APPENDIX H
QUALITY CONTROL SUMMARY REPORT

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APPENDIX H

Quality Control Summary Report

Phase II Remedial Investigation of Load Line 3
at the
Ravenna Army Ammunition Plant
Ravenna, Ohio

May 2004

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CONTENTS

TABLES

ACRONYMS

DQA	data quality assessment
DQCR	Daily Quality Control Reports
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
LCS	laboratory control sample
MPR	Monthly Progress Report
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RPD	relative percent difference
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
STL	Severn Trent laboratories, Inc.
SVOC	semivolatile organic compound
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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 verification process and this data quality assessment (DQA) are intended to provide current and future data users assistance throughout the interpretation of this data.

The purpose of this Quality Control Summary Report is (1) to describe the quality control (QC) procedures followed to ensure data generated by Science Applications International Corporation (SAIC) during the Phase II Remedial Investigations (RIs) of Load Lines 2, 3, and 4 at the Ravenna Army Ammunition Plant (RVAAP) would meet project requirements; (2) to describe the quality of the data collected; and (3) to describe problems encountered during the course of the study and their solutions. A separate Chemical Quality Assessment Report will be completed by the U.S. Army Corp of Engineers (USACE), Louisville District quality assurance (QA) representative covering data generated from QA split samples remanded to their custody.

This report provides an assessment of the analytical information gathered during the course of the RVAAP Phase II RI for Load Line 3 performed during 2001. It documents that the quality of the data employed for the RI report and evaluation 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 that establish 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 the report, decisions were made during the initial scoping of the RI to define the quality and quantity of data required. Project-specific data quality objectives (DQOs) were established in the Phase II RI Sampling and Analysis Plan (SAP) Addendum (USACE 2001a) in accordance with protocols specified in the RVAAP Facility-wide SAP (USACE 2001b) to guide the implementation of the field sampling and laboratory analysis. A QA program was established as part of the Phase II RI SAP Addendum to standardize procedures and to document activities. This program provided a means to detect and correct any deficiencies in the process. Upon receipt by the project team, data were subjected to verification and review that identified and qualified problems related to the analysis. These review steps contribute to this final DQA, which defines that data used in the investigation met the criteria and are employed appropriately.

2.0 QUALITY ASSURANCE PROGRAM

A Facility-wide Quality Assurance Project Plan (QAPP) and a Phase II RI QAPP Addendum for Load Line 3 were developed and included in the respective Facility-wide SAP and Phase II RI SAP Addendum to guide the investigation. The purpose of these documents was to enumerate the quantity and type of samples to be taken to inspect the area of concern, and to define the quantity and type of QA/QC samples to be used to evaluate the quality of the data obtained.

The QAPP established requirements for both field and laboratory QC procedures. In general, field QC requirements were as follows:

- 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 (MSs), laboratory control samples (LCSs), 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 during field operations and data verification and review. 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 RVAAP and the Ohio Environmental Protection Agency. Access to these reports can be obtained through the USACE, Louisville District 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; sub-tier contractors on-site, equipment on-site, 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 for this project identified requirements for laboratory data reporting and identified Severn Trent Laboratories, Inc. (STL), North Canton, Ohio, as the laboratory for the project. During the execution of the project, the North Canton facility took the lead and performed the majority of the analyses, while STL, Knoxville, Tennessee, performed explosives by High Pressure Liquid Chromatography and STL, Sacramento, California, performed nitroguanidine and nitrocellulose determinations. U.S. Environmental Protection Agency (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,
- LCS results,
- laboratory sample MS recoveries,
- laboratory duplicate results,
- surrogate recoveries [for VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and explosives],
- sample extraction dates, and
- 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 Section H 4.0 of this appendix.

3.0 DATA VERIFICATION

The objective when evaluating the project data quality is to determine its usability. The evaluation is based on the interpretation of laboratory QC measures, field QC measures, and the project DQOs. This project implemented checklists to facilitate laboratory data review. These checklists were completed by the project-designated verification staff and were reviewed by the project laboratory coordinator. Data verification checklists for each laboratory sample delivery group have been retained with laboratory data deliverables in the project files, with a copy of all checklists being forwarded to the USACE, Louisville District project chemist. Independent third-party validation of a percentage of the Phase II RI data will be conducted by the USACE, Louisville District data validation subcontractor.

3.1 FIELD DATA VERIFICATION

DQCRs were completed by the Field Team Leader. 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 on-site. These logs and all associated field information have been delivered to the USACE, Louisville District Project Manager and copies are retained in the Architect and Engineering contractor project file.

3.2 LABORATORY DATA VERIFICATION

Analytical data generated for this project have been subjected to a process of data verification and review. The following describes this systematic process and the evaluation activities performed. Several criteria have been established against which the data were compared and from which a judgment was 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-99/008, October 1999; and

- RVAAP Facility-wide SAP and Phase II RI SAP Addendum for Load Lines 2, 3, and 4 (USACE 2001a and 2001b).

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. As part of data verification, standardized laboratory electronic data deliverables were subjected to review. This technical evaluation ensured that all contract-specified requirements had been met, and that electronic information conformed to reported hardcopy data. QA program Nonconformance Report and Corrective Action systems were implemented as required.

During the verification 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 EPA functional guidelines and SAIC internal procedures for laboratory data review. These data review 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. This process did not include in-depth review of raw data instrument out-put or recalculation of results from the primary instrument out-put. This data verification and analytical review process included, but was not necessarily limited to, the following parameters:

- Data completeness;
- Analytical holding times and sample preservation;
- Calibration (initial and continuing);
- Method blanks;
- Sample results verification;
- Surrogate recovery;
- LCS analysis;
- Internal standard performance;
- 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 verification and review 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 (FLAGS)

During the data verification process, all laboratory data were assigned appropriate data qualification flags and reason codes. Qualification 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 has raised significant questions as to the reality of the information presented.
"="	Indicates the analyte has been reviewed, the analyte has been positively identified, and the associated concentration value is accurate.

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

3.4 DATA ACCEPTABILITY

Over 250 environmental soil, sediment, surface water, groundwater, and field QC samples were collected with approximately 19,100 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment (these totals do not include field measurements and field descriptions). The on-site field laboratory processed over 200 soil and sediment samples to produce over 330 trinitrotoluene and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) screening measurements. The project produced acceptable results for over 99% of the sample analyses performed. Data that were rejected are relegated primarily to antimony non-detect levels in soils and SVOC compound determinations in water samples.

