

APPENDIX B

Data Quality Evaluation Report and Analytical Data January – March 2011

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ACRONYMS AND ABBREVIATIONS

%	percent
%D	percent difference
BFF	Bulk Fuels Facility
CCV	continuing calibration verification
CN	cyanide
DoD	U.S. Department of Defense
EDB	1,2-dibromoethane/ethylene dibromide
EPA	U.S. Environmental Protection Agency
Hg	mercury
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
ppb	parts per billion
ppm	parts per million
QAPjP	BFF Spill site-specific quality assurance/quality control plan
QC	quality control
QSM	Quality Systems Manual
quarterly report	<i>Quarterly Pre-Remedy Monitoring and Site Investigation Report for January – March 2011, Bulk Fuels Facility, Solid Waste Management Units ST-106 and SS-111</i>
RPD	relative percent difference
RRF	relative response factor
SDG	sample delivery groups
SM	Standard Method
SVOC	semivolatile organic compound

ACRONYMS AND ABBREVIATIONS (concluded)

TPH	total petroleum hydrocarbon
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

DATA QUALITY EVALUATION REPORTS & ANALYTICAL DATA, JANUARY – MARCH 2011

1.1 Laboratory Data Quality Summary

This laboratory data quality summary describes the findings of the review of data from the first-quarter 2011 groundwater monitoring event and is provided to document the quality of the analytical data used in the *Quarterly Pre-Remedy Monitoring and Site Investigation Report for January – March 2011, Bulk Fuels Facility, Solid Waste Management Units ST-106 and SS-111* (quarterly report). Sampling procedures and overall quality control (QC) and quality assurance protocols for the first-quarter 2011 groundwater monitoring event are presented in the draft *Quality Assurance Project Plan (QAPjP), Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico* (U.S. Army Corps of Engineers [USACE], 2011).

Thirty-eight groundwater samples, two field duplicates, two equipment rinse blanks, two ambient blanks, and twenty trip blanks were collected during the period from January 25 through March 9, 2011, and sent to Empirical Laboratories LLC, Nashville, Tennessee for analyses. The laboratory holds a current U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program certification to perform the listed analyses.

Groundwater samples were analyzed for the following list of parameters:

- Volatile organic compounds (VOCs) - SW8260B;
- 1,2-dibromoethane (EDB) - SW8011;
- Semivolatile organic compounds (SVOCs) – SW8270C (new wells only);
- Polynuclear aromatic hydrocarbons (PAHs) – SW8270C low-level (VA-2 well only);
- Total petroleum hydrocarbons (TPH) as gasoline (C6-C10) - SW8015B;
- TPH as diesel (C10-C28) - SW8015B;
- Total and dissolved metals - SW6010B;
- Anions – U.S. Environmental Protection Agency (EPA) 300.0;
- Ammonia as nitrogen - Standard Method (SM) 4500 NH3BG;
- Sulfide - SM 4500 S2CF; and
- Carbonate and bicarbonate alkalinity - SM2320B.

All analytical results obtained from the first-quarter 2011 groundwater monitoring vent were submitted in sample deliverable groups Kirtland-001 through Kirtland-006. An EPA Level III data review was performed on analytical results for the six sample delivery groups (SDGs). The review was performed in accordance with the guidelines and control criteria specified in the following documents:

- The site-specific Bulk Fuels Facility (BFF) Spill QAPjP (USACE, 2011);
- *DoD Quality Systems Manual for Environmental Laboratories, Version 4.2* (DoD, 2010);
- *USEPA Contract Laboratory Program, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (2006) (SW-846, 2006 and updates);
- American Public Health Association et al., *Standard Methods for the Examination of Water and Wastewater (21st Edition)* (2005);
- USACE 200-1-10, *Environmental Quality – Guidance for Evaluating Performance-Based Chemical Data* (2005);
- *USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Data Review* (June 2008); and
- EPA Contract Laboratory Program, *National Functional Guidelines for Inorganic Superfund Data Review, Final* (January 2010).

The following QC elements were included in the EPA Level III data review:

- Sample preservation and sample extraction and analysis holding times;
- Laboratory method blanks;
- Initial and continuing calibration blanks (metals, anions, and ammonia analysis only);
- Surrogate recoveries (organic analyses);
- Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) recoveries;
- Matrix spike (MS)/matrix spike duplicate (MSD) recoveries;
- Relative percent differences (RPDs);
- Initial calibration and verifications;
- Continuing calibration verifications;
- Inductively coupled plasma (ICP) interference check samples (metal analysis only);
- ICP serial dilution (metal analysis only);
- Sample confirmation (EDB analysis only);
- Field blanks; and
- Field duplicates.

Analytical data were reviewed in terms of precision, bias, representativeness, comparability, and completeness as follows:

- *Bias* is demonstrated by recovery of target analytes from fortified blank and sample matrices, LCS/LCSD, and MS/MSD, respectively. For organic methods, bias is also demonstrated through recovery of surrogates from each field and QC sample. The recovery of target analytes from fortified samples is compared to the acceptance criteria defined in the QAPjP and DoD Quality Systems Manual (QSM) (DoD, 2010). When the acceptance criteria are not available in the DoD QSM, results are compared to the laboratory in-house control limits. When these criteria are not met, the data are flagged accordingly.
- *Precision* is expressed as the RPD between the results of replicate sample analyses: sample duplicates, LCSDs, and MSDs. When analyte RPDs exceed the acceptance criteria, the data are flagged accordingly.
- *Representativeness* of the samples submitted for analysis is ensured by adherence to standard sampling techniques and protocols.
- *Comparability* of sample results is ensured through the use of approved sampling and analysis methods.
- *Completeness* is expressed as a ratio of the number of usable data to total of analytical data results.

The following presents EPA Level III data review findings. The discussion summarizes data quality exceedances and their potential impact on the data quality and usability of analytical results. Table 1 (at the end of this report) presents definitions of data qualification and reason codes applied to the analytical results.

