BASIC REMEDIATION COMPANY
STANDARD OPERATING PROCEDURES
BMI COMMON AREAS
CLARK COUNTY, NEVADA

SOP-40

DATA REVIEW/VALIDATION

STANDARD OPERATING PROCEDURES

SOP-40
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DISCLAIMER

THE FOLLOWING STANDARD OPERATING PROCEDURE PROVIDES GENERAL GUIDANCE FOR BRC CONTRACTORS FOR TECHNICAL ISSUES ADDRESSED DURING ENVIRONMENTAL SITE INVESTIGATION AND REMEDIATION ACTIVITIES. IT IS NOTED, HOWEVER, THAT EACH SITE IS UNIQUE AND THESE GUIDELINES ARE NOT A SUBSTITUTE FOR COMMON SENSE AND GOOD MANAGEMENT PRACTICES BASED ON PROFESSIONAL TRAINING AND EXPERIENCE. IN ADDITION, INDIVIDUAL CONTRACT TERMS MAY AFFECT THE IMPLEMENTATION OF THIS STANDARD OPERATING PROCEDURE. BRC CONTRACTORS RESERVE THE UNRESTRICTED RIGHT TO CHANGE, MODIFY OR NOT APPLY THESE GUIDELINES IN THEIR SOLE, COMPLETE, AND UNRESTRICTED DISCRETION TO MEET CERTAIN CIRCUMSTANCES, CONTRACTUAL REQUIREMENTS SITE CONDITIONS, OR JOB REQUIREMENTS. ANY DEVIATIONS FROM STANDARD OPERATING PROCEDURES SHALL BE DOCUMENTED IN THE DATA VALIDATION REPORT IN THE APPROPRIATE QUALITY CONTROL SECTION.

1.0 INTRODUCTION

The *BRC Quality Assurance Project Plan* (QAPP; BRC and ERM 2009) provides the criteria and procedures by which data generated in the field and at the laboratories will be verified and validated. Sample results will be validated in accordance with the following U.S. Environmental Protection Agency (USEPA), U.S. Department of Energy (DOE), and Nevada Department of Environmental Protection (NDEP) guidance documents:

- USEPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 1999).
- USEPA *Contract Laboratory Program National Functional Guidelines for Low-Concentration Organic Data Review* (USEPA 2001).
- USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004).
- USEPA *National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review* (USEPA 2005).
- USEPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA 2008) as modified in NDEP's *Supplemental Guidance on Data Validation: Revisions to Data Validation of Organic Data based on June 2008 National Function Guidelines for Superfund Organic Methods Data Review – USEPA-540-R-08-01* (NDEP 2009a).
- USDOE *Evaluation of Radiochemical Data Usability, ES/ER/MS-5* (USDOE 1997).
- NDEP *Supplemental Guidance on Data Validation: NDEP Data Verification and Validation Requirements – Supplement April, 2009* (NDEP 2009b).

These documents provide detailed procedures for review of analytical data and are to be the primary source of guidance for validation of data collected for BMI Common Areas projects. Throughout the project duration, if a given set of USEPA guidelines is superseded or if NDEP issues updated modifications to the above-listed or future USEPA guidelines, the data quality review process will be modified to follow the updated guidelines as modified by NDEP. Recognizing that not all possible analytical deviations are presented in the Functional Guidelines, these guidance documents allow for the use of individual professional judgment in

data validation. In addition, the specific analytical methods used in site characterization shall be used to evaluate laboratory data and the laboratories' adherence to the analytical methods.

The purpose of this Standard Operating Procedure (SOP) is to provide further guidance regarding issues subject to professional judgment, to ensure consistency in the data validation process and in qualifier application for BMI Common Areas data. This SOP is to be used in conjunction with the Functional Guidelines and the QAPP and does not serve as complete instruction for data validation. Only those clarifications made to specific parameters are discussed in this SOP (see Section 4).

It should be noted that this SOP has been developed to provide additional project-specific guidelines beyond those presented in the Functional Guidelines. All data review/validation for the BMI Common Areas project will be directed by a qualified project chemist who will use professional judgment in all aspects of the data review/validation process. It is possible that a situation could arise such that deviations from this SOP could be warranted based on the project chemist's professional judgment. Such deviations will not be lightly undertaken, as it is BRC's intent to sustain a high level of comparability in the project data set. In such cases, the deviations will be clearly noted and the rationale explained in the associated quality assurance/quality control (QA/QC) report.

