

**RADIATION MONITORING REPORT
FOR LICENSE SUB-1435
JEFFERSON PROVING GROUND**

**Summary of Results for the May and October 2019
Sampling Events**

FINAL

Submitted by:

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LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|----------------|---|
| °C | Degrees Celsius |
| μR/hr | Microrentgens per Hour |
| μg/L | Micrograms per Liter |
| CFR | Code of Federal Regulations |
| CHPPM | (U.S. Army) Center for Health Promotion and Preventive Medicine |
| DQO | Data Quality Objective |
| DU | Depleted Uranium |
| ERM | Environmental Radiation Monitoring |
| ERMP | Environmental Radiation Monitoring Program |
| I.D. | Identification |
| ICP-MS | Inductively Coupled Plasma-Mass Spectrometry |
| JPG | Jefferson Proving Ground |
| LCL | Lower Control Limit |
| MDC | Minimum Detectable Concentration |
| MDL | Method Detection Limit |
| mg/kg | Milligrams per Kilogram |
| mg/L | Milligrams per Liter |
| mS/cm | MilliSiemens per Centimeter |
| NRC | (U.S.) Nuclear Regulatory Commission |
| pCi/g | Picocuries per Gram |
| pCi/L | Picocuries per Liter |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| R ² | Coefficient of Correlation |
| SOP | Standard Operating Procedure |
| TPU | Total Propagated Uncertainty |
| U-234 | Uranium-234 |
| U-235 | Uranium-235 |
| U-238 | Uranium-238 |
| UCL | Upper Control Limit |
| USEPA | U.S. Environmental Protection Agency |

1. INTRODUCTION

Environmental radiation monitoring (ERM) activities are being conducted at Jefferson Proving Ground (JPG), Madison, Indiana, to ensure that depleted uranium (DU), present within the DU Impact Area as a result of the Army's past DU testing program, does not pose a threat to human health and the environment through inadvertent or unanticipated release or migration. The Environmental Radiation Monitoring Program (ERMP) is described in the standard operating procedure (SOP) developed and issued by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), predecessor organization to the U.S. Army Public Health Center. This SOP, which is in Appendix A, is designed to meet the requirements of applicable Federal and state regulations, including Nuclear Regulatory Commission (NRC) regulations and requirements under Radioactive Materials License SUB-1435 (NRC 1985).

The overall goals of JPG's ERMP are to provide:

- A historical and current perspective of DU levels in various media
- A timely indication of the magnitude and extent of any DU release or migration from past operations.

This report summarizes the methodology, results, and conclusions of the May and October 2019 sampling events, which were the two planned sampling events in 2019 for this biannual program. License Amendment No. 20 for SUB-1435 (ML19088A305) was issued on 26 September 2019 and documented revisions to the ERMP, and the revisions were performed during the October 2019 sampling event. The sampling requirements and approach are presented in Section 2. The results from the multimedia sampling events are presented and discussed in Section 3. Historical data and trend analyses from the ERMP are discussed in Section 4. Conclusions and recommendations are summarized in Section 5. References cited are identified in Section 6. The appendices of this report include the SOP (Appendix A), field logbooks and sampling forms (Appendix B), data validation summaries (Appendix C), and graph of the "Relative Uranium-238/Uranium-234 Activity Ratios for Mixtures of Depleted and Natural Uranium" (Appendix D). Tables and figures are generally presented at the end of their respective sections.

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2. SAMPLING REQUIREMENTS AND APPROACH

The ERMP SOP (CHPPM 2000) specifies the U.S. Army Public Health Center's (formerly CHPPM's) protocol for the collection and analysis of 11 groundwater, 8 surface water, 8 sediment, and 4 soil samples (with appropriate duplicates) in and near the DU Impact Area for the spring 2019 sampling event. The plan was approved by the NRC and is described in an SOP, which is provided in Appendix A.

License Amendment No. 20 for SUB-1435 (ML19088A305) was issued on 26 September 2019 and documented revisions to the ERMP, and the revisions were performed during the fall 2019 sampling event. As a result of the revisions, the ERMP sampling scope has been reduced to the following:

1. Co-located surface water and sediment sampling locations downstream from the DU Impact Area in Middle Fork Creek (SD-DU-001/SW-DU-001, SD-DU-007/SW-DU-007) and Big Creek (SD-DU-002/SW-DU-002, SD-DU-008/SW-DU-008).
2. Groundwater sampling locations at MW-DU-001, MW-DU-005, MW-DU-006, and MW-DU-0011.
3. Soil sampling is no longer required.

The reduced ERMP sampling scope was provided to the NRC within the Renewal Application dated 21 December 2016 (ML17004A186). The Renewal Application included the Environmental Radiation Monitoring Plan for the DU Impact Area at Jefferson Proving Ground, Indiana, dated 21 December 2016 (ML17004A186) and was amended by responses to NRC Requests for Additional Information dated 25 May 2018 (ML18156A002). With the issuance of License Amendment No. 20 for SUB-1435, the NRC approved the revisions to the ERMP, including the reduced ERMP sampling scope. The Army has executed the plans and reports the findings to fulfill the responsibilities for monitoring under Radioactive Materials License SUB-1435.

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3. RESULTS

A field crew of contractor personnel prepared for and conducted sampling at JPG during the periods of 6-7 May 2019 and 21-211 October 2019. Appendix B contains a copy of the field logbook pages and sampling forms, which document environmental monitoring report field activities during the sampling efforts. No unusual or abnormal conditions (e.g., soil or water discoloration, odd odors, and elevated radiation levels) were observed during the two sampling events.

The locations for the groundwater, surface water, sediment, and soil samples are depicted on Figure 3-1. Sections 3.1 and 3.2 summarize the sampling results for the spring and fall 2019 sampling events, respectively. Data uncertainties are reported with two standard deviations (95 percent confidence level). The results of the data validation are presented in Appendix C. All data were determined to meet data quality objectives (DQOs) and criteria presented in the SOP (as provided in Appendix A).

The radiological and chemical analysis results for uranium are used to distinguish natural uranium from DU. Natural uranium is defined by NRC as "...uranium containing the relative concentrations of isotopes found in nature (0.7 percent uranium-235 [U-235], 99.3 percent uranium-238 [U-238], and a trace amount of uranium-234 [U-234] by mass). In terms of radioactivity, however, natural uranium contains approximately 2.2 percent U-235, 48.6 percent U-238, and 49.2 percent U-234..." (NRC 2012a). U-234 and U-238 in natural uranium exhibit secular equilibrium such that they are present at approximately the same activity concentration. Secular equilibrium is disturbed by the extraction of most U-234 together with the U-235 such that the activity exhibited by DU is about 60 percent of that from natural uranium. Hence, DU is defined by NRC as "...uranium with a percentage of U-235 lower than the 0.7 percent (by mass) contained in natural uranium. (The normal residual U-235 content in depleted uranium is 0.2-0.3 percent, with U-238 comprising the remaining 98.7-98.8 percent.)..." (NRC 2012b).

Samples are initially analyzed using alpha spectrometry to determine the activity concentrations for U-234, U-235, and U-238, which are summed for total uranium. As discussed in Section 4, the action levels for total uranium established for the ERM for JPG are 150 picocuries per liter (pCi/L) for surface water and groundwater, and 35 picocuries per gram (pCi/g) for soil and sediment outside the perimeter of the DU Impact Area. For comparison, a liquid effluent concentration limit for uranium of 300 pCi/L is specified in 10 Code of Federal Regulations (CFR) 20, Appendix B. The following sample results are well below these action levels.

Even though no action is required, additional evaluation is performed in an effort to determine whether certain sample results are suggestive of DU, natural uranium, or some combination of the two. The selection criterion is whether the U-238/U-234 ratio plus the value of total propagated uncertainty (TPU) exceeds 3.0. Information relative to U-238/U-234 activity ratios for mixtures of depleted and natural uranium is provided in Appendix D. Adding the TPU to the ratios for comparison to this selection criterion is a conservative measure, resulting in more samples being selected for additional evaluation.

Selected samples are sent for a confirmatory laboratory analysis, this time using inductively coupled plasma-mass spectrometry (ICP-MS) to reduce detection and uncertainty values from those achieved with alpha spectroscopy. If the ICP-MS results for U-235 and total uranium exceed their method detection limits (MDLs), the U-235 weight percentage can be calculated. If the weight percent of U-235 exceeds 0.49¹, the sample result is suggestive of natural uranium, otherwise DU is suggested.

If ICP-MS results for U-235 are non-detect, the total uranium result is evaluated against a lower comparison value and, if needed, an upper comparison value. A total uranium sample result less than the lower comparison value is suggestive of natural uranium. A total uranium sample result exceeding the upper

¹ 0.49 = 0.56 × 0.72 + 0.44 × 0.20, where 0.56 and 0.44 are the natural uranium and DU fractions when the U-238/U-234 activity ratio is 3.0 (Appendix D), and 0.72 and 0.20 are the U-235 mass percentages for natural uranium and DU.

comparison value is suggestive of DU. A total uranium result between the lower and upper comparison values is suggestive of a mixture of both natural uranium and DU.

The lower comparison value, against which total uranium is compared, is based on considering whether the result is consistent with background sample results for total uranium. The lower comparison values for the three types of environmental media are provided in Table 3-1.

The upper comparison value, against which total uranium is compared, is based on considering whether enough DU is present to cause the amount of U-235 to be too small to be detected (i.e., if natural uranium were the cause of the result, the U-235 result would exceed the MDL). The upper comparison value is calculated as follows:

$$\text{Upper Comparison Value} = \frac{\text{Sample MDL for U} - 235}{(0.56 \times 0.0072) + (0.44 \times 0.002)}$$

where:

- 0.56 = The natural uranium fraction when the U-238/U-234 ratio is 3 (Appendix D)
- 0.0072 = The U-235 mass fraction for natural uranium
- 0.44 = The DU fraction when the U-238/U-234 ratio is 3.0 (Appendix D)
- 0.002 = The U-235 mass fraction for DU.

3.1 SPRING 2019 SAMPLING RESULTS

Sections 3.1.1 through 3.1.4 summarize the spring 2019 sampling results for each environmental medium and are reported with a maximum of two significant digits.

3.1.1 Groundwater

The concentrations of dissolved total and isotopic uranium in groundwater at the 11 monitoring wells plus 1 duplicate sample are presented in Table 3-2. Groundwater quality parameter measurements are presented in Table 3-3. Groundwater samples were collected at the locations shown on Figure 3-1.

Total uranium concentrations in the May 2019 groundwater samples ranged from 0.24 ± 0.11 pCi/L for MW-DU-011 to 4.0 ± 0.5 pCi/L for MW-DU-006. The average total uranium concentration, computed using the average value for duplicates, was 1.5 ± 0.9 pCi/L.

In addition to the individual isotopic concentrations, Table 3-2 presents the U-238/U-234 activity ratios for each sample. These ratios ranged from non-detect for MW-DU-011 to 0.65 ± 0.15 for MW-DU-006. A U-238/U-234 ratio of 3.0 or less is generally representative of natural uranium, whereas higher ratios are potentially indicative of DU (U.S. Army 2002). For the purposes of this report, samples with U-238/U-234 ratios in excess of 3.0 are investigated further to validate if the sample is representative of DU or natural uranium. Given that the maximum U-238/U-234 ratio was 0.65 ± 0.15 , groundwater samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.1.2 Surface Water

The concentrations of dissolved total and isotopic uranium in surface water at eight sampling locations plus one duplicate sample are presented in Table 3-4. Surface water quality parameter measurements are presented in Table 3-5. Surface water samples were collected at the locations shown on Figure 3-1. Total uranium concentrations in surface water ranged from 0.30 ± 0.11 pCi/L for SW-DU-004 to 0.96 ± 0.21 pCi/L for SW-DU-008 with an average concentration of 0.52 ± 0.47 pCi/L, computed using the average value for duplicates.

In addition to the individual isotopic concentrations, Table 3-4 presents the U-238/U-234 activity ratios for each sample. The U-238/U-234 ratios ranged from non-detect for SW-DU-003, SW-DU-006, and SW-DU-007 to 0.80 ± 0.55 for SW-DU-002. Given that the maximum U-238/U-234 ratio was 0.80 ± 0.55 , surface water samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.1.3 Sediment

The concentrations of total and isotopic uranium in sediment at eight sampling locations plus one duplicate sample are presented in Table 3-6. Sediment samples were collected at the same locations as surface water samples, as shown on Figure 3-1. Total uranium concentrations ranged from 0.44 ± 0.10 pCi/g for SD-DU-001 to 1.3 ± 0.2 pCi/g for SD-DU-003 with an average concentration of 0.80 ± 0.36 pCi/g, computed using the average value for duplicates.

In addition to the individual isotopic concentrations, Table 3-6 presents the U-238/U-234 activity ratios for each sample. The U-238/U-234 ratios ranged from 0.83 ± 0.31 for SD-DU-006 to 1.7 ± 0.6 for SD-DU-005. Given that the maximum U-238/U-234 ratio was 1.7 ± 0.6 , sediment samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.1.4 Soils

The concentrations of total and isotopic uranium in surface soils at four sample locations plus one duplicate sample are presented in Table 3-7. Soil samples were collected at the locations shown on Figure 3-1. Total uranium concentrations ranged from 1.1 ± 0.2 pCi/g for SS-DU-004 to 1.6 ± 0.2 pCi/g for SS-DU-001. The average total uranium concentration of 1.4 ± 0.4 pCi/g was computed using the average value for duplicates.

In addition to the individual isotopic concentrations, Table 3-7 presents the U-238/U-234 activity ratios for each sample. The U-238/U-234 ratio ranged from 0.94 ± 0.23 for SS-DU-002 to 1.2 ± 0.3 for SS-DU-003. Given that the maximum U-238/U-234 ratio was 1.2 ± 0.3 , soil samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.2 FALL 2019 SAMPLING RESULTS

Sections 3.2.1 through 3.2.4 summarize the fall 2019 sampling results for each environmental medium and are reported with a maximum of two significant digits.

3.2.1 Groundwater

The concentrations of dissolved total and isotopic uranium in groundwater at the four monitoring wells plus one duplicate sample are presented in Table 3-8. Groundwater quality parameter measurements are presented in Table 3-9. Groundwater samples were collected at the locations shown on Figure 3-1.

Total uranium concentrations in the October 2019 groundwater samples ranged from 0.60 ± 0.12 pCi/L for MW-DU-005D to 3.4 ± 0.4 pCi/L for MW-DU-006. The average total uranium concentration, computed using the average value for duplicates, was 1.4 ± 0.4 pCi/L.

In addition to the individual isotopic concentrations, Table 3-8 presents the U-238/U-234 ratios for each sample. These ratios ranged from 0.20 ± 0.10 for MW-DU-011 to 0.83 ± 0.18 for MW-DU-006. Given that the maximum U-238/U-234 ratio was 0.83 ± 0.18 , groundwater samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.2.2 Surface Water

The concentrations of dissolved total and isotopic uranium in surface water at four sampling locations plus one duplicate sample are presented in Table 3-10. Surface water quality parameter measurements are presented in Table 3-11. Surface water samples were collected at the locations shown on Figure 3-1. Total uranium concentrations in surface water ranged from 0.27 ± 0.10 pCi/L for SW-DU-007 to 0.57 ± 0.12 pCi/L for SW-DU-008 with an average concentration of 0.37 ± 0.23 pCi/L, computed using the average value for duplicates.

In addition to the individual isotopic concentrations, Table 3-10 presents the U-238/U-234 ratios for each sample. The U-238/U-234 ratios ranged from 0.44 ± 0.34 for SW-DU-007 to 2.1 ± 1.0 for SW-DU-008. As noted above, for the purposes of this report, when U-238/U-234 plus TPU for U-238/U-234 exceeds 3.0, that sample is selected for laboratory analysis by ICP-MS. Only SW-DU-002D and SW-DU-008 exceeded this criterion. ICP-MS results for SW-DU-002D equated to 0.62, non-detect, non-detect, and 0.62 micrograms per liter ($\mu\text{g/L}$) for total uranium, U-234, U-235, and U-238, respectively. ICP-MS results for SW-DU-008 equated to 1.4, non-detect, non-detect, and 1.4 $\mu\text{g/L}$ for total uranium, U-234, U-235, and U-238, respectively. Given that U-235 was not detected by ICP-MS, the total uranium result is compared to the lower comparison value from Table 3-1. The total uranium result for SW-DU-002D is less than the lower comparison value 1.2 $\mu\text{g/L}$ for surface water, which is suggestive of natural uranium. The total uranium result for SW-DU-008 is greater than the lower comparison value of 1.2 $\mu\text{g/L}$ for surface water, so the upper comparison value had to be derived. The upper comparison value was calculated to be 6.1 $\mu\text{g/L}$ based on a U-235 MDL of 0.03 $\mu\text{g/L}$. Since the total uranium result of 1.4 $\mu\text{g/L}$ for SW-DU-008 is less than the upper comparison value of 6.1 $\mu\text{g/L}$, it is suggestive of a mixture of both natural uranium and DU.

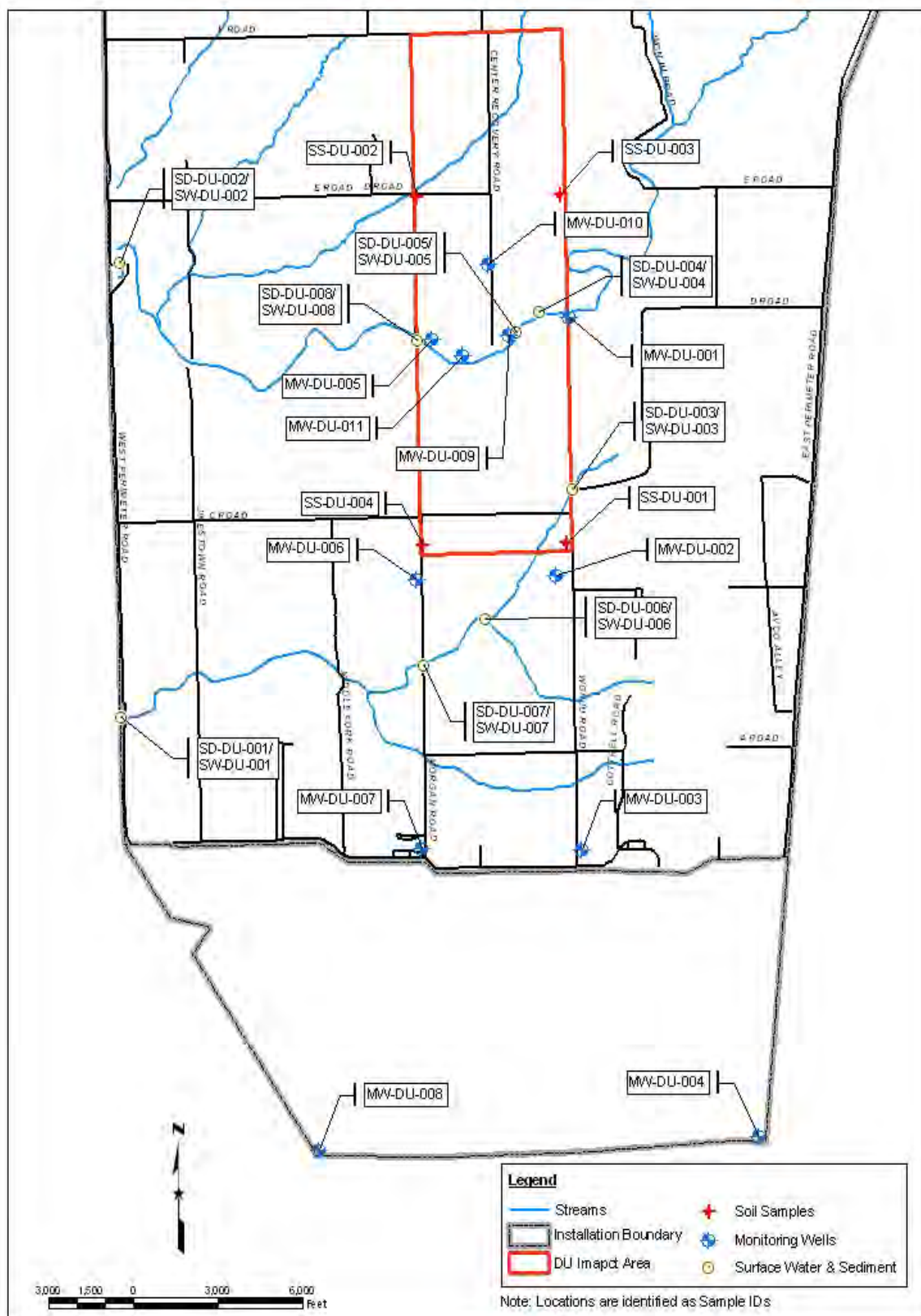
3.2.3 Sediment

The concentrations of total and isotopic uranium in sediment at four sampling locations plus one duplicate sample are presented in Table 3-12. Sediment samples were collected at the same locations as surface water samples, as shown on Figure 3-1. Total uranium concentrations ranged from 0.31 ± 0.08 pCi/g for SD-DU-002 to 1.3 ± 0.2 pCi/g for SD-DU-007 with an average concentration of 0.71 ± 0.29 pCi/g, computed using the average value for duplicates.

In addition to the individual isotopic concentrations, Table 3-12 presents the U-238/U-234 ratios for each sample. The U-238/U-234 ratio for the samples ranged from 0.91 ± 0.41 for SD-DU-001 to 1.5 ± 0.8 for SD-DU-002. As noted above, for the purposes of this report, samples with U-238/U-234 ratios in excess of 3.0 are subjected to additional investigation. Given a maximum U-238/U-234 ratio of 1.5 ± 0.8 , sediment samples did not exhibit the potential for the U-238/U-234 ratios to equal or exceed 3.0 at the upper end of its statistical range. As such, confirmatory analysis by ICP-MS was not needed.

3.2.4 Soils

As a result of the issuance of License Amendment No. 20 for SUB-1435 (ML19088A305) on 26 September 2019, soil sampling as part of the biannual ERMP is no longer required and soil samples were not collected during the fall 2019 sampling event.



**Table 3-1. Lower Comparison Values
Jefferson Proving Ground, Madison, Indiana**

| Environmental Medium | Background Activity Concentration for Total Uranium ^a | | | Background Mass Concentration for Total Uranium ^b | | | Lower Comparison Value ^c | |
|----------------------|--|---------|--------------------|--|---------|--------------------|-------------------------------------|--------------------|
| | Average | Maximum | Units ^d | Average | Maximum | Units ^d | Value | Units ^d |
| Soil/Sediment | 1.5 | 3.8 | pCi/g | 2.22 | 5.61 | mg/kg | 4.0 | mg/kg |
| Surface Water | 0.44 | 2.83 | pCi/L | 0.65 | 4.18 | µg/L | 1.2 | µg/L |
| Groundwater | 1.2 | 6.42 | pCi/L | 1.77 | 9.48 | µg/L | 3.2 | µg/L |

^a From pages 4-2, 4-3, 6-14, and 6-45 of the Army's Environmental Report for NRC Materials License SUB-1435 (U.S. Army 2013).

^b Calculated using the specific activity of 677,000 pCi/g for natural uranium from Appendix B to 10 CFR 20.

^c Calculated by the equation $R = 0.56R + 0.44R$, where 0.56R is the portion of the overall result (R) attributed to natural uranium, 0.44R is the portion of R attributed to DU, the average background mass concentration is substituted for 0.56R, and solving for R. The values 0.56 and 0.44 are the percentages when the U-238/U-234 ratio is 3.0 (Appendix D).

^d Units are picocuries per gram (pCi/g), picocuries per liter (pCi/L), milligrams per kilogram (mg/kg), and micrograms per liter (µg/L).

**Table 3-2. Uranium in Groundwater (Spring 2019)
Jefferson Proving Ground, Madison, Indiana**

| Sample I.D. ^a | Activity Concentration (pCi/L) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|-----------------|---------------|----------------------------|-----------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| MW-DU-001 | 0.34 ± 0.13 | 0.007 ± 0.028 U | 0.16 ± 0.08 | 0.51 ± 0.15 | 0.47 ± 0.30 |
| MW-DU-002 | 1.1 ± 0.2 | 0.04 ± 0.04 | 0.40 ± 0.13 | 1.5 ± 0.3 | 0.36 ± 0.14 |
| MW-DU-003 | 0.95 ± 0.21 | 0.02 ± 0.03 U | 0.30 ± 0.11 | 1.3 ± 0.2 | 0.31 ± 0.14 |
| MW-DU-004 | 0.44 ± 0.14 | 0.03 ± 0.04 U | 0.28 ± 0.11 | 0.75 ± 0.18 | 0.64 ± 0.32 |
| MW-DU-005 | 0.99 ± 0.22 | 0.05 ± 0.06 U | 0.23 ± 0.10 | 1.3 ± 0.3 | 0.23 ± 0.11 |
| MW-DU-006 | 2.3 ± 0.4 | 0.11 ± 0.08 | 1.5 ± 0.3 | 4.0 ± 0.5 | 0.65 ± 0.15 |
| MW-DU-007 | 1.74 ± 0.3 | 0.09 ± 0.06 | 0.70 ± 0.18 | 2.5 ± 0.4 | 0.40 ± 0.12 |
| MW-DU-008 ^d | 0.52 ± 0.16 | 0.03 ± 0.04 U | 0.15 ± 0.08 | 0.69 ± 0.18 | 0.28 ± 0.18 |
| MW-DU-008D ^d | 0.90 ± 0.22 | 0.09 ± 0.07 | 0.29 ± 0.12 | 1.3 ± 0.3 | 0.32 ± 0.15 |
| MW-DU-009 | 0.64 ± 0.18 | 0.01 ± 0.03 U | 0.16 ± 0.08 | 0.80 ± 0.20 | 0.25 ± 0.15 |
| MW-DU-010 | 2.2 ± 0.3 | 0.15 ± 0.09 | 0.69 ± 0.18 | 3.0 ± 0.4 | 0.32 ± 0.10 |
| MW-DU-011 | 0.21 ± 0.10 | 0.008 ± 0.029 U | 0.03 ± 0.04 U | 0.24 ± 0.11 | ND |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for MW-DU-008 and its duplicate are 1.0 ± 0.2 pCi/L and 0.30 ± 0.23 , respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not performed.

Table 3-3. Groundwater Water Quality Parameters and Exposure Readings (Spring 2019)
Jefferson Proving Ground, Madison, Indiana

| JPG Location Designation ^a | Sample I.D. | pH | Temp (°C) | Conductivity (mS/cm) | Dissolved Oxygen (mg/L) | Exposure Rate ^b (μR/hr) |
|---------------------------------------|-------------|------|-----------|----------------------|-------------------------|------------------------------------|
| MW01 | MW-DU-001 | 8.13 | 14.24 | 0.362 | 12.04 | 5 |
| MW02 | MW-DU-002 | 8.10 | 14.05 | 0.361 | 11.82 | 5 |
| MW03 | MW-DU-003 | 7.70 | 13.38 | 0.507 | 12.19 | 5 |
| MW04 | MW-DU-004 | 6.09 | 17.65 | 0.673 | 8.99 | 5 |
| MW05 | MW-DU-005 | 7.48 | 17.28 | 0.322 | 12.47 | 6 |
| MW06 | MW-DU-006 | 7.79 | 17.18 | 0.539 | 9.90 | 6 |
| MW07 | MW-DU-007 | 8.30 | 17.31 | 0.507 | 9.54 | 5 |
| MW08 | MW-DU-008 | 8.13 | 15.93 | 0.398 | 10.64 | 6 |
| MW09 | MW-DU-009 | 7.79 | 19.79 | 3.51 | 10.01 | 6 |
| MW10 | MW-DU-0010 | 7.73 | 22.48 | 0.379 | 10.54 | 6 |
| MW11 | MW-DU-0011 | 8.40 | 15.44 | 0.284 | 40.88 | 6 |

^a Represents sample designation developed in previous sampling programs.

