

Appendix C

Quality Assurance and Quality Control

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Appendix C

Quality Assurance and Quality Control

H. L. Anastos and C. J. Thompson

This appendix presents fiscal year (FY) 2007 quality assurance/quality control (QA/QC) information for groundwater monitoring at the Hanford Site. Both long-term and interim action groundwater monitoring are managed by Fluor Hanford, Inc. via the Soil and Groundwater Remediation Project (groundwater project). The phrase “long-term monitoring” refers to monitoring performed to meet the requirements of the *Resource Conservation and Recovery Act* (RCRA) and the *Atomic Energy Act* (AEA). Long-term monitoring also includes monitoring performed at *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) sites with no active groundwater remediation. Interim action monitoring encompasses monitoring at sites with active groundwater remediation under CERCLA. The QA/QC practices used by the groundwater project assess and enhance the reliability and validity of field and laboratory measurements conducted to support these programs. Accuracy, precision, and detection are the primary parameters used to assess data quality (Mitchell et al. 1985). Representativeness, completeness, and comparability may also be evaluated for overall quality. These parameters are evaluated through laboratory QC checks (e.g., matrix spikes, laboratory blanks), replicate sampling and analysis, analysis of blind standards and blanks, and interlaboratory comparisons. Acceptance criteria have been established for each of these parameters. When a parameter is outside the criteria, groundwater project staff review the data, and if appropriate, corrective actions are taken to prevent a future occurrence.

The QA/QC practices for RCRA samples are based on guidance from the U.S. Environmental Protection Agency (EPA) (OSWER-9950.1 and SW-846). U.S. Department of Energy (DOE) Orders and internal requirements provide the guidance for the collection and analysis of samples for other long-term monitoring. The QA/QC practices for the groundwater project are described in the project-specific QA plan (GRP-QA-001, HNF-20635). Guidance for interim action monitoring QA/QC practices is provided in project-specific documents (e.g., DOE/RL-90-08; DOE/RL-91-03; DOE/RL-91-46; DOE/RL-92-76; DOE/RL-96-07; DOE/RL-96-90; DOE/RL-97-36; DOE/RL-2002-10; DOE/RL-2002-17). A glossary of QA/QC terms is provided in PNNL-13080. Additional information about the QA/QC program and FY 2007 data (e.g., results of individual QC samples and/or associated groundwater samples) is available on request.

C.1 Sample Collection and Analysis

H. L. Anastos and C. J. Thompson

Fluor Hanford, Inc. sampling crews collected groundwater samples for FY 2007. Their tasks included bottle preparation, sample set coordination, field measurements, sample collection, sample shipping, well pumping, and coordination of purge water containment and disposal.

During FY 2007, the groundwater project transitioned most of the chemical and radiological analyses from TestAmerica (TA) Laboratories (Richland and St. Louis) to the Waste Sampling and Characterization Facility (WSCF). WSCF is an on-site laboratory managed by Fluor Hanford, Inc. Section C.6.6 provides additional information about the transition.

TestAmerica Laboratories, Inc. was previously known as Severn Trent Laboratories, Incorporated. In June 2007, Severn Trent Laboratories filed a corporate charter amendment and changed their name to TestAmerica

Laboratories, Inc. This was a corporate name change only, and the laboratory is still part of the same legal corporate entity.

TA St. Louis and WSCF performed most of the routine analyses of Hanford groundwater samples for hazardous and non-hazardous chemicals. Lionville Laboratory, Incorporated, Lionville, Pennsylvania (Lionville Laboratory), served as a secondary laboratory for chemical analyses of split samples and blind standards. TA Knoxville, Tennessee (TA Knoxville), performed dioxin analyses. A limited number of hexavalent chromium and volatile organic analyses were performed by an on-site mobile laboratory. The mobile laboratory is also managed by Fluor Hanford, Inc.

TA Richland and the WSCF laboratory performed the majority of radiological analyses on Hanford groundwater samples. Eberline Services, Richmond, California, also analyzed samples for radiological constituents.

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

C.2 Data Review and Validation

H. Hampt and M. J. Hartman

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

- Review of sampling documents and analytical data verification.
- Quality control evaluation.
- Project scientists' evaluation.
- Statistical evaluation.
- Resolution of data issues that arose during the evaluation.

Sampling documents include the groundwater sampling record, chain-of-custody forms, field logbook pages, and other paperwork associated with sampling and shipping. Project staff review these forms to determine if the documents are filled out completely, signed appropriately, and legible. Staff also verify that analytical data from the laboratories are complete and reported correctly. Moreover, staff review laboratory documents to check the condition of the samples upon receipt at the laboratory and determine if problems arose during analysis that may have affected the data.

A quarterly evaluation of QC data is conducted as part of the validation process. Groundwater project staff assess the laboratories' internal QC practices and submit field QC samples and blind standards to the laboratories on a regular basis. QC results are then summarized for project scientists, DOE, and other data users.

Data management staff generate a series of routine data reports that project scientists review. Among these are biweekly data reports, which are generated twice each month and include analytical data that were loaded into the HEIS database since the previous reporting period. The tables are organized by groundwater interest area, RCRA site, or special project (e.g., confined aquifer data). As soon as practical after receiving a report, the project scientists review the data, typically by viewing trend plots, to determine (1) if there are significant changes in contaminant concentrations or distribution and (2) if there are data points that appear erroneous.

Project scientists also review quarterly compilations of the data. The quarterly review provides a method for project staff to check whether there were problems with sampling, all requested analyses were received, and the data seem to represent actual groundwater quality. Unlike the biweekly reports, the quarterly reports

usually include a full data set (i.e., all the data from the wells sampled during the previous quarter have been received and loaded into HEIS). This review also includes water-level data, preliminary maps of selected analytical data, and a partial listing of sampling comments. When specific questions arise regarding field measurements, analytical results, dates of analysis or sampling, or sample or well numbers, the project scientist requests a formal data review. The process for data reviews is described in Section C.2.1.

C.2.1 Requests for Data Review

Requests for data reviews are the formal mechanism used by the groundwater project to resolve specific issues with data that appear to have problems. When potential anomalies are encountered during a review of analytical data or water-level measurements, the project scientist reviewing the data will initiate a request for data review. Depending on the type of data issue, project staff will then do some or all of the following: request a laboratory recheck, recount, or re-analysis, review hard copy laboratory data, review sampling documents for data-entry errors or other problems, and/or flag the affected data with one of the review codes described in Table C.1.

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

Requests for data reviews are most commonly resolved by assigning Y, G, or R review codes to the data in HEIS; however, all of the review codes help define limitations on the data. If a review determines that the result is valid, the result is flagged with a G. If there is clear, documented evidence that a result is erroneous, the result is flagged with an R. The Y code is used when a review did not show if a result was valid or invalid, but the result appears suspect. Data flagged with a Y or R are typically excluded from statistical evaluations, maps, and other interpretations, but are not deleted from HEIS. Occasionally, a request for data review is submitted on data that are not managed by the groundwater project (e.g., data associated with active remediation projects). In those cases, the data owner is notified, but no further action is taken by the groundwater project.

Table C.2 lists the number of analytical and water-level results that were flagged during FY 2007 as a result of the request for data review process. As of December 13, 2007, the resolution of a number of requests is pending, and additional requests may yet be filed on FY 2007 data. Requests for data reviews have been filed on 1,470 out of 69,911 analytical results (~2%), an increase over FY 2006 (1%). Similarly, 5.6% (222 out of 3937) water-level results were associated with requests for data reviews in FY 2007, an increase from FY 2006 (2.8%). In several instances, trends were observed in the requests for data reviews that warranted further evaluation by QC staff. A summary of the steps taken to troubleshoot those issues is found in section C.6.5.

C.3 Data Completeness

C. J. Thompson

Data judged to be complete are data that are not suspect, rejected, associated with a missed holding time, out-of-limit field duplicate or field blank, or qualified to indicate laboratory blank contamination. During FY 2007, 94% of the groundwater data (both long-term and interim action monitoring) were considered complete. The percentages of potentially invalid data were 2.1% for field QC problems, 0.9% for exceeded holding times, 0.5% for rejected results, 0.2% for suspect values, and 3.4% for laboratory blank contamination. These values are similar to the percentages observed in FY 2006.

C.4 Field Quality Control Samples

H. L. Anastos and C. J. Thompson

Field QC samples include field duplicates, split samples, and three types of field blanks. The three types of field blanks are full trip, field transfer, and equipment blanks. Field duplicates are used to assess sampling and measurement precision. Split samples are used to confirm out-of-trend results and for interlaboratory comparisons. Field blanks provide an overall measure of contamination introduced during the sampling and analysis process.

The groundwater project's criteria for evaluating the analytical results of field QC samples are as follows:

- **Field Duplicates** – Results of field duplicates must have precision within 20%, as measured by the relative percent difference. Only those field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated.
- **Split Samples** – Results must have a relative percent difference <20%. Only those results that are greater than five times the method detection limit or minimum detectable activity at both laboratories are evaluated.
- **Field Blanks** – For most chemical constituents, results above two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit. Results for metals are flagged if they exceed two times the method detection limit. For radiological data, blank results are flagged if they are greater than two times the total minimum detectable activity.

If a field blank does not meet the established criteria, it is assumed that there are potential problems with the data for all associated samples. For full-trip and field-transfer blanks, an associated sample is one that was collected on the same day and analyzed by the same method as a full-trip or field-transfer blank. For equipment blanks, an associated sample is one that has all of the following in common with an equipment blank:

- Collection date.
- Collection method/sampling equipment.
- Analysis method.

Data associated with out-of-limit field blanks are flagged with a Q in the database to indicate a potential contamination problem. A Q is also applied to both duplicate results when their precision exceeds the QC limits.

The percentages of acceptable field blank ($8,246/8,541 = 97\%$) and duplicate ($2,146/2,189 = 98\%$) results evaluated in FY 2007 were high, indicating little problem with contamination and good precision overall. Due to the laboratory transition, 88 split samples were collected this fiscal year. Approximately 1,100 pairs of data were produced from the split samples, and overall, the laboratories obtained reasonable agreement.

Tables C.3 through C.6 summarize the field blank and field duplicate results that exceeded QC limits. To assist with their evaluation, the tables are divided into the following categories, where applicable: general chemistry parameters, ammonia and anions, metals, volatile organic compounds, semivolatile organic compounds, and radiological parameters. Constituents not listed in the tables had 100% acceptable field blanks and/or field duplicates.

With the exception of semivolatile organic compounds, all classes of constituents had results that were flagged as potentially contaminated because of out-of-limit field blank results. A few constituents such as alkalinity, total organic halides, chloride, nitrogen in nitrate, barium, calcium, chromium, cobalt, copper, iron, magnesium, silver, sodium, vanadium, zinc, carbon disulfide, carbon tetrachloride, methylene chloride, gross

beta, and tritium had several quantifiable field blank results; however, the concentrations were much lower than the levels of these constituents in almost all groundwater samples.

Compared to FY 2006, the number of elevated field blank results for total organic carbon decreased (11% to 0%). The frequency and magnitude of elevated field blanks for other general chemistry parameters remained consistent with FY 2006.

Relative to FY 2006, the number of field blank results for chloride that exceeded the QC limits decreased significantly (54% to 17%). The laboratory method blank detections for chloride also decreased in FY 2007 (from 47.5% to 27.3% for TA and 0% for WSCF). Approximately 81% of the chloride field blank detections were from TA, indicating that many of these results may be due to false positives. However, the results detected were much lower than the levels of chloride typically found in Hanford groundwater.

Eighty-two field blank results for metals exceeded the QC limits, which is higher than the number (27) from last year. Most of the unacceptable results were within a factor of 5 of the detection limits. Relative to FY 2006, the number of elevated field blank results this year increased, for example, chromium (2% to 9%), silver (0% to 15%) and zinc (13% to 22%). Several of the metals (i.e., arsenic, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, silver, sodium, strontium, vanadium, and zinc) with out-of-limit field blank results had one or more comparable method blank results, suggesting that some of the elevated field blank values were caused by false detections or laboratory contamination.

Concentrations of six volatile organic compounds exceeded the QC limits in one or more field blanks. Methylene chloride was the predominant volatile contaminant, accounting for 86% of the volatile out-of-limit results. Laboratory contamination is the suspected source of this common contaminant, because similar concentrations were also measured in several method blanks. Seven field blanks, however, had concentrations that were more than two times greater than that of the highest laboratory blank. Trace levels of several other volatile organic compounds were also measured in field blanks (Tables C.3 and C.4). In general, the frequencies of detection for these compounds were low (<5%). The overall impact on the data is believed to be minor.

Gross beta, strontium-90, tritium, and uranium were the only radiological constituents with out-of-limit field blank results. Although their field blank concentrations were low, they were greater than levels of these constituents in some of the associated groundwater samples. Gross beta and uranium were also measured in one or more laboratory method blanks at concentrations similar to the field blank values.

Duplicate results were flagged for all constituent classes except semivolatile organic compounds (Table C.6). Overall, the relative number of flagged duplicate results was very low (2%), but the percentages of unacceptable results were high for several constituents based on the number of duplicates that met the evaluation criteria. Most of the associated samples in the radiological parameters category were unfiltered; thus, suspended solids in heterogeneous sample fractions may have caused some of the discrepancies in the results. The majority of the out-of-limit duplicate results appear to be anomalous instances of poor precision based on other QC indicators such as the results from the laboratory duplicates. In several cases, the laboratory was asked to re-analyze or investigate duplicate results with a very high relative percent difference, but the checks did not reveal the source of the problem. Especially poor agreement was observed between pairs of results for nitrite (i.e., non-detect and 2000 µg/L; non-detect and 821 µg/L; non-detect and 460 µg/L; non-detect and, 3940 µg/L). All eleven duplicate failures for nitrite were associated with the TA St. Louis laboratory. Nitrite issues at TA St. Louis are discussed in more detail in Section C.6.5.

In FY 2007, 88 split samples were analyzed for 91 different analytes generating nearly 1,100 field split pairs of data. In general, there was reasonable agreement between laboratories when both data pairs were greater than five times the reporting limit (or minimum detectable activity for radionuclides). Fifty-five of the pairs were outside the acceptance limits of 20% relative percent difference. Chloride, cyanide, fluoride, nitrogen in nitrate, iron, and manganese had several pairs that exceeded the 20% relative percent difference criteria. The results for field splits that exceeded QC limits are summarized in Table C.7.

In addition, the splits data was used to evaluate the performance of the laboratories during the transition of most analyses to the WSCF laboratory. For this review, the data was evaluated even when the result was less than five times the reporting limit. Overall, most of the data from WSCF agree reasonably well with the data generated from the commercial laboratories. A few discrepancies have been identified for metals, anions, gross alpha, gross beta, cyanide and strontium-90.

Several metals, such as iron, potassium and zinc had several splits with poor agreement. The WSCF data does not show a consistent trend (high or low), but generally appears to show more variability than the other laboratories. WSCF is currently troubleshooting their metal analyses and the groundwater project will submit additional blind samples in FY 2008 to investigate further.

The chloride and fluoride anion data generated by WSCF is 20% to 40% lower than the TA data. However, review of the raw data has indicated that the issue is most likely elevation of the TA data due to organic acid interference. Section C.6.5 discusses some of the other current issues associated with TA anion analyses.

Some of the WSCF gross alpha data originally showed a very high bias; however, this was resolved by changing to an alpha discrete analysis technique. Data affected by this bias were either re-analyzed or flagged as not valid in HEIS. See Section C.6.5 for more discussion on the alpha discrete method. Since implementation of the alpha discrete method, the data appear to be consistent with the commercial laboratories and in line with previous trends. WSCF gross beta data continues to show a high bias relative to the commercial laboratories. Additional investigation is underway to determine if this is solely due to method calibration differences (see Section C.6.2).

WSCF cyanide data is consistently 20% to 50% higher than the corresponding TA data. However, all of the recent blind data and performance evaluation data for both laboratories are within acceptable ranges. The cause for the difference in laboratory results is not known at this time. Additional blind samples will be submitted in FY 2008 to continue to investigate this method.

WSCF strontium-90 data also show a high degree of variability relative to the commercial laboratories' data. This may be because WSCF used smaller sample sizes, as is noted in Section C.6.2. The laboratory has been directed to use larger samples sizes for all groundwater samples. Additional blind samples will be submitted in FY 2008 to continue to investigate this method.

C.5 Holding Times

H. Hampt and H. L. Anastos

Holding time is the elapsed time period between sample collection and analysis. Samples should be analyzed within recommended holding times to minimize the possibility of changes in constituent concentrations caused by volatilization, decomposition, or other chemical alterations. Samples are also refrigerated to slow potential chemical reactions within the sample matrix. Maximum recommended holding times for constituents frequently analyzed for the groundwater project are listed in Table C.8. Radiological constituents do not have recommended maximum holding times because these constituents are not typically lost under ambient temperatures when appropriate preservatives are used. Results of radionuclide analysis are corrected for decay from sampling date to analysis date.

During FY 2007, recommended holding times were exceeded for 280 out of 7,651 (3.7%) non-radiological sample analysis requests. This is a decrease compared to FY 2006 (4.9%). Use of the onsite laboratory (WSCF) shortens the shipping time and is expected to decrease the number of missed holding times. In general, the missed holding times should not have a significant impact on the data. Results for samples with missed holding times are flagged with an H in the database. TA St. Louis exceeded the holding times for 235 out of 4,904 (4.8%) sample analysis requests. A sample analysis request is defined as a sample that is submitted for analysis by a particular analytical method.

The constituents with the most missed holding times were alkalinity (25 samples), anions by EPA Method 300.0 (84 samples), total organic carbon (28 samples), cyanide (28 samples) and total organic halides (53 samples). TA Richland exceeded holding times for 2 out of 50 coliform analyses, but all 14 of the laboratory's hexavalent chromium analyses were performed within the recommended holding time. The WSCF laboratory missed holding times on 44 of 2,622 analyses (2%). Sixteen of the missed holding times were due to re-analysis requests on metals samples. The mobile laboratory missed the holding time on 1 of 28 hexavalent chromium samples.

C.6 Laboratory Performance

D. S. Sklarew, H. Hampt, S. J. Trent, and C. J. Thompson

Laboratory performance is measured by several indicators, including national performance evaluation studies, double-blind standard analyses, laboratory audits, and internal laboratory QA/QC programs. This section provides a detailed discussion of the performance indicators for TA St. Louis, TA Richland, and WSCF. Brief summaries of performance measures for Lionville Laboratory and Eberline Services are also presented throughout this section. The majority of the laboratories' results were within the acceptance limits indicating good performance overall.

C.6.1 National Performance Evaluation Studies

During FY 2007, Environmental Resources Associates and DOE conducted national studies to evaluate laboratory performance for chemical and radiological constituents. TA St. Louis, TA Richland, WSCF, and Lionville Laboratory participated in the EPA sanctioned Water Pollution and Water Supply Performance Evaluation studies conducted by Environmental Resources Associates. TA Richland, WSCF, and Eberline participated in the Environmental Resources Associates' InterLaB RadChem Proficiency Testing Program. All five laboratories took part in DOE's Mixed Analyte Performance Evaluation Program. Results of those studies related to groundwater monitoring at the Hanford Site are described in this section.

C.6.1.1 Water Pollution Studies

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

For the two water pollution studies (ERA WP-144 and 150), two water supply studies (ERA WS-123 and 129) and one QuiKTMResponse study (041307A) in which TA St. Louis participated this year, the percentage of results within acceptance limits submitted to the groundwater project ranged from 88% to 95% (Table C.9). Forty-five different constituents had unacceptable results, but only hexachlorobutadiene, benzene in gasoline range organics, and tetrachloroethene were out of limits in two studies in which they were measured. Several nutrients, total organic carbon, total organic halides, trace metals, several volatile organic compounds, and several nitroaromatics were out of limits in one of the studies. The laboratory provided information about possible causes for some of the unacceptable results and suggested corrective actions where appropriate. The

constituents that were out of limits in more than one study last year, fluoride and volatile solids, were also out of limits in one study this year. Fluoride was within limits in a second study (volatile solids was measured in only one study this year). Constituents that were out of limits in only one study during FY 2006 were within limits in FY 2007, except for ammonia as nitrogen; calcium hardness as calcium carbonate; orthophosphate as phosphorus; oil and grease (gravimetric); iron; chloromethane; hexachlorobutadiene; 1,2,3-trichloropropane; total organic halides; and benzene in gasoline range organics. Analyses for calcium hardness, oil and grease, and benzene in gasoline range organics are not performed on Hanford groundwater samples, so these unacceptable results do not impact the interpretation of Hanford groundwater data.

TA Richland participated in one water pollution study this year (ERA WP-144) for total coliforms and hexavalent chromium; both results were acceptable (Table C.9).

For the three water pollution studies (ERA WP-138, 144 and 150) and four Quik™Response studies (091306B, 100506C, 031507A, 090607E) in which WSCF participated this year, the percentage of results within acceptance limits ranged from 97% to 100% (Table C.10). The number of constituents reported in the water pollution studies was considerably fewer than those reported by TA St. Louis, so percentage results are not directly comparable. Six different constituents had unacceptable results in one of the studies, including three metals, total organic carbon, non-filterable residue, and chemical oxygen demand. The laboratory provided information about possible causes for some of the unacceptable results and suggested corrective actions where appropriate. Analyses for non-filterable residue are not performed on Hanford groundwater samples, so this unacceptable result does not impact the interpretation of Hanford groundwater data.

Lionville Laboratory submitted results to the groundwater project for one water pollution study (ERA WP-144) and one water supply study (ERA WS-109) this year. The percentage of results within the acceptance limits ranged from 98% to 100% (Table C.11). The unacceptable results for four organic constituents and orthophosphate as P do not impact the interpretation of Hanford groundwater data since Lionville does not analyze these constituents for the Hanford groundwater program.

C.6.1.2 DOE Mixed Analyte Performance Evaluation Programs

DOE's Mixed Analyte Performance Evaluation Program examines laboratory performance in the analysis of soil and water samples containing metals, volatile and 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 Mixed Analyte Performance Evaluation Program results for radiological and inorganic samples by determining if they fall within a 30% bias of the reference value.

One study was available for FY 2007 (MAPEP-07-MaW17&OrW17&GrW17). One result for TA St. Louis was unacceptable, viz. tritium (Table C.12). Two results were unacceptable for WSCF, viz., 4-chloroaniline and chrysene; one other result was acceptable with warning (Table C.13). All results were acceptable for TA Richland (Table C.12), Lionville Laboratory, and Eberline Services (Table C.14). The unacceptable results appear to be isolated incidences.

In addition, WSCF reported on results for MAPEP-06-MaW16&OrW16&GrW16; results for the other laboratories were included in last year's annual report. One result was unacceptable for WSCF in this study, viz., di-n-butylphthalate (Table C.13).

C.6.1.3 InterLaB RadChem Proficiency Testing Program Studies

The purpose of the InterLaB RadChem Proficiency Testing Program, conducted by Environmental Resources Associates, is to evaluate the performance of laboratories in analyzing selected radionuclides. This program provides blind standards that contain specific amounts of one or more radionuclides in a water matrix to participating laboratories. Environmental Resources Associates standards were prepared for the following radionuclides/parameters: barium-133, cesium-134, cesium-137, cobalt-60, gross alpha, gross beta, iodine-131,

radium-226, radium-228, strontium-89, strontium-90, tritium, uranium (natural), uranium (natural) mass, and zinc-65. After sample analysis, the results were forwarded to Environmental Resources Associates for comparison with known values and with results from other laboratories. Environmental Resources Associates bases its control limits on the EPA's National Standards for Water Proficiency Testing Studies Criteria Document (NERL-Ci-0045).

In the one study in which TA Richland participated this year (RAD-67), a total of 16 constituents were analyzed. All results were acceptable (Table C.12).

WSCF participated in two studies (RAD-68 and 70) and one Quik™Response study (100506D) this year; a total of fifteen constituents were analyzed. The one result for zinc-65 was unacceptable (Table C.13).

Eberline Services participated in two studies (RAD-68 and 70) and one Quik™Response study (022607B) this year; a total of thirty constituents were analyzed. Two of the results, gross alpha and zinc-65, were unacceptable (Table C.14).

C.6.2 Double-Blind Standard Evaluation

During FY 2007, the groundwater project forwarded blind QC standards to TA Richland and St. Louis, WSCF, Lionville Laboratory, and Eberline Services. Blind-spiked standards were generally prepared in triplicate and submitted to the laboratories to check the accuracy and precision of analyses. For most constituents, the standards were prepared in a groundwater matrix from a background well. Standards for specific conductance were commercially prepared in deionized water. In all cases, the standards were submitted to the laboratories in double-blind fashion (i.e., the standards were disguised as regular groundwater samples). After analysis, the laboratory's results were compared with the spiked concentrations, and a set of control limits were used to determine if the data were acceptable. Generally, if a result was out of limits, the data were reviewed for errors. In situations where several results for the same method were unacceptable, the results were discussed with the laboratory, potential problems were investigated, and corrective actions were taken if appropriate.

Tables C.15 through C.17 summarize the number and types of blind standards used in FY 2007 along with the control limits and number of unacceptable results for each constituent. Overall, 88% of the blind spike determinations were acceptable. This was slightly higher than the percentage from FY 2006 (85%). A total of 15 results (~6%) were out of limits for TA Richland and St. Louis. Total organic halides, nitrate as nitrogen, hexavalent chromium, carbon tetrachloride, trichloroethene, and tritium were the constituents with out-of-limit results. The WSCF laboratory had a relatively high percentage of unacceptable results (50/242 = 21%). Groundwater staff are working closely with the laboratory to help improve future performance. Constituents affected included total organic carbon, total organic halides, nitrate as nitrogen, hexavalent chromium, carbon tetrachloride, trichloroethene, gross alpha, gross beta, strontium-90, and tritium. All of the results from Lionville Laboratory and Eberline Services were within the acceptance limits.

