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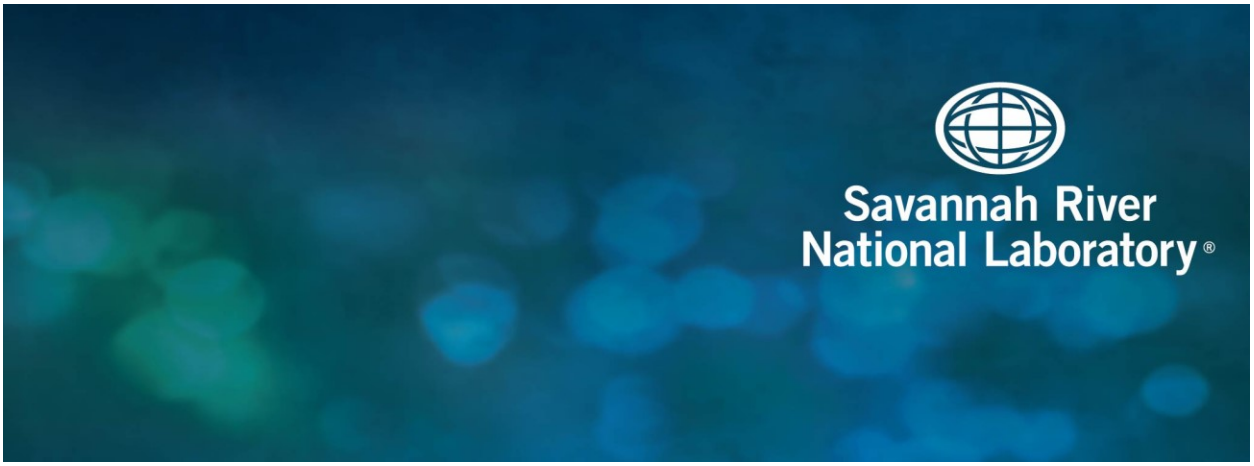


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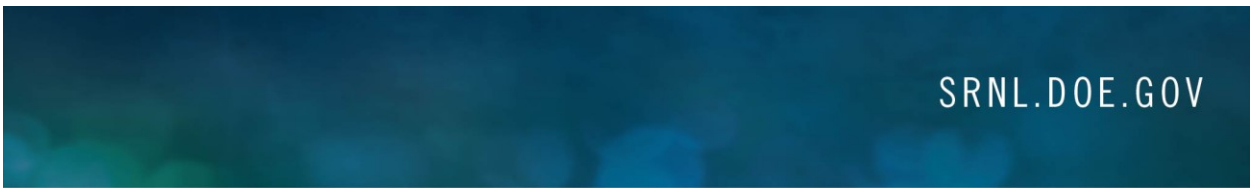
# Product Consistency Test Results for the LAW ALG Glasses

**M. C. Hsieh**

November 2021

SRNL-STI-2021-00518, Revision 0



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**Prepared for**
**U.S. Department of Energy**

SRNL-STI-2021-00518
Revision 0

**Keywords:** *Hanford, WTP, waste glass, low-activity waste, durability*

**Retention:** *Permanent*

# Product Consistency Test Results for the LAW ALG Glasses

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November 2021

Savannah River National Laboratory is operated by Battelle Savannah River Alliance for the U.S. Department of Energy under Contract No. 89303321CEM000080.

# REVIEWS AND APPROVALS

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APPROVAL:

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# ACKNOWLEDGEMENTS

The author would like to thank Daniel Jones, Kandice Miles, Whitney Riley, Kimberly Wyszynski at Savannah River National Laboratory for their skilled assistance with the sample analyses described in this report. The author thanks Viviana Gervasio and Renee Russell Pacific Northwest National Laboratory for helpful discussions and review of these data and the report. Funding from the U.S. Department of Energy through Inter-Entity Work Order HAN-M0SRV00101 as managed by Albert A. Kruger is gratefully acknowledged.

# EXECUTIVE SUMMARY

This report provides the results of the Product Consistency Test leachates from the Low-Activity Waste Algorithm glasses, a series of simulated nuclear waste glasses designed and fabricated at the Pacific Northwest National Laboratory. The series included quenched and canister centerline cooled versions of the glasses. These data will be used in the development, validation, and implementation of enhanced property/composition models for waste glass vitrification at Hanford.

Several blanks had measured silicon values slightly above the detection limit. One blank had a measured silicon value 2 times higher than the detection limit. The measured concentrations (mg/L) of sodium for several of the low-activity test reference material glass included with the Product Consistency Tests were slightly higher than the expected low-activity test reference material test results. The measured glass compositions for the study glasses were close to target values, therefore, little difference was seen when evaluating the normalized values using the targeted or measured glass compositions. In most cases, heat treatment had marginal impact on the normalized concentration values. Three glasses had $NC_B$ and $NC_{Na}$ values that were greater than the Hanford Tank Waste Treatment and Immobilization Plant low-activity waste constraint of 4 g/L.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| BDL | below detection limit |
| CCC | canister centerline cooled |
| DF | dilution factor |
| DOE | Department of Energy |
| ICP-OES | inductively coupled plasma – optical emission spectroscopy |
| ID | identifier |
| LAW | low-activity waste |
| LAW ALG | Low-Activity Waste Algorithm |
| LRM | low-activity test reference material |
| $NC_i$ | normalized concentration of element "*i*" |
| ORP | Office of River Protection |
| PCT | Product Consistency Test |
| PNNL | Pacific Northwest National Laboratory |
| Q | quenched |
| %RSD | percent relative standard deviation |
| seq. | sequence |
| SRNL | Savannah River National Laboratory |
| std | High Purity Standards ICP multi-element custom solution SM-744-013 |
| TTQAP | Task Technical and Quality Assurance Plan |
| wt.% | weight percent |
| WTP | Hanford Tank Waste Treatment and Immobilization Plant |

## 1.0 Introduction

The U.S. Department of Energy (DOE) is responsible for building the Hanford Tank Waste Treatment and Immobilization Plant (WTP) at the Hanford site in Washington to remediate 55 million gallons of radioactive waste that is temporarily stored in 177 underground tanks. The Office of River Protection (ORP) has requested that the Savannah River National Laboratory (SRNL) contribute in areas of recognized capabilities and expertise for glass waste form development to support successful startup of the WTP.

Successful efforts have allowed for demonstration of greatly enhanced treatment efficiencies of those projected from the minimum requirements set forth in the WTP Contract[a]. Additional flexibility and expansion of the qualified glass forming region are the current focus.[1] SRNL support of this work is defined in the Task Technical and Quality Assurance Plan (TTQAP).[2]

This report provides the Product Consistency Test (PCT) leachates from the Low-Activity Waste Algorithm (LAWALG) glasses, a series of simulated nuclear waste glasses designed fabricated at the Pacific Northwest National Laboratory (PNNL). The series included quenched (Q) and canister centerline cooled (CCC) versions of the glasses. The glasses were selected as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.[3] These data will be used in the development, validation, and implementation of enhanced property/composition models for nuclear waste glasses.[1]

## 2.0 Experimental Procedure

### 2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.[4] Laboratory data for this study were recorded in the SRNL Electronic Laboratory Notebook system, experiment L6390-00441-03. The leachates were provided by PNNL following a Task Plan.[1]

### 2.2 Glasses Selected for Study

The baseline (quenched) glass compositions in this study were selected and fabricated by PNNL. PNNL performed CCC heat treatments on a subsample of each of the glasses. American Society for Testing and Materials (ASTM) C1285 PCT Method A[5] was performed on Q and CCC versions of each of the study glasses. The resulting PCT leachates were sent to SRNL for chemical analysis. Identifiers (ID) for the PCT leachates are listed in Table 2-1.

[a] Contract DE-AC27-01RV14136, as amended, U.S. Department of Energy, Richland, WA (2000).

**Table 2-1. Identifiers for the PCT Leachates**

| PNNL Solution ID | Lab ID | PNNL Solution ID | Lab ID |
|---|---|---|---|
| LAWALG-01-Q-PCT-A | S-13121 | LAWALG-14-Q-PCT-A | S-13170 |
| LAWALG-01-Q-PCT-B | S-13122 | LAWALG-14-Q-PCT-B | S-13171 |
| LAWALG-01-Q-PCT-C | S-13123 | LAWALG-14-Q-PCT-C | S-13172 |
| LAWALG-02-Q-PCT-A | S-13124 | LAWALG-15-Q-PCT-A | S-13173 |
| LAWALG-02-Q-PCT-B | S-13125 | LAWALG-15-Q-PCT-B | S-13174 |
| LAWALG-02-Q-PCT-C | S-13126 | LAWALG-15-Q-PCT-C | S-13175 |
| LAWALG-03-Q-PCT-A | S-13127 | LRM-PCT-A-7/14/21 | S-13176 |
| LAWALG-03-Q-PCT-B | S-13128 | LRM-PCT-B-7/14/21 | S-13177 |
| LAWALG-03-Q-PCT-C | S-13129 | LRM-PCT-C-7/14/21 | S-13178 |
| LAWALG-04-Q-PCT-A | S-13130 | DI WATER BLANK-A-7/14/21 | S-13179 |
| LAWALG-04-Q-PCT-B | S-13131 | DI WATER BLANK-B-7/14/21 | S-13180 |
| LAWALG-04-Q-PCT-C | S-13132 | LAWALG-16-Q-PCT-A | S-13181 |
| LAWALG-05-1-Q-PCT-A | S-13133 | LAWALG-16-Q-PCT-B | S-13182 |
| LAWALG-05-1-Q-PCT-B | S-13134 | LAWALG-16-Q-PCT-C | S-13183 |
| LAWALG-05-1-Q-PCT-C | S-13135 | LAWALG-17-Q-PCT-A | S-13184 |
| LRM-STD-PCT-A-6/16/21 | S-13136 | LAWALG-17-Q-PCT-B | S-13185 |
| LRM-STD-PCT-B-6/16/21 | S-13137 | LAWALG-17-Q-PCT-C | S-13186 |
| LRM-STD-PCT-C-6/16/21 | S-13138 | LAWALG-01-CCC-PCT-A | S-13187 |
| DI WATER BLANK-A-6/16/21 | S-13139 | LAWALG-01-CCC-PCT-B | S-13188 |
| DI WATER BLANK-B-6/16/21 | S-13140 | LAWALG-01-CCC-PCT-C | S-13189 |
| LAWALG-06-Q-PCT-A | S-13141 | LAWALG-02-CCC-PCT-A | S-13190 |
| LAWALG-06-Q-PCT-B | S-13142 | LAWALG-02-CCC-PCT-B | S-13191 |
| LAWALG-06-Q-PCT-C | S-13143 | LAWALG-02-CCC-PCT-C | S-13192 |
| LAWALG-07-Q-PCT-A | S-13144 | LAWALG-04-CCC-PCT-A | S-13193 |
| LAWALG-07-Q-PCT-B | S-13145 | LAWALG-04-CCC-PCT-B | S-13194 |
| LAWALG-07-Q-PCT-C | S-13146 | LAWALG-04-CCC-PCT-C | S-13195 |
| LAWALG-08-Q-PCT-A | S-13147 | LRM-PCT-A-7/16/21 | S-13196 |
| LAWALG-08-Q-PCT-B | S-13148 | LRM-PCT-B-7/16/21 | S-13197 |
| LAWALG-08-Q-PCT-C | S-13149 | LRM-PCT-C-7/16/21 | S-13198 |
| LAWALG-09-Q-PCT-A | S-13150 | DI WATER BLANK-A-7/16/21 | S-13199 |
| LAWALG-09-Q-PCT-B | S-13151 | DI WATER BLANK-B-7/16/21 | S-13200 |
| LAWALG-09-Q-PCT-C | S-13152 | LAWALG-03-CCC-PCT-A | S-13201 |
| LAWALG-10-Q-PCT-A | S-13153 | LAWALG-03-CCC-PCT-B | S-13202 |
| LAWALG-10-Q-PCT-B | S-13154 | LAWALG-03-CCC-PCT-C | S-13203 |
| LAWALG-10-Q-PCT-C | S-13155 | LAWALG-08-CCC-PCT-A | S-13204 |
| LRM-PCT-A-6/24/21 | S-13156 | LAWALG-08-CCC-PCT-B | S-13205 |
| LRM-PCT-B-6/24/21 | S-13157 | LAWALG-08-CCC-PCT-C | S-13206 |
| LRM-PCT-C-6/24/21 | S-13158 | LAWALG-10-CCC-PCT-A | S-13207 |
| DI WATER BLANK-A-6/24/21 | S-13159 | LAWALG-10-CCC-PCT-B | S-13208 |
| DI WATER BLANK-B-6/24/21 | S-13160 | LAWALG-10-CCC-PCT-C | S-13209 |
| LAWALG-11-Q-PCT-A | S-13161 | LAWALG-12-CCC-PCT-A | S-13210 |
| LAWALG-11-Q-PCT-B | S-13162 | LAWALG-12-CCC-PCT-B | S-13211 |
| LAWALG-11-Q-PCT-C | S-13163 | LAWALG-12-CCC-PCT-C | S-13212 |
| LAWALG-12-Q-PCT-A | S-13164 | LAWALG-13-CCC-PCT-A | S-13213 |
| LAWALG-12-Q-PCT-B | S-13165 | LAWALG-13-CCC-PCT-B | S-13214 |
| LAWALG-12-Q-PCT-C | S-13166 | LAWALG-13-CCC-PCT-C | S-13215 |
| LAWALG-13-Q-PCT-A | S-13167 | LRM-PCT-A-7/27/21 | S-13216 |
| LAWALG-13-Q-PCT-B | S-13168 | LRM-PCT-B-7/27/21 | S-13217 |
| LAWALG-13-Q-PCT-C | S-13169 | LRM-PCT-C-7/27/21 | S-13218 |

**Table 2-1. Identifiers for the PCT Leachates (continued)**

| PNNL Solution ID | Lab ID | PNNL Solution ID | Lab ID |
|---|---|---|---|
| DI WATER BLANK-A-7/27/21 | S-13219 | DI WATER BLANK-A-7/29/21 | S-13239 |
| DI WATER BLANK-B-7/27/21 | S-13220 | DI WATER BLANK-B-7/29/21 | S-13240 |
| LAWALG-05-1-CCC-PCT-A | S-13221 | LAWALG-07-CCC-PCT-A | S-13241 |
| LAWALG-05-1-CCC-PCT-B | S-13222 | LAWALG-07-CCC-PCT-B | S-13242 |
| LAWALG-05-1-CCC-PCT-C | S-13223 | LAWALG-07-CCC-PCT-C | S-13243 |
| LAWALG-06-CCC-PCT-A | S-13224 | LAWALG-11-CCC-PCT-A | S-13244 |
| LAWALG-06-CCC-PCT-B | S-13225 | LAWALG-11-CCC-PCT-B | S-13245 |
| LAWALG-06-CCC-PCT-C | S-13226 | LAWALG-11-CCC-PCT-C | S-13246 |
| LAWALG-09-CCC-PCT-A | S-13227 | LAWALG-16-CCC-PCT-A | S-13247 |
| LAWALG-09-CCC-PCT-B | S-13228 | LAWALG-16-CCC-PCT-B | S-13248 |
| LAWALG-09-CCC-PCT-C | S-13229 | LAWALG-16-CCC-PCT-C | S-13249 |
| LAWALG-14-CCC-PCT-A | S-13230 | LAWALG-17-CCC-PCT-A | S-13250 |
| LAWALG-14-CCC-PCT-B | S-13231 | LAWALG-17-CCC-PCT-B | S-13251 |
| LAWALG-14-CCC-PCT-C | S-13232 | LAWALG-17-CCC-PCT-C | S-13252 |
| LAWALG-15-CCC-PCT-A | S-13233 | LRM-PCT-A-8/4/21 | S-13253 |
| LAWALG-15-CCC-PCT-B | S-13234 | LRM-PCT-B-8/4/21 | S-13254 |
| LAWALG-15-CCC-PCT-C | S-13235 | LRM-PCT-C-8/4/21 | S-13255 |
| LRM-PCT-A-7/29/21 | S-13236 | DI WATER BLANK-A-8/4/21 | S-13256 |
| LRM-PCT-B-7/29/21 | S-13237 | DI WATER BLANK-B-8/4/21 | S-13257 |
| LRM-PCT-C-7/29/21 | S-13238 | | |

2.3 PCT Leachate Analysis

The PCT leachate samples were analyzed by inductively couple plasma – optical emission spectroscopy (ICP-OES)[6] under the auspices of an analytical study plan.[7] Samples of High Purity Standards ICP multi-element custom solution SM-744-013 (std) were also included in the analytical plan as a check of the accuracy of the instrument used for these measurements. PNNL provided the dilution factor (DF) used in preparing the PCT leachates for analyses. The leachate measurements were adjusted using the provided DF of 5 as described further below. Normalized release values were calculated for each glass based on the targeted and measured[8] glass compositions.

## 3.0 Results and Discussion

JMP® Version 14.3.0 (SAS Institute, Inc.)[9] was used to support these analyses.

3.1 Measured Compositions of the PCT Leachates

Table A-1 in Appendix A provides the elemental concentration measurements in mg/L for the PCT leachates and standard solutions as measured by ICP-OES in analytical sequence. These values are shown as received from the analytical laboratory and after using the provided DF of 5 to correct for dilutions performed at PNNL. These unprocessed data are provided so that the values are readily available should they be of interest for future reviews. One sample, LAWALG-06-Q-PCT-B (S-13142), was excluded from calculations due to a possible error in the initial dilution. This sample is listed in italics in Table A-1. Note that the measured concentrations of the analytes in most of the test blank samples were below detection limits (BDL) and denoted by a less than symbol (<). However, several test blanks had measured Si values slightly above the detection limit. One test blank had a measured Si value 2 times higher than the detection limit. The results for the Si measurements of these test blanks are listed in Table 3-1.

