Appendix D

Quality Assurance and Quality Control

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Appendix D — Quality Assurance and Quality Control

C.J. Thompson

This appendix presents calendar year (CY) 2010 quality assurance (QA)/quality control (QC) information for groundwater monitoring at the Hanford Site. Groundwater monitoring activities were managed by CH2M HILL Plateau Remediation Company (CHPRC) via the Soil and Groundwater Remediation Project (Groundwater Project). This includes monitoring performed to meet the requirements of the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954* (AEA); and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The QA/QC practices used by the Groundwater Project assess and enhance the reliability and validity of field and laboratory measurements conducted to support these programs. Accuracy, precision, and detection are the primary parameters used to assess data quality ("Determination of Measurement Data Quality and Establishment of Achievable Goals for Environmental Measurements" [Mitchell et al., 1985]). Representativeness, completeness, and comparability can also be evaluated for overall quality; however, representativeness and comparability are considered qualitative and do not have specific evaluation criteria in this report. These six parameters are evaluated through laboratory QC checks (e.g., matrix spikes and laboratory blanks), replicate sampling and analysis, analysis of blind standards and field blanks, and inter-laboratory comparisons. Acceptance criteria have been established for each of these QC checks. When QC results are outside the criteria, groundwater analytical support staff review the data and ensure that appropriate data qualifying flags are entered in the Hanford Environmental Information System (HEIS) database. When a recurring problem is identified, corrective actions are taken.

This appendix summarizes the overall QA/QC program for the Groundwater Project. Through a comprehensive review of performance indicators, the Groundwater Project identifies and resolves issues with data quality and initiates process improvements. The annual QA/QC appendix is a tool for data users in determining usability of specific data sets for decision-making purposes.

Several comparisons to 2009 performance are made throughout this appendix. Due to a change in reporting period from a fiscal year (FY) to a calendar year (CY), the 2009 reporting period covered 15 months (October 1, 2008, through December 31, 2009). Although the current, CY reporting period is shorter, comparisons between the two timeframes are provided because they help indicate relative quality trends in the data.

The QA/QC practices for RCRA samples are based on guidance from the U.S. Environmental Protection Agency (EPA) in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*. The U.S. Department of Energy (DOE) orders and internal requirements provide the guidance for the collection and analysis of samples for other long-term monitoring. The QA/QC practices for the Groundwater Project are described in the CHPRC QA plan (CHPRC-00189, *CH2M HILL Plateau Remediation Company Quality Assurance Program Plan*). A glossary of QA/QC terms is provided in Section D.9. Additional information about the QA/QC program and data from this year (e.g., results of individual QC samples and/or associated groundwater samples) are available upon request. Referenced data from the previous reporting period can be found in *Hanford Site Groundwater Monitoring and Performance for 2009* (DOE/RL-2010-11).

D.1 Sample Collection and Analysis

C.J. Thompson

Groundwater Project staff collected groundwater samples during the reporting period. Tasks related to sampling included bottle preparation, sample set coordination, measurement of field parameters, sample collection, sample shipping, well pumping, and coordination of purge water containment and disposal.

The Waste Sampling and Characterization Facility (WSCF) is an onsite laboratory managed by Mission Support Alliance. The WSCF was the primary analytical laboratory supporting the Groundwater Project during 2010.

Excluding field measurements, WSCF performed 83% of the sample analyses for groundwater monitoring during the reporting period; the percentage performed by WSCF is 55% when field measurements are included.

WSCF and Test America St. Louis (St. Louis, Missouri) (TA St. Louis) performed most of the routine analyses of Hanford Site groundwater samples for hazardous and nonhazardous chemicals. Lionville Laboratory, Inc. (Lionville, Pennsylvania) (Lionville Laboratory) performed less than 1% of the chemical analyses. Test America Knoxville (Knoxville, Tennessee) (TA Knoxville) performed polychlorinated biphenyl congener and dioxin analysis. Finally, the onsite 222-S Laboratory, which is managed by Advanced Technologies and Laboratories International, Inc., analyzed approximately 100 samples (~0.2%) for anions and hexavalent chromium between February and April.

The majority of radiological analyses on groundwater samples were performed by WSCF and Test America Richland (Richland, Washington) (TA Richland). Eberline Services (Richmond, California) (Eberline) analyzed approximately 4% of the samples for radiological constituents.

Standard methods from EPA, the American Society for Testing and Materials (ASTM), and the *Standard Methods for the Examination of Water and Wastewater* (APHA et al., 1998) were used for the analysis of chemical constituents. Methods employed for radiological constituents were developed by the analyzing laboratories and are recognized as acceptable within the radiochemical industry. Descriptions of the analytical methods used are available upon request.

D.2 Data Review and Validation

S. Champoux

Groundwater staff review and validate groundwater data according to an established process. Validation produces an electronic data set, with suspect or erroneous data corrected or flagged. The validation process includes the following activities:

- Review of sampling documents and analytical data verification
- QC evaluation
- Project scientists' evaluations
- Resolution of data issues identified during the evaluation.

D.2.1 Review of Sampling Documents and Data Verification

Sampling documents include the groundwater sampling record, chain-of-custody forms, field logbook pages, and other paperwork associated with sampling and shipping. Groundwater staff review these forms to determine if the documents are filled out completely, signed appropriately, and legible, as well as to determine if problems arose during sampling that may impact the data. Staff also verify that analytical data from the laboratories are complete and reported correctly. Moreover, staff review laboratory documents to check the condition of the samples upon receipt at the laboratory and determine if problems arose during analysis that may have affected the data. Identified issues are documented, investigated, and resolved (Section D.2.4 and D.6.3.1).

D.2.2 Quality Control Evaluation

A quarterly evaluation of field and laboratory QC data is conducted as part of the validation process. Groundwater analytical support staff assess the laboratories' internal QC practices and submit field QC samples and blind standards to the laboratories on a regular basis.

D.2.3 Project Scientists' Evaluation

Data management staff generate routine data reports for project scientists' review. These reports include biweekly data reports and include analytical data loaded into the HEIS database since the previous reporting period. The tables are organized by groundwater interest area, RCRA site, or special project (e.g., confined aquifer data). As soon as practical after receiving a report, the project scientists review the data, typically by viewing trend plots, to determine the following:

- Whether there are any significant changes in contaminant concentrations or distribution
- If there are data points that appear erroneous (e.g., significantly out of trend).

Project scientists also review quarterly compilations of the data. The quarterly review provides a method for groundwater staff to check whether there were problems with sampling, all requested analyses were received, and that the data seem to represent actual groundwater quality. Unlike biweekly reports, the quarterly reports usually include a full data set (i.e., all data from the wells sampled during the previous quarter that have been received and loaded into the HEIS database). This review also includes water-level data, preliminary maps of selected constituent distribution (plume maps), and a partial listing of sampling comments. When specific questions arise regarding field measurements, analytical results, dates of analysis or sampling, or sample or well numbers, the project scientist requests a formal data review. Section D.2.4 describes the process for data reviews.

D.2.4 Resolution of Data Issues

Requests for data reviews are the formal mechanism used by the Groundwater Project to resolve specific issues with data. When potential anomalies are encountered during a review of analytical data or water-level measurements, the Groundwater Project Support staff or the project scientist reviewing the data will initiate a request for data review. Depending on the type of data issue identified, groundwater analytical support staff resolve the request for data review through some or all of the following actions:

- Request a laboratory recheck, recount, or re-analysis
- Review laboratory hardcopy data
- Review sampling documents for data entry errors or other problems.
- Flag the affected data with one of the flags described in Table D-1.

A review of the sampling documents and/or hardcopy data from the laboratory can sometimes provide an explanation for unusual results (e.g., data-entry errors or samples swapped in the field). Laboratory rechecks involve an internal laboratory review of the data. When discrepancies are discovered by the laboratory, the data are re-reported. The original data are removed from the HEIS database, the corrected data are loaded into HEIS, and the data are flagged appropriately. However, when a laboratory reanalysis or recount is requested, the laboratory reanalyzes or recounts the original sample and reports the new results. If a discrepancy occurs between the original and new results, groundwater staff determine which results appear to be more representative and assign an appropriate review code to the results loaded into the HEIS database.

Requests for data reviews are most commonly resolved by assigning “Y,” “G,” or “R” flags to the HEIS data. If a review determines that the result is valid, the result is flagged with a “G.” If clear, documented evidence exists that a result is erroneous, the result is flagged with an “R.” If a review was unable to determine the validity of the result, the result is considered suspect and flagged as “Y.” Data flagged with a “Y” or “R” are typically excluded from statistical evaluations, maps, and other interpretations, but the data are not deleted from the HEIS database. Occasionally, a request for data review is submitted on data that are not managed by the Groundwater Project. In those cases, the data owner is notified, but no further action is taken by the Groundwater Project.

Table D-2 lists the number of analytical and water-level results that were flagged during the reporting period as a result of the request for data review process. As of February 8, 2011, requests for data reviews have been filed on 2,613 of 245,705 analytical results (~ 1%). Requests for data reviews of water-level measurements have been filed on 70 of 3,718 measurements (<2%). The resolution of 339 analytical requests for review is pending, and additional requests may yet be filed on data from the reporting period. There are no pending water-level measurement requests for data review. During the reporting period, WSCF analyses generated ~55% of the analytical (laboratory and field) results for groundwater monitoring, and WSCF data had 87% of the requests for data review. The bulk of the requests for data review (46%) were filed on metals results. Requests for data review also were filed on WSCF results from wet chemistry methods (6%), organic methods (20%), and radiological methods (28%). Requests for data review to the field and other laboratories were scattered among a varied group of methods and issues. No other trends in data review requests from the field or other laboratories were identified.

D.3 Data Completeness

C.J. Thompson

Data judged to be complete are data that are not suspect, rejected, associated with a missed holding time, out-of-limit field duplicate, or qualified to indicate laboratory blank contamination. Table D-3 provides a summary of data completeness. During the reporting period, 90% of the groundwater data were considered complete. The percentages of potentially invalid data were 2.4% for field QC problems, 0.5% for exceeding holding times, 0.2% for suspect values, and 7.4% for laboratory blank contamination. These values are similar to the percentages observed in 2009 for field QC problems, suspect data, and rejected data. However, significant increases occurred in the number of flagged results for missed holding times and method blank contamination. Most of the missed holding times were for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) at Lionville Laboratory, TA St. Louis, and WSCF. The percentage of results that were qualified for method blank detection increased from 0.5% in to 2009 to 7.4% this year. This large increase is mainly associated with metals analyses conducted by WSCF. Analytical support staff are working with the laboratory to implement process improvements to reduce metal blank-detection frequencies in the future.

D.4 Field Quality Control Samples

J. Douglas

Field QC samples include three types of field blanks (full trip, field transfer, and equipment blanks), field duplicate samples, and field split samples. Section D.9 provides definitions for these QC samples. Field QC samples are used to assess precision, repeatability, and potential contamination related to both sampling and laboratory activities. Tables D-4 through D-8 summarize the field QC results that exceeded QC limits. Constituents not listed in the tables had 100% acceptable field QC. The tables are divided into the following categories, where applicable: general chemistry parameters, ammonia and anions, metals, VOCs, SVOCs, and radiological parameters. Table D-9 provides additional information on the method categories.

D.4.1 Field Blanks

Field blanks are used to assess potential contamination associated with sampling and laboratory activities. The percentage of acceptable field blank results evaluated during the reporting period was 97%, indicating little problem with contamination.

Field blank results above two times the method detection limit are identified as suspected contamination; however, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit. For radiological data, blank results are identified as potentially contaminated if they are greater than two times the minimum detectable activity. Results associated with field blanks that are above these criteria are flagged with a “Q” in the HEIS database to indicate potential contamination issues. For full trip and field transfer blanks, an associated sample is one that was collected on the same day and analyzed by the same method as a full trip or field transfer blank. For equipment blanks, an associated sample is one that has the same collection date, collection method/sampling equipment, and analysis method as the equipment blank. Data users must evaluate the usability of data associated with quality issues based on the data quality objective requirements established for the specific monitoring campaign.

The acceptable field blank percentage of 97% for CY 2010 is the same as that for the 2009 reporting period. As with the 2009 reporting period, the largest percentage of out-of-limit results were associated with metals analysis at 4.9%; this represents an increase from the 1.8% out-of-limit results for metals blank values in the 2009 reporting period and the 2.7% out-of-limit results in FY 2008. The WSCF laboratory generated all the blank failures for metals during CY 2010. However for CY 2010, WSCF also generated all 7,500 blank results for metals except for two hexavalent chromium values generated at TA Richland. While field blank concentrations of calcium, magnesium, potassium, and sodium were frequently above QC limits, the levels detected in the majority of the blanks were 10 to 100 times lower than the average concentration of these constituents in Hanford Site groundwater. One equipment

blank associated with well 299-W19-44 had four of the highest out-of-limit metal results. This failure is most likely from a groundwater sample swapped with the field blank, but whether a swap occurred in the field or the laboratory was not determined.

Of the 6,262 VOCs results for all field blanks, 229 (3.7%) exceeded the QC limits. This represents an increase over the percentages in the 2009 reporting period (1%) and FY 2008 (1.7%). Methylene chloride continues to be the predominant volatile organic contaminant, accounting for 69% of the VOC out-of-limit results. Similar concentrations of methylene chloride were measured in method blanks; therefore, laboratory contamination is suspected. In addition, 82 field blanks had concentrations of methylene chloride greater than the drinking water standard (DWS) of 5 µg/L. This limits the usability of data with low-level detections for methylene chloride in groundwater monitoring samples. Affected results were flagged as "Q" (quality failures) and/or "Y" (data are suspect) in the HEIS database. Groundwater analytical support staff continue to work with the laboratories to decrease both the frequency and magnitude of methylene chloride contamination.

For carbon tetrachloride, 13 of 235 field blank results, or 5.5%, exceeded the QC limits. This is less than the 2009 reporting period out-of-limits percentage of 12% (41 of 342) and the FY 2008 out-of-limits percentage of 8% (19 of 235). Eight of the thirteen failures were greater than the DWS of 5 µg/L. Trace levels of several other VOCs were also measured in field blanks (Tables D-4 through D-6). The frequencies of detection for these other compounds were low (1%) and the impact on the data is minor.

A small number of other non-metal, non-VOC chemical and radiological constituents were detected at levels that exceeded blank QC limits (Tables D-4 and D-6). However, the out-of-limits percentage (2%) for these compounds was low, and no trends were identified.

D.4.2 Field Duplicate Samples

Field duplicate samples ("field duplicates") are used to assess field sampling and measurement precision. Results of field duplicates must have precision within ±20%, as measured by the relative percent difference. Only field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated. Results associated with field duplicates that have greater than ±20% relative percent difference are flagged as "Q" in the HEIS database to indicate potential precision issues.

Of the 2,490 duplicate results evaluated, a total of 2,318, or 93%, were acceptable, indicating reasonable precision overall. However, this represents a decrease from the acceptable results percentage of 99% for the 2009 reporting period. Table D-7 presents the duplicate results that exceeded quality control limits.

Most of out-of-limit duplicates (67%) were associated with metal results from WSCF. Seventy-five of the duplicates that exceeded QC limits were from unfiltered samples. Suspended solids in heterogeneous sample fractions may have caused some of the discrepancies in the results. Likewise, all of the associated samples in the radiological parameters category were unfiltered, which may explain some of the out-of-limit results.

The majority of the out-of-limit duplicate results appear to be anomalous instances of poor precision based on other QC indicators, such as the results from the laboratory duplicates. In several cases, the laboratory was asked to reanalyze or investigate duplicate results with a very high relative percent difference, but the source of the problem was not discovered.

D.4.3 Field Split Samples

Field split samples ("split samples") are used to confirm out-of-trend results and for inter-laboratory comparisons. Results must have a relative percent difference less than or equal to 20%. Only those results that are greater than five times the method detection limit or minimum detectable activity at both laboratories were evaluated. For total organic carbon (TOC) and total organic halides (TOX), sample splits most often consisted of two groups of quadruplicate samples (i.e., four matching samples were submitted to each laboratory). The two sets of quadruplicate samples were evaluated by comparing the average concentration from each laboratory.

During CY 2010, 370 split samples were analyzed for 264 different analytes generating 2,331 split pairs of data. The split sample data were used to evaluate the performance of the laboratories and to determine the extent of any analytical problems. The results for field splits that exceeded QC limits are summarized in Table D-8. For CY 2010,

the percentage of out-of-limit results for evaluated duplicates was 22%. This represents a slight decrease from the 23% out-of-limits percentage in the 2009 reporting period and 25% in FY 2008.

The metals splits constituted 65% of the split failures. Of all the hexavalent chromium splits results evaluated, the TA Richland laboratory showed a distinct low bias compared to the WSCF values. The Method 6010 ICP metals showed no strong bias between the TA St. Louis and WSCF laboratories.

After the metals, the anions contributed next most frequently to the split failures with 22% of the failures. Fluoride results generated by ion chromatography continue to demonstrate poor precision. Of the fluoride splits evaluated, the TA St. Louis results showed a very distinct high bias with respect to the WSCF results. Based on past review of raw chromatographic data, it is possible that one or more of the laboratories may be experiencing interferences from poorly integrated fluoride peaks that elute immediately after the water peak or from the presence of small organic acids that elute near the fluoride peak.

D.5 Holding Times

J. Douglas

Holding time is the elapsed time period between sample collection and analysis. Samples are required to be analyzed within recommended holding times to minimize the possibility of changes in constituent concentrations caused by volatilization, decomposition, or other chemical processes. Samples are also refrigerated to slow potential chemical reactions within the sample matrix. Maximum recommended holding times for constituents frequently analyzed for the Groundwater Project are listed in Table D-10. Results for samples with missed holding times are flagged as "H" in the HEIS database.

Radiological constituents do not have recommended maximum holding times because these constituents are not typically lost under ambient temperatures when appropriate preservatives are used. The results of radionuclide analysis are decay-corrected from the sampling date to analysis date.

During the reporting period, recommended holding times were met for over 99% of nonradiological results (Table D-3). Holding times were exceeded for 1,155 nonradiological results. Missed holding times for volatile organic analyses contributed the single largest fraction to the missed holding times total at 25%. Missed holding times were attributed to late delivery to the laboratory, high sample load at the laboratory, or other laboratory issues.

D.6 Laboratory Performance

D.S. Sklarew, S.J. Champoux, J.G. Douglas, and C.J. Thompson

Laboratory performance is measured by several indicators, including national performance evaluation studies, double-blind standard analyses, laboratory audits, and internal laboratory QA/QC programs. This section provides a detailed discussion of the performance indicators for WSCF, TA St. Louis, and TA Richland. Brief summaries of performance measures for Lionville, Eberline, and 222-S Laboratory are also presented throughout this section.

D.6.1 National Performance Evaluation Studies

During the reporting period, Environmental Resources Associates (ERA) and DOE conducted national studies to evaluate laboratory performance for chemical and radiological constituents. TA St. Louis, TA Richland, and WSCF participated in the EPA sanctioned Water Pollution/Supply Performance Evaluation (WP/WS) studies conducted by Environmental Resources Associates. TA Richland, TA St. Louis, WSCF, and Eberline participated in the Environmental Resources Associates' InterLaB RadCheM Proficiency Testing Program (RAD). All six laboratories supporting the groundwater project (WSCF, TA St. Louis, TA Richland, Lionville, Eberline, and 222-S) took part in DOE's Mixed Analyte Performance Evaluation Program (MAPEP). The results of those studies related to groundwater monitoring at the Hanford Site are described in this section.

D.6.1.1 Water Pollution/Supply Performance Evaluation Studies

The purpose of water pollution/supply performance evaluation studies is to evaluate the performance of laboratories in analyzing selected organic and inorganic compounds in water matrices. An accredited agency (e.g., Environmental Resource Associates) distributes standard water samples to participating laboratories. These samples contain specific organic and inorganic analytes at concentrations unknown to the participating laboratories. After analysis, the laboratories submit results to the accredited agency, which uses regression equations to determine acceptance and warning limits for the study participants. The results of these studies are expressed in the following section as a percentage of the results that the accredited agency found acceptable and independently verify the level of laboratory performance. In the event of an unacceptable result, the laboratories may order an ERA QuiK™Response sample to verify successful corrective action. QuiK™Response samples are similar to water pollution/water supply samples, and results are reported in a comparable fashion.

For the two water pollution and one QuiK™Response performance evaluation studies (ERA WP-180 and WP-186) in which WSCF participated during the reporting period, the percentage of results within the acceptance limits was 98% (160 results) (Table D-11). Three different constituents had unacceptable results.

