



April 22, 2015

Ms. Laurie Kauffman  
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Division of Nuclear Material Safety  
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**SUBJECT: INDEPENDENT CONFIRMATORY SURVEY RESULTS FOR THE  
UTILITY TRENCH CHARACTERIZATION, UNITED NUCLEAR  
CORPORATION NAVAL PRODUCTS SITE,  
NEW HAVEN, CONNECTICUT (RFTA 14-004)  
DCN: 2040-SR-04-0**

Dear Ms. Kauffman:

Oak Ridge Associated Universities (ORAU), operating under the Oak Ridge Institute for Science and Education (ORISE) contract, is pleased to provide the enclosed final report that details the confirmatory survey activities that were performed at the United Nuclear Corporation Naval Products site in New Haven, Connecticut during the period October 20 through 22, 2014. Comments provided on the draft report have been incorporated.

Please contact me at 865.576.5073 or Erika Bailey at 865.576.6659 if you have any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Timothy J. Vitkus', is written over a horizontal line.

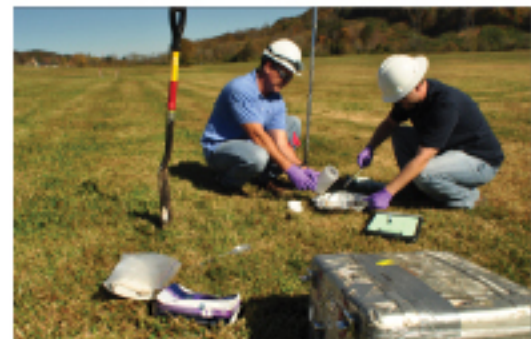
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# **INDEPENDENT CONFIRMATORY SURVEY RESULTS FOR THE UTILITY TRENCH CHARACTERIZATION, UNITED NUCLEAR CORPORATION NAVAL PRODUCTS SITE, NEW HAVEN, CONNECTICUT**

**Timothy J. Vitkus**

Prepared for the U.S. Nuclear Regulatory Commission

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Prepared by

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Prepared for the  
U.S. Nuclear Regulatory Commission

**FINAL REPORT**

**APRIL 2015**

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**INDEPENDENT CONFIRMATORY SURVEY RESULTS FOR THE  
UTILITY TRENCH CHARACTERIZATION,  
UNITED NUCLEAR CORPORATION NAVAL PRODUCTS SITE,  
NEW HAVEN, CONNECTICUT**

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**FINAL REPORT**

**APRIL 2015**



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## ACRONYMS

|                     |   |
|---------------------|---|
| AEC                 | Atomic Energy Commission  |
| cpm                 | counts per minute   |
| CsI                 | cesium iodide   |
| CSI                 | Cabrera Services, Inc.  |
| DCGL <sub>EMC</sub> | derived concentration guideline level elevated measurement comparison |
| DCGL <sub>W</sub>   | derived concentration guideline level                                 |
| DER                 | duplicate error ratio   |
| EU                  | enriched uranium  |
| GE                  | General Electric  |
| keV                 | kilo electron volt  |
| mrem/yr             | millirem per year   |
| NRC                 | U.S. Nuclear Regulatory Commission                                    |
| ORAU                | Oak Ridge Associated Universities                                     |
| ORISE               | Oak Ridge Institute for Science and Education                         |
| pCi/g               | picocuries per gram   |
| Q-Q                 | quantile-quantile   |
| ROC                 | radionuclide of concern   |
| RPD                 | relative percent difference   |
| RSS                 | ranked set sampling   |
| UNC                 | United Nuclear Corporation  |



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**INDEPENDENT CONFIRMATORY SURVEY RESULTS FOR THE  
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**1. INTRODUCTION**

United Nuclear Corporation (UNC) Naval Products fabricated fuel elements for the Naval Reactors Program at the New Haven, Connecticut, H-Tract facility from 1961 until 1976 under U.S. Nuclear Regulatory Commission (NRC) Docket No. 70-371, License No. SNM-368. This license authorized UNC to possess and use enriched uranium (EU) and later source material—including natural uranium, depleted uranium, and thorium—for research and nuclear fuel fabrication. The primary fuel fabrication, chemistry, and assembly operations were performed within Buildings 3H and 6H. Once facility operations ceased, the radioactive material inventory was transferred from the New Haven location to the UNC Montville, Connecticut facility. UNC performed final status surveys and the license was amended in April 1976 to remove the New Haven facility. The UNC license was terminated on June 8, 1994, following decommissioning activities at the Montville facility.

The NRC initiated a program during the 1990s to ensure that facilities formerly licensed through the Atomic Energy Commission (AEC) and/or early NRC had been terminated in accordance with the NRC's current release criteria for unrestricted use. As part of this program, the UNC site was identified as a site that required additional review since final radiological survey records were either incomplete or inadequate (NRC 1981 and 1991). The additional review and subsequent site investigations identified residual EU contamination in certain subsurface/subfloor soil areas inside the building and inside a connected inactive sewer system (NRC 1996 and ORISE 1997).

General Electric Corporation acquired UNC (UNC/GE) and although they are no longer the site owner, UNC/GE agreed to proceed with site characterization and remediation of the residual contamination identified at the facility, with the goal of releasing the property and the surrounding area for unrestricted use. Cabrera Services, Inc. (CSI) is the current contractor performing remediation and final status survey activities. Most recently, CSI completed asbestos abatement and remediation of the utility trenches present in Buildings 3H and 6H. CSI also investigated the soil near several trench drain holes and identified contaminated soil beneath the base of the trenches that had resulted from water seepage. As a result, CSI developed and implemented a plan to characterize

the soils beneath the utility trenches to define soil areas requiring remediation and/or to provide sufficient data to demonstrate compliance with unrestricted release soil concentration limits. The characterization consisted of advancing systematic boreholes through the trench floor and collecting samples from the trench floor/soil interface to a depth of approximately three feet (0.9 meters). CSI extracted samples in one foot (0.3 meter) increments for laboratory analysis.

The NRC Region I Office requested that Oak Ridge Associated Universities (ORAU), operating under the Oak Ridge Institute for Science and Education (ORISE) contract, perform independent confirmatory investigations of the boreholes and to provide confirmatory analysis of sub-trench soil samples.

## **2. SITE DESCRIPTION**

The site is located at 71 Shelton Avenue in New Haven, Connecticut. Buildings 3H and 6H consist of a conjoined facility. Building 3H occupies the eastern one-third of the structure and 6H occupies the remaining western area. The structure itself is a large, one-story building subdivided into several high-bays on the northern side and multiple rooms along the south side (Figure A-1). The building is currently being used for storage of impounded vehicles and other miscellaneous materials. The utility trenches investigated during this survey are located along the north and south edges of the floor in both buildings. There is also a lateral trench connecting the north and south trenches (Figure A-2).

## **3. OBJECTIVES**

The objectives of the survey were to provide independent measurements and sample analyses for use by the NRC in determining the adequacy of the characterization of the soils underlying the utility trenches.

## **4. PROCEDURES**

ORAU performed confirmatory evaluations of the utility trench boreholes during the period of October 20 through 22, 2014. The survey was performed in accordance with the *ORAU Radiological*

*and Environmental Survey Procedures Manual* and the *ORAU Environmental Services and Radiation Training Quality Program Manual* (ORAU 2014a and 2014b).

#### **4.1 REFERENCE SYSTEM**

Confirmatory investigations were referenced to borehole identification numbers that CSI had assigned, the depth below grade, and the depth below the trench bottom. There were 63 boreholes associated with the three utility trench systems (north, south, and lateral trenches). Depth of the boreholes ranged from approximately 2.4 to 3.6 meters below grade. CSI referenced samples as either the one, two, or three foot depth below the trench bottom.

#### **4.2 GAMMA RADIATION SCANS/MEASUREMENTS**

ORAU performed gamma radiation scans over the full depth of 30 boreholes. Scans were performed using a Ludlum Model 44-159 cesium iodide (CsI) scintillation detector coupled to a Ludlum Model 2221 ratemeter-scaler with audible indication. Additionally, the ratemeter-scaler was coupled via serial port to a Trimble Recon datalogger to enable electronic capture of the scan data at one second intervals.

The maximum observed gamma radiation levels within the soil column depth of each borehole investigated was determined by the audible output and one minute static direct measurement results.

#### **4.3 CONFIRMATORY SAMPLE SELECTION AND ANALYSIS**

The static gamma radiation measurement results were used to randomly select CSI characterization samples for confirmatory analysis. A ranked set sampling (RSS) method was applied to the confirmatory gamma measurement data to select random samples for analysis. Additional borehole samples were also selected either judgmentally, based on RSS data, or randomly. Table B-1 provides these data.

### **5. SAMPLE ANALYSIS AND DATA INTERPRETATION**

CSI shipped the selected samples under chain-of-custody to the ORAU/ORISE Radiological and Environmental Analytical Laboratory in Oak Ridge, Tennessee for analysis. Sample analyses were

performed in accordance with the *ORAU Radiological and Environmental Analytical Laboratory Procedures Manual* (ORAU 2015). Samples were analyzed by solid-state gamma spectroscopy for U-235 and U-238 and by alpha spectroscopy for isotopic uranium, including U-234, U-235/236, and U-238. Analytical results were reported in units of picocuries per gram (pCi/g).

## **6. APPLICABLE SITE GUIDELINES**

The primary radionuclides of concern (ROCs) for the UNC facility are uranium isotopes (with associated uranium isotopic ratios characteristic of uranium enriched in the U-235 isotope) and the respective decay radionuclides. The derived concentration guideline level (DCGL<sub>w</sub>) was developed to comply with the state of Connecticut's 19 millirem per year (mrem/yr) site release criterion, which is lower than the NRC's dose limit of 25 mrem/yr (UNC 2013). The average residual total uranium concentrations in soil must be less than the DCGL<sub>w</sub> of 435 pCi/g.

## **7. FINDINGS AND RESULTS**

The results for each of the verification activities are discussed below.

### **7.1 DOCUMENT REVIEW**

The ORAU review of the UNC characterization plan determined that the number of borehole locations required to estimate the mean/median ROC concentration was developed appropriately based on available existing data inputs. The determination of locations, which was based on a random-start point/systematic design, was also appropriate. The results for the review of the characterization sample analytical data comparisons are provided under the Confirmatory Analysis section of this report.

### **7.2 BOREHOLE GAMMA SCANS AND STATIC MEASUREMENTS**

The gamma scan data, in counts per minute (cpm), for each borehole independently scanned are provided via quantile-quantile (Q-Q) plots in Figures A-4 through A-13. The Q-Q plots include the data for contiguous boreholes plotted together with a gamma background data set. The borehole data show a step function where the gamma count rates in the lower-left quadrant of the plot

represent the observed gamma counts of the borehole sleeve that was in the trench air space above the trench floor. The upper right quadrant represents data collected below the ground surface of the trench. Boreholes 45 and 61 exhibited the highest count rates observed. The static gamma measurement data, representing the maximum observed direct radiation location observed in each borehole are provided in Table B-1 and shown in Figure A-3. Boreholes 45 and 61 also exhibited the maximum static measurement results at 4,100 and 2,400 cpm respectively.

### 7.3 CONFIRMATORY ANALYSIS RESULTS

Table B-2 provides the consolidated gamma spectroscopy data and comparison with the CSI results for U-235 and U-238. Table B-3 provides the alpha spectroscopy results, which are also summarized in Table 7.1.

| Table 7.1. Isotopic Uranium Concentration Ranges (pCi/g)<br>by Alpha Spectroscopy |               |               |               |
|---|---------------|---------------|---------------|
| U-234   | U-235         | U-238         | Total Uranium |
| 0.33 to 690   | 0.099 to 25.1 | 0.343 to 2.15 | 0.69 to 720   |
| Average Concentration   |               |               |               |
| 28.6  | 1.09          | 0.60          | 30.3          |

The confirmatory sample analysis results were evaluated via multiple steps as discussed in the following sections.