1.2 Sample Preservation, Sample Extraction and Analysis Holding Times (Reason Code H)

The sample coolers and samples received within were received intact at the laboratory and were within the required 0-6 degrees Celsius, and in compliance with EPA and Standard Method preservation requirements.

Sample holding times were evaluated by comparing the sample collection dates to the sample extraction dates and analysis dates. Extraction and analysis holding times were reviewed for all samples to

determine the validity of the sample results. Holding time exceedances were noted in SW8270C and SW8011 Methods and EPA Method 300.0 and listed below:

Analytical Method	Holding Time Outliers	Holding Time Requirement	Qualifier
SW8270C	14 days for extraction	7 days for extraction	UJ for all non-detected SVOCs in GW0034
SW8270C, Low Level	8 days for extraction	7 days for extraction	UJ for all non-detected PAHs in GW0037
SW8270C, Low Level	8 days for extraction	7 days for extraction	UJ for all non-detected PAHs in GW0036
EPA 300.0, Nitrate	53 hours for analysis	48 hours	UJ for non-detected nitrate in GW0038
EPA 300.0, Nitrate	52 hours for analysis	48 hours	UJ for non-detected nitrate in GW0037
EPA 300.0, Nitrate	52 hours for analysis	48 hours	UJ for non-detected nitrate in GW0036
EPA 300.0, Nitrate	4 days for analysis	48 hours	J- for detected nitrate in GW0033
SW8011	17 days for analysis	14 days	UJ for non-detected EDB in GW0016
SW8011	16 days for analysis	14 days	J- for detected EDB in GW0018

A request for SVOC analysis for one sample (GW0034) and PAH analysis for two samples (GW0036 and GW0037) was made after the 7-day extraction holding time had expired. The affected samples were extracted as soon as the request was received and were analyzed within the 40-day analysis holding time. SVOCs and PAHs were not detected in the mentioned samples, and their limits of quantitation (LOQs) were qualified as estimated (UJ) as a result of the extraction holding time violations. During the first-quarter 2011 groundwater monitoring event, SVOCs, including PAHs, were analyzed in order to determine TPH fuel related contamination in groundwater. A review of VOCs and TPH gasoline and diesel in the same three samples indicated that TPH gasoline in sample GW0034 was detected slightly above the detection limit and therefore the detected level is considered estimated. TPH-related VOCs and TPH diesel were not detected in sample GW0034, and further TPH-related VOCs, and TPH gasoline and diesel were not present in samples GW0036 and GW0037. Based on the analytical results of the VOC and TPH analyses, it appears that the non-detected SVOCs and PAHs results in the three samples were consistent with the associated VOCs and TPH data, and that significant low biased SVOCs and PAH results were not reported as a result of additional sample storage.

Sample GW0033 for nitrate analysis was collected on February 4, 2011 and shipped to the laboratory on the same day. However, due to weather issues on the East Coast, samples were received by the laboratory on February 8, 2011, which was after the required 48-hour analysis holding time had expired for nitrate analysis. The sample was analyzed for nitrate on the same day that the sample was received. Although the analysis holding time was exceeded by two times the requirement, the analyte was still detected and was qualified as estimated (J-) with a potential low bias.

Nitrate in three additional samples was also analyzed outside the holding time requirement. Three samples (GW0036, 0037 and 0038) were collected and shipped to the laboratory on the same day, and were received by the laboratory on the following day. As a result of laboratory oversight, the 48- hour analysis holding time for nitrate in these samples was missed by 4 to 5 hours. Nitrate was not detected in the samples, and the LOQ was qualified as estimated (UJ). Since the degree of holding time exceedance was minor, the data usability of the sample results is not affected.

Due to an instrument malfunction, two EDB samples were analyzed 2 to 3 days outside the 14-day analysis holding time requirement. Due to the analysis holding time outliers, the detected result and non-detected LOQ for the analyte were qualified as estimated (J-) and (UJ), respectively. During the first-quarter 2011 groundwater monitoring event, the same samples were also analyzed for VOCs by SW8260B Method within the holding time requirement. The EDB results from the two methods were compared and found to be comparable.

1.3 Laboratory Method Blanks (Reason Code B1)

The field sample results were evaluated with respect to the laboratory method blank prepared and analyzed for each analytical batch and for each analytical method. Positive results in the laboratory method blanks for SW8260B and SW8270C Methods were observed and are summarized below:

Analytical Method	Laboratory QC Batch #	Contaminant	Contaminant Level (ppb)	LOQ (ppb)	Qualifier
SW8260B	IB09001	Hexachlorobutadiene	0.471	1.0	U for the analyte in GW8004-TB
SW8260B	IB15004	Hexachlorobutadiene	0.754	1.0	U for the analyte in GW0026
SW8260B	IB17009	Acetone	3.62	10	U for the analyte in GW0020
SW8260B	IB24021	Hexachlorobutadiene	0.317	1.0	U for the analyte in GW8018-TB
SW8270C	IB18006	1-Methylnaphthalene	0.0749	0.187	U for the analyte in GW0039-R
SW8270C	IB18006	2-Methylnaphthalene	0.259	0.187	U for the analyte in GW0039-R
SW8270C	IB18006	Naphthalene	0.184	0.187	U for the analyte in GW0039-R

Based on the DoD QSM requirements, laboratory method blank levels are considered acceptable when contaminant levels in the blank are less than one-half the LOQ for target analytes and less than the LOQ for common laboratory contaminants, such as acetone and methylene chloride. Except for batch IB15004 for hexachlorobutadiene and batch IB18006 for 2-methylnaphthalene and naphthalene, the listed laboratory method blank levels met the blank acceptance criteria. As a result of the blank detections, the detected results for hexachlorobutadiene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in the associated samples were qualified as non-detected (U) at their respective LOQs as the detected concentrations in the samples were less than or equal to five times their corresponding level detected in the blank. The detected result for acetone was also qualified as non-detected (U) at the LOQ when the detected sample result was less than ten times the blank level. The blank qualification has no impact on the data usability.

