APPENDIX F

DATA VALIDATION AND REVIEW

APPENDIX F-1

DATA VALIDATION REPORTS

RAMBOLL

ENVIRONMENT
& HEALTH

MEMORANDUM

Job	**SATES Phase IA Part 1 Initial Test Plot Screening Data Validation Summary Sample Delivery Groups K1708839, K1708840, K1708841, K1708842, K1708843, K1708844, K1708845, K1708846, K1708847, K1708848, K1708849, K1708850, K1708851, K1708852, K1708945, K1708951, K1708957, K1708960, K1708961, K1708964, K1708967, K1708971, K1708973, K1708974, K1708975, K1708976, K1708977, K1708979, K1708980, K1708981, K1708982, K1708983, K1708984, K1709014, K1709015**
Client	**Teck American Incorporated**
To	**Dave Enos and Denise Mills**
From	**Amy Kephart and Julie Weicheld**
Copy to	**Kris McCaig, Teck American Incorporated; Cristy Kessel, Teck American Incorporated; Mike Arnold, Ramboll Environ; Rosalind Schoof, Ramboll Environ**

Date June 20, 2018

Ramboll Environ
901 Fifth Avenue
Suite 2820
Seattle, WA 98164
USA

T +1 206 336 1650
F +1 206 336 1651
www.ramboll-environ.com

1. Introduction

In accordance with the *Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES), Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation* (Work Plan; Ramboll 2017), initial test plot screening has been conducted as part of the evaluation and selection process for test plots that will be carried forward to detailed characterization. The initial screening of the test plots constitutes Phase IA Part 1 of the SATES program, as described in the Work Plan.

Test plot screening completed in mid-August 2017 included the establishment of six 100-foot by 100-foot test plots in decision units (DUs) 258, 401, and 441, and determination of total solids, total arsenic and total lead in shallow soil at each test plot using laboratory analysis. Field measurements of soil type, pH and thickness of overlying woody and other organic debris (duff) were also conducted. These test plots were designated as follows:

DU 258: 258-1, 258-2, and 258-3;

DU 401: 401-1 and 401-2; and

DU 441: 441-1.

The data from the test plot screening were collected to evaluate which test plots will be suitable for additional analysis in the test plot characterization effort and subsequently for use for the pilot testing of amendment options.

Consistent with the Work Plan and the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (United States Environmental Protection Agency (USEPA) 2017), Ramboll Environ U.S. Corporation (Ramboll) performed a Level 2 data validation of data collected as part of the Phase IA initial test plot screening. This memorandum covers thirty-five laboratory reports produced by ALS Environmental for the sample delivery groups (SDGs)

listed in Table 1, Reports and Sample Delivery Groups Reviewed. The laboratory reports reviewed by Ramboll contained analytical data for soil and field quality control (QC) samples collected on August 16 through 19, 21, and 22, 2017. Table 2, Samples Included in this Quality Assurance Review, lists the samples reviewed in this memorandum. A total of 630 samples were submitted to ALS Environmental and analyzed for total solids by USEPA Method 160.3 and for lead and arsenic by USEPA Method 6010C. This memo summarizes the methods and results for the Level 2 data validation of the Phase IA initial test plot screening sampling event.

Soil type, duff thickness and soil pH were measured and recorded in the field at each sample location, consistent with the Work Plan. Validation criteria do not exist for these data, so they are not discussed in this memo. However, Ramboll reviewed the field notes and duff thickness and pH data for quality and completeness, and found that they are in accordance with the Work Plan.

2. Methods

The Work Plan specifies the QC requirements for Phase I, which were applied during data validation. The QC information checked by Ramboll included chain-of-custody (COC) forms, holding times, analysis performed, reporting limits, matrix spike and matrix spike duplicate (MS/MSD) analyses, laboratory control sample (LCS) analysis, field duplicates, and blanks.

Ramboll's data validation review was conducted in accordance with procedures outlined in the Work Plan and the *National Functional Guidelines for Inorganic Superfund Data* Review (USEPA 2017). The USEPA guidelines provide criteria on how to review laboratory and field quality control information and, if appropriate, attach data qualifiers to the laboratory data. Analytical results received from ALS Environmental were assessed by reviewing COC forms, holding times, reporting limits, laboratory replicates and blanks, and the quality control criteria specified in Table 3, Laboratory Quality Control Limits from SATES Work Plan. Ramboll assigned qualifiers to data falling outside of the specified control criteria after review of all pertinent laboratory information contained in ALS Environmental's analytical reports. The data validation qualifiers considered and assigned to some results by Ramboll are defined in Table 4, Validation Qualifier Definitions, and in Section 18.1 of the Work Plan. A sample falling outside of the control criteria does not necessarily indicate the data should be qualified.

Quality control criteria, data accuracy, and precision were assessed using methods specified in the Work Plan (Ramboll 2017). Data accuracy and precision objectives are included on Table 3. Precision of the field homogenization process and the laboratory analyses were assessed using field duplicate samples[1], and laboratory data precision was assessed using MS, MSD, LCS, and laboratory duplicates. Data precision was measured using the relative percent difference (RPD), calculated as follows:

$$RPD=(A-B)\div\left((A+B)\div 2\right)\times 100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement

[1] According to the Work Plan, field duplicate samples were collected to assess the precision of the discrete soil sampling process. However, upon further review, the description of the field duplicate sampling process from field activities and in the Work Plan is more representative of field split sample collection rather than a co-located field duplicate. Thus, the results of these duplicate samples provide an assessment of the precision of field homogenization process and the laboratory analysis rather than and assessment of the field sample collection procedures.

Data accuracy was assessed for laboratory analyses using MS, MSD, and LCS data. Laboratory accuracy was calculated as the percent recovery as follows:

$$\% \text{ Recovery} = (A-X) \div B \times 100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements.

3. Results

ALS Environmental provided 35 analytical reports quantifying total solids, arsenic concentrations, and lead concentrations in soils collected during SATES Phase IA Part 1. COCs were complete for all SDGs. There were no holding time exceedances. Several SDGs were received out of the temperature range specified in the Work Plan for inorganic analytes (4 ± 2°C); however, this does not impact the results for lead or arsenic because they are not temperature-sensitive in soils. The USEPA method used to detect lead and arsenic in soil, Method 6010C, does not reference a temperature requirement or note any interferences from temperature issues (USEPA 2007). SDGs that were received out of the acceptable temperature range are noted in the data validation summaries for arsenic and lead (Table 5 and Table 6).

Laboratory analysis of total solids was reviewed using the replicate sample summary and RPD criteria specified by ALS Environmental (RPD Limit of 20 percent). The total solids analysis met the precision criteria for laboratory replicates specified by ALS Environmental in all SDG groups. In addition to reviewing the laboratory control criteria, Ramboll reviewed the total solids results and made the following determinations about data quality:

In SDG K1708847, the parent sample for 401-2-J04-081717 had an anomalously low percent solids result of 62.3, but the duplicate sample was reported within normal range at 96 percent. Follow-up was conducted with ALS and the field sampling team to determine the reason for the low total solids result. Photographs of the sample archived at the laboratory revealed the sample was saturated. The field team confirmed that samples collected in the field were not saturated. On the cooler receipt form, ALS noted that there was insufficient ice in the cooler these samples were shipped in, and the ice that had been included melted. A review of sample packing methods with the field team revealed that there may have been some inconsistencies in how samples were packaged for shipping, of which some methods deviated from the method specified in SOP-10 of the Work Plan. Individual sample jars were not consistently shipped within an individual sealable plastic bag. Thus, water from the melted ice may have seeped into sample 401-2-J04-081717 during transport, causing the unusually low total solids result. The arsenic and lead results for this sample were within control limits. However, because of the possibility of sample flooding, the arsenic and lead results for 401-2-J04-081717 were "R" qualified (unusable).

After it was discovered that sample 401-2-J04-081717 was likely flooded during transport, all samples with total solids results below 90 percent were reviewed by ALS laboratory staff on February 9, 2018. Sample jars with total solids results below 90 percent were photographed by ALS and reviewed by Ramboll. Upon visual inspection of the photographs, it was determined that sample 441-1-B01-082217 (in SDG K1708971),

which had a total solids results of 61.8 percent, may also have been flooded during transport. The cooler receipt form from ALS did not include a note about insufficient or melted ice in the cooler. Arsenic and lead results for this sample were within control limits. All other samples appeared in good condition. Because of the possibility of flooding, the arsenic and lead results for 441-1-B01-082217 were "R" qualified (unusable).

Data validation results for arsenic and lead are summarized in Table 5, Summary of Arsenic Phase IA Part 1 Data Validation Results and Table 6, Summary of Lead Phase IA Part 1 Data Validation Results, respectively. All of the lead and arsenic analytical results were reported at concentrations above the reporting limits. All arsenic samples met the laboratory and field control criteria specified by the Work Plan and the laboratory, so no data qualifiers were assigned to arsenic samples. Several SDGs had MS and MSD percent recovery values for lead that were outside the acceptable data accuracy and data precision control limits specified in the Work Plan and by the laboratory. All percent recovery values in the LCS and method blanks for lead were within the acceptable range. Analytical results associated with MS and MSDs where the percent recovery values were outside of laboratory control limits were assigned either an "N" or "#" qualifier by ALS Environmental, where "N" indicates the 'MS sample recovery is not within control limits', and "#" indicates the 'control criteria are not applicable'. Ramboll reviewed the information provided by ALS Environmental for the MS, MSD, and LCS analyses that were outside of the control criteria, and made the following determinations about data quality:

In SDGs K1708843, K1708974, and K1708844, for the Method 6010C analysis for lead, the laboratory noted that the MSD Percent Recovery (%R) value exceeded the upper laboratory control limit. Because the LCS %R value was acceptable, the laboratory did not perform a post-digestion spike analysis. Lead concentrations detected above the reporting limit are "J+" qualified (results estimated, potential high bias).

In SDGs K1708973, K1708980, K1708981, K1708983, K1708984, and K1709014, for the Method 6010C analysis for lead, the laboratory noted that the MS %R value was below the lower acceptable laboratory limit for lead due to the heterogeneous character of the sample. Because the LCS %R value was acceptable, the laboratory did not perform a post-digestion spike analysis. Lead concentrations detected above the reporting limits are "J-" qualified (results estimated, potential low bias).

In SDGs K1708842, K1708845, K1708846, K1708847, K1708848, K1708849, K1708850, K1708852, K1708975, K1708979, and K1708982, for the Method 6010C analysis for lead, the MS/MSD %R values exceeded the upper acceptable laboratory limits. However, spike recovery limits do not apply when the concentration of the spike added is less than 4 times the concentration of the analyte in the sample that is spiked, as is the case for these SDGs. Because the LCS %R values for lead is acceptable, no data qualification is necessary.

Results for lead for Sample 401-2-C09-081617, and its field duplicate, 401-2-C09-081617-D, and Sample 258-3-B10-082117, and its field duplicate, 258-3-B10-082117-D, exceeded the field duplicate RPD limit. Arsenic and total solids results were within the acceptable range for these samples. Soil lead variation is typical under normal field conditions, and the variability in these results can likely be attributed to characteristic lead heterogeneity in soil.

Although a field duplicate RPD for total solids was not specified in the Work Plan, the total solids field duplicate RPD for Sample 401-2-J04-081717, and its field duplicate, Sample 401-2-J04-081717-D, was elevated compared to other samples. The RPD for these samples analyzed for total solids was 42.6 percent, whereas the RPD for all other field duplicates analyzed for

total solids was below four percent. This is discussed further above. No samples exceeded the arsenic field duplicate RPD criteria. No data qualifiers were assigned to samples exceeding field duplicate RPD criteria, but these sample results will be discussed in the SATES Phase IA Data Summary Report.

Of the 630 samples analyzed for lead, arsenic, and total solids, Ramboll's data validation assessment resulted in 60 lead data points being "J+" qualified, 115 lead data points being "J-" qualified, two lead data points being rejected, and two arsenic data points being rejected. No other validation qualifiers were assigned for the lead, arsenic, or total solids results.

4. Conclusions

Based on the Level 2 Data Validation Assessment of the SATES Phase IA Part 1 soil data, Ramboll has determined all data are acceptable, with the exception of four data points being rejected for samples 401-2-J04-081717 and 441-1-B01-082217. Additionally, 175 lead results were qualified as estimated concentrations. All but four (i.e., arsenic and lead results for samples 401-2-J04-081717 and 441-1-B01-082217) of the data points are useable for future analysis and reporting.

5. References

Ramboll Environ U.S. Corporation (Ramboll). 2017. FINAL Work Plan for the Soil Amendment Technology Evaluation Study Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation. Prepared for Teck American Incorporated. Seattle, WA.

United States Environmental Protection Agency (USEPA). 2007. Method 6010C (SW-846): Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 3. Office of Research and Development, National Homeland Security Research Center. Cincinnati, OH.

United States Environmental Protection Agency (USEPA). 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. OSWER 9355.0-131. Office of Superfund Remediation and Technology Innovation. Washington, D.C.

TABLES

Table 1. Reports and Sample Delivery Groups Reviewed			
SDG No.	**Number of Samples**	**Sample Matrix**	**ALS Environmental Report Date**
K1708839	20	Soil	09/06/2017
K1708840	20	Soil	09/05/2017
K1708841	20	Soil	09/05/2017
K1708842	20	Soil	09/05/2017
K1708843	20	Soil	09/05/2017
K1708844	20	Soil	09/05/2017
K1708845	20	Soil	09/05/2017
K1708846	20	Soil	09/05/2017
K1708847	20	Soil	09/05/2017
K1708848	20	Soil	09/05/2017
K1708849	20	Soil	09/05/2017
K1708850	20	Soil	09/05/2017
K1708851	20	Soil	09/05/2017
K1708852	3	Soil	09/07/2017
K1708945	20	Soil	09/07/2017
K1708951	20	Soil	09/07/2017
K1708957	12	Soil	09/08/2017
K1708960	20	Soil	09/08/2017
K1708961	12	Soil	09/08/2017
K1708964	20	Soil	09/08/2017
K1708967	12	Soil	09/12/2017
K1708971	20	Soil	09/08/2017
K1708973	20	Soil	09/08/2017
K1708974	20	Soil	09/08/2017
K1708975	20	Soil	09/12/2017
K1708976	13	Soil	09/12/2017
K1708977	20	Soil	09/12/2017
K1708979	20	Soil	09/12/2017
K1708980	20	Soil	09/12/2017
K1708981	20	Soil	09/12/2017
K1708982	11	Soil	09/12/2017
K1708983	20	Soil	09/12/2017
K1708984	15	Soil	09/12/2017
K1709014	20	Soil	09/12/2017
K1709015	12	Soil	09/13/2017