Most of this year's total organic carbon results were acceptable, but all four of WSCF's first quarter results were biased high with recoveries of ~175%. As discussed in Section C.6.5, WSCF had a problem with calibration standards that resulted in many low-biased results between November 20 and March 7. However, the standardization problem does not account for the elevated blind-standard results. After implementing several corrective actions to address the bias problem, WSCF demonstrated acceptable performance on two national performance evaluation samples. Moreover, all of WSCF's blind-standard results from the last 3 quarters were within the acceptance limits. TA St. Louis and Lionville Laboratory had 100% acceptable results for total organic carbon.

Two types of blind standards were used to evaluate laboratory performance for total organic halides. The first group was spiked with 2,4,5-trichlorophenol, which is chemically similar to the compound used to calibrate the analyzers. All of TA St. Louis' results for the first group were acceptable. WSCF had three out-of-limit results during the third quarter. However, WSCF's high recoveries (~150%) were not unreasonable, because the third quarter standards were spiked at levels very close to the method detection limit. The second group of standards was spiked with a varying mixture of carbon tetrachloride, chloroform, and trichloroethene

to evaluate performance for volatile analytes. For this group, TA St. Louis had four out-of-limit results (50-70% recoveries) while WSCF had nine unacceptable results (50% to 160% recoveries). The low recoveries are attributed to volatilization or weak retention of the volatile compounds on the charcoal cartridges used in the analysis. Three of WSCF's unacceptable results were biased high, although two of these were for volatile standards that were spiked at concentrations close to the detection limit. Since relatively few (~2%) total organic halides results for regular groundwater samples were flagged as suspect during FY 2007, the problems with the blind standards are believed to be isolated.

In general, TA St. Louis and WSCF performed well on the analysis of anions in blind standards. All of the cyanide results from both labs were within the acceptance limits, and most ion chromatography results were satisfactory. However, WSCF had three unacceptable results for nitrogen in nitrate during the fourth quarter. TA St. Louis also had a high-biased result for nitrogen in nitrate in the fourth quarter. The out-of-limit recoveries were not exceptionally high (most were less than 130%); the data are under investigation at the time of this writing.

One of the weaker performance areas for TA St. Louis and WSCF was on the analysis of volatile organic compounds. The laboratories' percentages of unacceptable results were 17 and 47%, respectively. With one exception (i.e., an elevated TA St. Louis result for trichloroethene), all of the out-of-limit results were biased low; most had recoveries between 65% and 75%. Pacific Northwest National Laboratory (PNNL) analyses of split samples during the first three quarters confirmed that the standards had been spiked close to the expected concentrations. All of the chloroform results for both laboratories were acceptable. Since the water solubility of chloroform is much higher than that of carbon tetrachloride and trichloroethene, the low recoveries may be caused by volatilization of the less-soluble compounds prior to analysis. Additional investigation into this issue is planned during FY 2008.

The majority of the laboratories' results for gross alpha and gross beta were within the QC limits. All of the results from Eberline Services (gross beta only) and TA Richland were satisfactory. WSCF had two unacceptable results for each parameter. One of the out-of-limit results for gross alpha was from the third quarter, when the spiked concentration was within a factor of three of the minimum detectable activity. During the last quarter, two sets of combined gross alpha and gross beta standards were prepared to verify whether WSCF's new discrete alpha method is effective at eliminating interference from beta emitters (Section C.6.5 contains more information about this problem). While one of the corresponding gross alpha results was out of limits (61% recovery), the data indicate that the alpha results were not impacted by relatively high levels of strontium-90 and yttrium-90 (~21,000 pCi/L). Over the entire year, WSCF's gross beta recoveries tended to be ~10-15% higher than those from Eberline Services and TA Richland. This may be partially due to differences in the isotopes used for gross beta calibration: WSCF calibrated with cesium-137, while Eberline Services and TA Richland utilized strontium-90. The gross beta blind standards were spiked with strontium-90.

Initially, four out of six of WSCF's second and third quarter results for strontium-90 were unacceptable. After discussing the problem with laboratory staff, three of the corresponding samples were re-analyzed with larger sample volumes, and the results were improved. Recoveries for two of the April standards dropped from ~1,800% to ~107%. The laboratory has been instructed to ensure that adequate sample volumes are used for the analysis in the future. Six blind standards were submitted to WSCF during the last quarter—three were spiked at 26 pCi/L, and the others were spiked at 2,020 pCi/L. All of the results were acceptable, although the recoveries were high (~122% to 130%) for the standards spiked at the lower concentration. TA Richland's results for strontium-90 were all within the QC limits.

During FY 2007, several of TA Richland's results for regular-level tritium were approximately three times higher than the expected concentrations. Both TA Richland and WSCF had similar results for the first quarter of this year too. An overly concentrated spiking solution was the suspected cause of the elevated results. Beginning with the second quarter of this year, a new tritium spiking standard was used to prepare the blind standards, and most of the subsequent results were significantly improved. WSCF failed to detect tritium in the second quarter standards, but those sample bottles may have been inadvertently filled with the wrong solution

after the standards had been prepared. All of TA Richland's results for samples prepared with the new spiking solution were acceptable. WSCF also had satisfactory recoveries for the third quarter. Low-level tritium results were not affected by the spiking standard; all of TA Richland's low-level results were within the QC limits.

C.6.3 Laboratory Internal QA/QC Programs

TA Richland, TA St. Louis, WSCF, Eberline Services, and Lionville Laboratory maintain internal QA/QC programs that generate data on analytical performance by analyzing method blanks, laboratory control samples, matrix spikes and matrix spike duplicates, matrix duplicates, and surrogates (see PNNL-13080 for definitions of these terms). This information provides a means to assess laboratory performance and the suitability of a method for a particular sample matrix. Laboratory QC data are not currently used for in-house validation of individual sample results unless the laboratory is experiencing unusual performance problems with an analytical method. An assessment of the laboratory QC data for FY 2007 is summarized in this section. TA and WSCF data are discussed in detail. Tables C.18 and C.19 provide a summary of the TA and WSCF QC data, respectively, by listing the percentage of QC results that were out of limits for each analyte category and QC parameter. Additional details are presented in Tables C.20 through C.23. Constituents not listed in these tables did not exceed TA's or WSCF's QC limits. A brief summary of Lionville Laboratory and Eberline Services data is presented at the end of the section.

Most of FY 2007 laboratory QC results were within acceptance limits, suggesting that the analyses were in control and reliable data were generated. Nevertheless, a number of parameters had unacceptable results.

Evaluation of results for method blanks was based on the frequency of detection above the blank QC limits. In general, these limits are two times the method detection limit for chemical constituents and two times the total propagated error for radiochemistry parameters. Because minimum detectable activity levels are not available for radiochemistry components from WSCF, two times the practical quantitation limit was used as the QC limit for WSCF. For common laboratory contaminants such as 2-butanone, acetone, methylene chloride, phthalate esters, and toluene, the QC limit is five times the method detection limit.

Table C.20 summarizes method blank results from TA Richland and St. Louis. The ammonia and anions and general chemistry parameters categories had the greatest percentages of method blank results exceeding the QC limits. The following parameters had >10% of method blank results outside the QC limits: chloride, nitrogen in ammonia, phosphate, lithium, and oil and grease. Table C.21 summarizes method blank results from WSCF. The metals and volatile organic compounds categories had the greatest percentages of method blank results outside the QC limits. The following parameters had >10% of method blank results outside the QC limits: alkalinity, aluminum, magnesium, nickel, silver, vanadium, and zinc. The out-of-limit method blank results for alkalinity, calcium, and magnesium are not a significant problem because the values are typically much lower than the levels measured in Hanford Site groundwater. Similarly, the highest method blank results for chloride (0.47mg/L), sulfate (0.6 mg/L), and sodium (1,540 µg/L) are typically lower than the respective levels measured in Hanford groundwater. For TA, the percentage of out-of-limit method blanks decreased compared to FY 2006 for chloride, sulfate, aluminum, arsenic, barium, calcium, zinc, and methylene chloride, while the percentage increased for alkalinity, total organic halides, nitrogen in ammonia, phosphate, and manganese.

Table C.22 summarizes results for the laboratory control samples from TA Richland and St. Louis. Semivolatile organic compounds and general chemistry parameters had >2% of their measurements outside the QC limits. Both of these categories had an increased percentage of results outside the QC limits compared to FY 2006 results (2% to 6% for semivolatile organics and 0.6% to 2% for general chemistry parameters). Specific compounds with >10% of out-of-limit laboratory control samples included cyanide; phosphate; hexavalent chromium; 1,1,1,2-tetrachloroethane; 2-chloroethyl vinyl ether; bromochloromethane; bromomethane; chloroethane; ethyl acetate; iodomethane; trans-1,4-dichloro-2-butene; vinyl acetate; 2,4,5-trichlorophenol; 4-bromophenylphenyl ether; anthracene; benzo(a)anthracene; benzo(ghi)perylene; bis(2-chloroethoxy)methane; carbazole; dibenz[a,h]anthracene; dimethylphthalate; heptachlor; hexachlorobenzene; indeno(1,2,3-cd)pyrene;

isophorone; nitrobenzene; oil and grease; and uranium-235. In all of these cases except cyanide, phosphate, and 2,4,5-trichlorophenol, the number of QC samples analyzed was limited (<20). Many of these constituents are not routinely monitored in Hanford groundwater. Table C.23 summarizes results for the laboratory control samples from WSCF. None of the compound categories had >1% of their measurements outside the QC limits and none of the constituents had >10% of out-of-limit results.

Table C.24 summarizes results for the matrix spikes and matrix spike duplicates from TA Richland and St. Louis. The ammonia and anions category had the greatest percentage of matrix spikes/spike duplicates exceeding the QC limits. This represents an increase compared to FY 2006 results that were out of limits for the ammonia and anions category (23% to 49%). The metals category also showed an increase in the percentage of results out of limits compared to FY 2006 results (0.7% to 1.6%); the semivolatile organic compounds and radiological parameters categories showed a decrease relative to FY 2006 (2% to 0.8% and 7% to 4%, respectively). The percentage of out-of-limit results increased significantly compared to FY 2006 for chloride; fluoride; nitrogen in nitrate; nitrogen in nitrite, sulfate; sulfide; calcium; iron; magnesium; potassium; sodium; strontium (elemental); 1,1,1,2-tetrachloroethane; 1,2-dibromo-3-chloropropane; 1,2-dichloropropane; 2-chloroethylvinyl ether; 2-methyl-1-propanol; ethyl acetate; styrene; tetrahydrofuran; trichloroethene; and nitrobenzene. Table C.25 summarizes results for the matrix spikes and matrix spike duplicates from WSCF. The general chemistry parameters and radiological parameters categories had the greatest percentage of matrix spikes/spike duplicates exceeding the QC limits. The only compound with >10% of out-of-limit matrix spike results was technetium-99.

For matrix duplicates, only those samples with values five times greater than the method detection limit or the minimum detectable activity (or practical quantitation limit for WSCF) are considered. Quantifiable matrix duplicates are evaluated by comparing the relative percent difference with an acceptable relative percent difference maximum for each constituent. Table C.26 lists the constituents from TA St. Louis and Richland that exceeded the relative percent difference limits. The semivolatile organic compounds, ammonia and anions, and volatile organic compounds categories had the greatest percentage of matrix duplicates exceeding the QC limits. The ammonia and anions and volatile organic compounds categories showed an increase in the percentage of results out of limits compared to FY 2006 results (1% to 4%; 1% to 4%, respectively); the general chemistry parameters and semivolatile organic compounds categories showed a decrease relative to FY 2006 (2% to 0.7% and 13% to 5%, respectively). Table C.27 lists the constituents that exceeded the relative percent difference limits for WSCF. A number of duplicates did not have a relative percent difference reported even though the value was above the method detection limit. The radiological parameters category had the greatest percentage of matrix duplicates exceeding the QC limits; all other categories had less than 1% out of limits. Specific compounds with >10% of out-of-limit duplicates included gross beta and strontium.

Surrogate data from TA St. Louis that were out of limits included six compounds for volatile organics and five for semivolatile organics. For volatile organic compounds, 3% of the surrogate results were outside of QC limits. The semivolatile organic surrogates had 5% of the results out of limits, an increase compared to FY 2006 results (2%). Surrogate data from WSCF that were out of limits included three compounds for volatile organics and one for semivolatile organics.

QC data for Eberline Services and Lionville Laboratory were limited for FY 2007 because these laboratories did not analyze many samples for routine groundwater monitoring. Lionville Laboratory analyzed a limited number (<10 each) of method blanks, laboratory control samples, matrix spikes, and matrix duplicates for total organic carbon, total organic halides, anions by ion chromatography, gasoline range organics, diesel range organics, and metals by inductively coupled plasma-atomic emission spectroscopy. All of the QC data for total organic carbon and total organic halides were within limits. Method blanks for a number of metals (aluminum, barium, calcium, sodium, and zinc) had some results that were out of limits. The levels for the method blanks for calcium and sodium that were out of limits were much lower than the levels measured in the groundwater samples. Two of the duplicates for one metal (zinc) and one matrix spike for one anion (phosphate) were also

out of limits. Eberline Services QC data were limited to gross alpha, gross beta, protactinium-231, radionuclides by gamma spectroscopy, strontium-90, and tritium. All of the QC data were within limits.

C.6.3.1 Issue Resolution

Issue resolution forms are documents used to record and resolve problems encountered with sample receipt, sample analysis, missed holding times, and data reporting (e.g., broken bottles or QC problems). The laboratories generate these forms and forward them to the groundwater project as soon as possible after a potential problem is identified. The forms provide a means for the project to give direction to the laboratory on resolution of the issues. The documentation is intended to identify occurrences, deficiencies, and/or issues that may potentially have an adverse effect on data integrity. During FY 2007, 126 issue resolution forms were submitted by TA Richland, TA St. Louis, and WSCF laboratories. Issue of resolution forms were not received by the secondary or limited use laboratories.

Table C.28 indicates the specific issues identified this year and the number of analytical requests that were impacted. The number of affected analytical requests was small (~500) compared to the total number of analytical requests submitted (~12,000). The number of the issue tracking problems after receipt at the laboratories was greater than FY 2006 in most categories. This increase may be due to better reporting of issues by the laboratories, particularly in cases where the holding time was exceeded. The frequencies of issues prior to receipt at the laboratory were slightly higher than the previous year. Part of this increase may be because a greater number of wells were sampled this year relative to recent years. In addition, there were a number of new personnel collecting samples this year. About 20% of the missed holding time issues were related to shipping delays. Missed holding times at TA St. Louis were generally due to the laboratory reanalyzing samples at different dilution factors out of holding time. At the WSCF laboratory, missed holding times were mostly due to staffing issues. WSCF is not typically staffed after 4:30 p.m. or on weekends; therefore, samples delivered near those times may not meet holding times. Laboratory QC issues were not isolated to any particular methods, but were found infrequently in radiological, wet chemistry, and organic methods.

C.6.3.2 Laboratory Audits and Assessments

Laboratory activities are regularly assessed by surveillance and auditing processes to ensure that quality problems are prevented and/or detected. During FY 2007, six of these audits were conducted on laboratories that routinely analyzed Hanford groundwater samples. Five audits were conducted on commercial analytical service providers. These audits were performed by the DOE Consolidated Audit Program. One assessment was conducted on the WSCF laboratory. This assessment was performed by an integrated contractor assessment team comprised of assessors from Fluor Hanford, Inc.; Washington Closure Hanford; PNNL; Advanced Technologies Laboratory (ATL); and CH2M Hill Hanford.

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. The specific 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 methods and the handling of DOE samples and associated waste in a manner that protects human health and the environment. All laboratories were evaluated against the requirements of DOE's document *Quality Systems for Analytical Services*, Revision 2.1 (DOECAP 2005).

The DOE Consolidated Audit Program audits were performed at the following laboratories: TA Knoxville, Tennessee, December 11 through 13, 2006; TA St. Louis, Missouri, April 10 through 12, 2007; Eberline Services, Richmond, California, February 27 through March 1, 2007; Lionville Laboratory, Lionville, Pennsylvania, July 24 through 26, 2007; and TA Richland, Washington, June 19 through 21, 2007. The audits at the TA laboratories were initiated prior to the laboratory name change, and therefore, were issued to Severn Trent Laboratories, Incorporated. However, as noted in Section C.1, the name change to TestAmerica Laboratories, Incorporated does not affect the review of the laboratory audits as the laboratories are still part of the same legal corporate entity.

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

1. QA management systems and general laboratory practices.
2. Data quality for organic analyses.
3. Data quality for inorganic and wet chemistry analyses.
4. Data quality for radiochemistry analysis.
5. Hazardous and radioactive materials management.
6. Verification of corrective-action implementation from previous audit findings.

A total of 48 findings and 34 observations were noted for the five of the DOE audits. Results of each of these audits are summarized in Table C.29. Of particular note are audit findings associated with the TA St. Louis laboratory. The DOE audit team identified two “Priority I” findings associated with the radiochemistry section of the laboratory. A Priority I finding represents a significant deficiency regarding key management or programmatic control(s), which in and of itself represents a concern of sufficient magnitude to potentially render the audited facility unacceptable to provide services to the DOE if not resolved via immediate and/or expedited corrective action(s). The areas of concern were (1) in the radioactive material tracking and accountability process and (2) an unfilled technical director position in the radiochemistry department of the laboratory. The Priority I audit findings were subsequently closed during a follow-up surveillance conducted by the DOE audit team. Because the groundwater project does not use the TA St. Louis laboratory for radiochemical analyses, these findings did not impact the continued use of the laboratory for chemical analyses.

All other corrective actions have been accepted for all audits, and verification of the corrective actions will be performed in future audits. All laboratories have been qualified to continue to provide analytical services for samples generated at DOE sites.

Integrated Contractor Assessment Team Assessments. An integrated contractor assessment team assessment is performed by Hanford Site contractor personnel on Hanford Site analytical laboratories and is used to verify the implementation of the requirements stated in *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD), Volumes 1 and 4 (DOE/RL-96-68). An integrated contractor assessment team assessment of the WSCF laboratory was performed on February 5 through February 8, 2007. The overall results of the assessment indicated that programs and processes reviewed were in place and implemented in accordance with the laboratory QA program plan and DOE/RL-96-68. No issues were noted to indicate concern over the technical adequacy of WSCF to meet the needs of the groundwater project.

A total of six findings and 15 observations were noted during the assessment. Results of this assessment are summarized in Table C.29. Corrective actions have been accepted for all findings and observations, and verification of the corrective actions will be performed in a future assessment.

C.6.4 Filtered and Unfiltered Chromium Comparison

M. J. Hartman

Hanford Site groundwater samples are analyzed for chromium in several ways:

- Total chromium in unfiltered samples
- Total chromium in filtered samples
- Hexavalent chromium in unfiltered samples
- Hexavalent chromium in filtered samples

Hexavalent chromium is soluble while trivalent chromium is not. Dissolved chromium in Hanford Site groundwater is virtually all hexavalent (WHC-SD-EN-TI-302). Hence hexavalent chromium in filtered and

unfiltered samples is assumed to be approximately equal, and total chromium in filtered samples (dissolved chromium) is assumed to be equal to hexavalent chromium. This discussion reviews FY 2007 chromium data from Hanford groundwater samples to test the validity of these assumptions.

C.6.4.1 Methods

The HEIS database was queried for FY 2007 chromium and hexavalent chromium data. The data were extracted in October 2007, when some FY 2007 data had not yet been received from the laboratory (i.e., September data). A total of 3,712 results were extracted. Any replicate samples (e.g., filtered, hexavalent chromium) were averaged.

Many samples are analyzed only for one type of chromium and unfiltered/filtered pairs were not usually collected in FY 2007. A total of 295 data pairs or sets with more than one type of chromium data were identified. Table C.30 lists those data sets.

Filtered and unfiltered results were compared by calculating the signed percent difference (SPD), where the SPD is:

$$\text{SPD} = \frac{(x_2 - x_1)}{(x_1 + x_2)/2} \times 100$$

Results where both concentrations were $<10 \mu\text{g/L}$ were excluded. These low values would skew the calculations because of lower analytical precision near detection limits. Small absolute differences in concentrations could have a large effect on percentage difference. Some of the low values also represent detection limits and not measured concentrations.

C.6.4.2 Hexavalent Chromium in Filtered vs. Unfiltered Samples

Few filtered/unfiltered pairs are available for hexavalent chromium results (41 pairs of results; 24 pairs had concentrations $>10 \mu\text{g/L}$; see Table C.30). The unfiltered samples were, on average, 10% lower than filtered samples. However, this result was affected strongly by an anomalous result from aquifer tubes AT-D-2-M ($5 \mu\text{g/L}$ unfiltered and $18 \mu\text{g/L}$ filtered). Excluding this result, the percent difference between unfiltered and filtered hexavalent chromium was only 5%. Figure C.1 shows a graph of the filtered/unfiltered pairs analyzed for hexavalent chromium. The graph includes all data pairs, including those with concentrations $<10 \mu\text{g/L}$. The data define a 1:1 relationship with minimal scatter on either side of the regression line.

C.6.4.3 Total Chromium in Filtered vs. Unfiltered Samples

A total of 152 filtered/unfiltered pairs were analyzed for total chromium (see Table C.30). Of these, 93 pairs had concentrations $>10 \mu\text{g/L}$. For 62 of the 93 filtered/unfiltered pairs of results (67%), there was not a significant difference in chromium concentrations (signed percent difference between 20% and -20%). For the remaining 31 pairs (33%), unfiltered chromium was significantly higher than filtered. On average, concentrations in unfiltered samples were higher than the filtered samples by 35%.

Figure C.2 plots all of the data pairs and also looks specifically at the results $<500 \mu\text{g/L}$. The difference between filtered and unfiltered samples is most significant at lower concentrations.

Some wells that typically show unfiltered chromium higher than filtered chromium have erratic unfiltered levels and low filtered levels (e.g., well 699-48-77A, Figure C.3). Iron concentrations follow similar trends, suggesting the presence of particulate matter in the unfiltered samples. Samples from this well occasionally have high turbidity, e.g., up to 16 NTU in FY 2007. However, not all of the high, unfiltered metals are associated with high turbidity.

Figure C.4 shows well 199-K-36, an example of a well with a large difference between unfiltered and filtered chromium results, but the two trend parallel to one another. This well has elevated filtered chromium and hexavalent chromium. All of the recent turbidity readings from this well are low ($<5 \text{ NTU}$ since 2002). Unfiltered iron concentrations also tend to be high, but do not follow the same trend as chromium.

C.6.4.4. Filtered, Total Chromium vs. Hexavalent Chromium

The signed percent difference between filtered samples analyzed for total chromium and hexavalent chromium in either filtered or unfiltered samples, whichever was available, was calculated (if both were available we used filtered hexavalent results). On average, the total chromium results were 8% lower than the hexavalent results (see Table C.30). If the one outlier (-112% in well 199-K-117A, where the total chromium result was 3.1 µg/L and the hexavalent chromium was 11 µg/L) is excluded, the difference drops to -6.5%. Figure C.5 graphs the results. Overall, filtered, total chromium gives an excellent representation of hexavalent chromium.

C.6.4.5. Conclusions About Filtered vs. Non-Filtered Chromium

The groundwater project's QC program considers duplicate or split samples acceptable if the relative percent difference is <20%. Applying a similar standard to chromium results (signed percent difference is between 20% and -20%), it is concluded that:

- Total chromium results in some wells are significantly affected by whether the samples are filtered or not. Concentrations in unfiltered samples were an average of 35% higher than in filtered samples.
- Hexavalent chromium results from unfiltered (x2) and filtered samples (x1) are essentially equivalent (-5.2% signed percent difference).
- Total chromium in filtered samples is equivalent to hexavalent chromium (-6.5% signed percent difference).

Hexavalent chromium is a contaminant of concern for the 100 Areas. The groundwater project typically averages filtered, total chromium data and all hexavalent chromium data to construct plume maps. This practice is an acceptable way to reflect hexavalent chromium in Hanford's groundwater.

C.6.5 Analytical Troubleshooting

H. L. Anastos and C. J. Thompson

During evaluations of requests for data review submittals, trends may be observed that warrant further investigation by the QC staff. As was noted in Section C.2.1, compared to FY 2006, the number of requests for data review submitted has increased (611 to 1,470). Approximately 57% of the requests for data review were associated with the WSCF laboratory, 30% with TA St. Louis, 10% with the mobile laboratory, and 3% with TA Richland. The high number of requests for data review associated with WSCF is not unexpected, based on the transition of workload from TA Richland and TA St. Louis to WSCF. However, several analytical issues for the laboratories were investigated by QC staff. The issues discussed below account for approximately 60% of the total requests for data review processed in FY2007 to date. The remaining 40% of the total requests appear to be isolated issues.

Nitrite - Approximately 76% of the requests for data review associated with the TA St. Louis laboratory (23% of the total) were for anion analysis by ion chromatography. Elevated nitrite results and apparent false detections were observed in several wells across the site. The problem has been determined to be instrument related, although the exact cause is unknown. The laboratory has made several attempts to resolve the issue, and the number of nitrite detections has decreased. However, a few anomalous results were identified in June and July, suggesting that the problem has not been resolved. Additional information about this problem can be found in Section B-1 of the *Quarterly RCRA Groundwater Monitoring Data for the Period October through December 2006* (SGW-33492). At the time of this writing, WSCF is analyzing most groundwater samples for anions, and the Eberline laboratory is being used as a secondary laboratory. TA St. Louis is continuing to troubleshoot their method.

Total Organic Carbon – Approximately 12% of the requests for data review associated with WSCF (7% of the total) were for total organic carbon. Between November 20, 2006, and March 7, 2007, an improperly

prepared calibration standard was used for analysis, resulting in sample results that were biased low by approximately 35%. Results for 108 samples were corrected by the laboratory, while 26 samples from the same time period were unaffected (non-detects). Groundwater staff agreed to take a conservative approach and reject this data in the HEIS database by applying an “R” flag to all detected results. Corrective actions have been completed and verified. More information about this problem can be found in Section B-1 of the *Quarterly RCRA Groundwater Monitoring Data for the Period January through March 2007* (SGW-34359).