In addition to the above, hexachlorobutadiene was reported at trace levels below the LOQ in 11 other laboratory method blanks. Because the analyte was not detected in any samples processed with those laboratory method blanks, the sample results were not affected by the blank detections. Chloride was also reported at a level below the LOQ in one laboratory method blank. The detected chloride results in all associated samples exceeded five times the blank level, and thus the results were not affected by the blank

detection. No data qualification was applied to the sample results because of the hexachlorobutadiene and chloride detections. All laboratory method blanks were free of EDB, TPH gasoline and diesel, metals, sulfide, and alkalinity.

1.4 Initial and Continuing Calibration Blanks (Reason Code B2)

In addition to the laboratory method blank for metals, anions, and ammonia analyses, initial and continuing calibration blank results were reviewed to ensure that the instrument was free of contamination prior to the analyses. Positive results in calibration blanks were observed for EPA Method 300.0 and SW6010B Method and are shown below:

Analytical Method	Laboratory QC Batch #	Contaminant	Contaminant Level (ppm)	LOQ (ppm)	Qualifier
EPA 300.0	IB04712-CCB3	Chloride	0.578	1.0	None
EPA 300.0	IB03813-CCB1	Chloride	0.354	1.0	None
EPA 300.0	IB03813-CCB3	Chloride	0.366	1.0	None
EPA 300.0	IB04809-CCB2	Chloride	0.207	1.0	None
SW6010B	IB03704-CCB1	Iron	39.8	LOD: 60	None

Except for batch (IB04712-CCB3) for chloride, the chloride detections in all other calibration blanks were below one-half the LOQ, and the iron detection in one calibration blank was less than the limit of detection (LOD), and thus met the calibration blank acceptance criteria. All listed calibration blank detections did not affect the quality of the sample results as the detected chloride results in the associated samples were greater than five times the level reported in the continuing calibration blank, and iron was not detected in any associated samples. No data qualification was warranted because of the calibration blank detections. All initial and continuing calibration blanks were free of ammonia as nitrogen.

1.5 Surrogate Recoveries (Reason Code S)

Surrogate standards are organic compounds added to field and laboratory QC samples for organic analysis to evaluate matrix effect and method performance on an individual sample basis. Biased surrogate recoveries were noted for SW8260B and SW8015B Methods as summarized below:

Analytical Method	Sample	Surrogate Recovery Outlier (%)	Control Limit (%)	Qualifier
SW8260B	GW0038	Dibromofluoromethane: 116%	85-115%	None
SW8015B TPH Diesel (C10-C28)	GW005	o-Terphenyl: diluted out	30-140%	None
SW8015B TPH Diesel (C10-C28)	GW006	o-Terphenyl: diluted out	30-140%	None

In sample GW0038, the surrogate dibromofluoromethane was recovered slightly above the upper control limit, however the recoveries of the remaining surrogates bromofluorobenzene, 1,2-dichloroethane-d4, and toluene-d8 in the same sample were within the control range. Since no VOCs were detected in the sample, the high biased surrogate recovery of dibromofluoromethane did not affect the sample results. In samples GW005 and GW006 for TPH diesel analysis, elevated TPH diesel concentrations were observed and exceeded the instrument upper calibration range. In order to bring the sample results within the range, samples GW005 and GW006 were diluted at 100 and 200 dilution factors, respectively, and consequently, the surrogate o-terphenyl was diluted out. Data qualification was not applied to the TPH diesel results because of the dilutions.

Except where noted, surrogate recoveries in other samples analyzed for VOCs, SVOCs, TPH gasoline, and TPH diesel met the acceptance criteria. No surrogates were spiked into any samples analyzed for EDB before purging. The bias of the EDB analysis was assessed through LCS/LCSD and MS/MSD analyses.

1.6 Laboratory Control Sample/Laboratory Control Sample Duplicate Recoveries (Reason Code L)

The LCS is an aliquot of analyte-free matrix spiked with target analytes and is prepared with each analytical batch for each analytical method. The recovery of target analytes from the LCS analysis is a measurement of method performance in an interference-free sample matrix. LCS recovery biases were reported for SW8260B and SW8270C Methods as presented below:

Analytical Method	Laboratory QC Batch #	LCS Recovery Outliers (%)	Control Limit (%)	Qualifier
SW8260B	IB09001	2,2-Dichloropropane: 68%	70-135%	UJ for non-detected analyte in GW0034, GW8004-TB
SW8260B	IB14003	2,2-Dichloropropane: 84/65.5%	70-135%	UJ for non-detected analyte in GW0025, GW0027, GW8001-AB, GW8001-RB, GW8001-TB
SW8260B	IC12006	Isopropylbenzene: 127%	75-125%	J+ for detected analyte in GW0018
SW8270C	IB11003	Caprolactam: 18/17%	20-110%	UJ for non-detected analyte in GW0033 and GW0034
SW8270C	IB11003	Hexachlorobudatiene: 19/28%	25-105%	UJ for non-detected analyte in GW0033 and GW0034
SW8270C	IB11003	Hexachloroethane: 17/21%	30-100%	UJ for non-detected analyte in GW0033 and GW0034

Due to the low LCS/LCSD recovery biases, the LOQs for the non-detected results 2,2-dichloropropane, caprolactam, hexachlorobutadiene, and hexachloroethane were qualified as estimated (UJ). As a result of the high LCS/LCSD recovery bias, the detected result for isopropylbenzene was qualified as estimated (J+). This data qualification was applied to all samples in the non-compliant batches. As shown above, the reported LCS recovery biases did not significantly deviate from their respective lower or upper control limit, and therefore the data usability is not affected. As discussed above, surrogate recoveries in the qualified samples met the accuracy (bias) requirements and demonstrated acceptable laboratory method performance on a sample basis.

