51320	100850	0 - 1	"
51225	98825	0 - 2, 2 - 4	"
51760	100243	0 - 2, 2 - 4	"
52220	100750	0 - 2, 2 - 4	"
50850	100100	0 - 2, 2 - 4	"
49468	100712	0 - 2, 2 - 4	"
52400	101400	0 - 2, 2 - 4	"
50100	100650	0 - 6", 2 - 2.5	VOA,SV,PCB
50040	100700	0 - 6", 2 - 2.5	VOA,SV,PCB
50440	100450	0 - 6"	VOA,SV,PCB
50340	100420	0 - 6", 2 - 2.5	VOA,SV,PCB
50610	98370	0 - 6"	VOA,PCB
49370	100740	0 - 2, 2 - 4	NITROAROMATICS
52280	100890	0 - 2, 2 - 4	NITROAROMATICS
51815	100360	0 - 2, 2 - 4	NITROAROMATICS
50850	100185	0 - 2, 2 - 4	NITROAROMATICS
51565	100850	0 - 2, 2 - 4	NITROAROMATICS
51225	98825	0 - 2, 2 - 4	NITROAROMATICS
50140	101225	0 - 2, 2 - 4	NITROAROMATICS
52300	101400	0 - 2, 2 - 4	NITROAROMATICS
52900	100400	0 - 2, 2 - 4	NITROAROMATICS
51400	100700	0 - 2, 2 - 4	NITROAROMATICS
49860	99340	0 - 6"	VOA,SV
50550	101070	0 - 6"	SV
50500	100140	0 - 6", 2 - 2.5	VOA,SV,PCB*
49775	99975	0 - 6", 2 - 2.5	VOA,SV,PCB*
49830	99470	0 - 6"	VOA,SV
50480	100640	0 - 6", 2 - 2.5	PCB
FIRE TRAINING PIT			VOA,SV,PCB
50790	98300	0 - 6", 2 - 2.5	PCB
49950	99740	0 - 6", 2 - 2.5	PCB
50680	99990	0 - 6", 2 - 2.5	PCB
49700	100360	0 - 6", 2 - 2.5	PCB
50310	100450	0 - 6"	PCB

* - ONLY PCB/PESTICIDE ANALYSES TO BE PERFORMED ON DEEPER SAMPLE

Twenty-three soil samples were collected from 14 locations and analyzed for PCBs. The results from these samples indicate that low concentrations of Aroclor-1254 and Aroclor-1260 are present near transformer pads. Check samples also confirmed that PCBs are not widely distributed in site soils. The check sample results detected higher concentrations of PCBs than the original samples. These variances were noted at site coordinants 49700 East and 100360 North. Check samples detected a total of 74 μg/g of Aroclors while the original sample did not detect PCBs. This heterogeneity may be attributed to the nature of the source. PCB contamination adjacent to transformer pads likely originated as small spills during routine transformer servicing.

Thirty-two soil samples were collected from 18 locations and analyzed for nitroaromatics. The results generally agree with historical data which determined that nitroaromatic compounds are present only in low concentration in isolated areas. The check sampling program only yielded two locations with detected concentrations of nitroaromatic compounds. A sample collected from 0 ft to 2 ft at site coordinates 51565 east and 100850 north contained 0.049 μg/g of nitrotoluene. A sample from this location originally detected 1.73 μg/g of 2,6-DNT in the 4 ft to 6 ft depth interval. The original investigations did not include analysis for nitrotoluene. A check sample collected from the 2 ft to 4 ft depth interval at site coordinants 50850 East and 100850 North detected 0.14 μg/g of trinitrotoluene (TNT). Original samples from this location did not detect contamination.

All other check samples did not detect nitroaromatic compounds, including those collected from site coordinants 51280 east and 100890 north. Samples from this location originally detected 647 μg/g of TNT and 1.21 μg/g of 1,3,5-Trinitrobenzene. The absence of contamination in the check samples indicates that the contamination is very isolated and not uniformly distributed over a large area.

4.3.5 Summary

Analytical results confirmed the absence of significant volatile organic, semivolatile organic and PCB compound contamination in raffinate sludges and soils. Minor PCB soil contamination was confirmed near transformer pads. Isolated areas of low concentrations of nitroaromatic compounds were detected in soils at former ordnance production areas. Silver results for raffinate sludges may have been biased low in the original analyses. The absence of volatile organic or semivolatile organic compounds in both groundwater and surface water was

confirmed. These results are summarized in Table 4-3. The historical concentrations and distributions of nitroaromatic compounds in groundwater were also confirmed.

In summary, the check sampling program satisfied the objectives of the sampling plan. The data collected during this program has been validated and supports the validation of the historical data.

TABLE 4-3 Summary of Check Sample Results versus Original Sample Results

Analytical Category		Percentage Identical
PCBs	- Soil	76%
	- Sludge	82%
Volatile Organics Compounds	- Soil	92%
	- Sludge	91%
	- Water	100%
Semivolatile Organic Compounds	- Soil	97%
	- Sludge	99%
	- Water	100%
Nitroaromatic Compounds	- Soil	97%
	- Sludge	100%

Percentage identical is based on number of exactly identical results (on a parameter to parameter check) in both the check sample and the original sample. Samples with detected concentrations of laboratory contaminants, with estimated concentrations, or with concentrations below the contract required detection limits (CRDL) were used in calculating these percentages.

5 CONCLUSION AND RECOMMENDATIONS

Based on the review of the comparability of the duplicate samples, the validation of the 12K data points, and the check sample program the Project Management Contractor (PMC) has concluded that the database is adequate for use as the basis for the *Chemical Plant and Raffinate Pit Remedial Investigation and Feasibility Study* (RI/FS). The database provides an accurate basis for determining which contaminants are present at Weldon Spring Site Remedial Action Project (WSSRAP) and which are not present, and also provides an accurate basis for defining the range and distribution of the contamination. The data are adequate to determine remedial action costs to a +50% and -30% accuracy as required for an RI/FS.

However, the quality of the data must be continually reassessed as the project progresses through the RI/FS phase and on to design, where a more detailed definition of the range and distribution of the contaminants is necessary. Specifically, the following tasks are recommended.

1. Additional soil samples should be collected and analyzed for pesticides and polychlorinated biphenyls (PCBs). As discussed in Section 4.0 the check sample program did not always show good agreement between the samples analyzed by metaTRACE and the samples collected for the check sample program. The lack of agreement is probably due to the fact that the exact location of the previous samples could not be duplicated (the previous sample locations were disturbed) by the check sample program. Since the PCB spills were small confined spills, any variation in the location of the samples would result in somewhat differing measured concentrations. The check sample program did confirm that PCBs are only present in low concentrations in very localized areas near former transformer locations and additional sampling will assist in more accurately defining the extent of the contamination.

2. A limited number of additional water samples should be collected and analyzed for isotopic thorium. Although there is no reason to indicate that the previous samples were improperly analyzed, a large percentage of the laboratory records could not be found and it is considered prudent to further confirm the previous analyses.

3. The accuracy and precision of the data has been evaluated against the action levels developed through the FS process. As shown in Table 3-4 the accuracy and/or precision

of certain contaminants does not meet WSSRAP data quality requirements (DQRs). These contaminants are primarily soil and sludge samples which are very difficult to analyze and improving the accuracy and/or precision may not be possible. Generally, these chemicals are not important to the site because they occur in very low concentrations. However, following the development of action levels, the PMC will evaluate whether the accuracy and precision of chemicals with concentrations near the action levels are adequate.

4. While the database is sound and has an overall estimated percent completeness of 89.2% (refer to Table 3-3), users of the data must be aware that if they choose to use a single data point or a small group of data points for a key calculation, that data point or group of points should be validated. This is necessary because WSSRAP has validated a significant percentage of the database and applied the results of this validation to define the quality of the entire database as recommended by the U.S. Environmental Protection Agency (EPA) RI/FS guidance documents. Other than this, there should be no further restrictions placed on the use of the data.

ATTACHMENT A
DATA QUALITY REQUIREMENTS

DATA QUALITY REQUIREMENTS FOR THE WSSRAP

PRECISON AND ACCURACY GUIDELINES FOR ROUTINE MONITORING AND CHARACTERIZATION

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL LEVEL	ANALYTICAL METHOD	MDL a (ug/g)	SOIL PRECISION	SOIL ACCURACY	MDL a (ug/l)	WATER PRECISION	WATER ACCURACY	COMMENTS
Radiation Screening	Gross Alpha	I	2.6.4 *	NA	NA	NA	NA	NA	NA	ES&H SOP
	Gross Beta/Gamma	I	2.6.3 *	NA	NA	NA	NA	NA	NA	ES&H SOP
Field Measurements	pH	I	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Temperature	I	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Conductivity	I	4.5.2 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Specific Ions	I	4.5.5 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Organic Vapors	I	3.1.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Settleable Solids	I	4.5.7 *	NA	NA	NA	0.1	NA	NA	ES&H SOP
	Th-230, Th-232	II	UNC	2 pCi/g	50	50	NA	NA	NA	
Onsite Radiological Measurements	U-238, U-235	III	901.1	1 pCi/g	50	30	NA	NA	NA	
	Ra-226, Ra-228	III	901.1	1 pCi/g	50	20	NA	NA	NA	
	Th-230, Th-232	II	UNC	2 pCi/g	50	20	NA	NA	NA	
	Gross Alpha	III	2.4.3 *	NA	NA	NA	NA	NA	NA	ES&H SOP
Offsite Radiological Measurements	Nat. Uranium	III	EPA 908.0	1 pCi/g	50	30	1 pCi/l	20	20	
	Ra-226, Ra-228	III	EPA 903.1	1 pCi/g	50	30	1 pCi/l	20	20	
	Th-230, Th-232	III	EERF 00/07	1 pCi/g	50	30	1 pCi/l	20	20	
	Gross Alpha	III	EPA 900.0	3 pCi/g	50	30	3 pCi/l	40	40	
	Gross Beta	III	EPA 900.0	3 pCi/g	50	30	8 pCi/l	40	40	
Nitroaromatic Compounds	2,4,6-TNT	III	Chromatographic	1.2	d	d	0.03 c	e	e	
	2,4-DNT	III	Chromatographic	0.75	d	d	0.03 c	e	e	
	2,6-DNT	III	Chromatographic	1.41	d	d	0.01 c	e	e	
	1,3,5-TNB	III	Chromatographic	0.57	d	d	0.03 c	e	e	
	1,3-DNB	III	Chromatographic	0.9	d	d	0.09 c	e	e	
	Nitrobenzene	III	Chromatographic	1.44	d	d	0.03 c	e	e	
Organics	Volatiles (CLP)	IV	CLP	CRQL	as required by CLP		CRQL	as required by CLP		
	Semi-Volatiles (CLP)	IV	CLP	CRQL	as required by CLP		CRQL	as required by CLP		
	Pesticides/PCBs (CLP)	IV	CLP	CRQL	as required by CLP		CRQL	as required by CLP		

DATA QUALITY REQUIREMENTS FOR THE WSSRAP

PRECISON AND ACCURACY GUIDELINES FOR ROUTINE MONITORING AND CHARACTERIZATION (cont'd)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL LEVEL	ANALYTICAL METHOD	MDL a (ug/g)	SOIL PRECISION	SOIL ACCURACY	MDL a (ug/l)	WATER PRECISION	WATER ACCURACY	COMMENTS
Misc.	TSS	III	EPA 160.2	NA	NA	NA	2	20	20	
	TDS	III	EPA 160.2	NA	NA	NA		20	20	
	TOC	III	EPA 415.1				0.1	20	20	
	Lithium	III	EPA 200.7	5	50	50	50	20	20	
	Molybdenum	III	EPA 200.7	4	50	50	4	20	20	
	Zirconium	III	EPA 200.7	20	50	50	20	20	20	
	Trivalent Chromium	III	EPA 200.7		50	50	10	20	20	
	Hexavalent Chromium	III	Colorimetric		50	50	5	20	20	
	TOX	III	EPA 450.0	5	50	50		20	20	
	Nitrate	III	300.0/353.2 b	0.5	50	50	0.25/0.1 b*	20	20	mg/l
	Sulfate	III	300.0/375.4 b	5	50	50	1.0/1.0 b*	20	20	mg/l
	Chloride	III	300.0/325.1 b	1.5	50	50	0.25/0.2 b*	20	20	mg/l
	Fluoride	III	300.0/340.2 b	1.25	50	50	0.25/0.6 b*	20	20	mg/l
	Nitrite	III	300.0	0.5	50	50		20	20	mg/l
	% Moisture	II	ASTM	NA	50	NA	NA	NA	NA	
	pH (soil)	III	EPA 160.2	NA	50	NA	NA	NA	NA	
	Asbestos – PCM/TEM	III	3.1.4 •	NA	NA	NA	NA	NA	NA	ES&H SOP
Metals	Aluminum	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Antimony	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Arsenic	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Barium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Beryllium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Cadmium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Calcium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Chromium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Cobalt	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Copper	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Iron	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Lead	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Magnesium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Manganese	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Mercury	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Nickel	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		

DATA QUALITY REQUIREMENTS FOR THE WSSRAP

PRECISON AND ACCURACY GUIDELINES FOR ROUTINE MONITORING AND CHARACTERIZATION (cont'd)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL LEVEL	ANALYTICAL METHOD	MDL a (ug/g)	SOIL PRECISION	SOIL ACCURACY	MDL a (ug/l)	WATER PRECISION	WATER ACCURACY	COMMENTS
Metals (cont'd)	Potassium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Selenium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Silver	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Sodium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Thallium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Vanadium	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
	Zinc	IV	CLP	CRDL	as required by CLP		CRDL	as required by CLP		
Other Parameters not listed		II,III,IV	TBD	TBD	50	50	TBD	20	20	See Note

* – See Comment Section.