**Table 3-1. Test Blanks with Si Measured Concentrations (mg/L)**

| PNNL Solution ID | Lab ID | Si ar* | Si+ |
|---|---|---|---|
| DI WATER BLANK-B-7/16/21 | S-13200 | 2.19 | 11.0 |
| DI WATER BLANK-A-7/27/21 | S-13219 | 1.25 | 6.25 |
| DI WATER BLANK-B-7/27/21 | S-13220 | 1.30 | 6.50 |
| DI WATER BLANK-A-8/4/21 | S-13256 | 1.25 | 6.25 |

* Si measurements as received from the analytical lab
+ Dilution-corrected Si measurements using the DF of 5

Table A-2 in Appendix A provides measurements for the samples of the low-activity test reference material (LRM) reference glass included in the PCTs after using the provided DF of 5 to correct for dilutions performed at PNNL. Note that the measured Na concentrations (mg/L) were slightly higher than the LRM expected test results[10] for some of the samples. Values that fall outside the ranges of the expected test results are shaded grey in the table.

Following the guidance in ASTM C1285,[5] the mean, standard deviation, and percent relative standard deviation (%RSD) were determined for each element present in the solution standard for each analytical block. As shown in Table A-3 in Appendix A, the mean value for each analytical block was found to be less than 10% from the reference value (i.e., a percent relative bias less than 10%), and the %RSD was less than 10% for each element. Thus, these analytical results are acceptable per the criteria in ASTM C1285[5], which indicates no significant issues with the analytical outcomes for the measurements of the PCT leachates.

Exhibit A-1 in Appendix A provides plots of the triplicate leachate concentrations by the glass ID. Both linear and logarithmic plots are provided for selected elements: Al, B, Li, Na, and Si. Plotting the data in this format allows for the assessment of the repeatability of the measurements for each glass.

### 3.2 Normalization of PCT Data

The PCT leachate data were used to determine normalized concentrations for each element of interest using both the targeted and average measured compositions[8] of the glasses following the expression given in ASTM C1285.[5]

$$NC_i = \frac{c_i(sample)}{f_i}$$

where $NC_i$ is the normalized concentration in units of $g_{waste\ form}/L_{leachant}$, $c_i(sample)$ is the concentration of element "*i*" in the leachate in units of $g_i/L$ (corrected for the dilutions performed at PNNL), and $f_i$ is the mass fraction of element "*i*" in the unleached glass in units of $g_i/g_{glass}$.[b]

An equation was developed to allow for calculation of the $NC_i$ values using the units of measurement provided with the analytical results for this study and to accommodate the triplicate leachate measurements for each of the study glasses. Note that the symbols in this second equation were kept consistent with those used in ASTM C1285,[5] but the units of measurement differ. The common logarithm of the normalized concentration for each element "*i*" ($NC_i$) for each of the study glasses was determined using the equation:

[b] Note that the waste forms in this study were assumed to be of similar density. The PCT-A reference volume of leachant to sample mass ratio was used, and the 100 to 200 mesh reference particle size was used. Thus, no adjustment for the density of the glasses was made in normalizing the PCT results. Data provided in the appendices of this report allow for the calculation of normalized elemental mass loss ($NL_i$) if glass densities are measured at a later date.

$$\log_{10}\left(NC_i\right) = \overline{\log_{10} c_i} - \left[1 + \log_{10} f_i\right]$$

where $NC_i$ remains in units of $g_{waste\ form}/L_{leachant}$, $\overline{\log_{10} c_i}$ is the average of the common logarithms of the measured concentrations of element "*i*" in the triplicate leachates in units of mg/L (corrected for the dilutions performed at PNNL as discussed in Section 3.1), and $\log_{10} f_i$ is either the common logarithm of the targeted concentration of element "*i*" in the glass in units of weight percent (wt.%) or the common logarithm of the average measured concentration of element "*i*" in the glass in units of wt.% (reported previously[8]).

Table B-1 in Appendix B provides the normalized PCT responses for the Q and CCC for each of the study glasses as well as the responses for the LRM reference glass[10]. The results are grouped by compositional view. Note that an indicator (<) is provided as part of these plots to show results involving BDL values. The plots of Exhibit B-1 in Appendix B provide a graphical comparison between the PCT responses for the two versions of each study glass. Exhibit B-2 in Appendix B provides plots of the normalized PCT responses for the samples of LRM reference glass.

A review of the PCT data resulted in the following observations:

- The measured glass compositions for the study glasses[8] were close to target values, therefore, little difference was seen when evaluating the normalized values using the targeted or measured glass compositions.
- In most cases, heat treatment had marginal impact on the $NC_i$ values.
    - LAWALG-03-CCC $NC_B$, $NC_{Na}$, and $NC_{Si}$ values were approximately 2 times lower than LAWALG-03-Q values.
    - LAWALG-12-CCC $NC_B$, $NC_{Na}$, and $NC_{Si}$ values were approximately 3 times lower than LAWALG-12-Q values.
- Three of the glasses, LAWALG-03-Q, LAWALG-03-CCC, and LAWALG-12-Q, exceeded the WTP $NC_B$ and $NC_{Na}$ 4 g/L constraints.[c]

## 4.0 Summary

Several blanks had Si measurements slightly above the detection limit. One blank had an Si measurement 2 times higher than the detection limit. The measured Na concentrations (mg/L) for several of the LRM reference glass included with the PCTs were slightly higher than the expected LRM test results. The measured glass compositions for the study glasses were close to target values, therefore, little difference was seen when evaluating the normalized values using the targeted or measured glass compositions. In most cases, heat treatment had marginal impact on the $NC_i$ values. Three of the glasses had $NC_B$ and $NC_{Na}$ values that were greater than the WTP low-activity waste constraint of 4 g/L.

## 5.0 References

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[c] Contract DE-AC27-01RV14136, as amended, U.S. Department of Energy, Richland, WA (2000).

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# Appendix A. Tables Containing the Measurement Data for the LAW ALG PCT Leachates

**Table A-1. PCT Leachate Measurements (mg/L) Measured by ICP-OES**

| PNNL Solution ID | Block | Seq. | Lab ID | Al | B | Cr | K | Li | Na | Si | Zr | DF | Al | B | Cr | K | Li | Na | Si | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| std | 1 | 1 | std-11 | 3.92 | 19.7 | <1.00 | 9.52 | 9.94 | 78.7 | 48.3 | <1.00 | 1 | 3.92 | 19.7 | <1.00 | 9.52 | 9.94 | 78.7 | 48.3 | <1.00 |
| LAWALG-03-CCC-PCT-A | 1 | 2 | S-13201 | <1.00 | 39.5 | <1.00 | <1.00 | <1.00 | 254 | 66.6 | <1.00 | 5 | <5.00 | 198 | <5.00 | <5.00 | <5.00 | 1270 | 333 | <5.00 |
| LAWALG-17-CCC-PCT-A | 1 | 3 | S-13250 | 2.29 | 4.55 | <1.00 | <1.00 | <1.00 | 43.2 | 11.5 | <1.00 | 5 | 11.5 | 22.8 | <5.00 | <5.00 | <5.00 | 216 | 57.5 | <5.00 |
| LAWALG-01-Q-PCT-B | 1 | 4 | S-13122 | <1.00 | 2.87 | <1.00 | <1.00 | 2.40 | 23.6 | 16.8 | <1.00 | 5 | <5.00 | 14.4 | <5.00 | <5.00 | 12.0 | 118 | 84.0 | <5.00 |
| LAWALG-08-CCC-PCT-C | 1 | 5 | S-13206 | <1.00 | 5.80 | <1.00 | <1.00 | 1.20 | 10.6 | 16.8 | <1.00 | 5 | <5.00 | 29.0 | <5.00 | <5.00 | 6.00 | 53.0 | 84.0 | <5.00 |
| LRM-PCT-C-7/27/21 | 1 | 6 | S-13218 | 3.05 | 5.72 | <1.00 | <1.00 | <1.00 | 33.5 | 15.8 | <1.00 | 5 | 15.3 | 28.6 | <5.00 | <5.00 | <5.00 | 168 | 79.0 | <5.00 |
| LAWALG-13-CCC-PCT-A | 1 | 7 | S-13213 | <1.00 | 7.28 | <1.00 | <1.00 | 1.07 | 20.1 | 17.2 | <1.00 | 5 | <5.00 | 36.4 | <5.00 | <5.00 | 5.35 | 101 | 86.0 | <5.00 |
| LAWALG-12-CCC-PCT-C | 1 | 8 | S-13212 | <1.00 | 15.7 | <1.00 | <1.00 | <1.00 | 54.3 | 28.9 | <1.00 | 5 | <5.00 | 78.5 | <5.00 | <5.00 | <5.00 | 272 | 145 | <5.00 |
| std | 1 | 9 | std-12 | 4.02 | 20.2 | <1.00 | 9.72 | 10.1 | 81.5 | 49.0 | <1.00 | 1 | 4.02 | 20.2 | <1.00 | 9.72 | 10.1 | 81.5 | 49.0 | <1.00 |
| LAWALG-05-1-Q-PCT-B | 1 | 10 | S-13134 | <1.00 | 8.31 | <1.00 | <1.00 | 1.8 | 13.8 | 19.2 | <1.00 | 5 | <5.00 | 41.6 | <5.00 | <5.00 | 9.00 | 69.0 | 96.0 | <5.00 |
| LAWALG-03-Q-PCT-B | 1 | 11 | S-13128 | <1.00 | 87.2 | <1.00 | <1.00 | <1.00 | 490 | 103 | <1.00 | 5 | <5.00 | 436 | <5.00 | <5.00 | <5.00 | 2450 | 515 | <5.00 |
| LAWALG-13-Q-PCT-B | 1 | 12 | S-13168 | <1.00 | 8.61 | <1.00 | <1.00 | 1.23 | 25.1 | 19.4 | <1.00 | 5 | <5.00 | 43.1 | <5.00 | <5.00 | 6.15 | 126 | 97.0 | <5.00 |
| LAWALG-15-Q-PCT-B | 1 | 13 | S-13174 | 2.48 | 5.79 | <1.00 | <1.00 | <1.00 | 55.3 | 14.7 | <1.00 | 5 | 12.4 | 29.0 | <5.00 | <5.00 | <5.00 | 277 | 73.5 | <5.00 |
| LRM-PCT-A-8/4/21 | 1 | 14 | S-13253 | 3.02 | 5.72 | <1.00 | <1.00 | <1.00 | 33.5 | 15.8 | <1.00 | 5 | 15.1 | 28.6 | <5.00 | <5.00 | <5.00 | 168 | 79.0 | <5.00 |
| LAWALG-17-Q-PCT-B | 1 | 15 | S-13185 | 2.62 | 5.47 | <1.00 | <1.00 | <1.00 | 49.9 | 12.2 | <1.00 | 5 | 13.1 | 27.4 | <5.00 | <5.00 | <5.00 | 250 | 61.0 | <5.00 |
| LAWALG-11-Q-PCT-B | 1 | 16 | S-13162 | 3.56 | 2.28 | <1.00 | 3.19 | <1.00 | 51.8 | 11.5 | <1.00 | 5 | 17.8 | 11.4 | <5.00 | 16.0 | <5.00 | 259 | 57.5 | <5.00 |
| std | 1 | 17 | std-13 | 4.08 | 20.4 | <1.00 | 9.68 | 10.1 | 82.7 | 49.4 | <1.00 | 1 | 4.08 | 20.4 | <1.00 | 9.68 | 10.1 | 82.7 | 49.4 | <1.00 |
| LAWALG-01-CCC-PCT-A | 1 | 18 | S-13187 | <1.00 | 2.61 | <1.00 | <1.00 | 2.24 | 19.9 | 15.3 | <1.00 | 5 | <5.00 | 13.1 | <5.00 | <5.00 | 11.2 | 99.5 | 76.5 | <5.00 |
| LAWALG-09-Q-PCT-B | 1 | 19 | S-13151 | 3.55 | 5.65 | <1.00 | <1.00 | <1.00 | 48.4 | 12.8 | <1.00 | 5 | 17.8 | 28.3 | <5.00 | <5.00 | <5.00 | 242 | 64.0 | <5.00 |
| LAWALG-05-1-CCC-PCT-A | 1 | 20 | S-13221 | <1.00 | 7.75 | <1.00 | <1.00 | 1.65 | 12.5 | 18.2 | <1.00 | 5 | <5.00 | 38.8 | <5.00 | <5.00 | 8.25 | 62.5 | 91.0 | <5.00 |
| DI WATER BLANK-B-8/4/21 | 1 | 21 | S-13257 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-15-CCC-PCT-A | 1 | 22 | S-13233 | 2.63 | 5.07 | <1.00 | <1.00 | <1.00 | 46.6 | 12.6 | <1.00 | 5 | 13.2 | 25.4 | <5.00 | <5.00 | <5.00 | 233 | 63.0 | <5.00 |
| LAWALG-07-Q-PCT-B | 1 | 23 | S-13145 | <1.00 | 11.8 | <1.00 | <1.00 | <1.00 | 83.9 | 28.2 | <1.00 | 5 | <5.00 | 59.0 | <5.00 | <5.00 | <5.00 | 420 | 141 | <5.00 |
| LAWALG-07-CCC-PCT-A | 1 | 24 | S-13241 | <1.00 | 11.8 | <1.00 | <1.00 | <1.00 | 84.7 | 28.0 | <1.00 | 5 | <5.00 | 59.0 | <5.00 | <5.00 | <5.00 | 424 | 140 | <5.00 |
| std | 1 | 25 | std-14 | 4.10 | 20.6 | <1.00 | 9.83 | 10.3 | 83.7 | 49.9 | <1.00 | 1 | 4.10 | 20.6 | <1.00 | 9.83 | 10.3 | 83.7 | 49.9 | <1.00 |
| LAWALG-06-CCC-PCT-C | 1 | 26 | S-13226 | <1.00 | 11.8 | <1.00 | <1.00 | <1.00 | 61.7 | 18.3 | <1.00 | 5 | <5.00 | 59.0 | <5.00 | <5.00 | <5.00 | 309 | 91.5 | <5.00 |
| DI WATER BLANK-B-7/14/21 | 1 | 27 | S-13180 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-14-CCC-PCT-C | 1 | 28 | S-13232 | <1.00 | 7.12 | <1.00 | <1.00 | <1.00 | 23.3 | 17.0 | <1.00 | 5 | <5.00 | 35.6 | <5.00 | <5.00 | <5.00 | 117 | 85.0 | <5.00 |
| DI WATER BLANK-A-6/24/21 | 1 | 29 | S-13159 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-16-CCC-PCT-C | 1 | 30 | S-13249 | 2.69 | 4.41 | <1.00 | <1.00 | <1.00 | 47.2 | 12.9 | <1.00 | 5 | 13.5 | 22.1 | <5.00 | <5.00 | <5.00 | 236 | 64.5 | <5.00 |
| LAWALG-10-CCC-PCT-C | 1 | 31 | S-13209 | 2.63 | 4.79 | <1.00 | <1.00 | <1.00 | 48.9 | 13.1 | <1.00 | 5 | 13.2 | 24.0 | <5.00 | <5.00 | <5.00 | 245 | 65.5 | <5.00 |
| DI WATER BLANK-A-7/29/21 | 1 | 32 | S-13239 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LRM-PCT-C-6/16/21 | 1 | 33 | S-13138 | 2.80 | 4.71 | <1.00 | <1.00 | <1.00 | 31.7 | 17.9 | <1.00 | 5 | 14.0 | 23.6 | <5.00 | <5.00 | <5.00 | 159 | 89.5 | <5.00 |
| std | 1 | 34 | std-15 | 4.20 | 20.9 | <1.00 | 9.69 | 10.3 | 86.4 | 50.3 | <1.00 | 1 | 4.20 | 20.9 | <1.00 | 9.69 | 10.3 | 86.4 | 50.3 | <1.00 |
| LAWALG-02-CCC-PCT-C | 1 | 35 | S-13192 | <1.00 | 13.8 | <1.00 | <1.00 | <1.00 | 57.4 | 21.3 | <1.00 | 5 | <5.00 | 69.0 | <5.00 | <5.00 | <5.00 | 287 | 107 | <5.00 |
| LAWALG-09-CCC-PCT-A | 1 | 36 | S-13227 | 4.76 | 5.56 | <1.00 | <1.00 | <1.00 | 43.6 | 13.2 | <1.00 | 5 | 23.8 | 27.8 | <5.00 | <5.00 | <5.00 | 218 | 66.0 | <5.00 |
| LRM-PCT-B-7/16/21 | 1 | 37 | S-13197 | 3.02 | 5.61 | <1.00 | <1.00 | <1.00 | 35.3 | 17.9 | <1.00 | 5 | 15.1 | 28.1 | <5.00 | <5.00 | <5.00 | 177 | 89.5 | <5.00 |
| LAWALG-11-CCC-PCT-A | 1 | 38 | S-13244 | 3.68 | 2.41 | <1.00 | 2.79 | <1.00 | 52.9 | 11.3 | <1.00 | 5 | 18.4 | 12.1 | <5.00 | 14.0 | <5.00 | 265 | 56.5 | <5.00 |
| LRM-PCT-A-7/14/21 | 1 | 39 | S-13176 | 2.93 | 5.13 | <1.00 | <1.00 | <1.00 | 33.9 | 18.1 | <1.00 | 5 | 14.7 | 25.7 | <5.00 | <5.00 | <5.00 | 170 | 90.5 | <5.00 |
| LAWALG-04-CCC-PCT-C | 1 | 40 | S-13195 | 2.51 | 4.95 | <1.00 | <1.00 | <1.00 | 48.7 | 12.9 | <1.00 | 5 | 12.6 | 24.8 | <5.00 | <5.00 | <5.00 | 244 | 64.5 | <5.00 |
| std | 1 | 41 | std-16 | 4.15 | 20.8 | <1.00 | 10.0 | 10.5 | 85.5 | 50.4 | <1.00 | 1 | 4.15 | 20.8 | <1.00 | 10.0 | 10.5 | 85.5 | 50.4 | <1.00 |
| std | 2 | 1 | std-21 | 3.83 | 19.4 | <1.00 | 9.51 | 9.96 | 79.8 | 48.3 | <1.00 | 1 | 3.83 | 19.4 | <1.00 | 9.51 | 9.96 | 79.8 | 48.3 | <1.00 |
| DI WATER BLANK-B-7/16/21 | 2 | 2 | S-13200 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 2.19 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | 11.0 | <5.00 |
| LAWALG-12-Q-PCT-A | 2 | 3 | S-13164 | <1.00 | 50.1 | <1.00 | <1.00 | <1.00 | 170 | 51.9 | <1.00 | 5 | <5.00 | 251 | <5.00 | <5.00 | <5.00 | 850 | 260 | <5.00 |
| LAWALG-11-Q-PCT-C | 2 | 4 | S-13163 | 2.94 | 2.19 | <1.00 | 3.20 | <1.00 | 51.6 | 11.9 | <1.00 | 5 | 14.7 | 11.0 | <5.00 | 16.0 | <5.00 | 258 | 59.5 | <5.00 |
| LAWALG-10-Q-PCT-A | 2 | 5 | S-13153 | 2.58 | 5.91 | <1.00 | <1.00 | <1.00 | 55.9 | 14.1 | <1.00 | 5 | 12.9 | 29.6 | <5.00 | <5.00 | <5.00 | 280 | 70.5 | <5.00 |
| LAWALG-01-Q-PCT-C | 2 | 6 | S-13123 | <1.00 | 2.81 | <1.00 | <1.00 | 2.49 | 23.2 | 15.3 | <1.00 | 5 | <5.00 | 14.1 | <5.00 | <5.00 | 12.5 | 116 | 76.5 | <5.00 |
| LAWALG-06-Q-PCT-A | 2 | 7 | S-13141 | <1.00 | 12.3 | <1.00 | <1.00 | <1.00 | 66.5 | 19.3 | <1.00 | 5 | <5.00 | 61.5 | <5.00 | <5.00 | <5.00 | 333 | 96.5 | <5.00 |

