Appendix D – Quality Assurance and Quality Control

J.G. Douglas and S.L. Fitzgerald

This appendix presents 2011 quality assurance/quality control (QA/QC) information for groundwater monitoring at the Hanford Site. CH2M HILL Plateau Remediation Company (CHPRC) managed groundwater monitoring activities through the Soil and Groundwater Remediation 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*; and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*. 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 limits are the primary parameters used to assess data quality (Mitchell et al., 1985, "Determination of Measurement Data Quality and Establishment of Achievable Goals for Environmental Measurements"). 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 such as 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 datasets for decision making purposes.

Several comparisons to 2010 performance are made throughout the appendix. Comparisons between 2010 and 2011 are provided to 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) *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846). The U.S. Department of Energy (DOE) orders and internal requirements provide guidance for the collection and analysis of samples for other long-term monitoring. The QA/QC practices for the groundwater project are described in *CH2M HILL Plateau Remediation Company Quality Assurance Program Plan* (CHPRC-00189). A glossary of QA/QC terms is provided in Section D.9. Additional information about the QA/QC program and data for 2011 (results of individual QC samples or associated groundwater samples) are available upon request. Referenced data from the previous reporting period can be found in DOE/RL-2011-01, *Hanford Site Groundwater Monitoring Report for 2010*.

D.1 Sample Collection and Analysis

Tasks related to groundwater 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 2011. WSCF performed 62 percent of the laboratory analyses for groundwater monitoring during the reporting period (not including field measurements; 56 percent if field measurements are included) compared to 83 percent during 2010. The smaller portion of analyses performed at WSCF during 2011 versus 2010 is largely due to a safety outage that occurred at WSCF during most of

September through December of 2011. During that period, groundwater samples were diverted from WSCF to the other laboratories listed below for analysis.

Besides WSCF, several other laboratories provided additional analytical services for the groundwater monitoring program:

- 222-S Laboratory (Hanford Site, managed by Advanced Technologies and Laboratories International, Inc.) (222-S) provided sample analysis for chemical constituents; 222-S generated less than 1 percent of the analytical results.
- Eberline Services (Richmond, California) provided sample analysis for radiochemical constituents; Eberline Services generated less than 1 percent of the analytical results.
- Lionville Laboratory (Exton, Pennsylvania) provided sample analysis for chemical constituents; Lionville Laboratory generated less than 1 percent of the analytical results.
- TestAmerica Richland (Richland, Washington) provided sample analysis for chemical and radiochemical constituents; TestAmerica Richland generated 4 percent of the analytical results.
- TestAmerica St. Louis (St. Louis, Missouri) provided sample analysis for chemical constituents; TestAmerica St. Louis generated 33 percent of the analytical results.

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

D.2 Data Review and Validation

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

- Review of sampling documents and analytical data verification
- Project scientists' evaluations
- Resolution of data issues (Request for Data Review)

D.2.1 Sample Issue Resolution, 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 reviews these forms to determine whether the documents are filled out completely, signed appropriately and legible, and to determine whether problems arose during sampling that may affect the data. Staff also verifies that analytical data from the laboratories are complete and reported correctly. Moreover, staff reviews laboratory documents to check the condition of the samples upon receipt at the laboratory and determine whether problems arose during analysis that may have affected the data. Identified issues are documented, investigated, and resolved (Sections D.2.3 and D.2.4).

D.2.2 Project Scientists' Evaluation

Data management staff generates routine data reports for project scientists to review. These reports include biweekly data reports for 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 (for

example, 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:

- Changes in contaminant concentrations or distribution
- Data points that appear erroneous (for example, significantly out of trend)

Project scientists also review quarterly compilations of the data. The quarterly review provides a method for groundwater staff to check for problems with sampling, to confirm all requested analyses were received, and to verify that the data represent actual groundwater quality. Unlike biweekly reports, the quarterly reports include a full dataset (that is, 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 contaminant distribution (plume maps), and a partial listing of sampling comments. When specific questions arise about field measurements, analytical results, dates of analysis or sampling, or sample or well numbers, the project scientist requests a formal data review. Section D.2.3 describes the process for data reviews.

D.2.3 Resolution of Data Issues (Request for Data Review)

Requests for data reviews are the formal mechanism used by the groundwater project to resolve specific issues with data. A single request for data review may cover multiple analytes and samples from multiple sources. 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 resolves 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 or hardcopy data from the laboratory can sometimes provide an explanation for unusual results (for example, data entry errors or samples swapped in the field). Laboratory rechecks involve an internal laboratory review of the data. When the laboratory discovers discrepancies, the corrected data are re-reported in place of the original data. 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 re-analysis or recount is requested, the laboratory re-analyzes or recounts the original sample and reports the new results. If a discrepancy occurs between the original and new results, groundwater staff determines which results appear to be more representative. If the new results appear more representative, the old results are removed from HEIS and the new results loaded instead. Finally, whether the old results are retained or the new results are accepted, an appropriate review code is assigned to the reviewed results in the HEIS database to indicate that the review is complete.

Requests for data reviews are most commonly resolved by assigning G, Y, 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 is 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 for groundwater monitoring samples acquired in 2011 that were flagged because of the request for data review process. As of March 5, 2012, requests for data reviews have been filed on 1,406 of 175,221 analytical results (~1 percent). Requests for data reviews of water-level measurements have been filed on 70 of 3,718 measurements (less than 2 percent). The resolution of 456 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 ~56 percent of the analytical results (including laboratory and field results) for groundwater monitoring. WSCF data had 79 percent of the requests for data review. The bulk of the requests for data review (57.5 percent) were filed on metals results. Requests for data review also were filed on WSCF results from wet chemistry methods (18.5 percent), organic methods (14.4 percent), and radiological methods (9.6 percent). 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.2.4 Sample Issue Resolution

The Sample Issue Resolution (SIR) process is used to record and resolve problems encountered with sample receipt, sample analysis, missed holding times, and data reporting (for example, broken bottles or QC problems) that may adversely affect data integrity. The SIR system was expanded in April 2011 to incorporate the previously used Issue Resolution Form. For this report, the term SIR refers to the SIR process and the Issue Resolution Form process used during 2011. The laboratories or Sample Management and Reporting personnel may generate SIR requests, depending on the nature of the issue. The SIR process also allows the groundwater project to direct the laboratories to resolve problems. During 2011, 191 SIR requests concerning groundwater monitoring samples were processed.

Table D-3 indicates the specific issues identified during the reporting period. The issues included the following:

- Analysis holding times exceeded
- Chain-of-custody issues (for example, missing or incorrect dates, broken chains)
- Broken sample bottles
- Incorrect sample preservation
- Other general laboratory direction (such as clarification of requested analyses for samples diverted from one lab to another)
- QC failures (such as laboratory control sample recovery outside QC limits)
- Data package turnaround time or due date modifications

Most of the other general laboratory direction issues were generated because of the diversion of samples from WSCF to offsite laboratories during the fourth quarter of 2011. The offsite laboratories receiving these diverted samples frequently had analytical methods that differed in name from the WSCF analytical methods requested on the chains-of-custody. In those cases, SIRs were generated to translate the WSCF method name to the offsite lab method name in order that the offsite lab could perform the correct sample analysis.

SIR issues are tracked, and when adverse trends are identified, corrective actions are initiated. For example, TestAmerica Richland submitted several SIR requests about incorrect sample preservation because some sample temperatures were not at 4°C at the time of sample receipt. The issue was forwarded to the field sampling organization for resolution. The resolution was that the samples were transported to TestAmerica Richland's sample receiving area very shortly after sample collection, and the

samples had not had sufficient time to cool to 4°C before sample receipt. In those cases, the direction to TestAmerica Richland was to proceed with sample analysis as requested.

D.3 Data Completeness

Groundwater monitoring data judged to be complete are not suspect, rejected, associated with a missed holding time, an out-of-limit field duplicate, or qualified to indicate laboratory blank contamination. For this completeness determination, 140,437 groundwater monitoring results consisting of field measurements, laboratory sample results, field blank results, and blind standards results were considered. Table D-4 provides a summary of data completeness. For 2011, 96.8 percent of the groundwater data were considered complete. The percentages of potentially invalid data were 0.5 percent for suspect values, less than 0.1 percent for rejected data, 1.9 percent for field QC problems, 0.4 percent for exceeding holding times, and 0.4 percent for laboratory method blank contamination. These percentages reflect an improvement over the 2010 data completeness. For 2010, 89.5 percent of the groundwater data were considered complete, with a failure rate of 0.2 percent for suspect values, less than 0.1 percent for rejected data, 2.4 percent for field QC problems, 0.5 percent for exceeding holding times, and 7.4 percent for laboratory blank contamination.

D.4 Field Quality Control Samples

Field QC samples include three types of field blanks (full trip, field transfer, and equipment blanks), field duplicate samples, and field split samples. The glossary in Section D.9 provides definitions for these QC samples. Field QC samples are used to assess precision, repeatability, and potential contamination related to sampling and laboratory activities. The criteria for evaluating field QC samples are given in DOE/RL-91-50, *Environmental Monitoring Plan United States Department of Energy Richland Operations Office*, and are outlined in the subsections below. Those field QC results that do not meet the QC criteria are given a review qualifier of Q in the HEIS database (DOE/RL-91-50). Tables D-5 through D-7 and Tables D-9 and D-10 summarize the field QC results that exceeded QC limits. Constituents not listed in the tables had 100 percent acceptable field QC. The tables are divided into the following six categories as applicable: general chemistry parameters, ammonia and anions, metals, volatile organic compounds, semivolatile organic compounds, and radiological parameters. Table D-8 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 this reporting period were 98 percent (compared to 97 percent for 2010), indicating little problem with contamination. Tables D-5 through D-7 summarize the field blank QC results that exceeded QC limits.

Field blank results greater than two times the method detection limit are identified as suspected contamination. 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 for samples associated with field blanks that are above these criteria are flagged with a Q in the Review Qualifier field of the HEIS database to indicate potential contamination issues. For full trip and field transfer blanks, an associated sample is defined as being collected on the same day and analyzed by the same method as the corresponding 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.

Of the 12,271 field blank results generated for 2011, 73 (0.6 percent) were flagged as suspect (Y-flagged) in the Review Qualifier field because of the Request for Data Review process. Because most of the Y-flagged values were attributed to well samples that had been substituted for blank samples, either in the field or at the lab, these Y-flagged results were not included in this field blank assessment. In most of these cases, uncertainty exists as to if the well samples had been substituted for the blanks in the field or in the laboratory; therefore, no attempt was made to reassign the suspect blank data to well samples.

The 2011 field blank data consisted of 12,198 results, of which 247 (2 percent) exceeded QC limits. Of the 253 general chemical parameter results, 23 results (9 percent) exceeded QC limits, including 10 alkalinity measurements and 8 total organic halide determinations. Of the 603 ammonia/anion results, 18 (3 percent) exceeded QC limits, including 5 chloride and 5 sulfide results. Of the 3,591 metals results, 84 (2 percent) exceeded QC limits, including 32 sodium, 16 magnesium, and 14 calcium results.

Of the 6,158 volatile organic compound results, 115 (2 percent) exceeded QC limits and included 103 methylene chloride results. A total of 80 methylene chloride results exceeded the drinking water standard of 5 µg/L; this result limits the usability of data with low-level detections for methylene chloride in groundwater monitoring samples.

During 2011, a study was begun to elucidate the likely source(s) of volatile organic compounds in field blanks. The study looked at field blank data and laboratory method blank data, and included observations of sample collection in the field and the volatile organic analysis of field samples at WSCF. This study resulted in the publication of a white paper that outlined possible sources of volatile organic compounds in field blanks and samples (SGW-52194, *Volatile Organic Compound Contamination in Groundwater Samples and Field Blanks*). The major results of the study were:

- Methylene chloride, and to a lesser extent carbon tetrachloride and chloroform, appear as volatile organic carbon contaminants in the field blanks associated with groundwater samples; the source of this contamination is likely the deionized water used to generate the field blanks.
- The appearance of acetone, bromomethane, carbon disulfide, chloromethane, tetrachloroethene, and toluene in laboratory method blanks indicates that these volatile organic analytes may appear as spurious contaminants in groundwater samples introduced during laboratory sample preparation and analysis.
- The vendor for the 40 mL volatile organic compound sample vials used by both Field Sampling Operations and WSCF typically certifies the vials only to 0.5 µg/L for many of the groundwater project's volatile organic compounds of interest. This means that the presence of volatile organic compounds with detected concentrations less than 0.5 µg/L in groundwater samples and blanks may not be distinguishable from sample vial background levels.

Several corrective actions resulted from field observations associated with the report. Groundwater analytical support staff continues to work with field sampling operations and the laboratories to decrease the frequency and magnitude of methylene chloride contamination.

Of the 1,050 semivolatile organic compound results, only 2 (less than 1 percent) exceeded QC limits. Of the 543 radiochemical parameter results, 5 (1 percent) exceeded QC limits, of which 3 were total beta radiostrontium (strontium-90).

For 2010, the largest percentage of out-of-limit blank results was associated with metals analysis at 4.9 percent.

D.4.2 Field Duplicate Samples

Field duplicate samples (field duplicates) are replicate samples sent to the same laboratory. Field duplicates are used to assess field sampling and laboratory measurement precision. The results of field duplicates must have precision less than or equal to 20 percent as measured by the relative percent

difference (RPD). Field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity were evaluated. Field samples for total organic carbon and total organic halides are usually taken in quadruplicate. For those analytes, relative standard deviation was calculated for the results of the quadruplicate sample set and compared to the precision limit of 20 percent. The results for the primary sample and its associated field duplicate that have greater than 20 percent RPD are flagged as Q in the Review Qualifier field of the HEIS database to indicate potential precision issues. Field duplicate values with a Y in the Review Qualifier field were included in the assessment of duplicate precision.

Of the 1,191 duplicate results for 2011, 218 duplicates met the criteria to be evaluated. Of these 218 duplicates, 207 (95 percent) were acceptable, indicating reasonable field sampling and intra-laboratory precision. For comparison, the 2010 percentage of acceptable duplicate results was 93 percent, and the 2009 reporting period acceptable results percentage was 99 percent. Table D-9 presents the duplicate results that exceeded quality control limits.

The seven out-of-limit duplicates for the metals were roughly divided equally between unfiltered and filtered samples. For the unfiltered samples, suspended solids in the samples may have caused some of the discrepancies in the results.

D.4.3 Field Split Samples

Field split samples (field splits) are duplicate samples that are sent to two different laboratories to allow interlaboratory comparisons of analytical results. These interlaboratory comparisons are used to evaluate the performance of the laboratories, to determine the extent of any analytical problems, and to confirm out-of-trend results. Results from the field splits must have an RPD less than or equal to 20 percent. Only those field splits with at least one result greater than five times the method detection limit or minimum detectable activity at both laboratories were evaluated. If the laboratory reported an estimated quantitation limit instead of a method detection limit, the evaluation criterion was one times the estimated quantitation limit instead of five times the method detection limit. For total organic carbon and total organic halides, field splits frequently consisted of two groups of replicate samples; that is, multiple matching samples were submitted to each laboratory. The two sets of replicate samples were evaluated by comparing the average concentration from each laboratory.

For 2011, 391 field splits were analyzed for 110 different analytes generating 1,524 pairs of field splits data. Of the 1,524 pairs, 355 pairs met the evaluation criterion. For the evaluated field splits, 16 percent (57 pairs) exceeded the 20 percent RPD criterion. For comparison, the percentage of out-of-limit results was 22 percent for 2010 and 23 percent for the 2009 reporting period. Table D-10 summarizes the results for field splits that exceeded the 20 percent RPD limit.

The metals analyses constituted 58 percent of the split failures. Most of these failures occurred on unfiltered samples; hence, suspended solids in the samples may have caused some of the discrepancies in the results. After the metals analyses, the radiochemical parameter results accounted for 30 percent of the split sample failures, with carbon-14 and tritium constituting most of the failures. All the carbon-14 failures showed TestAmerica Richland biased low with respect to Eberline Services. TestAmerica Richland also reported carbon-14 blind standard results that were less than the lower control limit (see Section D.6.2). This likely indicates a low bias for TestAmerica Richland's carbon-14 results. For the failed tritium results, TestAmerica Richland tended to show a high bias compared to Eberline Services and WSCF. While not greater than the upper recovery limit for the tritium blind standards (see Section D.6.2), most of the tritium blind standard results reported by TestAmerica Richland had recoveries greater than 100 percent. This may indicate a slightly high bias for TestAmerica Richland's tritium results. The two nitrite split failures between TestAmerica St. Louis and WSCF are because of a possible high-nitrite bias at WSCF (see Section D.6.5.3). Groundwater project personnel will continue to monitor these issues and will initiate corrective actions as required.

D.5 Holding Times

Holding time is the time that elapses between sample collection and sample 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 or biological processes. Samples are also refrigerated to slow potential chemical reactions or biological degradation within the sample matrix. Maximum recommended holding times for constituents frequently analyzed for the groundwater project are listed in Table D-11. 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 conditions when appropriate preservatives are used. The results of radionuclide analysis are decay-corrected from the sampling date to analysis date. As a practical matter, the laboratories are typically requested to complete radiochemical analyses within six months of sample collection.

For 2011, recommended holding times were met for more than 99 percent of nonradiological results (Table D-4); this outcome is comparable to the more than 99 percent holding time compliance observed for 2010. Holding times were exceeded for 533 nonradiological results. Missed holding times for anions, mainly nitrate/nitrite (48-hour holding time), contributed the single largest fraction of the missed holding times at 53 percent. Missed holding times were attributed to late sample delivery to the laboratories, high sample loads at the laboratories, or other laboratory issues.

D.6 Laboratory Performance

Several indicators, including national performance evaluation studies, blind standard analyses, laboratory audits, and internal laboratory QA/QC programs, measure laboratory performance. This section provides a detailed discussion of the performance indicators for TestAmerica Richland, TestAmerica St. Louis, and WSCF. Brief summaries of performance measures for Lionville Laboratory and Eberline Services are also presented in this section. At the time of this writing, performance evaluation data were not available from 222-S and will not be discussed; however, 222-S generated less than 1 percent of the analytical results for groundwater monitoring during 2011.

D.6.1 National Performance Evaluation Studies

During 2011, Environmental Resources Associates (ERA) and DOE conducted national studies to evaluate laboratory performance for chemical and radiological constituents. TestAmerica St. Louis, TestAmerica Richland, and WSCF participated in the EPA-sanctioned water pollution/supply performance evaluation (WP/WS) studies conducted by ERA. TestAmerica Richland, TestAmerica St. Louis, WSCF, and Eberline Services participated in ERA's InterLaB RadCheM Proficiency Testing Program (RAD). All five laboratories supporting the groundwater project (WSCF, TestAmerica St. Louis, TestAmerica Richland, Lionville Laboratories, and Eberline Services) 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., ERA) 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. If there is 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 performance evaluation studies (ERA WP-194 and WP-198) in which WSCF participated during the reporting period, the percentage of results within the acceptance limits was 98 percent (167 results) (Table D-12). Three different constituents had unacceptable results.

For the five water pollution/supply and three QuiK™Response performance evaluation studies in which TestAmerica St. Louis participated during 2011 (ERA WP-191, WP-192, WP-198, and WS-183), the percentage of results within the acceptance limits was 99 percent (811 results) (Table D-13). Eleven different constituents had unacceptable results, none of which was repeated across studies or in more than one WP/WS study during 2011. As noted, the number of constituents reported by TestAmerica St. Louis in the water pollution studies was considerably greater than those constituents reported by WSCF; therefore, the percentages from the two laboratories are not directly comparable.

For the one water pollution performance evaluation study (ERA WP-192) in which TestAmerica Richland participated during the reporting period, the percentage of results within the acceptance limits was 100 percent (2 results). As noted, the number of constituents was very limited; therefore, 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 RAD Proficiency Testing Program (also conducted by ERA) 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 ERA for comparison with the known values and with results from other laboratories. ERA bases its control limits on *National Standards for Water Proficiency Testing Studies, Criteria Document* (EPA NERL-Ci-0045).

During the reporting period, WSCF participated in two studies, RAD-84 and RAD-86 (Table D-12), with an acceptance percentage of 80 percent (5 results with 1 unacceptable).

TestAmerica Richland participated in three studies, RAD-84, RAD-85, and RAD- 86 (Table D-13), with an acceptance percentage of 92 percent (39 results with 3 unacceptable).

TestAmerica St. Louis participated in three studies, MRAD-15, RAD-85, and RAD-87 (Table D-13), and analyzed a total of 44 constituents with an acceptance percentage of 86 percent (6 unacceptable results).

Eberline Services participated in four studies (RAD-84, RAD-85, RAD-86, and RAD-800), and analyzed a total of 36 constituents with an acceptance percentage of 94 percent (2 unacceptable results) (Table D-14).