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
258-1-A01-082117	K1708977	K1708977-001	8/21/2017	Soil
258-1-A02-082117	K1708977	K1708977-002	8/21/2017	Soil
258-1-A03-082117	K1708977	K1708977-003	8/21/2017	Soil
258-1-A04-082117	K1708977	K1708977-004	8/21/2017	Soil
258-1-A05-082117	K1708977	K1708977-005	8/21/2017	Soil
258-1-A06-082117	K1708977	K1708977-006	8/21/2017	Soil
258-1-A07-082117	K1708977	K1708977-007	8/21/2017	Soil
258-1-A08-082117	K1708977	K1708977-008	8/21/2017	Soil
258-1-A09-082117	K1708977	K1708977-009	8/21/2017	Soil
258-1-A10-082117	K1708977	K1708977-010	8/21/2017	Soil
258-1-B01-082117	K1708977	K1708977-011	8/21/2017	Soil
258-1-B02-082117	K1708977	K1708977-012	8/21/2017	Soil
258-1-B03-082117	K1708977	K1708977-013	8/21/2017	Soil
258-1-B04-082117	K1708977	K1708977-014	8/21/2017	Soil
258-1-B05-082117	K1708977	K1708977-015	8/21/2017	Soil
258-1-B06-082117	K1708977	K1708977-016	8/21/2017	Soil
258-1-B07-082117	K1708977	K1708977-017	8/21/2017	Soil
258-1-B08-082117	K1708977	K1708977-018	8/21/2017	Soil
258-1-B09-082117	K1708977	K1708977-019	8/21/2017	Soil
258-1-B10-082117	K1708977	K1708977-020	8/21/2017	Soil
258-1-C01-082117	K1708984	K1708984-001	8/21/2017	Soil
258-1-C02-082117	K1708984	K1708984-002	8/21/2017	Soil
258-1-C02-082117-D	K1708984	K1708984-011	8/21/2017	Soil
258-1-C03-082117	K1708984	K1708984-003	8/21/2017	Soil
258-1-C04-082117	K1708984	K1708984-004	8/21/2017	Soil
258-1-C05-082117	K1708984	K1708984-005	8/21/2017	Soil
258-1-C06-082117	K1708984	K1708984-006	8/21/2017	Soil
258-1-C07-082117	K1708984	K1708984-007	8/21/2017	Soil
258-1-C08-082117	K1708984	K1708984-008	8/21/2017	Soil
258-1-C09-082117	K1708984	K1708984-009	8/21/2017	Soil
258-1-C10-082117	K1708984	K1708984-010	8/21/2017	Soil
258-1-D01-082117	K1708964	K1708964-001	8/21/2017	Soil
258-1-D02-082117	K1708964	K1708964-002	8/21/2017	Soil
258-1-D03-082117	K1708964	K1708964-003	8/21/2017	Soil
258-1-D04-082117	K1708964	K1708964-004	8/21/2017	Soil
258-1-D05-082117	K1708964	K1708964-005	8/21/2017	Soil
258-1-D05-082117-D	K1708964	K1708964-011	8/21/2017	Soil
258-1-D06-082117	K1708964	K1708964-006	8/21/2017	Soil
258-1-D07-082117	K1708964	K1708964-007	8/21/2017	Soil
258-1-D08-082117	K1708964	K1708964-008	8/21/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
258-1-D09-082117	K1708964	K1708964-009	8/21/2017	Soil
258-1-D10-082117	K1708964	K1708964-010	8/21/2017	Soil
258-1-E01-082117	K1708964	K1708964-012	8/21/2017	Soil
258-1-E02-082117	K1708964	K1708964-013	8/21/2017	Soil
258-1-E03-082117	K1708964	K1708964-014	8/21/2017	Soil
258-1-E04-082117	K1708964	K1708964-015	8/21/2017	Soil
258-1-E05-082117	K1708964	K1708964-016	8/21/2017	Soil
258-1-E06-082117	K1708964	K1708964-017	8/21/2017	Soil
258-1-E07-082117	K1708964	K1708964-018	8/21/2017	Soil
258-1-E08-082117	K1708964	K1708964-019	8/21/2017	Soil
258-1-E09-082117	K1708964	K1708964-020	8/21/2017	Soil
258-1-E10-082117	K1708967	K1708967-001	8/21/2017	Soil
258-1-E10-082117-D	K1708967	K1708967-002	8/21/2017	Soil
258-1-F01-082117	K1708967	K1708967-003	8/21/2017	Soil
258-1-F02-082117	K1708967	K1708967-004	8/21/2017	Soil
258-1-F03-082117	K1708967	K1708967-005	8/21/2017	Soil
258-1-F04-082117	K1708967	K1708967-006	8/21/2017	Soil
258-1-F05-082117	K1708967	K1708967-007	8/21/2017	Soil
258-1-F06-082117	K1708967	K1708967-008	8/21/2017	Soil
258-1-F07-082117	K1708967	K1708967-009	8/21/2017	Soil
258-1-F08-082117	K1708967	K1708967-010	8/21/2017	Soil
258-1-F09-082117	K1708967	K1708967-011	8/21/2017	Soil
258-1-F10-082117	K1708967	K1708967-012	8/21/2017	Soil
258-1-G01-082117	K1708981	K1708981-001	8/21/2017	Soil
258-1-G02-082117	K1708981	K1708981-002	8/21/2017	Soil
258-1-G03-082117	K1708981	K1708981-003	8/21/2017	Soil
258-1-G04-082117	K1708981	K1708981-004	8/21/2017	Soil
258-1-G05-082117	K1708981	K1708981-005	8/21/2017	Soil
258-1-G06-082117	K1708981	K1708981-006	8/21/2017	Soil
258-1-G07-082117	K1708981	K1708981-007	8/21/2017	Soil
258-1-G08-082117	K1708981	K1708981-008	8/21/2017	Soil
258-1-G09-082117	K1708981	K1708981-009	8/21/2017	Soil
258-1-G10-082117	K1708981	K1708981-010	8/21/2017	Soil
258-1-H01-082117	K1708981	K1708981-011	8/21/2017	Soil
258-1-H02-082117	K1708981	K1708981-012	8/21/2017	Soil
258-1-H03-082117	K1708981	K1708981-013	8/21/2017	Soil
258-1-H04-082117	K1708981	K1708981-014	8/21/2017	Soil
258-1-H05-082117	K1708981	K1708981-015	8/21/2017	Soil
258-1-H06-082117	K1708981	K1708981-016	8/21/2017	Soil
258-1-H07-082117	K1708981	K1708981-017	8/21/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
258-1-H08-082117	K1708981	K1708981-018	8/21/2017	Soil
258-1-H09-082117	K1708981	K1708981-019	8/21/2017	Soil
258-1-H10-082117	K1708981	K1708981-020	8/21/2017	Soil
258-1-I01-082117	K1708983	K1708983-001	8/21/2017	Soil
258-1-I02-082117	K1708983	K1708983-002	8/21/2017	Soil
258-1-I03-082117	K1708983	K1708983-003	8/21/2017	Soil
258-1-I04-082117	K1708983	K1708983-004	8/21/2017	Soil
258-1-I05-082117	K1708983	K1708983-005	8/21/2017	Soil
258-1-I06-082117	K1708983	K1708983-006	8/21/2017	Soil
258-1-I07-082117	K1708983	K1708983-007	8/21/2017	Soil
258-1-I07-082117-D	K1708984	K1708984-013	8/21/2017	Soil
258-1-I08-082117	K1708983	K1708983-008	8/21/2017	Soil
258-1-I09-082117	K1708983	K1708983-009	8/21/2017	Soil
258-1-I10-082117	K1708983	K1708983-010	8/21/2017	Soil
258-1-J01-082117	K1708983	K1708983-011	8/21/2017	Soil
258-1-J01-082117-D	K1708984	K1708984-012	8/21/2017	Soil
258-1-J02-082117	K1708983	K1708983-012	8/21/2017	Soil
258-1-J03-082117	K1708983	K1708983-013	8/21/2017	Soil
258-1-J04-082117	K1708983	K1708983-014	8/21/2017	Soil
258-1-J05-082117	K1708983	K1708983-015	8/21/2017	Soil
258-1-J06-082117	K1708983	K1708983-016	8/21/2017	Soil
258-1-J07-082117	K1708983	K1708983-017	8/21/2017	Soil
258-1-J08-082117	K1708983	K1708983-018	8/21/2017	Soil
258-1-J09-082117	K1708983	K1708983-019	8/21/2017	Soil
258-1-J10-082117	K1708983	K1708983-020	8/21/2017	Soil
258-2-A01-081917	K1708945	K1708945-001	8/19/2017	Soil
258-2-A02-081917	K1708945	K1708945-002	8/19/2017	Soil
258-2-A03-081917	K1708945	K1708945-003	8/19/2017	Soil
258-2-A04-081917	K1708945	K1708945-004	8/19/2017	Soil
258-2-A05-081917	K1708945	K1708945-005	8/19/2017	Soil
258-2-A06-081917	K1708945	K1708945-006	8/19/2017	Soil
258-2-A07-081917	K1708945	K1708945-007	8/19/2017	Soil
258-2-A08-081917	K1708945	K1708945-008	8/19/2017	Soil
258-2-A09-081917	K1708945	K1708945-009	8/19/2017	Soil
258-2-A10-081917	K1708945	K1708945-010	8/19/2017	Soil
258-2-B01-081917	K1708945	K1708945-011	8/19/2017	Soil
258-2-B02-081917	K1708945	K1708945-012	8/19/2017	Soil
258-2-B03-081917	K1708945	K1708945-013	8/19/2017	Soil
258-2-B04-081917	K1708945	K1708945-014	8/19/2017	Soil
258-2-B05-081917	K1708945	K1708945-015	8/19/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
258-2-B06-081917	K1708945	K1708945-016	8/19/2017	Soil
258-2-B07-081917	K1708945	K1708945-017	8/19/2017	Soil
258-2-B08-081917	K1708945	K1708945-018	8/19/2017	Soil
258-2-B09-081917	K1708945	K1708945-019	8/19/2017	Soil
258-2-B10-081917	K1708945	K1708945-020	8/19/2017	Soil
258-2-C01-081917	K1708951	K1708951-001	8/19/2017	Soil
258-2-C02-081917	K1708951	K1708951-002	8/19/2017	Soil
258-2-C03-081917	K1708951	K1708951-003	8/19/2017	Soil
258-2-C04-081917	K1708951	K1708951-004	8/19/2017	Soil
258-2-C05-081917	K1708951	K1708951-005	8/19/2017	Soil
258-2-C06-081917	K1708951	K1708951-006	8/19/2017	Soil
258-2-C06-081917-D	K1708951	K1708951-011	8/19/2017	Soil
258-2-C07-081917	K1708951	K1708951-007	8/19/2017	Soil
258-2-C08-081917	K1708951	K1708951-008	8/19/2017	Soil
258-2-C09-081917	K1708951	K1708951-009	8/19/2017	Soil
258-2-C10-081917	K1708951	K1708951-010	8/19/2017	Soil
258-2-D01-081917	K1708951	K1708951-012	8/19/2017	Soil
258-2-D01-081917-D	K1708957	K1708957-002	8/19/2017	Soil
258-2-D02-081917	K1708951	K1708951-013	8/19/2017	Soil
258-2-D03-081917	K1708951	K1708951-014	8/19/2017	Soil
258-2-D04-081917	K1708951	K1708951-015	8/19/2017	Soil
258-2-D05-081917	K1708951	K1708951-016	8/19/2017	Soil
258-2-D06-081917	K1708951	K1708951-017	8/19/2017	Soil
258-2-D07-081917	K1708951	K1708951-018	8/19/2017	Soil
258-2-D08-081917	K1708951	K1708951-019	8/19/2017	Soil
258-2-D09-081917	K1708951	K1708951-020	8/19/2017	Soil
258-2-D10-081917	K1708957	K1708957-001	8/19/2017	Soil
258-2-E01-081917	K1708957	K1708957-003	8/19/2017	Soil
258-2-E02-081917	K1708957	K1708957-004	8/19/2017	Soil
258-2-E03-081917	K1708957	K1708957-005	8/19/2017	Soil
258-2-E04-081917	K1708957	K1708957-006	8/19/2017	Soil
258-2-E05-081917	K1708957	K1708957-007	8/19/2017	Soil
258-2-E06-081917	K1708957	K1708957-008	8/19/2017	Soil
258-2-E07-081917	K1708957	K1708957-009	8/19/2017	Soil
258-2-E08-081917	K1708957	K1708957-010	8/19/2017	Soil
258-2-E09-081917	K1708957	K1708957-011	8/19/2017	Soil
258-2-E10-081917	K1708957	K1708957-012	8/19/2017	Soil
258-2-F01-081917	K1708839	K1708839-001	8/19/2017	Soil
258-2-F02-081917	K1708839	K1708839-002	8/19/2017	Soil
258-2-F03-081917	K1708839	K1708839-003	8/19/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
258-2-F04-081917	K1708839	K1708839-004	8/19/2017	Soil
258-2-F05-081917	K1708839	K1708839-005	8/19/2017	Soil
258-2-F06-081917	K1708839	K1708839-006	8/19/2017	Soil
258-2-F07-081917	K1708839	K1708839-007	8/19/2017	Soil
258-2-F08-081917	K1708839	K1708839-008	8/19/2017	Soil
258-2-F09-081917	K1708839	K1708839-009	8/19/2017	Soil
258-2-F10-081917	K1708839	K1708839-010	8/19/2017	Soil
258-2-F10-081917-D	K1708839	K1708839-011	8/19/2017	Soil
258-2-G01-081917	K1708839	K1708839-012	8/19/2017	Soil
258-2-G02-081917	K1708839	K1708839-013	8/19/2017	Soil
258-2-G03-081917	K1708839	K1708839-014	8/19/2017	Soil
258-2-G04-081917	K1708839	K1708839-015	8/19/2017	Soil
258-2-G05-081917	K1708839	K1708839-016	8/19/2017	Soil
258-2-G06-081917	K1708839	K1708839-017	8/19/2017	Soil
258-2-G07-081917	K1708839	K1708839-018	8/19/2017	Soil
258-2-G08-081917	K1708839	K1708839-019	8/19/2017	Soil
258-2-G09-081917	K1708839	K1708839-020	8/19/2017	Soil
258-2-G10-081917	K1708840	K1708840-001	8/19/2017	Soil
258-2-H01-081917	K1708840	K1708840-002	8/19/2017	Soil
258-2-H01-081917-D	K1708840	K1708840-012	8/19/2017	Soil
258-2-H02-081917	K1708840	K1708840-003	8/19/2017	Soil
258-2-H03-081917	K1708840	K1708840-004	8/19/2017	Soil
258-2-H04-081917	K1708840	K1708840-005	8/19/2017	Soil
258-2-H05-081917	K1708840	K1708840-006	8/19/2017	Soil
258-2-H06-081917	K1708840	K1708840-007	8/19/2017	Soil
258-2-H07-081917	K1708840	K1708840-008	8/19/2017	Soil
258-2-H08-081917	K1708840	K1708840-009	8/19/2017	Soil
258-2-H09-081917	K1708840	K1708840-010	8/19/2017	Soil
258-2-H10-081917	K1708840	K1708840-011	8/19/2017	Soil
258-2-I01-081917	K1708840	K1708840-013	8/19/2017	Soil
258-2-I02-081917	K1708840	K1708840-014	8/19/2017	Soil
258-2-I03-081917	K1708840	K1708840-015	8/19/2017	Soil
258-2-I04-081917	K1708840	K1708840-016	8/19/2017	Soil
258-2-I05-081917	K1708840	K1708840-017	8/19/2017	Soil
258-2-I06-081917	K1708840	K1708840-018	8/19/2017	Soil
258-2-I07-081917	K1708840	K1708840-019	8/19/2017	Soil
258-2-I08-081917	K1708840	K1708840-020	8/19/2017	Soil
258-2-I09-081917	K1708841	K1708841-001	8/19/2017	Soil
258-2-I10-081917	K1708841	K1708841-002	8/19/2017	Soil
258-2-J01-081917	K1708841	K1708841-003	8/19/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
258-2-J02-081917	K1708841	K1708841-004	8/19/2017	Soil
258-2-J03-081917	K1708841	K1708841-005	8/19/2017	Soil
258-2-J04-081917	K1708841	K1708841-006	8/19/2017	Soil
258-2-J05-081917	K1708841	K1708841-007	8/19/2017	Soil
258-2-J05-081917-D	K1708841	K1708841-013	8/19/2017	Soil
258-2-J06-081917	K1708841	K1708841-008	8/19/2017	Soil
258-2-J07-081917	K1708841	K1708841-009	8/19/2017	Soil
258-2-J08-081917	K1708841	K1708841-010	8/19/2017	Soil
258-2-J09-081917	K1708841	K1708841-011	8/19/2017	Soil
258-2-J10-081917	K1708841	K1708841-012	8/19/2017	Soil
258-3-A01-082117	K1708973	K1708973-001	8/21/2017	Soil
258-3-A02-082117	K1708973	K1708973-002	8/21/2017	Soil
258-3-A03-082117	K1708973	K1708973-003	8/21/2017	Soil
258-3-A04-082117	K1708973	K1708973-004	8/21/2017	Soil
258-3-A05-082117	K1708973	K1708973-005	8/21/2017	Soil
258-3-A06-082117	K1708973	K1708973-006	8/21/2017	Soil
258-3-A07-082117	K1708973	K1708973-007	8/21/2017	Soil
258-3-A08-082117	K1708973	K1708973-008	8/21/2017	Soil
258-3-A09-082117	K1708973	K1708973-009	8/21/2017	Soil
258-3-A10-082117	K1708973	K1708973-010	8/21/2017	Soil
258-3-B01-082117	K1708973	K1708973-011	8/21/2017	Soil
258-3-B02-082117	K1708973	K1708973-012	8/21/2017	Soil
258-3-B03-082117	K1708973	K1708973-013	8/21/2017	Soil
258-3-B04-082117	K1708973	K1708973-014	8/21/2017	Soil
258-3-B05-082117	K1708973	K1708973-015	8/21/2017	Soil
258-3-B06-082117	K1708973	K1708973-016	8/21/2017	Soil
258-3-B07-082117	K1708973	K1708973-017	8/21/2017	Soil
258-3-B08-082117	K1708973	K1708973-018	8/21/2017	Soil
258-3-B09-082117	K1708973	K1708973-019	8/21/2017	Soil
258-3-B10-082117	K1708973	K1708973-020	8/21/2017	Soil
258-3-B10-082117-D	K1708976	K1708976-011	8/21/2017	Soil
258-3-C01-082217	K1708976	K1708976-001	8/22/2017	Soil
258-3-C02-082217	K1708976	K1708976-002	8/22/2017	Soil
258-3-C03-082217	K1708976	K1708976-003	8/22/2017	Soil
258-3-C04-082217	K1708976	K1708976-004	8/22/2017	Soil
258-3-C05-082217	K1708976	K1708976-005	8/22/2017	Soil
258-3-C06-082217	K1708976	K1708976-006	8/22/2017	Soil
258-3-C07-082217	K1708976	K1708976-007	8/22/2017	Soil
258-3-C08-082217	K1708976	K1708976-008	8/22/2017	Soil
258-3-C09-082217	K1708976	K1708976-009	8/22/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
258-3-C10-082217	K1708976	K1708976-010	8/22/2017	Soil
258-3-D01-082217	K1708960	K1708960-001	8/22/2017	Soil
258-3-D02-082217	K1708960	K1708960-002	8/22/2017	Soil
258-3-D03-082217	K1708960	K1708960-003	8/22/2017	Soil
258-3-D04-082217	K1708960	K1708960-004	8/22/2017	Soil
258-3-D05-082217	K1708960	K1708960-005	8/22/2017	Soil
258-3-D06-082217	K1708960	K1708960-006	8/22/2017	Soil
258-3-D07-082217	K1708960	K1708960-007	8/22/2017	Soil
258-3-D08-082217	K1708960	K1708960-008	8/22/2017	Soil
258-3-D09-082217	K1708960	K1708960-009	8/22/2017	Soil
258-3-D09-082217-D	K1708960	K1708960-011	8/22/2017	Soil
258-3-D10-082217	K1708960	K1708960-010	8/22/2017	Soil
258-3-E01-082217	K1708960	K1708960-012	8/22/2017	Soil
258-3-E02-082217	K1708960	K1708960-013	8/22/2017	Soil
258-3-E03-082217	K1708960	K1708960-014	8/22/2017	Soil
258-3-E04-082217	K1708960	K1708960-015	8/22/2017	Soil
258-3-E05-082217	K1708960	K1708960-016	8/22/2017	Soil
258-3-E06-082217	K1708960	K1708960-017	8/22/2017	Soil
258-3-E07-082217	K1708960	K1708960-018	8/22/2017	Soil
258-3-E08-082217	K1708960	K1708960-019	8/22/2017	Soil
258-3-E09-082217	K1708960	K1708960-020	8/22/2017	Soil
258-3-E10-082217	K1708961	K1708961-001	8/22/2017	Soil
258-3-F01-082217	K1708961	K1708961-002	8/22/2017	Soil
258-3-F01-082217-D	K1708961	K1708961-012	8/22/2017	Soil
258-3-F02-082217	K1708961	K1708961-003	8/22/2017	Soil
258-3-F03-082217	K1708961	K1708961-004	8/22/2017	Soil
258-3-F04-082217	K1708961	K1708961-005	8/22/2017	Soil
258-3-F05-082217	K1708961	K1708961-006	8/22/2017	Soil
258-3-F06-082217	K1708961	K1708961-007	8/22/2017	Soil
258-3-F07-082217	K1708961	K1708961-008	8/22/2017	Soil
258-3-F08-082217	K1708961	K1708961-009	8/22/2017	Soil
258-3-F09-082217	K1708961	K1708961-010	8/22/2017	Soil
258-3-F10-082217	K1708961	K1708961-011	8/22/2017	Soil
258-3-G01-082217	K1708974	K1708974-001	8/22/2017	Soil
258-3-G02-082217	K1708974	K1708974-002	8/22/2017	Soil
258-3-G03-082217	K1708974	K1708974-003	8/22/2017	Soil
258-3-G04-082217	K1708974	K1708974-004	8/22/2017	Soil
258-3-G05-082217	K1708974	K1708974-005	8/22/2017	Soil
258-3-G06-082217	K1708974	K1708974-006	8/22/2017	Soil
258-3-G07-082217	K1708974	K1708974-007	8/22/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
258-3-G08-082217	K1708974	K1708974-008	8/22/2017	Soil
258-3-G09-082217	K1708974	K1708974-009	8/22/2017	Soil
258-3-G10-082217	K1708974	K1708974-010	8/22/2017	Soil
258-3-H01-082217	K1708974	K1708974-011	8/22/2017	Soil
258-3-H02-082217	K1708974	K1708974-012	8/22/2017	Soil
258-3-H03-082217	K1708974	K1708974-013	8/22/2017	Soil
258-3-H04-082217	K1708974	K1708974-014	8/22/2017	Soil
258-3-H05-082217	K1708974	K1708974-015	8/22/2017	Soil
258-3-H06-082217	K1708974	K1708974-016	8/22/2017	Soil
258-3-H07-082217	K1708974	K1708974-017	8/22/2017	Soil
258-3-H07-082217-D	K1708976	K1708976-012	8/22/2017	Soil
258-3-H08-082217	K1708974	K1708974-018	8/22/2017	Soil
258-3-H09-082217	K1708974	K1708974-019	8/22/2017	Soil
258-3-H10-082217	K1708974	K1708974-020	8/22/2017	Soil
258-3-I01-082217	K1708975	K1708975-001	8/22/2017	Soil
258-3-I02-082217	K1708975	K1708975-002	8/22/2017	Soil
258-3-I03-082217	K1708975	K1708975-003	8/22/2017	Soil
258-3-I04-082217	K1708975	K1708975-004	8/22/2017	Soil
258-3-I05-082217	K1708975	K1708975-005	8/22/2017	Soil
258-3-I06-082217	K1708975	K1708975-006	8/22/2017	Soil
258-3-I07-082217	K1708975	K1708975-007	8/22/2017	Soil
258-3-I08-082217	K1708975	K1708975-008	8/22/2017	Soil
258-3-I09-082217	K1708975	K1708975-009	8/22/2017	Soil
258-3-I10-082217	K1708975	K1708975-010	8/22/2017	Soil
258-3-J01-082217	K1708975	K1708975-011	8/22/2017	Soil
258-3-J02-082217	K1708975	K1708975-012	8/22/2017	Soil
258-3-J03-082217	K1708975	K1708975-013	8/22/2017	Soil
258-3-J04-082217	K1708975	K1708975-014	8/22/2017	Soil
258-3-J04-082217-D	K1708976	K1708976-013	8/22/2017	Soil
258-3-J05-082217	K1708975	K1708975-015	8/22/2017	Soil
258-3-J06-082217	K1708975	K1708975-016	8/22/2017	Soil
258-3-J07-082217	K1708975	K1708975-017	8/22/2017	Soil
258-3-J08-082217	K1708975	K1708975-018	8/22/2017	Soil
258-3-J09-082217	K1708975	K1708975-019	8/22/2017	Soil
258-3-J10-082217	K1708975	K1708975-020	8/22/2017	Soil
401-1-A01-081817	K1708847	K1708847-019	8/18/2017	Soil