2.0 DEFINITIONS

%R	Percent recovery
CCV	Continuing calibration verification
USEPA	U.S. Environmental Protection Agency
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
MS	Matrix spike
MSD	Matrix spike duplicate
NDEP	Nevada Department of Environmental Protection
PQL	Practical Quantitation Limit
QA	Quality assurance
QC	Quality control
RPD	Relative percent difference
SQL	Sample Quantitation Limit
TDS	Total Dissolved Solids

3.0 VALIDATION QUALIFICATIONS

Based on data validation and review, data qualifiers are placed in the electronic database to signify whether the data are acceptable, acceptable with qualification, or rejected. Definitions of laboratory qualifiers, validation qualifiers, and reason codes that define a particular validation qualifier that are used to qualify data are presented in Tables 1 through 4 below. Validation qualifiers and definitions are based on those used by USEPA in the current validation guidelines presented in Section 1.

Table 1. Laboratory Qualifiers

Laboratory Qualifier	Definition
U	Organic and inorganic analyses: the analyte was not detected above the level of the reported sample quantitation limit (SQL).
B	Inorganic analyses: the analyte was detected between the method detection limit and the SQL. Organic analyses: the analyte was detected in the associated method blank.
J	Organic analyses: the analyte was detected between the method detection limit and the SQL.
E	Organic and inorganic analyses: the sample concentration was greater than the calibration's upper limit and should be considered to be an estimated value.
*	Inorganic analyses: the analytical duplicate precision was not within control limits.
N	Inorganic analyses: the matrix spike (MS) was not within control limits.
D	Organic and inorganic analyses: the sample result was diluted.

Table 2. Functional Guidelines Validation Qualifiers

Functional Guidelines Validation Qualifier	Definition
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U	The analyte was detected, but qualified as nondetected during data validation due to blank contamination.
UJ	The nondetected analyte was qualified as estimated at the SQL. The reported SQL is approximate and may be inaccurate or imprecise.

R	The sample result is rejected and unusable due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.
J+	Inorganics analyses: the result is an estimated quantity, biased high. The associated numerical value is the approximate concentration of the analyte in the sample.
J-	Inorganics analyses: the result is an estimated quantity, biased low. The associated numerical value is the approximate concentration of the analyte in the sample.

Table 3. Project-Specific Validation Qualifiers

Project-Specific Validation Qualifier	Definition
X	The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
Z	The associated data has not been subjected to the data review/validation process.
J+	Organics analyses: the result is an estimated quantity, biased high. The associated numerical value is the approximate concentration of the analyte in the sample.
J-	Organics analyses: the result is an estimated quantity, biased low. The associated numerical value is the approximate concentration of the analyte in the sample.
J-TDS	Inorganic analysis: the analytical result is estimated based on failure of Total Dissolved Solids (TDS) correctness check performed in accordance with Standard Methods (see Section 5.1)
J-CAB	Inorganic analysis: the analytical result is estimated based on failure of cation-anion balance correctness check performed in accordance with Standard Methods
J-TDS&CAB	Inorganic analysis: the analytical result is unreliable based on failure of cation-anion balance and TDS correctness checks performed in accordance with Standard Methods.

Table 4. Validation Reason Codes

Validation Reason Code	Definition
1	The sample preparation and/or analytical holding time was exceeded.
2#	The analyte was detected below the report limit but above the method detection limit.
3	The analyte was detected in an associated laboratory blank sample.
4	The MS/MSD recovery was outside of control limits.