D.6.1.3 DOE Mixed Analyte Performance Evaluation Program

DOE's Mixed Analyte Performance Evaluation Program (MAPEP) examines laboratory performance in the analysis of soil and water samples containing metals, semivolatile organic compounds, and radionuclides. This report considers only water samples. The program is conducted at the Radiological and Environmental Sciences Laboratory in Idaho Falls, Idaho. DOE evaluates the accuracy of the MAPEP results for radiological, inorganic, and organic analytes by determining if they fall within 30 percent of the reference value. Three studies were available for all labs during the reporting period (MAPEP-10-23, MAPEP-11-24, and MAPEP-11-25). For the MAPEP-10-23 and MAPEP-11-24 studies, WSCF analyzed

radionuclides, including gross alpha/beta, inorganics, and semivolatile organics (Table D-12). Of 180 analytes, 4 had unacceptable results yielding a 98 percent acceptable result rate. The missed analytes were copper, nickel, thallium, and hexachlorobenzene. All these constituents had acceptable results in the previous studies. For the MAPEP-10-23, MAPEP-11-24, and MAPEP-11-25 studies, TestAmerica St. Louis analyzed radionuclides, including gross alpha/beta, inorganics, and semivolatile organics (Table D-13). Of 342 analytes, four had unacceptable results, resulting in 99 percent acceptable results. The missed analytes were uranium-235, acenaphthene, nickel-63, and iodine-129. Except iodine-129, which was a new constituent, all of these constituents were within limits in the preceding study.

TestAmerica Richland reported results for radionuclides, including gross alpha/beta, for the MAPEP-10-23, MAPEP-11-24, and MAPEP-11-25 studies (Table D-13). Of 58 constituents, 2 had unacceptable results, resulting in 97 percent acceptable results. The missed analytes were iron-55 and iodine-129. The iron-55 was also unacceptable in the preceding study and the iodine-129 was a new constituent.

For the MAPEP-11-25 study, Lionville Laboratory analyzed inorganics and semivolatile organics (Table D-14). Of 73 constituents, 100 percent had acceptable results. For the MAPEP-10-23, MAPEP-11-24, and MAPEP-11-25 studies, Eberline Services analyzed radionuclides, including gross alpha/beta (Table D-14). Of 58 analytes, 2 had unacceptable results yielding a 97 percent acceptable result rate.

D.6.2 Quarterly Blind Standard Evaluation

The groundwater monitoring program issues blind standards to the supporting laboratories to provide a measure of inter- and intra-laboratory precision and accuracy. These standards help groundwater staff troubleshoot analytical problems identified through data reviews and QC evaluations. The blind standards also may be used to confirm the adequacy of corrective actions to resolve analytical problems. The *Soil and Groundwater Remediation Quality Assurance Project Plan* appendix of CHPRC-00189 lists the quality requirements and control limits for the groundwater monitoring blind standards.

During the first three quarters of 2011, the groundwater project sent blind standards to Eberline Services, Lionville Laboratory, TestAmerica Richland, TestAmerica St. Louis, and WSCF. Because WSCF, the primary analytical laboratory for the groundwater project, was unable to receive samples for most of the fourth quarter of 2011, blind standards were not prepared or submitted to the laboratories for that quarter.

Blind standards were generally prepared in triplicate and submitted to the laboratories to check the accuracy and precision of analyses. For most constituents, the blind standards were prepared in a groundwater matrix from an appropriate background well to simulate actual groundwater samples. Standards for specific conductance were commercially prepared in deionized water. The blind standards were submitted to the laboratories as regular groundwater samples.

After analysis, the laboratories' results were compared with the spiked concentrations to generate percent recoveries for the results, and the percent recoveries were compared to the control limits to determine whether the data were acceptable. Out-of-limit results were reviewed for errors. In situations where several results for the same method were unacceptable, the Request for Data Review process was invoked for reanalysis of the samples (if within holding times) or for recheck of the results. Any remaining out-of-limit results were discussed with the laboratory, potential problems were investigated, and corrective actions requested when appropriate.

In summary, the evaluation of the double-blind standards for 2011 indicates that each of the participating laboratories meets or nearly meets the 80 percent acceptable results requirement for the groundwater monitoring project. Eberline Services and TestAmerica Richland acceptable results rate was 79 percent. Overall, the performance of the laboratories as measured with the blind standards stayed

roughly the same between 2011 and 2010. Eberline Services showed some improvement over 2010. Specific analytical areas at each laboratory continue to be identified for process improvements.

Tables D-15 through D-19 summarize the number and types of blind standards generated and analyzed during 2011, along with the number of unacceptable results and control limits for each constituent. Of the total for all laboratories for 2011, 84 percent of the blind sample determinations were acceptable. This percentage is comparable to the 84 percent rate for 2010 but is lower than the 87 percent rate for the 2009 reporting period.

The most notable blind standard failures for 2011 were the following:

- Lionville Laboratory failed 6 of 12 total organic carbon blind standards; the six failed determinations all failed high. For the third quarter of 2011, Lionville Laboratory failed all four replicate total organic carbon blind standards with recoveries greater than 250 percent. TestAmerica St. Louis and WSCF also returned results for the total organic carbon blind standards during 2011: TestAmerica St. Louis failed 2 of 12 determinations and WSCF failed 3 of 12 determinations. WSCF will continue to be the primary laboratory for total organic carbon determinations, and TestAmerica St. Louis will be the backup laboratory.
- Eberline Services failed all six of its total-uranium blind standards; the triplicate samples sent first quarter 2011 all failed high, and the triplicate samples sent third quarter 2011 all failed low. Eberline Services used a kinetic phosphorescence method for these determinations. TestAmerica Richland and WSCF had acceptable recoveries for these same uranium blind standards. For their uranium determinations, TestAmerica Richland also used kinetic phosphorescence while WSCF used inductively coupled plasma – mass spectrometry.
- TestAmerica St. Louis reported a number of metals values with percent recoveries that fell outside blind standard recovery criteria. The TestAmerica St. Louis metal results were determined by inductively coupled plasma – atomic emission spectroscopy or by inductively coupled plasma – mass spectrometry. The failures included the following:
    - Boron by inductively coupled plasma – mass spectrometry (three of three failed high)
    - Magnesium by inductively coupled plasma – atomic emission spectroscopy (two of three failed high)
    - Potassium by inductively coupled plasma – atomic emission spectroscopy (three of three failed, one high, and two low). WSCF reported potassium values by inductively coupled plasma – atomic emission spectroscopy with percent recoveries that exceeded blind-standard acceptance criteria (three of three failed high)
    - Thallium by inductively coupled plasma – mass spectrometry (three of three failed high)
    - Zinc by inductively coupled plasma – atomic emission spectroscopy (six of six failed high). Lionville Laboratory and WSCF had acceptable recoveries for all zinc values they reported.
- TestAmerica St. Louis and WSCF continued to report low recoveries for the volatile organic compound blind standards. This trend has been observed historically for this analysis and has been attributed in part to volatile losses of the volatile organic compounds from those blind standards during standards make-up and sample handling. TestAmerica St. Louis and WSCF reported identical overall volatile organic compound blind standard success rates of 53 percent for 2011; for 2010, the two laboratories both reported 78 percent success rates.

- TestAmerica Richland failed all nine of its carbon-14 blind standards. All nine failures had recoveries less than 50 percent. Eberline Services passed all nine of its carbon-14 determinations within acceptance criteria.
- Eberline Services, TestAmerica Richland, and WSCF all reported gross alpha results with failure rates during 2011. Eberline Services reported four of nine results with recoveries outside acceptance criteria (two high and two low). TestAmerica Richland reported six of nine results with recoveries outside acceptance criteria (all six low). WSCF reported seven of nine results with recoveries outside acceptance limits (all seven low).

Groundwater project personnel will continue to monitor identified failures and will initiate corrective actions as required.

The blind standards program also revealed some notable improvements in 2011 over 2010:

- For the total organic halides blind standards, WSCF reported an 86 percent acceptance rate. For 2010, WSCF reported a 62 percent acceptance rate. TestAmerica St. Louis had comparable acceptance rates for both years: 90 percent for 2011 and 100 percent for 2010.
- For hexavalent chromium, TestAmerica Richland showed an improvement in the acceptance rate of blind standard results in 2011 over 2010: 100 percent for 2011 and 71 percent for 2010. This may be attributed to a TestAmerica Richland procedural change that requires dilution and reanalysis of samples with initially determined hexavalent chromium concentrations greater than 1,000 µg/L. Samples with concentrations greater than 1,000 µg/L appear to exceed the linear calibration range of the TestAmerica Richland hexavalent chromium method. Hence, diluting and reanalyzing the sample brings the sample concentration within the linear range of the method and provides more accurate results.
- For iodine-129, Eberline Services showed an improved acceptance rate in 2011 over 2010: 78 percent for 2011 and 33 percent for 2010. TestAmerica Richland had an acceptance rate of 83 percent for 2011 and 100 percent for 2010. TestAmerica Richland will remain the primary laboratory for the determination of iodine-129, especially for low-level determinations.

D.6.3 Laboratory Internal Quality Assurance/Quality Control Programs

This section provides a brief assessment of the laboratory QC data for 2011. The 222-S Laboratory, Eberline Services, Lionville Laboratory, TestAmerica Richland, TestAmerica St. Louis, and WSCF maintain internal QA/QC programs to monitor the laboratory's analytical performance. As part of their QA/QC programs, each laboratory analyzes a variety of QC samples in the same batch as customer samples. These QC samples may consist of method blanks, laboratory control samples, matrix spikes and matrix spike duplicates, sample duplicates, and surrogates (see Section D.9 for definitions of these terms). When the laboratories detect failures in these QC samples, the laboratories apply a laboratory QC flag to the data as noted in the remainder of this section.

Laboratory QC data are not used for groundwater monitoring validation of individual sample results unless the laboratory is experiencing unusual performance problems with an analytical method. All the laboratories supporting the groundwater monitoring project except Lionville Laboratory submit their laboratory QC data electronically. Only those QC data electronically available are reported here; hence, the Lionville QC data are not considered in this report.

Data from laboratory QC samples were evaluated against the acceptance limits for each type of QC sample (CHPRC-00189); the acceptance limits are stated in Tables D-22 through D-43. These evaluations provide a means to assess laboratory performance and the suitability of a method for a particular sample matrix. Laboratory QC samples provide three different types of information regarding the analytical process:

- Laboratory method blanks provide a measure of the cleanliness of the analytical process. The appearance of measurable analytes in the method blank may indicate contamination of customer samples during sample preparation and analysis.
- Laboratory control samples, matrix spike samples, and surrogates provide a measure of the accuracy of the analytical process. Percent recovery is the metric used to determine analytical accuracy. Percent recoveries consistently less than or greater than 100 percent may indicate a bias in the analytical process.
- Laboratory control sample duplicates, matrix spike duplicates, sample duplicates, and surrogate duplicates provide a measure of the reproducibility of the analytical process. Relative percent difference is the metric used to determine reproducibility.

Approximately 99 percent of the laboratory QC results for 2011 were within the acceptance limits and is similar to the 98 percent reported in the 2010 and 2009 annual reports. This percentage indicates that the analyses were in control and reliable data were generated. Table D-20 summarizes the laboratory QC data for 222-S Laboratory, Eberline Services, TestAmerica Richland, TestAmerica St. Louis, and WSCF. Table D-21 summarizes the laboratory QC data by analyte category. Additional details are presented by individual laboratory and QC sample type in Tables D-22 through D-43. Constituents not listed in these tables did not exceed the QC limits.

D.6.3.1 Laboratory Method Blanks

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. 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. Results associated with out-of-limit blank results are flagged in the laboratory qualifier field in the HEIS database. For inorganic analytes (including the indicator analytes total organic carbon and total organic halides), results associated with an out-of-limit blank are flagged with a C. For organic analytes, results associated with an out-of-limit blank are flagged with a B.

Tables D-22 through D-26 summarize the method blank results for 2011. Overall, 99.5 percent of the results were acceptable; this is similar to that reported in 2010. The method blank results may be summarized by analyte category as follows:

- General chemical parameters had the largest method blank percentage out of limits at 5.1 percent. Most of these failures were traceable to the total organic halides results from TestAmerica St. Louis; the laboratory recognized this issue and took corrective actions to resolve the problem.
- Ammonia/anions had a method-blank failure rate of 0.8 percent. Most of these failures were traceable to the TestAmerica St. Louis laboratory with cyanide, nitrogen-in-ammonia, and sulfide determinations having the highest failure rates.
- Metals had the second greatest percentage of method blank results outside the QC limits at 0.9 percent; this is similar to the 1.1 percent reported for 2010.
- Volatile organic compounds had a blank failure rate of 0.1 percent with method blank results exceeding QC limits for three volatile organic compounds: acetone, methylene chloride, and tetrachloroethene. TestAmerica St. Louis and WSCF reported QC data for volatile organic compounds. TestAmerica St. Louis reported all the volatile organic compound method blank failures; however, the method detection limits that TestAmerica St. Louis reported were typically an order of magnitude lower than those for WSCF. Acetone and methylene chloride

are common laboratory contaminants, and low-level detections of these analytes in Hanford Site groundwater samples may be considered suspect.

- Semivolatile organic compounds had a blank failure rate of 0.1 percent with method blank results exceeding QC limits for three semivolatile organic compounds: acenaphthylene, bis(2-ethylhexyl) phthalate, and hexachlorophene. TestAmerica St. Louis and WSCF reported QC data for semivolatile organic compounds. As with the volatile organic compounds, TestAmerica St. Louis reported all the semivolatile organic compound method blank failures. Again, the method detection limits that TestAmerica St. Louis reported were typically an order of magnitude lower than those for WSCF were.
- Radiochemical parameters had a blank failure rate of 0.5 percent. TestAmerica Richland and WSCF reported method blank results for radiochemical parameters. Of the radiochemical parameter blank failures, 42 percent were attributed to five total beta radiostrontium (strontium-90) blank failures at WSCF.

D.6.3.2 Laboratory Control Samples and Laboratory Control Sample Duplicates

Tables D-27 through D-31 summarize the laboratory control sample and laboratory control sample duplicate results for 2011. Overall, 99 percent of the laboratory control sample percent recoveries were acceptable and 98 percent of the laboratory control sample duplicate relative percent differences were acceptable. The laboratory control sample recoveries give a measure of the accuracy of an analytical result, and the duplicate relative percent difference gives a measure of the repeatability of the analytical result. Laboratories may apply a laboratory QC flag of X and an accompanying explanatory note when laboratory control sample recoveries or laboratory control sample duplicate relative percent differences are outside QC limits. Laboratory control sample duplicate results were available primarily for volatile and semivolatile organic compounds.

The laboratory control sample results may be summarized by analyte category as follows:

- General chemical parameters, ammonia/anions, and radiochemical parameters had no laboratory control sample QC failures.
- Metals had a laboratory control sample QC failure rate of 0.1 percent; all seven of the QC failures failed high. These QC failures were nearly evenly distributed among beryllium, boron, mercury, potassium, and sodium.
- The volatile organic compounds had a laboratory control sample QC failure rate of 1 percent. Of these QC failures, 5 percent failed low and 95 percent failed high. Of the two laboratories reporting these QC data electronically, TestAmerica St. Louis had a failure rate of 1.5 percent and WSCF reporting no failures. The failures were distributed over 31 compounds with acrolein having the highest failure rate at 19.5 percent.
- The semivolatile organic compounds had the largest percentage of laboratory control sample QC failures at 3.9 percent. Of these QC failures, 27 percent failed low and 73 percent failed high. Of the two laboratories reporting these QC data electronically, TestAmerica St. Louis had a failure rate of 4.2 percent and WSCF's failure rate was 1.4 percent. The failures were distributed over 56 compounds; 4-chloroanaline had the highest failure rate at WSCF with 100 percent failures on three samples. The next highest failure rate was 70 percent for 10 determinations of delta-BHC at TestAmerica St. Louis.

Most of the unacceptable results were associated with high recoveries. This may suggest that some of the associated groundwater results may be biased high. Matrix spikes (Section D.6.3.3) and surrogates (Section D.6.3.5) also showed high recoveries.

The laboratory control sample duplicate relative percent differences were available primarily for volatile and semivolatile organic compounds. These QC results may be summarized as follows:

- For the volatile organic compounds, 2 percent of the laboratory control sample relative percent differences exceeded QC limits. The out-of-limit results were associated with 1,4-dioxane (31.9 percent failure rate), acetone (25 percent failure rate), and 1-butanol (12.5 percent failure rate) at TestAmerica St. Louis. The WSCF laboratory did not report any laboratory control sample duplicate data for volatile organic compounds.
- For the semivolatile organic compounds, 1.9 percent of the laboratory control sample relative percent differences exceeded QC limits. The out-of-limit results were associated with two acenaphthylene laboratory control sample duplicates at TestAmerica St. Louis. WSCF did not report any out-of-limits laboratory control sample duplicate data.

D.6.3.3 Matrix Spikes and Matrix Spike Duplicates

Tables D-32 through D-36 summarize the matrix spike and matrix spike duplicate results for 2011. Only those samples that were spiked at a level at least one-fourth of the original sample concentration were included in the evaluation. Approximately 98.5 percent of the results were acceptable, similar to the 99 percent acceptance rates for 2010 and 2009. For matrix spike/matrix spike duplicate recovery failures, the laboratories apply a laboratory QC flag of N for non-gas chromatography – mass spectrometry methods, and a flag of T for gas chromatography – mass spectrometry methods.

The matrix spike recovery results may be summarized by analyte category as follows:

- General chemical parameters had the second highest matrix spike recovery failure rate at 2 percent; 82 percent of the spikes failed high and 18 percent failed low. Five of the nine high failures were from alkalinity determinations at TestAmerica St. Louis. The remaining high failures were two each for total organic carbon and total organic halide determinations at WSCF.
- The ammonia/anions category had 36 matrix spikes out with a failure rate of 0.8 percent. Of the out-of-limit matrix spikes, 19 percent failed high and 81 percent failed low. TestAmerica St. Louis had four out-of-limits matrix spikes for a failure rate of 1.1 percent. WSCF had 32 out-of-limits matrix spikes for a failure rate of 0.8 percent. Most of the WSCF matrix spike failures were from chloride determinations (91 percent failed low) and sulfate determinations (88 percent failed low).
- Metals had the lowest matrix spike failure rate at 0.7 percent; 62 percent of the failures failed high and 38 percent failed low. The metals most affected by these out-of-limits matrix spikes were calcium at TestAmerica St. Louis and potassium at WSCF. Of the calcium matrix spike failures at TestAmerica St. Louis, 62 percent failed high. Of the potassium failures at WSCF, 80 percent failed high.
- Volatile organic compounds had a matrix spike failure rate of 1.6 percent with 69 percent of the failures high and 31 percent low. TestAmerica St. Louis reported all the matrix spike failures. Of these, acrolein had 18 failed matrix spike recoveries; 94 percent of the failed recoveries failed high.
- The semivolatile organic compounds had the highest matrix spike failure rate at 3.6 percent. Of the failures, 63 percent failed high and 37 percent failed low. At TestAmerica St. Louis, the matrix spike recovery failure rate for individual semivolatile compounds ranged from 1.2 to 35 percent with pesticides having the highest out-of-limits rates. At WSCF, the overall matrix spike failure rate was 3.1 percent; this is much improved over the 20.1 percent failure rate reported in 2010. The semivolatile organic compound matrix spike out-of-limits rate at

WSCF ranged from 3.8 to 13 percent with the highest failure rate for petroleum hydrocarbons – diesel range.

- Only four radiochemical parameter matrix spikes were reported out of limits. Eberline Services reported one tritium matrix spike low, and TestAmerica Richland reported three technetium-99 matrix spikes outside QC limits, with one high and two low.

The matrix spike duplicate relative percent difference results were available for all the analytical categories except for the radiochemical parameters. Three of the categories, general chemical parameters, ammonia/anions, and metals, had negligible failure rates. Observations for the matrix spike duplicate failures for the volatile organic compounds and semivolatile organic compounds may be summarized as follows:

- The volatile organic compounds had a matrix spike duplicate failure rate of 3.9 percent. For TestAmerica St. Louis, the compounds with the greatest failure rates were primarily polar species such as cyclohexanone, 1,4-dioxane, diethyl ether, and so forth. These failures are almost undoubtedly caused by the greater solubility of these compounds in water, thus making them more difficult to volatilize from an aqueous matrix than non-polar compounds. In addition, these failures are likely caused by the tendency for these compounds to stick to any active polar sites during chromatography. WSCF did not report any matrix spike duplicate failures for the volatile organic compounds.
- The semivolatile organic compounds had a matrix spike duplicate failure rate of 3.2 percent. For TestAmerica St. Louis, the compounds with the greatest failure rate were Endrin aldehyde, 2,4-dinitrophenol, 3,3'-dichlorobenzidine, and total petroleum hydrocarbons – diesel range. Again, WSCF did not report any matrix spike duplicate failures for the semivolatile organic compounds.