For the five water pollution/supply performance evaluation studies in which TA St. Louis participated during the reporting period (ERA WP-180, WP-186, WP-188, WS-165, and WS-171), the percentage of results within the acceptance limits was 98% (1,659 results) (Table D-12). Thirty-one different constituents had unacceptable results, only three of which (volatile solids and manganese) were repeated across studies or in more than one WP/WS study this year. As noted, the number of constituents reported by TA St. Louis in the water pollution studies was considerably greater than those reported by WSCF, so the percentages from the two laboratories are not directly comparable.

For the two water pollution performance evaluation studies (ERA WP-180 and WP-186) in which TA Richland participated during the reporting period, the percentage of results within the acceptance limits was 100% (two results). As noted, the number of constituents was very limited, so the percentage of results is not comparable to that of the other two laboratories.

D.6.1.2 InterLaB RadCheM Proficiency Testing Program Studies

The purpose of the InterLaB RadCheM Proficiency Testing Program (also conducted by Environmental Resources Associates) is to evaluate the performance of laboratories in the analysis of selected radionuclides. This program provides blind standards that contain specific amounts of one or more radionuclides in a water matrix to participating laboratories. After sample analysis, the results are forwarded to Environmental Resources Associates for comparison with the known values and with results from other laboratories. Environmental Resources Associates bases its control limits on the EPA's *National Standards for Water Proficiency Testing Studies Criteria Document* (NERL-Ci-0045).

During the reporting period, WSCF participated in one study, RAD-80 (Table D-11), acceptably quantifying all four constituents.

TA Richland participated in three studies, RAD-80, RAD-81, and RAD-82 (Table D-12). All 47 constituents had acceptable results.

TA St. Louis participated in one study, RAD-81 (Table D-12), and analyzed a total of twenty-three constituents. Three results were unacceptable, barium-133 (2) and uranium (nat) mass, all with a high bias.

Eberline Services participated in three studies (RAD-80, RAD-81, and RAD-82), and analyzed a total of 31 constituents. Only one result was unacceptable, radium-228 with a high bias (Table D-13).

D.6.1.3 DOE Mixed Analyte Performance Evaluation Program

The DOE's Mixed Analyte Performance Evaluation Program examines laboratory performance in the analysis of soil and water samples containing metals, SVOCs, and radionuclides. This report considers only water samples. The program is conducted at the Radiological and Environmental Sciences Laboratory in Idaho Falls, Idaho. The DOE evaluates the accuracy of the Mixed Analyte Performance Evaluation Program results for radiological, inorganic, and organic analytes by determining if they fall within ±30% of the reference value. Two studies were available for all laboratories during the reporting period (MAPEP-09-21 and MAPEP-09-22). The results for MAPEP-09-21 for WSCF and Eberline were reported in last year's annual report.

For the MAPEP-09-22 study, WSCF analyzed radionuclides, including gross alpha/beta, inorganics, and semivolatile organics (Table D-11). Out of 89 analytes, one had an unacceptable result and one received a warning, resulting in 99% acceptable results. The missed analyte was technetium-99 and the warning was for mercury. Both of these constituents were acceptable in the previous study.

For the MAPEP-09-21 and 09-22 studies, 222-S analyzed radionuclides, including gross alpha/beta, and inorganics (Table D-11). Out of 60 analytes, five had unacceptable results, resulting in 92% acceptable results. The missed constituents included uranium-total, manganese-54, plutonium-238, gross beta, and arsenic. None of these unacceptable results were repeated across studies.

For the MAPEP-09-21 and 09-22 studies, TA St. Louis analyzed radionuclides, including gross alpha/beta, inorganics, and semivolatile organics (Table D-11). Out of 222 analytes, three had unacceptable results and one received a warning, resulting in 99% acceptable results. The missed analytes were arsenic, 4,4'-DDE, and 4,4'-DDT, and the warning was for beta-BHC. All of these constituents were within limits in the preceding study.

TA Richland reported results for radionuclides, including gross alpha/beta, for the MAPEP-09-21 and 09-22 studies (Table D-12). Out of 38 constituents, two had unacceptable results and one received a warning, resulting in 95% acceptable results. The missed analytes were iron-55 and plutonium-239/240; the warning was for tritium. These constituents were acceptable in the preceding study.

For the MAPEP-09-21 and 09-22 studies, Lionville Laboratory analyzed inorganics and semivolatile organics (Table D-13). Out of 144 constituents, three had unacceptable results, resulting in 98% acceptable results. The missed constituents included mercury, vanadium, and hexachlorobutadiene. All of these constituents were within limits in the previous study.

For the MAPEP-09-22 study, Eberline Services analyzed radionuclides, including gross alpha/beta (Table D-13). Out of eighteen analytes, 100% had acceptable results.

D.6.2 Double-Blind Standard Evaluation

Double-blind standards are issued quarterly during the calendar year to provide a measure of both inter- and intra-laboratory precision and accuracy. These studies also help groundwater staff troubleshoot analytical problems identified through data reviews and QC evaluations. The double-blind standards also may be used to confirm the adequacy of corrective actions to resolve analytical problems. During the first three quarters of the reporting period, the groundwater project sent double-blind QC standards to Eberline Services, Lionville Laboratory, TA Richland, TA St. Louis, and WSCF. Blind standards for the fourth quarter of CY 2010 were not prepared and submitted to the laboratories in time for the results to be included in this report. Blind standards were generally prepared in triplicate and submitted to the laboratories to check the accuracy and precision of analyses. For most constituents, the standards were matrix-matched double-blind standards prepared in a groundwater matrix from an appropriate background well. Standards for specific conductance were commercially prepared in deionized water. In all cases, the double-blind standards were submitted to the laboratories as regular groundwater samples. After analysis, the laboratories' results were compared with the spiked concentrations, and a set of control limits were used to determine if the data were acceptable. Out-of-limit results were reviewed for errors. In situations where several results for the same method were unacceptable, the results were discussed with the laboratory, potential problems were investigated, and corrective actions were taken when appropriate.

In summary, the evaluation of the double-blind standards indicates that the current laboratories, except Eberline, meet acceptable results requirements for the groundwater monitoring project. Eberline's percentage of acceptable results was only 67%. In general, the performance of the laboratories as measured with the double-blind standards decreased during CY 2010 compared to the 2009 reporting period. Specific analytical areas at each laboratory continue to be identified for process improvements.

Tables D-14 through D-16 summarize the number and types of double-blind standards generated and analyzed in the reporting period, along with the number of unacceptable results and control limits for each constituent. Totaled over all laboratories for CY 2010, 84% of the blind sample determinations were acceptable; this was lower than the 87% for the 2009 reporting period. WSCF and TA (both Richland and St. Louis laboratories) were provided approximately the same number of test samples (198 and 225, respectively), allowing for direct comparison between

their results. For CY 2010, WSCF had 86% of their blind results within control limits compared to 87% in the 2009 reporting period and 91% in FY 2008. For CY 2010, TA (Richland and St. Louis) reported acceptable results for 87% of the blind constituents compared to 88% in the 2009 reporting period. Lionville and Eberline received fewer blinds, both in number and type. The Lionville Laboratory performance remained nearly unchanged, reporting 81% of the blinds correctly compared to 80% in the 2009 reporting period. Eberline's overall performance for CY 2010 radiochemistry blind standards was 67%, which is lower than CY 2009.

The TOC blind sample results for both WSCF (83%) and TA St. Louis (83%) were acceptable, and these laboratories will continue to provide the primary analytical service for this analysis. The Lionville Laboratory's acceptable results percentage for TOC analysis was 56%. All the Lionville Laboratory out-of-limit TOC results were biased about 50% high. Corrective action is needed prior to Lionville performing this work scope.

Blind standards for TOX were prepared using two different spiking solutions: 2,4,5-trichlorophenol and a mixture of carbon tetrachloride, chloroform, and trichloroethene. During this reporting period, TA St. Louis correctly reported 100% of the TOX blinds, while WSCF correctly reported only 62%. For the 2009 reporting period, TA St. Louis reported 92% correctly, and WSCF correctly reported 97%. For the CY 2010 reporting period, the WSCF failures were split between the 2,4,5-trichlorophenol and volatile organic halide standards. The phenol standard failures were all biased high, and the volatile organic halide standard failures were all biased low. The low bias for the volatile organic halide is probably explained by the method WSCF uses to prepare aqueous samples for TOX determination versus the method TA St. Louis uses. The WSCF laboratory uses gas pressure to force aqueous samples through activated charcoal adsorption filters while the TA St. Louis laboratory uses a syringe method. The gas pressure method generates a headspace into which volatile organic halides may be lost from the sample prior to adsorption onto the activated charcoal.

The WSCF and TA St. Louis laboratories are currently performing anion analysis routinely for the groundwater project. The WSCF laboratory reported the anions correctly at 81%; the TA St. Louis laboratory reported the anions correctly at 75%. The laboratories had some difficulty with the analysis of ion-chromatography anions in blind standards, especially with chloride, fluoride, and nitrate. Poor performance for fluoride was noted in the 2009 annual report and warrants continued investigation. Lionville Laboratory's CY 2010 blind sample performance for anions was 89% with all the failures due to nitrate.

The WSCF and TA Richland laboratories perform hexavalent chromium determinations for the groundwater project. The WSCF laboratory reported hexavalent chromium correctly at 100% while the TA Richland laboratory reported correctly at 71%. All of the TA Richland failures were on blind standards with hexavalent chromium values greater than 10,000 µg/L. This issue was identified to TA Richland laboratory management, and corrective actions have been initiated at that facility to mitigate this analytical problem. Until the TA Richland laboratory demonstrates adequate recoveries for samples with high hexavalent chromium content, WSCF will remain the primary laboratory for these determinations.

The TA St. Louis and WSCF laboratories continue to perform the analysis of VOCs for the groundwater project. The acceptance rates for the VOC blind standards were 78% for TA St. Louis and 78% for WSCF. The principal failures at both laboratories were poor recovery of trichloroethene on the same VOC samples. The results reported by the two laboratories for trichloroethene on these samples were nearly identical; this may indicate a possible issue with the standard value itself and is not necessarily attributable solely to poor analytical recovery at the laboratories. The CY 2010 results are an improvement over the 2009 reporting period acceptable result rates: 75% for TA St. Louis and 61% for WSCF. Historically, failures have been associated with carbon tetrachloride and trichloroethene. Because the water solubility of chloroform is much higher than that of carbon tetrachloride and trichloroethene, the low recoveries may be caused by volatilization of the less-soluble compounds prior to analysis.

For the radiochemical blind standards, the percentage of acceptable results was 94% for WSCF, 93% for TA Richland, and 67% for Eberline. By comparison with the 2009 reporting period, the percentage of acceptable results for radiochemical blind standards were WSCF at 84%, TA Richland at 92%, and Eberline at 86%. The failures during CY 2010 were mostly in the determinations for gross alpha and neptunium-237. The Eberline laboratory experienced low percentages of acceptable results in the determination of carbon-14 (67%), low-level iodine-129 (0%) plutonium-239 (67%), technetium-99 (50%), and uranium-238 (67%). For the 2009 reporting period, low-level

iodine-129 was identified as a problem analyte. The TA Richland laboratory returned 100% acceptable results for iodine-129, including six samples at 1.37 pCi/L. Eberline reported all six of its 1.22 pCi/L iodine-129 blind standards as less than detectable. Eberline is currently troubleshooting their ability to quantitate iodine-129 near the 1 pCi/L level.

D.6.3 Laboratory Internal Quality Assurance/Quality Control Programs

WSCF, TA Knoxville, TA Richland, TA St. Louis, Eberline, 222-S, and Lionville maintain internal QA/QC programs that generate data on analytical performance by analyzing method blanks, laboratory control samples, matrix spikes and matrix spike duplicates, matrix duplicates, and surrogates (see Section D.9 for definitions of these terms). This information provides a means to assess laboratory performance and the suitability of a method for a particular sample matrix. Laboratory QC data are not currently used for Groundwater Project validation of individual sample results unless the laboratory is experiencing unusual performance problems with an analytical method. A brief assessment of the laboratory QC data for the January 1, 2010, through December 31, 2010, reporting period is provided in this section. Tables D-17 and D-18 provide a summary of the WSCF and TA (Knoxville, Richland, and St. Louis) internal QC data, respectively, by listing the percentage of QC results that were out of limits for each analyte category and QC parameter. Additional details are presented in Tables D-19 through D-26. Constituents not listed in these tables did not exceed the QC limits for WSCF or any of the TA laboratories. An overview of the data from Lionville and Eberline is presented at the end of the section.

Approximately 98% of the laboratory QC results for the reporting period were within the acceptance limits, which is approximately the same as last year. This percentage indicates that the analyses were in control and reliable data were generated. Method blanks, laboratory control samples, matrix spikes and matrix spike duplicates, matrix duplicates, and surrogates QC results were evaluated against the acceptance limits.

Evaluation of results for method blanks was based on the frequency of detection above the blank QC limits. Except as noted, these limits are two times the method detection limit for chemical constituents and two times the sample-specific minimum detectable activity for radiochemistry parameters. Because minimum detectable activities were not electronically reported for radiochemistry analytes from WSCF, two times the practical quantitation limit (PQL) was used as the radiochemistry QC limit for WSCF. For common laboratory contaminants such as 2-butanone, acetone, methylene chloride, phthalate esters, and toluene, the QC limit is five times the method detection limit.

Table D-19 summarizes method blank results from WSCF. Overall, 99.2% of the results were acceptable. Metals had the greatest percentage of method blank results outside the QC limits (~1.4%), accounting for 96% of the out-of-limit blank results. In most cases, the metal concentrations were greater than a factor of four times the method detection limit, though in most cases, for a given metal, less than 5% of the method blanks were out of limits. Compared to last year, many more metals had out of limit method blanks. The failed blanks are indicative of process improvements needed for metals analysis at the laboratory. Results associated with out-of-limit metal blank results are flagged with a “C” in the HEIS database. Two VOCs, acetone and methylene chloride, had method blank results that exceeded the QC limits. Both compounds are common laboratory contaminants, and low-level detections in Hanford Site groundwater samples should be considered suspect. Results associated with out-of-limit volatile blank results are flagged with a “B” by the laboratory. One radiochemistry parameter, total beta radiostrontium, had method blank results that exceeded the QC limits. As noted above, these out of limit results are based on PQLs and not minimum detectable activities and are, therefore, not directly comparable to those of the other laboratories.

Table D-20 summarizes method blank results from TestAmerica (Knoxville, Richland, and St. Louis). The general chemistry parameters had the greatest percentage of method blank results outside the QC limits (~5%). The percentage and number of different metals, VOCs, and SVOCs that were out of limits increased this year compared to last year; however, for 60% of the analytes, only one method blank was out of limits. Of the blanks that were out of limits, 45% exceeded the method detection limit by more than a factor of four. Most of the VOCs and SVOCs that had results that exceeded the QC limits were found at trace levels (less than 1 µg/L). Blank concentrations for three of the constituents (chloride, silicon, and specific conductance) were relatively insignificant compared to typical levels of these constituents in Hanford Site groundwater. As noted above, results associated with out-of-limit inorganic blank results are flagged with a “C” by the laboratory in both the hard copy and electronic data. Results associated with out-of-limit organic blank results are flagged with a “B” by the laboratory in both the hardcopy and electronic data. In summary, the method blank results for WSCF and TA indicate acceptable laboratory performance.

Table D-21 summarizes results for the laboratory control samples from WSCF. WSCF had a relatively low number of failures; 99.6% of the results were within the control limits. Most of the unacceptable results were associated with low recoveries (10% to 79%), which suggest that some of the associated groundwater results may be biased low. Eighteen of the failed laboratory control sample results were for SVOCs, an increase from last year. Table D-22 summarizes results for the laboratory control samples from TA Knoxville, Richland, and St. Louis. Several VOCs had five or more unacceptable results, mainly biased high; these included acetone, acrolein, bromomethane, carbon disulfide, chloromethane, iodomethane, and tetrahydrofuran. Some bias is likely in the associated groundwater sample results for these compounds.

Table D-23 summarizes results for the matrix spikes and matrix spike duplicates from WSCF. Only those samples that were spiked at a level at least one-fourth of the original sample concentration were included in the evaluation. Approximately 99% of the results were acceptable, similar to last year. The semivolatile organics had the largest percentage of matrix spikes out of limits, 20.1%, a large increase from last year. Most of the individual SVOCs and VOCs had >10% of their analyses out of limits. For these two categories, many of the failures appeared to be caused by poor analytical precision (i.e., lack of agreement between the matrix spike and matrix spike duplicate) rather than sample-matrix issues. The metals had 57 results out of limits. For the metals, both low and high recoveries were observed with the cause of failure possibly due to actual sample matrix issues rather than analytical precision. Table D-24 summarizes the results for the matrix spikes and matrix spike duplicates from TA Knoxville, Richland, and St. Louis. Approximately 92% of the results were acceptable, similar to last year. The categories of ammonia-anions and VOCs had approximately 9% of their results outside the QC limits, and SVOCs had over 6% out of limits.

For matrix duplicates, only those sample results with values five times greater than the method detection limit, the minimum detectable activity, or practical quantitation limit for WSCF are considered. Quantifiable matrix duplicates are evaluated by comparing the relative percent difference with an acceptable relative percent difference maximum for each constituent. Tables D-25 and D-26 list the constituents from WSCF and the TestAmerica laboratories (Knoxville, Richland, and St. Louis), respectively, that exceeded the relative percent difference limits. Overall, the percentage of duplicates having poor precision was less than 1% for all the laboratories, demonstrating good analytical reproducibility. WSCF had minor issues with gross alpha, gross beta, and total beta radiostrontium; eight, eleven and five of the respective matrix duplicates had relative percent differences between 21% and 203%. Bromide, chloride, and nitrogen in nitrite had relative percent differences of 53 to 200% for three, one, and two of the respective matrix duplicates. For the TestAmerica laboratories, no constituent had more than one matrix duplicate that failed to meet the acceptance.

Surrogate data from WSCF that were out of limits included 59 compounds for VOCs and 443 for SVOCs, an increase from last year. Approximately 97% of WSCF's surrogate results were acceptable. Surrogate data from TestAmerica laboratories that were out of limits included 108 compounds for volatile organics and 38 compounds for semivolatile organics. Approximately 98% of TestAmerica's surrogate results were within the acceptance limits.

The QC data for Eberline, 222-S, and Lionville were limited for the reporting period because they did not analyze many samples for routine groundwater monitoring. Lionville reported results for five different wet chemistry and organic methods. The total number of QC results was 2,456. Six QC results (0.2%) were considered to have failed: orthophosphate had 2 elevated matrix spike recoveries, dichlorodifluorobenzene had low recoveries for a laboratory control standard and a matrix spike duplicate, and 4-bromofluorobenzene had 2 elevated surrogate recoveries. No major trends were noted. Eberline's QC data were limited to 14 radiological methods for a total of 649 QC results. Nine laboratory control samples were out of limits; seven of those were low for total alpha energy emitted from radium. One carbon-14 laboratory control sample was slightly low and one radium-228 was slightly high. The remainder of the Eberline QC data were acceptable. The 222-S Laboratory analyzed a limited number of method blanks, laboratory control samples, matrix spikes, and matrix duplicate for anions by ion chromatography and for hexavalent chromium. Four anion blanks (three chloride and one nitrate) were out of limits (1.8%). Only one laboratory control sample was out of limits for nitrite; the recovery was very slightly low at 89.9%. All other 222-S QC data were within the acceptance criteria.

D.6.3.1 Issue Resolution

Issue resolution forms are documents used to record and resolve problems encountered with sample receipt, sample analysis, missed holding times, and data reporting (e.g., broken bottles or QC problems). The laboratories generate these forms and submit them to the Groundwater Project as soon as possible after a potential problem is identified. The forms provide a way for the Groundwater Project to direct the laboratory to resolve problems. The documentation is intended to identify occurrences, deficiencies, and/or issues that may potentially have an adverse impact on data integrity. During the reporting period, 296 issue resolution forms addressing analytical requests for groundwater monitoring samples were submitted by the WSCF, TA St. Louis, TA Richland, Eberline, and Lionville laboratories.