Table H-1 presents a summary of the collected investigation samples and tallies the successful collection of all targeted field QC and QA split samples, while Table H-2 identifies a cross reference for duplicate and QA split sample pair numbers. Table H-3 provides a summary of rejected analyses grouped by media and analyte category. The majority of estimated values were based on values observed between the laboratory method detection levels and the project reporting levels. Values determined in this region have an inherently higher variability and need to be considered estimated, at best.

For this RVAAP study, a total of 22 field duplicates were analyzed for soil, sediment, groundwater, and surface water media. Three equipment rinsates were collected and analyzed for this project. One site potable water source was sampled (sample ID LL31166). A total of seven trip blanks were analyzed for VOCs relative to each shipment of VOC water samples.

4.0 DATA QUALITY EVALUATION

4.1 METALS

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. Initial calibration and continuing calibration criteria were achieved for the majority of the data, although a few thallium, lead, and mercury values were qualified as estimated J or UJ due to continuing calibration verification results being slightly elevated. Minor method blank levels did result in qualification of beryllium, cadmium, selenium, and thallium values in a few samples as non-detect or estimated non-detect U or UJ. Antimony and thallium concentrations were consistently qualified as estimated J, UJ due to low MS results and five non-detect thallium values were actually rejected, due to extremely low MS recoveries (LL30964, LL30952, LL30917, LL30798, and LL30832). Many of the other metals were occasionally estimated due to MS values being low or high relative to criteria. None of these deviations were considered significant enough to reject any of the data. Post-digestion spike recoveries for thallium contributed to its estimation as J or UJ in a few soil samples. Occasional serial dilution variations caused beryllium, chromium, cobalt, copper, lead, nickel, and potassium levels to be estimated in various samples. LCS determinations were considered acceptable throughout the data set. Reporting levels are considered to be consistent with the QAPP goals. Laboratory duplicate comparisons were elevated in several instances and caused various data to be estimated as J or UJ; however, none of the deviations were considered severe enough to reject any of the data. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. Rejected thallium values exhibit an unknown negative bias and should not be used. Complete data results, with associated qualifiers, are provided in Appendix I of the Load Line 3 Phase II RI report, and are maintained in the SAIC Ravenna environmental database.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. Initial calibration and continuing calibration criteria were achieved with the exception of some elevated continuing calibration results that caused some mercury values to be estimated UJ in surface water samples. Minor method blank levels did result in the occasional qualification of aluminum, antimony, cadmium, chromium, cobalt, iron, manganese, mercury, nickel, potassium, selenium, thallium, vanadium, and zinc concentrations in samples as non-detect or estimated non-detect U or UJ. MS recoveries were satisfactory, with the exception of some elevated recoveries for aluminum and iron and a few low recoveries for thallium. Data were estimated as a consequence in these instances. All other MS data were acceptable. Post-digestion spike recoveries for thallium contributed to its estimation as J or UJ in a few samples. Occasional serial dilution variations caused manganese, potassium, thallium, and zinc levels to be estimated in various samples. LCS determinations were considered acceptable throughout the data set. Elevated relative percent differences (RPDs) for mercury surface water duplicates produced an estimation of this element in the associated samples. Reporting levels are considered to be consistent with the QAPP goals. Some of these data were qualified as estimated; however, none of the deviations were considered severe enough to reject any of the data. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. Complete data results, with associated qualifiers, are provided in Appendix I of the Load Line 4 Phase II RI report, and are maintained in the SAIC Ravenna environmental database.

