APPENDIX J

QUALITY CONTROL SUMMARY REPORT

FINAL REPORT
GROUNDWATER INVESTIGATION
RAMSDELL QUARRY LANDFILL
RAVENNA ARMY AMMUNITION PLANT

Quality Control Summary Report

Ramsdell Quarry Landfill Groundwater Investigation

at the
Ravenna Army Ammunition Plant
Ravenna, Ohio

October 1999

1.0 PURPOSE OF THIS REPORT

Environmental data must always be interpreted relative to its known limitations and its intended use. As can be expected in environmental media of this type, there are areas and data points where the user needs to be cautioned relative to the quality of the project information presented. The data validation process and this data quality assessment are intended to provide current and future data users assistance throughout the interpretation of this data.

The purpose of this Quality Control Summary Report (QCSR) is to describe the Quality Control (QC) procedures followed to ensure data generated by SAIC during these investigations at the Ravenna Army Ammunition Plant (RVAAP) would meet project requirements; the quality of the data collected; and the problems encountered during the course of the study and their solutions. A quality assurance (QA) report will be completed by the U.S. Army Corp of Engineers (USACE) QA Laboratory covering data generated from SAIC collected QA split samples remanded to their custody.

This report provides an assessment of the analytical information gathered during the course of the RVAAP Ramsdell Quarry Landfill (RQL) Groundwater Investigation over the period covering July 1998 through July 1999. It documents that the quality of the data employed for the report and evaluation thereof met their objectives. Evaluation of field and laboratory QC measures will constitute the majority of this assessment; however, references will also be directed toward those QA procedures establishing data credibility. The primary intent of this assessment is to illustrate that data generated for these studies can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy.

Multiple activities must be performed to achieve the desired data quality in this project. As discussed in this report, decisions were made during the initial scoping of the Groundwater Investigation to define the quality and quantity of data required. Data Quality Objectives (DQOs) were established to guide the implementation of the field sampling and laboratory analysis (refer to Chapter 1.0 of the Final Groundwater Investigation Report). A QA program was established to standardize procedures and to document activities in accordance with the RVAAP Facility-wide Sampling and Analysis Plan (SAP) [includes the Quality Assurance Project Plan (QAPP)] (USACE 1996) and the (RQL SAP (includes QAPP) Addendum USACE 1998). This program provided a means to detect and correct any deficiencies in the process. Upon receipt by the project team, data were subjected to a verification and validation review which identified and qualified problems related to the analysis. These review steps contribute to this final Data Quality Assessment (DQA), which defines that data used in the investigation met the criteria and are employed appropriately.

2.0 QUALITY ASSURANCE PROGRAM

The Facility-wide SAP and QAPP (USACE 1996) and RQL SAP Addendum (USACE 1998) were developed to guide the investigation. The purpose of these documents was to enumerate the quantity and type of samples to be taken for inspection of the area of concern, and to define the quantity and type of QA/QC samples to be used for evaluating the quality of the data obtained.

The QAPP established requirements for both field and laboratory QC procedures. In general, field QC duplicates and QA split samples were required for each environmental sample matrix collected in the area being investigated; volatile organic compounds (VOC) trip blanks were to accompany each cooler containing water samples for VOC determinations; and analytical laboratory QC duplicates, matrix spikes, laboratory control samples, and method blanks were required for every 20 samples or less of each matrix and analyte.

A primary goal of the RVAAP QA Program is to ensure that the quality of results for all environmental measurements are appropriate for their intended use. To this end, the QAPP Addendum and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set for the QA Program. Surveillances were conducted to determine the adequacy of field performance as evaluated against the QA plan and procedures.

2.1 MONTHLY PROGRESS REPORTS

Monthly Progress Reports (MPRs) were completed by the SAIC Project Manager for each month of the project's duration. The MPRs contained the following information: work completed, problems encountered, corrective actions/solutions, summary of findings, and upcoming work. These reports were issued to the USACE Louisville District Project Manager with copies forwarded to the Ohio Environmental Protection Agency (Ohio EPA). Access to these reports can be obtained through the SAIC Project Manager.

2.2 DAILY QUALITY CONTROL REPORTS

The Field Team Leader produced all Daily Quality Control Reports (DQCRs). These include information such as, but not limited to, on-site sub-tier contractors, on-site equipment, work performed summaries, QC activities, Health and Safety activities, problems encountered, and corrective actions. The DQCRs were submitted to the USACE Louisville District Project Manager and may be obtained through his office.

2.3 LABORATORY "DEFINITIVE" LEVEL DATA REPORTING

The QAPP addenda for this project identified requirements for laboratory data reporting and identified Quanterra Laboratories, North Canton, Ohio as the laboratory for the project. EPA "definitive" data have been reported, including the following basic information:

- laboratory case narratives;
- sample results (soils/sediments reported per dry weight);
- laboratory method blank results;
- laboratory control standard results;
- laboratory sample matrix spike recoveries;
- laboratory duplicate results;
- surrogate recoveries [VOCs, and semivolatile organic compounds (SVOCs), Pesticide/PCBs];

- sample extraction dates;
- sample analysis dates.

This information from the laboratory, along with field information, provides the basis for subsequent data evaluation relative to sensitivity, precision, accuracy, representativeness, and completeness. These have been presented in Chapter 4.

3.0 DATA VALIDATION

The objective when evaluating the quality of the project data is to determine its usability. The evaluation is based on the interpretation of laboratory QC measures, field QC measures, and project DQOs. This project implemented data validation checklists to facilitate laboratory data validation. These checklists were completed by the project-designated validation staff and were reviewed by the project laboratory coordinator. Data validation checklists for each laboratory sample delivery group (SDG) have been retained with laboratory data deliverables.

3.1 FIELD DATA VALIDATION

The DQCRs and other field-generated documents, such as sampling logs, boring logs, daily health and safety summaries, daily safety inspections, equipment calibration and maintenance logs, and sample management logs, were peer-reviewed onsite. These logs and all associated field information are placed in the project record and are delivered to the USACE Louisville District Project Manager upon completion of the delivery order and can be obtained through his office.

3.2 LABORATORY DATA VALIDATION

Analytical data generated for this project have been subjected to a process of data verification, validation, and review. The following describes this systematic process and the evaluation activities performed. Several criteria have been established against which the data are compared and from which a judgment is rendered regarding the acceptance and qualification of the data. Because it is beyond the scope of this report to cite those criteria, the reader is directed to the following documents for specific detail:

- SAIC Technical Support Contractor QA Technical Procedure (TP-DM-300-7) Data Verification and Validation;

- EPA - National Functional Guidelines for Inorganic Data Review, EPA-540/R-94/013, February 1994;

- EPA - National Functional Guidelines for Organic Data Review, EPA-540/R-94/012, February 1994; and

- Ramsdell Quarry Groundwater Investigation Sampling and Analysis Plan Addendum, (USACE 1998).

Upon receipt of field and analytical data, verification staff performed a systematic examination of the reports, following standardized data package checklists to ensure the content, presentation, and administrative validity of the data. Discrepancies identified during this process were recorded and documented utilizing the checklists. QA program Nonconformance Report (NCR) and Corrective Action systems were implemented as required.

As part of data verification, standardized laboratory electronic data diskettes were subjected to review utilizing SAIC electronic data deliverable (EDD) review software. This software performed both a structural and technical assessment of the laboratory-delivered reports. The structural evaluation ensured that all required data had been reported and that they had been accurately transcribed from raw data. This technical evaluation ensured that all contract-specified requirements had been met.

During the validation phase of the review and evaluation process, data were subjected to a systematic technical review by examining all field and analytical QC results and laboratory documentation, following appropriate functional guidelines for laboratory data validation. These data validation guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. Data verification/validation included but was not necessarily limited to the following parameters:

- data completeness,
- holding times,
- calibration (initial and continuing),
- method blanks,
- sample results verification,
- surrogate recovery,
- laboratory control standard (LCS) analysis,
- internal standard performance,
- matrix spike (MS) recovery,
- duplicate analysis comparison,
- reported detection limits,
- compound, element, isotope quantification,
- reported detection levels, and
- secondary dilutions.

As an end result of this phase of the review, the data were qualified based on the technical assessment of the validation criteria. Qualifiers were applied to each field and analytical result to indicate the usability of the data for its intended purpose.

3.3 DEFINITION OF DATA QUALIFIERS

During the data validation process, all laboratory data were assigned appropriate data validation flags and reason codes. Validation flags are defined as follows:

"U"   Indicates the analyte was analyzed for, but not detected above the level of the associated value.

"J"   Indicates the analyte was positively identified, however, the associated numerical value is an approximate concentration of the analyte in the sample.

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

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

"="   Indicates the analyte has been validated, the analyte has been positively identified, and the associated concentration value is accurate.

SAIC validation reason codes have been provided as Attachment 1, while copies of validation checklists and qualified data forms are on-file with the analytical laboratory deliverable.

3.4 DATA ACCEPTABILITY

Over 90 environmental sediment, surface water, groundwater, and field QC samples were collected with approximately 12,300 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment (these totals do not include field measurements and field descriptions). The project produced acceptable results for over 99% of the sample analyses performed and successfully collected investigation samples under the direction of the SAP and the USACE Louisville District. Data that were rejected are relegated to a few metal and explosive compound determinations and are primarily associated with groundwater measurements.