Table D-27 indicates the specific issues identified during the reporting period and the number of analytical requests that were impacted. An analytical request is a request for a laboratory to analyze a sample by a particular method. Generally, several analytical requests are made per sample number, and multiple results will be produced for each analytical request. Issues are categorized based on whether they occurred prior to or after receipt at the laboratory. Approximately 1% of the analytical requests were documented as having a problem on an issue resolution form. Roughly one-third of the issues occurred prior to receipt at the laboratories. During the last reporting period, the frequency was approximately the same. The issues that occurred prior to receipt at the laboratory were missed holding times, broken bottles, samples received outside of temperature specifications, insufficient sample volume collected, chain-of-custody issues, requests for discontinued methods, and incorrect preservation of samples. These issues are tracked and, when adverse trends are identified, corrective actions are initiated.

The number of issue resolution forms varies from year to year based on laboratory reporting. Issue resolution forms submitted by WSCF for analyses impacted after receipt at the laboratory were associated with missed holding times (55%), broken bottles (<1%), temperature deviations (<1%), QC issues (31%), and analytical/method deviations (5%).

D.6.3.2 Laboratory/Field Audits, Assessments, and Surveillances

Laboratory and field activities were regularly evaluated by audits, assessments, and surveillances to ensure that quality problems are identified and corrected. Evaluation of laboratory and analytical activities is performed by various oversight organizations, with each using slightly differing criteria and terminology.

During FY 2010, a total of five formal reviews (audits and/or assessments) were conducted on laboratories that routinely analyzed Hanford Site groundwater samples. These formal reviews were audits performed on commercial laboratories by the DOE Consolidated Audit Program. In addition to the formal reviews, a total of thirteen surveillances were performed on sampling, well construction, and analytical data verification activities. Corrective actions were initiated for all findings associated with surveillances, and process improvements were evaluated.

DOE Consolidated Audit Program audits. The goal of the DOE Consolidated Audit Program is to design and implement a program to consolidate site audits of commercial and DOE environmental laboratories providing services to DOE Environmental Management. To support this goal, audits were performed on five commercial laboratories. Audit objectives of the DOE Consolidated Audit Program were to assess the ability of the laboratories to produce data of acceptable and documented quality through analytical operations that follow approved and technically sound methods, and the handling of DOE samples and associated waste in a manner that protects human health and the environment. The DOE Consolidated Audit Program audits were performed at the following laboratories:

- Test America (TA St. Louis), Earth City, Missouri, May 11 to 13, 2010 (100513-TAS)
- Eberline Services, Richmond, California, February 2 to 4, 2010 (100204-ESR)
- Lionville Laboratory, Inc, Lionville, Pennsylvania, February 23 to 25, 2010 (100225-LLI)
- Test America (TA Richland), Richland, Washington, June 21 to 23, 2010 (100623-TAR)
- Test America (TA Knoxville), Knoxville, Tennessee, November 9 to 5, 2010 (101111-TAK).

The scope of the DOE Consolidated Audit Program assessment included the following specific functional areas:

- QA management systems and general laboratory practices
- Data quality for organic analyses
- Data quality for inorganic and wet chemistry analyses

- Data quality for radiochemistry analysis
- Laboratory information management systems/electronic data management
- Hazardous and radioactive materials management
- Verification of corrective action implementation from previous audit findings.

A total of 38 findings and 40 observations were noted for the five DOE audits. All corrective actions have been accepted, and verification of the corrective actions will be performed in future audits. All of the laboratories have been recommended by the DOE Consolidated Audit Program for continuation to provide analytical services for samples generated at DOE sites.

Groundwater Project surveillance. Thirteen surveillances were performed by Groundwater Project QA personnel on various field sampling, well construction, and data management verification activities during FY 2010. Surveillances identified a total of fifteen findings and twelve opportunities for improvement. A list of the surveillances performed is provided below:

- Groundwater Project surveillances on field sampling activities:
  - *Chromium Analysis of Water Samples at the Pump and Treat Facilities*: March 22 to March 24, 2010 (QA-SGRP-SURV-10-012)
  - *Surveillance of CHPRC Sample Hold Time Limit*: May 1 to September 30, 2010 (QA-EQA-SURV-10-012)
  - *Field Surveillance of Groundwater Sample Collection*: May 11 to June 1, 2010 (QA-SGRP-SURV-10-067)
  - *Field Surveillance to Assess Meeting QA Requirements for Sample Bottles*: August 11 to August 23, 2010 (QA-SGRP-SURV-10-032)
  - *Field Surveillance of Groundwater Sample Preservation*: December 1 to December 9, 2010 (QA-SGRP-SURV-11-007)
  - *Control of Field Measurement Equipment used by Soil and Groundwater Sample Personnel*: November through December 2010 (QA-SGRP-SURV-11-008)
  - *Document Control (QA review and approval of Environmental Documents)*: November through December 2010 (QA-SGRP-SURV-11-010)
- Groundwater Project surveillance on well construction activity:
  - *Field surveillance of decontamination/cleaning of down-hole well drilling equipment*: April 6 to May 4, 2010 (QA-SGRP-SURV-10-018)
  - *Field surveillance of well construction materials at 2 well drilling/material lay down yards*: June10, June 22, June 28, 2010 (QA-SGRP-SURV-10-025)
  - *QA oversight of construction activities of the DX Pump and Treat*: October 2009 to September 2010 (QA-SGRP-SURV-10-036)
- Groundwater Project surveillances on data management and verification activities:
  - *Data Verification – Sample Management and Reporting*: June1 to June 24, 2010 (QA-SGRP-SURV-10-026)
  - *Field surveillance of pump and treat facilities logbooks, control and use*: July 12 to August 5, 2010 (QA-SGRP-SURV-10-030)
  - *Data Quality Assessment*: September 1 to September 30, 2010 (QA-SGRP-SURV-10-037).

D.6.4 Analytical Method Issues

This section outlines significant analytical issues that were identified during the CY 2010 reporting period. Three issues were identified: (1) the nickel inter-element correction factor at WSCF, (2) difficulty determining low-level iodine-129 activities near the 1 pCi/L method detection limit at the Eberline laboratory, and (3) low-biased hexavalent chromium results for samples containing more than 2,500 µg/L hexavalent chromium at the TA Richland laboratory.

D.6.4.1 Nickel Inter-Element Correction Factor

In June 2010, a high bias in nickel results was identified in data reported by WSCF. The nickel results were determined using EPA Method 6010 (inductively coupled plasma– atomic emission spectroscopy). The high bias was caused by omission of an inter-element correction (IEC) factor that accounts for a silicon spectral interference with nickel. The omission apparently occurred when the IEC table was reinstalled after maintenance on the instrument. The date range of the affected nickel data was April 14 to June 2, 2010, when the nickel IEC factor was entered into the IEC table for the instrument. The affected nickel data were recalculated with the IEC factor and re-reported to the project. In addition to adding the nickel IEC, WSCF personnel reviewed and confirmed the rest of the IEC factors were correctly entered in the IEC table for the instrument. All corrected nickel results were submitted to the program by October 4, 2010.

Analytical Support Group personnel are currently following this issue with a work site assessment to determine if WSCF has sufficient controls in place to ensure that analytical methods continue to perform correctly after instrument maintenance.

D.6.4.2 Low-Level Iodine-129 Method

During the 2009 reporting period, groundwater Analytical Support staff worked with the laboratories to improve the low-level iodine-129 method to ensure that minimum detection levels were at or below the 1 pCi/L DWS. Monitoring of the low-level iodine-129 method continued during CY 2010. Six iodine-129 double-blind standards near 1 pCi/L were sent each to TA Richland and Eberline Services laboratories. The TA Richland laboratory reported detected values within ±30% for all six samples. Eberline reported less-than-detectable results for all six of their samples; the highest nondetect value reported was 1.56 pCi/L. TA Richland will continue to be the primary laboratory for low-level iodine-129. Analytical Support personnel will continue to work with Eberline to ensure their low-level method can reliably achieve a method detection limit of 1 pCi/L.

D.6.4.3 Hexavalent Chromium Method

Both the WSCF and TA Richland laboratories perform hexavalent chromium determinations for the groundwater project. While the WSCF laboratory reported 100% correct results for hexavalent chromium double-blind standards, the TA Richland laboratory reported only 71% correct results. All the TA Richland failures were on blind standards with hexavalent chromium values greater than 10,000 µg/L. Samples with hexavalent chromium concentrations between 4,000 and 10,000 µg/L had acceptable but low-biased hexavalent chromium results. The TA Richland laboratory was informed of this issue and has modified its hexavalent chromium procedure to dilute samples that exhibit hexavalent chromium concentrations greater than 1000 µg/L. Analytical Support personnel will continue to monitor the TA Richland laboratory's ability to accurately analyze samples with high hexavalent chromium concentrations.

D.7 Limit of Detection, Limit of Quantitation, and Method Detection Limit

C.A. Newbill, S. Champoux, and C.J. Thompson

Detection and quantitation limits are essential to evaluate data quality and usefulness because they provide the limits of a method's measurement. The detection limit is the lower limit at which a measurement can be differentiated from background. The quantitation limit is the lower limit where a measurement becomes quantifiably meaningful. The limit of detection, limit of quantitation, and method detection limit are all useful for evaluating groundwater data.

The limit of detection is defined as the lowest concentration level statistically different from a blank (*Detection in Analytical Chemistry: Importance, Theory, and Practice* [Currie, 1988]). The concentration at which an analyte can be detected depends on the variability of the blank response. For the purpose of this discussion, the blank is discussed as a method blank.

In general, the limit of detection is calculated as the mean concentration in the blank plus three standard deviations of that concentration (EPA/540/P-87/001, *A Compendium of Superfund Field Operations Methods*). The blank-corrected limit of detection is simply three times the blank standard deviation. At three standard deviations from the blank mean, the false-positive and the false-negative error rates are each ~7% (*Statistics for Analytical Chemistry, Second Edition*

[Miller and Miller, 1988]). A false-positive error is an instance when an analyte is declared present, but is absent; a false-negative error is an instance when an analyte is declared absent, but is present.

The limit of detection for a radionuclide is typically computed from the counting error associated with each reported result (EPA/520/1-80/012, *Upgrading Environmental Radiation Data*) and represents instrumental or background conditions at the time of analysis. In contrast, the limit of detection and limit of quantitation for the radionuclides shown in Table D-28 are based on variabilities that result from both counting errors and uncertainties introduced by sample handling. In the latter case, distilled water (submitted as a sample) is processed as if it were an actual sample. Thus, any random cross-contamination of the blank during sample processing will be included in the overall error. The values shown in Table D-28 are most useful to assess long-term variability in the overall measurement process.

The limit of quantitation is defined as the level above which quantitative results may be obtained with a specified degree of confidence (*Environmental Sampling and Analysis: A Practical Guide* [Keith, 1991]). The limit of quantitation is calculated as the blank mean plus 10 standard deviations of the blank (EPA/540/P-87/001). The blank-corrected limit of quantitation is simply ten times the blank standard deviation. The limit of quantitation is most useful for defining the lower limit of the useful range of concentration measurement technology. When the analyte signal is ten times larger than the standard deviation of the blank measurements, a 95% probability exists that the true concentration of the analyte is within ±25% of the measured concentration.

The method detection limit is defined as the minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero. The method detection limit is determined from analysis of a sample in a given matrix containing the analyte (Currie, 1988). The method detection limit is 3.14 times the standard deviation of the results of seven replicates of a low-level standard. Note that the method detection limit, as defined above, is based on the variability of the response of low-level standards rather than on the variability of the blank response. This is the reporting limit most commonly provided from the analytical laboratories with groundwater data (i.e., the reporting limit in the HEIS database).

For this report, TOC, TOX, and radionuclide field blank data are available for limit of detection and limit of quantitation determinations. The field blanks are QC samples that are introduced into a process to monitor the performance of the system. The use of field blanks to calculate the limit of detection and the limit of quantitation is preferred over the use of laboratory blanks because field blanks include error contributions from sample preparation and handling, in addition to analytical uncertainties. Methods to calculate the limit of detection and the limit of quantitation are described in detail in Appendix A of the *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site for 1990* (DOE/RL-91-03).

Because of the lack of blank data for other constituents of concern, it was necessary to calculate approximate limit of detection and limit of quantitation values by using variability information obtained from low-level standards. The data from the low-level standards are obtained from laboratory method detection limit studies. If low-level standards are used, the variability of the difference between the sample and blank response is increased by a factor of two (Currie, 1988, p. 84). The minimum detection level (MDL), level of detection (LOD), and limit of quantitation (LOQ) calculated as follows:

$$MDL = 3.14 * s$$

$$LOD = 3(* \text{ s}) = 4.24 * s$$

$$LOQ = 10(* \text{ s}) = 14.4 * s$$

where s = standard deviation from the seven replicates of the low-level standard.

The results of limit of detection, limit of quantitation, and method detection limit calculations for most nonradiological constituents of concern (other than TOC and TOX) are listed in Tables D-29 and D-30. The values in Table D-29 apply to WSCF and the values in Table D-30 apply to TA St. Louis. The radiological constituents, TOC, and TOX are provided in Table D-28.

D.8 Conclusions

C.J. Thompson

Overall, assessments of QA/QC information from the reporting period indicate that groundwater monitoring data are reliable and defensible. Little contamination or other sampling-related problems were encountered that affected data integrity. Likewise, laboratory performance was good in most respects, based on the large percentages of acceptable field and laboratory QC results. Laboratory audits and generally acceptable results in nationally based performance evaluation studies also demonstrated acceptable laboratory performance for the Groundwater Project. However, the following areas of concern were identified and should be considered when interpreting groundwater monitoring results from the current reporting period.

A few QC samples were probably swapped in the field or at the laboratory based on a small number of unusually high field-blank results and duplicate results with poor precision. The same problem likely occurred for a small number of groundwater samples. Mismatched results for key constituents are identified during data review and flagged when appropriate.

Several indicator parameters, anions, metals, VOCs, and radiological parameters were detected at low levels in field and/or laboratory method blanks. In particular, trace levels of metals were frequently detected in several of WSCF's method blanks. Results associated with this QC issue are flagged in the HEIS database. Data users must consider data flags when making decisions regarding data usability.

Maximum recommended holding times were exceeded for 0.5% of groundwater monitoring samples that were analyzed by nonradiological methods. This is an increase from 0.2% in 2009. Most of the missed holding times were for VOCs and SVOCs. Affected data are flagged with "H" in the HEIS database. Data users should consider "H" flags when making decisions regarding data usability.

Several analytical areas have been identified for continued evaluation and follow up. These include metals, VOCs, and low-level detection of iodine-129.

D.9 Glossary

Accuracy: Closeness of agreement between an observed value and a true value. Accuracy is assessed by means of reference samples and percent recoveries. Laboratory matrix spikes; laboratory control samples; EPA water pollution, water supply and inter-laboratory comparison programs; and blind standards are all used to assess accuracy.

Blind standard: Sample that contains a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The analyzing laboratory is informed that the sample is a QC sample and not a field sample. Blind, double-blind, and matrix-matched double-blind standards are used to evaluate analytical accuracy and precision as a measure of laboratory performance.

Comparability: Degree to which one set of data can be compared to another. For example, the results from samples analyzed by more than one laboratory may or may not be comparable. Ideally, comparability should be evaluated using identical samples to ensure that valid comparisons can be made.

Completeness: Amount of acceptable data divided by the total number of data points. The Groundwater Project determines completeness by calculating the number of unflagged data resulting from the validation process, dividing by the total number of data evaluated, and multiplying by 100. The calculated percentages used in reporting completeness are conservative because all data flagged with "B," "H," "Q," "R," and "Y" (flags) are used in calculating the percentage complete; however, flagged data may still be valid.

Data management staff: Groundwater Project staff responsible for tracking samples and data from sample planning through data receipt. This title includes staff responsible for management of the databases and electronic tools used to support data management activities.

Double-blind standards: Sample that contains a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The analyzing laboratory is not informed that the sample is a QC sample. All attempts are

made to make sure this sample appears like a field sample. Double-blind standards may or may not include matrix matching. Blind, double-blind, and matrix-matched double-blind standards are used to evaluate analytical accuracy and precision as a measure of laboratory performance.

Equipment blank: Sample that contains reagent water and any required preservative(s). An equipment blank is filled by pumping or washing reagent water through nondedicated sampling equipment. The equipment blank is analyzed for all constituents scheduled for the sampling event. Equipment blanks are used to monitor contamination due to improperly cleaned equipment.

Field duplicate sample: Replicate sample to determine the precision of the sampling and analytical measurement process by comparing results from identical samples collected at the same time and location. Matching field duplicates are stored in separate containers and are analyzed independently by the same laboratory.

Field split sample (split sample): Samples sequentially collected from the same location in the same sampling event and analyzed by different laboratories. Filed split samples are used to evaluate laboratory precision and comparability.

Field transfer blank): Sample that contains reagent water and any required preservative(s). At the time of sample collection, the field transfer blank is filled at the sampling site by pouring reagent water from a cleaned container into sample vials. After collection, the field transfer blank is treated in the same manner as the samples collected during the sampling event. Field transfer blanks are collected only on days when other samples are collected for volatile organic analysis and are analyzed only for volatile organic constituents. Field transfer blanks are used to check for volatile organic contamination associated with sampling activities.

Flags (as qualifiers): Codes that alert data users to limitations on reported data values. Data flags may be assigned by the laboratory or by Groundwater Project analytical support staff. A complete list of review flags is provided in Table D-1. The common flags used include, but are not limited to, the following:

- B: Data associated with contamination in the laboratory method blank (organics).
- B: Result detected was less than the contract-required detection limit but greater than the minimum detection level (inorganics).
- B: Data associated with contamination in the blank greater than two times the minimum detectable activity (radiochemistry).
- C: Data associated with contamination in the laboratory method blank (inorganics).
- F: Suspect data currently under review.
- H: Holding time exceeded.
- G: Reviewed data found to be valid.
- P: Potential problem with the sample or well that may have affected the data.
- Q: Result associated with suspect field QC data.
- R: Reviewed data found to be unusable.
- Y: Reviewed data found to be suspect.

Full trip blank: Sample that contains reagent water and any required preservative(s). A full trip blank is used to check for contamination in sample bottles and sample preparation. A full trip blank is analyzed for all constituents of interest and is collected in all types of sample bottles used during that sampling period. The full trip blank is filled during bottle preparation using the same sample preparation procedures as for regular well samples. The full trip blank is then handled the same as all other samples through delivery to the laboratory but is not opened in the field.

Groundwater Project analytical support staff: Groundwater Project staff responsible for reviewing and assessing the quality of data and analytical services. This group performs quarterly and annual reviews of QC data and ensures appropriate data flags are applied. They monitor the qualification and performance of the laboratories supporting the Groundwater Project.

Groundwater Project: The Hanford Site Groundwater Monitoring Program.

Groundwater staff: Employees of the Groundwater Project, including project scientists, analytical support staff, data management staff, field staff, etc.

Laboratory control sample: Sample of reagent water spiked with a known amount of the target analyte(s). The sample is extracted (if appropriate) and analyzed to monitor the performance of the analytical method.

Matrix duplicate: Replicate analysis (including preparation) of a regular (i.e., groundwater) sample performed as part of a laboratory's analytical batch quality control. Matrix duplicates and matrix spike duplicates are used to evaluate the precision of an analysis method. The maximum limit of precision expected for matrix duplicates is ±20%.

Matrix-matched double-blind standard: Sample prepared that contains a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The sample matrix is selected to closely match that of field samples. Matrix-matched double-blind standards are disguised to appear as regular well samples to help ensure that any analyses performed are representative of those for routine well samples. Most of the blind standards submitted for the Groundwater Project are matrix-matched double-blind standards.

Matrix spikes/matrix spike duplicates: Sample(s) prepared at the analytical laboratory by adding known quantities of one or more target analytes to a sample prior to extraction and analysis. Comparison of the original (i.e., unspiked) sample and matrix spike results provides information about the suitability of an analysis for the sample matrix. For example, unusually high or low recoveries of the spiked compounds may indicate that components in the sample matrix interfere with the analysis. Matrix spike duplicates are replicate matrix spike samples that are used to assess the precision of an analysis. The maximum limit of precision expected for matrix spike duplicates is ±20%.

Method blank: Sample of reagent water prepared in the laboratory, extracted (if appropriate), and analyzed as if it were a regular sample. Method blanks are used to monitor the possible introduction of contaminants during sample preparation and analysis at the laboratory.

Precision: Agreement among individual measurements of the same property, usually under prescribed similar conditions. For a set of duplicate measurements, precision is calculated by the relative percent difference of the duplicate results. For the Groundwater Project, results from laboratory duplicates, matrix spike duplicates, blind standards, split samples, and field duplicates are used to evaluate precision.

Project scientist: Groundwater Project scientist responsible for the technical evaluation of data for a specific well or set of wells.