#### 7.3.1 Duplicate Error Ratio

The initial step of the confirmatory analysis evaluation was the comparison of results for the same samples using the duplicate error ratio (DER) method. The DER may be used in lieu of the relative percent difference (RPD) for duplicate analyses that include both a result and the associated one-sigma analytical error. A  $DER \leq 3$  indicates that, at a 99% confidence interval, the sample results do not differ significantly when compared to their respective one standard deviation (sigma) uncertainty (ANSI N42.22). The DER is calculated using the following equation:

$$DER = \frac{|O - C|}{\sqrt{(U_o^2 + U_c^2)}}$$

Where:

O = ORAU sample result

C = CSI sample result

$U_o$  = ORAU sample one sigma uncertainty

$U_c$  = CSI sample one sigma uncertainty

Of the 66 gamma spectroscopy results (U-235 and U-238 for each sample) available for DER evaluation, only 4 DERs could be appropriately calculated with the CSI-provided data, as most results were reported as the minimum detectable concentration without an uncertainty. Three of the four calculations resulted in a DER of >3. Further examination of the gamma spectroscopy data without the associated uncertainty suggested a probable CSI analytical bias. The bias was most apparent when the results for ORAU sample 2040S0063 (CSI sample UNC-CHA-45-1) were compared—the confirmatory U-238 result of 0.42 pCi/g vs. the CSI result of 14.19 pCi/g. The confirmatory alpha spectroscopy U-238 result for this sample was  $2.15 \pm 0.92$ , verifying the bias. Per correspondence with CSI, the 93 kilo electron volt (keV) photopeak from the U-238 progeny, Th-234, was used to quantify U-238. The 93 keV photopeak is encumbered by similar energy x-rays emitted by U-235, and when elevated U-235 concentrations are present—25.1 pCi/g in this sample—the U-238 concentration will be biased high due to the additional counts in the 93 keV region of interest.

### 7.3.2 Relative Percent Difference

As only 6% of the analytical results could be compared via the DER method, the results for the total uranium concentrations in samples were evaluated by calculating the RPD. CSI calculated the total uranium based on the gamma spectroscopy results via the following equation where the concentration of U-234 is a calculated amount based on U-234 to U-235 ratio of 27:1:

$$\text{Total Uranium} = [\text{U-235}] + 27*[\text{U-235}] + [\text{U-238}]$$

For direct RPD comparison, the confirmatory gamma spectroscopy results were used to calculate the total uranium concentrations using the same formula. The RPDs were calculated as follows and are provided in Table 7.2.

$$\text{RPD} = \frac{|\text{O}-\text{C}|}{\frac{\text{O}+\text{C}}{2}} \times 100$$

Where:

O = ORAU total-U concentration

C = CSI total-U concentration

**Table 7.2. Total Uranium Relative Percent Difference**

| Sample IDs                 | ORAU/CSI<br>Total-U<br>(pCi/g) | Total<br>Uranium<br>RPD (%) | Sample IDs                 | ORAU/CSI<br>Total-U<br>(pCi/g) | Total<br>Uranium<br>RPD (%) |
|----------------------------|--------------------------------|-----------------------------|----------------------------|--------------------------------|-----------------------------|
| 2040S0048/<br>UNC-CHA-56-1 | 51.82/5.65                     | 150.4                       | 2040S0065/<br>UNC-CHA-45-3 | 2.17/5.5                       | 77                          |
| 2040S0049/<br>UNC-CHA-56-2 | 5.46/5.54                      | 31.6                        | 2040S0066/<br>UNC-CHA-6-1  | 0.91/7.87                      | 162.3                       |
| 2040S0050/<br>UNC-CHA-56-3 | 3.39/5.98                      | 84.1                        | 2040S0067/<br>UNC-CHA-6-2  | 0.86/8.06                      | 153.9                       |
| 2040S0051/<br>UNC-CHA-36-1 | 0.95/7.49                      | 211                         | 2040S0068/<br>UNC-CHA-6-3  | 0.89/8.21                      | 124.2                       |
| 2040S0052/<br>UNC-CHA-36-2 | 1.01/7.64                      | 105                         | 2040S0069/<br>UNC-CHA-32-1 | 0.86/5.81                      | 95.7                        |
| 2040S0053/<br>UNC-CHA-36-3 | 1/7.42                         | 151.7                       | 2040S0070/<br>UNC-CHA-32-2 | 0.79/5.54                      | 87.4                        |
| 2040S0054/<br>UNC-CHA-61-1 | 165.73/77.71                   | 57.2                        | 2040S0071/<br>UNC-CHA-32-3 | 0.73/5.77                      | 229.8                       |
| 2040S0055/<br>UNC-CHA-61-2 | 8.69/5.56                      | 6.1                         | 2040S0072/<br>UNC-CHA-47-1 | 1.35/5.31                      | 106.9                       |
| 2040S0056/<br>UNC-CHA-61-3 | 1.32/6.03                      | 88.5                        | 2040S0073/<br>UNC-CHA-47-2 | 1.19/5.72                      | 176.3                       |
| 2040S0057/<br>UNC-CHA-2-1  | 1.08/7.09                      | 154.9                       | 2040S0074/<br>UNC-CHA-47-3 | 0.83/5.8                       | 96.3                        |
| 2040S0058/<br>UNC-CHA-2-2  | 1.3/7.49                       | 86.2                        | 2040S0075/<br>UNC-CHA-14-1 | 1.95/1.7                       | 81.3                        |
| 2040S0059/<br>UNC-CHA-2-3  | 2.42/7.34                      | 141                         | 2040S0076/<br>UNC-CHA-14-2 | 1.07/6.1                       | 103.9                       |
| 2040S0060/<br>UNC-CHA-50-1 | 1.37/3.05                      | 442.1                       | 2040S0077/<br>UNC-CHA-14-3 | 0.96/5.51                      | 78.3                        |
| 2040S0061/<br>UNC-CHA-50-2 | 1.48/5.68                      | 74.1                        | 2040S0078/<br>UNC-CHA-43-1 | 2.91/5.43                      | 85                          |



**Table 7.2. Total Uranium Relative Percent Difference**

| Sample IDs                 | ORAU/CSI<br>Total-U<br>(pCi/g) | Total<br>Uranium<br>RPD (%) | Sample IDs                 | ORAU/CSI<br>Total-U<br>(pCi/g) | Total<br>Uranium<br>RPD (%) |
|----------------------------|--------------------------------|-----------------------------|----------------------------|--------------------------------|-----------------------------|
| 2040S0062/<br>UNC-CHA-50-3 | 0.69/5.43                      | 223.4                       | 2040S0079/<br>UNC-CHA-43-2 | 2.24/2.81                      | 25.7                        |
| 2040S0063/<br>UNC-CHA-45-1 | 714.68/320.55                  | 62.9                        | 2040S0080/<br>UNC-CHA-43-3 | 1.67/5.65                      | 113                         |
| 2040S0064/<br>UNC-CHA-45-2 | 15.25/5.32                     | 134.1                       | <b>Average RPD</b>         |                                | <b>121</b>                  |

RPDs between less than 25% are considered acceptable for duplicate analyses as a measure of precision (DoD/DOE 2013). Two of the 33 RPDs were within this acceptance criterion.

### 7.3.3 Two-Sample Wilcoxon Mann-Whitney Hypothesis Test

The final data evaluation process applied the Two-Sample Wilcoxon Mann-Whitney test. The two-sided test form was selected at the 95% confidence interval. The null hypothesis ( $H_0$ ) was stated as follows:

$$H_0: \text{CSI total-U mean/median} = \text{ORAU total-U mean/median}$$

The alternative hypothesis ( $H_A$ ) was stated as follows:

$$H_A = \text{CSI total-U mean/median} < \text{or} > \text{ORAU total-U mean/median}$$

The total uranium data were input into ProUCL v.5.0.00.  $H_0$  was rejected in favor of  $H_A$ , a conclusion that the results are not comparable (Figure A-14).

## 8. COMPARISON OF RESULTS WITH GUIDELINES

The confirmatory sample results were directly compared with the total uranium DCGL<sub>w</sub> of 435 pCi/g. The total uranium concentration of 720 pCi/g in sample 2040S0063 exceeded the DCGL<sub>w</sub>. This sample represented the 0 to 30 cm soil depth in Borehole 45 which was located in the eastern portion of the South Trench, adjacent to Column 42. UNC has not developed DCGLs for elevated measurement comparisons (DCGL<sub>EMC</sub>). All remaining confirmatory soil concentrations were less than the DCGL<sub>w</sub>.

## 9. SUMMARY

At NRC's request, ORAU conducted confirmatory borehole investigations beneath the utility trenches located in Buildings 3H and 6H at the UNC site in New Haven, Connecticut. The on-site activities were performed October 20 through 22, 2014. The survey activities included visual inspections and independent gamma radiation scans and measurements. The results of the independent measurements were then used to select for confirmatory analysis soil samples that CSI had collected and analyzed during the characterization of the sub-trench soils.

Based on the results of the confirmatory analyses, the total uranium concentrations are not considered comparable. The probable cause is likely the result of one or more positive and/or negative systematic biases in the CSI on-site analysis. Due to the results of the DER and RPD evaluations, it is ORAU's opinion that the CSI data should be considered semi-quantitative due to the large uncertainties in the reported results that ORAU identified.

Although ORAU concludes that the CSI data are semi-quantitative, the observed median total uranium concentration in the confirmatory samples was 1.3 pCi/g (Figure A-13), which is a small fraction of the  $DCGL_w$ . The CSI median for these samples was 5.77 pCi/g. However, at the time of this report, CSI has not provided an assessment of the final radiological status of the sub-trench soils for ORAU's independent evaluation. Additionally, the CSI results for all samples were reviewed to determine if there were additional borehole locations that could exceed the 435 pCi/g  $DCGL_w$ , based on total uranium activity underestimate factor of 2.2 observed in the confirmatory results for sample 2040S0063/UNC-CHA-45-1. One additional sample would exceed the  $DCGL_w$ ; sample UNC-CHA-61-1-core.



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**APPENDIX A**  
**FIGURES**