^b Dose rate data were collected using Ludlum Model 19, serial number 207535, which was calibrated on 6 February 2019.

Table 3-4. Uranium in Surface Water (Spring 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/L) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|-----------------|---------------|----------------------------|-----------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| SW-DU-001 | 0.31 ± 0.12 | 0.03 ± 0.04 U | 0.05 ± 0.05 | 0.39 ± 0.13 | 0.17 ± 0.16 |
| SW-DU-002 | 0.21 ± 0.09 | 0.00 ± 0.01 U | 0.17 ± 0.08 | 0.37 ± 0.13 | 0.80 ± 0.55 |
| SW-DU-003 | 0.34 ± 0.12 | 0.04 ± 0.04 | 0.04 ± 0.04 U | 0.41 ± 0.13 | ND |
| SW-DU-004 | 0.19 ± 0.09 | 0.00 ± 0.01 U | 0.11 ± 0.07 | 0.30 ± 0.11 | 0.57 ± 0.45 |
| SW-DU-005 | 0.38 ± 0.13 | 0.03 ± 0.04 U | 0.25 ± 0.10 | 0.65 ± 0.17 | 0.66 ± 0.35 |
| SW-DU-006 ^d | 0.39 ± 0.13 | 0.03 ± 0.04 U | 0.05 ± 0.05 U | 0.47 ± 0.15 | ND |
| SW-DU-007 ^d | 0.29 ± 0.12 | 0.00 ± 0.01 U | 0.05 ± 0.05 U | 0.34 ± 0.13 | ND |
| SW-DU-007D ^d | 0.77 ± 0.20 | 0.07 ± 0.07 U | 0.08 ± 0.06 | 0.91 ± 0.22 | 0.10 ± 0.09 |
| SW-DU-008 | 0.71 ± 0.18 | 0.008 ± 0.029 U | 0.24 ± 0.11 | 0.96 ± 0.21 | 0.34 ± 0.17 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for SW-DU-007 and its duplicate were 0.63 ± 0.25 pCi/L and non-detect, respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not performed.

Table 3-5. Surface Water Quality Parameters and Exposure Readings (Spring 2019)
Jefferson Proving Ground, Madison, Indiana

| JPG Location Designation ^a | Sample I.D. | pH | Temp (°C) | Conductivity (mS/cm) | Dissolved Oxygen (mg/L) | Exposure Rate ^b (μR/hr) |
|---------------------------------------|-------------|------|-----------|----------------------|-------------------------|------------------------------------|
| SWS01 | SW-DU-001 | 8.56 | 18.75 | 0.158 | 11.20 | 5 |
| SWS02 | SW-DU-002 | 8.42 | 19.72 | 0.132 | 11.56 | 5 |
| SWS03 | SW-DU-003 | 8.30 | 16.75 | 0.046 | 41.8 | 5 |
| SWS04 | SW-DU-004 | 8.40 | 17.00 | 0.173 | 10.53 | 5 |
| SWS05 | SW-DU-005 | 9.06 | 19.84 | 0.284 | 16.59 | 6 |
| SWS06 | SW-DU-006 | 8.57 | 14.41 | 0.137 | 18.71 | 5 |
| SWS07 | SW-DU-007 | 8.61 | 19.96 | 0.117 | 10.65 | 5 |
| SWS08 | SW-DU-008 | 8.39 | 19.09 | 0.176 | 12.42 | 5 |

^a Represents sample designation developed in previous sampling programs.

^b Dose rate data were collected using Ludlum Model 19, serial number 207535, which was calibrated on 6 February 2019.

Table 3-6. Uranium in Sediment (Spring 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/g) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|------------------|-------------|----------------------------|--------------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| SD-DU-001 | 0.23 ± 0.07 | -0.001 ± 0.014 U | 0.21 ± 0.06 | 0.44 ± 0.10 | 0.88 ± 0.38 |
| SD-DU-002 | 0.36 ± 0.09 | 0.03 ± 0.03 U | 0.39 ± 0.09 | 0.78 ± 0.13 | 1.1 ± 0.4 |
| SD-DU-003 | 0.56 ± 0.11 | 0.04 ± 0.03 | 0.68 ± 0.13 | 1.3 ± 0.2 | 1.2 ± 0.3 |
| SD-DU-004 | e | e | e | e | e |
| SD-DU-005 | 0.33 ± 0.08 | 0.004 ± 0.019 U | 0.57 ± 0.11 | 0.90 ± 0.14 | 1.7 ± 0.6 |
| SD-DU-006 ^d | 0.35 ± 0.09 | 0.03 ± 0.03 U | 0.29 ± 0.08 | 0.68 ± 0.12 | 0.83 ± 0.31 |
| SD-DU-006D ^d | 0.33 ± 0.08 | 0.03 ± 0.03 | 0.30 ± 0.08 | 0.66 ± 0.12 | 0.93 ± 0.34 |
| SD-DU-007 | 0.45 ± 0.07 | 0.04 ± 0.02 | 0.6 ± 0.09 | 1.1 ± 0.1 | 1.3 ± 0.3 |
| SD-DU-008 | 0.25 ± 0.07 | 0.003 ± 0.012 U | 0.23 ± 0.07 | 0.48 ± 0.10 | 0.93 ± 0.38 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for SD-DU-006 and its duplicate are 0.67 ± 0.17 pCi/g and 0.88 ± 0.46, respectively.

^e Sample container broke during transportation to the laboratory; therefore, analysis was not performed.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

Table 3-7. Uranium in Surface Soil (Spring 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/g) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|---------------|-------------|----------------------------|--------------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| SS-DU-001 ^d | 0.71 ± 0.13 | 0.10 ± 0.05 | 0.79 ± 0.14 | 1.6 ± 0.2 | 1.1 ± 0.3 |
| SS-DU-001D ^d | 0.71 ± 0.13 | 0.02 ± 0.02 | 0.78 ± 0.14 | 1.5 ± 0.2 | 1.1 ± 0.3 |
| SS-DU-002 | 0.72 ± 0.12 | 0.09 ± 0.04 | 0.68 ± 0.12 | 1.5 ± 0.2 | 0.94 ± 0.23 |
| SS-DU-003 | 0.66 ± 0.13 | 0.04 ± 0.04 U | 0.79 ± 0.14 | 1.5 ± 0.2 | 1.2 ± 0.3 |
| SS-DU-004 | 0.55 ± 0.11 | 0.02 ± 0.02 | 0.55 ± 0.11 | 1.1 ± 0.2 | 1.0 ± 0.3 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for SS-DU-001 and its duplicate are 1.6 ± 0.3 pCi/g and 1.1 ± 0.4, respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

Table 3-8. Uranium in Groundwater (Fall 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/L) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|---------------|-------------|----------------------------|--------------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| MW-DU-001 | 0.47 ± 0.11 | 0.01 ± 0.02 U | 0.25 ± 0.08 | 0.73 ± 0.14 | 0.52 ± 0.21 |
| MW-DU-005 ^d | 0.48 ± 0.11 | 0.02 ± 0.03 U | 0.18 ± 0.07 | 0.68 ± 0.13 | 0.38 ± 0.17 |
| MW-DU-005D ^d | 0.35 ± 0.09 | 0.01 ± 0.02 U | 0.24 ± 0.08 | 0.60 ± 0.12 | 0.67 ± 0.28 |
| MW-DU-006 | 1.8 ± 0.3 | 0.09 ± 0.06 J | 1.5 ± 0.2 | 3.4 ± 0.4 | 0.83 ± 0.18 |
| MW-DU-011 | 0.63 ± 0.13 | 0.03 ± 0.03 J | 0.12 ± 0.05 | 0.78 ± 0.14 | 0.20 ± 0.10 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for MW-DU-005 and its duplicate are 0.64 ± 0.18 pCi/L and 0.53 ± 0.32, respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not performed.

Table 3-9. Groundwater Water Quality Parameters and Exposure Readings (Fall 2019)
Jefferson Proving Ground, Madison, Indiana

| JPG Location Designation ^a | Sample I.D. | pH | Temp (°C) | Conductivity (mS/cm) | Dissolved Oxygen (mg/L) | Exposure Rate ^b (μR/hr) |
|---------------------------------------|-------------|------|-----------|----------------------|-------------------------|------------------------------------|
| MW01 | MW-DU-001 | 7.99 | 12.30 | 0.445 | 12.44 | 5 |
| MW05 | MW-DU-005 | 7.36 | 15.94 | 1.01 | 11.20 | 6 |
| MW06 | MW-DU-007 | 7.27 | 11.83 | 0.549 | 10.70 | 5 |
| MW11 | MW-DU-0011 | 6.40 | 15.31 | 6.33 | 13.84 | 6 |

^a Represents sample designation developed in previous sampling programs.

^b Dose rate data were collected using Ludlum Model 19, serial number 243118, which was calibrated on 12 February 2019.

Table 3-10. Uranium in Surface Water (Fall 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/L) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|-----------------|---------------|----------------------------|-----------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| SW-DU-001 | 0.15 ± 0.06 | 0.004 ± 0.014 U | 0.13 ± 0.05 | 0.28 ± 0.08 | 0.82 ± 0.47 |
| SW-DU-002 ^d | 0.12 ± 0.06 J | 0.01 ± 0.03 U | 0.19 ± 0.07 | 0.31 ± 0.10 | 1.6 ± 1.0 |
| SW-DU-002D ^d | 0.13 ± 0.065 J | 0.02 ± 0.03 U | 0.25 ± 0.09 | 0.39 ± 0.11 | 1.9 ± 1.2 |
| SW-DU-007 | 0.19 ± 0.08 | 0.006 ± 0.022 U | 0.08 ± 0.05 J | 0.27 ± 0.10 | 0.44 ± 0.34 |
| SW-DU-008 | 0.18 ± 0.07 | 0.008 ± 0.016 U | 0.39 ± 0.10 | 0.57 ± 0.12 | 2.1 ± 1.0 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for SW-DU-002 and its duplicate were 0.35 ± 0.15 pCi/L and 1.8 ± 1.5, respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not performed.

Table 3-11. Surface Water Quality Parameters and Exposure Readings (Fall 2019)
Jefferson Proving Ground, Madison, Indiana

| JPG Location Designation ^a | Sample I.D. | pH | Temp (°C) | Conductivity (mS/cm) | Dissolved Oxygen (mg/L) | Exposure Rate ^b (μR/hr) |
|---------------------------------------|-------------|------|-----------|----------------------|-------------------------|------------------------------------|
| SWS01 | SW-DU-001 | 8.60 | 15.35 | 0.378 | 17.43 | 5 |
| SWS02 | SW-DU-002 | 7.37 | 16.53 | 0.272 | 12.76 | 5 |
| SWS07 | SW-DU-007 | 7.55 | 10.71 | 0.315 | 43.68 | 5 |
| SWS08 | SW-DU-008 | 8.22 | 15.83 | 0.514 | 6.43 | 6 |

^a Represents sample designation developed in previous sampling programs.

^b Dose rate data were collected using Ludlum Model 19, serial number 243118, which was calibrated on 12 February 2019.

Table 3-12. Uranium in Sediment (Fall 2019)
Jefferson Proving Ground, Madison, Indiana

| Sample I.D. ^a | Activity Concentration (pCi/g) ^b | | | | Ratio U-238/U-234 ^{c, d} |
|--------------------------|---|-----------------|-------------|----------------------------|-----------------------------------|
| | U-234 | U-235 | U-238 | Total Uranium ^d | |
| SD-DU-001 | 0.21 ± 0.06 | 0.01 ± 0.02 U | 0.19 ± 0.06 | 0.41 ± 0.09 | 0.91 ± 0.41 |
| SD-DU-002 | 0.12 ± 0.05 | 0.004 ± 0.014 U | 0.19 ± 0.06 | 0.31 ± 0.08 | 1.5 ± 0.8 |
| SD-DU-007 | 0.62 ± 0.12 | 0.06 ± 0.04 J | 0.61 ± 0.12 | 1.3 ± 0.2 | 1.0 ± 0.3 |
| SD-DU-008 ^d | 0.37 ± 0.094 | 0.02 ± 0.02 J | 0.54 ± 0.12 | 0.93 ± 0.15 | 1.5 ± 0.5 |
| SD-DU-008D ^d | 0.29 ± 0.08 | 0.03 ± 0.03 J | 0.41 ± 0.10 | 0.73 ± 0.13 | 1.5 ± 0.5 |

^a Identification.

^b Laboratory uncertainties are specified with two standard deviations (95 percent confidence level).

^c Unitless.

^d Merged total uranium and U-238/U-234 ratio for SD-DU-008 and its duplicate are 0.83 ± 0.20 pCi/g and 1.5 ± 0.7, respectively.

U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantification limit.

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4. HISTORICAL DATA ASSESSMENT AND TREND ANALYSIS

Historical data from the ERMP are reviewed and discussed in this section in the context of existing action levels and corrective actions for environmental media documented in the SOP for the ERMP and License Amendment No. 20 for SUB-1435 (ML19088A305). The action levels and associated corrective actions are provided in Table 4-1.

**Table 4-1. Action Levels and Corrective Actions for Total Uranium in Environmental Media
Jefferson Proving Ground, Madison, Indiana**

| Medium | Total Uranium Action Level | Corrective Action |
|---|-------------------------------|---|
| Groundwater and Surface Water | ≥ 150 pCi/L * | Resample. If activity verified, notify NRC and assess results. The findings and recommended corrective actions will be documented for the Army's Radiation Control Committee. The Committee will provide recommendations to the JPG License Holder based on its evaluation. |
| | Less than 150 pCi/L | No action. |
| Soil and Sediment: Perimeter and Background Samples | ≥ 35 pCi/g | Collect five additional samples in a 1-meter grid. If average activity exceeds 35 pCi/g, decontaminate to 35 pCi/g. |
| | Less than 35 pCi/g | No corrective action. |

* Effluent concentration limit for uranium is 300 pCi/L, as specified in 10 CFR 20, Appendix B, Table 2, Column 2.
Source: U.S. Army 1999 and CHPPM 2000 (see Appendix A, pages A-6 and A-7).

An assessment of historical trends for ERMP data was first provided in the April 2006 Radiation Monitoring Report (SAIC 2006). That assessment focused on available sampling data for groundwater, surface water, sediment, and soil since 1998. Quality assurance/quality control (QA/QC) records for data collected prior to 1998 were not available to support the trend analyses. In addition, changes to analytical methods were made that were implemented beginning in December 2004. Therefore, although historical data are reported beginning in 1998, trend analyses included in this ERM report addresses the time period from December 2004 to the present. In addition, surface water and groundwater results for the April 2004 sampling event were not trended, given that the results were provided in units of $\mu\text{g/L}$ rather than pCi/L.

As noted above, the April 2006 Radiation Monitoring Report (SAIC 2006) provided detailed information about the trending methods employed and why certain data were or were not included in the initial trend analysis. To avoid confusion, that information is not repeated in this report. This report section re-examines the ERMP data for historical trends following the addition of the ERMP data collected during the spring and fall 2019 sampling events. Stated numbers of samples and summary statistics are based on data generated since December 2004 (when laboratory analytical methods were revised and standardized).

4.1 GROUNDWATER

For 363 discrete samples (inclusive of duplicates) available from 11 monitoring wells (MW-DU-001 to MW-DU-011) during the period from 2004 through the October 2019 sampling event, the average total uranium activity-concentration is 1.4 pCi/L, the standard deviation is 1.1 pCi/L, and the maximum detected activity-concentration is 5.7 ± 0.6 pCi/L. The activity-concentrations at each monitoring location are well below the 150 pCi/L action level for groundwater. Note that only four monitoring wells (MW-DU-001, MW-DU-005, MW-DU-006, MW-DU-011) were sampled during the October 2019 sampling event, as required in License Amendment No. 20 for SUB-1435 (ML19088A305).

Data for each monitoring well are summarized in run charts, as shown on Figures 4-1 through 4-11. Total uranium results are displayed along with each measurement's associated error bars. The error bars

are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. The associated coefficient of correlation (R^2) and trend lines are also provided and are listed on each figure. An R^2 value that approaches 1.0 suggests a strong relationship between the sample results and the sampling dates. Most monitoring wells exhibit negative trend lines such that total uranium results generally exhibit decreasing activity. The exceptions are MW-DU-005, MW-DU-007, MW-DU-008, and MW-DU-011, which exhibited a very limited, but statistically insignificant, increasing trend. Although the figures for all 11 individual monitoring wells indicate no significant trends, the trend line for MW-DU-009 reflected an R^2 value of 0.58 (i.e., somewhat significant) with a declining slope.

In addition to the aforementioned run charts (Figures 4-1 through 4-11), individual variable control charts were created in April 2006 for each monitoring well with the upper control limit (UCL) and the lower control limit (LCL) defined at three standard deviations above or below the mean. The control charts were created to determine if any single sample result warranted further examination. These control charts were updated (as applicable) with new groundwater data and re-examined in this report. All total uranium results at each groundwater sampling location for the May and October 2019 sampling efforts were within the cited control limits. An example individual control chart for MW-DU-001 is provided on Figure 4-12.

The 11 monitoring wells also were examined in aggregate to determine if some wells or particular sampling events were distinctive. A simple individual control chart was created using the pooled data for all monitoring wells and all data collected after December 2004 (Figure 4-13).

Figure 4-13 indicates that three points lie on or above the UCL of 4.65 pCi/L applicable to the full data set. All three of these data points were from MW-DU-006. MW-DU-006 samples exceeding the UCL were for the December 2004, May 2005, and October 2010 sampling events and exhibited individual concentration values of 4.8, 5.3, and 5.7 pCi/L, respectively. The mean and standard deviation for MW-DU-006 is 3.4 ± 1.1 pCi/L, whereas the overall mean and standard deviation for the groundwater wells is 1.4 ± 1.1 pCi/L. Clearly, MW-DU-006 has exhibited, and continues to exhibit, total uranium results exceeding that of the other wells. Review of total uranium concentrations in MW-DU-006, as depicted in Figure 4-6, suggests a generally decreasing, but statistically insignificant, trend. The Army will continue to closely monitor results from MW-DU-006. As reflected on Figure 4-13, individual sample results vary about the mean, as expected. The maximum groundwater total uranium concentration for the May and October 2019 sampling event was 4.0 ± 0.5 pCi/L.

Notably, U-238/U-234 activity ratios for May and October 2019 groundwater sampling range from non-detect (MW-DU-011) to 0.83 ± 0.18 pCi/L (MW-DU-006), suggesting that significant concentrations of DU were not encountered (see graph of the “Relative Uranium-238/Uranium-234 Activity Ratios for Mixtures of Depleted and Natural Uranium” in Appendix D).

4.2 SURFACE WATER

For 267 discrete samples (inclusive of duplicates) available from 8 surface water sampling locations (SW-DU-001 to SW-DU-008) during the period from 2004 through the October 2019 sampling event, the average total uranium activity-concentration is 0.7 pCi/L, the standard deviation is 1.8 pCi/L, and the maximum detected activity-concentration is 19 ± 2 pCi/L. The activity-concentrations at each surface water sampling location are well below the 150 pCi/L action level for surface water. Note that only four surface water sampling locations (SW-DU-001, SW-DU-002, SW-DU-007, SW-DU-008) were sampled during the October 2019 sampling event, as required in License Amendment No. 20 for SUB-1435 (ML19088A305).

Data for each surface water sampling location are summarized in run charts, as shown on Figures 4-14 through 4-21. Total uranium results are displayed along with each measurement’s associated error bars. The error bars are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. Where trend lines are provided, the associated coefficient of correlation also is provided (the R^2 value listed on each figure). As noted in Section 4.1, an R^2 value that approaches 1.0 suggests a strong relationship

between the sample results and the sampling dates. The results at most surface water sampling locations exhibit negative trend lines such that total uranium results generally exhibit decreasing activity. Exceptions are SW-DU-001, SW-DU-002, SW-DU-007, and SW-DU-008, which exhibit a very limited, but statistically insignificant, increasing trend. None of the samples exhibited trend lines with R^2 values greater than 0.5 (i.e., somewhat significant).

Individual variable control charts were created to determine if any single surface water sample result warranted further examination. The control charts were updated with new surface water data and re-examined in this report. All total uranium results at each surface water sampling location for the May and October 2019 sampling efforts were within the cited control limits. The eight surface water sampling locations also were examined in aggregate to determine if some locations or particular sampling events were distinctive. A simple individual control chart was created using the pooled data for all surface water sampling locations and data collected beginning in December 2004 (Figure 4-22). Figure 4-22 indicates that four data points have exceeded the UCL of 6.21 pCi/L for total uranium. The total uranium concentrations in SW-DU-005 of 6.9 and 19 pCi/L exceeded the UCL in October 2008 and October 2010, respectively. Analytical results for SW-DU-004 reflected concentrations of 14 and 16 pCi/L for the sample and its duplicate, respectively, for the October 2010 sampling event. The maximum surface water total uranium concentration for the May and October 2019 sampling event was 1.0 ± 0.2 pCi/L.

Results for SW-DU-002D and SW-DU-008 from the October 2019 sampling event represent the only surface water sample location results with the potential to exceed the threshold of 3.0 with a U-238/U-234 activity ratio of 1.8 ± 1.6 and 2.1 ± 1.0 , respectively. During further investigation through reanalysis by ICP-MS of these samples and given that the mass of U-235 was not detected, lower and upper comparison values were derived to determine if the results are suggestive of the possible presence of DU in surface water at SW-DU-008. Since the total uranium result at SW-DU-002D was less than the lower comparison value, the results are suggestive of natural uranium in surface water at SW-DU-002D. Since the total uranium result at SW-DU-008 was greater than the lower comparison value but lower than the upper comparison value, the results are suggestive of a mixture of both natural uranium and DU in surface water at SW-DU-008.

With regard to the surface water samples, it is notable that the maximum surface water concentration of 1.0 pCi/L is approximately equal to 5 percent of the U.S. Environmental Protection Agency's (USEPA's) uranium primary drinking water standard of 30 $\mu\text{g/L}$ (which converts to approximately 20 pCi/L) and less than 1 percent of the effluent water limit prescribed in Title 10, CFR, Part 20, Appendix B (CFR 2014). In addition, it is notable that all results are well below the action levels/corrective actions listed in Table 4-1. Nonetheless, surface water results for each sampling locations will continue to be closely monitored with samples exceeding a U-238/U-234 ratio of 3.0 being subjected to confirmatory analysis by ICP-MS.

4.3 SEDIMENT

For 272 discrete samples (inclusive of duplicates) available from 8 sediment sampling locations (SD-DU-001 to SD-DU-008) during the period from December 2004 through the October 2019 sampling event, the average total uranium activity-concentration is 0.93 pCi/g, the standard deviation is 0.47 pCi/g, and the maximum detected activity-concentration is 2.5 ± 0.3 pCi/g. The activity-concentrations at each location are well below the 35 pCi/g action level. Note that only four sediment sampling locations (SD-DU-001, SD-DU-002, SD-DU-007, SD-DU-008) were sampled during the October 2019 sampling event, as required in License Amendment No. 20 for SUB-1435 (ML19088A305).

Data for each sediment sampling location are summarized in run charts, as shown on Figures 4-23 through 4-30. Total uranium results are displayed along with each measurement's associated error bars. The error bars are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. Where trend lines are provided, the associated coefficient of correlation also is provided (the R^2 value listed

on each figure). As noted in Section 4.1, an R^2 value that approaches 1.0 suggests a strong relationship between the sample results and the sampling dates. The results at most sediment sampling locations exhibit negative trend lines such that total uranium results generally exhibit decreasing activity. Exceptions are SD-DU-005, which exhibited a very limited, but statistically insignificant, increasing trend. None of the samples exhibited trend lines with R^2 values greater than 0.5 (i.e., somewhat significant).

Individual variable control charts were created to determine if any single sediment sample result warranted further examination. The control charts were updated with new sediment data and re-examined in this report. All total uranium results at each sediment sampling location for the May and October 2019 sampling efforts were within the cited control limits. The eight sediment sampling locations also were examined in aggregate to determine if some locations or particular sampling events were distinctive. A simple individual control chart was created using the pooled data for all sediment sampling locations and all data collected after December 2004 (Figure 4-31). Figure 4-31 indicates that two data points have equaled or exceeded the UCL of 2.35 pCi/g for total uranium. The total uranium concentrations of 2.4 pCi/g in SD-DU-004 and 2.5 pCi/g in SD-DU-007 equaled or exceeded the UCL in April 2007 and November 2016, respectively. The maximum sediment total uranium concentration for the May and October 2019 sampling event was 1.3 ± 0.2 pCi/g.

U-238/U-234 activity ratios for May and October 2019 sediment sampling range from 0.88 ± 0.38 pCi/g (SD-DU-001) to 1.7 ± 0.6 pCi/g (SD-DU-005), suggesting that significant concentrations of DU were not encountered.

4.4 SOILS

For 156 discrete samples (inclusive of duplicates) available from 4 surface soil sampling locations (SS-DU-001 to SS-DU-004) during the period from 2004 through the May 2019 sampling event, the average total uranium activity-concentration is 1.4 pCi/g, the standard deviation is 0.3 pCi/g, and the maximum detected activity-concentration is 2.2 ± 0.5 pCi/g. The activity-concentration at each location is well below the action level of 35 pCi/g. As a result of the issuance of License Amendment No. 20 for SUB-1435 (ML19088A305), soil sampling as part of the biannual ERMP is no longer required and soil samples were not collected during the October 2019 sampling event.

Data for each surface soil sampling location are summarized in run charts, as shown on Figures 4-32 through 4-35. Total uranium results are displayed along with each measurement's associated error bars. The error bars are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. Where trend lines are provided, the associated coefficient of correlation also is provided (the R^2 value listed on each figure). As noted in Section 4.1, an R^2 value that approaches 1.0 suggests a strong relationship between the sample results and the sampling dates. The figures for all four individual surface soil sampling locations indicate no significant trends. The overall slope of the trend line for SS-DU-001 continues to be negative with the activity concentrations decreasing from approximately 2.0 pCi/g to approximately 1.6 pCi/g over the period 2004 to the present, with only two samples collected since 2004 exhibiting concentrations equaling or exceeding 2.0 pCi/g. The results at two soil sampling locations exhibit negative trend lines such that total uranium results generally exhibit decreasing activity. The exceptions are SS-DU-002 and SS-DU-003, which exhibit a very limited, but statistically insignificant, increasing trend.