Reagent water: Distilled or deionized water free of contaminants that may interfere with analytical tests.

Relative percent difference (RPD): Calculated as follows:

$$RPD = \frac{|D1 - D2|}{(D1 + D2) / 2} \times 100$$

where $D1$ = original sample value and $D2$ = duplicate sample value.

Representativeness: Expression of the degree to which samples represent the actual composition of the material tested (e.g., groundwater in the aquifer). Representativeness is addressed qualitatively by the specification of well construction, sampling locations, sampling intervals, and sampling and analysis techniques addressed in monitoring plans.

Split samples: See *Field split samples*.

Surrogates: Organic compounds similar to analytes of interest in chemical composition, extraction, and analytical properties, but which are not normally found in environmental samples. Surrogates are spiked into method blanks, samples, and matrix spikes and are then extracted and analyzed to monitor the effectiveness of sample preparation and analysis on individual samples.

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Table D-1. Data Review Flags

Flag	Definition
F	Result is being reviewed as part of the RDR process. This flag is assigned when an RDR is initiated.
G	Result is valid according to further review.
H	Holding time exceeded before the sample was analyzed.
P	Potential problem. Collection/analysis circumstances make value questionable.
Q	Associated quality control sample is out of limits.
R	Result is not valid according to further review.
Y	Result is suspect. Review had insufficient evidence to show result valid or invalid.
Z	Miscellaneous circumstance exists. See project file.

RDR = request for data review

Table D-2. Requests for Data Review, Current Reporting Period Data

Flag G	Flag Y	Flag R	Flag P	Other Action	Pending	Number of Results with Assigned RDR
Analytical Results*						
525	1,637	16	0	96	339	2,613
Water-Level Measurements						
18	43	8	1	0	0	70

* The software used to track RDRs underwent a major upgrade during 2010. Some values in this table may be incorrect (i.e., slightly low) due to problems encountered during the upgrade.

G = result was reviewed and determined to be correct or data was corrected

P = potential problem with the well, collection, or analysis that makes the result questionable

R = result was reviewed and found to be unusable

RDR = requests for data review

Y = result is suspect

Table D-3. Summary of Data Completeness

	Suspect Data	Rejected Data	Field QC	Holding Time	Method Blank	Total
Number of results flagged	586	35	5,819	1,155	18,139	24,645
Percent flagged data	0.2%	0.0%	2.4%	0.5%	7.4%	10.0%
Percent acceptable data	--	--	97.6%	99.5%	92.6%	90.0%

Notes: Total number of reported results was 245,705.

Table D-4. Full Trip Blanks Exceeding Quality Control Limits

Constituent	Number of Analyses	Number Out of Limits	Percent Out of Limits	Range of QC Limits[a]	Range of Out-of-Limit Results
General Chemistry Parameters					
Total organic halides	80	1	1.3	10 µg/L	27.8 µg/L
Ammonia and Anions					
Chloride	109	4	3.7	40 - 860 µg/L	4,880 - 16,500 µg/L
Fluoride	109	3	2.8	20 - 600 µg/L	189 - 286 µg/L
Nitrogen in ammonium	4	1	25.0	6.18 - 8.76 µg/L	12 µg/L
Nitrogen in nitrate	108	4	3.7	76.2 - 2,740 µg/L	1,620 - 110,000 µg/L
Sulfate	109	3	2.8	100 - 1,320 µg/L	9,370 - 64,000 µg/L
Metals					
Arsenic	170	1	0.6	0.8 - 130 µg/L	6.48 µg/L
Barium	266	9	3.4	0.4 - 8 µg/L	0.81 - 67 µg/L
Beryllium	266	1	0.4	0.1 - 8 µg/L	0.27 µg/L
Boron	64	1	1.6	38 - 82 µg/L	98 µg/L
Calcium	196	65	33.2	54 - 78 µg/L	162 - 46,100 µg/L
Chromium	266	3	1.1	1 - 28 µg/L	32 - 465 µg/L
Cobalt	266	1	0.4	0.1 - 8 µg/L	0.29 µg/L
Copper	266	6	2.3	0.2 - 10 µg/L	0.43 - 10 µg/L
Hexavalent chromium	104	2	1.9	4 - 7.4 µg/L	24.7 - 27.1 µg/L
Iron	196	6	3.1	36 - 76 µg/L	39.5 - 492 µg/L
Lithium	64	2	3.1	8 µg/L	14 - 15 µg/L
Magnesium	196	38	19.4	28 - 32 µg/L	32.2 - 12,300 µg/L
Manganese	196	1	0.5	8 - 12 µg/L	69.1 µg/L
Molybdenum	134	5	3.7	0.1 - 8 µg/L	0.46 - 16 µg/L
Nickel	196	1	0.5	8 µg/L	18 µg/L
Phosphorus	64	1	1.6	110 - 144 µg/L	174 µg/L
Potassium	196	6	3.1	110 - 146 µg/L	3,090 - 5,740 µg/L
Selenium	140	1	0.7	0.6 - 94 µg/L	1.7 µg/L
Silicon	64	2	3.1	50 - 122 µg/L	7,710 - 16,300 µg/L
Sodium	196	50	25.5	22 - 46 µg/L	23 - 21,600 µg/L
Strontium	196	6	3.1	8 µg/L	79.1 - 277 µg/L
Thallium	142	1	0.7	0.1 - 98 µg/L	0.29 µg/L
Tin	136	2	1.5	0.1 - 98 µg/L	0.21 - 0.34 µg/L
Uranium	64	3	4.7	0.1 - 0.2 µg/L	0.20 - 8.11 µg/L
Vanadium	196	1	0.5	24 - 34 µg/L	25.8 µg/L
Zinc	196	4	2.0	8 - 12 µg/L	10 - 590 µg/L
Volatile Organic Compounds					
1,4-Dichlorobenzene	73	1	1.4	0.22 - 400 µg/L	0.32 µg/L
Bromomethane	35	5	14.3	0.17 - 0.5 µg/L	0.46 - 1.1 µg/L
Carbon disulfide	73	3	4.1	0.1 - 400 µg/L	0.19 - 0.36 µg/L

Table D-4. (Cont.)

Constituent	Number of Analyses	Number Out of Limits	Percent Out of Limits	Range of QC Limits[a]	Range of Out-of-Limit Results
Carbon tetrachloride	73	2	2.7	0.13 - 400 µg/L	6.6 - 6.7 µg/L
Chloroform	73	1	1.4	0.13 - 400 µg/L	2.5 µg/L
Chloromethane	35	8	22.9	0.15 µg/L	0.16 - 0.77 µg/L
Iodomethane	35	2	5.7	0.18 µg/L	0.51 - 0.53 µg/L
Methylene chloride	73	36	49.3	0.5 - 1,000 µg/L	0.78 - 89 µg/L
Styrene	35	1	2.9	0.072 - 0.15 µg/L	0.17 µg/L
Tetrachloroethene	73	1	1.4	0.13 - 400 µg/L	0.22 µg/L
Semivolatile Organic Compounds					
Aldrin	6	1	16.7	0.02 µg/L	0.12 µg/L
Radiological Parameters[b]					
Americium-241	12	1	8.3	0.11 - 0.66 pCi/L	0.31 pCi/L
Gross alpha	68	3	4.4	1.6 - 5.4 pCi/L	3.2 - 11 pCi/L
Gross beta	75	2	2.7	3 - 6.8 pCi/L	6.9 - 24 pCi/L
Technetium-99	64	3	4.7	12.4 - 19.7 pCi/L	16 - 2,900 pCi/L
Total beta radiostrontium	50	1	2.0	2.8 - 22 pCi/L	210 pCi/L
Tritium	89	6	6.7	57.2 - 480 pCi/L	380 - 3,500 pCi/L

a. Because method detection limits are specific to the laboratory and may change throughout the year, the limits are presented as a range. However, each result was evaluated according to the method detection limit in effect at the time the sample was analyzed.

b. The limit for radiological analyses is determined by the sample-specific total propagated uncertainty.

Table D-5. Field Transfer Blanks Exceeding Quality Control Limits

Constituent	Number of Analyses	Number Out of Limits	Percent Out of Limits	Range of QC Limits*	Range of Out-of-Limit Results
Volatile Organic Compounds					
1,4-Dichlorobenzene	240	2	0.83	0.22 - 10 µg/L	0.35 - 0.51 µg/L
Acetone	240	3	1.25	1.7 - 50 µg/L	2.5 - 190 µg/L
Bromomethane	24	3	12.50	0.5 - 20 µg/L	0.54 - 0.6 µg/L
Carbon disulfide	240	6	2.50	0.1 - 10 µg/L	0.12 - 0.37 µg/L
Carbon tetrachloride	240	11	4.58	0.13 - 10 µg/L	0.16 - 10 µg/L
Chloromethane	24	7	29.17	0.15 - 20 µg/L	0.18 - 0.3 µg/L
Iodomethane	24	1	4.17	0.18 - 10 µg/L	0.46 µg/L
Methylene chloride	240	115	47.92	0.5 - 30 µg/L	0.61 - 37 µg/L
Tetrachloroethene	240	1	0.42	0.13 - 10 µg/L	0.31 µg/L

* Because method detection limits are specific to the laboratory and may change throughout the year, the limits are presented as a range. However, each result was evaluated according to the method detection limit in effect at the time the sample was analyzed.

Table D-6. Equipment Blanks Exceeding Quality Control Limits

Constituent	Number of Analyses	Number Out of Limits	Percent Out of Limits	Range of QC Limits*	Range of Out-of-Limit Results
General Chemistry Parameters					
Alkalinity	26	2	7.7	2,000 µg/L	73,000 - 94,000 µg/L
Ammonia and Anions					
Chloride	34	5	14.7	6.2 - 172 µg/L	11.5 - 1,610 µg/L
Nitrogen in nitrate	33	2	6.1	168 - 548 µg/L	2,430 - 2,510 µg/L
Sulfate	34	1	2.9	43.8 - 340 µg/L	13,000 µg/L
Metals					
Barium	86	9	10.5	0.4 - 8 µg/L	1.35 - 339 µg/L
Beryllium	86	1	1.2	0.1 - 8 µg/L	0.40 µg/L
Cadmium	86	1	1.2	0.2 - 8 µg/L	0.42 µg/L
Calcium	62	24	38.7	54 - 78 µg/L	91.6 - 272,000 µg/L
Chromium	86	4	4.7	1 - 28 µg/L	3.91 - 234 µg/L
Cobalt	86	3	3.5	0.1 - 8 µg/L	0.21 - 0.57 µg/L
Copper	86	17	19.8	0.2 - 10 µg/L	0.89 - 30.8 µg/L
Iron	62	7	11.3	36 - 78 µg/L	40.9 - 856 µg/L
Lead	48	3	6.3	0.2 - 84 µg/L	0.74 - 1.51 µg/L
Magnesium	62	17	27.4	28 - 32 µg/L	36.9 - 85,100 µg/L
Manganese	64	3	4.7	0.4 - 12 µg/L	1.45 - 31 µg/L
Molybdenum	48	4	8.3	0.1 - 8 µg/L	0.29 - 0.90 µg/L
Nickel	64	2	3.1	0.8 - 8 µg/L	4.98 - 16 µg/L
Potassium	62	8	12.9	110 - 146 µg/L	207 - 11,700 µg/L
Silicon	24	2	8.3	50 - 122 µg/L	9,140 - 9,240 µg/L
Sodium	62	27	43.5	22 - 46 µg/L	23 - 209,000 µg/L
Strontium	64	7	10.9	0.4 - 8 µg/L	0.64 - 1,390 µg/L
Thallium	48	1	2.1	0.1 - 98 µg/L	0.81 µg/L
Tin	48	2	4.2	0.1 - 98 µg/L	0.27 - 0.29 µg/L
Zinc	64	3	4.7	3.2 - 12 µg/L	5.42 - 21 µg/L
Volatile Organic Compounds					
Acetone	23	5	21.7	1.7 - 5 µg/L	1.9 - 15 µg/L
Bromomethane	12	4	33.3	0.17 - 0.5 µg/L	0.17 - 0.99 µg/L
Chloroform	23	7	30.4	0.2 - 2 µg/L	0.68 - 9.5 µg/L
Chloromethane	12	2	16.7	0.15 µg/L	0.63 - 0.65 µg/L
Methylene chloride	23	2	8.7	0.55 - 5 µg/L	7.8 - 21 µg/L
Semivolatile Organic Compounds					
Aldrin	1	1	100.0	0.02 µg/L	0.074 µg/L
Radiological Parameters					
Gross alpha	14	1	7.1	1.32 - 4.8 pCi/L	2.5 pCi/L
Gross beta	14	2	14.3	3.8 - 6.6 pCi/L	8.2 - 60 pCi/L
Total beta radiostrontium	15	2	13.3	3.2 - 4.6 pCi/L	5.5 - 21 pCi/L
Tritium	28	2	7.1	320 - 480 pCi/L	610 - 860 pCi/L
Uranium-233/234	1	1	100.0	0.048 pCi/L	0.053 pCi/L

* Because method detection limits are laboratory specific and may change throughout the year, the limits are presented as a range. However, each result was evaluated according to the method detection limit in effect at the time the sample was analyzed.

Table D-7. Field Duplicates Exceeding Quality Control Limits

Constituent	Total Number of Duplicates	Number of Duplicates Evaluated[a]	Number Out of Limits	Percent Out of Limits	Range of Out-of-Limit RPD[b]
Ammonia and Anions					
Bromide	42	3	1	33.3	127
Chloride	120	119	1	0.8	188
Cyanide	15	4	2	50.0	25.0 - 26.4
Fluoride	120	18	2	11.1	32.1 - 56.3
Nitrogen in nitrate	117	112	1	0.9	195
Nitrogen in nitrite	117	4	2	50.0	28.9 -158
Sulfate	120	118	1	0.8	196
Metals					
Aluminum	142	14	9	64.3	20.9 - 164
Arsenic	162	36	1	2.8	65.5
Barium	297	269	8	3.0	21.1 - 162
Cadmium	297	1	1	100.0	38.6
Calcium	223	220	8	3.6	24.7 - 164
Chromium	297	64	4	6.3	20.3 - 144
Cobalt	297	12	6	50.0	24.4 - 171
Copper	297	12	5	41.7	46.2 - 177
Hexavalent chromium	155	73	2	2.7	27.0 - 29.9
Iron	223	38	15	39.5	25.9 - 189
Lead	151	6	4	66.7	90.6 - 199
Magnesium	223	220	6	2.7	23.5 - 163
Manganese	221	24	6	25.0	22.8 - 173
Molybdenum	138	75	7	9.3	26.9 - 136
Nickel	221	18	3	16.7	29.3 - 131
Phosphorus	60	4	1	25.0	23.2
Potassium	223	219	6	2.7	22.0 - 164
Selenium	140	20	5	25.0	24.8 - 56.6
Silicon	60	59	2	3.4	24.1 - 163
Sodium	223	220	4	1.8	22.8 - 162
Strontium	221	218	5	2.3	23.4 - 163
Uranium	61	57	4	7.0	23.1 - 41.8
Zinc	221	16	3	18.8	28.2 - 93.3
Volatile Organic Compounds					
1,2-Dichloroethane	76	1	1	100.0	157
1,4-Dichlorobenzene	76	1	1	100.0	100
Bromomethane	28	3	1	33.3	20.7
Carbon tetrachloride	76	17	5	29.4	28.6 - 186
Chloromethane	28	2	1	50.0	150
Iodomethane	28	2	2	100.0	151 - 152
Methylene chloride	76	5	5	100.0	147 - 191
Styrene	28	1	1	100.0	125
Trichloroethene	76	13	3	23.1	36.7 - 183

Table D-7. (Cont.)

Constituent	Total Number of Duplicates	Number of Duplicates Evaluated[a]	Number Out of Limits	Percent Out of Limits	Range of Out-of-Limit RPD[b]
Semivolatile Organic Compounds					
Aldrin	3	1	1	100.0	194
Diethylphthalate	10	1	1	100.0	194
Radiological Parameters					
Carbon-14	25	9	3	33.3	21.9 - 50.0
Gross alpha	57	6	3	50.0	25.8 - 114
Gross beta	66	39	8	20.5	28.6 - 150
Iodine-129	35	10	2	20.0	37.9 - 51.9
Technetium-99	66	32	1	3.1	94.1
Total beta radiostrontium	49	8	2	25.0	20.2 - 211
Tritium	85	58	4	6.9	22.2 - 208
Uranium-233/234	5	4	1	25.0	20.3
Uranium-235	5	4	1	25.0	75.0

a. Duplicates with both results less than five times the method detection limit or minimum detectable activity were excluded from the evaluation.

b. In cases where a nondetect result was compared with a measured value, the method detection limit or minimum detectable activity was used for the nondetect concentration.

Table D-8. Field Splits Exceeding Quality Control Limits

Constituent	Total Number of Splits	Number of Splits Evaluated[a]	Number Out of Limits	Percent Out of Limits	Range of Out-of-Limit RPD[b]
General Chemistry Parameters					
Total petroleum hydrocarbons-diesel range	4	1	1	100	76.5
Ammonia and Anions					
Fluoride	33	30	23	76.7	22.2 - 117
Nitrogen in nitrate	32	31	1	3.2	21.1
Nitrogen in nitrite	32	3	1	33.3	30.0 - 94.7
Phosphorus in phosphate	15	1	1	100	114
Metals					
Aluminum	20	2	2	100	56.6 - 59.1
Antimony	54	6	3	50.0	22.7 - 66.3
Arsenic	20	2	2	100	104 - 124
Barium	54	46	1	2.2	93.3
Boron	20	2	1	50.0	37.7
Cadmium	54	2	1	50.0	22.2
Calcium	54	54	2	3.7	24.8 - 137
Chromium	54	25	3	12.0	21.8 - 162
Hexavalent chromium	73	38	4	10.5	20.1 - 180
Iron	54	7	7	100	22.5 - 152
Magnesium	54	54	1	1.9	22.6
Manganese	54	10	4	40.0	24.7 - 36.7
Nickel	54	2	1	50.0	130
Potassium	54	54	34	63.0	20.0 - 154
Silicon	20	20	2	10.0	21.7 - 32.3
Sodium	54	54	2	3.7	22.9 - 37.3
Strontium	54	54	4	7.4	20.2 - 136
Vanadium	54	4	2	50.0	41.4 - 58.2
Volatile Organic Compounds					
Bromomethane	6	1	1	100	167
Carbon tetrachloride	15	3	2	66.7	29.9 - 39.1
Chloroform	15	6	2	33.3	22.2 - 141
Methylene chloride	15	2	2	100	78.8
Trichloroethene	14	2	2	100	47.8 - 140
Semivolatile Organic Compounds					
Acenaphthene	3	1	1	100	72.1
Naphthalene	3	1	1	100	164
Phenanthrene	3	1	1	100	94.9
Pyrene	3	1	1	100	40.0
Radiological Parameters					
Total beta radiostrontium	1	1	1	100	439.0

a. Splits with both results less than five times the method detection limit or minimum detectable activity were excluded from the evaluation.

b. In cases where a nondetect result was compared with a measured value, the method detection limit or minimum detectable activity was used for the nondetect concentration.