4.2 VOLATILE ORGANIC ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. All surrogate recoveries were acceptable. Internal standard area counts were acceptable. However, a few values were qualified as estimated due to low area counts for 1,1,2,2-tetrachloroethane. Initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks were clear of contamination. LCS and MS evaluations included all project-targeted analytes. Slightly low LCS recoveries were observed for acetone, chloroform, and 2-butanone. Associated compound values were qualified as estimated J or UJ. All other LCS recoveries were within criteria. MS recoveries and MS/matrix spike duplicate (MSD) RPD values were acceptable, with the exception of few elevated RPDs for toluene and benzene. Associated values were estimated J, as required. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. All surrogate recoveries and internal standard areas were acceptable. Initial calibration criteria and continuing calibration criteria were met for all compounds with the exception of a few elevated acetone initial calibration relative standard deviations that resulted in data being estimated J. Method blanks and trip blanks were clear of contamination with the exception of measurable levels of acetone, benzene, and toluene. Sample data for most observed low concentrations of these compounds were, therefore, qualified as non-detect U based on a 5-times action level for these compounds. LCS and MS/MSD evaluations included all project-targeted analytes. Occasionally, low LCS recoveries were observed for acetone, bromodichloromethane, and tetrachloroethene. Associated values were qualified as estimated J or UJ. All other LCS recoveries were within criteria. MS recoveries and MS/MSD RPD values were acceptable for the water matrices. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.3 SEMIVOLATILE ORGANIC ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were not met for all samples. Some SVOC extraction times exceeded the recommended time and associated values were estimated J or UJ as a result. These instances occurred when analytical protocol required re-extraction due to initial analysis QC aberrations. Re-extraction times were within 2 times the recommend extraction time window. Internal standard area counts were acceptable with the exception of polycyclic aromatic hydrocarbon compound area counts for sample LL30918 and LL31120. Associated data were estimated J. Surrogate recoveries were acceptable with the exception of low surrogate recoveries for benzoic acid and in sample LL30699 causing concentrations to be estimated. Extremely low surrogate recovery for phenolic compounds in sample LL31082 resulted in all associated values being rejected R. Initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks were clear of contamination. LCS and MS/MSD evaluations included all project-targeted analytes. Benzoic acid was estimated UJ in a few samples due to elevated LCS recoveries, while 4-nitrophenol and 2,4-methylphenol were estimated UJ due to low LCS recovery. Extremely low MS recoveries for 4-notrophenol and pentachlorophenol caused 10 analyses to be rejected R in samples LL30823, LL30842, LL31065, LL31077, and LL31084. While some of this data were qualified as estimated, only a few analyses exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for most samples; however sample LL31105 was extracted slightly outside the holding time and data were estimated J or UJ. Surrogate recoveries and internal standard area counts were acceptable, with the exception of samples LL31101, LL31103, LL31104, and LL31106 that had extremely poor phenolic surrogate recovery resulting in the rejection R of 63 values. Sample LL31105 also had low phenolic surrogate recovery; however, the data required only estimation as UJ. All initial calibration criteria and continuing calibration criteria were met. Method blanks were clear of contamination. LCS and MS/MSD evaluations included all project-targeted analytes. Low LCS recoveries for 2,4-dimethylphenol, diethyl phthalate, and dimethyl phthalate resulted in estimation of these compounds. Poor LCS or MS recovery information created the need to reject R several hexachlorocyclopentadiene, dimethyl phthalate, 2,4-dimethylphenol, and 3,3'dichlorobenzidine values in multiple samples. Other LCS and MS water matrix recoveries were within criteria. While some of this water data were qualified as estimated, a small number of data points did exhibit enough significant deviation to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.4 PESTICIDE/POLYCHLORINATED BIPHENYL ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for samples. Surrogate recoveries were predominantly acceptable with the exception of a few elevated surrogates for pesticides, causing values to be estimated. Continuing calibration verification percent differences greater than 25 caused sporadic qualification of the pesticide compounds as estimated J or UJ in the data set. All other initial calibration criteria and continuing calibration criteria were met for compounds. Method blanks were clear of contamination. LCS and MS/MSD evaluations included the project-targeted pesticides; however, PCB evaluations only included Aroclors-1016 and -1260. PCBs were estimated J or UJ in a few samples due to elevated LCS recoveries. Other LCS recoveries were within criteria. Poor MS recoveries caused some PCB and pesticide data to be estimated J. Very poor LCS recovery caused floor sweeping samples delta-BHC non-detect levels to be rejected R. Several positive PCB and pesticide compound results were qualified as estimated J based on the percent difference between the primary column quantification and the secondary column quantification. While some of this data were qualified as estimated, only a few data points exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. All surrogate recoveries were acceptable with the exception of low recovery for sample LL31110 causing PCB results to be estimated J. All initial calibration criteria and continuing calibration criteria were met for all compounds with the exception of elevated continuing calibration verification percent differences in a few instances. Toxaphene, and 4,4'-DDT data were estimated UJ in these isolated cases. Method blanks were clear of contamination. LCS and MS/MSD evaluations included the project-targeted pesticides; however, PCB evaluations only included Aroclors-1016 and -1260. Water LCS and MS recoveries were within criteria, except for elevated recoveries for 4,4'-DDD. Some heptachlor epoxide and beta-BHC compound results were qualified as estimated J based on the percent difference between the primary column quantification and the secondary column quantification. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.5 EXPLOSIVE ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for most analyses; however, a few nitroguanidine determinations were qualified as estimated J or UJ for extended holding times. Initial calibration criteria and continuing calibration criteria were met for all compounds. A few method blanks contained low concentrations of nitrocellulose. This resulted in some low concentrations being qualified as un-detected U. All other method blanks were clear of contamination. Surrogate compound recoveries were acceptable for analyses, with the exception of a few high recoveries causing data to be estimated J in samples LL30805, LL30688, LL31053, and LL31122. LCS and MS/MSD evaluations included the project-targeted analytes, with the exception of nitroglycerine. LCS recoveries were within criteria. MS recoveries were acceptable; however, most nitrocellulose analyses were estimated J or UJ due to low MS recoveries. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for samples, with the exception of extraction times for some nitroguanidine analyses. Data for these analyses were qualified as estimated UJ. All initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks were clear of contamination. Surrogate compound recoveries were acceptable with the exception of slightly low recoveries in sample LL31087. Associated sample results were qualified as estimated J or UJ. LCS and MS/MSD evaluations included the project-targeted analytes, with the exception of nitroglycerine. Water LCS and MS recoveries were within criteria. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.6 MISCELLANEOUS ANALYSES

Soils, Sediments, Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all total organic carbon and cyanide determinations. Hexavalent chromium analyses were predominantly run outside holding time. Analyses performed outside holding times were qualified as estimated J or UJ. Initial calibration criteria and continuing calibration criteria were met for all analyses. All method blanks were clear of contamination for these analytes. MS data were mostly satisfactory. However, three hexavalent chromium values were rejected R in sediment samples LL31071, LL31079, and LL31073 due to very low MS recoveries. LCS recoveries were consistently within criteria. While some of this data were qualified as estimated, only a few data points exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.7 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 in Table H-4 presents the absolute difference or RPD for field duplicate measurements, by analyte. RPD was calculated only when both samples were >5 times the reporting level. When one or both sample values were between the reporting 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 information, this DQA 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 3 times the reporting level.

Field duplicate metal comparisons are considered good. Of 368 RPD and absolute difference observations in soil duplicates, 349 (95%) were <50 or had acceptable absolute differences. Only 2% of the soil RPD comparisons were >100 and only 5% were >50. Eleven of the 19 unacceptable comparisons were within the one duplicate set of samples LL30745 and LL31131. Field duplicate sediment comparisons were equally satisfactory. Of 69 RPD and absolute difference observations in sediment duplicates, 63 (91%) were <50 or had acceptable absolute differences. None of the sediment RPD comparisons were >100 and all those observed at >50 RPD were attributed to the duplicate set LL30957 and LL31125. Surface water and groundwater field duplicate metal comparisons were all <30 RPD or had acceptable absolute differences. VOC and cyanide field duplicate comparisons were all acceptable. SVOC soil duplicate comparisons exhibited 326 acceptable observations in 330 (99%). Only four observations were RPD values > 50 or unacceptable absolute differences. Pesticide and PCB field duplicate comparisons were acceptable, with the exception two PCB comparisons. All sediment and water SVOC and pesticide/PCB field duplicate comparisons were acceptable. Explosives field duplicate comparisons were acceptable, with the exception of two sediment comparisons, one octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine at an RPD of 94 and one RDX at an RPD of 114.