Table 3-1 (a and b) presents a summary of the collected investigation samples. It tallies the successful collection of all targeted field QC and QA split samples and provides a cross-reference for sample and QA split sample numbers. Table 3-2 provides a summary of rejected analyses grouped by media and analyte category.

For the RVAAP RQL Groundwater Investigation, a total of nine field duplicates were analyzed for sediment, surface water, and groundwater media. Four equipment rinsates were collected and analyzed, while the site potable water source and ASTM water source were sampled and analyzed prior to initiating field work. Trip blanks for VOC determinations were analyzed relative to each shipment of VOC water samples, totaling 12 analyses for this report.

Rejected sediment data consisted of two reported values for explosives (one nitroguanidine and one tetryl) due to extremely low MS recovery determinations. Copper values (four surface water and 26 groundwater) were compromised due to negative drifts in the instrumental baseline. The low concentration reported in combination with instrumental shifts does not allow accurate measurement of this analyte for these samples. Fifty-four non-detect results for explosive compounds from five samples were rejected because associated percent surrogate recoveries were zero.

The majority of estimated results were values observed between the laboratory method detection levels and the project reporting levels. Results determined in this region have an inherently higher variability and need to be considered estimated, at best.

In the sample shipment made on September 21, 1998 four out of six coolers were received by the laboratory with temperatures that exceeded 4 degrees centigrade. The shipment of the samples to the local analytical laboratory (Canton, Ohio facility) was done by direct courier. Samples were chilled following collection and prior to shipment; therefore, it is possible that samples arrived at the laboratory prior to reaching requisite temperatures. Considering these issues, the quality of the results is not suspected to have been impacted.

4.0 DATA EVALUATION

4.1 ACCURACY

Accuracy provides a gauge or measure of the agreement between an observed result and the true value for an analysis. Analytical accuracy is evaluated by measuring the agreement between an analytical result and its known or true value. This is generally determined through use of LCSs, MS analysis, and Performance Evaluation (PE) Samples. Accuracy, as measured through the use of LCSs, determine the method implementation accuracy independent of sample matrix. They document laboratory analytical process control. Accuracy determined by the MS is a function of both matrix and analytical process. Table 4-1 lists the average, maximun, and minimum analytical LCS recovery values for VOC, SVOC, explosive compounds, pesticide compounds, PCB compounds, metals, and miscellaneous analyses. Average, minimum, and maximum method blank surrogate compounds recoveries for organic parameters are compiled in Table 4-2. Table 4-3 consolidates the sample MS recovery values for metal, VOC, SVOC, explosive, pesticide, PCB, and miscellaneous parameters.

Metals

Average LCS percent recovery values for metal analysis of sediments ranged from 85.5% for selenium to 108.0% for mercury. All LCS recoveries were within the reference materials assigned variation and within project accuracy goals of 75-125%. None of the sediment data required qualification based on the LCS. LCS percent recovery values for metal analysis in water were all within 88-118% and average recovery values ranged from 97.8% for cobalt to 108.4% for silver.

Sample MS information for metals produced some estimated values (in particular, antimony and magnesium sediment values); however, the overall accuracy for these measurements is considered acceptable. Average sediment percent recoveries ranged from 57.0% for magnesium to 109.3% for mercury. Results for water MS data were satisfactory and provide confidence in the accuracy of the measurements. Aluminum and manganese were estimated in a few samples due to high MS recoveries; however, average sample MS recoveries were comparable to LCS recoveries with averages ranging from 92.8% for iron to 106.7 % for mercury.

In summary, LCS information demonstrates the analytical laboratory process was in control and accurate. Matrix spike, post-digestion spike analyses, and serial dilutions also provide confidence in the accuracy of elemental metal results.

Volatile Organic Compounds

Recovery of VOC LCS samples, method blank surrogate recovery, and MS recovery information provide measures of accuracy. Recoveries determined for the laboratory volatile organic method blank spike analyses (LCS) indicate the analytical process was in control. Summaries in Table 4-1 show average sediment LCS values range from 100.8% for trichloroethene to 106.5% for 1,1-dichloroethene, while water LCS values range from 96.3% for 1,1-dichloroethene to 99.8% for benzene. All volatile LCS recoveries were between 87% and 114%. Method blank surrogate recoveries (Table 4-2) were all within 85 to 118% for VOCs. These values establish that the analytical process was in control.

Recoveries for VOC MS samples (Table 4-3) indicate analytical accuracy for these compounds was in control and the data are usable. Average sediment MS recoveries ranged from 71.5% for chlorobenzene to 90.0% for 1,1-dichloroethene, while average water MS recoveries ranged from 99.3% for trichloroethene to 101.7% for benzene and toluene.

Explosive Compounds

Nitroaromatic compound measures of accuracy are also derived from LCS, surrogate, and MS recovery information. Overall, the laboratory explosives analytical process was demonstrated to be under control by maintaining a general 50-150% LCS recovery for both water and soil matrices. Average sediment LCS recoveries ranged from 55.0% for nitrocellulose to 105.5% for 4-amino-2,6-dinitrotoluene, with average water LCS recoveries ranging from 81.3% for 2-nitrotoluene to 104.3% for nitroguanidine. Average surrogate recoveries were 93.7% for water and 101.0% for sediment analyses.

Matrix spike information also demonstrates acceptable accuracy control for both sediments and waters for the majority of the analyses, with the exception of tetryl in sediment. Average sediment MS recoveries ranged from 24.0% for nitrocellulose to 136.3% for 4-amino-2,6-dinitrotoluene, with average water MS recoveries ranging from 69.4% for nitrocellulose to 123.6% for RDX. Matrix spike recoveries were more variable than LCS recoveries, with several individual values being either very high or very low. Project data were qualified as required relative to these QC results.

SVOCs, Pesticides, and PCBs

Laboratory control sample percent recovery values for semivolatile analysis of sediments were in the 40 to 90% range, with average recoveries ranging from 52.0% for pentachlorophenol to 76.0% for pyrene. Water average LCS values range from 55.6% for phenol to 74.3% for 2,4-dinitrotoluene, with all values between 35 and 110%. Pesticide and PCB LCS recoveries for waters are in the general range of 75 to 115%. These values are well within the normally accepted advisory limits tabulated in Table 4-4. They are also within project accuracy goals of 30 to 140% for SVOCs and 35 to 135% for pesticide and PCB compounds. None of the data required qualification based on LCS recoveries.

Method blank surrogate recoveries (Table 4-2) were all within acceptable ranges for SVOCs and pesticide and PCB compounds. Re-enforcing the knowledge that the analytical process was in-control.

Sample MS information for SVOCs, pesticides, and PCBs (Table 4-3) paralleled LCS data, with the overall accuracy for these measurements being considered acceptable. Average sediment percent recoveries ranged from 33.7% for pentachlorophenol to 66.6% for 1,4-dichlorobenzene in the semivolatile fraction. Results for the water MS data were also satisfactory, with average values between 54.1% for phenol to 101.5% for Aroclor-1260. The MS results provide confidence in the accuracy of the measurements.

Miscellaneous Analytes

These analyses include anions and general water quality parameters, such as chemical oxygen demand (COD) and total dissolved solids (TDS). All LCS data ranged from 70 to 124% recovery while all MS data ranged from 72 to 124% recovery. None of the data required qualification based on LCS or MS recoveries.

4.2 PRECISION

Laboratory Precision

As a measure of analytical precision, Table 4-5 contains the average relative percent difference (RPD) for laboratory duplicate pairs for metal, VOC, SVOC, explosive, pesticide, PCB, and miscellaneous parameters where both values meet or exceed five times the reported quantitation level for that analyte. As the RPD approaches zero, complete agreement is achieved between the duplicate sample pairs. Sample homogeneity, analytical method performance, and the quantity of analyte being measured all contribute to this measure of sample analytical precision.

The goal for laboratory sediment and water precision was set as acceptable when the RPD does not exceed 35. This goal was not exceeded for analyte average RPDs; however, some individual RPDs for 2,4,6-trinitrotoluene, aluminum, calcium, and magnesium did exceed this goal. Analyses were qualified as estimated "J" through the validation process to indicate data impact, when necessary. In general, the RPD values are considered good for these media and reflect great effort on the part of the field and laboratory teams to homogenize the samples prior to aliquotting for analysis.

Individual data points affected by poor precision measures appear in the data set qualified as estimated, when necessary. The precision for those data is considered acceptable and has been determined to be useable for project objectives.

Field Precision

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision. Field duplicate samples were collected from the same spatial and temporal conditions as the primary environmental sample. Soil samples were collected from the same sampling device, after homogenization for all analytes except VOCs.

Field duplicate comparison information (Tables 4-6 and 4-7 for metals in groundwater; Table 4-8 for organics in groundwater; and Table 4-9 for metals and organics in sediment) present by analyte the absolute difference or RPD for field duplicate measurements. The RPD was calculated only when both samples were >5 times the reporting level. When one or both sample values were between the quantitation level and 5 times the reporting level the absolute difference was evaluated.

If both samples were not detected for a given analyte, precision was considered acceptable. In order to review this information, this data quality assessment has implemented general criteria for comparison of absolute difference measurements and RPDs. RPD criteria were set at 50 and absolute difference criteria were set at three times the reporting level. This slightly broader acceptance criterion was applied to field duplicate samples because they are co-located spatially at the site and do not represent analysis from the same homogenized sample container, as is presented by laboratory duplicate comparisons.