Table D-9. Summary of Analytical Method Categories

Category	HEIS Method Name	Description
General chemistry parameters	120.1_CONDUCT	Specific conductivity, conductance bridge
	150.1_PH	pH by electrode
	160.2_TSS	Total suspended solids
	1664A_OILGREASE	Oil and grease, n-hexane extractable material, gravimetric, solid phase extraction
	170.1_TEMP_FLD	Temperature, field measurement
	2320_ALKALINITY	Alkalinity
	310.1_ALKALINITY	Alkalinity, titrametric
	360.1_OXYGEN	Dissolved oxygen
	360.1_OXYGEN_FLD	Dissolved oxygen
	410.4_COD	Chemical oxygen demand, automated; manual
	9020_TOX	Total organic halides
	9060_TOC	Total organic carbon
	9070_OILGREASE	Total recoverable oil and grease, gravimetric
	9223_COLIFORM	Coliform by enzyme substrate test
	CONDUCT_FLD	Field conductivity by instrument manufacturer instructions
	PH_ELECT_FLD	pH analysis by electrode, field measurement
	REDOX_PROBE_FLD	Oxidation-reduction potential by platinum electrode
	TEMP_FLD	Temperature, field measurement
	TURBIDITY_FLD	Nephelometric turbidity, field measurement
	WTPH_DIESEL	Total petroleum hydrocarbons, SE/GC-FID, Ecology
	WTPH_GASOLINE	Total petroleum hydrocarbons, P&T/GC-FID, Ecology
Ammonia and anions	300.0_ANIONS_IC	Anions by ion chromatography
	300.7_CATIONS_IC	Cations by ion chromatography
	335.2_CYANIDE	Total cyanide, titrametric, spectrophotometric
	9012_CYANIDE	Cyanide, automated colorimetric
	9030_SULFIDE	Sulfide by titration
Metals	200.8_METALS_ICPMS	Metals by inductively coupled plasma- mass spectrometry
	6010_METALS_ICP	Metals by inductively coupled plasma
	6020_METALS_ICPMS	Metals by inductively coupled plasma- mass spectrometry
	7196_CR6	Hexavalent chromium, colorimetric
	7470_HG_CVAA	Mercury (Hg) by CVAA
Volatile organic compounds	8015_VOA_GC	Nonhalogenated volatiles by gas chromatography
	8260_VOA_GCMS	Volatile organics by gas chromatography/mass spectrometry capillary column
	RSK175_VOA_HDSPC_GC	Nonhalogenated volatiles (light hydrocarbon) analysis via headspace equilibrium – gas chromatography
Semivolatile organic compounds	1668A_PCB_CONGENER	Polychlorinated biphenyl congeners by high-resolution gas chromatography/high-resolution mass spectrometry
	8040_PHENOLIC_GC	Phenols by gas chromatography
	8081_PEST_GC	Organoclhorine pesticides by gas chromatography
	8082_PCB_GC	Polychlorinated biphenyls by gas chromatography
	8270_SVOA_GCMS	Semivolatiles by gas chromatograpy/mass spectrometry
	8310_SVOA_HPLC	Semivolatile organic analytes by HPLC (PAHs)
	8316_SVOA_HPLC	Semivolatile organic analytes by HPLC (acrylamide, acrylonitrile and acrolein)

Table D-9. (Cont.)

Category	HEIS Method Name	Description
Radiological parameters	900.0_ALPHABETA_GPC	Gross alpha/beta by gas proportional counting
	906.0_H3_LSC	Tritium in drinking water, liquid scintillation
	906.0ML_H3_LSC	Tritium in drinking water, mid-level, liquid scintillation
	9310_ALPHABETA_GPC	Gross alpha and gross beta by gas proportional counting
	ALPHA_GPC	Gross alpha, gas proportional counting
	AMCMISO_EIE_PLT_AEA	Americium/curium isotopic, separated by sequential eichrom ion exchange resin, plated, alpha spectrometry
	AMCMISO_IE_PREC_AEA	Americium/curium isotopic, separated by ion exchange, precipitated, alpha spectrometry
	BETA_GPC	Gross beta gas proportional counting
	C14_CHEM_LSC	Carbon-14, chemical oxidation/liquid scintillation counting
	C14_LSC	Carbon-14 analysis by unknown method
	GAMMA_GS	Gamma spectroscopy, germanium high-energy detectors
	GAMMALL_GS	Gamma spectroscopy, low-level, germanium high-energy detector
	I129_SEP_LEPS_GS	Iodine-129, separation, precipitation, LEPS
	I129LL_SEP_LEPS_GS	Iodine-129, low-level, separation, precipitation, LEPS detection
	NI63_LSC	Nickel-63 by liquid scintillation
	NP237_LLE_PLATE_AEA	Neptunium isotopic, liquid-liquid extraction, electroplated, alpha spectrometry
	PUISO_IE_PRECIP_AEA	Isotopic plutonium, ion-exchange separation, precipitated on disk, alpha spectrometry
	PUISO_PLATE_AEA	Isotopic plutonium, unknown separation, electroplated, alpha spectrometry
	RAISO_SEP_GPC	Radium-226 and radium-228 separated by EDTA, precipitated for alpha scintillation and gas proportional counting
	RATOT_GPC	Total radium, gas proportional counting
	SE79_SEP_DIS_LSC	Selenium-79, separated, distillation, liquid scintillation
	SE79_SEP_IE_LSC	Selenium-79, separated, ion-exchange resin, liquid scintillation
	SRISO_SEP_PRECIP_GPC	Strontium beta isotopic, chemical separation, precipitated, gas proportional counting
	SRTOT_SEP_PRECIP_GPC	Total beta strontium, chemical separation, precipitation, gas proportional counting
	TC99_3MDSK_LSC	Technetium-99, 3M disk separation, liquid scintillation counting
	TC99_ETVDSK_LSC	Technetium-99, eichrome teva disk separation, liquid scintillation counting
	TC99_SEP_LSC	Technetium-99, ppt. and ion-exchange resin separation, liquid scintillation counting
	TC99_TR_SEP_GPC	Technetium-99, separated, tracer yield, gas proportional counting
	THISO_IE_PLATE_AEA	Isotopic thorium, ion exchanges separation with and from lead-210, plated, alpha spectrometry
	THISO_IE_PRECIP_AEA	Isotopic thorium, ion-exchanges separation with and from lead-210, precipitated, alpha spectrometry
	TRITIUM_EIE_LSC	Tritium in water, purification by eichrome ion exchange, liquid scintillation counting
	UISO_IE_PRECIP_AEA	Uranium isotopic, purification by ion exchange, precipitated, alpha spectrometry
	UISO_PLATE_AEA	Uranium isotopic, separation unknown, electroplated, alpha spectrometry
	UTOT_KPA	Total uranium, unknown separation, laser phosphorimetry

Table D-10. Hanford Site Groundwater Remediation Project Maximum Recommended Holding Times

Method	Constituent	Holding Time
120.1 (EPA-600/4-81-004)	Conductivity	28 days
160.1 (EPA-600/4-81-004)	Total dissolved solids	7 days
300.0 (EPA-600/4-81-004)	Bromide	28 days
300.0 (EPA-600/4-81-004)	Chloride	28 days
300.0 (EPA-600/4-81-004)	Fluoride	28 days
300.0 (EPA-600/4-81-004)	Nitrate	48 hours
300.0 (EPA-600/4-81-004)	Nitrite	48 hours
300.0 (EPA-600/4-81-004)	Phosphate	48 hours
300.0 (EPA-600/4-81-004)	Sulfate	28 days
310.1 (EPA-600/4-81-004)	Alkalinity	14 days
350.1 (EPA-600/4-81-004)	Ammonia	28 days
410.4 (EPA-600/4-81-004)	Chemical oxygen demand	28 days
6010 (SW-846)/200.7	Inductively coupled plasma metals	6 months
	Mercury	28 days
6020 (SW-846)/200.8	Inductively coupled plasma-mass spectrometry metals	6 months
	Mercury	28 days
7196 (SW-846)	Hexavalent chromium	24 hours
7470 (SW-846)	Mercury	28 days
8015M (SW-846)	Total petroleum hydrocarbons	14 days
8040 (SW-846)	Phenols	7 days before extraction 40 days after extraction
8081 (SW-846)	Pesticides	7 days before extraction 40 days after extraction
8082 (SW-846)	Polychlorinated biphenyls	1 year before extraction 1 year after extraction
8260 (SW-846)	Volatile organics	14 days
8270 (SW-846)	Semivolatile organics	7 days before extraction 40 days after extraction
9012 (SW-846)	Cyanide	14 days
9020 (SW-846)	Total organic halides	28 days
9030 (SW-846)	Sulfides	7 days
9060 (SW-846)	Total organic carbon	28 days
9223 (APHA/AWWA/WEF)	Coliform	24 hours

Table D-11. Summary of WSCF and 222-S Performance Evaluation Studies

WatR™ Pollution/WatR™ Supply Performance Evaluation Studies, Environmental Resource Associates		
Study and Date	**WSCF**	**222-S**
WP-180, March 2010	74/76[a]	--
WP-186, September 2010	83/84[b]	--
InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates		
Study and Date	**WSCF**	**222-S**
RAD-80, March 2010	4/4	--
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory		
Study and Date	**WSCF**	**222-S**
MAPEP-09-MaW21, June 2010	--[g]	24/27[d]
MAPEP-09-GrW21, June 2010	--[g]	1/2[e]
MAPEP-09-MaW22, June 2010	29/30[c]	28/29[f]
MAPEP-09-GrW22, June 2010	2/2	2/2

a. Unacceptable results were for nonfilterable residue and strontium.

b. Unacceptable result was for hexane extractable material.

c. Unacceptable result was for technetium-99

d. Unacceptable results were for uranium-total, manganese-54, and plutonium-38.

e. Unacceptable result was for gross beta.

f. Unacceptable result was for arsenic.

g. Reported in 2009.

Table D-12. Summary of TestAmerica Performance Evaluation Studies

WatR™ Pollution/WatR™ Supply Performance Evaluation Studies, Environmental Resource Associates		
Study and Date	**TA St. Louis**	**TA Richland**
WP-180, March 2010	711/737[a]	1/1
WS-165, May 2010	61/62[b]	--
WP-186, September 2010	628/630[c]	1/1
WP-188, October 2010	165/168[d]	--
WS-171, November 2010	61/62[e]	--
InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates		
Study and Date	**TA St. Louis**	**TA Richland**
RAD-80, March 2010	--	15/15
RAD-81, May 2010	20/23[f]	17/17
RAD-82, August 2010	--	15/15
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory		
Study and Date	**TA St. Louis**	**TA Richland**
MAPEP-09-MaW21 June 2010	35/35	17/17
MAPEP-09-GrW21 June 2010	2/2	2/2
MAPEP-09-OrW21 June 2010	72/74[g]	--
MAPEP-09-MaW22 June 2010	33/34[h]	15/17[i]
MAPEP-09-GrW22 June 2010	2/2	2/2
MAPEP-09-OrW22 June 2010	75/75	--

a. Unacceptable results were for volatile solids (2), nitrate and nitrite as N, orthophosphate as P, nitrate as N, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron (2), manganese, nickel, silver, vanadium, zinc, tin, 2,4-D, Dalapon, and endrin ketone (3).

b. Unacceptable result was for 1,2,4-trichlorobenzene.

c. Unacceptable results were for volatile solids and total phosporus as P.

d. Unacceptable results were for manganese (3).

e. Unacceptable result was for n-propylbenzene.

f. Unacceptable results were for barium-133 (2) and uranium (nat) mass.

g. Unacceptable results were for 4,4'-DDE and 4,4'-DDT.

h. Unacceptable result was for arsenic.

i. Unacceptable results were for iron-55 and plutonium-239/240.

Table D-13. Summary of Eberline Services and Lionville Laboratory Performance Evaluation Studies

InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates		
Study and Date	**Eberline**	**Lionville**
RAD-80, March 2010	15/15	--
RAD-81, May 2010	1/1	--
RAD-82, August 2010	14/15[a]	--
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory		
Study and Date	**Eberline**	**Lionville**
MAPEP-09-MaW21, June 2010	--[b]	15/15
MAPEP-09-GrW21, June 2010	--[b]	--
MAPEP-09-OrW21, June 2010	--[b]	56/57[c]
MAPEP-09-MaW22, June 2010	16/16	13/15[d]
MAPEP-09-GrW22, June 2010	2/2	--
MAPEP-09-OrW22, June 2010	--	57/57

a. Unacceptable result was for radium-228.

b. Reported in 2009.

c. Unacceptable result was for hexachlorobutadiene.

d. Unacceptable results were for mercury and vanadium.

Table D-14. Summary of WSCF Double-Blind Spike Determinations

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
General Chemical Parameters					
Specific conductance	Quarterly	9	0	100%	±25
Total organic carbon (potassium hydrogen phthalate spike)	Quarterly	12	2	83%	±25
Total organic halides (2,4,5-trichlorophenol spike)	Quarterly	11	3	73%	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene spike)	Quarterly	10	5	50%	±25
Ammonia and Anions					
Chloride	Quarterly	12	3	75%	±25
Cyanide	Semiannually	6	0	100%	±25
Fluoride	Quarterly	12	3	75%	±25
Nitrate as nitrogen	Quarterly	12	3	75%	±25
Nitrite as nitrogen	Semiannually	6	0	100%	±25
Metals					
Chromium (total)	Quarterly	18	1	94%	±20
Hexavalent chromium	Quarterly	21	0	100%	±20
Volatile Organic Compounds					
Carbon tetrachloride	Quarterly	6	1	83%	±25
Chloroform	Quarterly	6	0	100%	±25
Trichloroethene	Quarterly	6	3	50%	±25
Radiological Parameters					
Gross alpha (plutonium-239 spike)	Quarterly	6	3	50%	±30
Gross beta (strontium-90 spike)	Quarterly	9	0	100%	±30
Cesium-137	Annually	3	0	100%	±30
Cobalt-60	Annually	3	0	100%	±30
Neptunium-237	Annually	3	0	100%	±30
Plutonium-239	Semiannually	6	0	100%	±30
Technetium-99	Quarterly	9	0	100%	±30
Tritium	Semiannually	3	0	100%	±30
Uranium-238	Quarterly	9	0	100%	±30

a. Blind standards were generally submitted in triplicate or quadruplicate.

b. Each result must be within the specified percentage of the known value to be acceptable.

Table D-15. Summary of TestAmerica Laboratories Double-Blind Spike Determinations

Constituent	Laboratory	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
General Chemical Parameters						
Specific conductance	St. Louis	Quarterly	9	0	100%	±25
Total organic carbon (potassium hydrogen phthalate spike)	St. Louis	Quarterly	12	2	83%	±25
Total organic halides (2,4,5-trichlorophenol spike)	St. Louis	Quarterly	11	0	100%	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene spike)	St. Louis	Quarterly	10	0	100%	±25
Ammonia and Anions						
Chloride	St. Louis	Quarterly	12	4	67%	±25
Cyanide	St. Louis	Quarterly	9	0	100%	±25
Fluoride	St. Louis	Quarterly	12	5	58%	±25
Nitrate as nitrogen	St. Louis	Quarterly	12	4	67%	±25
Nitrite as nitrogen	St. Louis	Semiannually	6	0	100%	±25
Metals						
Chromium (total)	St. Louis	Quarterly	18	0	100%	±20
Hexavalent chromium	Richland	Quarterly	21	6	71%	±20
Volatile Organic Compounds						
Carbon tetrachloride	St. Louis	Semiannually	6	1	83%	±25
Chloroform	St. Louis	Semiannually	6	0	100%	±25
Trichloroethene	St. Louis	Semiannually	6	3	50%	±25
Radiological Parameters						
Gross alpha (plutonium-239 spike)	Richland	Quarterly	6	0	100%	±30
Gross beta (strontium-90 spike)	Richland	Quarterly	9	0	100%	±30
Carbon-14	Richland	Annually	3	3	0%	±30
Cesium-137	Richland	Annually	3	0	100%	±30
Cobalt-60	Richland	Annually	3	0	100%	±30
Iodine-129	Richland	Semiannually	9	0	100%	±30
Neptunium-237	Richland	Annually	3	1	67%	±30
Nickel-63	Richland	Annually	3	0	100%	±30
Plutonium-239	Richland	Quarterly	9	1	89%	±30
Technetium-99	Richland	Quarterly	9	0	100%	±30
Tritium	Richland	Semiannually	9	0	100%	±30
Uranium-238	Richland	Quarterly	9	0	100%	±30

a. Blind standards were generally submitted in triplicate or quadruplicate.

b. Each result must be within the specified percentage of the known value to be acceptable.

Table D-16. Summary of Lionville Laboratory and Eberline Services Double-Blind Spike Determinations

Constituent	Laboratory	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limit[b] (%)
General Chemical Parameters						
Total organic carbon (potassium hydrogen phthalate spike)	Lionville	Quarterly	9	4	56%	±25
Ammonia and Anions						
Chloride	Lionville	Quarterly	9	0	100%	±25
Fluoride	Lionville	Quarterly	9	0	100%	±25
Nitrate as nitrogen	Lionville	Quarterly	6	3	50%	±25
Nitrite as nitrogen	Lionville	Semiannually	3	0	100%	±25
Radiological Parameters						
Gross alpha (plutonium-239 spike)	Eberline	Semiannually	3	1	67%	±30
Gross beta (strontium-90 spike)	Eberline	Quarterly	9	2	78%	±30
Carbon-14	Eberline	Annually	3	1	67%	±30
Cesium-137	Eberline	Annually	3	0	100%	±30
Cobalt-60	Eberline	Annually	3	0	100%	±30
Iodine-129	Eberline	Semiannually	9	6	33%	±30
Neptunium-237	Eberline	Annually	3	2	33%	±30
Nickel-63	Eberline	Annually	3	0	100%	±30
Plutonium-239	Eberline	Semiannually	6	2	67%	±30
Technetium-99	Eberline	Quarterly	6	3	50%	±30
Tritium	Eberline	Annually	3	0	100%	±30
Uranium-238	Eberline	Semiannually	6	2	67%	±30

a. Blind standards were generally submitted in triplicate or quadruplicate.

b. Each result must be within the specified percentage of the known value to be acceptable.

Table D-17. Percentage of Out-of-Limit Quality Control Results by Category, WSCF

QC Parameter	General Chemistry Parameters	Ammonia and Anions	Metals	VOC	SVOC	Radiological Parameters	Total
Method blanks	0.0	0.0	1.4	0.1	0.0	0.2	0.8
Laboratory control samples	0.2	0.0	0.2	0.0	7.8	1.8	0.4
Matrix spikes	1.6	0.5	0.5	0.3	20.1	0.5	0.9
Matrix duplicates	0.0	0.3	0.0	0.0	0.0	0.1	0.6
Surrogates	—	—	—	0.6	7.6	—	3.1

Notes: "Total" column indicates the number of QC out-of-limits divided by the total number of QC multiplied by 100.

Table D-18. Percentage of Out-of-Limit Quality Control Results by Category, TestAmerica Laboratories (Knoxville, Richland, and St. Louis)

QC Parameter	General Chemistry Parameters	Ammonia and Anions	Metals	VOC	SVOC	Radiological Parameters	Total
Method blanks	5.3	0.9	2.4	1.1	0.2	0.0	0.7
Laboratory control samples	0.0	0.4	0.4	2.4	2.2	1.2	2.0
Matrix spikes	2.0	9.0	2.2	9.3	6.5	0.0	7.6
Matrix duplicates	0.0	0.0	2.1	0.0	0.0	0.1	0.1
Surrogates	—	—	—	2.6	1.6	—	2.2

Notes: "Total" column indicates the number of QC out-of-limits divided by the total number of QC multiplied by 100.

Table D-19. Method Blank Results, WSCF

Constituent	Percent Out of Limit[a]	Number of Analyses	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total general chemistry parameters	0.0	288	—
Ammonia and Anions			
Total ammonia and anions	0.0	2,714	—
Metals			
Total metals	1.4	9,267	—
Aluminum (ICP)	1.5	134	36.2 – 97.0 µg/L
Calcium (ICP)	2.3	266	61.0 – 185.0 µg/L
Copper (ICP)	0.4	268	131.0 µg/L
Iron (ICP)	0.7	268	48.0 – 73.3 µg/L
Lead (ICP)	1.5	137	51.0 – 55.0 µg/L
Magnesium (ICP)	1.1	266	36.5 – 52.9 µg/L
Phosphorus (ICP)	1.5	135	122.0 – 159.0 µg/L
Potassium (ICP)	0.4	265	152.0 µg/L
Silicon (ICP)	16.1	137	55.0 – 342.0 µg/L
Sodium (ICP)	5.2	268	23.0 – 105.0 µg/L
Thallium (ICP)	0.7	136	75.0 µg/L
Vanadium (ICP)	0.4	267	25.0 µg/L
Zinc (ICP)	1.1	267	24.0 – 89.1 µg/L
Volatile Organic Compounds			
Total volatile organic compounds	0.1	3,482	—
Acetone[b]	0.8	133	400 µg/L
Methylene chloride[b]	0.8	133	54 µg/L
Semivolatile Organic Compounds			
Total semivolatile organic compounds	0.0	379	—
Radiological Parameters			
Total radiochemistry parameters	0.2	1,928	—
Total beta radiostrontium	1.8	226	4.2 – 4.3 pCi/L

a. The QC limits are twice the method detection limit.

b. The QC limits are five times the method detection limit.