**Table A-1. PCT Leachate Measurements (mg/L) Measured by ICP-OES (continued)**

| PNNL Solution ID | Block | Seq. | Lab ID | Al | B | Cr | K | Li | Na | Si | Zr | DF | Al | B | Cr | K | Li | Na | Si | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAWALG-04-Q-PCT-A | 2 | 8 | S-13130 | 2.48 | 5.67 | <1.00 | <1.00 | <1.00 | 55.2 | 13.5 | <1.00 | 5 | 12.4 | 28.4 | <5.00 | <5.00 | <5.00 | 276 | 67.5 | <5.00 |
| std | 2 | 9 | std-22 | 3.82 | 19.1 | <1.00 | 9.67 | 9.86 | 79.4 | 47.7 | <1.00 | 1 | 3.82 | 19.1 | <1.00 | 9.67 | 9.86 | 79.4 | 47.7 | <1.00 |
| LAWALG-11-CCC-PCT-B | 2 | 10 | S-13245 | 3.40 | 2.30 | <1.00 | 2.98 | <1.00 | 49.4 | 10.4 | <1.00 | 5 | 17.0 | 11.5 | <5.00 | 14.9 | <5.00 | 247 | 52.0 | <5.00 |
| LRM-PCT-C-7/29/21 | 2 | 11 | S-13238 | 2.88 | 5.78 | <1.00 | <1.00 | <1.00 | 36.0 | 16.6 | <1.00 | 5 | 14.4 | 28.9 | <5.00 | <5.00 | <5.00 | 180 | 83.0 | <5.00 |
| LAWALG-13-Q-PCT-C | 2 | 12 | S-13169 | <1.00 | 7.91 | <1.00 | <1.00 | 1.27 | 24.4 | 19.0 | <1.00 | 5 | <5.00 | 39.6 | <5.00 | <5.00 | 6.35 | 122 | 95.0 | <5.00 |
| LAWALG-05-1-CCC-PCT-B | 2 | 13 | S-13222 | <1.00 | 7.13 | <1.00 | <1.00 | 1.70 | 13.2 | 17.4 | <1.00 | 5 | <5.00 | 35.7 | <5.00 | <5.00 | 8.50 | 66.0 | 87.0 | <5.00 |
| LAWALG-09-Q-PCT-C | 2 | 14 | S-13152 | 2.95 | 5.08 | <1.00 | <1.00 | <1.00 | 47.1 | 13.4 | <1.00 | 5 | 14.8 | 25.4 | <5.00 | <5.00 | <5.00 | 236 | 67.0 | <5.00 |
| LAWALG-17-CCC-PCT-B | 2 | 15 | S-13251 | 2.16 | 4.17 | <1.00 | <1.00 | <1.00 | 42.2 | 11.1 | <1.00 | 5 | 10.8 | 20.9 | <5.00 | <5.00 | <5.00 | 211 | 55.5 | <5.00 |
| LAWALG-07-Q-PCT-C | 2 | 16 | S-13146 | <1.00 | 11.6 | <1.00 | <1.00 | <1.00 | 86.2 | 28.9 | <1.00 | 5 | <5.00 | 58.0 | <5.00 | <5.00 | <5.00 | 431 | 145 | <5.00 |
| std | 2 | 17 | std-23 | 3.85 | 19.2 | <1.00 | 9.63 | 9.95 | 81.3 | 48.1 | <1.00 | 1 | 3.85 | 19.2 | <1.00 | 9.63 | 9.95 | 81.3 | 48.1 | <1.00 |
| LAWALG-17-Q-PCT-C | 2 | 18 | S-13186 | 2.35 | 5.00 | <1.00 | <1.00 | <1.00 | 48.9 | 12.2 | <1.00 | 5 | 11.8 | 25.0 | <5.00 | <5.00 | <5.00 | 245 | 61.0 | <5.00 |
| LAWALG-16-Q-PCT-A | 2 | 19 | S-13181 | 2.47 | 4.56 | <1.00 | <1.00 | <1.00 | 51.2 | 14.2 | <1.00 | 5 | 12.4 | 22.8 | <5.00 | <5.00 | <5.00 | 256 | 71.0 | <5.00 |
| LAWALG-14-Q-PCT-A | 2 | 20 | S-13170 | <1.00 | 6.94 | <1.00 | <1.00 | <1.00 | 26.0 | 16.4 | <1.00 | 5 | <5.00 | 34.7 | <5.00 | <5.00 | <5.00 | 130 | 82.0 | <5.00 |
| DI WATER BLANK-A-8/4/21 | 2 | 21 | S-13256 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 1.25 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | 6.25 | <5.00 |
| LAWALG-01-CCC-PCT-B | 2 | 22 | S-13188 | <1.00 | 2.83 | <1.00 | <1.00 | 2.50 | 22.2 | 15.4 | <1.00 | 5 | <5.00 | 14.2 | <5.00 | <5.00 | 12.5 | 111 | 77.0 | <5.00 |
| LAWALG-15-Q-PCT-C | 2 | 23 | S-13175 | 2.51 | 5.47 | <1.00 | <1.00 | <1.00 | 51.9 | 12.8 | <1.00 | 5 | 12.6 | 27.4 | <5.00 | <5.00 | <5.00 | 260 | 64.0 | <5.00 |
| LRM-PCT-B-6/16/21 | 2 | 24 | S-13137 | 2.77 | 4.93 | <1.00 | <1.00 | <1.00 | 32.3 | 16.0 | <1.00 | 5 | 13.9 | 24.7 | <5.00 | <5.00 | <5.00 | 162 | 80.0 | <5.00 |
| std | 2 | 25 | std-24 | 3.84 | 19.1 | <1.00 | 9.67 | 9.95 | 80.5 | 47.7 | <1.00 | 1 | 3.84 | 19.1 | <1.00 | 9.67 | 9.95 | 80.5 | 47.7 | <1.00 |
| LAWALG-07-CCC-PCT-B | 2 | 26 | S-13242 | <1.00 | 11.2 | <1.00 | <1.00 | <1.00 | 81.9 | 27.4 | <1.00 | 5 | <5.00 | 56.0 | <5.00 | <5.00 | <5.00 | 410 | 137 | <5.00 |
| LAWALG-15-CCC-PCT-B | 2 | 27 | S-13234 | 2.47 | 4.80 | <1.00 | <1.00 | <1.00 | 46.5 | 12.5 | <1.00 | 5 | 12.4 | 24.0 | <5.00 | <5.00 | <5.00 | 233 | 62.5 | <5.00 |
| DI WATER BLANK-A-7/14/21 | 2 | 28 | S-13179 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LRM-PCT-A-7/16/21 | 2 | 29 | S-13196 | 2.98 | 5.98 | <1.00 | <1.00 | <1.00 | 36.3 | 16.4 | <1.00 | 5 | 14.9 | 29.9 | <5.00 | <5.00 | <5.00 | 182 | 82.0 | <5.00 |
| LAWALG-08-Q-PCT-A | 2 | 30 | S-13147 | <1.00 | 6.50 | <1.00 | <1.00 | 1.60 | 14.1 | 17.5 | <1.00 | 5 | <5.00 | 32.5 | <5.00 | <5.00 | 8.00 | 70.5 | 87.5 | <5.00 |
| LAWALG-03-Q-PCT-C | 2 | 31 | S-13129 | <1.00 | 83.1 | <1.00 | <1.00 | <1.00 | 466 | 101 | <1.00 | 5 | <5.00 | 416 | <5.00 | <5.00 | <5.00 | 2330 | 505 | <5.00 |
| LAWALG-09-CCC-PCT-B | 2 | 32 | S-13228 | 4.28 | 5.19 | <1.00 | <1.00 | <1.00 | 42.0 | 12.3 | <1.00 | 5 | 21.4 | 26.0 | <5.00 | <5.00 | <5.00 | 210 | 61.5 | <5.00 |
| LRM-PCT-C-6/24/21 | 2 | 33 | S-13158 | 2.93 | 5.24 | <1.00 | <1.00 | <1.00 | 33.7 | 15.5 | <1.00 | 5 | 14.7 | 26.2 | <5.00 | <5.00 | <5.00 | 169 | 77.5 | <5.00 |
| std | 2 | 34 | std-25 | 3.84 | 18.9 | <1.00 | 9.31 | 10.0 | 80.2 | 47.7 | <1.00 | 1 | 3.84 | 18.9 | <1.00 | 9.31 | 10.0 | 80.2 | 47.7 | <1.00 |
| LAWALG-05-1-Q-PCT-C | 2 | 35 | S-13135 | <1.00 | 7.58 | <1.00 | <1.00 | 1.83 | 14.3 | 18.5 | <1.00 | 5 | <5.00 | 37.9 | <5.00 | <5.00 | 9.15 | 71.5 | 92.5 | <5.00 |
| LAWALG-02-Q-PCT-A | 2 | 36 | S-13124 | <1.00 | 15.9 | <1.00 | <1.00 | <1.00 | 69.1 | 23.9 | <1.00 | 5 | <5.00 | 79.5 | <5.00 | <5.00 | <5.00 | 346 | 120 | <5.00 |
| LRM-PCT-B-7/27/21 | 2 | 37 | S-13217 | 2.93 | 5.47 | <1.00 | <1.00 | <1.00 | 34.1 | 15.3 | <1.00 | 5 | 14.7 | 27.4 | <5.00 | <5.00 | <5.00 | 171 | 76.5 | <5.00 |
| LAWALG-03-CCC-PCT-B | 2 | 38 | S-13202 | <1.00 | 39.9 | <1.00 | <1.00 | <1.00 | 265 | 69.2 | <1.00 | 5 | <5.00 | 200 | <5.00 | <5.00 | <5.00 | 1330 | 346 | <5.00 |
| LAWALG-13-CCC-PCT-B | 2 | 39 | S-13214 | <1.00 | 6.61 | <1.00 | <1.00 | 1.13 | 20.9 | 16.7 | <1.00 | 5 | <5.00 | 33.1 | <5.00 | <5.00 | 5.65 | 105 | 83.5 | <5.00 |
| std | 2 | 40 | std-26 | 3.79 | 18.8 | <1.00 | 9.26 | 9.92 | 80.0 | 47.4 | <1.00 | 1 | 3.79 | 18.8 | <1.00 | 9.26 | 9.92 | 80.0 | 47.4 | <1.00 |
| std | 3 | 1 | std-31 | 3.86 | 19.3 | <1.00 | 9.56 | 9.91 | 80.1 | 47.9 | <1.00 | 1 | 3.86 | 19.3 | <1.00 | 9.56 | 9.91 | 80.1 | 47.9 | <1.00 |
| LAWALG-12-CCC-PCT-A | 3 | 2 | S-13210 | <1.00 | 15.2 | <1.00 | <1.00 | <1.00 | 55.3 | 28.0 | <1.00 | 5 | <5.00 | 76.0 | <5.00 | <5.00 | <5.00 | 277 | 140 | <5.00 |
| LRM-PCT-A-7/27/21 | 3 | 3 | S-13216 | 2.88 | 5.51 | <1.00 | <1.00 | <1.00 | 33.9 | 15.2 | <1.00 | 5 | 14.4 | 27.6 | <5.00 | <5.00 | <5.00 | 170 | 76.0 | <5.00 |
| LAWALG-03-CCC-PCT-C | 3 | 4 | S-13203 | <1.00 | 40.0 | <1.00 | <1.00 | <1.00 | 267 | 68.8 | <1.00 | 5 | <5.00 | 200 | <5.00 | <5.00 | <5.00 | 1340 | 344 | <5.00 |
| LAWALG-08-CCC-PCT-A | 3 | 5 | S-13204 | <1.00 | 5.48 | <1.00 | <1.00 | 1.28 | 11.6 | 16.0 | <1.00 | 5 | <5.00 | 27.4 | <5.00 | <5.00 | 6.40 | 58.0 | 80.0 | <5.00 |
| LRM-PCT-C-8/4/21 | 3 | 6 | S-13255 | 3.01 | 5.69 | <1.00 | <1.00 | <1.00 | 35.3 | 16.0 | <1.00 | 5 | 15.1 | 28.5 | <5.00 | <5.00 | <5.00 | 177 | 80.0 | <5.00 |
| LAWALG-13-CCC-PCT-C | 3 | 7 | S-13215 | <1.00 | 7.04 | <1.00 | <1.00 | 1.16 | 21.1 | 17.3 | <1.00 | 5 | <5.00 | 35.2 | <5.00 | <5.00 | 5.80 | 106 | 86.5 | <5.00 |
| LAWALG-07-CCC-PCT-C | 3 | 8 | S-13243 | <1.00 | 11.2 | <1.00 | <1.00 | <1.00 | 81.7 | 26.7 | <1.00 | 5 | <5.00 | 56.0 | <5.00 | <5.00 | <5.00 | 409 | 134 | <5.00 |
| std | 3 | 9 | std-32 | 3.93 | 19.6 | <1.00 | 9.81 | 10.1 | 82.4 | 48.5 | <1.00 | 1 | 3.93 | 19.6 | <1.00 | 9.81 | 10.1 | 82.4 | 48.5 | <1.00 |
| LAWALG-02-Q-PCT-B | 3 | 10 | S-13125 | <1.00 | 16.3 | <1.00 | <1.00 | <1.00 | 70.3 | 25.0 | <1.00 | 5 | <5.00 | 81.5 | <5.00 | <5.00 | <5.00 | 352 | 125 | <5.00 |
| LAWALG-14-Q-PCT-B | 3 | 11 | S-13171 | <1.00 | 6.98 | <1.00 | <1.00 | <1.00 | 25.5 | 16.5 | <1.00 | 5 | <5.00 | 34.9 | <5.00 | <5.00 | <5.00 | 128 | 82.5 | <5.00 |
| LAWALG-01-CCC-PCT-C | 3 | 12 | S-13189 | <1.00 | 2.53 | <1.00 | <1.00 | 2.30 | 19.6 | 13.7 | <1.00 | 5 | <5.00 | 12.7 | <5.00 | <5.00 | 11.5 | 98.0 | 68.5 | <5.00 |
| LAWALG-05-1-CCC-PCT-C | 3 | 13 | S-13223 | <1.00 | 7.28 | <1.00 | <1.00 | 1.72 | 12.9 | 17.4 | <1.00 | 5 | <5.00 | 36.4 | <5.00 | <5.00 | 8.60 | 64.5 | 87.0 | <5.00 |
| LAWALG-14-CCC-PCT-A | 3 | 14 | S-13230 | <1.00 | 6.49 | <1.00 | <1.00 | <1.00 | 23.4 | 15.7 | <1.00 | 5 | <5.00 | 32.5 | <5.00 | <5.00 | <5.00 | 117 | 78.5 | <5.00 |
| LRM-PCT-B-6/24/21 | 3 | 15 | S-13157 | 3.04 | 5.33 | <1.00 | <1.00 | <1.00 | 33.4 | 15.5 | <1.00 | 5 | 15.2 | 26.7 | <5.00 | <5.00 | <5.00 | 167 | 77.5 | <5.00 |