Gross Alpha – Approximately 18% of the requests for data review associated with WSCF (10% of the total) were for gross alpha. Elevated gross alpha results have been identified at several wells across the site. The problem is specific to samples that have significant amounts of technetium-99 and/or strontium-90 (beta emitters). This type of interference is referred to as crosstalk and is largely resolved by adjusting the operating voltage of the detector and measuring gross alpha and gross beta separately (WSCF was performing a simultaneous count). At the groundwater project’s request, WSCF implemented an independent alpha counting method in August 2007. Re-analyses by the discrete alpha method confirmed that simultaneous counting was causing high biased results. Future samples are being scheduled for analysis by the new gross alpha procedure. More information about this problem can be found in Section B-1 of the *Quarterly RCRA Groundwater Monitoring Data for the Period April through June 2007* (SGW-35502).

Metals – Approximately 35% of the requests for data review associated with WSCF (20% of the total) were for metals. Thirty-nine of these requests were due to the dilution of samples which resulted in the required detection limit for chromium not being met. The need for dilution was due to an instrument limitation that was quickly resolved. The majority of the requests for data review for metals (258) were associated with elevated, out-of-trend results obtained in the May through August time frame. The problem was tied to specific analytical batches performed at the laboratory on specific days, although the exact cause is unknown. The laboratory is still investigating the issue to determine cause. Re-analysis of the samples yielded in trend results, and the issue does not appear to have recurred. Additional blind samples will be submitted in FY 2008 to further troubleshoot the metals analyses.

C.6.6 Laboratory Transition Overview

C. J. Thompson and H. L. Anastos

As noted in Section C.1, a majority of the analytical services supporting groundwater monitoring were transferred from TA Richland and St. Louis to WSCF during FY 2007. This change was required when Fluor Hanford, Inc. assumed oversight of long-term groundwater monitoring at the site due to a union labor agreement between Fluor Hanford, Inc. and the Hanford Atomic Metal Trades Council. To minimize impacts to the monitoring program, a gradual transition of the sample load to WSCF was implemented. Figure C.6 summarizes the total number of analyses performed by WSCF and the TA laboratories for each month of the fiscal year, and Figure C.7 shows the laboratories’ relative percentages by quarter for the most frequently requested analysis methods.

In general, the number of analyses performed by WSCF increased throughout the year. As a result of WSCF’s calibration problem with total organic carbon (Section C.6.5), the number of total organic carbon and total organic halides analyses performed by WSCF decreased during the third quarter. Also, the total number of analyses for several methods decreased during the last quarter of the year. This is due to a limited sampling schedule in July and August. Based on past experiences with fire restrictions delaying sampling during these months, the sampling schedule was planned accordingly.

WSCF’s performance relative to the commercial laboratories was monitored using split samples and QC blind standards in addition to comparing WSCF results with historical trends at numerous sites. Summaries of the split-sample and blind-standard results are provided in Sections C.4, and C.6.2, respectively. Some additional observations about data comparability are provided below.

Overall, most of the data from WSCF agree reasonably well with historical trends, and the majority of WSCF’s blind-standard and split-sample results for the year were acceptable. Trend analysis identified some

discrepancies for several metals, gross alpha, and gross beta at multiple wells. The changes in the data and follow-up investigative actions for metals and gross alpha were summarized in the previous section (C.6.5). Observed differences in the gross beta results were less significant, but many wells showed an increase of 10% to 20% after the analyses were shifted to WSCF. As noted in Section C.6.2, WSCF also obtained higher recoveries on most of the gross beta blind standards. WSCF uses a different isotope for gross beta calibration (cesium-137; TA and Eberline Services use strontium-90), which may partially explain why WSCF's values are higher. During the transition to WSCF, several apparent outliers were also observed for other constituents (e.g., cyanide, carbon tetrachloride, total organic carbon, total organic halides, and strontium-90), but they appeared to be isolated cases. Most of the suspect results have been flagged in the HEIS database.

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

C. A. Newbill, H. Hampt, and D. S. Sklarew

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

The limit of detection is defined as the lowest concentration level statistically different from a blank (Currie 1988). The concentration at which an analyte can be detected depends on the variability of the blank response. For the purpose of this discussion, the blank is taken to be a method blank.

In general, the limit of detection is calculated as the mean concentration in the blank plus three standard deviations of that concentration (EPA/540/P-87/001, OSWER 9355.0-14). 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% (Miller and Miller 1988). A false-positive error is an instance when an analyte is declared present but is, in fact, absent. A false-negative error is an instance when an analyte is declared absent but is, in fact, present.

The limit of detection for a radionuclide is typically computed from the counting error associated with each reported result (e.g., EPA 520/1-80-012) and represents instrumental or background conditions at the time of analysis. In contrast, the limit of detection and limit of quantitation for the radionuclides shown in Table C.31 are based on variabilities that result from both counting errors and uncertainties introduced by sample handling. In the latter case, distilled water, submitted as a sample, is processed as if it were an actual sample. Thus, any random cross contamination of the blank during sample processing will be included in the overall error, and the values shown in Table C.31 are most useful to assess long-term variability in the overall 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). The limit of quantitation is calculated as the blank mean plus 10 standard deviations of the blank (EPA/540/P-87/001, OSWER 9355.0-14). 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% probability that the true concentration of the analyte is within $\pm 25\%$ of the measured concentration.

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

For this report, total organic carbon, total organic halides, and radionuclide field blank data are available for limit of detection and limit of quantitation determinations. The field blanks are QC samples that are introduced into a process to monitor the performance of the system. The use of field blanks to calculate the limit of detection and the limit of quantitation is preferred over the use of laboratory blanks because field blanks include error contributions from sample preparation and handling, in addition to analytical uncertainties. Methods to calculate the limit of detection and the limit of quantitation are described in detail in Appendix A of DOE/RL-91-03. The results of the limit of detection and limit of quantitation determinations are listed in Table C.32 for TA and C.33 for WSCF.

Because of the lack of blank data for other constituents of concern, it was necessary to calculate approximate limit of detection and limit of quantitation values by using variability information obtained from low-level standards. The data from the low-level standards are obtained from laboratory method detection limit studies. If low-level standards are used, the variability of the difference between the sample and blank response is increased by a factor of 2 (Currie 1988, p. 84). The formulas are summarized below: where s = standard deviation from the seven replicates of the low-level standard.

The results of limit of detection, limit of quantitation, and method detection limit calculations for most non-radiological constituents of concern (besides total organic carbon and total organic halides) are listed in Tables C.32 and C.33. The values in Table C.32 apply to TA St. Louis and the values in Table C.33 apply to WSCF.

Specific evaluation of detection-limit issues for the interim action groundwater monitoring was not performed for this report. Detection limit issues are primarily assessed as part of site-specific validation activities. No validation activities were performed on interim action groundwater monitoring data in FY 2007.

C.8 Conclusions

H. L. Anastos and C. J. Thompson

Overall, assessments of FY 2007 QA/QC information indicate that groundwater monitoring data are reliable and defensible. Sampling was conducted in accordance with reviewed procedures. Few 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. Blind samples, split samples and historical data trend analysis provide confidence that the transition of laboratory services to the WSCF laboratory had no major impact on groundwater data. However, the following areas of concern were identified and should be considered when interpreting groundwater monitoring results:

- 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 and/or laboratory method blanks. The most significant contaminants were chromium, magnesium, methylene chloride, nitrogen in ammonia, nitrogen in nitrate, silver, tritium, and zinc.
- Maximum recommended holding times were exceeded for ~3.7% of groundwater monitoring samples that were analyzed by non-radiological methods. Anions were primarily affected, though the data impacts are considered minor.
- Laboratory performance on blind standards was good overall: 88% of the results were acceptable. Constituents with out-of-limit results from TA (St. Louis and Richland) were carbon tetrachloride, hexavalent

chromium, nitrogen as nitrate, total organic halides, trichloroethene, and tritium. Constituents with out-of-limit results from WSCF were carbon tetrachloride, chloride, gross alpha, gross beta, hexavalent chromium, nitrogen as nitrate, strontium-90, technetium-99, total organic carbon, total organic halides, trichloroethene, and tritium. All of Lionville Laboratory's and Eberline Services' results were acceptable.

- Several analytical areas have been identified for continued evaluation and follow-up in FY2008. These include anions, gross beta, metals, strontium-90, and volatile organic compounds.

C.9 References

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Table C.1. Data Review Codes

Code	Definition
F	Result is being reviewed as part of the RDR process. This flag is assigned when an RDR is initiated.
G	Result is valid according to further review.
H	Laboratory 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 C.2. Requests for Data Review, FY 2007 Data

Flag G	Flag Y	Flag R	Flag P	Notify Owner	Other Action	Pending	Number of Results with an Assigned RDR
Analytical Results							
442	205	367	4	4	19	429	1470
Water-Level Measurements							
18	40	68	--	--	--	94	222
RDR = Requests for data review.							

Table C.3. Full Trip Blanks Exceeding Quality Control Limits

Constituent	Number Out of Limits	Number of Analyses	Percent Out of Limits	Range of QC Limits ^(a)	Range of Out-of-Limit Results
General Chemistry Parameters					
Alkalinity	3	57	5.3	1,700 – 5,000 µg/L	6,000 – 120,000 µg/L
Specific conductance	1	1	100.0	0.98 µS/cm	2.25 µS/cm
Total organic halides	13	61	21.3	4.4 – 10 µg/L	5 – 14.6 µg/L
Ammonia and Anions					
Chloride	12	72	16.7	30 – 64 µg/L	49 – 180 µg/L
Nitrogen in ammonia	1	2	50.0	12.16 µg/L	15.4 µg/L
Nitrogen in Nitrate	5	72	6.9	25.6 – 390 µg/L	36.7 – 278 µg/L
Phosphate	1	3	33.3	20 – 320 µg/L	290 µg/L
Metals					
Arsenic	1	7	14.3	3.2 – 4 µg/L	4.1 µg/L
Barium	3	65	4.6	2 – 20 µg/L	2.2 – 70.8 µg/L
Calcium	7	65	10.8	36 – 400 µg/L	67.6 – 45,800 µg/L
Chromium	6	65	9.2	5 – 28 µg/L	8.5 – 783 µg/L
Cobalt	4	65	6.2	4 – 28 µg/L	8.9 – 10.2 µg/L
Copper	3	65	4.6	3.6 – 28 µg/L	9.9 – 13 µg/L
Iron	4	65	6.2	18 – 132 µg/L	19.4 – 37.4 µg/L
Magnesium	14	65	21.5	12 – 512 µg/L	13.6 – 14,400 µg/L
Manganese	1	65	1.5	1.72 – 12 µg/L	8.8 µg/L
Nickel	1	65	1.5	8 – 20 µg/L	8.4 µg/L
Silver	10	65	15.4	3.4 – 44 µg/L	11.4 – 18.2 µg/L
Sodium	4	65	6.2	54 – 460 µg/L	98.7 – 95,100 µg/L
Strontium	2	65	3.1	1.12 – 8 µg/L	207 – 237 µg/L
Thallium	1	1	100.0	0.64 µg/L	0.66 µg/L
Uranium	1	8	12.5	0.1 µg/L	0.133 µg/L
Vanadium	7	65	10.8	11.8 – 56 µg/L	15.4 – 36.5 µg/L
Zinc	13	65	21.5	4 – 38.6 µg/L	9.5 – 114 µg/L
Volatile Organic Compounds					
Methylene chloride	9	20	45.0	0.5 – 5 µg/L	0.72 – 3.1 µg/L
Radiological Parameters					
Gross beta	3	42	7.1	2.4 – 7.6 pCi/L ^(b)	3.3 – 8.67 pCi/L
Strontium-90	1	16	6.3	0.836 – 1.214 pCi/L ^(b)	2.12 pCi/L
Tritium	8	50	16.0	10.18 – 688 pCi/L ^(b)	40.8 – 105 pCi/L
Uranium	1	26	3.8	0.1508 – 0.42 µg/L	0.133 µg/L
<p>(a) Because method detection limits 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.</p> <p>(b) The limit for radiological analyses is determined by the sample-specific total propagated uncertainty.</p> <p>QC = Quality control.</p>					

Table C.4. Field Transfer Blanks Exceeding Quality Control Limits

Constituent	Number Out of Limits	Number of Analyses	Percent Out of Limits	Range of QC Limits ^(a)	Range of Out-of-Limit Results
Carbon disulfide	4	193	2.1	0.062 – 2 µg/L	0.23 – 0.44 µg/L
Carbon tetrachloride	9	193	4.7	0.078 – 2 µg/L	0.26 – 0.59 µg/L
Chloroform	2	193	1.0	0.096 – 2 µg/L	0.36 – 0.37 µg/L
cis-1,2-Dichloroethene	1	193	0.5	0.096 – 2 µg/L	0.12 µg/L
Methylene chloride	99	192	51.6	0.5 – 5 µg/L	0.59 – 36 µg/L
Trichloroethene	2	193	1.0	0.074 – 2 µg/L	0.11 – 0.31 µg/L

(a) Because method detection limits 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 C.5. Equipment Blanks Exceeding Quality Control Limits

Constituent	Number Out of Limits	Number of Analyses	Percent Out of Limits	Range of QC Limits ^(a)	Range of Out-of-Limit Results
General Chemistry Parameters					
Total organic halides	8	8	100.0	4.4 – 10 µg/L	23.4 – 36.2 µg/L
Ammonia and Anions					
Chloride	4	6	66.7	30 – 60 µg/L	44.1 – 160 µg/L
Nitrogen in nitrate	5	6	83.3	35.4 – 58.4 µg/L	75.3 – 753 µg/L
Sulfate	2	6	33.3	82 – 140 µg/L	140 – 155 µg/L
Metals					
Calcium	3	4	75.0	68 – 400 µg/L	98 – 529 µg/L
Chromium	1	4	25.0	6.2 – 9.8 µg/L	10.6 µg/L
Copper	1	4	25.0	5.6 – 8 µg/L	11.2 µg/L
Iron	1	4	25.0	18 – 74.4 µg/L	39.7 µg/L
Magnesium	2	4	50.0	12 – 512 µg/L	17.7 – 224 µg/L
Sodium	3	4	75.0	54 – 314 µg/L	340 – 696 µg/L
Strontium	2	4	50.0	1.12 – 8 µg/L	1.5 – 1.6 µg/L
Vanadium	1	4	25.0	11.8 – 24.2 µg/L	17.8 µg/L
Zinc	1	4	25.0	8 – 38.6 µg/L	12.8 µg/L
Volatile Organic Compounds					
Chloroform	2	2	100.0	0.096 µg/L	4.9 – 30 µg/L
Radiological Parameters					
Tritium	3	4	75.0	14.9 – 596 pCi/L	60.5 – 6100 pCi/L

(a) Because method detection limits 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 C.6. 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 Differences ^(b)
Ammonia and Anions					
Chloride	52	52	2	3.8	24.5 - 26.0
Cyanide	14	5	2	40.0	36.7 - 60.3
Fluoride	52	45	4	8.9	20.7 - 37.8
Nitrogen in nitrate	52	52	1	1.9	94.3
Nitrogen in nitrite	52	19	11	57.9	35.3 - 197.4
Metals					
Manganese	49	7	1	14.3	95.6
Potassium	49	30	1	3.33	26.7
Volatile Organic Compounds					
Methylene chloride	11	3	3	100.0	160.0 - 180.0
trans-1,2-Dichloroethene	11	1	1	100.0	20.2
Trichloroethene	11	5	3	60.0	168.0 - 187.0
Radiological Parameters					
Cobalt-60	20	5	1	20.00	26.6
Gross alpha	29	8	5	62.50	20.7 - 131.9
Gross beta	38	30	5	16.67	29.6 - 71.9
Iodine-129	12	3	1	33.33	46.6
Technetium-99	34	25	1	4.00	23.9
Tritium	46	38	1	2.63	20.7
<p>(a) Duplicates with both results less than five times the method detection limit or minimum detectable activity were excluded from the evaluation.</p> <p>(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.</p>					

Table C.7. 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)
Ammonia and Anions					
Chloride	36	36	13	36.1	20.6 - 67.5
Cyanide	19	9	5	55.6	24.7 - 97.7
Fluoride	35	25	14	56.0	21.4 - 178.0
Nitrogen in nitrate	36	30	3	10.0	22.9 - 199.6
Sulfate	36	36	2	5.6	22.0 - 196.0
Metals					
Barium	25	19	1	5.3	76.0
Iron	25	7	5	71.4	22.8 - 132.2
Magnesium	24	24	1	4.2	22.9
Manganese	25	7	4	57.1	48.8 - 108.8
Potassium	25	3	1	33.3	32.2
Sodium	25	25	1	4.0	32.9
Strontium	25	25	1	4.0	23.0
Zinc	25	3	1	33.3	113.0
Radiological Parameters					
Gross beta	17	6	1	16.7	75.4
Strontium-90	14	3	2	66.7	37.5 - 87.4
<p>(a) Splits with both results less than five times the method detection limit or minimum detectable activity were excluded from the evaluation.</p> <p>(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..</p>					

Table C.8. Hanford Site Groundwater Remediation Project Maximum Recommended Holding Times

Method	Constituent	Holding Time
120.1 (EPA-600/4-81-004)	Conductivity	28 days
160.1 (EPA-600/4-81-004)	Total dissolved solids	7 days
300.0 (EPA-600/4-81-004)	Bromide	28 days
300.0 (EPA-600/4-81-004)	Chloride	28 days
300.0 (EPA-600/4-81-004)	Fluoride	28 days
300.0 (EPA-600/4-81-004)	Nitrate	48 hours
300.0 (EPA-600/4-81-004)	Nitrite	48 hours
300.0 (EPA-600/4-81-004)	Phosphate	48 hours
300.0 (EPA-600/4-81-004)	Sulfate	28 days
310.1 (EPA-600/4-81-004)	Alkalinity	14 days
350.1 (EPA-600/4-81-004)	Ammonia	28 days
410.4 (EPA-600/4-81-004)	Chemical oxygen demand	28 days
6010 (SW-846)	Inductively coupled plasma metals	6 months
6020 (SW-846)	Inductively coupled plasma-mass spectrometry metals	6 months
7060 (SW-846)	Arsenic	6 months
7196 (SW-846)	Hexavalent chromium	24 hours
7421 (SW-846)	Lead	6 months
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	7 days before extraction; 40 days after extraction
8260 (SW-846)	Volatile organics	14 days
8270 (SW-846)	Semivolatile organics	7 days before extraction; 40 days after extraction
9012 (SW-846)	Cyanide	14 days
9020 (SW-846)	Total organic halides	28 days
9030 (SW-846)	Sulfides	7 days
9060 (SW-846)	Total organic carbon	28 days
9223 (APHA/AWWA/WEF)	Coliform	24 hours

Table C.9. Summary of TestAmerica Water Pollution and Water Supply Performance Evaluation Studies

Accreditation Laboratory, Environmental Resource Associates	TA St. Louis					TA Richland
	WP-144 March 2007	WP-150 September 2007	WS-123 December 2006	WS-129 June 2007	Quik™ Response 041307A May 2007	WP-144 March 2007
Acceptable Results/Total	504/532 ^(a)	523/548 ^(b)	56/60 ^(c)	53/60 ^(d)	11/12 ^(e)	2/2
<p>(a) Unacceptable results were for total organic carbon, total organic halides, ammonia as N, orthophosphate as P, oil and grease (gravimetric), conductivity at 25°C, nitrite as N, iron, hexachlorobutadiene, chlordane (technical), 2-(2-methyl-4-chlorophenoxy)propionic acid (MCP), acenaphthylene, and benzene, ethylbenzene, toluene, and total xylenes in gasoline range organics.</p> <p>(b) Unacceptable results were for calcium; calcium hardness as CaCO₃; chemical oxygen demand; cadmium; fluoride; sulfide; volatile solids; tetrachloroethylene; 4-amino-2,6-dinitrotoluene; 2-amino-4,6-dinitrotoluene; 1,3-dinitrobenzene; 2,4-dinitrotoluene; 2,6-dinitrotoluene; nitrobenzene; 2-nitrotoluene; 3-nitrotoluene; 4-nitrotoluene; RDX; 1,3,5-trinitrobenzene; and 2,4,6-trinitrotoluene.</p> <p>(c) Unacceptable results were for tetrachloroethene; hexachlorobutadiene; dibromochloropropane; and 1,2,3-trichloropropane.</p> <p>(d) Unacceptable results were for bromoform; sec-butylbenzene; chloromethane; 4-chlorotoluene; 4-isopropyltoluene; 1,1,1,2-tetrachloroethane; and 1,2,3-trichlorobenzene.</p> <p>(e) Unacceptable result was for benzene in gasoline range organics.</p> <p>WP = Water pollution. WS = Water supply.</p>						

Table C.10. Summary of WSCF Water Pollution and Water Supply Performance Evaluation Studies

Accreditation Laboratory, Environmental Resource Associates	WP-138 October 2006	WP-144 March 2007	WP-150 September 2007	Quik™ Response 091306B October 2006	Quik™ Response 100506C November 2006	Quik™ Response 031507A March 2007	Quik™ Response 090607E September 2007
Acceptable Results/Total	86/89 ^(a)	81/82 ^(b)	82/84 ^(c)	8/8	2/2	1/1	2/2
<p>(a) Unacceptable results were for lead, manganese, and sodium.</p> <p>(b) Unacceptable result was for total organic carbon.</p> <p>(c) Unacceptable results were for non-filterable residue and chemical oxygen demand.</p> <p>WP = Water pollution.</p>							

Table C.11. Summary of Lionville Laboratory Water Supply Performance Evaluation Studies

Accreditation Laboratory, Environmental Resource Associates	WP-144 March 2007	WS-126 March 2007
Acceptable Results/Total	471/479 ^(a)	9/9
<p>(a) Unacceptable results were for orthophosphate as P, 1,1-dichloroethane, 1,1-dichloroethylene, ethyl parathion, and diesel range organics.</p> <p>WP = Water pollution. WS = Water supply.</p>		

Table C.12. Summary of TestAmerica Interlaboratory Water Supply Performance, FY 2007

Constituent	Number of Results Reported for Each	Number Within Acceptable Control Limits
DOE Mixed Analyte Performance Evaluation Program (MAPEP-07-MaW17&OrW17&GrW17) Radiological and Environmental Sciences Laboratory		
Americium-241, cesium-134, cesium-137, cobalt-57, cobalt-60, iron-55, manganese-54, nickel-63, plutonium-238, plutonium-239/240, strontium-90, technetium-99, uranium-234/233, uranium-238, zinc-65, gross alpha, gross beta	2 ^(a,b)	2
Tritium	2 ^(a,b)	1 ^(c)
Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, thallium, uranium-total, uranium-235, uranium-238, vanadium, zinc	1 ^(b)	1
Aniline; phenol; 2-chlorophenol; 1,3-dichlorobenzene; 1,4-dichlorobenzene; benzyl alcohol; 1,2-dichlorobenzene; hexachloroethane; nitrobenzene; isophorone; 2-nitrophenol; 2,4-dimethylphenol; 2,4-dichlorophenol; 1,2,4-trichlorobenzene; naphthalene; hexachlorobutadiene; 4-chloro-3-methylphenol; 2-methylnaphthalene; 2-methylphenol; hexachlorocyclopentadiene; 3+4-methylphenol; 2,4,6-trichlorophenol; 2,6-dichlorophenol; o-toluidine; 1,4-phenylenediamine; 2-chloronaphthalene; 2-nitroaniline; dimethylphthalate; acenaphthylene; 2,6-dinitrotoluene; 3-nitroaniline; acenaphthene; 2,4-dinitrotoluene; 2,4-dinitrophenol; 4-chloroaniline; dibenzofuran; 4-nitrophenol; 2-naphthylamine; 1,4-naphthoquinone; fluorene; diethylphthalate; 4,6-dinitro-2-methylphenol; 1,2,4,5-tetrachlorobenzene; 2,4,5-trichlorophenol; hexachlorobenzene; 2,3,4,6-tetrachlorophenol; fluoranthene; pyrene; dinoseb; butylbenzylphthalate; benzo(a)anthracene; chrysene; bis(2-ethylhexyl)phthalate; di-n-octylphthalate; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; indeno(1,2,,3-c,d)pyrene; dibenzo(a,h)anthracene; benzo(g,h,i)perylene; alpha-BHC; beta-BHC; gamma-BHC (lindane); delta-BHC; heptachlor; aldrin; heptachlor epoxide; endosulfan I; 4,4'-DDE; dieldrin; endrin; 4,4'-DDD; endosulfan II; 4,4-DDT; endrin aldehyde; endosulfan sulfate; endrin ketone; methoxychlor	1 ^(b)	1
ERA InterLaB RadChem Proficiency Testing Program (RAD-67) Environmental Resource Associates		
Gross alpha, radium-226	2 ^(a)	2 ^(d)
Barium-133, cesium-134, cesium-137, cobalt-60, gross beta, iodine-131, radium-228, strontium-89, strontium-90, tritium, uranium (natural), zinc-65	1 ^(a)	1 ^(d)
<p>(a) Results from TA Richland. (b) Results from TA St. Louis. (c) Result from TA St. Louis was not acceptable. (d) Control limits from <i>National Standards for Water Proficiency Testing Studies Criteria Document</i> (NERL-Ci-0045) and National Environmental Laboratory Accreditation Conference PT Field of Testing list.</p>		