TBD – To Be Determined.

NA – Not Applicable.

Accuracy = Percent Bias = Percent Recovery – 100

a – Detection limits and methods from contract with metaTRACE, inc. – new limits and/or methods to be established with new laboratories.

b – JTC methods and detection limits.

c – Army Environmental Hygiene Agency (AEHA) detection limits

d – To be negotiated with the laboratory.

e – To be provided by AEHA.

NOTE: Generic DQRs apply to media and/or analytical methods not listed in this table. Specific DQRs may be developed as a part of future sampling and analysis plans.

ATTACHMENT B
DATA VERIFICATION PROCEDURE

ES&H 4.9.1a ENVIRONMENTAL MONITORING DATA VERIFICATION

SET I.D. #028

1.0 PURPOSE

The purpose of this procedure is to establish the system for data verification and provide the objective evidence necessary for timely review and verification of laboratory analytical results for the Weldon Spring Site Remedial Action Project (WSSRAP).

2.0 SCOPE

This procedure applies to all environmental, waste management, health physics, and geotechnical samples collected at the WSS, and data from chemical, radiological, and physical analyses performed by off-site subcontractor laboratories. Verification includes review of hard copy, electronic data, and other documentation. This procedure excludes data collected from field measurements.

3.0 REFERENCES

3.1 EPA, SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods.*

3.2 EPA, *A Compendium of Superfund Field Operations Methods*, Volume 2, Section 16.

3.3 *Environmental Data Administration Plan*, May 1990, DOE/OR/21548-119.

4.0 DEFINITIONS

4.1 Verification: A non-analytical preliminary review of analytical laboratory data and associated documentation performed to ensure that the samples are preserved, shipped, maintained, and analyzed in accordance with established data quality objectives and standard operating procedures.

4.2 Holding time: The period of time from sample collection to the time the sample is extracted and analyzed.

4.3 Validation: A thorough review of the analytical data utilizing laboratory analytical records to assess laboratory performance to quality control criteria, data quality objectives and procedural requirements.

ACRONYMS

DQO Data Quality Objectives
QC Quality Control
EDAP Environmental Data Administration Plan

5.0 RESPONSIBILITIES

The Environmental Protection Manager shall be responsible for implementing this procedure.

6.0 PROCEDURE

6.1 All laboratory data are to be received by the Procurement Department and delivered to the Verification Group.

6.2 All documentation collected as a result of data verification activities shall be retained in verification packages. The verification packages shall be filed by shipment or laboratory request number.

6.3 The Verification Group will receive hard copies and electronic copies of the analytical data. The original hard copies shall be sent to the Quality Assurance Department and copies shall be maintained in the ES&H filing system. The electronic copies shall be maintained in the ES&H filing system.

6.4 Hard copy data results shall be distributed to the designated data reviewers for review. This review process shall be documented on Form 4.9.1.1, Data Verification Data Review Sheet.

6.5 Completed Data Verification Data Review Sheets shall be returned to the Verification Department within two working days of the date distributed.

6.6 After the hard copy data has been reviewed for consistency with validated historical data, they shall be evaluated using Form 4.9.1.2, the Data Verification Checklist. The data shall be reviewed for timeliness of the report, chain-of-custody compliance, accurate sample identifications, completeness and correctness of the data report, and compliance to extraction and analytical holding time.

6.7 Electronic data records shall be compared to the verified hard copy data reports prior to incorporation into the WSSRAP computerized database system. All electronic records shall be standardized to appropriate categories, parameters, and units of measure (see Exhibit 5). Electronic records shall be compared manually on a record-by-record basis with the hard copy reports. Corrections shall be made as required and final verified printouts of the electronic data shall be attached to the Verification Checklist. The verified electronic data shall then be merged into the WSSRAP databases.

6.8 Electronic data requiring unit conversions shall be calculated using equations listed in Exhibit 6. Results of all conversions shall be shown on the hard copy report which shall be retained as part of the verification checklist package. All calculations shall be double checked by a second reviewer.

6.9 Deficiencies and/or discrepancies noted during the verification process shall be documented on Form 4.9.1.4, Verification Discrepancy Documentation Form. Corrective actions shall be made according to Standard Operating Procedures ES&H 4.1.1a, 4.1.2s, 4.4.1s, the Environmental Monitoring Plan, and data quality objectives defined in the EDAP. Corrective actions shall be reviewed by two persons and documented on form 4.9.1.4 (Exhibit 3).

6.10 Data validation shall be conducted according to SOP ENG-9a. Data reviewed during the verification process can be petitioned for validation review. Requests for data validation shall be completed by the ES&H Department or other WSSRAP participants using the Data Validation Request Form 4.9.1.5 (Exhibit 4). All validation requests shall be submitted to the validation group for processing.

7.0 RECORDS

Verification packages, including data verification data review sheets and discrepancy documentation, shall be transmitted to the Quality Assurance Department for retention as QA records in accordance with QAPP-9 for the duration of the project or as directed by DOE. Copies of data reports shall be maintained in the ES&H Department files. Data in electronic format shall be maintained in database files with access protection methods. Periodic backups of electronic data shall be made and stored in fireproof areas.

8.0 EXHIBITS

Exhibit 1 - Data Verification Data Review Sheet, Form 4.9.1.1
Exhibit 2 - Data Verification Checklist, Form 4.9.1.2
Exhibit 3 - Verification Discrepancy Documentation, Form 4.9.1.4
Exhibit 4 - Data Validation Request Form 4.9.1.5
Exhibit 5 - Reporting Standards for Parameters and Units
Exhibit 6 - Unit Conversion Methods

EXHIBIT 1
DATA VERIFICATION DATA REVIEW SHEET

WELDON SPRING REMEDIAL ACTION PROJECT (WSSRAP)
DATA VERIFICATION DATA REVIEW SHEET
FORM 4.9.1.1

Laboratory: _____

Request Number(s): _____

Date Received: _____

Reviewer(s): _____

Review Date: _____

Data is: Acceptable:__ Unacceptable:__

Comments: _____

_____

_____

_____

_____

_____

Signature: _____

Date Returned: _____

REVIEWER: THIS SHEET SHOULD BE RETURNED TO THE VERIFICATION DEPARTMENT WITHIN <u>TWO WORKING DAYS</u> OF DATE RECEIVED.

EXHIBIT 2

DATA VERIFICATION CHECKLIST

WELDON SPRING SITE REMEDIAL ACTION PROJECT (WSSRAP)

VERIFICATION CHECKLIST

FORM 4.9.1.2

Request Number: _____

Date Sampled: _____

Date Shipped: _____

Date laboratory received samples: _____

Date WSSRAP received analytical results: _____

Turnaround time requested:__S(28 days) __P(14 days) __U(5 days) __E(48 hrs.)

Were turnaround times met?__yes __no If not, specify/explain: _____

_____

Laboratory name: _____

Sample ID numbers: _____

Parameters requested: _____

Samples preserved and labelled at WSSRAP according to applicable procedure:

☐yes ☐no

Chain of custody completed according to established procedure: ☐yes ☐no

Extraction holding times met? ☐yes ☐no

Comments: _____

_____

Analytical holding times met? ☐yes ☐no

Comments: _____

_____

Data reviewed by:_____

Verification Checklist completed by:

Signature:_____Date:_____

EXHIBIT 3

VERIFICATION DISCREPANCY DOCUMENTATION

FORM 4.9.1.4

Date:_____

WSSRAP Sample ID:_____

Laboratory Performing Analysis:_____

Laboratory ID:_____

Describe Discrepancy:_____

Corrective Action Taken:_____

Reviewed By:_____

Signature:_____ Date:_____

EXHIBIT 4
DATA VALIDATION REQUEST FORM

FORM 4.9.1.5

Requestor: _____
WBS Code: _____
Department: _____
Date: _____

USE ONE FORM PER LABORATORY

Lab Name: _____
Request No: _____

SAMPLES RECOMMENDED FOR VALIDATION:

WSSRAP IDENTIFICATION	LAB I.D.	SAMPLE DATE	PARAMETER	FOR REVIEW USE

FOR REVIEW USE:

DATE REC'D: _____
SUBMITTED TO VALIDATION: _____
DATE OF REQUEST TO LAB: _____
DATE COMPLETED: _____

EXHIBIT 5
REPORTING STANDARDS FOR PARAMETERS AND UNITS

--,--,

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
** CATEGORY IONS		
BROMIDE	MG/L	UG/G
CHLORIDE	MG/L	UG/G
FLUORIDE	MG/L	UG/G
NITRATE	MG/L	UG/G
NITRITE	MG/L	UG/G
SULFATE	MG/L	UG/G
SULFIDE	MG/L	UG/G
** CATEGORY METALS		
ALUMINUM	UG/L	UG/G
ANTIMONY	UG/L	UG/G
ARSENIC	UG/L	UG/G
BARIUM	UG/L	UG/G
BERYLLIUM	UG/L	UG/G
CADMIUM	UG/L	UG/G
CALCIUM	UG/L	UG/G
CHROMIUM	UG/L	UG/G
COBALT	UG/L	UG/G
COPPER	UG/L	UG/G
IRON	UG/L	UG/G
LEAD	UG/L	UG/G
LITHIUM	UG/L	UG/G
MAGNESIUM	UG/L	UG/G
MANGANESE	UG/L	UG/G
MERCURY	UG/L	UG/G
MOLYBDENUM	UG/L	UG/G
NICKEL	UG/L	UG/G
POTASSIUM	UG/L	UG/G
SELENIUM	UG/L	UG/G
SILVER	UG/L	UG/G
SODIUM	UG/L	UG/G
THALLIUM	UG/L	UG/G
TITANIUM	UG/L	UG/G
VANADIUM	UG/L	UG/G
ZINC	UG/L	UG/G
ZIRCONIUM	UG/L	UG/G
** CATEGORY MISC.		
2,4,5-TP (SILVEX)	UG/L	UG/G
2,4-D	UG/L	UG/G
ASBESTOS		F/MM2
ASH		PRCNT
BIOCHEMICAL OXYGEN DEMAND	MG/L	UG/G
BTU	CALORIES	
CONDUCTIVITY	MMHOS/C	
CYANIDE	UG/L	UG/G

EXHIBIT 5 (Continued)

Page No. 2
12/21/90

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
ETHYLENE GLYCOL	UG/L	UG/G
FECAL COLIFORM	MG/L	UG/G
FLASHPOINT	DEG C	
FLOW RATE	GPM	
HARDNESS	MG/L	UG/G
HEPTACHLORODIBENZO-P-DIOXIN	NG/L	NG/G
HEPTACHLORODIBENZOFURAN	NG/L	NG/G
HEXACHLORODIBENZO-P-DIOXIN	NG/L	NG/G
HEXACHLORODIBENZOFURAN	NG/L	NG/G
HEXANE	MG/L	UG/KG
NUISANCE DUST		MG
OCTACHLORODIBENZO-P-DIOXIN	NG/L	NG/G
OCTACHLORODIBENZOFURAN	NG/L	NG/G
OIL & GREASE	MG/L	UG/G
PENTACHLORODIBENZO-P-DIOXIN	NG/L	NG/G
PENTACHLORODIBENZOFURAN	NG/L	NG/G
PERCENT MOISTURE		PRCNT
PERCENT SOLID		PRCNT
PH	UNITS	UNITS
PHOSPHOROUS	MG/L	UG/G
REACTIVITY	MG/L	UG/G
SPECIFIC GRAVITY	N/A	N/A
TEMPERATURE (IN-SITU)	DEG C	
TETRACHLORODIBENZO-P-DIOXIN	NG/L	NG/G
TETRACHLORODIBENZOFURAN	NG/L	NG/G
TOLUENE	UG/L	UG/KG
TOTAL DISSOLVED SOLIDS	MG/L	UG/G
TOTAL ORGANIC CARBON	MG/L	UG/G
TOTAL RECOVERABLE HYDROCARBONS	MG/L	UG/G
TOTAL SOLIDS	MG/L	UG/G
TOX	MG/L	UG/G
TOXAPHENE	UG/L	UG/KG
TRICHLOROEHTYLENE	UG/L	UG/KG
TOTAL SUSPENDED SOLIDS	MG/L	UG/G
TURBIDITY	MG/L	UG/G
WATER LEVEL IN WELL (TOC)	FEET	
** CATEGORY NITROAROMATICS		
1,3,5-TRINITROBENZENE	UG/L	UG/KG
1,3-DINITROBENZENE	UG/L	UG/KG
2,4,6-TNT	UG/L	UG/KG
2,4,6-TRINITROBENZENE	UG/L	UG/KG
2,4-DNT	UG/L	UG/KG
2,6-DNT	UG/L	UG/KG
NITROBENZENE	UG/L	UG/KG
NITROTOLUENE	UG/L	UG/KG