Figure A-1. UNC Site, 71 Shelton Ave., Showing Buildings 3H and 6H



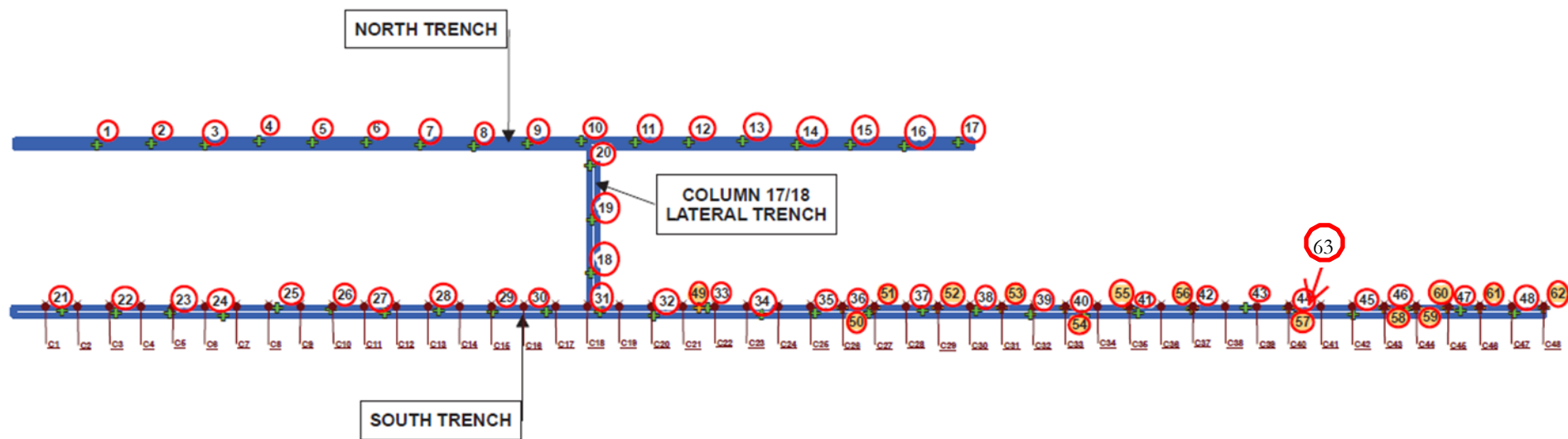


Figure A-2. South, Lateral, and North Trenches Showing CSI Borehole Number

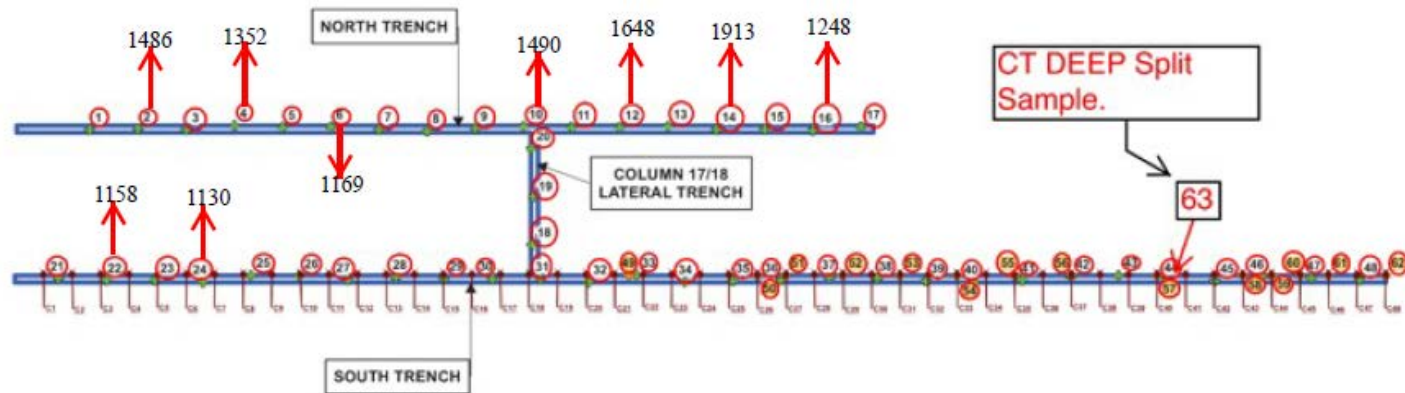
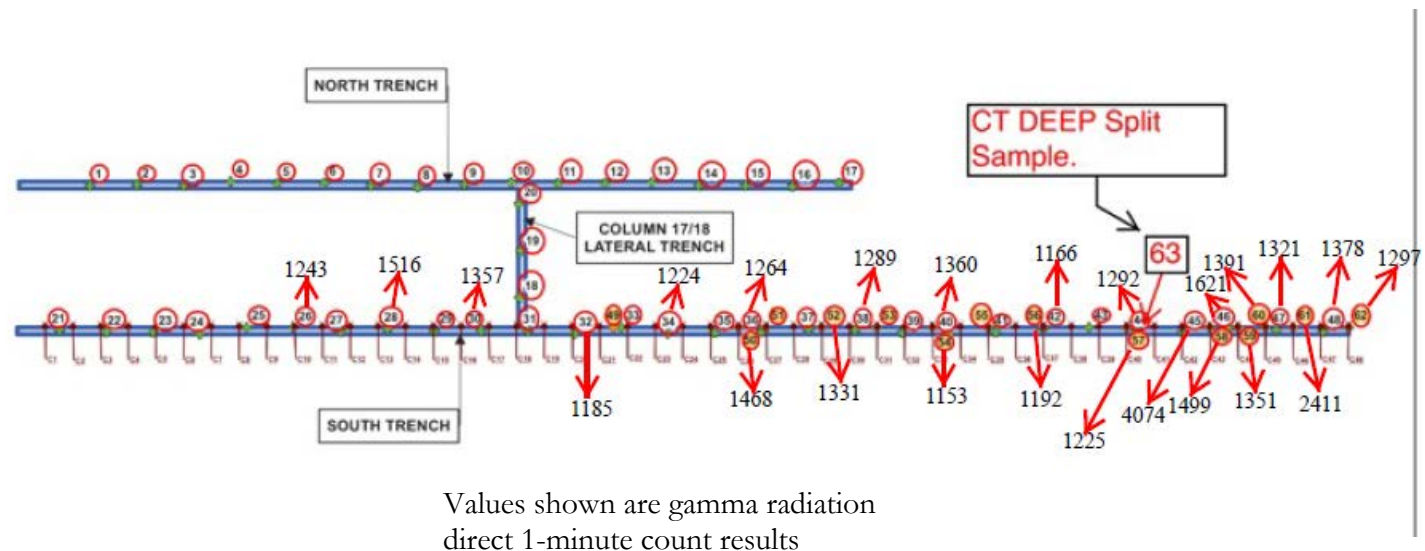
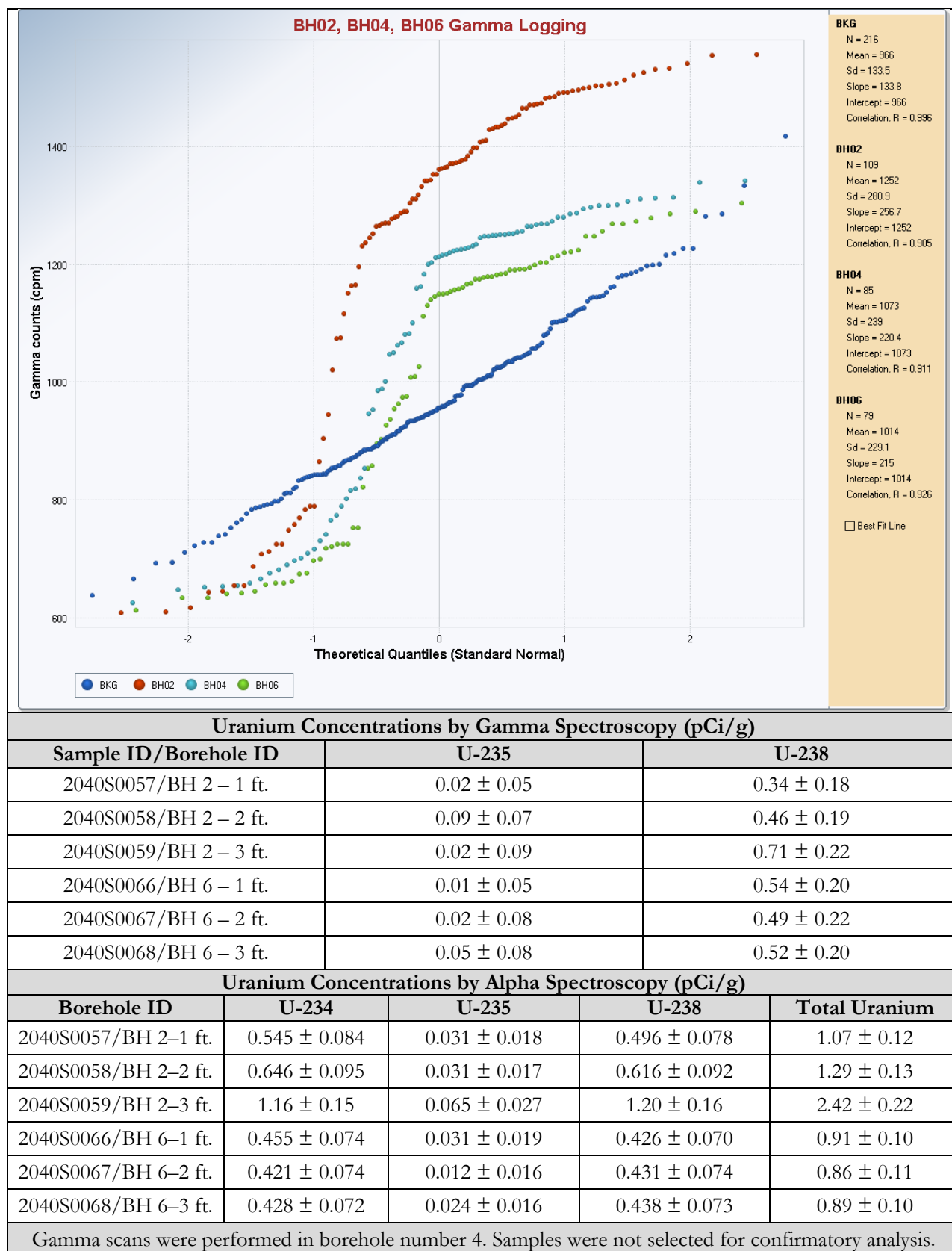
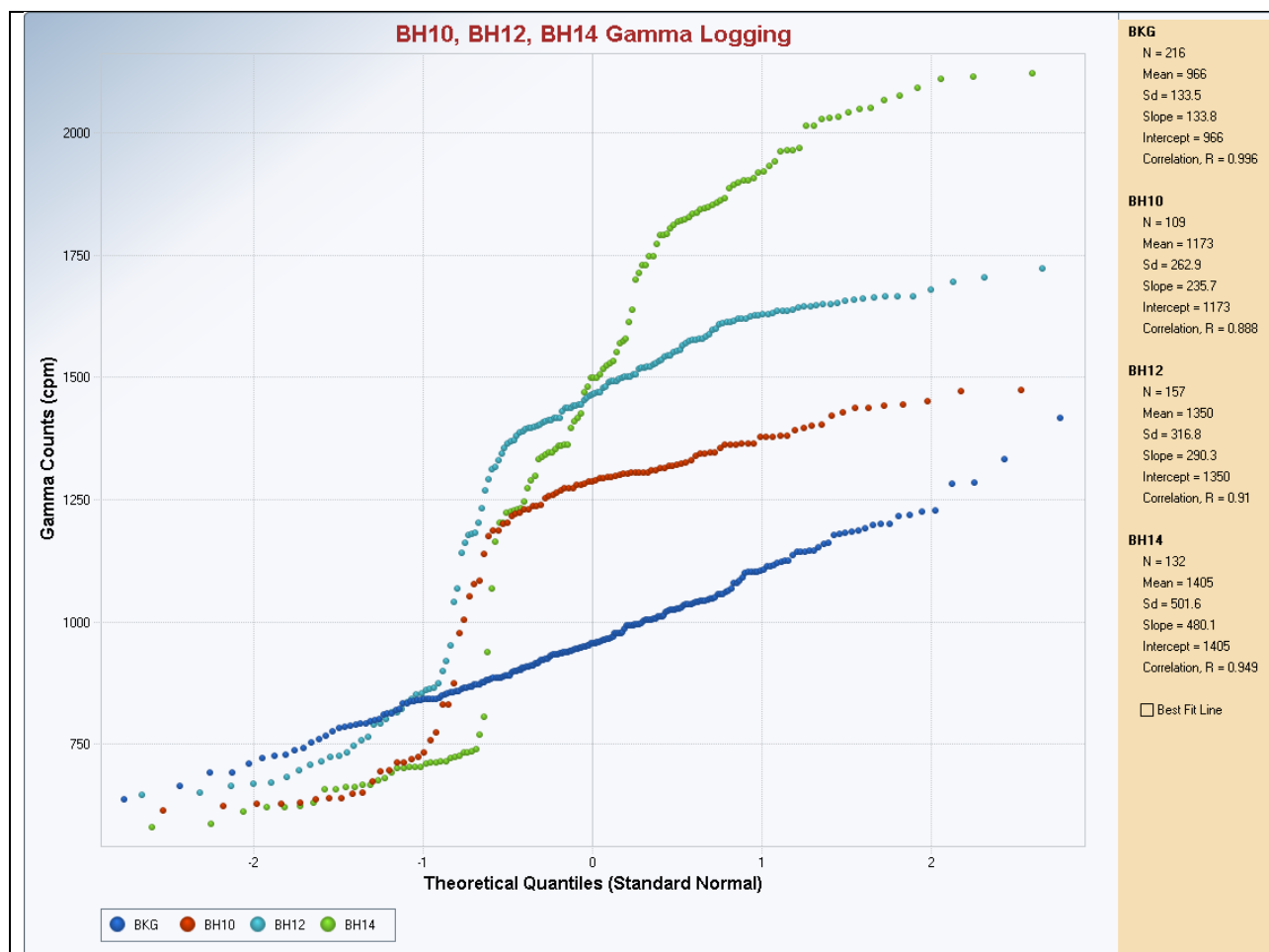