Table C.13. Summary of WSCF Interlaboratory Performance, FY 2007

Constituent	Number of Results Reported for Each	Number Within Acceptable Control Limits
DOE Mixed Analyte Performance Evaluation Program (MAPEP-06-MaW16&OrW16&GrW16 and MAPEP-07-MaW17&OrW17&GrW17) Radiological and Environmental Sciences Laboratory		
Americium-241, cesium-134, cesium-137, cobalt-57, cobalt-60, plutonium-238, plutonium-239/240, strontium-90, technetium-99, tritium, uranium-234/233, uranium-238, zinc-65, gross alpha, gross beta	2	2
Manganese-54	1	1
Arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, thallium, uranium-total, vanadium, zinc	2	2
Antimony, silver, technetium-99	1	1 ^(a)
Aniline; phenol; 2-chlorophenol; 1,3-dichlorobenzene; 1,4-dichlorobenzene; benzyl alcohol; 1,2-dichlorobenzene; hexachloroethane; nitrobenzene; isophorone; 2-nitrophenol; 2,4-dimethylphenol; 2,4-dichlorophenol; 1,2,4-trichlorobenzene; naphthalene; hexachlorobutadiene; 4-chloro-3-methylphenol; 2-methylnaphthalene; 2-methylphenol; hexachlorocyclopentadiene; 3&4-methylphenol; 2,4,6-trichlorophenol; 2,6-dichlorophenol; o-toluidine; 1,4-phenylenediamine; 2-chloronaphthalene; 2-nitroaniline; dimethylphthalate; acenaphthylene; 2,6-dinitrotoluene; 3-nitroaniline; acenaphthene; 2,4-dinitrotoluene; 2,4-dinitrophenol; dibenzofuran; 4-nitrophenol; 2-naphthylamine; 1,4-naphthoquinone; fluorene; diethylphthalate; 4,6-dinitro-2-methylphenol; 1,2,4,5-tetrachlorobenzene; 2,4,5-trichlorophenol; hexachlorobenzene; pentachlorophenol; 4-nitroaniline; phenanthrene; anthracene; 1,4-dinitrobenzene; 1,3-dinitrobenzene; 1,2-dinitrobenzene; pentachlorobenzene; pentachloronitrobenzene; 2,3,4,6-tetrachlorophenol; fluoranthene; pyrene; dinoseb; butylbenzylphthalate; benzo(a)anthracene; bis(2-ethylhexyl)phthalate; di-n-octylphthalate; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; indeno(1,2,3-c,d)pyrene;	2	2
4-Chloroaniline, di-n-butylphthalate, chrysene	2	1
ERA InterLaB RadChem Proficiency Testing Program (RAD-68, 70; Quik™Response 100506D) Environmental Resource Associates		
Tritium	3	3 ^(b)
Radium-226, radium-228, uranium (natural), uranium (natural) mass	2	2 ^(b)
Barium-133, cesium-134, cesium-137, cobalt-60	1	1 ^(b)
Zinc-65	1	0 ^(b)
<p>(a) One result for antimony was acceptable but outside warning limits.</p> <p>(b) Control limits from National Standards for Water Proficiency Testing Studies Criteria Document (NERL-Ci-0045) and National Environmental Laboratory Accreditation Conference PT Field of Testing list.</p>		

Table C.14. Summary of Eberline Services and Lionville Laboratory Interlaboratory Performance, FY 2007

Constituent	Number of Results Reported for Each	Number Within Acceptable Control Limits
DOE Mixed Analyte Performance Evaluation Program (MAPEP-07-MaW17&OrW17&GrW17) Radiological and Environmental Sciences Laboratory		
Americium-241, cesium-134, cesium-137, cobalt-57, cobalt-60, iron-55, manganese-54, nickel-63, plutonium-238, plutonium-239/240, strontium-90, technetium-99, tritium, uranium-234/233, uranium-238, zinc-65, gross alpha, gross beta	1 ^(a)	1
Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, thallium, uranium-total, vanadium, zinc	1 ^(b)	1
Phenol, 2-chlorophenol; 1,3-dichlorobenzene; 1,4-dichlorobenzene; 1,2-dichlorobenzene; hexachloroethane; nitrobenzene; isophorone; 2-nitrophenol; 2,4-dimethylphenol; 2,4-dichlorophenol; 1,2,4-trichlorobenzene; naphthalene; hexachlorobutadiene; 4-chloro-3-methylphenol; 2-methylnaphthalene; 2-methylphenol; hexachlorocyclopentadiene; 3+4-methylphenol; 2,4,6-trichlorophenol; 2-chloronaphthalene; dimethylphthalate; acenaphthylene; 2,6-dinitrotoluene; acenaphthene; 2,4-dinitrotoluene; 2,4-dinitrophenol; dibenzofuran; 4-nitrophenol; fluorene; diethylphthalate; 4,6-dinitro-2-methylphenol; 2,4,5-trichlorophenol; hexachlorobenzene; pentachlorophenol; phenanthrene; anthracene; di-n-butylphthalate; fluoranthene; pyrene; butylbenzylphthalate; benzo(a)anthracene; chrysene; bis(2-ethylhexyl)phthalate; di-n-octylphthalate; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; indeno(1,2,3-c,d)pyrene; dibenzo(a,h)anthracene; benzo(g,h,i)perylene	1 ^(b)	1
ERA InterLaB RadChem Proficiency Testing Program (RAD-68, 70; Quik™ Response 022607B) Environmental Resource Associates		
Gross beta	3 ^(a)	3 ^(c)
Gross alpha	3 ^(a)	2 ^(c)
Barium-133, cesium-134, cesium-137, cobalt-60, radium-226, radium-228, strontium-89, strontium-90, tritium, uranium(natural), uranium (natural) mass	2 ^(a)	2 ^(c)
Zinc-65	2 ^(a)	1 ^(d,e)
<p>(a) Results from Eberline Services. (b) Results from Lionville Laboratory. (c) Control limits from <i>National Standards for Water Proficiency Testing Studies Criteria Document</i> (NERL-Ci-0045) and from National Environmental Laboratory Accreditation Conference PT Field of Testing list.</p>		

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

Constituent	Laboratory	Sample Frequency	Number of Results Reported ^(a)	Number of Results Outside QC Limits	Control Limits ^(b) (%)
General Chemical Parameters					
Specific conductance	St. Louis	Quarterly	12	0	±25
Total organic carbon (potassium hydrogen phthalate spike)	St. Louis	Quarterly	16	0	±25
Total organic halides (2,4,5-trichlorophenol spike)	St. Louis	Quarterly	14	0	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene spike)	St. Louis	Quarterly	14	4	±25
Ammonia and Anions					
Chloride	St. Louis	Quarterly	9	0	±25
Cyanide	St. Louis	Quarterly	12	0	±25
Fluoride	St. Louis	Quarterly	12	0	±25
Nitrate as nitrogen	St. Louis	Quarterly	12	1	±25
Nitrite as nitrogen	St. Louis	Annually	3	0	±25
Metals					
Chromium (total)	St. Louis	Semiannually	6	0	±20
Hexavalent chromium	St. Louis	Semiannually	6	1	±20
Volatile Organic Compounds					
Carbon tetrachloride	St. Louis	Quarterly	12	5	±25
Chloroform	St. Louis	Quarterly	12	0	±25
Trichloroethene	St. Louis	Quarterly	12	1	±25
Radiological Parameters					
Gross alpha (plutonium-239 spike)	Richland	Quarterly	12	0	±30
Gross beta (strontium-90 spike)	Richland	Quarterly	12	0	±30
Cesium-137	Richland	Annually	3	0	±30
Cobalt-60	Richland	Annually	3	0	±30
Iodine-129	Richland	Semiannually	3	0	±30
Plutonium-239	Richland	Quarterly	12	0	±30
Strontium-90	Richland	Quarterly	12	0	±30
Technetium-99	Richland	Quarterly	12	0	±30
Tritium	Richland	Quarterly	9	3	±30
Tritium (low level)	Richland	Quarterly	9	0	±30
Uranium-238	Richland	Quarterly	12	0	±30
(a) Blind standards were generally submitted in triplicate or quadruplicate.					
(b) Each result must be within the specified percentage of the known value to be acceptable.					
QC = Quality control.					

Table C.16. Summary of WSCF Double-Blind Spike Determinations

Constituent	Sample Frequency	Number of Results Reported ^(a)	Number of Results Outside QC Limits	Control Limits ^(b) (%)
General Chemical Parameters				
Specific conductance	Quarterly	12	0	±25
Total organic carbon (potassium hydrogen phthalate spike)	Quarterly	16	4	±25
Total organic halides (2,4,5-trichlorophenol spike)	Quarterly	14	3	±25
Total organic halides (carbon tetrachloride, chloroform, and trichloroethene spike)	Quarterly	14	9	±25
Ammonia and Anions				
Chloride	Quarterly	9	3	±25
Cyanide	Quarterly	12	0	±25
Fluoride	Quarterly	12	0	±25
Nitrate as nitrogen	Quarterly	12	3	±25
Nitrite as nitrogen	Annually	3	0	±25
Metals				
Chromium (total)	Semiannually	6	0	±20
Hexavalent chromium	Semiannually	6	1	±20
Volatile Organic Compounds				
Carbon tetrachloride	Quarterly	12	7	±25
Chloroform	Quarterly	12	0	±25
Trichloroethene	Quarterly	12	10	±25
Radiological Parameters				
Gross alpha (plutonium-239 spike)	Quarterly	15	2	±30
Gross beta (strontium-90 spike)	Quarterly	15	2	±30
Cesium-137	Annually	3	0	±30
Cobalt-60	Annually	3	0	±30
Plutonium-239	Quarterly	12	0	±30
Strontium-90	Quarterly	12	2	±30
Technetium-99	Quarterly	12	1	±30
Tritium	Quarterly	9	6	±30
Uranium-238	Quarterly	9	0	±30
(a) Blind standards were generally submitted in triplicate or quadruplicate.				
(b) Each result must be within the specified percentage of the known value to be acceptable.				
QC = Quality control.				

Table C.17. Summary of Lionville Laboratory, Inc. and Eberline Services Double-Blind Spike Determinations

Constituent	Laboratory	Sample Frequency	Number of Results Reported ^(a)	Number of Results Outside QC Limits	Control Limits ^(b) (%)
General Chemical Parameters					
Total organic carbon (potassium hydrogen phthalate spike)	Lionville	Quarterly	16	0	±25
Radiological Parameters					
Gross beta (strontium-90 spike)	Eberline	Quarterly	12	0	±30
(a) Blind standards were generally submitted in triplicate or quadruplicate.					
(b) Each result must be within the specified percentage of the known value to be acceptable.					
QC = Quality control.					

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

QC Parameter	General Chemistry Parameters	Ammonia and Anions	Metals	VOC	SVOC	Radiological Parameters	Total
Method Blanks	2.7	7.2	1.0	0.5	0.1	0.1	1.2
Lab Control Samples	2.2	1.2	0.3	1.9	6.0	0.7	1.7
Matrix Spikes	5.7	48.9	1.6	2.9	0.8	3.7	5.0
Matrix Duplicates	0.7	3.9	0.8	3.5	4.7	0.7	2.7
Surrogates	—	—	—	2.7	4.5	—	3.1
QC = Quality control.							
SVOC = Semivolatile organic compounds.							
VOC = Volatile organic compounds.							

Table C.19. Percentage of Out-of-Limit Quality Control Results by Category, WSCF

QC Parameter	General Chemistry Parameters	Ammonia and Anions	Metals	VOC	SVOC	Radiological Parameters	Total
Method Blanks	1.3	0.0	8.1	2.3	0.0	0.3	2.0
Lab Control Samples	0.0	0.0	0.1	0.0	0.0	0.6	0.1
Matrix Spikes	4.6	0.9	0.7	0.0	0.0	3.8	0.9
Matrix Duplicates	0.0	0.4	0.6	0.0	1.0	4.4	0.8
Surrogates	—	—	—	0.9	1.2	—	1.0
QC = Quality control.							
SVOC = Semivolatile organic compounds.							
VOC = Volatile organic compounds.							

Table C.20. Method Blank Results, TestAmerica (Richland and St. Louis)

Constituent	Percent Out of Limit ^(a)	Number of Analyses	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total General Chemistry Parameters	2.7	222	—
Alkalinity	7.9	38	2 mg/L
Total organic halides	3.2	94	4.6 – 5.4 µg/L
Ammonia and Anions			
Total Ammonia and Anions	7.2	975	—
Chloride	27.3	176	0.047 – 0.47mg/L
Cyanide	6.3	32	9.8 – 19.5 µg/L
Nitrogen in ammonia	42.1	19	11.1 – 42.2 µg/L
Nitrogen in nitrate	1.1	184	0.011 – 0.013 mg/L
Phosphate	26.1	23	0.21 – 0.73 mg/L
Sulfate	2.2	178	0.17 – 0.6 mg/L
Metals			
Total Metals	1.0	1,894	—
Beryllium	1.0	96	2.3 µg/L
Calcium	6.3	96	72.5 – 1040 µg/L
Copper	1.0	96	8.8 µg/L
Iron	1.0	99	61.5 µg/L
Lithium	12.5	8	17.8 µg/L
Manganese	3.1	96	2.3 – 5.4 µg/L
Sodium	2.1	97	269 – 1,540 µg/L
Strontium (elemental)	2.1	96	2.3 – 2.5 µg/L
Zinc	1.0	96	2.5 µg/L
Volatile Organic Compounds			
Total Volatile Organic Compounds	0.5	3,335	—
Acetone ^(b)	1.0	104	5.6 µg/L
Benzene	1.0	104	0.13 µg/L
Chloroform	1.0	104	0.12 µg/L
Chloromethane	5.6	18	0.1 µg/L
Methylene chloride ^(b)	8.7	104	0.54 – 2.8 µg/L
Toluene ^(b)	1.9	104	0.13 – 0.16 µg/L
Semivolatile Organic Compounds			
Total Semivolatile Organic Compounds	0.1	1,025	—
Oil and grease	14.3	7	1.7 mg/L
Radiological Parameters			
Total Radiochemistry Parameters	0.1	2,104	—
Carbon-14	3.8	26	48.9 pCi/L
Gross beta	1.0	101	4.67 pCi/L
Uranium	1.1	95	3.72 µg/L
(a) Quality control limits are twice the method detection limit.			
(b) Quality control limits are five times the method detection limit.			

Table C.21. Method Blank Results, WSCF

Constituent	Percent Out of Limit ^(a)	Number of Analyses	Concentration Range of Out-of-Limit Results
General Chemistry Parameters			
Total General Chemistry Parameters	1.3	76	—
Alkalinity	33.3	3	2.2 mg/L
Ammonia and Anions			
Total Ammonia and Anions	0.0	2,416	—
Metals			
Total Metals	8.1	950	—
Aluminum	14.3	7	709 µg/L
Calcium	6.7	45	72.7 - 390 µg/L
Chromium	6.3	48	12.3 – 15.5 µg/L
Cobalt	6.3	48	9.2 – 10.5 µg/L
Iron	8.9	45	18.4 – 26.2 µg/L
Magnesium	44.4	45	12.4 – 29.1 µg/L
Nickel	10.4	48	9.1 – 15.2 µg/L
Silver	29.2	48	11.5 – 36.8 µg/L
Strontium (elemental)	2.2	45	2.6 µg/L
Vanadium	12.5	48	14.4 – 27.8 µg/L
Zinc	35.4	48	8.3 – 37.7 µg/L
Volatile Organic Compounds			
Total Volatile Organic Compounds	2.3	1,102	—
1,1,1-Trichloroethane	2.4	41	4.7 µg/L
1,1,2-Trichloroethane	2.4	41	5.8 µg/L
1,1-Dichloroethane	2.4	41	5.4 µg/L
1,1-Dichloroethene	2.4	41	5.3 µg/L
1,2-Dichloroethane	2.4	41	5.6 µg/L
2-Butanone ^(b)	2.4	41	6.2 µg/L
2-Methyl-2-pentanone	4.9	41	5.5 – 5.8 µg/L
Acetone ^(b)	9.8	41	6.5 – 9.3 µg/L
Benzene	2.4	41	5.7 µg/L
Carbon disulfide	2.4	41	4.2 µg/L
Carbon tetrachloride	2.4	41	4.3 µg/L
Chlorobenzene	2.4	41	7.6 µg/L
cis-1,2-Dichloroethylene	2.4	41	5.1 µg/L
Ethylbenzene	4.9	41	8.3 – 11 µg/L
Methylene chloride ^(b)	2.4	41	5.9 µg/L
Tetrachloroethene	2.4	41	3.5 µg/L
trans-1,2-Dichloroethylene	2.4	41	4.4 µg/L
Trichloroethene	2.4	41	4.6 µg/L
Vinyl chloride	2.4	41	2.8 µg/L
Xylenes (total)	2.7	37	5.2 µg/L
Semivolatile Organic Compounds			
Total Semivolatile Organic Compounds	0.0	210	—
Radiological Parameters			
Total Radiochemistry Parameters	0.3	379	—
Gross beta	1.3	80	12.9 pCi/L
(a) Quality control limits are twice the method detection limit.			
(b) Quality control limits are five times the method detection limit.			

Table C.22. Laboratory Control Samples, TestAmerica Laboratories (Richland and St. Louis)

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total General Chemistry Parameters	2.2	226
Total organic carbon	7.5	67
Ammonia and Anions		
Total Ammonia and Anions	1.2	1,002
Cyanide	11.1	54
Nitrogen in nitrite	1.7	178
Phosphate	13.0	23
Metals		
Total Metals	0.3	1,892
Hexavalent chromium	11.1	18
Iron	3.0	99
Potassium	1.0	96
Volatile Organic Compounds		
Total Volatile Organic Compounds	1.9	3,248
1,1,1,2-Tetrachloroethane	11.1	18
1,1-Dichloroethane	1.0	104
1,1-Dichloroethene	1.0	104
1,4-Dichlorobenzene	0.8	118
1,4-Dioxane	1.9	103
1-Butanol	1.0	103
2-Butanone	3.8	104
2-Chloroethyl vinyl ether	50.0	2
4-Methyl-2-pentanone	2.9	104
Acetone	4.8	104
Acrolein	5.6	18
Allyl chloride	5.6	18
Benzene	1.0	104
Bromochloromethane	50.0	2

Table C.22. (contd)

Constituent	Percent Out of Limit	Number of Analyses
Bromomethane	16.7	18
Carbon disulfide	5.8	104
Carbon tetrachloride	2.7	112
Chloroethane	11.1	18
Chloroform	2.9	104
cis-1,2-Dichloroethylene	1.0	105
Ethyl acetate	27.3	11
Fluorotrichloromethane	5.6	18
Iodomethane	22.2	18
Methylene chloride	1.9	104
Tetrahydrofuran	1.9	104
Toluene	1.0	104
trans-1,2-Dichloroethylene	1.0	104
trans-1,4-Dichloro-2-butene	11.1	18
Trichloroethene	1.0	104
Vinyl acetate	16.7	18
Semivolatile Organic Compounds		
Total Semivolatile Organic Compounds	6.0	818
2,3,4,6-Tetrachlorophenol	8.0	25
2,4,5-Trichlorophenol	11.1	27
2,4,6-Trichlorophenol	7.4	27
2,4-Dichlorophenol	5.1	39
2,4-Dimethylphenol	7.4	27
2,4-Dinitrophenol	7.4	27
2,6-Dichlorophenol	8.0	25
2-Chlorophenol	7.4	27
2-Methylphenol	5.1	39
2-Nitrophenol	5.1	39
2-secButyl-4,6-dinitrophenol	3.7	27

Table C.22. (contd)

Constituent	Percent Out of Limit	Number of Analyses
3-+4-Methylphenol	5.3	38
4-Bromophenylphenyl ether	50.0	2
4-Chloro-3-methylphenol	7.4	27
4-Nitrophenol	7.4	27
Anthracene	50.0	2
Benzo(a)anthracene	50.0	2
Benzo(g,h,i)perylene	50.0	2
bis(2-Chloroethoxy)methane	50.0	2
Carbazole	100.0	1
Dibenz[a,h]anthracene	50.0	2
Dimethylphthalate	50.0	2
Heptachlor	40.0	5
Hexachlorobenzene	50.0	2
Indeno(1,2,3-cd)pyrene	50.0	2
Isophorone	50.0	2
Naphthalene	6.3	16
Nitrobenzene	50.0	2
Oil and grease	28.6	7
Pentachlorophenol	2.6	39
Phenol	7.0	43
Radiological Parameters		
Total Radiochemistry Parameters	0.7	1,399
Cobalt-60	0.9	110
Iodine-129	1.0	100
Uranium	3.1	191
Uranium-235	50.0	4

Table C.23. Laboratory Control Samples, WSCF

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total General Chemistry Parameters	0.0	162
Ammonia and Anions		
Total Ammonia and Anions	0.0	1,249
Metals		
Total Metals	0.1	951
Antimony	2.1	48
Volatile Organic Compounds		
Total Volatile Organic Compounds	0.0	218
Semivolatile Organic Compounds		
Total Semivolatile Organic Compounds	0.0	106
Radiological Parameters		
Total Radiochemistry Parameters	0.6	330
Tritium	2.9	69

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

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total General Chemistry Parameters	5.7	262
Alkalinity	2.5	40
Chemical oxygen demand	16.7	6
Conductivity	20.0	5
Total organic carbon	6.8	103
Total organic halides	4.7	107
Ammonia and Anions		
Total Ammonia and Anions	48.9	937
Chloride	38.0	171
Cyanide	30.8	39
Fluoride	41.7	168
Nitrogen in ammonia	21.7	23
Nitrogen in nitrate	44.4	169
Nitrogen in nitrite	94.0	168
Phosphate	44.4	18
Sulfate	36.3	171
Sulfide	30.0	10
Metals		
Total Metals	1.6	5,101
Antimony	0.8	264
Barium	0.4	264
Beryllium	0.4	264
Cadmium	0.4	264
Calcium	4.2	264
Chromium	3.0	264
Cobalt	0.4	264
Copper	0.4	262
Iron	4.9	268
Magnesium	1.9	264
Manganese	0.4	264
Mercury	3.2	63
Nickel	0.4	264
Potassium	2.7	264
Silicon	100.0	2
Silver	1.1	264
Sodium	5.4	260
Strontium (elemental)	1.5	260
Vanadium	0.4	260
Zinc	0.4	260
Volatile Organic Compounds		
Total Volatile Organic Compounds	2.9	7,414
1,1,1,2-Tetrachloroethane	9.5	42
1,1,1-Trichloroethane	0.4	235
1,1,2-Trichloroethane	0.9	235
1,1-Dichloroethane	0.4	235
1,1-Dichloroethene	2.6	235
1,2-Dibromo-3-chloropropane	7.1	42
1,2-Dibromoethane	4.8	42
1,2-Dichloroethane	1.3	237

Table C.25. Matrix Spikes and Matrix Spike Duplicates, WSCF

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total General Chemistry Parameters	4.6	194
Total organic carbon	5.4	112
Total organic halides	3.9	76
Ammonia and Anions		
Total Ammonia and Anions	0.9	2,488
Chloride	0.4	484
Nitrogen in nitrate	0.6	482
Nitrogen in nitrite	3.0	474
Phosphorus in Phosphate	4.2	24
Sulfate	0.4	476
Metals		
Total Metals	0.7	1,744
Barium	2.3	88
Iron	1.1	88
Silver	2.3	88
Zinc	9.1	88
Volatile Organic Compounds		
Total Volatile Organic Compounds	0.0	424
Semivolatile Organic Compounds		
Total Semivolatile Organic Compounds	0.0	209
Radiological Parameters		
Total Radiochemistry Parameters	3.8	133
Technetium-99	25.0	20

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

Constituent	Percent Out of Limit	Number of Analyses
General Chemistry Parameters		
Total General Chemistry Parameters	0.7	458
Total organic halides	2.4	127
Ammonia and Anions		
Total Ammonia and Anions	3.9	1,995
Chloride	4.3	373
Cyanide	9.3	43
Fluoride	4.1	370
Nitrogen in ammonia	2.4	41
Nitrogen in nitrate	1.3	378
Nitrogen in nitrite	8.4	370
Phosphate	5.9	34
Sulfate	0.5	374
Sulfide	9.1	11
Metals		
Total Metals	0.8	2,631
Antimony	0.7	135
Barium	0.7	135
Beryllium	0.7	135
Calcium	0.7	135
Chromium	0.7	135
Cobalt	0.7	135
Copper	0.7	134
Hexavalent chromium	8.1	37
Iron	1.5	137
Magnesium	0.7	135
Manganese	0.7	135
Nickel	0.7	135
Potassium	0.7	135
Silver	0.7	135
Sodium	0.8	133
Strontium (elemental)	0.8	133
Vanadium	0.7	143
Zinc	0.8	133

Table C.26. (contd)

Volatile Organic Compounds		
Total Volatile Organic Compounds	3.5	7,603
1,1,1-Trichloroethane	1.2	254
1,1,2-Trichloroethane	0.8	254
1,1-Dichloroethane	2.0	254
1,1-Dichloroethene	2.0	254
1,2-Dibromo-3-chloropropane	5.7	35
1,2-Dichloroethane	0.8	254
1,4-Dichlorobenzene	1.1	270
1,4-Dioxane	9.9	253
1-Butanol	20.9	253
2-Butanone	13.0	254
2-Hexanone	2.9	35
2-Methyl-1-propanol	11.4	35
4-Methyl-2-pentanone	1.2	254
Acetone	16.1	254
Acetonitrile	11.4	35
Acrolein	11.1	36
Benzene	1.2	254
Bromoform	2.9	35
Bromomethane	2.9	35
Carbon disulfide	3.5	254
Carbon tetrachloride	1.3	232
Chloroform	1.6	252
Chloromethane	2.9	35
cis-1,2-Dichloroethylene	1.6	254
Cyclohexanone	16.7	6
Dichlorodifluoromethane	2.9	35
Ethyl acetate	4.3	23
Ethyl cyanide	1.6	254
Ethyl methacrylate	2.9	35
Ethylbenzene	1.2	254
Iodomethane	11.4	35
Methylene chloride	2.4	254
Tetrachloroethene	2.0	254
Tetrahydrofuran	2.4	254
Toluene	1.6	254
trans-1,2-Dichloroethylene	2.4	254
Trichloroethene	1.2	252
Vinyl chloride	2.8	254

Table C.26. (contd)

Semivolatile Organic Compounds		
Total Semivolatile Organic Compounds	4.7	1,095
2,3,4,6-Tetrachlorophenol	18.4	38
2,4,5-Trichlorophenol	5.0	40
2,4,6-Trichlorophenol	5.0	40
2,4-Dichlorophenol	3.7	54
2,4-Dimethylphenol	5.0	40
2,4-Dinitrophenol	7.5	40
2,6-Dichlorophenol	5.3	38
2-Chlorophenol	5.0	40
2-Methylphenol	3.7	54
2-Nitrophenol	3.7	54
2-secButyl-4,6-dinitrophenol	10.0	40
3-+4-Methylphenol	3.8	53
4,6-Dinitro-2-methylphenol	10.0	40
4-Chloro-3-methylphenol	5.0	40
4-Nitrophenol	15.0	40
Pentachlorophenol	7.4	54
Phenol	3.4	58
TPH Diesel	2.8	36
Radiological Parameters		
Total Radiochemistry Parameters	0.7	2,031
Carbon-14	10.7	28
Cobalt-60	1.8	113
Gross alpha	2.2	91
Gross beta	1.0	99
Iodine-129	2.0	98
Plutonium-239/240	4.0	25
Technetium-99	0.8	125
Tritium	0.7	135
Uranium-235	9.1	11

Table C.27. Matrix Duplicates, WSCF

Constituent	Percent Out of Limit	Number of Analyses ^(a)
General Chemistry Parameters		
Total General Chemistry Parameters	0.0	137
Ammonia and Anions		
Total Ammonia and Anions	0.4	2,312
Fluoride	0.8	476
Nitrogen in nitrate	0.8	484
Nitrogen in nitrite	0.4	476
Metals		
Total Metals	0.6	819
Barium	4.5	44
Iron	2.3	44
Zinc	4.5	44
Volatile Organic Compounds		
Total Volatile Organic Compounds	0.0	213
Semivolatile Organic Compounds		
Total Semivolatile Organic Compounds	1.0	104
Phenol	10.0	10
Radiological Parameters		
Total Radiochemistry Parameters	4.4	383
Gross alpha	6.4	78
Gross beta	11.7	77
Strontium	23.1	13
(a) Relative percent difference values were not reported for 284 duplicates whose value was not below the method detection limit.		