In addition to the above, high LCS recovery biases were noted for other VOCs and SVOCs in several batches. The non-compliant analytes included bromodichloromethane, dichlorodifluoromethane,

1,1,1,2-tetrachloroethane, 1,2-dichloroethane, bromomethane, and bromoform analyzed by SW8260B Method, and butylbenzylphthalate and 4-nitroaniline analyzed by SW8270C Method. Because these analytes were not detected in any samples, the sample results were not affected by the high LCS recovery biases and no data qualification was warranted.

The LCS bias and precision results met the acceptance criteria for EDB, TPH gasoline and diesel, metals, ammonia, anions, sulfide, and alkalinity analyses.

1.7 Matrix Spike/Matrix Spike Duplicate Recoveries (Reason Code M)

The MS and MSD samples are a portion of a field sample spiked with target analytes and are prepared with each analytical batch. The MS/MSD results are used to evaluate any bias introduced to the method due to matrix interference, and to measure bias and precision for each analytical batch.

In accordance with the QAPjP requirements (Shaw, 2011), the MS/MSD samples are to be collected at a rate of one per 20 groundwater samples. During the first-quarter 2011 groundwater monitoring event, two MS/MSD samples were collected from locations KAFB-10610 and KAFB-10624, and therefore met the MS/MSD sample frequency requirement. The laboratory performed additional MS/MSD analyses on Kirtland site-specific groundwater samples to verify presence of a matrix effect and its potential impact on the precision and bias of the analytical results.

The following Kirtland site-specific groundwater samples were spiked for MS/MSD analysis:

Well Location	Sample Number	MS/MSD Analysis
KAFB10610	GW0011	VOCs, EDB, TPH gasoline and diesel, metals, anions, ammonia as nitrogen, sulfide, and alkalinity
KAFB10624	GW0026	VOCs, EDB, TPH gasoline and diesel, metals, anions, ammonia as nitrogen, sulfide, and alkalinity
KAFB1064	GW0004	Metals, TPH gasoline, and metals
KAFB3411	GW0032	Ammonia as nitrogen and alkalinity
KAFB1062	GW0002	Anions

Well Location	Sample Number	MS/MSD Analysis
KAFB10623	GW0025	Anions
KAFB10645	GW0034	TPH gasoline and anions
KAFB10612	GW0013	Alkalinity
KAFB10644	GW0033	Alkalinity

The RPDs between the MS and MSD recoveries met the precision acceptance criteria for all the listed analyses, however MS recovery biases were observed for alkalinity, anions, sulfide, metals, EDB, TPH gasoline and diesel, and VOCs analyses, as summarized below:

Analytical Method	Spiked Sample	MS Recovery Outliers (%)	Control Limit (%)	Qualifier
SM2300B	GW0032	Alkalinity: 149/148%	80-120%	J+ for detected analyte in GW0032
EPA 300.0	GW0034	Chloride: 108/125%	80-120%	J+ for detected analyte in GW0034
SW8260B	GW0011	Bromodichloromethane: 145/129%	75-120%	None
SW8260B	GW0011	Dichlorodifluoromethane: 185/175%	30-155%	None
SW8260B	GW0011	1,2-Dichloroethane: 131/117%	70-130%	None
SW8260B	GW0011	1,1,1,2-Tetrachloroethane: 134/122%	80-130%	None
SW8260B	GW0011	1,1,1-Trichloroethane: 133/122%	65-130%	None
SW8260B	GW0011	Trichlorofluoromethane: 146/125%	60-145%	None
SW8260B	GW0011	Toluene: 88/74%	75-120%	J- for detected analyte in GW0011
SW8015B	GW0011	TPH gasoline: -1555/-1280%	50-150%	None
SW8015B	GW0011	TPH diesel: -343/292%	50-150%	None
SW8011	GW0011	EDB: 4660/4700%	70-130%	None
SM4500S2CF	GW0011	Sulfide: 71/67%	75-125%	UJ for non-detected analyte in GW0011
SM4500S2CF	GW0026	Sulfide: 60.7/60.7%	75-125%	UJ for non-detected analyte in GW0026
SM2320B	GW0033	Alkalinity: 127/126%	75-125%	J+ for detected analyte in GW0033
SW6010B	GW0026	Calcium: 49/43%	80-120%	None
SW6010B	GW0026	Sodium: 57/65%	80-120%	None
SW8260B	GW0026	Bromodichloromethane: 127/132%	75-120%	None
SW8260B	GW0026	Dichlorodifluoromethane: 167/169%	30-155%	None

As a result of the MS recovery biases, the LOQ for the non-detected result sulfide and the detected results for alkalinity, chloride, and toluene in the spiked samples were qualified as estimated UJ and J+/J-, respectively. There is no impact on the data usability because of the minor MS/MSD recovery biases. The

associated LCS recoveries for sulfide, alkalinity, anions, and VOCs analyses met the acceptance criteria indicating acceptable laboratory method performance for all the samples in the batch.

In addition, high MS/MSD recovery biases were reported for EDB; while low MS/MSD recovery biases were observed for TPH gasoline, diesel, and metals analyses as listed above. In those spiked samples, concentrations for TPH gasoline and diesel, EDB, and metals well exceeded four times their spike levels. These elevated sample concentrations produced a matrix effect which led to the MS/MSD recovery biases. Since sample concentrations were greater than four times the spike levels, no data qualification was applied to the TPH gasoline, diesel, EDB, and metals results.

The analytes bromodichloromethane, dichlorodifluoromethane, 1,2-dichloroethane, 1,1,1,2-tetrachloroethane, 1,1,1-trichloroethane, and trichlorofluoromethane were not detected in the spiked samples, and thus the sample results were not affected by the high MS/MSD recovery biases and no data qualification was necessary.

Except where noted, the MS precision and bias results were acceptable for all other analyses.