Individual variable control charts were created to determine if any single surface soil sample result warranted further examination. The control charts were updated with new surface soil data and re-examined in this report. All total uranium results at each surface soil sampling location for the May and October 2019 sampling efforts were within the cited control limits. The four surface soil sampling locations also were examined in aggregate to determine if some locations or particular sampling events were distinctive. A simple individual control chart was created using the pooled data for all surface soil sampling locations and all data collected beginning in December 2004 (Figure 4-36). As data are added to the control chart, the UCL, mean, and LCL are automatically recalculated. Figure 4-36 reflects that data from SS-DU-002 from

the October 2008 sampling event that exhibited a total uranium concentration of 0.36 ± 0.09 . This concentration is below the LCL of 0.56 pCi/g. All other surface soil data were within the range of the control limits. The maximum soil total uranium concentration for the May 2019 sampling event was 1.6 ± 0.2 pCi/g.

U-238/U-234 activity ratios for May 2019 soil sampling range from 0.94 ± 0.23 pCi/g (SS-DU-002) to 1.2 ± 0.3 pCi/g (SS-DU-003), suggesting that significant concentrations of DU were not encountered.

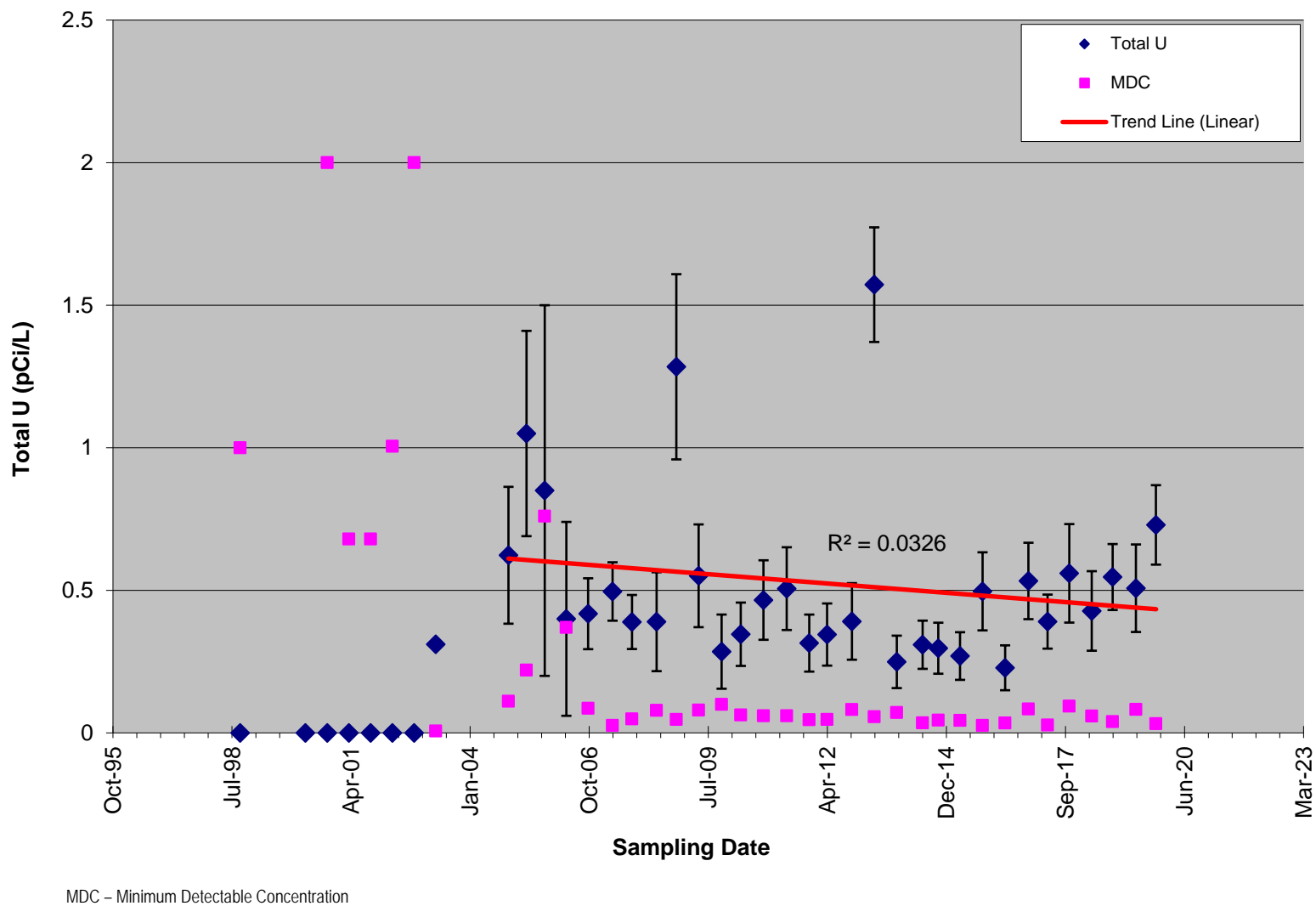
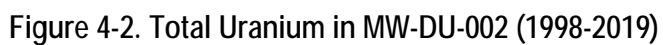
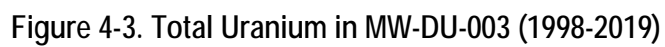
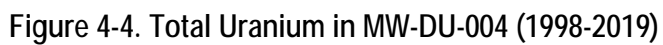
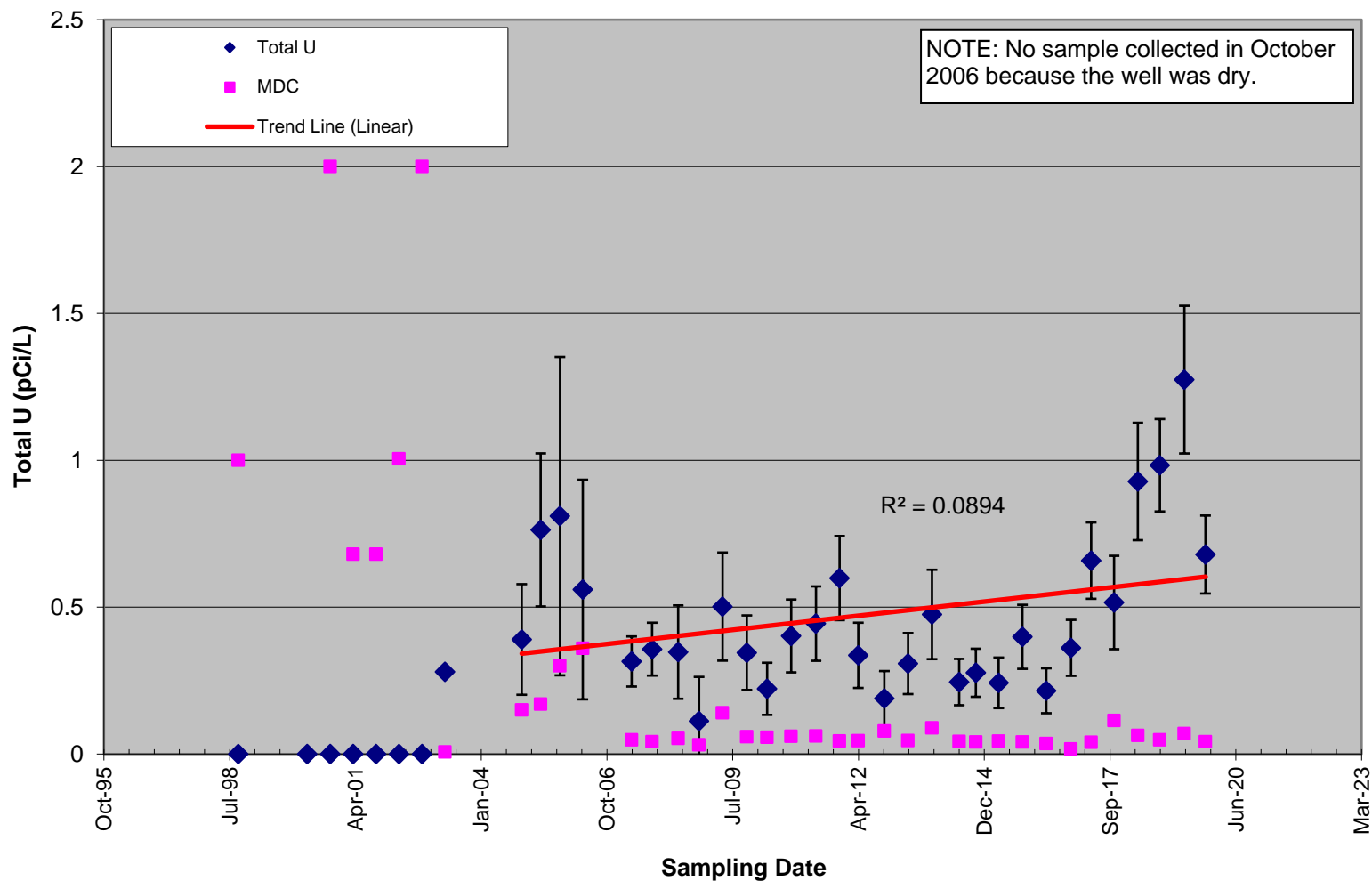


Figure 4-1. Total Uranium in MW-DU-001 (1998-2019)





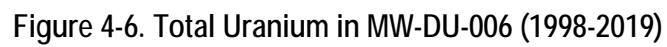


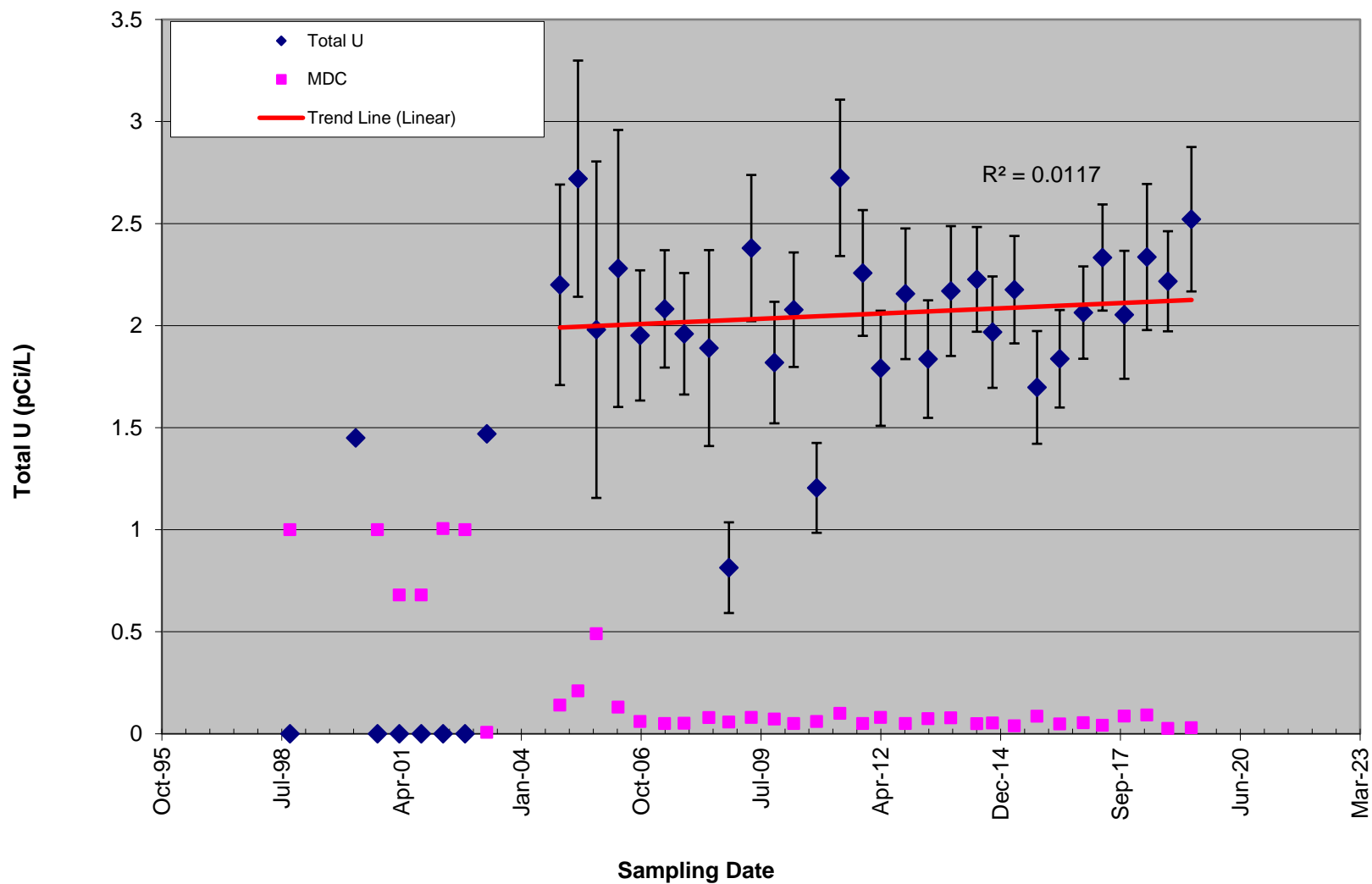


MDC – Minimum Detectable Concentration

NOTE: No sample was collected in October 2006 because the well was dry.

Figure 4-5. Total Uranium in MW-DU-005 (1998-2019)





MDC – Minimum Detectable Concentration

Figure 4-7. Total Uranium in MW-DU-007 (1998-2019)

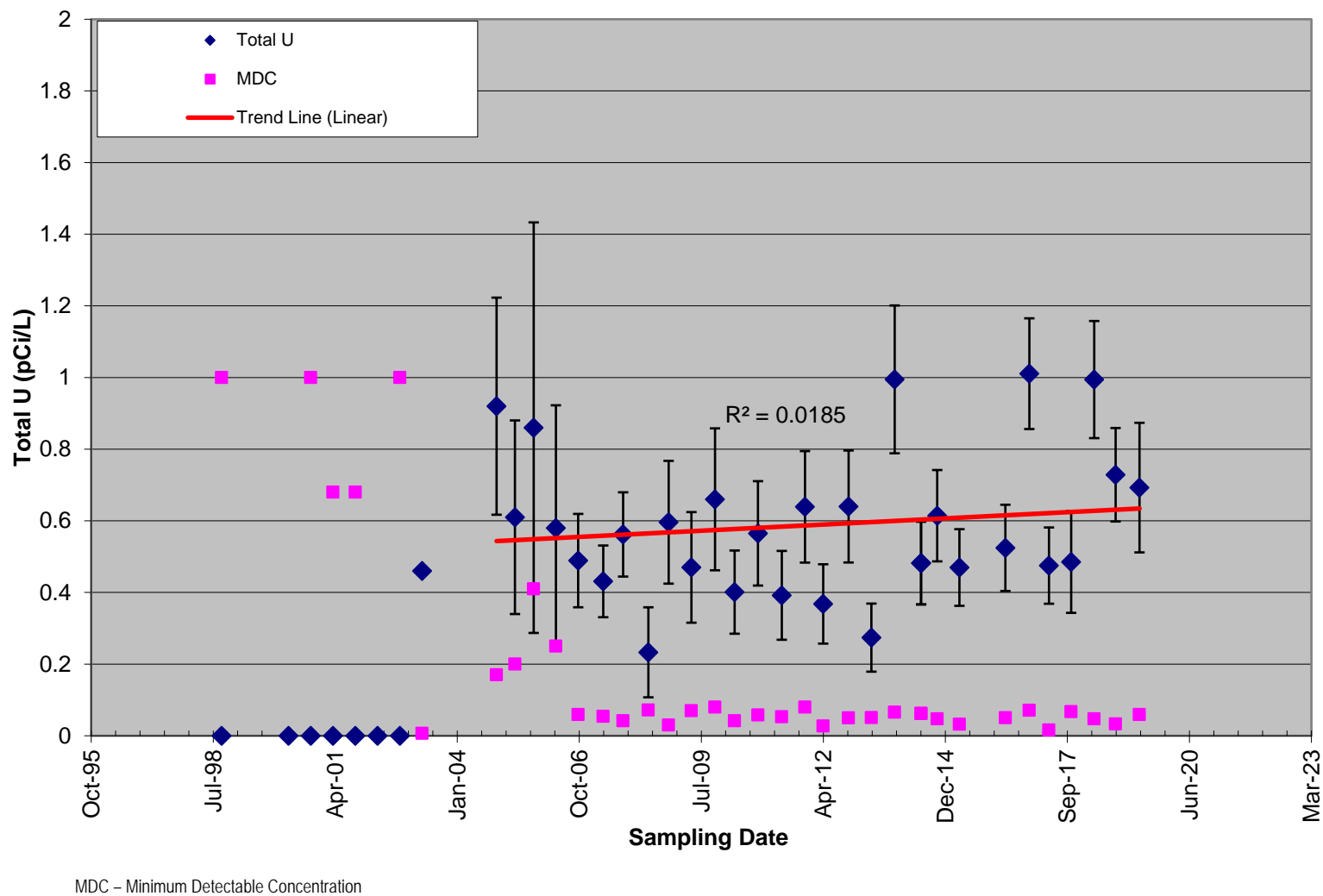


Figure 4-8. Total Uranium in MW-DU-008 (1998-2019)

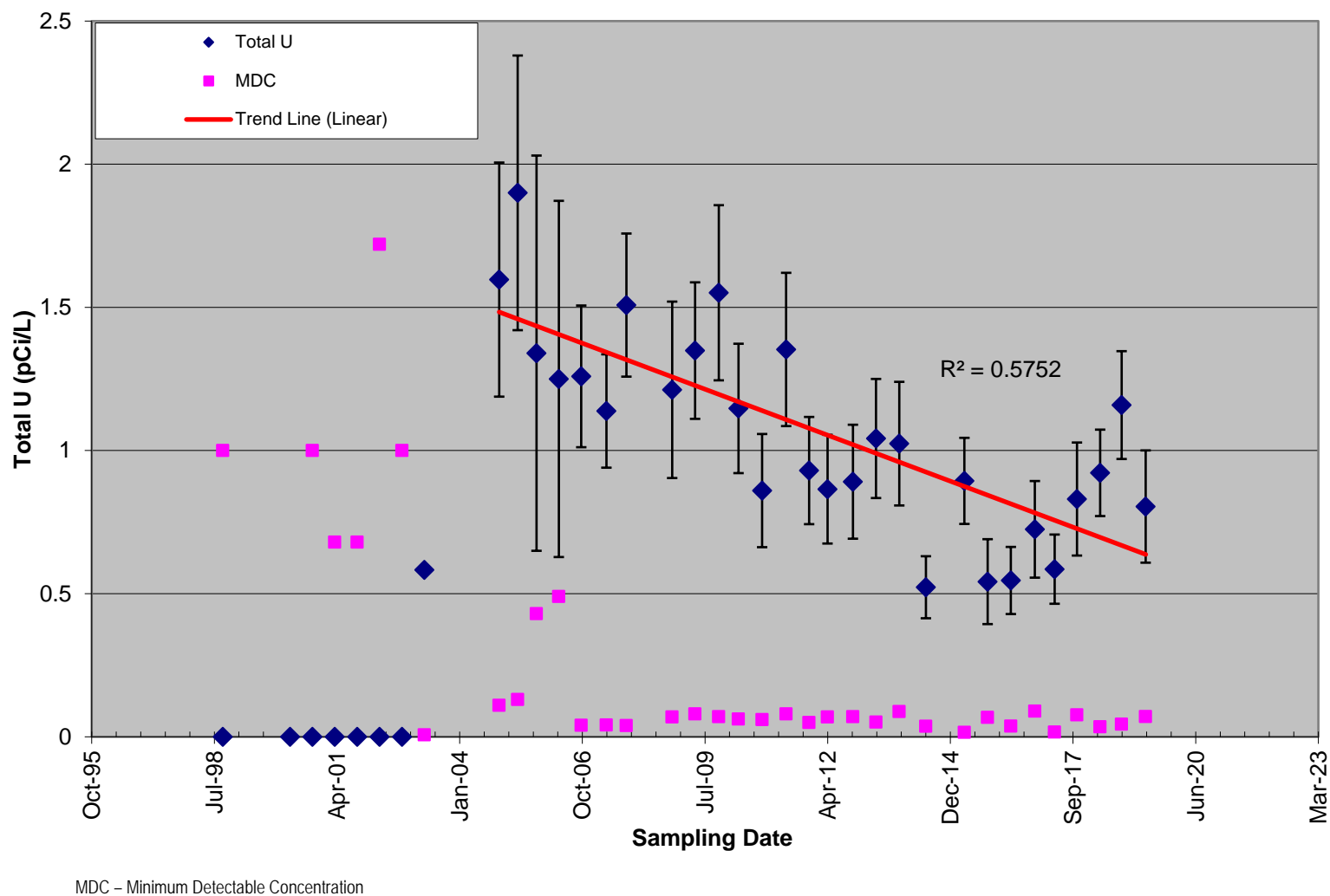
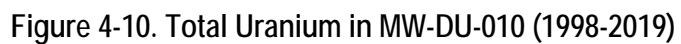
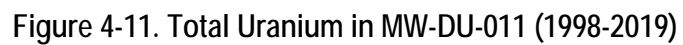
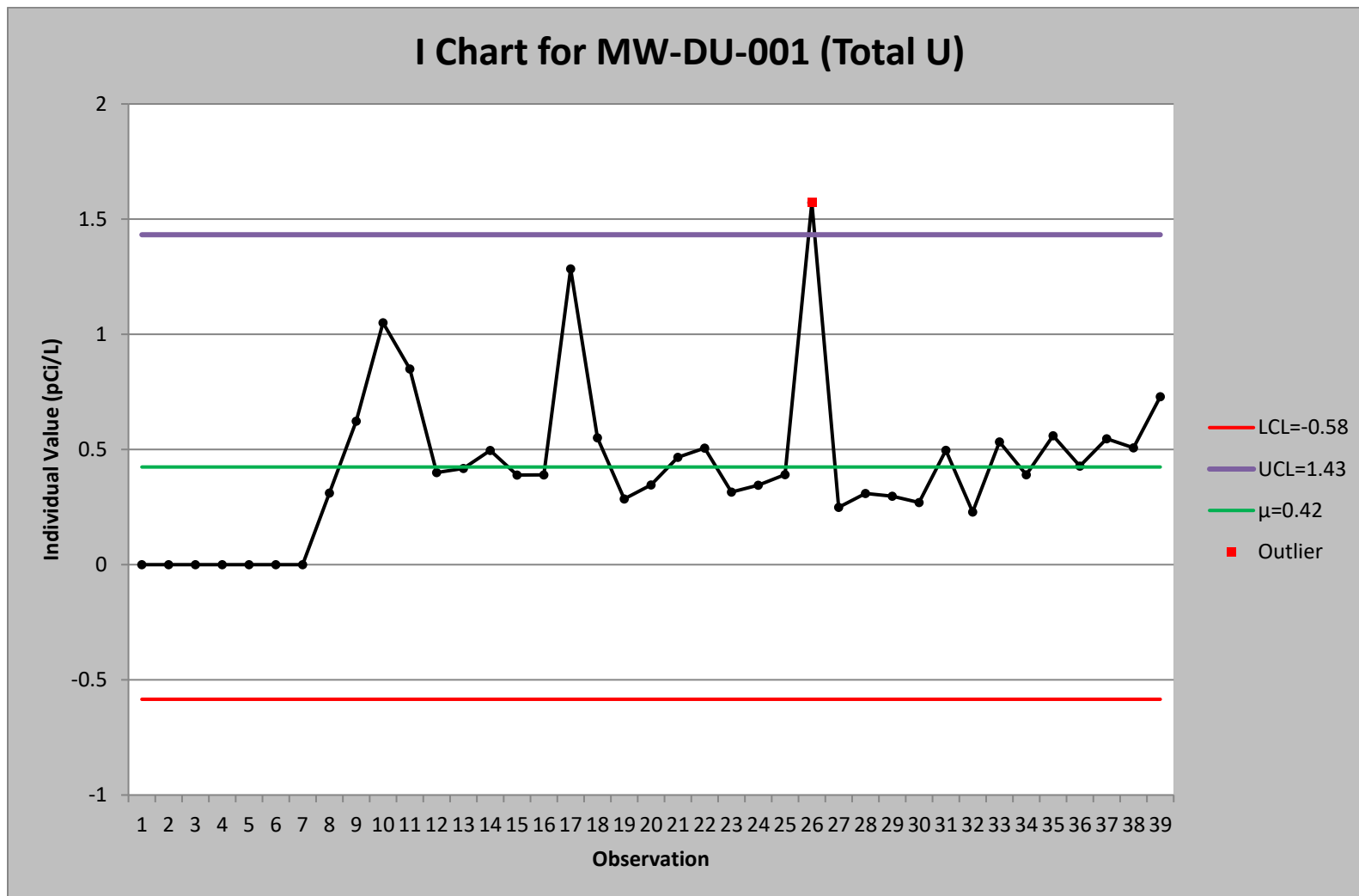


Figure 4-9. Total Uranium in MW-DU-009 (1998-2019)

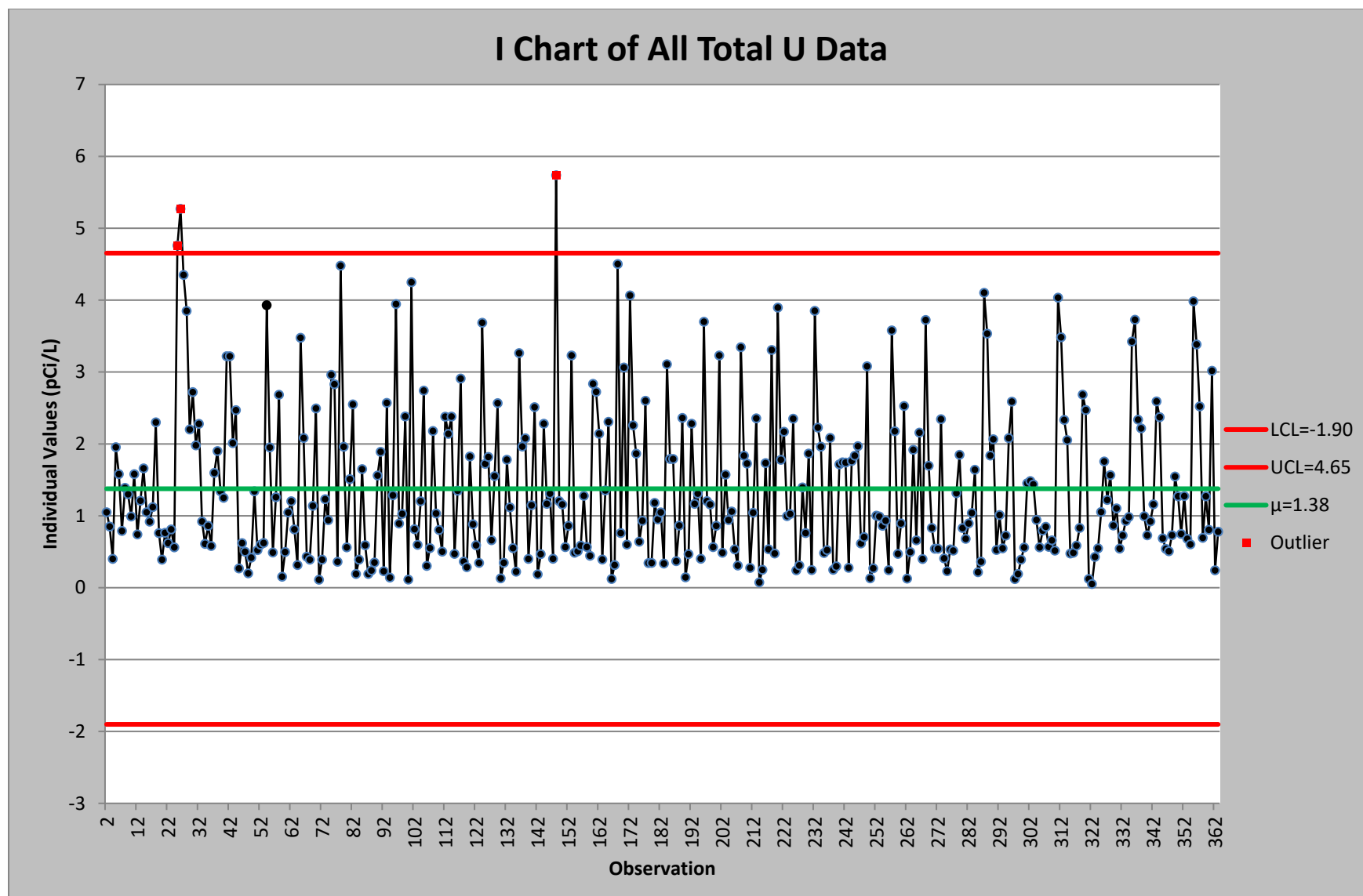






NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares.