401-1-A02-081817	K1708847	K1708847-020	8/18/2017	Soil
401-1-A03-081817	K1708845	K1708845-001	8/18/2017	Soil
401-1-A04-081817	K1708845	K1708845-002	8/18/2017	Soil
401-1-A05-081817	K1708845	K1708845-003	8/18/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
401-1-A06-081817	K1708845	K1708845-004	8/18/2017	Soil
401-1-A06-081817-D	K1708845	K1708845-009	8/18/2017	Soil
401-1-A07-081817	K1708845	K1708845-005	8/18/2017	Soil
401-1-A08-081817	K1708845	K1708845-006	8/18/2017	Soil
401-1-A09-081817	K1708845	K1708845-007	8/18/2017	Soil
401-1-A10-081817	K1708845	K1708845-008	8/18/2017	Soil
401-1-B01-081817	K1708845	K1708845-010	8/18/2017	Soil
401-1-B02-081817	K1708845	K1708845-011	8/18/2017	Soil
401-1-B03-081817	K1708845	K1708845-012	8/18/2017	Soil
401-1-B04-081817	K1708845	K1708845-013	8/18/2017	Soil
401-1-B05-081817	K1708845	K1708845-014	8/18/2017	Soil
401-1-B06-081817	K1708845	K1708845-015	8/18/2017	Soil
401-1-B07-081817	K1708845	K1708845-016	8/18/2017	Soil
401-1-B08-081817	K1708845	K1708845-017	8/18/2017	Soil
401-1-B09-081817	K1708845	K1708845-018	8/18/2017	Soil
401-1-B10-081817	K1708845	K1708845-019	8/18/2017	Soil
401-1-C01-081817	K1708845	K1708845-020	8/18/2017	Soil
401-1-C02-081817	K1708849	K1708849-001	8/18/2017	Soil
401-1-C03-081817	K1708849	K1708849-002	8/18/2017	Soil
401-1-C04-081817	K1708849	K1708849-003	8/18/2017	Soil
401-1-C05-081817	K1708849	K1708849-004	8/18/2017	Soil
401-1-C06-081817	K1708849	K1708849-005	8/18/2017	Soil
401-1-C07-081817	K1708849	K1708849-006	8/18/2017	Soil
401-1-C08-081817	K1708849	K1708849-007	8/18/2017	Soil
401-1-C09-081817	K1708849	K1708849-008	8/18/2017	Soil
401-1-C09-081817-D	K1708849	K1708849-010	8/18/2017	Soil
401-1-C10-081817	K1708849	K1708849-009	8/18/2017	Soil
401-1-D01-081817	K1708849	K1708849-011	8/18/2017	Soil
401-1-D02-081817	K1708849	K1708849-012	8/18/2017	Soil
401-1-D03-081817	K1708849	K1708849-013	8/18/2017	Soil
401-1-D04-081817	K1708849	K1708849-014	8/18/2017	Soil
401-1-D05-081817	K1708849	K1708849-015	8/18/2017	Soil
401-1-D06-081817	K1708849	K1708849-016	8/18/2017	Soil
401-1-D07-081817	K1708849	K1708849-017	8/18/2017	Soil
401-1-D08-081817	K1708849	K1708849-018	8/18/2017	Soil
401-1-D09-081817	K1708849	K1708849-019	8/18/2017	Soil
401-1-D10-081817	K1708849	K1708849-020	8/18/2017	Soil
401-1-E01-081817	K1708851	K1708851-001	8/18/2017	Soil
401-1-E02-081817	K1708851	K1708851-002	8/18/2017	Soil
401-1-E02-081817-D	K1708851	K1708851-011	8/18/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
401-1-E03-081817	K1708851	K1708851-003	8/18/2017	Soil
401-1-E04-081817	K1708851	K1708851-004	8/18/2017	Soil
401-1-E05-081817	K1708851	K1708851-005	8/18/2017	Soil
401-1-E06-081817	K1708851	K1708851-006	8/18/2017	Soil
401-1-E07-081817	K1708851	K1708851-007	8/18/2017	Soil
401-1-E08-081817	K1708851	K1708851-008	8/18/2017	Soil
401-1-E09-081817	K1708851	K1708851-009	8/18/2017	Soil
401-1-E10-081817	K1708851	K1708851-010	8/18/2017	Soil
401-1-F01-081817	K1708851	K1708851-012	8/18/2017	Soil
401-1-F02-081817	K1708851	K1708851-013	8/18/2017	Soil
401-1-F03-081817	K1708851	K1708851-014	8/18/2017	Soil
401-1-F04-081817	K1708851	K1708851-015	8/18/2017	Soil
401-1-F05-081817	K1708851	K1708851-016	8/18/2017	Soil
401-1-F06-081817	K1708851	K1708851-017	8/18/2017	Soil
401-1-F07-081817	K1708851	K1708851-018	8/18/2017	Soil
401-1-F08-081817	K1708851	K1708851-019	8/18/2017	Soil
401-1-F09-081817	K1708851	K1708851-020	8/18/2017	Soil
401-1-F10-081817	K1708848	K1708848-001	8/18/2017	Soil
401-1-G01-081817	K1708848	K1708848-002	8/18/2017	Soil
401-1-G02-081817	K1708848	K1708848-003	8/18/2017	Soil
401-1-G03-081817	K1708848	K1708848-004	8/18/2017	Soil
401-1-G04-081817	K1708848	K1708848-005	8/18/2017	Soil
401-1-G05-081817	K1708848	K1708848-006	8/18/2017	Soil
401-1-G06-081817	K1708848	K1708848-007	8/18/2017	Soil
401-1-G07-081817	K1708848	K1708848-008	8/18/2017	Soil
401-1-G08-081817	K1708848	K1708848-009	8/18/2017	Soil
401-1-G09-081817	K1708848	K1708848-010	8/18/2017	Soil
401-1-G09-081817-D	K1708848	K1708848-012	8/18/2017	Soil
401-1-G10-081817	K1708848	K1708848-011	8/18/2017	Soil
401-1-H01-081817	K1708848	K1708848-013	8/18/2017	Soil
401-1-H02-081817	K1708848	K1708848-014	8/18/2017	Soil
401-1-H03-081817	K1708848	K1708848-015	8/18/2017	Soil
401-1-H04-081817	K1708848	K1708848-016	8/18/2017	Soil
401-1-H05-081817	K1708848	K1708848-017	8/18/2017	Soil
401-1-H06-081817	K1708848	K1708848-018	8/18/2017	Soil
401-1-H07-081817	K1708848	K1708848-019	8/18/2017	Soil
401-1-H08-081817	K1708848	K1708848-020	8/18/2017	Soil
401-1-H09-081817	K1708850	K1708850-001	8/18/2017	Soil
401-1-H10-081817	K1708850	K1708850-002	8/18/2017	Soil
401-1-I01-081817	K1708850	K1708850-003	8/18/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
401-1-I02-081817	K1708850	K1708850-004	8/18/2017	Soil
401-1-I03-081817	K1708850	K1708850-005	8/18/2017	Soil
401-1-I04-081817	K1708850	K1708850-006	8/18/2017	Soil
401-1-I05-081817	K1708850	K1708850-007	8/18/2017	Soil
401-1-I05-081817-D	K1708850	K1708850-013	8/18/2017	Soil
401-1-I06-081817	K1708850	K1708850-008	8/18/2017	Soil
401-1-I07-081817	K1708850	K1708850-009	8/18/2017	Soil
401-1-I08-081817	K1708850	K1708850-010	8/18/2017	Soil
401-1-I09-081817	K1708850	K1708850-011	8/18/2017	Soil
401-1-I10-081817	K1708850	K1708850-012	8/18/2017	Soil
401-1-J01-081817	K1708850	K1708850-014	8/18/2017	Soil
401-1-J02-081817	K1708850	K1708850-015	8/18/2017	Soil
401-1-J03-081817	K1708850	K1708850-016	8/18/2017	Soil
401-1-J04-081817	K1708850	K1708850-017	8/18/2017	Soil
401-1-J05-081817	K1708850	K1708850-018	8/18/2017	Soil
401-1-J06-081817	K1708850	K1708850-019	8/18/2017	Soil
401-1-J07-081817	K1708850	K1708850-020	8/18/2017	Soil
401-1-J08-081817	K1708852	K1708852-001	8/18/2017	Soil
401-1-J09-081817	K1708852	K1708852-002	8/18/2017	Soil
401-1-J10-081817	K1708852	K1708852-003	8/18/2017	Soil
401-2-A01-081717	K1708844	K1708844-006	8/17/2017	Soil
401-2-A02-081717	K1708844	K1708844-007	8/17/2017	Soil
401-2-A03-081717	K1708844	K1708844-008	8/17/2017	Soil
401-2-A04-081717	K1708844	K1708844-009	8/17/2017	Soil
401-2-A05-081717	K1708844	K1708844-010	8/17/2017	Soil
401-2-A06-081617	K1708841	K1708841-014	8/16/2017	Soil
401-2-A07-081617	K1708841	K1708841-015	8/16/2017	Soil
401-2-A08-081617	K1708841	K1708841-016	8/16/2017	Soil
401-2-A09-081617	K1708841	K1708841-017	8/16/2017	Soil
401-2-A10-081617	K1708841	K1708841-018	8/16/2017	Soil
401-2-B01-081717	K1708844	K1708844-011	8/17/2017	Soil
401-2-B02-081717	K1708844	K1708844-012	8/17/2017	Soil
401-2-B03-081717	K1708844	K1708844-013	8/17/2017	Soil
401-2-B04-081717	K1708844	K1708844-014	8/17/2017	Soil
401-2-B05-081717	K1708844	K1708844-015	8/17/2017	Soil
401-2-B06-081617	K1708841	K1708841-019	8/16/2017	Soil
401-2-B07-081617	K1708841	K1708841-020	8/16/2017	Soil
401-2-B07-081617-D	K1708842	K1708842-004	8/16/2017	Soil
401-2-B08-081617	K1708842	K1708842-001	8/16/2017	Soil
401-2-B09-081617	K1708842	K1708842-002	8/16/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
401-2-B10-081617	K1708842	K1708842-003	8/16/2017	Soil
401-2-C01-081717	K1708844	K1708844-016	8/17/2017	Soil
401-2-C02-081717	K1708844	K1708844-017	8/17/2017	Soil
401-2-C03-081717	K1708844	K1708844-018	8/17/2017	Soil
401-2-C04-081717	K1708844	K1708844-019	8/17/2017	Soil
401-2-C05-081717	K1708844	K1708844-020	8/17/2017	Soil
401-2-C06-081617	K1708842	K1708842-005	8/16/2017	Soil
401-2-C07-081617	K1708842	K1708842-006	8/16/2017	Soil
401-2-C08-081617	K1708842	K1708842-007	8/16/2017	Soil
401-2-C09-081617	K1708842	K1708842-008	8/16/2017	Soil
401-2-C09-081617-D	K1708842	K1708842-010	8/16/2017	Soil
401-2-C10-081617	K1708842	K1708842-009	8/16/2017	Soil
401-2-D01-081717	K1708846	K1708846-001	8/17/2017	Soil
401-2-D02-081717	K1708846	K1708846-002	8/17/2017	Soil
401-2-D03-081717	K1708846	K1708846-003	8/17/2017	Soil
401-2-D04-081717	K1708846	K1708846-004	8/17/2017	Soil
401-2-D05-081717	K1708846	K1708846-005	8/17/2017	Soil
401-2-D06-081617	K1708842	K1708842-011	8/16/2017	Soil
401-2-D07-081617	K1708842	K1708842-012	8/16/2017	Soil
401-2-D08-081617	K1708842	K1708842-013	8/16/2017	Soil
401-2-D09-081617	K1708842	K1708842-014	8/16/2017	Soil
401-2-D10-081617	K1708842	K1708842-015	8/16/2017	Soil
401-2-E01-081717	K1708846	K1708846-006	8/17/2017	Soil
401-2-E02-081717	K1708846	K1708846-007	8/17/2017	Soil
401-2-E03-081717	K1708846	K1708846-008	8/17/2017	Soil
401-2-E04-081717	K1708846	K1708846-009	8/17/2017	Soil
401-2-E05-081717	K1708846	K1708846-010	8/17/2017	Soil
401-2-E05-081717-D	K1708846	K1708846-011	8/17/2017	Soil
401-2-E06-081617	K1708842	K1708842-016	8/16/2017	Soil
401-2-E07-081617	K1708842	K1708842-017	8/16/2017	Soil
401-2-E08-081617	K1708842	K1708842-018	8/16/2017	Soil
401-2-E09-081617	K1708842	K1708842-019	8/16/2017	Soil
401-2-E10-081617	K1708842	K1708842-020	8/16/2017	Soil
401-2-F01-081717	K1708846	K1708846-012	8/17/2017	Soil
401-2-F02-081717	K1708846	K1708846-013	8/17/2017	Soil
401-2-F03-081717	K1708846	K1708846-014	8/17/2017	Soil
401-2-F04-081717	K1708846	K1708846-015	8/17/2017	Soil
401-2-F05-081717	K1708846	K1708846-016	8/17/2017	Soil
401-2-F06-081617	K1708843	K1708843-001	8/16/2017	Soil
401-2-F07-081617	K1708843	K1708843-002	8/16/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
401-2-F08-081617	K1708843	K1708843-003	8/16/2017	Soil
401-2-F09-081617	K1708843	K1708843-004	8/16/2017	Soil
401-2-F10-081617	K1708843	K1708843-005	8/16/2017	Soil
401-2-G01-081717	K1708846	K1708846-017	8/17/2017	Soil
401-2-G02-081717	K1708846	K1708846-018	8/17/2017	Soil
401-2-G02-081717-D	K1708847	K1708847-002	8/17/2017	Soil
401-2-G03-081717	K1708846	K1708846-019	8/17/2017	Soil
401-2-G04-081717	K1708846	K1708846-020	8/17/2017	Soil
401-2-G05-081717	K1708847	K1708847-001	8/17/2017	Soil
401-2-G06-081617	K1708843	K1708843-006	8/16/2017	Soil
401-2-G07-081617	K1708843	K1708843-007	8/16/2017	Soil
401-2-G08-081617	K1708843	K1708843-008	8/16/2017	Soil
401-2-G09-081617	K1708843	K1708843-009	8/16/2017	Soil
401-2-G10-081617	K1708843	K1708843-010	8/16/2017	Soil
401-2-H01-081717	K1708847	K1708847-003	8/17/2017	Soil
401-2-H02-081717	K1708847	K1708847-004	8/17/2017	Soil
401-2-H03-081717	K1708847	K1708847-005	8/17/2017	Soil
401-2-H04-081717	K1708847	K1708847-006	8/17/2017	Soil
401-2-H05-081717	K1708847	K1708847-007	8/17/2017	Soil
401-2-H06-081617	K1708843	K1708843-011	8/16/2017	Soil
401-2-H07-081617	K1708843	K1708843-012	8/16/2017	Soil
401-2-H08-081617	K1708843	K1708843-013	8/16/2017	Soil
401-2-H09-081617	K1708843	K1708843-014	8/16/2017	Soil
401-2-H10-081617	K1708843	K1708843-015	8/16/2017	Soil
401-2-I01-081717	K1708847	K1708847-008	8/17/2017	Soil
401-2-I02-081717	K1708847	K1708847-009	8/17/2017	Soil
401-2-I03-081717	K1708847	K1708847-010	8/17/2017	Soil
401-2-I04-081717	K1708847	K1708847-011	8/17/2017	Soil
401-2-I05-081717	K1708847	K1708847-012	8/17/2017	Soil
401-2-I06-081617	K1708843	K1708843-016	8/16/2017	Soil
401-2-I07-081617	K1708843	K1708843-017	8/16/2017	Soil
401-2-I08-081617	K1708843	K1708843-018	8/16/2017	Soil
401-2-I09-081617	K1708843	K1708843-019	8/16/2017	Soil
401-2-I10-081617	K1708843	K1708843-020	8/16/2017	Soil
401-2-J01-081717	K1708847	K1708847-013	8/17/2017	Soil
401-2-J02-081717	K1708847	K1708847-014	8/17/2017	Soil
401-2-J03-081717	K1708847	K1708847-015	8/17/2017	Soil
401-2-J04-081717	K1708847	K1708847-016	8/17/2017	Soil
401-2-J04-081717-D	K1708847	K1708847-018	8/17/2017	Soil
401-2-J05-081717	K1708847	K1708847-017	8/17/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
401-2-J06-081617	K1708844	K1708844-001	8/16/2017	Soil
401-2-J07-081617	K1708844	K1708844-002	8/16/2017	Soil
401-2-J08-081617	K1708844	K1708844-003	8/16/2017	Soil
401-2-J09-081617	K1708844	K1708844-004	8/16/2017	Soil
401-2-J10-081617	K1708844	K1708844-005	8/16/2017	Soil
441-1-A01-082217	K1708971	K1708971-001	8/22/2017	Soil
441-1-A02-082217	K1708971	K1708971-002	8/22/2017	Soil
441-1-A03-082217	K1708971	K1708971-003	8/22/2017	Soil
441-1-A04-082217	K1708971	K1708971-004	8/22/2017	Soil
441-1-A05-082217	K1708971	K1708971-005	8/22/2017	Soil
441-1-A06-082217	K1708971	K1708971-006	8/22/2017	Soil
441-1-A07-082217	K1708971	K1708971-007	8/22/2017	Soil
441-1-A08-082217	K1708971	K1708971-008	8/22/2017	Soil
441-1-A08-082217-D	K1708971	K1708971-011	8/22/2017	Soil
441-1-A09-082217	K1708971	K1708971-009	8/22/2017	Soil
441-1-A10-082217	K1708971	K1708971-010	8/22/2017	Soil
441-1-B01-082217	K1708971	K1708971-012	8/22/2017	Soil
441-1-B02-082217	K1708971	K1708971-013	8/22/2017	Soil
441-1-B03-082217	K1708971	K1708971-014	8/22/2017	Soil
441-1-B04-082217	K1708971	K1708971-015	8/22/2017	Soil
441-1-B05-082217	K1708971	K1708971-016	8/22/2017	Soil
441-1-B06-082217	K1708971	K1708971-017	8/22/2017	Soil
441-1-B07-082217	K1708971	K1708971-018	8/22/2017	Soil
441-1-B08-082217	K1708971	K1708971-019	8/22/2017	Soil
441-1-B09-082217	K1708971	K1708971-020	8/22/2017	Soil
441-1-B10-082217	K1708982	K1708982-001	8/22/2017	Soil
441-1-C01-082217	K1708982	K1708982-002	8/22/2017	Soil
441-1-C02-082217	K1708982	K1708982-003	8/22/2017	Soil
441-1-C03-082217	K1708982	K1708982-004	8/22/2017	Soil
441-1-C04-082217	K1708982	K1708982-005	8/22/2017	Soil
441-1-C05-082217	K1708982	K1708982-006	8/22/2017	Soil
441-1-C06-082217	K1708982	K1708982-007	8/22/2017	Soil
441-1-C07-082217	K1708982	K1708982-008	8/22/2017	Soil
441-1-C08-082217	K1708982	K1708982-009	8/22/2017	Soil
441-1-C09-082217	K1708982	K1708982-010	8/22/2017	Soil
441-1-C10-082217	K1708982	K1708982-011	8/22/2017	Soil
441-1-D01-082217	K1709014	K1709014-001	8/22/2017	Soil
441-1-D02-082217	K1709014	K1709014-002	8/22/2017	Soil
441-1-D03-082217	K1709014	K1709014-003	8/22/2017	Soil
441-1-D04-082217	K1709014	K1709014-004	8/22/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
441-1-D05-082217	K1709014	K1709014-005	8/22/2017	Soil
441-1-D06-082217	K1709014	K1709014-006	8/22/2017	Soil
441-1-D07-082217	K1709014	K1709014-007	8/22/2017	Soil
441-1-D08-082217	K1709014	K1709014-008	8/22/2017	Soil
441-1-D09-082217	K1709014	K1709014-009	8/22/2017	Soil
441-1-D10-082217	K1709014	K1709014-010	8/22/2017	Soil
441-1-D10-082217-D	K1709015	K1709015-012	8/22/2017	Soil
441-1-E01-082217	K1709014	K1709014-011	8/22/2017	Soil
441-1-E02-082217	K1709014	K1709014-012	8/22/2017	Soil
441-1-E03-082217	K1709014	K1709014-013	8/22/2017	Soil
441-1-E04-082217	K1709014	K1709014-014	8/22/2017	Soil
441-1-E05-082217	K1709014	K1709014-015	8/22/2017	Soil
441-1-E06-082217	K1709014	K1709014-016	8/22/2017	Soil
441-1-E07-082217	K1709014	K1709014-017	8/22/2017	Soil
441-1-E08-082217	K1709014	K1709014-018	8/22/2017	Soil
441-1-E09-082217	K1709014	K1709014-019	8/22/2017	Soil
441-1-E10-082217	K1709014	K1709014-020	8/22/2017	Soil
441-1-F01-082217	K1709015	K1709015-001	8/22/2017	Soil
441-1-F02-082217	K1709015	K1709015-002	8/22/2017	Soil
441-1-F03-082217	K1709015	K1709015-003	8/22/2017	Soil
441-1-F04-082217	K1709015	K1709015-004	8/22/2017	Soil
441-1-F05-082217	K1709015	K1709015-005	8/22/2017	Soil
441-1-F06-082217	K1709015	K1709015-006	8/22/2017	Soil
441-1-F06-082217-D	K1709015	K1709015-011	8/22/2017	Soil
441-1-F07-082217	K1709015	K1709015-007	8/22/2017	Soil
441-1-F08-082217	K1709015	K1709015-008	8/22/2017	Soil
441-1-F09-082217	K1709015	K1709015-009	8/22/2017	Soil
441-1-F10-082217	K1709015	K1709015-010	8/22/2017	Soil
441-1-G01-082217	K1708979	K1708979-001	8/22/2017	Soil
441-1-G02-082217	K1708979	K1708979-002	8/22/2017	Soil
441-1-G03-082217	K1708979	K1708979-003	8/22/2017	Soil
441-1-G04-082217	K1708979	K1708979-004	8/22/2017	Soil
441-1-G05-082217	K1708979	K1708979-005	8/22/2017	Soil
441-1-G06-082217	K1708979	K1708979-006	8/22/2017	Soil
441-1-G07-082217	K1708979	K1708979-007	8/22/2017	Soil
441-1-G08-082217	K1708979	K1708979-008	8/22/2017	Soil
441-1-G09-082217	K1708979	K1708979-009	8/22/2017	Soil
441-1-G10-082217	K1708979	K1708979-010	8/22/2017	Soil
441-1-H01-082217	K1708979	K1708979-011	8/22/2017	Soil
441-1-H02-082217	K1708979	K1708979-012	8/22/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Solids by EPA 160.3; Lead and Arsenic by EPA 6010C)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
441-1-H03-082217	K1708979	K1708979-013	8/22/2017	Soil
441-1-H04-082217	K1708979	K1708979-014	8/22/2017	Soil
441-1-H05-082217	K1708979	K1708979-015	8/22/2017	Soil
441-1-H06-082217	K1708979	K1708979-016	8/22/2017	Soil
441-1-H07-082217	K1708979	K1708979-017	8/22/2017	Soil
441-1-H08-082217	K1708979	K1708979-018	8/22/2017	Soil
441-1-H09-082217	K1708979	K1708979-019	8/22/2017	Soil
441-1-H10-082217	K1708979	K1708979-020	8/22/2017	Soil
441-1-I01-082217	K1708980	K1708980-001	8/22/2017	Soil
441-1-I02-082217	K1708980	K1708980-002	8/22/2017	Soil
441-1-I03-082217	K1708980	K1708980-003	8/22/2017	Soil
441-1-I04-082217	K1708980	K1708980-004	8/22/2017	Soil
441-1-I04-082217-D	K1708984	K1708984-014	8/22/2017	Soil
441-1-I05-082217	K1708980	K1708980-005	8/22/2017	Soil
441-1-I06-082217	K1708980	K1708980-006	8/22/2017	Soil
441-1-I07-082217	K1708980	K1708980-007	8/22/2017	Soil
441-1-I08-082217	K1708980	K1708980-008	8/22/2017	Soil
441-1-I09-082217	K1708980	K1708980-009	8/22/2017	Soil
441-1-I10-082217	K1708980	K1708980-010	8/22/2017	Soil
441-1-J01-082217	K1708980	K1708980-011	8/22/2017	Soil
441-1-J02-082217	K1708980	K1708980-012	8/22/2017	Soil
441-1-J03-082217	K1708980	K1708980-013	8/22/2017	Soil
441-1-J04-082217	K1708980	K1708980-014	8/22/2017	Soil
441-1-J05-082217	K1708980	K1708980-015	8/22/2017	Soil
441-1-J06-082217	K1708980	K1708980-016	8/22/2017	Soil
441-1-J07-082217	K1708980	K1708980-017	8/22/2017	Soil
441-1-J07-082217-D	K1708984	K1708984-015	8/22/2017	Soil
441-1-J08-082217	K1708980	K1708980-018	8/22/2017	Soil
441-1-J09-082217	K1708980	K1708980-019	8/22/2017	Soil
441-1-J10-082217	K1708980	K1708980-020	8/22/2017	Soil