1.8 Initial Calibration (Reason Code G)

Instrument calibration is performed for VOCs, PAHs, SVOCs, EDB, TPH gasoline and diesel, metals, anions, and ammonia analyses according to the EPA method requirements. The linear analytical range is established for each method by analysis of standards prepared at increasing concentrations that cover the expected sample concentrations. The acceptability of the initial calibration is determined by calculation of a percent relative standard deviation or coefficient. The initial calibration results were acceptable for all the listed methods.

Immediately after the initial calibration for each method, an initial calibration verification (ICV) was conducted at the mid-point of instrument calibration range by using a second source calibration standard to verify the accuracy of the initial calibration. A percent difference (%D) between the reported concentration and expected concentration for VOC analysis exceeded the acceptance criteria as summarized below:

Analytical Method	Instrument#	ICV Outliers (%)	Control Limit (%)	Qualifier
SW8260B	MSVOA3	Dichlorodifluoromethane: +43%	<20%	None

Because the analyte dichlorodifluoromethane was not detected in any associated samples, the high biased %D did not affect the sample results and no data qualification was warranted. Except where noted, the ICV results met the acceptance criteria for all other analyses.

1.9 Continuing Calibration Verification (Reason Code C)

Routinely during sample analysis, the stability of the analytical system is monitored by analysis of continuing calibration standards at concentrations near the mid-point of the linear range. Percent differences between the relative response factor (RRF) in the initial calibration and the RRF in the continuing calibration exceeded the acceptance criteria for VOCs, SVOCs, TPH diesel, and anions analyses. The continuing calibration outliers that resulted in data qualification are summarized below:

Analytical Method	Calibration ID	CCV Outlier (%)	Control Limit (%)	Qualifier
SW8260B	IB03303-CCV1	Bromomethane: -41.4%	<20%	UJ for non-detected analyte in GW0002, GW0003, GW0004, and GW8003-TB
SW8260B	IB03303-CCV1	Chloromethane: -24.2%	<20%	UJ for non-detected analyte in GW0002, GW0003, GW0004, and GW8003-TB
SW8260B	IB03303-CCV1	Dichlorodifluoromethane: -21.4%	<20%	UJ for non-detected analyte in GW0002, GW0003, GW0004, and GW8003-TB
SW8260B	IB03305-CCV1	Bromomethane: -40.7%	<20%	UJ for non-detected analyte in GW0001, GW0017, GW0032,

Analytical Method	Calibration ID	CCV Outlier (%)	Control Limit (%)	Qualifier
				GW8001-TB, and GW8002-TB
SW8260B	IB03305-CCV1	Chloromethane: -20.5%	<20%	UJ for non-detected analyte in GW0001, GW0017, GW0032, GW8001-TB, and GW8002-TB
SW8260B	IB05006-CCV1	Bromomethane: -43%	<20%	UJ for non-detected analyte in GW0020, GW0021, and GW8013-TB
SW8260B	IB05006-CCV2	Acetone: +29.4%	<20%	J+ for detected analyte in GW0019
SW8260B	IB05006-CCV2	Bromomethane: -39.9%	<20%	UJ for non-detected analyte in GW0019
SW8260B	IB050401-CCV1	Acetone: +39%	<20%	J+ for detected analyte in GW0011 and GW0031
SW8260B	IB050401-CCV1	Bromomethane: -28.8%	<20%	UJ for the analyte in GW0011 and GW0031
SW8260B	IB050401-CCV1	2-Butanone: +35.6%	<20%	J+ for detected analyte in GW0011
SW8260B	IB050401-CCV1	4-Methyl-2-Pentanone: +47.2%	<20%	J+ for detected analyte in GW0011 and GW0031
SW8260B	IB05611-CCV1	Acetone: +52.6%	<20%	J+ for detected analyte in GW0009
SW8260B	IB05611-CCV1	2-Butanone: +23.2%	<20%	J+ for detected analyte in GW0009
SW8260B	IB05611-CCV1	2-Hexanone: +23.2%	<20%	J+ for detected analyte in GW0009
SW8260B	IB05611-CCV1	4-Methyl-2-Pentanone: +35.5%	<20%	J+ for detected analyte in GW0009
SW8260B	IB05612-CCV1	Acetone: +55%	<20%	J+ for detected analyte in GW0015, GW0005, GW0006, and GW0007
SW8260B	IB05612-CCV1	2-Butanone: +30.4%	<20%	J+ for detected analyte in GW0015, GW0005, GW0006
SW8270C	IB04714-CCV1	Benzaldehyde: - 40.8%	<20%	UJ for non-detected analyte GW0033 and GW0034
SW8270C	IB04714-CCV1	Benzidine: - 54.5%	<20%	UJ for non-detected analyte GW0033 and GW0034
SW8015B	IC06012-CCV2	TPH diesel: +40.7%	<20%	J+ for detected analyte in GW0005, GW0006, and GW0007
EPA 300.0	IB03813-CCV1	Sulfate: +11%	<10%	J+ for detected analyte GW0001

As a result of the low biased percent differences, the LOQs for the non-detected results bromomethane, chloromethane, and dichlorodifluoromethane analyzed by SW8260B Method, and benzaldehyde and benzidine analyzed by SW8270C Method were qualified as estimated (UJ) in all samples associated with the non-compliant continuing calibrations. The high biased percent differences led to qualification of the detected results for acetone, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, TPH diesel, and sulfate as estimated (J+) in the affected samples. There is no impact on the data usability because of the continuing calibration outliers.

Additionally, high biased percent differences were reported for other VOCs and SVOCs. Because these analytes were not detected in samples associated with the calibration outliers, the high biased percent differences did not affect the sample results and therefore did not lead to any data qualification.

Except where noted above, the continuing calibration results were acceptable for all other analyses.

1.10 Interference Check Samples (Reason Code O)

The ICP interference check sample (ICS) verifies the interelement and background correction factors. An ICS was analyzed at the beginning and end of each analytical sequence. All ICS results were within the established control limit.