Figure A-3. Confirmatory Trench Evaluation Gamma Radiation Direct Measurement Results



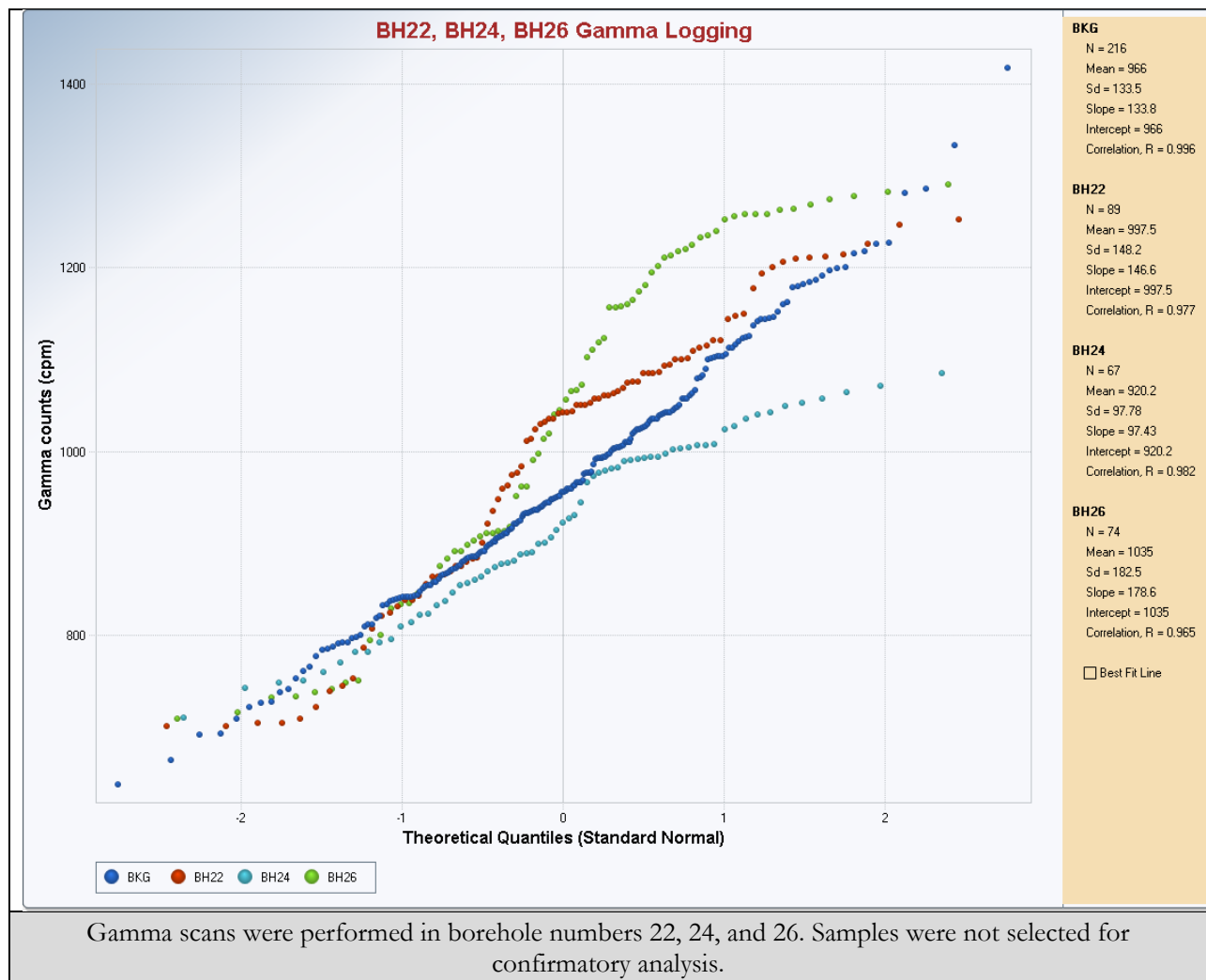
**Figure A-4. Boreholes 02, 04, and 06 Summary Data**



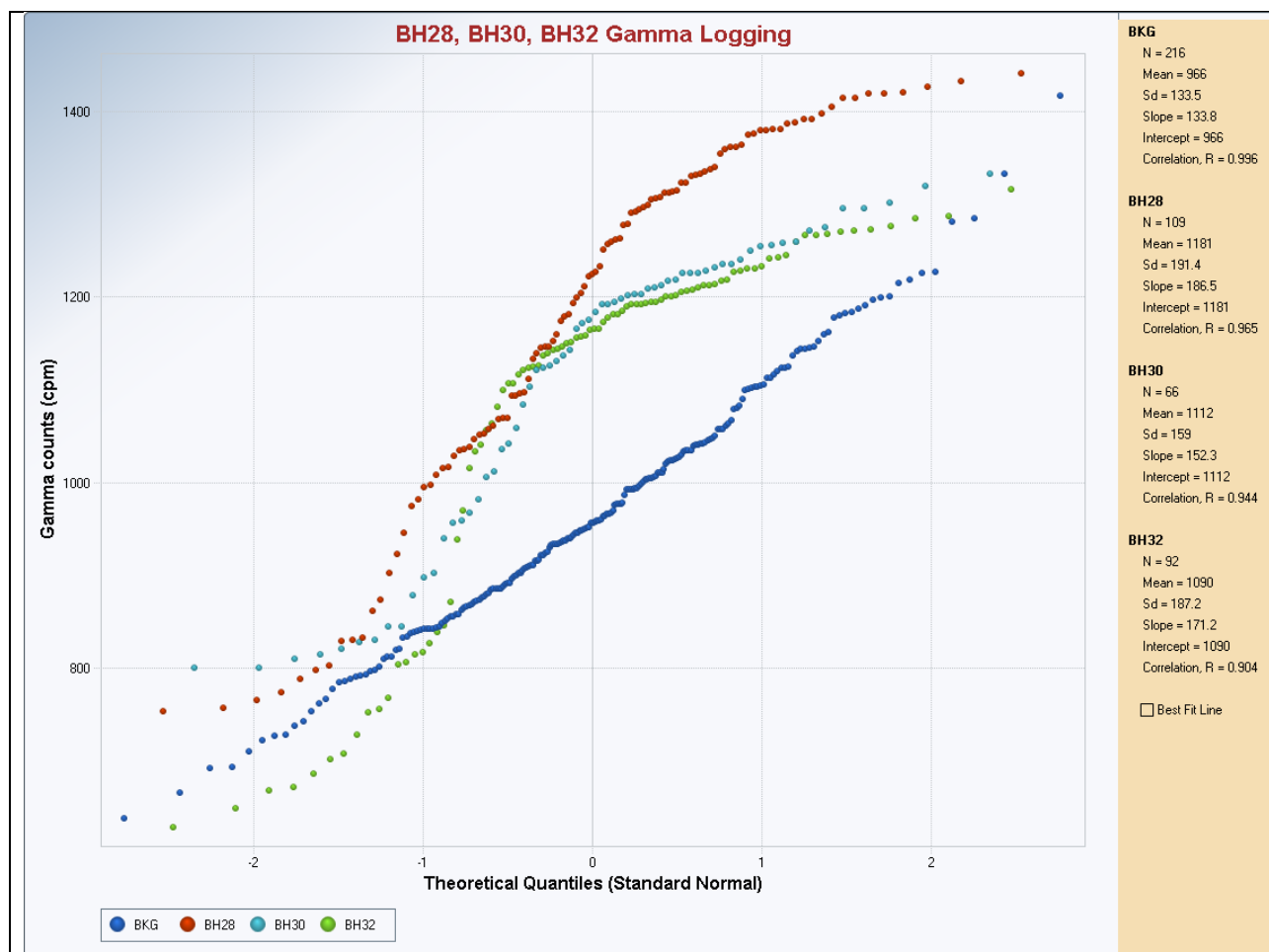


| Uranium Concentrations by Gamma Spectroscopy (pCi/g)   |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
| Borehole ID  |               | U-235         |               | U-238         |
| 2040S0075/BH 14 – 1 ft.  |               | 0.10 ± 0.11   |               | 1.23 ± 0.32   |
| 2040S0076/BH 14 – 2 ft.  |               | 0.05 ± 0.07   |               | 0.53 ± 0.19   |
| 2040S0077/BH 14 – 3 ft.  |               | 0.08 ± 0.05   |               | 0.17 ± 0.18   |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)  |               |               |               |               |
| Borehole ID  | U-234         | U-235         | U-238         | Total Uranium |
| 2040S0075/BH 14–1 ft.  | 1.09 ± 0.15   | 0.044 ± 0.021 | 0.82 ± 0.12   | 1.96 ± 0.19   |
| 2040S0076/BH 14–2 ft.  | 0.549 ± 0.080 | 0.019 ± 0.014 | 0.504 ± 0.075 | 1.07 ± 0.11   |
| 2040S0077/BH 14–3 ft.  | 0.441 ± 0.072 | 0.022 ± 0.014 | 0.495 ± 0.078 | 0.96 ± 0.11   |
| Gamma scans were performed in borehole numbers 10 and 12. Samples were not selected for confirmatory analysis. |               |               |               |               |