4.8 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 thallium in water. Actual laboratory method detection levels achieved during this investigation are presented in Table H-5 with original project quantitation level goals. Individual analyte reporting levels varied due to matrix differences and contaminant analyte concentrations. Reporting levels were elevated in soils and sediments due to inherent moisture content variability and results being reported in the standard dry weight format. However, there were larger elevations of reporting levels in several soil and sediment PCB, pesticide, and semivolatile results due to high levels of individual contaminants. This caused solid sample reporting levels for other analytes to be elevated by factors of 10 to 50 times, as a result of required dilutions. High level of 2,4,6-trinitrotoluene also caused explosive and semivolatile analyses to be diluted and reporting levels to be elevated in solid samples. Water determinations consistently met project reporting level goals. Reporting level variations have been considered during data interpretation and statistical applications.

Method blank determinations were performed with each analytical sample batch for each analyte under investigation. These blanks were evaluated during data review to determine their potential impact on individual data points, if any. Review action levels are set at 5 times the reporting level for all analytes, except those designated as common laboratory contaminants (methylene chloride, acetone, and phthalate compounds) with action levels set at 10 times the reporting levels. During data review, reported sample concentrations are assessed against method blank action levels and the following qualifications are made when reportable quantities of analyte were observed in the associated method blank.

- When the analyte sample concentration is above the 5- or 10-times action level, the data are not qualified and it is considered a positive value. It will receive a reason code of "F01, F08."

- When the analyte sample concentration is determined below the 5- or 10-times action level but above the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the analyte value reported. These data are then qualified as U with a reason code of "F01, F07."

- When the analyte sample concentration is determined below the 5- or 10-times action level and below the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the reporting level. These data are then qualified as U with a reason code of "F01, F06."

No data were rejected as a result of method blank contamination; however, various analytes are qualified as non-detect U according to the above reason codes.

Evaluation of overall project sensitivity can be gained through review of field blank information. These actual sample analyses 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 and a site potable water source.

There were only minor concentrations of the VOCs acetone, benzene, 2-butanone, and toluene detected in project trip blanks. The concentrations observed were: acetone from 11 J to 29 µg/L (reporting level at 10 µg/L); 2-butanone from 0.67 to 0.85 J µg/L (reporting level at 10 µg/L); toluene from 0.23 to 0.54 J µg/L (reporting level at 1 µg/L); one chloromethane value at 0.44 J (reporting level at 1 µg/L); and one 1,1-dichloroethene value at 0.27 J µg/L (reporting level at 1 µg/L). The impact of these values has been assessed during data review and values have been qualified where necessary. It is, therefore, determined that VOC analyses were not affected through the transportation and storage process, and that the procedures and precautions employed were effective in preserving the integrity of the sample analysis.

Equipment rinsate samples (LL31163, LL31164, and LL31165) exhibited similar levels for acetone and 2-butanone as the trip blanks, plus very minor amounts of carbon disulfide, bis-2-ethylhexylphthalate, nickel and chromium. All rinsates were associated with solids sampling equipment cleaning operations and none of the contaminant levels impacted the sample values being reported. The field's final rinsate source water blank LL31166 (08/08/2001) exhibited no analyte levels above project reporting levels.

Field source water blank (sample ID LL41178 collected 8/14/2001) exhibited few analyte levels above project reporting levels. Those detected included normal levels of calcium, magnesium, potassium, sodium, and zinc, with minor concentrations of acetone, bromodichloromethane, dibromochloromethane, and chloroform indicative of a chlorinated water source. There is no indication that the source water impacted associated sample levels.

4.9 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. Samples were delivered directly to the laboratory by courier, were received in good condition, and at appropriate temperature. Several organic analyses were conducted outside the holding time because samples were re-extracted and re-analyzed due to analytical difficulties or low surrogate recoveries. These data were qualified accordingly as outside of the holding time, per EPA 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 an individual project data set. These RVAAP AOC investigations 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. Table H-6 presents the standardized parameter groups, analytical methods, sample containers, preservation techniques, and associated holding times.

4.10 COMPLETENESS

Usable data are defined as those data that pass individual scrutiny during the verification and review 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.

5.0 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of RVAAP Load Line 3 Phase II RI information meets or exceeds the established project objectives. The project produced usable results for over 99% of the sample analyses performed and successfully collected all the samples planned. Through proper implementation of the project data verification, data review, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, estimated J or UJ, or rejected R. 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. Qualifiers have been applied to data when necessary.

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.

6.0 REFERENCES

USACE (U.S. Army Corps of Engineers) 2001a. *Sampling and Analysis Plan Addendum No. 1 for the Load Lines 2, 3, and 4 Phase II Remedial Investigation, Ravenna Army Ammunition Plant, Ravenna, Ohio,* F44650-99-D-0007, ECAS 186, July.

USACE 2001b. *Facility-wide Sampling and Analysis Plan (SAP) for the Ravenna Army Ammunition Plant, Ravenna, Ohio,* DACA62-00-D-0001, DO CY 02, March.

Table H-1. RVAAP Load Line 3 Phase II RI Sample Summary

Area	Media	Environmental Samples	Field Duplicates	Trip Blanks	Equipment Rinsate Blanks	Site Source Water Blanks	USACE Split Samples
Laboratory Analyses	Soils	170	16	-	-	-	16
	Sediment	27	3	-	-	-	3
	Surface Waters	10	2	3	-	-	2
	Groundwater	12	1	4	3	1	1
	Floor Sweepings	3	-	-	-	-	-
Totals		**222**	**22**	**7**	**3**	**1**	**22**
Field Analyses	Soil and Sediment	195	11	-	-	-	-

RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.
USACE = U.S. Army Corps of Engineers.