Table 3. Laboratory Quality Control Limits from SATES Work Plan (Ramboll 2017)						
		Accuracy - Percent Recovery		Precision - RPD		
Analysis	**Sample Analysis Method Reference**	**MS/ MSD**	**LCS**	**MS/ MSD**	**LCS/ LCSD**	**Field Duplicate**
Total Arsenic and Lead	USEPA 6010C	75-125	80-120	30	20	50

Notes:
LCS = Laboratory control spike
LCS/LCSD = Laboratory control spike/laboratory control spike duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference

Table 4. Validation Qualifier Definitions	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
U*	The analyte should be considered not detected because it was detected in an associated blank at a similar concentration.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
UB	Compound considered non-detect at the listed value due to associated blank contamination.
EPMC	Chromatographic peaks are present in the expected retention time window; however, the peaks do not meet all of the conditions required for positive identification. The detection limit represents the estimated maximum possible concentration if the analyte was present.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

Notes:
Definitions from USEPA (2017) and Ramboll (2017).

Table 5. Summary of arsenic Phase IA Part 1 data validation results

SDG	Test Plot	Method Blank		Laboratory Control Sample (LCS)		Matrix Spike (MS)		Matrix Spike Duplicate (MSD)		MS/MSD		Field Duplicate		Data Validation Flag Assigned	Comments Assigned in Data Validation
		Value	Within Range (Yes/No)	% R	Within Range[a] (Yes/No)	% R	Within Range[b] (Yes/No)	% R	Within Range[b] (Yes/No)	RPD	Within Limit[c] (Yes/No)	RPD (%)	Within Limit[d] (Yes/No)		
K1708839	258-2	ND	Yes	99	Yes	95	Yes	97	Yes	2	Yes	27.03	Yes	None	sample received out of temperature range
K1708840	258-2	ND	Yes	98	Yes	100	Yes	97	Yes	7	Yes	4.38	Yes	None	sample received out of temperature range
K1708841	258-2 and 401-2	ND	Yes	101	Yes	96	Yes	96	Yes	<1	Yes	--	--	None	sample received out of temperature range
K1708842	401-2	ND	Yes	99	Yes	97	Yes	98	Yes	<1	Yes	9.78	Yes	None	sample received out of temperature range
K1708843	401-2	ND	Yes	98	Yes	93	Yes	96	Yes	2	Yes	--	--	None	sample received out of temperature range
K1708844	401-2	ND	Yes	94	Yes	95	Yes	95	Yes	3	Yes	--	--	None	sample received out of temperature range
K1708845	401-1	ND	Yes	102	Yes	98	Yes	99	Yes	6	Yes	5.52	Yes	None	sample received out of temperature range
K1708846	401-2	ND	Yes	99	Yes	99	Yes	96	Yes	<1	Yes	12.58	Yes	None	sample received out of temperature range
K1708847	401-1 and 401-2	ND	Yes	100	Yes	93	Yes	98	Yes	6	Yes	5.41	Yes	R (one sample)	Result for sample 401-2-J04-081717 was rejected due to sample being compromised; sample received out of temperature range
K1708848	401-1	ND	Yes	99	Yes	99	Yes	99	Yes	<1	Yes	5.73	Yes	None	sample received out of temperature range
K1708849	401-1	ND	Yes	102	Yes	97	Yes	100	Yes	5	Yes	6.85	Yes	None	sample received out of temperature range
K1708850	401-1	ND	Yes	99	Yes	102	Yes	104	Yes	1	Yes	5.24	Yes	None	sample received out of temperature range
K1708851	401-1	ND	Yes	101	Yes	98	Yes	99	Yes	<1	Yes	6.06	Yes	None	sample received out of temperature range
K1708852	401-1	ND	Yes	98	Yes	95	Yes	99	Yes	2	Yes	--	--	None	sample received out of temperature range
K1708945	258-2	ND	Yes	96	Yes	94	Yes	96	Yes	6	Yes	--	--	None	sample received out of temperature range
K1708951	258-2	ND	Yes	97	Yes	94	Yes	93	Yes	3	Yes	3.39	Yes	None	sample received out of temperature range
K1708957	258-2	ND	Yes	98	Yes	97	Yes	96	Yes	2	Yes	--	--	None	sample received out of temperature range
K1708960	258-3	ND	Yes	98	Yes	93	Yes	94	Yes	<1	Yes	4.12	Yes	None	None
K1708961	258-3	ND	Yes	101	Yes	93	Yes	95	Yes	<1	Yes	2.96	Yes	None	None
K1708964	258-1	ND	Yes	100	Yes	96	Yes	98	Yes	2	Yes	14.89	Yes	None	None
K1708967	258-1	ND	Yes	101	Yes	95	Yes	95	Yes	3	Yes	6.58	Yes	None	None
K1708971	441-1	ND	Yes	99	Yes	94	Yes	95	Yes	2	Yes	14.63	Yes	R (one sample)	Result for sample 441-1-B01-082217 was rejected due to sample being compromised
K1708973	258-3	ND	Yes	98	Yes	88	Yes	93	Yes	5	Yes	--	--	None	None
K1708974	258-3	ND	Yes	95	Yes	97	Yes	94	Yes	5	Yes	--	--	None	None
K1708975	258-3	ND	Yes	96	Yes	95	Yes	96	Yes	<1	Yes	--	--	None	None
K1708976	258-3	ND	Yes	98	Yes	96	Yes	98	Yes	4	Yes	--	--	None	None
K1708977	258-1	ND	Yes	99	Yes	98	Yes	93	Yes	3	Yes	--	--	None	None
K1708979	441-1	ND	Yes	97	Yes	97	Yes	95	Yes	<1	Yes	--	--	None	None
K1708980	441-1	ND	Yes	99	Yes	94	Yes	94	Yes	3	Yes	--	--	None	None
K1708981	258-1	ND	Yes	99	Yes	98	Yes	99	Yes	<1	Yes	--	--	None	None
K1708982	441-1	ND	Yes	96	Yes	96	Yes	91	Yes	3	Yes	--	--	None	None
K1708983	258-1	ND	Yes	95	Yes	91	Yes	93	Yes	5	Yes	--	--	None	None
K1708984	258-1 and 441-1	ND	Yes	97	Yes	95	Yes	95	Yes	5	Yes	--	--	None	None
K1709014	441-1	ND	Yes	98	Yes	97	Yes	93	Yes	<1	Yes	--	--	None	None
K1709015	441-1	ND	Yes	101	Yes	96	Yes	98	Yes	<1	Yes	5.14	Yes	None	None

Notes:
a. Acceptable range for LCS defined as 80-120 percent recovery
b. Acceptable range for MS and MSD defined as 75-125 percent recovery
c. Acceptable limit for MS/MSD defined as 30 relative percent difference between the MS and MSD
d. Acceptable limit for field duplicate defined as 50 relative percent difference between the original and duplicate field sample
MS/MSD= matrix spike/matrix spike duplicate
ND= non-detect
% R= percent recovery
RPD= relative percent difference
SDG= sample delivery group
-- = field duplicate not collected in SDG

Table 6. Summary of lead Phase IA Part 1 data validation results

SDG	Test Plot	Method Blank		Laboratory Control Sample (LCS)		Matrix Spike (MS)		Matrix Spike Duplicate (MSD)		MS/MSD		Field Duplicate		Data Validation Flag Assigned	Comments Assigned in Data Validation
		Value	Within Range (Yes/No)	% R	Within Range[a] (Yes/No)	% R	Within Range[b] (Yes/No)	% R	Within Range[b] (Yes/No)	RPD	Within Limit[c] (Yes/No)	RPD (%)	Within Limit[d] (Yes/No)		
K1708839	258-2	ND	Yes	103	Yes	99	Yes	101	Yes	1	Yes	4.16	Yes	None	sample received out of temperature range
K1708840	258-2	ND	Yes	101	Yes	117	Yes	101	Yes	7	Yes	10.41	Yes	None	sample received out of temperature range
K1708841	258-2 and 401-2	ND	Yes	98	Yes	93	Yes	87	Yes	2	Yes	--	--	None	sample received out of temperature range
K1708842	401-2	ND	Yes	96	Yes	71#	No	-68#	No	19	Yes	63.72	No	None	sample received out of temperature range
K1708843	401-2	ND	Yes	93	Yes	290N	No	89	Yes	38*	No	--	--	J+	sample received out of temperature range
K1708844	401-2	ND	Yes	94	Yes	125	Yes	138N	No	2	Yes	--	--	J+	sample received out of temperature range
K1708845	401-1	ND	Yes	104	Yes	124#	Yes	139#	No	4	Yes	11.68	Yes	None	sample received out of temperature range
K1708846	401-2	ND	Yes	103	Yes	180#	No	161#	No	<1	Yes	2.20	Yes	None	sample received out of temperature range
K1708847	401-1 and 401-2	ND	Yes	106	Yes	27#	No	57#	No	7	Yes	1.30	Yes	R (one sample)	Result for sample 401-2-J04-081717 was rejected due to sample being compromised; sample received out of temperature range
K1708848	401-1	ND	Yes	99	Yes	115#	Yes	113#	Yes	<1	Yes	7.04	Yes	None	sample received out of temperature range
K1708849	401-1	ND	Yes	98	Yes	139#	No	205#	No	8	Yes	28.39	Yes	None	sample received out of temperature range
K1708850	401-1	ND	Yes	104	Yes	576#	No	512#	No	5	Yes	11.34	Yes	None	sample received out of temperature range
K1708851	401-1	ND	Yes	95	Yes	86	Yes	89	Yes	<1	Yes	2.52	Yes	None	sample received out of temperature range
K1708852	401-1	ND	Yes	101	Yes	81#	Yes	65#	No	2	Yes	--	--	None	sample received out of temperature range
K1708945	258-2	ND	Yes	102	Yes	94	Yes	100	Yes	4	Yes	--	--	None	sample received out of temperature range
K1708951	258-2	ND	Yes	101	Yes	98	Yes	100	Yes	1	Yes	3.04	Yes	None	sample received out of temperature range
K1708957	258-2	ND	Yes	102	Yes	98	Yes	99	Yes	<1	Yes	--	--	None	sample received out of temperature range
K1708960	258-3	ND	Yes	103	Yes	82	Yes	79	Yes	1	Yes	4.72	Yes	None	None
K1708961	258-3	ND	Yes	99	Yes	83	Yes	85	Yes	<1	Yes	3.51	Yes	None	None
K1708964	258-1	ND	Yes	99	Yes	96	Yes	98	Yes	<1	Yes	3.70	Yes	None	None
K1708967	258-1	ND	Yes	99	Yes	85	Yes	88	Yes	<1	Yes	8.60	Yes	None	None
K1708971	441-1	ND	Yes	97	Yes	85	Yes	82	Yes	2	Yes	6.06	Yes	R (one sample)	Result for sample 441-1-B01-082217 was rejected due to sample being compromised
K1708973	258-3	ND	Yes	95	Yes	56N	No	102	Yes	20	Yes	--	--	J-	None
K1708974	258-3	ND	Yes	93	Yes	225N	No	1855N	No	133*	No	--	--	J+	None
K1708975	258-3	ND	Yes	95	Yes	96#	Yes	85#	Yes	2	Yes	--	--	None	None
K1708976	258-3	ND	Yes	98	Yes	93	Yes	95	Yes	4	Yes	--	--	None	None
K1708977	258-1	ND	Yes	99	Yes	98	Yes	87	Yes	4	Yes	--	--	None	None
K1708979	441-1	ND	Yes	97	Yes	111#	Yes	125#	Yes	3	Yes	--	--	None	None
K1708980	441-1	ND	Yes	99	Yes	47N	No	51N	No	2	Yes	--	--	J-	None
K1708981	258-1	ND	Yes	98	Yes	52N	No	42N	No	3	Yes	--	--	J-	None
K1708982	441-1	ND	Yes	97	Yes	23#	No	-81#	No	12	Yes	--	--	None	None
K1708983	258-1	ND	Yes	95	Yes	39N	No	36N	No	<1	Yes	--	--	J-	None
K1708984	258-1 and 441-1	ND	Yes	96	Yes	52N	No	52N	No	2	Yes	--	--	J-	None
K1709014	441-1	ND	Yes	98	Yes	38N	No	31N	No	3	Yes	--	--	J-	None
K1709015	441-1	ND	Yes	99	Yes	100	Yes	103	Yes	<1	Yes	4.01	Yes	None	None

Notes:
a. Acceptable range for LCS defined as 80-120 percent recovery
b. Acceptable range for MS and MSD defined as 75-125 percent recovery
c. Acceptable limit for MS/MSD defined as 30 relative percent difference between the MS and MSD
d. Acceptable limit for field duplicate defined as 50 relative percent difference between the original and duplicate field sample
MS/MSD= matrix spike/matrix spike duplicate
ND= non-detect
% R= percent recovery
RPD= relative percent difference
SDG= sample delivery group
-- = field duplicate not collected

RAMBOLL

ENVIRONMENT
& HEALTH

MEMORANDUM

Job	**SATES Phase IA Part 2 ALS Environmental Data Validation Summary Memo** **Sample Delivery Group K1711288**
Client	**Teck American Incorporated**
To	**Dave Enos and Denise Mills**
From	**Amy Kephart and Julie Weicheld**
Copy to	**Kris McCaig, Teck American Incorporated; Cristy Kessel, Teck American Incorporated; Mike Arnold, Ramboll Environ; Rosalind Schoof, Ramboll Environ**

Date March 27, 2018

Ramboll
901 Fifth Avenue
Suite 2820
Seattle, WA 98164
USA

T +1 206 336 1650
F +1 206 336 1651
www.ramboll.com

1. INTRODUCTION

In accordance with the *Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES)*, *Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation* (Work Plan; Ramboll 2017), initial test plot characterization has been conducted to establish baseline conditions to inform amendment technology option screening and monitor the effects of the soil amendment options once they are applied. The characterization of the test plots is included in Phase IA Part 2 of the SATES program, as described in the Work Plan.