Sediment field duplicate metal and organic RPDs (Table 4-9) are considered good, with 44 of 48 observations being <50 RPD. Absolute differences were all within three times the reporting level criteria, with the exception of one phenanthrene comparison.

Groundwater and surface water field duplicate sample comparisons are also considered acceptable. Organic results were predominantly below reporting levels and were therefore comparable. Metal (total) comparisons indicated 57 of 58 observations with <50 RPD and absolute differences being within three times the reporting level criteria. Filtered metal duplicate evaluations provided similar results with 46 of 46 observations being <50 RPD. Table 4-10 provides RPD and absolute difference comparisons for total versus filtered metals, with comparisons indicating 65 of 70 observations <50 RPD and absolute differences being acceptable. It is, therefore, determined that groundwater and surface water sampling techniques and analyses have obtained representative samples and have not perturbed the well or surface water location significantly, causing inclusion of disturbed silt or sediment into the water samples.

4.3 SENSITIVITY

Determination of minimum detectable values allows the investigation to assess the relative confidence that can be placed in a value relative to the magnitude or level of analyte concentration observed. The closer a measured value comes to the minimum detectable concentration, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the QAPP. These levels were achieved or exceeded throughout the analytical process, with the exception of SVOC analyses, which were reported at approximately two times the project goals (i.e., 25 µg/L versus the goal of 10 µg/L). There were other individual exceptions, which have generated qualification of the data or elevation of detections levels when the original goal was not achieved. Actual laboratory method detection levels achieved during this investigation are presented in Table 4-11 with original practical quantitation level goals.

Evaluation of overall project sensitivity can be gained through review of field blank information. These actual sample analysis may provide a comprehensive look at the combined sampling and analysis sensitivity attained by the project. Field QC blanks obtained during sampling activities at RVAAP included samples of VOC trip blank waters, ATSM deionized water source, site potable water source, and samples of the final equipment decontamination rinse water.

There were only minor concentrations of VOCs detected in project trip blanks. These were primarily below their associated project reporting levels. Compounds and values detected are listed in Table 4-12. Therefore, VOC analyses are determined to have not been affected through the transportation and storage process, and the procedures and precautions employed were effective in preserving the integrity of the sample analysis.

Equipment rinsate samples that document effective decontamination of equipment have been collected for those contaminants of primary interest to the project. Few metal, VOC, explosive, SVOC, pesticide, or PCB parameters were observed above their associated reporting levels and only minor levels were reported above the laboratory instrument detection levels. A single value of 40 μg/L of bis-(2-ethylhexyl)phthalate was observed in rinsate 0050ER (7/7/1998). This value is considered sporadic contamination and similar concentrations were not observed in associated project samples. There is no indication that cross-contamination has occurred nor has any data been qualified relative to these rinsates.

Field source water blanks 0049SB (7/17/1998) and 0083SB (2/12/1999) exhibited no analyte levels above project reporting levels, with the exception of 2,4-dinitrotoluene at 0.16 μg/L and 0.32 μg/L, respectively. There is no indication that the field source waters impacted associated sample levels.

4.4 REPRESENTATIVENESS AND COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental site and is the qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. A few organic analyses were conducted outside the holding time because samples were re-extracted and re-analyzed due to low surrogate recoveries. These data were qualified accordingly as outside of the holding time per EPA validation protocols. These instances occurred when initial extraction results required the laboratory to repeat semivolatile extractions for a sample beyond the standard holding time, but within the direction and guidance of the analytical methodology. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied. Estimated values qualified as being outside of the holding time were utilized with the requisite precautions in some of the report data interpretations. Use of these data might result in some additional uncertainty in specific interpretations where the values were incorporated, but are not believed to have detracted from achieving the overall project DQOs.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. The RVAAP RQL Groundwater Investigation employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information.

4.5 COMPLETENESS

Usable data are defined as those data that pass individual scrutiny during the verification and validation process and are accepted for unrestricted application to the human health risk assessment evaluation or equivalent type applications. It has been determined that estimated data are acceptable for RVAAP project objectives.

Objectives for the RVAAP RQL Groundwater Investigation have been achieved. The project produced valid results for 99% of the sample analyses performed and successfully collected all the samples planned.

5.0 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of RQL Groundwater Investigation data meets or exceeds the established project objectives. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, but estimated when necessary. Data that have been estimated provide indications of either accuracy, precision, or sensitivity being less than desired, but adequate for interpretation. Data that are not acceptable for use have been rejected and qualifiers have been applied.

Data produced for this project demonstrate that they can withstand scientific scrutiny, are appropriate for its intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA and QC measures. The environmental information presented has an established confidence that allows utilization for the project objectives and provides data for future needs.

Table 3-1a. RVAAP RQL Groundwater Investigation QCSR Sample Summary

Area	Media	Environmental Samples	Field Duplicates	Trip Blanks	Equipment Rinsate Blanks	Site Source Water Blanks	USACE Split Samples
Ramsdell Quarry							
	Sediment	14	3	-	-	-	2
	Surface Water	9	2	3	-	-	1
	Groundwater	41	4	9	4	2	4
Totals		64	9	12	4	2	7

Table 3-1b. RVAAP RQL Groundwater Investigation QCSR - Sample/Field Duplicate/QA Split Sample Number Reference

Media	Primary Sample Number	Field Duplicate Sample Number	USAEC Split Sample Number	Sampling Date
Sediment	RQ0023	RQ0053	RQ0055	7/8/98
	RQ0064	RQ0065	RQ0066	7/28/98
Surface Water	RQ0018	RQ0051	RQ0052	7/8/98
Groundwater	RQ0017	RQ0047	RQ0048	7/27/98
	RQ0068	RQ0074	RQ0077	9/20/98
	RQ0113	RQ0075	RQ0079	4/11/99
	RQ0076	RQ0123	RQ0078	5/26/99

Table 3-2. RVAAP RQL Groundwater Investigation - QCSR Summary of Rejected Analytes
(grouped by media and analysis group)

Media	Analysis Group	Rejected/	Total	Percent Rejected
Sediment	Metals	0/	391	0.0
	Volatile Organics	0/	561	0.0
	Semivolatile Organics	0/	1,088	0.0
	Explosives	2/	255	0.8
	Cyanide	0/	17	0.0
	Subtotal	2/	2,312	0.1
Surface Water	Metals	4/	460	0.9
	Volatile Organics	0/	354	0.0
	Semivolatile Organics	0/	640	0.0
	Pesticides and/or PCBs	0/	84	0.0
	Explosives	0/	150	0.0
	Cyanide	0/	10	0.0
	Miscellaneous	0/	32	0.0
	Subtotal	4/	1,730	0.2
Groundwater	Metals	26/	2,110	1.2
	Volatile Organics	0/	1,677	0.0
	Semivolatile Organics	0/	2,944	0.0
	Pesticides and/or PCBs	0/	560	0.0
	Explosives	54/	685	7.9
	Cyanide	0/	45	0.0
	Miscellaneous	0/	214	0.0
	Subtotal	80/	8,235	1.0
Project Total		**86/**	**12,277**	**0.7**

**Table 4-1. RVAAP RQL Groundwater Investigation QCSR Laboratory Control Sample Evaluation
Average Percent Recovery (%rec)**

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Metals								
Aluminum	101.5	88	110	8	93.5	92	95	2
Antimony	98.3	92	104	8	90.5	86	95	2
Arsenic	99.6	93	107	8	90.5	85	96	2
Barium	102.3	96	109	8	96.0	92	100	2
Beryllium	99.1	93	106	8	91.0	85	97	2
Cadmium	100.5	94	110	8	93.5	87	100	2
Calcium	99.0	93	107	8	94.5	94	95	2
Chromium	102.9	96	112	8	99.0	93	105	2
Cobalt	97.8	90	109	8	91.5	86	97	2
Copper	101.4	93	109	8	97.0	92	102	2
Iron	107.9	91	118	8	101.0	98	104	2
Lead	98.9	93	108	8	92.5	86	99	2
Magnesium	98.1	89	110	8	89.5	89	90	2
Manganese	103.3	96	111	8	99.5	97	102	2
Mercury	100.0	92	112	8	108.0	105	111	2
Nickel	100.0	94	110	8	94.0	87	101	2
Potassium	99.0	94	105	8	86.0	82	90	2
Selenium	98.6	91	104	8	85.5	81	90	2
Silver	108.4	102	115	8	99.5	94	105	2
Sodium	99.8	95	105	8	87.0	82	92	2
Thallium	101.5	94	118	8	94.0	87	101	2
Vanadium	100.9	95	109	8	96.5	91	102	2
Zinc	105.1	98	115	8	101.5	97	106	2