Table H-2. RVAAP Load Line 3 Phase II RI Primary, Duplicate, and Split Sample Correlation Table

Media	Station #	Sample #/ Duplicate #	SDG # Metals, etc.	SDG # Explosives	SDG # Propellants	Split #
Surface Soil						
Surface Soil	LL3-057	LL30693 LL31121	A1H020111 A1H020111	A1H020111 A1H020111	None None	LL31143
Surface Soil	LL3-074	LL30736 LL31124	A1H100121 A1H100121	A1H110109 A1H100121	A1H100165 None	LL31146
Surface Soil	LL3-077	LL30745 LL31131	A1H110106 A1H110106	A1H140151 None	None None	LL31156
Surface Soil	LL3-082	LL30760 LL31125	A1H110106 A1H110106	A1H110109 A1H110106	None None	LL31148
Surface Soil	LL-087	LL30775 LL31135	A1H080125 A1H080125	None None	None None	LL31157
Surface Soil	LL3-090	LL30784 LL31127	A1H020111 A1H020111	A1H020111 None	None None	LL31149
Surface Soil	LL3-097	LL30799 LL31119	A1H090137 A1H090137	A1H110109 A1H090137	A1H080176 A1H080176	LL31141
Surface Soil	LL3-112	LL30836 LL31128	A1H080144 A1H080144	None None	None None	LL31150
Surface Soil	LL3-127	LL30875 LL31123	A1H090164 A1H090164	A1H110109 A1H090164	None None	LL31145
Surface Soil	LL3-139	LL30911 LL31133	A1H140115 A1H140115	None None	None None	LL31154
Surface Soil	LL3-142	LL30918 LL31120	A1H110102 A1H110102	A1H110106 A1H110102	A1H100165 A1H100165	LL31142
Surface Soil	LL3-153	LL30951 LL31134	A1H140151 A1H140151	A1H140151 None	A1H100165 None	LL31153
Surface Soil	LL3-173	LL30999 LL31132	A1H110109 A1H110109	None None	None None	LL31155
Surface Soil	LL3-189	LL31015 LL31136	A1H140131 A1H140131	None None	None None	LL31158
Surface Soil	LL3-065	LL31128 LL31129	A1H080144 A1H080144	A1H110102 None	None None	LL31151

Table H-2. RVAAP Load Line 3 Phase II RI Primary, Duplicate, and Split Sample Correlation Table (continued)

Media	Station #	Sample #/ Duplicate #	SDG # Metals, etc.	SDG # Explosives	SDG # Propellants	Split #
Subsurface Soil						
Subsurface Soil	LL3-111	LL30834 LL31137	A1H110109 A1H140151	A1H110109 None	None None	LL31159
Sediment						
Sediment	LL3-155	LL30957 LL31125	A1H110106 A1H110106	A1H110109 A1H110106	None None	LL31147
Sediment	LL3-210	LL31053 LL31122	A1H080125 A1H080125	A1H080125 A1H080125	A1H080176 None	LL31144
Sediment	LL3-224	LL31089 LL31130	A1H090137 A1H090137	A1H090104 None	None None	LL31152
Surface Water						
Surface Water	LL3-209	LL31052 LL31139	A1H080144 A1H080125	A1H080144 A1H080125	A1H080176 A1H080176	LL31161
Surface Water	LL3-053(p2)	LL31074 LL31140	A1H090164 A1H090164	A1H090164 A1H090164	A1H080176 A1H080176	LL31162
Groundwater						
Groundwater	LL3-243	LL31112 LL31138	A1I120105 A1I120105	A1I120105 A1I120105	A1I120109 A1I120109	LL31160

SDG = sample delivery group.
RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.

Table H-3. RVAAP Load Line 3 Phase II RI
Summary of Rejected Analytes (Laboratory)
(grouped by medium and analysis group)

Media	Analysis Group	Rejected/	Total	Percent Rejected
Soil (surface and subsurface)	Metals	2/	4,278	0.1
	Volatile Organics	0/	1,435	0.0
	Semivolatile Organics	4/	2,706	0.1
	Pesticides/PCBs	0/	1,337	0.0
	Explosives	0/	1,223	0.0
	Miscellaneous	0/	20	0.0
	Subtotal	6/	10,999	0.1
Sediment	Metals	0/	690	0.0
	Volatile Organics	0/	420	0.0
	Semivolatile Organics	21/	792	2.7
	Pesticides/PCBs	0/	462	0.0
	Explosives	0/	265	0.0
	Miscellaneous	3/	16	18.8
	Subtotal	24/	2,645	0.9
Surface Water, Groundwater, and QC	Metals	0/	667	0.0
	Volatile Organics	0/	1,190	0.0
	Semivolatile Organics	102/	1,716	5.9
	Pesticides/PCBs	0/	770	0.0
	Explosives	0/	485	0.0
	Miscellaneous	0/	25	10.0
	Subtotal	102/	4,726	2.2
Floor Sweepings	Metals	3/	69	4.3
	Volatile Organics	0/	105	0.0
	Semivolatile Organics	0/	198	0.0
	Pesticides/PCBs	3/	84	3.6
	Explosives	0/	45	0.0
	Miscellaneous	0/	9	0.0
	TCLP extract analyses	0/	117	0.0
	Subtotal	6/	627	1.0
Project Total		**138/**	**19,124**	**0.7**

PCB = polychlorinated biphenyl.
QC = quality control.
RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.
TCLP = Toxicity Characteristic Leaching Procedure.

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison

Analysis	LL30693/LL31121 Surface Soil RPD	LL30736/LL31124 Surface Soil RPD	LL30745/LL31131 Surface Soil RPD	LL30760/LL31126 Surface Soil RPD
Metals				
Aluminum	12	15	32	7
Antimony	*	*	132	*
Arsenic	5	13	UNAC	16
Barium	18	3	96	16
Beryllium	*	*	3	11
Cadmium	*	*	44	67
Calcium	26	28	47	18
Chromium	9	0	154	19
Cobalt	24	20	190	16
Copper	13	17	68	11
Iron	17	10	81	11
Lead	27	11	140	32
Magnesium	22	8	24	10
Manganese	18	31	19	13
Mercury	*	36	38	17
Nickel	18	6	67	6
Potassium	*	*	*	*
Selenium	*	*	*	*
Silver	*	*	UNAC	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	2	14	55	13
Zinc	31	2	82	16
Cyanide	*	NA	NA	NA
Volatile Organic Compounds				
All compounds	*	*	NA	NA
Semivolatile Organic Compounds				
All compounds	*	*	NA	NA
Except multiple PAHs	avg. RPD = 31	*	NA	NA
cabazole	30	*	NA	NA
dibenzofuran	8	*	NA	NA
Explosive Compounds				
All compounds	*	*	NA	*
Except 2,4,6-TNT	26	*	NA	*
2-amino-4,6-DNT	24	*	NA	*
Pesticide/PCB Compounds				
All compounds	*	*	*	*
Except Aroclor-1254/-1260	UNAC	18	1	60