Test plot characterization was completed in mid-October 2017 following the initial establishment and screening of six 100-foot by 100-foot test plots completed in mid-August 2017 (Phase IA Part 1) in decision units (DUs) 258, 401, and 441. Of the six initial test plots established during the screening, the following four were selected for evaluation during Phase IA Part 2: 258-3; 401-1, 401-2; and 441-1. In addition to establishing baseline conditions at these four test plots, the data from the test plot characterization were collected to inform the screening of available amendment technology options and assist in selection of amendments that will be evaluated as part of bench scale testing.

This memorandum covers one laboratory report with analytical results produced by ALS Environmental for sample delivery group K1711288, as shown on Table 1, Report and Sample Delivery Group Reviewed.

The analyses performed by ALS Environmental included total solids, total organic carbon, total sulfide, and synthetic precipitation leaching procedure (SPLP) metals. Additional data collected and evaluated during the SATES Phase IA Part 2 by other laboratories are discussed separately in subsequent memos.

Consistent with the Work Plan and the National Functional Guidelines for Inorganic Superfund Methods Data Review (United States Environmental Protection Agency (USEPA 2017), Ramboll U.S. Corporation (Ramboll) performed a Level 2 data validation of the data analyzed by ALS Environmental as part of the Phase IA test plot characterization. The laboratory report reviewed by Ramboll contained analytical data for soil and field quality control (QC) samples collected on October 10, 11, 12, 16, and 17, 2017. Table 2, Samples Included in this Quality Assurance Review, lists the samples reviewed in this memorandum. A total of 19 samples were submitted to ALS Environmental and analyzed for total solids by USEPA Method 160.3 modified, total organic carbon by USEPA Method 9060, total sulfide by Puget Sound Estuary Program (PSEP) Sulfide, and SPLP metals by USEPA Method 6010C. This memo summarizes the methods and results for the Level 2 data validation of the analyses performed by ALS Environmental for the Phase IA Part 2 test plot characterization sampling event.

2. METHODS

The Work Plan specifies the QC requirements for Phase I, which were applied during data validation. The QC information checked by Ramboll included chain-of-custody (COC) forms, holding times, analysis performed, reporting limits, matrix spike and matrix spike duplicate (MS/MSD) analyses, laboratory control sample (LCS) analysis, laboratory replicates, field duplicates and triplicates, and blanks.

Ramboll's data validation was conducted in accordance with procedures outlined in the Work Plan and the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA 2017). The USEPA guidelines provide criteria on how to review laboratory and field quality control information and, if appropriate, attach data qualifiers to the laboratory data. Analytical results received from ALS Environmental were assessed by reviewing COC forms, holding times, reporting limits, laboratory replicates and blanks, and the quality control criteria specified in Table 3, Laboratory Quality Control Limits from the SATES Work Plan. Ramboll assigned qualifiers to data falling outside of the specified control criteria after review of all pertinent laboratory information contained in ALS Environmental's analytical report. The data validation qualifiers considered and assigned to some results by Ramboll are defined in Table 4, Validation Qualifier Definitions, and in Section 18.1 of the Work Plan. A sample falling outside of the control criteria does not necessarily indicate the data should be qualified.

Quality control criteria, data accuracy, and precision were assessed using methods specified in the Work Plan (Ramboll 2017). Data accuracy and precision objectives are included in Table 3. Precision of the field homogenization process and the laboratory analyses were assessed using discrete field duplicate samples[1], and field data precision was assessed using incremental composite (IC) duplicate and triplicate samples. Laboratory data precision was assessed using MS, MSD, LCS, LCSD, and laboratory duplicates. Data precision was measured using the relative percent difference (RPD) for all duplicate analyses, calculated as follows:

$$RPD=(A-B)\div\big((A+B)\div 2\big)\times 100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement

Field data precision was also measured using the relative standard deviation (RSD) for the triplicate IC sample, calculated as follows:

$$RSD=\text{Standard Deviation (A,B,C)} \div \text{Mean (A,B,C)}$$

Where:
A = Analytical result from one of three triplicate measurements
B = Analytical result from the second measurement
C = Analytical result from the third measurement

[1] According to the Work Plan, field duplicate samples were collected to assess the precision of the discrete soil sampling process. However, upon further review, the description of the field duplicate sampling process from field activities and in the Work Plan is more representative of field split sample collection rather than a co-located field duplicate. Thus, the results of these duplicate samples provide an assessment of the precision of field homogenization process and the laboratory analysis rather than and assessment of the field sample collection procedures.

Data accuracy was assessed for laboratory analyses using MS, MSD, and LCS data. Field measurement accuracy was performed in the field by experienced field personnel and is not included as part of the data validation. Laboratory accuracy was calculated as the percent recovery as follows:

$$\% \text{ Recovery} = (A-X) \div B \times 100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements.

3. RESULTS

ALS Environmental provided one analytical report quantifying total solids, total organic carbon, total sulfide, and SPLP metals in soils collected during SATES Phase IA Part 2. The COC was complete for the sample delivery group. The one-week holding time was exceeded for Method 160.3 PSEP Sulfide, for seven samples, including the reanalysis of Sample IC-441-1B-101617, as discussed below. No other hold times were exceeded for any of the other analyses. All samples were received within the appropriate temperature range specified in the Work Plan (4 ± 2°C).

Laboratory analysis of total solids was reviewed using the replicate sample summary and RPD criteria specified by ALS Environmental (RPD limit of 20 percent). The total solids analysis met the precision criteria specified by the laboratory. No data qualifiers were assigned.

Several MS and MSD percent recovery values for the SPLP metals analyses were outside the acceptable data accuracy and data precision control limits specified in the Work Plan and by the laboratory. The percent recovery values for method blanks were within the acceptable range, except as discussed below. Analytical results associated with MS and MSDs where the percent recovery values were outside the established laboratory control limits were assigned a "#" qualifier by ALS Environmental, indicating the "control criteria is not applicable".

Data validation results are summarized in Table 5, Sample Results Qualified During Data Validation (Lab Report K1711288, ALS Environmental). ALS Environmental "J" flagged 166 results that were reported at concentrations below the reporting limit but above the method detection limit and "U" flagged 69 results that were not detected at or above the associated detection limit. Ramboll confirmed these qualifiers were appropriate. In addition, Ramboll reviewed the information provided by ALS Environmental regarding holding times, blanks, and the MS/MSD analyses that were outside of the control criteria and made the assessments about data quality that are summarized below.

The following results were qualified by Ramboll during the data validation:

- For the Method 160.3 PSEP Sulfide analysis, the laboratory analyzed samples IC-401-1A-101017, IC-401-1B-101017, IC-401-1C-101117, IC-401-1C-101117-D, IC-401-1D-101117, and IC-401-2B-101117 past the one-week holding time. These samples were extracted 9 days after they were collected and analyzed shortly thereafter. The Work Plan states that all samples exceeding holding time requirements will be flagged as estimated ("J" qualified) or rejected ("R" qualified). Because the sample analysis occurred slightly outside of the holding time specified in the Work Plan, results for IC-401-1C-101117, IC-401-1C-101117-D, IC-401-1D-101117, and IC-401-2B-101117 are "J" qualified. Sulfide in samples IC-401-1A-101017 and IC-401-1B-101017 was not detected, so these results are "UJ" flagged.

- For the Method 160.3 PSEP Sulfide, the laboratory noted that sample IC-441-1B-101617 was received and initially analyzed within holding time, but due to detection in the method blank, this sample was reanalyzed, and the reanalysis occurred over three weeks past the acceptable holding time. Because total sulfide was not detected in this sample, and the sample analysis occurred three weeks past the holding time, the total sulfide result for this sample is "R" qualified (unusable).
- For the Method 6010C analysis for SPLP metals, several metals were present between the detection and reporting limits in the Method Blank KQ1717330-02: 1.8J mg/L for calcium, 0.009J mg/L for iron, 0.20J mg/L for magnesium, 0.08J mg/L for potassium, and 1.2J mg/L for sodium. The USEPA guidelines state that any reported concentrations less than 10 times the concentration detected below the reporting limit in an associated blank (in this case, any concentration less than 10 x 1.8 mg/L for calcium, or 18 mg/L; 10 x 0.009 mg/L, or 0.09 mg/L for iron; 10 x 0.20 mg/L, or 2.0 mg/L for magnesium; 10 x 0.08 mg/L, or 0.8 mg/L for potassium; and 10 x 1.2 mg/L, or 12 mg/L for sodium) should be "J-" qualified (results estimated, potential low bias) and detections below the reporting limit should be "U" qualified (analyte was analyzed for but not detected above the reporting limit). Qualified results are identified in Table 5.

Additionally, Ramboll reviewed the following results that were outside of control criteria and determined that no data qualification is necessary:

- For the Method 6010C analysis for SPLP metals, aluminum was detected above the reporting limit in the Method Blank KQ1717330-02 at 0.065 mg/L. The USEPA guidelines state that any reported concentrations less than 10 times the reported concentration in an associated blank (in this case, any concentration less than 10 x 0.065 mg/L for aluminum, or 0.65 mg/L) should be qualified. Because all aluminum results are greater than 0.65 mg/L, no qualification is necessary.
- For the Method 6010C analysis for SPLP metals, the RPD from the laboratory replicate analysis for silver (120%) exceeded the upper acceptable laboratory limit of 20%. The laboratory indicated that the control limits are not applicable to this result because the concentration of silver in both the sample and the replicate were below the reporting limit. No data qualification is necessary.
- For the Method 6010C analysis for SPLP metals, the MS percent recovery (%R) values fell below the lower laboratory control limit of 75%, at 25% for aluminum and 64% for iron. The laboratory indicated that the control limits are not applicable for this result. The data indicate that due to high concentrations of aluminum and iron in the spiked samples, the MS/MSD calculations do not provide useful spike recovery information. Spike recovery limits do not apply when the concentration of the spike added is less than 4 times the concentration of the analyte in the spiked sample, as is the case for aluminum and iron. No data qualification is necessary.

In addition to the laboratory analyses, Ramboll assessed Sample IC-401-1C-101117, and its field duplicate, IC-401-1C-101117-D, for precision. All IC sample field duplicate RPDs were below 50 percent for the total solids, total organic carbon, total sulfide, and SPLP metals analyses. Ramboll also assessed the triplicate IC sample, IC1-401-2A-101217, IC2-401-2A-101217, and IC3-401-2A-101217 for field precision using the Interstate Technology and Regulatory Council (2012) relative standard deviation (RSD) control criteria of 30 percent. The SPLP metals results for beryllium and silver exceeded the RSD control criteria. However, these results were either below the laboratory reporting limit or were not detected. All other results were below the 30 percent RSD standard. No qualification is necessary for any of the samples exceeding field precision criteria.

Ramboll's data validation assessment resulted in 1 total sulfide result being "R" qualified, 4 sulfide results being "J" qualified, 2 sulfide results being "UJ" qualified, 17 magnesium results being "J-"

qualified, 19 sodium results being "U" qualified, and 19 calcium results being "J-" qualified. No other validation qualifiers were assigned during the data validation.

4. CONCLUSIONS

Based on the Level 2 Data Validation Assessment of the SATES Phase IA Part 2 soil analysis results from ALS Environmental, Ramboll has determined all data are acceptable with the exception of one data point being rejected: sulfide analysis for sample IC-441-1B-101617. Of the 494 results, 221 were qualified by the laboratory, and 62 were qualified during data validation, resulting in 257 of the results reported by ALS Environmental being qualified. All but one (i.e., the sulfide analytical result for sample IC-441-1B-101617) of the results reported by ALS Environmental are useable for future analysis and reporting.

5. REFERENCES

Interstate Technology and Regulatory Council. (ITRC) 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. Interstate Technology and Regulatory Council: Washington, DC. 475 pp. Available online at: http://www.itrcweb.org/gd.asp.

Ramboll Environ U.S. Corporation (Ramboll). 2017. FINAL Work Plan for the Soil Amendment Technology Evaluation Study Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation. Prepared for Teck American Incorporated. Seattle, WA.

United States Environmental Protection Agency (USEPA). 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. OSWER 9355.0-131. Office of Superfund Remediation and Technology Innovation. Washington, D.C.

RAMBØLL

TABLES

RAMBOLL

Table 1. Report and Sample Delivery Group Reviewed

SDG No.	Number of Samples	Sample Matrix	ALS Environmental Report Date
K1711288 Revision 1: K1711288.01 Revision 2: K1711288.02	19	Soil	12/05/2017 Revision 1: 01/05/2018 Revision 2 (Report)[1]: 1/31/2018 Revision 2 (EDD)[2]: 3/16/2018

Notes:
1. Report was revised to include sample preparation description in case narrative
2. The revised EDD updated the measured value of non-detects to reflect the method detection limit instead of the reporting limit, as originally reported
SDG No. = Sample delivery group number
EDD = electronic data deliverable

Table 2. Samples Included in this Quality Assurance Review: (Organic Carbon by EPA 9060; Solids by EPA 160.3; Sulfide by PSEP ID; Metals by EPA 6010C)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
IC-401-1A-101017	K1711288	K1711288-001	10/10/2017	Soil
IC-401-1B-101017	K1711288	K1711288-002	10/10/2017	Soil
IC-401-1C-101117	K1711288	K1711288-003	10/11/2017	Soil
IC-401-1C-101117-D	K1711288	K1711288-004	10/11/2017	Soil
IC-401-1D-101117	K1711288	K1711288-005	10/11/2017	Soil
IC-401-2B-101117	K1711288	K1711288-006	10/11/2017	Soil
IC1-401-2A-101217	K1711288	K1711288-007	10/12/2017	Soil
IC2-401-2A-101217	K1711288	K1711288-008	10/12/2017	Soil
IC3-401-2A-101217	K1711288	K1711288-009	10/12/2017	Soil
IC-401-2C-101217	K1711288	K1711288-010	10/12/2017	Soil
IC-401-2D-101217	K1711288	K1711288-011	10/12/2017	Soil
IC-258-3A-101717	K1711288	K1711288-012	10/17/2017	Soil
IC-258-3B-101717	K1711288	K1711288-013	10/17/2017	Soil
IC-258-3C-101717	K1711288	K1711288-014	10/17/2017	Soil
IC-258-3D-101717	K1711288	K1711288-015	10/17/2017	Soil
IC-441-1A-101617	K1711288	K1711288-016	10/16/2017	Soil
IC-441-1B-101617	K1711288	K1711288-017	10/16/2017	Soil
IC-441-1C-101617	K1711288	K1711288-018	10/16/2017	Soil
IC-441-1D-101617	K1711288	K1711288-019	10/16/2017	Soil

Table 3. Laboratory Quality Control Limits from SATES Work Plan (Ramboll 2017)								
		Accuracy - Percent Recovery		Precision - RPD			Precision- RSD	Hold Time (from Sample Collection Date, days)
Analysis	Sample Analysis Method Reference	MS/ MSD	LCS	MS/ MSD	LCS/ LCSD	Field Duplicate	Field Triplicate	
Total Organic Carbon	USEPA 9060	70-122	72-122	20	20	50	30	28
Total Sulfide	PSEP Sulfide	28-175	39-166	43	43	50	30	7
SPLP Metals	USEPA 6010C	75-125	80-120	20	20	50	30	180[1]

Notes:
1. The hold time of 28 days specified in the Work Plan is applicable to metals in water, not soils. The hold time was updated to 180 days as documented in the Corrective Action Record.
LCS = Laboratory control spike
LCS/LCSD = Laboratory control spike/laboratory control spike duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference
RSD = Relative standard deviation
SPLP = Synthetic precipitation leaching procedure

Table 4. Validation Qualifier Definitions	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
U*	The analyte should be considered not detected because it was detected in an associated blank at a similar concentration.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
UB	Compound considered non-detect at the listed value due to associated blank contamination.
EPMC	Chromatographic peaks are present in the expected retention time window; however, the peaks do not meet all of the conditions required for positive identification. The detection limit represents the estimated maximum possible concentration if the analyte was present.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
Notes: Definitions from USEPA (2017) and Ramboll (2017).	

Table 5. Sample Results Qualified During Data Validation (Lab Report K1711288, ALS Environmental)

Analysis	Sample	Value	Units	Detection Limit	Reporting Limit	Lab Qualifier	Validator Qualifier	Reason for Data Validation Qualification
Calcium	IC-401-1C-101117	3.2	mg/L	0.008	2.0		J-	The reported concentration was less than ten times the concentration detected below the reporting limit in the associated method blank
	IC-401-1C-101117-D	3.2	mg/L	0.008	2.0		J-	
	IC-401-1A-101017	3.4	mg/L	0.008	2.0		J-	
	IC-401-1B-101017	3.0	mg/L	0.008	2.0		J-	
	IC-401-1D-101117	3.4	mg/L	0.008	2.0		J-	
	IC-401-2B-101117	3.5	mg/L	0.008	2.0		J-	
	IC1-401-2A-101217	3.1	mg/L	0.008	2.0		J-	
	IC2-401-2A-101217	3.2	mg/L	0.008	2.0		J-	
	IC3-401-2A-101217	3.3	mg/L	0.008	2.0		J-	
	IC-401-2C-101217	3.2	mg/L	0.008	2.0		J-	
	IC-401-2D-101217	3.7	mg/L	0.008	2.0		J-	
	IC-258-3A-101717	4.3	mg/L	0.008	2.0		J-	
	IC-258-3C-101717	4.2	mg/L	0.008	2.0		J-	
	IC-258-3D-101717	4.1	mg/L	0.008	2.0		J-	
	IC-441-1A-101617	7.5	mg/L	0.008	2.0		J-	
	IC-441-1B-101617	7.3	mg/L	0.008	2.0		J-	
	IC-258-3B-101717	3.9	mg/L	0.008	2.0		J-	
	IC-441-1C-101617	9.2	mg/L	0.008	2.0		J-	
	IC-441-1D-101617	6.6	mg/L	0.008	2.0		J-	
Magnesium	IC-401-1C-101117	1.09	mg/L	0.002	0.50		J-	
	IC-401-1C-101117-D	1.13	mg/L	0.002	0.50		J-	
	IC-401-1A-101017	1.29	mg/L	0.002	0.50		J-	
	IC-401-1B-101017	0.97	mg/L	0.002	0.50		J-	
	IC-401-1D-101117	0.98	mg/L	0.002	0.50		J-	
	IC-401-2B-101117	0.98	mg/L	0.002	0.50		J-	
	IC1-401-2A-101217	1.08	mg/L	0.002	0.50		J-	
	IC2-401-2A-101217	1.04	mg/L	0.002	0.50		J-	
	IC3-401-2A-101217	1.10	mg/L	0.002	0.50		J-	
	IC-401-2C-101217	1.00	mg/L	0.002	0.50		J-	
	IC-401-2D-101217	1.06	mg/L	0.002	0.50		J-	
	IC-258-3A-101717	1.08	mg/L	0.002	0.50		J-	
	IC-441-1B-101617	1.67	mg/L	0.002	0.50		J-	
	IC-258-3B-101717	1.10	mg/L	0.002	0.50		J-	
	IC-258-3C-101717	1.02	mg/L	0.002	0.50		J-	
	IC-258-3D-101717	1.04	mg/L	0.002	0.50		J-	
	IC-441-1D-101617	1.54	mg/L	0.002	0.50		J-	
Sodium	IC-401-1C-101117	1.8	mg/L	0.03	2.0	J	U	The reported concentration was below the reporting limit, and the associated method blank's concentration was between the detection and reporting limit
	IC-401-1C-101117-D	1.8	mg/L	0.03	2.0	J	U	
	IC-401-1A-101017	1.9	mg/L	0.03	2.0	J	U	
	IC-401-1B-101017	1.8	mg/L	0.03	2.0	J	U	
	IC-401-1D-101117	1.9	mg/L	0.03	2.0	J	U	
	IC-401-2B-101117	1.9	mg/L	0.03	2.0	J	U	
	IC1-401-2A-101217	2.0	mg/L	0.03	2.0	J	U	
	IC2-401-2A-101217	1.9	mg/L	0.03	2.0	J	U	
	IC3-401-2A-101217	1.9	mg/L	0.03	2.0	J	U	
	IC-401-2C-101217	1.9	mg/L	0.03	2.0	J	U	
	IC-401-2D-101217	1.8	mg/L	0.03	2.0	J	U	
	IC-258-3A-101717	1.7	mg/L	0.03	2.0	J	U	
	IC-258-3B-101717	1.7	mg/L	0.03	2.0	J	U	