Figure 4-12. Variable Control Chart for Total Uranium in MW-DU-001 (2004-2019)



NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares.

Figure 4-13. Control Chart for All Monitoring Well Data (2004-2019)







Figure 4-16. Total Uranium in SW-DU-003 (1998-2019)

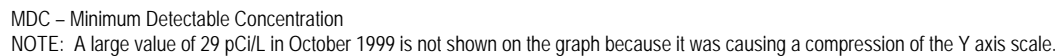
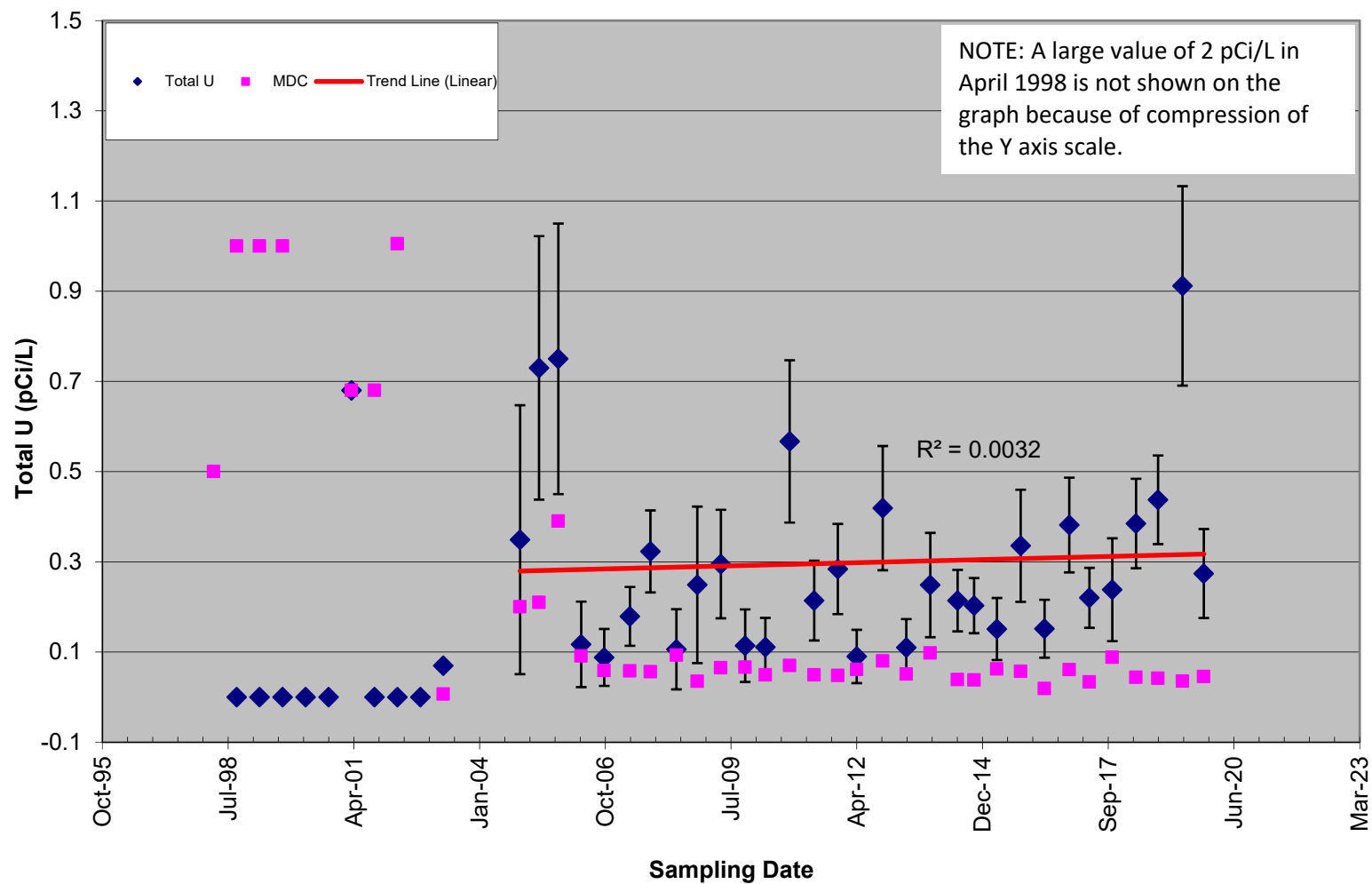


Figure 4-18. Total Uranium in SW-DU-005 (1998-2019)



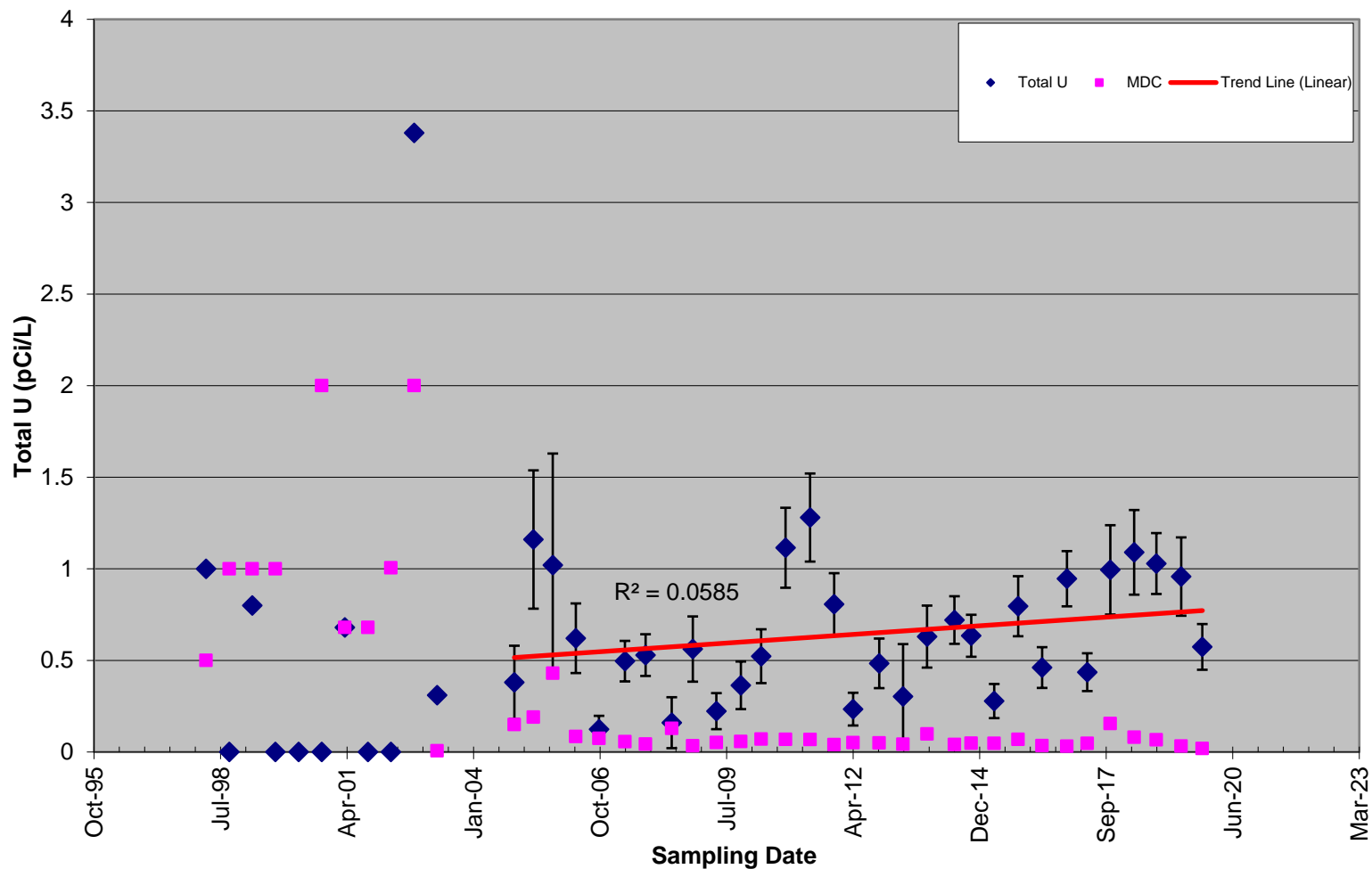
Figure 4-19. Total Uranium in SW-DU-006 (1998-2019)



MDC – Minimum Detectable Concentration

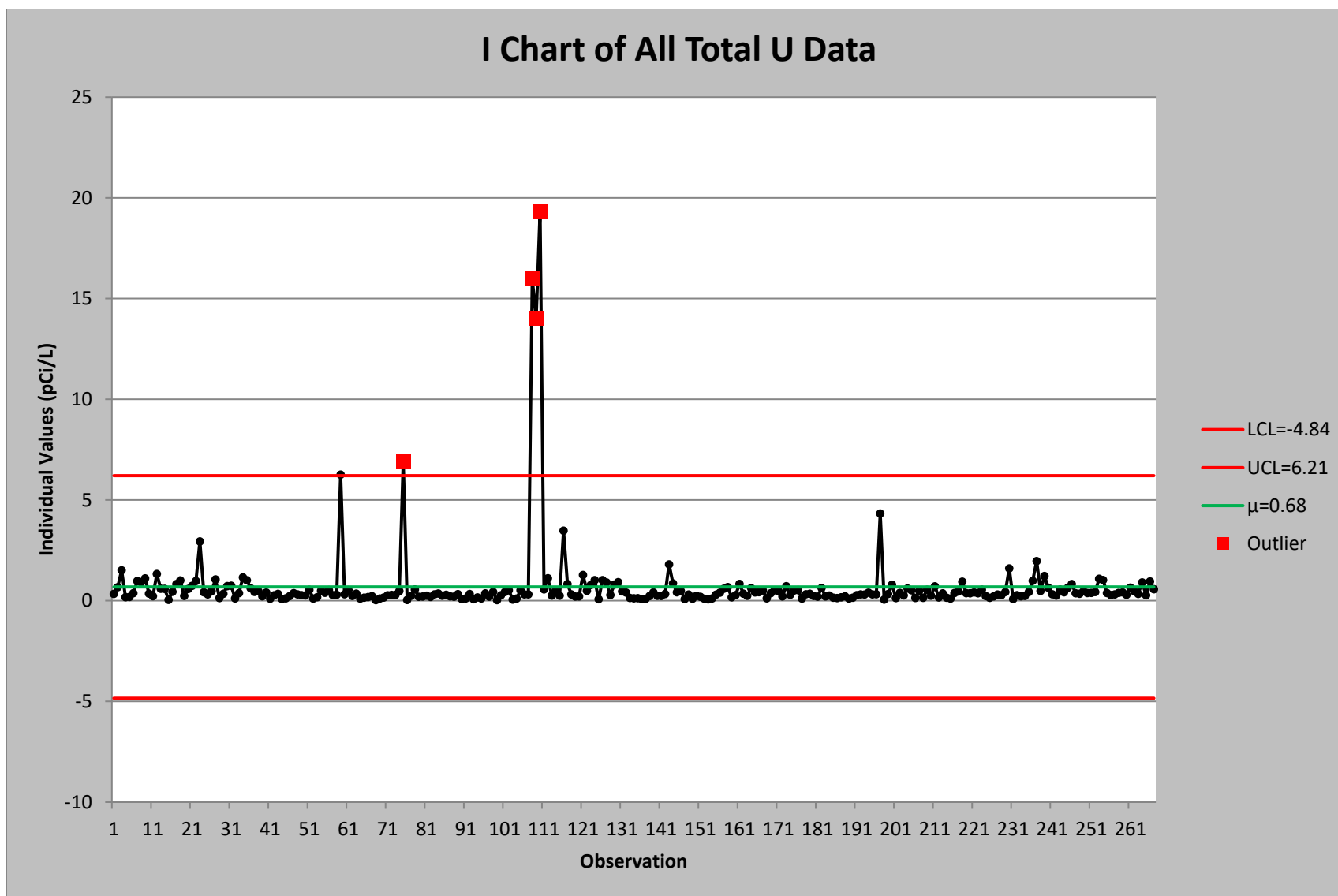
NOTE: A large value of 2 pCi/L in April 1998 is not shown on the graph because it was causing a compression of the Y axis scale.

Figure 4-20. Total Uranium in SW-DU-007 (1998-2019)



MDC – Minimum Detectable Concentration

Figure 4-21. Total Uranium in SW-DU-008 (1998-2019)



NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares.

Figure 4-22. Control Chart for All Surface Water Data (2004-2019)



Figure 4-23. Total Uranium in SD-DU-001 (1998-2019)

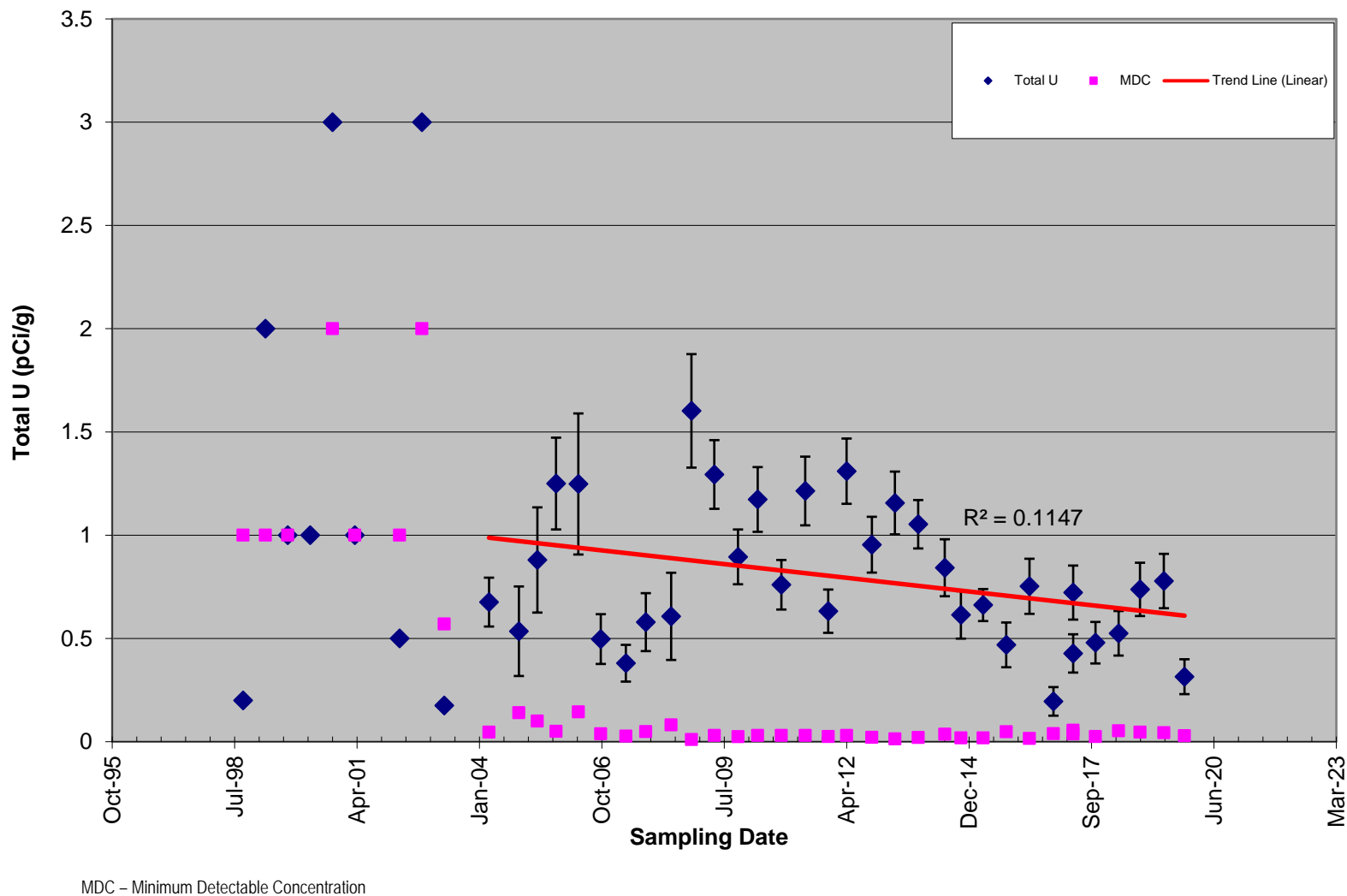
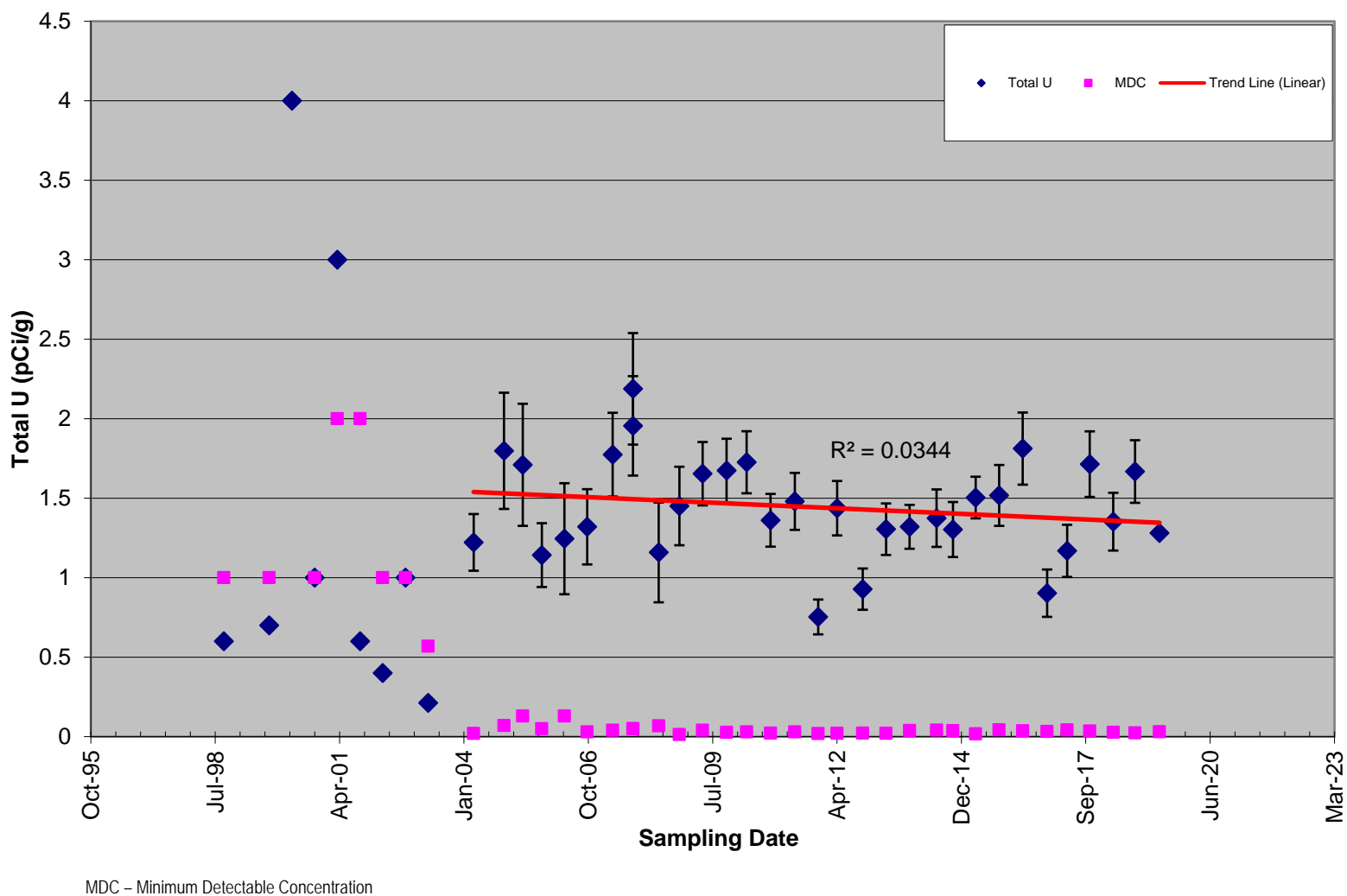


Figure 4-24. Total Uranium in SD-DU-002 (1998-2019)