**Figure A-5. Boreholes 10, 12, and 14 Summary Data**

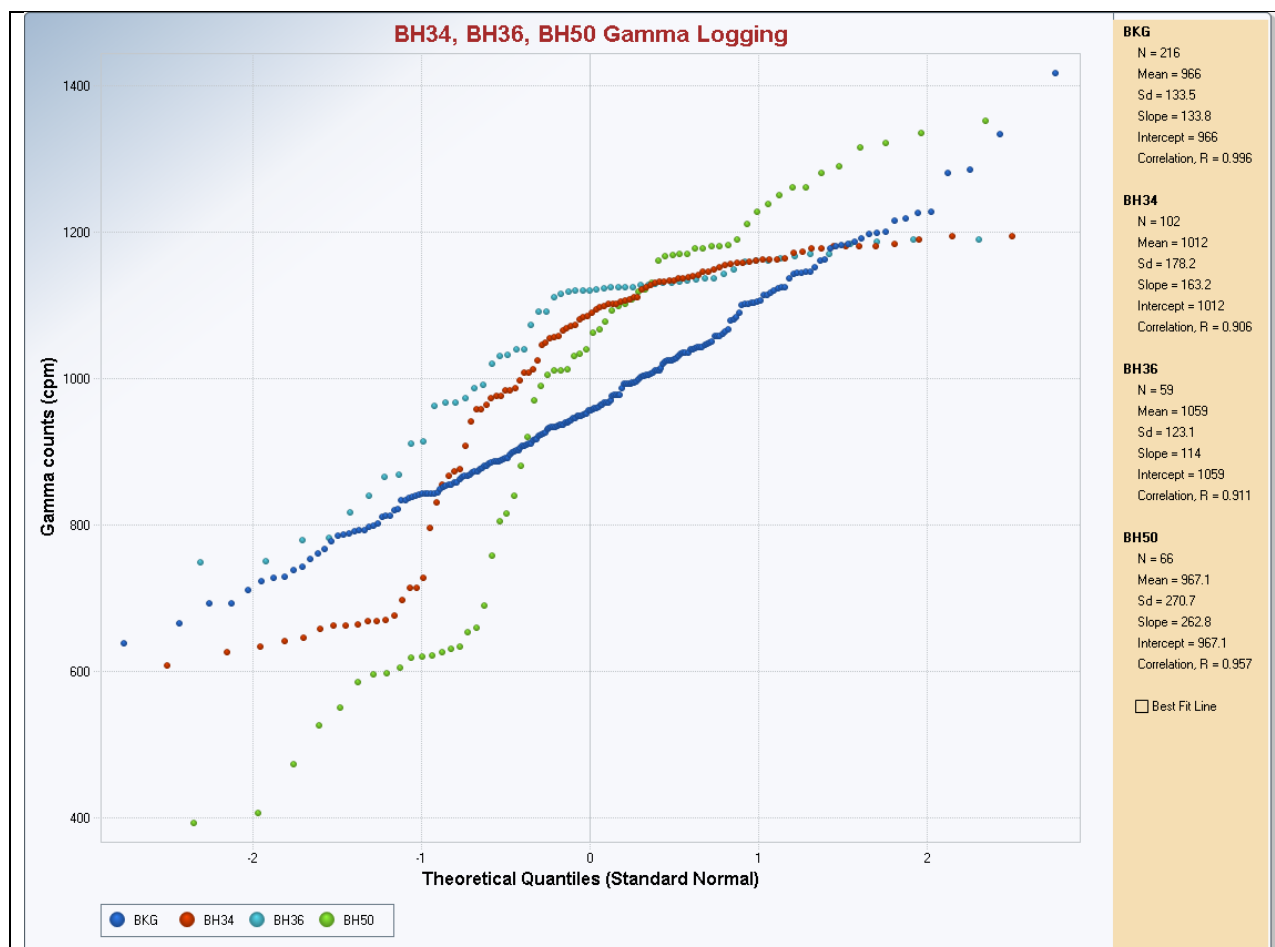


**Figure A-6. Boreholes 22, 24, and 26 Summary Data**



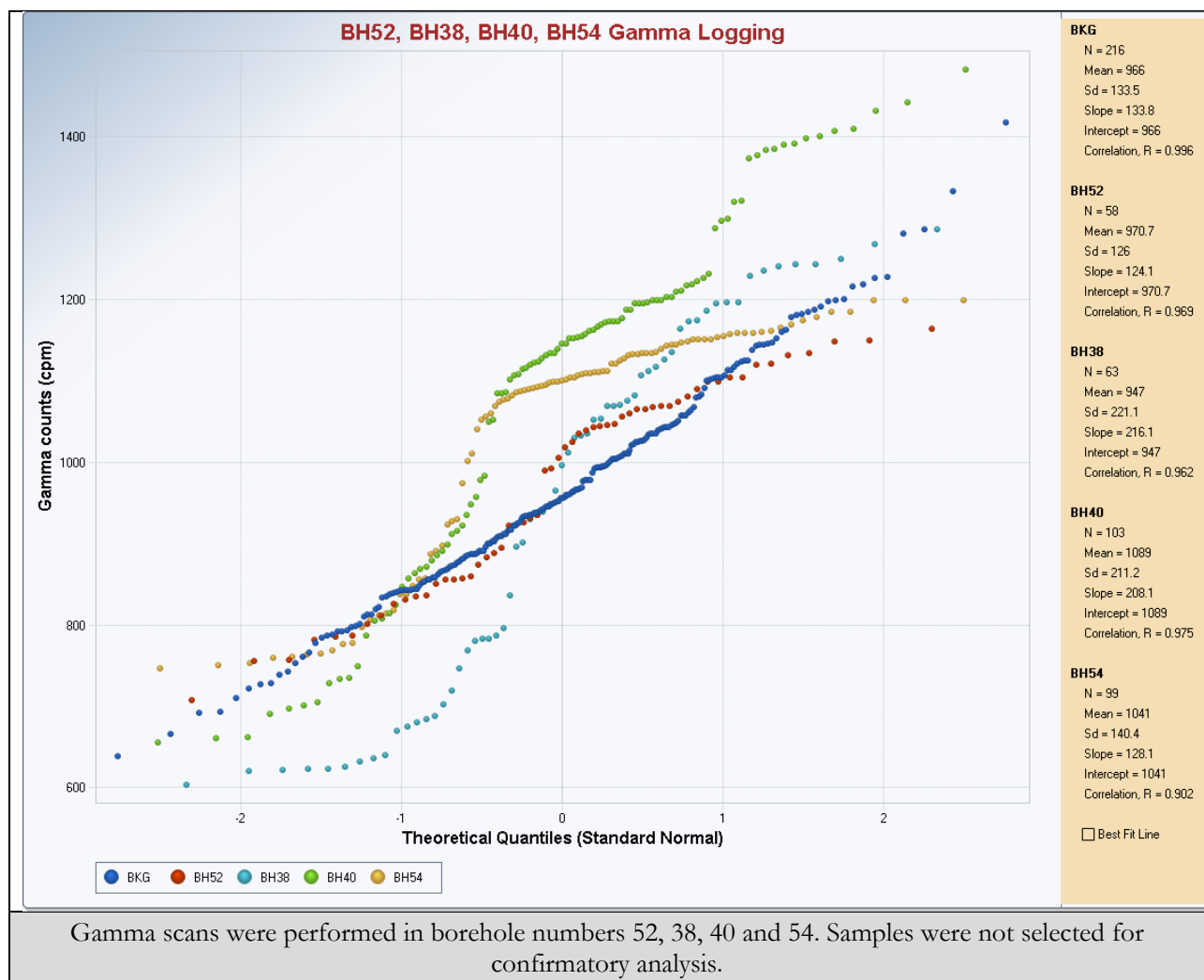
| Uranium Concentrations by Gamma Spectroscopy (pCi/g)   |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
| Borehole ID  | U-235         |               | U-238         |               |
| 2040S0069/BH 32 – 1 ft.  | 0.06 ± 0.07   |               | 0.37 ± 0.17   |               |
| 2040S0070/BH 32 – 2 ft.  | 0.06 ± 0.07   |               | 0.49 ± 0.19   |               |
| 2040S0071/BH 32 – 3 ft.  | -0.03 ± 0.06  |               | 0.44 ± 0.17   |               |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)  |               |               |               |               |
| Borehole ID  | U-234         | U-235         | U-238         | Total Uranium |
| 2040S0069/BH 32–1 ft.  | 0.454 ± 0.071 | 0.014 ± 0.012 | 0.401 ± 0.065 | 0.87 ± 0.10   |
| 2040S0070/BH 32–2 ft.  | 0.395 ± 0.066 | 0.024 ± 0.016 | 0.371 ± 0.063 | 0.790 ± 0.093 |
| 2040S0071/BH 32–3 ft.  | 0.356 ± 0.063 | 0.011 ± 0.012 | 0.362 ± 0.063 | 0.730 ± 0.090 |
| Gamma scans were performed in borehole numbers 28 and 30. Samples were not selected for confirmatory analysis. |               |               |               |               |

**Figure A-7. Boreholes 28, 30, and 32 Summary Data**

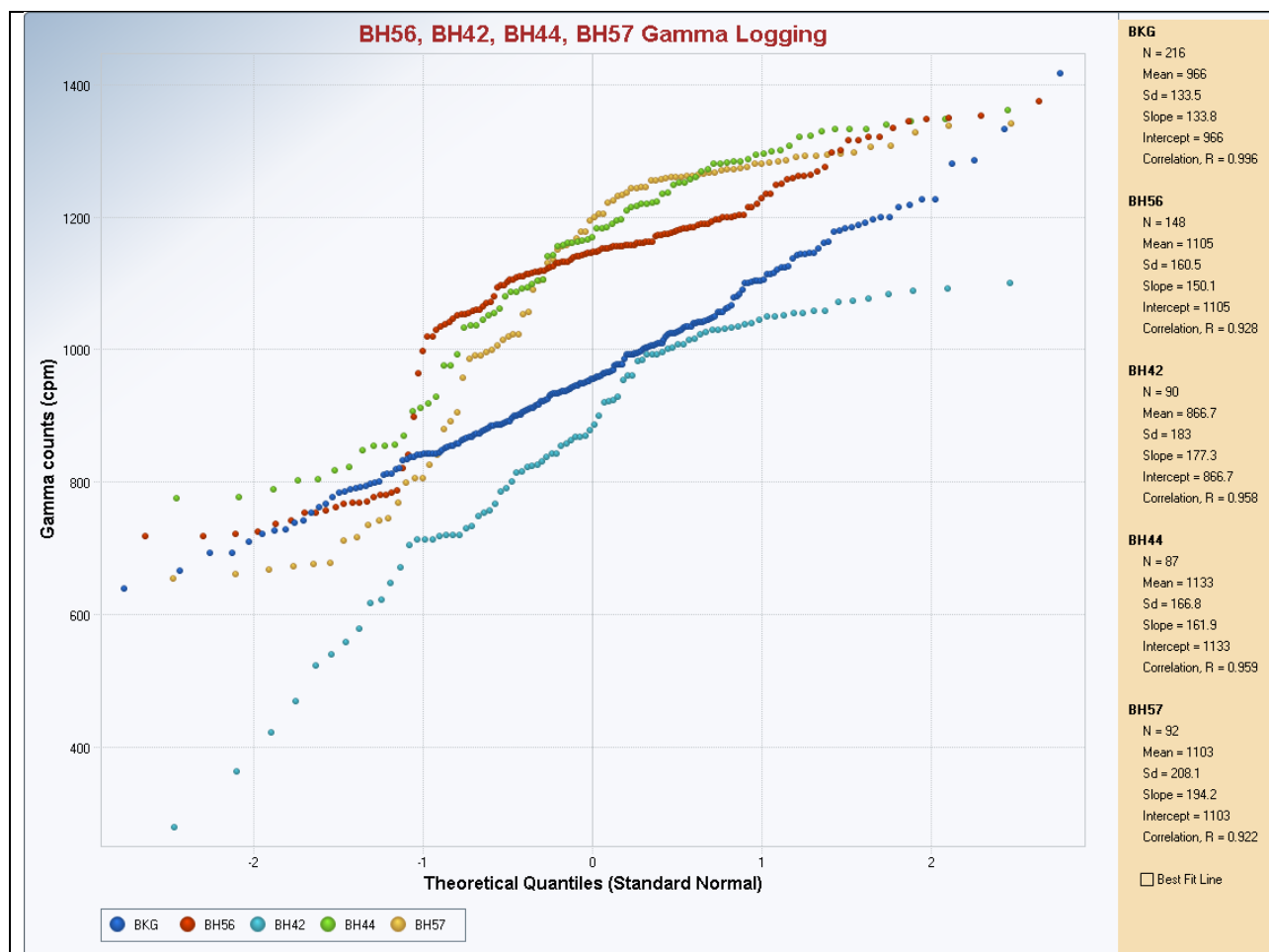


| Uranium Concentrations by Gamma Spectroscopy (pCi/g)   |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
| Borehole ID  |               | U-235         | U-238         |               |
| 2040S0051/BH 36 – 1 ft.  |               | -0.02 ± 0.07  | 0.36 ± 0.18   |               |
| 2040S0052/BH 36– 2 ft.   |               | 0.07 ± 0.04   | 0.42 ± 0.16   |               |
| 2040S0053/BH 36 – 3 ft.  |               | 0.02 ± 0.04   | 0.46 ± 0.16   |               |
| 2040S0060/BH 50 – 1 ft.  |               | -0.06 ± 0.07  | 0.53 ± 0.16   |               |
| 2040S0061/BH 50– 2 ft.   |               | 0.08 ± 0.07   | 0.37 ± 0.17   |               |
| 2040S0062/BH 50 – 3 ft.  |               | -0.02 ± 0.07  | 0.26 ± 0.18   |               |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)  |               |               |               |               |
| Borehole ID  | U-234         | U-235         | U-238         | Total Uranium |
| 2040S0051/BH 36–1 ft.  | 0.507 ± 0.078 | 0.014 ± 0.012 | 0.426 ± 0.068 | 0.95 ± 0.10   |
| 2040S0052/BH 36–2 ft.  | 0.455 ± 0.073 | 0.028 ± 0.017 | 0.517 ± 0.079 | 1.00 ± 0.11   |
| 2040S0053/BH 36–3 ft.  | 0.464 ± 0.076 | 0.025 ± 0.019 | 0.508 ± 0.081 | 1.00 ± 0.11   |
| 2040S0060/BH 50–1 ft.  | 0.69 ± 0.10   | 0.038 ± 0.018 | 0.637 ± 0.092 | 1.36 ± 0.14   |
| 2040S0061/BH 50–2 ft.  | 0.73 ± 0.11   | 0.027 ± 0.016 | 0.72 ± 0.10   | 1.47 ± 0.15   |
| 2040S0062/BH 50–3 ft.  | 0.33 ± 0.06   | 0.017 ± 0.014 | 0.343 ± 0.057 | 0.69 ± 0.08   |
| Gamma scans were performed in borehole number 34. Samples were not selected for confirmatory analysis. |               |               |               |               |