Table 5. Sample Results Qualified During Data Validation (Lab Report K1711288, ALS Environmental)

Analysis	Sample	Value	Units	Detection Limit	Reporting Limit	Lab Qualifier	Validator Qualifier	Reason for Data Validation Qualification
	IC-441-1B-101617	1.9	mg/L	0.03	2.0	J	U	
	IC-441-1C-101617	1.8	mg/L	0.03	2.0	J	U	
	IC-441-1D-101617	1.7	mg/L	0.03	2.0	J	U	
	IC-258-3C-101717	2.0	mg/L	0.03	2.0	J	U	
	IC-258-3D-101717	1.7	mg/L	0.03	2.0	J	U	
	IC-441-1A-101617	1.8	mg/L	0.03	2.0	J	U	
Sulfide[a]	IC-441-1B-101617	2.1	mg/kg	0.7	2.1	U,*	R	Sample was re-analyzed outside of specified holding time at over three weeks, and sample result was non-detect
	IC-401-1C-101117	0.5	mg/kg	0.5	1.6	J,*	J	Sample was analyzed outside of specified holding time
	IC-401-1C-101117-D	0.8	mg/kg	0.6	1.7	J,*	J	
	IC-401-1A-101017	1.7	mg/kg	0.6	1.7	U,*	UJ	
	IC-401-1B-101017	1.7	mg/kg	0.6	1.7	U,*	UJ	
	IC-401-1D-101117	0.6	mg/kg	0.6	1.9	J,*	J	
	IC-401-2B-101117	0.5	mg/kg	0.5	1.7	J,*	J	

Notes
a. Measured as dry weight

RAMBOLL

ENVIRONMENT
& HEALTH

MEMORANDUM

Job	**Revised SATES Phase IA Part 2 Ohio State University (OSU) Environmental Data Validation Summary Memo[1] Sample Delivery Groups OSU18A**
Client	**Teck American Incorporated**
To	**Dave Enos and Denise Mills**
From	**Amy Kephart and Julie Tu**
Copy to	**Kris McCaig, Teck American Incorporated; Cristy Kessel, Teck American Incorporated; Mike Arnold, Ramboll Environ; Rosalind Schoof, Ramboll Environ**

Date January 9, 2019

Ramboll
901 Fifth Avenue
Suite 2820
Seattle, WA 98164
USA

T +1 206 336 1650
F +1 206 336 1651
www.ramboll.com

1. INTRODUCTION

In accordance with the *Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES), Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation* (Work Plan; Ramboll 2017), initial test plot characterization has been conducted to establish baseline conditions to inform amendment technology option screening and monitor the effects of the soil amendment options once they are applied. The characterization of the test plots is included in Phase IA Part 2 of the SATES program, as described in the Work Plan.

Test plot characterization was completed in mid-October 2017 following the initial establishment and screening of six 100-foot by 100-foot test plots completed in mid-August 2017 (Phase IA Part 1) in decision units (DUs) 258, 401, and 441. Of the six initial test plots established during the screening, the following four were selected for evaluation during Phase IA Part 2: 258-3; 401-1, 401-2; and 441-1. In addition to establishing baseline conditions at these four test plots, the data from the test plot characterization were collected to inform the screening of available amendment technology options and assist in selection of amendments that will be evaluated as part of bench scale testing.

This memorandum covers one laboratory report with analytical results produced by The Ohio State University (OSU) for sample delivery group OSU18A as shown on Table 1, Report and Sample Delivery Group Reviewed. Ramboll received the data in electronic data deliverable (EDD) format on January 18, 2018 and January 30, 2018, and an analytical report on February 23, 2018. Because the written report was not received until later, data validation was performed using the EDDs. Samples analyzed by OSU included discrete and incremental composite (IC) soil samples.

The analyses performed by OSU included total Target Analyte List (TAL) metals on discrete and IC samples, bioaccessible lead and arsenic at pH 1.5 and pH 2.5, Mehlich III extractable lead and phosphorus, electrical conductivity, total carbon and nitrogen, chloride, sulfate, and grain size analysis on IC samples, and water storage capacity on discrete core samples. Additionally, pH was measured in IC samples, and phosphorus was measured in IC and discrete samples although they were not specified analyses in the Work Plan (Ramboll 2017). Additional data collected and evaluated during the SATES Phase IA Part 2 by other laboratories are discussed separately in subsequent memos.

[1] Original data validation memorandum, dated March 22, 2018, was revised on January 9, 2019 following further review of the laboratory results and verification of the analytical method used for the subject analyses.

Consistent with the Work Plan and the *National Functional Guidelines for Inorganic Superfund Data Methods Review* (United States Environmental Protection Agency (USEPA 2017), Ramboll U.S. Corporation (Ramboll) performed a Level 2 data validation of the data analyzed by OSU as part of the Phase IA test plot characterization. The EDDs reviewed by Ramboll contained analytical data for soil and field quality control (QC) samples collected on October 4, 5, 6, 7, 10, 11, 12, 13, 16, and 17, 2017. Table 2, Samples Included in this Quality Assurance Review, lists the samples reviewed in this memorandum. A total of 135 samples (19 incremental composite and 116 discrete samples) were submitted to OSU. IC and discrete samples were analyzed for total TAL metals by USEPA Method 6010. IC samples were analyzed for arsenic and lead bioaccessibility at pH 1.5 & 2.5 by EPA Method EPA6010_9200, Mehlich III extractable lead and phosphorus by USEPA Method 6010B, electrical conductivity by Standard Methods Online (SM) Method 2510B, total carbon and nitrogen using Bremner and Mulvaney 1982 and Nelson and Sommers 1982 methods, total chloride and sulfate by USEPA Method 300.0, and grain size analysis by American Society for Testing Materials (ASTM) Method D422. Discrete core samples were analyzed for water storage capacity by ASTM Method D2166 modified. Additionally, pH was measured by Thomas 1996 method, and phosphorus was measured by USEPA Method 6010. This memo summarizes the methods and results for the Level 2 data validation of the analyses performed by OSU for the Phase IA Part 2 test plot characterization sampling event.

2. METHODS

The Work Plan specifies the QC requirements for Phase I, which were applied during data validation. The QC information checked by Ramboll included chain-of-custody (COC) forms, holding times, analysis performed, reporting limits, matrix spike and matrix spike duplicate (MS/MSD) analyses, certified reference value recovery (CRM) analyses, standard reference materials (SRM), laboratory replicates, field duplicates and triplicates, and blanks.

Ramboll's data validation was conducted in accordance with procedures outlined in the Work Plan and the *National Functional Guidelines for Inorganic Superfund Data Methods Review* (USEPA 2017). The USEPA guidelines provide criteria on how to review laboratory and field quality control information and, if appropriate, attach data qualifiers to the laboratory data. Analytical results received from OSU were assessed by reviewing COC forms, holding times, reporting limits, SRMs, laboratory replicates and blanks, and the quality control criteria specified in Table 3, Laboratory Quality Control Limits from SATES Work Plan. Ramboll assigned qualifiers to data falling outside of the specified control criteria after review of all pertinent laboratory information contained in OSU's analytical report. The data validation qualifiers considered and assigned to some results by Ramboll are defined in Table 4, Validation Qualifier Definitions, and in Section 18.1 of the Work Plan. A sample falling outside of the control criteria does not necessarily indicate the data should be qualified.

Quality control criteria, data accuracy, and precision were assessed using methods specified in the Work Plan (Ramboll 2017). Data accuracy and precision objectives are included in Table 3. Precision of the field homogenization process and the laboratory analyses were assessed using discrete field duplicate samples[2], and field data precision was assessed using IC duplicate and triplicate samples. Laboratory data precision was assessed using MS, MSD, and laboratory duplicates. Data precision was measured using the relative percent difference (RPD) for all duplicate analyses, calculated as follows:

[2] According to the Work Plan, field duplicate samples were collected to assess the precision of the discrete soil sampling process. However, upon further review, the description of the field duplicate sampling process from field activities and in the Work Plan is more representative of field split sample collection rather than a co-located field duplicate. Thus, the results of these duplicate samples provide an assessment of the precision of field homogenization process and the laboratory analysis rather than and assessment of the field sample collection procedures.

$$RPD=(A-B)\div\left((A+B)\div2\right)\times100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement

Field data precision was also measured using the relative standard deviation (RSD) for the triplicate IC sample, calculated as follows:

$$RSD=\text{Standard Deviation (A,B,C)} \div \text{Mean (A,B,C)}$$

Where:
A = Analytical result from one of three triplicate measurements
B = Analytical result from the second measurement
C = Analytical result from the third measurement

Data accuracy was assessed for laboratory analyses using MS, MSD, and CRM data. Field measurement accuracy was performed in the field by experienced field personnel and is not included as part of the data validation. Laboratory accuracy was calculated as the percent recovery as follows:

$$\%\ Recovery=(A-X)\div B\times100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements.

3. RESULTS

OSU provided two EDDs, the first of which quantified total TAL metals, bioaccessible lead and arsenic at pH 1.5 and pH 2.5, electrical conductivity, Mehlich III extractable lead and phosphorus, water storage capacity, chloride, sulfate, and grain size, and the second which quantified total carbon and nitrogen collected during SATES Phase IA Part 2. The COCs were complete for the sample delivery group. Holding times were exceeded for the chloride and sulfate, electrical conductivity, total carbon and nitrogen, and pH methods, which affected all applicable samples, as discussed below. No other hold times were exceeded. All samples were received within the appropriate temperature range specified in the Work Plan (4 ± 2°C).

Several MS, MSD, and CRM percent recovery values for the total TAL metals analyses were outside the acceptable data accuracy and data precision control limits specified in the Work Plan and by the laboratory. Qualifiers were assigned as needed as discussed below. There were several instances where analytes were detected above the reporting limit in the method blank, or the method blank percent recovery was outside the acceptable range, but it was determined that no qualification was necessary. Additionally, some laboratory replicates exceeded the acceptable RPD but no qualification was necessary. These instances are discussed in detail in the bullet points below.

The Phase IA percent bioaccessibility for lead at pH 1.5 results range from 61.9% to 64.9%. These results are within in the EPA-specified QC limits. Thus, none of the lead bioaccessibility results at pH 1.5 require qualification. The percent bioaccessibility data for arsenic at pH 1.5 and 2.5 and lead at

pH 2.5 across batches of samples for Phase IA were confirmed to be reproducible (i.e., <30% RPD) for these analyses.[3]

Data validation results are summarized in Table 5, Summary of Sample Results Qualified During Data Validation (Lab Report OSU18A, Ohio State University). OSU "rl" flagged 491 results that were reported at concentrations below the reporting limit but above the method detection limit, "<MDL" flagged 160 results that were not detected at or above the associated detection limit, and "<RL" flagged three results that were detected below the reporting limit with no detection limit specified. Ramboll updated these qualifiers to correspond with the qualifiers specified in Table 4. Results flagged as "rl" by OSU were qualified as "J", and results flagged as "<MDL" or "<RL" were qualified as "U". In addition, Ramboll reviewed the information provided by OSU regarding holding times, blanks, laboratory replicates, SRMs, CRMs, and the MS/MSD analyses that were outside of the control criteria and made the assessments about data quality that are summarized below.

The following results were qualified by Ramboll during the data validation:

- For the Method 6010 analysis, the MS percent recovery for silver was below the lower acceptable laboratory limit of 75% in Batch 3 (71%), Batch 4 (69%), and Batch 5 (63%). Because silver was not detected above the reporting limits in these batches, silver results for these batches should be "UJ" qualified (results estimated, reporting limits approximate).
- For the Method 6010 analysis, the MS percent recovery for chromium exceeded the upper acceptable laboratory limit of 125% in Batch 3 (128%). All chromium results detected above the reporting limit in this QC batch should be "J+" qualified (results estimated, potential high bias).
- For the Method 6010 analysis, the CRM percent recovery exceeded the upper laboratory control limit of 120% for multiple analytes in all batches: silver, aluminum, barium, beryllium, chromium, potassium, manganese, antimony, and selenium in Batch 1; silver, aluminum, barium, beryllium, chromium, potassium, manganese, and antimony in Batches 2 and 4; silver, aluminum, barium, beryllium, chromium, potassium, and antimony in Batch 3; and aluminum, beryllium, chromium, potassium, and antimony in Batch 5. Detections of these analytes in the affected batches above the reporting limit should be "J+" qualified (results estimated, potential high bias).
- For the Method 6010_9200 analysis at pH 1.5 for arsenic, the spiked blank had a percent recovery below the lower acceptable limit of 80%, at -0.0519% in Batch 3. Additionally, the matrix spike had a percent recovery below the lower acceptable limit of 75%, at -0.432% in Batch 3. Because arsenic was detected above the reporting limit in all of the associated samples these results should be "J" qualified (results estimated).
- All of the samples for Method 300.0 (chloride and sulfate) exceeded the 28-day holding time specified in Table 3. Because the sample analysis occurred outside of the holding time specified in the Work Plan, at 49-56 days, the results are "J-" qualified (results estimated, potential low bias).
- All of the samples for Method SM2510B (electrical conductivity) exceeded the 28-day holding specified in Table 3. Because the sample analysis occurred slightly outside of the holding time

[3] The QC information provided by OSU to Ramboll in January of 2018 specified that National Institute of Standards and Technology (NIST) Montana II soil (SRM 2711a) was used to assess lead percent bioaccessibility at pH 1.5. However, it was later discovered (in October 2018) that NIST Montana I soil (SRM 2710a) was used. The acceptable percent bioaccessibility range for SRM 2710a is 60.7 - 74.2%. There is no EPA method that specifies percent bioaccessibility QC ranges for SRM 2710a for arsenic at pH 1.5 and 2.5 or lead at pH 2.5. Absent a reference value or range for comparison, the percent bioaccessibility data across batches of samples for Phase IA and over time were compared to a reproducibility criterion for these analyses.

specified in the Work Plan, at 29-36 days, the conductivity results are "J-" qualified (results estimated, potential low bias).

- All of the samples analyzed by the Nelson 82 and Bremner 82 Methods for total carbon and total nitrogen exceeded the 60-day holding time from sample collection to sample analysis listed in Table 9 of the Work Plan. The equivalent standard and EPA methods for total carbon have holding times listed of 7 days (SM 5310B for TOC in water), 28 days (EPA Method 415.3 for TOC in water), and not specified (for EPA Method 9060A TOC in water and waste). The equivalent standard and EPA methods for total nitrogen have holding times of 28 days (EPA Method 1687 for Total Kjeldahl Nitrogen in Water; and SM 4500 N (organic) C in Water; and EPA Method 351.3 for Total Kjeldahl Nitrogen in Water). Because the sample analysis occurred outside of the holding time specified in the Work Plan at 84-91 days, which is already nearly double the generally accepted holding time for these analytes, and total carbon and total nitrogen were detected in all samples, the results for these analytes are "J-" qualified (results estimated, potential low bias).
- No control criteria was specified for pH because it was not in the Work Plan. The holding time of the corresponding EPA Method, EPA Method 9045D, was applied, which specifies "as soon as possible"; this is widely interpreted by laboratories to be less than 24-hours. The samples had a holding time of 29-36 days from sample collection to analysis. Based on this, all of the pH results are "R" qualified (results unusable).

Additionally, Ramboll reviewed the following results that were outside of control criteria and determined that no data qualification is necessary:

- For the Method 6010 analysis, several analytes were detected above the reporting limit in one of the method blanks: iron in Batches 1, 2, 3, 4, and 5; phosphorus in Batches 1 and 3; aluminum in Batches 2, 3, and 4; lead analyzed by Method 6010_Mehlich 3 in Batch 9; and phosphorus analyzed by Method 6010_Mehlich 3 in Batch 1 at 0.059584 mg/L. The USEPA guidelines state that any reported concentrations less than 10 times the reported concentration in an associated blank should be qualified. Because all results for the associated samples are greater than 10 times the associated blank, no qualification is necessary.
- For the Method 6010 analysis, the RPD from the laboratory replicate analysis exceeded the acceptable laboratory limit of 30% for multiple analytes: thallium in Batches 2, 3, and 5; selenium in Batches 4 and 5, and chromium in Batch 5. According to USEPA guidelines, no data qualification is necessary.
- For the Method 6010_9200 analyses at pH 1.5 for arsenic and lead, both analytes were detected above the reporting limit in one of the method blanks: lead in Batches 1 and 2, and arsenic in Batch 3. The USEPA guidelines state that any reported concentrations less than 10 times the reported concentration in an associated blank should be qualified. Because all results for the associated samples are greater than 10 times the associated blank, no qualification is necessary.
- For the Method 6010_9200 analysis at pH 2.5 for lead, lead was detected above the reporting limit in the method blanks in Batches 1 and 3. The USEPA guidelines state that any reported concentrations less than 10 times the reported concentration in an associated blank should be qualified. Because all results for the associated samples are greater than 10 times the associated blank, no qualification is necessary.

In addition to the laboratory analyses, Ramboll assessed field duplicate precision for discrete and IC samples, and field triplicate precision for IC samples. Of the 88 discrete sample results analyzed for total TAL metals field duplicate precision, six exceeded the RPD criteria of 50 percent specified in the Work Plan. The analytes exceeding control criteria were antimony, arsenic, cadmium, lead, and zinc in

sample D-401-2C-101317-2-4, and sodium in sample D-258-3C-101317-2-4. Only one IC field duplicate result, the result for chloride, exceeded the control criteria. Ramboll also assessed the triplicate IC sample, IC1-401-2A-101217, IC2-401-2A-101217, and IC3-401-2A-101217 for field precision using the Interstate Technology and Regulatory Council (2012) RSD control criteria of 30 percent. The <2 mm fraction total metals result for selenium exceeded the triplicate RSD criteria. However, the selenium results for the triplicate samples were all below the laboratory reporting limit. No data qualification was necessary for any of the samples exceeding field precision criteria.

Ramboll's data validation assessment resulted in all IC sample results for pH (19) being "R" qualified. This analysis was not specified in the Work Plan. Sixty-six IC and discrete sample silver results were "UJ" qualified. All IC sample results for chloride (19), sulfate (19), conductivity (19), total carbon (19), and total nitrogen (19) were "J-" qualified. IC sample and discrete sample results for aluminum (138), antimony (87), barium (119), chromium (138), manganese (91), and potassium (138) were "J+" qualified. Ten arsenic bioaccessibility results at pH 1.5 (as mg/kg and % bioaccessible) were "J" qualified. Additionally, 494 results were "J" flagged because they were between the detection limit and reporting limit, and 163 results were "U" flagged because they were not detected. No other validation qualifiers were assigned during the data validation.

4. CONCLUSIONS

Based on the Level 2 Data Validation Assessment of the SATES Phase IA Part 2 soil analysis results from OSU, Ramboll has determined the data are acceptable with the exception of the pH results, which were not a planned analysis. Of the 3,570 results, 1,577 were qualified. All but 19 (i.e., all IC sample results for pH) of the results reported by OSU are useable for future analysis and reporting.

5. REFERENCES

Interstate Technology and Regulatory Council. (ITRC) 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. Interstate Technology and Regulatory Council: Washington, DC. 475 pp. Available online at: http://www.itrcweb.org/gd.asp.

Ramboll Environ U.S. Corporation (Ramboll). 2017. FINAL Work Plan for the Soil Amendment Technology Evaluation Study Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation. Prepared for Teck American Incorporated. Seattle, WA.