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

Analysis	**LL30775/LL31135 Surface Soil RPD**	**LL30784/LL31127 Surface Soil RPD**	**LL30799/LL31119 Surface Soil RPD**	**LL30834/LL31137 Subsurface Soil RPD**
Metals				
Aluminum	21	1	30	9
Antimony	*	*	26	*
Arsenic	0	16	9	55
Barium	10	1	11	6
Beryllium	*	*	32	8
Cadmium	18	*	*	0
Calcium	55	3	29	29
Chromium	10	12	1	8
Cobalt	2	1	4	3
Copper	4	1	0	4
Iron	10	10	12	6
Lead	3	18	12	27
Magnesium	16	7	33	6
Manganese	26	5	25	6
Mercury	*	*	*	16
Nickel	4	2	14	127
Potassium	*	*	*	2
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	9	3	14	11
Zinc	7	6	5	1
Cyanide	NA	NA	*	NA
Volatile Organic Compounds				
All compounds	NA	NA	*	NA
Semivolatile Organic Compounds				
All compounds	NA	NA	*	NA
Explosive Compounds				
All compounds	NA	NA	*	NA
Pesticide/PCB Compounds				
All compounds	NA	NA	*	NA

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL30836/LL31128 Surface Soil RPD	LL308759/LL31123 Surface Soil RPD	LL30911/LL31133 Surface Soil RPD	LL30918/LL31120 Surface Soil RPD
Metals				
Aluminum	13	6	5	19
Antimony	*	*	*	14
Arsenic	6	3	10	2
Barium	18	10	11	23
Beryllium	*	*	*	*
Cadmium	*	3	*	20
Calcium	21	9	25	8
Chromium	19	10	19	27
Cobalt	19	1	13	14
Copper	12	2	13	15
Iron	9	4	7	5
Lead	50	2	77	22
Magnesium	12	6	2	19
Manganese	0	3	16	3
Mercury	*	*	*	*
Nickel	4	5	5	12
Potassium	*	6	10	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	10	2	6	6
Zinc	18	4	32	9
Cyanide	NA	NA	NA	*
Volatile Organic Compounds				
All compounds	NA	*	NA	*
Semivolatile Organic Compounds				
All compounds	NA	*	NA	*
Explosive Compounds				
All compounds	NA	*	NA	*
Pesticide/PCB Compounds				
All compounds	*	*	*	*
Except Aroclor-1254/ -1260	18	*	*	23

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

Analysis	**LL30951/LL31134 Surface Soil RPD**	**LL30999/LL31132 Surface Soil RPD**	**LL31015/LL31136 Surface Soil RPD**	**LL31128/LL31129 Surface Soil RPD**
Metals				
Aluminum	18	12	16	8
Antimony	*	*	5	*
Arsenic	17	4	24	26
Barium	21	12	7	17
Beryllium	*	*	*	*
Cadmium	14	*	*	*
Calcium	20	9	82	18
Chromium	41	10	2	4
Cobalt	9	4	22	17
Copper	9	14	11	0
Iron	46	2	27	4
Lead	40	3	6	25
Magnesium	33	14	46	1
Manganese	61	1	27	49
Mercury	*	*	*	*
Nickel	2	11	16	16
Potassium	*	*	*	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	67	8	14	8
Zinc	10	13	7	27
Cyanide	NA	NA	NA	NA
Volatile Organic Compounds				
All compounds	NA	NA	NA	NA
Semivolatile Organic Compounds				
All compounds	NA	NA	NA	NA
Explosive Compounds				
All compounds	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	*	*	NA	*
Except Aroclor-1254/ -1260	34	*	NA	17

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL30957/LL31125 Sediment RPD	LL31053/LL31122 Sediment RPD	LL31089/LL31130 Sediment RPD	
Metals				
Aluminum	48	4	20	
Antimony	*	7	1	
Arsenic	41	4	21	
Barium	47	23	35	
Beryllium	*	*	*	
Cadmium	7	4	13	
Calcium	79	7	37	
Chromium	51	35	5	
Cobalt	36	16	23	
Copper	25	1	12	
Iron	60	4	15	
Lead	25	36	10	
Magnesium	66	1	28	
Manganese	70	8	40	
Mercury	*	*	*	
Nickel	42	0	12	
Potassium	35	*	*	
Selenium	*	*	20	
Silver	*	UNAC	*	
Sodium	17	*	*	
Thallium	*	*	*	
Vanadium	26	4	24	
Zinc	24	2	17	
Volatile Organic Compounds				
All compounds	NA	*	NA	
Semivolatile Organic Compounds				
All compounds	NA	*	NA	
Explosive Compounds				
All compounds	*	*	NA	
Except HMX	*	94	NA	
1,3,5-trinitrobenzene	*	13	NA	
2,4,6-trinitrotoluene	*	0	NA	
RDX	*	114	NA	
4-amino-2,6-DNT	*	0	NA	
2-amino-4,6-DNT	*	6	NA	
Pesticide/PCB Compounds				
All compounds	*	*	*	
Except Aroclor-1254/-1260	42	15	41	
Misc. pesticides	NA	avg. RPD = 14	NA	

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL31052/LL31139 Surface Water RPD	LL31074/LL31140 Surface Water RPD		LL31112/LL31138 Groundwater RPD
Metals				
Aluminum	*	*		*
Antimony	*	*		*
Arsenic	*	8		*
Barium	4	4		1
Beryllium	*	*		*
Cadmium	*	*		*
Calcium	2	3		0
Chromium	*	*		*
Cobalt	*	*		*
Copper	5	*		*
Iron	*	7		*
Lead	*	*		*
Magnesium	1	4		0
Manganese	*	3		0
Mercury	*	*		*
Nickel	*	*		24
Potassium	1	2		0
Selenium	*	*		*
Silver	*	*		*
Sodium	3	2		2
Thallium	*	*		*
Vanadium	*	*		*
Zinc	13	6		*
Cyanide	*	*		*
Volatile Organic Compounds				
All compounds	*	*		*
Semivolatile Organic Compounds				
All compounds	*	*		*
Explosive Compounds				
All compounds	*	*		*
Except HMX	38	*		*
1,3,5-trinitrobenzene	31	*		*
2,4,6-trinitrotoluene	11	*		*
RDX	15	*		*
4-amino-2,6-DNT	9	*		*
2-amino-4,6-DNT	15	*		*
Pesticide/PCB Compounds				
All compounds	*	*		*

Table H-4. RVAAP Load Line 3 Phase II RI Field Duplicate Comparison (continued)

* At least one value is <5 times the reporting level, and duplicate comparison is within 3 times the reporting level.
NA = not applicable.
PAH = polycyclic aromatic hydrocarbon.
PCB = polychlorinated biphenyl.
RI = Remedial Investigation.
RPD = relative percent difference.
RVAAP = Ravenna Army Ammunition Plant.
UNAC = At least one value is <5 times the reporting level, and duplicate comparison is NOT within 3 times the reporting level.