Table 4-1 (continued)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Explosive Compounds								
1,3,5-Trinitrobenzene	98.8	89	116	16	98.5	98	99	2
1,3-Dinitrobenzene	96.6	85	114	16	95.5	92	99	2
2,4,6-Trinitrotoluene	92.1	79	115	16	90.0	83	97	2
2,4-Dinitrotoluene	93.8	80	114	16	94.0	90	98	2
2,6-Dinitrotoluene	97.7	87	141	16	98.0	90	106	2
2-Amino-4,6-dinitrotoluene	90.4	72	110	16	95.0	91	99	2
2-Nitrotoluene	81.3	63	101	16	93.0	89	97	2
3-Nitrotoluene	84.8	68	103	16	93.0	87	99	2
4-Amino-2,6-dinitrotoluene	93.8	68	129	16	105.5	104	107	2
4-Nitrotoluene	85.9	67	104	16	93.5	90	97	2
HMX	91.5	80	114	16	87.0	80	94	2
Nitrobenzene	87.9	75	107	16	94.5	91	98	2
RDX	98.3	73	119	16	87.0	88	103	2
Tetryl	93.0	79	113	16	88.0	79	97	2
Nitroguanidine	104.3	91	111	16	99.0	98	100	2
Nitrocellulose	87.4	64	133	16	55.0	53	57	2
Volatile Organic Compounds								
1,1-Dichloroethene	96.3	87	109	15	106.5	97	114	4
Benzene	99.8	89	107	15	105.3	101	111	4
Chlorobenzene	99.0	89	105	15	105.5	98	111	4
Toluene	98.9	87	105	15	103.8	101	110	4
Trichloroethene	99.2	90	108	15	100.8	94	109	4
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	63.8	51	84	12	63.7	59	69	3
1,4-Dichlorobenzene	61.6	44	80	12	65.3	59	69	3
2,4-Dinitrotoluene	74.3	54	93	12	61.0	55	65	3
2-Chlorophenol	65.6	52	80	12	64.3	56	71	3
4-Chloro-3-methylphenol	70.2	55	91	12	63.7	57	68	3
4-Nitrophenol	64.9	37	83	12	54.3	43	61	3
Acenaphthene	70.0	56	90	12	62.3	56	66	3

Table 4-1 (continued)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
N-Nitrosodi-n-propylamine	61.8	50	85	12	57.0	52	60	3
Pentachlorophenol	66.4	52	96	12	52.0	43	58	3
Phenol	55.6	35	74	12	60.7	54	65	3
Pyrene	94.4	82	110	12	76.0	64	90	3
Pesticide Compounds								
4,4'-DDT	100.1	92	114	8	-	-	-	-
Aldrin	87.5	83	95	8	-	-	-	-
Dieldrin	93.5	86	104	8	-	-	-	-
Endrin	85.8	72	102	8	-	-	-	-
Gamma-BHC (Lindane)	87.3	80	99	8	-	-	-	-
Heptachlor	88.0	76	96	8	-	-	-	-
PCB Aroclors								
Aroclor-1016	84.8	80	97	6	-	-	-	-
Aroclor-1260	95.0	86	100	6	-	-	-	-
Miscellaneous Analytes								
Alkalinity	98.8	93	103	4	-	-	-	-
Ammonia	99.3	95	103	3	-	-	-	-
Chemical Oxygen Demand	98.4	93	108	5	-	-	-	-
Chloride	98.3	90	104	4	-	-	-	-
Cyanide	94.9	70	109	10	-	-	-	-
Nitrate/Nitrite	92.0	90	93	3	-	-	-	-
Sulfate	98.3	91	103	4	-	-	-	-
Total Dissolved Solids	95.5	84	102	4	-	-	-	-
Total Organic Carbon	97.0	94	102	5	-	-	-	-
Total Phenols	88.3	82	97	3	-	-	-	-

Table 4-2. RVAAP RQL Groundwater Investigation QCSR Method Blank Surrogate
Average Percent Recovery (% Rec)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Explosive Compounds								
1-Chloro-3-nitrobenzene	93.7	65	140	10	101.0	101	101	2
Volatile Organic Compounds								
1,2-Dichloroethane-d4	102.3	92	111	14	90.7	85	98	3
Toluene-d8	100.1	96	108	14	112.3	109	115	3
Bromofluorobenzene	101.8	99	109	14	111.7	107	118	3
Dibromofluoromethane	102.0	96	116	14	110.3	109	112	3
Semivolatile Organic Compounds								
2,4,6-Tribromophenol	59.7	54	76	11	72.7	53	104	3
2-Fluorobiphenyl	57.1	48	86	11	63.3	43	90	3
2-Fluorophenol	52.1	42	74	11	72.0	61	93	3
Nitrobenzene-d5	66.6	46	83	11	69.3	51	97	3
Phenol-d5	50.7	38	76	11	67.0	50	91	3
Terphenyl-d14	88.3	62	140	11	99.7	81	127	3
Pesticide Compounds								
Decachlorobiphenyl	69.2	92	50	5	-	-	-	-
Tetrachloro-m-xylene	80.2	112	60	5	-	-	-	-
PCB Compounds								
Decachlorobiphenyl	69.0	63	76	4	-	-	-	-
Tetrachloro-m-xylene	73.5	63	81	4	-	-	-	-

Table 4-3. RVAAP RQL Groundwater Investigation QCSR Matrix Spike Sample Evaluation
Average Percent Recovery (%rec)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Metals								
Aluminum	101.5	84	146	28	-	-	-	-
Antimony	96.9	83	105	28	59.8	59	61	4
Arsenic	98.4	83	111	28	89.8	87	93	4
Barium	100.4	86	111	28	94.8	93	99	4
Beryllium	97.0	84	113	28	91.5	88	96	4
Cadmium	98.2	83	123	28	97.0	94	100	4
Calcium	98.1	87	142	28	73.8	50	102	4
Chromium	100.0	84	118	28	102.3	92	108	4
Cobalt	94.5	79	112	28	91.5	90	97	4
Copper	100.1	89	111	28	101.0	95	107	4
Iron	92.8	79	112	28	-	-	-	-
Lead	97.0	81	118	28	91.8	89	94	4
Magnesium	98.5	86	146	28	57.0	26	88	4
Manganese	98.0	79	112	28	-	-	-	-
Mercury	106.7	89	126	28	109.3	100	120	4
Nickel	97.3	84	117	28	92.3	90	97	4
Potassium	97.2	87	107	28	89.8	82	99	4
Selenium	96.9	81	108	28	86.5	85	89	4
Silver	106.3	97	112	28	104.0	102	106	4
Sodium	97.9	89	107	28	89.3	84	94	4
Thallium	99.4	87	113	28	93.5	89	98	4
Vanadium	98.7	84	107	28	100.0	96	103	4
Zinc	101.8	88	124	28	87.0	78	95	4

Table 4-3 (continued)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Explosive Compounds								
1,3,5-Trinitrobenzene	93.4	77	107	8	91.5	82	104	4
1,3-Dinitrobenzene	93.9	77	104	8	94.5	87	106	4
2,4,6-Trinitrotoluene	88.0	78	98	8	75.8	30	201	4
2,4-Dinitrotoluene	90.8	76	100	8	98.3	84	118	4
2,6-Dinitrotoluene	88.5	72	101	8	102.3	85	118	4
2-Amino-4,6-dinitrotoluene	86.1	64	100	8	92.0	82	97	4
2-Nitrotoluene	71.8	47	94	8	96.3	85	116	4
3-Nitrotoluene	82.0	65	96	6	93.3	84	108	4
4-Amino-2,6-dinitrotoluene	85.1	58	100	8	136.3	89	202	4
4-Nitrotoluene	81.4	69	95	8	93.0	85	107	4
HMX	95.6	88	106	8	82.3	62	106	4
Nitrobenzene	81.8	59	96	8	98.0	89	115	4
RDX	123.6	95	187	8	90.0	79	105	4
Tetryl	82.6	70	96	8	27.0	0	64	4
Nitroguanidine	103.6	94	111	16	26.5	25	28	2
Nitrocellulose	69.4	50	94	10	24.0	21	27	2
Volatile Organic Compounds								
1,1-Dichloroethene	100.0	89	115	18	90.0	89	91	2
Benzene	101.7	91	114	18	82.0	80	84	2
Chlorobenzene	101.1	91	111	18	71.5	71	72	2
Toluene	101.7	89	112	18	77.5	75	80	2
Trichloroethene	99.3	90	110	18	80.0	79	81	2
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	66.4	52	81	18	64.8	57	74	6
1,4-Dichlorobenzene	62.2	46	81	18	66.6	58	72	6
2,4-Dinitrotoluene	69.8	52	84	18	60.7	51	69	6
2-Chlorophenol	64.5	52	79	18	62.3	55	68	6
4-Chloro-3-methylphenol	71.1	56	86	18	65.8	57	73	6
4-Nitrophenol	67.3	32	96	18	53.2	44	60	6

Table 4-3 (continued)