United States Environmental Protection Agency (USEPA). 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. OSWER 9355.0-131. Office of Superfund Remediation and Technology Innovation. Washington, D.C.

RAMBØLL

TABLES

Table 1. Report and Sample Delivery Group Reviewed			
Sample Delivery Group	**Number of Samples**	**Sample Matrix**	**OSU Report Date**
OSU18A OSU18A_report2	135 19	Soil	01/18/2018 01/30/2018

Table 2. Samples Included in this Quality Assurance Review: (TAL Metals by EPA 6010, Total Chloride and Sulfate by EPA 300; Grain Size Analysis by ASTM D422; Water Storage Capacity by ASTM D2116 Modified; As and Pb Bioaccessibility at pH 1.5 & 2.5 by EPA 6010_9200; Mehlich III extractable Pb and P by EPA 6010B; Electrical Conductivity by SM 2510B; Total Carbon and Nitrogen by Bremner and Mulvaney 1982 and Nelson and Sommers 1982; pH by Thomas 1996; Phosphorus by EPA 6010)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
D-441-1B-101317-6-8	OSU18A	SA_32	10/13/2017	Soil
D-441-1A-101317-8-10	OSU18A	SA_99	10/13/2017	Soil
D-401-1B-101317-4-6	OSU18A	SA_13	10/13/2017	Soil
D-401-1B-101317-2-4	OSU18A	SA_7	10/13/2017	Soil
D-258-3C-101317-0-2	OSU18A	SA_83	10/13/2017	Soil
D-401-1B-101317-2-4D	OSU18A	SA_29	10/13/2017	Soil
D-441-1C-101317-8-10	OSU18A	SA_36	10/13/2017	Soil
D-441-1D-101317-6-8	OSU18A	SA_92	10/13/2017	Soil
D-401-1C-101317-4-6	OSU18A	SA_14	10/13/2017	Soil
D-441-1A-101317-10-12	OSU18A	SA_100	10/13/2017	Soil
D-401-1A-101317-8-10	OSU18A	SA_24	10/13/2017	Soil
D-401-1D-101317-6-8	OSU18A	SA_11	10/13/2017	Soil
D-401-2D-101317-10-12	OSU18A	SA_5	10/13/2017	Soil
D-441-1B-101317-8-10	OSU18A	SA_33	10/13/2017	Soil
D-401-1B-101317-6-8	OSU18A	SA_19	10/13/2017	Soil
D-401-1C-101317-6-8	OSU18A	SA_20	10/13/2017	Soil
D-401-1D-101317-8-10	OSU18A	SA_17	10/13/2017	Soil
D-401-1C-101317-10-12	OSU18A	SA_22	10/13/2017	Soil
D-401-1B-101317-0-2	OSU18A	SA_3	10/13/2017	Soil
D-401-1D-101317-0-2	OSU18A	SA_8	10/13/2017	Soil
D-401-1A-101317-2-4	OSU18A	SA_6	10/13/2017	Soil
D-401-1C-101317-0-2	OSU18A	SA_1	10/13/2017	Soil
D-401-1C-101317-2-4	OSU18A	SA_10	10/13/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (TAL Metals by EPA 6010, Total Chloride and Sulfate by EPA 300; Grain Size Analysis by ASTM D422; Water Storage Capacity by ASTM D2116 Modified; As and Pb Bioaccessibility at pH 1.5 & 2.5 by EPA 6010_9200; Mehlich III extractable Pb and P by EPA 6010B; Electrical Conductivity by SM 2510B; Total Carbon and Nitrogen by Bremner and Mulvaney 1982 and Nelson and Sommers 1982; pH by Thomas 1996; Phosphorus by EPA 6010)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
D-401-1A-101317-4-6	OSU18A	SA_12	10/13/2017	Soil
D-441-1B-101317-2-4D	OSU18A	SA_28	10/13/2017	Soil
D-441-1D-101317-0-2	OSU18A	SA_34	10/13/2017	Soil
D-401-2C-101317-2-4D	OSU18A	SA_26	10/13/2017	Soil
D-401-1D-101317-2-4	OSU18A	SA_9	10/13/2017	Soil
D-401-1A-101317-0-2	OSU18A	SA_2	10/13/2017	Soil
D-441-1B-101317-4-6	OSU18A	SA_31	10/13/2017	Soil
D-258-3C-101317-2-4D	OSU18A	SA_27	10/13/2017	Soil
D-441-1D-101317-2-4	OSU18A	SA_35	10/13/2017	Soil
D-401-1A-101317-6-8	OSU18A	SA_18	10/13/2017	Soil
D-401-1D-101317-4-6	OSU18A	SA_15	10/13/2017	Soil
D-401-1D-101317-10-12	OSU18A	SA_23	10/13/2017	Soil
D-401-1C-101317-8-10	OSU18A	SA_16	10/13/2017	Soil
D-401-2B-101317-10-12	OSU18A	SA_4	10/13/2017	Soil
D-401-1B-101317-10-12	OSU18A	SA_30	10/13/2017	Soil
D-401-1A-101317-10-12	OSU18A	SA_21	10/13/2017	Soil
D-401-1B-101317-8-10	OSU18A	SA_25	10/13/2017	Soil
D-441-1B-101317-10-12	OSU18A	SA_40	10/13/2017	Soil
D-441-1B-101317-0-2	OSU18A	SA_38	10/13/2017	Soil
D-441-1C-101317-6-8	OSU18A	SA_45	10/13/2017	Soil
D-441-1B-101317-2-4	OSU18A	SA_39	10/13/2017	Soil
D-441-1C-101317-2-4	OSU18A	SA_43	10/13/2017	Soil
D-441-1C-101317-10-12	OSU18A	SA_37	10/13/2017	Soil
D-401-2D-101317-8-10	OSU18A	SA_63	10/13/2017	Soil
D-401-2A-101317-10-12	OSU18A	SA_65	10/13/2017	Soil
D-401-2B-101317-6-8	OSU18A	SA_68	10/13/2017	Soil
D-441-1C-101317-4-6	OSU18A	SA_44	10/13/2017	Soil
D-401-2C-101317-8-10	OSU18A	SA_70	10/13/2017	Soil
D-401-2C-101317-4-6	OSU18A	SA_72	10/13/2017	Soil
D-401-2B-101317-8-10	OSU18A	SA_62	10/13/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (TAL Metals by EPA 6010, Total Chloride and Sulfate by EPA 300; Grain Size Analysis by ASTM D422; Water Storage Capacity by ASTM D2116 Modified; As and Pb Bioaccessibility at pH 1.5 & 2.5 by EPA 6010_9200; Mehlich III extractable Pb and P by EPA 6010B; Electrical Conductivity by SM 2510B; Total Carbon and Nitrogen by Bremner and Mulvaney 1982 and Nelson and Sommers 1982; pH by Thomas 1996; Phosphorus by EPA 6010)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
D-441-1C-101317-0-2	OSU18A	SA_42	10/13/2017	Soil
D-401-2D-101317-6-8	OSU18A	SA_69	10/13/2017	Soil
D-401-2C-101317-10-12	OSU18A	SA_64	10/13/2017	Soil
D-401-2A-101317-8-10	OSU18A	SA_61	10/13/2017	Soil
D-401-2D-101317-2-4	OSU18A	SA_71	10/13/2017	Soil
D-401-2A-101317-6-8	OSU18A	SA_67	10/13/2017	Soil
D-401-2C-101317-6-8	OSU18A	SA_66	10/13/2017	Soil
D-258-3D-101317-8-10	OSU18A	SA_54	10/13/2017	Soil
D-258-3B-101317-6-8	OSU18A	SA_57	10/13/2017	Soil
D-258-3D-101317-10-12	OSU18A	SA_55	10/13/2017	Soil
D-258-3A-101317-0-2	OSU18A	SA_46	10/13/2017	Soil
D-258-3A-101317-2-4	OSU18A	SA_47	10/13/2017	Soil
D-258-3A-101317-4-6	OSU18A	SA_48	10/13/2017	Soil
D-258-3A-101317-8-10	OSU18A	SA_50	10/13/2017	Soil
D-258-3D-101317-4-6	OSU18A	SA_52	10/13/2017	Soil
D-258-3A-101317-6-8	OSU18A	SA_49	10/13/2017	Soil
D-258-3D-101317-2-4	OSU18A	SA_51	10/13/2017	Soil
D-258-3B-101317-4-6	OSU18A	SA_56	10/13/2017	Soil
D-258-3B-101317-10-12	OSU18A	SA_59	10/13/2017	Soil
D-258-3B-101317-8-10	OSU18A	SA_58	10/13/2017	Soil
D-258-3A-101317-10-12	OSU18A	SA_41	10/13/2017	Soil
D-258-3D-101317-6-8	OSU18A	SA_53	10/13/2017	Soil
D-258-3D-101317-0-2	OSU18A	SA_60	10/13/2017	Soil
IC-441-1D-101617	OSU18A	SA_135	10/16/2017	Soil
IC3-401-2A-101217	OSU18A	SA_125	10/12/2017	Soil
IC-401-1C-101117-D	OSU18A	SA_120	10/11/2017	Soil
IC-441-1A-101617	OSU18A	SA_132	10/16/2017	Soil
IC-401-2B-101117	OSU18A	SA_122	10/11/2017	Soil
IC-401-2C-101217	OSU18A	SA_126	10/12/2017	Soil
IC-441-1B-101617	OSU18A	SA_133	10/16/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (TAL Metals by EPA 6010, Total Chloride and Sulfate by EPA 300; Grain Size Analysis by ASTM D422; Water Storage Capacity by ASTM D2116 Modified; As and Pb Bioaccessibility at pH 1.5 & 2.5 by EPA 6010_9200; Mehlich III extractable Pb and P by EPA 6010B; Electrical Conductivity by SM 2510B; Total Carbon and Nitrogen by Bremner and Mulvaney 1982 and Nelson and Sommers 1982; pH by Thomas 1996; Phosphorus by EPA 6010)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
IC-401-1D-101117	OSU18A	SA_121	10/11/2017	Soil
IC2-401-2A-101217	OSU18A	SA_124	10/12/2017	Soil
IC-441-1C-101617	OSU18A	SA_134	10/16/2017	Soil
IC1-401-2A-101217	OSU18A	SA_123	10/12/2017	Soil
IC-258-3A-101717	OSU18A	SA_128	10/17/2017	Soil
IC-401-1B-101017	OSU18A	SA_118	10/10/2017	Soil
IC-401-1C-101117	OSU18A	SA_119	10/11/2017	Soil
IC-401-1A-101017	OSU18A	SA_117	10/10/2017	Soil
IC-401-2D-101217	OSU18A	SA_127	10/12/2017	Soil
IC-258-3C-101717	OSU18A	SA_130	10/17/2017	Soil
IC-258-3D-101717	OSU18A	SA_131	10/17/2017	Soil
IC-258-3B-101717	OSU18A	SA_129	10/17/2017	Soil
D-258-3C-101317-6-8	OSU18A	SA_90	10/13/2017	Soil
D-441-1D-101317-10-12	OSU18A	SA_94	10/13/2017	Soil
D-258-3C-101317-10-12	OSU18A	SA_88	10/13/2017	Soil
D-258-3C-101317-8-10	OSU18A	SA_89	10/13/2017	Soil
D-441-1D-101317-8-10	OSU18A	SA_93	10/13/2017	Soil
D-441-1D-101317-4-6	OSU18A	SA_91	10/13/2017	Soil
D-441-1A-101317-4-6	OSU18A	SA_97	10/13/2017	Soil
D-441-1A-101317-2-4	OSU18A	SA_96	10/13/2017	Soil
D-401-2C-101317-2-4	OSU18A	SA_78	10/13/2017	Soil
D-441-1A-101317-6-8	OSU18A	SA_98	10/13/2017	Soil
D-401-2B-101317-4-6	OSU18A	SA_74	10/13/2017	Soil
D-401-2A-101317-4-6	OSU18A	SA_73	10/13/2017	Soil
D-401-2B-101317-0-2	OSU18A	SA_76	10/13/2017	Soil
D-441-1A-101317-0-2	OSU18A	SA_95	10/13/2017	Soil
D-401-2A-101317-2-4	OSU18A	SA_79	10/13/2017	Soil
D-401-2C-101317-0-2	OSU18A	SA_84	10/13/2017	Soil
D-401-2B-101317-2-4	OSU18A	SA_80	10/13/2017	Soil
D-401-2D-101317-4-6	OSU18A	SA_75	10/13/2017	Soil

RAMBOLL

Table 2. Samples Included in this Quality Assurance Review: (TAL Metals by EPA 6010, Total Chloride and Sulfate by EPA 300; Grain Size Analysis by ASTM D422; Water Storage Capacity by ASTM D2116 Modified; As and Pb Bioaccessibility at pH 1.5 & 2.5 by EPA 6010_9200; Mehlich III extractable Pb and P by EPA 6010B; Electrical Conductivity by SM 2510B; Total Carbon and Nitrogen by Bremner and Mulvaney 1982 and Nelson and Sommers 1982; pH by Thomas 1996; Phosphorus by EPA 6010)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
D-401-2A-101317-0-2	OSU18A	SA_85	10/13/2017	Soil
D-401-2D-101317-0-2	OSU18A	SA_77	10/13/2017	Soil
D-258-3C-101317-2-4	OSU18A	SA_82	10/13/2017	Soil
D-258-3C-101317-4-6	OSU18A	SA_81	10/13/2017	Soil
D-258-3B-101317-2-4	OSU18A	SA_86	10/13/2017	Soil
D-258-3B-101317-0-2	OSU18A	SA_87	10/13/2017	Soil
D-258-3A-100717-0-6	OSU18A	SA_109	10/7/2017	Soil
D-441-1D-100617-0-6	OSU18A	SA_110	10/6/2017	Soil
D-258-3C-100717-0-6	OSU18A	SA_106	10/7/2017	Soil
D-401-2D-100517-0-6	OSU18A	SA_108	10/5/2017	Soil
D-441-1A-100617-0-6	OSU18A	SA_105	10/6/2017	Soil
D-401-1A-100417-0-6	OSU18A	SA_112	10/4/2017	Soil
D-401-1C-100417-0-6	OSU18A	SA_101	10/4/2017	Soil
D-401-1B-100417-0-6	OSU18A	SA_115	10/4/2017	Soil
D-441-1C-100617-0-6	OSU18A	SA_113	10/6/2017	Soil
D-258-3D-100717-0-6	OSU18A	SA_104	10/7/2017	Soil
D-258-3B-100717-0-6	OSU18A	SA_116	10/7/2017	Soil
D-401-2A-100517-0-6	OSU18A	SA_107	10/5/2017	Soil
D-401-1D-100417-0-6	OSU18A	SA_114	10/4/2017	Soil
D-441-1B-100617-0-6	OSU18A	SA_111	10/6/2017	Soil
D-401-2C-100517-0-6	OSU18A	SA_103	10/5/2017	Soil
D-401-2B-100517-0-6	OSU18A	SA_102	10/5/2017	Soil

Table 3. Laboratory Quality Control Limits from SATES Work Plan (Ramboll 2017)

		Accuracy - Percent Recovery		Precision - RPD			Precision- RSD	Hold Time (from Sample Collection Date, days)
Analysis	**Sample Analysis Method Reference**	**MS/ MSD**	**LCS**	**MS/ MSD**	**LCS/ LCSD**	**Field Duplicate**	**Field Triplicate**	
Total TAL Metals (except mercury)	USEPA 6010	75-125	80-120	30	30	50	30	180[1]
Bioaccessible Arsenic and Lead	USEPA 6010B	75-125	85-115	20	20	50	30	180
Mehlich III Extractable Lead and Phosphorous	USEPA 6010	75-125	85-115	20	20	50	30	180
Electrical Conductivity	SM 2510B	NA	85-115	NA	NA	20	30	28
Chloride	USEPA 300.0	80-120	80-120	20	20	50	30	28
Sulfate	USEPA 300.0	80-120	80-120	20	20	50	30	28
Soil Moisture Capacity	ASTM D2216/Cassel, D.K. and D.R. Nielsen 1986	NA	NA	NA	NA	NA	30	28
Grain Size Analysis	ASTM D422	NA	NA	NA	NA	20	30	180
Total Carbon and Nitrogen	Bremner and Mulvaney 1982, Nelson and Sommers 1982	23-174	82-131	20	20	50	30	60

Notes:
1. The hold time of 28 days specified in the Work Plan is applicable to metals in water, not soils. The hold time was updated to 180 days as documented in the Corrective Action Record.
LCS = Laboratory control spike; LCS/LCSD = Laboratory control spike/laboratory control spike duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference
RSD = Relative standard deviation
SPLP = Synthetic precipitation leaching procedure

Table 4. Validation Qualifier Definitions	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
U*	The analyte should be considered not detected because it was detected in an associated blank at a similar concentration.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
UB	Compound considered non-detect at the listed value due to associated blank contamination.
EPMC	Chromatographic peaks are present in the expected retention time window; however, the peaks do not meet all of the conditions required for positive identification. The detection limit represents the estimated maximum possible concentration if the analyte was present.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
Notes: Definitions from USEPA (2017) and Ramboll (2017).	

Table 5. Summary of Sample Results Qualified During Data Validation (Lab Report OSU18A, Ohio State University)

Analysis	Soil Fraction	Method	Count	Minimum Value Qualified	Maximum Value Qualified	Units	Detection Limit	Reporting Limit	Validator Qualifier	Reason for Data Validation Qualification
Aluminum	< 150 µm	EPA6010	19	19803	26893	mg/kg	0.183	5	J+	CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	119	4766	25983	mg/kg	0.183	5	J+	CRM percent recovery exceeded acceptable upper laboratory limit
Antimony	< 150 µm	EPA6010	19	8.61	54.0	mg/kg	0.460	5	J+	CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	68	4.92	47.6	mg/kg	0.460	5	J+	CRM percent recovery exceeded acceptable upper laboratory limit
Arsenic	< 150 µm	Bioaccess1.5pH	5	12.5	24.7	%	--	--	J	Spiked blank and MS percent recovery below the acceptable lower laboratory limit
	< 150 µm	EPA6010_9200Bio1.5	5	5.29	9.74	mg/kg	0.386	1	J	Spiked blank and MS percent recovery below the acceptable lower laboratory limit
Barium	< 150 µm	EPA6010	19	204	338	mg/kg	0.0033	1	J+	CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	100	47.6	369	mg/kg	0.0033	1	J+	CRM percent recovery exceeded acceptable upper laboratory limit
Chloride	< 2mm	EPA_300.0	19	15.9	29.1	mg/kg	--	10	J-	Holding time exceeded
Chromium	< 150 µm	EPA6010	19	19.1	54.3	mg/kg	0.0345	1	J+	MS percent recovery exceeded acceptable upper laboratory limit; CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	119	11.7	53.2	mg/kg	0.0345	1	J+	MS percent recovery exceeded acceptable upper laboratory limit; CRM percent recovery exceeded acceptable upper laboratory limit
Conductivity	Bulk	SM2510B	19	4.52	15.0	mS/m	--	--	J-	Holding time exceeded
Manganese	< 150 µm	EPA6010	19	748	1244	mg/kg	0.0255	1	J+	CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	72	188	990	mg/kg	0.0255	1	J+	CRM percent recovery exceeded acceptable upper laboratory limit
pH	Bulk	Thomas1996	19	4.55	6.16	SU	--	--	R	Holding time exceeded
Potassium	< 150 µm	EPA6010	19	1838	3475	mg/kg	0.698	10	J+	CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	119	667	3790	mg/kg	0.698	10	J+	CRM percent recovery exceeded acceptable upper laboratory limit
Silver	< 150 µm	EPA6010	19	0.2	0.2	mg/kg	0.2	5	UJ	MS percent recovery was below acceptable lower laboratory limit, result was not detected; CRM percent recovery exceeded acceptable upper laboratory limit
	< 2mm	EPA6010	47	0.2	0.2	mg/kg	0.2	5	UJ	MS percent recovery was below acceptable lower laboratory limit, result was not detected; CRM percent recovery exceeded acceptable upper laboratory limit
Sulfate	< 2mm	EPA_300.0	19	30	100	mg/kg	--	30	J-	Holding time exceeded
Total Carbon	< 2mm	NELSON82	19	2.32	10.5	%	--	0.7	J-	Holding time exceeded
Total Nitrogen	< 2mm	BREMNER82	19	0.117	0.472	%	--	0.05	J-	Holding time exceeded

Table 5. Summary of Sample Results Qualified During Data Validation (Lab Report OSU18A, Ohio State University)

Analysis	Soil Fraction	Method	Count	Minimum Value Qualified	Maximum Value Qualified	Units	Detection Limit	Reporting Limit	Validator Qualifier	Reason for Data Validation Qualification

Notes
CRM = certified reference value recovery material
MS = matrix spike
-- = none reported
µm = micrometers
mm = millimeter
mg/kg = milligrams per kilogram
mS/m = millisiemens per meter
SU = standard units

RAMBOLL

ENVIRONMENT & HEALTH

MEMORANDUM

Job	**SATES Phase IA Test Plot Characterization Geotechnical Data Quality Assurance and Quality Control Summary: HWA Geosciences Inc. Results**
Client	**Teck American Incorporated**
To	**Dave Enos and Denise Mills**
From	**Amy Kephart and Julie Weicheld**
Copy to	**Kris McCaig, Teck American Incorporated; Cristy Kessel, Teck American Incorporated; Mike Arnold, Ramboll; Rosalind Schoof, Ramboll**

Date January 18, 2018

Ramboll Environ
901 Fifth Avenue
Suite 2820
Seattle, WA 98164
USA

T +1 206 336 1650
F +1 206 336 1651
www.ramboll-environ.com

1. Introduction

In accordance with the Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES), Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation (Work Plan; Ramboll 2017), test plot characterization has been conducted as part of the evaluation and selection process for test plots and sub-plots that will be carried forward for use in the pilot testing of amendment options. As part of the test plot characterization for the initial amendment alternatives evaluation, soil samples were collected in October 2017 for physical testing to characterize soil structure and amendment fluid infiltration rates.