**Table A-1. PCT Leachate Measurements (mg/L) Measured by ICP-OES (continued)**

| PNNL Solution ID | Block | Seq. | Lab ID | Al | B | Cr | K | Li | Na | Si | Zr | DF | Al | B | Cr | K | Li | Na | Si | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAWALG-02-CCC-PCT-A | 3 | 16 | S-13190 | <1.00 | 12.5 | <1.00 | <1.00 | <1.00 | 54.2 | 20.3 | <1.00 | 5 | <5.00 | 62.5 | <5.00 | <5.00 | <5.00 | 271 | 102 | <5.00 |
| std | 3 | 17 | std-33 | 3.99 | 19.7 | <1.00 | 10.1 | 10.3 | 84.5 | 48.4 | <1.00 | 1 | 3.99 | 19.7 | <1.00 | 10.1 | 10.3 | 84.5 | 48.4 | <1.00 |
| DI WATER BLANK-B-7/27/21 | 3 | 18 | S-13220 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 1.30 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | 6.50 | <5.00 |
| LRM-PCT-A-6/16/21 | 3 | 19 | S-13136 | 2.54 | 4.50 | <1.00 | <1.00 | <1.00 | 30.0 | 15.5 | <1.00 | 5 | 12.7 | 22.5 | <5.00 | <5.00 | <5.00 | 150 | 77.5 | <5.00 |
| DI WATER BLANK-B-6/16/21 | 3 | 20 | S-13140 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-08-Q-PCT-B | 3 | 21 | S-13148 | <1.00 | 6.67 | <1.00 | <1.00 | 1.61 | 13.8 | 17.3 | <1.00 | 5 | <5.00 | 33.4 | <5.00 | <5.00 | 8.05 | 69.0 | 86.5 | <5.00 |
| LAWALG-16-CCC-PCT-A | 3 | 22 | S-13247 | 2.63 | 4.33 | <1.00 | <1.00 | <1.00 | 47.5 | 12.8 | <1.00 | 5 | 13.2 | 21.7 | <5.00 | <5.00 | <5.00 | 238 | 64.0 | <5.00 |
| LAWALG-12-Q-PCT-B | 3 | 23 | S-13165 | <1.00 | 52.0 | <1.00 | <1.00 | <1.00 | 182 | 53.8 | <1.00 | 5 | <5.00 | 260 | <5.00 | <5.00 | <5.00 | 910 | 269 | <5.00 |
| LAWALG-06-CCC-PCT-A | 3 | 24 | S-13224 | <1.00 | 12.1 | <1.00 | <1.00 | <1.00 | 65.5 | 18.5 | <1.00 | 5 | <5.00 | 60.5 | <5.00 | <5.00 | <5.00 | 328 | 92.5 | <5.00 |
| std | 3 | 25 | std-34 | 4.00 | 19.7 | <1.00 | 9.73 | 10.2 | 83.3 | 48.3 | <1.00 | 1 | 4.00 | 19.7 | <1.00 | 9.73 | 10.2 | 83.3 | 48.3 | <1.00 |
| LAWALG-16-Q-PCT-B | 3 | 26 | S-13182 | 2.66 | 4.78 | <1.00 | <1.00 | <1.00 | 50.6 | 13.2 | <1.00 | 5 | 13.3 | 23.9 | <5.00 | <5.00 | <5.00 | 253 | 66.0 | <5.00 |
| DI WATER BLANK-A-7/16/21 | 3 | 27 | S-13199 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-10-Q-PCT-B | 3 | 28 | S-13154 | 2.46 | 5.44 | <1.00 | <1.00 | <1.00 | 56.2 | 14.6 | <1.00 | 5 | 12.3 | 27.2 | <5.00 | <5.00 | <5.00 | 281 | 73.0 | <5.00 |
| LAWALG-04-CCC-PCT-A | 3 | 29 | S-13193 | 2.37 | 4.67 | <1.00 | <1.00 | <1.00 | 47.8 | 12.5 | <1.00 | 5 | 11.9 | 23.4 | <5.00 | <5.00 | <5.00 | 239 | 62.5 | <5.00 |
| LAWALG-17-CCC-PCT-C | 3 | 30 | S-13252 | 2.44 | 4.47 | <1.00 | <1.00 | <1.00 | 44.3 | 11.1 | <1.00 | 5 | 12.2 | 22.4 | <5.00 | <5.00 | <5.00 | 222 | 55.5 | <5.00 |
| LAWALG-04-Q-PCT-B | 3 | 31 | S-13131 | 2.62 | 5.88 | <1.00 | <1.00 | <1.00 | 57.9 | 13.9 | <1.00 | 5 | 13.1 | 29.4 | <5.00 | <5.00 | <5.00 | 290 | 69.5 | <5.00 |
| LAWALG-15-CCC-PCT-C | 3 | 32 | S-13235 | 2.50 | 4.85 | <1.00 | <1.00 | <1.00 | 47.2 | 12.3 | <1.00 | 5 | 12.5 | 24.3 | <5.00 | <5.00 | <5.00 | 236 | 61.5 | <5.00 |
| LAWALG-09-CCC-PCT-C | 3 | 33 | S-13229 | 4.39 | 5.17 | <1.00 | <1.00 | <1.00 | 41.5 | 12.1 | <1.00 | 5 | 22.0 | 25.9 | <5.00 | <5.00 | <5.00 | 208 | 60.5 | <5.00 |
| std | 3 | 34 | std-35 | 4.00 | 19.5 | <1.00 | 9.65 | 10.3 | 83.2 | 48.4 | <1.00 | 1 | 4.00 | 19.5 | <1.00 | 9.65 | 10.3 | 83.2 | 48.4 | <1.00 |
| LRM-PCT-C-7/14/21 | 3 | 35 | S-13178 | 2.97 | 5.60 | <1.00 | <1.00 | <1.00 | 34.8 | 15.5 | <1.00 | 5 | 14.9 | 28.0 | <5.00 | <5.00 | <5.00 | 174 | 77.5 | <5.00 |
| LAWALG-10-CCC-PCT-A | 3 | 36 | S-13207 | 2.48 | 4.51 | <1.00 | <1.00 | <1.00 | 47.3 | 12.2 | <1.00 | 5 | 12.4 | 22.6 | <5.00 | <5.00 | <5.00 | 237 | 61.0 | <5.00 |
| LAWALG-11-CCC-PCT-C | 3 | 37 | S-13246 | 2.93 | 2.17 | <1.00 | 2.97 | <1.00 | 49.4 | 11.5 | <1.00 | 5 | 14.7 | 10.9 | <5.00 | 14.9 | <5.00 | 247 | 57.5 | <5.00 |
| LRM-PCT-B-7/29/21 | 3 | 38 | S-13237 | 3.19 | 6.17 | <1.00 | <1.00 | <1.00 | 36.9 | 16.8 | <1.00 | 5 | 16.0 | 30.9 | <5.00 | <5.00 | <5.00 | 185 | 84.0 | <5.00 |
| *LAWALG-06-Q-PCT-B** | *3* | *39* | *S-13142* | *<1.00* | *6.83* | *<1.00* | *<1.00* | *<1.00* | *37.7* | *10.6* | *<1.00* | *9* | *<9.00* | *61.5* | *<9.00* | *<9.00* | *<9.00* | *340* | *95.5* | *<9.00* |
| std | 3 | 40 | std-36 | 3.98 | 19.4 | <1.00 | 10.1 | 10.2 | 83.3 | 48.1 | <1.00 | 1 | 3.98 | 19.4 | <1.00 | 10.1 | 10.2 | 83.3 | 48.1 | <1.00 |
| std | 4 | 1 | std-41 | 3.95 | 19.2 | <1.00 | 9.37 | 9.92 | 80.5 | 48.2 | <1.00 | 1 | 3.95 | 19.2 | <1.00 | 9.37 | 9.92 | 80.5 | 48.2 | <1.00 |
| LAWALG-08-Q-PCT-C | 4 | 2 | S-13149 | <1.00 | 6.68 | <1.00 | <1.00 | 1.61 | 13.9 | 17.4 | <1.00 | 5 | <5.00 | 33.4 | <5.00 | <5.00 | 8.05 | 69.5 | 87.0 | <5.00 |
| LAWALG-06-CCC-PCT-B | 4 | 3 | S-13225 | <1.00 | 11.4 | <1.00 | <1.00 | <1.00 | 60.8 | 18.1 | <1.00 | 5 | <5.00 | 57.0 | <5.00 | <5.00 | <5.00 | 304 | 90.5 | <5.00 |
| LAWALG-12-CCC-PCT-B | 4 | 4 | S-13211 | <1.00 | 14.8 | <1.00 | <1.00 | <1.00 | 54.0 | 28.0 | <1.00 | 5 | <5.00 | 74.0 | <5.00 | <5.00 | <5.00 | 270 | 140 | <5.00 |
| LRM-PCT-A-6/24/21 | 4 | 5 | S-13156 | 2.89 | 5.24 | <1.00 | <1.00 | <1.00 | 32.8 | 15.1 | <1.00 | 5 | 14.5 | 26.2 | <5.00 | <5.00 | <5.00 | 164 | 75.5 | <5.00 |
| LAWALG-14-CCC-PCT-B | 4 | 6 | S-13231 | <1.00 | 5.82 | <1.00 | <1.00 | <1.00 | 21.4 | 14.7 | <1.00 | 5 | <5.00 | 29.1 | <5.00 | <5.00 | <5.00 | 107 | 73.5 | <5.00 |
| LAWALG-10-CCC-PCT-B | 4 | 7 | S-13208 | 1.95 | 3.68 | <1.00 | <1.00 | <1.00 | 43.3 | 12.7 | <1.00 | 5 | 9.75 | 18.4 | <5.00 | <5.00 | <5.00 | 217 | 63.5 | <5.00 |
| DI WATER BLANK-A-6/16/21 | 4 | 8 | S-13139 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| std | 4 | 9 | std-42 | 4.00 | 19.4 | <1.00 | 9.81 | 10.1 | 81.3 | 49.1 | <1.00 | 1 | 4.00 | 19.4 | <1.00 | 9.81 | 10.1 | 81.3 | 49.1 | <1.00 |
| LAWALG-01-Q-PCT-A | 4 | 10 | S-13121 | <1.00 | 2.59 | <1.00 | <1.00 | 2.39 | 23.6 | 18.7 | <1.00 | 5 | <5.00 | 13.0 | <5.00 | <5.00 | 12.0 | 118 | 93.5 | <5.00 |
| LAWALG-13-Q-PCT-A | 4 | 11 | S-13167 | <1.00 | 7.22 | <1.00 | <1.00 | 1.23 | 23.7 | 18.6 | <1.00 | 5 | <5.00 | 36.1 | <5.00 | <5.00 | 6.15 | 119 | 93.0 | <5.00 |
| LAWALG-04-Q-PCT-C | 4 | 12 | S-13132 | 2.38 | 5.35 | <1.00 | <1.00 | <1.00 | 54.9 | 14.3 | <1.00 | 5 | 11.9 | 26.8 | <5.00 | <5.00 | <5.00 | 275 | 71.5 | <5.00 |
| LAWALG-10-Q-PCT-C | 4 | 13 | S-13155 | 2.60 | 5.26 | <1.00 | <1.00 | <1.00 | 53.2 | 13.4 | <1.00 | 5 | 13.0 | 26.3 | <5.00 | <5.00 | <5.00 | 266 | 67.0 | <5.00 |
| LAWALG-08-CCC-PCT-B | 4 | 14 | S-13205 | <1.00 | 5.54 | <1.00 | <1.00 | 1.33 | 10.8 | 16.9 | <1.00 | 5 | <5.00 | 27.7 | <5.00 | <5.00 | 6.65 | 54.0 | 84.5 | <5.00 |
| DI WATER BLANK-A-7/27/21 | 4 | 15 | S-13219 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 1.25 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | 6.25 | <5.00 |
| LAWALG-17-Q-PCT-A | 4 | 16 | S-13184 | 2.45 | 5.17 | <1.00 | <1.00 | <1.00 | 49.6 | 12.3 | <1.00 | 5 | 12.3 | 25.9 | <5.00 | <5.00 | <5.00 | 248 | 61.5 | <5.00 |
| std | 4 | 17 | std-43 | 3.98 | 19.0 | <1.00 | 10.1 | 10.2 | 81.3 | 47.8 | <1.00 | 1 | 3.98 | 19.0 | <1.00 | 10.1 | 10.2 | 81.3 | 47.8 | <1.00 |
| LAWALG-04-CCC-PCT-B | 4 | 18 | S-13194 | 2.41 | 4.74 | <1.00 | <1.00 | <1.00 | 47.4 | 12.3 | <1.00 | 5 | 12.1 | 23.7 | <5.00 | <5.00 | <5.00 | 237 | 61.5 | <5.00 |
| LRM-PCT-A-7/29/21 | 4 | 19 | S-13236 | 3.00 | 5.65 | <1.00 | <1.00 | <1.00 | 35.0 | 16.3 | <1.00 | 5 | 15.0 | 28.3 | <5.00 | <5.00 | <5.00 | 175 | 81.5 | <5.00 |
| LAWALG-14-Q-PCT-C | 4 | 20 | S-13172 | <1.00 | 7.90 | <1.00 | <1.00 | <1.00 | 28.5 | 18.4 | <1.00 | 5 | <5.00 | 39.5 | <5.00 | <5.00 | <5.00 | 143 | 92.0 | <5.00 |
| LAWALG-02-CCC-PCT-B | 4 | 21 | S-13191 | <1.00 | 12.4 | <1.00 | <1.00 | <1.00 | 53.2 | 19.7 | <1.00 | 5 | <5.00 | 62.0 | <5.00 | <5.00 | <5.00 | 266 | 98.5 | <5.00 |
| LRM-PCT-B-8/4/21 | 4 | 22 | S-13254 | 2.85 | 4.96 | <1.00 | <1.00 | <1.00 | 31.1 | 14.4 | <1.00 | 5 | 14.3 | 24.8 | <5.00 | <5.00 | <5.00 | 156 | 72.0 | <5.00 |
| LAWALG-03-Q-PCT-A | 4 | 23 | S-13127 | <1.00 | 82.2 | <1.00 | <1.00 | <1.00 | 466 | 101 | <1.00 | 5 | <5.00 | 411 | <5.00 | <5.00 | <5.00 | 2330 | 505 | <5.00 |

*Sample LAWALG-06-Q-PCT-B (S-13142) which was excluded from calculations and is italicized in the table for easy reference.

**Table A-1. PCT Leachate Measurements (mg/L) Measured by ICP-OES (continued)**

| PNNL Solution ID | Block | Seq. | Lab ID | Al | B | Cr | K | Li | Na | Si | Zr | DF | Al | B | Cr | K | Li | Na | Si | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAWALG-09-Q-PCT-A | 4 | 24 | S-13150 | 3.25 | 5.46 | <1.00 | <1.00 | <1.00 | 47.4 | 11.7 | <1.00 | 5 | 16.3 | 27.3 | <5.00 | <5.00 | <5.00 | 237 | 58.5 | <5.00 |
| std | 4 | 25 | std-44 | 3.99 | 19.2 | <1.00 | 9.63 | 10.2 | 81.5 | 48.3 | <1.00 | 1 | 3.99 | 19.2 | <1.00 | 9.63 | 10.2 | 81.5 | 48.3 | <1.00 |
| LAWALG-06-Q-PCT-C | 4 | 26 | S-13143 | <1.00 | 12.3 | <1.00 | <1.00 | <1.00 | 67.9 | 19.7 | <1.00 | 5 | <5.00 | 61.5 | <5.00 | <5.00 | <5.00 | 340 | 98.5 | <5.00 |
| DI WATER BLANK-B-7/29/21 | 4 | 27 | S-13240 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| LAWALG-16-Q-PCT-C | 4 | 28 | S-13183 | 2.56 | 4.56 | <1.00 | <1.00 | <1.00 | 50.2 | 13.6 | <1.00 | 5 | 12.8 | 22.8 | <5.00 | <5.00 | <5.00 | 251 | 68.0 | <5.00 |
| LAWALG-02-Q-PCT-C | 4 | 29 | S-13126 | <1.00 | 16.7 | <1.00 | <1.00 | <1.00 | 71.6 | 24.8 | <1.00 | 5 | <5.00 | 83.5 | <5.00 | <5.00 | <5.00 | 358 | 124 | <5.00 |
| LRM-PCT-C-7/16/21 | 4 | 30 | S-13198 | 2.89 | 5.64 | <1.00 | <1.00 | <1.00 | 34.8 | 15.6 | <1.00 | 5 | 14.5 | 28.2 | <5.00 | <5.00 | <5.00 | 174 | 78.0 | <5.00 |
| LAWALG-11-Q-PCT-A | 4 | 31 | S-13161 | 3.45 | 2.19 | <1.00 | 3.28 | <1.00 | 49.8 | 10.6 | <1.00 | 5 | 17.3 | 11.0 | <5.00 | 16.4 | <5.00 | 249 | 53.0 | <5.00 |
| LAWALG-07-Q-PCT-A | 4 | 32 | S-13144 | <1.00 | 11.4 | <1.00 | <1.00 | <1.00 | 88.2 | 29.2 | <1.00 | 5 | <5.00 | 57.0 | <5.00 | <5.00 | <5.00 | 441 | 146 | <5.00 |
| LRM-PCT-B-7/14/21 | 4 | 33 | S-13177 | 2.91 | 5.21 | <1.00 | <1.00 | <1.00 | 33.1 | 15.7 | <1.00 | 5 | 14.6 | 26.1 | <5.00 | <5.00 | <5.00 | 166 | 78.5 | <5.00 |
| std | 4 | 34 | std-45 | 3.98 | 18.8 | <1.00 | 9.97 | 10.2 | 81.3 | 48.2 | <1.00 | 1 | 3.98 | 18.8 | <1.00 | 9.97 | 10.2 | 81.3 | 48.2 | <1.00 |
| LAWALG-15-Q-PCT-A | 4 | 35 | S-13173 | 2.29 | 5.25 | <1.00 | <1.00 | <1.00 | 52.1 | 13.9 | <1.00 | 5 | 11.5 | 26.3 | <5.00 | <5.00 | <5.00 | 261 | 69.5 | <5.00 |
| LAWALG-05-1-Q-PCT-A | 4 | 36 | S-13133 | <1.00 | 7.64 | <1.00 | <1.00 | 1.87 | 13.8 | 18.2 | <1.00 | 5 | <5.00 | 38.2 | <5.00 | <5.00 | 9.35 | 69.0 | 91.0 | <5.00 |
| LAWALG-16-CCC-PCT-B | 4 | 37 | S-13248 | 2.71 | 4.27 | <1.00 | <1.00 | <1.00 | 47.5 | 12.9 | <1.00 | 5 | 13.6 | 21.4 | <5.00 | <5.00 | <5.00 | 238 | 64.5 | <5.00 |
| LAWALG-12-Q-PCT-C | 4 | 38 | S-13166 | <1.00 | 53.0 | <1.00 | <1.00 | <1.00 | 188 | 53.3 | <1.00 | 5 | <5.00 | 265 | <5.00 | <5.00 | <5.00 | 940 | 267 | <5.00 |
| DI WATER BLANK-B-6/24/21 | 4 | 39 | S-13160 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 | 5 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| std | 4 | 40 | std-46 | 4.04 | 19.1 | <1.00 | 9.82 | 10.3 | 82.3 | 48.2 | <1.00 | 1 | 4.04 | 19.1 | <1.00 | 9.82 | 10.3 | 82.3 | 48.2 | <1.00 |

**Table A-2. Dilution-Corrected LRM Leachate Measurements (mg/L)**

| PNNL Solution ID | Lab ID | B | Na | Si |
|---|---|---|---|---|
| LRM-PCT-A-6/16/21 | S-13136 | 22.5 | 150 | 77.5 |
| LRM-PCT-B-6/16/21 | S-13137 | 24.7 | 162 | 80.0 |
| LRM-PCT-C-6/16/21 | S-13138 | 23.6 | 159 | 89.5 |
| LRM-PCT-A-6/24/21 | S-13156 | 26.2 | 164 | 75.5 |
| LRM-PCT-B-6/24/21 | S-13157 | 26.7 | 167 | 77.5 |
| LRM-PCT-C-6/24/21 | S-13158 | 26.2 | 169 | 77.5 |
| LRM-PCT-A-7/14/21 | S-13176 | 25.7 | 170 | 90.5 |
| LRM-PCT-B-7/14/21 | S-13177 | 26.1 | 166 | 78.5 |
| LRM-PCT-C-7/14/21 | S-13178 | 28.0 | 174 | 77.5 |
| LRM-PCT-A-7/16/21 | S-13196 | 29.9 | 182 | 82.0 |
| LRM-PCT-B-7/16/21 | S-13197 | 28.1 | 177 | 89.5 |
| LRM-PCT-C-7/16/21 | S-13198 | 28.2 | 174 | 78.0 |
| LRM-PCT-A-7/27/21 | S-13216 | 27.6 | 170 | 76.0 |
| LRM-PCT-B-7/27/21 | S-13217 | 27.4 | 171 | 76.5 |
| LRM-PCT-C-7/27/21 | S-13218 | 28.6 | 168 | 79.0 |
| LRM-PCT-A-7/29/21 | S-13236 | 28.3 | 175 | 81.5 |
| LRM-PCT-B-7/29/21 | S-13237 | 30.9 | 185 | 84.0 |
| LRM-PCT-C-7/29/21 | S-13238 | 28.9 | 180 | 83.0 |
| LRM-PCT-A-8/4/21 | S-13253 | 28.6 | 168 | 79.0 |
| LRM-PCT-B-8/4/21 | S-13254 | 24.8 | 156 | 72.0 |
| LRM-PCT-C-8/4/21 | S-13255 | 28.5 | 177 | 80.0 |

Ranges of Expected Test Results for LRM[d]
Boron: 19.5 – 33.9 mg/L (26.7 ± 7.2 mg/L)
Sodium: 147 – 173 mg/L (160 ± 13.0 mg/L)
Silicon: 69.3 – 94.7 mg/L (82.0 ± 12.7 mg/L)
Values that fall outside of the reference ranges are shaded grey.