Analysis	Average %Rec	Water Min. %Rec	Max. %Rec	N	Average %Rec	Sediment Min. %Rec	Max. %Rec	N
Acenaphthene	68.4	55	80	18	60.7	42	73	6
N-Nitrosodi-n-propylamine	57.3	47	74	18	56.7	50	62	6
Pentachlorophenol	78.3	53	102	18	33.7	27	41	6
Phenol	54.1	27	71	18	57.2	48	66	6
Pyrene	92.4	62	119	18	65.3	4	110	6
Pesticide Compounds								
4,4'-DDT	90.0	86	92	4	-	-	-	-
Aldrin	82.8	79	85	4	-	-	-	-
Dieldrin	85.3	83	87	4	-	-	-	-
Endrin	85.3	79	93	4	-	-	-	-
gamma-BHC (Lindane)	90.5	85	95	4	-	-	-	-
Heptachlor	87.0	84	90	4	-	-	-	-
PCB Aroclors								
Aroclor-1016	91.8	82	104	4	-	-	-	-
Aroclor-1260	101.5	94	113	4	-	-	-	-
Miscellaneous Analytes								
Alkalinity	96.0	87	102	10	-	-	-	-
Ammonia	95.9	78	124	8	-	-	-	-
Chemical Oxygen Demand	103.6	94	113	8	-	-	-	-
Chloride	99.4	93	106	12	-	-	-	-
Cyanide	95.7	80	112	22	-	-	-	-
Nitrate/Nitrite	82.3	69	94	6	-	-	-	-
Sulfate	99.9	96	104	14	-	-	-	-
Total Organic Carbon	97.8	97	100	6	-	-	-	-
Total Phenols	87.5	72	101	8	-	-	-	-

Table 4-4. RVAAP Groundwater Investigation QCSR
EPA Organic Surrogate and LCS Recovery Criteria - Percent Recovery (%Rec) and RPD

Analysis	Soil Min. %Rec	Max. %Rec	RPD	Water Min. %Rec	Max. %Rec	RPD
Volatile Organic Compounds						
1,2-DICHLOROETHANE-d4	70	121		76	114	
BROMOFLUOROBENZENE	59	113		86	115	
TOLUENE-d8	84	138		88	110	
1,1-DICHLOROETHANE	59	172	22	61	145	14
TRICHLOROETHENE	62	173	24	71	120	14
BENZENE	66	142	21	76	127	11
TOLUENE	59	139	21	76	125	13
CHLOROBENZENE	60	133	21	75	130	13
Semivolatile Organic Compounds						
1,2-DICHLOROBENZENE-d4	20	130		16	110	
2,4,6-TRIBROMOPHENOL	19	122		10	123	
2-CHLOROPHENOL-d4	20	130		33	110	
2-FLUOROBIPHENYL	30	115		43	116	
2-FLUOROPHENOL	25	121		21	110	
NITROBENZENE-d5	23	120		35	114	
PHENOL-d5	24	113		10	110	
TERPHENYL-d14	18	137		33	141	
PHENOL	26	90	35	12	110	42
2-CHLOROPHENOL	25	102	50	27	123	40
1,4-DICHLOROBENZENE	28	104	27	36	97	28
N-NITROSO-DI-N-PROPYLAMINE	41	126	38	41	116	38
1,2,4-TRICHLOROBENZENE	38	107	23	39	98	28
4-CHLORO-3-METHYLPHENOL	26	103	33	23	97	42
ACENAPHTHENE	31	137	19	46	118	31
4-NITROPHENOL	11	114	50	10	80	50
2,4-DINITROTOLUENE	28	89	47	24	96	38
PENTACHLOROPHENOL	17	109	47	9	103	50
PYRENE	35	142	36	26	127	31
Pesticides/PCBs						
DECACHLOROBIPHENYL(1)	60	150		60	150	
DECACHLOROBIPHENYL(2)	60	150		60	150	
TETRACHLORO-m-XYLENE(1)	60	150		60	150	
TETRACHLORO-m-XYLENE(2)	60	150		60	150	
GAMMA-BHC (LINDANE)	46	127	15	56	123	50
HEPTACHLOR	35	130	20	40	131	31
ALDRIN	34	132	22	40	120	43
DIELDRIN	31	134	18	52	126	38
ENDRIN	42	139	21	56	121	45
4,4'-DDT	23	134	27	38	127	50

**Table 4-5. RVAAP RQL Groundwater Investigation QCSR Laboratory Duplicate Evaluation
Relative Percent Difference (RPD)**

Analysis	Average RPD	Water Min. RPD	Max. RPD	N	Average RPD	Sediment Min. RPD	Max. RPD	N
Metals								
Aluminum	8.6	0	36	14	-	-	-	-
Antimony	4.8	0	13	13	2.5	2	3	2
Arsenic	6.1	1	13	14	3.0	3	3	2
Barium	5.8	1	13	14	2.0	0	4	2
Beryllium	6.2	0	16	14	3.0	2	4	2
Cadmium	6.9	0	26	13	3.5	3	4	2
Calcium	9.1	1	41	13	6.5	4	9	2
Chromium	6.3	0	17	13	3.5	0	7	2
Cobalt	6.1	0	16	14	4.0	4	4	2
Copper	5.1	1	12	14	4.5	3	6	2
Iron	9.0	1	25	6	-	-	-	-
Lead	6.2	1	13	14	3.5	3	4	2
Magnesium	9.6	1	43	14	4.0	3	5	2
Manganese	5.3	0	13	6	-	-	-	-
Mercury	3.5	0	13	13	10.5	10	11	2
Nickel	6.8	1	19	14	2.0	0	4	2
Potassium	4.9	1	13	14	5.5	5	6	2
Selenium	5.6	1	12	14	3.0	2	4	2
Silver	5.1	1	14	13	2.5	2	3	2
Sodium	4.1	1	12	14	2.5	2	3	2
Thallium	4.5	0	14	14	3.0	3	3	2
Vanadium	5.5	0	13	14	2.0	1	3	2
Zinc	9.9	1	28	14	2.0	2	2	2

Table 4-5 (continued)

Analysis	Average RPD	Water Min. RPD	Max. RPD	N	Average RPD	Sediment Min. RPD	Max. RPD	N
Explosive Compounds								
1,3,5-Trinitrobenzene	3.0	2	5	4	6.0	4	8	2
1,3-Dinitrobenzene	2.0	0	5	4	6.0	2	10	2
2,4,6-Trinitrotoluene	2.0	1	4	4	23.5	2	45	2
2,4-Dinitrotoluene	2.0	0	4	4	13.0	9	17	2
2,6-Dinitrotoluene	2.5	1	4	4	11.5	9	14	2
2-Amino-4,6-dinitrotoluene	3.0	1	5	4	5.5	0	11	2
2-Nitrotoluene	5.5	1	10	4	9.5	2	17	2
3-Nitrotoluene	4.7	3	8	4	6.0	1	11	2
4-Amino-2,6-dinitrotoluene	3.0	1	5	4	20.5	13	28	2
4-Nitrotoluene	3.8	2	6	4	6.0	0	12	2
HMX	4.0	1	11	4	7.0	4	10	2
Nitrobenzene	4.0	2	7	4	8.5	1	16	2
RDX	1.3	1	2	4	4.5	1	8	2
Tetryl	2.5	1	3	4	17.5	0	35	2
Nitroguanidine	3.1	0	8	8	11	-	-	1
Nitrocellulose	6.4	0	18	5	25	-	-	1
Volatile Organic Compounds								
1,1-Dichloroethene	3.1	1	12	9	3	-	-	1
Benzene	2.7	0	10	9	4	-	-	1
Chlorobenzene	2.4	0	11	9	2	-	-	1
Toluene	3.2	1	12	9	6	-	-	1
Trichloroethene	3.1	0	10	9	2	-	-	1
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	8.2	2	15	9	6.7	6	7	3
1,4-Dichlorobenzene	7.8	1	15	9	7.7	5	9	3
2,4-Dinitrotoluene	5.0	0	13	9	9.3	8	11	3
2-Chlorophenol	8.0	2	17	9	5.7	5	7	3

Table 4-5 (continued)

Analysis	Average RPD	Water Min. RPD	Max. RPD	N	Average RPD	Sediment Min. RPD	Max. RPD	N
4-Chloro-3-methylphenol	4.6	0	12	9	8.3	7	9	3
4-Nitrophenol	6.4	0	19	9	4.7	0	12	3
Acenaphthene	4.9	0	14	9	9.0	8	11	3
N-Nitrosodi-n-propylamine	6.1	1	12	9	5.3	4	7	3
Pentachlorophenol	6.3	0	16	9	15.0	9	19	3
Phenol	9.6	3	16	9	5.7	4	8	3
Pyrene	7.4	0	13	9	25.3	19	31	3
Pesticide Compounds								
4,4'-DDT	2.0	0	4	2	-	-	-	-
Aldrin	3.0	1	5	2	-	-	-	-
Dieldrin	1.5	1	2	2	-	-	-	-
Endrin	3.0	1	5	2	-	-	-	-
Gamma-BHC (Lindane)	4.5	3	6	2	-	-	-	-
Heptachlor	4.5	2	7	2	-	-	-	-
PCB Aroclors								
Aroclor-1016	16.0	9	23	2	-	-	-	-
Aroclor-1260	13.0	7	19	2	-	-	-	-

Table 4-5 (continued)

Analysis	Average RPD	Water Min. RPD	Max. RPD	N	Average RPD	Sediment Min. RDP	Max. RPD	N
Miscellaneous Analytes								
Alkalinity	4.4	0	10	5	-	-	-	-
Ammonia	10.0	2	26	4	-	-	-	-
Chemical Oxygen Demand	4.3	0	10	4	-	-	-	-
Chloride	2.2	1	3	6	-	-	-	-
Conductivity	2.7	1	6	7	-	-	-	-
Cyanide	5.4	0	23	11	-	-	-	-
Nitrate/Nitrite	9.3	3	14	3	-	-	-	-
PH	0.7	0	2	6	-	-	-	-
Sulfate	2.3	1	4	7	-	-	-	-
Total Dissolved Solids	1.5	0	3	9	-	-	-	-
Total Organic Carbon	0.3	0	1	3	-	-	-	-
Total Phenols	1.5	0	6	4	-	-	-	-