**Figure A-8. Boreholes 34, 36, and 50 Summary Data**

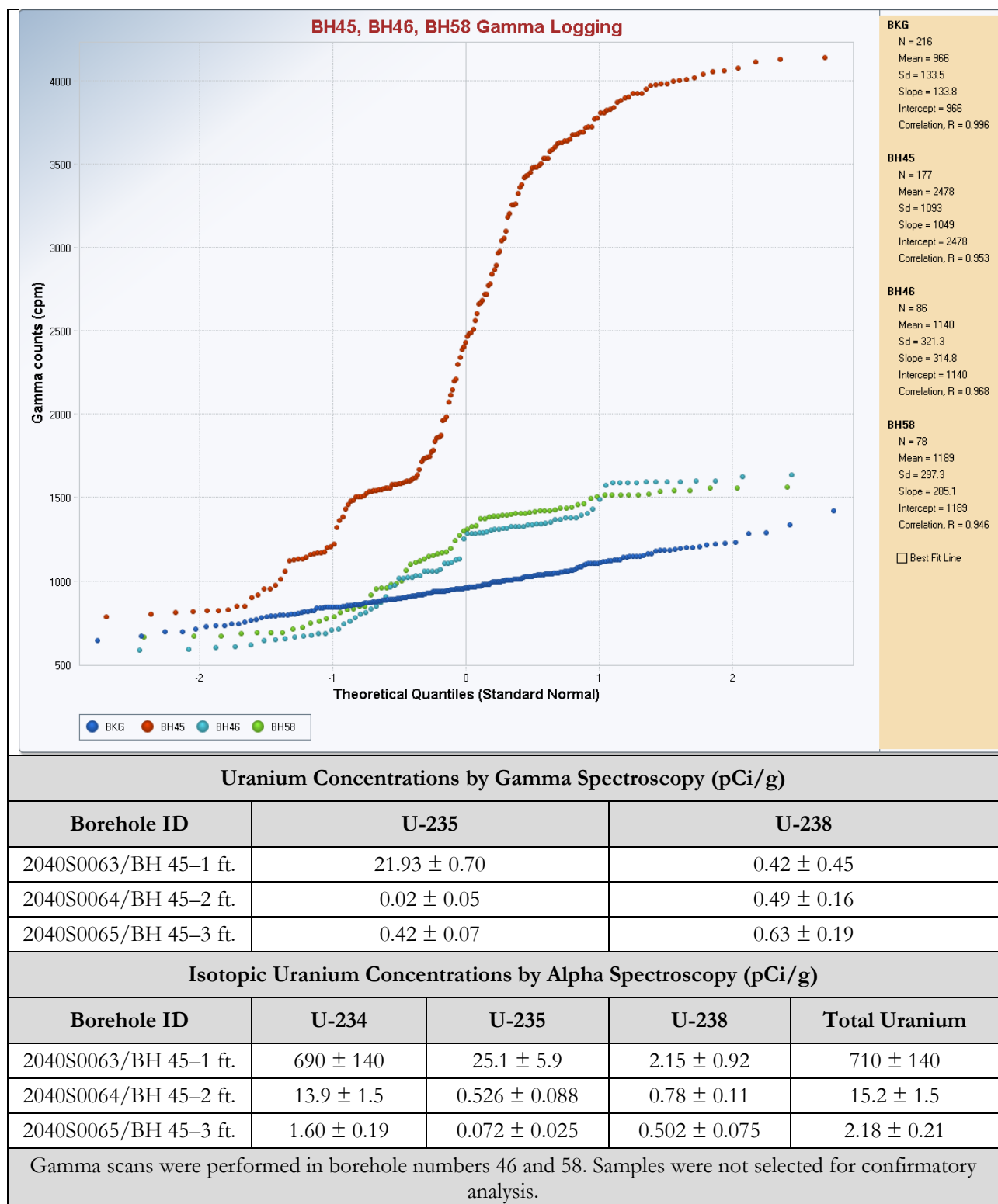


**Figure A-9. Boreholes 52, 38, 40, and 54 Summary Data**

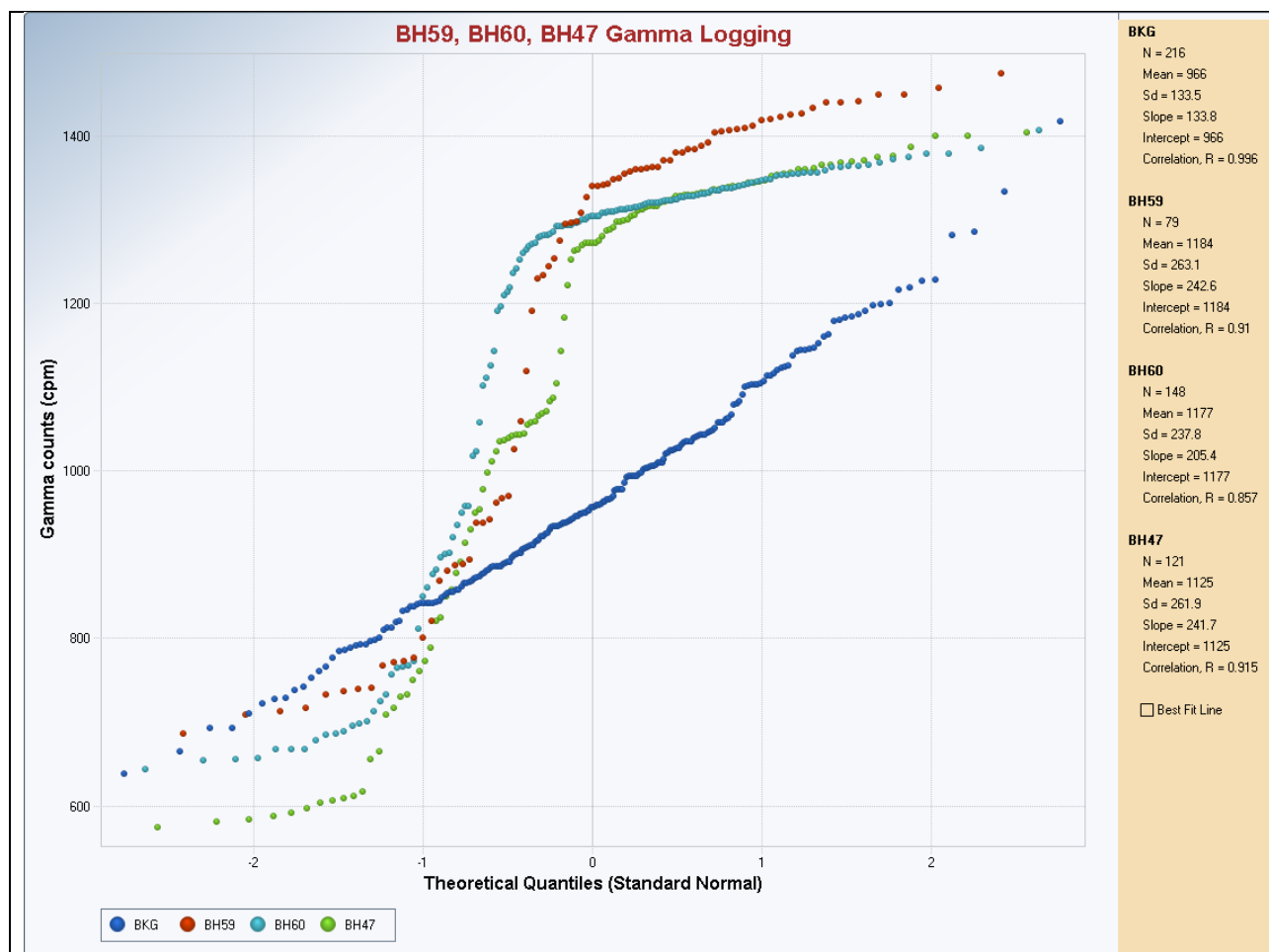


| Uranium Concentrations by Gamma Spectroscopy (pCi/g)  |             |               |               |               |
|---|-------------|---------------|---------------|---------------|
| Borehole ID   | U-235       |               | U-238         |               |
| 2040S0048/BH 56 – 1 ft.   | 1.41 ± 0.09 |               | 0.47 ± 0.22   |               |
| 2040S0049/BH 56– 2 ft.  | 0.13 ± 0.04 |               | 0.39 ± 0.17   |               |
| 2040S0050/BH 56 – 3 ft.   | 0.07 ± 0.04 |               | 0.48 ± 0.18   |               |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)   |             |               |               |               |
| Borehole ID   | U-234       | U-235         | U-238         | Total Uranium |
| 2040S0048/BH 56–1 ft.   | 49.4 ± 5.1  | 1.97 ± 0.23   | 0.426 ± 0.067 | 51.8 ± 5.1    |
| 2040S0049/BH 56–2 ft.   | 4.75 ± 0.52 | 0.166 ± 0.041 | 0.542 ± 0.082 | 5.45 ± 0.53   |
| 2040S0050/BH 56–3 ft.   | 2.74 ± 0.31 | 0.099 ± 0.029 | 0.555 ± 0.082 | 3.40 ± 0.32   |
| Gamma scans were performed in borehole numbers 42, 44, and 57. Samples were not selected for confirmatory analysis. |             |               |               |               |