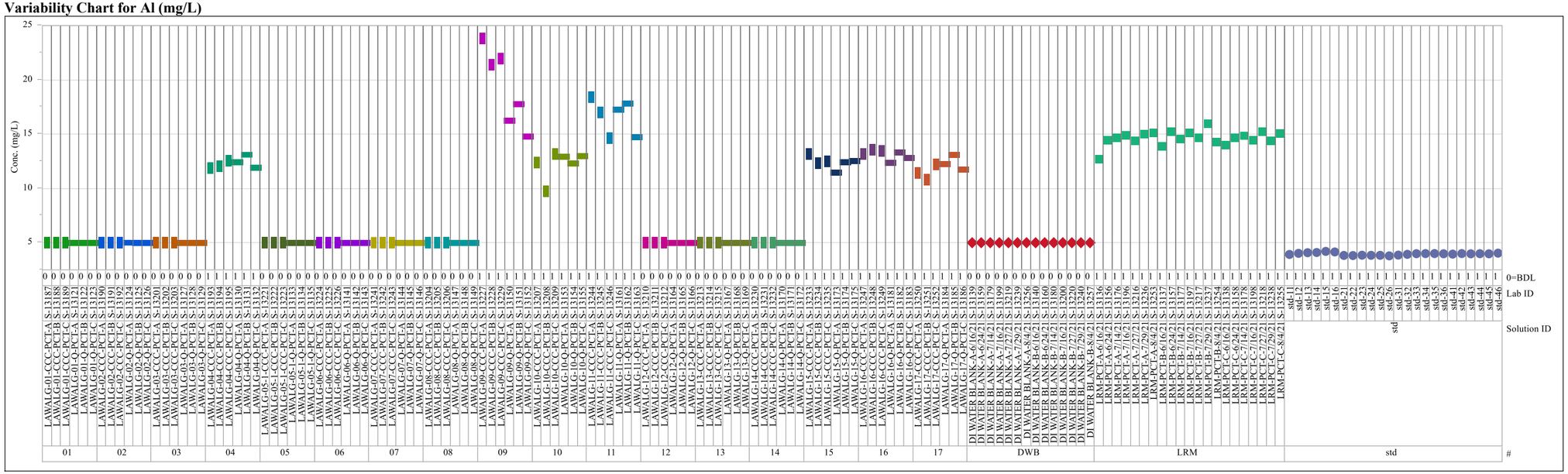
[d] W.L. Ebert and S.F. Wolf, "Round-Robin Testing of a Reference Glass for Low-Activity Waste Forms," Argonne National Laboratory, Argonne, IL, ANL-99/22, Revision 0, 1999

**Table A-3. Results from Samples of the Multi-Element Solution Standard Included with the PCT Leachates**

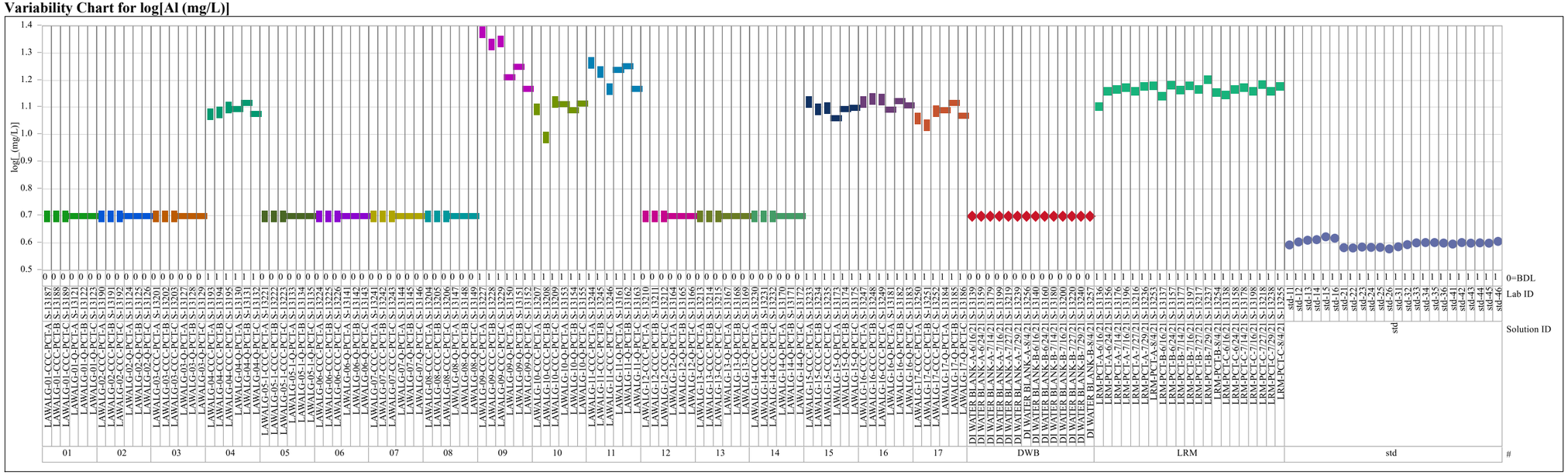
| Analytical Block | 1 | 2 | 3 | 4 | Reference Values (mg/L) |
|---|---|---|---|---|---|
| **Mean (Al (mg/L))** | 4.08 | 3.83 | 3.96 | 3.99 | 4.00 |
| **Mean (B (mg/L))** | 20.4 | 19.1 | 19.5 | 19.1 | 20.0 |
| **Mean (K (mg/L))** | 9.74 | 9.51 | 9.83 | 9.78 | 10.0 |
| **Mean (Li (mg/L))** | 10.2 | 9.94 | 10.2 | 10.2 | 10.0 |
| **Mean (Na (mg/L))** | 83.1 | 80.2 | 82.8 | 81.4 | 81.0 |
| **Mean (Si (mg/L))** | 49.5 | 47.8 | 48.3 | 48.3 | 50.0 |
| | | | | | |
| **% relative bias, Al** | 2.0% | -4.3% | -1.0% | -0.3% | <10% per ASTM C1285 |
| **% relative bias, B** | 2.2% | -4.6% | -2.3% | -4.4% | |
| **% relative bias, K** | -2.6% | -4.9% | -1.8% | -2.2% | |
| **% relative bias, Li** | 2.1% | -0.6% | 1.7% | 1.5% | |
| **% relative bias, Na** | 2.6% | -1.0% | 2.2% | 0.5% | |
| **% relative bias, Si** | -0.9% | -4.4% | -3.5% | -3.4% | |
| | | | | | |
| **Standard Deviation (Al (mg/L))** | 0.10 | 0.02 | 0.06 | 0.03 | |
| **Standard Deviation (B (mg/L))** | 0.44 | 0.21 | 0.16 | 0.20 | |
| **Standard Deviation (K (mg/L))** | 0.16 | 0.18 | 0.23 | 0.26 | |
| **Standard Deviation (Li (mg/L))** | 0.20 | 0.05 | 0.15 | 0.13 | |
| **Standard Deviation (Na (mg/L))** | 2.80 | 0.65 | 1.48 | 0.58 | |
| **Standard Deviation (Si (mg/L))** | 0.81 | 0.33 | 0.23 | 0.43 | |
| | | | | | |
| **%RSD (Al (mg/L))** | 2.4% | 0.6% | 1.4% | 0.7% | <10% per ASTM C1285 |
| **%RSD (B (mg/L))** | 2.2% | 1.1% | 0.8% | 1.1% | |
| **%RSD (K (mg/L))** | 1.7% | 1.9% | 2.3% | 2.6% | |
| **%RSD (Li (mg/L))** | 1.9% | 0.5% | 1.4% | 1.3% | |
| **%RSD (Na (mg/L))** | 3.4% | 0.8% | 1.8% | 0.7% | |
| **%RSD (Si (mg/L))** | 1.6% | 0.7% | 0.5% | 0.9% | |