Table D-20. Method Blank Results, TestAmerica Laboratories (Knoxville, Richland, and St. Louis)

Constituent	Percent Out of Limit[a]	Number of Analyses	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total general chemistry parameters	5.3	38	—
Specific conductance	100.0	2	0.2 – 0.51 µS/cm
Ammonia and Anions			
Total ammonia and anions	0.9	217	—
Chloride	2.9	35	0.044 mg/L
Phosphorus in phosphate	7.7	13	0.21 mg/L
Metals			
Total metals	2.4	1,154	—
Antimony (ICP)	2.7	37	10.1 µg/L
Arsenic (ICP)	11.8	17	5.8 – 9.3 µg/L
Boron (ICP)	5.9	17	44.4 µg/L
Iron (ICP)	2.7	37	58.1 µg/L
Lithium (ICP)	5.9	17	23.2 µg/L
Phosphorus (ICP)	12.5	8	152 µg/L
Potassium (ICP)	2.7	37	3320 µg/L
Selenium (ICP)	5.9	17	5.8 µg/L
Silicon (ICP)	5.9	17	127 µg/L
Zinc (ICP)	2.7	37	28.7 µg/L
Aluminum (ICP-MS)	7.1	14	70.3 µg/L
Arsenic (ICP-MS)	7.1	14	2.4 µg/L
Boron (ICP-MS)	100.0	1	60.4 µg/L
Copper (ICP-MS)	14.3	14	0.35 – 0.64 µg/L
Molybdenum (ICP-MS)	21.4	14	0.64 – 1.6 µg/L
Selenium (ICP-MS)	7.1	14	2.7 µg/L
Thallium (ICP-MS)	14.3	14	1.3 – 1.4 µg/L
Tin (ICP-MS)	42.9	14	0.62 – 2.5 µg/L
Volatile Organic Compounds			
Total volatile organic compounds	1.1	5,646	—
1,2-Dichloroethane	1.0	103	0.7 µg/L
1,4-Dichlorobenzene	1.9	103	0.35 – 0.64 µg/L
Acetone[b]	1.9	103	2.8 – 3.1 µg/L
Benzene	1.0	104	0.14 µg/L
Bromomethane	22.0	91	0.26 – 2.9 µg/L
Carbon disulfide	1.0	103	0.15 µg/L
Chloromethane	19.6	92	0.17 – 0.82 µg/L
Iodomethane	7.6	92	0.33 – 1.9 µg/L
Methylene chloride[b]	3.9	103	0.63 – 1.5 µg/L
Styrene	4.3	92	0.15 – 0.41 µg/L
Tetrachloroethene	1.0	104	0.21 µg/L
Trichloroethene	1.0	103	0.88 µg/L
Xylenes (total)	1.0	103	0.42 µg/L

Table D-20. (Cont.)

Constituent	Percent Out of Limit[a]	Number of Analyses	Concentration Range of Out-of-Limit Results
Semivolatile Organic Compounds			
Total semivolatile organic compounds	0.2	6,155	—
Aldrin	12.0	25	0.058 – 0.085 µg/L
Dibenz[a,h]anthracene	4.5	22	0.38 µg/L
Fluoranthene	4.5	22	0.13 µg/L
Fluorene	4.5	22	0.093 µg/L
Phenanthrene	9.1	22	0.073 – 0.32 µg/L
Pyrene	9.1	22	0.047 – 0.2 µg/L
Radiological Parameters			
Total radiochemistry parameters	0.0	1,318	—

a. The QC limits are twice the method detection limit.

b. The QC limits are five times the method detection limit.

Table D-21. Laboratory Control Samples, WSCF

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemistry parameters	0.2	513
Total petroleum hydrocarbons-diesel range	2.0	49
Ammonia and Anions		
Total ammonia and anions	0.0	2,731
Metals		
Total metals	0.2	9,221
Iron (ICP)	0.4	269
Phosphorus (ICP)	0.7	135
Potassium (ICP)	1.5	267
Silver (ICP)	0.4	268
Sodium (ICP)	0.4	266
Thallium (ICP)	4.4	137
Mercury (ICP-MS)	0.7	149
Volatile Organic Compounds		
Total volatile organic compounds	0.0	687
Semivolatile Organic Compounds		
Total semivolatile organic compounds	7.8	232
1,2,4-Trichlorobenzene	33.3	12
1,4-Dichlorobenzene	33.3	12
2-Picoline	10.0	10
4-Nitrophenol	10.0	10
Acenaphthene	18.2	11
n-Nitrosodi-n-dipropylamine	18.2	11
Pentachlorophenol	16.7	12
Phenol	20.0	10
Radiological Parameters		
Total radiochemistry parameters	1.8	1,162
Gross alpha	4.5	221
Gross beta	1.3	240
Plutonium-239/240	3.3	30
Total beta radiostrontium	2.1	195
Tritium	1.1	176
Uranium-238	5.9	17

Table D-22. Laboratory Control Samples, TestAmerica Laboratories (Knoxville, Richland, and St. Louis)

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemical parameters	0.0	44
Ammonia and Anions		
Total ammonia and anions	0.4	223
Cyanide	8.3	12
Metals		
Total metals	0.4	1,153
Beryllium	2.7	37
Phosphorus	12.5	8
Potassium	8.1	37
Volatile Organic Compounds		
Total volatile organic compounds	2.4	5,357
1,2-Dibromoethane	1.1	92
1,2-Dichloropropane	1.1	92
1,4-Dichlorobenzene	1.0	103
1,4-Dioxane	2.9	103
1-Butanol	2.9	103
Acetone	10.7	103
Acetonitrile	2.2	92
Acrolein	17.4	92
Benzene	1.0	103
Bromodichloromethane	1.1	92
Bromoform	4.3	92
Bromomethane	16.5	92
Carbon disulfide	5.8	103
Chloroethane	2.2	92
Chloromethane	6.5	92
cis-1,2-Dichloroethylene	1.0	103
cis-1,3-Dichloropropene	1.1	92
Dibromochloromethane	2.2	92
Dichlorodifluoromethane	1.1	92
Ethyl cyanide	2.9	103
Ethylbenzene	1.0	103
Iodomethane	12.0	92
Isobutyl alcohol	1.1	92
Methacrylonitrile	2.2	92
Methyl methacrylate	4.3	92
Methylene chloride	2.9	103
Styrene	2.2	92
Tetrachloroethene	3.9	103
Tetrahydrofuran	7.8	103
trans-1,3-Dichloropropene	3.3	92
trans-1,4-Dichloro-2-butene	2.2	92
Trichloroethene	1.0	104

Table D-22. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
Vinyl acetate	2.2	92
Vinyl chloride	1.0	103
Semivolatile Organic Compounds		
Total semivolatile organic compounds	2.2	3,438
2,3,4,6-Tetrachlorophenol	4.2	24
2,4,5-Trichlorophenol	4.2	24
2,4,6-Trichlorophenol	4.2	24
2,4-Dichlorophenol	4.2	24
2,4-Dimethylphenol	4.2	24
2,4-Dinitrophenol	12.5	24
2,6-Dichlorophenol	4.2	24
2-Chlorophenol	8.3	24
2-Methylphenol (cresol, o-)	4.2	24
2-Nitrophenol	4.2	24
3+4 Methylphenol (cresol, m+p)	4.2	24
4,6-Dinitro-2-methylphenol	4.2	24
4-Chloro-3-methylphenol	4.2	24
4-Nitrophenol	4.2	24
Dinoseb(2-secButyl-4,6-dinitrophenol)	4.2	24
Pentachlorophenol	4.2	24
Phenol	4.2	24
beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)	4.0	25
Delta-BHC	4.0	25
Heptachlor	4.0	25
1,2-Dichlorobenzene	2.9	34
1,3-Dichlorobenzene	2.9	34
1,4-Dichlorobenzene	2.8	36
2,4-Dichlorophenol	2.8	36
2-Nitrophenol	2.8	36
3+4 Methylphenol (cresol, m+p)	11.1	9
3-Nitroaniline	2.9	34
4-Chloroaniline	5.9	34
Bis(2-chloroethyl) ether	2.9	34
Hexachlorocyclopentadiene	2.9	34
Hexachloroethane	2.9	34
Acenaphthene	13.6	22
Acenaphthylene	18.2	22
Anthracene	9.1	22
Benzo(a)anthracene	4.5	22
Benzo(a)pyrene	4.5	22
Benzo(b)fluoranthene	13.6	22
Benzo(ghi)perylene	13.6	22
Benzo(k)fluoranthene	9.1	22

Table D-22. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
Chrysene	13.6	22
Dibenz[a,h]anthracene	18.2	22
Fluorene	18.2	22
Indeno(1,2,3-cd)pyrene	4.5	22
Naphthalene	18.2	22
Phenanthrene	4.5	22
Pyrene	13.6	22
Radiological Parameters		
Total radiochemistry parameters	1.2	674
Cobalt-60	10.0	10
Thorium-228	100.0	2
Thorium-232	100.0	2
Thorium-228	100.0	2
Thorium-232	100.0	1

Table D-23. Matrix Spikes and Matrix Spike Duplicates, WSCF

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemistry parameters	1.6	619
Total organic halides	0.7	286
Total organic carbon	0.8	241
Total petroleum hydrocarbons-diesel range	10.3	58
Ammonia and Anions		
Total ammonia and anions	0.5	3,531
Bromide	1.1	179
Fluoride	1.5	605
Nitrogen in nitrate	0.3	607
Nitrogen in nitrite	0.3	626
Phosphorus in phosphate	1.0	194
Sulfate	0.2	608
Metals		
Total metals	0.5	11,313
Barium (ICP)	0.5	417
Calcium (ICP)	0.2	458
Chromium (ICP)	0.5	415
Iron (ICP)	1.4	419
Magnesium (ICP)	0.7	461
Phosphorus (ICP)	0.8	124
Potassium (ICP)	2.1	419
Silver (ICP)	2.4	411
Sodium (ICP)	0.7	456
Strontium (ICP)	1.5	411
Thallium (ICP)	0.8	124
Zinc (ICP)	0.5	414
Barium (ICP-MS)	1.8	113
Chromium (ICP-MS)	3.5	114
Mercury (ICP-MS)	3.3	120
Hexavalent chromium	0.4	270
Volatile Organic Compounds		
Total volatile organic compounds	0.3	608
Ethanol	10.0	10
Methanol	16.7	6
Semivolatile Organic Compounds		
Total semivolatile organic compounds	20.1	299
1,2,4-Trichlorobenzene	41.2	17
1,4-Dichlorobenzene	43.8	16
2,4-Dichlorophenol	14.3	14
2,4-Dinitrotoluene	14.3	14

Table D-23. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
2-Chlorophenol	18.8	16
2-Methylphenol (cresol, o-)	14.3	14
2-Nitrophenol	15.4	13
2-Picoline	7.7	13
4-Chloro-3-methylphenol	15.4	13
4-Nitrophenol	57.1	14
Bis(2-ethylhexyl) phthalate	28.6	14
Pentachlorophenol	43.8	16
Phenol	46.2	13
Pyrene	14.3	14
Tributyl phosphate	13.3	15
Tris-2-chloroethyl phosphate	23.1	13
Radiological Parameters		
Total radiochemistry parameters	0.5	208
Tritium	0.9	117

Table D-24. Matrix Spikes and Matrix Spike Duplicates, TestAmerica Laboratories (Richland and St. Louis)

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemistry parameters	2.0	51
Total petroleum hydrocarbons-diesel range	8.3	12
Ammonia and Anions		
Total ammonia and anions	9.0	234
Chloride	5.3	38
Fluoride	2.6	39
Nitrogen in nitrate	7.7	39
Nitrogen in nitrite	5.1	39
Phosphorus in phosphate	78.6	14
Sulfate	5.1	39
Metals		
Total metals	2.2	2,412
Beryllium (ICP)	1.3	80
Bismuth (ICP)	6.3	32
Calcium (ICP)	7.5	80
Magnesium (ICP)	1.3	80
Phosphorus (ICP)	7.1	14
Potassium (ICP)	38.5	78
Silver (ICP)	3.8	78
Strontium (ICP)	2.5	80
Hexavalent chromium	4.3	94
Mercury (CVAA)	7.1	28
Volatile Organic Compounds		
Total volatile organic compounds	9.3	11,346
1,1,1,2-Tetrachloroethane	6.8	176
1,1,1-Trichloroethane	5.8	240
1,1,2,2-Tetrachloroethane	19.7	178
1,1,2-Trichloroethane	6.7	240
1,1-Dichloroethane	5.0	240
1,1-Dichloroethene	7.5	240
1,2-Dibromo-3-chloropropane	4.5	176
1,2-Dibromoethane	6.8	176
1,2-Dichloroethane	5.0	240
1,2-Dichloroethene (Total)	6.7	178
1,2-Dichloropropane	6.2	178
1,4-Dichlorobenzene	11.3	240
1,4-Dioxane	27.3	238
1-Butanol	22.9	240
2-Butanone	12.1	240
2-Hexanone	6.7	178

Table D-24. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
4-Methyl-2-pentanone	5.8	240
Acetone	18.3	240
Acetonitrile	17.4	178
Acrolein	40.9	176
Allyl chloride	6.2	178
Benzene	3.8	240
Bromodichloromethane	6.7	178
Bromoform	7.4	176
Bromomethane	28.7	178
Carbon disulfide	6.3	240
Carbon tetrachloride	6.8	236
Chlorobenzene	5.6	178
Chloroethane	7.9	178
Chloroform	5.0	240
Chloromethane	7.4	176
Chloroprene	4.5	178
cis-1,2-Dichloroethylene	5.8	240
cis-1,3-Dichloropropene	8.4	178
Dibromochloromethane	6.7	178
Dichlorodifluoromethane	3.9	178
Ethyl cyanide	9.2	240
Ethyl methacrylate	6.2	178
Ethylbenzene	5.4	240
Iodomethane	31.3	176
Isobutyl alcohol	15.7	178
Methacrylonitrile	5.1	178
Methyl methacrylate	3.9	178
Methylene chloride	4.2	238
Styrene	4.5	178
Tetrachloroethene	2.9	240
Tetrahydrofuran	14.6	240
Toluene	8.3	240
trans-1,2-Dichloroethylene	6.3	240
trans-1,3-Dichloropropene	6.7	178
trans-1,4-Dichloro-2-butene	11.9	176
Trichloroethene	5.0	240
Trichloromonofluoromethane	4.5	178
Vinyl acetate	8.4	178
Vinyl chloride	3.3	240
Semivolatile Organic Compounds		
Total semivolatile organic compounds	6.5	4,996
2,3,4,6-Tetrachlorophenol	8.3	48

Table D-24. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
2,4,5-Trichlorophenol	12.5	48
2,4,6-Trichlorophenol	4.2	48
2,4-Dichlorophenol	2.1	48
2,4-Dimethylphenol	12.5	48
2,4-Dinitrophenol	33.3	48
2,6-Dichlorophenol	12.5	48
2-Chlorophenol	8.3	48
2-Methylphenol (cresol, o-)	8.3	48
2-Nitrophenol	18.8	48
3+4 Methylphenol (cresol, m+p)	8.3	48
4,6-Dinitro-2-methylphenol	18.8	48
4-Chloro-3-methylphenol	12.5	48
4-Nitrophenol	20.8	48
Dinoseb (2-secButyl-4,6-dinitrophenol)	22.9	48
Pentachlorophenol	16.7	48
Phenol	8.3	48
4,4'-DDT (Dichlorodiphenyltrichloroethane)	2.1	48
Delta-BHC	4.2	48
Endosulfan II	4.2	48
Endosulfan sulfate	4.2	48
Endrin aldehyde	8.3	48
Heptachlor	18.8	48
Heptachlor epoxide	4.2	48
Methoxychlor	12.5	48
2,4-Dinitrophenol	6.8	44
3,3'-Dichlorobenzidine	9.1	44
3-Nitroaniline	4.5	44
4-Bromophenylphenyl ether	2.3	44
4-Chloroaniline	18.2	44
4-Nitrophenol	4.5	44
Benzo(a)pyrene	2.3	44
Benzo(ghi)perylene	4.5	44
Dibenz[a,h]anthracene	4.5	44
Hexachlorobenzene	4.5	44
Hexachlorocyclopentadiene	4.5	44
Hexachloroethane	9.1	44
Indeno(1,2,3-cd)pyrene	9.1	44
Pentachlorophenol	3.8	52
Phenol	7.7	52
Acenaphthene	25.0	32
Acenaphthylene	40.6	32

Table D-24. (Cont.)

Constituent	Percent Out of Limit	Number of Analyses
Anthracene	25.0	32
Benzo(a)anthracene	37.5	32
Benzo(a)pyrene	18.8	32
Benzo(b)fluoranthene	28.1	32
Benzo(ghi)perylene	25.0	32
Benzo(k)fluoranthene	18.8	32
Chrysene	37.5	32
Dibenz[a,h]anthracene	28.1	32
Fluoranthene	25.0	32
Fluorene	37.5	32
Indeno(1,2,3-cd)pyrene	21.9	32
Naphthalene	43.8	32
Phenanthrene	28.1	32
Pyrene	12.5	32
Radiological Parameters		
Total radiochemistry parameters	0.0	50

Table D-25. Matrix Duplicates, WSCF

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemistry parameters	0.0	147
Ammonia and Anions		
Total ammonia and anions	0.3	3,042
Bromide	1.5	203
Chloride	0.2	511
Fluoride	0.6	499
Nitrogen in nitrite	0.4	515
Metals		
Total metals	0.0	452
Volatile Organic Compounds		
Total volatile organic compounds	0.0	24
Semivolatile Organic Compounds		
Total semivolatile organic compounds	0.0	0
Radiological Parameters		
Total radiochemistry parameters	0.1	3,289
Gross alpha	3.1	258
Gross beta	3.9	283
Technetium-99	1.8	168
Total beta radiostrontium	2.5	202
Tritium	0.1	228

Table D-26. Matrix Duplicates, TestAmerica Laboratories (Richland and St. Louis)

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total general chemistry parameters	0.0	35
Ammonia and Anions		
Total ammonia and anions	0.0	257
Metals		
Total metals	2.1	47
Hexavalent chromium	2.1	47
Volatile Organic Compounds		
Total volatile organic compounds	0.0	0
Semivolatile Organic Compounds		
Total semivolatile organic compounds	0.0	0
Radiological Parameters		
Total radiochemistry parameters	0.1	1,291
Iodine-129	1.5	68

Table D-27. Summary of Issue Resolution Forms, Current Reporting Period

Issue Category	Number of Analyses Impacted				
	Prior to Receipt at Laboratory	After Receipt at WSCF	After Receipt at TA Laboratory[a]	After Receipt at Eberline Laboratory[b]	After Receipt at 222-S Laboratory
Hold time missed	57	156	3	--	31
Broken bottles	30	1	--	--	--
Canceled analysis	--	19	4	2	--
Temperature deviation	21	6	--	--	--
Addition of analysis	--	1	--	1	--
Chain-of-custody form issues	99	--	--	--	--
Laboratory QC out of limits/ incomplete	--	87	30	36	16
Incorrect preservation of the sample	4	--	1	--	--
Analytical preparation deviations/method failures/ discontinued analyses	9	13	12	--	36
Insufficient volume	1	--	1	--	--
Late analysis	--	--	8	--	--
Totals	**221**	**283**	**66**	**39**	**83**

a. Includes data from TA St. Louis and TA Richland Laboratories

b. Includes data from Eberline and Lionville Laboratories

Table D-28. Summary of Analytical Laboratory Detection/Quantitation Limits Determined from Field Blanks Data, TestAmerica Laboratories (Richland and St. Louis) and WSCF

Period[a]	Number of Samples	Mean	Standard Deviation	Limit of Detection[c]	Limit of Quantitation[c]
Total Organic Carbon (µg/L)					
4/8/09 to 3/25/10	70	-35.16	113.0	339	1,130
7/23/09 to 6/13/10	83	-19.54	104.3	313	1,040
10/4/09 to 9/20/10	92	-12.10	98.83	296	988
1/12/10 to 12/16/10	83	-23.77	21.00	63	210
Summary	**83**	**-23.77**	**21.00**	**63**	**210**
Total Organic Halides (µg/L)					
4/10/09 to1/6/10	64	1.38	1.14	3.4	11.4
7/23/09 to 6/13/10	77	1.37	1.20	3.6	12.0
10/4/09 to 9/20/10	86	1.31	1.21	3.6	12.1
1/6/10 to 12/2/10	78	1.37	1.18	3.5	11.8
Summary	**78**	**1.37**	**1.18**	**3.5**	**11.8**
Cesium-137 (pCi/L)					
1/6/10 to 3/31/10	19	0.56	2.75	8.24	27.5
4/9/10 to 6/22/10	17	0.77	2.24	6.73	22.4
7/12/10 to 9/23/10	21	-0.67	2.52	7.55	25.2
11/10/10 to 12/20/10	11	0.81	3.55	10.64	35.5
Summary	**68**	**0.27**	**2.71**	**8.12**	**27.1**
Constituent: Cobalt-60 (pCi/L)					
1/6/10 to 3/31/10	15	0.78	1.93	5.78	19.3
4/9/10 to 6/22/10	17	0.00	0.94	2.83	9.44
7/12/10 to 9/23/10	20	-0.94	2.44	7.31	24.4
11/10/10 to 12/20/10	11	0.33	1.55	4.65	15.5
Summary	**63**	**-0.05**	**1.85**	**5.56**	**18.5**
Europium-152 (pCi/L)					
1/6/10 to 3/31/10	15	2.46	5.73	17.2	57.3
4/9/10 to 6/22/10	17	-1.93	6.44	19.3	64.4
7/12/10 to 9/23/10	20	-0.62	7.60	22.8	76.0
11/10/10 to 12/20/10	11	-2.55	6.49	19.5	64.9
Summary	**63**	**-0.58**	**6.69**	**20.1**	**66.9**
Europium-154 (pCi/L)					
1/6/10 to 3/31/10	19	-0.08	9.43	28.3	94.3
4/9/10 to 6/22/10	17	0.42	3.28	9.8	32.8
7/12/10 to 9/23/10	20	1.99	5.17	15.5	51.7
11/10/10 to 12/20/10	11	-0.61	3.74	11.2	37.4
Summary	**67**	**0.58**	**6.20**	**18.6**	**62.0**
Europium-155 (pCi/L)					
1/6/10 to 3/31/10	15	1.06	6.27	18.8	62.7
4/9/10 to 6/22/10	17	0.48	3.24	9.71	32.4
7/12/10 to 9/23/10	20	1.46	9.18	27.5	91.8
11/10/10 to 12/20/10	11	2.36	3.67	11.0	36.7
Summary	**63**	**1.26**	**6.45**	**19.4**	**64.5**

Table D-28. (Cont.)