EXHIBIT 5 (Continued)

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
•• CATEGORY PESTICIDE /PCB'S		
4,4'-DDD	UG/L	UG/KG
4,4'-DDE	UG/L	UG/KG
4,4'-DDT	UG/L	UG/KG
ALDRIN	UG/L	UG/KG
ALPHA-BHC	UG/L	UG/KG
ALPHA-CHLORDANE	UG/L	UG/KG
AROCLOR-1016	UG/L	UG/KG
AROCLOR-1221	UG/L	UG/KG
AROCLOR-1232	UG/L	UG/KG
AROCLOR-1242	UG/L	UG/KG
AROCLOR-1248	UG/L	UG/KG
AROCLOR-1254	UG/L	UG/KG
AROCLOR-1260	UG/L	UG/KG
BETA-BHC	UG/L	UG/KG
DELTA-BHC	UG/L	UG/KG
DIELDRIN	UG/L	UG/KG
ENDOSULFAN I	UG/L	UG/KG
ENDOSULFAN II	UG/L	UG/KG
ENDOSULFAN SULFATE	UG/L	UG/KG
ENDRIN	UG/L	UG/KG
ENDRIN KETONE	UG/L	UG/KG
GAMMA-BHC (LINDANE)	UG/L	UG/KG
GAMMA-CHLORDANE	UG/L	UG/KG
HEPTACHLOR	UG/L	UG/KG
HEPTACHLOR EPOXIDE	UG/L	UG/KG
METHXYCHLOR	UG/L	UG/KG
TOXAPHENE	UG/L	UG/KG
CHLORDANE	UG/L	UG/KG
TOTAL PCB'S	UG/L	UG/KG
•• CATEGORY RADIOCHEMICAL		
GROSS ALPHA	PCI/L	PCI/G
GROSS BETA	PCI/L	PCI/G
LEAD 210	PCI/L	PCI/G
POLONIUM-210	PCI/L	PCI/G
RADIUM	PCI/L	PCI/G
RADIUM-226	PCI/L	PCI/G
RADIUM-228	PCI/L	PCI/G
RADON-222	PCI/L	PCI/G
THORIUM-228	PCI/L	PCI/G
THORIUM-230	PCI/L	PCI/G
THORIUM-232	PCI/L	PCI/G
URANIUM, TOTAL	PCI/L	PCI/G
URANIUM-234	PCI/L	PCI/G
URANIUM-235	PCI/L	PCI/G
URANIUM-238	PCI/L	PCI/G

EXHIBIT 5 (Continued)

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
** CATEGORY SEMI-VOLATILES		
1,2,4-TRICHLOROBENZENE	UG/L	UG/KG
1,2-DICHLOROBENZENE	UG/L	UG/KG
1,3-DICHLOROBENZENE	UG/L	UG/KG
1,4-DICHLOROBENZENE	UG/L	UG/KG
2,4,5-TRICHLOROPHENOL	UG/L	UG/KG
2,4,6-TRICHLOROPHENOL	UG/L	UG/KG
2,4-DICHLOROPHENOL	UG/L	UG/KG
2,4-DIMETHYLPHENOL	UG/L	UG/KG
2,4-DINITROPHENOL	UG/L	UG/KG
2,4-DINITROTOLUENE	UG/L	UG/KG
2,6-DINITROTOLUENE	UG/L	UG/KG
2-CHLORONAPHTHALENE	UG/L	UG/KG
2-CHLOROPHENOL	UG/L	UG/KG
2-METHYLNAPHTHALENE	UG/L	UG/KG
2-METHYLPHENOL	UG/L	UG/KG
2-NITROANILINE	UG/L	UG/KG
2-NITROPHENOL	UG/L	UG/KG
3,3'-DICHLOROBENZIDINE	UG/L	UG/KG
3-METHYLPHENOL	UG/L	UG/KG
3-NITROANILINE	UG/L	UG/KG
4,6-DINITRO-2-METHYLPHENOL	UG/L	UG/KG
4-BROMOPHENYL PHENYL ETHER	UG/L	UG/KG
4-CHLORO-3-METHYL PHENOL	UG/L	UG/KG
4-CHLOROANILINE	UG/L	UG/KG
4-CHLOROPHENYL PHENYL ETHER	UG/L	UG/KG
4-METHYLPHENOL	UG/L	UG/KG
4-NITROANILINE	UG/L	UG/KG
4-NITROPHENOL	UG/L	UG/KG
ACENAPHTHENE	UG/L	UG/KG
ACENAPHTHYLENE	UG/L	UG/KG
ANILINE	UG/L	UG/KG
ANTHRACENE	UG/L	UG/KG
BENZIDINE	UG/L	UG/KG
BENZO(A)ANTHRACENE	UG/L	UG/KG
BENZO(A)PYRENE	UG/L	UG/KG
BENZO(B)FLUORANTHENE	UG/L	UG/KG
BENZO(G,H,I)PERYLENE	UG/L	UG/KG
BENZO(K)FLUORANTHENE	UG/L	UG/KG
BENZOIC ACID	UG/L	UG/KG
BENZYL ALCOHOL	UG/L	UG/KG
BIS(2-CHLORIOSIPROPYL)ETHER	UG/L	UG/KG
BIS(2-CHLOROETHOXY)METHANE	UG/L	UG/KG
BIS(2-CHLOROETHYL)ETHER	UG/L	UG/KG
BIS(2-CHLOROISOPROPYL)ETHER	UG/L	UG/KG
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	UG/KG

EXHIBIT 5 (Continued)

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
BUTYLBENZYLPHTHALATE	UG/L	UG/KG
CHRYSENE	UG/L	UG/KG
DI-N-BUTYL PHTHALATE	UG/L	UG/KG
DI-N-OCTYL PHTHALATE	UG/L	UG/KG
DIBENZO(A,H)ANTHRACENE	UG/L	UG/KG
DIBENZOFURAN	UG/L	UG/KG
DIETHYLPHTHALATE	UG/L	UG/KG
DIMETHYLPHTHALATE	UG/L	UG/KG
FLUORANTHENE	UG/L	UG/KG
FLUORENE	UG/L	UG/KG
HEXACHLOROBENZENE	UG/L	UG/KG
HEXACHLOROBUTADIENE	UG/L	UG/KG
HEXACHLOROCYCLOPENTADIENE	UG/L	UG/KG
HEXACHLOROETHANE	UG/L	UG/KG
INDENO(1,2,3-CD)PYRENE	UG/L	UG/KG
ISOPHORONE	UG/L	UG/KG
METHOXYCHLOR	UG/L	UG/KG
N-NITROSO-DI-N-DIPROPYLAMINE	UG/L	UG/KG
N-NITROSODIMETHYLAMINE	UG/L	UG/KG
N-NITROSODIPHENYLAMINE	UG/L	UG/KG
NAPHTHALENE	UG/L	UG/KG
NITROBENZENE	UG/L	UG/KG
PENTACHLOROPHENOL	UG/L	UG/KG
PERCENT MOISTURE	UG/L	UG/KG
PHENANTHRENE	UG/L	UG/KG
PHENOL	UG/L	UG/KG
PYRENE	UG/L	UG/KG
PYRIDINE	UG/L	UG/KG
* CATEGORY VOLATILES		
1,1,1-TRICHLOROETHANE	UG/L	UG/KG
1,1,2,2-TETRACHLOROETHANE	UG/L	UG/KG
1,1,2-TRICHLOROETHANE	UG/L	UG/KG
1,1-DICHLOROETHANE	UG/L	UG/KG
1,1-DICHLOROETHENE	UG/L	UG/KG
1,2-DICHLOROETHANE	UG/L	UG/KG
1,2-DICHLOROETHENE (TOTAL)	UG/L	UG/KG
1,2-DICHLOROETHYLENE	UG/L	UG/KG
1,2-DICHLOROPROPANE	UG/L	UG/KG
2-BUTANONE	UG/L	UG/KG
2-HEXANONE	UG/L	UG/KG
4-METHYL-2-PENTANONE	UG/L	UG/KG
ACETONE	UG/L	UG/KG
ACROLEIN	UG/L	UG/KG
ACRYLONTRILE	UG/L	UG/KG
BENZENE	UG/L	UG/KG
BROMODICHLOROMETHANE	UG/L	UG/KG

EXHIBIT 5 (Continued)

Page No. 6
12/21/90

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
BROMOFORM	UG/L	UG/KG
BROMOMETHANE	UG/L	UG/KG
CARBON DISULFIDE	UG/L	UG/KG
CARBON TETRACHLORIDE	UG/L	UG/KG
CHLOROBENZENE	UG/L	UG/KG
CHLOROETHANE	UG/L	UG/KG
CHLOROFORM	UG/L	UG/KG
CHLOROMETHANE	UG/L	UG/KG
CIS-1,3-DICHLOROPROPENE	UG/L	UG/KG
DIBROMOCHLOROMETHANE	UG/L	UG/KG
ETHYL BENZENE	UG/L	UG/KG
METHYLENE CHLORIDE	UG/L	UG/KG
PERCENT MOISTURE	UG/L	UG/KG
STYRENE	UG/L	UG/KG
TETRACHLOROETHENE	UG/L	UG/KG
TOLUENE	UG/L	UG/KG
TRANS-1,3-DICHLOROPROPENE	UG/L	UG/KG
TRICHLOROETHENE	UG/L	UG/KG
VINYL ACETATE	UG/L	UG/KG
VINYL CHLORIDE	UG/L	UG/KG
XYLENES, TOTAL	UG/L	UG/KG

EXHIBIT 6
UNIT CONVERSION METHODS

UNIT CONVERSION

SUMMARY OF UNITS

Parts per million (ppm)	Parts per billion (ppb)
ug/g	ug/kg
mg/l	ug/l
ug/ml	
mg/kg	

$$ppm * 1000 = ppb$$

$$\frac{ppb}{1000} = ppm$$

RADIOCHEMICAL DATA

UG/L * 0.68 = PCI/L
MG/L * 680 = PCI/L
UG/ML * 680 = PCI/L
UCI/ML * 10^9 = PCI/L
UG/G * 0.68 = PCI/G
UCI/G * 10^8 = PCI/G
NG/1000 = UG/G

ATTACHMENT C
DATA VALIDATION PROCEDURE

RC-31a ENVIRONMENTAL MONITORING DATA VALIDATION

1.0 PURPOSE

The purpose of this procedure is to specify the practices and processes relating to the technical review and validation of the laboratory analytical data for the Weldon Spring Site Remedial Action Project (WSSRAP).

2.0 SCOPE

This procedure applies to all environmental and radiological analytical measurements, excluding field measurements, performed by subcontract laboratories for WSSRAP.

3.0 REFERENCES

3.1 U.S. Department of Energy, Order 5400.1.
3.2 *USEPA Organic, Inorganic, and Dioxin CLP Scopes of Work.*
3.3 *WSSRAP Environmental Data Administration Plan.*
3.4 Procedure ES&H 4.9.1a, *Environmental Monitoring Data Verification.*
3.5 QAPP-9, *Quality Assurance Records.*

Environmental Compliance Procedures:
3.6 RC-34s, *Data Validation - Inorganic Parameters* (in preparation)
3.7 RC-35s, *Data Validation - Organic Parameters* (in preparation)
3.8 RC-36s, *Data Validation - Radiochemical Parameters* (in preparation)

4.0 DEFINITIONS

4.1 Preliminary Review - a cursory screening of the data deliverables packages to identify and correct any obvious deficiencies and to setup the validation datasets in preparation for the technical review.