## Exhibit A-1. PCT Measurements by Glass ID

**Analyte=Al**
**Variability Chart for Al (mg/L)**

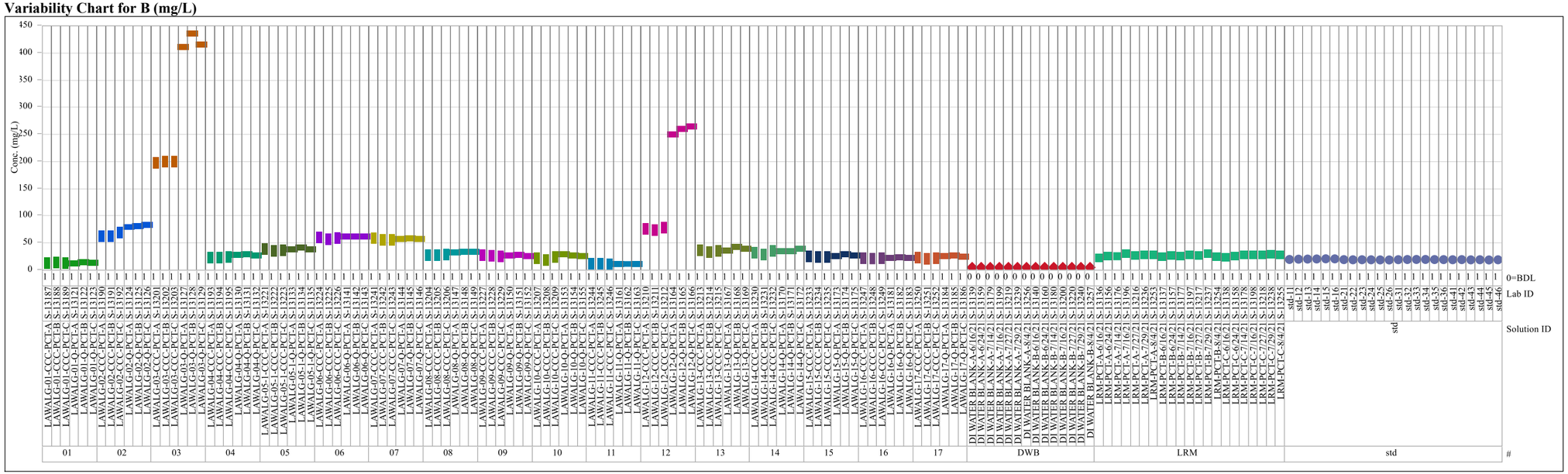



**Analyte=Al**
**Variability Chart for log[Al (mg/L)]**

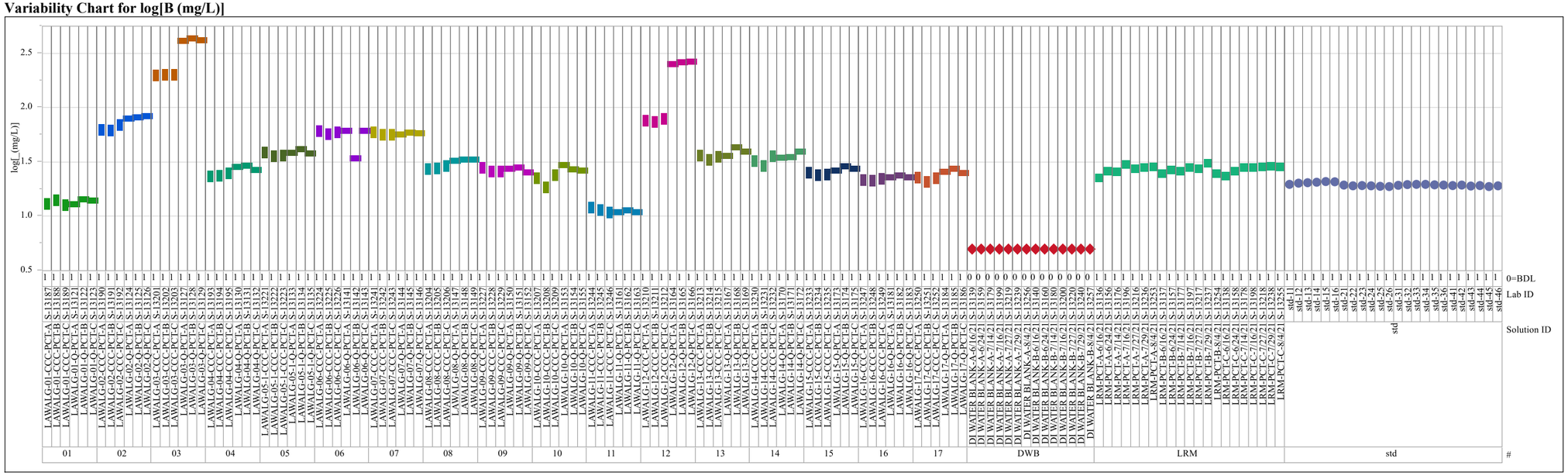


## Exhibit A-1. PCT Measurements by Glass ID (continued)

**Analyte=B**
**Variability Chart for B (mg/L)**

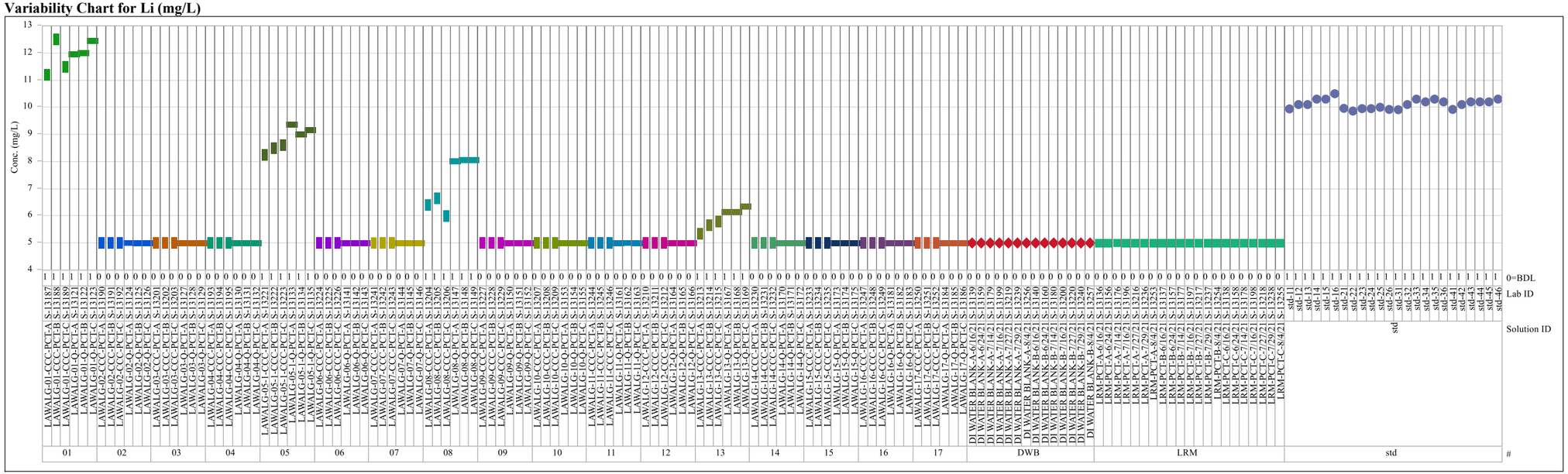



**Analyte=B**
**Variability Chart for log[B (mg/L)]**

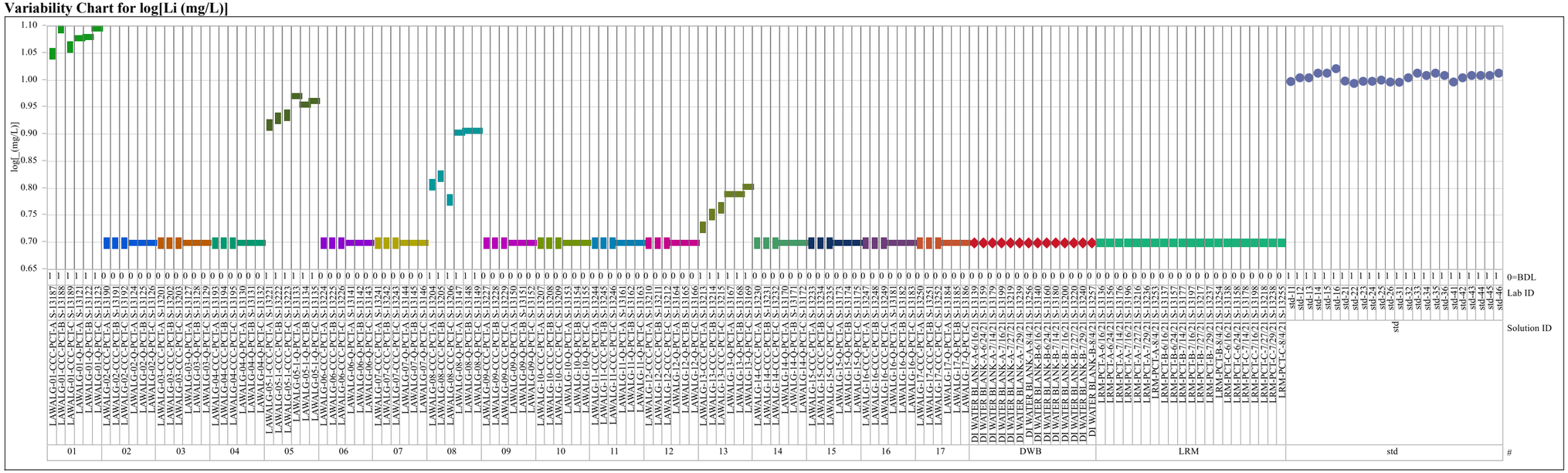


## Exhibit A-1. PCT Measurements by Glass ID (continued)

**Analyte=Li**
**Variability Chart for Li (mg/L)**

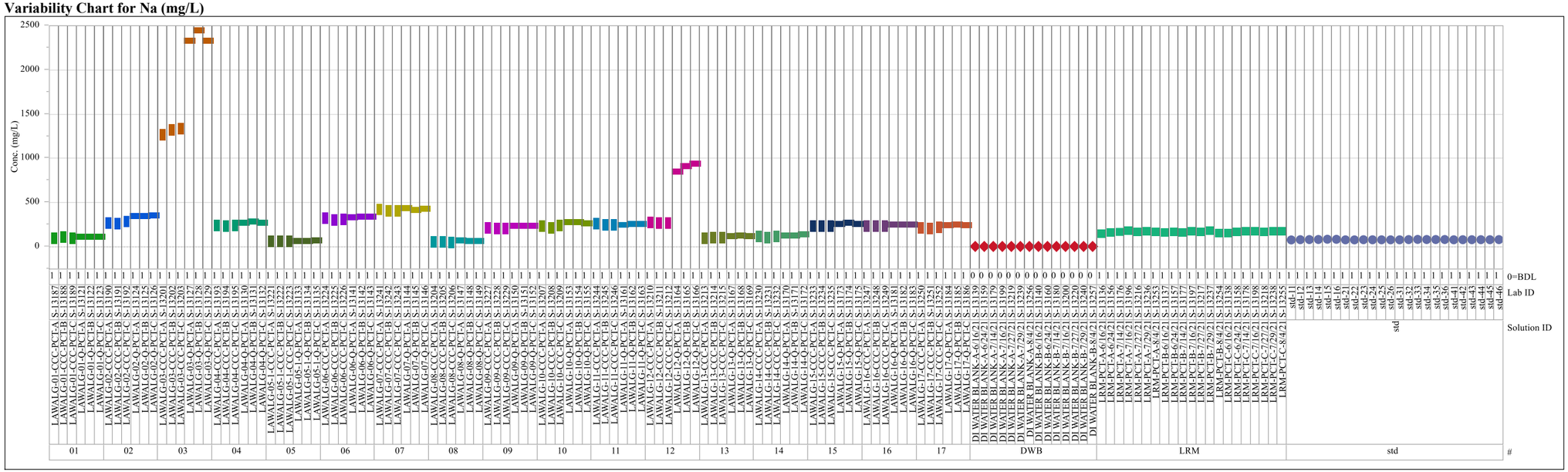



**Analyte=Li**
**Variability Chart for log[Li (mg/L)]**

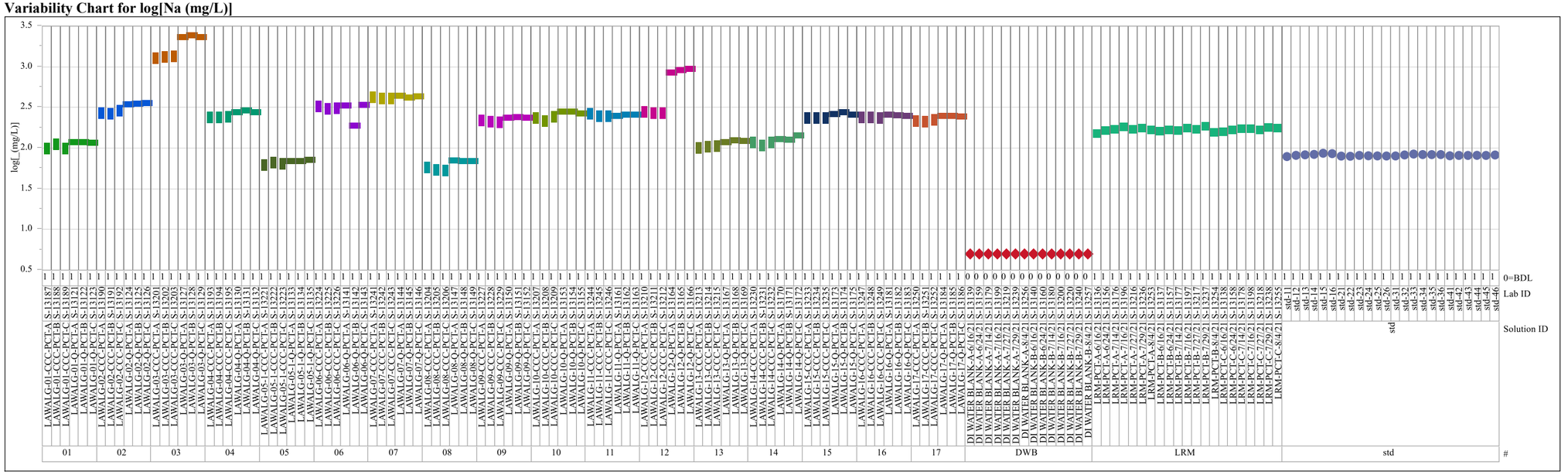


## Exhibit A-1. PCT Measurements by Glass ID (continued)

**Analyte=Na**
**Variability Chart for Na (mg/L)**

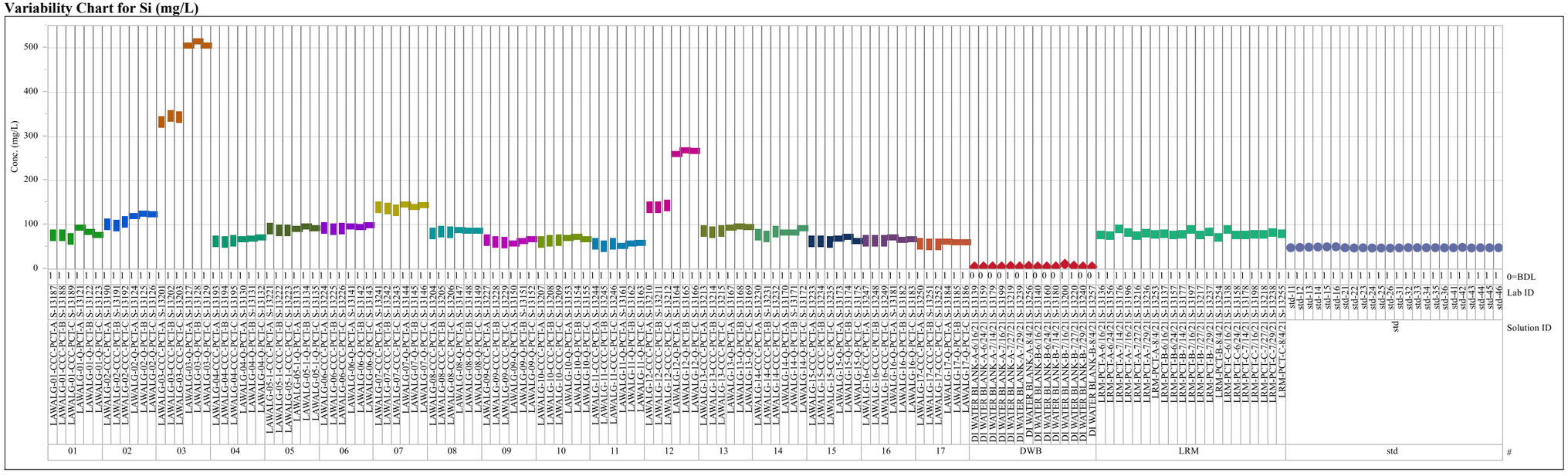



**Analyte=Na**
**Variability Chart for log[Na (mg/L)]**

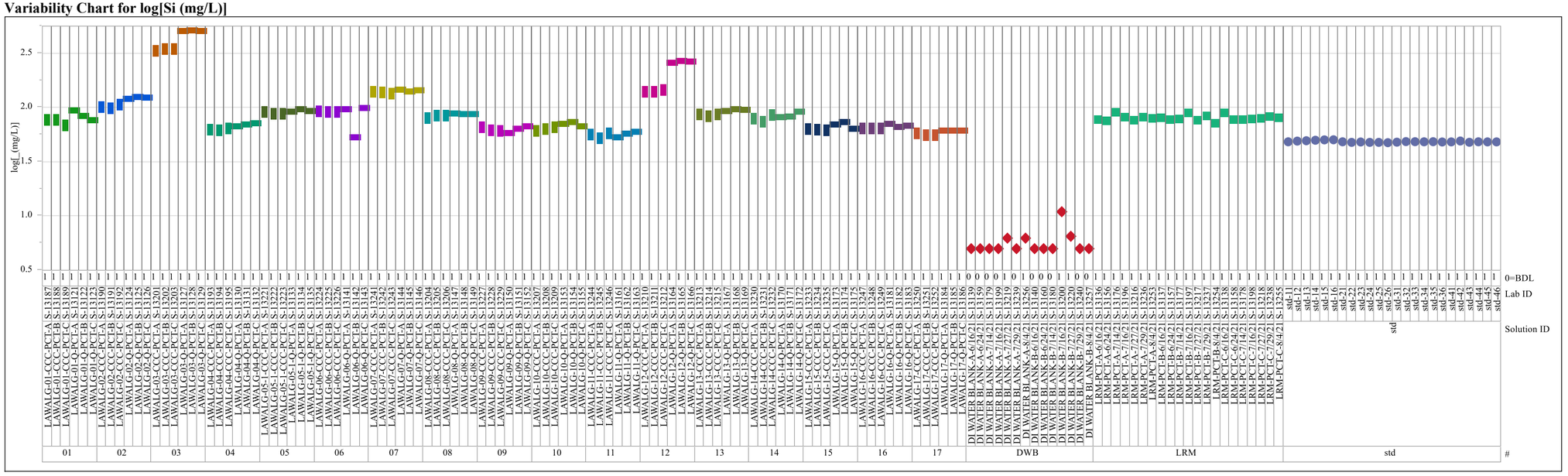


## Exhibit A-1. PCT Measurements by Glass ID (continued)

**Analyte=Si**
**Variability Chart for Si (mg/L)**




**Analyte=Si**
**Variability Chart for log[Si (mg/L)]**



# Appendix B. Normalized PCT Results

**Table B-1. Normalized PCT Results for Selected Elements**

| Glass ID | Comp. View | $NC_{Al}$ (g/L) | $NC_{B}$ (g/L) | $NC_{Li}$ (g/L) | $NC_{Na}$ (g/L) | $NC_{Si}$ (g/L) |
|---|---|---|---|---|---|---|
| LAWALG-01-Q | Target | <0.265 | 0.521 | 0.953 | 1.06 | 0.374 |
| LAWALG-01-Q | Measured | <0.268 | 0.530 | 0.940 | 1.09 | 0.378 |
| LAWALG-01-CCC | Target | <0.265 | 0.502 | 0.921 | 0.929 | 0.327 |
| LAWALG-01-CCC | Measured | <0.268 | 0.511 | 0.909 | 0.957 | 0.331 |
| LAWALG-02-Q | Target | <0.175 | 2.02 | NA | 2.42 | 0.630 |
| LAWALG-02-Q | Measured | <0.173 | 2.10 | <5.00 | 2.49 | 0.646 |
| LAWALG-02-CCC | Target | <0.175 | 1.59 | NA | 1.89 | 0.524 |
| LAWALG-02-CCC | Measured | <0.173 | 1.66 | <5.00 | 1.94 | 0.537 |
| LAWALG-03-Q | Target | <0.173 | 19.4 | NA | 14.3 | 2.84 |
| LAWALG-03-Q | Measured | <0.170 | 19.8 | <5.00 | 14.6 | 2.84 |
| LAWALG-03-CCC | Target | <0.173 | 9.20 | NA | 7.91 | 1.90 |
| LAWALG-03-CCC | Measured | <0.170 | 9.39 | <5.00 | 8.07 | 1.90 |
| LAWALG-04-Q | Target | 0.272 | 1.03 | NA | 1.61 | 0.375 |
| LAWALG-04-Q | Measured | 0.265 | 1.06 | <5.00 | 1.63 | 0.374 |
| LAWALG-04-CCC | Target | 0.266 | 0.880 | NA | 1.38 | 0.339 |
| LAWALG-04-CCC | Measured | 0.258 | 0.897 | <5.00 | 1.39 | 0.338 |
| LAWALG-05-1-Q | Target | <0.265 | 0.926 | 1.18 | 1.04 | 0.396 |
| LAWALG-05-1-Q | Measured | <0.262 | 0.948 | 1.22 | 1.00 | 0.401 |
| LAWALG-05-1-CCC | Target | <0.265 | 0.873 | 1.09 | 0.956 | 0.376 |
| LAWALG-05-1-CCC | Measured | <0.262 | 0.893 | 1.12 | 0.924 | 0.381 |
| LAWALG-06-Q | Target | <0.151 | 1.79 | NA | 2.16 | 0.534 |
| LAWALG-06-Q | Measured | <0.146 | 1.83 | <5.00 | 2.11 | 0.528 |
| LAWALG-06-CCC | Target | <0.151 | 1.71 | NA | 2.01 | 0.501 |
| LAWALG-06-CCC | Measured | <0.146 | 1.75 | <5.00 | 1.97 | 0.496 |
| LAWALG-07-Q | Target | <0.164 | 2.25 | NA | 2.54 | 0.767 |
| LAWALG-07-Q | Measured | <0.162 | 2.30 | <5.00 | 2.64 | 0.771 |
| LAWALG-07-CCC | Target | <0.164 | 2.21 | NA | 2.44 | 0.730 |
| LAWALG-07-CCC | Measured | <0.162 | 2.26 | <5.00 | 2.54 | 0.734 |
| LAWALG-08-Q | Target | <0.264 | 0.779 | 1.04 | 0.948 | 0.371 |
| LAWALG-08-Q | Measured | <0.259 | 0.800 | 1.07 | 0.925 | 0.377 |
| LAWALG-08-CCC | Target | <0.264 | 0.660 | 0.817 | 0.748 | 0.353 |
| LAWALG-08-CCC | Measured | <0.259 | 0.678 | 0.849 | 0.729 | 0.359 |
| LAWALG-09-Q | Target | 0.341 | 1.02 | NA | 1.41 | 0.379 |
| LAWALG-09-Q | Measured | 0.332 | 1.06 | <5.00 | 1.38 | 0.383 |
| LAWALG-09-CCC | Target | 0.470 | 1.00 | NA | 1.25 | 0.377 |
| LAWALG-09-CCC | Measured | 0.457 | 1.04 | <5.00 | 1.23 | 0.380 |
| LAWALG-10-Q | Target | 0.274 | 1.02 | NA | 1.58 | 0.377 |
| LAWALG-10-Q | Measured | 0.270 | 1.05 | <5.00 | 1.57 | 0.383 |
| LAWALG-10-CCC | Target | 0.251 | 0.794 | NA | 1.33 | 0.341 |
| LAWALG-10-CCC | Measured | 0.247 | 0.818 | <5.00 | 1.32 | 0.345 |
| LAWALG-11-Q | Target | 0.359 | 0.580 | NA | 1.56 | 0.335 |
| LAWALG-11-Q | Measured | 0.354 | 0.613 | <5.00 | 1.63 | 0.330 |
| LAWALG-11-CCC | Target | 0.361 | 0.599 | NA | 1.55 | 0.327 |
| LAWALG-11-CCC | Measured | 0.356 | 0.633 | <5.00 | 1.61 | 0.322 |
| LAWALG-12-Q | Target | <0.265 | 6.44 | NA | 7.03 | 1.30 |
| LAWALG-12-Q | Measured | <0.264 | 6.40 | <5.00 | 7.12 | 1.29 |
| LAWALG-12-CCC | Target | <0.265 | 1.90 | NA | 2.13 | 0.696 |
| LAWALG-12-CCC | Measured | <0.264 | 1.89 | <5.00 | 2.16 | 0.689 |