Table 4. Validation Reason Codes

Validation Reason Code	Definition
5	The laboratory control sample (LCS) recovery was outside of control limits.
6##	The MS/MSD relative percent difference (RPD) was outside of control limits.
7##	The LCS RPD was outside of control limits.
8	The surrogate recovery was outside of control limits.
9##	Level IV data validation qualification.
10	The sample chromatogram did not resemble the standard hydrocarbon pattern.
11	The sample concentration was greater than the instrument's calibration range.
12	The calibration criterion of RRF, %D, and/or %RSD was not met.
13	The analyte was detected in field blank, rinsate blank, and/or trip blank sample.
14	The internal standards did not meet control criteria.
15	The serial dilution did not meet control criteria.
16	The difference between columns did not meet control criteria.
17	Field duplicates did not meet the 50% RPD control criterion.
18	Sample receipt temperature exceeded the acceptable range of from 4 to 6 degrees Celsius.
19	Analytical duplicate precision did not meet control criteria.
20	Headspace in vials containing water samples to be analyzed for volatiles.
21	The tracer yields did not meet control criteria.
22	The ratio of the measured TDS value to the mathematically calculated TDS sum was outside the specified error range (the cation-anion balance was within the error limits specified in Standard Methods).
23	The cation-anion balance was outside the error limits specified in Standard Methods (the ratio of the measured TDS value to the mathematically calculated TDS sum was within the specified error range).
24	The cation-anion balance was outside the error limits specified in Standard Methods, and the ratio of the measured TDS value to the mathematically calculated TDS sum was outside the specified error range.
25	Other

This reason code is applied to data entries with lab qualifiers J or B, as defined above.

These reason codes were used in the validation of historical data and will not be used in current and future site investigations.

In historical data validation, the qualifiers B and BJ were used to denote samples that were qualified as nondetected and/or nondetected and estimated at the report limit. In keeping with the Functional Guidelines, the U qualifier will be used for those data that are qualified as nondetected due to blank contamination.

Although it is BRC's intention that all data collected for the BMI Common Areas project will be subjected to data review and/or data validation, for certain historical data and potential future data there may be occasions in which it is deemed infeasible or unnecessary. For any such data included in the database, a Z qualifier will be assigned in the qualifier column to indicate that the associated data have not been subjected to the data review/validation process.

4.0 GUIDELINES

4.1 Chain of Custody

The chain of custody shall be evaluated for any discrepancies, and if any are found, they will be documented in the narrative. The laboratory shall be contacted to resolve any chain of custody discrepancies.

4.2 Preservation and Holding Times

The Functional Guidelines shall be followed for qualification of sample data for preservation or holding time exceedances with the following clarification. Non-detected volatile sample results should be rejected (R) if the sample temperature is considered to be at or above 15 degrees Celsius, and the sample shipments have arrived at the laboratory more than four hours after collection of the last sample. If this condition exists, detected sample results should be qualified as estimated, with a low bias (J-).

Holding time exceedances are qualified due to the potential loss of analyte. Detections will be qualified as estimated, with a low bias (J-). However, in the case of pH where an exceedance of holding time does not necessarily correspond to a potential decrease in value, results will be qualified as estimated (J). Non-detect values are qualified as estimated (UJ) for organic and non-metal exceedances less than two times the holding time, or rejected (R) if exceeded for metals or if the holding time is exceeded by two times for organics and non-metals.

4.3 Percent Moisture

Based on NDEP's Supplemental Guidance (NDEP 2009a), for non-aqueous samples only, if the percent moisture is greater than 70 percent but less than 90 percent, all detected sample results are qualified as estimated (J) and non-detect values as estimated (UJ). If the percent moisture is greater than or equal to 90 percent, all detected sample results for non-aqueous samples are qualified as estimated (J) and non-detect values as rejected (R).

4.4 Calibration

The Functional Guidelines shall be followed for the qualification of sample data based on calibration exceedances with the following clarification. Non-detected organic sample data shall be rejected (R) if the continuing calibration verification (CCV) percent difference (%D) exceeds ±75%. Detected sample data shall be qualified as estimated (J- or J+, depending on the bias of the CCV %D).

4.5 Blanks

The NDEP Supplemental Guidance (NDEP 2009a) shall be followed for the qualification of organic sample data based on blank contamination (Table 5). As shown in Table 5, the use of professional judgment is specified for organic analyses (excluding dioxins/furans and PCB congener analyses) in cases where the sample analyte result is greater than the blank result. In such cases, if the sample concentration is greater than two times the blank concentration no data will be qualified unless widespread gross contamination is demonstrated. Those sample results between the blank concentration and two times the blank concentration will be evaluated on a case-by-case basis. For dioxins/furans and PCB congener analyses, sample concentrations less than five times the blank concentration will be qualified.

The following clarification applies to inorganic sample data qualified on the basis of blank results. The Functional Guidelines allow for professional judgment in the qualification of sample data when the blank contamination is greater than the SQL, but less than the practical quantitation limit (PQL), and the sample results are greater than the PQL. If deemed appropriate, professional judgment can be used to qualify these results as estimated, with a high bias (J+).