4.2 Technical Review - A thorough evaluation of the analytical data utilizing the data deliverables to qualify the data quality and useability based on sample integrity, laboratory performance, procedural quality control (QC) criteria, and data quality objectives (DQOs); and to measure the accuracy, precision, and completeness of the reported analytical data.

4.3 Validation - The preliminary review and technical review of the target samples and target analyses.

4.4 Target Sample - A WSSRAP sample that has been selected for data validation.

4.5 Target Analysis - The analysis associated with a target sample that is requested for data validation.

4.6 Accuracy - A statistical measurement, expressed as a percentage, which represents how close the analytical data are to the "true" value. This measurement is based on the percent recoveries associated with the laboratory analytical control spikes (blank spikes), surrogate spikes, or matrix spikes. 100% accuracy is the best accuracy.

4.7 Precision - A statistical measurement, expressed as a percentage, which represents the repeatability of the analytical system. This measurement is based on the percent differences between laboratory duplicates. 0% precision is the best precision.

4.8 Completeness - The percentage of acceptable datapoints associated with a group of data, such as those in a validation request or those addressed in a quarterly or summary validation report. Acceptable datapoints are all datapoints that have been qualified with an A, A+, 1, 2, 3, 4, or V qualifier.

4.9 Qualifiers - A set of codes and flags which abbreviate the results and findings of the data validation technical review (See Exhibit 1).

4.10 Dataset - the minimum analytical sequence consisting of the target samples and associated QC measurements as required by the analytical protocol that can be evaluated independently; is often synonymous with the laboratory analytical lot.

4.11 Data Deliverables - laboratory analytical records including, but not limited to:

- CLP Deliverables Package (as defined in the most recent USEPA CLP Scope of Work)
- Sample custody transfer records (WSSRAP and laboratory records)
- Sample preparation/extraction/digestion logs
- Sample and QC data summary sheets/benchsheets/log-book entries
- Instrument printouts/chromatograms/spectra
- Analytical run-sequence logs
- Instrument tuning and calibration printouts and data
- Control charts
- Corrective action/exception reports
- Standards preparation logs
- Percent moisture determinations

5.0 RESPONSIBILITIES

5.1 The Environmental Compliance Manager shall be responsible for ensuring implementation of this procedure.

5.2 The Data Validation Manager shall be responsible for implementing this procedure.

6.0 PROCEDURE

6.1 Requests for Data Validation

6.1.1 Requests for data validation shall fall into one of the following three categories:

- Random requests, which are selected for validation prior to shipment of samples to the laboratory for analysis. The laboratory is not to know these data are to be validated until after the analysis is complete. These requests shall be initiated by the Data Verification Manager.

- Biased requests, which are selected for validation after the data have been reported by the laboratory. These requests shall be initiated by any user of WSSRAP data.

- Special requests, which are selected for validation based on the use of the data. These requests shall be initiated by any user of WSSRAP data.

6.1.2 All requests for validation shall be made in writing from the requestor and directed to the Data Verification Group. The Verification Group shall be responsible for requesting the validation documentation from the laboratory through the Procurement Department and shall be responsible for notifying the Validation Group of the pending request.

6.1.3 Requests for validation shall be maintained by the Data Validation Group as random, biased, or special requests. When the validation data deliverables package is received, the data package shall be logged into a Validation Tracking Record (Exhibit 2) which shall be used to track the status of the validation activity.

6.2 Datasets

6.2.1 The data from the target samples and analyses shall be grouped into datasets for the purpose of validation review and record keeping. A unique, sequential dataset number (i.e. 00001) shall be assigned to each dataset. A rubber stamp shall be utilized to maintain the next dataset number in sequence. This number shall be placed on the cover pages of all validation data documentation and validation review checklists and spreadsheets.

6.2.2 All samples (including QC samples) within each dataset shall be arranged chronologically. The date/time "stamp" from the analytical instrumentation may be used for this purpose. In cases where an instrumental date/time "stamp" is not available or in cases where samples from an analytical lot have not been provided by the laboratory (i.e. non-WSSRAP samples), the data reviewer shall use a "best guess" estimate to reconstruct the analytical order. A sequence number shall be assigned to each sample in the dataset to represent this order of analysis. The sequence number shall be identified on the raw data in such a fashion that it is clear which data are associated with which sequence number. No two analytical injections, aspirations, or measurements shall have the same combination of dataset number and sequence number.

6.2.3 A computerized database file shall be used to cross reference each target sample and target analysis with its assigned dataset number and sequence number. This database will be maintained by the data validation group.

6.3 Validation Reviews

6.3.1 The data validation technical review process for each dataset shall be directed by analysis-specific checklists and shall utilize computerized spreadsheets to confirm and document analytical calculations. The checklists and spreadsheets shall become part of the validation dataset documentation package.

Each technical review shall address as a minimum:

- Sample Integrity
- Calibration and Quantitation
- Qualitative Identification
- Background and Contamination
- Accuracy and Precision

The details associated with the technical review and the use of the corresponding checklists are described in separate SOPs for inorganics, organics, and radiochemical analyses.

6.3.2 The validation technical review requires evaluating the data and the analysis for compliance with established performance criteria (i.e. USEPA CLP). During the review of a particular dataset, it shall be appropriate for the reviewer to use the validation checklist only as a guide. Circumstances may arise that are not specifically handled by the checklist. Consequently, some degree of professional judgement will be required during the review. Since many published analytical procedures define data evaluation criteria, the mathematics involved, and the irregularities that may be intrinsic to certain types of samples, it is important that the data reviewer read and understand the analytical procedures being assessed.

6.3.3 Any changes made to any validation documentation shall be made by drawing a single line through the old entry, adding the new entry (if any), and initialing/dating the changes. Major changes (i.e. large portions of a page) may be made by drawing a single "X" through the page block, initialing, dating, and providing a brief note explaining the change.

6.3.4 All validation checklists shall be signed and dated by the reviewer, and reviewed, countersigned and dated by the Data Validation Manager.

6.3.5 An example of a validation checklist is included in this procedure (see Exhibit 5).

6.4 Reports

6.4.1 Data Validation Summary Reports shall be prepared to report the results of the validation review. Each summary report shall address the target samples and

analyses associated with an individual validation request.

6.4.2 All summary reports shall be addressed to the Data Verification Manager and shall include a copy to the Environmental Compliance Manager and to the Quality Assurance Department.

6.4.3 For Biased and Special validation requests, copies of the summary reports shall also be forwarded to the individual data requester. For Random validation requests, copies shall be forwarded to the ES&H Environmental Protection Manager.

6.4.4 Each summary report shall address at a minimum:
- WSSRAP Sample ID
- Analysis
- Lab Number
- Dataset Number
- Validation Qualifiers
- Accuracy and Precision
- Completeness for the Summary Report
- Analytical Deficiencies (if any)

6.4.5 Quarterly validation status reports shall be prepared and submitted to the Deputy Project Manager, Environmental Compliance Manager, ES&H Environmental Protection Manager, and the Quality Assurance Manager.

6.4.6 The quarterly status reports shall identify the quarterly completeness by laboratory, and shall identify the samples and analyses for which:
- validation documentation had been received during the quarter
- the validation review had been completed during the quarter
- the validation review is in progress
- the validation review is ON-HOLD, the reasons and the remedies

6.4.7 The quarterly status reports shall also calculate and report the percentages of validation requests made during the quarter for the bias and random requests. The percentage calculation shall be based on the total number of samples collected during the quarter versus the number of those samples for which validation requests have been made. If the requested percentage for a quarter falls below 5%, the Validation Manager shall notify the Verification Manager in writing in an effort to initiate additional requests to raise the percentage to at least 5%.

6.5 Qualifiers

6.5.1 Data validation qualifiers and flags shall be used to report the results of the data validation review in the WSSRAP database files (GURU). A qualifier shall be assigned to each and every parameter associated with an analysis. The qualifiers designate the validation status; the flags serve an informational purpose.

6.5.2 The validation qualifiers shall be assigned by the data reviewer and approved by the Data Validation Manager. Access rights to append, edit, or delete qualifiers in the qualifier field of the database files shall be limited to the Data Validation Group and the database administrators.

6.5.3 A list of Data Validation Qualifiers and Flags is provided as Exhibit 1. Additional qualifiers and flags may be implemented for use by the Data Validation Manager. Amendments to the qualifier list shall be issued to the data users when additions or changes are made.

6.5.4 The "N" qualifier (meaning not selected for data validation) shall be automatically assigned to the qualifier field of each new data record as it is received by the Data Verification Group from the laboratory.

6.5.5 When samples are selected for validation and their associated data deliverables are received, the "P" qualifier (meaning data validation is in progress) shall replace the "N" qualifier.

6.5.6 Upon completion of the validation review, the "P" qualifier shall be replaced with the qualifiers assigned to the data point based on the data quality determined during the review.

6.5.7 When information critical to the validation of the data is missing from the data deliverables package, or when data in the WSSRAP database files are incorrect, the data shall be placed on-hold using the "O" qualifier. Reasons for the on-hold status, actions taken to remedy the situation, and follow-up actions shall be documented Data Validation ON-HOLD Form (Exhibit 3) and maintained with the dataset.

6.5.8 In the cases where critical information needed for validation is missing and is unlikely to be retrieved from the laboratory, the affected data are to be determined non-validatable and labeled with an "X" qualifier. The non-validatable status shall be documented on the Data validation NON-VALIDATABLE form (Exhibit 4) and maintained with the dataset.

NOTE: When data are non-validatable, the data users are encouraged to take alternate means to substitute those data points with other data points (i.e., use other samples or resample and reanalyze.

6.6 Software Controls

Computerized software needed for data validation is commercially available (i.e., Quattro Pro, Lotus 1-2-3, dBase III, and dBase IV) and requires adherence to manufacturer controls only.

7.0 RECORDS

7.1 Data validation records, including checklists, spreadsheet printouts, logs, notes, and laboratory analytical records, shall be maintained on file with the data validation group

while they are active and validation reviews are in progress. Information pertaining to a specific dataset shall be filed numerically by dataset number.

Information pertaining to a specific dataset are to be filed numerically by laboratory and dataset number. Information that relates to numerous datasets (i.e. initial calibrations, instrument tunes, extraction/digestion records, custody transfer records) shall be maintained in master files and shall be filed by laboratory and type and in chronological order.

7.2 The data validation filing cabinets shall be kept locked and custody maintained by the Data Validation Manager.

7.3 Originals of the data validation records shall be transmitted to the Quality Assurance Department for retention as QA records in accordance with QAPP-9 as soon as practical upon completion of the validation review process and after the records are no longer active or in use.

8.0 EXHIBITS

Exhibit 1 - WSSRAP Data Validation Qualifier List
Exhibit 2 - Data Validation Tracking Record
Exhibit 3 - Data Validation ON-HOLD Listing Form
Exhibit 4 - Data Validation NON-VALIDATABLE Listing Form
Exhibit 5 - Example Validation Checklist

EXHIBIT 1
WSSRAP DATA VALIDATION QUALIFIER LIST

WSSRAP DATA VALIDATION QUALIFIER LIST

QUALIFIER

4 (or A+)	-	Data meeting all QA/QC requirements.
3	-	Good quantitative data not meeting all objective QA/QC requirements, but are generally valid.
2	-	Data that are adequate for semi-quantitative comparisons (i.e., the order of magnitude of the reported value is credible, but the exactness of the value is questionable).
1	-	Data that are adequate for a qualitative assessment (i.e., the target analyte is a real artifact, not contamination), but have no quantitative validity.
A	-	Acceptable, but has restrictions.
V	-	Data that appear to be valid based on data from identical sampling locations or by comparison to historical records.
R	-	Data that are not valid.
N	-	Data not petitioned for validation; or validation documentation not yet received from the laboratory.
O	-	Validation Technical Review ON-HOLD.
P	-	Validation Technical Review IN-PROGRESS or PENDING.
X	-	Data not validatable.

FLAGS[1]

>	-	High Bias (i.e., accuracy > DQO limit)
<	-	Low Bias (i.e., accuracy < DQO limit)
C	-	Calibration/Quantitation Deficiencies
Q	-	Quality Control Deficiencies
I	-	Qualitative Deficiencies or Instrument Interferences Present
B	-	Contamination or High Background Present
H(##)	-	Holding Times Exceeded (#days exceeded for prep/analysis)
F	-	Matrix-Related Interferences Present
J	-	Estimated Value (may be linked with other flags)
Y	-	Custody Deficiencies
T	-	Typographical/Mathematical Error
M	-	Poor Matrix Spike Recoveries (matrix accuracy)
D	-	Poor Duplicate RPD (precision)
?	-	Other (see applicable validation report)

NOTE: Other flags may be added as needed.