D.6.3.4 Laboratory Sample Duplicates

For laboratory sample duplicates, only those sample results with values five times greater than the method detection limit or the minimum detectable activity, or one times the estimated quantitation limit were considered. Quantifiable sample duplicates were evaluated by comparing the relative percent difference with an acceptable relative percent difference maximum for each constituent. Laboratories may apply a laboratory QC flag of X and an accompanying explanatory note when laboratory sample duplicate relative percent differences are outside QC limits. The failure rate over all sample duplicates was less than 1 percent, which demonstrates good analytical reproducibility. TestAmerica St. Louis delivered the largest failure rate for laboratory sample duplicates at 2.9 percent. Tables D-37 through D-41 list the constituents by laboratory that exceeded the relative percent difference limits. Sample duplicate data were not available for semivolatile organic compounds and sample duplicate failures were negligible for the metals and volatile organic compounds. The following are observations for the categories of general chemical parameters, ammonia/anions, and radiochemical parameters:

- For the general chemistry parameters, TestAmerica St. Louis had three total organic halide sample duplicates that exceeded the relative percent difference criterion.
- For ammonia/anions, TestAmerica St. Louis reported a 20 percent failure rate for sulfide sample duplicates. Other analytes with higher failure rates were fluoride (TestAmerica St. Louis, 4.2 percent failure rate) and nitrogen in ammonia (WSCF, 6.3 percent failure rate).
- For the radiochemical parameters, TestAmerica Richland had an overall sample duplicate failure rate of 1 percent; see Table D-39 for the breakdown by radionuclide. WSCF had an overall failure rate of 1.6 percent; see Table D-41.

D.6.3.5 Surrogates and Surrogate Duplicates

Surrogate and surrogate duplicate data were available only for the volatile organic compounds and semivolatile organic compounds from TestAmerica St. Louis and WSCF. Laboratories may apply a laboratory QC flag of X and an accompanying explanatory note when laboratory surrogate/surrogate duplicate percent recoveries or relative percent differences are outside QC limits. Tables D-42 and D-43 list the constituents by laboratory that exceeded the QC criteria for surrogates and surrogate duplicates. For TestAmerica St. Louis, 96.5 percent of the surrogate recovery data were within QC acceptance limits compared to 98 percent reported for 2010. For WSCF, 98.7 percent of the surrogate recovery data were within QC acceptance limits compared to 97 percent for 2010. By category, 1.5 percent of the volatile organic compound surrogate recoveries were outside QC acceptance limits and was attributed to TestAmerica St. Louis. WSCF did not report any surrogate recovery failures for volatile organic compounds. Of the out-of-limit recoveries, 91.5 percent were greater than the upper recovery limit. For the semivolatile organic compounds, 4.4 percent of the surrogate recoveries were outside QC limits. Of the failed semivolatile organic compound surrogate recoveries, 52 percent failed high. TestAmerica St. Louis had a failure rate of 3.7 percent for semivolatile organic compound surrogate recoveries, and WSCF had a failure rate of 7.1 percent.

For the surrogate duplicate data, both TestAmerica St. Louis and WSCF had ~98 percent of the surrogate duplicate relative percent differences within QC acceptance limits. By category, 0.7 percent of the volatile organic compound surrogate duplicate relative percent differences was outside QC acceptance limits. Most of these surrogate duplicate failures was attributed to TestAmerica St. Louis, which had a 1.1 percent failure rate; WSCF had a 0.2 percent failure rate. For the semivolatile organic compound surrogate duplicates, 96.2 percent of the duplicate relative percent differences were within QC acceptance limits. Most of the failures were attributed to WSCF with an 8.3 percent failure rate; TestAmerica St. Louis had a 2.8 percent failure rate.

D.6.4 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 2011, five formal reviews (audits and/or assessments) were conducted on laboratories that routinely analyzed Hanford Site groundwater samples. These formal reviews included four audits performed on commercial laboratories by the DOE Consolidated Audit Program. In addition to the formal reviews, 13 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.

D.6.4.1 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 four 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:

- TestAmerica St. Louis, Earth City, Missouri, March 22-24, 2011 (110324-TAS)

- Eberline Services, Richmond, California, March 1-3, 2011 (110303-ESR)
- Lionville Laboratory, Inc, Lionville, Pennsylvania, May 3-5, 2011 (110505-LLI)
- TestAmerica Richland, Richland, Washington, June 14-16, 2011 (110616-TAR)

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 analyses
- Laboratory information management systems/electronic data management
- Hazardous and radioactive materials management
- Verification of corrective action implementation from previous audit findings

A total of 28 new findings, 10 open findings from previous audits, and 26 observations resulted from the four DOE audits. All corrective actions have been accepted, and verification of the corrective actions will be performed in future audits. The DOE Consolidated Audit Program has recommended all of the laboratories for continuation to provide analytical services for samples generated at DOE sites.

D.6.4.2 Integrated Contractor Audit Team

The goal of the Integrated Contractor Audit Team (ICAT) audit program is to use resources from the multiple Hanford contractors to ensure that onsite laboratories supporting the Hanford Site are meeting DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents (HASQARD)*. To this end, an ICAT audit was performed at WSCF from July 11 to 15, 2011 (MSA-AVS-11-23).

The scope of the ICAT assessment included the functional areas of the laboratory governed by volumes one and two of the HASQARD. The audit team identified a total of nine findings and eleven observations. All corrective actions have been accepted and verification of the corrective actions will be performed in future audits.

D.6.4.3 Groundwater Project Surveillance

Groundwater project QA personnel performed nineteen groundwater project surveillances on various field sampling, well construction, and data management verification activities during 2011. Surveillances identified a total of two findings and nine opportunities for improvement. A list of the surveillances performed is provided below:

- Groundwater Project surveillances on field sampling activities:
  - *Chemical Analysis of Water Samples at the Pump and Treat Facilities*, September 1 to September 22, 2011 (SGRP-2011-SURV-9565)
  - *QA Verification of Installed Depths of 7 New 100-HX Extraction Wells Pumps and Transducers*, May 17 to May 23 and June 21, 2011 (SGRP-2011-SURV-10620)
  - *QA Verification of Installed Depths of 3 New 100-DX Extraction Wells Pumps and Transducers*, May 18, 2011 (SGRP-2011-SURV-10619, Rev. 1)
  - *SGRP Sample Storage Units*, March 2011 (SGRP-2011-SURV-9564)

  - *QA Verification of Installed Depths of 24 New 100-HX Extraction Wells Pumps and Transducers*, February 2011 to May 2011 (SGRP-2011-SURV-10592)
  - *QA Verification of Installed Depths of 3 New 100-DX Extraction Wells Pumps and Transducers*, February 2011 to May 2011 (SGRP-2011-SURV-10591, Rev. 1)
  - *Chemical Analyses of Water Samples at the Pump and Treat Facilities*, September 1 to September 22, 2011 (SGRP-2011-SURV-9565)
- Groundwater Project surveillance on well construction activity:
  - *Final Acceptance of Three Groundwater Wells in the 100-FR-3 OU*, December 2010 to January 2011 (QA-SGRP-SURV-11-016)
  - *Special Inspection Implementation at the 200 West Pump-and-Treat*, February 22 to February 28, 2011 (SGRP-2011-SURV-9551)
  - *Final Acceptance of 11 Pump-and-Treat Wells in the 200-ZP-1 Operable Unit*, September 2010 to March 2011 (SGRP-2011-SURV-10521)
  - *Final Acceptance of 16 Groundwater RI/FS Wells in the 100-HR-3 Operable Unit*, May 2010 to June 2011 (SGRP-2011-SURV-10664)
  - *Final Acceptance of 6 Groundwater RI/FS Wells in the 100-BC-5 Operable Unit*, December 2010 through July 2011 (SGRP-2011-SURV-10604)
  - *Well Maintenance* June 1 to June 6, 2011 (SGRP-2011-SURV-9558)
  - *Final Acceptance of 13 Groundwater Monitoring Wells in the 100-KR-4 Operable Unit*, November 18, 2010 to June 9, 2011 (SGRP-2011-SURV-10607)
  - *Final Acceptance of 4 IRFC Wells in the 300-FF-5 Operable Unit*, March 2011 to June 2011 (SGRP-2011-SURV-10643)
  - *Final Acceptance of 2 Groundwater Supply Wells in the 300-FF-2 Operable Unit*, November 2010 to May 2011 (SGRP-2011-SURV-10642, Rev. 1)
- Groundwater Project surveillances on data management and verification activities:
  - *QA Surveillance of Well Maintenance Activities*, December 01 to December 08, 2011 (SGRP-2012-SURV-10845)
  - *Data Verification*, June 20 to June 27, 2011 (SGRP-2011-SURV-9552)
  - *Chain of Custody Documentation*, March 29, 2011 (SGRP-2011-SURV-9545)

D.6.5 Analytical Method Issues

This section outlines three analytical issues that were identified during 2011: zinc contamination at WSCF, a positive bias in low-level strontium-90 at WSCF resulting in multiple false positives, and many low-level positive detections for nitrite occurring at WSCF.

D.6.5.1 Zinc Contamination

In May 2011, a high bias for zinc was identified in data reported by WSCF. The zinc results were determined using EPA method 6010 (inductively coupled plasma – atomic emission spectroscopy). The bias was caused by zinc contamination found in a filtration system the lab had recently begun using. The contamination issue was not immediately recognized by the laboratory because method blanks were not being filtered, as were customer samples. The date range of the affected zinc data was January 31 through April 14, 2011. In most cases, the affected data were rerun and re-reported by the laboratory, or reported by EPA method 200.8 (inductively coupled plasma – mass spectrometry) when data were available. In cases where samples were not available for rerun, the data were R-flagged as unusable.

Because of this issue, the laboratory put corrective actions in place to ensure that analytical batch QC samples are run through all the same preparation steps as customer samples.

D.6.5.2 Positive Bias in Low-Level Strontium-90 Results

During 2011, groundwater project scientists noticed an elevated number of false positive strontium-90 results reported by the WSCF lab at or near the minimum detectable activity. Upon notification, WSCF investigated this issue and determined that method changes to meet more rapid turnaround requests were the source of the false positives. The method changes included decreased sample size, shorter in-growth times, and shorter count times. These changes increased the associated uncertainty in the strontium-90 measurement and effectively increased the minimum detectable activity for strontium-90. The increase in the minimum detectable activity resulted in the false positives because WSCF was still reporting to the minimum detectable activity associated with the original method before the method changes. At the end of the 2011, WSCF returned to their original strontium-90 analytical method. Where possible, the identified false positive samples were rerun and the resulting non-detects were reported. For those samples that could not be rerun and where historical data supported it, the strontium-90 data were flagged as suspect.

WSCF recently eliminated another source of uncertainty in the strontium-90 determination by switching from a strontium-85 tracer to a gravimetrically measured cold-strontium carrier to determine strontium recovery. Initial results indicate that this method change will further reduce the number of strontium-90 false positive results.

D.6.5.3 Low-Level Detections for Nitrite

In August 2011, groundwater project scientists began noting a trend of low-level nitrite detected results from WSCF for a number of wells in which nitrite had historically not been detected. These nitrite results were generated in conjunction with other anion results using ion chromatography. Most of these low-level results were just above the method detection limit for nitrite. Further investigation indicated that this trend began in early June 2011. The laboratory was notified and began investigating the issue. WSCF personnel have proposed that when high chloride concentrations are present, nitrite elutes on an elevated baseline produced by the tail of the chloride peak; this chloride peak tailing effect artificially inflates the area of the nitrite peak and results in an overestimate of the nitrite concentration. WSCF personnel have also proposed that recent improvements in ion chromatography instrumentation now allow lower levels of nitrite to be detected and quantitated in Hanford Site groundwater where previously nitrite could not be detected with older, less capable instrumentation.

Working with the instrument manufacturer, the lab has recently implemented a new nitrite peak integration protocol that seems to produce more accurate nitrite concentrations. The application of the new integration protocol to the out-of-trend nitrite data is being evaluated.

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

Detection and quantitation limits are essential for evaluating data quality and usefulness because they provide the limits of a method's measurement. The limit of detection is the lower limit at which a measurement can be differentiated from background. The limit of quantitation is the lower limit at which 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 (Currie, 1988, *Detection in Analytical Chemistry: Importance, Theory, and Practice*). The concentration at which an analyte can be detected depends on the variability of the blank response.

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 percent (Miller and Miller, 1988, *Statistics for Analytical Chemistry*). 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*). The limit 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-44 for the TestAmerica Laboratories and Table D-45 for WSCF are based on variabilities that result from 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 Tables D-44 and D-45 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 (Keith, 1991, *Environmental Sampling and Analysis: A Practical Guide*). 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 10 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 10 times larger than the standard deviation of the blank measurements, there is a 95 percent probability that the true concentration of the analyte is within 25 percent 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 percent 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 (that is, the reporting limit in the HEIS database).

For this report, uncensored data for total organic carbon, total organic halides, and radionuclides are available from field blanks for calculating limits of detection and limits of quantitation. Uncensored blank data are those actual concentration values produced by the method for a blank sample, as opposed to reporting method detection limits when measured concentration values are less than the method detection limits. Uncensored field blank data for total organic carbon and total organic halides are available from laboratory bench sheets. These bench sheets are requested quarterly from the participating laboratories. Uncensored field blank data for the radiological species are available directly from HEIS. 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 DOE/RL-91-03, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site for 1990*.

Because of the lack of uncensored blank data for other constituents reported to the groundwater monitoring project, approximate limit-of-detection and limit-of-quantitation values were derived from laboratory-reported method detection limits. These method detection limits were assumed to have been generated using low-level standards. When low-level standards are used, the variability of the difference

between the sample and blank response is increased by a factor of $2^{0.5}$ (Currie, 1988). The method detection limit, limit of detection, and limit of quantitation were calculated as follows:

$$MDL = 3.14 * s$$

$$LOD = 3(2^{0.5} * s) = 4.24 * s$$

$$LOQ = 10(2^{0.5} * s) = 14.14 * s$$

Where:

MDL = method detection limit

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

LOD = level of detection

LOQ = level of quantitation

The results of limit of detection, limit of quantitation, and method detection limit calculations for total organic carbon, total organic halides, and the radiological constituents, are provided in Table D-44 for the TestAmerica Laboratories and Table D-45 for WSCF. The same information for most nonradiological constituents of concern (other than total organic carbon and total organic halides) is listed in Tables D-46 and D-47. The values in Table D-46 apply to TestAmerica Richland and TestAmerica St. Louis and the values in Table D-47 apply to WSCF.

D.8 Conclusions

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, volatile organic compounds, and radiological parameters were detected at low levels in field or laboratory method blanks. Results associated with this QC issue are flagged in the HEIS database. Data users must consider data flags when making decisions about data usability.

Several analytical areas have been identified for continued evaluation and follow up. These include analyte issues identified via the blind standards program, especially total organic carbon at Lionville Laboratories, total uranium analyses at Eberline Services, gross alpha at several laboratories, and carbon-14 and tritium at TestAmerica Richland. Additional tracking will continue for the analyte method issues at WSCF with low-level strontium-90 and nitrite.

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.

Blank spike: See *Laboratory control sample*.

Blind standard: Sample that contains a concentration of analyte known to the supplier but unknown to the analyzing laboratory. Blind standards are used to evaluate analytical accuracy and precision as a measure of laboratory performance and are submitted to the analyzing laboratory as field samples. Blind standards may or may not include groundwater matrix matching.

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: Number 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 for blank contamination (B for organics or C for inorganics), H, Q, R, or Y 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.

Equipment blank: Sample that contains reagent water and any required preservatives. An equipment blank is filled by pumping or washing reagent water through non-dedicated sampling equipment. The equipment blank is analyzed for all constituents scheduled for the sampling event. Equipment blanks are used to monitor contamination resulting from improperly cleaned equipment.

Field duplicate sample (field duplicate): 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 matrix spike: See *Blind standard*.

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

Field transfer blank: Sample that contains reagent water and any required preservatives. 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.

Full trip blank: Sample that contains reagent water and any required preservatives. 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 those 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, and others.

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

Matrix spike/matrix spike duplicate: Samples prepared at the analytical laboratory by adding known quantities of one or more target analytes to a sample before extraction and analysis. Comparison of the original (that is, 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 percent.

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 RPD 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 (for example, groundwater in the aquifer). Representativeness is addressed qualitatively by the specification of well construction, sampling locations, sampling intervals, and sampling and analysis techniques specified in monitoring plans.

Sample duplicate: Replicate sample preparation and analysis of a customer sample performed as part of a laboratory's analytical batch quality control. Sample duplicates and matrix spike duplicates are used to evaluate the precision of an analysis method. For the groundwater program, the maximum limit of precision expected for matrix duplicates is 20 percent.

Split samples: See *Field split samples*.

Surrogates: Organic compounds similar to analytes of interest in chemical composition, extraction, and analytical properties but that are not normally found in environmental samples. Surrogates are spiked into method blanks, samples, and matrix spikes. They 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
A	Administrative issue, usually a chain-of-custody issue (e.g., broken chain).
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 for 2011

Flag G	Flag Y	Flag R	Flag P	Other Action	Pending	Number of Results with an Assigned RDR
Analytical Results*						
284	661	2	0	13	456	1406
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 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 Sample Issue Resolutions for 2011

Issue Category	Number of SIRs Generated						
	Totals	Field	222-S	LVL	TARL	TASL	WSCF
Addition of Analyses	3	---	---	1	---	1	1
Analysis Holding Time Exceeded	27	---	---	---	4	15	8
Broken Sample Bottle	2	---	---	---	---	2	---
Cancellation of Analyses	1	---	---	---	---	1	---
Chain of Custody Issue (Field)	43	---	---	---	6	6	31
Chain of Custody Issue (Laboratory)	6	---	---	---	---	2	4
Clarification of Direction	4	---	---	1	1	---	2
Incorrect Method Analysis Requested	1	---	---	---	1	---	---
Incorrect Sample Preservation	19	---	---	---	11	6	2
Instrument Failure/Facility Outage	2	---	---	---	---	1	1
Other Field Sampling Issue	1	---	---	---	---	---	1
Other General Laboratory Direction	39	---	1	---	15	11	12
Other Laboratory Issue	6	---	---	---	3	1	2
Other Sample Management and Reporting Issue	1	---	---	---	---	1	---
Quality Control Failure	20	1	---	---	3	7	9
Reporting Issue	1	---	---	---	---	---	1
Sample Collection Issue	3	1	---	---	1	---	1
Sample Re-Analysis	1	---	---	---	---	1	---
Turnaround Time and Due Date Modification	11	---	---	---	8	2	1
Total SIRs Processed:	**191**	**2**	**1**	**2**	**53**	**57**	**76**

Table D-4. Data Completeness Summary

	Suspect Data	Rejected Data	Field QC	Holding Time	Method Blank	Total
Number of Results Flagged	667	41	2,699	531	534	4,472
Percent Flagged Data	0.5%	0.03%	1.9%	0.4%	0.4%	3.2%
Percent Acceptable Data	99.5%	100.0%	98.1%	99.6%	99.6%	96.8%

Note: Total number of reported results was 140,437.

Table D-5. 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					
Alkalinity[b]	99	9	9%	1,080 - 2,000 µg/L	2,100 - 125,000 µg/L
Total dissolved solids	4	1	25%	7,000 - 20,000 µg/L	36,000 µg/L
Total organic carbon	59	4	7%	200 - 520 µg/L	204 - 476 µg/L
Total organic halides	53	8	15%	3.6 - 10 µg/L	3.9 - 12.1 µg/L
Ammonia and Anions					
Chloride	85	4	5%	40 - 3,800 µg/L	110 - 302 µg/L
Cyanide	15	1	7%	3 - 8 µg/L	4 µg/L
Sulfate	85	1	1%	100 - 7,200 µg/L	1,600 µg/L
Sulfide	7	4	57%	200 - 1,600 µg/L	1,600 µg/L
Metals					
Arsenic	54	1	2%	0.8 - 100 µg/L	2.2 µg/L
Calcium	140	12	9%	56 - 212 µg/L	106 - 254 µg/L
Hexavalent Chromium	64	3	5%	4 - 7.4 µg/L	5.3 - 22.7 µg/L
Magnesium	143	12	8%	8 - 264 µg/L	14.5 - 121 µg/L
Manganese	143	1	1%	0.4 - 12 µg/L	0.43 µg/L
Mercury	14	1	7%	0.12 - 0.2 µg/L	0.13 µg/L
Potassium	140	5	4%	146 - 3,300 µg/L	153 - 647 µg/L
Silver	150	3	2%	0.08 - 14 µg/L	11 - 21 µg/L
Sodium	140	23	16%	20 - 648 µg/L	21 - 893 µg/L
Thallium	16	2	13%	0.2 - 98 µg/L	1.3 - 1.9 µg/L
Uranium	54	1	2%	0.1 - 0.46 µg/L	0.79 µg/L
Zinc	140	3	2%	8 - 14 µg/L	9 - 98 µg/L
Volatile Organic Compounds					
Carbon tetrachloride	35	1	3%	0.24 - 2 µg/L	0.48 µg/L
Methylene chloride	35	14	40%	0.55 - 5 µg/L	2.2 - 79 µg/L

Table D-5. 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
Radiological Parameters					
Technetium-99	40	1	3%	11.6 - 20.4 pCi/L	29.2 pCi/L
Total beta radiostrontium	23	3	13%	2.8 - 4.8 pCi/L	4 - 7.4 pCi/L
Tritium	61	1	2%	52.6 - 814 pCi/L	710 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. Alkalinity includes total alkalinity, bicarbonate, carbonate, and hydroxyl ion determinations.