Table C.28. Summary of Issue Resolution Forms, FY 2007

Issue Category	Number of Analyses Impacted		
	Prior to Receipt at the Laboratory	After Receipt at the TA Laboratory ^(a)	After Receipt at the WSCF Laboratory
Hold Time Missed	49	200	30
Broken Bottles	9	--	--
Late analysis	--	40	3
Temperature Deviation	25	--	30
pH Variance	--	--	--
Bottle Size/Type (insufficient volume or headspace)	17	--	--
Chain-of-Custody Forms Incomplete/SDG Assignment	1	8	--
Laboratory QC Out of Limits		50	4
Incorrect Preservation of the Sample	9	6	--
Analytical Preparation Deviations	--	7	9
Method Failures/Discontinued Analyses	--	3	--

(a) Includes data from TA St. Louis and TA Richland
 QC = Quality control.
 SDG = Sample delivery group.
 TA = TestAmerica Laboratories, Inc.
 WSCF = Waste Sampling and Characterization Facility.

Table C.29. Laboratory Audits and Assessment Results

Laboratory	Findings	Observations	Summary of Results
Severn Trent, Inc. St Louis, MO	21	18	Two "Priority I" audit findings addressing the lack of a technical director for the radiochemistry department and inadequate controls on handling radioactive materials within the facility. Other findings include: No annual review of large percentage of SOPs, no documentation of daily refrigerator temperature checks or calibration of refrigerator thermometers, incorrect interpretation of ion chromatography data, analysis of ICP-MS interference check solutions not always done on a 12-hour basis, linear dynamic range of ICP not verified every 6 months, several problems with radiochemical analysis setup and operations, inadequate documentation of subcontracted work in data packages.
Severn Trent Inc. Richland, WA	0	2	No findings issued.
Eberline Services, Richmond, CA	5	5	Verification of gamma spectrometer software not available for review, no specification on tracer addition during sample preparation, MDL estimation for total uranium by KPA does not follow the QSAS, control limit specification for method blank acceptance does not follow the QSAS, no PE results for GEA, and gross alpha/beta on air filters.
Lionville Laboratory, Inc., Lionville, PA	5	5	Health and Safety retraining not in compliance with SOPs, current version of SOPs do not reference current version of QSAS, no demonstrated lot check for Florisil cartridges, calibration of DO meter not verified after use, no documentation of auditing of waste management facilities.
Severn Trent Inc., Knoxville, TN	2	0	Not all client requirements are well documented, calibration certificates for radiological survey instruments are not kept for the required 5 years.
Waste Sampling and Characterization Facility, Hanford Site	6	15	MDL check samples for ICP not analyzed on quarterly basis, TOX analyst did not meet minimum training requirements, no written SOP for TPH gasoline analysis in soils, ambient temperature for TCLP analyses were out side of temperature tolerance limits, no SOP defining in-house preparation of standards and reagents, SOPs do not define control charting for calibration verification checks for radionuclide analysis.

DO = Dissolved oxygen.

GEA = Gamma energy analysis.

ICP = Inductively coupled plasma.

ICP-MS = Inductively coupled plasma mass spectroscopy.

KPA = Kinetic phosphorescence analysis.

MDL = Method detection limit.

PE = Performance evaluation.

QSAS = Quality Systems for Analytical Services.

SOP = Standard operating procedure.

TCLP = Toxicity characteristics leaching procedure.

TPH = Total petroleum hydrocarbon.

TOX = Total organic halides.

Table C.30. Comparison of FY 2007 Hanford Site Groundwater Chromium Data

C.30. Comparison of FY 2007 Hanford Site Groundwater Chromium Data								
Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/Filtered SPD	Total Chromium Unfiltered/Filtered SPD	Total Chromium, Filtered/Hexavalent Chromium SPD
199-B3-1	1/16/2007		28.0	23.8		NA	NA	-16.22%
199-B3-46	1/30/2007		18.0	16.5		NA	NA	-8.70%
199-B3-47	1/16/2007		64.0	55.2		NA	NA	-14.77%
199-B5-1	1/11/2007		12.0	11.4		NA	NA	-5.13%
199-D2-6	11/27/2006	38.5		45.2		NA	NA	15.90%
199-D2-8	1/25/2007	114.0		116.0		NA	NA	1.74%
199-D3-2	11/14/2006	23.0		17.4	18.7	NA	7.20%	-27.72%
199-D4-1	11/14/2006	5.0		3.1		NA	NA	NC
199-D4-13	11/14/2006	5.0		7.0	7.0	NA	NC	NC
199-D4-14	11/14/2006	45.0		45.5	44.1	NA	-3.13%	1.10%
199-D4-15	11/20/2006	1,437.3		1,390.0	1,460.0	NA	4.91%	-3.35%
199-D4-19	11/14/2006	5.0		7.0	7.0	NA	NC	NC
199-D4-20	11/14/2006	186.5		170.0	172.0	NA	1.17%	-9.26%
199-D4-22	11/14/2006	940.0		848.0	862.0	NA	1.64%	-10.29%
199-D4-23	11/14/2006	16.0		11.2	34.6	NA	102.18%	-35.29%
199-D4-26	11/14/2006	553.0		554.0		NA	NA	0.18%
199-D4-31	12/7/2006	583.0		586.0		NA	NA	0.51%
199-D4-32	11/20/2006	80.0		81.4		NA	NA	1.73%
199-D4-36	11/20/2006	289.0		285.0		NA	NA	-1.39%
199-D4-38	11/14/2006	369.0		366.0		NA	NA	-0.82%
199-D4-39	11/14/2006	650.0		665.0		NA	NA	2.28%
199-D4-4	11/20/2006	5.0		3.1		NA	NA	NC
199-D4-5	11/21/2006	5.0		3.1		NA	NA	NC
199-D4-6	11/14/2006	5.0		3.1		NA	NA	NC
199-D4-62	11/14/2006	5.0		3.1		NA	NA	NC
199-D4-7	12/12/2006	86.0		70.4		NA	NA	-19.95%
199-D4-78	11/21/2006	30.0		35.6		NA	NA	17.07%
199-D4-84	11/20/2006	48.0		45.7		NA	NA	-4.91%
199-D4-85	11/20/2006	16.0		14.0		NA	NA	-13.33%
199-D4-86	11/20/2006	16.0		12.1		NA	NA	-27.76%
199-D5-13	11/22/2006	506.0		528.0	563.0	NA	6.42%	4.26%
199-D5-14	11/22/2006	450.0		510.0	500.0	NA	-1.98%	12.50%
199-D5-15	11/22/2006	1,172.0		1,210.0	1,260.0	NA	4.05%	3.19%
199-D5-15	12/7/2006	1,070.0		1,045.0	1,055.0	NA	0.95%	-2.36%
199-D5-16	2/26/2007	94.0		82.6	86.8	NA	4.96%	-12.91%
199-D5-20	11/27/2006	424.5		420.5	413.5	NA	-1.68%	-0.95%
199-D5-32	11/27/2006	429.0		424.5		NA	NA	-1.05%
199-D5-33	11/20/2006	5.5		3.1		NA	NA	NC
199-D5-34	11/20/2006	622.0		641.0		NA	NA	3.01%
199-D5-36	11/27/2006	5.0		7.0		NA	NA	NC
199-D5-37	12/12/2006	46.3		44.7		NA	NA	-3.41%
199-D5-38	11/14/2006	392.0		364.0	358.0	NA	-1.66%	-7.41%
199-D5-39	11/14/2006	1,734.0		1,630.0	1,650.0	NA	1.22%	-6.18%
199-D5-40	11/22/2006			239.0	268.0	NA	11.44%	NA
199-D5-41	11/22/2006	512.0		531.0	539.0	NA	1.50%	3.64%
199-D5-43	11/14/2006	726.0		713.0		NA	NA	-1.81%

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, µnfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, µnfiltered (µg/L)	Hexavalent Chromium Unfiltered/ Filtered SPD	Total Chromium Unfiltered/ Filtered SPD	Total Chromium, Filtered/ Hexavalent Chromium SPD
199-D5-43	2/13/2007	702.0		681.0	684.0	NA	0.44%	-3.04%
199-D5-92	11/20/2006	210.0		216.0		NA	NA	2.82%
199-D5-93	1/26/2007	175.0		182.0		NA	NA	3.92%
199-D8-4	11/8/2006			186.0	198.0	NA	6.25%	NA
199-D8-5	11/8/2006			245.0	277.0	NA	12.26%	NA
199-D8-54B	11/8/2006	9.0		7.0	8.9	NA	NC	NC
199-D8-55	11/8/2006	28.0		19.1	20.8	NA	8.52%	-37.79%
199-D8-70	11/8/2006	95.5		88.9		NA	NA	-7.16%
199-D8-73	11/27/2006	208.0		214.0		NA	NA	2.84%
199-D8-88	11/8/2006	78.0		78.6		NA	NA	0.77%
199-H3-2C	11/8/2006			49.8	52.9	NA	6.04%	NA
199-H4-10	11/8/2006	24.0		19.3	18.9	NA	-2.09%	-21.71%
199-H4-12C	11/27/2006	92.0		89.8	90.3	NA	0.56%	-2.42%
199-H4-13	11/8/2006	19.0		13.2	14.0	NA	5.88%	-36.02%
199-H4-16	11/9/2006	9.0		7.0	7.0	NA	NC	NC
199-H4-46	11/21/2006	10.0		7.5	10.6	NA	34.25%	NC
199-H4-48	11/9/2006	18.0		13.2		NA	NA	-30.77%
199-H4-49	11/21/2006	20.0		18.4		NA	NA	-8.33%
199-H4-5	11/9/2006	13.0		7.8		NA	NA	-50.00%
199-H4-6	11/27/2006	11.0		9.7	15.9	NA	48.63%	NC
199-H4-8	11/20/2006	9.0		7.8	24.9	NA	104.59%	NC
199-H4-9	11/27/2006	9.0		7.1	30.7	NA	124.87%	NC
199-H5-1A	11/27/2006	8.0		6.8		NA	NA	NC
199-H6-1	12/20/2006			12.8	14.3	NA	11.46%	NA
199-K-106A	1/18/2007	6.0		4.6		NA	NA	NC
199-K-106A	4/16/2007	8.0		4.0		NA	NA	NC
199-K-106A	8/7/2007	5.0		4.0		NA	NA	NC
199-K-107A	10/12/2006	447.0		441.5	434.0	NA	-1.71%	-1.24%
199-K-107A	1/18/2007	543.0		526.0		NA	NA	-3.18%
199-K-107A	4/16/2007	614.0		610.0		NA	NA	-0.65%
199-K-107A	7/19/2007	409.5		404.0		NA	NA	-1.35%
199-K-108A	10/12/2006	29.6		26.4	29.4	NA	10.75%	-11.26%
199-K-108A	4/27/2007	60.0		61.7		NA	NA	2.79%
199-K-109A	12/20/2006			16.5	15.5	NA	-6.47%	NA
199-K-11	12/22/2006			14.0	14.0	NA	0.00%	NA
199-K-110A	10/31/2006			7.0	21.5	NA	101.75%	NA
199-K-111A	10/16/2006	34.9		33.9	39.4	NA	14.88%	-2.91%
199-K-117A	10/16/2006	11.0		3.1		NA	NA	
199-K-120A	8/13/2007	49.0	51.0			4.00%	NA	NA
199-K-120A	8/13/2007	47.0	51.0			8.16%	NA	NA
199-K-132	1/9/2007	122.0		139.0		NA	NA	13.03%
199-K-132	4/12/2007	112.0		106.0		NA	NA	-5.50%
199-K-132	7/31/2007	82.0		83.2		NA	NA	1.45%
199-K-137	10/24/2006	1,942.0		2,095.0	2,040.0	NA	-2.66%	7.58%
199-K-139	10/31/2006	293.5		283.5	282.0	NA	-0.53%	-3.47%
199-K-140	10/31/2006	161.0		148.0	149.0	NA	0.67%	-8.41%
199-K-143	2/23/2007	22.2		20.2	23.3	NA	14.25%	-9.43%

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/Filtered SPD	Total Chromium Unfiltered/Filtered SPD	Total Chromium, Filtered/Hexavalent Chromium SPD
199-K-158	1/19/2007		6.5			NA	NA	NA
199-K-18	10/19/2006	145.0		128.0	130.0	NA	1.55%	-12.45%
199-K-19	10/19/2006	58.5		50.0	55.3	NA	10.07%	-15.61%
199-K-20	10/18/2006	21.0		15.6	31.3	NA	66.95%	-29.51%
199-K-21	10/18/2006	11.0		7.0	29.8	NA	123.91%	-44.44%
199-K-22	10/26/2006	120.5	116.0	119.5	117.0	-3.81%	-2.11%	-0.83%
199-K-27	12/1/2006			7.0	12.8	NA	58.59%	NA
199-K-30	10/19/2006			7.0	7.0	NA	NC	NA
199-K-31	10/19/2006			10.8	9.7	NA	-10.73%	NA
199-K-32A	10/19/2006			14.3	43.3	NA	100.69%	NA
199-K-32B	10/19/2006			8.9	47.9	NA	137.32%	NA
199-K-34	10/31/2006			13.7	19.4	NA	34.44%	NA
199-K-34	1/22/2007	22.0		20.6		NA	NA	-6.57%
199-K-34	4/27/2007	32.0		31.2		NA	NA	-2.53%
199-K-34	7/19/2007	21.5		27.6		NA	NA	25.08%
199-K-35	10/19/2006			7.0	42.1	NA	142.97%	NA
199-K-36	10/19/2006	28.0		24.3	89.9	NA	114.89%	-14.15%
199-K-37	10/26/2006	83.0		75.6	79.2	NA	4.65%	-9.33%
299-E17-22	10/13/2006			7.8	8.8	NA	NC	NA
299-E17-22	2/20/2007			7.1	7.7	NA	NC	NA
299-E17-22	3/20/2007			8.0	8.3	NA	NC	NA
299-E17-22	4/23/2007			8.4	8.9	NA	NC	NA
299-E17-23	10/13/2006			29.6	29.8	NA	0.67%	NA
299-E17-23	2/20/2007			29.0	28.2	NA	-2.80%	NA
299-E17-23	3/20/2007			29.7	30.2	NA	1.67%	NA
299-E17-23	4/23/2007			28.4	28.1	NA	-1.06%	NA
299-E17-23	7/5/2007			26.9	26.7	NA	-0.75%	NA
299-E17-25	10/13/2006			24.4	24.5	NA	0.41%	NA
299-E17-25	2/20/2007			21.3	21.0	NA	-1.42%	NA
299-E17-25	3/20/2007			23.4	23.0	NA	-1.72%	NA
299-E17-25	4/23/2007			22.2	22.0	NA	-0.90%	NA
299-E17-25	7/5/2007			20.1	20.6	NA	2.46%	NA
299-E17-26	11/2/2006			10.0	10.2	NA	1.98%	NA
299-E17-26	2/22/2007			11.6	11.9	NA	2.55%	NA
299-E17-26	3/20/2007			13.6	13.5	NA	-0.74%	NA
299-E17-26	4/23/2007			12.6	12.1	NA	-4.05%	NA
299-E17-26	7/5/2007			13.5	13.2	NA	-2.25%	NA
299-E18-1	10/18/2006			7.6	18.3	NA	82.63%	NA
299-E18-1	2/20/2007			14.0	22.0	NA	44.44%	NA
299-E18-1	3/20/2007			23.6	30.4	NA	25.19%	NA
299-E18-1	4/23/2007			10.4	19.8	NA	62.25%	NA
299-E18-1	7/5/2007			11.4	21.7	NA	62.24%	NA
299-E24-21	10/18/2006			3.5	3.7	NA	NC	NA
299-E24-21	2/20/2007			3.4	3.4	NA	NC	NA
299-E24-21	3/20/2007			5.9	13.9	NA	80.81%	NA
299-E24-21	4/23/2007			4.0	3.2	NA	NC	NA
299-E24-21	7/5/2007			4.9	4.9	NA	NC	NA

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/ Filtered SPD	Total Chromium Unfiltered/ Filtered SPD	Total Chromium, Filtered/ Hexavalent Chromium SPD
199-K-158	1/19/2007		6.5			NA	NA	NA
199-K-18	10/19/2006	145.0		128.0	130.0	NA	1.55%	-12.45%
199-K-19	10/19/2006	58.5		50.0	55.3	NA	10.07%	-15.61%
199-K-20	10/18/2006	21.0		15.6	31.3	NA	66.95%	-29.51%
199-K-21	10/18/2006	11.0		7.0	29.8	NA	123.91%	-44.44%
199-K-22	10/26/2006	120.5	116.0	119.5	117.0	-3.81%	-2.11%	-0.83%
199-K-27	12/1/2006			7.0	12.8	NA	58.59%	NA
199-K-30	10/19/2006			7.0	7.0	NA	NC	NA
199-K-31	10/19/2006			10.8	9.7	NA	-10.73%	NA
199-K-32A	10/19/2006			14.3	43.3	NA	100.69%	NA
199-K-32B	10/19/2006			8.9	47.9	NA	137.32%	NA
199-K-34	10/31/2006			13.7	19.4	NA	34.44%	NA
199-K-34	1/22/2007	22.0		20.6		NA	NA	-6.57%
199-K-34	4/27/2007	32.0		31.2		NA	NA	-2.53%
199-K-34	7/19/2007	21.5		27.6		NA	NA	25.08%
199-K-35	10/19/2006			7.0	42.1	NA	142.97%	NA
199-K-36	10/19/2006	28.0		24.3	89.9	NA	114.89%	-14.15%
199-K-37	10/26/2006	83.0		75.6	79.2	NA	4.65%	-9.33%
299-E17-22	10/13/2006			7.8	8.8	NA	NC	NA
299-E17-22	2/20/2007			7.1	7.7	NA	NC	NA
299-E17-22	3/20/2007			8.0	8.3	NA	NC	NA
299-E17-22	4/23/2007			8.4	8.9	NA	NC	NA
299-E17-23	10/13/2006			29.6	29.8	NA	0.67%	NA
299-E17-23	2/20/2007			29.0	28.2	NA	-2.80%	NA
299-E17-23	3/20/2007			29.7	30.2	NA	1.67%	NA
299-E17-23	4/23/2007			28.4	28.1	NA	-1.06%	NA
299-E17-23	7/5/2007			26.9	26.7	NA	-0.75%	NA
299-E17-25	10/13/2006			24.4	24.5	NA	0.41%	NA
299-E17-25	2/20/2007			21.3	21.0	NA	-1.42%	NA
299-E17-25	3/20/2007			23.4	23.0	NA	-1.72%	NA
299-E17-25	4/23/2007			22.2	22.0	NA	-0.90%	NA
299-E17-25	7/5/2007			20.1	20.6	NA	2.46%	NA
299-E17-26	11/2/2006			10.0	10.2	NA	1.98%	NA
299-E17-26	2/22/2007			11.6	11.9	NA	2.55%	NA
299-E17-26	3/20/2007			13.6	13.5	NA	-0.74%	NA
299-E17-26	4/23/2007			12.6	12.1	NA	-4.05%	NA
299-E17-26	7/5/2007			13.5	13.2	NA	-2.25%	NA
299-E18-1	10/18/2006			7.6	18.3	NA	82.63%	NA
299-E18-1	2/20/2007			14.0	22.0	NA	44.44%	NA
299-E18-1	3/20/2007			23.6	30.4	NA	25.19%	NA
299-E18-1	4/23/2007			10.4	19.8	NA	62.25%	NA
299-E18-1	7/5/2007			11.4	21.7	NA	62.24%	NA
299-E24-21	10/18/2006			3.5	3.7	NA	NC	NA
299-E24-21	2/20/2007			3.4	3.4	NA	NC	NA
299-E24-21	3/20/2007			5.9	13.9	NA	80.81%	NA
299-E24-21	4/23/2007			4.0	3.2	NA	NC	NA
299-E24-21	7/5/2007			4.9	4.9	NA	NC	NA

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/Filtered SPD	Total Chromium Unfiltered/Filtered SPD	Total Chromium, Filtered/Hexavalent Chromium SPD
299-E24-23	4/10/2007		2.0		1.8	NA	NA	NA
299-E24-24	10/18/2006			3.1	3.1	NA	NC	NA
299-E24-24	2/20/2007			3.1	3.1	NA	NC	NA
299-E24-24	3/21/2007			3.1	3.1	NA	NC	NA
299-E24-24	4/9/2007			3.1	3.1	NA	NC	NA
299-E24-24	7/10/2007			4.9	4.9	NA	NC	NA
299-E25-32P	11/1/2006			3.1	20.7	NA	147.90%	NA
299-E27-12	12/22/2006			3.1	8.6	NA	NC	NA
299-E27-22	12/22/2006			3.1	3.1	NA	NC	NA
299-E33-50	3/2/2007		2.0		1.9	NA	NA	NA
299-E33-50	3/6/2007		2.0		2.6	NA	NA	NA
299-E33-50	3/7/2007		2.0		0.5	NA	NA	NA
299-W10-33	7/6/2007		167.0		147.0	NA	NA	NA
299-W10-33	7/10/2007		290.0		262.0	NA	NA	NA
299-W10-33	7/11/2007		91.0		84.1	NA	NA	NA
299-W10-33	7/12/2007		162.0		118.0	NA	NA	NA
299-W10-33	7/16/2007		170.0		86.7	NA	NA	NA
299-W10-33	7/17/2007		46.0		33.5	NA	NA	NA
299-W10-33	7/24/2007		59.0		1.2	NA	NA	NA
299-W11-48	4/6/2007		20.0		19.0	NA	NA	NA
299-W11-48	4/10/2007		28.0		28.1	NA	NA	NA
299-W11-48	4/11/2007		66.0		63.0	NA	NA	NA
299-W11-48	4/13/2007		7.0		0.5	NA	NA	NA
299-W11-48	4/17/2007		95.0		93.1	NA	NA	NA
299-W11-48	4/25/2007		90.5		79.9	NA	NA	NA
299-W11-48	5/3/2007		2.0		0.7	NA	NA	NA
299-W11-48	5/16/2007		4.0		0.8	NA	NA	NA
299-W11-48	5/17/2007		41.0		23.8	NA	NA	NA
299-W11-48	5/21/2007		2.0		2.0	NA	NA	NA
299-W11-48	5/22/2007		142.0		131.0	NA	NA	NA
299-W11-48	5/23/2007		2.0		0.8	NA	NA	NA
299-W11-48	5/29/2007		21.0		21.6	NA	NA	NA
299-W11-48	6/5/2007		9.0		8.2	NA	NA	NA
299-W19-105	10/3/2006	9.0		3.4		NA	NA	NA
299-W19-105	11/29/2006	8.0		3.2		NA	NA	NA
299-W19-105	7/12/2007	3.8		6.0		NA	NA	NA
299-W19-107	12/21/2006	5.0		3.1		NA	NA	NA
299-W22-69	12/14/2006	12.0		11.4		NA	NA	NA
299-W22-69	6/14/2007	10.8		11.5		NA	NA	NA
299-W22-72	1/10/2007	6.0		3.1		NA	NA	NA
299-W22-72	6/14/2007	3.1		2.5		NA	NA	NA
299-W22-86	6/5/2007	32.9		30.6		NA	NA	NA
299-W22-87	6/5/2007	2.0		2.5		NA	NA	NA
299-W26-13	1/29/2007	14.0		21.4		NA	NA	NA
299-W26-14	1/24/2007	5.0		3.1		NA	NA	NA
299-W26-14	6/20/2007	5.0		4.0		NA	NA	NA
299-W27-2	1/29/2007	7.5		4.2		NA	NA	NA