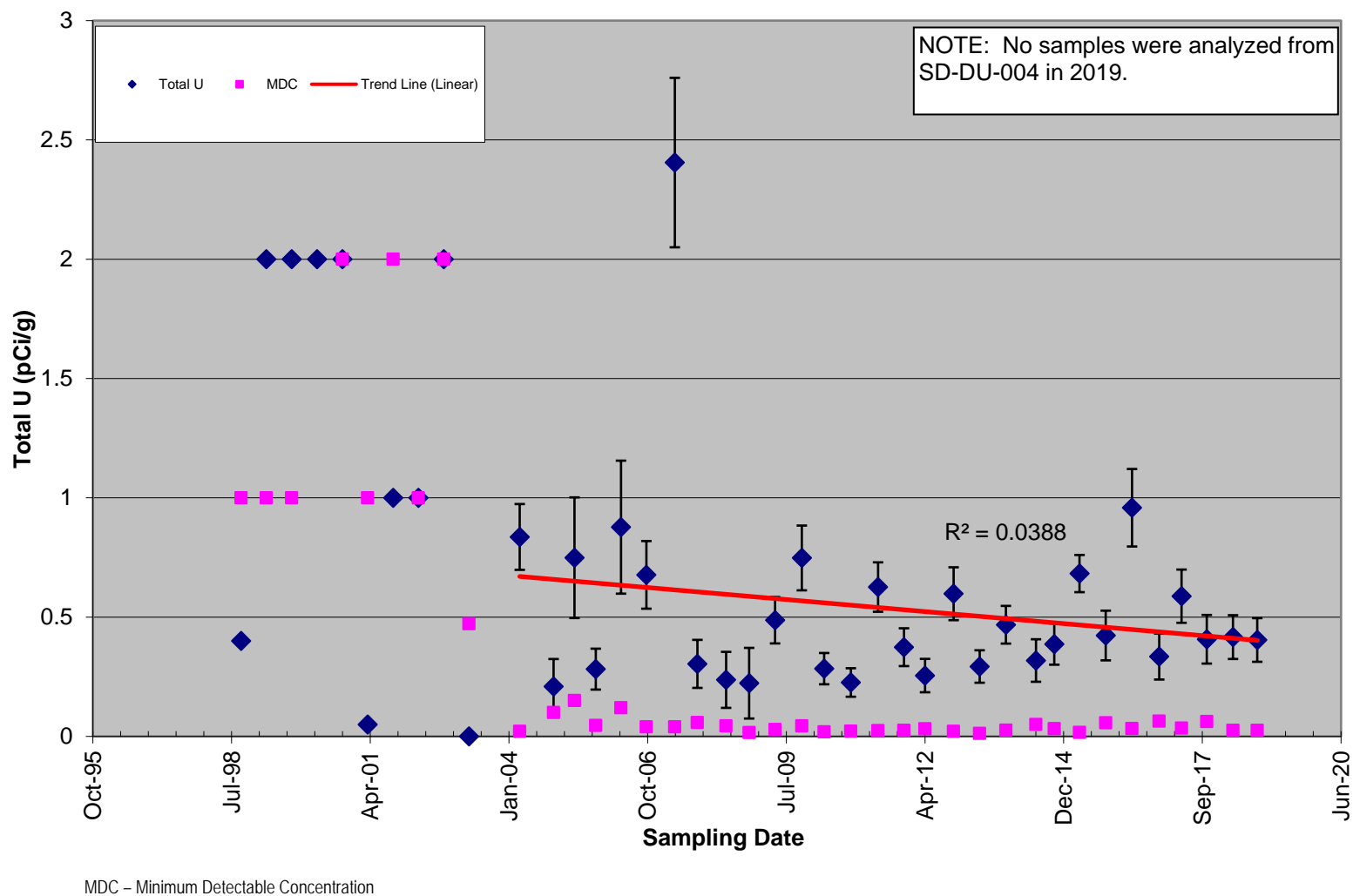
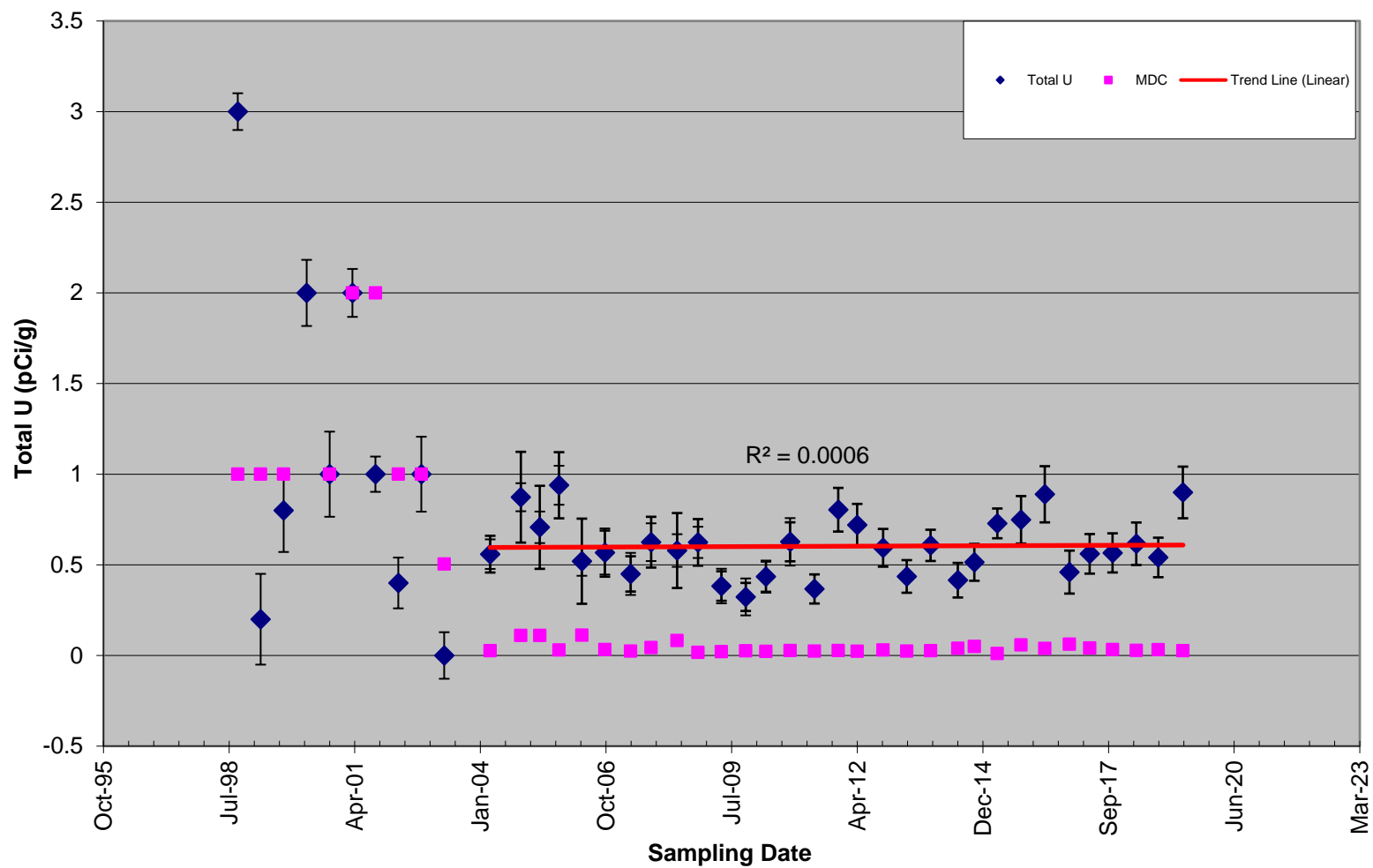
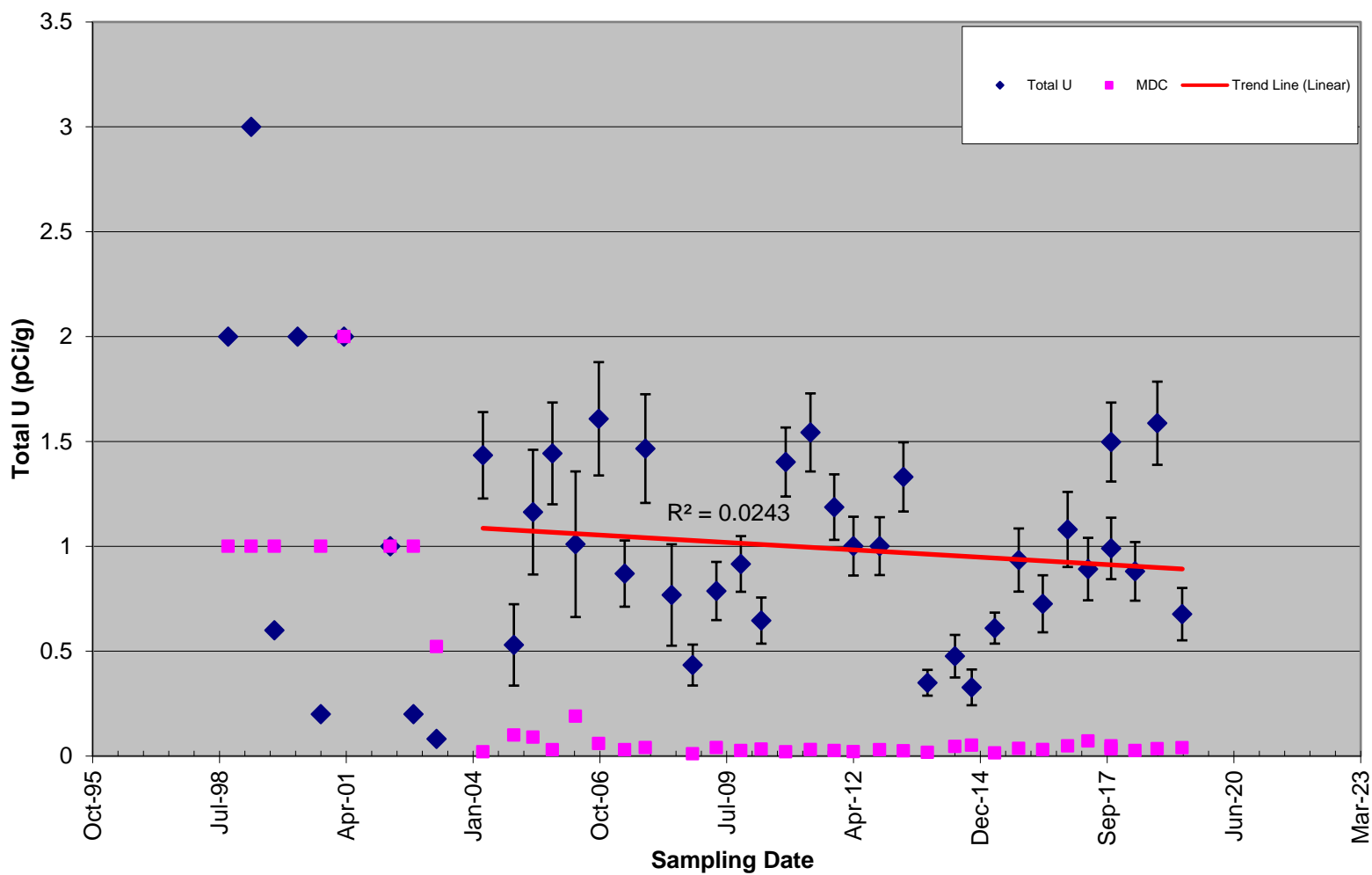


Figure 4-26. Total Uranium in SD-DU-004 (1998-2019)



MDC – Minimum Detectable Concentration

Figure 4-27. Total Uranium in SD-DU-005 (1998-2019)



MDC - Minimum Detectable Concentration

Figure 4-28. Total Uranium in SD-DU-006 (1998-2019)

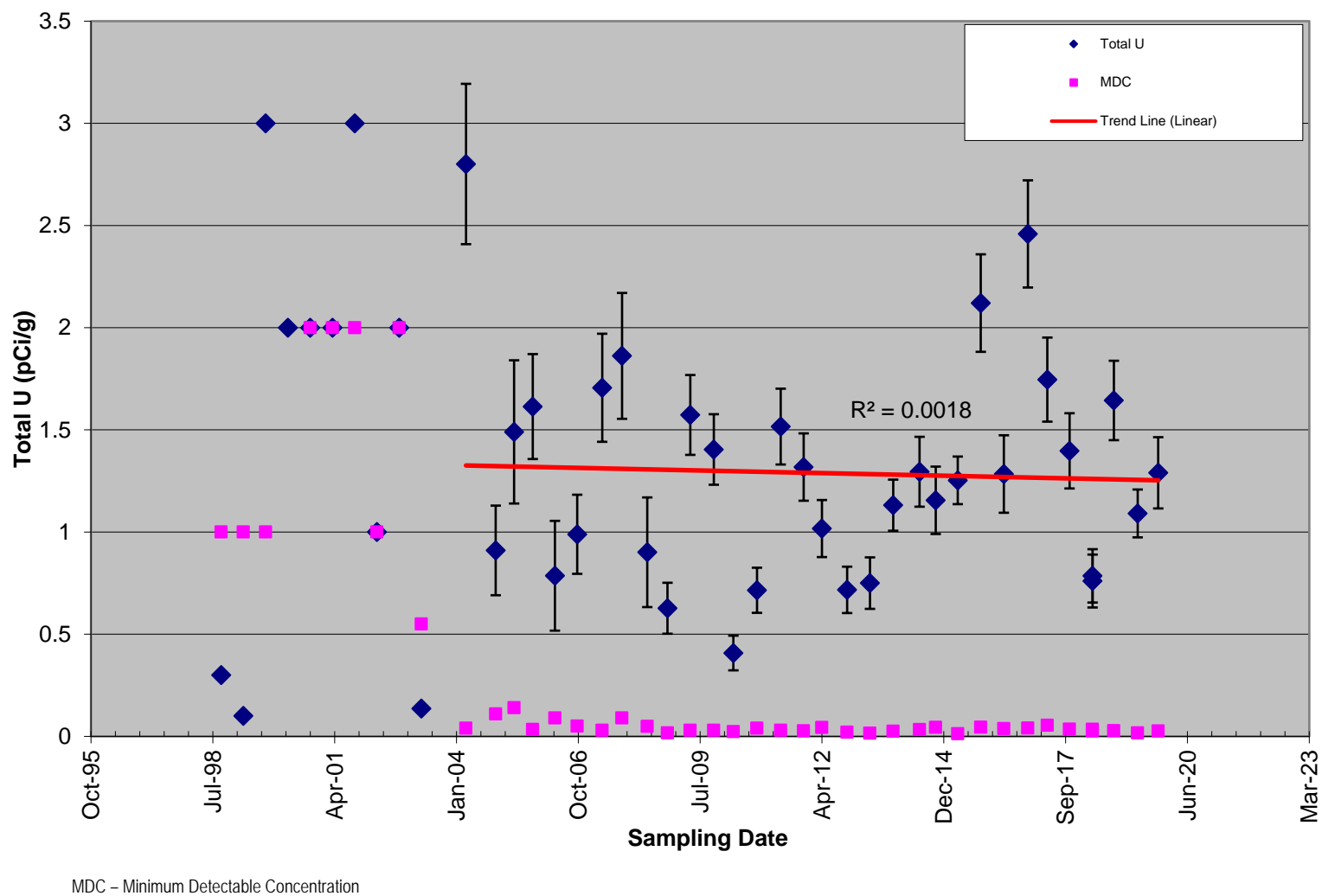
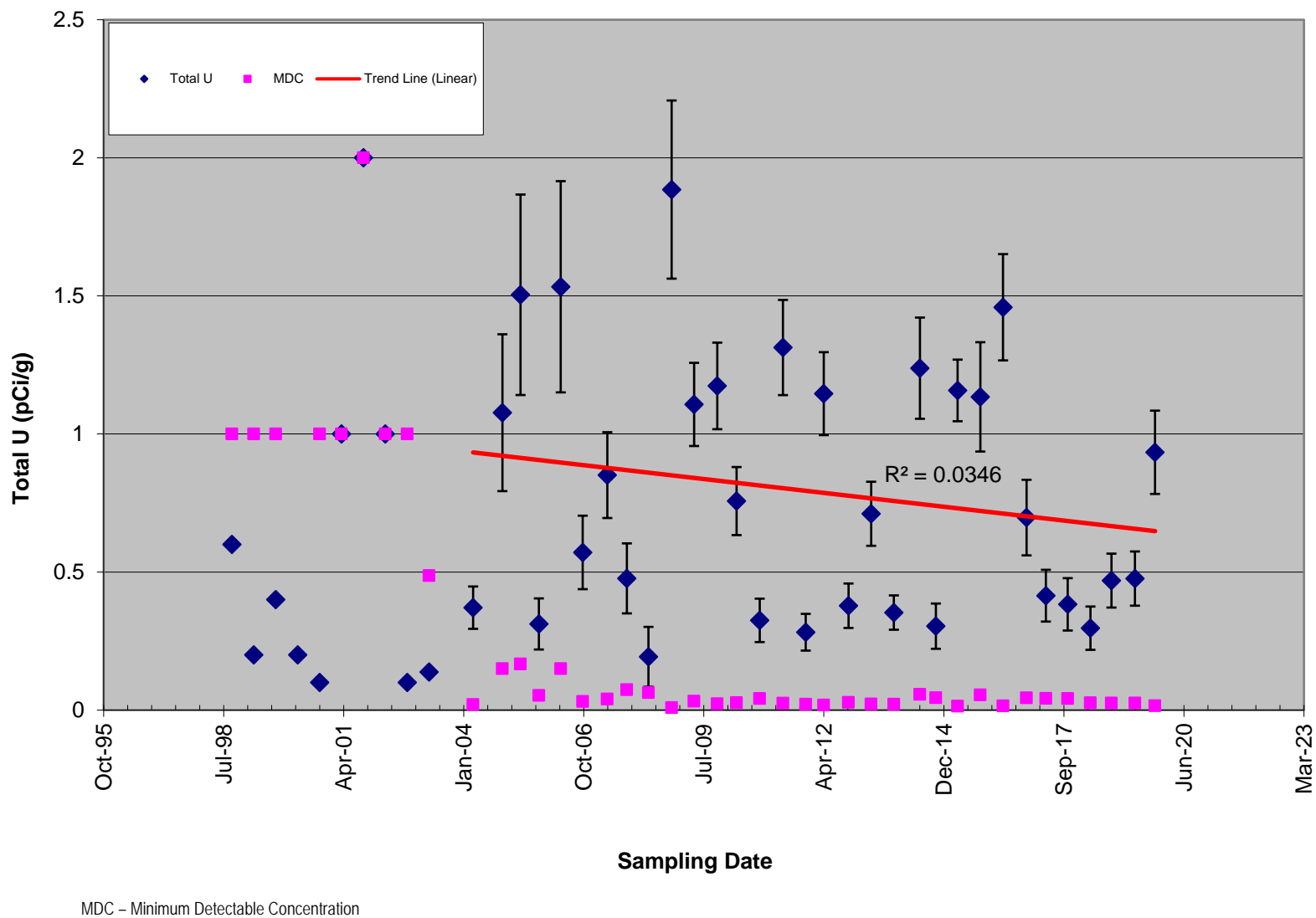
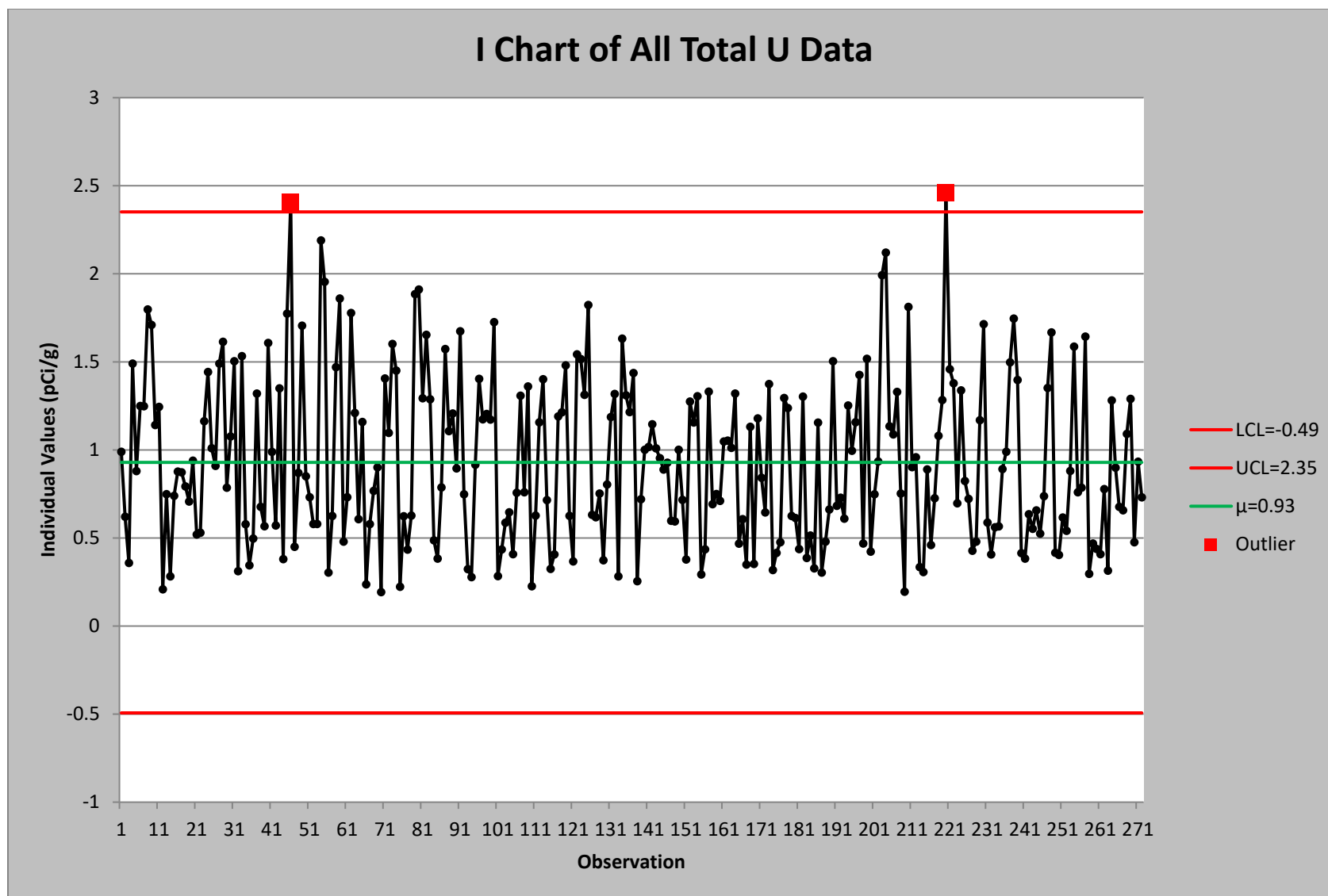


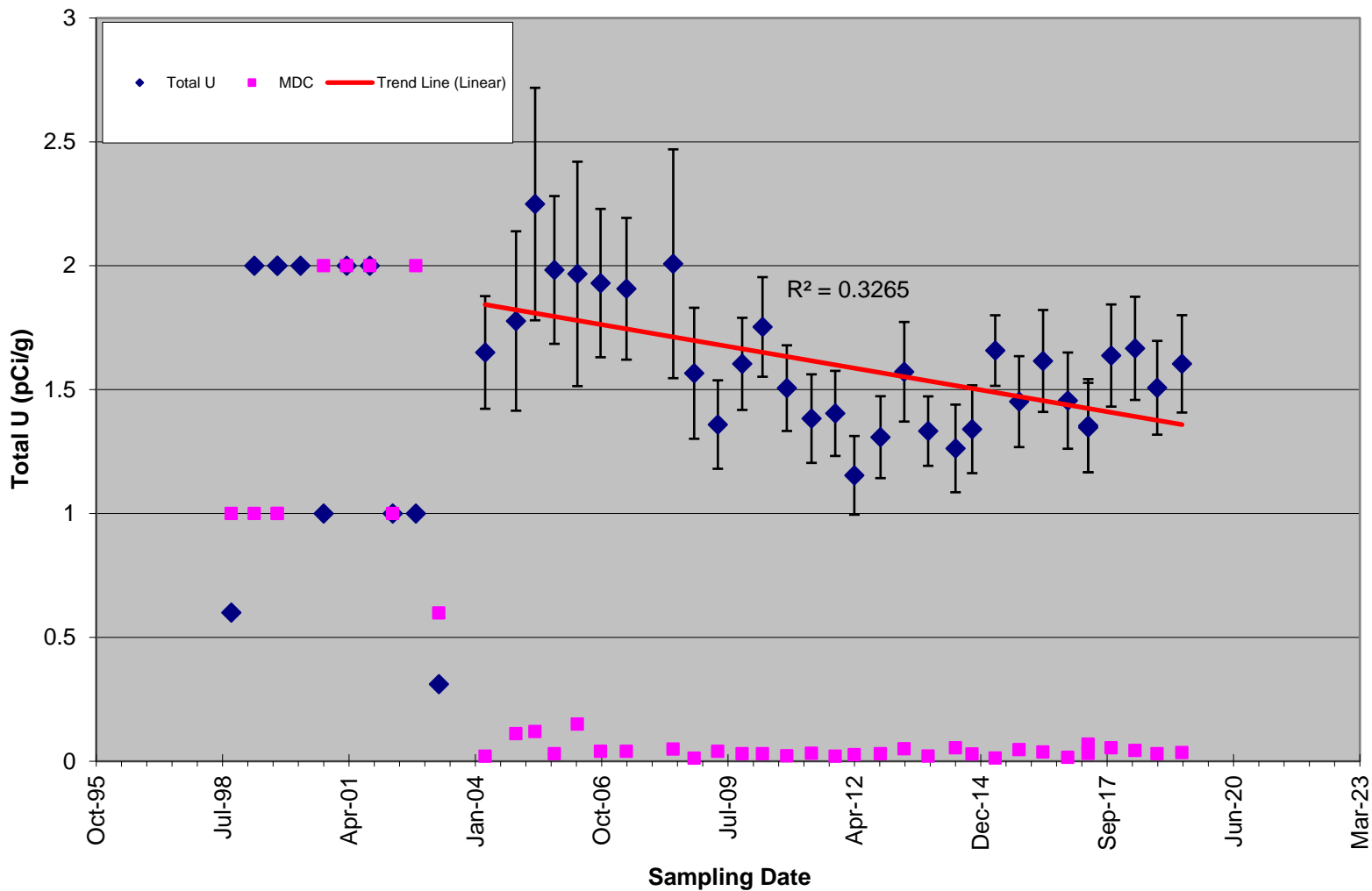
Figure 4-29. Total Uranium in SD-DU-007 (1998-2019)





NOTE: Results that exceed the UCL or fall below the LCL are reflected in the red square.

Figure 4-31. Control Chart for All Sediment Data (2004-2019)



MDC – Minimum Detectable Concentration

Figure 4-32. Total Uranium in SS-DU-001 (1998-2019)

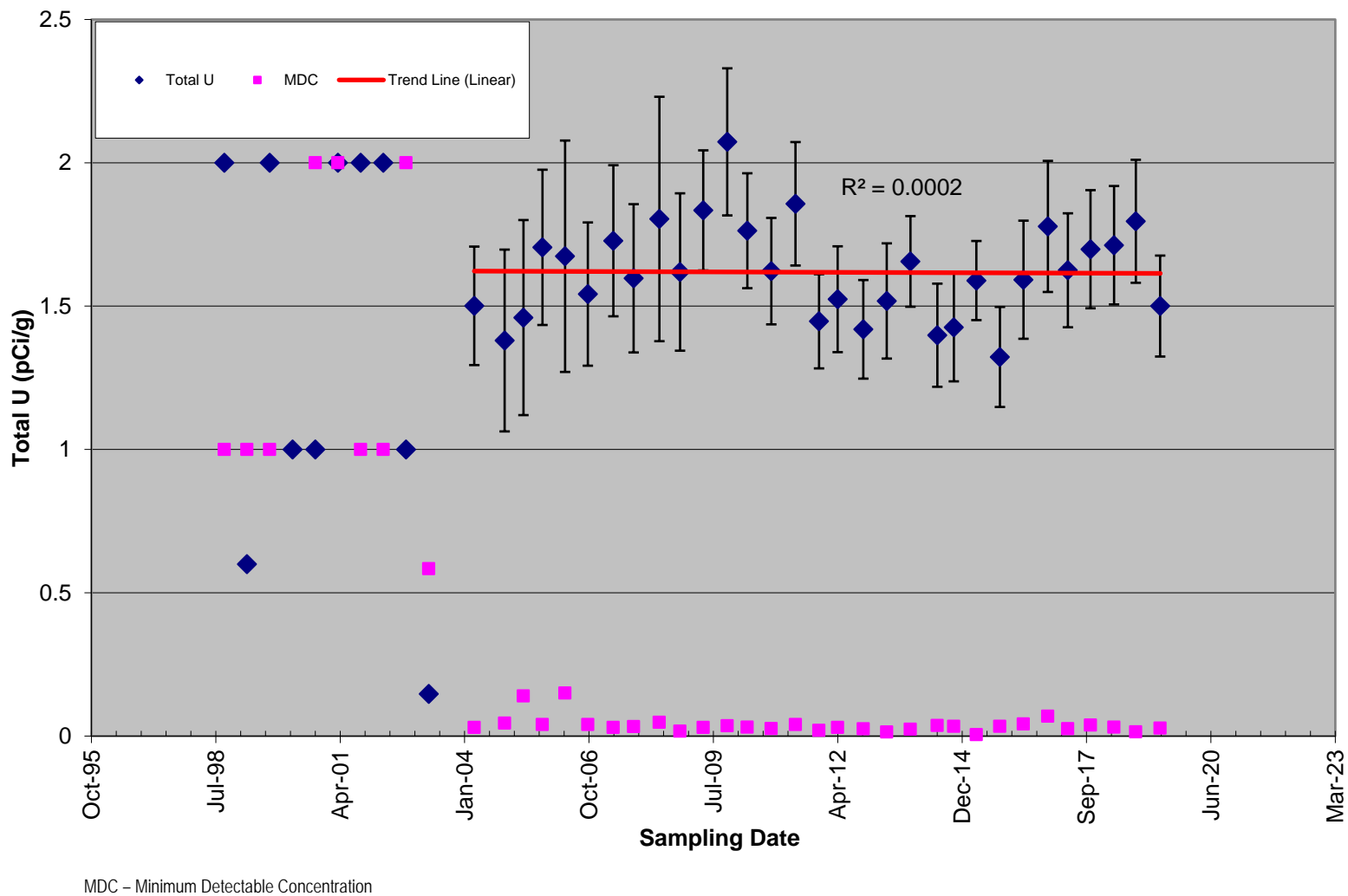


Figure 4-33. Total Uranium in SS-DU-002 (1998-2019)