4.6 Internal Standards

The Functional Guidelines will be followed with limited exceptions for volatile organic compounds and semi-volatile organic compounds. The following exceptions are described in the

NDEP Supplemental Guidance (NDEP 2009a): if the retention time of the internal standard differs by more than 20 seconds from the associated CCV; all detected and non-detect sample results should be qualified as rejected (R); and if the sample internal standard area is 25 percent of the associated CCV internal standard area, all detected and non-detect samples results should be qualified as rejected (R). However, if mass spectral criteria indicate an appropriate identification was made, then caveats may be made and perhaps partial rejection of the associated compounds.

4.7 Duplicates

4.7.1 Analytical Duplicates

The Functional Guidelines shall be followed for the qualification of inorganic sample data based on analytical duplicate results.

4.7.2 Field Duplicates

The Functional Guidelines do not specify qualification of samples based on field duplicate imprecision. However, the QAPP for the BMI Common Areas (BRC and ERM 2008) has determined a control criterion of a RPD of 50 percent for field duplicates.

If the field duplicate RPD exceeds the 50 percent limit, non-detected sample results shall be qualified as estimated at the SQL (UJ) and detected results shall be qualified as estimated (J). The RPD will be calculated using the reporting limit for non-detected sample results. Similar to analytical duplicates, this limit does not apply when the result for either the sample or its duplicate is less than five times the PQL. For this situation, the absolute value of the PQL is to be used as the control limit.

4.8 Spikes

4.8.1 Organic Analyses

Organic analyses are commonly reported with a LCS (or commonly referred to as a blank spike), and an LCS duplicate (LCSD), although an LCSD is not always analyzed and reported with a sample batch. In addition, a MS and a matrix spike duplicate (MSD) are sometimes included in the data report.

Spike Exceedances that do not Result in Qualified Data

- Organic sample data are not qualified on the basis of RPD outliers if ***any*** of the LCS, LCSD, MS, and/or MSD percent recoveries (%R) are in control.
- Organic sample data are not qualified if a spike is biased high and the associated sample results are non-detected as described in the Functional Guidelines.
- Organic sample data are not qualified if ***any one*** LCS, LCSD, MS, or MSD is out of control, but ***any other*** LCS, LCSD, MS, or MSD associated with the batch is in control.
- Organic sample data are not qualified if the MS/MSD used is from a different client or sample batch (batch QC). However, if the sample used for the MS/MSD is a site sample and it can reasonably be determined that the sample matrix is similar, professional judgment should be used to determine if the remaining samples in the analytical batch should be qualified based on the MS/MSD outlier.

Spike Exceedances that Result in Qualified Data

- If LCS and/or LCSD percent recoveries are less than 10 percent and the MS/MSD results are biased low or no MS/MSD was analyzed with the batch, qualify non-detected organic sample results as rejected (R) and detected sample results as estimated, biased low (J-).
- If a particular organic compound in all of the LCS, LCSD, MS, ***and*** MSDs is biased low, qualify associated detected data for that compound as estimated, biased low (J-), and associated non-detected data as estimated at the report limit (UJ).
- If a particular compound in all of the LCS, LCSD, MS, ***and*** MSDs is biased high, qualify detected data for that compound as estimated, biased high (J+).
- Professional judgment should be used when MS/MSD results are out of control and other QA/QC parameters such as surrogate spikes and internal standards are out of control as well, even if the LCS/LCSD is in control. This would indicate a systematic matrix interference and qualification would be justified.

4.8.2 Inorganic Analyses

Inorganic analyses are commonly reported with an LCS and a MS, although there may be circumstances when a laboratory may report an LCS/LCSD and/or a MS/MSD.

Spike Exceedances that do not Result in Qualified Data

- Inorganic sample data are not qualified on the basis of RPD outliers if the LCS/LCSD and MS/MSD percent recoveries are in control.
- Inorganic sample data are not qualified if a spike is biased high and the associated sample results are non-detected as described in the Functional Guidelines.
- Inorganic sample data are not qualified if the MS/MSD used is from a different client or sample batch (batch QC). However, if the sample used for the MS/MSD is a site sample and it can reasonably be determined that the sample matrix is similar, professional judgment should be used to determine if the remaining samples in the analytical batch should be qualified based on the MS/MSD outlier.