**Table B-1. Normalized PCT Results for Selected Elements (continued)**

| Glass ID | Comp. View | $NC_{Al}$ (g/L) | $NC_{B}$ (g/L) | $NC_{Li}$ (g/L) | $NC_{Na}$ (g/L) | $NC_{Si}$ (g/L) |
|---|---|---|---|---|---|---|
| LAWALG-13-Q | Target | <0.264 | 0.933 | 1.17 | 1.22 | 0.440 |
| LAWALG-13-Q | Measured | <0.266 | 0.935 | 1.16 | 1.25 | 0.436 |
| LAWALG-13-CCC | Target | <0.264 | 0.824 | 1.06 | 1.04 | 0.395 |
| LAWALG-13-CCC | Measured | <0.266 | 0.826 | 1.05 | 1.06 | 0.392 |
| LAWALG-14-Q | Target | <0.264 | 0.858 | <1.32 | 1.18 | 0.399 |
| LAWALG-14-Q | Measured | <0.255 | 0.891 | <1.56 | 1.14 | 0.410 |
| LAWALG-14-CCC | Target | <0.264 | 0.763 | <1.32 | 1.01 | 0.368 |
| LAWALG-14-CCC | Measured | <0.255 | 0.792 | <1.56 | 0.973 | 0.379 |
| LAWALG-15-Q | Target | 0.259 | 1.01 | NA | 1.53 | 0.378 |
| LAWALG-15-Q | Measured | 0.254 | 1.02 | <5.00 | 1.50 | 0.374 |
| LAWALG-15-CCC | Target | 0.270 | 0.901 | NA | 1.35 | 0.342 |
| LAWALG-15-CCC | Measured | 0.265 | 0.914 | <5.00 | 1.32 | 0.339 |
| LAWALG-16-Q | Target | 0.275 | 0.896 | NA | 1.46 | 0.368 |
| LAWALG-16-Q | Measured | 0.269 | 0.922 | <5.00 | 1.42 | 0.371 |
| LAWALG-16-CCC | Target | 0.287 | 0.839 | NA | 1.36 | 0.347 |
| LAWALG-16-CCC | Measured | 0.281 | 0.863 | <5.00 | 1.33 | 0.349 |
| LAWALG-17-Q | Target | 0.265 | 1.01 | NA | 1.45 | 0.342 |
| LAWALG-17-Q | Measured | 0.259 | 1.04 | <5.00 | 1.48 | 0.345 |
| LAWALG-17-CCC | Target | 0.246 | 0.850 | NA | 1.26 | 0.314 |
| LAWALG-17-CCC | Measured | 0.240 | 0.876 | <5.00 | 1.29 | 0.316 |
| LRM-6/16/21 | Reference | 0.268 | 0.966 | <9.79 | 1.06 | 0.324 |
| LRM-6/24/21 | Reference | 0.293 | 1.08 | <9.79 | 1.12 | 0.303 |
| LRM-7/14/21 | Reference | 0.292 | 1.09 | <9.79 | 1.14 | 0.324 |
| LRM-7/16/21 | Reference | 0.294 | 1.18 | <9.79 | 1.20 | 0.328 |
| LRM-7/27/21 | Reference | 0.293 | 1.14 | <9.79 | 1.14 | 0.305 |
| LRM-7/29/21 | Reference | 0.300 | 1.20 | <9.79 | 1.21 | 0.327 |
| LRM-8/4/21 | Reference | 0.294 | 1.12 | <9.79 | 1.12 | 0.304 |