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1 To be used in conjunction with any of the above qualifiers, except for qualifier 4 or A+, which by definition shall stand alone.

EXHIBIT 2
DATA VALIDATION TRACKING RECORD

DATA VALIDATION REQUEST & TRACKING LOG

PAGE____OF_____
YEAR_____QUARTER_____

LAB:_____
REQ.#:_____ 5% RANDOM_____ 5% BIASED_____

	WSSRAP ID	ANALYSIS	P	VALD RECPT DATE	DATA REC'D COMPL(CHK)	DS #	LAB #	COMPL. DATE	QUALS. (see sum sht)	REPORT DATE
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18.										
19.										
20.										
21.										
22.										
23.										
24.										
25.										

EXHIBIT 3
DATA VALIDATION ON-HOLD LISTING FORM

DATA VALIDATION FORM GEN 5
ON-HOLD LISTING

DATASET:_____
LAB:_____
REQ. #:_____
DATE:_____
SIGNATURE:_____

VALIDATION ON-HOLD

ANALYSIS:	
SAMPLES (list)	
1.	11.
2.	12.
3.	13.
4.	14.
5.	15.
6.	16.
7.	17.
8.	18.
9.	19.
10.	20.
REASON (describe)	
CORRECTIVE ACTION	
Date:	
RESOLVED	
Date:	

EXHIBIT 4
DATA VALIDATION NON-VALIDATABLE LISTING FORM

DATA VALIDATION FORM GEN 6
ON-HOLD LISTING

DATASET:_____
LAB:_____
REQ. #:_____
DATE:_____
SIGNATURE:_____

NON-VALIDATABLE

SAMPLE	PARAMETER

Add additional pages, if needed.

EXHIBIT 5
EXAMPLE VALIDATION CHECKLIST

Dataset#:_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST
MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

The criteria in this review are based on the USEPA "FUNCTIONAL GUIDELINES FOR EVALUATING INORGANIC ANALYSES", July 1, 1988.	Laboratory & Req.#

I. The following WSSRAP samples are included in this dataset:

	WSSRAP Sample ID	Lab ID	Sample Date	Analysis Date
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

Analytical Protocol (check one):

- [ ] CLP
- [ ] SW846
- [ ] EPA 200 Series
- [ ] Other (list)

Date Reviewer Date	Review Approved for Release by Date

Dataset#_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST

MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

II. PRELIMINARY REVIEW

Check Action

	A. Assign Analytical Sequence Numbers to the instrument printout.
	B. Prepare Analytical Sequence Run Log if not provided by the laboratory.
	C. Prepare a Sample Qualifier Summary for each sample.

III. DOCUMENT SUBMITTAL

A. CLP Data Forms

Check the list of documents below that have been received for validation. If "Not Applicable" check "NA". If the document item is required and has not been received, place the sample ON-HOLD and request the documents from the laboratory.

Y	N		
		1. Organic Cover Page	
		2. Sample Data Sheets(FORM I)	
		3. Calibrations (FORM IIA)	
		4. Blanks (FORM III)	
		5. Matrix Spike (FORM V)	
		6. Duplicate (FORM VI)	
		7. LCS (FORM VII)	
		8. Holding Times (FORM X)	
		9. IDLs (FORM XIII)	REQUIRED
		10. Prep Log (FORM XIII)	
		11. Analysis Log (FORM XIV)	

B. Raw Data

Check the list of documentation below that have been received for validation. If "Not Applicable" check "NA". If the document item is applicable and required and has not been received, place the sample ON-HOLD and request the documents from the laboratory. If item has not been performed by lab, check "X".

Y	NA	X		
			1. Target Samples	REQUIRED
			2. Calibration Standards	REQUIRED
			3. Blanks	REQUIRED
			4. Matrix Spike	REQUIRED
			5. Duplicates	REQUIRED
			6. LCS	REQUIRED

 Dataset#:_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST —
MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

C. True Values

Check the list of true values below that been received for validation. If "Not Applicable", check "NA". If the information is required and has not been received, place the sample ON-HOLD and request the information from the laboratory. If the item has not been performed by lab, check "X".

Y	NA	3X		
			1. Initial Calibration Verification	REQUIRED
			2. Continuing Calibration Verification	REQUIRED
			3. Laboratory Control Sample	REQUIRED

D. Other

Check the list of documentation below that have been received for validation. If "Not Applicable", check "NA". If the document is required and has not been received, place the sample ON-HOLD and request the document from the laboratory.
NOTE: The WSSRAP Custody Sheet may be retrieved from Data Verification.

Y	NA		
		1. Sample Digestion Log	REQUIRED
		2. % Solids Data	
		3. WSSRAP Custody Sheet	
		4. Laboratory Custody Sheet	
		5. Case Narrative	

COMMENTS:

 Datase#:_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST —
MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

IV. TECHNICAL REVIEW

A. Calculation Confirmation

When checking or confirming any calculation, place a check mark next to the data item on the form or spreadsheet to show the item has been checked. The recommended spreadsheet to confirm calculations for the related items is listed below in parentheses for each item.

Check Action

- [ ] 1. Holding Time Calculations (DV Form HG 1)
- [ ] 2. WSSRAP Sample Data Calculations (DV Form HG 2)
- [ ] 3. Calibration Verifications Calculations (DV Form HG 3)
- [ ] 4. Preparation Blank Calculations (DV Form HG 5)
- [ ] 5. Calibration Blank Calculations (DV Form HG 5)
- [ ] 6. Matrix Spike Calculations (DV Form HG 6)
- [ ] 7. Sample Duplicate Calculations (DV Form HG 7)
- [ ] 8. Laboratory Control Sample Calculations (DV Form HG 8)

For the following sections, a set of criteria are listed. If a given criterion is not met, a recommended Data Validation action is listed. These actions are only recommendations and may be changed or omitted (with comment) by the data reviewer. If an item is not applicable, enter "NA".

[ ] B. Sample Integrity

Criteria	If Criteria not met....
Sample Custody: o Documented with signatures by WSSRAP samplers and lab custodian.	o -"Y" flag the affected sample data.
Sample Preservation o Documented on custody sheet Nitric acid to pH < 2 for aqueous samples; 4°C±2°C for non-aqueous samples	o -Handled on a case-by-case basis.
Holding Times o analysis completed with 26 days or less from sample date for aqueous and non-aqueous samples.	o -"H" flag all affected data. o -If negative and exceeded by > 10 days, REJECT all affected data. o -If positive and exceeded by > 10 days, "J" flag all affected data.
Data Consistency o No improper manipulations, font changes, time gaps, auto-zeroing, etc. are present with data.	o -Handled on a case-by-case basis.

Dataset#:_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST

MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

[ ] C. Wavelengths

Mercury measurements are typically made at 253.7 nm. Note if the wavelength used is other than 253.7 nm.

[ ] D. Instrument Calibration

Criteria	If Criteria not met...
Initial Calibration: o performed with each analytical run o consists of 4 stds and 1 blk o correlation coefficient ≥0.995	o -REJECT ALL ASSOCIATED DATA & "C" FLAG. o -If consists of 3 stds and blk, "Q" flag all associated data o -if 2 stds or less, REJECT ALL ASSOCIATED DATA & "C" FLAG. o -"C"flag all associated data.
Correlation Coefficient: Y Intercept: Slope:	
Verification Checks: o performed 1 per 10 samples or per 2 hours o % recovery between 80-120%	o -"Q" flag all samples not within 6 samples of a CCV. o -If within 65-79%, "C" flag associated data. o -if within 121-135%, "C" flag positive data. o -if < 65%, REJECT DATA & "C" flag. o -If > 135%, REJECT POSITIVE DATA & "C" flag.
Calibration Blanks: o performed 1 per 10 samples or per 2 hours o absolute value ≤ CRDL	o -"Q" flag all samples not within 6 samples of a CCB. o -Evaluate closely; reject & "B" flag if necessary

[ ] E. Preparation Blank

Criteria	If Criteria not met...
o performed at least 1 prep blank per matrix o performed 1 prep blk/20 samples or batch o sample once. < 10X prep blank conc.	o -If sample data > IDL, REJECT & "B" FLAG. o -"Q" flag all positive data. o -REJECT AFFECTED DATA & "B" FLAG.

If more than 1 prep blank, use the blank with highest concentrations.

Dataset#_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST
MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

F. Laboratory Control Sample

Criteria	If Criteria not met....
o performed at least 1 LCS per matrix NOTE: An aqueous LCS is not required for Mercury, per CLP. o performed 1 LCS per 20 samples or batch	o -REJECT ASSOCIATED SAMPLE DATA & "Q" FLAG. o "Q" flag all associated data.
Aqueous LCS: o % recovery between 80-120%.	o -If > 120% & sample data negative, no action o -If > 120% & sample data positive, ">" flag. o -if between 50-79%, "<" flag associated data. o -If < 50%, REJECT ASSOCIATED DATA & "<" FLAG.
Non-Aqueous LCS o % recovery within established control limits	o -If > upper limit & sample data negative, no action. o -if > upper limit & sample data positive, ">" flag. o -if < lower limit, "<" flag all associated data.

G. Sample Duplicates

Criteria	If Criteria not met....
o performed 1 dup pair/20 samples or batch (excluding field blanks)	o -"Q" flag associated data. Note that precision measurements are not available.
Aqueous Samples IF both Sample conc. ≥5X CRDL o RPD ≤ 20% ELSE either Sample conc. <5X CRDL o Diff < CRDL	 o -"D" flag associated data. o -"D" flag associated data.
Non-Aqueous Samples If both Sample conc. ≥ 5X CRDL o RPD ≤ 35% ELSE either Sample conc. < 5X CRDL o Diff < 2X CRDL	 o -"D" flag associated data. o -"D" flag associated data.

NOTE: If the sample duplicate data are rejected based on the criteria listed above AND these duplicates are the only source of precision for the analytical lot, the precision value from these duplicates are not useable and the target sample data should be "D" flagged and noted that PRECISION DATA ARE NOT AVAILABLE.

Dataset#_____

WSSRAP DATA VALIDATION REVIEW CHECKLIST

MERCURY BY COLD VAPOR ATOMIC ABSORPTION (CVAA)

[ ] H. Matrix Spike

Criteria	If Criteria not met....
o performed 1 MS per 20 samples or batch	o -"Q" flag associated data
o % recovery between 75-125% AND sample conc. < 4X spike level	o -If > 125% and sample data negative, no action. o -If > 125% and sample data positive, "M" flag associated data. o -If < 30% and negative, REJECT ASSOCIATED DATA AND "M" FLAG. o -If < 30% and positive, "M" flag associated data.

[ ] I. WSSRAP Field Samples

Criteria	If Criteria not met....
o no observed transcription, mathematic, or other errors observed o all readings within the HG curve linear range o all IDLs ≤ CRDL	o -If necessary, place data ON-HOLD UNTIL ERROR IS CORRECTED o -"C" flag all data over range. o -REJECT AND "C" FLAG ALL DATA < applicable IDL.

J. Supplemental Validation Checklists/Forms

[ ] 1. DV HG 1 - Holding Time Assessment
[ ] 2. DV HG 2 - Sample Data Summary
[ ] 3. DV HG 3 - Calibration Verifications
[ ] 4. DV HG 5 - Prep and Cal Blanks
[ ] 5. DV HG 6 - Matrix Spike
[ ] 6. DV HG 7 - Sample Duplicates
[ ] 7. DV HG 8 - Lab Control Sample (LCS)
[ ] 8. DV GEN 1 - Analytical Sequence
[ ] 9. DV GEN 2 - Metals Qualifiers Summary (1 per sample)
[ ] 10. DV Review Checklist for EP Tox/TCLP Method of Standard Addition
[ ] 11. Other (list)

Notes: (attached additional pages if necessary)

It is appropriate for the data reviewer to make professional judgements and express concerns and comments on the validity of the overall data in this dataset. This is particularly appropriate when there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the data users concerning data quality and data limitations in order to assist those users from inappropriate use of the data, while not precluding any consideration of the data at all. As a consequence, it may often be necessary for the data reviewer to use subjective means when assigning the final qualifiers (A, 1,2,3,4,R,V) to the data in this dataset.