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI

Parameters/Methods	Water		Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Volatile Organic Compounds SW 846-8260B	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Chloromethane	10	1.1	10	0.73
Bromomethane	10	0.92	10	1.2
Vinyl chloride	10	0.58	10	0.66
Chloroethane	10	0.67	10	0.92
Methylene chloride	5	0.4	5	1.4
Acetone	10	5.9	10	1.8
Carbon disulfide	5	0.4	5	1.1
1,1-Dichloroethene	5	0.53	5	067
1,1-Dichloroethane	5	0.62	5	063
1,2-Dichloroethene (total)	5	0.87	5	9.61
Chloroform	5	0.51	5	0.71
1,2-Dichloroethane	5	0.43	5	0.57
2-Butanone	10	9.7	10	4.8
1,1,1-Trichloroethane	5	0.63	5	0.71
Carbon tetrachloride	5	0.41	5	0.62
Bromodichloromethane	5	0.39	5	0.65
1,2-Dichloropropane	5	0.32	5	0.65
cis-1,3-Dichloropropene	5	0.35	5	0.61
Trichloroethene	5	0.54	5	0.7
Dibromochloromethane	5	0.36	5	0.57
1,1,2-Trichloroethane	5	0.41	5	0.54
Benzene	5	0.45	5	0.63
trans-1,3-Dichloropropene	5	0.64	5	0.59
Tribromomethane	5	0.35	5	0.50
4-Methyl-2-pentanone	10	5.5	10	3.3
2-Hexanone	10	8.6	10	1.2
Tetrachloroethene	5	1.3	5	074

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Toluene	5	0.45	5	0.75
1,1,2,2-Tetrachloroethane	5	0.57	5	0.7
Chlorobenzene	5	0.43	5	0.72
Ethylbenzene	5	0.41	5	0.84
Styrene	5	0.43	5	0.65
Xylenes (total)	5	1.4	5	0.2
Semivolatile Organic Compounds SW 846-8270C	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Phenol	10	1.3	330	35
bis(2-Chloroethyl) ether	10	2.1	330	33
2-Chlorophenol	10	1.6	330	28
1,3-Dichlorobenzene	10	1	330	32
1,4-Dichlorobenzene	10	0.9	330	36
1,2-Dichlorobenzene	10	0.9	330	29
2-Methylphenol	10	1.1	330	37
2,2'- oxybis(1-Chloropropane)	10	1.3	330	93
4-Methylphenol	10	1.7	330	27
N-nitroso-di-n-dipropylamine	10	1	330	31
Hexachloroethane	10	2.3	330	40
Nitrobenzene	10	2.6	330	32
Isophorone	10	2.7	330	32
2-Nitrophenol	10	1	330	44
2,4-Dimethylphenol	10	1.1	330	57
bis(2-chloroethoxy) methane	10	2.6	330	21
2,4-Dichlorophenol	10	1	330	45
1,2,4-Trichlorobenzene	10	2.5	330	38
Naphthalene	10	0.7	330	35
4-Chloroaniline	10	2.8	330	33

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Hexachlorobutadiene	10	1.2	330	31
4-chloro-3-methylphenol	10	1.2	330	31
2-Methylnaphthalene	10	0.9	330	33
Hexachlorocyclopentadiene	10	3.4	330	150
2,4,6-Trichlorophenol	10	1.3	330	57
2,4,5-Trichlorophenol	25	1.1	800	69
2-Chloronaphthalene	10	2.5	330	32
2-Nitroaniline	25	1.4	800	33
Dimethylphthalate	10	3.7	330	36
Acenaphthylene	10	2.7	330	35
2,6-Dinitrotoluene	10	2.8	330	30
3-Nitroaniline	25	2	800	33
Acenaphthene	10	2.7	330	35
2,4-Dinitrophenol	25	13	800	150
4-Nitrophenol	25	4.8	800	350
Dibenzofuran	10	2.8	330	36
2,4-Dinitrotoluene	10	0.8	330	41
Diethylphthalate	10	3.2	330	38
4-Chlorophenyl-phenyl ether	10	1.3	330	36
Fluorene	10	2.9	330	29
4-Nitroaniline	25	1.2	800	47
4,6-Dinitro-2-methylphenol	25	7.5	800	180
N-nitrosodiphenylamine	10	0.9	330	37
4-bromophenyl-phenylether	10	1	300	35
Hexachlorobenzene	10	1.8	330	41
Pentachlorophenol	25	0.6	800	34
Phenanthrene	10	2.4	330	43
Anthracene	10	0.9	330	37

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Carbazole	10	1.1	330	42
Di-n-butylphthalate	10	1.1	330	59
Fluoranthene	10	0.9	330	38
Pyrene	10	1.4	330	57
Butylbenzylphthalate	10	1.9	330	44
3,3'-Dichlorobenzidine	10	1.1	330	140
Benzo(a)anthracene	10	2.8	330	35
Chrysene	10	0.9	330	50
bis(2-Ethylhexyl)phthalate	10	2.1	330	65
Di-n-octylphthalate	10	2	330	50
Benzo(b)fluoranthene	10	2.6	330	35
Benzo(k)fluoranthene	10	1.2	330	41
Benzo(a)pyrene	10	3	330	33
Indeno(1,2,3-cd)pyrene	10	1.2	330	42
Dibenzo(a,h)anthracene	10	1.2	330	38
Benzo(g,h,i)perylene	10	3.3	330	45
PCBs SW 846-8082	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Arochlor-1016	1.0	0.02	33	5.3
Arochlor-1221	2.0	0.09	67	19
Arochlor-1232	1.0	0.16	33	11
Arochlor-1242	1.0	0.3	33	18
Arochlor-1248	1.0	0.22	33	4.6
Arochlor-1254	1.0	0.10	33	20
Arochlor-1260	1.0	0.07	33	7.4
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	0.09	2	0.18
RDX (cyclonite) Hexahydro-1,3,5-trinitro-1,3,5-triazine	20	0.09	2	0.17