QC = quality control

Table D-6. 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					
1,2-Dichloroethane	160	1	1%	0.2 - 2 µg/L	0.88 µg/L
Acetone	160	2	1%	1.7 - 5 µg/L	2.4 - 3.2 µg/L
Carbon tetrachloride	160	2	1%	0.24 - 2 µg/L	2.1 - 2.4 µg/L
Chloromethane	5	1	20%	0.154 µg/L	0.27 µg/L
Methylene chloride	160	84	53%	0.55 - 5 µg/L	1.7 - 50 µg/L
Trichloroethene	160	1	1%	0.5 - 2 µg/L	0.85 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.

QC = quality control

Table D-7. Equipment 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					
Alkalinity[b]	19	1	5%	100 - 7,000 µg/L	2,100 µg/L
Total dissolved solids	4	1	25%	7,000 - 20,000 µg/L	36,000 µg/L
Total organic carbon	59	4	7%	200 - 520 µg/L	204 - 476 µg/L
Total organic halides	53	8	15%	3.6 - 10 µg/L	3.9 - 12.1 µg/L
Ammonia and Anions					
Chloride	22	1	5%	40 - 240 µg/L	361 µg/L
Cyanide	5	2	40%	3 - 8 µg/L	3.9 - 5.9 µg/L
Nitrogen in Nitrate	22	2	9%	17.2 - 75.9 µg/L	39 - 110 µg/L
Sulfate	22	1	5%	100 - 440 µg/L	220 µg/L
Sulfide	1	1	100%	166 µg/L	400 µg/L
Metals					
Calcium	35	2	6%	56 - 212 µg/L	125 - 217 µg/L
Copper	36	1	3%	0.9 - 10.2 µg/L	15 µg/L
Iron	36	1	3%	38 - 76 µg/L	126 µg/L
Magnesium	36	4	11%	8 - 264 µg/L	8.5 - 44 µg/L
Sodium	35	9	26%	20 - 648 µg/L	28 - 428 µg/L
Volatile Organic Compounds					
Chloroform	19	3	16%	0.2 - 2 µg/L	2.3 - 4.4 µg/L
Chloromethane	4	1	25%	0.154 µg/L	0.16 µg/L
Methylene chloride	19	4	21%	0.55 - 5 µg/L	1.1 - 12 µg/L
Tetrachloroethene	19	1	5%	0.36 - 2 µg/L	0.41 µg/L
Semivolatile Organic Compounds					
Benzo(a)pyrene	3	1	33%	0.15 µg/L	2.2 µg/L
Naphthalene	4	1	25%	0.4 - 1.8 µg/L	2.8 µg/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. Alkalinity includes total alkalinity, bicarbonate, carbonate, and hydroxyl ion determinations.

QC = quality control

Table D-8. Summary of Analytical Method Categories

Category	HEIS Method Name	Description
General Chemistry Parameters	120.1_CONDUCT	Specific Conductivity, Conductance Bridge
	160.1_TDS	Total Dissolved Solids
	2320_ALKALINITY	Alkalinity
	2540C_TDS	Total dissolved solids: Standard Method 2540C filter and dry and 180C
	310.1_ALKALINITY	Alkalinity, Titrametric
	360.1_OXYGEN	Dissolved Oxygen
	360.1_OXYGEN_FLD	Dissolved Oxygen (DO)
	410.4_COD	Chemical Oxygen Demand (COD), Automated; Manual
	420.2_PHENOLIC	Phenolics, Automated Colorimetric
	9020_TOX	Total Organic Halides (TOX)
	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, Washington State Dept. of Ecology
	WTPH_GASOLINE	Total Petroleum Hydrocarbons, P&T/GC-FID, Washington State Dept. of Ecology
Ammonia and Anions	300.0_ANIONS_IC	Anions by Ion Chromatography
	300.7_CATIONS_IC	Cations by ion chromatography (Nitrogen in ammonium)
	335.2_CYANIDE	Total Cyanide, Titrametric, Spectrophotometric
	350.1_AMMONIA	Ammonia, Automated Phenate
	4500E_CN	Cyanide
	9012_CYANIDE	Cyanide, Automated Colorimetric
	9014_CYANIDE	EPA 9014 cyanide (222-S method = microdistillation + colorimetric determination)
	9030_SULFIDE	Sulfide by Titration

Table D-8. Summary of Analytical Method Categories

Category	HEIS Method Name	Description
	9056_ANIONS_IC	Anions by Ion Chromatography
Metals	200.8_METALS_ICPMS	Metals by ICPMS
	6010_METALS_ICP	Metals by ICP
	6010_METALS_ICP_TR	Metals by ICP, trace
	6020_METALS_ICPMS	Metals by ICPMS
	7196_CR6	Chromium(Hex) - Cr+6, Colorimetric
	7470_HG_CVAA	Mercury (Hg) by CVAA
Volatile Organic Compounds	8015_VOA_GC	Non-Halogenated Volatiles by GC
	8260_VOA_GCMS	Volatile Organics by GC/MS Capillary Column
Semivolatile Organic Compounds	8040_PHENOLIC_GC	Phenols by GC
	8081_PEST_GC	Organochlorine pesticides by GC
	8082_PCB_GC	PCBs BY GC
	8270_SVOA_GCMS	Semivolatiles by GCMS
	8310_SVOA_HPLC	SemiVOAs by HPLC (PAHs)
Radiological Parameters	900.0_ALPHABETA_GPC	Gross Alpha/Beta by GPC
	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 GPC
	ALPHA_GPC	Gross Alpha, GPC
	BETA_GPC	Gross Beta GPC
	C14_CHEM_LSC	C-14, Chemical Oxidation/LSC
	C14_LSC	C-14 analysis by unknown method
	GAMMA_GS	Gamma Spectroscopy, Germanium High Energy Detectors
	GAMMALL_GS	Gamma spectroscopy, low-level, germanium high-energy detector
	I129LL_SEP_LEPS_GS	Iodine-129, low-level, separation, precipitation, LEPS detection
	NP237_LLE_PLATE_AEA	Neptunium Isotopic, Liquid-Liquid Extraction, Electroplated, Alpha Spec
	PUISO_IE_PRECIP_AEA	Isotopic Plutonium, Ion Exchange Separation, Precipitated on Disk, Alpha Spec
	PUISO_PLATE_AEA	Isotopic Plutonium, Unknown Separation, Electroplated, Alpha Spec

Table D-8. Summary of Analytical Method Categories

Category	HEIS Method Name	Description
	SE79_SEP_IE_LSC	Selenium-79, separated, ion exchange resin, Liquid Scintillation
	SRISO_SEP_PRECIP_GPC	Strontium beta isotopic, chemical separation, precipitated, GPC
	SRTOT_SEP_PRECIP_GPC	Total Beta Strontium, chemical separation, precipitation, GPC
	TC99_3MDSK_LSC	Technetium-99, 3M Disk separation, LSC
	TC99_ETVDSK_LSC	Technetium-99, Eichrome Teva Disk separation, LSC
	TC99_SEP_LSC	Technetium-99, ppt. and ion exchange resin separation, LSC
	TC99_TR_SEP_GPC	Technetium-99, separated, tracer yield, GPC
	TRITIUM_EIE_LSC	Tritium in water, purification by Eichrome ion exchange, LSC
	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-9. 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 Relative Percent Difference[b]
Metals					
Aluminum	10	1	1	100	148
Cobalt	24	1	1	100	138
Iron	20	4	1	25	129
Manganese	20	5	2	40	77 - 139
Potassium	20	20	1	5	20.1
Zinc	20	3	1	33	177
Volatile Organic Compounds					
Acetone	4	2	2	100	133 - 142
Radiological Parameters					
Tritium	9	2	1	50	73
Uranium-233/234	2	2	1	50	21

Note: Duplicate control limit is a relative percent difference less than or equal to 20%.

a. Duplicates with at least one result five times greater than the method detection limit or minimum detectable activity were evaluated.

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

Table D-10. 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 Relative Percent Differences[b]
General Chemistry Parameters					
Alkalinity	10	10	1	10	37
Total petroleum hydrocarbons - diesel range	6	2	2	100	157 - 166
Ammonia and Anions					
Fluoride	25	4	1	25	22
Nitrogen in Nitrite	23	2	2	100	80 - 174
Metals					
Aluminum	10	1	1	100	36
Calcium	26	26	3	12	20.4 - 26
Chromium	50	16	1	6	61
Hexavalent Chromium	37	21	4	19	30 - 38
Iron	26	5	4	80	41 - 132
Lead	22	8	7	88	23 - 111
Manganese	26	4	2	50	28 - 32
Potassium	26	2	2	100	28 - 39
Strontium	26	26	5	19	20.2 - 32
Vanadium	26	1	1	100	41
Zinc	26	4	3	75	23 - 153
Volatile Organic Compounds					
Xylenes (total)	9	1	1	100	74
Radiological Parameters					
Carbon-14	14	9	9	100	31 - 77
Gross beta	11	6	2	33	21 - 43
Technetium-99	15	4	1	25	26
Tritium	18	8	5	63	21 - 36

Note: Field split control limit is a relative percent difference less than or equal to 20%.

a. Field splits with at least one result five times greater than the method detection limits or minimum detectable activities at both laboratories were evaluated.

b. When a non-detected result was compared with a measured value, the method detection limit or minimum detectable activity was used for the non-detected concentration.

Table D-11. Hanford Groundwater Monitoring 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)	Inductively coupled plasma metals	6 months
6020 (SW-846)	Inductively coupled plasma-mass spectrometry metals	6 months
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 (AWWA et al., 2005)	Coliform	24 hours

Table D-12. Summary of WSCF Performance Evaluation Studies

Study Number	Date	Correct Results / Total Results
WatR™ Pollution/WatR™ Supply Performance Evaluation Studies, Environmental Resource Associates		
WP-194	March 2011	83/83
WP-198	March 2011	81/84[a]
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory		
MAPEP-10-MaW23	January 2011	28/31[b]
MAPEP-10-GrW23	January 2011	2/2
MAPEP-10-OrW23	January 2011	56/57[c]
MAPEP-11-MaW24	July 2011	31/31
MAPEP-11-GrW24	July 2011	2/2
MAPEP-11-OrW24	July 2011	57/57
InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates		
RAD-84	March 2011	4/4
RAD-86	September 2011	0/1[d]

Sources: AWWA/APHA/WEF, 2005, *Standard Methods for the Examination of Water and Wastewater*.

EPA-600/4-81-004, *Environmental Radioactivity Laboratory Intercomparison Studies Program Fiscal Year 1981-1982*.

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

a. Unacceptable results were for Aroclors 1016 and 1232 and hexavalent chromium.

b. Unacceptable results were for copper, nickel, and thallium.

c. Unacceptable result was for hexachlorobenzene.

d. Unacceptable result was for tritium.

Table D-13. Summary of TestAmerica Performance Evaluation Studies

Study Number	Date	Correct Results / Total Results	
		TA St. Louis	TA Richland
WatR™ Pollution/WatR™ Supply Performance Evaluation Studies, Environmental Resource Associates			
WP-191	January 2011	2/2	--
020911D Quick Response	February 2011	21/21	--
WP-192	March 2011	383/392[a]	2/2
030111C Quick Response	March 2011	4/5[b]	--
0318110 Quick Response	March 2011	1/1	--
WP-198	September 2011	327/328[c]	--
WS-183	November 2011	62/62	--
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory			
MAPEP-10-MaW23	January 2011	36/36	17/17
MAPEP-10-GrW23	January 2011	2/2	2/2
MAPEP-10-OrW23	January 2011	75/75	--
MAPEP-11-MaW24	August 2011	35/36[d]	16/16
MAPEP-11-GrW24	August 2011	2/2	2/2
MAPEP-11-OrW24	August 2011	74/75[e]	--
MAPEP-11-MaW25	December 2011	35/36[f]	17/18[j]
MAPEP-11-GrW25	December 2011	2/2	2/2
MAPEP-11-XaW25	December 2011	0/1[g]	0/1[g]
MAPEP-11-OrW25	December 2011	77/77	--
InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates			
MRAD-15	November 2011	11/13[m]	--
RAD-84	March 2011	--	15/15
RAD-85	May 2011	18/20[h]	17/19[k]
RAD-86	September 2011	--	4/5[l]
RAD-87	November 2011	9/11[i]	--

Table D-13. Summary of TestAmerica Performance Evaluation Studies

Study Number	Date	Correct Results / Total Results	
		TA St. Louis	TA Richland

a. Unacceptable results were for total solids, iron, copper, manganese, mercury, hexavalent chromium, and PCBs (2 Aroclors).

b. Unacceptable result was for cobalt-60

c. Unacceptable result was for sulfide.

d. Unacceptable result was for uranium-235.

e. Unacceptable result was for acenaphthene.

f. Unacceptable result was for nickel-63.

g. Unacceptable result was for iodine-129.

h. Unacceptable results were for stontium-90 (2).

i. Unacceptable results were for cesium-137 and gross alpha.

j. Unacceptable result was for iron-55.

k. Unacceptable results were for radium-226 and iodine-131.

l. Unacceptable result was for gross beta.

m. Unacceptable results were for plutonium -238 and plutonium-239.

Table D-14. Summary of Eberline Services and Lionville Laboratory Performance Evaluation Studies

Study Number	Date	Correct Results / Total Results	
		Eberline	Lionville
DOE Mixed Analyte Performance Evaluation Program, Radiological and Environmental Sciences Laboratory			
MAPEP-10-MaW23	January 10, 2011	16/17[a]	--
MAPEP-10-GrW23	January 10, 2011	2/2	--
MAPEP-11-MaW24	July 5, 2011	17/17	--
MAPEP-11-GrW24	July 5, 2011	2/2	--
MAPEP-11MaW25	August 2011	17/17	16/16
MAPEP-11-GrW25	August 2011	1/2[b]	--
MAPEP-11-OrW25	August 2011	--	57/57
MAPEP-11-XaW25	August 2011	1/1	--
ERA InterLaB RadCheM Proficiency Testing Program, Environmental Resource Associates			
RAD-84	March 2011	13/15[c]	--
RAD-85	May 2011	6/6	--
RAD-86	September 2011	6/6	--
RAD-800	September 2011	9/9	--
Water Proficiency Testing Program, Wibby Environmental			
WS0711	July 2011	--	18/18
WP0711	July 2011	--	294/295[d]

a. Unacceptable result was for tritium.

b. Unacceptable result was for gross alpha.

c. Unacceptable results were for barium-133 and strontium-89.

d. Unacceptable result was for fluoride.

Table D-15. Summary of Blind Standard Determinations: Eberline Services

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Total for 2011	—	72	15	79%	—
Metals					
Uranium	Quarterly	6	6	0%	±20
Radiological Parameters					
Carbon-14	N/A	9	0	100%	±30
Cesium-137	Semiannually	3	0	100%	±30
Cobalt-60	Semiannually	3	0	100%	±30
Gross alpha	Quarterly	9	4	56%	±30
Gross beta	Quarterly	12	1	92%	±30
Iodine-129	Semiannually	9	2	78%	±30
Neptunium-237	Annually	3	0	100%	±30
Plutonium-239	Quarterly	6	2	67%	±30
Strontium-90	Annually	3	0	100%	±30
Technetium-99	Quarterly	6	0	100%	±30
Tritium	Semiannually	3	0	100%	±30

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

b. The recovery of each result must be within the specified percentage of the known value to be acceptable.

Table D-16. Summary of Blind Standard Determinations: Lionville Laboratory

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Total for 2011	—	39	7	82%	—
General Chemical Parameters					
Total organic carbon (potassium hydrogen phthalate)	Quarterly	12	6	50%	±25
Ammonia and Anions					
Chloride	Quarterly	9	1	89%	±25
Fluoride	Quarterly	9	0	100%	±25
Nitrate as Nitrogen	Quarterly	3	0	100%	±25
Nitrite as Nitrogen	Quarterly	3	0	100%	±25
Metals					
Selenium	N/A	See footnote c			±20
Zinc	Annually	3	0	100%	±20

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

b. The recovery of each result must be within the specified percentage of the known value to be acceptable.

c. Blind standard for selenium was submitted to lab but no results returned.

Table D-17. Summary of Blind Standard Determinations: TestAmerica Richland

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b](%)
Total for 2011	—	105	22	79%	—
Metals					
Hexavalent chromium	Quarterly	12	0	100%	±20
Uranium	Quarterly	9	3	67%	±20
Radiological Parameters					
Carbon-14	N/A	9	9	0%	±30
Cesium-137	Semiannually	3	0	100%	±30
Cobalt-60	Semiannually	3	0	100%	±30
Gross alpha	Quarterly	9	6	33%	±30
Gross beta	Quarterly	12	0	100%	±30
Iodine-129	Semiannually	12	2	83%	±30
Neptunium-237	Annually	3	0	100%	±30
Plutonium-239	Quarterly	9	0	100%	±30
Strontium-90	Annually	6	0	100%	±30
Technetium-99	Quarterly	9	2	78%	±30
Tritium	Semiannually	9	0	100%	±30

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

b. The recovery of each result must be within the specified percentage of the known value to be acceptable.

Table D-18. Summary of Blind Standard Determinations: TestAmerica St. Louis

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Total for 2011	—	219	39	82%	—
General Chemical Parameters					
Specific conductance	Quarterly	9	0	100%	±25
Total organic carbon (potassium hydrogen phthalate)	Quarterly	12	2	83%	±25
Total organic halides (2,4,5-trichlorophenol)	Semiannually	11	0	100%	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene)	Semiannually	10	2	80%	±25
Ammonia and Anions					
Chloride	Quarterly	9	0	100%	±25
Cyanide	Semiannually	9	0	100%	±25
Fluoride	Quarterly	9	0	100%	±25
Nitrate as Nitrogen	Quarterly	9	0	100%	±25
Nitrite as Nitrogen	Quarterly	9	0	100%	±25
Metals					
Aluminum	N/A	3	0	100%	±20
Antimony	N/A	6	2	67%	±20
Arsenic	Annually	3	0	100%	±20
Barium	Annually	6	0	100%	±20
Beryllium	N/A	6	0	100%	±20
Boron	N/A	3	3	0%	±20

Table D-18. Summary of Blind Standard Determinations: TestAmerica St. Louis

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Cadmium	Semiannually	6	0	100%	±20
Calcium	N/A	3	0	100%	±20
Chromium (total)	Quarterly	9	0	100%	±20
Cobalt	Semiannually	6	0	100%	±20
Copper	Semiannually	6	0	100%	±20
Iron	Semiannually	3	0	100%	±20
Lead	N/A	3	0	100%	±20
Magnesium	Annually	3	2	33%	±20
Manganese	Annually	3	0	100%	±20
Mercury	N/A	See footnote c			±20
Nickel	Annually	3	0	100%	±20
Potassium	Annually	3	3	0%	±20
Selenium	N/A	6	2	67%	±20
Silver	N/A	3	0	100%	±20
Sodium	Annually	3	0	100%	±20
Strontium	N/A	3	0	100%	±20
Thallium	N/A	3	3	0%	±20
Vanadium	Annually	3	0	100%	±20
Zinc	Annually	6	6	0%	±20

Table D-18. Summary of Blind Standard Determinations: TestAmerica St. Louis

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Volatile Organic Compounds					
Carbon tetrachloride	Quarterly	9	4	56%	±25
Chloroform	Semiannually	9	1	89%	±25
Tetrachloroethene	N/A	3	3	0%	±25
Trichloroethene	Quarterly	9	6	33%	±25

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

b. The recovery of each result must be within the specified percentage of the known value to be acceptable.

c. Mercury blind standards were submitted to laboratory but were not analyzed.