ATTACHMENT D
STANDARD DATA PRESENTATION FORMAT

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
** CATEGORY IONS		
BROMIDE	mg/l	µg/g
CHLORIDE	mg/l	µg/g
FLUORIDE	mg/l	µg/g
NITRATE	mg/l	µg/g
NITRITE	mg/l	µg/g
SULFATE	mg/l	µg/g
SULFIDE	mg/l	µg/g
** CATEGORY METALS		
ALUMINUM	µg/l	µg/g
ANTIMONY	µg/l	µg/g
ARSENIC	µg/l	µg/g
BARIUM	µg/l	µg/g
BERYLLIUM	µg/l	µg/g
CADMIUM	µg/l	µg/g
CALCIUM	µg/l	µg/g
CHROMIUM	µg/l	µg/g
COBALT	µg/l	µg/g
COPPER	µg/l	µg/g
IRON	µg/l	µg/g
LEAD	µg/l	µg/g
LITHIUM	µg/l	µg/g
MAGNESIUM	µg/l	µg/g
MANGANESE	µg/l	µg/g
MERCURY	µg/l	µg/g
MOLYBDENUM	µg/l	µg/g
NICKEL	µg/l	µg/g
POTASSIUM	µg/l	µg/g
SELENIUM	µg/l	µg/g
SILVER	µg/l	µg/g
SODIUM	µg/l	µg/g

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
THALLIUM	µg/l	µg/g
TITANIUM	µg/l	µg/g
VANADIUM	µg/l	µg/g
ZINC	µg/l	µg/g
ZIRCONIUM	µg/l	µg/g
** CATEGORY MISC.		
2,4,5-TP (SILVEX)	µg/l	µg/g
2,4-D	µg/l	µg/g
ASBESTOS		f/mm^2
ASH		PRCNT
BIOCHEMICAL OXYGEN DEMAND	mg/l	µg/g
BTU	CALORIES	
CONDUCTIVITY	MMHOS/C	
CYANIDE	µg/l	µg/g
ETHYLENE GLYCOL	µg/l	µg/g
FECAL COLIFORM	mg/l	µg/g
FLASHPOINT	DEG C	
FLOW RATE	GPM	
HARDNESS	mg/l	µg/g
HEPTACHLORODIBENZO-P-DIOXIN	ng/l	ng/g
HEPTACHLORODIBENZOFURAN	ng/l	ng/g
HEXACHLORODIBENZO-P-DIOXIN	ng/l	ng/g
HEXACHLORODIBENZOFURAN	ng/l	ng/g
HEXANE	mg/l	µg/kg
NUISANCE DUST		mg
OCTACHLORODIBENZO-P-DIOXIN	ng/l	ng/g
OCTACHLORODIBENZOFURAN	ng/l	ng/g
OIL & GREASE	mg/l	µg/g
PENTACHLORODIBENZO-P-DIOXIN	ng/l	ng/g
PENTACHLORODIBENZOFURAN	ng/l	ng/g
PERCENT MOISTURE		PRCNT
PERCENT SOLID		PRCNT
PH	UNITS	UNITS
PHOSPHORUS	mg/l	µg/g

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
REACTIVITY	mg/l	µg/g
SPECIFIC GRAVITY	N/A	N/A
TEMPERATURE (IN-SITU)	DEG C	
TETRACHLORODIBENZO-P-DIOXIN	ng/l	ng/g
TETRACHLORODIBENZOFURAN	ng/l	ng/g
TOLUENE	µg/l	µg/kg
TOTAL DISSOLVED SOLIDS	mg/l	µg/g
TOTAL ORGANIC CARBON	mg/l	µg/g
TOTAL RECOVERABLE HYDROCARBONS	mg/l	µg/g
TOTAL SOLIDS	mg/l	µg/g
TOX	mg/l	µg/g
TOXAPHENE	µg/l	µg/kg
TRICHLOROETHYLENE	µg/l	µg/kg
TOTAL SUSPENDED SOLIDS	mg/l	µg/g
TURBIDITY	mg/l	µg/g
WATER LEVEL IN WELL (TOC)	FEET	
** CATEGORY NITROAROMATICS		
1,3,5-TRINITROBENZENE	µg/l	µg/kg
1,3-DINITROBENZENE	µg/l	µg/kg
2,4,6-TNT	µg/l	µg/kg
2,4,6-TRINITROBENZENE	µg/l	µg/kg
2,4-DNT	µg/l	µg/kg
2,6-DNT	µg/l	µg/kg
NITROBENZENE	µg/l	µg/kg
NITROTOLUENE	µg/l	µg/kg
** CATEGORY PESTICIDE/PCB'S		
4,4'-DDD	µg/l	µg/kg
4,4'-DDE	µg/l	µg/kg
4,4'-DDT	µg/l	µg/kg
ALDRIN	µg/l	µg/kg
ALPHA-BHC	µg/l	µg/kg
ALPHA-CHLORDANE	µg/l	µg/kg

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
AROCLOR-1016	µg/l	µg/kg
AROCLOR-1221	µg/l	µg/kg
AROCLOR-1232	µg/l	µg/kg
AROCLOR-1242	µg/l	µg/kg
AROCLOR-1248	µg/l	µg/kg
AROCLOR-1254	µg/l	µg/kg
AROCLOR-1260	µg/l	µg/kg
BETA-BHC	µg/l	µg/kg
DELTA-BHC	µg/l	µg/kg
DIELCRIN	µg/l	µg/kg
ENDOSULFAN I	µg/l	µg/kg
ENDOSULFAN II	µg/l	µg/kg
ENDOSULFAN SULFATE	µg/l	µg/kg
ENDRIN	µg/l	µg/kg
ENDRIN KETONE	µg/l	µg/kg
GAMMA-BHC (LINDANE)	µg/l	µg/kg
GAMMA-CHLORDANE	µg/l	µg/kg
HEPTACHLOR	µg/l	µg/kg
HEPTACHLOR EPOXIDE	µg/l	µg/kg
METHOXYCHLOR	µg/l	µg/kg
TOXAPHENE	µg/l	µg/kg
CHLORDANE	µg/l	µg/kg
TOTAL PCB'S	µg/l	µg/kg

** CATEGORY RADIOCHEMICAL

GROSS ALPHA	Pci/l	Pci/g
GROSS BETA	Pci/l	Pci/g
LEAD 210	Pci/l	Pci/g
POLONIUM-210	Pci/l	Pci/g
RADIUM	Pci/l	Pci/g
RADIUM-226	Pci/l	Pci/g
RADIUM-228	Pci/l	Pci/g
RADON-222	Pci/l	Pci/g
THORIUM-228	Pci/l	Pci/g
THORIUM-230	Pci/l	Pci/g

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
THORIUM 232	Pci/l	Pci/g
URANIUM, TOTAL	Pci/l	Pci/g
URANIUM-234	Pci/l	Pci/g
URANIUM-235	Pci/l	Pci/g
URANIUM-238	Pci/l	Pci/g
** CATEGORY SEMI-VOLATILES		
1,2,4-TRICHLOROBENZENE	µg/l	µg/kg
1,2-DICHLOROBENZENE	µg/l	µg/kg
1,3-DICHLOROBENZENE	µg/l	µg/kg
1,4-DICHLOROBENZENE	µg/l	µg/kg
2,4,5-TRICHLOROPHENOL	µg/l	µg/kg
2,4,6-TRICHLOROPHENOL	µg/l	µg/kg
2,4-DICHLOROPHENOL	µg/l	µg/kg
2,4-DIMETHYLPHENOL	µg/l	µg/kg
2,4-DINITROPHENOL	µg/l	µg/kg
2,4-DINITROTOLUENE	µg/l	µg/kg
2,6-DINITROTOLUENE	µg/l	µg/kg
2-CHLORONAPHTHALENE	µg/l	µg/kg
2-CHLOROPHENOL	µg/l	µg/kg
2-METHYLNAPHTHALENE	µg/l	µg/kg
2-METHYLPHENOL	µg/l	µg/kg
2-NITROANILINE	µg/l	µg/kg
2-NITROPHENOL	µg/l	µg/kg
3,3'-DICHLOROBENZIDINE	µg/l	µg/kg
3-METHYLPHENVOL	µg/l	µg/kg
3-NITROANILINE	µg/l	µg/kg
4,6-DINITRO-2-METHYLPHENOL	µg/l	µg/kg
4-BROMOPHENYL PHENYL ETHER	µg/l	µg/kg
4-CHLORO-3-METHYL PHENOL	µg/l	µg/kg
4-CHLOROANILINE	µg/l	µg/kg
4-CHLOROPHENYL PHENYL ETHER	µg/l	µg/kg
4- METHYLPHENOL	µg/l	µg/kg
4-NITROANILINE	µg/l	µg/kg
4-NITROPHENOL	µg/l	µg/kg

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
ACENAPHTHENE	µg/l	µg/kg
ACENAPHTHYLENE	µg/l	µg/kg
ANILINE	µg/l	µg/kg
ANTHRACENE	µg/l	µg/kg
BENZIDINE	µg/l	µg/kg
BENZO(A)ANTHRACENE	µg/l	µg/kg
BENZO(A)PYRENE	µg/l	µg/kg
BENZO(B)FLUORANTHENE	µg/l	µg/kg
BENZO(G,H,I)PERYLENE	µg/l	µg/kg
BENZO(K)FLUORANTHENE	µg/l	µg/kg
BENZOIC ACID	µg/l	µg/kg
BENZYL ALCOHOL	µg/l	µg/kg
BIS(2-CHLORIOSIPROPYL)ETHER	µg/l	µg/kg
BIS(2-CHLOROETHOXY)METHANE	µg/l	µg/kg
BIS(2-CHLOROETHYL)ETHER	µg/l	µg/kg
BIS(2-CHLOROISOPROPYL)ETHER	µg/l	µg/kg
BIS(2-ETHYLHEXYL)PHYTHALATE	µg/l	µg/kg
BUTYLBENZYLPHTHALATE	µg/l	µg/kg
CHRYSENE	µg/l	µg/kg
DI-N-BUTYL PHTHALATE	µg/l	µg/kg
DI-N-OCTYL PHTHALATE	µg/l	µg/kg
DIBENZO(A,H)ANTHRACENE	µg/l	µg/kg
DIBENZOFURAN	µg/l	µg/kg
DIETHYLPHTHALATE	µg/l	µg/kg
DIMETHYLPHTHALATE	µg/l	µg/kg
FLUORANTHENE	µg/l	µg/kg
FLUORENE	µg/l	µg/kg
HEXACHLOROBENZENE	µg/l	µg/kg
HEXACHLOROBUTADIENE	µg/l	µg/kg
HEXACHLOROCYCLOPENTADIENE	µg/l	µg/kg
HEXACHLOROETHANE	µg/l	µg/kg
INDENO(1,2,3-CD)PYRENE	µg/l	µg/kg
ISOPHORONE	µg/l	µg/kg
METHOXYCHLOR	µg/l	µg/kg
N-NITROSO-DI-N-DIPROPYLAMINE	µg/l	µg/kg
N-NITROSODIMETHYLAMINE	µg/l	µg/kg

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
N-NITROSODIPHENYLAMINE	µg/l	µg/kg
NAPHTHALENE	µg/l	µg/kg
NITROBENZENE	µg/l	µg/kg
PENTACHLOROPHENOL	µg/l	µg/kg
PERCENT MOISTURE	µg/l	µg/kg
PHENANTHRENE	µg/l	µg/kg
PHENOL	µg/l	µg/kg
PYRENE	µg/l	µg/kg
PYRIDINE	µg/l	µg/kg
** CATEGORY VOLATILES		
1,1,1-TRICHLOROETHANE	µg/l	µg/kg
1,1,2,2-TETRACHLOROETHANE	µg/l	µg/kg
1,1,2-TRICHLOROETHANE	µg/l	µg/kg
1,1-DICHLOROETHANE	µg/l	µg/kg
1,1-DICHLOROETHENE	µg/l	µg/kg
1,2-DICHLOROETHANE	µg/l	µg/kg
1,2-DICHLOROETHENE (TOTAL)	µg/l	µg/kg
1M2-DICHLOROETHYLENE	µg/l	µg/kg
1,2-DICHLOROPROPANE	µg/l	µg/kg
2-BUTANONE	µg/l	µg/kg
2-HEXANONE	µg/l	µg/kg
4-METHYL-2-PENTANONE	µg/l	µg/kg
ACETONE	µg/l	µg/kg
CROLEIN	µg/l	µg/kg
ACRYLONTRILE	µg/l	µg/kg
BENZENE	µg/l	µg/kg
BROMODICHLOROMETHANE	µg/l	µg/kg
BROMOFORM	µg/l	µg/kg
BROMOMETHANE	µg/l	µg/kg
CARBON DISULFIE	µg/l	µg/kg
CARBON TETRACHLORIDE	µg/l	µg/kg
CHLOROBENZENE	µg/l	µg/kg
CHLOROETHANE	µg/l	µg/kg
CHLOROFORM	µg/l	µg/kg