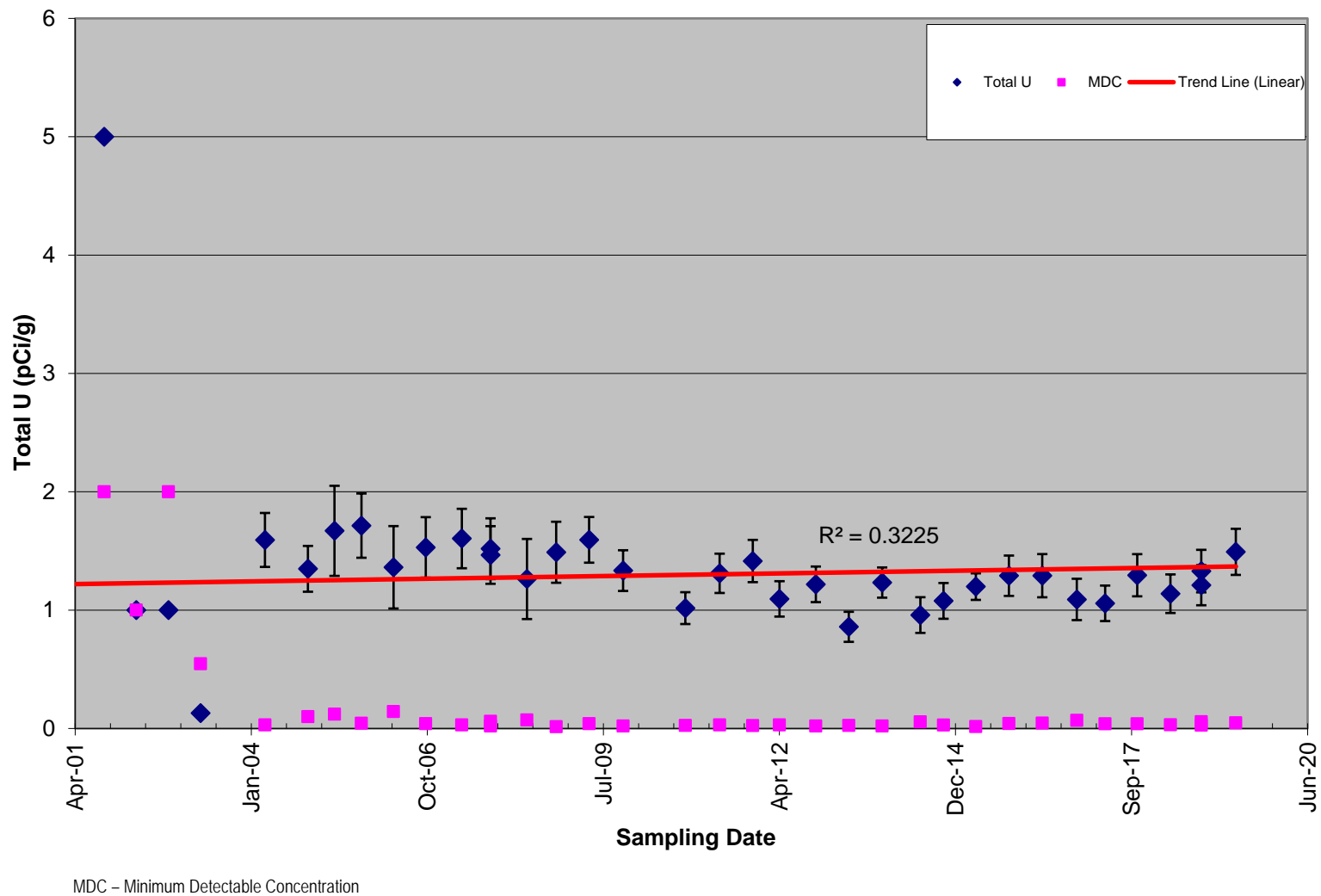
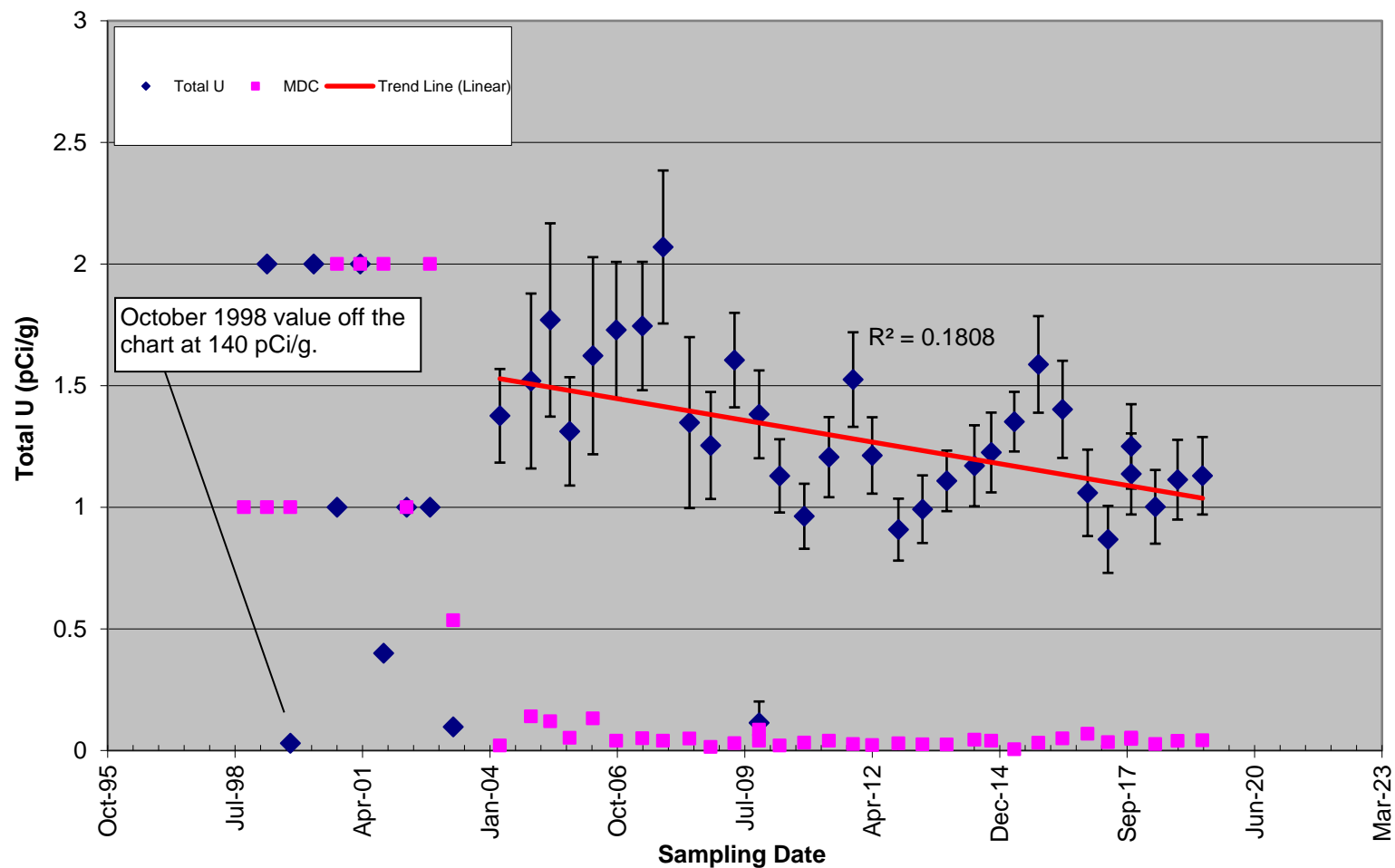
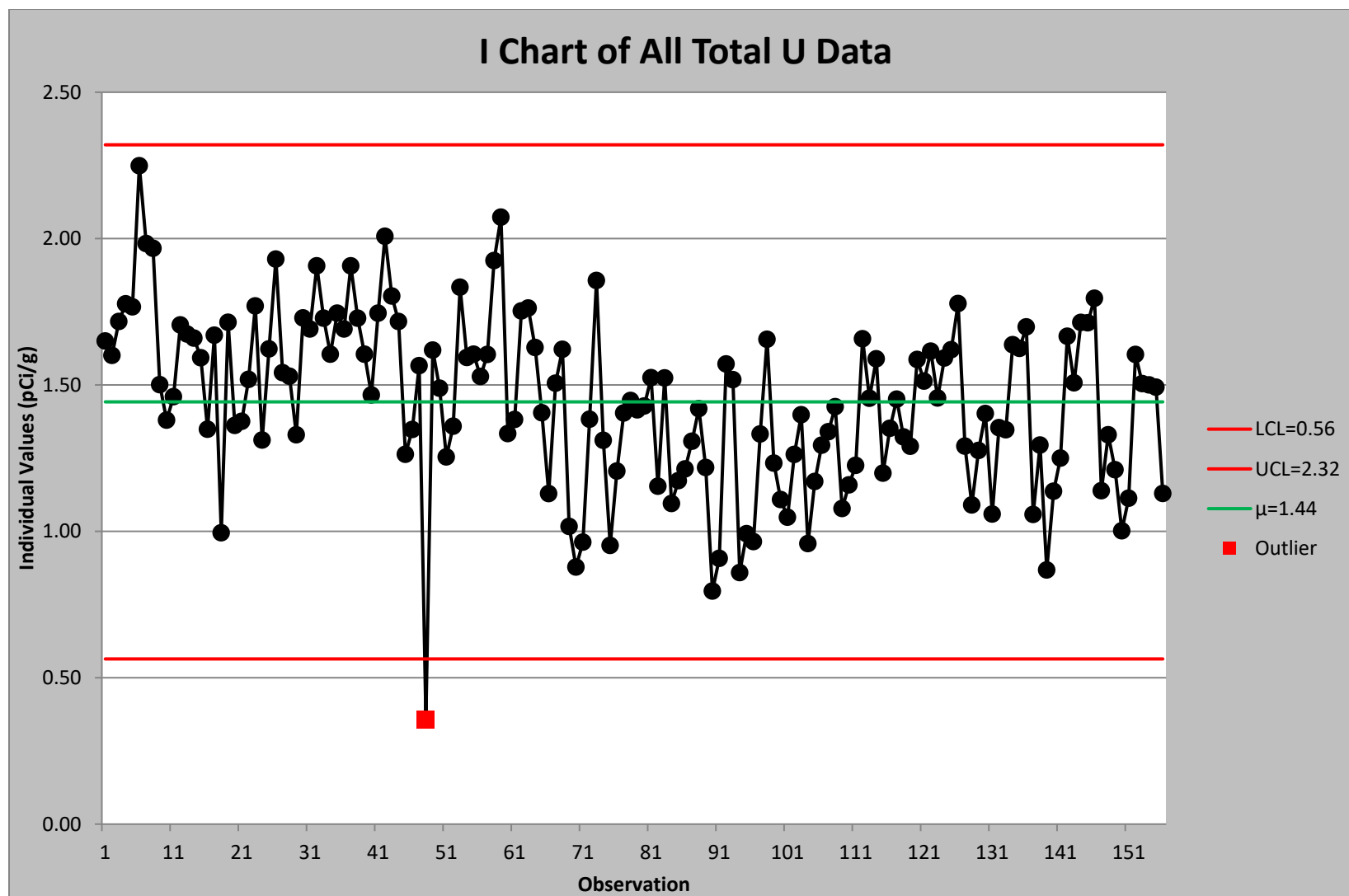


Figure 4-34. Total Uranium in SS-DU-003 (1998-2019)





NOTE: Results that exceed the UCL or fall below the LCL are reflected in the red square.

Figure 4-36. Control Chart for All Surface Soil Data (2004-2019)

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5. CONCLUSIONS AND RECOMMENDATIONS

The May and October 2019 sampling events were conducted in accordance with the SOP (CHPPM 2000) and License Amendment No. 20 for SUB-1435 (ML19088A305), and all data were determined to comply with the requirements of the Quality Assurance Project Plan (QAPP) (see Appendix A). The environmental media sample results are generally a small fraction of the action levels (see Table 4-1).

For the purposes of this report, samples with U-238/U-234 ratios potentially exceeding 3.0 were investigated further to validate whether a sample result was representative of DU or natural uranium. The only samples for which the U-238/U-234 ratio could exceed 3.0 was SW-DU-002D and SW-DU-008 (1.9 ± 1.2 and 2.1 ± 1.0 pCi/L, respectively) from the October 2019 sampling event.

ICP-MS results for SW-DU-002D equated to 0.62, non-detect, non-detect, and 0.62 µg/L for total uranium, U-234, U-235, and U-238, respectively. ICP-MS results for SW-DU-008 equated to 1.4, non-detect, non-detect, and 1.4 µg/L for total uranium, U-234, U-235, and U-238, respectively. Given that U-235 was not detected by ICP-MS, the total uranium result is compared to the lower comparison value from Table 3-1. The total uranium result for SW-DU-002D is less than the lower comparison value of 1.2 µg/L for surface water, which is suggestive of natural uranium. The total uranium result for SW-DU-008 is greater than the lower comparison value of 1.2 µg/L for surface water, so the upper comparison value had to be derived. The upper comparison value was calculated to be 6.1 µg/L based on a U-235 MDL of 0.03 µg/L. Since the total uranium result of 1.4 µg/L for SW-DU-008 is less than the upper comparison value of 6.1 µg/L, it is suggestive of a mixture of both natural uranium and DU. As noted in Sections 3 and 4, these results support the conclusion that total uranium concentrations are compliant with applicable criteria, including action levels defined in Table 4-1.

Trend analysis reflected that no sample location exhibited an R^2 value of 1.0, which would have indicated a strong relationship between sampling results and sampling dates. The lone sample that reflected an R^2 value exceeding 0.50 (i.e., somewhat significant) was groundwater sample MW-DU-009. The samples from this location reflected an R^2 value of 0.58. The total uranium concentrations for samples from MW-DU-009 continue to exhibit a decreasing trend.

In conclusion, no action levels defined in Radioactive Materials License SUB-1435 (NRC 1985) were exceeded, and future environmental monitoring will continue to be completed in accordance with License Amendment No. 20 for SUB-1435 (ML19088A305).

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6. REFERENCES

- CHPPM (U.S. Army Center for Health Promotion and Preventative Medicine). 2000. Standard Operating Procedure, Depleted Uranium Sampling Program, Environmental Radiation Monitoring Program. SOP No. OHP 40-2. 10 March.
- CFR (Code of Federal Regulations). 2014. 10 CFR 20. Energy. Nuclear Regulatory Commission. Standards for Protection Against Radiation.
- NRC (Nuclear Regulatory Commission). 1985. License Number SUB-1435, Jefferson Proving Ground, Madison, Indiana. U.S. Army, TECOM, Aberdeen Proving Ground, Maryland.
- NRC. 2012a. NRC Homepage, Glossary: <http://www.nrc.gov/reading-rm/basic-ref/glossary/natural-uranium.html>. Page last reviewed/updated 10 December.
- NRC. 2012b. NRC Homepage, Background Information on Depleted Uranium: <http://www.nrc.gov/reading-rm/basic-ref/glossary/depleted-uranium.html>. Page last reviewed/updated 10 December.
- SAIC (Science Applications International Corporation). 2006. Radiation Monitoring Report for License SUB-1435 Jefferson Proving Ground, Summary of Results for 10-13 April 2006 Sampling Event. Final. October.
- U.S. Army. 1999. U.S. Army Test and Evaluation Command, Environmental Radiation Monitoring (ERM) Plan for Jefferson Proving Ground. Memorandum to Mr. Larry W. Camper, Chief, Decommissioning Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, United States Nuclear Regulatory Commission, Washington, DC 20555-001 from Dal M. Nett, Chief, Safety Division, Directorate for Mission Support.
- U.S. Army. 2002. Decommissioning Plan for License SUB-1435. Jefferson Proving Ground, Madison, Indiana. Prepared for the U.S. Army SBCCOM by SAIC. June.
- U.S. Army. 2013. Army's Environmental Report for NRC Materials License SUB-1435. Depleted Uranium Impact Area. Jefferson Proving Ground, Madison, Indiana. Prepared for the U.S. Army by SAIC. August.

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APPENDIX A
STANDARD OPERATING PROCEDURE

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STANDING OPERATING PROCEDURE

**Depleted Uranium Sampling Program
Environmental Radiation Monitoring Program
Jefferson Proving Ground, Madison, IN**

This SOP supersedes, in its entirety, the SOP of the same name dated April 1998.

1. **Purpose.** This Standing Operating Procedure (SOP) prescribes policies, responsibilities, and procedures for administration and execution of the Health Physics Program (HPP), USACHPPM support of the Soldier and Biological Chemical Command (SBCCOM) biannual Environmental Radiation Monitoring (ERM) Program conducted at the Jefferson Proving Ground, Madison, Indiana.
2. **Authority.**
 - a. US Nuclear Regulatory Commission License No. SUB-1435.
 - b. Program Services Meeting, 14 September 1999, between SBCCOM and HPP, USACHPPM.
3. **Scope.** This SOP applies to Health Physics Program personnel performing the collection of environmental samples in support of the ERM.
4. **Definitions, Abbreviations.** A list of terms and abbreviations used in this SOP can be found in Annex A.
5. **Forms, Labels, and Worksheets.** A sample of all forms, sample labels, and sample collection worksheets can be found in Annex B.
6. **Point(s) of Contact for Program Coordination:**
 - a. **Soldier and Biological Chemical Command**
Ms. Joyce Kuykendall, SBCCOM Health Physicist
Comm: 410-436-7118
DSN : 584-7118
email: joyce.kuykendall@sbccom.apgea.army.mil

Effective Date 10 Mar 00
Date Removed from Service _____

**b. US Army Center for Health Promotion and Preventive
Medicine**

Health Physics Program (Pgm 26)

Comm: 410-436-3502

DSN : 584-3502

fax : 410-436-8261/8263

Radiologic, Classic and Clinical Chemistry Division
(RCCCD)

Comm: 410-436-3983/8235

DSN: 584-8235

c. Jefferson Proving Ground

Mr. Ken Knouf, Site Manager

Mr. Phil Mann

Ms. Yvette Hayes

Comm: 812-273-2551/2522/6075

7. Survey Coordination.

a. Pre-Survey Coordination: 60 days prior to scheduled sample date.

1) Initial Coordination: - made through the SBCCOM Health Physicist. Close coordination with the site management team at JPG will be required to ensure support will be onsite at the time of sampling.

2) USACHPPM HPP Program Assistant, (410) 436-1303, (if call from the Edgewood Arsenal: 5-1303) will be contacted to initiate travel orders. Due to the nature of the sampling program, a four-wheel drive vehicle is required to perform this project. The project and associated report number will be 26-MA-8260-R#-YY. The R# will be a "1" for the October and "2" for the April survey, and the YY will be the current fiscal year.

3) Prepare CHPPM Form 330-R-E (Request for Laboratory Services. (See Annex B) This form can be found on the USACHPPM Web Site or through intranet FormFlow program. Current DLS Test Codes being used are as follows:

Evaluations for Uranium in Soils for the soil and sediment samples, DLS Test Code: 803; STD Method: G-002.

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Evaluations for Uranium in Water for the ground and surface water samples, DLS Test Code: 586; STD Method: U-002.

Note: Sample containers for all medium except soils, are provided by SBCCOM and will be onsite however sample labels should be requested from the lab.

Ensure that sample bags, labels and coolers are shipped to the following address:

US Army Jefferson Proving Ground
1661 West J.P.G. Niblo Road (Bldg. 125)
Madison, IN 47250
(812) 273-2551

4) Request for instrumentation to support the sampling program should be made no later than 30 days prior to the scheduled departure date.

Radiation detection instrumentation and soil sampling tools will be coordinated through the HPP Instrumentation Coordinator, ext. 8228. Electronic message will be used for coordination.

Water Quality Instrumentation (pH meter, temperature, and conductivity) will be coordinated through the Surface Water and Waste Water Program (Pgm 32) at extension 3310/4211.

5) Final coordination for project should be completed no later than 14 days prior to departure date.

Contact the site management personnel at JPG and schedule dates for purging of wells prior to arrival. Purging should be accomplished no later than the Friday preceding and no earlier than 14 days prior to the scheduled start date of the sampling visit.

b. Field instrument quality control. Upon receipt of field instruments from the HPP Instrument Coordinator and the Surface Water and Waste Water Program, appropriate instrument quality control checks will be conducted to ensure proper operation prior to departure.

1) Radiation detection instrumentation will be checked for response against a radiation check source. This check source should also be shipped to the survey site for instrument verification on

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site. The radiation check source used need not be a calibrated source as instrument response is the parameter being evaluated.

2) Water quality instruments should also be verified using guidance provided by water program personnel. At a minimum, verify the accuracy of the pH meter using the certified pH solution packets.

8. Sample Collection. Four separate sample matrixes will be collected in support of the ERM. Methodologies for sampling can be found in US Army Environmental Hygiene Agency (the predecessor to USACHPPM) Technical Guide 155, Environmental Sampling Guide, February 1993.

a. Ground Water Samples. A total of 11 monitoring wells have been established to be used for the Environmental Monitoring Program. Wells are indicated on the ground water sample map (figure 1, Annex C) using an alphanumeric code containing the letters MW and a two digit sample number (01-11).

1) Sample will be collected using a new hand bailer for each sample. Care will be taken when lowering the bailer into the well to prevent unnecessary aeration or contamination of the sample.

2) A total quantity to be collected will be 1 US gallon.

3) A portion of the first bailer full of water will be placed into a clean beaker, or other suitable container, and an evaluation of radiation level, temperature, pH and conductivity will be conducted and recorded.

4) Sample information will be recorded on the Ground Water Sample Collection Worksheet. (Annex B)

5) Samples will not be filtered or persevered in the field.

b. Soil Samples. A total of 4 soil samples will be collected, one from each corner of the trapezoidal impact area. Sample locations are indicated on the soil sample map (figure 2, Annex C).

1) Sample will be collected using a new or properly cleaned scoop, trowel, or other suitable tool. Sample will be placed in a self sealing (Ziploc®) bag.

2) A sample quantity of approximately 1000 grams will be collected.

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3) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Soil Sample Collection Worksheet (Annex B).

c. Surface Water Samples. A total of 8 sample locations have been identified for the collection of water sample from the two creeks that run through the DU impact area (figure 3, Annex C).

1) Sample will be collected using the grab method. Sample container will be positioned pointing upstream and below the surface of the water.

2) A sample quantity of 1 US gallon will be collected.

3) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Surface Water Sample Worksheet (Annex B).

4) Water sample will not be filtered or preserved in the field.

d. Sediment Sample. A total of 8 sample locations have been identified for the collection of sediment samples from the two creeks that run through the DU impact area. Sediment samples will be collected at the sites selected for surface water collection (figure 3, Annex C).

1) Sample will be collected using a new or properly cleaned scoop, trowel, or other suitable tool. Sample will be placed in a glass sample jar.

2) Sediment sample will be collected only after the water sample has been collected.

3) While a sediment sample is usually considered a solid sample matrix, a certain amount of water is expected in the sample. The sample should not be drained of water that is collected as part of the sample.

4) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Sediment Sample Worksheet (Annex B).

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9. **Sample Management.** Since sample collected are in support of NRC License commitments, chain-of-custody procedures will be followed.

a. Samples will be secured from unauthorized access during the period of sampling.

b. Prior to shipment of samples to USACHPPM, a properly completed CHPPM Form 235-R-E, Chain of Custody Record (Annex B), will be placed in each shipping container. Survey personnel will maintain a copy of the Chain of Custody Record for verification of sample transport.

c. Water samples must reach RCCCD no later than 4 days from the time of sampling. To ensure this time frame is met and that the laboratory has time to filter and preserve the sample if necessary, water samples should be collected on the first day of the sampling trip and shipped the following day. It is not necessary to ship the water, sediments, and soils together.

10. **Sample Analysis.** Sample analysis of all environmental samples will be performed through the USACHPPM RCCCD.

a. Samples will be analyzed in accordance with RCCCD established protocols and procedures. All environmental samples will be coordinated with the SBCCOM RPO for disposal instructions.

1) Water samples will be analyzed fluorometrically for dissolved total uranium.

2) Soil and sediment samples will be analyzed using gamma spectroscopy, keying on the isotopic peaks of the Thorium-234. The thorium is the daughter of U-238 and is considered to be in equilibrium therefore the activity would be equal.

b. The QC for laboratory instruments will be performed by RCCCD.

c. Reports of analysis will be forwarded to the USACHPPM project officer responsible for requesting the sampling. Electronic as well as hard copy reports will be requested.

11. **Action Levels.** Every effort will be made to maintain radiation exposures and releases of radioactive and non-radioactive toxic metals to unrestricted areas as low as is reasonable achievable (ALARA).

a. The following criteria for the restricted area will be used to limit DU exposure. (Limits were established in the NRC Approved ERM)

SOIL:

- Perimeter and background samples:
 - ≤ 35 pCi/g - no corrective action.
 - > 35 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 35 pCi/g is confirmed, recommendation to decontaminate soil to ≤ 35 pCi/g will be made to the SBCCOM RPO.
- Sample locations along the lines of fire:
 - < 100 pCi/g - no corrective action
 - 100-300 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 100 pCi/g is confirmed, investigate to determine reason for the high level.
 - > 300 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 300 pCi/g is confirmed, investigate to determine reason for the high level and immediately notify the SBCCOM RPO to initiate notification to the NRC.

WATER:

- Uranium limit established in 10 CFR 2, Annex B is 3.0×10^{-1} pCi/ml
 - $< 1.5 \times 10^{-1}$ pCi/ml - no corrective action.
 - $> 1.5 \times 10^{-1}$ pCi/ml - resample; if results above 1.5×10^{-1} pCi/ml is confirmed, investigate to determine reason for the high level and immediately notify the SBCCOM RPO to initiate notification to the NRC.

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b. Basis for Action. If any of the action levels are exceeded, an evaluation of cause will be performed by the SBCCOM RPO. The RPO will provide a report of findings to the RCC. Based on their determination, recommendations to the commander on corrective action will be made.

GARY J. MATCEK
MAJ, MS
Program Manager, Health Physics Program

Effective Date 10 Mar 00
Date Removed from Service

ANNEX A

DEFINITIONS AND ABBREVIATION

1. **Definitions:**

a. **Action Level:** The numerical value that will cause the decision maker to choose one of the alternative actions. The action level may be a regulatory standard or may be a level set to ensure that corrective action is initiated before regulatory standards are met.

b. **Area:** A general term referring to any portion of a site, up to and including the entire site.

c. **Background Sample:** A sample collected from an area similar to the one being studied, but in an area thought to be free of contaminant of concern.

d. **Calibration:** Comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

e. **Chain-of-Custody:** Documentation of the possession and handling of a sample from the time it is collected to the final disposition.

f. **Detection Limit:** The lowest concentration at which given analytical procedures can identify.

e. **Duplicate Samples:** Samples collected simultaneously from the same source, under identical conditions, into separate containers.

g. **Ground Water Sample:** A sample of water taken from an established monitoring well.

h. **Preservation:** Techniques which retard physical and/or chemical changes in a sample after it has been collected.

i. **Quality Assurance:** A monitoring program which ensures the production of quality data and identifies and quantifies all sources of error associated with each step of the sampling and analytical effort.

j. **Sample:** A part or selection from a medium located in a survey area that represents the quality or quantity of a given parameter or nature of the whole area.

k. **Sediment:** A sample of the mineral and/or organic matter deposited by surface waters.

l. **Soil Sample:** A sample of the soil taken from the first 15 centimeters (6 inches) of surface soil.

m. **Split Sample:** A sample, which has been portioned into two or more containers from a single sample container.

n. **Surface Water:** Water found above the surface of the soil, particularly water contained in creeks and streams.