**Figure A-10. Boreholes 56, 42, 44, and 57 Summary Data**



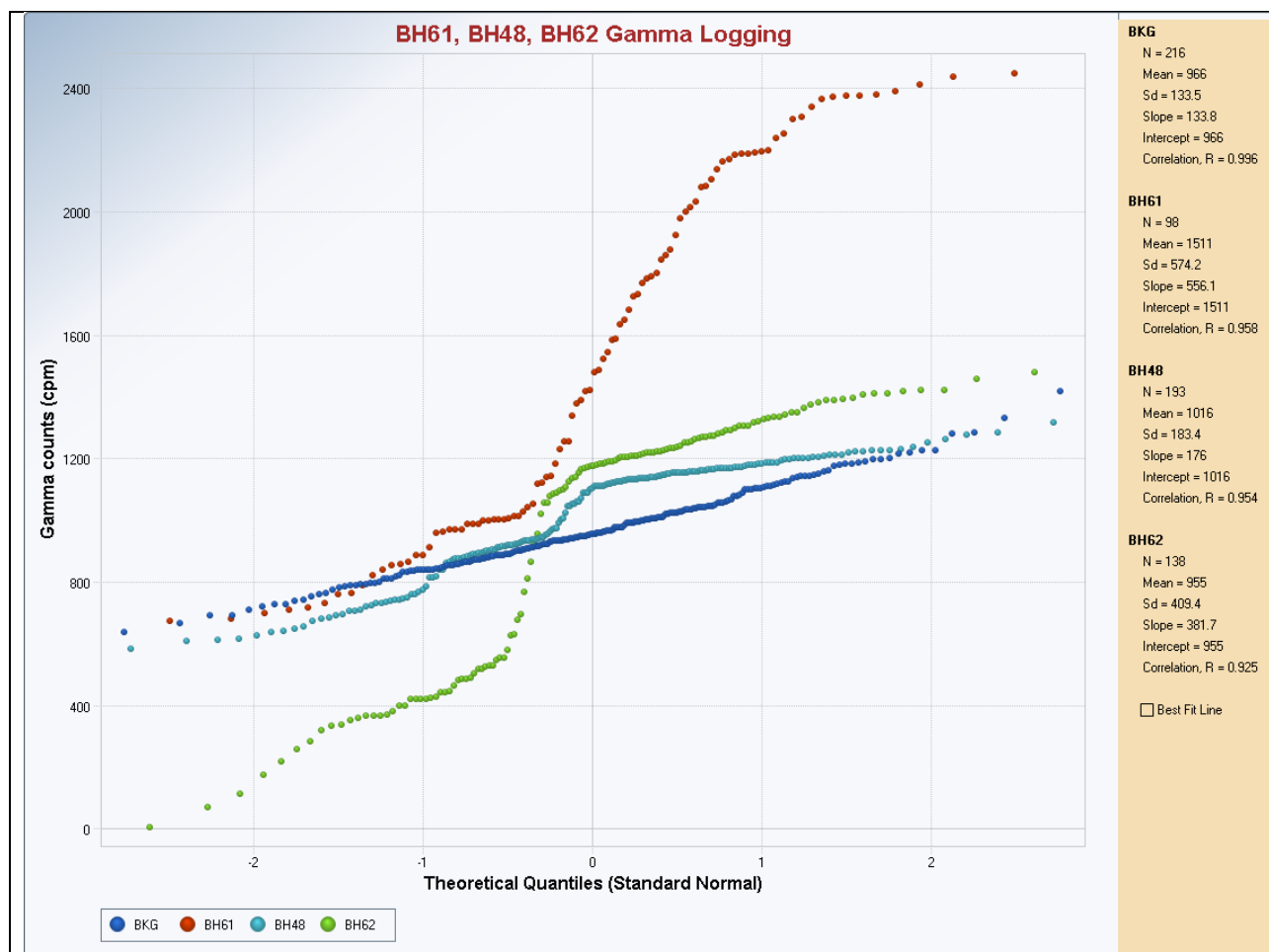
**Figure A-11. Boreholes 45, 46, and 58 Summary Data**



| Uranium Concentrations by Gamma Spectroscopy (pCi/g)   |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
| Borehole ID  | U-235         |               | U-238         |               |
| 2040S0072/BH 47-1 ft.  | 0.04 ± 0.07   |               | 0.49 ± 0.17   |               |
| 2040S0073/BH 47-2 ft.  | 0.00 ± 0.07   |               | 0.36 ± 0.17   |               |
| 2040S0074/BH 47-3 ft.  | 0.06 ± 0.04   |               | 0.35 ± 0.16   |               |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)  |               |               |               |               |
| Borehole ID  | U-234         | U-235         | U-238         | Total Uranium |
| 2040S0072/BH 47-1 ft.  | 0.83 ± 0.12   | 0.039 ± 0.019 | 0.478 ± 0.077 | 1.35 ± 0.14   |
| 2040S0073/BH 47-2 ft.  | 0.615 ± 0.093 | 0.042 ± 0.023 | 0.529 ± 0.083 | 1.19 ± 0.13   |
| 2040S0074/BH 47-3 ft.  | 0.376 ± 0.064 | 0.033 ± 0.017 | 0.418 ± 0.069 | 0.83 ± 0.10   |
| Gamma scans were performed in borehole numbers 59 and 60. Samples were not selected for confirmatory analysis. |               |               |               |               |

**Figure A-12. Boreholes 59, 60, and 47 Summary Data**





| Uranium Concentrations by Gamma Spectroscopy (pCi/g)   |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
| Borehole ID  | U-235         |               | U-238         |               |
| 2040S0054/BH 61–1 ft.  | 4.98 ± 0.18   |               | 0.45 ± 0.27   |               |
| 2040S0055/BH 61–2 ft.  | 0.19 ± 0.06   |               | 0.59 ± 0.19   |               |
| 2040S0056/BH 61–3 ft.  | 0.07 ± 0.05   |               | 0.37 ± 0.20   |               |
| Isotopic Uranium Concentrations by Alpha Spectroscopy (pCi/g)  |               |               |               |               |
| Borehole ID  | U-234         | U-235         | U-238         | Total Uranium |
| 2040S0054/BH 61–1 ft.  | 158 ± 16      | 6.77 ± 0.73   | 0.77 ± 0.11   | 166 ± 16      |
| 2040S0055/BH 61–2 ft.  | 7.47 ± 0.80   | 0.289 ± 0.059 | 0.93 ± 0.13   | 8.68 ± 0.82   |
| 2040S0056/BH 61–3 ft.  | 0.638 ± 0.092 | 0.051 ± 0.021 | 0.627 ± 0.090 | 1.31 ± 0.13   |
| Gamma scans were performed in borehole numbers 48 and 62. Samples were not selected for confirmatory analysis. |               |               |               |               |

**Figure A-13. Boreholes 61, 48, and 62 Summary Data**

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|--|--|---|--|--|--|--|--|--|--|--|--|--|--|
| Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs |  |   |  |  |  |  |  |  |  |  |  |  |  |
| User Selected Options  |  |   |  |  |  |  |  |  |  |  |  |  |  |
| Date/Time of Computation 1/30/2015 14:47   |  |   |  |  |  |  |  |  |  |  |  |  |  |
| From File  |  | WorkSheet.xls   |  |  |  |  |  |  |  |  |  |  |  |
| Full Precision   |  | OFF   |  |  |  |  |  |  |  |  |  |  |  |
| Confidence Coefficient 95%   |  |   |  |  |  |  |  |  |  |  |  |  |  |
| Substantial Difference 0   |  |   |  |  |  |  |  |  |  |  |  |  |  |
| Selected Null Hypothesis   |  | Sample 1 Mean/Median = Sample 2 Mean/Median (Two Sided Alternative) |  |  |  |  |  |  |  |  |  |  |  |
| Alternative Hypothesis   |  | Sample 1 Mean/Median <> Sample 2 Mean/Median                        |  |  |  |  |  |  |  |  |  |  |  |
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| Sample 1 Data: CSI Total-U   |  |   |  |  |  |  |  |  |  |  |  |  |  |
| Sample 2 Data: ORAU Total-U  |  |   |  |  |  |  |  |  |  |  |  |  |  |
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| Raw Statistics   |  |   |  |  |  |  |  |  |  |  |  |  |  |
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Figure A-14. Wilcoxon Mann-Whitney Test Results

**APPENDIX B**  
**TABLES**

| Table B-1. Borehole Gamma Static Gamma Measurements and RSS Results |                    |  |                          |                     |
|---|--------------------|--|--------------------------|---------------------|
| Borehole ID   | Gamma counts (cpm) | RSS ID   | RSS Ranking <sup>a</sup> | Sample ID           |
| BH16  | 1248               | 1-1-1  | 2                        | --                  |
| BH48  | 1378               | 1-1-2  | 3                        | --                  |
| BH60  | 1391               | 1-1-3  | 4                        | --                  |
| <b>BH56</b>   | <b>1192</b>        | <b>1-1-4</b>   | <b>1</b>                 | <b>2040S0048-50</b> |
|   |                    |  |                          |                     |
| <b>BH36</b>   | <b>1264</b>        | <b>1-2-1</b>   | <b>2</b>                 | <b>2040S0051-53</b> |
| BH38  | 1289               | 1-2-2  | 3                        | --                  |
| BH61  | 2411               | 1-2-3  | 4                        | (J) <sup>b</sup>    |
| BH54  | 1153               | 1-2-4  | 1                        | --                  |
|   |                    |  |                          |                     |
| <b>BH02</b>   | <b>1486</b>        | <b>1-3-1</b>   | <b>3</b>                 | <b>2040S0057-59</b> |
| BH57  | 1225               | 1-3-2  | 2                        | --                  |
| BH08  | MNC <sup>c</sup>   | 1-3-3  | 1                        | --                  |
| BH28  | 1516               | 1-3-4  | 4                        | --                  |
|   |                    |  |                          |                     |
| <b>BH50</b>   | <b>1468</b>        | <b>1-4-1</b>   | <b>4</b>                 | <b>2040S0060-62</b> |
| BH26  | 1243               | 1-4-2  | 1                        | --                  |
| BH62  | 1297               | 1-4-3  | 2                        | --                  |
| BH59  | 1351               | 1-4-4  | 3                        | --                  |
|   |                    |  |                          |                     |
| BH34  | 1224               | 2-1-1  | 2                        | --                  |
| BH45  | 4074               | 2-1-2  | 4                        | (J)                 |
| <b>BH06</b>   | <b>1169</b>        | <b>2-1-3</b>   | <b>1</b>                 | <b>2040S0066-68</b> |
| BH12  | 1648               | 2-1-4  | 3                        | --                  |
|   |                    |  |                          |                     |
| BH04  | 1352               | 2-2-1  | 3                        | --                  |
| BH24  | 1130               | 2-2-2  | 1                        | --                  |
| <b>BH32</b>   | <b>1185</b>        | <b>2-2-3</b>   | <b>2</b>                 | <b>2040S0069-71</b> |
| BH30  | 1357               | 2-2-4  | 4                        | --                  |
|   |                    |  |                          |                     |
| BH22  | 1158               | 2-3-1  | 1                        | --                  |
| <b>BH47</b>   | <b>1321</b>        | <b>2-3-2</b>   | <b>3</b>                 | <b>2040S0072-74</b> |
| BH58  | 1499               | 2-3-3  | 4                        | --                  |
| BH42  | 1166               | 2-3-4  | 2                        | --                  |
|   |                    |  |                          |                     |
| BH10  | 1490               | 2-4-1  | 2                        | --                  |
| BH52  | 1331               | 2-4-2  | 1                        | --                  |
| BH46  | 1621               | 2-4-3  | 3                        | --                  |
| <b>BH14</b>   | <b>1913</b>        | <b>2-4-4</b>   | <b>4</b>                 | <b>2040S0075-77</b> |
| BH40  | 1360               | Results were randomly excluded from the RSS population |                          | --                  |
| BH44  | 1292               |  |                          |                     |
| BH43  | Judgmental         |  |                          | 2040S0078-80        |
| BH45  | RSS Judgmental     |  |                          | 2040S0063-65        |
| BH61  | RSS Judgmental     |  |                          | 2040S0054-56        |

<sup>a</sup>Values 1–4 represent the gamma count ranking from lowest to highest.

<sup>b</sup>J = Location selected judgmentally for confirmatory analysis.