WSSRAP Environmental Database
Standards for Reporting
Category, Parameter, Units

Parameter	Units of Measure (Water)	Units of Measure (Soils)
CHLOROMETHANE	µg/l	µg/kg
CIS-1,3-DICHLOROPROPENE	µg/l	µg/kg
DIBROMOCHLOROMETHANE	µg/l	µg/kg
ETHYL BENZENE	µg/l	µg/kg
METHYLENE CHLORIDE	µg/l	µg/kg
PERCENT MOISTURE	µg/l	µg/kg
STYRENE	µg/l	µg/kg
TETRACHLOROETHANE	µg/l	µg/kg
TOLUENE	µg/l	µg/kg
TRANS-1,3-DICHLOROPROPENE	µg/l	µg/kg
TRICHLOROETHENE	µg/l	µg/kg
VINYL ACETATE	µg/l	µg/kg
VINYL CHLORIDE	µg/l	µg/kg
XYLENES, TOTAL	µg/l	µg/kg

ATTACHMENT E
LISTING OF CHANGE INDICATORS

Database Change Indicators

Indicator	Modification
OK	No modification - accurate as originally reported
V	Value in Concentration Field
P	Parameter spelling
C	Category spelling/assignment
E	Value in Radiological Field
U	Units of measure assignment
M	Missing or new add record
ND3	Values below CRDL to "ND" value
T	Change in record due to 12K data points validation results

ATTACHMENT F
LISTING OF 12000 DATA POINTS VALIDATED

ATTACHMENT G
CALIBRATION CRITERIA

ATTACHMENT G

Calibration Criteria for Volatiles & Semi-Volatiles by GCMS

(based on UPEPA CLP requirements)

I. Calibrations for the Control Compounds

A. Control compound present in sample

1. % RSD criteria not met in initial[1]

a. initial RRF20 closer to 1 than mean RRF

1) daily RRF closer to 1 than mean RRF
-if conc. < 20 ppb[2]; reject & flag (C)
-if conc. ≥ 20 ppb; accept & flag (CJ)

2) daily RRF farther from 1 than mean RRF; reject & flag (C)

b. initial RRF20 farther from 1 than mean RRF

1) daily RRF closer to 1 than mean RRF
-if conc. < 50 ppb[3]; reject & flag (C)
-if conc. ≥ 50 ppb; accept & flag (CJ)

2) daily RRF farther from 1 than mean RRF; reject & flag (C)

2. % RSD criteria met in the initial

a. % Diff criteria not met in daily

1) daily RRF closer to 1 than mean RRF
-if conc. < 50 ppb; reject & flag (C)
-if conc. ≥ 50 ppb; accept & flag (CJ)

---

1 Curve not linear

2 Level of the lowest initial calibration standard (use 660 ug/kg for soils)

3 Level of the daily calibration standard (use 1600 ug/kg for soils).

2) daily RRF farther from 1 than mean RRF; reject & flag (C)

b. % Diff criteria met in daily; accept

B. Control compound <u>not</u> present in sample

1. % RSD criteria not met in initial[4]

a. initial RRF20 closer to 1 than mean RRF

1) daily RRF closer to 1 than mean RRF; accept & flag (C)
2) daily RRF farther from 1 than mean RRF; reject & flag (C)

b. initial RRF20 farther from 1 than mean RRF

1) daily RRF closer to 1 than mean RRF; accept & flag (CJ)
2) daily RRF farther from 1 than mean RRF; reject & flag (C)

2. % RSD criteria met in the initial

a. % Diff criteria not met in daily

1) daily RRF closer to 1 than mean RRF; accept & flag (C)
2) daily RRF farther from 1 than mean RRF; reject & flag (C)

b. % Diff criteria met in daily; accept

---

[4] The non-linearity of the initial curve may not effect the ND result for the compound(s).

II. Calibrations for the NON-Control Compounds

A. Compound present in sample

1. % RSD from initial > 30%; accept & flag (CJ)
2. % RSD from initial ≤ 30%

a. % Diff from daily > 25%; accept & flag (CJ)
b. % Diff from daily ≤ 25%; accept

B. Compound <u>not</u> present in sample

1. % RSD from initial > 30%; accept & flag (C)
2. % RSD from initial ≤ 30%

a. % Diff from daily > 25%; accept & flag (C)
b. % Diff from daily ≤ 25%; accept

VALIDATION SAMPLE LISTING – 12K DATA POINTS

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
AIR SAMPLES									
AP-1009-Q389	ACCU						*		
AP-1010-Q389	ACCU						*		
AP-4011-Q389	ACCU						*		
GROUNDWATER SAMPLES									
GW-1002-Q187	META								*
GW-1005-Q187	META								*
GW-1005-Q188-DU	ACCU						*		
GW-1006-Q289-DU	JTC	*			*				
GW-1006-Q289-DU	ACCU						*		
GW-1007-Q289	ACCU						*		
GW-1010-Q187	META							*	*
GW-1011-Q187	META							*	*
GW-1012-Q188-DU	ACCU						*		
GW-1015-Q289-DU	JTC	*			*				
GW-1017-Q188-DU	ACCU						*		
GW-1018-0787	META							*	
GW-1018-Q188-DU	ACCU						*		
GW-1021-Q388	META				*		*		
GW-1024-Q388	META	*		*	*		*		
GW-1024-Q488	META				*		*		
GW-1026-Q289	META				*		*		
GW-1027-Q289	META	*					*		
GW-1028-031290	JTC	*							
GW-106D-030790	ACCU						*		
GW-106S-030790-DU	ACCU						*		
GW-2001-Q187	META							*	*
GW-2001-Q187-MS	META							*	*
GW-2001-Q187-MSD	META							*	*
GW-2001-Q388	META	*	*	*	*		*		
GW-2003-Q488-DU	JTC	*		*	*				
GW-2004-Q187	META							*	*
GW-2004-Q388	META		*						
GW-2005-Q187	META							*	
GW-2006-Q488-DU	JTC	*		*	*				
GW-2008-Q388	META	*	*	*	*		*		
GW-2009-Q187	META							*	*
GW-2010-Q187	META							*	*
GW-2011-Q187	META							*	*
GW-2012-Q187	META							*	*
GW-2013-Q187	META								*
GW-2014-Q187	META								*

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
GROUNDWATER SAMPLES (cont'd)									
GW-2017-Q187	META								*
GW-2017-Q388	META						*		
GW-2019-Q187	META							*	
GW-2020-Q187	META							*	*
GW-2020-Q388	META		*						
GW-2021-Q289	ACCU						*		
GW-2023-Q388	META	*							
GW-2024-Q388	META	*							
GW-2028-Q388	META	*							
GW-2101-Q187	META							*	
GW-2101-Q388	META	*		*	*		*		
GW-2108-Q388	META	*	*	*	*		*		
GW-3001-Q187	META							*	
GW-3001-Q289-DU	ACCU						*		
GW-3002-Q187	META							*	*
GW-3002-Q388	META	*	*	*	*		*		
GW-3003-Q187	META							*	*
GW-3003-Q388	META	*					*		
GW-3006-Q388	META	*					*		
GW-3006-Q489-DU	ACCU						*		
GW-3008-Q187	META							*	*
GW-3008-Q187-FB	META							*	*
GW-3101-Q187	META							*	
GW-3102-Q388	META	*	*	*	*		*		
GW-3106-Q489-DU	ACCU						*		
GW-4003-Q389-DU	JTC	*							
GW-4003-Q489	ACCU						*		
GW-4008-Q289-DU	ACCU						*		
GW-4012-Q388	META	*	*	*	*		*	*	*
GW-4012-Q489	ACCU						*		
GW-4013-Q388	META	*	*	*	*		*		
GW-4013-Q389-DU	JTC				*				
GW-4013-Q489-PB	ACCU						*		
GW-4014-Q388	META		*						
GW-4015-Q289-DU	JTC				*				
GW-4015-Q388	META				*				
GW-4016-Q189-DU	JTC	*							
GW-4018-Q489	ACCU						*		
GW-4018-Q489 MD	ACCU						*		
GW-4018-Q489 MS	ACCU						*		
GW-4019-032790	JTC	*							

VALIDATION SAMPLE LISTING – 12K DATA POINTS (CONT'D)

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
GROUNDWATER SAMPLES (cont'd)									
GW-4019-Q388	META		*						
GW-4020-Q388	META	*	*				*		
GW-4021-Q388	META	*	*	*	*		*		
GW-4022-032790	JTC	*							
GW-4022-Q388	META	*	*	*	*		*		
GW-4022-Q489	ACCU						*		
GW-4023-Q489	ACCU						*		
GW-4109-Q489	JTC	*							
GW-4113-Q388	META	*	*	*	*		*		
GW-FIELD BLANK-030287	META								
GW-FIELD BLANK-030687	META								
GW-FIELD BLANK-031087	META								
GW-FIELD BLANK-031187	META								
GW-FIELD BLANK-031287	META								
GW-PW02-041189	META				*		*		
GW-PW02-Q190	JTC		*						
GW-PW03-Q489	ACCU						*		
GW-PW04-Q190	ACCU						*		
GW-PW07-Q489	ACCU						*		
GW-RMW1-Q189-DU	ACCU						*		
GW-RMW1-Q489	JTC	*	*		*				
GW-RMW2-041189	META		*		*		*		
GW-RMW4-Q489	JTC	*	*						
GW-RMWX-Q489	JTC	*	*		*				
GW-RMWX-Q489	ACCU						*		
NPDES SAMPLES									
NP-0001-020290	JTC	*		*					
NP-0001-020290	ACCU						*		
NP-0002-030890	JTC	*		*					
NP-0002-030890	ACCU						*		
NP-0003-030190	ACCU						*		
NP-0003-041090	ACCU						*		
NP-0003-111589	JTC			*					
NP-0005-041090	JTC			*					
NP-0005-041090	ACCU						*		
NP-000X-041090	JTC	*		*					
NP-000X-041090	ACCU						*		
WIPES/OIL SAMPLES									
OT-2000-051189	JTC					*			
OT-2001-030190	JTC					*			

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
WIPES/OIL SAMPLES (cont'd)									
OT-2009-021589	JTC					*			
OT-2011-031389	JTC					*			
OT-2012-021589	JTC					*			
OT-2012-031389	JTC					*			
OT-2019-022789	JTC					*			
OT-2020-022789	JTC					*			
OT-2020-051689	JTC					*			
OT-2021-022789	JTC					*			
OT-2021-051789 MS	JTC					*			
OT-2021-051789 MSD	JTC					*			
OT-2022-052489	JTC					*			
OT-2023-052489	JTC					*			
OT-2029-022889	JTC					*			
OT-2031-022889	JTC					*			
WASTE SAMPLES									
RS-BA41-072689-B	ACCU						*		
RS-BA43-072689-B	ACCU						*		
RS-BA44-072689-B	ACCU						*		
RS-BA46-072689-B	ACCU						*		
RS-BA49-072689-B	ACCU						*		
RS-WSC610-022790	ACCU						*		
RS-WSC611-022790	ACCU						*		
RS-WSCHEM54-032990	JTC			*					
RS-WSQ-4(12"-18")	META						*		
WSQ-28(6"-12"0)(SS-4)	META						*		
WSQ-70(O"-6")(TS-8)	META						*		
WSQ-75(0"-6")(ORS-3)	META						*		
WSQ-84(O"-6")(ORS-4)	META						*		
WSQ-89(36-48)-1	META						*		
SLUDGE SAMPLES									
SD-3101-071790	ITAS							*	*
SD-3101-0990	ITAS								*
SD-3102-0406-I	META	*	*						
SD-3102-0406-O	META				*	*		*	
SD-3102-071790	ITAS							*	*
SD-3102-0990	ITAS								*
SD-3103-0204-I	META	*	*						
SD-3103-0204-O	META					*		*	
SD-3103-0204-V	META								*
SD-3103-0406-RC	META						*		

VALIDATION SAMPLE LISTING – 12K DATA POINTS (CONT'D)