Table D-19. Summary of Blind Standard Determinations: WSCF

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Total for 2011	—	288	35	88%	—
General Chemical Parameters					
Specific conductance	Quarterly	9	0	100%	±25
Total organic carbon (potassium hydrogen phthalate)	Quarterly	12	3	75%	±25
Total organic halides (2,4,5-trichlorophenol)	Semiannually	11	1	91%	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene)	Semiannually	10	2	80%	±25
Ammonia and Anions					
Chloride	Quarterly	9	0	100%	±25
Cyanide	Semiannually	9	0	100%	±25
Fluoride	Quarterly	9	1	89%	±25
Nitrate as Nitrogen	Quarterly	9	0	100%	±25
Nitrite as Nitrogen	Quarterly	9	0	100%	±25
Metals					
Aluminum	N/A	9	0	100%	±20
Antimony	N/A	3	0	100%	±20
Arsenic	Annually	3	0	100%	±20
Barium	Annually	6	0	100%	±20
Beryllium	N/A	6	0	100%	±20
Cadmium	Semiannually	6	0	100%	±20
Calcium	N/A	3	0	100%	±20

Table D-19. Summary of Blind Standard Determinations: WSCF

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Chromium (total)	Quarterly	9	0	100%	±20
Cobalt	Semiannually	6	0	100%	±20
Copper	Semiannually	6	0	100%	±20
Hexavalent chromium	Quarterly	12	0	100%	±20
Iron	Semiannually	3	0	100%	±20
Lead	N/A	3	0	100%	±20
Magnesium	Annually	3	0	100%	±20
Manganese	Annually	3	0	100%	±20
Mercury	N/A	See footnote c			±20
Nickel	Annually	3	0	100%	±20
Potassium	Annually	3	3	0%	±20
Selenium	N/A	3	0	100%	±20
Silver	N/A	3	0	100%	±20
Sodium	Annually	3	0	100%	±20
Strontium	N/A	3	0	100%	±20
Thallium	N/A	3	0	100%	±20
Uranium	Quarterly	9	0	100%	±20
Vanadium	Annually	3	1	67%	±20
Zinc	Annually	6	0	100%	±20
Volatile Organic Compounds					
Carbon tetrachloride	Quarterly	9	5	44%	±25

Table D-19. Summary of Blind Standard Determinations: WSCF

Constituent	Sample Frequency	Number of Results Reported[a]	Number of Results Outside QC Limits	Acceptable Results	Control Limits[b] (%)
Chloroform	Semiannually	9	4	56%	±25
Tetrachloroethene	N/A	3	0	100%	±25
Trichloroethene	Quarterly	9	5	44%	±25
Radiological Parameters					
Cesium-137	Semiannually	3	1	67%	±30
Cobalt-60	Semiannually	3	0	100%	±30
Gross alpha	Quarterly	9	7	22%	±30
Gross beta	Quarterly	12	0	100%	±30
Neptunium-237	Annually	3	1	67%	±30
Plutonium-239	Quarterly	6	1	83%	±30
Strontium-90	Annually	3	0	100%	±30
Technetium-99	Quarterly	9	0	100%	±30
Tritium	Semiannually	3	0	100%	±30

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

b. The recovery of each result must be within the specified percentage of the known value to be acceptable.

c. Mercury blind standards were submitted to laboratory but were not analyzed.

Table D-20. Laboratory Quality Control Results by Laboratory

QC Parameter	222-S Laboratory	Eberline Services	TestAmerica Richland	TestAmerica St. Louis	WSCF	Total
Method Blanks Total	43	80	1,256	9,822	12,511	23,712
Method Blanks Out	1	0	4	47	63	115
Method Blanks Out Percent	2.3	0.0	0.3	0.5	0.5	0.5
Lab Control Samples Total	48	45	725	9,076	9,838	19,732
Lab Control Samples Out	0	0	0	187	11	198
Lab Control Samples Out Percent	0.0	0.0	0.0	2.1	0.1	1.0
Lab Control Sample Duplicates Total	—	—	—	1,810	23	1,833
Lab Control Sample Duplicates Out	—	—	—	37	0	37
Lab Control Sample Duplicates Out Percent	—	—	—	2.0	0.0	2.0
Matrix Spikes Total	10	16	211	15,760	17,955	33,952
Matrix Spikes Out	0	1	4	415	95	515
Matrix Spikes Out Percent	0.0	6.3	1.9	2.6	0.5	1.5
Matrix Spike Duplicates Total	—	—	67	15,269	8,706	24,042
Matrix Spike Duplicates Out	—	—	0	510	1	511
Matrix Spike Duplicates Out Percent	—	—	0.0	3.3	0.0	2.1
Sample Duplicates Total	10	70	1,202	385	3,419	5,086
Sample Duplicates Out	0	0	11	11	21	43
Sample Duplicates Out Percent	0.0	0.0	0.9	2.9	0.6	0.8
Surrogates Total	—	—	—	6,675	5,192	11,867
Surrogates Out	—	—	—	232	67	299
Surrogates Out Percent	—	—	—	3.5	1.3	2.5

Table D-20. Laboratory Quality Control Results by Laboratory

QC Parameter	222-S Laboratory	Eberline Services	TestAmerica Richland	TestAmerica St. Louis	WSCF	Total
Surrogate Duplicates Total	—	—	—	1,717	789	2,506
Surrogate Duplicates Out	—	—	—	32	17	49
Surrogate Duplicates Out Percent	—	—	—	1.9	2.2	2.0

Table D-21. Laboratory Quality Control Results by Analyte Category

QC Parameter	General Chemical Parameters	Ammonia / Anions	Metals	Volatile Organic Compounds	Semivolatile Organic Compounds	Radiochemical Parameters	Total
Method Blanks Total	276	2,448	6,733	6,764	5,269	2,222	23,712
Method Blanks Out	14	19	60	5	5	12	115
Method Blanks Out Percent	5.1	0.8	0.9	0.1	0.1	0.5	0.5
Lab Control Samples Total	465	2,363	6,588	5,548	3,468	1,300	19,732
Lab Control Samples Out	0	0	7	57	134	0	198
Lab Control Samples Out Percent	0.0	0.0	0.1	1.0	3.9	0.0	1.0
Lab Control Sample Duplicates Total	2	—	—	1,726	105	—	1,833
Lab Control Sample Duplicates Out	0	—	—	35	2	—	37
Lab Control Sample Duplicates Out Percent	0.0	—	—	2.0	1.9	—	2.0
Matrix Spikes Total	554	4,412	12,453	9,962	6,334	237	33,952
Matrix Spikes Out	11	36	82	155	227	4	515
Matrix Spikes Out Percent	2.0	0.8	0.7	1.6	3.6	1.7	1.5
Matrix Spike Duplicates Total	237	2,011	7,575	8,267	5,952	—	24,042
Matrix Spike Duplicates Out	0	0	1	320	190	—	511
Matrix Spike Duplicates Out Percent	0.0	0.0	0.0	3.9	3.2	—	2.1
Sample Duplicates Total	150	2,325	410	36	—	2,165	5,086
Sample Duplicates Out	3	13	0	0	—	27	43
Sample Duplicates Out Percent	2.0	0.6	0.0	0.0	—	1.2	0.8
Surrogates Total	—	—	—	7,773	4,094	—	11,867
Surrogates Out	—	—	—	117	182	—	299

Table D-21. Laboratory Quality Control Results by Analyte Category

QC Parameter	General Chemical Parameters	Ammonia / Anions	Metals	Volatile Organic Compounds	Semivolatile Organic Compounds	Radiochemical Parameters	Total
Surrogates Out Percent	—	—	—	1.5	4.4	—	2.5
Surrogate Duplicates Total	—	—	—	1,517	989	—	2,506
Surrogate Duplicates Out	—	—	—	11	38	—	49
Surrogate Duplicates Out Percent	—	—	—	0.7	3.8	—	2.0

Table D-22. Method Blank Results: 222-S

Constituent	Number of Blanks	Percent Out of Limit*	Concentration Range of Out-of-Limit Results
Ammonia and Anions			
Total Ammonia and Anions	43	2.3	—
Cyanide	1	100.0	8.2 µg/L

* Quality control limits are twice the method detection limit.

Table D-23. Method Blank Results: Eberline Services

Constituent	Number of Blanks	Percent Out of Limit*	Concentration Range of Out-of-Limit Results
Metals			
Total Metals	1	0.0	—
Radiological Parameters			
Total Radiochemistry Parameters	79	0.0	—

* Quality control limits are twice the method detection limit or minimum detectable activity.

Table D-24. Method Blank Results: TestAmerica Richland

Constituent	Number of Blanks	Percent Out of Limit*	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total General Chemistry Parameters	8	0.0	—
Metals			
Total Metals	81	1.2	—
Uranium	15	6.7	1.11 µg/L
Radiological Parameters			
Total Radiochemistry Parameters	1,167	0.3	—
Carbon-14	50	2.0	18 pCi/L
Iodine-129	58	1.7	2.83 pCi/L
Uranium-234	2	50.0	0.12 pCi/L

* Quality control limits are twice the method detection limit or minimum detectable activity.

Table D-25. Method Blank Results: TestAmerica St. Louis

Constituent	Number of Blanks	Percent Out of Limit[a]	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total General Chemistry Parameters	93	14.0	—
Specific Conductance	1	100.0	0.31 µS/cm
Total organic carbon	12	16.7	710 µg/L
Total organic halides	17	58.8	4.2 – 13.3 µg/L
Ammonia and Anions			
Total Ammonia and Anions	289	6.2	—
Chloride	47	6.4	41 – 100 µg/L
Cyanide	10	70.0	3.1 – 4.9 µg/L
Nitrogen in ammonia	4	25.0	23.1 µg/L
Nitrogen in nitrite	47	2.1	11 µg/L
Sulfate	47	2.1	350 µg/L
Sulfide	20	25.0	200 – 400 µg/L
Metals			
Total Metals	1,678	0.4	—
Beryllium (ICP-AES)	59	1.7	1.4 µg/L
Potassium (ICP-AES)	59	1.7	4,930 µg/L
Strontium (ICP-AES)	59	1.7	1.7 µg/L
Boron (ICP-MS)	26	7.7	21.5 – 32.5 µg/L
Mercury (CVAA)	12	8.3	0.15 µg/L
Volatile Organic Compounds			
Total Volatile Organic Compounds	3,141	0.2	—
Acetone [b]	62	1.6	1.8 µg/L
Methylene chloride	62	4.8	1.4 – 2.4 µg/L
Tetrachloroethene	61	1.6	0.67 µg/L
Semivolatile Organic Compounds			
Total Semivolatile Organic Compounds	4,621	0.1	—
Acenaphthylene	43	2.3	11 µg/L
Bis(2-ethylhexyl) phthalate [b]	37	5.4	7.0 – 8.8 µg/L

Table D-25. Method Blank Results: TestAmerica St. Louis

Constituent	Number of Blanks	Percent Out of Limit[a]	Concentration Range of Out-of-Limit Results
Hexachlorophene	28	7.1	60 – 61 µg/L

a. Quality control limits are twice the method detection limit.

b. Quality control limits are five times the method detection limit.

CVAA = cold-vapor atomic absorption

ICP-AES = inductively coupled plasma - atomic emission spectroscopy

ICP-MS = inductively coupled plasma - mass spectrometry

Table D-26. Method Blank Results: WSCF

Constituent	Number of Blanks	Percent Out of Limit*	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total General Chemistry Parameters	175	0.6	—
Chemical Oxygen Demand	4	25.0	147 mg/L
Ammonia and Anions			
Total Ammonia and Anions	2,116	0.0	—
Metals			
Total Metals	4,973	1.1	—
Calcium (ICP-AES)	157	4.5	60 – 983 µg/L
Copper (ICP-AES)	160	0.6	11 µg/L
Iron (ICP-AES)	155	0.6	48.6 µg/L
Magnesium (ICP-AES)	163	2.5	9.3 – 28 µg/L
Potassium (ICP-AES)	154	0.6	158 µg/L
Silicon (ICP-AES)	33	18.2	74 – 168 µg/L
Silver (ICP-AES)	162	1.2	14 – 19.8 µg/L
Sodium (ICP-AES)	158	4.4	21.9 – 67 µg/L
Zinc (ICP-AES)	163	3.7	13 – 530 µg/L
Aluminum (ICP-MS)	65	4.6	12.1 – 27.1 µg/L
Barium (ICP-MS)	70	1.4	1.31 µg/L
Chromium (ICP-MS)	87	2.3	0.22 – 0.31 µg/L
Copper (ICP-MS)	70	5.7	0.22 – 1.02 µg/L
Manganese (ICP-MS)	53	3.8	0.21 – 0.45 µg/L
Tin (ICP-MS)	49	2.0	0.66 µg/L

Table D-26. Method Blank Results: WSCF

Constituent	Number of Blanks	Percent Out of Limit*	Concentration Range of Out-of-Limit Results
Vanadium (ICP-MS)	52	5.8	0.49 – 1.11 µg/L
Zinc (ICP-MS)	45	4.4	2.07 – 2.14 µg/L
Volatile Organic Compounds			
Total Volatile Organic Compounds	3,623	0.0	—
Semivolatile Organic Compounds			
Total Semivolatile Organic Compounds	648	0.0	—
Radiological Parameters			
Total Radiochemistry Parameters	976	0.9	—
Potassium-40	39	5.1	510 pCi/L
Total beta radiostrontium	85	5.9	3.4 – 5.0 pCi/L
Uranium-233/234	10	20.0	0.15 – 0.17 pCi/L

* Quality control limits are twice the method detection limit or minimum detectable activity.

ICP-AES = inductively coupled plasma - atomic emission spectroscopy

ICP-MS = inductively coupled plasma - mass spectrometry

Table D-27. Laboratory Control Sample Results: 222-S

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 80% - 120%				
Total General Chemistry Parameters	4	0.0	—	—
Ammonia and Anions: Recovery Limits = 80% - 120%				
Total Ammonia and Anions	44	0.0	—	—

LCS = laboratory control sample

LCSD = laboratory control sample duplicate

RPD = relative percent difference

Table D-28. Laboratory Control Sample Results: Eberline Services

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
Metals: Recovery Limits = 80% - 120%				
Total Metals	1	0.0	—	—
Radiological Parameters: Recovery Limits = 70% - 130%				
Total Radiochemistry Parameters	44	0.0	—	—

LCS = laboratory control sample

LCSD = laboratory control sample duplicate

RPD = relative percent difference

Table D-29. Laboratory Control Sample Results: TestAmerica Richland

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
Metals: Recovery Limits = 80% - 120%				
Total Metals	96	0.0	—	—
Radiological Parameters: Recovery Limits = 70% - 130%				
Total Radiochemistry Parameters	629	0.0	—	—

LCS = laboratory control sample

LCSD = laboratory control sample duplicate

RPD = relative percent difference

Table D-30. Laboratory Control Sample Results: TestAmerica St. Louis

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 80% - 120%, RPD Limit = 20%				
Total General Chemistry Parameters	139	0.0	2	0.0
Ammonia and Anions: Recovery Limits = 80% - 120%				
Total Ammonia and Anions	298	0.0	—	—
Metals: Recovery Limits = 80% - 120%				
Total Metals	1,678	0.1	—	—
Beryllium (ICP-AES)	59	1.7	—	—
Mercury (CVAA)	12	8.3	—	—

Table D-30. Laboratory Control Sample Results: TestAmerica St. Louis

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
Volatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	3,920	1.5	1,726	2.0
1,1,1,2-Tetrachloroethane	57	1.8	28	0.0
1,1-Dichloroethane	78	1.3	34	0.0
1,1-Dichloroethene	78	1.3	34	0.0
1,2-Dichloroethene (Total)	64	3.1	28	0.0
1,2-Dichloropropane	65	1.5	30	0.0
1,4-Dichlorobenzene	75	4.0	32	0.0
1,4-Dioxane	80	2.5	38	31.6
1-Butanol	74	0.0	32	12.5
2-Butanone	79	3.8	36	5.6
2-Hexanone	63	1.6	28	7.1
4-Methyl-2-pentanone	76	1.3	32	0.0
Acetone	77	1.3	32	25.0
Acrolein	57	19.3	28	7.1
Acrylonitrile	38	2.6	20	0.0
Benzene	76	2.6	32	0.0
Bromodichloromethane	66	1.5	30	0.0
Bromoform	65	3.1	30	0.0
Bromomethane	63	4.8	28	0.0
Chlorobenzene	65	4.6	29	0.0
Chloroform	79	3.8	34	0.0
Chloroprene	57	1.8	28	0.0
cis-1,2-Dichloroethene	76	3.9	32	0.0
Ethyl cyanide	77	1.3	34	0.0
Ethyl methacrylate	57	1.8	28	0.0
Ethylbenzene	78	1.3	34	0.0
Isobutyl alcohol	57	1.8	28	7.1
Methacrylonitrile	57	1.8	28	0.0
Methylene chloride	78	1.3	34	0.0

Table D-30. Laboratory Control Sample Results: TestAmerica St. Louis

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
Tetrachloroethene	78	3.8	27	3.7
Tetrahydrofuran	76	0.0	32	6.3
Vinyl acetate	57	1.8	28	0.0
Semivolatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	3,041	4.2	82	2.4
2,3,4,6-Tetrachlorophenol	30	6.7	—	—
2,4,5-Trichlorophenol	61	9.8	—	—
2,4,6-Trichlorophenol	61	8.2	—	—
2,4-Dichlorophenol	71	4.2	2	0.0
2,4-Dimethylphenol	61	4.9	—	—
2,4-Dinitrophenol	61	13.1	—	—
2,4-Dinitrotoluene	31	3.2	—	—
2,6-Dichlorophenol	30	10.0	—	—
2,6-Dinitrotoluene	31	3.2	—	—
2-Chlorophenol	61	9.8	—	—
2-Methylphenol (cresol, o-)	71	4.2	2	0.0
2-Nitroaniline	31	3.2	—	—
2-Nitrophenol	71	4.2	2	0.0
3+4 Methylphenol (cresol, m+p)	63	4.8	2	0.0
4,4'-DDD (Dichlorodiphenyldichloroethane)	10	20.0	—	—
4,4'-DDT (Dichlorodiphenyltrichloroethane)	10	10.0	—	—
4,6-Dinitro-2-methylphenol	61	3.3	—	—
4-Chloro-3-methylphenol	61	6.6	—	—
4-Chlorophenylphenyl ether	31	3.2	—	—
4-Nitrophenol	61	4.9	—	—
Acenaphthylene	48	4.2	4	50.0
Anthracene	48	4.2	4	0.0
Benzo(a)anthracene	48	2.1	4	0.0
Benzo(a)pyrene	48	4.2	4	0.0
Benzo(b)fluoranthene	48	2.1	4	0.0

Table D-30. Laboratory Control Sample Results: TestAmerica St. Louis

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
Benzo(ghi)perylene	48	2.1	4	0.0
Bis(2-chloroethyl) ether	31	3.2	—	—
Butylbenzylphthalate	31	3.2	—	—
Chrysene	48	2.1	4	0.0
Delta-BHC	10	70.0	—	—
Dibenz[a,h]anthracene	48	6.3	4	0.0
Dibenzofuran	31	3.2	—	—
Dieldrin	10	10.0	—	—
Dimethyl phthalate	31	6.5	—	—
Di-n-butylphthalate	31	3.2	—	—
Di-n-octylphthalate	31	3.2	—	—
Dinoseb(2-secButyl-4,6-dinitrophenol)	30	16.7	—	—
Endosulfan II	10	10.0	—	—
Endosulfan sulfate	10	10.0	—	—
Endrin	10	10.0	—	—
Fluoranthene	48	6.3	4	0.0
Fluorene	48	2.1	4	0.0
Gamma-BHC (Lindane)	10	10.0	—	—
Heptachlor	10	20.0	—	—
Hexachlorobenzene	31	3.2	—	—
Hexachlorobutadiene	31	9.7	—	—
Methoxychlor	10	10.0	—	—
n-Nitrosodi-n-dipropylamine	31	3.2	—	—
Pentachlorophenol	71	18.3	2	0.0
Phenanthrene	48	2.1	4	0.0
Phenol	71	2.8	2	0.0
Pyrene	48	2.1	4	0.0
trans-Chlordane	4	25.0	—	—

Table D-30. Laboratory Control Sample Results: TestAmerica St. Louis

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit

BHC = benzene hexachloride (This is an erroneous name for hexachlorocyclohexane.)
CVAA = cold-vapor atomic absorption
ICP-AES = inductively coupled plasma - atomic emission spectroscopy
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
RPD = relative percent difference

Table D-31. Laboratory Control Sample Results: WSCF

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 80% - 120%				
Total General Chemistry Parameters	322	0.0	—	—
Ammonia and Anions: Recovery Limits = 80% - 120%				
Total Ammonia and Anions	2,021	0.0	—	—
Metals: Recovery Limits = 80% - 120%				
Total Metals	4,813	0.1	—	—
Potassium (ICP-AES)	173	0.6	—	—
Sodium (ICP-AES)	154	1.3	—	—
Boron (ICP-MS)	1	100.0	—	—
Mercury (ICP-MS)	69	1.4	—	—
Volatile Organic Compounds: Recovery Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	1,628	0.0	—	—
Semivolatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	427	1.4	23	0.0
4-Chloroaniline	3	100.0	—	—
4-Nitrophenol	16	6.3	1	0.0
Aroclor-1254	24	4.2	2	0.0
Total petroleum hydrocarbons - diesel range	25	4.0	1	0.0
Radiological Parameters: Recovery Limits = 70% - 130%				
Total Radiochemistry Parameters	627	0.0	—	—

Table D-31. Laboratory Control Sample Results: WSCF

Constituent	Number of LCS	Percent Out of Limit	Number of LCSD	Percent RPD Out of Limit

ICP-AES = inductively coupled plasma - atomic emission spectroscopy
ICP-MS = inductively coupled plasma - mass spectrometry
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
RPD = relative percent difference

Table D-32. Matrix Spike Results: 222-S

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 75% - 125%, RPD Limit = 20%*				
Total General Chemistry Parameters	2	0.0	—	—
Ammonia and Anions: Recovery Limits = 75% - 125%, RPD Limit = 20%*				
Total Ammonia and Anions	8	0.0	—	—

*Sample duplicate RPD limit was used to evaluate matrix spike duplicates.
MS = matrix spike
RPD = relative percent difference

Table D-33. Matrix Spike Results: Eberline Services

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Radiological Parameters: Recovery Limits = 60% - 140%*				
Total Radiochemistry Parameters	16	6.3	—	—
Tritium	3	33.3	—	—

* Recovery limits for technetium-99 and uranium were applied to all radiochemical parameters.
MS = matrix spike
RPD = relative percent difference

Table D-34. Matrix Spike Results: TestAmerica Richland

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Metals: Recovery Limits = 75% - 125%, RPD Limit = 20%				
Total Metals	149	0.7	67	0.0
Uranium	15	6.7	—	—
Radiological Parameters: Recovery Limits = 60% - 140%*				
Total Radiochemistry Parameters	62	4.8	—	—
Technetium-99	62	4.8	—	—

* Recovery limits for technetium-99 were applied to all radiochemical parameters.