1.11 ICP Serial Dilution (Reason Code A)

The ICP serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. An ICP serial dilution was performed on two project samples GW0011 and GW0026. The ICP serial dilution results were acceptable for both samples.

1.12 Sample Confirmation

As required by the DoD and EPA, when samples are analyzed by either a gas chromatography or high-performance liquid chromatography method, all positive results with the exception of TPH gasoline and diesel, must be confirmed by a second column or a different detector. As indicated in all six SDGs for the sampling event, all positive EDB results for SW8011 method were confirmed by a second column, and the precision results between the primary and secondary columns were within the precision control limit for all the detected samples. In all cases, the higher detection from either the primary or secondary column was reported.

1.13 Ambient Blanks (Reason Code K2)

Ambient blanks serve as a check on environmental contamination from contaminants in air at a sampling location. The ambient blank is prepared by pouring distilled water into a clean sample container in the field, and exposing this blank in the field at the time of sample collection and at a particular well location.

During the first-quarter 2011 groundwater monitoring event, one ambient blank sample (GW8001-AB) was collected on February 8, 2011 from location KAFB-10623 and a second ambient blank (GW8002-AB) was collected on February 15, 2011 from location KAFB-10620. Both ambient blanks were submitted to the laboratory for VOC analysis. One positive result in the blank is reported and summarized below:

Analytical Method	Well Location	Contaminant	Contaminant Level (ppb)	LOQ (ppb)	Qualifier
SW8260B	KAFB-10620	Acetone	9.75	1.0	U for the analyte in GW0022

On February 15, a groundwater sample GW0022 was collected from well KAFB-10620 where the ambient blank (GW8002-AB) was collected. Acetone was reported at 3.26 ppb and 9.75 ppb in the groundwater sample and the ambient blank, respectively. Although acetone is a common laboratory contaminant, the analyte in the laboratory method blank processed with the groundwater and ambient blank samples was not detected. Due to the ambient blank detection, the detected result for acetone in sample GW0022 was qualified as non-detected (U) at the LOQ. There is no impact on the data usability because of the blank qualification. Except for acetone, no other VOCs were detected in the ambient blank (GW8002-AB). The second ambient blank was free of any VOCs.

1.14 Trip Blanks (Reason Code K3)

Trip blanks were prepared by the laboratory and stored with the groundwater samples collected for VOC analysis. Samples for VOC analysis were maintained in as few coolers as possible to minimize the number of required trip blanks. One trip blank was submitted with VOC samples collected on each day from January 25 through March 9, 2011, which resulted in a total of 20 trip blanks for the entire sampling event. Positive results in the trip blanks are summarized below:

Analytical Method	Trip Blank	Contaminant	Contaminant Level (ppb)	LOQ (ppb)	Qualifier
SW8260B	GW8001-TB	Isopropylbenzene	0.701	1.0	U for the analyte in GW0001
SW8260B	GW8002-TB	Isopropylbenzene	0.706	1.0	U for the analyte in GW0017, GW0032
SW8260B	GW8004-TB	Hexachlorobutadiene	0.373	1.0	None
SW8260B	GW8005-TB	Hexachlorobutadiene	0.453	1.0	None
SW8260B	GW8011-TB	Hexachlorobutadiene	0.349	1.0	None
SW8260B	GW8014-TB	Hexachlorobutadiene	0.279	1.0	None
SW8260B	GW8014-TB	Methylene Chloride	1.52	10	None
SW8260B	GW8015-TB	Trichloroethene	0.265	1.0	None
SW8260B	GW8017-TB	Trichloroethene	0.298	1.0	None
SW8260B	GW80013-TB	Hexachlorobutadiene	0.352	1.0	none
SW8260B	GW8020-TB	Methylene Chloride	0.567	10	None

As indicated above, the majority of the trip blank levels were less than one-half the LOQs for target analytes and less than the LOQ for laboratory common contaminants, such as methylene chloride. Therefore these blank levels met the blank acceptance criteria. Due to the trip blank detections, the detected results for isopropylbenzene in three samples shipped with the trip blanks were qualified as non-detected (U). Although hexachlorobudadiene, methylene chloride, and trichloroethene were also reported in the trip blanks, these analytes were not detected in any associated groundwater samples, and therefore the sample results were not affected by the trip blank detections. The remaining 10 trip blanks were free of any VOCs. Overall, the trip blank results were acceptable, indicating good sample storage and shipping procedures.

1.15 Equipment Rinse Blanks (Reason Code K1)

Equipment rinse blanks are designed to check for contamination from sampling equipment and the results of the equipment rinse blanks are used for evaluating the efficiency of equipment decontamination procedures.

During the first-quarter 2011 groundwater monitoring event, two equipment rinse blanks (GW8001-RB and GW8002-RB) were collected on February 8 and 15, respectively when non-dedicated sampling equipment was used to collect groundwater samples. These two equipment rinse blank samples were prepared by rinsing the decontaminated pump with the distilled water obtained from the laboratory and then collecting the final rinse into appropriate sample containers. Both equipment rinse blank samples were analyzed for VOCs, TPH gasoline and diesel, and metals.