Table 4-6. RVAAP RQL Groundwater Investigation QCSR
Water Field Duplicate Evaluation (TOTAL) Relative Percent Differences (RPDs) and Absolute Difference

Analysis	Groundwater 005-0005GW 005-0047FD (7/13/98) RPD	Groundwater 011-0017GW 011-9047FD (7/27/98) RPD	Groundwater 007-0068GW 007-0074FD (9/20/98) RPD	Groundwater 009-0113GW 009-0075FD (4/11/99) RPD	Surface Water 012(p)-0018S 012(p)-0051FD (7/8/98) RPD	Surface Water 013(p)-0123S 013(p)-0076FD (5/26/99) RPD
Metals (ICP and AA)						
Aluminum	*	51	*	7	23	*
Antimony	*	*	*	*	*	*
Arsenic	*	*	4	*	6	*
Barium	*	8	7	0	0	*
Beryllium	*	*	*	*	*	*
Cadmium	*	*	*	*	*	*
Calcium	7	3	5	7	8	1
Chromium	*	*	*	*	13	*
Cobalt	*	19	5	*	6	*
Copper	*	*	*	0	3	*
Iron	3	12	4	3	5	2
Lead	*	*	*	6	10	*
Magnesium	9	10	4	13	0	1
Manganese	6	8	4	24	10	6
Mercury	*	*	*	*	*	*
Nickel	*	15	4	*	4	*
Potassium	10	14	5	1	39	5
Selenium	*	*	*	*	*	*
Silver	*	*	*	*	*	*
Sodium	*	19	7	7	0	*
Thallium	*	*	*	*	*	*
Vanadium	*	*	*	*	21	*
Zinc	*	1	17	*	8	*

*   Acceptable = At least one value is <5X the reported detection level and duplicate comparison is within 3X the reported detection level.
UNAC   Unacceptable = At least one value is <5X the reported detection level and duplicate comparison is greater than 3X the reported detection level.

Table 4-7. RVAAP RQL Groundwater Investigation QCSR
Water Field Duplicate Evaluation (FILTERED) - Relative Percent Differences (RPDs) and Absolute Difference

Analysis	Groundwater Filtered RPD 005-0005GW 005-0047FD (7/13/98)	Groundwater Filtered RPD 011-0017GW 011-9047FD (7/27/98)	Groundwater Filtered RPD 007-0068GW 007-0074FD (9/20/98)	Groundwater Filtered RPD 009-0113GW 009-0075FD (4/11/99)	Surface Water Filtered RPD 012(p)-0018S 012(p)-0051FD (7/8/98)	Surface Water 013(p)-0123S 013(p)-0076FD (5/26/99) RPD
Metals (ICP and AA)						
Aluminum	*	11	*	10	*	*
Antimony	*	*	*	*	*	*
Arsenic	*	*	0	*	*	*
Barium	*	3	4	2	10	*
Beryllium	*	*	*	*	*	*
Cadmium	*	*	*	*	*	*
Calcium	1	1	6	4	6	1
Chromium	*	*	*	*	*	*
Cobalt	*	3	5	*	*	*
Copper	*	*	*	*	*	*
Iron	9	1	3	31	*	34
Lead	*	*	*	*	*	*
Magnesium	5	0	5	4	9	0
Manganese	2	2	5	2	15	5
Mercury	*	*	*	*	*	*
Nickel	*	2	10	*	*	*
Potassium	4	3	5	3	11	4
Selenium	*	*	*	*	*	*
Silver	*	*	*	*	*	*
Sodium	*	4	4	7	2	*
Thallium	*	*	*	*	*	*
Vanadium	*	*	*	*	*	*
Zinc	*	20	8	*	*	*

* Acceptable = At least one value is <5X the reported detection level and duplicate comparison is within 3X the reported detection level.
UNAC   Unacceptable = At least one value is <5X the reported detection level and duplicate comparison is greater than 3X the reported detection level.

**Table 4-8. RVAAP RQL Groundwater Investigation Organic Field Duplicate Evaluation
Relative Percent Differences (RPDs) and Absolute Difference**

Analysis	Groundwater 005-0005GW 005-0047FD (7/13/98) RPD	Groundwater 011-0017GW 011-9047FD (7/27/98) RPD	Groundwater 007-0068GW 007-0074FD (9/20/98) RPD	Groundwater 009-0113GW 009-0075FD (4/11/99) RPD	Surface Water 012(p)-0018S 012(p)-0051FD (7/8/98) RPD	Surface Water 013(p)-0123S 013(p)-0076FD (5/26/99) RPD
Volatile Organic Compounds All Compounds	*	*	*	*	*	*
Semivolatile Organic Compounds All Compounds	*	*	*	*	*	*
Pesticide/PCB Compounds All Compounds	-	-	-	*	-	*
Explosive Compounds All Compounds Except 2,4,6-TNT	* 4	* *	* *	* *	* *	* *

*   Acceptable = At least one value is <5X the reported detection level and duplicate comparison is within 3X the reported detection level.
UNAC   Unacceptable = At least one value is <5X the reported detection level and duplicate comparison is greater than 3X the reported detection level.

Table 4-9. RVAAP RQL Groundwater Investigation QCSR
Sediment Field Duplicate Evaluation - Relative Percent Differences (RPDs) and Absolute Difference

Analysis	012(p)-0023SD 012(p)-0053FD (7/8/98) RPD	012(p)-0064SD 012(p)-0065FD (7/27/98) RPD	022(p)-0038SD 022(p)-0054FD (7/8/98) RPD
Metals (ICP and AA)			
Aluminum	2	21	42
Antimony	*	*	*
Arsenic	30	18	25
Barium	0	16	26
Beryllium	*	*	*
Cadmium	*	*	*
Calcium	7	28	19
Chromium	4	13	36
Cobalt	3	13	29
Copper	29	18	25
Iron	18	11	30
Lead	100	11	30
Magnesium	15	16	26
Manganese	185	19	18
Mercury	158	*	*
Nickel	12	13	29
Potassium	10	18	48
Selenium	*	*	*
Silver	*	*	*
Sodium	*	*	*
Thallium	*	*	*
Vanadium	9	17	33
Zinc	6	5	23
Volatile Organics			
All Compounds	*	*	*
Semivolatile Organics			
All Compounds	*	*	*
Except			
Fluoranthene	96	*	*
Phenanthrene	UNAC	*	*
Explosives			
All Compounds	*	*	*
Except			
HMX	17	*	*

*   Acceptable = At least one value is <5X the reported detection level and duplicate comparison is within 3X the reported detection level.

UNAC   Unacceptable = At least one value is <5X the reported detection level and duplicate comparison is greater than 3X the reported detection level.

Table 4-10. RVAAP RQL Groundwater Investigation
Groundwater Total and Filtered Evaluation - Relative Percent Difference (RPD)
and Absolute Difference

Analysis	Groundwater 005-0005GW Total vs Filt'd RPD	Groundwater 005-0047FD Total vs Filt'd RPD	Groundwater 011-0017GW Total vs Filt'd RPD	Groundwater 011-9047FD Total vs Filt'd RPD	Groundwater 007-0068GW Total vs Filt'd RPD	Groundwater 007-0074FD Total vs Filt'd RPD	Groundwater 009-0113GW Total vs Filt'd RPD	Groundwater 009-0075FD Total vs Filt'd RPD
Metals (ICP and AA)								
Aluminum	*	*	18	57	*	*	94	97
Antimony	*	*	*	*	*	*	*	*
Arsenic	*	*	*	*	6	0	*	*
Barium	*	*	6	1	1	4	6	8
Beryllium	*	*	*	*	*	*	*	*
Cadmium	*	*	*	*	*	*	*	*
Calcium	4	11	4	1	1	6	7	1
Chromium	*	*	*	*	*	*	*	*
Cobalt	*	*	13	1	5	5	*	*
Copper	*	*	*	*	*	*	*	*
Iron	21	27	7	6	1	3	118	98
Lead	*	*	*	*	*	*	*	*
Magnesium	4	7	8	3	0	5	30	13
Manganese	5	9	6	3	0	5	47	22
Mercury	*	*	*	*	*	*	*	*
Nickel	*	*	11	3	5	10	*	*
Potassium	2	8	9	2	1	5	2	0
Selenium	*	*	*	*	*	*	*	*
Silver	*	*	*	*	*	*	*	*
Sodium	*	*	23	0	2	4	49	49
Thallium	*	*	*	*	*	*	*	*
Vanadium	*	*	*	*	*	*	*	*
Zinc	*	*	8	12	12	14	*	*

*   Acceptable = At least one value is <5X the reported detection level and duplicate comparison is within 3X the reported detection level.
UNAC   Unacceptable = At least one value is <5X the reported detection level and duplicate comparison is greater than 3X the reported detection level.