**Exhibit B-1. Normalized PCT Results by Glass Version by Compositional View for Each Glass**

**Variability Chart for $NC_{Al}$ (g/L)**

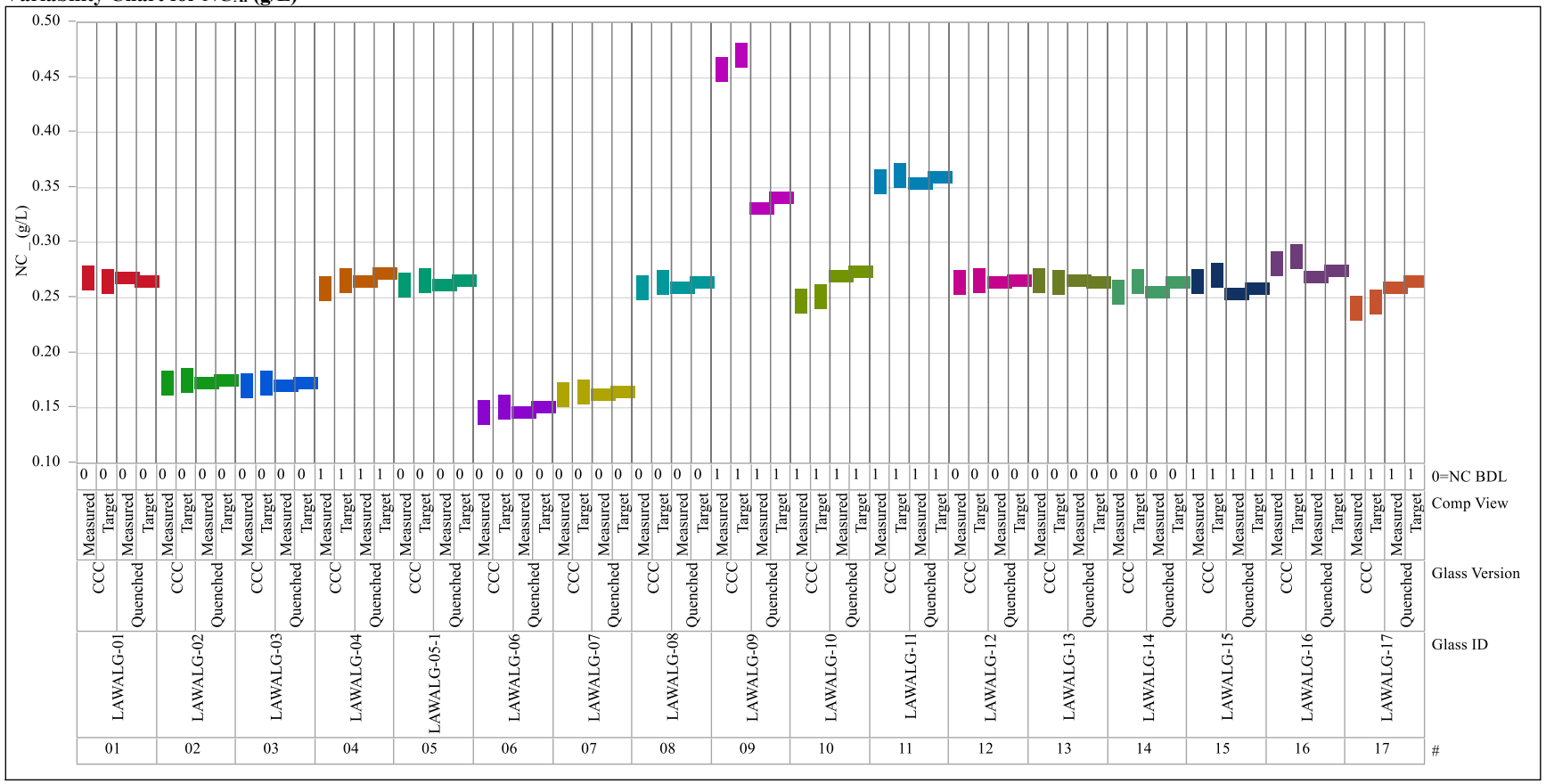


**Exhibit B-1. Normalized PCT Results by Glass Version by Compositional View for Each Glass (continued)**

**Variability Chart for $NC_B$ (g/L)**

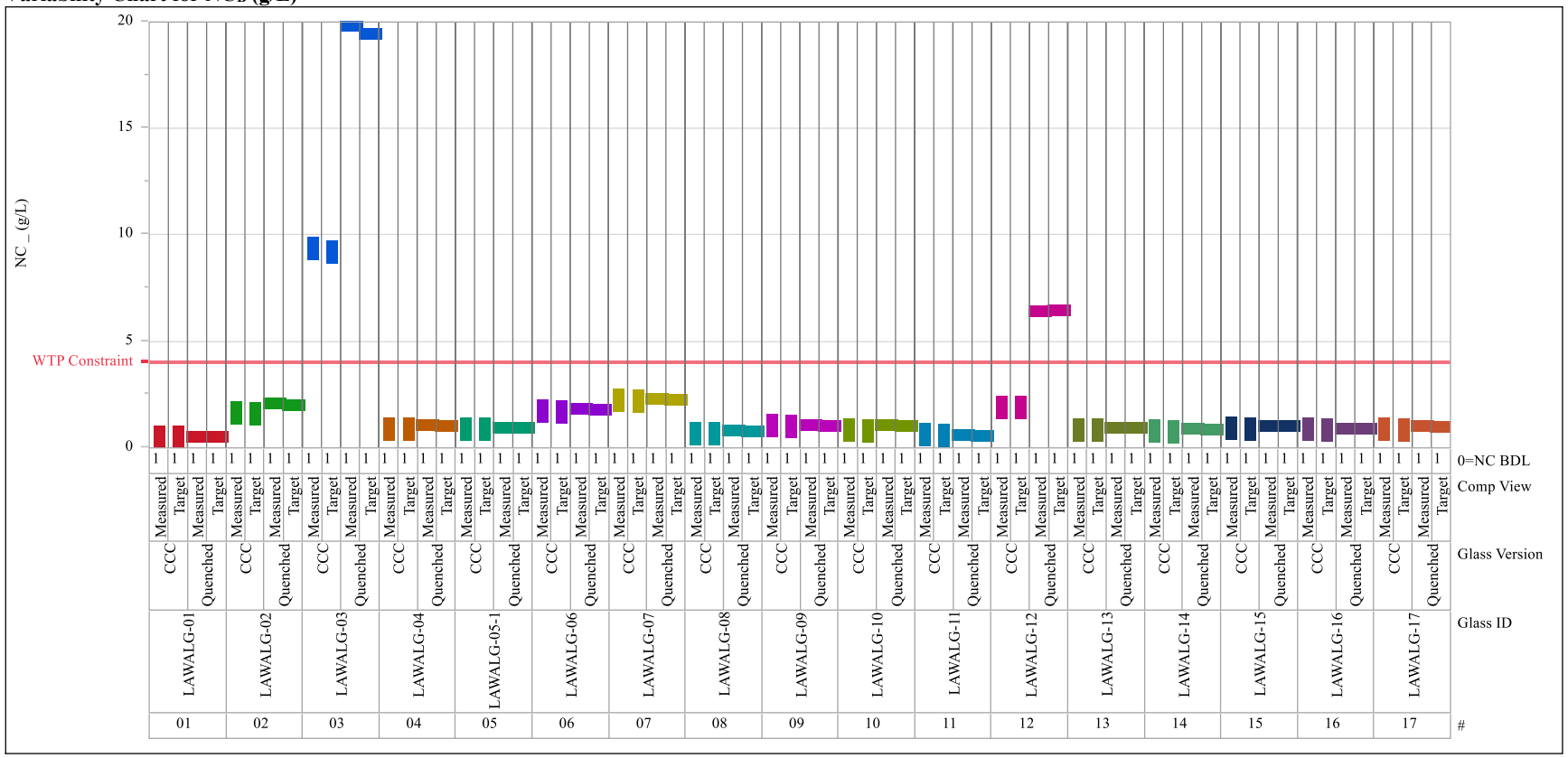


**Exhibit B-1. Normalized PCT Results by Glass Version by Compositional View for Each Glass (continued)**

**Variability Chart for $NC_{Li}$ (g/L)**

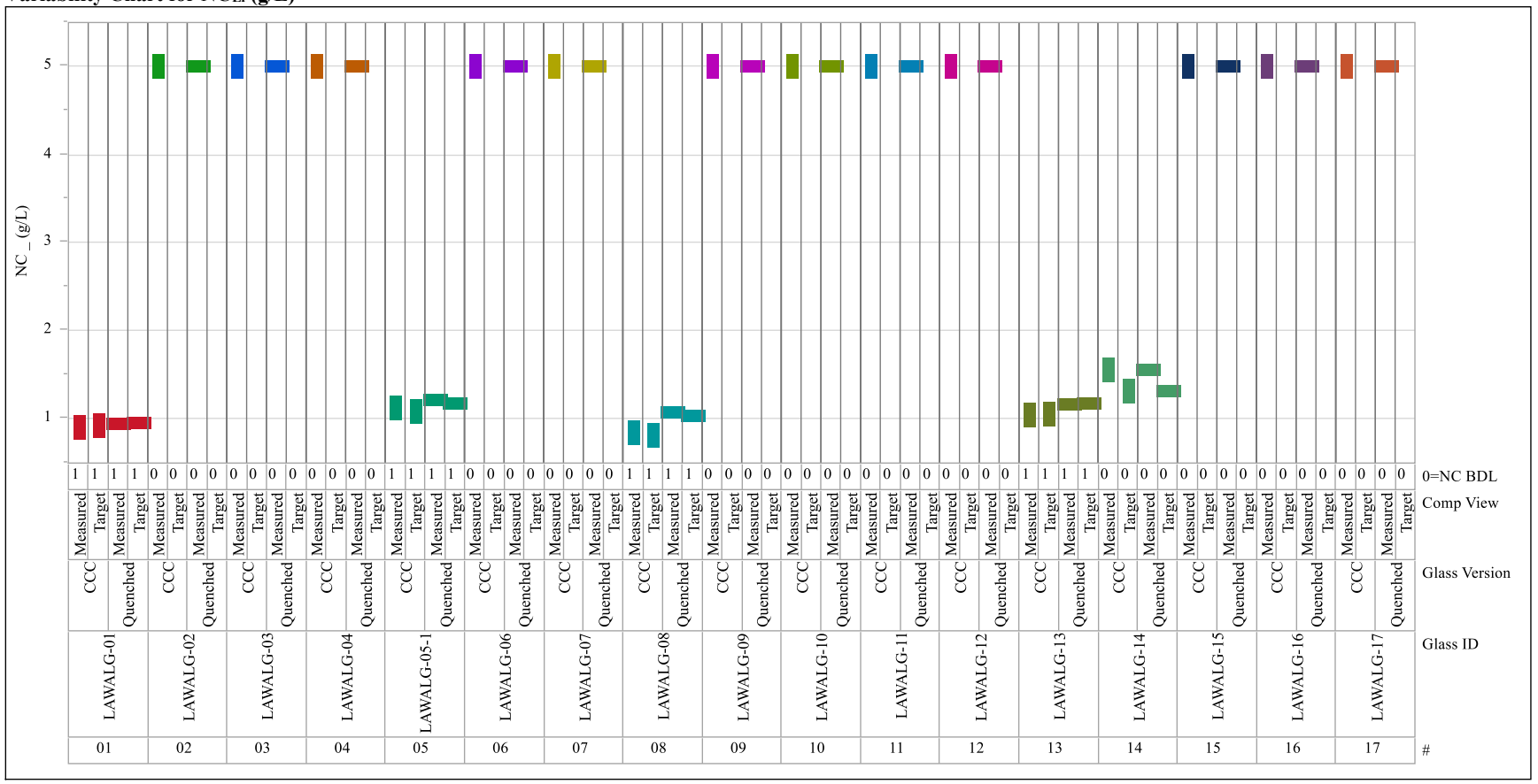


**Exhibit B-1. Normalized PCT Results by Glass Version by Compositional View for Each Glass (continued)**

**Variability Chart for $NC_{Na}$ (g/L)**

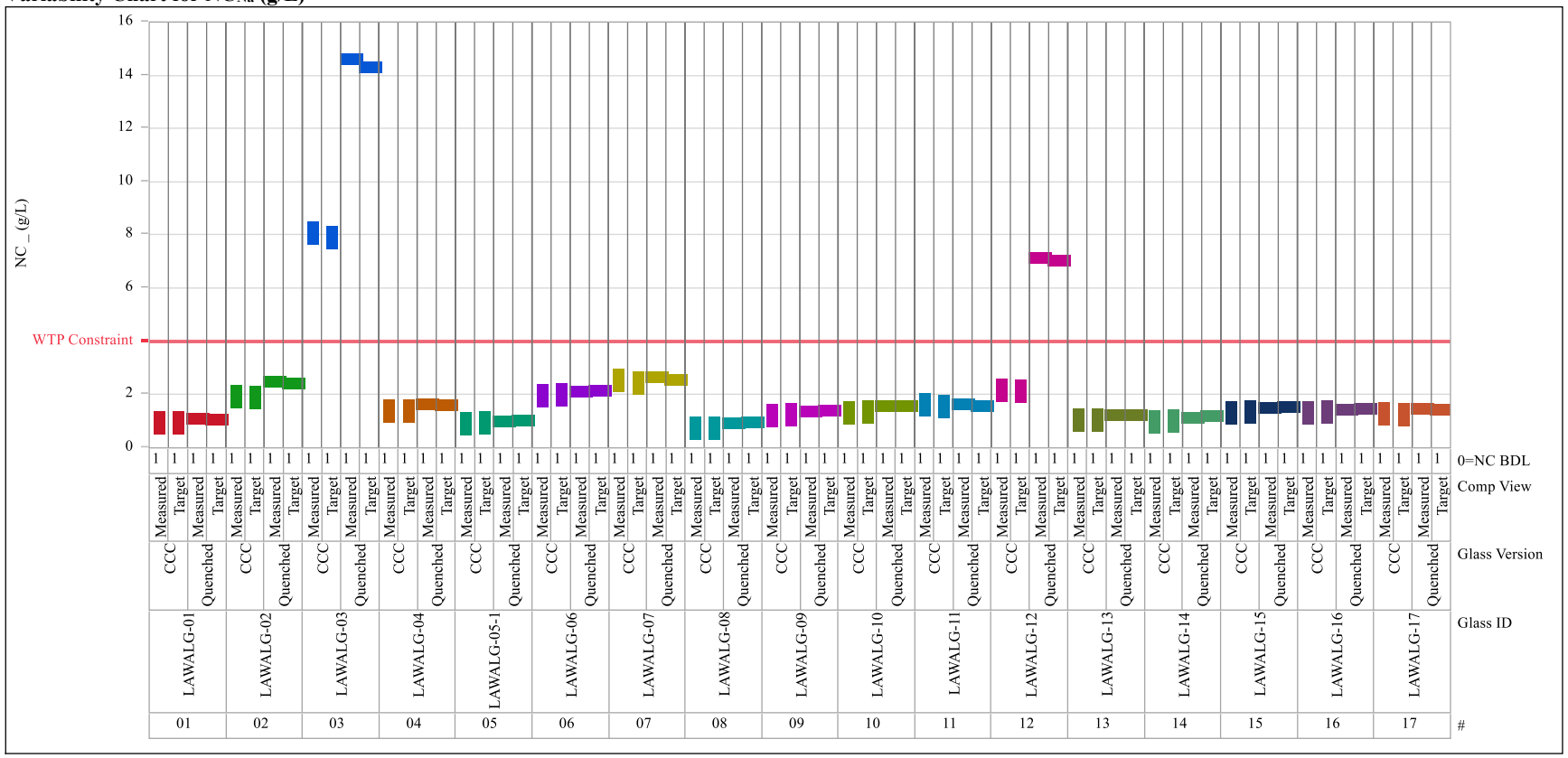


**Exhibit B-1. Normalized PCT Results by Glass Version by Compositional View for Each Glass (continued)**

**Variability Chart for $NC_{Si}$ (g/L)**

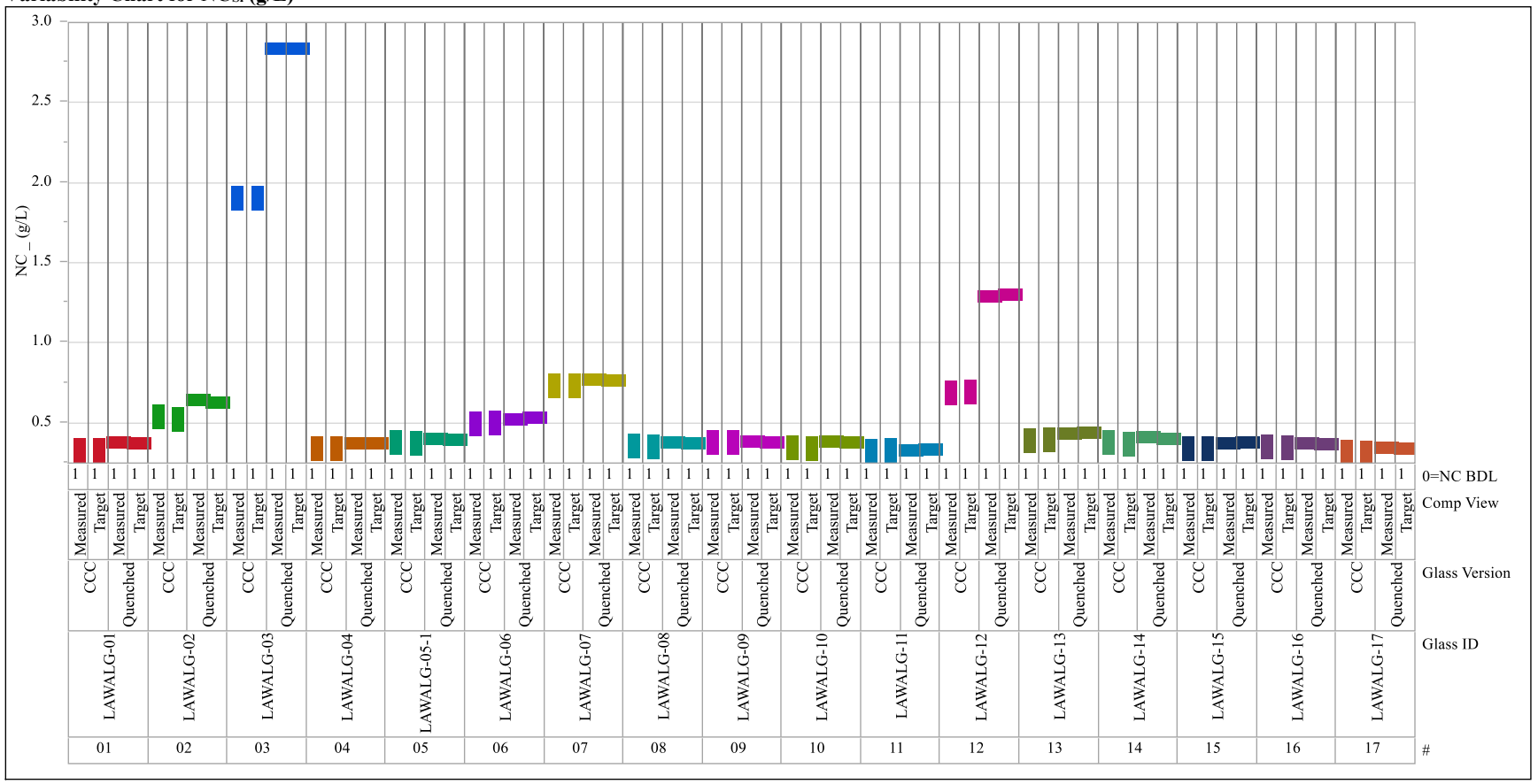
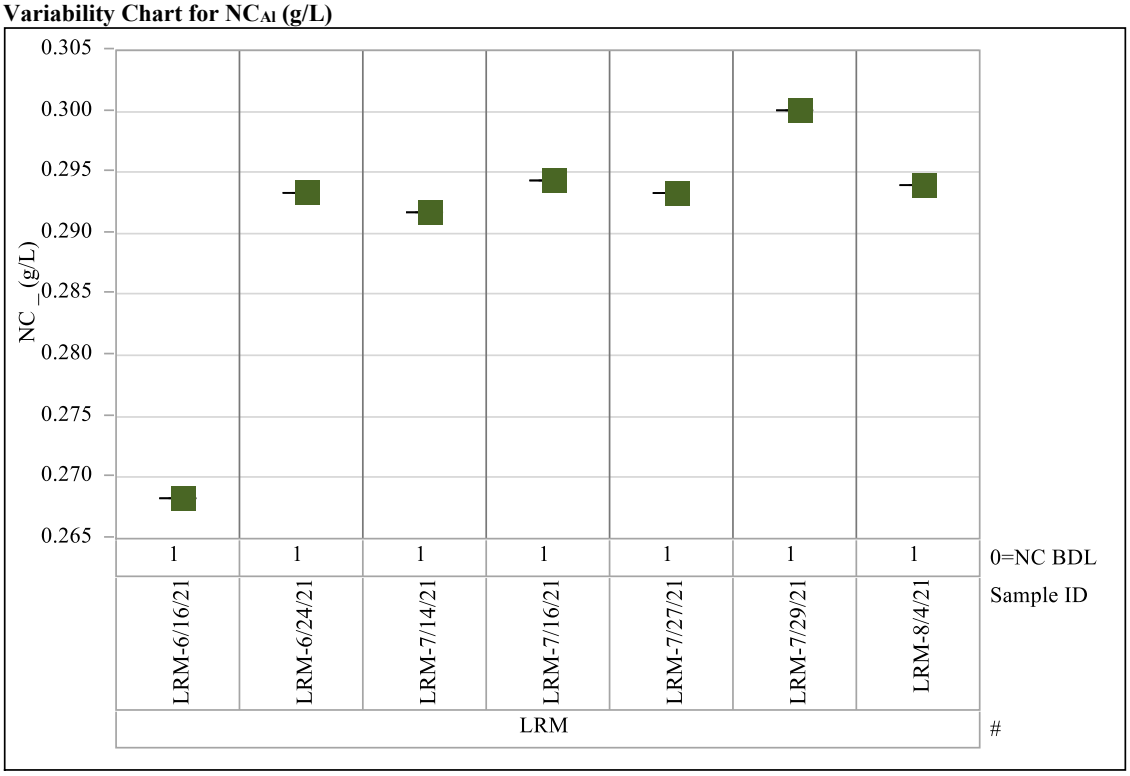


**Exhibit B-2. Normalized PCT Results for the LRM Samples**

**Variability Chart for $NC_{Al}$ (g/L)**




**Variability Chart for $NC_{B}$ (g/L)**

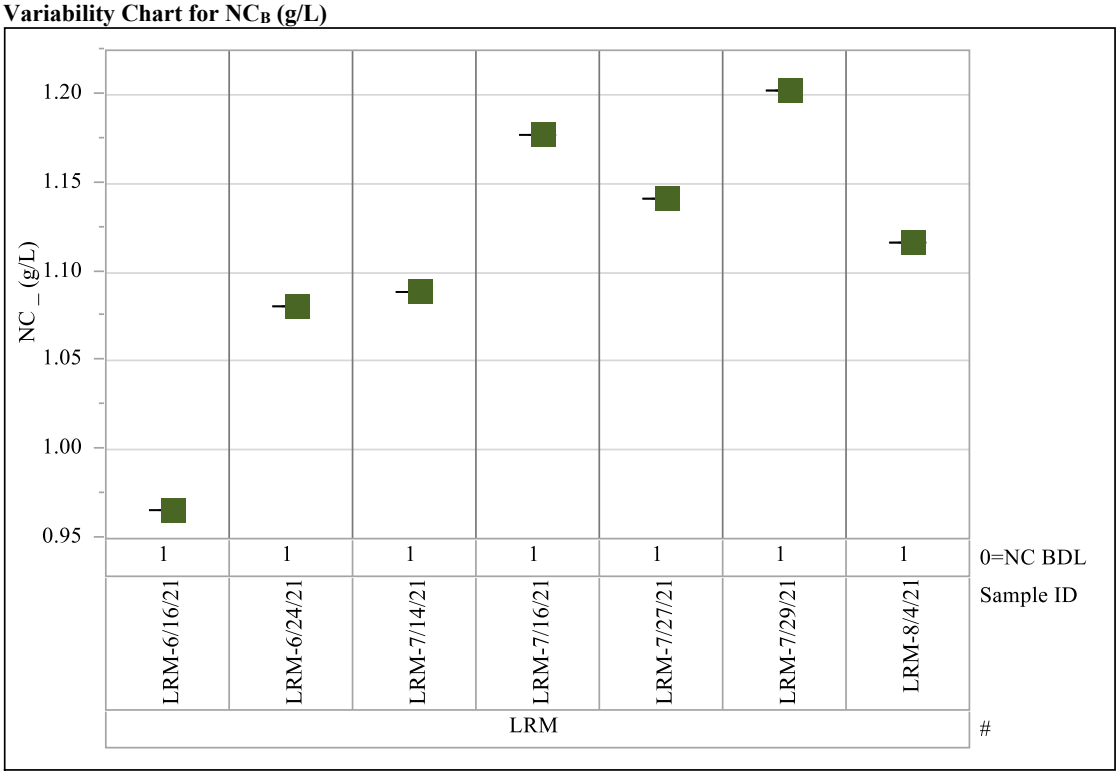
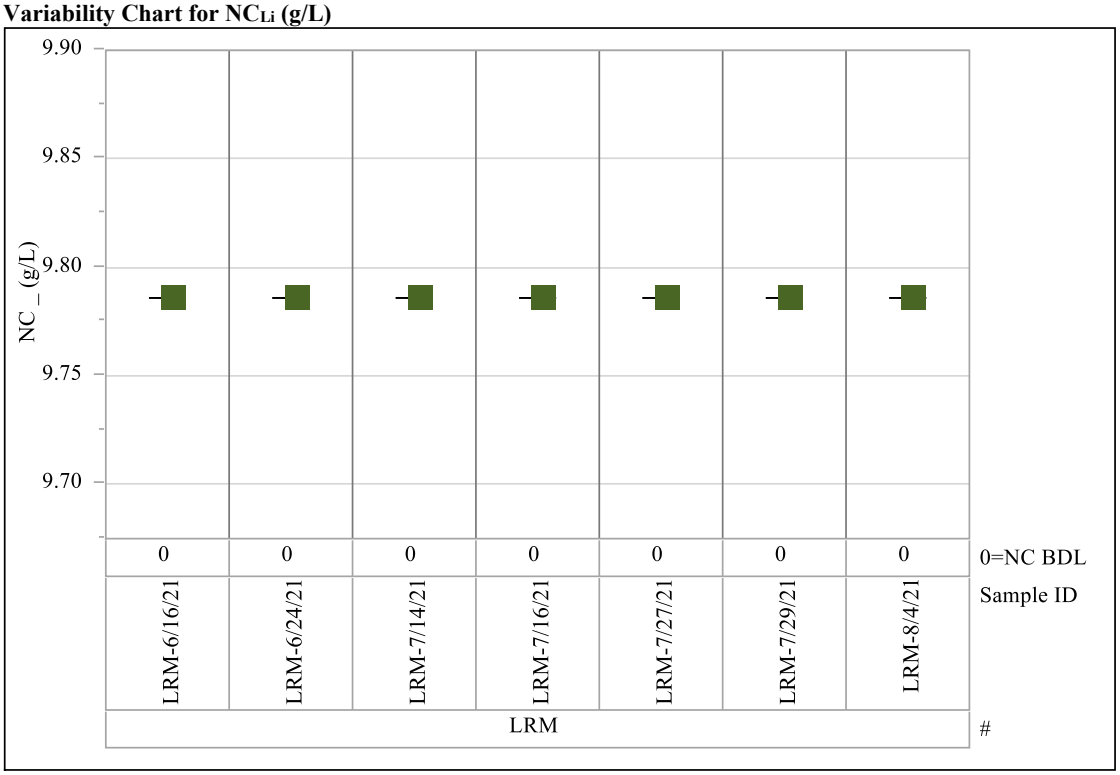


**Exhibit B-2. Normalized PCT Results for the LRM Samples (continued)**

**Variability Chart for $NC_{Li}$ (g/L)**




**Variability Chart for $NC_{Na}$ (g/L)**

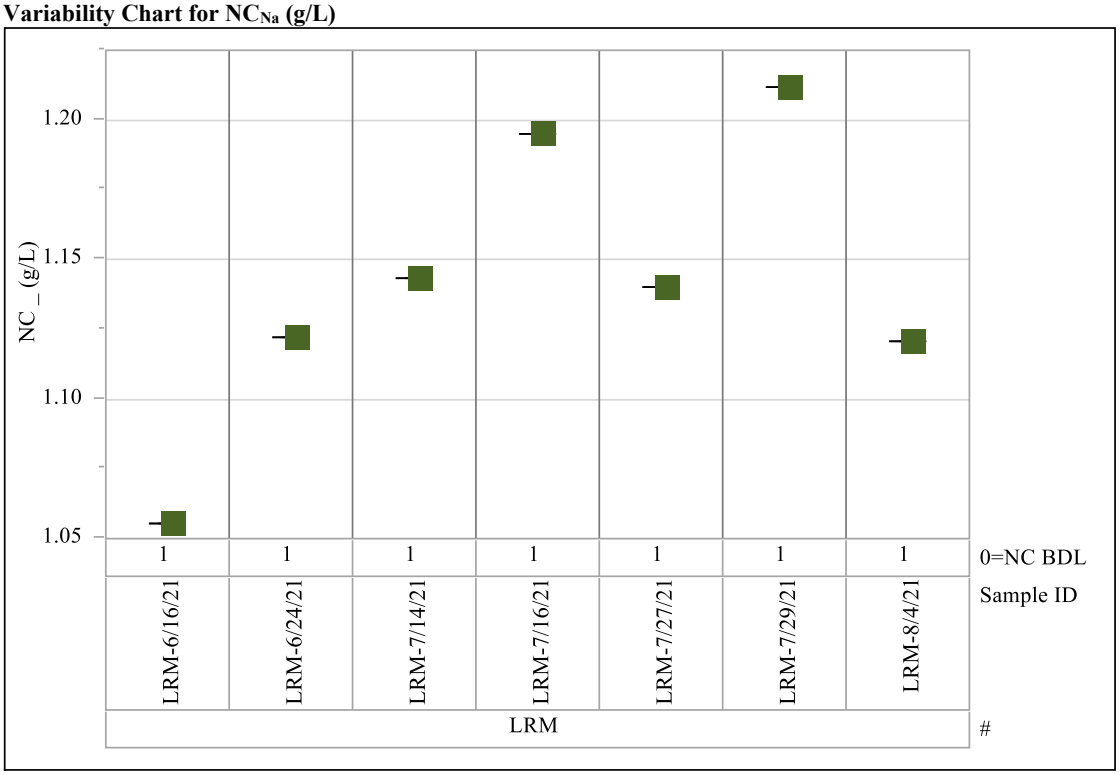
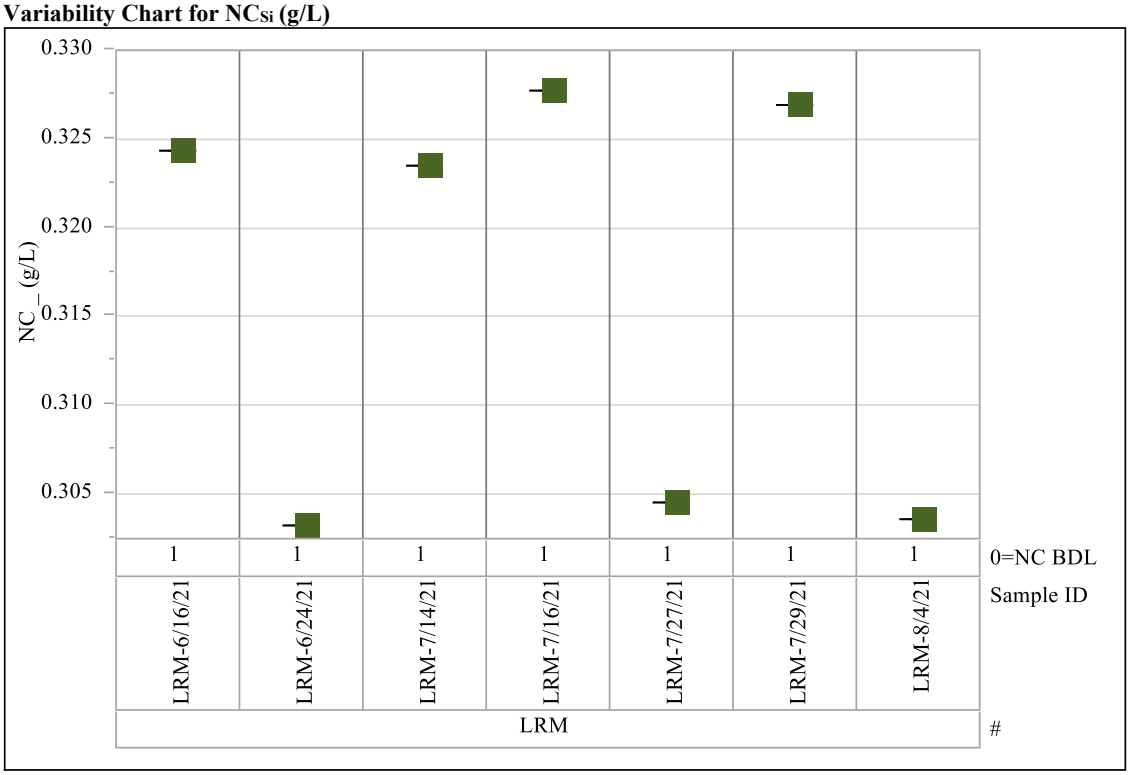


**Exhibit B-2. Normalized PCT Results for the LRM Samples (continued)**

**Variability Chart for $NC_{Si}$ (g/L)**



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