MS = matrix spike

RPD = relative percent difference

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 75% - 125%				
Total General Chemistry Parameters	78	9.0	—	—
Alkalinity	35	20.0	—	—
Ammonia and Anions: Recovery Limits = 75% - 125%				
Total Ammonia and Anions	370	1.1	—	—
Fluoride	60	1.7	—	—
Nitrogen in ammonia	3	33.3	—	—
Nitrogen in Nitrate	64	1.6	—	—
Phosphorus in phosphate	11	9.1	—	—
Metals: Recovery Limits = 75% - 125%, RPD Limit = 20%				
Total Metals	3,040	1.4	3,040	0.0
Calcium (ICP-AES)	112	18.8	112	0.0
Iron (ICP-AES)	110	1.8	110	0.0
Magnesium (ICP-AES)	112	1.8	112	0.0
Potassium (ICP-AES)	110	3.6	110	0.0
Silicon (ICP-AES)	4	50.0	4	0.0
Sodium (ICP-AES)	112	4.5	112	0.0

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Strontium (ICP-AES)	108	2.8	108	0.0
Boron (ICP-MS)	48	6.3	48	0.0
Magnesium (ICP-MS)	14	14.3	14	0.0
Volatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	6,658	2.3	6,615	4.8
1,1,1,2-Tetrachloroethane	98	2.0	98	4.1
1,1,1-Trichloroethane	138	1.4	138	2.9
1,1,2,2-Tetrachloroethane	108	1.9	108	3.7
1,1,2-Trichloroethane	138	1.4	138	2.9
1,1-Dichloroethane	138	0.7	138	2.9
1,1-Dichloroethene	138	2.2	131	3.1
1,2,3-Trichloropropane	36	0.0	36	5.6
1,2-Dibromo-3-chloropropane	94	0.0	91	11.0
1,2-Dibromoethane	98	3.1	95	4.2
1,2-Dichloroethane	138	3.6	138	2.9
1,2-Dichloroethene (Total)	112	2.7	112	3.6
1,2-Dichloropropane	108	2.8	108	3.7
1,4-Dichlorobenzene	128	1.6	128	1.6
1,4-Dioxane	124	2.4	124	30.6
1-Butanol	126	3.2	126	17.5
2-Butanone	138	2.2	138	4.3
2-Chloroethyl vinyl ether	2	100.0	2	0.0
2-Hexanone	108	0.9	108	3.7
4-Methyl-2-pentanone	138	1.4	138	7.2
Acetone	138	2.9	138	10.1
Acetonitrile	100	2.0	100	10.0
Acrolein	98	18.4	98	4.1
Allyl chloride	98	1.0	98	4.1
Benzene	138	1.4	138	2.9
Bromodichloromethane	112	2.7	112	3.6

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Bromoform	108	2.8	108	1.9
Bromomethane	108	6.5	102	3.9
Carbon disulfide	138	1.4	138	2.9
Carbon tetrachloride	112	2.7	112	3.6
Chlorobenzene	112	0.9	112	1.8
Chloroethane	108	0.9	108	3.7
Chloroform	142	0.7	142	4.2
Chloromethane	108	1.9	108	3.7
Chloroprene	98	0.0	98	2.0
cis-1,2-Dichloroethene	124	3.2	122	3.3
cis-1,3-Dichloropropene	108	1.9	108	3.7
Cyclohexanone	10	20.0	10	40.0
Dibromochloromethane	108	2.8	103	3.9
Dichlorodifluoromethane	98	3.1	98	4.1
Diethyl ether	10	20.0	10	20.0
Ethyl acetate	10	20.0	10	20.0
Ethyl cyanide	128	2.3	128	6.3
Ethyl methacrylate	98	1.0	98	4.1
Ethylbenzene	134	1.5	134	1.5
Iodomethane	98	0.0	98	2.0
Isobutyl alcohol	98	2.0	98	10.2
Methacrylonitrile	98	2.0	98	4.1
Methyl methacrylate	98	2.0	98	6.1
Methylene chloride	138	1.4	138	2.9
Styrene	108	0.9	108	1.9
Tetrachloroethene	138	4.3	132	1.5
Tetrahydrofuran	128	3.9	128	6.3
Toluene	138	0.7	138	1.4
trans-1,2-Dichloroethene	124	3.2	122	4.9
trans-1,3-Dichloropropene	108	0.9	108	3.7

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
trans-1,4-Dichloro-2-butene	98	2.0	98	12.2
Trichloroethene	140	2.9	131	3.1
Trichloromonofluoromethane	98	1.0	98	2.0
Vinyl acetate	100	3.0	100	4.0
Vinyl chloride	138	1.4	138	2.9
Semivolatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	5,614	3.7	5,614	3.4
1,2-Dichlorobenzene	58	1.7	58	0.0
1,3-Dichlorobenzene	58	1.7	58	3.4
2,3,4,6-Tetrachlorophenol	58	6.9	58	6.9
2,4,5-Trichlorophenol	116	5.2	116	5.2
2,4,6-Trichlorophenol	116	4.3	116	5.2
2,4-Dichlorophenol	132	3.0	132	4.5
2,4-Dimethylphenol	116	4.3	116	5.2
2,4-Dinitrophenol	114	6.1	114	19.3
2,4-Dinitrotoluene	58	3.4	58	0.0
2,6-Dichlorophenol	58	6.9	58	6.9
2,6-Dinitrotoluene	58	3.4	58	0.0
2-Chloronaphthalene	58	1.7	58	0.0
2-Chlorophenol	116	6.0	116	5.2
2-Methylphenol (cresol, o-)	132	3.8	132	4.5
2-Nitroaniline	58	0.0	58	3.4
2-Nitrophenol	132	3.8	132	4.5
3,3'-Dichlorobenzidine	58	0.0	58	13.8
3+4 Methylphenol (cresol, m+p)	116	3.4	116	10.3
4,4'-DDD (Dichlorodiphenyldichloroethane)	20	10.0	20	10.0
4,4'-DDE (Dichlorodiphenyldichloroethene)	20	5.0	20	10.0
4,4'-DDT (Dichlorodiphenyltrichloroethane)	20	20.0	20	10.0
4,6-Dinitro-2-methylphenol	116	4.3	116	3.4
4-Bromophenylphenyl ether	58	1.7	58	0.0

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
4-Chloro-3-methylphenol	116	3.4	116	5.2
4-Chloroaniline	58	0.0	58	6.9
4-Chlorophenylphenyl ether	58	1.7	58	0.0
4-Nitroaniline	58	0.0	58	3.4
4-Nitrophenol	116	4.3	116	10.3
Acenaphthene	84	4.8	84	0.0
Aldrin	20	10.0	20	10.0
Alpha-BHC	20	5.0	20	10.0
Anthracene	84	3.6	84	0.0
Benzo(a)anthracene	84	2.4	84	0.0
Benzo(a)pyrene	84	1.2	84	0.0
Benzo(b)fluoranthene	84	2.4	84	0.0
Benzo(ghi)perylene	84	1.2	84	0.0
Benzo(k)fluoranthene	84	1.2	84	0.0
beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)	20	10.0	20	10.0
Bis(2-chloroethyl) ether	58	6.9	58	0.0
Bis(2-ethylhexyl) phthalate	74	1.4	74	0.0
Butylbenzylphthalate	58	1.7	58	0.0
Chrysene	84	4.8	84	2.4
Delta-BHC	20	35.0	20	10.0
Dibenz[a,h]anthracene	84	4.8	84	0.0
Dibenzofuran	58	3.4	58	0.0
Dieldrin	20	10.0	20	10.0
Diethylphthalate	58	6.9	58	0.0
Dimethyl phthalate	58	1.7	58	0.0
Di-n-butylphthalate	58	1.7	58	0.0
Di-n-octylphthalate	58	1.7	58	0.0
Dinoseb(2-secButyl-4,6-dinitrophenol)	58	8.6	58	6.9
Diphenylamine+N-Nitrosodiphenylamine	28	3.6	28	7.1
Endosulfan I	20	10.0	20	10.0

Table D-35. Matrix Spike Results: TestAmerica St. Louis

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Endosulfan II	20	10.0	20	10.0
Endosulfan sulfate	20	5.0	20	10.0
Endrin	20	10.0	20	10.0
Endrin aldehyde	20	20.0	20	20.0
Fluoranthene	84	3.6	84	0.0
Fluorene	84	2.4	84	0.0
Gamma-BHC (Lindane)	20	10.0	20	0.0
Heptachlor	20	25.0	20	10.0
Heptachlor epoxide	20	10.0	20	10.0
Hexachlorobenzene	60	1.7	60	0.0
Hexachlorobutadiene	58	10.3	58	0.0
Hexachlorocyclopentadiene	58	0.0	58	6.9
Hexachloroethane	58	0.0	58	3.4
Indeno(1,2,3-cd)pyrene	84	0.0	84	2.4
Isophorone	58	1.7	58	0.0
Methoxychlor	20	10.0	20	0.0
Naphthalene	100	2.0	100	0.0
n-Nitrosodi-n-dipropylamine	58	5.2	58	0.0
n-Nitrosodiphenylamine	36	5.6	36	0.0
Pentachlorophenol	134	8.2	134	3.0
Phenanthrene	84	4.8	84	0.0
Phenol	132	1.5	132	7.6
Pyrene	84	3.6	84	2.4
Total petroleum hydrocarbons - diesel range	16	0.0	16	12.5

BHC = benzene hexachloride (This is an erroneous name for hexachlorocyclohexane.)
ICP-AES = inductively coupled plasma - atomic emission spectroscopy
ICP-MS = inductively coupled plasma - mass spectrometry
MS = matrix spike
RPD = relative percent difference

Table D-36. Matrix Spike Results: WSCF

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
General Chemistry Parameters: Recovery Limits = 75% - 125%, RPD Limit = 20%[a]				
Total General Chemistry Parameters	474	0.8	237	0.0
Total organic carbon	222	0.9	111	0.0
Total organic halides	248	0.8	124	0.0
Ammonia and Anions: Recovery Limits = 75% - 125%, RPD Limit = 20%[a]				
Total Ammonia and Anions	4,034	0.8	2,011	0.0
Chloride	662	1.7	330	0.0
Cyanide	54	3.7	27	0.0
Nitrogen in ammonium	32	6.3	16	0.0
Sulfate	662	2.6	330	0.0
Metals: Recovery Limits = 75% - 125%, RPD Limit = 20%				
Total Metals	9,264	0.4	4,468	0.0
Hexavalent Chromium	326	0.6	—	—
Aluminum (ICP-AES)	50	2.0	25	0.0
Iron (ICP-AES)	308	1.0	154	0.0
Potassium (ICP-AES)	308	3.2	154	0.0
Silicon (ICP-AES)	64	1.6	32	3.1
Silver (ICP-AES)	308	0.6	154	0.0
Sodium (ICP-AES)	308	0.3	153	0.0
Strontium (ICP-AES)	308	1.3	154	0.0
Thallium (ICP-AES)	42	4.8	21	0.0
Zinc (ICP-AES)	308	0.3	154	0.0
Barium (ICP-MS)	136	1.5	68	0.0
Boron (ICP-MS)	2	100.0	1	0.0
Mercury (ICP-MS)	138	1.4	69	0.0
Strontium (ICP-MS)	60	3.3	30	0.0
Uranium (ICP-MS)	198	1.0	99	0.0
Volatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	3,304	0.0	1,652	0.0

Table D-36. Matrix Spike Results: WSCF

Constituent	Number of Matrix Spikes	Percent MS Recovery Out of Limit	Number of Matrix Spike Duplicates	Percent MS RPD Out of Limit
Semivolatile Organic Compounds: Recovery and RPD Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	720	3.1	338	0.0
1,2,4-Trichlorobenzene	26	11.5	12	0.0
2,4-Dichlorophenol	26	11.5	12	0.0
2-Chlorophenol	26	3.8	12	0.0
2-Nitrophenol	26	3.8	12	0.0
2-Picoline	26	7.7	12	0.0
4-Nitrophenol	26	3.8	12	0.0
Naphthalene	26	3.8	12	0.0
Pentachlorophenol	26	3.8	12	0.0
Pyrene	26	3.8	12	0.0
Total petroleum hydrocarbons - diesel range	46	13.0	23	0.0
Tributyl phosphate	26	7.7	12	0.0
Radiological Parameters: Recovery Limits = 60% - 140%[b]				
Total Radiochemistry Parameters	159	0.0	—	—

a. Sample duplicate RPD limit was used to evaluate matrix spike duplicates.

b. Recovery limits for technetium-99 and uranium were applied to all radiochemical parameters.

ICP-AES = inductively coupled plasma - atomic emission spectroscopy

ICP-MS = inductively coupled plasma - mass spectrometry

MS = matrix spike

RPD = relative percent difference

Table D-37. Laboratory Sample Duplicate Results: 222-S

Constituent	Number of Laboratory Duplicates	Percent Relative Percent Difference Out of Limit
General Chemistry Parameters: Relative Percent Difference Limit = 20%		
Total General Chemistry Parameters	2	0.0
Ammonia and Anions: Relative Percent Difference Limit = 20%		
Total Ammonia and Anions	8	0.0

Table D-38. Laboratory Sample Duplicate Results: Eberline Services

Constituent	Number of Laboratory Duplicates	Percent Relative Percent Difference Out of Limit
Metals: Relative Percent Difference Limit = 20%*		
Total Metals	1	0.0
Radiological Parameters: Relative Percent Difference Limit = 20%		
Total Radiochemistry Parameters	69	0.0

* Derived from the matrix spike/matrix spike duplicate relative percent difference limit for inductively coupled plasma metals.

Table D-39. Laboratory Sample Duplicate Results: TestAmerica Richland

Constituent	Number of Laboratory Duplicates	Percent Relative Percent Difference Out of Limit
General Chemistry Parameters: Relative Percent Difference Limit = 20%		
Total General Chemistry Parameters	4	0.0
Metals: Relative Percent Difference Limit = 20%*		
Total Metals	82	0.0
Radiological Parameters: Relative Percent Difference Limit = 20%		
Total Radiochemistry Parameters	1,116	1.0
Carbon-14	50	10.0
Cobalt-60	74	1.4
Iodine-129	58	5.2
Strontium-90	44	2.3
Uranium-235	2	50.0

* Derived from the matrix spike/matrix spike duplicate relative percent difference limit for inductively coupled plasma metals.

Table D-40. Laboratory Sample Duplicate Results: TestAmerica St. Louis

Constituent	Number of Laboratory Duplicates	Percent Relative Percent Difference Out of Limit
General Chemistry Parameters: Relative Percent Difference Limit = 20%		
Total General Chemistry Parameters	80	3.8
Total organic halides	18	16.7
Ammonia and Anions: Relative Percent Difference Limit = 20%		
Total Ammonia and Anions	305	2.6
Fluoride	48	4.2
Nitrogen in Nitrate	50	2.0
Sulfide	25	20.0

Table D-41. Laboratory Sample Duplicate Results: WSCF

Constituent	Number of Laboratory Duplicates	Percent Relative Percent Difference Out of Limit
General Chemistry Parameters: Relative Percent Difference Limit = 20%		
Total General Chemistry Parameters	64	0.0
Ammonia and Anions: Relative Percent Difference Limit = 20%		
Total Ammonia and Anions	2,012	0.2
Fluoride	340	0.6
Nitrogen in ammonium	16	6.3
Nitrogen in Nitrate	334	0.6
Metals: Relative Percent Difference Limit = 20%*		
Total Metals	327	0.0
Hexavalent Chromium	327	0.0
Volatile Organic Compounds: Relative Percent Difference Limit = Laboratory Specific (Statistically Derived)		
Total Volatile Organic Compounds	36	0.0
Radiological Parameters: Relative Percent Difference Limit = 20%		
Total Radiochemistry Parameters	980	1.6
Gross alpha	127	2.4
Gross beta	158	0.6
Plutonium-239/240	9	11.1
Total beta radiostrontium	86	2.3
Tritium	100	4.0
Uranium-233/234	10	10.0
Uranium-238	10	40.0

* Derived from the matrix spike/matrix spike duplicate relative percent difference limit for inductively coupled plasma metals.

Table D-42. Surrogate Results: TestAmerica St. Louis

Constituent	Number of Surrogate Results	Percent Surrogate Recovery Out of Limit	Number of Surrogate Duplicates	Percent Surrogate Relative Percent Difference Out of Limit
Volatile Organic Compounds: Recovery and Relative Percent Difference Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	3,527	3.3	920	1.1
1,2-Dichloroethane-d4	872	1.8	227	2.6
4-Fluorobromobenzene	874	1.9	227	0.0
Dibromofluoromethane	873	5.0	228	1.8
Toluene-d8	875	4.6	228	0.0
Semivolatile Organic Compounds: Recovery and Relative Percent Difference Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	3,148	3.7	797	2.8
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	102	1.0	22	0.0
2,4,5,6-Tetrachloro-m-xylene	88	3.4	19	0.0
2,4,6-Tribromophenol	614	5.7	156	3.8
2-Fluorobiphenyl	391	6.4	98	2.0
2-Fluorophenol	612	4.4	156	5.1
Nitrobenzene-d5	391	1.8	98	0.0
o-Terphenyl	65	0.0	20	20.0
Phenol-d5	391	1.8	98	2.0
p-terphenyl	103	3.9	32	0.0
p-terphenyl-d14	391	1.5	98	0.0

Table D-43. Surrogate Results: WSCF

Constituent	Number of Surrogate Results	Percent Surrogate Recovery Out of Limit	Number of Surrogate Duplicates	Percent Surrogate Relative Percent Difference Out of Limit
Volatile Organic Compounds: Recovery and Relative Percent Difference Limits = Laboratory Specific (Statistically Derived)				
Total Volatile Organic Compounds	4,246	0.0	597	0.2
Ethylene Bromohydrin	51	0.0	12	8.3
Semivolatile Organic Compounds: Recovery and Relative Percent Difference Limits = Laboratory Specific (Statistically Derived)				
Total Semivolatile Organic Compounds	946	7.1	192	8.3
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	140	14.3	27	11.1
2,4,5,6-Tetrachloro-m-xylene	140	8.6	27	0.0
2,4,6-Tribromophenol	75	2.7	17	11.8
2-Fluorobiphenyl	75	1.3	17	0.0
2-Fluorophenol	75	4.0	17	11.8
Nitrobenzene-d5	75	5.3	17	0.0
o-Terphenyl	196	6.1	30	13.3
Phenol-d5	75	16.0	17	23.5
Terphenyl-d14 (7CI)	75	1.3	17	5.9

TableD-44. Summary of Analytical Laboratory Detection / Quantitation Limits Determined from Field Blanks Data: TestAmerica Laboratories

Period	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Total Organic Carbon (µg/L)					
Apr-2010 - Mar-2011	14	35.07	162.32	487	1,620
Jul-2010 - Jun-2011	—	—	—	—	—
Oct-2010 - Aug-2011	—	—	—	—	—
Jan-2011 - Dec-2011	12	2.92	202.66	608	2,030
Total Organic Halides (µg/L)					
Apr-2010 - Mar-2011	—	—	—	—	—
Jul-2010 - Jun-2011	—	—	—	—	—
Oct-2010 - Aug-2011	—	—	—	—	—

TableD-44. Summary of Analytical Laboratory Detection / Quantitation Limits Determined from Field Blanks Data: TestAmerica Laboratories

Period	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Jan-2011 - Dec-2011	12	3.33	3.41	10.2	34.1
Cesium-137 (pCi/L)					
Jan-2011 - Dec-2011	10	0.63	0.53	1.58	5.27
Cobalt-60 (pCi/L)					
Jan-2011 - Dec-2011	10	-0.20	1.07	3.22	10.7
Europium-152 (pCi/L)					
Jan-2011 - Dec-2011	10	-0.12	1.70	5.11	17.0
Europium-154 (pCi/L)					
Jan-2011 - Dec-2011	10	0.20	2.84	8.52	28.4
Europium-155 (pCi/L)					
Jan-2011 - Dec-2011	10	-0.24	1.85	5.54	18.5
Gross alpha (pCi/L)					
Jan-2011 - Dec-2011	7	0.0622	0.238	0.715	2.38
Gross beta (pCi/L)					
Jan-2011 - Dec-2011	7	1.01	1.03	3.10	10.3
Iodine-129 (pCi/L)					
Jan-2011 - Dec-2011	31	0.0250	0.0762	0.229	0.762
Strontium-90 (pCi/L)					
Jan-2011 - Dec-2011	5	0.0173	0.312	0.936	3.12
Technetium-99 (pCi/L)					
Jan-2011 - Dec-2011	10	2.10	2.68	8.03	26.8
Tritium (pCi/L)					
Jan-2011 - Dec-2011	14	12.3	81.5	244	815

Note: Total organic carbon and total organic halides data are from TestAmerica St. Louis. Radiological data are from TestAmerica Richland.