**Table 4-11. Project Quantitation Limit Goals and Achieved Method Detection Levels
for the RVAAP RQL Groundwater Investigation**

	Water		Sediment	
Parameters/Methods	**Project Quantitation Goal**	**Achieved Method Detection Level**	**Project Quantitation Goal**	**Achieved Method Detection Level**
Volatile Organic Compounds (VOCs) SW 846-8260B	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Chloromethane	10	1.1	10	0.56
Bromomethane	10	0.92	10	0.9
Vinyl chloride	10	0.58	10	0.15
Chloroethane	10	0.67	10	0.45
Methylene chloride	5	0.4	5	0.28
Acetone	10	5.9	10	2.3
Carbon disulfide	5	0.4	5	0.35
1,1-Dichloroethene	5	0.53	5	0.2
1,1-Dichloroethane	5	0.62	5	0.2
1,2-Dichloroethene (total)	5	0.87	5	1.1
Chloroform	5	0.51	5	0.25
1,2-Dichloroethane	5	0.43	5	0.24
2-Butanone	10	9.7	10	1
1,1,1-Trichloroethane	5	0.63	5	0.12
Carbon tetrachloride	5	0.41	5	0.11
Bromodichloromethane	5	0.39	5	0.21
1,2-Dichloropropane	5	0.32	5	0.29
cis-1,3-Dichloropropene	5	0.35	5	0.25
Trichloroethene	5	0.54	5	0.23
Dibromochloromethane	5	0.36	5	0.21
1,1,2-Trichloroethane	5	0.41	5	0.2
Benzene	5	0.45	5	0.25
trans-1,3-Dichloropropene	5	0.64	5	0.11
Tribromomethane	5	0.35	5	0.27
4-Methyl-2-pentanone	10	5.5	10	0.46

Table 4-11 (continued)

	Water		Soil/Sediment	
Parameters/Methods	**Project Quantitation Goal**	**Achieved Method Detection Level**	**Project Quantitation Goal**	**Achieved Method Detection Level**
2-Hexanone	10	8.6	10	0.7
Tetrachloroethene	5	1.3	5	0.2
Toluene	5	0.45	5	0.25
1,1,2,2-Tetrachloroethane	5	0.57	5	0.35
Chlorobenzene	5	0.43	5	0.22
Ethylbenzene	5	0.41	5	0.27
Styrene	5	0.43	5	0.24
Xylenes (total)	5	1.4	5	0.72
Semivolatile Organic Compounds (SVOCs) **SW 846-8270C**	(μg/L)	(• μg/L)	(μg/kg)	(μg/kg)
Phenol	10	2.7	330	25
bis(2-Chloroethyl) ether	10	2.8	330	33
2-Chlorophenol	10	3.0	330	29
1,3-Dichlorobenzene	10	2.6	330	28
1,4-Dichlorobenzene	10	2.6	330	18
1,2-Dichlorobenzene	10	2.5	330	24
2-Methylphenol	10	2.9	330	31
2,2'- oxybis(1-Chloropropane)	10	3.2	330	18
4-Methylphenol	10	3.1	330	31
N-nitroso-di-n-dipropylamine	10	2.7	330	29
Hexachloroethane	10	2.4	330	22
Nitrobenzene	10	2.9	330	40
Isophorone	10	2.8	330	14
2-Nitrophenol	10	2.9	330	26
2,4-Dimethylphenol	10	2.8	330	73
bis(2-chloroethoxy) methane	10	2.6	330	21
2,4-Dichlorophenol	10	2.9	330	26

Table 4-11 (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
1,2,4-Trichlorobenzene	10	2.5	330	17
Naphthalene	10	2.7	330	14
4-Chloroaniline	10	3.8	330	39
Hexachlorobutadiene	10	2.6	330	40
4-chloro-3-methylphenol	10	2.9	330	26
2-Methylnaphthalene	10	3	330	16
Hexachlorocyclopentadiene	10	1	330	26
2,4,6-Trichlorophenol	10	2.9	330	18
2,4,5-Trichlorophenol	25	3.1	800	25
2-Chloronaphthalene	10	2.5	330	13
2-Nitroaniline	25	3.3	800	26
Dimethylphthalate	10	2.6	330	16
Acenaphthylene	10	2.8	330	22
2,6-Dinitrotoluene	10	2.7	330	32
3-Nitroaniline	25	3	800	31
Acenaphthene	10	2.7	330	18
2,4-Dinitrophenol	25	3.3	800	71
4-Nitrophenol	25	3.4	800	120
Dibenzofuran	10	2.9	330	25
2,4-Dinitrotoluene	10	3.1	330	31
Diethylphthalate	10	2.4	330	20
4-Chlorophenyl-phenyl ether	10	2.8	330	17
Fluorene	10	2.7	330	20
4-Nitroaniline	25	2.8	800	53
4,6-Dinitro-2-methylphenol	25	3.4	800	26
N-nitrosodiphenylamine	10	2.9	330	28
4-bromophenyl-phenylether	10	2.7	300	23
Hexachlorobenzene	10	2.9	330	34

Table 4-11 (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Pentachlorophenol	25	3.3	800	27
Phenanthrene	10	2.9	330	19
Anthracene	10	2.7	330	22
Carbazole	10	2.8	330	24
Di-n-butylphthalate	10	2.8	330	19
Fluoranthene	10	3.2	330	26
Pyrene	10	2.8	330	30
Butylbenzylphthalate	10	2.3	330	34
3,3'-Dichlorobenzidine	10	2.7	330	29
Benzo(a)anthracene	10	2.7	330	34
Chrysene	10	3.0	330	29
bis(2-Ethylhexyl)phthalate	10	3.0	330	37
Di-n-octylphthalate	10	3.1	330	47
Benzo(b)fluoranthene	10	2.7	330	36
Benzo(k)fluoranthene	10	3.0	330	40
Benzo(a)pyrene	10	2.7	330	41
Indeno(1,2,3-cd)pyrene	10	2.9	330	41
Dibenzo(a,h)anthracene	10	3.2	330	52
Benzo(g,h,i)perylene	10	3.2	330	48
Pesticides/PCBs				
SW 846-8081	(• µg/L)	(µg/L)	(µg/kg)	(µg/kg)
alpha-BHC	0.05	0.007	1.7	0.14
beta-BHC	0.05	0.011	1.7	0.38
delta-BHC	0.05	0.0082	1.7	0.28
gamma-BHC (Lindane)	0.05	0.0069	1.7	0.21
Heptachlor	0.05	0.0025	1.7	0.23
Aldrin	0.05	0.0045	1.7	0.37
Heptachlor epoxide	0.05	0.0092	1.7	0.3
Endosulfan I	0.05	0.0072	1.7	0.46

Table 4-11 (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	**Achieved Method Detection Level**	**Project Quantitation Goal**	**Achieved Method Detection Level**
Dieldrin	0.1	0.0075	3.3	0.5
4,4'-DDE	0.1	0.008	3.3	0.55
Endrin	0.1	0.013	3.3	0.43
Endosulfan II	0.1	0.0078	3.3	0.47
4,4'-DDD	0.1	0.0096	3.3	0.4
Endosulfan sulfate	0.1	0.011	3.3	0.49
4,4'-DDT	0.1	0.005	3.3	0.86
Methoxychlor	0.5	0.049	17	2.8
Endrin ketone	0.1	0.02	3.3	0.65
Endrin aldehyde	0.1	0.0097	3.3	0.92
alpha-Chlordane	0.05	0.016	1.7	0.68
gamma-Chlordane	0.05	0.0045	1.7	0.32
Toxaphene	5.0	0.33	170	10
PCBs **SW 846-8082**				
Arochlor-1016	1.0	0.41	33	12
Arochlor-1221	2.0	0.47	67	29
Arochlor-1232	1.0	0.12	33	8
Arochlor-1242	1.0	0.47	33	18
Arochlor-1248	1.0	0.37	33	3.9
Arochlor-1254	1.0	0.21	33	8.1
Arochlor-1260	1.0	0.36	33	7.3
Explosive Compounds **SW 846-8330**	(μg/L)	(μg/L)	(mg/Kg)	(mg/Kg)
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	20	0.06	2	0.05
RDX (cyclonite) Hexahydro-1,3,5-trinitro-1,3,5-triazine	20	0.04	2	0.02
1,3,5-Trinitrobenzene	2	0.03	1	0.02
1,3-Dinitrobenzene	3	0.03	1	0.02

Table 4-11 (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	**Achieved Method Detection Level**	**Project Quantitation Goal**	**Achieved Method Detection Level**
Tetryl	50	0.03	5	0.03
Nitrobenzene	10	0.04	1	0.10
2,4,6-Trinitrotoluene	3	0.06	1	0.02
2,4-Dinitrotoluene	0.1	0.03	1	0.03
2,6-Dinitrotoluene	0.1	0.03	1	0.06
o-Nitrotoluene	10	0.05	1	0.02
m-Nitrotoluene	10	0.05	1	0.03
p-Nitrotoluene	10	0.07	1	0.02
Additional Explosive Compounds:				
Nitroglycerin	10	1	1	0.2
Nitroquanidine	10	0.96	1	0.023
Nitrocellulose	10	0.37	1	0.28
Metals (Target Analyte List) SW 846-6010B/6020 or 7000	(µg/L)	(µg/L)	(mg/Kg)	(mg/Kg)
Aluminum	200	54	20	4.4
Antimony	5	3	0.5	2.1
Arsenic	5	3	0.5	0.24
Barium	200	3	20	0.22
Beryllium	4	1	0.5	0.067
Cadmium	5	1	0.5	0.49
Calcium	5000	150	500	14
Chromium	10	3	1	0.54
Cobalt	50	2	15	0.59
Copper	25	3	2.5	0.31
Iron	100	50	10	6.1
Lead	3	2	0.3	0.19
Magnesium	5000	52	500	11
Manganese	15	3	1.5	0.082

Table 4-11 (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Mercury (CVAA) SW 846-7470A/7471A	0.2	0.1	0.1	0.019
Nickel	40	15	4	1.1
Potassium	5000	120	500	8
Selenium	5	5	0.5	0.49
Silver	10	1	1	0.42
Sodium	5000	340	500	14
Thallium	2	1.0	0.5	0.65
Vanadium	50	1	5	0.57
Zinc	20	11	2	1.2

[a]*Test Methods for Evaluating Solid Waste*, U.S. EPA, SW-846 Third Edition.