Specifically, 48 discrete soil samples were collected from each of the test plots using Shelby tube samplers to obtain undisturbed samples for assessment of *in situ* soil properties. Of these, 32 were analyzed for bulk density using American Society for Testing Materials (ASTM) standard method D7263 and 16 were analyzed for the coefficient of permeability (hydraulic conductivity) using the standard method established in ASTM D2434. The chain-of-custody (COC) forms signed by Arcadis U.S. Inc. and HWA Geosciences Inc. (HWA) show that the samples were collected on October 4, 5, 6, and 7, 2017, and delivered to HWA on October 18, 2017. HWA produced a final materials testing laboratory report on December 1, 2017.

2. HWA Geosciences Laboratory Analysis Quality Control Review

The COC records and HWA materials laboratory report were reviewed according to the data verification methods specified in the Work Plan including:

- evaluation of completeness of data package;
- verification that field COC forms were completed and that samples were handled properly;
- verification that parameters were analyzed according to the methods specified; and
- review of quality assurance/quality control (QA/QC) data (i.e., verify that maximum percent deviation from average values for hydraulic conductivity results are acceptable [less than 25 percent as specified by HWA]).

The HWA report and data package were complete, the samples were handled properly to minimize sample disturbance for the bulk density and permeability analyses, and all sample names matched the COC documentation and met the completeness criteria specified in the

Work Plan. Table 1, Summary of Analyses Performed by HWA, summarizes the sample intervals tested and analyses performed.

Table 2, Samples Included in this Quality Assurance Review, lists the samples reviewed in this memorandum. The analyses were performed according to the methods specified in the Work Plan amendments, documented on attached Corrective Action Forms signed September 8, 2017, which identified changes to the ASTM standard methods to be used for the bulk density and permeability testing by HWA. For the permeability analyses, the maximum percent deviation from average values for hydraulic conductivity results for samples from each test plot location were confirmed to be well below 25 percent (final results ranged from 1.2 to 7.7 percent), as specified by HWA's bench protocols.

Given that the bulk density and permeability testing was conducted consistent with the ASTM standard methods specified herein, with no notable exceptions, the data are considered representative of the respective test plot soil conditions. Therefore, the data are useable for future analysis and reporting.

3. References

Ramboll Environ U.S. Corporation (now Ramboll). 2017. FINAL Work Plan for the Soil Amendment Technology Evaluation Study Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation. Prepared for Teck American Incorporated. Seattle, WA.

TABLES

Table 1. Summary of Analyses Performed by HWA			
Analysis Performed	**ASTM Method**	**Number of Samples**	**Sample Depth (in.)**
Bulk Density	D7263	16	0-3
		16	6-9
Coefficient of Permeability (Hydraulic Conductivity)	D2434	16	0-6

Table 2. Samples Included in this Quality Assurance Review: (Bulk Density by ASTM D7263B; Hydraulic Conductivity by ASTM D2434; Calculated Moisture Content)

Teck American Incorporated Sample Name	Laboratory Sample Delivery Group	Laboratory Sample Number	Date of Sample Collection	Matrix
D-258-3A-100717-0-3	HWA17A	D-258-3A-100717-0-3	10/07/2017	Soil
D-258-3A-100717-0-6	HWA17A	D-258-3A-100717-0-6	10/07/2017	Soil
D-258-3A-100717-6-9	HWA17A	D-258-3A-100717-6-9	10/07/2017	Soil
D-258-3B-100717-0-3	HWA17A	D-258-3B-100717-0-3	10/07/2017	Soil
D-258-3B-100717-0-6	HWA17A	D-258-3B-100717-0-6	10/07/2017	Soil
D-258-3B-100717-6-9	HWA17A	D-258-3B-100717-6-9	10/07/2017	Soil
D-258-3C-100717-0-3	HWA17A	D-258-3C-100717-0-3	10/07/2017	Soil
D-258-3C-100717-0-6	HWA17A	D-258-3C-100717-0-6	10/07/2017	Soil
D-258-3C-100717-6-9	HWA17A	D-258-3C-100717-6-9	10/07/2017	Soil
D-258-3D-100717-0-3	HWA17A	D-258-3D-100717-0-3	10/07/2017	Soil
D-258-3D-100717-0-6	HWA17A	D-258-3D-100717-0-6	10/07/2017	Soil
D-258-3D-100717-6-9	HWA17A	D-258-3D-100717-6-9	10/07/2017	Soil
D-401-1A-100417-0-3	HWA17A	D-401-1A-100417-0-3	10/04/2017	Soil
D-401-1A-100417-0-6	HWA17A	D-401-1A-100417-0-6	10/04/2017	Soil
D-401-1A-100417-6-9	HWA17A	D-401-1A-100417-6-9	10/04/2017	Soil
D-401-1B-100417-0-3	HWA17A	D-401-1B-100417-0-3	10/04/2017	Soil
D-401-1B-100417-0-6	HWA17A	D-401-1B-100417-0-6	10/04/2017	Soil
D-401-1B-100417-6-9	HWA17A	D-401-1B-100417-6-9	10/04/2017	Soil
D-401-1C-100417-0-3	HWA17A	D-401-1C-100417-0-3	10/04/2017	Soil
D-401-1C-100417-0-6	HWA17A	D-401-1C-100417-0-6	10/04/2017	Soil
D-401-1C-100417-6-9	HWA17A	D-401-1C-100417-6-9	10/04/2017	Soil
D-401-1D-100417-0-3	HWA17A	D-401-1D-100417-0-3	10/04/2017	Soil
D-401-1D-100417-0-6	HWA17A	D-401-1D-100417-0-6	10/04/2017	Soil
D-401-1D-100417-6-9	HWA17A	D-401-1D-100417-6-9	10/04/2017	Soil

Table 2. Samples Included in this Quality Assurance Review: (Bulk Density by ASTM D7263B; Hydraulic Conductivity by ASTM D2434; Calculated Moisture Content)				
Teck American Incorporated Sample Name	**Laboratory Sample Delivery Group**	**Laboratory Sample Number**	**Date of Sample Collection**	**Matrix**
D-401-2A-100517-0-3	HWA17A	D-401-2A-100517-0-3	10/05/2017	Soil
D-401-2A-100517-0-6	HWA17A	D-401-2A-100517-0-6	10/05/2017	Soil
D-401-2A-100517-6-9	HWA17A	D-401-2A-100517-6-9	10/05/2017	Soil
D-401-2B-100517-0-3	HWA17A	D-401-2B-100517-0-3	10/05/2017	Soil
D-401-2B-100517-0-6	HWA17A	D-401-2B-100517-0-6	10/05/2017	Soil
D-401-2B-100517-6-9	HWA17A	D-401-2B-100517-6-9	10/05/2017	Soil
D-401-2C-100517-0-3	HWA17A	D-401-2C-100517-0-3	10/05/2017	Soil
D-401-2C-100517-0-6	HWA17A	D-401-2C-100517-0-6	10/05/2017	Soil
D-401-2C-100517-6-9	HWA17A	D-401-2C-100517-6-9	10/05/2017	Soil
D-401-2D-100517-0-3	HWA17A	D-401-2D-100517-0-3	10/05/2017	Soil
D-401-2D-100517-0-6	HWA17A	D-401-2D-100517-0-6	10/05/2017	Soil
D-401-2D-100517-6-9	HWA17A	D-401-2D-100517-6-9	10/05/2017	Soil
D-441-1A-100617-0-3	HWA17A	D-441-1A-100617-0-3	10/06/2017	Soil
D-441-1A-100617-0-6	HWA17A	D-441-1A-100617-0-6	10/06/2017	Soil
D-441-1A-100617-6-9	HWA17A	D-441-1A-100617-6-9	10/06/2017	Soil
D-441-1B-100617-0-3	HWA17A	D-441-1B-100617-0-3	10/06/2017	Soil
D-441-1B-100617-0-6	HWA17A	D-441-1B-100617-0-6	10/06/2017	Soil
D-441-1B-100617-6-9	HWA17A	D-441-1B-100617-6-9	10/06/2017	Soil
D-441-1C-100617-0-3	HWA17A	D-441-1C-100617-0-3	10/06/2017	Soil
D-441-1C-100617-0-6	HWA17A	D-441-1C-100617-0-6	10/06/2017	Soil
D-441-1C-100617-6-9	HWA17A	D-441-1C-100617-6-9	10/06/2017	Soil
D-441-1D-100617-0-3	HWA17A	D-441-1D-100617-0-3	10/06/2017	Soil
D-441-1D-100617-0-6	HWA17A	D-441-1D-100617-0-6	10/06/2017	Soil
D-441-1D-100617-6-9	HWA17A	D-441-1D-100617-6-9	10/06/2017	Soil

CORRECTIVE ACTION RECORD

Audit Report No. : _____ Date: September 7, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

We've determined that a bulk density measurement from an unconsolidated IC sample will not be a value that is meaningful for amendment application. In addition to the 0-3" bulk density sample, we would like to collect deeper in situ bulk density samples. We would collect in situ bulk density samples from each test pit area from 0-3" and 6-9".

Date and Time Problem Recognized: 8/30/17 12:20pm By: Amy Kephart

Date of Actual Occurrence: Not Applicable- no samples collected By: _____

Analyte: Bulk Density Analytical Method: ASTM E1109

Cause of Problem:

This method is not appropriate for site soils.

CORRECTIVE ACTION PLANNED:

We propose to change the 0-3" bulk density IC sample to an in situ discrete sample. This will meet data quality objectives and provide data that can be used for determining future amendment applications. In situ bulk density will no longer be ASTM E1109. It will be ASTM D 7263. HWA Geosciences Inc. will analyze the samples.

Person Responsible for Corrective Action: Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute corrective action form to laboratory.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

CORRECTIVE ACTION RECORD

Page 1 of 1

Audit Report No. : _____ Date: September 7, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

The lab method specified for in-situ permeability in the work plan (ASTM D5084 - 16a) is not appropriate for the soil types at the site.

Date and Time Problem Recognized: 9/6/17 4:11pm By: Rebecca Andresen

Date of Actual Occurrence: Not Applicable- no samples collected By: _____

Analyte: In Situ permeability Analytical Method: ASTM D5084 - 16a

Cause of Problem:

This method is not appropriate for site soils.

CORRECTIVE ACTION PLANNED:

In situ permeability will no longer be analyzed using ASTM D5084 - 16a. It will be analyzed using ASTM D2434.

Person Responsible for Corrective Action: Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute appropriate information including the corrective action form to field team, laboratory, and SATES Technical team.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

APPENDIX F-2

FIELD QUALITY CONTROL SUMMARY TABLES

Table F-2-1. Phase IA Part 1 Screening Soil Sample RPD Results

	N	Number of RPDs > ± 50%[a]	Number of RPDs < ± 50%[a]	Maximum RPD (%)	Minimum RPD (%)
Conventional Parameters					
Solids	30	0	30	42.6	0
Metals/Metalloids					
Arsenic	30	0	30	28.6	0.922
Lead	30	2[b]	28	63.7	0

Notes:

Highlighted cells identify relative percent differences (RPDs) greater than the control limit.

[a] As specified in the Final Work Plan for the Soil Amendment Technology Evaluation Study (Ramboll 2017a), +/-50% is a data quality indicator used to assess precision in the measurements between primary and duplicate soil field samples. The RPD is calculated as the difference between the primary and duplicate sample results divided by the average of those results and expressed as a percentage.

[b] Samples 401-2-C09-081617 and 258-3-B10-082117.

N - number of samples

Table F-2-2. Phase IA Part 2 RPD and RSD Data for Soil Sample Metals Analyses

	Discrete				Incremental Composite					
	Duplicate RPD (% Absolute Value)[a]				Duplicate RPD (% Absolute Value)[a]			Triplicate RSD (% Absolute Value)[b]		
	D-258-3C-101317-2-4	D-401-1B-101317-2-4	D-401-2C-101317-2-4	D-441-1B-101317-2-4	IC-401-1C-101117			IC-401-2A-101217		
Analysis	TAL Metals from < 2-mm Fraction				SPLP Metals from < 2-mm Fraction	TAL Metals from < 2-mm Fraction	TAL Metals from < 150-µm Fraction	SPLP Metals from < 2-mm Fraction	TAL Metals from < 2-mm Fraction	TAL Metals from < 150-µm Fraction
Aluminum	11.7	5.41	6.12	9.14	2.93	0.520	3.92	4.29	3.45	2.91
Antimony	1.53	1.12[c]	80.2	2.77	10.0	11.7	2.65	12.8	13.8	6.73
Arsenic	6.65	14.5	116	6.98	5.18	12.6	2.47	2.31	4.62	2.68
Barium	9.47	8.86	10.1	4.70	6.06[c]	4.91	0.282	3.77[c]	3.22	1.64
Beryllium	12.3[c]	12.3[c]	18.4[c]	10.2[c]	40.0[c]	0[d]	4.23[c]	161[c,d]	0[d]	2.43[c]
Cadmium	2.17	6.86	57.3	8.50	0[c]	6.21	0.861	9.12[c]	2.45	7.45
Calcium	22.9	14.6	10.9	13.5	0.00	5.19	4.17	3.13	11.7	2.24
Chromium	42.3	2.00	45.1	12.3	0[c]	36.4	0.216	17.3[c]	20.0	7.00
Cobalt	19.5	1.50	26.0	2.18	0[c]	7.71	4.02	0[c]	1.95	1.17
Copper	2.97	16.3	45.8	5.63	4.88	1.06	2.34	4.38	7.04	4.18
Iron	8.48	5.01	7.88	4.66	0.798	0.805	6.27	3.93	1.90	4.21
Lead	1.60	0.102	132	12.2	2.73	10.4	4.41	4.87	20.1	11.4
Magnesium	5.99	5.34	3.48	4.37	3.60	9.61	3.60	2.85	3.29	2.50
Manganese	6.67	8.22	32.0	4.18	1.69	0.451	0.0580	7.44	3.88	4.46
Nickel	6.07	12.3	7.94	7.72	22.2[c]	2.66	1.06	0[c]	1.60	1.67
Phosphorus[e]	7.65	13.7	41.25	5.45	N/A	0.666	0.771	N/A	3.58	2.42
Potassium	28.2	4.17	25.2	10.1	7.48	6.29	6.50	2.96	5.14	2.53
Selenium	41.5[c]	1.08[c]	13.0[c]	31.0[c]	0[d]	12.7[c]	6.85[c]	0[d]	39.8[c]	7.11[c]
Silver	0[d]	0[d]	0[d]	0[d]	22.2[c]	0[d]	0[d]	43.3[c]	0[d]	0[d]
Sodium	62.0	18.3	46.9	48.1	0[c]	3.23	16.7	2.99[c]	10.2	5.43
Thallium	46.4[c]	42.2[c]	41.5[c]	25.8[c]	0[d]	32.5[c]	32.4[c]	0[d]	17.7[c]	25.0[c]
Vanadium	18.8	2.66	8.30	12.2	8.70	3.60	6.44	5.59	4.47	5.16
Zinc	0.338	5.20	71.1	1.79	0.271	4.88	3.19	7.04	3.94	6.40

Notes:

Highlighted cells identify relative percent differences (RPDs) or relative standard deviations (RSD) outside of the control limit.

[a] As specified in the Final Work Plan for the Soil Amendment Technology Evaluation Study (Ramboll 2017a), 50% is a data quality indicator used to assess precision in the measurements between primary and duplicate soil field samples. The RPD is calculated as the difference between the primary and duplicate sample results divided by the average of those results and expressed as a percentage.

[b] As specified in ITRC guidance (2012), 30% is a data quality indicator used to assess precision in the measurements between triplicate soil field samples. The RSD is calculated as the standard deviation of the triplicate samples divided by the mean.

[c] One or more results reported below the reporting limit.

[d] One or more results reported as nondetected.

[e] Phosphorus was not specified as a target analyte list (TAL) metal in the Final Work Plan for the Soil Amendment Technology Evaluation Study (Ramboll 2017a), but analysis was performed by Ohio State University (OSU).

N/A - not analyzed

SPLP - Synthetic precipitation leaching procedure

Table F-2-3. Phase IA Part 2 RPD and RSD Data for Soil Sample Chemical and Mehlich III Extractable Elements

Analysis	Duplicate RPD (% Absolute Value)[a] IC-401-1C-101117	Triplicate RSD (% Absolute Value)[b] IC-401-2A-101217
Total Solids (air dried)	0.411	0.551
Total Solids (wet weight)	0.211	0.282
pH[c]	7.45	2.00
Conductivity	12.7	7.30
Chloride	52.7	2.76
Total Organic Carbon	5.55	29.3
Sulfide	46.2[d]	7.07[e]
Sulfate	10.3	0.442
Lead (Mehlich III)	2.16	11.1
Phosphorus (Mehlich III)	1.50	7.44

Notes:

Yellow highlighted cells identify relative percent differences (RPDs) or relative standard deviations (RSD) greater than the control limit.

[a] As specified in the Final Work Plan for the Soil Amendment Technology Evaluation Study (Ramboll 2017a), 50% is a data quality indicator used to assess precision in the measurements between primary and duplicate soil field samples. The RPD is calculated as the difference between the primary and duplicate sample results divided by the average of those results and expressed as a percentage.

[b] As specified in ITRC guidance (2012), 30% is a data quality indicator used to assess precision in the measurements between triplicate soil field samples. The RSD is calculated as the standard deviation of the triplicate samples divided by the mean.

[c] pH was not a specified analysis for Phase IA Part 2 in the Final Work Plan for the Soil Amendment Technology Evaluation Study (Ramboll 2017a), but analysis was performed by Ohio State University (OSU).

[d] One or more results reported below the reporting limit.

[e] One or more results reported as nondetected.