µg/L = micrograms per liter

pCi/L = picoCuries per liter

Table D-45. Summary of Analytical Laboratory Detection / Quantitation Limits Determined from Field Blanks Data: WSCF

Period	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Total Organic Carbon (µg/L)					
Apr-2010 - Mar-2011	8	-4.52	23.5	71	240
Jul-2010 - Jun-2011	24	-10.6	67.0	201	670
Oct-2010 - Aug-2011	15	24.0	82.1	246	820
Jan-2011 - Dec-2011	3	42.9	97.6	293	980
Total Organic Halides (µg/L)					
Apr-2010 - Mar-2011	4	1.37	1.18	3.5	11.8
Jul-2010 - Jun-2011	8	1.75	1.50	4.5	15.0
Oct-2010 - Aug-2011	24	3.23	2.55	7.7	25.5
Jan-2011 - Dec-2011	13	3.86	2.81	8.4	28.1
Cesium-137 (pCi/L)					
Jan-2011 - Dec-2011	10	0.63	0.53	1.58	5.27
Cobalt-60 (pCi/L)					
Jan-2011 - Dec-2011	6	-0.12	6.21	18.6	62.1
Europium-152 (pCi/L)					
Jan-2011 - Dec-2011	6	-2.83	21.1	63.4	211
Europium-154 (pCi/L)					
Jan-2011 - Dec-2011	6	-0.95	10.2	30.5	102
Europium-155 (pCi/L)					
Jan-2011 - Dec-2011	6	10.3	17.7	53.2	177
Gross alpha (pCi/L)					
Jan-2011 - Dec-2011	28	-0.401	0.616	1.85	6.16
Gross beta (pCi/L)					
Jan-2011 - Dec-2011	40	0.742	1.34	4.03	13.4
Total beta radiostrontium (pCi/L)					
Jan-2011 - Dec-2011	19	0.705	1.96	5.89	19.6
Technetium-99 (pCi/L)					
Jan-2011 - Dec-2011	28	-3.71	3.78	11.3	37.8
Tritium (pCi/L)					
Jan-2011 - Dec-2011	46	7.77	122	365	1,215

µg/L = micrograms per liter
pCi/L = picoCuries per liter

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
EPA-600/4-81-004, 310.1	Alkalinity	540	729.01	2,430.02	—	—	—	—
EPA-410.4	Chemical Oxygen Demand	6,500	8,775.08	29,250.26	—	—	—	—
EPA-600/4-81-004, 413.1	Oil and grease	2,100	2,835.03	9,450.09	—	—	—	—
EPA-420.2	Phenols	14	18.90	63.00	—	—	—	—
EPA-600/4-81-004, 120.1	Specific Conductance (µS/cm)	0.097	0.13	0.44	—	—	—	—
Anions								
EPA-600/R-93/100, 300.0	Bromide	25	33.75	112.50	—	—	—	—
EPA-600/R-93/100, 300.0	Chloride	20	27.00	90.00	—	—	—	—
EPA-600/R-93/100, 300.0	Fluoride	10	13.50	45.00	—	—	—	—
EPA-600/R-93/100, 300.0	Nitrogen in Nitrate	8.6	11.59	38.63	—	—	—	—
EPA-600/R-93/100, 300.0	Nitrogen in Nitrite	3	4.05	13.50	—	—	—	—
EPA-600/R-93/100, 300.0	Phosphorus in phosphate	54	72.90	243.00	—	—	—	—
EPA-600/R-93/100, 300.0	Sulfate	50	67.50	225.00	—	—	—	—
SW-846, 9012	Cyanide	1.5	2.03	6.75	—	—	—	—
EPA-600/R-93/100, 350.1	Nitrogen in Ammonium	9.2	12.42	41.40	—	—	—	—
SW-846, 9030	Sulfide	83	112.05	373.50	—	—	—	—
Metals								
SW-846, 6010	Aluminum	79.9	107.87	359.55	—	—	—	—
SW-846, 6010	Antimony	4	5.40	18.00	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Arsenic	2.7	3.65	12.15	—	—	—	—
SW-846, 6010	Barium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Beryllium	0.61	0.82	2.75	—	—	—	—
SW-846, 6010	Bismuth	105	141.75	472.50	—	—	—	—
SW-846, 6010	Boron	10.8	14.58	48.60	—	—	—	—
SW-846, 6010	Cadmium	0.91	1.23	4.10	—	—	—	—
SW-846, 6010	Calcium	106	143.10	477.00	—	—	—	—
SW-846, 6010	Chromium	3.1	4.19	13.95	—	—	—	—
SW-846, 6010	Cobalt	4	5.40	18.00	—	—	—	—
SW-846, 6010	Copper	4.6	6.21	20.70	—	—	—	—
SW-846, 6010	Iron	28.2	38.07	126.90	—	—	—	—
SW-846, 6010	Lead	1.5	2.03	6.75	—	—	—	—
SW-846, 6010	Lithium	9.6	12.96	43.20	—	—	—	—
SW-846, 6010	Magnesium	132	178.20	594.01	—	—	—	—
SW-846, 6010	Manganese	3.3	4.46	14.85	—	—	—	—
SW-846, 6010	Molybdenum	5	6.75	22.50	—	—	—	—
SW-846, 6010	Nickel	13.3	17.96	59.85	—	—	—	—
SW-846, 6010	Phosphorus	75	101.25	337.50	—	—	—	—
SW-846, 6010	Potassium	1,650	2,227.52	7,425.07	—	—	—	—
SW-846, 6010	Selenium	5	6.75	22.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Silicon	40	54.00	180.00	—	—	—	—
SW-846, 6010	Silver	6	8.10	27.00	—	—	—	—
SW-846, 6010	Sodium	324	437.40	1,458.01	—	—	—	—
SW-846, 6010	Strontium	0.54	0.73	2.43	—	—	—	—
SW-846, 6010	Thallium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Tin	13.5	18.23	60.75	—	—	—	—
SW-846, 6010	Vanadium	4.1	5.54	18.45	—	—	—	—
SW-846, 6010	Zinc	7	9.45	31.50	—	—	—	—
SW-846, 6020	Aluminum	12.9	17.42	58.05	—	—	—	—
SW-846, 6020	Antimony	1.7	2.30	7.65	—	—	—	—
SW-846, 6020	Arsenic	0.95	1.28	4.28	—	—	—	—
SW-846, 6020	Barium	0.2	0.27	0.90	—	—	—	—
SW-846, 6020	Beryllium	0.35	0.47	1.58	—	—	—	—
SW-846, 6020	Boron	10	13.50	45.00	—	—	—	—
SW-846, 6020	Cadmium	0.1	0.14	0.45	—	—	—	—
SW-846, 6020	Calcium	68.1	91.94	306.45	—	—	—	—
SW-846, 6020	Chromium	3.3	4.46	14.85	—	—	—	—
SW-846, 6020	Cobalt	0.22	0.30	0.99	—	—	—	—
SW-846, 6020	Copper	0.45	0.61	2.03	—	—	—	—
SW-846, 6020	Iron	20.4	27.54	91.80	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6020	Lead	0.17	0.23	0.77	—	—	—	—
SW-846, 6020	Magnesium	5.2	7.02	23.40	—	—	—	—
SW-846, 6020	Manganese	0.24	0.32	1.08	—	—	—	—
SW-846, 6020	Molybdenum	0.41	0.55	1.85	27-May-11	1	1.35	4.50
SW-846, 6020	Nickel	0.4	0.54	1.80	—	—	—	—
SW-846, 6020	Potassium	41.6	56.16	187.20	—	—	—	—
SW-846, 6020	Selenium	1.6	2.16	7.20	—	—	—	—
SW-846, 6020	Silicon	17.8	24.03	80.10	—	—	—	—
SW-846, 6020	Silver	0.04	0.05	0.18	—	—	—	—
SW-846, 6020	Sodium	15	20.25	67.50	—	—	—	—
SW-846, 6020	Strontium	1	1.35	4.50	—	—	—	—
SW-846, 6020	Thallium	0.55	0.74	2.48	—	—	—	—
SW-846, 6020	Tin	1	1.35	4.50	—	—	—	—
SW-846, 6020	Titanium	2	2.70	9.00	—	—	—	—
SW-846, 6020	Uranium	0.23	0.31	1.04	—	—	—	—
SW-846, 6020	Vanadium	2.4	3.24	10.80	—	—	—	—
SW-846, 6020	Zinc	8.3	11.21	37.35	—	—	—	—
EPA-7196	Hexavalent Chromium	3.7	5.00	16.65	—	—	—	—
EPA-7074	Mercury	0.05	0.07	0.23	13-Jul-11	0.06	0.08	0.27
UTOT-KPA	Uranium	0.14	0.19	0.63	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
Volatile Organic Compounds								
SW-846, 8260	1,1,1,2-Tetrachloroethane	0.09	0.12	0.41	—	—	—	—
SW-846, 8260	1,1,1-Trichloroethane	0.069	0.09	0.31	—	—	—	—
SW-846, 8260	1,1,2,2-Tetrachloroethane	0.098	0.13	0.44	—	—	—	—
SW-846, 8260	1,1,2-Trichloro-1,2,2-trifluoroethane	0.1	0.14	0.45	—	—	—	—
SW-846, 8260	1,1,2-Trichloroethane	0.15	0.20	0.68	—	—	—	—
SW-846, 8260	1,1-Dichloroethane	0.068	0.09	0.31	—	—	—	—
SW-846, 8260	1,1-Dichloroethene	0.083	0.11	0.37	—	—	—	—
SW-846, 8260	1,1-Dichloropropene	0.079	0.11	0.36	—	—	—	—
SW-846, 8260	1,2,3-Trichlorobenzene	0.087	0.12	0.39	—	—	—	—
SW-846, 8260	1,2,3-Trichloropropane	0.15	0.20	0.68	—	—	—	—
SW-846, 8260	1,2,4-Trichlorobenzene	0.078	0.11	0.35	—	—	—	—
SW-846, 8260	1,2,4-Trimethylbenzene	0.084	0.11	0.38	—	—	—	—
SW-846, 8260	1,2-Dibromo-3-chloropropane	0.41	0.55	1.85	—	—	—	—
SW-846, 8260	1,2-Dibromoethane	0.13	0.18	0.59	—	—	—	—
SW-846, 8260	1,2-Dichlorobenzene	0.06	0.08	0.27	—	—	—	—
SW-846, 8260	1,2-Dichloroethane	0.1	0.14	0.45	—	—	—	—
SW-846, 8260	1,2-Dichloroethene (Total)	0.15	0.20	0.68	—	—	—	—
SW-846, 8260	1,2-Dichloropropane	0.097	0.13	0.44	—	—	—	—
SW-846, 8260	1,3,5-Trimethylbenzene	0.081	0.11	0.36	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	1,3-Dichlorobenzene	0.078	0.11	0.35	—	—	—	—
SW-846, 8260	1,3-Dichloropropane	0.072	0.10	0.32	—	—	—	—
SW-846, 8260	1,4-Dichlorobenzene	0.12	0.16	0.54	—	—	—	—
SW-846, 8260	1,4-Dioxane	7.6	10.26	34.20	—	—	—	—
SW-846, 8260	1-Butanol	12	16.20	54.00	—	—	—	—
SW-846, 8260	2,2-Dichloropropane	0.14	0.19	0.63	—	—	—	—
SW-846, 8260	2-Butanone	0.52	0.70	2.34	—	—	—	—
SW-846, 8260	2-Chloroethyl vinyl ether	0.16	0.22	0.72	—	—	—	—
SW-846, 8260	2-Chlorotoluene	0.078	0.11	0.35	—	—	—	—
SW-846, 8260	2-Hexanone	0.22	0.30	0.99	—	—	—	—
SW-846, 8260	2-Nitropropane	0.4	0.54	1.80	—	—	—	—
SW-846, 8260	4-Chlorotoluene	0.081	0.11	0.36	—	—	—	—
SW-846, 8260	4-Methyl-2-pentanone	0.12	0.16	0.54	—	—	—	—
SW-846, 8260	Acetic acid, methyl ester	0.37	0.50	1.67	—	—	—	—
SW-846, 8260	Acetone	0.34	0.46	1.53	—	—	—	—
SW-846, 8260	Acetonitrile	2	2.70	9.00	—	—	—	—
SW-846, 8260	Acrolein	2.8	3.78	12.60	—	—	—	—
SW-846, 8260	Acrylonitrile	0.58	0.78	2.61	—	—	—	—
SW-846, 8260	Allyl chloride	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Benzene	0.064	0.09	0.29	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	Bromobenzene	0.076	0.10	0.34	—	—	—	—
SW-846, 8260	Bromochloromethane	0.13	0.18	0.59	—	—	—	—
SW-846, 8260	Bromodichloromethane	0.088	0.12	0.40	—	—	—	—
SW-846, 8260	Bromoform	0.17	0.23	0.77	—	—	—	—
SW-846, 8260	Bromomethane	0.25	0.34	1.13	—	—	—	—
SW-846, 8260	Carbon disulfide	0.051	0.07	0.23	—	—	—	—
SW-846, 8260	Carbon tetrachloride	0.12	0.16	0.54	—	—	—	—
SW-846, 8260	Chlorobenzene	0.15	0.20	0.68	—	—	—	—
SW-846, 8260	Chloroethane	0.099	0.13	0.45	—	—	—	—
SW-846, 8260	Chloroform	0.1	0.14	0.45	—	—	—	—
SW-846, 8260	Chloromethane	0.077	0.10	0.35	—	—	—	—
SW-846, 8260	Chloroprene	0.097	0.13	0.44	—	—	—	—
SW-846, 8260	cis-1,2-Dichloroethene	0.087	0.12	0.39	—	—	—	—
SW-846, 8260	cis-1,3-Dichloropropene	0.073	0.10	0.33	—	—	—	—
SW-846, 8260	Cyclohexane	0.067	0.09	0.30	—	—	—	—
SW-846, 8260	Cyclohexanone	5.8	7.83	26.10	—	—	—	—
SW-846, 8260	Dibromochloromethane	0.13	0.18	0.59	—	—	—	—
SW-846, 8260	Dibromomethane	0.21	0.28	0.95	—	—	—	—
SW-846, 8260	Dichlorodifluoromethane	0.084	0.11	0.38	—	—	—	—
SW-846, 8260	Diethyl ether	0.26	0.35	1.17	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	Ethyl acetate	0.18	0.24	0.81	—	—	—	—
SW-846, 8260	Ethyl cyanide	1.4	1.89	6.30	—	—	—	—
SW-846, 8260	Ethyl methacrylate	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Ethylbenzene	0.086	0.12	0.39	—	—	—	—
SW-846, 8260	Hexachlorobutadiene	0.087	0.12	0.39	—	—	—	—
SW-846, 8260	Hexane	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Iodomethane	0.092	0.12	0.41	—	—	—	—
SW-846, 8260	Isobutyl alcohol	8.7	11.75	39.15	—	—	—	—
SW-846, 8260	Isopropylbenzene	0.083	0.11	0.37	—	—	—	—
SW-846, 8260	Methacrylonitrile	0.5	0.68	2.25	—	—	—	—
SW-846, 8260	Methyl cyclohexane	0.1	0.14	0.45	—	—	—	—
SW-846, 8260	Methyl methacrylate	0.26	0.35	1.17	—	—	—	—
SW-846, 8260	Methyl tert-butyl ether	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Methylene chloride	0.11	0.15	0.50	04-Jul-11	0.27	0.36	1.22
SW-846, 8260	Naphthalene	0.16	0.22	0.72	—	—	—	—
SW-846, 8260	n-Butylbenzene	0.25	0.34	1.13	—	—	—	—
SW-846, 8260	n-Propylbenzene	0.062	0.08	0.28	—	—	—	—
SW-846, 8260	o-Xylene	0.063	0.09	0.28	—	—	—	—
SW-846, 8260	p-Cymene	0.085	0.11	0.38	—	—	—	—
SW-846, 8260	Pentachloroethane	0.34	0.46	1.53	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	sec-Butylbenzene	0.086	0.12	0.39	—	—	—	—
SW-846, 8260	Styrene	0.074	0.10	0.33	—	—	—	—
SW-846, 8260	tert-Butylbenzene	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Tetrachloroethene	0.18	0.24	0.81	—	—	—	—
SW-846, 8260	Tetrahydrofuran	1.1	1.49	4.95	—	—	—	—
SW-846, 8260	Toluene	0.072	0.10	0.32	—	—	—	—
SW-846, 8260	trans-1,2-Dichloroethene	0.083	0.11	0.37	—	—	—	—
SW-846, 8260	trans-1,3-Dichloropropene	0.083	0.11	0.37	—	—	—	—
SW-846, 8260	trans-1,4-Dichloro-2-butene	0.29	0.39	1.31	—	—	—	—
SW-846, 8260	Trichloroethene	0.25	0.34	1.13	—	—	—	—
SW-846, 8260	Trichloromonofluoromethane	0.11	0.15	0.50	—	—	—	—
SW-846, 8260	Vinyl acetate	0.18	0.24	0.81	—	—	—	—
SW-846, 8260	Vinyl chloride	0.084	0.11	0.38	—	—	—	—
SW-846, 8260	Xylenes (total)	0.2	0.27	0.90	—	—	—	—
SW-846, 8015	TPH, gasoline fraction	10	13.50	45.00	—	—	—	—
Semivolatile Organic Compounds								
SW-846, 8040	2,3,4,6-Tetrachlorophenol	2	2.70	9.00	—	—	—	—
SW-846, 8040	2,4,5-Trichlorophenol	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	2,4,6-Trichlorophenol	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	2,4-Dichlorophenol	2.1	2.84	9.45	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8040	2,4-Dimethylphenol	2.1	2.84	9.45	—	—	—	—
SW-846, 8040	2,4-Dinitrophenol	2.4	3.24	10.80	—	—	—	—
SW-846, 8040	2,6-Dichlorophenol	2.1	2.84	9.45	—	—	—	—
SW-846, 8040	2-Chlorophenol	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	2-Methylphenol (cresol, o-)	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	2-Nitrophenol	2.3	3.11	10.35	—	—	—	—
SW-846, 8040	3+4 Methylphenol (cresol, m+p)	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	4,6-Dinitro-2-methylphenol	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	4-Chloro-3-methylphenol	2.4	3.24	10.80	—	—	—	—
SW-846, 8040	4-Nitrophenol	2.2	2.97	9.90	—	—	—	—
SW-846, 8040	Dinoseb(2-secButyl-4,6-dinitrophenol)	2.4	3.24	10.80	—	—	—	—
SW-846, 8040	Pentachlorophenol	2.4	3.24	10.80	—	—	—	—
SW-846, 8040	Phenol	2.3	3.11	10.35	—	—	—	—
SW-846, 8081	4,4'-DDD (Dichlorodiphenyldichloroethane)	0.01	0.01	0.05	—	—	—	—
SW-846, 8081	4,4'-DDE (Dichlorodiphenyldichloroethene)	0.01	0.01	0.05	—	—	—	—
SW-846, 8081	4,4'-DDT (Dichlorodiphenyltrichloroethane)	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-Hexachlorocyclohexane (beta-BHC)	0.013	0.02	0.06	—	—	—	—
SW-846, 8081	Chlordane	0.23	0.31	1.04	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
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	0.01	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)	0.01	0.01	0.05	—	—	—	—
SW-846, 8081	Heptachlor	0.01	0.01	0.05	—	—	—	—
SW-846, 8081	Heptachlor epoxide	0.01	0.01	0.05	16-May-11	0.017	0.02	0.08
SW-846, 8081	Methoxychlor	0.01	0.01	0.05	—	—	—	—
SW-846, 8081	Toxaphene	0.66	0.89	2.97	—	—	—	—
SW-846, 8082	Aroclor-1016	0.24	0.32	1.08	—	—	—	—
SW-846, 8082	Aroclor-1221	0.24	0.32	1.08	—	—	—	—
SW-846, 8082	Aroclor-1232	0.24	0.32	1.08	—	—	—	—
SW-846, 8082	Aroclor-1242	0.24	0.32	1.08	—	—	—	—
SW-846, 8082	Aroclor-1248	0.24	0.32	1.08	—	—	—	—
SW-846, 8082	Aroclor-1254	0.17	0.23	0.77	—	—	—	—
SW-846, 8082	Aroclor-1260	0.17	0.23	0.77	—	—	—	—
SW-846, 8270	1,2,4,5-Tetrachlorobenzene	1	1.35	4.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	1,2,4-Trichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,2-Dichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,3-Dichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,4-Dichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,4-Dioxane	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,4-Naphthoquinone	1	1.35	4.50	18-Jul-11	2.3	3.11	10.35
SW-846, 8270	1-Naphthylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,3,4,6-Tetrachlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4,5-Trichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4,6-Trichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dichlorophenol	1	1.35	4.50	18-Jul-11	1.1	1.49	4.95
SW-846, 8270	2,4-Dimethylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dinitrophenol	2	2.70	9.00	—	—	—	—
SW-846, 8270	2,4-Dinitrotoluene	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,6-Dichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,6-Dinitrotoluene	2.2	2.97	9.90	—	—	—	—
SW-846, 8270	2-Acetylaminofluorene	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Chloronaphthalene	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Chlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Methylnaphthalene	1	1.35	4.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	2-Methylphenol (cresol, o-)	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Naphthylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Nitroaniline	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Nitrophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Picoline	2	2.70	9.00	—	—	—	—
SW-846, 8270	3,3'-Dichlorobenzidine	1	1.35	4.50	18-Jul-11	1.3	1.76	5.85
SW-846, 8270	3,3'-Dimethylbenzidine	2.6	3.51	11.70	—	—	—	—
SW-846, 8270	3+4 Methylphenol (cresol, m+p)	2	2.70	9.00	—	—	—	—
SW-846, 8270	3-Methylcholanthrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	3-Nitroaniline	1	1.35	4.50	—	—	—	—
SW-846, 8270	4,6-Dinitro-2-methylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Aminobiphenyl	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Bromophenylphenyl ether	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Chloro-3-methylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Chloroaniline	1	1.35	4.50	18-Jul-11	2.2	2.97	9.90
SW-846, 8270	4-Chlorophenylphenyl ether	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Methylphenol (cresol, p-)	10	13.50	45.00	23-Sep-11	1	1.35	4.50
SW-846, 8270	4-Nitroaniline	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Nitrophenol	2	2.70	9.00	—	—	—	—
SW-846, 8270	4-Nitroquinoline-1-oxide	5	6.75	22.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	5-Nitro-o-toluidine	1	1.35	4.50	—	—	—	—
SW-846, 8270	7,12-Dimethylbenz[a]anthracene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Acenaphthene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Acenaphthylene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Acetophenone	1	1.35	4.50	18-Jul-11	1.1	1.49	4.95
SW-846, 8270	alpha,alpha-Dimethylphenethylamine	22	29.70	99.00	—	—	—	—
SW-846, 8270	Aniline	1	1.35	4.50	18-Jul-11	1.3	1.76	5.85
SW-846, 8270	Anthracene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Aramite	20	27.00	90.00	23-Sep-11	2	2.70	9.00
SW-846, 8270	Azobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzo(a)anthracene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzo(a)pyrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzo(b)fluoranthene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzo(ghi)perylene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzo(k)fluoranthene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzothiazole	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzyl alcohol	1	1.35	4.50	—	—	—	—
SW-846, 8270	Bis(2-chloro-1-methylethyl)ether	1	1.35	4.50	—	—	—	—
SW-846, 8270	Bis(2-Chloroethoxy)methane	1	1.35	4.50	—	—	—	—
SW-846, 8270	Bis(2-chloroethyl) ether	1	1.35	4.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Bis(2-ethylhexyl) phthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Butylbenzylphthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Carbazole	1	1.35	4.50	—	—	—	—
SW-846, 8270	Chlorobenzilate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Chrysene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Diallate	2	2.70	9.00	—	—	—	—
SW-846, 8270	Dibenz[a,h]anthracene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Dibenzofuran	1	1.35	4.50	—	—	—	—
SW-846, 8270	Diethylphthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Dimethoate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Dimethyl phthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Di-n-butylphthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Di-n-octylphthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Dinoseb(2-secButyl-4,6-dinitrophenol)	2	2.70	9.00	—	—	—	—
SW-846, 8270	Diphenylamine+N-Nitrosodiphenylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	Disulfoton	1	1.35	4.50	—	—	—	—
SW-846, 8270	Ethyl methanesulfonate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Famphur	1.7	2.30	7.65	—	—	—	—
SW-846, 8270	Fluoranthene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Fluorene	1	1.35	4.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Hexachlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Hexachlorobutadiene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Hexachlorocyclopentadiene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Hexachloroethane	1	1.35	4.50	—	—	—	—
SW-846, 8270	Hexachlorophene	10	13.50	45.00	—	—	—	—
SW-846, 8270	Hexachloropropene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Indeno(1,2,3-cd)pyrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Isodrin	1	1.35	4.50	—	—	—	—
SW-846, 8270	Isophorone	1	1.35	4.50	—	—	—	—
SW-846, 8270	Isosafrole	1.3	1.76	5.85	—	—	—	—
SW-846, 8270	Kepone	20	27.00	90.00	—	—	—	—
SW-846, 8270	m-Dinitrobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Methapyrilene	1.3	1.76	5.85	—	—	—	—
SW-846, 8270	Methyl methanesulfonate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Methyl parathion	1	1.35	4.50	—	—	—	—
SW-846, 8270	Naphthalene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Nitrobenzene	1	1.35	4.50	18-Jul-11	1.1	1.49	4.95
SW-846, 8270	Nitrosopyrrolidine	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosodiethylamine	1	1.35	4.50	18-Jul-11	1.1	1.49	4.95
SW-846, 8270	n-Nitrosodimethylamine	2	2.70	9.00	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	n-Nitrosodi-n-butylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosodi-n-dipropylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosodiphenylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosomethylethylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosomorpholine	1	1.35	4.50	18-Jul-11	1.2	1.62	5.40
SW-846, 8270	n-Nitrosopiperidine	1	1.35	4.50	—	—	—	—
SW-846, 8270	O,O,O-Triethyl phosphorothioate	1	1.35	4.50	29-Jul-11	1.1	1.49	4.95
SW-846, 8270	O,O-Diethyl O-2-pyrazinyl phosphorothioate	1	1.35	4.50	—	—	—	—
SW-846, 8270	o-Toluidine	1	1.35	4.50	—	—	—	—
SW-846, 8270	Parathion	1	1.35	4.50	—	—	—	—
SW-846, 8270	p-Dimethylaminoazobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pentachlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pentachloroethane	1	1.35	4.50	18-Jul-11	1.3	1.76	5.85
SW-846, 8270	Pentachloronitrobenzene (PCNB)	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pentachlorophenol	1.3	1.76	5.85	—	—	—	—
SW-846, 8270	Phenacetin	1	1.35	4.50	—	—	—	—
SW-846, 8270	Phenanthrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Phenol	2	2.70	9.00	—	—	—	—
SW-846, 8270	Phorate	1	1.35	4.50	—	—	—	—
SW-846, 8270	p-Phenylenediamine	1	1.35	4.50	—	—	—	—