Spike Exceedances that Result in Qualified Data

- For LCS %Rs that are less than 50 percent, use the Functional Guidelines' rule to qualify non-detected inorganic data as rejected (R) and detected data as estimated, biased low (J-).
- For MS/MSD %Rs that are less than 30 percent, use the Functional Guidelines' rule to qualify non-detected inorganic data as rejected (R) and detected results as estimated, biased low (J-).
- If analytes in the LCS and LCSD are biased low, qualify detected data as estimated, biased low (J-), and associated non-detected inorganic data as estimated at the report limit (UJ).
- If analytes in the MS and MSD are biased low, qualify detected data as estimated, biased low (J-), and associated non-detected inorganic data as estimated at the report limit (UJ).
- If analytes in the LCS and LCSD are biased high, qualify detected data as estimated, biased high (J+).
- If analytes in the MS and MSD are biased high, qualify detected data as estimated, biased high (J+).
- If the LCS %R is less than 50 percent and the LCSD %R (or vice versa) is lower than the control limit but not less than 50 percent, qualify non-detected inorganic sample results as rejected (R), and qualify detected sample results as estimated, biased low (J-).

- If the MS %R is less than 30 percent and the MSD %R (or vice versa) is lower than the control limit but not less than 30 percent, qualify non-detected inorganic sample results as rejected (R), and qualify detected sample results as estimated, biased low (J-).

5.0 DATA REVIEW AND DATA VALIDATION

5.1 Data Review

A data review is conducted on data packages that are considered summary data packages, which include a case narrative, summary forms listing the sample results, surrogate results (as appropriate), and QA/QC forms summarizing method blanks, LCS/LCSDs, and MS/MSDs. In addition, analytical duplicates, if performed, will be presented in the summary data package. No raw data are included in a summary data package. Only those QA/QC results that are presented shall be evaluated. No judgments will be made to the data based on missing QA/QC results, given that every opportunity shall be made to identify and locate such records. For applicable inorganics data packages (i.e., those containing cation-anion and TDS data for water samples), the QA/QC will include performing correctness checks as described in the American Public Health Association *Standard Methods for the Examination of Water and Wastewater* (APHA, 1999), including cation-anion balances and determination of measured versus calculated TDS. The inorganic correctness check qualifiers shown in Table 5 will be applied to ions and TDS where appropriate.

5.2 Data Validation

Data validation is performed on full data packages. These data packages include all of the elements listed above, plus all associated raw data. In addition to reviewing all of the data quality parameters listed in the Functional Guidelines for each analysis type, recalculation of 10 percent of the data, including QA/QC samples, will be performed. QA/QC Review items, decision points, applicable qualifiers, and data subject to those qualifiers are presented in Table 5.

Table 5. Data Review/Validation Decision Points

Data Review Item	Condition	Detect Result Qualifier[1]	Non-Detect Result Qualifier[1]	Scope of Qualification
HOLDING TIMES (SOP 40, § 4.2) **Data Review and Validation**	Holding time consistent with Method requirements	none	none	
	Organic and Non-Metal Analyses: Holding time exceeded by 2 times or less	J- or J (for pH)	UJ	All analytes reported in the affected sample and method
	Holding time exceeded by greater than 2 times	J- or J (for pH)	R	
	Metal Analyses: Holding time exceeded	J-	R	
SAMPLE TEMPERATURE (SOP 40, § 4.2) **Data Review and Validation**	Temperature consistent with Method requirements	none	none	
	Cooler temperature > 6°C	J-	UJ	All analytes reported in the affected sample and method
	Cooler temperature ≥ 15°C and samples arrived at laboratory > 4 hours after last sample collected	J-	R (volatiles only)	
CALIBRATION (SOP 40, § 4.3) **Data Validation**	Please see the appropriate National Functional Guidelines for individual criteria. The RRF and linearity criteria in the Functional Guidelines shall be followed.			
	Organic Analyses: Continuing calibration verification (CCV) percent difference > appropriate GC or GC/MS limit ≤ ±75%	J+/J- (depending on bias)	UJ (if biased low)	All affected analytes associated with the CCV
	Continuing calibration verification (CCV) percent difference > ±75%	J+/J- (depending on bias)	R	
BLANKS (method, field, equipment, trip) (SOP 40, § 4.4) **Data Review and Validation**	**Organic Analyses (excluding Dioxins/Furans and PCB congener analyses)**: If the blank result is greater than the sample analyte result. (2X for methylene chloride, 2-butanone, and acetone; 5X for phthalates).	Report sample value with U	none	Analytes detected in samples that are detected in the associated blank
	If the sample analyte result is greater than the blank result	Use professional judgment as discussed in Section 4.5.	none	
	Dioxin and PCB congener analyses: Sample analyte result ≤ blank result multiplied by 5X	U	none	
	Sample analyte result > blank result multiplied by 5X	none	none	