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/ Filtered SPD	Total Chromium Unfiltered/ Filtered SPD	Total Chromium, Filtered/ Hexavalent Chromium SPD
299-W7-3	10/26/2006			7.8		NA	NA	NA
299-W7-4	10/26/2006	2.0		3.1		NA	NA	NA
699-19-88	4/4/2007		2.0	3.6		NA	NA	NC
699-19-88	6/14/2007		2.0	5.3		NA	NA	NC
699-40-36	10/9/2006			0.8	1.6	NA	NC	NA
699-40-36	1/17/2007			0.7	5.7	NA	NC	NA
699-40-36	4/3/2007			0.7	1.7	NA	NC	NA
699-40-36	7/23/2007			0.7	1.7	NA	NC	NA
699-41-35	10/9/2006			2.0	4.4	NA	NC	NA
699-41-35	1/17/2007			5.1	7.4	NA	NC	NA
699-41-35	4/3/2007			1.8	5.3	NA	NC	NA
699-41-35	7/23/2007			2.1	4.8	NA	NC	NA
699-42-37	10/9/2006			3.1	6.5	NA	NC	NA
699-42-37	1/17/2007			2.0	4.8	NA	NC	NA
699-42-37	4/3/2007			1.7	4.6	NA	NC	NA
699-42-37	7/23/2007			6.7	12.2	NA	58.75%	NA
699-42-42B	1/29/2007			3.1	5.2	NA	NC	NA
699-43-44	1/29/2007			3.1	55.6	NA	178.88%	NA
699-43-45	11/2/2006			3.1	16.0	NA	135.08%	NA
699-44-39B	2/1/2007			3.7	11.5	NA	102.63%	NA
699-48-50B	12/4/2006		2.0		1.9	NA	NA	NA
699-48-50B	7/31/2007	2.0		4.9		NA	NA	NA
699-48-77A	10/9/2006			4.9	20.6	NA	123.01%	NA
699-48-77A	2/7/2007			5.4	173.0	NA	187.94%	NA
699-48-77A	4/3/2007			4.9	49.1	NA	163.70%	NA
699-48-77A	7/23/2007			10.8	35.6	NA	106.90%	NA
699-48-77C	10/9/2006			1.4	4.9	NA	NC	NA
699-48-77C	1/17/2007			1.6	5.3	NA	NC	NA
699-48-77C	4/3/2007			1.8	6.1	NA	NC	NA
699-48-77C	7/23/2007			1.8	8.2	NA	NC	NA
699-48-77D	10/9/2006			2.1	6.9	NA	NC	NA
699-48-77D	1/17/2007			2.3	6.8	NA	NC	NA
699-48-77D	4/3/2007			4.4	19.6	NA	126.53%	NA
699-48-77D	7/23/2007			5.5	15.7	NA	96.23%	NA
699-50-56	11/28/2006	2.0		0.5		NA	NA	NA
699-78-62	12/5/2006	28.0		24.0	22.7	NA	-5.57%	-15.38%
699-87-55	12/5/2006			22.4		NA	NA	NA
699-96-43	12/27/2006	85.0		82.9	83.8	NA	1.08%	-2.50%
699-96-49	12/6/2006	27.0		26.2	29.3	NA	11.17%	-3.01%
699-97-43	12/5/2006	94.0		113.0	125.0	NA	10.08%	18.36%
699-97-51A	12/27/2006	33.0		30.6	32.7	NA	6.64%	-7.55%
01-M	2/22/2007	7.0	3.0	2.9	6.2	NC	NC	NC
03-D	2/22/2007	6.0	2.0			NC	NA	NA
04-D	2/26/2007	10.0	13.0			26.09%	NA	NA
04-M	2/26/2007	8.0	13.0			47.62%	NA	NA
04-S	2/26/2007		9.5	7.1	7.6	NA	NC	NC
05-D	2/27/2007		18.0		24.8	NA	NA	NA

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/ Filtered SPD	Total Chromium Unfiltered/ Filtered SPD	Total Chromium, Filtered/ Hexavalent Chromium SPD
05-D	2/27/2007		45.0	45.2	44.9	NA	-0.67%	0.44%
07-D	2/28/2007		20.5	19.6	19.4	NA	-1.03%	-4.49%
13-S	3/1/2007		4.8		3.9	NA	NA	NA
14-D	1/24/2007	5.0	3.0			NC	NA	NA
17-D	1/23/2007	7.0	4.3	4.1	4.4	NC	NC	NC
18-S	1/22/2007		3.5	1.0	1.2	NA	NC	NC
23-D	2/20/2007	5.0	2.0			NC	NA	NA
36-S	1/9/2007	31.0	29.0			-6.67%	NA	NA
37-S	1/10/2007	5.0	2.0			NC	NA	NA
38-M	1/10/2007	22.0	19.0			-14.63%	NA	NA
43-M	2/20/2007	37.0	32.0			-14.49%	NA	NA
44-D	2/20/2007	13.0	8.0			-47.62%	NA	NA
45-D	2/20/2007	6.0	3.0			NC	NA	NA
47-D	2/6/2007	8.0	8.0			NC	NA	NA
48-M	1/31/2007	8.0	4.0			NC	NA	NA
49-D	1/31/2007	5.0	9.0			NC	NA	NA
50-M	1/31/2007	20.0	14.0			-35.29%	NA	NA
62-M	2/12/2007	7.0	2.0	1.6	2.6	NC	NC	NC
63-S	2/12/2007	8.0	4.0	4.2	4.4	NC	NC	NC
64-D	2/12/2007		4.0	4.3	4.6	NA	NC	NC
66-D	2/1/2007		6.5	4.7	5.0	NA	NC	NC
67-M	2/1/2007		4.3	2.3	2.2	NA	NC	NC
68-D	2/1/2007		2.0		2.0	NA	NA	NA
68-M	2/1/2007		2.0		2.2	NA	NA	NA
72-M	2/13/2007		11.0	8.4		NA	NA	-26.45%
72-M	2/13/2007		8.0		8.6	NA	NA	NA
74-D	2/13/2007		5.0	1.8		NA	NA	NC
74-D	2/13/2007		2.0		1.9	NA	NA	NA
76-D	2/13/2007		6.0	2.8	2.8	NA	NC	NC
77-D	2/15/2007		3.0	3.2	6.4	NA	NC	NC
80-D	2/14/2007		4.0	0.6	0.6	NA	NC	NC
AT-3-1-M	12/11/2006			2.1	2.8	NA	NC	NA
AT-3-2-M	12/11/2006			0.9	1.2	NA	NC	NA
AT-3-3-M	12/11/2006			1.4	1.3	NA	NC	NA
AT-3-4-D	12/12/2006			2.7	1.5	NA	NC	NA
AT-B-3-D	2/28/2007		22.0	22.7	23.5	NA	3.46%	3.13%
AT-B-4-S	2/28/2007	10.0	16.0			46.15%	NA	NA
AT-D-1-D	1/8/2007	8.0	4.0			NC	NA	NA
AT-D-2-M	1/8/2007	18.0	5.0			-113.04%	NA	NA
AT-D-3-D	1/8/2007	50.0	46.0			-8.33%	NA	NA
AT-F-1-D	2/8/2007	9.0	3.5	5.5	6.4	NC	NC	NC
AT-F-2-M	2/8/2007	9.0	3.5		5.3	NC	NC	NA
AT-F-3-M	2/12/2007	8.0	6.0	6.5	6.5	NC	NC	NC
AT-F-4-D	2/15/2007	5.0	2.0	1.1	1.1	NC	NC	NC
AT-H-1-S	2/6/2007	14.0	11.5			-19.61%	NA	NA
AT-H-3-S	2/6/2007	11.0	10.0			-9.52%	NA	NA
AT-K-1-D	1/23/2007		4.0	2.0	3.5	NA	NC	NC

Table C.30. (contd)

Well	Date	Hexavalent Chromium, Filtered (µg/L)	Hexavalent Chromium, unfiltered (µg/L)	Total Chromium, Filtered (µg/L)	Total Chromium, unfiltered (µg/L)	Hexavalent Chromium Unfiltered/ Filtered SPD	Total Chromium Unfiltered/ Filtered SPD	Total Chromium, Filtered/ Hexavalent Chromium SPD
AT-K-2-D	2/7/2007		2.0	0.8	1.9	NA	NC	NC
AT-K-3-D	2/5/2007	75.0	82.0			8.92%	NA	NA
AT-K-3-M	2/5/2007		62.3		59.0	NA	NA	NA
AT-K-3-S	2/5/2007	14.0	19.0			30.30%	NA	NA
AT-K-5-D	1/11/2007	63.0		59.3		NA	NA	-6.05%
DD-15-3	1/8/2007	18.0	8.0			-76.92%	NA	NA
DD-17-2	1/10/2007	23.0	19.0			-19.05%	NA	NA
DD-39-3	12/6/2006	102.0	100.0		95.1	-1.98%	NA	NA
DD-41-2	12/7/2006	39.0	32.0		29.0	-19.72%	NA	NA
DD-44-4	12/18/2006		64.7	55.2	59.0	NA	6.57%	-15.80%
DK-04-2	1/11/2007		48.5		45.2	NA	N/A	NA
Redox-2-6.0	1/9/2007	27.0	22.5			-18.18%	NA	NA
Redox-3-4.6	12/7/2006	58.0	68.0			15.87%	NA	NA
Redox-4-6.0	12/7/2006	51.0	46.0			-10.31%	NA	NA
AVERAGE						-9.67%	34.69%	-6.51%
NA = Not applicable (both analyses not available) NC = Not calculated if both values <10 µg/L SPD = Signed percent difference = $(x_1 - x_2) / [(x_1 + x_2) / 2]$ Includes data collected October 2006 through early September 2007. Duplicate samples averaged.								

Table C.31. Summary of Analytical Laboratory Detection/Quantitation Limits Determined from Field Blanks Data, Severn Trent Laboratories (Richland and St. Louis) and Waste Sampling and Characterization Facility

Period ^(a)	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Constituent: Total Organic Carbon, µg/L					
1/18/06 - 11/7/06	58 ^(b)	265.0	207.0	620 ^(c)	2,070 ^(c)
5/15/06 - 2/20/07	49	250.1	234.3	700	2,340
7/21/06 - 6/28/07	63	119.5	145.3	436	1,450
10/3/06 - 9/12/07	65	113.4	143.3	430	1,430
Summary	65	113.4	143.3	430	1,430
Constituent: Total Organic Halides, µg/L					
1/18/06 - 12/18/06	55 ^(b)	1.53	2.26	6.8 ^(c)	22.6 ^(c)
5/15/06 - 2/13/07	48 ^(b)	0.91	1.30	3.9	13.0
7/21/06 - 6/23/07	59	1.85	2.25	6.8	22.5
10/3/06 - 9/12/07	60 ^(b)	2.23	2.29	6.9	22.9
Summary	60 ^(b)	2.23	2.29	6.9	22.9
Constituent: Cesium-137, pCi/L					
11/17/06 - 11/28/06	3	0.27	1.02	3.06 ^(c)	10.18 ^(c)
1/10/07 - 2/23/07	2	0.7	0.09	0.28	0.94
4/5/07 - 6/23/07	9	0.37	1.08	3.23	10.77
9/7/07 - 9/30/07	4	-0.09	0.41	1.22	4.05
Summary	18	0.28	0.92	2.76	9.2
Constituent: Cobalt-60, pCi/L					
11/17/06 - 11/28/06	3	0.91	1.38	4.13 ^(c)	13.77 ^(c)
1/10/07 - 2/23/07	2	-0.43	0.37	1.10	3.66
4/5/07 - 6/23/07	9	0.05	0.78	2.34	7.8
9/7/07 - 9/30/07	4	0.46	0.34	1.03	3.44
Summary	18	0.23	0.81	2.43	8.08
Constituent: Europium-152, pCi/L					
11/17/06 - 11/28/06	3	-3.67	1.99	5.96 ^(c)	19.86 ^(c)
1/10/07 - 2/23/07	2	-0.94	1.12	3.36	11.21
4/5/07 - 6/23/07	9	-0.13	1.68	5.03	16.77
9/7/07 - 9/30/07	4	-0.63	1.88	5.64	18.81
Summary	18	-0.92	1.74	5.21	17.37
Constituent: Europium-154, pCi/L					
11/17/06 - 11/28/06	3	-1.29	4.20	12.61 ^(c)	42.04 ^(c)
1/10/07 - 2/23/07	2	-0.73	0.99	2.96	9.86
4/5/07 - 6/23/07	9	1.29	4.20	12.60	42.01
9/7/07 - 9/30/07	4	-1.75	1.21	3.62	12.06
Summary	18	-0.04	3.60	10.81	36.04

Table C.31. (contd)

Period ^(a)	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Constituent: Europium-155, pCi/L					
11/17/06 - 11/28/06	3	-1.41	3.40	10.21 ^(c)	34.03 ^(c)
1/10/07 - 2/23/07	2	-0.63	0.06	0.17	0.57
4/5/07 - 6/23/07	9	0.24	1.99	5.98	19.92
9/7/07 - 9/30/07	4	-0.07	1.08	3.24	10.80
Summary	18	-0.20	2.04	6.13	20.43
Constituent: Gross Alpha, pCi/L					
10/26/06 - 12/22/06	9	0.01	0.33	0.98 ^(c)	3.26 ^(c)
1/5/07 - 2/23/07	7	0.41	0.39	1.16	3.87
4/19/07 - 6/28/07	13	0.11	0.21	0.64	2.13
9/6/07 - 9/30/07	7	0.19	0.22	0.67	2.25
Summary	36	0.16	0.28	0.85	2.85
Constituent: Gross Beta, pCi/L					
10/26/06 - 12/22/06	9 ^(b)	0.74	0.67	2.02 ^(c)	6.74 ^(c)
1/5/07 - 2/23/07	8	1.14	1.10	3.29	10.96
4/16/07 - 6/28/07	14 ^(b)	0.85	0.94	2.81	9.37
7/10/07 - 9/30/07	8	0.78	0.82	2.46	8.19
Summary	39 ^(b)	0.87	0.90	2.69	8.97
Constituent: Iodine-129, pCi/L					
10/3/06 - 11/17/06	4	-0.02	0.09	0.26 ^(c)	0.87 ^(c)
1/5/07 - 2/23/07	4	-0.02	0.06	0.18	0.61
4/16/07 - 6/22/07	7	0.04	0.11	0.33	1.11
9/12/07 - 9/30/07	2	-0.10	0.14	0.41	1.38
Summary	17	-0.01	0.10	0.30	0.99
Constituent: Strontium-90, pCi/L					
10/12/06 - 12/11/06	5	-0.10	0.14	0.42 ^(c)	1.41 ^(c)
1/9/07 - 1/10/07	2	0.24	0.05	0.15	0.49
4/5/07 - 8/24/07	8 ^(b)	0.10	0.17	0.51	1.69
Summary	15	0.05	0.16	0.48	1.60
Constituent: Technetium-99, pCi/L					
10/3/06 - 11/21/06	9	-0.27	3.31	9.94 ^(c)	33.1 ^(c)
1/5/07 - 3/29/07	10	0.03	1.58	4.73	15.8
4/16/07 - 6/28/07	12	0.81	2.41	7.24	24.1
8/7/07 - 9/16/07	5	-3.19	2.42	7.25	24.2
Summary	36	-0.23	2.49	7.46	24.9

Table C.31. (contd)

Period ^(a)	Number of Samples	Mean	Standard Deviation	Limit of Detection	Limit of Quantitation
Constituent: Technetium-99, Low-Level Method, pCi/L					
11/10/06 - 9/28/07	4	9.54	9.39	28.2 ^(c)	93.9 ^(c)
Constituent: Tritium, (pCi/L)					
10/3/06 - 12/22/06	10	115.3	88.7	266 ^(c)	887 ^(c)
1/10/07 - 2/23/07	11	63.9	109.7	329	1,097
4/9/07 - 6/22/07	13 ^(b)	40.3	94.2	283	942
8/7/07 - 9/12/07	7	43.9	50.4	151	504
Summary	41	65.5	90.8	272	908
Constituent: Tritium, Low-Level Method, pCi/L					
12/27/06 - 1/12/07	3	99.5	7.1	21.3 ^(c)	70.9 ^(c)
4/25-07 - 6/15/07	2	52.6	16.6	49.9	166.2
9/17/07 - 9/30/07	3	62.7	6.3	18.8	62.6
Summary	8	74.0	9.5	28.6	95.4
Constituent: Uranium, µg/L					
10/3/06 - 12/27/06	11	0.001	0.008	0.026 ^(d)	0.084 ^(d)
1/5/07 - 3/29/07	6	-0.004	0.008	0.019	0.073
4/16/07 - 6/23/07	7	-0.007	0.015	0.038	0.142
8/24/07 - 9/17/07	2	-0.002	0.003	0.006	0.026
Summary	26	-0.002	0.010	0.028	0.100
<p>(a) Time period covered for total organic carbon and total organic halides is a moving average of four quarters.</p> <p>(b) Excluded outliers.</p> <p>(c) Limit of detection (blank corrected) equals 3 times the blank standard deviation; limit of quantitation (blank corrected) equals 10 times the blank standard deviation. Numbers are rounded.</p> <p>(d) Limit of detection equals the mean blank concentration plus 3 standard deviations; limit of quantitation equals the mean blank concentration plus 10 standard deviations. Numbers are rounded.</p>					

Table C.32. Summary of Detection and Quantitation Units, TestAmerica Laboratory (St. Louis)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
EPA-600/4-81-004, 120.1	Conductivity ^(b)	0.2	0.3	0.9	03/30/07	0.23	0.3	1.0
EPA-600/4-81-004, 310.1	Alkalinity	2,500	3,376	11,258	04/17/07	850	1148	3828
EPA-600/4-81-004, 410.4	Chemical oxygen demand	9,200	12,423	41,429	01/25/07	14,400	19445	64846
EPA-600/4-81-004, 413.1	Oil and grease	1,800	2,431	8,106	04/06/07	500	675	2252
Ammonia and Anions								
EPA-600/4-81-004, 300.0 ^(c)	Bromide	50	68	225				
EPA-600/4-81-004, 300.0 ^(c)	Chloride	23	31	104	06/15/07	20	27	90
EPA-600/4-81-004, 300.0 ^(c)	Fluoride	20	27	90	06/15/07	25	34	113
EPA-600/4-81-004, 300.0 ^(c)	Nitrate	18	24	81	09/27/07	40	54	180
EPA-600/4-81-004, 300.0 ^(c)	Nitrite	13	18	59	06/15/07	16	22	72
EPA-600/4-81-004, 300.0 ^(c)	Phosphate	100	135	450	06/23/07	160	216	721
EPA-600/4-81-004, 300.0 ^(c)	Sulfate	50	68	225				
EPA-600/4-81-004, 350.1	Ammonia	6.7	9.0	30	04/27/07	6.1	8.2	27.5
EPA-600/4-81-004, 365.2	Phosphate	10	14	45				
SW-846, 9012	Cyanide	2.4	3.2	10.8	07/24/07	2.8	3.8	12.6
SW-846, 9030 ^(c)	Sulfide	310	419	1396	01/10/07	180	243	811
Metals								
SW-846, 6010	Aluminum	94.8	128	427	07/12/07	54.3	73.3	245
SW-846, 6010	Antimony	44.8	60.5	202				
SW-846, 6010	Barium	5	7	23				
SW-846, 6010	Beryllium ^(d)	0.51	0.69	2.3	08/02/07	1.1	1.5	5.0
SW-846, 6010	Cadmium	2.3	3.1	10	05/21/07	3.5	4.7	16
SW-846, 6010	Calcium ^(d)	36	49	162	07/10/07	100	135	450
SW-846, 6010	Chromium	3.1	4.2	14	05/31/07	2.5	3.4	11
SW-846, 6010	Cobalt	5	7	23	05/31/07	2	3	9
SW-846, 6010	Copper ^(d)	2.8	3.8	13	08/09/07	2	3	9
SW-846, 6010	Iron	25	34	113	06/04/07	19	25	84
SW-846, 6010	Lithium	8.7	12	39	07/12/07	10	14	46
SW-846, 6010	Magnesium	108	146	486	05/31/07	128	173	576
SW-846, 6010	Manganese ^(d)	2.5	3	11	08/09/07	1	1	5
SW-846, 6010	Nickel	7.5	10	34	05/31/07	4.6	6.2	20.7
SW-846, 6010	Potassium	1,500	2025	6755	06/04/07	1,630	2201	7340
SW-846, 6010	Silver	5.2	7.0	23	05/31/07	1.7	2.3	7.7

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 6010	Sodium	110	149	495	06/04/07	78.5	106	354
SW-846, 6010	Strontium (elemental)	0.56	0.76	2.5				
SW-846, 6010	Vanadium	5.9	8.0	27	05/31/07	6.1	8.2	27.5
SW-846, 6010	Zinc	9.6	13	43				
SW-846, 6020	Aluminum	7.9	11	36	08/22/07	9.9	13.4	44.6
SW-846, 6020	Antimony	0.5	0.7	2.3				
SW-846, 6020	Arsenic	2	3	9	06/01/07	1.6	2.2	7.2
SW-846, 6020	Barium	0.25	0.34	1.13				
SW-846, 6020	Beryllium	0.088	0.12	0.40				
SW-846, 6020	Boron	6.7	9.0	30				
SW-846, 6020	Cadmium	0.057	0.077	0.26				
SW-846, 6020	Calcium	21	28	95				
SW-846, 6020	Chromium	2.8	3.8	13				
SW-846, 6020	Cobalt	0.31	0.42	1.40				
SW-846, 6020	Copper	0.25	0.34	1.13				
SW-846, 6020	Iron	9.4	13	42				
SW-846, 6020	Lead	0.49	0.66	2.21				
SW-846, 6020	Magnesium	6.4	8.6	29				
SW-846, 6020	Manganese	0.34	0.46	1.53				
SW-846, 6020	Molybdenum	0.5	0.7	2.3				
SW-846, 6020	Nickel	0.52	0.70	2.34				
SW-846, 6020	Potassium	10	14	45				
SW-846, 6020	Selenium	1	1	5				
SW-846, 6020	Silicon	100	135	450				
SW-846, 6020	Silver	0.2	0.3	0.9				
SW-846, 6020	Sodium	11	15	50				
SW-846, 6020	Strontium (elemental)	0.53	0.72	2.39				
SW-846, 6020	Thallium	0.32	0.43	1.44	08/22/07	0.6	0.8	2.7
SW-846, 6020	Tin	0.2	0.3	0.9				
SW-846, 6020	Titanium	0.39	0.53	1.76				
SW-846, 6020	Vanadium	1.6	2.2	7.2				
SW-846, 6020	Zinc	1	1	5				
SW-846, 7470	Mercury	0.093	0.13	0.42				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
Volatile Organic Compounds								
SW-846, 8260	1,1,1,2-Tetrachloroethane ^(d)	0.15	0.20	0.68	08/27/07	0.1	0.1	0.5
SW-846, 8260	1,1,1-Trichloroethane ^(d)	0.15	0.20	0.68	06/28/07	0.1	0.1	0.5
SW-846, 8260	1,1,1,2-Tetrachloroethane	0.28	0.38	1.26	01/25/07	0.14	0.19	0.63
SW-846, 8260	1,1,2-Trichloroethane	0.23	0.31	1.04	01/25/07	0.092	0.12	0.41
SW-846, 8260	1,1-Dichloroethane	0.16	0.22	0.72	01/25/07	0.046	0.06	0.21
SW-846, 8260	1,1-Dichloroethylene	0.21	0.28	0.95	01/25/07	0.045	0.06	0.20
SW-846, 8260	1,2,3-Trichloropropane	0.27	0.36	1.22	01/25/07	0.24	0.32	1.08
SW-846, 8260	1,2-Dibromo-3-chloropropane	0.38	0.51	1.71	01/25/07	0.55	0.74	2.48
SW-846, 8260	1,2-Dibromoethane	0.23	0.31	1.04	01/25/07	0.13	0.18	0.59
SW-846, 8260	1,2-Dichloroethane	0.21	0.28	0.95	01/25/07	0.11	0.15	0.50
SW-846, 8260	1,2-Dichloroethene (total)	0.35	0.47	1.58	08/27/07	0.1	0.1	0.5
SW-846, 8260	1,2-Dichloropropane	0.16	0.22	0.72	01/25/07	0.077	0.10	0.35
SW-846, 8260	1,4-Dichlorobenzene ^(d)	0.2	0.3	0.9	06/28/07	0.1	0.1	0.5
SW-846, 8260	1,4-Dioxane	12	16	54				
SW-846, 8260	1-Butanol	2.6	3.5	11.7	01/25/07	14	19	63
SW-846, 8260	2-Butanone	0.56	0.76	2.52	01/25/07	1.8	2.4	8.1
SW-846, 8260	2-Chloro-1,3-butadiene	0.2	0.3	0.9	08/27/07	0.1	0.1	0.5
SW-846, 8260	2-Hexanone	0.19	0.26	0.86	01/25/07	1	1	5
SW-846, 8260	2-Methyl-1-propanol	5.7	7.7	25.7	01/25/07	29	39	131
SW-846, 8260	4-Methyl-2-pentanone	0.53	0.7	2.4	01/25/07	0.21	0.28	0.95
SW-846, 8260	Acetone	0.8	1.1	3.6				
SW-846, 8260	Acetonitrile	3.5	4.7	15.8	01/25/07	1.5	2.0	6.8
SW-846, 8260	Acrolein	1.4	1.9	6.3	01/25/07	0.44	0.59	1.98
SW-846, 8260	Acrylonitrile	0.78	1.05	3.51	01/25/07	0.57	0.77	2.57
SW-846, 8260	Allyl chloride	0.27	0.36	1.22	01/25/07	0.047	0.06	0.21
SW-846, 8260	Benzene ^(d)	0.17	0.23	0.77	06/28/07	0.1	0.1	0.5
SW-846, 8260	Bromodichloromethane	0.14	0.19	0.63	01/25/07	0.064	0.086	0.29
SW-846, 8260	Bromoform	0.21	0.28	0.95	01/25/07	0.12	0.16	0.54
SW-846, 8260	Bromomethane	0.28	0.38	1.26	01/25/07	0.085	0.11	0.38
SW-846, 8260	Carbon disulfide ^(d)	0.16	0.22	0.72	06/28/07	0.1	0.1	0.5
SW-846, 8260	Carbon tetrachloride ^(d)	0.15	0.20	0.68	06/23/07	0.1	0.1	0.5
SW-846, 8260	Chlorobenzene ^(d)	0.2	0.3	0.9	08/16/07	0.1	0.1	0.5
SW-846, 8260	Chloroethane ^(d)	0.16	0.22	0.72	08/16/07	0.1	0.1	0.5