Positive results observed in the equipment rinse blanks are presented below:

Analytical Method	Equipment Rinse Blank	Contaminant	Contaminant Level (ppb)	LOQ (ppb)	Qualifier
SW8260B	GW8001-RB	Benzene	0.6	1.0	None
SW8260B	GW8001-RB	Ethylbenzene	0.332	1.0	None
SW8260B	GW8001-RB	Toluene	2.52	1.0	U for the analyte in GW0025 and GW0027
SW8260B	GW8001-RB	m,p-xylene	0.751	2.0	None
SW8260B	GW8002-RB	Acetone	14.3	10	U for the analyte in GW0022
SW8260B	GW8002-RB	Toluene	3.84	1.0	U for the analyte in GW0022
SW6010B	GW8002-RB	Iron	36.0	100	None
SW6010B	GW8002-RB	Manganese	6.84	15	U for the analyte in GW0022

As noted by the sampling team, the equipment rinse blank detections may be attributed to vehicle exhaust from vehicles in the areas of sampling. As a result of the blank detections, the detected results for acetone, toluene, and manganese in the associated groundwater samples were qualified as non-detected (U) at their reported value. There is no impact on the data usability because of the blank qualification. Since benzene, ethylbenzene, m,p-xylene, and iron were not detected in the associated samples, the blank detections did not affect the sample results. Both equipment rinse blanks were free of TPH gasoline and diesel.

A portable pump was used to collect a majority of the groundwater samples for the first-quarter 2011 groundwater monitoring event; however, no additional equipment rinse blanks were collected to verify equipment decontamination procedure.

1.16 Field Duplicates

In accordance with the site-specific BFF Spill QAPjP (Shaw, 2011) requirements, field duplicate samples are to be collected at a minimum rate of 10 percent of the total number of groundwater samples. Field duplicate samples are evaluated by calculating the RPD between the sample and its duplicate. The RPD is calculated using the following equation:

$$RPD = \frac{|S-D|}{[(S+D)/2]} \times 100$$

where:

S = sample result
D = duplicate result

Acceptable precision control criteria are established at less than or equal 35 percent for water samples.

The RPD is calculated between pairs of field duplicate samples when both results are reported above the LOQ.

Two duplicate pairs were collected for the first-quarter 2011 groundwater monitoring event. Therefore, the 10 percent field duplicate frequency requirement was missed. The duplicate pairs were collected from locations KAFB-10626 and KAFB-10618 and analyzed for VOCs, EDB, TPH gasoline and diesel, metals, anions, sulfide, ammonia, and alkalinity. The field duplicate results are presented below:

Analytical Method	Analyte	KAFB10626 Sample ID: GW0028 and Concentration	KAFB10626 Duplicate ID: GW0029 and Concentration	RPD%	Control Limit
SW8260B	Toluene, ppb	5.10	4.98	2.4%	<35%
SW6010B	Calcium, ppb	77,100	76,500	0.8%	<35%
SW6010B	Magnesium, ppb	10,600	10,400	1.9%	<35%
SW6010B	Sodium, ppb	38,800	36,700	5.6%	<35%
SM2320B	Alkalinity, ppm	86.2	86.6	0.5%	<35%
EPA 300.0	Chloride, ppm	96.8	96.9	0.1%	<35%
EPA 300.0	Nitrate, ppm	4.52	4.52	0%	<35%
EPA 300.0	Sulfate, ppm	83.9	84.1	0.2%	<35%
Analytical Method	Analyte	KAFB-10618 Sample ID: GW0019 and Concentration	KAFB-10618 Duplicate ID: GW0020 and Concentration	RPD%	Control Limit
SW8260B	1,2-Dichloroethane, ppb	2.29	2.03	12%	<35%
SW8260B	1,2,4-Trimethylbenzene, ppb	30.6	29.5	3.7%	<35%
SW8260B	1,3,5-Trimethylbenzene, ppb	10.4	10.4	0.0%	<35%
SW8260B	4-Methyl-2-Pentanone, ppb	9.79	8.35	15.9%	<35%
SW8260B	Benzene, ppb	34.9	26.8	26.3%	<35%
SW8260B	Isopropylbenzene, ppb	17.4	12.1	35.9%	<35%
SW8260B	Naphthalene, ppb	1.33	1.24	7.0%	<35%
SW8260B	Toluene, ppb	12.7	9.74	26.4%	<35%
SW8260B	m,p-Xylene, ppb	65.7	62.9	4.4%	<35%
SW8260B	n-Propylbenzene, ppb	4.04	2.33	53.7%	<35%

Analytical Method	Analyte	KAFB10626 Sample ID: GW0028 and Concentration	KAFB10626 Duplicate ID: GW0029 and Concentration	RPD%	Control Limit
SW8260B	o-Xylene, ppb	5.22	4.66	11.3%	<35%
SW8260B	sec-Butylbenzene, ppb	1.87	1.42	27.4%	<35%
SW8260B	tert-butylbenzene, ppb	1.11	1.06	4.6%	<35%
SW8015B	TPH-gasoline, ppm	1.02	1.03	1.0%	<35%
SW8015B	TPH-diesel, ppm	4.48	4.05	10.1%	<35%
SW8011	EDB, ppb	0.864	0.95	9.5%	<35%
SW6010B	Calcium, ppb	42,000	44,6000	6.0%	<35%
SW6010B	Magnesium, ppb	5,990	6,380	6.3%	<35%
SW6010B	Sodium, ppb	24,700	26,600	7.4%	<35%
SW6010B	Iron, ppb	120	125	4.1%	<35%
SW6010B	Manganese, ppb	844	844	0.0%	<35%
EPA 300.0	Chloride, ppm	18.3	18.6	1.6%	<35%
EPA 300.0	Sulfate, ppm	39.2	39.9	1.8%	<35%
SM2300B	Alkalinity, ppm	129	129	0.0%	<35%

Except for isopropylbenzene and n-propylbenzene at location KAFB-10618, the RPDs for all other listed parameters were between 0 and 27.4 percent, well within the 35 percent field duplicate precision goal.

The RPDs for isopropylbenzene and n-propylbenzene were 35.9 and 53.7 percent, respectively, exceeding the field duplicate precision limit. Approximately 94 percent of the field duplicate results were within the field duplicate precision limit, indicating overall acceptable field and analytical procedures.

1.17 Completeness

The following sections present a discussion of contractual, analytical, and technical completeness for the first-quarter 2011 groundwater monitoring event. Completeness calculations were performed only for the groundwater samples that were used for project decisions.