Table 5. Data Review/Validation Decision Points

Data Review Item	Condition	Detect Result Qualifier[1]	Non-Detect Result Qualifier[1]	Scope of Qualification
BLANKS (Continued)	**Inorganic Analyses**: Blank result ≥ SQL but ≤ PQL and sample result ND or sample result > PQL	none	none	Analytes detected in samples that are detected in the associated blank
	Blank result ≥ SQL but ≤ PQL and sample result ≥ SQL but ≤ PQL	U	none	
	Blank result > PQL and sample result ND	none	none	
	Blank result > PQL and Sample Result ≥ SQL but ≤ PQL	U	none	
	Calibration Blank result > PQL and Sample Result > PQL but < Calibration blank result	U	none	
	Calibration Blank result > PQL and Sample Result > Calibration blank result	None; unless professional judgment suggests otherwise	none	
	Non-Calibration Blank (i.e. prep-aration, field or equipment) result > PQL and Sample Result > PQL but < 10x blank result	J+; unless professional judgment suggests "U"	none	
	Non-Calibration Blank result > PQL and Sample Result > 10x blank result	none	none	
DUPLICATES (SOP 40, § 4.5) **Data Review and Validation**	**Analytical Duplicates (inorganic results only):** Relative Percent Difference ≤ 20%	none	none	Apply to samples in the analytical batch
	Relative Percent Difference > 20%, when detection in sample and duplicate >5x PQL	J	UJ	
	Difference > Absolute value of PQL, when detection in sample **or** duplicate ≤5x PQL	J	UJ	
	Field Duplicates (inorganic or organic results): Relative Percent Difference ≤ 50%	none	none	Apply to sample and duplicate
	Relative Percent Difference > 50%, when detection in sample and duplicate >5x PQL	J	UJ	
	Difference > Absolute value of PQL, when detection in sample **or** duplicate ≤5x PQL	J	UJ	

Table 5. Data Review/Validation Decision Points

Data Review Item	Condition	Detect Result Qualifier[1]	Non-Detect Result Qualifier[1]	Scope of Qualification
SURROGATE RECOVERY (organic methods only) **TRACER/CARRIER RECOVERY (applicable radiochemistry methods only)** [as per Functional Guidelines; not discussed in SOP 40] **Data Review and Validation**	% Recovery ≤ 10	J-	R	For GC and GC/MS volatile organics and GC and HPLC semi-volatile organics, all analytes reported in the affected sample For GC/MS semi-volatile organics, all analytes in the affected sample that have the same acid or base-neutral fraction as the surrogate For radiochemistry methods, all reported isotopes in affected sample
	% Recovery > 10% and < Laboratory Lower Limit	J-	UJ	
	% Recovery > Laboratory Upper Limit Note: For GC/MS semi-volatile analysis, two or more surrogates in a fraction must be out of criteria for qualification unless recovery < 10%.	J+	none	
MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY (SOP 40, § 4.6) **Data Review and Validation**	**Organic Analyses**: % Recovery for a particular compound ≤ Laboratory Lower Limit in all LCS. LCSD, MS, and MSDs	J-	UJ	Affected analyte in the associated parent sample or all associated samples as discussed in the main text (2)
	% Recovery > Laboratory Lower Limit and ≤ Laboratory Upper Limit	none	none	
	% Recovery > Laboratory Upper Limit in all LCS. LCSD, MS, and MSDs	J+	none	
	Inorganic Analyses: MS/MSD % Recoveries ≤ 30%	J-	R	
	% Recovery for a particular compound ≤ 30% in **one** of either the MS or MSD and ≤ 75% for the other (MS or MSD)	J-	R	
	% Recovery for a particular compound > 30% and ≤ 75% in both the MS and MSD	J-	UJ	
	MS/MSD % Recoveries > 75% and ≤ 125%	none	none	
	% Recovery for a particular compound > 125% in both MS and MSD	J+	none	