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8260	Chloroform ^(d)	0.19	0.26	0.86	06/29/07	0.1	0.1	0.5
SW-846, 8260	Chloromethane ^(d)	0.2	0.3	0.9	08/27/07	0.1	0.1	0.5
SW-846, 8260	cis-1,2-Dichloroethene	0.19	0.26	0.86	01/25/07	0.048	0.06	0.22
SW-846, 8260	cis-1,3-Dichloropropene	0.2	0.3	0.9	01/25/07	0.05	0.1	0.2
SW-846, 8260	Dibromochloromethane	0.27	0.36	1.22	01/25/07	0.11	0.15	0.50
SW-846, 8260	Dibromomethane	0.23	0.31	1.04	01/25/07	0.12	0.16	0.54
SW-846, 8260	Dichlorodifluoromethane	0.27	0.36	1.22	01/25/07	0.045	0.06	0.20
SW-846, 8260	Ethyl acetate	0.23	0.31	1.04				
SW-846, 8260	Ethyl cyanide	1.7	2.3	7.7				
SW-846, 8260	Ethyl methacrylate	0.66	0.89	2.97	01/25/07	0.19	0.26	0.86
SW-846, 8260	Ethylbenzene	0.22	0.30	0.99	01/25/07	0.064	0.086	0.29
SW-846, 8260	Fluorotrichloromethane ^(d)	0.19	0.26	0.86	08/27/07	0.1	0.1	0.5
SW-846, 8260	Iodomethane	0.19	0.26	0.86	01/25/07	0.13	0.18	0.59
SW-846, 8260	Methacrylonitrile	2.1	2.8	9.5	01/25/07	0.3	0.4	1.4
SW-846, 8260	Methyl methacrylate	0.6	0.8	2.7	01/25/07	0.84	1.13	3.78
SW-846, 8260	Methylene chloride	0.1	0.1	0.5	01/25/07	0.6	0.8	2.7
SW-846, 8260	Styrene	0.28	0.38	1.26	08/27/07	0.1	0.1	0.5
SW-846, 8260	Tetrachloroethene	0.19	0.26	0.86	01/23/07	0.17	0.23	0.77
SW-846, 8260	Tetrahydrofuran	2.9	3.9	13.1	01/23/07	1.2	1.6	5.4
SW-846, 8260	Toluene ^(d)	0.2	0.3	0.9	06/28/07	0.1	0.1	0.5
SW-846, 8260	trans-1,2-Dichloroethylene ^(d)	0.16	0.22	0.72	06/28/07	0.1	0.1	0.5
SW-846, 8260	trans-1,3-Dichloropropene	0.23	0.31	1.04	01/25/07	0.085	0.11	0.38
SW-846, 8260	trans-1,4-Dichloro-2-butene	0.56	0.76	2.52	01/25/07	0.43	0.58	1.94
SW-846, 8260	Trichloroethene ^(d)	0.2	0.3	0.9	06/28/07	0.1	0.1	0.5
SW-846, 8260	Vinyl acetate	0.46	0.62	2.07	01/25/07	0.72	0.97	3.24
SW-846, 8260	Vinyl chloride	0.23	0.31	1.04	12/15/05	0.044	0.06	0.20
SW-846, 8260	Xylenes (total) ^(d)	0.58	0.78	2.61	06/28/07	0.3	0.4	1.4
SW-846, 8015	TPH, gasoline fraction	7.9	10.7	35.6	02/15/07	9.5	12.8	42.8
Semivolatile Organic Compounds								
SW-846, 8015	TPH, diesel fraction	50	68	225	08/02/07	33	45	149
SW-846, 8015	TPH, kerosene fraction	50	68	225	08/24/07	36	49	162
SW-846, 8040	2,3,4,6-Tetrachlorophenol	2	3	9				
SW-846, 8040	2,4,5-Trichlorophenol	2.2	3.0	9.9				
SW-846, 8040	2,4,6-Trichlorophenol	2.2	3.0	9.9				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8040	2,4-Dichlorophenol	2.1	2.8	9.5				
SW-846, 8040	2,4-Dimethylphenol	2.1	2.8	9.5				
SW-846, 8040	2,4-Dinitrophenol	2.4	3.2	10.8				
SW-846, 8040	2,6-Dichlorophenol	2.1	2.8	9.5				
SW-846, 8040	2-Chlorophenol	2.2	3.0	9.9				
SW-846, 8040	2-Methylphenol (cresol, o-)	2.2	3.0	9.9				
SW-846, 8040	2-Nitrophenol	2.3	3.1	10.4				
SW-846, 8040	2-secButyl-4,6-dinitrophenol(DNBP)	2.4	3.2	10.8				
SW-846, 8040	3- + 4-Methylphenol	2.2	3.0	9.9				
SW-846, 8040	4,6-Dinitro-2-methyl phenol	2.2	3.0	9.9				
SW-846, 8040	4-Chloro-3-methylphenol	2.4	3.2	10.8				
SW-846, 8040	4-Nitrophenol	2.2	3.0	9.9				
SW-846, 8040	Pentachlorophenol	2.4	3.2	10.8				
SW-846, 8040	Phenol	2.3	3.1	10.4				
SW-846, 8081	4,4'-DDD	0.004	0.005	0.018	04/25/07	0.0031	0.0042	0.0140
SW-846, 8081	4,4'-DDE	0.0082	0.011	0.037	04/25/07	0.0059	0.0080	0.0266
SW-846, 8081	4,4'-DDT	0.032	0.043	0.144	04/25/07	0.0098	0.013	0.044
SW-846, 8081	Aldrin	0.0052	0.0070	0.023	04/25/07	0.0047	0.0063	0.0212
SW-846, 8081	alpha-BHC	0.018	0.024	0.081	04/25/07	0.0044	0.0059	0.0198
SW-846, 8081	beta-BHC	0.0072	0.010	0.032	04/25/07	0.0065	0.0088	0.0293
SW-846, 8081	Chlordane	0.044	0.059	0.198	04/25/07	0.032	0.043	0.144
SW-846, 8081	delta-BHC	0.0034	0.005	0.015	04/25/07	0.0032	0.0043	0.0144
SW-846, 8081	Dieldrin	0.011	0.015	0.050	04/25/07	0.0036	0.0049	0.0162
SW-846, 8081	Endosulfan I	0.0061	0.0082	0.027	04/25/07	0.0031	0.0042	0.0140
SW-846, 8081	Endosulfan II	0.0035	0.005	0.016	04/25/07	0.0032	0.0043	0.0144
SW-846, 8081	Endosulfan sulfate	0.017	0.023	0.077	04/25/07	0.0082	0.011	0.037
SW-846, 8081	Endrin	0.0079	0.011	0.036	04/25/07	0.0067	0.0090	0.0302
SW-846, 8081	Endrin aldehyde	0.0048	0.0065	0.022	04/25/07	0.0027	0.0036	0.0122
SW-846, 8081	gamma-BHC (lindane)	0.0067	0.0090	0.030	04/25/07	0.0029	0.0039	0.0131
SW-846, 8081	Heptachlor	0.0036	0.0049	0.016	04/25/07	0.0052	0.0070	0.0234
SW-846, 8081	Heptachlor epoxide	0.0048	0.0065	0.022	04/25/07	0.0041	0.0055	0.0185
SW-846, 8081	Methoxychlor	0.0081	0.011	0.036				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8081	Toxaphene	0.22	0.30	0.99	04/25/07	0.19	0.26	0.86
SW-846, 8082	Aroclor-1016 ^(d)	0.31	0.42	1.40	01/31/07	0.27	0.36	1.22
SW-846, 8082	Aroclor-1221 ^(d)	0.31	0.42	1.40	01/31/07	0.27	0.36	1.22
SW-846, 8082	Aroclor-1232 ^(d)	0.31	0.42	1.40	01/31/07	0.27	0.36	1.22
SW-846, 8082	Aroclor-1242 ^(d)	0.31	0.42	1.40	01/31/07	0.27	0.36	1.22
SW-846, 8082	Aroclor-1248 ^(d)	0.31	0.42	1.40	01/31/07	0.27	0.36	1.22
SW-846, 8082	Aroclor-1254 ^(d)	0.28	0.38	1.26	01/31/07	0.21	0.28	0.95
SW-846, 8082	Aroclor-1260 ^(d)	0.28	0.38	1.26	01/31/07	0.21	0.28	0.95
SW-846, 8151	2,4,5-T	0.17	0.23	0.77				
SW-846, 8151	2,4,5-TP (silvex)	0.15	0.20	0.68				
SW-846, 8151	2,4-D	1.3	1.8	5.9				
SW-846, 8151	2-secButyl-4,6-dinitrophenol(DNBP)	0.6	0.8	2.7				
SW-846, 8270	1,2,4,5-Tetrachlorobenzene	1	1	5				
SW-846, 8270	1,2,4-Trichlorobenzene	1	1	5				
SW-846, 8270	1,2-Dichlorobenzene	1	1	5				
SW-846, 8270	1,3-Dichlorobenzene	1	1	5				
SW-846, 8270	1,4-Dichlorobenzene	1	1	5				
SW-846, 8270	1,4-Naphthoquinone	0.95	1.3	4.3				
SW-846, 8270	1-Naphthylamine	1	1	5				
SW-846, 8270	2,2'-Oxybis(1-chloropropane)	1	1	5				
SW-846, 8270	2,3,4,6-Tetrachlorophenol	1	1	5				
SW-846, 8270	2,4,5-Trichlorophenol	2	3	9				
SW-846, 8270	2,4,6-Trichlorophenol	2	3	9				
SW-846, 8270	2,4-Dichlorophenol	1	1	5				
SW-846, 8270	2,4-Dimethylphenol	1	1	5				
SW-846, 8270	2,4-Dinitrophenol	10	14	45				
SW-846, 8270	2,4-Dinitrotoluene	1.1	1.5	5.0				
SW-846, 8270	2,6-Dichlorophenol	1	1	5				
SW-846, 8270	2,6-Dinitrotoluene	1.1	1.5	5.0				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	2-Acetylaminofluorene	1	1	5				
SW-846, 8270	2-Chloronaphthalene	1	1	5				
SW-846, 8270	2-Chlorophenol	1	1	5				
SW-846, 8270	2-Methylnaphthalene	1	1	5				
SW-846, 8270	2-Methylphenol (cresol, o-)	2	3	9				
SW-846, 8270	2-Naphthylamine	1	1	5				
SW-846, 8270	2-Nitroaniline	2	3	9				
SW-846, 8270	2-Nitrophenol	1	1	5				
SW-846, 8270	2-Picoline	5.5	7.4	24.8				
SW-846, 8270	2-secButyl-4,6-dinitrophenol(DNBP)	2	3	9				
SW-846, 8270	3,3'-Dichlorobenzidine	1	1	5				
SW-846, 8270	3,3'-Dimehtylbenzidine	10	14	45				
SW-846, 8270	3- + 4-Methylphenol	1.2	1.6	5.4				
SW-846, 8270	3-Methylcholanthrene	1	1	5				
SW-846, 8270	3-Nitroaniline	1.1	1.5	5.0				
SW-846, 8270	4,6-Dinitro-2-methyl phenol	5	7	23				
SW-846, 8270	4-Aminobiphenyl	1	1	5				
SW-846, 8270	4-Bromophenylphenyl ether	1	1	5				
SW-846, 8270	4-Chloro-3-methylphenol	1	1	5				
SW-846, 8270	4-Chloroaniline	1	1	5				
SW-846, 8270	4-Chlorophenylphenyl ether	1	1	5				
SW-846, 8270	4-Methylphenol (cresol, p-)	1	1	5				
SW-846, 8270	4-Nitroaniline	1.3	1.8	5.9				
SW-846, 8270	4-Nitrophenol	5	7	23				
SW-846, 8270	4-Nitroquinoline-1-oxide	5	7	23				
SW-846, 8270	5-Nitro-o-toluidine	1	1	5				
SW-846, 8270	7,12-Dimethylbenz[a]anthracene	1	1	5				
SW-846, 8270	Acenaphthene	1	1	5				
SW-846, 8270	Acenaphthylene	1	1	5				
SW-846, 8270	Acetophenone	1	1	5				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	alpha,alpha-Dimethylphenethylamine	20	27	90				
SW-846, 8270	Aniline	1	1	5				
SW-846, 8270	Anthracene	1.1	1.5	5.0				
SW-846, 8270	Aramite	5	7	23				
SW-846, 8270	Azobenzene	1	1	5				
SW-846, 8270	Benzo(a)anthracene	1	1	5				
SW-846, 8270	Benzo(a)pyrene	1	1	5				
SW-846, 8270	Benzo(b)fluoranthene	1	1	5				
SW-846, 8270	Benzo(ghi)perylene	1	1	5				
SW-846, 8270	Benzo(k)fluoranthene	1	1	5				
SW-846, 8270	Benzothiazole	1	1	5				
SW-846, 8270	Benzyl alcohol	1	1	5				
SW-846, 8270	Bis(2-Chloroethoxy)methane	1	1	5				
SW-846, 8270	Bis(2-chloroethyl) ether	1	1	5				
SW-846, 8270	Bis(2-ethylhexyl) phthalate	1	1	5				
SW-846, 8270	Butylbenzylphthalate	1	1	5				
SW-846, 8270	Chlorobenzilate	1	1	5				
SW-846, 8270	Chrysene	1	1	5				
SW-846, 8270	Diallate	2	3	9				
SW-846, 8270	Di-n-butylphthalate	1	1	5				
SW-846, 8270	Di-n-octylphthalate	5	7	23				
SW-846, 8270	Dibenz[a,h]anthracene	1	1	5				
SW-846, 8270	Dibenzofuran	1	1	5				
SW-846, 8270	Diethylphthalate	1	1	5				
SW-846, 8270	Dimethoate	1.1	1.5	5.0				
SW-846, 8270	Dimethyl phthalate	1	1	5				
SW-846, 8270	Disulfoton	1	1	5				
SW-846, 8270	Ethyl methanesulfonate	1	1	5				
SW-846, 8270	Famphur	50	68	225				
SW-846, 8270	Fluoranthene	1	1	5				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Fluorene	1	1	5				
SW-846, 8270	Hexachlorobenzene	1	1	5				
SW-846, 8270	Hexachlorobutadiene	1	1	5				
SW-846, 8270	Hexachlorocyclopentadiene	2.5	3.4	11.3				
SW-846, 8270	Hexachloroethane	1	1	5				
SW-846, 8270	Hexachlorophene	10	14	45				
SW-846, 8270	Hexachloropropene	2.5	3.4	11.3				
SW-846, 8270	Indeno(1,2,3-cd)pyrene	1	1	5				
SW-846, 8270	Isodrin	1	1	5				
SW-846, 8270	Isophorone	1	1	5				
SW-846, 8270	Isosafrole	5.7	7.7	25.7				
SW-846, 8270	Kepone	20	27	90				
SW-846, 8270	m-Dinitrobenzene	1	1	5				
SW-846, 8270	Methapyrilene	14	19	63				
SW-846, 8270	Methyl methanesulfonate	5	7	23				
SW-846, 8270	Methyl parathion	1	1	5				
SW-846, 8270	Naphthalene	1	1	5				
SW-846, 8270	Nitrobenzene	1	1	5				
SW-846, 8270	Nitrosopyrrolidine	1	1	5				
SW-846, 8270	N-Nitrosodiethylamine	1	1	5				
SW-846, 8270	N-Nitrosodimethylamine	2	3	9				
SW-846, 8270	N-Nitroso-di-n-butylamine	1	1	5				
SW-846, 8270	N-Nitroso-di-n-propylamine	1	1	5				
SW-846, 8270	N-Nitrosodiphenylamine	1	1	5				
SW-846, 8270	N-Nitrosomethylethylamine	1	1	5				
SW-846, 8270	N-Nitrosomorpholine	0.96	1.3	4.3				
SW-846, 8270	N-Nitrosopiperidine	1	1	5				
SW-846, 8270	O,O,O-Triethyl phosphorothioate	1	1	5				
SW-846, 8270	O,O-DiethylO-2-pyrazinyl phospho	0.99	1.3	4.5				
SW-846, 8270	o-Toluidine	1	1.4	4.5				
SW-846, 8270	Parathion	1	1.4	4.5				
SW-846, 8270	p-Dimethylaminoazobenzene	1	1.4	4.5				

Table C.32. (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
SW-846, 8270	Pentachlorobenzene	2.7	3.6	12.2				
SW-846, 8270	Pentachloroethane	1	1	5				
SW-846, 8270	Pentachloronitrobenzene (PCNB)	1.1	1.5	5.0				
SW-846, 8270	Pentachlorophenol	2	3	9				
SW-846, 8270	Phanacetin	0.94	1.3	4.2				
SW-846, 8270	Phenanthrene	1	1	5				
SW-846, 8270	Phenol	4	5	18				
SW-846, 8270	Phorate	2.9	3.9	13.1				
SW-846, 8270	p-Phenylenediamine	1	1	5				
SW-846, 8270	Pronamide	1	1	5				
SW-846, 8270	Pyrene	1	1	5				
SW-846, 8270	Pyridine	5	7	23				
SW-846, 8270	Safrol	1	1	5				
SW-846, 8270	sym-Trinitrobenzene	5	7	23				
SW-846, 8270	Tetraethyl dithiopyrophosphate	1	1	5				
SW-846, 8270	Tributyl phosphate	1.1	1.5	5.0				
SW-846, 8270	tris-2-Chloroethyl phosphate	1.2	1.6	5.4				

(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) µMhos/cm.
(c) Units for this method are mg/L.
(d) Additional MDLs were used briefly during the year for these compounds.
LOD = Limit of detection.
LOQ = Limit of quantitation.
MDL = Method detection limit.

Table C.33 Summary of Detection and Quantitation Limits, WSCF

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
General Chemical Parameters								
EPA-600/4-81-004, 120.1	Conductivity ^(b)	0.49	0.66	2.21				
EPA-600/4-81-004, 160.1	Total dissolved solids	9	12	41				
EPA-600/4-81-004, 310.1	Alkalinity	1000	1350	4503				
EPA-600/4-81-004, 410.4	Chemical Oxygen Demand	10,000	13503	45032				
Ammonia and Anions								
EPA-600/4-81-004, 300.0 ^(d)	Bromide ^(c)	36	49	162				
EPA-600/4-81-004, 300.0 ^(d)	Chloride ^(c)	36	49	162	2/7/2007	30	41	135
EPA-600/4-81-004, 300.0 ^(d)	Fluoride ^(c)	6.4	9	29	6/26/2007	6	8	27
EPA-600/4-81-004, 300.0 ^(d)	Nitrate ^(c)	42.1	57	190	6/26/2007	22.1	30	100
EPA-600/4-81-004, 300.0 ^(d)	Nitrite ^(c)	75.5	102	340	11/29/2006	32.8	44	148
EPA-600/4-81-004, 300.0 ^(d)	Phosphate ^(c)	135	182	608	10/31/2006	123	166	554
EPA-600/4-81-004, 300.0 ^(d)	Sulfate ^(c)	63	85	284	4/23/2007	70	95	315
EPA-600/4-81-004, 300.7	Ammonium	2.58	3.5	11.6	4/27/2007	12	16.2	54.0
EPA-600/4-81-004	Cyanide	4	5.4	18.0				
Metals								
SW-846, 6010	Aluminum ^(c)	37	50.0	166.6	1/29/2007	30	41	135
SW-846, 6010	Antimony ^(c)	72	97	324	1/29/2007	32.0	43.2	144.1
SW-846, 6010	Barium ^(c)	1	1.4	4.5	1/29/2007	4	5.4	18.0
SW-846, 6010	Beryllium ^(c)	1	1.35	4.50	1/29/2007	4	5.40	18.01
SW-846, 6010	Cadmium ^(c)	3	4	14	1/30/2007	4	5.4	18.0
SW-846, 6010	Calcium ^(c)	31	42	140	1/29/2007	34	46	153
SW-846, 6010	Chromium ^(c)	7	9	32	1/30/2007	4	5.4	18.0
SW-846, 6010	Cobalt ^(c)	7	9	32	1/29/2007	4	5.4	18.0
SW-846, 6010	Copper ^(c)	7	9.5	31.5	1/30/2007	4	5.4	18.0
SW-846, 6010	Iron ^(c)	33	44.6	148.6	1/29/2007	9	12	41
SW-846, 6010	Magnesium ^(c)	15	20	68	1/29/2007	6	8	27
SW-846, 6010	Manganese ^(c)	3	4.1	13.5	1/29/2007	4	5	18
SW-846, 6010	Nickel ^(c)	5	7	23	1/29/2007	4	5.4	18.0
SW-846, 6010	Potassium ^(c)	220	297	991	1/29/2007	45	61	203
SW-846, 6010	Silver ^(c)	11	15	50	1/29/2007	5	6.8	22.5
SW-846, 6010	Sodium ^(c)	120	162	540	1/29/2007	27	36	122
SW-846, 6010	Strontium (elemental) ^(c)	1	1.4	4.5	1/30/2007	4	5.40	18.01
SW-846, 6010	Vanadium	14	18.9	63.0	1/29/2007	7	9.5	31.5
SW-846, 6010	Zinc ^(c)	2	2.7	9.0	1/29/2007	4	5.4	18.0

Table C.33 (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
Volatile Organic Compounds								
SW-846, 8260	1,1,1-Trichloroethane	1	1.35	4.50				
SW-846, 8260	1,1,2-Trichloroethane	1	1.35	4.50				
SW-846, 8260	1,1-Dichloroethane	1	1.4	4.5				
SW-846, 8260	1,1-Dichloroethene	1	1.35	4.50				
SW-846, 8260	1,2-Dichloroethane	1	1.4	4.5				
SW-846, 8260	1,4-Dichlorobenzene	1	1.35	4.50				
SW-846, 8260	1-Butanol	1	1.35	4.50				
SW-846, 8260	2-Butanone	1	1.35	4.50				
SW-846, 8260	2-Pentanone, 4-Methyl	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	1.4	4.5				
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	1	1.4	4.5				
SW-846, 8260	Ethylbenzene	1	1.35	4.50				
SW-846, 8260	Methylene chloride	1	1.4	4.5				
SW-846, 8260	Tetrachloroethene	1	1.35	4.50				
SW-846, 8260	Tetrahydrofuran	2	2.70	9.01				
SW-846, 8260	Toluene	1	1.35	4.50				
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				
SW-846, 8015	TPH, gasoline fraction	50	67.52	225.16				

Table C.33 (contd)

Method	Constituent	Initial MDL ^(a) (µg/L)	Initial LOD (µg/L)	Initial LOQ (µg/L)	Ending Values, Effective Date	Ending MDL ^(a) (µg/L)	Ending LOD (µg/L)	Ending LOQ (µg/L)
Semivolatile Organic Compounds								
SW-846, 8015	TPH, diesel fraction	120	162	540	9/13/2007	71	95.9	319.7
SW-846, 8082	Aroclor-1016	0.1	0.14	0.45	9/27/2007	0.11	0.15	0.50
SW-846, 8082	Aroclor-1221	0.2	0.27	0.90	9/27/2007	0.21	0.28	0.95
SW-846, 8082	Aroclor-1232	0.1	0.14	0.45	9/27/2007	0.11	0.15	0.50
SW-846, 8082	Aroclor-1242	0.1	0.14	0.45	9/27/2007	0.11	0.1	0.5
SW-846, 8082	Aroclor-1248	0.1	0.14	0.45	9/27/2007	0.11	0.15	0.50
SW-846, 8082	Aroclor-1254	0.1	0.14	0.45	9/27/2007	0.11	0.15	0.50
SW-846, 8082	Aroclor-1260	0.1	0.14	0.45	9/27/2007	0.11	0.15	0.50
SW-846, 8270	1,4-Dichlorobenzene ^(c)	1.5	2.03	6.75				
SW-846, 8270	2,4-Dichlorophenol ^(c)	0.48	0.6	2.2				
SW-846, 8270	2-Methylphenol (cresol, o-) ^(c)	0.48	0.6	2.2				
SW-846, 8270	2-Nitrophenol	0.48	0.6	2.2				
SW-846, 8270	2-Picoline ^(c)	4.8	6.5	21.6				
SW-846, 8270	3+4-Methylphenol (cresol, m+p) ^(c)	0.48	0.6	2.2				
SW-846, 8270	Benzothiazole ^(c)	0.67	0.9	3.0				
SW-846, 8270	Bis(2-ethylhexyl) phthalate ^(c)	0.52	0.7	2.3				
SW-846, 8270	Naphthalene ^(c)	1.9	3	9				
SW-846, 8270	Pentachlorophenol ^(c)	0.95	1.3	4.3				
SW-846, 8270	Phenol ^(c)	0.48	0.65	2.16				
SW-846, 8270	Total cresols ^(c)	0.62	0.84	2.79				
SW-846, 8270	Tributyl phosphate ^(c)	0.48	0.65	2.16				
SW-846, 8270	Tris-2-chloroethyl phosphate ^(c)	0.5	0.7	2.3				
<p>(b) 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.</p> <p>(b) µMhos/cm.</p> <p>(c) Additional MDLs were used during the year for these compounds.</p> <p>(d) Units for this method are mg/L.</p> <p>LOD = Limit of detection.</p> <p>LOQ = Limit of quantitation.</p> <p>MDL = Method detection limit.</p>								