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SLUDGE SAMPLES (cont'd)									
SD-3103-0608-I	META	*	*						
SD-3103-0608-O	META				*			*	
SD-3103-0608-V	META								*
SD-3103-071790	ITAS							*	*
SD-3103-0990	ITAS								*
SD-3103-0990 DU	ITAS								*
SD-3104-0406-I	META	*	*						
SD-3104-0406-I-FD	META	*	*						
SD-3104-0406-O	META							*	
SD-3104-0406-O-FD	META							*	
SD-3104-0406-V	META								*
SD-3104-0406-V-FD	META								*
SD-3201-0002-I	META	*	*						
SD-3201-0002-O	META				*			*	
SD-3201-0002-V	META								*
SD-3201-0204-I.C	META						*		
SD-3201-071890	ITAS		*		*	*	*		*
SD-3201-0990	ITAS								*
SD-3202-071890	ITAS		*		*	*	*	*	*
SD-3202-0810-I	META	*	*						
SD-3202-0810-I-MD	META	*	*						
SD-3202-0810-I-MS	META	*	*						
SD-3202-0810-O	META				*	*		*	
SD-3202-0810-O-MD	META				*	*		*	
SD-3202-0810-O-MS	META				*	*		*	
SD-3202-0810-V	META								*
SD-3202-0810-V-MD	META								*
SD-3202-0810-V-MS	META								*
SD-3202-0990	ITAS								*
SD-3203-071890	ITAS		*		*	*	*	*	*
SD-3203-0810-I	META	*	*						
SD-3203-0810-I-FC	META	*	*						
SD-3203-0810-I-O-FC	META				*				
SD-3203-0810-I.C.	META						*		
SD-3203-0810-O	META				*				
SD-3203-0810-V	META								*
SD-3203-0810-V-FC	META								*
SD-3203-0990	ITAS								*
SD-3205-0002-I	META	*	*						
SD-3205-0002-O	META			*					
SD-3205-0002-O.C.	META			*					
SD-3210-071890	ITAS							*	

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SLUDGE SAMPLES (cont'd)									
SD-3301-0004-I	META	*	*				*		
SD-3301-0408-O	META					*			
SD-3301-071990	ITAS		*			*	*	*	*
SD-3301-0812-I	META	*	*						
SD-3301-0812-I-FD	META	*	*						
SD-3301-0812-O	META			*		*		*	
SD-3301-0812-O-FD	META			*		*		*	
SD-3301-0812-V	META								*
SD-3301-0812-V-FD	META								*
SD-3301-1216-I	META	*	*				*		
SD-3302-0408-O	META			*		*		*	
SD-3302-0408-V	META								*
SD-3302-071990	ITAS		*			*	*	*	*
SD-3303-071990	ITAS		*			*	*	*	*
SD-3304-0608	META						*		
SD-3304-071990	ITAS		*			*	*	*	*
SD-3305-071990	ITAS		*			*	*	*	*
SD-3306-0002-I.C.	META						*		
SD-3306-071990	ITAS		*			*	*	*	*
SD-3307-0204-O	META			*					
SD-3307-0204-O-FD	META			*					
SD-3307-0204-V	META								*
SD-3307-0204-V-FD	META								*
SD-3307-071990	ITAS		*			*	*	*	*
SD-3308-0608-O	META				*	*			
SD-3308-0608-O-AB	META							*	
SD-3308-0608-O-FC	META							*	
SD-3308-0608-O.C. FC	META				*	*			
SD-3308-071990	ITAS		*			*	*	*	*
SD-3312-0406-I	META	*	*						
SD-3312-0406-O	META				*	*		*	
SD-3401-071890	ITAS		*		*	*	*	*	*
SD-3401-0990	ITAS								*
SD-3402-071890	ITAS		*		*	*	*	*	*
SD-3402-0990	ITAS								*
SD-3403-0002-I	META	*	*						
SD-3403-0002-O	META				*	*		*	
SD-3403-071890	ITAS		*		*	*	*	*	*
SD-3403-0990	ITAS								*
SD-3404-0002-I	META	*	*						
SD-3404-0002-O	META				*	*		*	
SD-3404-0002-V	META								*

VALIDATION SAMPLE LISTING – 12K DATA POINTS (CONT'D)

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SLUDGE SAMPLES (cont'd)									
SD-3406-0204-I	META	*	*						
SD-3406-0204-I.C.FC	META	*	*						
SD-3406-0204-O	META				*	*			
SD-3406-0204-O.C.FC	META				*	*			
SD-3406-0204-V	META								*
SD-3408-0002-I	META	*	*						
SD-3408-0002-I.C	META						*		
SD-3408-0002-O	META				*	*			
SD-3417-0002-I	META	*	*						
SD-3417-0002-O	META				*	*		*	
SD-3417-0002-V	META								*
SD-3419-0002-I.C. BU	META						*		
SD-4002:0-6	META							*	
SD-4004:0-6	META						*		
SD-4006:0-6	META						*		
SD-4007:0-6	META						*		
SD-4008:0-6	META		*		*	*	*	*	
SD-4012:0-6	META						*		
SD-4036:0-6	META						*		
SD-4047:0-6	META						*		
SD-4049:0-6	META						*		
SD-4049:6-12	META						*		
SD-4063:0-6	META					*			
SD-4065:0-6	META					*			
SD-4066:0-6	META					*	*	*	
SD-4068:0-6	META						*		
SD-4076:0-6	META						*		
SOIL SAMPLES									
S2-044143,106675-0.0,7.0 RE	JTC	*		*					
S2-044321,106293-8.0,15.0 RE	JTC	*	*						
S2-049270,100420-0.0,7.0 RE	JTC				*				
S2-049370,100740-6.0,8.0	META				*				
S2-049410,100758-12.0,14.0 RE	JTC		*						
S2-049700,100360-0.0,0.5	META					*			
S2-049750,099900-8.0,15.0 RE	JTC			*					
S2-049800,100620-0.0,0.5	META							*	
S2-049830,099470-0.0,1.0	META		*						
S2-049910,099830-3.0,5.0 RE	JTC	*		*		*		*	*
S2-050000,100020-8.0,15.0 RE	JTC	*	*	*	*				
S2-050340,100420-4.5,5.0	META		*						
S2-050350,100480-0.0,1.0	META					*			
S2-050360,100660-0.0,0.5	META		*						

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SOIL SAMPLES (cont'd)									
S2-050360,100660-2.0,3.5 RE	JTC								*
S2-050500,098350-0.0,7.0 RE	JTC				*				
S2-050550,0987790-8.0,15.0	META	*							
S2-050550,101210-0.0,1.0	META		*					*	
S2-050600,100950-8.0,10.0 RE	JTC	*	*		*				
S2-050750,100770-0.0,2.0 RE	JTC		*	*					
S2-050760,100150-0.0,2.0	META		*						
S2-050850,100185-4.0,6.0 RE	JTC	*		*					
S2-050910,100860-GRAB	META		*					*	
S2-051000,099430-0.0,7.0	META	*							
S2-051280,100890-2.0,4.0	META				*				
S2-051300,100850-0.0,1.0	META	*							
S2-051320,100878-0.0,2.0	META	*							
S2-051400,100450-4.0,6.0	META				*				
S2-051450,098850-8.0-15.0	META		*						
S2-051565,100850-0.0,2.0	META		*						
S2-051770,100430-8.0,15.0	META		*						
S2-051970,100520-0.0,1.5 RE	JTC				*				
S2-052000,100900-8.0,14.0 RE	JTC				*				
S2-052116,100760-0.0,2.0	META		*						
SO-049370,100740-0,2-0990	ITAS				*				
SO-049370,100740-2,4-0990	ITAS				*				
SO-049468,100712-0,2-0990	ITAS				*				
SO-049468,100712-2,4-0990	ITAS				*				
SO-049700,100360-0,0.5-0790	ITAS					*			
SO-049700,100360-2,2.5-0790	ITAS					*			
SO-049775,099975-0,0.5-0790	ITAS							*	*
SO-049830,099470-0,0.5-0790	ITAS							*	*
SO-049830,099470-2,2.5-0790	ITAS					*			
SO-049860,099340-0,0.5-0790	ITAS							*	*
SO-049950,099740-0,0.5-0790	ITAS					*			
SO-049950,099740-2,2.5-0790	ITAS					*			
SO-050040,100700-0,0.5-0790	ITAS					*		*	*
SO-050040,100700-2,2.5-0790	ITAS					*		*	*
SO-050100,100650-0,0.5-0790	ITAS					*		*	*
SO-050100,100650-2,2.5-0790	ITAS					*		*	*
SO-050140,101225-0,2-0990	ITAS				*				
SO-050140,101225-2,4-0990	ITAS				*				
SO-050310,100450-0,0.5-0790	ITAS					*			
SO-050340,100420-0,0.5-0790	ITAS					*		*	*
SO-050340,100420-2,2.5-0790	ITAS					*		*	*
SO-050430,100640-0,0.5-0790	ITAS					*			

VALIDATION SAMPLE LISTING – 12K DATA POINTS (CONT'D)

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SOIL SAMPLES (cont'd)									
SO-050430,100640-2,2.5-0790	ITAS					*			
SO-050440,100450-0,0.5-0790	ITAS					*		*	*
SO-050500,100140-0,0.5-0790	ITAS							*	*
SO-050500,100140-2,2.5-0790	ITAS					*			
SO-050550,101070-0,0.5-0790	ITAS							*	
SO-050610,098370-0,0.5-0790	ITAS					*			*
SO-050680,099990-0,0.5-0790	ITAS					*			
SO-050680,099990-2,2.5-0790	ITAS					*			
SO-050790,093300-0,0.5-0790	ITAS					*			
SO-050790,093300-2,2.5-0790	ITAS					*			
SO-050850,100100-0,2-0990	ITAS				*				
SO-050850,100185-0,2-0990	ITAS				*				
SO-050850,100185-2,4-0990	ITAS				*				
SO-050850-100100-0,2-0990	ITAS				*				
SO-051225,098825-0,2-0790	ITAS				*				
SO-051225,098825-2,4-0790	ITAS				*				
SO-051280,100890-0,2-0990	ITAS				*				
SO-051280,100890-2,4-0990	ITAS				*				
SO-051300,100850-0,1-0990	ITAS				*				
SO-051300,100850-0,1-0990DU	ITAS				*				
SO-051320,100850-0,1-0990	ITAS				*				
SO-051400,100400-0,2-0790	ITAS				*				
SO-051400,100400-2,4-0790	ITAS				*				
SO-051400,100700-0,2-0990	ITAS				*				
SO-051400,100700-2,4-0990	ITAS				*				
SO-051400,100800-2,4-0687	META		*						
SO-051565,100850-0,2-0990	ITAS				*				
SO-051565,100850-0,2-0990DU	ITAS				*				
SO-051565,100850-2,4-0990	ITAS				*				
SO-051760,100243-0,2-0790	ITAS				*				
SO-051815,100360-0,2-0790	ITAS				*				
SO-051815,100360-2,4-0790	ITAS				*				
SO-052220,100750-0,2-0790	ITAS				*				
SO-052220,100750-2,4-0790	ITAS				*				
SO-052300,101400-0,2-0790	ITAS				*				
SO-052300,101400-2,4-0790	ITAS				*				
SO-052350,100700-0,1-0790	ITAS				*				
SO-052400,100400-0,2-0790	ITAS				*				
SO-052400,100700-0,1-0790	ITAS				*				
SO-052400,101400-2,4-0790	ITAS				*				
SO-FRTP-0790	ITAS					*		*	*

WSSRAP SAMPLE ID	LAB	ANIONS	METALS	MISC	NITROS	PEST/PCB	RADIOCHEM	SEMIVOA	VOA
SPRING WATER SAMPLES									
SP-5203-022588	META				*		*		
SP-5301-Q489	JTC				*				
SP-5302-Q489	JTC				*				
SP-5303-022988	META				*		*		
SP-5503-120887	META				*		*		
SP-6301-121087-D2	ACCU						*		
SP-6301-Q189-B	META				*		*		
SP-6301-Q190	JTC		*						
SP-6306-022988	META				*		*		
SP-6306-Q489	JTC				*				
SURFACE WATER SAMPLES									
SW-0000-Q489	JTC	*							
SW-1002-031689	META				*				
SW-1002-Q189	META						*		
SW-1005-Q289	META	*			*		*		
SW-1006-0389	META				*		*		
SW-1008-Q489 MS	JTC				*				
SW-1008-Q489 MSD	JTC				*				
SW-1009-031689	META				*				
SW-1009-Q189	META						*		
SW-2002-Q188	META	*					*		
SW-2006-Q488	META	*					*		
SW-3001-031789	META		*				*		
SW-3001-031789-DISS	META		*						
SW-3001-Q187	META							*	
SW-3002-031789	META		*				*		
SW-3002-031789-DISS	META		*						
SW-3002-Q187	META							*	
SW-3003-031789	META		*				*		
SW-3003-031789-DISS	META		*						
SW-3003-Q187	META							*	
SW-3003-Q489	JTC	*							
SW-3004-031789	META		*				*		
SW-3004-031789-B	META		*				*		
SW-3004-031789-B-DISS	META		*						
SW-3004-Q187	META							*	
SW-3004-Q489	JTC	*							
SW-3004-031789-DISS	META		*						

ACCU = Accu-Labs
META = metaTRACE, Inc.
JTC = JTC Analytical
ITAS = IT Analytical Services (check samples)