Table 5. Data Review/Validation Decision Points

Data Review Item	Condition	Detect Result Qualifier[1]	Non-Detect Result Qualifier[1]	Scope of Qualification
LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATE RECOVERY (SOP 40, § 4.6) **Data Review and Validation**	**Organic Analyses**: LCS/LCSD % Recoveries for a particular compound ≤ 10% **and** MS/MSD not performed or biased low	J-	R	Affected analyte in the associated parent sample or all associated samples as discussed in the main text (2)
	% Recovery for a particular compound ≤ Laboratory Lower Limit in all LCS. LCSD, MS, and MSDs	J-	UJ	
	LCS/LCSD % Recoveries > Laboratory Lower Limit and ≤ Laboratory Upper Limit	none	none	
	% Recovery > Laboratory Upper Limit in all LCS. LCSD, MS, and MSDs	J+	none	
	Inorganic Analysis: LCS/LCSD % Recoveries ≤ 50%	J-	R	
	% Recovery for a particular compound < 50% in **one** of either the LCS or LCSD and ≤ Laboratory Lower Limit for the other (LCS or LCSD)	J-	R	
	% Recovery for a particular compound > 50% and ≤ Laboratory Lower Limit in both the LCS and LCSD	J-	UJ	
	LCS/LCSD % Recoveries > Laboratory Lower Limit and ≤ Laboratory Upper Limit	none	none	
	% Recovery for a particular compound > Laboratory Upper Limit in both LCS and LCSD	J+	none	

Table 5. Data Review/Validation Decision Points

Data Review Item	Condition	Detect Result Qualifier[1]	Non-Detect Result Qualifier[1]	Scope of Qualification
INORGANIC CORRECTNESS CHECKS (water samples) (SOP 40, § 5.1) **Data Review and Validation**	Ratio of TDS (Measured)/TDS (calculated) ≥1.0 and ≤1.2	none	none	All analytes used to calculate TDS and TDS in affected sample
	Ratio of TDS (Measured)/TDS (calculated) <1.0 or >1.2	J-TDS	none	
	Cation-anion difference falls below the criterion on the right (dependent on magnitude of anion sum): **When Anion Sum (meq/L)** / **Σ Cation Σ Anion Difference** 0 to 3.0 / ± 0.2 meq/L 3.0 to 10.0 / ± 2% (3) 10.0 to 800 / ± 5% (3)	none	none	All cations and anions in affected sample
	Using the above ranges/criteria, cation-anion difference falls above the criterion on the right:	J-CAB	none	
	Both TDS and cation-anion balance checks do not pass above metrics	J-TDS&CAB	none	TDS, analytes used to calculate TDS, and anions and cations in affected sample

Notes:

1. Data review qualifiers follow the EPA Functional Guidelines. The overall data-review qualifier is a summation of all qualifiers contributed by each applicable data review item listed here. The hierarchy is as follows:
   $J + U = UJ$
   $J + UJ = UJ$
   $J^+ + J = J$
   $J^- + J = J$
   $J^+ + J^- = J$
   R + any qualifier = R
   Each result record is updated with applicable individual data-review item qualifiers and the overall data-review qualifier.
2. For organic data, no qualifiers added on this basis if ***any one*** of the LCS, LCSD, MS, or MSD % Recoveries is in control. Furthermore, inorganic or organic sample data are not qualified if the MS/MSD used is from a different client or sample batch, unless it can be reasonably determined that the sample matrix is similar; professional judgment is used in such cases to determine whether qualifiers are warranted. Professional judgment should be used when MS/MSD results are out of control and other QA/QC parameters (i.e., surrogate spikes and internal standards) are out of control as well, even if the LCS/LCSD is in control; this would indicate a systematic matrix interference and qualification would be justified.
3. % difference for cation-anion balance to be determined using the following formula:

$$\% \text{ difference} = 100 \frac{\Sigma \text{ cations} - \Sigma \text{ anions}}{\Sigma \text{ cations} + \Sigma \text{ anions}}$$

6.0 REFERENCES

Basic Remediation Company (BRC) and Environmental Resources Management (ERM). 2009. BRC Quality Assurance Project Plan. BMI Common Areas, Clark County, Nevada. April

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