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI (continued)

	Water		Soil/Sediment	
Parameters/Methods	**Project Quantitation Goal**	**Achieved Method Detection Level**	**Project Quantitation Goal**	**Achieved Method Detection Level**
1,3,5-Trinitrobenzene	2	0.09	1	0.09
1,3-Dinitrobenzene	3	0.04	1	0.03
Tetryl	50	0.06	5	0.38
Nitrobenzene	10	0.06	1	0.05
2,4,6-Trinitrotoluene	3	0.05	1	0.05
2,4-Dinitrotoluene	0.1	0.05	1	0.05
2,6-Dinitrotoluene	0.1	0.09	1	0.09
4-Amino-2,6-dinitrotoluene	0.1	0.09	1	0.09
4-Amino-2,6-dinitrotoluene	0.1	0.09	1	0.09
o-Nitrotoluene	10	0.14	1	0.14
m-Nitrotoluene	10	0.14	1	0.14
p-Nitrotoluene	10	0.10	1	0.09
Additional Explosive Compounds	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Nitroglycerin	10	0.3	1	0.12
Nitroquanidine	10	0.96	1	0.023
Nitrocellulose	10	0.36	1	0.28
Metals (Target Analyte List) SW 846-6010B/6020 or 7000	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Aluminum	200	28	20	1.1
Antimony	5	2.2	0.5	0.49
Arsenic	5	4.1	0.5	0.3
Barium	200	3	20	0.13
Beryllium	4	0.54	0.5	0.046
Cadmium	5	0.28	0.5	0.04
Calcium	5,000	250	500	37
Chromium	10	1.4	1	0.38
Cobalt	50	1.3	15	0.15

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 3 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Explosive Compounds **SW 846-8330**	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Copper	25	4.2	2.5	0.27
Iron	100	88	10	6.6
Lead	3	2.5	0.3	0249
Magnesium	5,000	30	500	12
Manganese	15	0.9	1.5	0.15
Mercury (CVAA) SW 846-7470A/7471A	0.2	0.13	0.1	0.008
Nickel	40	2.2	4	0.27
Potassium	5,000	41	500	5.1
Selenium	5	4.5	0.5	0319
Silver	10	1.5	1	0152
Sodium	5,000	630	500	50
Thallium	2	5	0.5	0.5
Vanadium	50	0.82	5	0.13
Zinc	20	12	2	1.2

PCB = polychlorinated biphenyl.
RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.

Table H-6. Container Requirements for Environmental Investigations at RVAAP

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Soil and Sediment				
Volatile Organic Compounds 5030/8260B	One 2-oz glass jar with Teflon®-lined cap (no headspace)	20 g	Cool, 4 ºC	14 d
SVOCs 3540/8270C	One 8-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Pesticide Compounds 3540/8081A	Include in SVOC container	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
PCBs 3540/8082	Include in SVOC container	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Explosive Compounds 8330	One 4-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Propellant Compounds 8330, 353.2, and UV-HPLC	One 4-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Metals 6010B and 7471	One 4-oz glass jar with Teflon®-lined cap	50 g	Cool, 4 ºC	180 d; Hg at 28 d
Cyanide 9012A	Include in metals container	25 g	Cool, 4 ºC	14 d
Hexavalent Chromium 7196A	Include in metals container	25 g	Cool, 4 ºC	24 hr

Table H-6. Container Requirements for Environmental Investigations at RVAAP (continued)

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Water Matrix				
Volatile Organic Compounds 5030/8260B	Three 40-mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4 ºC	14 d
SVOCs 3520/8270C	Two 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Pesticide Compounds 3520/8081A	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
PCBs 3520/8082	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Explosive Compounds 8330	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Propellant Compounds 8330, 353.2, and UV-HPLC	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Metals 6010A and 7470	One 1-L polybottle	500 mL	HNO_3 to pH <2 Cool, 4 ºC	180 d; Hg at 28 d
Cyanide 9012A	500-mL polybottle	500 mL	NaOH to pH >12 Cool, 4 ºC	14 d
Anions (Br, Cl, F, SO4) 300.0	250-mL polybottle	250 mL	Cool, 4 ºC	28 d
Nitrate-Nitrite 353.2	250-mL polybottle	100 mL	H_2SO_4 to pH <2 Cool, 4 ºC	28 d
TSS/TDS 160.2 and 160.1	500-mL polybottle	100 mL ea.	Cool, 4 ºC	28 d

PCB = polychlorinated biphenyl.
RVAAP = Ravenna Army Ammunition Plant.
SVOC = semivolatile organic compound.
TDS = total dissolved solids.
TSS = total suspended solids
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ATTACHMENT H-1

SAIC Data Flagging Codes

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DATA 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 judgment 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 hrs.
B03 Mass calibration did not meet ion abundance criteria.
B04 Professional judgment 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 judgment 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 judgment 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 judgment 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 the IDL.
F11	Blanks were not analyzed at the required frequency.
F12	Professional judgment 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 judgment 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 judgment 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 judgment 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 times the CRDL.
J03	Duplicate sample results were <5 times the CRDL.
J04	Professional judgment 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 sec.
K04	Professional judgment 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 judgment 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 judgment 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 judgment 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 times the level found in the blank.
O03	Professional judgment 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 judgment was used to qualify the data.

Field Duplicate

Q01	Field duplicate RPDs were >30% for waters and/or >50% for soils.
Q02	Radiological field DER was outside the control limit.
Q03	Duplicate sample results were >5 times the CRDL.
Q04	Duplicate sample results were <5 times 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 judgment 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 judgment was used to qualify the data.