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Pronamide	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pyrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pyridine	2	2.70	9.00	—	—	—	—
SW-846, 8270	Safrol	1	1.35	4.50	—	—	—	—
SW-846, 8270	sym-Trinitrobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Tetraethyl dithiopyrophosphate (Sulfotepp)	1	1.35	4.50	—	—	—	—
SW-846, 8270	Total cresols	3	4.05	13.50	—	—	—	—
SW-846, 8270	Tributyl phosphate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Tris-2-chloroethyl phosphate	1	1.35	4.50	—	—	—	—
SW-846, 8310	Acenaphthene	0.65	0.88	2.93				
SW-846, 8310	Acenaphthylene	0.4	0.54	1.80				
SW-846, 8310	Anthracene	0.02	0.03	0.09				
SW-846, 8310	Benzo(a)anthracene	0.063	0.09	0.28				
SW-846, 8310	Benzo(a)pyrene	0.075	0.10	0.34				
SW-846, 8310	Benzo(b)fluoranthene	0.051	0.07	0.23				
SW-846, 8310	Benzo(ghi)perylene	0.16	0.22	0.72				
SW-846, 8310	Benzo(k)fluoranthene	0.074	0.10	0.33				
SW-846, 8310	Chrysene	0.035	0.05	0.16				
SW-846, 8310	Dibenz[a,h]anthracene	0.15	0.20	0.68				
SW-846, 8310	Fluoranthene	0.18	0.24	0.81				

Table D-46. Summary of Detection and Quantitation Limits: TestAmerica Laboratories

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8310	Fluorene	0.071	0.10	0.32				
SW-846, 8310	Indeno(1,2,3-cd)pyrene	0.14	0.19	0.63				
SW-846, 8310	Naphthalene	0.2	0.27	0.90				
SW-846, 8310	Phenanthrene	0.1	0.14	0.45	08-Jul-11	0.3	0.41	1.35
SW-846, 8310	Pyrene	0.083	0.11	0.37				
SW-846, 8015	TPH, diesel range	17	22.95	76.50				
SW-846, 8015	TPH, kerosene range	10	13.50	45.00				

Sources: EPA-600/4-81-004, *Environmental Radioactivity Laboratory Intercomparison Studies Program Fiscal Year 1981-1982*.

EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.

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

Note: Includes analytes from the TestAmerica Richland and TestAmerica St. Louis laboratories.

a. 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. These MDLs are adjusted to a dilution factor of one and the most commonly used sample volume. The MDLs reported with actual groundwater sample data are usually adjusted for the sample dilution factor or sample aliquot volume. Consequently, the MDLs reported with groundwater sample data may differ from those shown in this table.

BHC = benzene hexachloride (This is an erroneous name for hexachlorocyclohexane.)

LOD = limit of detection

LOQ = limit of quantitation

MDL = method detection limit

TPH = total petroleum hydrocarbons

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
SM 2320B	Alkalinity	1,000	1,350.01	4,500.04	—	—	—	—
EPA-410.4	Chemical Oxygen Demand	10,000	13,500.12	45,000.41	—	—	—	—
EPA-600/4-81-004, 120.1	Specific Conductance (µS/cm)	0.50	0.68	2.25	—	—	—	—
Ammonia / Anions								
EPA-600/R-93/100, 300.0	Bromide	55	74.25	247.50	28-Jan-11	110	148.50	495.00
EPA-600/R-93/100, 300.0	Chloride	42	56.70	189.00	10-Feb-11	60	81.00	270.00
EPA-600/R-93/100, 300.0	Fluoride	44	59.40	198.00	10-Feb-11	23	31.05	103.50
EPA-600/R-93/100, 300.0	Nitrogen in Nitrate	9.5	12.81	42.70	10-Feb-11	19	25.62	85.39
EPA-600/R-93/100, 300.0	Nitrogen in Nitrite	18	24.25	80.85	10-Feb-11	20	26.93	89.75
EPA-600/R-93/100, 300.0	Phosphorus in Phosphate	70	94.50	315.00	28-Jan-11	42	56.70	189.00
EPA-600/R-93/100, 300.0	Sulfate	85	114.75	382.50	10-Feb-11	110	148.50	495.00
EPA-600/R-93/100, 335.2	Cyanide	4	5.40	18.00	—	—	—	—
EPA-600/R-93/100, 300.7	Nitrogen in Ammonium	2.4	3.24	10.80	2-Feb-11	1.4	1.89	6.30
Metals								
SW-846, 6010	Aluminum	19	25.65	85.50	—	—	—	—
SW-846, 6010	Antimony	47	63.45	211.50	19-May-11	36	48.60	162.00
SW-846, 6010	Arsenic	50	67.50	225.00	—	—	—	—
SW-846, 6010	Barium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Beryllium	4	5.40	18.00	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Bismuth	37	49.95	166.50	—	—	—	—
SW-846, 6010	Boron	41	55.35	184.50	—	—	—	—
SW-846, 6010	Cadmium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Calcium	28	37.80	126.00	19-May-11	49	66.15	220.50
SW-846, 6010	Chromium	14	18.90	63.00	19-May-11	5	6.75	22.50
SW-846, 6010	Cobalt	4	5.40	18.00	—	—	—	—
SW-846, 6010	Copper	5	6.75	22.50	28-Jul-11	4	5.40	18.00
SW-846, 6010	Iron	38	51.30	171.00	19-May-11	19	25.65	85.50
SW-846, 6010	Lead	42	56.70	189.00	—	—	—	—
SW-846, 6010	Lithium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Magnesium	14	18.90	63.00	19-May-11	4	5.40	18.00
SW-846, 6010	Manganese	6	8.10	27.00	19-May-11	4	5.40	18.00
SW-846, 6010	Molybdenum	4	5.40	18.00	—	—	—	—
SW-846, 6010	Nickel	4	5.40	18.00	—	—	—	—
SW-846, 6010	Phosphorus	72	97.20	324.00	—	—	—	—
SW-846, 6010	Potassium	73	98.55	328.50	19-May-11	76	102.60	342.00
SW-846, 6010	Selenium	47	63.45	211.50	—	—	—	—
SW-846, 6010	Silicon	25	33.75	112.50	—	—	—	—
SW-846, 6010	Silver	7	9.45	31.50	19-May-11	4	5.40	18.00
SW-846, 6010	Sodium	11	14.85	49.50	19-May-11	10	13.50	45.00

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Strontium	4	5.40	18.00	28-Jul-11	9	12.15	40.50
SW-846, 6010	Thallium	49	66.15	220.50	—	—	—	—
SW-846, 6010	Tin	49	66.15	220.50	—	—	—	—
SW-846, 6010	Titanium	4	5.40	18.00	—	—	—	—
SW-846, 6010	Vanadium	17	22.95	76.50	19-May-11	5	6.75	22.50
SW-846, 6010	Zinc	4	5.40	18.00	28-Jul-11	5	6.75	22.50
EPA-600/R-94/111, 200.8	Aluminum	5	6.75	22.50	—	—	—	—
EPA-600/R-94/111, 200.8	Antimony	0.3	0.41	1.35	—	—	—	—
EPA-600/R-94/111, 200.8	Arsenic	0.4	0.54	1.80	9-Sep-11	0.2	0.27	0.90
EPA-600/R-94/111, 200.8	Barium	0.2	0.27	0.90	—	—	—	—
EPA-600/R-94/111, 200.8	Beryllium	0.05	0.07	0.23	9-Sep-11	0.1	0.14	0.45
EPA-600/R-94/111, 200.8	Boron	0.5	0.68	2.25	—	—	—	—
EPA-600/R-94/111, 200.8	Cadmium	0.1	0.14	0.45	26-Jun-11	0.05	0.07	0.23
EPA-600/R-94/111, 200.8	Chromium	0.5	0.68	2.25	26-Jun-11	0.1	0.14	0.45
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	0.45	—	—	—	—
EPA-600/R-94/111, 200.8	Lead	0.1	0.14	0.45	9-Sep-11	0.05	0.07	0.23
EPA-600/R-94/111, 200.8	Manganese	0.1	0.14	0.45	—	—	—	—
EPA-600/R-94/111, 200.8	Mercury	0.05	0.07	0.23	28-Jul-11	0.03	0.04	0.14
EPA-600/R-94/111, 200.8	Molybdenum	0.05	0.07	0.23	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
EPA-600/R-94/111, 200.8	Nickel	0.2	0.27	0.90	—	—	—	—
EPA-600/R-94/111, 200.8	Selenium	0.6	0.81	2.70	9-Sep-11	1	1.35	4.50
EPA-600/R-94/111, 200.8	Silver	0.1	0.14	0.45	26-Jun-11	0.05	0.07	0.23
EPA-600/R-94/111, 200.8	Strontium	0.1	0.14	0.45	—	—	—	—
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	0.45	—	—	—	—
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	0.90	—	—	—	—
EPA-600/R-94/111, 200.8	Zinc	0.8	1.08	3.60	—	—	—	—
EPA-7196	Hexavalent Chromium	2	2.70	9.00	—	—	—	—
Volatile Organic Compounds								
SW-846, 8015	1-Propanol	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8015	Diethyl ether	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8015	Ethanol	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8015	Ethyl acetate	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8015	Ethylene glycol	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8015	Methanol	2,000	2,700.02	9,000.08	—	—	—	—
SW-846, 8260	1,1,1-Trichloroethane	1	1.35	4.50	—	—	—	—
SW-846, 8260	1,1,2-Trichloroethane	1	1.35	4.50	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	1,1-Dichloroethane	1	1.35	4.50	—	—	—	—
SW-846, 8260	1,1-Dichloroethene	1	1.35	4.50	—	—	—	—
SW-846, 8260	1,2-Dichloroethane	1	1.35	4.50	—	—	—	—
SW-846, 8260	1,4-Dichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8260	1-Butanol	100	135.00	450.00	—	—	—	—
SW-846, 8260	2-Butanone	1	1.35	4.50	—	—	—	—
SW-846, 8260	4-Methyl-2-pentanone	1	1.35	4.50	—	—	—	—
SW-846, 8260	Acetone	1	1.35	4.50	—	—	—	—
SW-846, 8260	Benzene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Carbon disulfide	1	1.35	4.50	—	—	—	—
SW-846, 8260	Carbon tetrachloride	1	1.35	4.50	—	—	—	—
SW-846, 8260	Chlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Chloroform	1	1.35	4.50	—	—	—	—
SW-846, 8260	cis-1,2-Dichloroethene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Ethyl cyanide	2	2.70	9.00	—	—	—	—
SW-846, 8260	Ethylbenzene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Methylene chloride	1	1.35	4.50	—	—	—	—
SW-846, 8260	Tetrachloroethene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Tetrahydrofuran	2	2.70	9.00	—	—	—	—
SW-846, 8260	Toluene	1	1.35	4.50	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	trans-1,2-Dichloroethene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Trichloroethene	1	1.35	4.50	—	—	—	—
SW-846, 8260	Vinyl chloride	1	1.35	4.50	—	—	—	—
SW-846, 8260	Xylenes (total)	1	1.35	4.50	—	—	—	—
NWTPH-G	TPH, gasoline fraction	50	67.50	225.00	—	—	—	—
Semivolatile Organic Compounds								
EPA-8082	Aroclor 1016	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1221	0.2	0.27	0.90	—	—	—	—
EPA-8082	Aroclor 1232	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1242	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1248	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1254	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1260	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1262	0.1	0.14	0.45	—	—	—	—
EPA-8082	Aroclor 1268	0.1	0.14	0.45	—	—	—	—
SW-846, 8270	1,2,4-Trichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,4-Dichlorobenzene	1	1.35	4.50	—	—	—	—
SW-846, 8270	1,4-Dioxane	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,3,4,6-Tetrachlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4,5-Trichlorophenol	1	1.35	4.50	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	2,4,6-Trichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dimethylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dinitrophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,4-Dinitrotoluene	1	1.35	4.50	—	—	—	—
SW-846, 8270	2,6-Dichlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Chlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Methylphenol (cresol, o-)	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Nitrophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	2-Picoline	1	1.35	4.50	—	—	—	—
SW-846, 8270	3+4 Methylphenol (cresol, m+p)	1	1.35	4.50	—	—	—	—
SW-846, 8270	4,6-Dinitro-2-methylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Chloro-3-methylphenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	4-Nitrophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	Acenaphthene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Benzothiazole	1	1.35	4.50	—	—	—	—
SW-846, 8270	Bis(2-ethylhexyl) phthalate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Dinoseb(2-secButyl-4,6-dinitrophenol)	1	1.35	4.50	—	—	—	—
SW-846, 8270	Naphthalene	1	1.35	4.50	—	—	—	—
SW-846, 8270	n-Nitrosodimethylamine	1	1.35	4.50	—	—	—	—

Table D-47. Summary of Detection and Quantitation Limits: WSCF

Method	Constituent	Initial MDL[a,b] (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL[a,b] (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	n-Nitrosodi-n-dipropylamine	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pentachlorophenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	Phenol	1	1.35	4.50	—	—	—	—
SW-846, 8270	Pyrene	1	1.35	4.50	—	—	—	—
SW-846, 8270	Total cresols	1	1.35	4.50	—	—	—	—
SW-846, 8270	Tributyl phosphate	1	1.35	4.50	—	—	—	—
SW-846, 8270	Tris-2-chloroethyl phosphate	1	1.35	4.50	—	—	—	—
NWTPH-Dx	TPH, diesel fraction	70	94.50	315.00	—	—	—	—
NWTPH-Dx	TPH, kerosene fraction	70	94.50	315.00	—	—	—	—

Sources: EPA-600/4-81-004, *Environmental Radioactivity Laboratory Intercomparison Studies Program Fiscal Year 1981-1982*.

EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.

EPA-600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement I*.

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

a. 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. These MDLs are adjusted to a dilution factor of one and the most commonly used sample volume. The MDLs reported with actual groundwater sample data are usually adjusted for the sample dilution factor or sample aliquot volume. Consequently, the MDLs reported with groundwater sample data may differ from those shown in this table.

LOD = Limit of detection

LOQ = Limit of quantitation

MDL = Method detection limit

TPH = total petroleum hydrocarbons