2. **Abbreviations:**

- | | |
|--------|--|
| a. DU | Depleted Uranium |
| b. ERM | Environmental Radiation Monitoring Program |
| c. g | gram |
| d. HPP | Health Physics Program |
| e. JPG | Jefferson Proving Ground |
| f. ml | milliliter |
| g. NRC | Nuclear Regulatory Commission |
| h. pCi | pico-Curie |

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- i. QC Quality Control
- j. RCCCD Radiologic, Classic and Clinical Chemistry
Division
- k. RPO Radiation Protection Officer
- l. SBCCOM Soldier and Biological, Chemical Command
- m. SOP Standing Operating Procedure
- n. USACHPPM U.S. Army Center for Health Promotion and
Preventive Medicine

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Effective Date 10 Mar 00
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ANNEX B

FORMS, LABELS AND WORKSHEETS

Effective Date 10 Mar 00
 Date Removed from Service _____

Request for Laboratory Services

Page 1 of 2

Directorate of Laboratory Sciences REQUEST FOR LABORATORY SERVICES

PLEASE PRINT OR TYPE ALL REQUESTED INFORMATION

For DLS Use Only

LIMS JOB# _____

Date Received _____

PART 1: PROJECT INFORMATION

1. DATE OF REQUEST: 08/03/2000
2. PROJECT #: (CHPPM only) 26 MA 8260 XO# _____
3. FUND SOURCE: ☐ P84 ☐ DERA ☐ OTHER Supplemental (Specify) _____
4. DIVISION/PROGRAM: Health Physics Program
5. INSTALLATION: Jefferson Proving Ground
6. STATE WHERE SAMPLES TO BE COLLECTED: Indiana
7. NAME OF PROJECT OFFICER(s): Mr. David Collins
 TELEPHONE: (410) 436-3502 FAX# (410) 436-8261
 E-MAIL: david.collins@apg.amedd.army.mil
8. NAME OF SAMPLE COLLECTOR: Mr David Collins
9. PROJECT DESCRIPTION/OBJECTIVE (Screen, Monitoring, Regulatory or Health Concern, Etc.):
Sampling required as part of the Environmental Radiation Monitoring Plan

10. SAMPLE OR SITE HISTORY (High Toxicity, Etc):
DU Firing Range

11. PROJECT COORDINATOR/DLS TECHNICAL CONSULTANT - Was project coordinated with DLS? ☒ YES ☐ NO
 Name of Person in DLS: Mr. Gary Wright ext. 8235

PART 2: TURNAROUND TIME REQUESTED

1. DATE RESULTS REQUIRED: _____
2. INDICATE THE APPROPRIATE SAMPLE OR PROJECT DESIGNATION:
☒ STANDARD
(Note: All samples are routinely processed as Standard Analyses Unless Arrangements Have Been Made with DLS for High-Priority or Top-Priority Analyses.)
☐ HIGH-PRIORITY ☐ TOP-PRIORITY
(Note: High-Priority and Top-Priority Requests should be Coordinated with DLS and are Subject to Cost Surcharges.)

PART 3: REPORT DISTRIBUTION OPTIONS

1. REPORT RESULTS BY: (Indicate Preference)
☒ cc:MAIL/E-MAIL TO ADDRESS: david.collins@apg.amedd.army.mil
☐ FAX TO (Write Fax#): _____
☒ MAIL: _____

REQUESTED BY: Mr. David Collins

PRINT NAME: _____ SIGNATURE: _____

(Note: Signature Required if Submitted by Hard Copy)

CHPPM Form 330-R-E, 1 May 96, (MCHB-DC-LLI)

Replaces AEHA Form 330-R, Jul 93, which is obsolete.

Figure B-1a

- ## PART 5: SAMPLE ANALYSIS INFORMATION

Table May Be Continued on Next Page if Additional Space is Required.

A-14

Effective Date 10 Mar 00
Date Removed from Service

Sample Labels

Below is an example of a label to placed on each sample container.

| |
|--------------------|
| PROJECT #: |
| INSTALLATION: |
| POC: |
| SAMPLE #: |
| DATE COLLECTED: |
| TIME COLLECTED: |
| SAMPLE PRESERVED: |
| ANALYSIS REQUIRED: |

Figure B-2

Effective Date _____
 Date Removed from Service _____

JEFFERSON PROVING GROUND
 DU SAMPLING PROGRAM
 PROJECT NUMBER: 26-MA-R_-8260-__

| GROUND WATER SAMPLES | | | | | | |
|----------------------|-------------|--------------------------|---|----------|-----------|----------------------|
| Sample ID | Sample Date | Exposure Reading (μR/hr) | Sample Locations | Comments | | |
| | | | | pH | Temp (°C) | Conductivity (μMHOS) |
| MW01 | | | Well @ D-Road and Wonju Road (perimeter DU impact area) | | | |
| MW02 | | | Well between C-Road & Wonju Road (perimeter DU impact area) | | | |
| MW03 | | | Well between A-Road & gate on Wonju Road (perimeter DU impact area) | | | |
| MW04 | | | Well on South Perimeter Rd. (Along south border of JPG) | | | |
| MW05 | | | Well @ D-Road & Morgan Road (across Bridge No. 13) perimeter DU impact area | | | |
| MW06 | | | Well @ C-Road & Morgan Road (perimeter DU impact area) | | | |

Effective Date _____
 Date Removed from Service _____

JEFFERSON PROVING GROUND
 DU SAMPLING PROGRAM
 PROJECT NUMBER: 26-MA-R_-8260-__

| GROUND WATER SAMPLES | | | | | | |
|----------------------|-------------|--------------------------|--|----------|-----------|----------------------|
| Sample ID | Sample Date | Exposure Reading (μR/hr) | Sample Locations | Comments | | |
| | | | | pH | Temp (°C) | Conductivity (μMHOS) |
| MW07 | | | Well @ Oakdale School House on Morgan Road (perimeter DU impact area) | | | |
| MW08 | | | Well @ Southwest Corner of JPG (Along south border of JPG) | | | |
| MW09 | | | Well @ D-Road and Bridge No. 22 (inside DU impact area) | | | |
| MW10 | | | Well on Center Recovery Road (inside DU impact area) | | | |
| MW11 | | | Well on D-Road between Morgan and C Recovery Road (inside impact area) | | | |
| MW12 | | | Duplicate or Split Sample _____ | | | |

Effective Date _____
 Date Removed from Service _____

JEFFERSON PROVING GROUND
 DU SAMPLING PROGRAM
 PROJECT NUMBER: 26-MA-R_-8260-__

| SOIL SAMPLES | | | | |
|--------------|-------------|--------------------------------|---|-------------|
| Sample ID | Sample Date | Exposure Reading (μ R/hr) | Sample Locations | JPG ID Code |
| SOS1 | | | Vicinity at intersection of C-Road and Wonju Road) | (S44) |
| SOS2 | | | Vicinity at intersection of E-Road and Morgan Road | (S48) |
| SOS3 | | | 0.5 miles east of intersection at C-Road & East Recovery Road | (S43) |
| SOS4 | | | Corner of Morgan Road and C-Road | (S47) |
| SOS5 | | | Duplicate or Split of ____ | |
| SOS6 | | | Well on south perimeter road along south border of JPG | B-1 |
| SOS7 | | | West Perimeter Road at Fork Creek | B-3 |
| SOS8 | | | South Perimeter Road of JPG | B-5 |
| SOS9 | | | Well on SW Corner of JPG | B-6 |

NOTE: Per letter from the NRC dated 7 Sep 99, soil sample locations S6 and S8 that were previously sampled will no longer require sampling. No other changes to the ERM Plan have been approved.

Effective Date _____

Date Removed from Service _____

JEFFERSON PROVING GROUND

DU SAMPLING PROGRAM

PROJECT NUMBER: 26-MA-R_-8260-__

| SURFACE WATER SAMPLES | | | | |
|------------------------------|--------------------|--|--|--------------------|
| Sample ID | Sample Date | Exposure Reading (μR/hr) | Sample Locations | JPG ID Code |
| SWS1 | | | West Perimeter Road Middle Fork Creek (exits JPG property) | SWBS (M1) |
| SWS2 | | | Big Creek (exits JPG property) | SWBN (M2) |
| SWS3 | | | Wonju Road Middle Fork Creek (enters DU impact area) | SWSE (M3) |
| SWS4 | | | Big Creek (enters DU impact area) | SWNE (M4) |
| SWS5 | | | Bridge No. 22 Big Creek | SWM (M5) |
| SWS6 | | | Line of Fire Middle Fork Creek | SWS (M6) |
| SWS7 | | | Bridge No. 12 @ Morgan Road Middle Fork Creek | SWSW (M7) |
| SWS8 | | | Bridge No. 13 @ Morgan Road Big Creek | SWNW (M8) |
| SWS9 | | | Duplicate or Split of SWS_ | SWNE (M4) |

Effective Date _____

Date Removed from Service _____

JEFFERSON PROVING GROUND

DU SAMPLING PROGRAM

PROJECT NUMBER: 26-MA-R_-8260-__

| SEDIMENT SAMPLES | | | | |
|-------------------------|-------------|--------------------------------|--|-------------|
| Sample ID | Sample Date | Exposure Reading (μ R/hr) | Sample Locations | JPG ID Code |
| SES1 | | | West Perimeter Road Middle Fork Creek (exits JPG property) | (M1) |
| SES2 | | | Big Creek (exits JPG property) | (M2) |
| SES3 | | | Wonju Road Middle Fork Creek (enters DU impact area) | (M3) |
| SES4 | | | Big Creek (enters DU impact area) | (M4) |
| SES5 | | | Bridge No. 22 Big Creek | (M5) |
| SES6 | | | Line of Fire Middle Fork Creek | (M6) |
| SES7 | | | Bridge No. 12 @ Morgan Road Middle Fork Creek | (M7) |
| SES8 | | | Bridge No. 13 @ Morgan Road Big Creek | (M8) |
| SES9 | | | Duplicate or Split of SES_ | (M4) |

Effective Date _____
Date Removed from Service _____

ANNEX C

SAMPLE LOCATION MAPS

Effective Date _____
Date Removed from Service _____

**Jefferson Proving Ground: DU Sampling
GROUNDWATER MONITORING WELLS**



Figure 1: Groundwater samples (Sept. 1997)

Effective Date _____
Date Removed from Service _____

Jefferson Proving Ground: DU Sampling
SOIL SAMPLES



Figure 2: Soil Samples (Sept. 1997)

Effective Date _____
Date Removed from Service _____

Jefferson Proving Ground: DU Sampling
SURFACEWATER & SEDIMENT SAMPLES

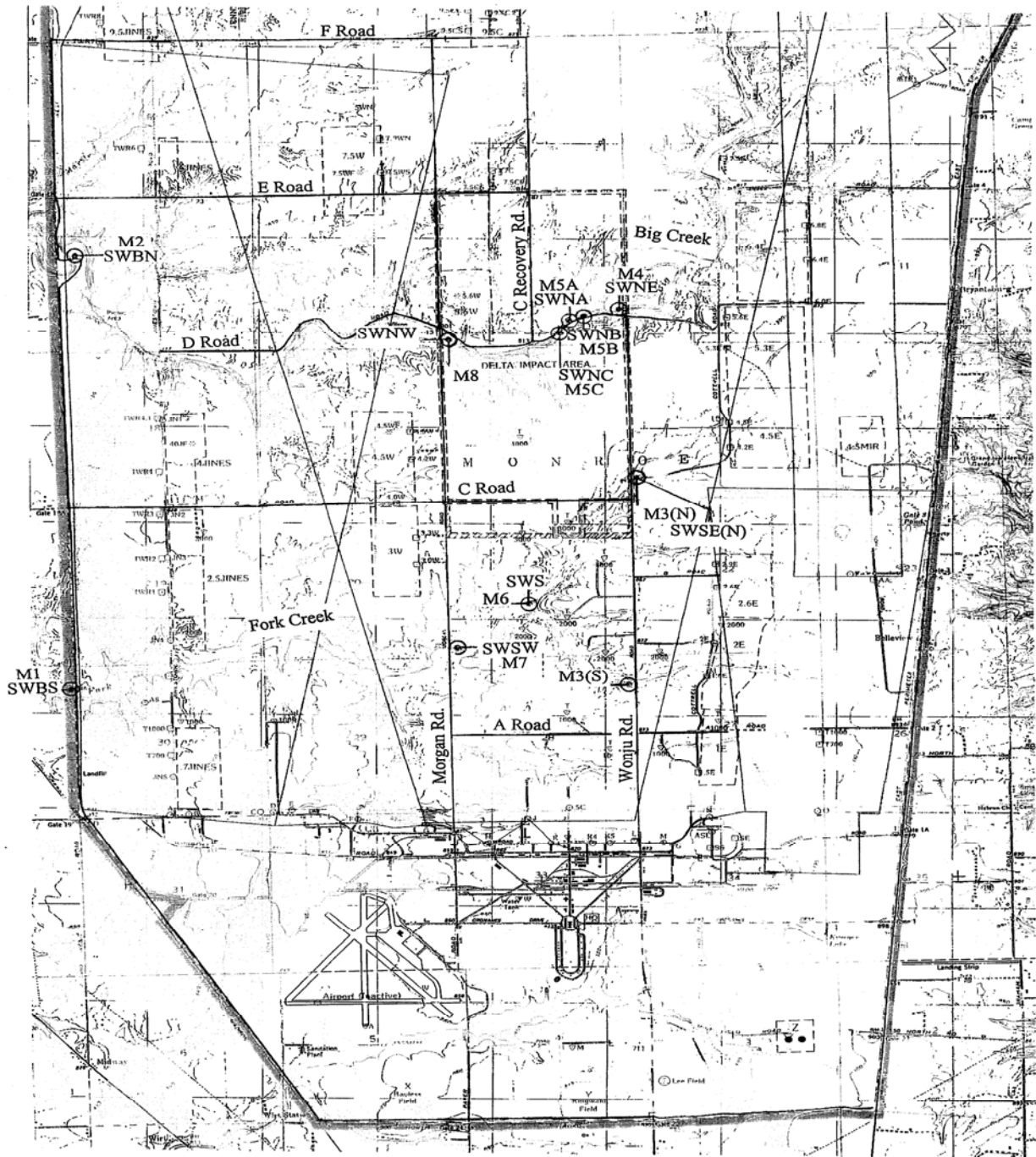


Figure 3: Surfacewater & Sediment Samples (Sept. 1997)

APPENDIX B

FIELD LOGBOOK AND SAMPLING FORMS

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SPRING 2019 FIELD LOGBOOK AND SAMPLING FORMS

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Well Identification: MW-1
Project Location: Madison, IN
Date: 4-29-19
Date: 5-7-19
Date: _____

Circle diameter and K used below: 1" I.D., K=0.041 gal/ft
2" I.D., K=0.163 gal/ft
4" I.D., K=0.653 gal/ft

6" I.D., K=1.469 gal/ft
8" I.D., K=2.61 gal/ft
10" ID, K=4.08 gal/ft

Total Depth (35.03 ft) - Depth to Water (9.85 ft) = Height of water column (25.18 ft)
Height of water column (25.18 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.10 gal)

1 Well Volume (4.10 gallons) x 3 = 3 Well Volumes (12.31 gallons)

Purge Rate (_____ gpm) x (_____ min) = 1 Well Volume

Purge Rate (gpm) x (min) = 3 Well Volume

PURGE INFORMATION:

| | | | |
|----------------------------|--------------|--------|---------|
| Time / Date Started: | 1520 | 1 | 4-29-19 |
| Time Purge End: | 1525 | | |
| Purge Method: Pump | | Bailer | X |
| Depth to Intake: | NA | | (ft) |
| Pump Type and ID: | NA | | |
| Purge Rate: | NA | | (gpm) |
| Purged Volume: | | | (gal) |
| Water Quality-Meter: | Horiba U-22# | | |
| How was yield measured? | | NA | |
| Was well cavitated? | | Yes | No |
| Water containerized/Amount | | | |
| Grunfos controller set | @ | NA | (Hertz) |

SAMPLING INFORMATION:

Time / Date Started: 0946 | 5-7-19
 Sampled by: D. Lawson & T. Farmer
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2-1000 ml poly
 Bottle Preservatives: None
 Recovering WL: —
 Duplicate Sampling: No
 Laboratory: TA
 COC Form: Yes

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.)

Water level at 9.93 At below top of casing on 5-7-19

Rad: Dose: 5 mR/h

Background: 29 cpm

Sample: 40



Well Identification: MW-2
Project Location: Madison, IN
Date: 4-29-19
Date: 5-7-19
Date: _____

Circle diameter and K used below:

| | |
|-------------------------|-------------------------|
| 1" I.D., K=0.041 gal/ft | 6" I.D., K=1.469 gal/ft |
| 2" I.D., K=0.163 gal/ft | 8" I.D., K=2.61 gal/ft |
| 4" I.D., K=0.653 gal/ft | 10" ID, K=4.08 gal/ft |

Total Depth (25.94 ft) - Depth to Water (9.60 ft) = Height of water column (16.34 ft)
Height of water column (16.34 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.66 gal)

Purge Rate (gpm) x (min) = 3 Well Volume

Time / Date Started: 0858 | 5-7-19
 Sampled by: D. Lawson & T. Farnsworth
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2-1000 ml poly
 Bottle Preservatives: None
 Recovering WL: —
 Duplicate Sampling: No
 Laboratory: TA
 COC Form: Per

~~71~~ 111 Water level at 9.82 ft below top of casing on 5-7-19

Rad: Dose: 5 μ R/h
Background: 38 cpm
Sample: 35 cpm



Well Identification: MW-4
Project Location: Madison, IN
Date: 4-29-19
Date: 5-6-19
Date: _____

Circle diameter and K used below:

| | |
|-------------------------|-------------------------|
| 1" I.D., K=0.041 gal/ft | 6" I.D., K=1.469 gal/ft |
| 2" I.D., K=0.163 gal/ft | 8" I.D., K=2.61 gal/ft |
| 4" I.D., K=0.653 gal/ft | 10" ID, K=4.08 gal/ft |

Total Depth (31.27 ft) - Depth to Water (3.61 ft) = Height of water column (27.66 ft)
Height of water column (27.66 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.50 gal)

1 Well Volume (4.50 gallons) x 3 = 3 Well Volumes (13.52 gallons)

Purge Rate (gpm) x (min) = 3 Well Volume

MS 4-29-19

| Grunfos controller set | @ | NA | (Hertz) |
|------------------------|---|----|---------|
|------------------------|---|----|---------|

_____ 7e5 _____

Sample: 33 4m



GROUNDWATER SAMPLE LOG

| | |
|---|--------------------------------------|
| Project Name: <u>Jefferson Proving Ground</u> | Well Identification: <u>MW-8</u> |
| Project Number: <u>ERM Sampling</u> | Project Location: <u>Madison, IN</u> |
| Purged by: <u>D. Lawson</u> & <u>M. Sherman</u> | Date: <u>4-29-19</u> |
| Sampled by: <u>D. Lawson</u> & <u>T. Farmer</u> | Date: <u>5-6-19</u> |
| Checked by: _____ & _____ | Date: _____ |

WELL VOLUME CALCULATION:

| | |
|---|-------------------------|
| Circle diameter and K used below: 1" I.D., K=0.041 gal/ft | 6" I.D., K=1.469 gal/ft |
| 2" I.D., K=0.163 gal/ft | 8" I.D., K=2.61 gal/ft |
| 4" I.D., K=0.653 gal/ft | 10" ID, K=4.08 gal/ft |

1 Well Volume:

Total Depth (30.51 ft) - Depth to Water (23.45 ft) = Height of water column (7.06 ft)
 Height of water column (7.06 ft) x K value (0.163 gal/ft) = 1 Well Volume (1.15 gal)

Purge Volume:

1 Well Volume (1.15 gallons) x 3 = 3 Well Volumes (3.45 gallons)
 Purge Rate (_____ gpm) x (_____ min) = 1 Well Volume
 Purge Rate (_____ gpm) x (_____ min) = 3 Well Volume

| Time | Temp °C | pH | Cond mS/cm | Turbidity NTU | D.O. mg/l | ORP mv | Purged Quantity | Well Volume | Depth to Water | Purge Rate |
|------|---------|------|------------|---------------|-----------|--------|-----------------|-------------|----------------|------------|
| 1347 | 15.93 | 8.13 | 0.398 | 60.1 | 10.64 | 190 | - | - | 23.44 | - |
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MS 4-29-19

PURGE INFORMATION: 1418

Time / Date Started: 1318 | 4-29-19
 Time Purge End: 1421
 Purge Method: Pump _____ Bailer X
 Depth to Intake: _____ NA _____ (ft)
 Pump Type and ID: NA
 Purge Rate: _____ NA _____ (gpm)
 Purged Volume: _____ (gal)
 Water Quality Meter: Horiba U-22#
 How was yield measured? _____ NA _____
 Was well cavitating? Yes _____ No _____
 Water containerized/Amount _____
 Grunfos controller set @ _____ NA _____ (Hertz)

SAMPLING INFORMATION:

Time / Date Started: 1347 | 5-6-19
 Sampled by: D. Lawson & T. Farmer
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2 - 1,000 ml Poly
 Bottle Preservatives: None
 Recovering WL: _____
 Duplicate Sampling: Yes
 Laboratory: TA
 COC Form: Yes

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.)

1111 Water level @ 23.44' below top of casing on 5-6-19
RAD: Dose: 6 mR/h: Duplicate collected.
Background: 36 cpm
Sample: 46 cpm



Water level at 2.05 Aft below top of casing on 5-7-19

Rad: Dose: 6 μ R/h

Background: 26 cpm

Sample: 36 cpm



GROUNDWATER SAMPLE LOG

Project Name: Jefferson Proving Ground
 Project Number: ERM Sampling
 Purged by: D. Lawson & M. Sherman
 Sampled by: D. Lawson & T. Farmer
 Checked by: _____ & _____

Well Identification: MW-11
 Project Location: Madison, IN
 Date: 4-29-19
 Date: 5-7-19
 Date: _____

WELL VOLUME CALCULATION:

Circle diameter and K used below: 1" I.D., K=0.041 gal/ft
 2" I.D., K=0.163 gal/ft
 4" I.D., K=0.653 gal/ft
 6" I.D., K=1.469 gal/ft
 8" I.D., K=2.61 gal/ft
 10" ID, K=4.08 gal/ft

1 Well Volume:

Total Depth (42.30 ft) - Depth to Water (7.21 ft) = Height of water column (35.09 ft)
 Height of water column (35.09 ft) x K value (0.163 gal/ft) = 1 Well Volume (5.72 gal)

Purge Volume:

1 Well Volume (5.72 gallons) x 3 = 3 Well Volumes (17.16 gallons)
 Purge Rate (_____ gpm) x (_____ min) = 1 Well Volume
 Purge Rate (_____ gpm) x (_____ min) = 3 Well Volume

| Time | Temp °C | pH | Cond mS/cm | Turbidity NTU | D.O. mg/l | ORP mv | Purged Quantity | Well Volume | Depth to Water | Purge Rate |
|-----------------|------------------|-----------------|------------------|-----------------|------------------|----------------|-----------------|-------------|----------------|------------|
| 1209 | 22.40 | 7.73 | 0.379 | 36.9 | 10.54 | 104 | — | — | <u>2.05'</u> | — |
| <u>1248</u> | <u>15.44</u> | <u>8.40</u> | <u>0.284</u> | <u>2.1</u> | <u>40.88</u> | <u>157</u> | — | — | <u>7.09</u> | — |
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PURGE INFORMATION:

Time / Date Started: 1558 | 4-29-19
 Time Purge End: 1610
 Purge Method: Pump Bailer ☒
 Depth to Intake: NA (ft)
 Pump Type and ID: NA
 Purge Rate: NA (gpm)
 Purged Volume: _____ (gal)
 Water Quality Meter: Horiba U-22#
 How was yield measured? NA
 Was well cavitated? Yes _____ No _____
 Water containerized/Amount _____
 Grunfos controller set @ NA (Hertz)

SAMPLING INFORMATION: 1248

Time / Date Started: 1209 ^{MC 5-7-19} | 5-7-19
 Sampled by: D. Lawson & T. Farmer
 Sample Method: Bailer ☒ Other _____
 Grab ☒ Composite _____
 # of Bottles Collected: 2 - 1000 ml poly
 Bottle Preservatives: None
 Recovering WL: —
 Duplicate Sampling: No
 Laboratory: TA
 COC Form: Yes

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.)

Water level at 2.05 ft below top of casing on 5-7-19
Water level at 7.09 ft below top of casing on 5-7-19.

Rad: Dose: 6.4R/h 6.4R/h
 Background: 26cpm 27cpm
 Sample: 36cpm 37cpm

SAMPLE LOG SHEET

PROJECT NAME:

JPG Spring '19 ERM

PROJECT NO:

—

SAMPLE ID NUMBER: SW-001
SD-001

DATE COLLECTED (MM/DD/YY): 05/06/19
TIME: 1445

SAMPLING LOCATION CODE: —

DESCRIPTION: Surface water & sediment

SAMPLING POINT CODE: —

DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: —: — TO — BLS

SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —

FIELD OBSERVATIONS: —

Background Rad: 34 cpm

Sample Rad: 23 cpm (SW)

" " : 40 cpm (Sed)

Dose: 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>18.75</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>8.56</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.158</u> | <u>mS/cm</u> | | |
| REDOX: | <u>176</u> | <u>mV</u> | | |
| DO: | <u>11.20</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | <u>6.2</u> | <u>NTU</u> | | |
| OTHER: <u>—</u> | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
 IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET

PROJECT NAME:

JPG Spring '19 ERM

PROJECT NO:

—

SAMPLE ID NUMBER: SW-002

SD-002

DATE COLLECTED (MM/DD/YY): 05/06/19

TIME: 1459

SAMPLING LOCATION CODE: —

DESCRIPTION: Sediment & surface water

SAMPLING POINT CODE: —

DESCRIPTION —

NORTHING: —

EASTING: —

ELEVATION: —

SAMPLE DEPTH CODE: —: — TO —

BLS

SAMPLE MEDIA CODE: —

DESCRIPTION: —

WEATHER: —

ACTIVITIES IN AREA: —

FIELD OBSERVATIONS:

Background Rad : 32 cpm

Sample Rad : 33 cpm (SW)

" " : 31 cpm (Sed)

Dose: 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|--------------|------------|-------------|
| RADIOACTIVITY: | 5 | μ R/hr | | |
| TEMPERATURE: | 19.72 | $^{\circ}$ C | | |
| pH: | 8.42 | pH | | |
| CONDUCTIVITY: | 0.132 | mS/cm | | |
| REDOX: | 167 | mV | | |
| DO: | 11.56 | mg/l | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | 11.6 | NTU | | |
| OTHER: | — | — | | |

SAMPLE TYPE: ☒ GRAB

☐ QC TRIP BLANK

☐ OTHER (SPECIFY) _____

☐ SPATIAL COMPOSITE

☐ QC RINSATE

☐ TIME COMPOSITE

☐ QC FIELD BLANK

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: Mark Caldwell
(Signature)

QC Checked By: _____

(Signature)

PROJECT NAME: JPG Spring '19 ERM

SAMPLE LOG SHEET

PROJECT NO: —

SAMPLE ID NUMBER: SW-003
SD-003

DATE COLLECTED (MM/DD/YY): 05/07/19
TIME: 0926

SAMPLING LOCATION CODE: —
DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: —
DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: —: — TO — BLS
SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS: —

Background Rad : 40 cpm
Sample Rad : 28 cpm (SW)
" : 44 cpm (Sed)
Dose : 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|--------------|------------|-------------|
| RADIOACTIVITY: | 5 | μ R/hr | | |
| TEMPERATURE: | 16.75 | $^{\circ}$ C | | |
| pH: | 8.30 | pH | | |
| CONDUCTIVITY: | 0.046 | mS/cm | | |
| REDOX: | 140 | mV | | |
| DO: | 41.80 | mg/l | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | 42.0 | NTU | | |
| OTHER: <u>—</u> | — | — | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:
—
—
—

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET
PROJECT NAME: JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SW-004
SD-004

DATE COLLECTED (MM/DD/YY): 05/07/19
TIME: 0944

SAMPLING LOCATION CODE: —
DESCRIPTION: Surface water & sediment

SAMPLING POINT CODE: —
DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: —: — TO — BLS
SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS: —

Background Rad : 29 cpm
Sample Rad : 28 cpm (SW)
" " : 38 cpm (Sed)
DOSE: 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>17.00</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>8.40</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.173</u> | <u>mS/cm</u> | | |
| REDOX: | <u>151</u> | <u>mV</u> | | |
| DO: | <u>10.53</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | <u>9.2</u> | <u>NTU</u> | | |
| OTHER: <u>—</u> | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:
—
—
—

Recorded By: Mick Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET
PROJECT NAME: JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SW-005
SD-005

DATE COLLECTED (MM/DD/YY): 05/07/19
TIME: 1236

SAMPLING LOCATION CODE: —
DESCRIPTION: Surface water & sediment

SAMPLING POINT CODE: —
DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: —: — TO — BLS
SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS: —

Background Rad : 41 cpm
Sample Rad : 32 cpm (SW)
" : 37 cpm (Sed)
Dose : 6 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>6</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>19.84</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>9.06</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.284</u> | <u>mS/cm</u> | | |
| REDOX: | <u>138</u> | <u>mV</u> | | |
| DO: | <u>16.59</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | <u>8.8</u> | <u>NTU</u> | | |
| OTHER: <u>—</u> | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:
—
—
—

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET

PROJECT NAME:

JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SW-006

DATE COLLECTED (MM/DD/YY): 05/07/19

SD-006

TIME: 0802

SD-006-Dyp

SAMPLING LOCATION CODE: —

DESCRIPTION: Surface water & sediment

SAMPLING POINT CODE: —

DESCRIPTION —

NORTHING: —

EASTING: —

ELEVATION: —

SAMPLE DEPTH CODE: — : — TO —

SAMPLE MEDIA CODE: — DESCRIPTION: — BLS

WEATHER: —

ACTIVITIES IN AREA: —

FIELD OBSERVATIONS: —

29 m 5.7.19

Background Rad : 25 cpm

Sample Rad : 39 cpm (SW)

" : 36 cpm (Sed)

Dose : 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>14.41</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>8.57</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.137</u> | <u>mS/cm</u> | | |
| REDOX: | <u>135</u> | <u>mV</u> | | |
| DO: | <u>18.71</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | <u>12.5</u> | <u>NTU</u> | | |
| OTHER: — | — | | | |

SAMPLE TYPE: ☒ GRAB

☐ QC TRIP BLANK

☐ OTHER (SPECIFY) —

☐ SPATIAL COMPOSITE

☐ QC RINSATE

☐ TIME COMPOSITE

☐ QC FIELD BLANK

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO

IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Duplicate sediment sample collected.