1.17.1 Contractual Completeness

Contractual completeness is a quantitative expression of how closely the laboratory adhered to the project requirements. The contractual completeness goal is 95 percent. Contractual completeness is calculated as follows:

$$\% \text{ Contractual Completeness} = \frac{\text{Number of Unqualified Results}}{\text{Total Number of Results}} \times 100$$

Contractual completeness is based on data qualified for QC outliers that are related to method performance and laboratory procedures only. These include data qualified for calibration or preparation blank contamination, missed holding times, and non-compliant LCS recovery and/or precision.

For the first-quarter 2011 groundwater monitoring event, the contractual completeness was 100 percent for TPH gasoline and diesel, metals, sulfide, ammonia as nitrogen, and alkalinity analyses. The 95-percent contractual completeness goal was also met for VOCs (99.8 percent), EDB (95 percent), and anions (96.7 percent). The contractual completeness goal was missed for SVOCs (47.8 percent) and PAHs (27.8 percent). As discussed previously, one SVOC sample and two PAH samples were extracted outside the 7-day extraction holding time requirement. Additional SVOCs and PAHs were qualified as non-detected or estimated due to laboratory method blank contamination and non-compliant LCS recoveries. The data usability is not affected because of these data quality issues.

1.17.2 Analytical Completeness

Analytical completeness is a quantitative expression of how closely the results adhered to all QC requirements based on the number of data points qualified for any reason. The analytical completeness goal is 90 percent. Analytical completeness is calculated as follows:

$$\% \text{ Analytical Completeness} = \frac{\text{Number of Unqualified Results}}{\text{Total Number of Results}} \times 100$$

Analytical completeness is based on samples qualified for any reason and includes all target analytes.

For the first-quarter 2011 groundwater monitoring event, the analytical completeness was 100 percent for TPH gasoline and ammonia as nitrogen analyses. The 90-percent analytical completeness objective was achieved for VOCs (98 percent), TPH diesel (92.5 percent), EDB (95 percent), metals (99.6 percent), sulfide and anions (95 percent), and alkalinity (97.5 percent). The 90-percent analytical completeness goal was not met for SVOCs (46.3 percent) and PAHs (27.8 percent) due to a combination of holding time exceedances, laboratory blank contamination, and calibration and LCS recovery outliers.

1.17.3 Technical Completeness

Technical completeness is a quantitative expression of the data usability based on the number of rejected data. For this project, the technical completeness for each method is established at equal to or greater than 95 percent. The technical completeness calculation considers all data that is not rejected to be usable and technical completeness is calculated as follows:

$$\% \text{ Technical Completeness} = \frac{\text{Number of Useable Results}}{\text{Total Number of Results}} \times 100$$

The technical completeness was 100 percent for all methods for the first-quarter 2011 groundwater monitoring event. Sufficient acceptable results were obtained to meet the project objectives.

1.18 Summary

The analytical data reported for this event have been reviewed for completeness, bias, and precision. Data quality issues observed consisted of holding time violations, biased surrogate, LCS/LCSD, MS/MSD recoveries, initial and continuing calibration outliers, and laboratory and field blank contamination. The

affected data was qualified as estimated or non detected. The 95-percent technical completeness goal was exceeded for all methods. All data are usable for their intended purposes.

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Table 1. Data Qualification Flags and Reason Codes**Data Qualifier Definitions for Organic Data Review**

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the reported sample quantitation limit.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; associated numerical value is its approximate concentration with a high bias in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The analyte was analyzed for, but the presence <u>or</u> absence of the analyte has not been verified. Resampling and reanalysis may be necessary to confirm or deny the presence of the analyte. Results are rejected and data are <u>unusable</u> for any purposes.

Data Qualifier Definitions For Inorganic Data Review

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the level of the reported value. The reported value is the instrument detection limit for waters and the method detection limit (MDL) for soils for all the analytes except cyanide (CN) and mercury (Hg). For CN and Hg, the reported value is the contract-required detection limit.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; associated numerical value is its approximate concentration with a high bias in the sample.
UJ	The analyte was analyzed for but was not detected above the reported value. The reported value may not accurately or precisely represent the sample reporting limit.
R	The analyte was analyzed for, but the presence <u>or</u> absence of the analyte has not been verified. Resampling and reanalysis may be necessary to confirm or deny the presence of the analyte. Results are rejected and data are <u>unusable</u> for any purposes.

Table 1. Data Qualification Flags and Reason Codes (concluded)**Reason Codes for Data Review and Validation**

Reason Code	Description
A	Serial dilution outside criteria (Level IV).
B1	Method blank contaminants above reporting limit.
B2	Calibration blank contaminants above reporting limit.
B2, Bias Flag “-“	Calibration blank indicates negative interference, false negatives may be present.
C	Calibration outside control limits.
D1	Sample duplicate RPD outside control limit.
D2	Matrix duplicate RPD outside control limit.
E	The sample results exceed the linear calibration range of the instrument.
F	Hydrocarbon pattern does not match hydrocarbon pattern in the standard.
G1	Initial calibration relative standard deviation outside control limit.
G2	Initial continuing calibration RRF outside control limit.
G3	Continuing calibration RRF outside control limit.
H	Holding time exceeded.
I	Internal standard recovery outside control limit.
K1	Equipment rinsate contamination.
K2	Ambient blank contamination.
K3	Trip blank contamination.
L	LCS outside control limits.
M	MS outside control limits.
O	Interference check sample outside acceptance criteria.
P	Analyte qualified based on the professional judgement of the reviewer.
S	Surrogate recovery outside control limit.
T	Temperature outside acceptance criteria.
Tr	Value reported detected between the MDL and practical quantitation limit.
W	Pesticide breakdown outside criteria (Level IV).
X	Raised reporting limit due to matrix interference or high analyte concentration.
Y	Analyte was not confirmed by a second column.
Y1	Primary and confirmation sample duplicate RPD outside control limit.