Period[a]	Number of Samples	Mean	Standard Deviation	Limit of Detection[c]	Limit of Quantitation[c]
Gross Alpha (pCi/L)					
1/4/10 to 3/31/10	21	0.06	0.80	2.40	7.99
4/9/10 to 6/14/10	24	0.43	1.18	3.54	11.8
7/12/10 to 9/23/10	22	0.16	1.11	3.32	11.1
11/10/10 to 12/27/10	15	0.16	0.90	2.70	9.00
Summary	**82**	**0.21**	**1.02**	**3.07**	**10.2**
Gross Beta (pCi/L)					
1/4/10 to 3/31/10	23[b]	1.23	1.32	3.96	13.2
4/9/10 to 6/28/10	26[b]	0.14	1.05	3.16	10.5
7/12/10 to 9/23/10	24[b]	0.70	1.50	4.51	15.0
11/10/10 to 12/27/10	16	1.34	1.87	5.61	18.7
Summary	**89[b]**	**0.79**	**1.42**	**4.25**	**14.2**
Iodine-129 (pCi/L)					
1/6/10 to 3/28/10	13	0.04	0.06	0.19	0.62
4/6/10 to 6/7/10	12	0.05	0.11	0.32	1.06
7/6/10 to 9/23/10	15[b]	0.01	0.04	0.12	0.38
11/10/10 to 12/20/10	13	-0.03	0.04	0.13	0.42
Summary	**53[b]**	**0.02**	**0.07**	**0.20**	**0.66**
Total Beta Radiostrontium (pCi/L)					
1/6/10 to 3/31/10	16	-2.82	3.63	10.90	36.3
4/9/10 to 6/30/10	16	-2.25	2.89	8.68	28.9
7/8/10 to 9/23/10	21	-3.95	3.59	10.76	35.9
11/3/10 to 12/30/10	20	-5.21	3.15	9.44	31.5
Summary	**73**	**-3.85**	**3.34**	**10.02**	**33.4**
Technetium-99 (pCi/L)					
1/6/10 to 3/31/10	18[b]	-5.28	5.83	17.49	58.3
4/5/10 to 6/14/10	23	-6.98	3.90	11.69	39.0
7/6/10 to 9/23/10	22[b]	-2.95	3.40	10.20	34.0
10/10/10 to 12/27/10	17	-3.34	3.59	10.77	35.9
Summary	**80[b]**	**-4.72**	**4.23**	**12.69**	**42.3**
Tritium (pCi/L)					
1/4/10 to 3/31/10	24[b]	70.2	136	407	1,360
4/5/10 to 6/30/10	32	33.4	93.1	279	931
7/6/10 to 9/23/10	35	22.6	72.0	216	720
11/3/10 to 12/30/10	24	87.2	183	550	1,830
Summary	**115[b]**	**49.0**	**122**	**365**	**1,220**

a. Time period covered for total organic carbon and total organic halides is a moving average of four quarters.

b. Excluded outliers.

c. Limit of detection (blank corrected) equals three times the blank standard deviation; limit of quantitation (blank-corrected) equals ten times the blank standard deviation. Numbers are rounded.

Table D-29. Summary of Detection and Quantitation Limits, WSCF

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
EPA-410.4	Chemical oxygen demand	10	13.50	45.86	--	--	--	--
Anions								
EPA-600/R-93/100, 300.0[b]	Bromide	45	60.76	206.37	8/10/10	54	72.92	247.64
EPA-600/R-93/100, 300.0[b]	Chloride	43	58.06	197.20	12/30/10	84	113.43	385.22
EPA-600/R-93/100, 300.0[b]	Fluoride	30	40.51	137.58	12/30/10	88	118.83	403.57
EPA-600/R-93/100, 300.0[b]	Nitrogen in nitrate	31	41.86	142.17	12/30/10	19	25.66	87.13
EPA-600/R-93/100, 300.0[b]	Nitrogen in nitrite	18	24.31	82.55	12/30/10	36	48.61	165.10
EPA-600/R-93/100, 300.0[b]	Phosphorus in phosphate	70	94.52	321.02	8/10/10	72	97.22	330.19
EPA-600/R-93/100, 300.0[b]	Sulfate	66	89.12	302.68	12/30/10	170	229.55	779.62
EPA-600/R-93/100, 335.2	Cyanide	4	5.40	18.34	--	--	--	--
Metals								
EPA-600/R-94/111, 200.8	Aluminum	5	6.75	22.93	--	--	--	--
EPA-600/R-94/111, 200.8	Antimony	0.3	0.41	1.38	--	--	--	--
EPA-600/R-94/111, 200.8	Arsenic	0.4	0.54	1.83	--	--	--	--
EPA-600/R-94/111, 200.8	Barium	0.2	0.27	0.92	--	--	--	--
EPA-600/R-94/111, 200.8	Beryllium	0.05	0.07	0.23	9/13/10	0.1	0.14	0.46
EPA-600/R-94/111, 200.8	Cadmium	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Chromium	0.5	0.68	2.29	--	--	--	--
EPA-600/R-94/111, 200.8	Cobalt	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Copper	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Lead	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Manganese	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Mercury	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Molybdenum	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Nickel	0.2	0.27	0.92	--	--	--	--
EPA-600/R-94/111, 200.8	Selenium	0.3	0.41	1.38	--	--	--	--
EPA-600/R-94/111, 200.8	Silver	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Strontium	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Thallium	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Thorium	0.1	0.14	0.46	--	--	--	--
EPA-600/R-94/111, 200.8	Tin	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Uranium	0.05	0.07	0.23	--	--	--	--
EPA-600/R-94/111, 200.8	Vanadium	0.2	0.27	0.92	--	--	--	--
EPA-600/R-94/111, 200.8	Zinc	0.8	1.08	3.67	--	--	--	--
SW-846, 6010	Aluminum	17	22.96	77.96	9/1/10	19	25.66	87.13
SW-846, 6010	Antimony	38	51.31	174.27	9/1/10	47	63.46	215.54
SW-846, 6010	Arsenic	65	87.77	298.09	9/1/10	50	67.52	229.30
SW-846, 6010	Barium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Beryllium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Bismuth	23	31.06	105.48	9/1/10	37	49.96	169.68
SW-846, 6010	Boron	19	25.66	87.13	9/1/10	41	55.36	188.03

Table D-29. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Cadmium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Calcium	39	52.66	178.85	9/23/10	28	37.81	128.41
SW-846, 6010	Chromium	13	17.55	59.62	9/1/10	14	18.90	64.20
SW-846, 6010	Cobalt	4	5.40	18.34	--	--	--	--
SW-846, 6010	Copper	4	5.40	18.34	9/1/10	5	6.75	22.93
SW-846, 6010	Iron	18	24.31	82.55	9/1/10	38	51.31	174.27
SW-846, 6010	Lead	23	31.06	105.48	9/1/10	42	56.71	192.61
SW-846, 6010	Lithium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Magnesium	16	21.61	73.38	9/1/10	14	18.90	64.20
SW-846, 6010	Manganese	4	5.40	18.34	9/1/10	6	8.10	27.52
SW-846, 6010	Molybdenum	4	5.40	18.34	--	--	--	--
SW-846, 6010	Nickel	4	5.40	18.34	--	--	--	--
SW-846, 6010	Phosphorus	55	74.27	252.23	9/1/10	72	97.22	330.19
SW-846, 6010	Potassium	55	74.27	252.23	9/1/10	73	98.57	334.78
SW-846, 6010	Selenium	45	60.76	206.37	9/1/10	47	63.46	215.54
SW-846, 6010	Silicon	61	82.37	279.75	9/1/10	25	33.76	114.65
SW-846, 6010	Silver	5	6.75	22.93	9/1/10	7	9.45	32.10
SW-846, 6010	Sodium	23	31.06	105.48	9/1/10	11	14.85	50.45
SW-846, 6010	Strontium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Thallium	35	47.26	160.51	9/1/10	49	66.17	224.71
SW-846, 6010	Tin	39	52.66	178.85	9/1/10	49	66.17	224.71
SW-846, 6010	Titanium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Vanadium	12	16.20	55.03	9/1/10	17	22.96	77.96
SW-846, 6010	Zinc	6	8.10	27.52	9/1/10	4	5.40	18.34
EPA-7196	Hexavalent chromium	2	2.70	9.17	--	--	--	--
Volatile Organic Compounds								
SW-846, 8260	1,1,1-Trichloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8260	1,1,2-Trichloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8260	1,1-Dichloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8260	1,1-Dichloroethene	1	1.35	4.59	--	--	--	--
SW-846, 8260	1,2-Dichloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8260	1,4-Dichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8260	1-Butanol	100	135.03	458.60	--	--	--	--
SW-846, 8260	2-Butanone	1	1.35	4.59	--	--	--	--
SW-846, 8260	4-Methyl-2-pentanone	1	1.35	4.59	--	--	--	--
SW-846, 8260	Acetone	1	1.35	4.59	--	--	--	--
SW-846, 8260	Benzene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Carbon disulfide	1	1.35	4.59	--	--	--	--
SW-846, 8260	Carbon tetrachloride	1	1.35	4.59	--	--	--	--
SW-846, 8260	Chlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Chloroform	1	1.35	4.59	--	--	--	--

Table D-29. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	cis-1,2-Dichloroethylene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Dibromochloromethane	1	1.35	4.59	--	--	--	--
SW-846, 8260	Ethyl cyanide	2	2.70	9.17	--	--	--	--
SW-846, 8260	Ethylbenzene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Methylene chloride	1	1.35	4.59	--	--	--	--
SW-846, 8260	Tetrachloroethene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Tetrahydrofuran	2	2.70	9.17	--	--	--	--
SW-846, 8260	Toluene	1	1.35	4.59	--	--	--	--
SW-846, 8260	trans-1,2-Dichloroethylene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Trichloroethene	1	1.35	4.59	--	--	--	--
SW-846, 8260	Vinyl chloride	1	1.35	4.59	--	--	--	--
SW-846, 8260	Xylenes (total)	1	1.35	4.59	--	--	--	--
SW-846, 8015	1-Propanol	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Diethyl ether	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Ethanol	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Ethyl acetate	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Ethylene glycol	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Methanol	2,000	2,700.64	9,171.97	--	--	--	--
SW-846, 8015	Total petroleum hydrocarbons-gasoline fraction	50	67.52	229.30	--	--	--	--
Semivolatile Organic Compounds								
SW-846, 8015	Total petroleum hydrocarbons-diesel fraction	80	108.03	366.88	--	--	--	--
SW-846, 8015	Total petroleum hydrocarbons-kerosene fraction	80	108.03	366.88	--	--	--	--
EPA-8082	Aroclor-1016	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1221	0.2	0.27	0.92	--	--	--	--
EPA-8082	Aroclor-1232	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1242	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1248	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1254	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1260	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1262	0.1	0.14	0.46	--	--	--	--
EPA-8082	Aroclor-1268	0.1	0.14	0.46	--	--	--	--
SW-846, 8270	1,2,4-Trichlorobenzene	0.7	0.95	3.21	1/20/10	1	1.35	4.59
SW-846, 8270	1,4-Dichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,3,4,6-Tetrachlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4,5-Trichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4,6-Trichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dichlorophenol	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	2,4-Dimethylphenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dinitrophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dinitrotoluene	0.5	0.68	2.29	1/20/10	1	1.35	4.59

Table D-29. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	2,6-Dichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Chlorophenol	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	2-Methylphenol (cresol, o-)	0.9	1.22	4.13	1/20/10	1	1.35	4.59
SW-846, 8270	2-Nitrophenol	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	2-Picoline	1	1.35	4.59	--	--	--	--
SW-846, 8270	3+4 Methylphenol (cresol, m+p)	0.7	0.95	3.21	1/20/10	1	1.35	4.59
SW-846, 8270	4,6-Dinitro-2-methylphenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Chloro-3-methylphenol	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	4-Nitrophenol	0.6	0.81	2.75	1/20/10	1	1.35	4.59
SW-846, 8270	Acenaphthene	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	Benzothiazole	0.6	0.81	2.75	1/20/10	1	1.35	4.59
SW-846, 8270	Bis(2-ethylhexyl) phthalate	0.8	1.08	3.67	1/20/10	1	1.35	4.59
SW-846, 8270	Dinoseb(2-secButyl-4,6-dinitrophenol)	1	1.35	4.59	--	--	--	--
SW-846, 8270	Naphthalene	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	n-Nitrosodimethylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosodi-n-dipropylamine	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	Pentachlorophenol	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	Phenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pyrene	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	Total cresols	1	1.35	4.59	--	--	--	--
SW-846, 8270	Tributyl phosphate	0.5	0.68	2.29	1/20/10	1	1.35	4.59
SW-846, 8270	Tris-2-chloroethyl phosphate	0.5	0.68	2.29	1/20/10	1	1.35	4.59

a. The MDLs for many constituents changed during the fiscal year. For these constituents, the initial MDL, LOD, and LOQ were in effect until the date the values were updated (ending values, effective date). In cases where the MDL did not change, no ending values are listed.

b. Units for this method are mg/L

c. Additional MDLs were used during the year for these compounds.

LOD = limit of detection

LOQ = limit of quantitation

MDL = method detection limit

Table D-30. Summary of Detection and Quantitation Units, TestAmerica Laboratories

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
EPA-600/4-81-004, 120.1	Specific conductance[b]	0.097	0.13	0.44	--	--	--	--
EPA-600/4-81-004, 310.1	Alkalinity	540	729.17	2,476.43	--	--	--	--
EPA-600/4-81-004, 413.1	Oil and grease	2,100	2,835.67	9,630.57	--	--	--	--
Anions								
EPA-600/R-93/100, 300.0[c]	Bromide	25	33.76	114.65	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Chloride	20	27.01	91.72	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Fluoride	10	13.50	45.86	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Nitrogen in nitrate	8.6	11.61	39.44	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Nitrogen in nitrite	3	4.05	13.76	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Phosphorus in phosphate	54	72.92	247.64	--	--	--	--
EPA-600/R-93/100, 300.0[c]	Sulfate	50	67.52	229.30	--	--	--	--
SW-846, 9012	Cyanide	3.6	4.86	16.51	--	--	--	--
SW-846, 9030[c]	Sulfide	83	112.08	380.64	--	--	--	--
Metals								
SW-846, 6010	Aluminum	79.9	107.89	366.42	--	--	--	--
SW-846, 6010	Antimony	4	5.40	18.34	--	--	--	--
SW-846, 6010	Arsenic	2	2.70	9.17	9/27/10	2.7	3.65	12.38
SW-846, 6010	Barium	4	5.40	18.34	--	--	--	--
SW-846, 6010	Beryllium	0.61	0.82	2.80	--	--	--	--
SW-846, 6010	Bismuth	105	141.78	481.53	--	--	--	--
SW-846, 6010	Boron	10.8	14.58	49.53	--	--	--	--
SW-846, 6010	Cadmium	0.91	1.23	4.17	--	--	--	--
SW-846, 6010	Calcium	106	143.13	486.11	--	--	--	--
SW-846, 6010	Chromium	3.1	4.19	14.22	--	--	--	--
SW-846, 6010	Cobalt	4	5.40	18.34	--	--	--	--
SW-846, 6010	Copper	4.6	6.21	21.10	3/19/10	4.6	6.21	21.10
SW-846, 6010	Iron	28.2	38.08	129.32	--	--	--	--
SW-846, 6010	Lead	1.3	1.76	5.96	--	--	--	--
SW-846, 6010	Lithium	9.6	12.96	44.03	--	--	--	--
SW-846, 6010	Magnesium	132	178.24	605.35	--	--	--	--
SW-846, 6010	Manganese	3.3	4.46	15.13	3/19/10	3.3	4.46	15.13
SW-846, 6010	Molybdenum	5	6.75	22.93	--	--	--	--
SW-846, 6010	Nickel	13.3	17.96	60.99	--	--	--	--
SW-846, 6010	Phosphorus	41.6	56.17	190.78	9/28/10	75	101.27	343.95
SW-846, 6010	Potassium	1,650	2,228.03	7,566.88	--	--	--	--
SW-846, 6010	Selenium	2.7	3.65	12.38	9/27/10	5	6.75	22.93
SW-846, 6010	Silicon	40	54.01	183.44	--	--	--	--
SW-846, 6010	Silver	6	8.10	27.52	--	--	--	--
SW-846, 6010	Sodium	324	437.50	1,485.86	--	--	--	--
SW-846, 6010	Strontium	0.54	0.73	2.48	--	--	--	--
SW-846, 6010	Thallium	4	5.40	18.34	--	--	--	--

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Tin	13.5	18.23	61.91	--	--	--	--
SW-846, 6010	Vanadium	4.1	5.54	18.80	--	--	--	--
SW-846, 6010	Zinc	5.2	7.02	23.85	9/27/10	7	9.45	32.10
SW-846, 6020	Aluminum	4.5	6.08	20.64	8/6/10	8.3	11.21	38.06
SW-846, 6020	Antimony	1.1	1.49	5.04	--	--	--	--
SW-846, 6020	Arsenic	0.95	1.28	4.36	--	--	--	--
SW-846, 6020	Barium	0.2	0.27	0.92	--	--	--	--
SW-846, 6020	Beryllium	0.11	0.15	0.50	8/6/10	0.35	0.47	1.61
SW-846, 6020	Boron	7.5	10.13	34.39	--	--	--	--
SW-846, 6020	Cadmium	0.055	0.07	0.25	--	--	--	--
SW-846, 6020	Calcium	68.1	91.96	312.31	--	--	--	--
SW-846, 6020	Chromium	3.3	4.46	15.13	--	--	--	--
SW-846, 6020	Cobalt	0.22	0.30	1.01	--	--	--	--
SW-846, 6020	Copper	0.097	0.13	0.44	8/6/10	0.45	0.61	2.06
SW-846, 6020	Iron	20.4	27.55	93.55	--	--	--	--
SW-846, 6020	Lead	0.17	0.23	0.78	--	--	--	--
SW-846, 6020	Magnesium	1.7	2.30	7.80	--	--	--	--
SW-846, 6020	Manganese	0.24	0.32	1.10	--	--	--	--
SW-846, 6020	Molybdenum	0.22	0.30	1.01	9/28/10	0.41	0.55	1.88
SW-846, 6020	Nickel	0.4	0.54	1.83	--	--	--	--
SW-846, 6020	Phosphorus	8.2	11.07	37.61	--	--	--	--
SW-846, 6020	Potassium	8.3	11.21	38.06	--	--	--	--
SW-846, 6020	Selenium	0.31	0.42	1.42	8/6/10	1.3	1.76	5.96
SW-846, 6020	Silicon	17.8	24.04	81.63	--	--	--	--
SW-846, 6020	Silver	0.04	0.05	0.18	--	--	--	--
SW-846, 6020	Sodium	15	20.25	68.79	--	--	--	--
SW-846, 6020	Strontium	0.15	0.20	0.69	--	--	--	--
SW-846, 6020	Thallium	0.55	0.74	2.52	--	--	--	--
SW-846, 6020	Tin	0.15	0.20	0.69	9/28/10	1	1.35	4.59
SW-846, 6020	Titanium	1	1.35	4.59	--	--	--	--
SW-846, 6020	Vanadium	2.4	3.24	11.01	--	--	--	--
SW-846, 6020	Zinc	8.3	11.21	38.06	--	--	--	--
EPA-7196	Hexavalent chromium	3.7	5.00	16.97	--	--	--	--
EPA-7074	Mercury	0.016	0.02	0.07	--	--	--	--
Volatile Organic Compounds								
SW-846, 8015	Ethanol	670	904.71	3,072.61				
SW-846, 8015	Ethylene glycol	2,100	2,835.67	9,630.57				
SW-846, 8015	Methanol	1,100	1,485.35	5,044.59	--	--	--	--
SW-846, 8260	1,1,1,2-Tetrachloroethane	0.09	0.12	0.41	--	--	--	--
SW-846, 8260	1,1,1-Trichloroethane	0.067	0.09	0.31	5/3/10	0.069	0.09	0.32
SW-846, 8260	1,1,2,2-Tetrachloroethane	0.098	0.13	0.45	--	--	--	--
SW-846, 8260	1,1,2-Trichloroethane	0.063	0.09	0.29	5/3/10	0.15	0.20	0.69