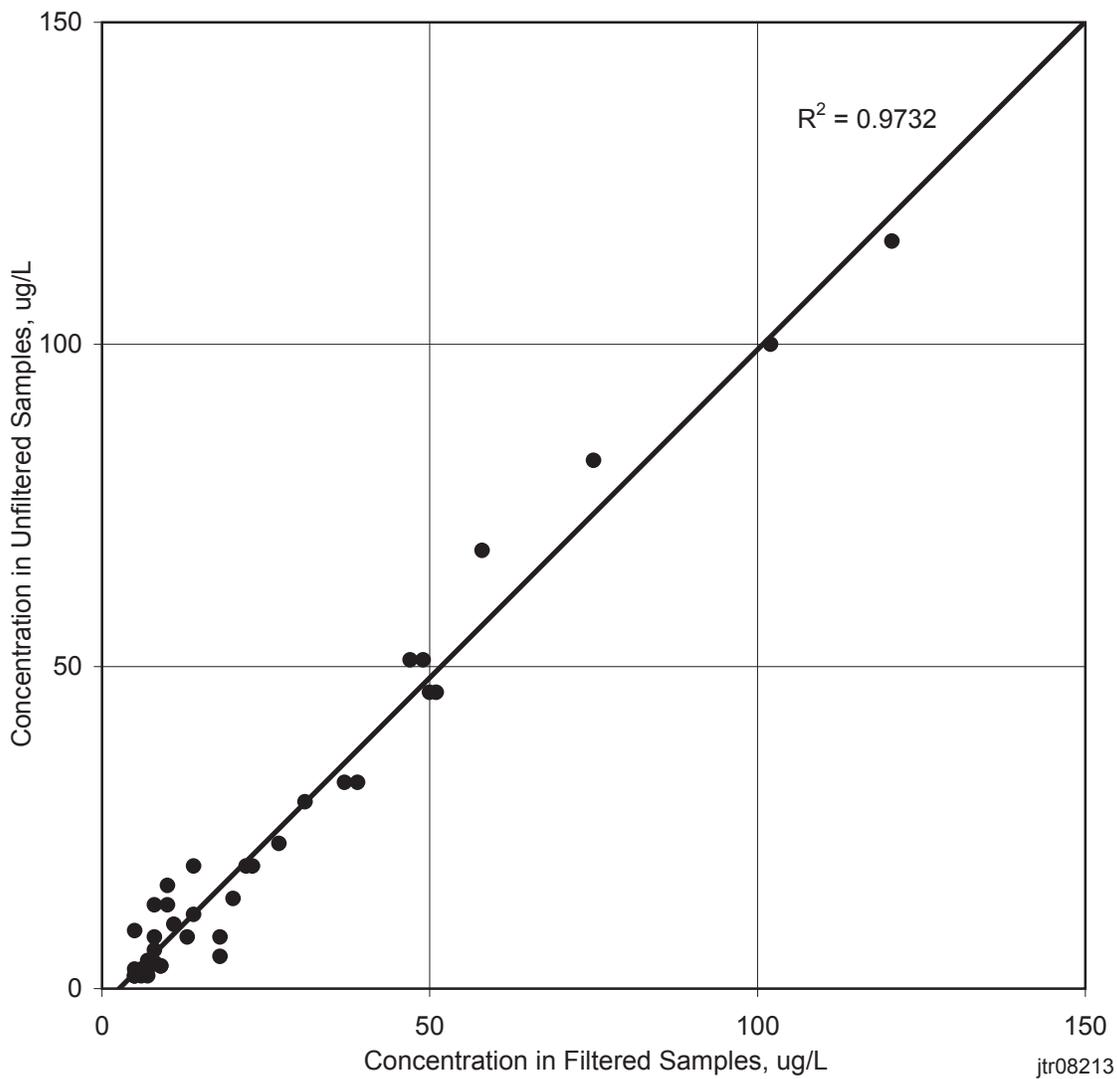
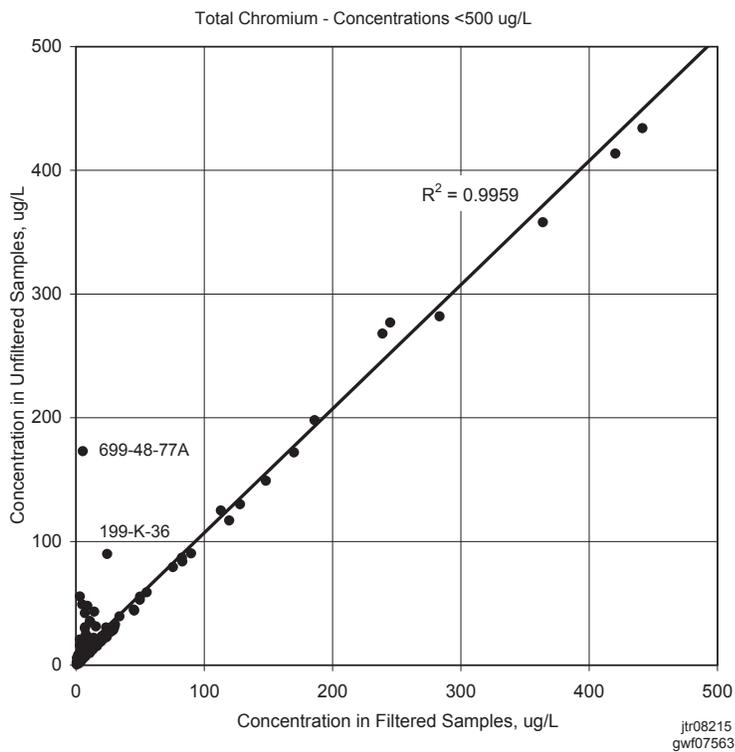
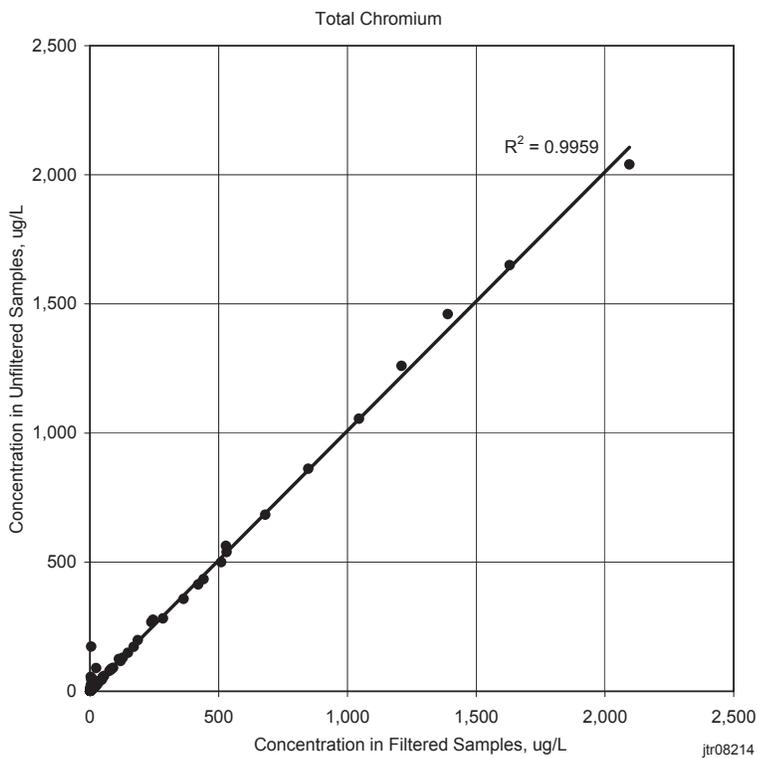


Figure C.1. Hexavalent Chromium in Filtered/Unfiltered Pairs



**Figure C.2. Total Chromium in Filtered/Unfiltered Pairs
(Bottom panel zooms on concentrations <500 $\mu\text{g/L}$.)**

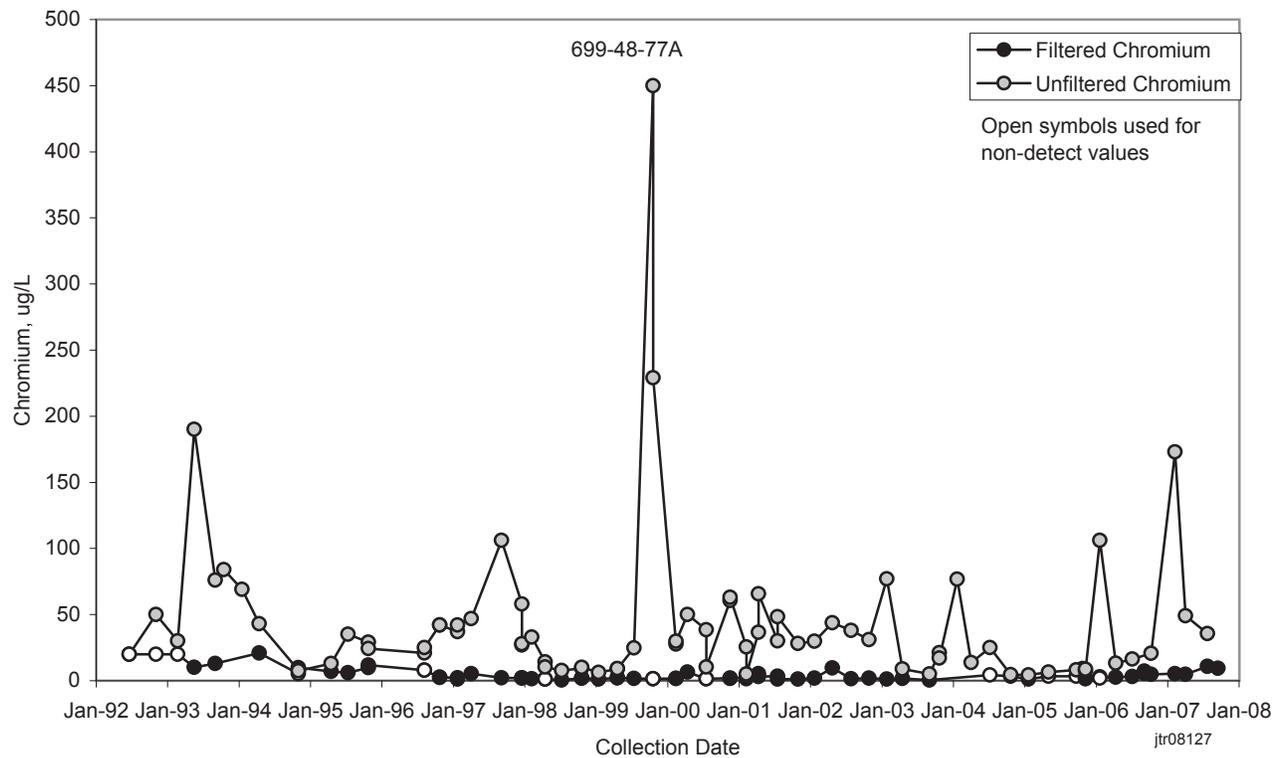


Figure C.3. Filtered and Unfiltered Total Chromium, Well 699-48-77A

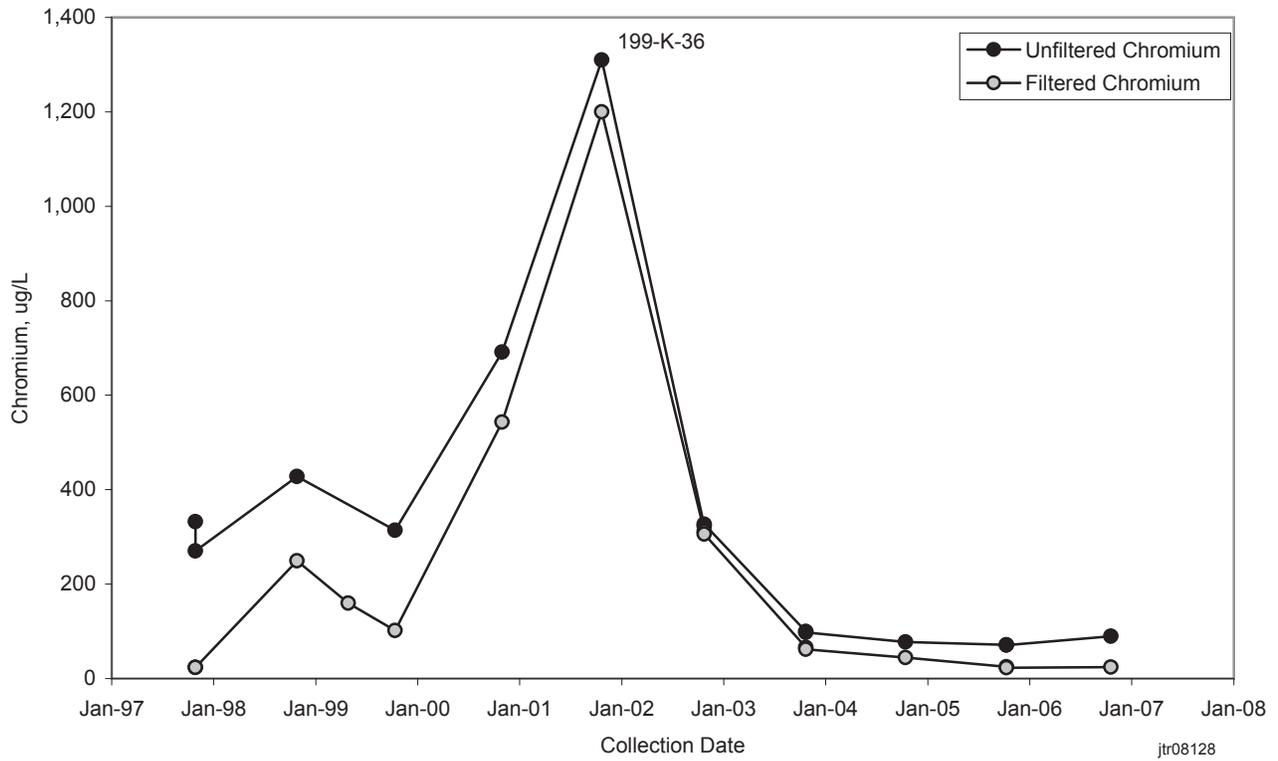


Figure C.4. Filtered and Unfiltered Total Chromium, Well 199-K-36

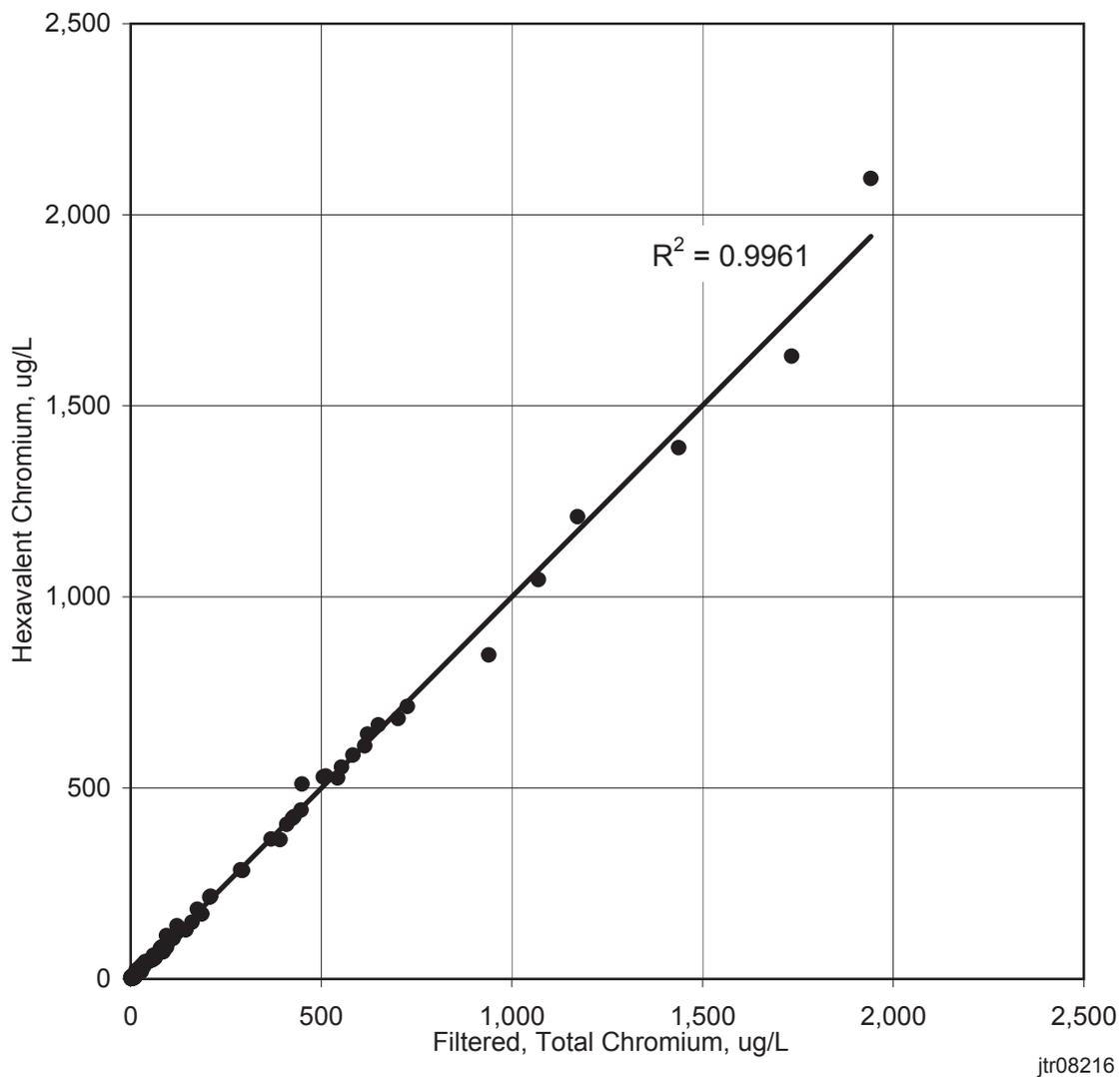


Figure C.5. Hexavalent Chromium and Filtered, Total Chromium

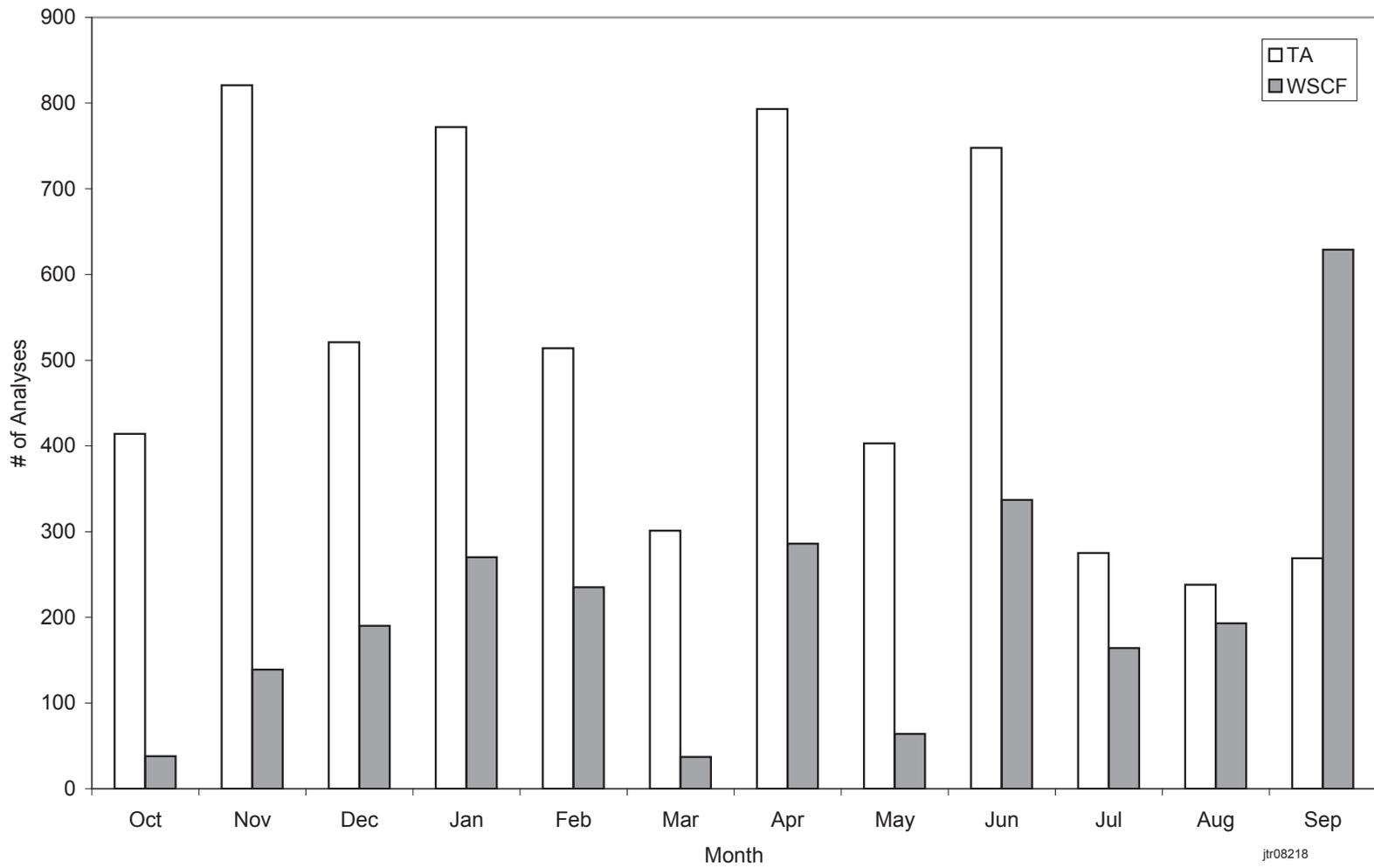


Figure C.6. Number of Analyses by Laboratory, FY 2007

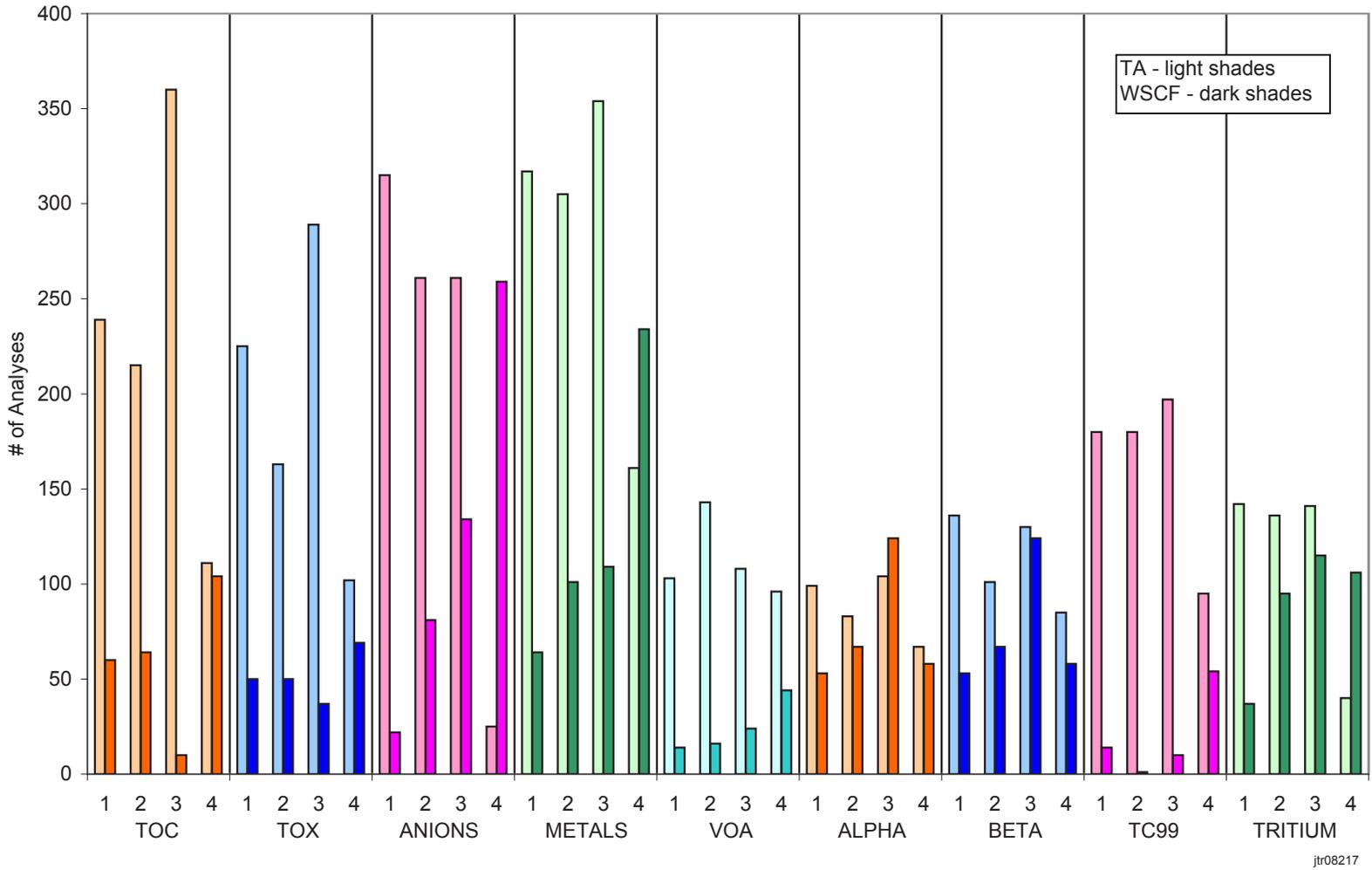


Figure C.7. Number of Analyses by Quarter, FY 2007

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