<sup>c</sup>MNC – measurement not collected

**Table B-2. Gamma Spectroscopy Confirmatory Results and Data Comparison**

| Sample ID |              | Borehole #/Depth | U-235 (pCi/g)            |              |      | U-238 (pCi/g) |             |     |
|-----------|--------------|------------------|--------------------------|--------------|------|---------------|-------------|-----|
|           |              |                  | ORAU                     | CSI          | DER  | ORAU          | CSI         | DER |
| 2040S0048 | UNC-CHA-56-1 | 56/1-ft          | 1.41 ± 0.09 <sup>a</sup> | 0 ± 0        | —    | 0.47 ± 0.22   | 5.65 ± 0    | —   |
| 2040S0049 | UNC-CHA-56-2 | 56/2-ft          | 0.13 ± 0.04              | 0 ± 0        | —    | 0.39 ± 0.17   | 5.54 ± 0    | —   |
| 2040S0050 | UNC-CHA-56-3 | 56/3-ft          | 0.07 ± 0.04              | 0 ± 0        | —    | 0.48 ± 0.18   | 5.98 ± 0    | —   |
| 2040S0051 | UNC-CHA-36-1 | 36/1-ft          | -0.02 ± 0.07             | 0 ± 0        | —    | 0.36 ± 0.18   | 7.49 ± 0    | —   |
| 2040S0052 | UNC-CHA-36-2 | 36/2-ft          | 0.07 ± 0.04              | 0 ± 0        | —    | 0.42 ± 0.16   | 7.64 ± 0    | —   |
| 2040S0053 | UNC-CHA-36-3 | 36/3-ft          | 0.02 ± 0.04              | 0 ± 0        | —    | 0.46 ± 0.16   | 7.42 ± 0    | —   |
| 2040S0054 | UNC-CHA-61-1 | 61/1-ft          | 4.98 ± 0.18              | 2.55 ± 0.95  | 5.0  | 0.45 ± 0.27   | 6.20 ± 0    | —   |
| 2040S0055 | UNC-CHA-61-2 | 61/2-ft          | 0.19 ± 0.06              | 0 ± 0        | —    | 0.59 ± 0.19   | 5.56 ± 0    | —   |
| 2040S0056 | UNC-CHA-61-3 | 61/3-ft          | 0.07 ± 0.05              | 0 ± 0        | —    | 0.37 ± 0.20   | 6.03 ± 0    | —   |
| 2040S0057 | UNC-CHA-2-1  | 2/1-ft           | 0.02 ± 0.05              | 0 ± 0        | —    | 0.34 ± 0.18   | 7.09 ± 0    | —   |
| 2040S0058 | UNC-CHA-2-2  | 2/2-ft           | 0.09 ± 0.07              | 0 ± 0        | —    | 0.46 ± 0.19   | 7.49 ± 0    | —   |
| 2040S0059 | UNC-CHA-2-3  | 2/3-ft           | 0.02 ± 0.09              | 0 ± 0        | —    | 0.71 ± 0.22   | 7.34 ± 0    | —   |
| 2040S0060 | UNC-CHA-50-1 | 50/1-ft          | -0.06 ± 0.07             | 0 ± 0        | —    | 0.53 ± 0.16   | 3.05 ± 0    | —   |
| 2040S0061 | UNC-CHA-50-2 | 50/2-ft          | 0.08 ± 0.07              | 0 ± 0        | —    | 0.37 ± 0.17   | 5.68 ± 0    | —   |
| 2040S0062 | UNC-CHA-50-3 | 50/3-ft          | -0.02 ± 0.07             | 0 ± 0        | —    | 0.26 ± 0.18   | 5.43 ± 0    | —   |
| 2040S0063 | UNC-CHA-45-1 | 45/1-ft          | 21.93 ± 0.70             | 10.94 ± 1.95 | 10.6 | 0.42 ± 0.45   | 14.19 ± 5.2 | 5.3 |
| 2040S0064 | UNC-CHA-45-2 | 45/2-ft          | 0.02 ± 0.05              | 0 ± 0        | —    | 0.49 ± 0.16   | 5.32 ± 0    | —   |
| 2040S0065 | UNC-CHA-45-3 | 45/3-ft          | 0.42 ± 0.07              | 0 ± 0        | —    | 0.63 ± 0.19   | 5.50 ± 0    | —   |
| 2040S0066 | UNC-CHA-6-1  | 6/1-ft           | 0.01 ± 0.05              | 0 ± 0        | —    | 0.54 ± 0.20   | 7.87 ± 0    | —   |
| 2040S0067 | UNC-CHA-6-2  | 6/2-ft           | 0.02 ± 0.08              | 0 ± 0        | —    | 0.49 ± 0.22   | 8.06 ± 0    | —   |
| 2040S0068 | UNC-CHA-6-3  | 6/3-ft           | 0.05 ± 0.08              | 0 ± 0        | —    | 0.52 ± 0.20   | 8.21 ± 0    | —   |
| 2040S0069 | UNC-CHA-32-1 | 32/1-ft          | 0.06 ± 0.07              | 0 ± 0        | —    | 0.37 ± 0.17   | 5.81 ± 0    | —   |
| 2040S0070 | UNC-CHA-32-2 | 32/2-ft          | 0.06 ± 0.07              | 0 ± 0        | —    | 0.49 ± 0.19   | 5.54 ± 0    | —   |
| 2040S0071 | UNC-CHA-32-3 | 32/3-ft          | -0.03 ± 0.06             | 0 ± 0        | —    | 0.44 ± 0.17   | 5.77 ± 0    | —   |
| 2040S0072 | UNC-CHA-47-1 | 47/1-ft          | 0.04 ± 0.07              | 0 ± 0        | —    | 0.49 ± 0.17   | 5.31 ± 0    | —   |
| 2040S0073 | UNC-CHA-47-2 | 47/2-ft          | 0.00 ± 0.07              | 0 ± 0        | —    | 0.36 ± 0.17   | 5.72 ± 0    | —   |
| 2040S0074 | UNC-CHA-47-3 | 47/3-ft          | 0.06 ± 0.04              | 0 ± 0        | —    | 0.35 ± 0.16   | 5.8 ± 0     | —   |
| 2040S0075 | UNC-CHA-14-1 | 14/1-ft          | 0.10 ± 0.11              | 0 ± 0        | —    | 1.23 ± 0.32   | 1.70 ± 0.85 | 1.0 |
| 2040S0076 | UNC-CHA-14-2 | 14/2-ft          | 0.05 ± 0.07              | 0 ± 0        | —    | 0.53 ± 0.19   | 6.10 ± 0    | —   |
| 2040S0077 | UNC-CHA-14-3 | 14/3-ft          | 0.08 ± 0.05              | 0 ± 0        | —    | 0.17 ± 0.18   | 5.51 ± 0    | —   |
| 2040S0078 | UNC-CHA-43-1 | 43/1-ft          | 0.06 ± 0.04              | 0 ± 0        | —    | 0.51 ± 0.15   | 5.43 ± 0    | —   |
| 2040S0079 | UNC-CHA-43-2 | 43/2-ft          | 0.06 ± 0.05              | 0 ± 0        | —    | 0.49 ± 0.16   | 2.81 ± 0    | —   |
| 2040S0080 | UNC-CHA-43-3 | 43/3-ft          | 0.04 ± 0.05              | 0 ± 0        | —    | 0.45 ± 0.15   | 5.65 ± 0    | —   |

<sup>a</sup>Uncertainties represent the total propagated uncertainty at the 95% confidence interval.

| Table B-3. Alpha Spectroscopy Confirmatory Results |  |               |               |               |
|--|--|---------------|---------------|---------------|
| Sample ID  | Isotopic Uranium Concentration (pCi/g) |               |               |               |
|  | U-234                                  | U-235/U-236   | U-238         | Total Uranium |
| 2040S0048  | 49.4 ± 5.1 <sup>a</sup>                | 1.97 ± 0.23   | 0.426 ± 0.067 | 51.8 ± 5.1    |
| 2040S0049  | 4.74 ± 0.52                            | 0.166 ± 0.041 | 0.542 ± 0.082 | 5.45 ± 0.53   |
| 2040S0050  | 2.74 ± 0.31                            | 0.099 ± 0.029 | 0.555 ± 0.082 | 3.40 ± 0.32   |
| 2040S0051  | 0.507 ± 0.078                          | 0.014 ± 0.012 | 0.426 ± 0.068 | 0.95 ± 0.10   |
| 2040S0052  | 0.455 ± 0.073                          | 0.028 ± 0.017 | 0.517 ± 0.079 | 1.00 ± 0.11   |
| 2040S0053  | 0.464 ± 0.076                          | 0.025 ± 0.019 | 0.508 ± 0.081 | 1.00 ± 0.11   |
| 2040S0054  | 160 ± 16                               | 6.77 ± 0.73   | 0.77 ± 0.11   | 166 ± 16      |
| 2040S0055  | 7.47 ± 0.80                            | 0.289 ± 0.059 | 0.93 ± 0.13   | 8.68 ± 0.82   |
| 2040S0056  | 0.638 ± 0.092                          | 0.051 ± 0.021 | 0.627 ± 0.090 | 1.31 ± 0.13   |
| 2040S0057  | 0.545 ± 0.084                          | 0.031 ± 0.018 | 0.496 ± 0.078 | 1.07 ± 0.12   |
| 2040S0058  | 0.646 ± 0.095                          | 0.031 ± 0.017 | 0.616 ± 0.092 | 1.29 ± 0.13   |
| 2040S0059  | 1.16 ± 0.15                            | 0.065 ± 0.027 | 1.20 ± 0.16   | 2.42 ± 0.22   |
| 2040S0060  | 0.69 ± 0.10                            | 0.038 ± 0.018 | 0.637 ± 0.092 | 1.36 ± 0.14   |
| 2040S0061  | 0.73 ± 0.11                            | 0.027 ± 0.016 | 0.72 ± 0.10   | 1.47 ± 0.15   |
| 2040S0062  | 0.33 ± 0.06                            | 0.017 ± 0.014 | 0.343 ± 0.057 | 0.69 ± 0.08   |
| 2040S0063  | 690 ± 140                              | 25.1 ± 5.9    | 2.15 ± 0.92   | 720 ± 140     |
| 2040S0064  | 13.9 ± 1.5                             | 0.526 ± 0.088 | 0.78 ± 0.11   | 15.2 ± 1.5    |
| 2040S0065  | 1.60 ± 0.19                            | 0.072 ± 0.025 | 0.502 ± 0.075 | 2.18 ± 0.21   |
| 2040S0066  | 0.455 ± 0.074                          | 0.031 ± 0.019 | 0.426 ± 0.070 | 0.91 ± 0.10   |
| 2040S0067  | 0.421 ± 0.074                          | 0.012 ± 0.016 | 0.431 ± 0.074 | 0.86 ± 0.11   |
| 2040S0068  | 0.428 ± 0.072                          | 0.024 ± 0.016 | 0.438 ± 0.073 | 0.89 ± 0.10   |
| 2040S0069  | 0.454 ± 0.071                          | 0.014 ± 0.012 | 0.401 ± 0.065 | 0.87 ± 0.10   |
| 2040S0070  | 0.395 ± 0.066                          | 0.024 ± 0.016 | 0.371 ± 0.063 | 0.79 ± 0.09   |
| 2040S0071  | 0.356 ± 0.063                          | 0.011 ± 0.012 | 0.362 ± 0.063 | 0.73 ± 0.09   |
| 2040S0072  | 0.83 ± 0.12                            | 0.039 ± 0.019 | 0.478 ± 0.077 | 1.35 ± 0.14   |
| 2040S0073  | 0.615 ± 0.093                          | 0.042 ± 0.023 | 0.529 ± 0.083 | 1.19 ± 0.13   |
| 2040S0074  | 0.376 ± 0.064                          | 0.033 ± 0.017 | 0.418 ± 0.069 | 0.83 ± 0.10   |
| 2040S0075  | 1.09 ± 0.15                            | 0.044 ± 0.021 | 0.82 ± 0.12   | 1.96 ± 0.19   |
| 2040S0076  | 0.549 ± 0.080                          | 0.017 ± 0.014 | 0.504 ± 0.075 | 1.07 ± 0.11   |
| 2040S0077  | 0.441 ± 0.072                          | 0.022 ± 0.014 | 0.495 ± 0.078 | 0.96 ± 0.11   |
| 2040S0078  | 2.32 ± 0.27                            | 0.079 ± 0.028 | 0.507 ± 0.080 | 2.90 ± 0.28   |
| 2040S0079  | 1.70 ± 0.20                            | 0.07 ± 0.02   | 0.470 ± 0.071 | 2.24 ± 0.21   |
| 2040S0080  | 1.21 ± 0.15                            | 0.07 ± 0.03   | 0.393 ± 0.066 | 1.68 ± 0.17   |

<sup>a</sup>Uncertainties represent the total propagated uncertainty at the 95% confidence interval.