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	1,1-Dichloroethane	0.068	0.09	0.31	--	--	--	--
SW-846, 8260	1,1-Dichloroethene	0.051	0.07	0.23	5/3/10	0.083	0.11	0.38
SW-846, 8260	1,2,3-Trichloropropane	0.15	0.20	0.69	--	--	--	--
SW-846, 8260	1,2-Dibromo-3-chloropropane	0.41	0.55	1.88	--	--	--	--
SW-846, 8260	1,2-Dibromoethane	0.13	0.18	0.60	--	--	--	--
SW-846, 8260	1,2-Dichloroethane	0.1	0.14	0.46	--	--	--	--
SW-846, 8260	1,2-Dichloroethene (Total)	0.13	0.18	0.60	5/3/10	0.15	0.20	0.69
SW-846, 8260	1,2-Dichloropropane	0.097	0.13	0.44	--	--	--	--
SW-846, 8260	1,4-Dichlorobenzene	0.12	0.16	0.55	--	--	--	--
SW-846, 8260	1,4-Dioxane	7.6	10.26	34.85	5/3/10	7.6	10.26	34.85
SW-846, 8260	1-Butanol	12	16.20	55.03	--	--	--	--
SW-846, 8260	2-Butanone	0.52	0.70	2.38	--	--	--	--
SW-846, 8260	2-Hexanone	0.22	0.30	1.01	--	--	--	--
SW-846, 8260	4-Methyl-2-pentanone	0.12	0.16	0.55	--	--	--	--
SW-846, 8260	Acetone	0.34	0.46	1.56	--	--	--	--
SW-846, 8260	Acetonitrile	2	2.70	9.17	--	--	--	--
SW-846, 8260	Acrolein	2.8	3.78	12.84	--	--	--	--
SW-846, 8260	Acrylonitrile	0.58	0.78	2.66	--	--	--	--
SW-846, 8260	Allyl chloride	0.091	0.12	0.42	5/3/10	0.11	0.15	0.50
SW-846, 8260	Benzene	0.045	0.06	0.21	5/3/10	0.06	0.09	0.29
SW-846, 8260	Bromodichloromethane	0.082	0.11	0.38	5/3/10	0.09	0.12	0.40
SW-846, 8260	Bromoform	0.094	0.13	0.43	5/3/10	0.17	0.23	0.78
SW-846, 8260	Bromomethane	0.084	0.11	0.39	7/2110	0.25	0.34	1.15
SW-846, 8260	Carbon disulfide	0.05	0.07	0.23	5/3/10	0.05	0.07	0.23
SW-846, 8260	Carbon tetrachloride	0.063	0.09	0.29	5/3/10	0.12	0.16	0.55
SW-846, 8260	Chlorobenzene	0.15	0.20	0.69	--	--	--	--
SW-846, 8260	Chloroethane	0.085	0.11	0.39	5/3/10	0.10	0.13	0.45
SW-846, 8260	Chloroform	0.1	0.14	0.46	--	--	--	--
SW-846, 8260	Chloromethane	0.077	0.10	0.35	--	--	--	--
SW-846, 8260	Chloroprene	0.086	0.12	0.39	5/3/10	0.10	0.13	0.44
SW-846, 8260	cis-1,2-Dichloroethylene	0.14	0.19	0.64	5/3/10	0.09	0.12	0.40
SW-846, 8260	cis-1,3-Dichloropropene	0.073	0.10	0.33	--	--	--	--
SW-846, 8260	Dibromochloromethane	0.057	0.08	0.26	5/3/10	0.13	0.18	0.60
SW-846, 8260	Dibromomethane	0.21	0.28	0.96	--	--	--	--
SW-846, 8260	Dichlorodifluoromethane	0.07	0.09	0.32	5/3/10	0.08	0.11	0.39
SW-846, 8260	Ethyl cyanide	2.1	2.84	9.63	5/3/10	1.40	1.89	6.42
SW-846, 8260	Ethyl methacrylate	0.11	0.15	0.50	--	--	--	--
SW-846, 8260	Ethylbenzene	0.11	0.15	0.50	3/3/10	0.09	0.12	0.39
SW-846, 8260	Iodomethane	0.092	0.12	0.42	--	--	--	--
SW-846, 8260	Isobutyl alcohol	8.7	11.75	39.90	--	--	--	--
SW-846, 8260	Methacrylonitrile	0.05	0.07	0.23	5/3/10	0.50	0.68	2.29
SW-846, 8260	Methyl methacrylate	0.26	0.35	1.19	--	--	--	--

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	Methylene chloride	0.1	0.14	0.46	3/3/10	0.11	0.15	0.50
SW-846, 8260	Styrene	0.036	0.05	0.17	5/3/10	0.07	0.10	0.34
SW-846, 8260	Tetrachloroethene	0.065	0.09	0.30	5/3/10	0.18	0.24	0.83
SW-846, 8260	Tetrahydrofuran	7.5	10.13	34.39	3/3/10	1.10	1.49	5.04
SW-846, 8260	Toluene	0.07	0.09	0.32	5/3/10	0.07	0.10	0.33
SW-846, 8260	trans-1,2-Dichloroethylene	0.081	0.11	0.37	3/3/10	0.08	0.11	0.38
SW-846, 8260	trans-1,3-Dichloropropene	0.083	0.11	0.38	--	--	--	--
SW-846, 8260	trans-1,4-Dichloro-2-butene	0.29	0.39	1.33	--	--	--	--
SW-846, 8260	Trichloroethene	0.091	0.12	0.42	7/21/10	0.25	0.34	1.15
SW-846, 8260	Trichloromonofluoromethane	0.041	0.06	0.19	5/3/10	0.11	0.15	0.50
SW-846, 8260	Vinyl acetate	0.17	0.23	0.78	5/3/10	0.18	0.24	0.83
SW-846, 8260	Vinyl chloride	0.091	0.12	0.42	5/3/10	0.084	0.11	0.39
SW-846, 8260	Xylenes (total)	0.22	0.30	1.01	5/3/10	0.2	0.27	0.92
EPA-RSK-175	Methane	0.22	0.30	1.01	--	--	--	--
SW-846, 8015	Total petroleum hydrocarbons-gasoline fraction	10	13.50	45.86	--	--	--	--
Semivolatile Organic Compounds								
SW-846, 8015	Total petroleum hydrocarbons-diesel fraction	17	22.96	77.96	--	--	--	--
SW-846, 8015	Total petroleum hydrocarbons-kerosene fraction	10	13.50	45.86	--	--	--	--
SW-846, 8040	2,3,4,6-Tetrachlorophenol	2	2.70	9.17	--	--	--	--
SW-846, 8040	2,4,5-Trichlorophenol	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	2,4,6-Trichlorophenol	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	2,4-Dichlorophenol	2.1	2.84	9.63	--	--	--	--
SW-846, 8040	2,4-Dimethylphenol	2.1	2.84	9.63	--	--	--	--
SW-846, 8040	2,4-Dinitrophenol	2.4	3.24	11.01	--	--	--	--
SW-846, 8040	2,6-Dichlorophenol	2.1	2.84	9.63	--	--	--	--
SW-846, 8040	2-Chlorophenol	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	2-Methylphenol (cresol, o-)	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	2-Nitrophenol	2.3	3.11	10.55	4/26/10	2.3	3.11	10.55
SW-846, 8040	3+4 Methylphenol (cresol, m+p)	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	4,6-Dinitro-2-methylphenol	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	4-Chloro-3-methylphenol	2.4	3.24	11.01	--	--	--	--
SW-846, 8040	4-Nitrophenol	2.2	2.97	10.09	--	--	--	--
SW-846, 8040	Dinoseb(2-secButyl-4,6-dinitro-phenol)	2.4	3.24	11.01	--	--	--	--
SW-846, 8040	Pentachlorophenol	2.4	3.24	11.01	--	--	--	--
SW-846, 8040	Phenol	2.3	3.11	10.55	4/26/10	2.3	3.11	10.55
SW-846, 8081	4,4'-DDD (Dichlorodiphenyldi-chloroethane)	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	4,4'-DDE (Dichlorodiphenyldi-chloroethylene)	0.02	0.03	0.09	8/31/10	0.01	0.01	0.05

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8081	4,4'-DDT (Dichlorodiphenyltri-chloroethane)	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Aldrin	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Alpha-BHC	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	beta-1,2,3,4,5,6-Hexachlorocy-clohexane (beta-BHC)	0.01	0.01	0.05	8/31/10	0.013	0.02	0.06
SW-846, 8081	Chlordane	0.04	0.05	0.18	8/31/10	0.23	0.31	1.05
SW-846, 8081	Delta-BHC	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Dieldrin	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Endosulfan I	0.02	0.03	0.09	8/31/10	0.01	0.01	0.05
SW-846, 8081	Endosulfan II	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Endosulfan sulfate	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Endrin	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Endrin aldehyde	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Gamma-BHC (Lindane)	0.003	0.00	0.01	8/31/10	0.01	0.01	0.05
SW-846, 8081	Heptachlor	0.003	0.00	0.01	8/31/10	0.01	0.01	0.05
SW-846, 8081	Heptachlor epoxide	0.01	0.01	0.05	--	--	--	--
SW-846, 8081	Methoxychlor	0.001	0.00	0.00	8/31/10	0.01	0.01	0.05
SW-846, 8081	Toxaphene	0.66	0.89	3.03	--	--	--	--
SW-846, 8082	Aroclor-1016	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1221	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1232	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1242	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1248	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1254	0.084	0.11	0.39	--	--	--	--
SW-846, 8082	Aroclor-1260	0.084	0.11	0.39	--	--	--	--
SW-846, 8270	1,2,4,5-Tetrachlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	1,2,4-Trichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	1,2-Dichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	1,3-Dichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	1,4-Dichlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	1,4-Dioxane	5	6.75	22.93	3/21/10	1	1.35	4.59
SW-846, 8270	1,4-Naphthoquinone	1	1.35	4.59	--	--	--	--
SW-846, 8270	1-Naphthylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,3,4,6-Tetrachlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4,5-Trichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4,6-Trichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dimethylphenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,4-Dinitrophenol	2	2.70	9.17	--	--	--	--
SW-846, 8270	2,4-Dinitrotoluene	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,6-Dichlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2,6-Dinitrotoluene	2.2	2.97	10.09	--	--	--	--

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	2-Acetylaminofluorene	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Chloronaphthalene	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Chlorophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Methylnaphthalene	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Methylphenol (cresol, o-)	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Naphthylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Nitroaniline	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Nitrophenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	2-Picoline	2	2.70	9.17	--	--	--	--
SW-846, 8270	3,3'-Dichlorobenzidine	1	1.35	4.59	--	--	--	--
SW-846, 8270	3,3'-Dimethylbenzidine	2.6	3.51	11.92	--	--	--	--
SW-846, 8270	3+4 Methylphenol (cresol, m+p)	2	2.70	9.17	--	--	--	--
SW-846, 8270	3-Methylcholanthrene	1	1.35	4.59	--	--	--	--
SW-846, 8270	3-Nitroaniline	1	1.35	4.59	--	--	--	--
SW-846, 8270	4,6-Dinitro-2-methylphenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Aminobiphenyl	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Bromophenylphenyl ether	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Chloro-3-methylphenol	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Chloroaniline	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Chlorophenylphenyl ether	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Methylphenol (cresol, p-)	10	13.50	45.86	--	--	--	--
SW-846, 8270	4-Nitroaniline	1	1.35	4.59	--	--	--	--
SW-846, 8270	4-Nitrophenol	2	2.70	9.17	--	--	--	--
SW-846, 8270	4-Nitroquinoline-1-oxide	5	6.75	22.93	--	--	--	--
SW-846, 8270	5-Nitro-o-toluidine	1	1.35	4.59	--	--	--	--
SW-846, 8270	7,12-Dimethylbenz[a]anthracene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Acenaphthene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Acenaphthylene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Acetophenone	1	1.35	4.59	--	--	--	--
SW-846, 8270	alpha,alpha-Dimethylphenethyl-amine	22	29.71	100.89	--	--	--	--
SW-846, 8270	Aniline	1	1.35	4.59	--	--	--	--
SW-846, 8270	Anthracene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Aramite	20	27.01	91.72	--	--	--	--
SW-846, 8270	Azobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzoaanthracene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzoapyrene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzobfluoranthene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzo(ghi)perylene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzo(k)fluoranthene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzothiazole	1	1.35	4.59	--	--	--	--
SW-846, 8270	Benzyl alcohol	1	1.35	4.59	--	--	--	--
SW-846, 8270	Bis(2-chloro-1-methylethyl)ether	1	1.35	4.59	--	--	--	--

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Bis(2-Chloroethoxy)methane	1	1.35	4.59	--	--	--	--
SW-846, 8270	Bis(2-chloroethyl) ether	1	1.35	4.59	--	--	--	--
SW-846, 8270	Bis(2-ethylhexyl) phthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Butylbenzylphthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Carbazole	1	1.35	4.59	--	--	--	--
SW-846, 8270	Chlorobenzilate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Chrysene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Diallate	2	2.70	9.17	--	--	--	--
SW-846, 8270	Dibenz[a,h]anthracene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Dibenzofuran	1	1.35	4.59	--	--	--	--
SW-846, 8270	Diethylphthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Dimethoate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Dimethyl phthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Di-n-butylphthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Di-n-octylphthalate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Dinoseb(2-secButyl-4,6-dinitro-phenol)	2	2.70	9.17	--	--	--	--
SW-846, 8270	Disulfoton	1	1.35	4.59	--	--	--	--
SW-846, 8270	Ethyl methanesulfonate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Famphur	1.7	2.30	7.80	--	--	--	--
SW-846, 8270	Fluoranthene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Fluorene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Hexachlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Hexachlorobutadiene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Hexachlorocyclopentadiene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Hexachloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8270	Hexachlorophene	10	13.50	45.86	--	--	--	--
SW-846, 8270	Hexachloropropene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Indeno(1,2,3-cd)pyrene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Isodrin	1	1.35	4.59	--	--	--	--
SW-846, 8270	Isophorone	1	1.35	4.59	--	--	--	--
SW-846, 8270	Isosafrole	1.3	1.76	5.96	--	--	--	--
SW-846, 8270	Kepone	20	27.01	91.72	--	--	--	--
SW-846, 8270	m-Dinitrobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Methapyrilene	1.3	1.76	5.96	--	--	--	--
SW-846, 8270	Methyl methanesulfonate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Methyl parathion	1	1.35	4.59	--	--	--	--
SW-846, 8270	Naphthalene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Nitrobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Nitrosopyrrolidine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosodiethylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosodimethylamine	2	2.70	9.17	--	--	--	--
SW-846, 8270	n-Nitrosodi-n-butylamine	1	1.35	4.59	--	--	--	--

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	n-Nitrosodi-n-dipropylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosodiphenylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosomethylethylamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosomorpholine	1	1.35	4.59	--	--	--	--
SW-846, 8270	n-Nitrosopiperidine	1	1.35	4.59	--	--	--	--
SW-846, 8270	O,O,O-Triethyl phosphorothioate	1	1.35	4.59	--	--	--	--
SW-846, 8270	O,O-Diethyl O-2-pyrazinyl phosphorothioate	1	1.35	4.59	--	--	--	--
SW-846, 8270	o-Toluidine	1	1.35	4.59	--	--	--	--
SW-846, 8270	Parathion	1	1.35	4.59	--	--	--	--
SW-846, 8270	p-Dimethylaminoazobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pentachlorobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pentachloroethane	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pentachloronitrobenzene (PCNB)	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pentachlorophenol	1.3	1.76	5.96	--	--	--	--
SW-846, 8270	Phenacetin	1	1.35	4.59	--	--	--	--
SW-846, 8270	Phenanthrene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Phenol	2	2.70	9.17	--	--	--	--
SW-846, 8270	Phorate	1	1.35	4.59	--	--	--	--
SW-846, 8270	p-Phenylenediamine	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pronamide	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pyrene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Pyridine	2	2.70	9.17	--	--	--	--
SW-846, 8270	Safrol	1	1.35	4.59	--	--	--	--
SW-846, 8270	sym-Trinitrobenzene	1	1.35	4.59	--	--	--	--
SW-846, 8270	Tetraethyl dithiopyrophosphate (Sulfotepp)	1	1.35	4.59	--	--	--	--
SW-846, 8270	Total cresols	3	4.05	13.76	--	--	--	--
SW-846, 8270	Tributyl phosphate	1	1.35	4.59	--	--	--	--
SW-846, 8270	Tris-2-chloroethyl phosphate	1	1.35	4.59	--	--	--	--
SW-846, 8310	Acenaphthene	0.3	0.41	1.38	12/5/10	0.65	0.88	2.98
SW-846, 8310	Acenaphthylene	0.28	0.38	1.28	12/5/10	0.4	0.54	1.83
SW-846, 8310	Anthracene	0.014	0.02	0.06	12/5/10	0.02	0.03	0.09
SW-846, 8310	Benzoaanthracene	0.021	0.03	0.10	12/5/10	0.063	0.09	0.29
SW-846, 8310	Benzoapyrene	0.044	0.06	0.20	12/5/10	0.075	0.10	0.34
SW-846, 8310	Benzobfluoranthene	0.022	0.03	0.10	12/5/10	0.051	0.07	0.23
SW-846, 8310	Benzo(ghi)perylene	0.063	0.09	0.29	12/5/10	0.16	0.22	0.73
SW-846, 8310	Benzo(k)fluoranthene	0.026	0.04	0.12	12/5/10	0.074	0.10	0.34
SW-846, 8310	Chrysene	0.015	0.02	0.07	12/5/10	0.035	0.05	0.16
SW-846, 8310	Dibenz[a,h]anthracene	0.053	0.07	0.24	12/5/10	0.15	0.20	0.69
SW-846, 8310	Fluoranthene	0.045	0.06	0.21	12/5/10	0.18	0.24	0.83
SW-846, 8310	Fluorene	0.02	0.03	0.09	12/5/10	0.071	0.10	0.33

Table D-30. (Cont.)

Method	Constituent	Initial MDL[a] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values Effective Date	Ending MDL[a] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8310	Indeno(1,2,3-cd)pyrene	0.052	0.07	0.24	12/5/10	0.14	0.19	0.64
SW-846, 8310	Naphthalene	0.43	0.58	1.97	12/5/10	0.2	0.27	0.92
SW-846, 8310	Phenanthrene	0.025	0.03	0.11	7/2/10	0.1	0.14	0.46
SW-846, 8310	Pyrene	0.023	0.03	0.11	12/5/10	0.083	0.11	0.38

a. The MDLs for many constituents changed during the fiscal year. For these constituents, the initial MDL, LOD, and LOQ were in effect until the date the values were updated (ending values, effective date). In cases where the MDL did not change, no ending values are listed.

b. µMhos/cm.

c. Units for this method are mg/L.

d. Additional MDLs were used during the year for these compounds.

LOD = limit of detection

LOQ = limit of quantitation

MDL = method detection limit.

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