Table 4-12. RVAAP RQL Groundwater Investigation - Trip Blank Levels
Values Reported Greater Than 1 ug/L

VOC Compound	0057TB 7/8/98 (µg/L)	0059TB 7/13/98 (µg/L)	0060TB 7/22/98 (µg/L)	0061TB 7/25/98 (µg/L)	0063TB 7/27/98 (µg/L)	0084TB 9/19/98 (µg/L)		
Acetone	6.9 J	8.3 J	7.3 J	10 U	10 U	19 J		
2-Butanone	10 U	10 U	10 U	10 U	10 U	15 J		
Methylene Chloride	5 U	5 U	5 U	5 U	5 U	5 U		
Toluene	5 U	5 U	5 U	5 U	5 U	3.3 J		
Xylenes	5 U	5 U	5 U	5 U	5 U	2.3 J		

VOC Compound	0086TB 10/19/98 (µg/L)	0087TB 2/12/99 (µg/L)	0088TB 4/10/99 (µg/L)	0090TB 5/26/99 (µg/L)	0092TB 5/27/99 (µg/L)	0093TB 5/28/99 (µg/L)		
Acetone	10 U	10 U	10 U	10 U	10 U	10 U		
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U		
Methylene Chloride	1.2 J	5 U	5 U	5 U	5 U	5 U		
Toluene	5 U	5 U	5 U	5 U	1.5 J	1.7 J		
Xylenes	5 U	5 U	5 U	5 U	5 U	5 U		

ATTACHMENT 1 TO APPENDIX J

SAIC DATA VALIDATION FLAGGING CODES

DATA VALIDATION REASON CODES

Organic, Inorganic, and Radiological Analytical Data

Holding Times

A01   Extraction holding times were exceeded.
A02   Extraction holding times were grossly exceeded.
A03   Analysis holding times were exceeded.
A04   Analysis holding times were grossly exceeded.
A05   Samples were not preserved properly.
A06   Professional judgement was used to qualify the data.

GC/MS Tuning

B01   Mass calibration was in error, even after applying expanded criteria.
B02   Mass calibration was not performed every 12 hours.
B03   Mass calibration did not meet ion abundance criteria.
B04   Professional judgement was used to qualify the data.

Initial/Continuing Calibration – Organics

C01   Initial calibration RRF was < 0.05.
C02   Initial calibration RDS was > 30%.
C03   Initial calibration sequence was not followed as required.
C04   Continuing calibration RRF was < 0.05.
C05   Continuing calibration %D was > 25%.
C06   Continuing calibration was not performed at the required frequency.
C07   Resolution criteria were not met.
C08   RPD criteria were not met.
C09   RDS criteria were not met.
C10   Retention time of compounds was outside windows.
C11   Compounds were not adequately resolved.
C12   Breakdown of endrin or DDT was > 30%.
C13   Combined breakdown of endrin/DDT was > 30%.
C14   Professional judgement was used to qualify the data.

Initial/Continuing Calibration – Inorganics

D01   ICV or CCV were not performed for every analyte.
D02   ICV recovery was above the upper control limit.

D03   ICV recovery was below the lower control limit.
D04   CCV recovery was above the upper control limit.
D05   CCV recovery was below the lower control limit.
D06   Standard curve was not established with the minimum number of standards.
D07   Instrument was not calibrated daily or each time the instrument was set up.
D08   Correlation coefficient was <0.995.
D09   Mid range cyanide standard was not distilled.
D10   Professional judgement was used to qualify the data.

ICP and Furnace Requirements

E01   Interference check sample recovery was outside the control limit.
E02   Duplicate injections were outside the control limit.
E03   Post digestion spike recovery was outside the control limit.
E04   MSA was required but not performed.
E05   MSA correlation coefficient was <0.995.
E06   MSA spikes were not at the correct concentration.
E07   Serial dilution criteria were not met.
E08   Professional judgement was used to qualify the data.

Blanks

F01   Sample data were qualified as a result of the method blank.
F02   Sample data were qualified as a result of the field blank.
F03   Sample data were qualified as a result of the equipment rinsate.
F04   Sample data were qualified as a result of the trip blank.
F05   Gross contamination exists.
F06   Concentration of the contaminant was detected at a level below the CRQL.
F07   Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
F08   Concentration of the contaminant was detected at a level that exceeds the action level.
F09   No laboratory blanks were analyzed.
F10   Blank had a negative value $>2\times$'s the IDL.
F11   Blanks were not analyzed at required frequency.
F12   Professional judgement was used to qualify the data.

Surrogate/Radiological Chemical Recovery

G01   Surrogate/radiological chemical recovery was above the upper control limit.
G02   Surrogate/radiological chemical recovery was below the lower control limit.
G03   Surrogate recovery was <10%.

G04   Surrogate recovery was zero.
G05   Surrogate/radiological chemical recovery data was not present.
G06   Professional judgement was used to qualify the data.
G07   Radiological chemical recovery was <20%.
G08   Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

H01   MS/MSD recovery was above the upper control limit.
H02   MS/MSD recovery was below the lower control limit.
H03   MD/MSD recovery was <10%.
H04   MS/MSD pairs exceed the RPD limit.
H05   No action was taken on MS/MSD limit.
H06   Professional judgement was used to qualify the data.
H07   Radiological MS/MSD recovery was <20%.
H08   Radiological MS/MSD recovery was >160%.
H09   Radiological MS/MSD samples were not analyzed at the required frequency.

Matrix Spike

I01   MS recovery was above the upper control limit.
I02   MS recovery was below the lower control limit.
I03   MS recovery was <30%.
I04   No action was taken on MS data.
I05   Professional judgement was used to qualify the data.

Laboratory Duplicate

J01   Duplicate RPD/radiological duplicate error ratio (DER) was outside the control
       limit.
J02   Duplicate sample results were >5× the CRDL.
J03   Duplicate sample results were <5× the CRDL.
J04   Professional judgement was used to qualify the data.
J05   Duplicate was not analyzed at the required frequency.

Internal Area Summary

K01   Area counts were outside the control limits.
K02   Extremely low area counts or performance was exhibited by a major drop off.
K03   IS retention time varied by more than 30 seconds.
K04   Professional judgement was used to qualify the data.

Pesticide Cleanup Checks

L01   10% recovery was obtained during either check.
L02   Recoveries during either check were >120%.
L03   GPC Cleanup recoveries were outside the control limits.
L04   Florisil cartridge cleanup recoveries were outside the control limits.
L05   Professional judgement was used to qualify the data.

Target Compound Identification

M01   Incorrect identifications were made.
M02   Qualitative criteria were not met.
M03   Cross contamination occurred.
M04   Confirmatory analysis was not performed
M05   No results were provided.
M06   Analysis occurred outside 12 hr GC/MS window.
M07   Professional judgement was used to qualify the data.
M08   The %D between the two pesticide/PCB column checks was >25%.

Compound Quantitation and Reported CRQLs

N01   Quantitation limits were affected by large off-scale peaks.
N02   MDLs reported by the laboratory exceeded corresponding CRQLs.
N03   Professional judgement used to qualify the data.

Tentatively Identified Compounds (TICs)

O01   Compound was suspected laboratory contaminant and was not detected in the blank.
O02   TIC result was not above 10× the level found in the blank.
O03   Professional judgement was used to qualify analytical data.

Laboratory Control Samples (LCSs)

P01   LCS recovery was above upper control limit.
P02   LCS recovery was below lower control limit.
P03   LCS recovery was <50%.
P04   No action was taken on the LCS data.
P05   LCS was not analyzed at required frequency.

P06   Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.

P07   Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.

P08   Professional judgement was used to qualify the data.

Field Duplicate

Q01   Field duplicate RPDs were >30% for waters and/or >50% for soils.

Q02   Radiological field duplicate error ratio (DER) was outside the control limit.

Q03   Duplicate sample results were >5× the CRDL.

Q04   Duplicate sample results were <5× the CRDL.

Radiological Calibration

R01   Efficiency calibration criteria were not met.

R02   Energy calibration criteria were not met.

R03   Resolution calibration criteria were not met.

R04   Background determination criteria were not met.

R05   Quench curve criteria were not met.

R06   Absorption curve criteria were not met.

R07   Plateau curve criteria were not met.

R08   Professional judgement was used to qualify the data.

Radiological Calibration Verification

S01   Efficiency verification criteria were not met.

S02   Energy verification criteria were not met.

S03   Resolution verification criteria were not met.

S04   Background verification criteria were not met.

S05   Cross-talk verification criteria were not met.

S06   Professional judgement was used to qualify the data.