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

PROJECT NAME: **SAMPLE LOG SHEET**
JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SD-007
SW-007
SW-007-DUP

DATE COLLECTED (MM/DD/YY): 05/06/19
TIME: 16.01

SAMPLING LOCATION CODE: —

DESCRIPTION: Sediment & surface water

SAMPLING POINT CODE: —

DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: — : — TO — BLS

SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —

FIELD OBSERVATIONS: —

Background Rad : 42 cpm
Sample Rad : 37 cpm (SW)
" : 38 cpm (Sed)
Dose : 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>19.96</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>8.61</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.117</u> | <u>mS/cm</u> | | |
| REDOX: | <u>197</u> | <u>mV</u> | | |
| DO: | <u>10.65</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | <u>7.4</u> | <u>NTU</u> | | |
| OTHER: — | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Collected surface water, duplicate.

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET

PROJECT NAME:

JPG Spring '19 ERM

PROJECT NO:

SAMPLE ID NUMBER: SW-008

SD-008

DATE COLLECTED (MM/DD/YY): 05/07/19

TIME: 1301

SAMPLING LOCATION CODE: —

DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: —

DESCRIPTION —

NORTHING: —

EASTING: —

ELEVATION: —

SAMPLE DEPTH CODE: —: — TO —

BLS

SAMPLE MEDIA CODE: —

DESCRIPTION: —

WEATHER: —

ACTIVITIES IN AREA: —

FIELD OBSERVATIONS:

Background Rad : 34 cpm

Sample Rad : 33 cpm (SW)

" : 45 cpm (Sed)

Dose : 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|--------------|------------|-------------|
| RADIOACTIVITY: | 5 | μ R/hr | | |
| TEMPERATURE: | 19.09 | $^{\circ}$ C | | |
| pH: | 8.39 | pH | | |
| CONDUCTIVITY: | 0.176 | mS/cm | | |
| REDOX: | 158 | mV | | |
| DO: | 12.42 | mg/l | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | 7.6 | NTU | | |
| OTHER: | — | | | |

SAMPLE TYPE: ☒ GRAB

☐ QC TRIP BLANK

☐ OTHER (SPECIFY) _____

☐ SPATIAL COMPOSITE

☐ QC RINSATE

☐ TIME COMPOSITE

☐ QC FIELD BLANK

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: Mark Caldwell
(Signature)

QC Checked By: _____

(Signature)

PROJECT NAME: **SAMPLE LOG SHEET**
JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SS-001
SS-001 - DUP

DATE COLLECTED (MM/DD/YY): 05/07/19
TIME: 0912

SAMPLING LOCATION CODE: —
DESCRIPTION: Soil

SAMPLING POINT CODE: —
DESCRIPTION: —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: — : — TO — BLS
SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS: —

Background Rad : 35 cpm
Sample Rad : cpm (SW)
" " : 47 cpm (Soil) Soil ml
Dose : 5 μ R/hr 5-7-19

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|----------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | | <u>$^{\circ}$C</u> | | |
| pH: | | <u>pH</u> | | |
| CONDUCTIVITY: | | <u>mS/cm</u> | | |
| REDOX: | | <u>mV</u> | | |
| DO: | | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | | <u>NTU</u> | | |
| OTHER <u>—</u> : | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Duplicate sample collected.

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

SAMPLE LOG SHEET

PROJECT NAME:

JPG Spring '19 ERM

PROJECT NO:

—

SAMPLE ID NUMBER: SS-002

DATE COLLECTED (MM/DD/YY): 05/02/19

TIME: 1156

SAMPLING LOCATION CODE: —

DESCRIPTION: Soil

SAMPLING POINT CODE: —

DESCRIPTION: —

NORTHING: —

EASTING: —

ELEVATION: —

SAMPLE DEPTH CODE: — : — TO —

BLS

SAMPLE MEDIA CODE: —

DESCRIPTION: —

WEATHER: —

ACTIVITIES IN AREA: —

FIELD OBSERVATIONS:

Background Rad : 38 cpm

Sample Rad : cpm (SW)

" " : 44 cpm (Seal) Soil re

Dose : 6 μ R/hr

5-7-19

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|--------------|------------|-------------|
| RADIOACTIVITY: | 6 | μ R/hr | | |
| TEMPERATURE: | | $^{\circ}$ C | | |
| pH: | | pH | | |
| CONDUCTIVITY: | | mS/cm | | |
| REDOX: | | mV | | |
| DO: | | mg/l | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | | NTU | | |
| OTHER: | — | | | |

SAMPLE TYPE: ☒ GRAB

☐ QC TRIP BLANK

☐ OTHER (SPECIFY) _____

☐ SPATIAL COMPOSITE

☐ QC RINSATE

☐ TIME COMPOSITE

☐ QC FIELD BLANK

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: Mark Caldwell
(Signature)

QC Checked By: _____

(Signature)

PROJECT NAME: **SAMPLE LOG SHEET**

JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SS-003

DATE COLLECTED (MM/DD/YY): 05/07/19

TIME: 1053

SAMPLING LOCATION CODE: —

DESCRIPTION: Soil

SAMPLING POINT CODE: —

DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: — : — TO — BLS

SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —

FIELD OBSERVATIONS: —

Background Rad : 29 cpm

Sample Rad : cpm (SW)

" " : 41 cpm (Sed)

Dose : 5 μ R/hr

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|--------------|------------|-------------|
| RADIOACTIVITY: | 5 | μ R/hr | | |
| TEMPERATURE: | | $^{\circ}$ C | | |
| pH: | | pH | | |
| CONDUCTIVITY: | | mS/cm | | |
| REDOX: | | mV | | |
| DO: | | mg/l | | |
| ORGANIC VAPORS: | — | — | | |
| TURBIDITY: | | NTU | | |
| OTHER _____: | — | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) _____

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
 IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: Mark Caldwell
 (Signature)

QC Checked By: _____
 (Signature)

SAMPLE LOG SHEET
PROJECT NAME: JPG Spring '19 ERM

PROJECT NO: —

SAMPLE ID NUMBER: SS-004

DATE COLLECTED (MM/DD/YY): 05/06/19

TIME: 1536

SAMPLING LOCATION CODE: —

DESCRIPTION: Soil sample

SAMPLING POINT CODE: —

DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

SAMPLE DEPTH CODE: —: — TO — BLS

SAMPLE MEDIA CODE: — DESCRIPTION: —

WEATHER: — ACTIVITIES IN AREA: —

FIELD OBSERVATIONS: —

Background Rad : 27 cpm

Sample Rad : cpm (sw)

" " : cpm (sed)

Dose : 6 μ R/hr 49 cpm (soil)

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|----------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>6</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>—</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>—</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>—</u> | <u>mS/cm</u> | | |
| REDOX: | <u>—</u> | <u>mV</u> | | |
| DO: | <u>—</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>—</u> | <u>—</u> | | |
| TURBIDITY: | <u>—</u> | <u>NTU</u> | | |
| OTHER <u>—</u> : | <u>—</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) —

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:
—
—
—

Recorded By: Mark Caldwell
(Signature)

QC Checked By: —
(Signature)

Location Former JPB - Madison, IN Date 5-6-19Project / Client Spring '19 ERM - USACESunny 78°

1221: Mark Caldwell (Fieldbook author) and Terry Farmer, both of XCEL Engineering at Army / Big Oaks HQ (Bldg 125). David Lawson of Leidos already on site. We will conduct the Spring '19 ERM this week. Details of water-level measurements, water-quality measurements, radiological readings, etc. will be recorded on individual sample-log forms and will not be recorded in this log book.

1242: Calibrating the Horiba, Model: U5000, MGS No. BS68MMYA, Date: July 2011.

Radiological Instruments used:

Micro R Model 19 Serial No: 207535

Model 3/44-9, ^{Serial} #s 211465 and 222376

Model 3 →

44-9 →

1257: Conducting safety briefing.

1324: Collecting sample at MW-04.

1347: Collecting sample at MW-08. Also collecting duplicate sample.

1415: Back at Bldg 125. Preparing to sample along western perimeter.

MC 5-6-19

Mark Caldwell

5-6-19

Location Former JPB - Madison, IN Date 5-6-19Project / Client Spring '19 ERM - USACE

1445: Collecting surface water (SW) and sediment (SD) at SW#SD-001.

1459: Collecting SW-002 and SD-002.

1522: Collecting MW-005.

1535: Collecting soil sample (SS) 004.

1546: Collecting sample @ MW-006.

1601: Collecting samples at SW-007 & SD-007. Also collecting a duplicate surface water.

1627: Back at Bldg 125. Collecting paper work.

1656: Leaving Bldg 125.

Mark Caldwell

5-6-19

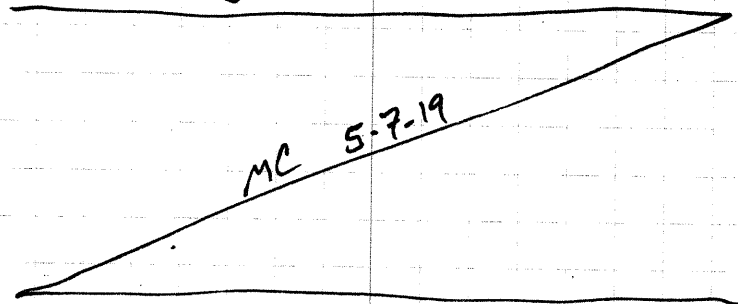
Location Farmer JPC - Madison, IN Date 5-7-19Project / Client Spring '19 ERM / USACEProjected sunny to partly cloudy, 70's
possible later showers

- 0658: Mark Caldwell & Terry Farmer (XCEL) at bldg 125. David Lawson & Jed Bradford (VRH) already here. Farmer is reviewing H&S Plan and AHAs with Bradford. Calibrating Horiba & rad equipment. Scanning equipment.
- 0721: H&S tailgate briefing. Site-specific radiological training.
- 0759: Collecting sample at MW-03.
- 0820: Collecting samples at SW-006 & SD-006. Collecting duplicate sediment sample.
- 0858: Collecting sample at MW-002
- 0912: Collecting sample at SS-001
- 0926: Collecting samples at SW-003 & SD-003.
- 0944: Collecting samples at SW-004 & SD-004
- ~~0952~~: Collecting sample at MW-001.
- 0956: no 5-7-19
- 1053: Collecting sample at SS-003.
- 1141: Breaking for lunch.
- 1156: Collecting sample at SS-002.
- 1209: Collecting sample @ MW-010.
- 1224: Collecting sample at MW-009

Mark Caldwell 5-7-19

Location Farmer JPC - Madison, IN Date 5-7-19Project / Client Spring '19 ERM / USACE

- 1236: Collecting samples at SW-005 and SD-005.
- 1248: Collecting sample at MW-011
- 1301: Collecting samples at SW-008 and SD-008
- 1324: Collecting sample at MW-007
- 1335: Back at Bldg 125. Completing forms, scanning equipment, packing samples.
- 1503: The coolers with samples have been sealed. They will be locked in the company truck over night and delivered to UPS tomorrow.
- 1538: Everything has been scanned and equipment/supplies packed. We are leaving Bldg 125.



Mark Caldwell

5-7-19

TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045

Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record
TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

| | | | | | | | | | |
|---|--|-----------------------------------|----------------|-----------------------------------|--|-----------------------------------|--------------------------------|----------------------------|--------------------------|
| Client Information | | Sampler: <u>Farmer / Caldwell</u> | | Lab PM: <u>Ivan Vania</u> | | Carrier Tracking No(s): <u>—</u> | | COC No: <u>—</u> | |
| Client Contact: Mr. Mark Caldwell | | Phone: <u>865.481.3200</u> | | E-Mail: <u>—</u> | | | | Page: <u>1 of 4</u> | |
| Company: XCEL Engineering Inc. | | | | Analysis Requested | | | | | |
| Address: 1066 Commerce Park Drive | | | | | | | | | |
| City: Oak Ridge | | | | Preservation Codes: | | | | | |
| State, Zip: TN, 37830 | | | | | | | | | |
| Phone: <u>865.766.8547</u> | | | | Other: | | | | | |
| Email: mccaldwell@xceleng.com | | | | | | | | | |
| Project Name: <u>5315-03</u> | | | | Special Instructions/Note: | | | | | |
| Site: <u>JPG - DU Impact Area</u> | | | | | | | | | |
| Sample Identification | | Sample Date | Sample Time | Sample Type (C=Comp, G=grab) | Matrix (W=water, S=solid, O=waste/oil, BT=tissue, A=air) | Field Filtered Sample (Yes or No) | Perform MS/MSD (Yes or No) | Total Number of containers | Total / Isotopic Uranium |
| | | | | | | | | | |
| <u>MW-DU-001</u> | | <u>5-7-19</u> | <u>0956</u> | <u>G</u> | <u>W</u> | <u>NN</u> | <u>2</u> | | |
| <u>002</u> | | <u>5-7-19</u> | <u>0858</u> | | | | | | |
| <u>003</u> | | <u>5-7-19</u> | <u>0759</u> | | | | | | |
| <u>004</u> | | <u>5-6-19</u> | <u>1324</u> | | | | | | |
| <u>005</u> | | <u>5-6-19</u> | <u>1522</u> | | | | | | |
| <u>006</u> | | <u>5-6-19</u> | <u>1546</u> | | | | | | |
| <u>007</u> | | <u>5-7-19</u> | <u>1324</u> | | | | | | |
| <u>008</u> | | <u>5-6-19</u> | <u>1347</u> | | | | | | |
| <u>008-DUP</u> | | <u>5-6-19</u> | <u>1347</u> | | | | | | |
| <u>009</u> | | <u>5-7-19</u> | <u>1224</u> | | | | | | |
| <u>010</u> | | <u>5-7-19</u> | <u>1209</u> | | | | | | |
| Possible Hazard Identification | | | | | Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) | | | | |
| <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input type="checkbox"/> Radiological | | | | | <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input checked="" type="checkbox"/> Archive For <u>1</u> Months | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) | | | | | Special Instructions/QC Requirements: | | | | |
| Empty Kit Relinquished by: <u>—</u> | | | Date: <u>—</u> | | Time: <u>—</u> | | Method of Shipment: <u>USP</u> | | |
| Relinquished by: <u>Mark Caldwell</u> | | Date/Time: <u>5-7-19 / 1503</u> | | Company: <u>XCEL</u> | | Received by: | | Date/Time: | |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | |
| Custody Seals Intact: <u>Δ Yes Δ No</u> | | | | | Cooler Temperature(s) °C and Other Remarks: | | | | |

THE LEADER IN ENVIRONMENTAL TESTING

| | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|---|--|---------------------------------|--|---|--|-----------------------------------|--|---|--|----------------------------|--|----------------------------|--|--|--|---------|--|--|--|
| Client Information | | Sampler: <u>Farmer / Caldwell</u> | | Lab PM: <u>Ivan Vania</u> | | Carrier Tracking No(s): | | COC No: | | | | | | | | | | | | | | | |
| Client Contact: Mr. Mark Caldwell | | Phone: <u>865.481.3200</u> | | E-Mail: <u>—</u> | | — | | Page: <u>2 of 4</u> | | | | | | | | | | | | | | | |
| Company: XCEL Engineering Inc. | | | | Analysis Requested | | | | | | Job #: | | | | | | | | | | | | | |
| Address: 1066 Commerce Park Drive | | Due Date Requested: <u>—</u> | | <div>Field Filtered Sample (Yes or No) Perform MS/MSD (Yes or No) <u>Total / Isotopic Uranium</u></div> | | | | | | Total Number of containers | | Preservation Codes: A - HCL M - Hexane B - NaOH N - None C - Zn Acetate O - AsNaO2 D - Nitric Acid P - Na2O4S E - NaHSO4 Q - Na2SO3 F - MeOH R - Na2S2O3 G - Amchlor S - H2SO4 H - Ascorbic Acid T - TSP Dodecahydrate I - Ice U - Acetone J - DI Water V - MCAA K - EDTA W - pH 4-5 L - EDA Z - other (specify) Other: | | | | | | | | | | | |
| City: Oak Ridge | | TAT Requested (days): <u>Standard</u> | | | | | | | | | | | | | | | | | | | | | |
| State, Zip: TN, 37830 | | PO #: | | | | | | | | | | | | | | | | | | | | | |
| Phone: <u>865.766.8547</u> | | WO #: | | | | | | | | | | | | | | | | | | | | | |
| Email: mccaldwell@xceleng.com | | Project #: | | | | | | | | | | | | | | | | | | | | | |
| Project Name: <u>5315-03</u> | | SSOW#: | | | | | | | | | | | | | | | | | | | | | |
| Site: <u>JPG - DU Impact Area</u> | | | | | | | | | | | | | | | | | | | | | | | |
| Sample Identification | | Sample Date | | Sample Time | | Sample Type (C=comp, G=grab) | | Matrix (W=water, S=solid, O=waste/oil, BT=tissue, A=air) | | Field Filtered Sample (Yes or No) | | Perform MS/MSD (Yes or No) | | Total Number of containers | | Special Instructions/Note: | | | | | | | |
| | | | | | | Preservation Code: | | | | | | | | | | | | | | | | | |
| <u>MW-DU-011</u> | | <u>5-7-19</u> | | <u>1248</u> | | <u>G</u> | | <u>W</u> | | <u>NN</u> | | <u>2</u> | | | | | | | | | | | |
| <u>SW-DU-001</u> | | <u>5-6-19</u> | | <u>1445</u> | | | | | | | | | | | | | | | | | | | |
| <u>002</u> | | <u>5-6-19</u> | | <u>1459</u> | | | | | | | | | | | | | | | | | | | |
| <u>003</u> | | <u>5-7-19</u> | | <u>0926</u> | | | | | | | | | | | | | | | | | | | |
| <u>004</u> | | <u>5-7-19</u> | | <u>0944</u> | | | | | | | | | | | | | | | | | | | |
| <u>005</u> | | <u>5-7-19</u> | | <u>1236</u> | | | | | | | | | | | | | | | | | | | |
| <u>006</u> | | <u>5-7-19</u> | | <u>0802</u> | | | | | | | | | | | | | | | | | | | |
| <u>007-</u> | | <u>5-6-19</u> | | <u>1601</u> | | | | | | | | | | | | | | | | | | | |
| <u>007-DUP</u> | | <u>5-6-19</u> | | <u>1601</u> | | | | | | | | | | | | | | | | | | | |
| <u>008</u> | | <u>5-7-19</u> | | <u>1301</u> | | <u>↓</u> | | <u>↓</u> | | <u>↓</u> | | <u>↓</u> | | | | | | | | | | | |
| Possible Hazard Identification <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input type="checkbox"/> Radiological | | | | | | | | | | | | | | | | | | | | | | | |
| Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input checked="" type="checkbox"/> Archive For <u>1</u> Months | | | | | | | | | | | | | | | | | | | | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) | | | | | | | | | | | | | | | | | | | | | | | |
| Special Instructions/QC Requirements: | | | | | | | | | | | | | | | | | | | | | | | |
| Empty Kit Relinquished by: <u>—</u> | | | | Date: <u>—</u> | | | | Time: <u>—</u> | | | | Method of Shipment: <u>USP</u> | | | | | | | | | | | |
| Relinquished by: <u>Mark Caldwell</u> | | | | Date/Time: <u>5-7-19/1503</u> | | | | Company: <u>XCEL</u> | | | | Received by: | | | | Date/Time: | | | | Company | | | |
| Relinquished by: | | | | Date/Time: | | | | Company | | | | Received by: | | | | Date/Time: | | | | Company | | | |
| Relinquished by: | | | | Date/Time: | | | | Company | | | | Received by: | | | | Date/Time: | | | | Company | | | |
| Custody Seals Intact: A Yes A No | | | | Custody Seal No.: | | | | Cooler Temperature(s) °C and Other Remarks: | | | | | | | | | | | | | | | |

THE LEADER IN ENVIRONMENTAL TESTING

| | | | | | | | | | | | | | | | |
|--|--|---------------------------------------|----------------|---|---|--|--------------------------------|---------------------|--|-----------------|--|----------------------------|--|--|--|
| Client Information | | Sampler: <u>Farmer / Caldwell</u> | | Lab PM: <u>Ivan Vania</u> | | Carrier Tracking No(s): | | COC No: <u>1</u> | | | | | | | |
| Client Contact: <u>Mr. Mark Caldwell</u> | | Phone: <u>865.481.3200</u> | | E-Mail: <u>—</u> | | — | | Page: <u>3 of 4</u> | | | | | | | |
| Company: <u>XCEL Engineering Inc.</u> | | | | Analysis Requested | | | | | | Job #: <u>—</u> | | | | | |
| Address: <u>1066 Commerce Park Drive</u> | | Due Date Requested: <u>—</u> | | <div>Field Filtered Sample (Yes or No) Perform MS/MSD (Yes or No) <u>Total / Isotopic Uranium</u></div> | | | | | | | | Total Number of containers | | Preservation Codes: A - HCL B - NaOH C - Zn Acetate D - Nitric Acid E - NaHSO4 F - MeOH G - Amchlor H - Ascorbic Acid I - Ice J - DI Water K - EDTA L - EDA M - Hexane N - None O - AsNaO2 P - Na2O4S Q - Na2SO3 R - Na2S2O3 S - H2SO4 T - TSP Dodecahydrate U - Acetone V - MCAA W - pH 4-5 Z - other (specify) Other: | |
| City: <u>Oak Ridge</u> | | TAT Requested (days): <u>Standard</u> | | | | | | | | | | | | | |
| State, Zip: <u>TN, 37830</u> | | PO #: <u>—</u> | | | | | | | | | | | | | |
| Phone: <u>865.766.8547</u> | | WO #: <u>—</u> | | | | | | | | | | | | | |
| Email: <u>mcaldwell@xceleng.com</u> | | Project #: <u>—</u> | | | | | | | | | | | | | |
| Project Name: <u>5315-03</u> | | SSOW#: <u>—</u> | | | | | | | | | | | | | |
| Site: <u>JPG - DU Impact Area</u> | | | | | | | | | | | | | | | |
| Sample Identification | | Sample Date | Sample Time | Sample Type (C=comp, G=grab) BT=Tissue, A=Air | Matrix (W=water, S=solid, O=waste/oil) | | | | | | | Special Instructions/Note: | | | |
| | | | | Preservation Code: | | | | | | | | | | | |
| <u>SD-DU-001</u> | | <u>5-6-19</u> | <u>1445</u> | <u>G</u> | <u>S</u> | <u>NN</u> | <u>1</u> | | | | | | | <u>All samples are consolidated into three (3) coolers. One (1) CDC for all samples.</u> | |
| <u>002</u> | | <u>5-6-19</u> | <u>1459</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>003</u> | | <u>5-7-19</u> | <u>0926</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>004</u> | | <u>5-7-19</u> | <u>0944</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>005</u> | | <u>5-7-19</u> | <u>1236</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>006</u> | | <u>5-7-19</u> | <u>0802</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>006-DUP</u> | | <u>5-7-19</u> | <u>0802</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>007</u> | | <u>5-6-19</u> | <u>1601</u> | <u> </u> | <u> </u> | <u> </u> | <u> </u> | | | | | | | | |
| <u>008</u> | | <u>5-7-19</u> | <u>1301</u> | <u>↓</u> | <u>↓</u> | <u>↓</u> | <u>↓</u> | | | | | | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | | | | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | | | | | | |
| Possible Hazard Identification <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input type="checkbox"/> Radiological | | | | | | Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input checked="" type="checkbox"/> Archive For <u>1</u> Months | | | | | | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) | | | | | | Special Instructions/QC Requirements: | | | | | | | | | |
| Empty Kit Relinquished by: <u>—</u> | | | Date: <u>—</u> | | Time: <u>—</u> | | Method of Shipment: <u>USP</u> | | | | | | | | |
| Relinquished by: <u>Mark Caldwell</u> | | Date/Time: <u>5-7-19/1503</u> | | Company: <u>XCEL</u> | | Received by: | | Date/Time: | | Company: | | | | | |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | | Company: | | | | | |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | | Company: | | | | | |
| Custody Seals Intact: <u>^</u> Yes <u>^</u> No | | Custody Seal No.: | | | | Cooler Temperature(s) °C and Other Remarks: | | | | | | | | | |

TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045

Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record
TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

| | | | | | | | | | | |
|---|--|--|-------------|---|--|--|----------------------------|--|----------------------------|--|
| Client Information | | Sampler: <u>Farmer / Caldwell</u> | | Lab PM: <u>Ivan Vania</u> | | Carrier Tracking No(s): <u>—</u> | | COC No: <u>—</u> | | |
| Client Contact: Mr. Mark Caldwell | | Phone: <u>865.481.3200</u> | | E-Mail: <u>—</u> | | | | Page: <u>4 of 4</u> | | |
| Company: XCEL Engineering Inc. | | | | Analysis Requested <div style="display: flex; justify-content: space-between;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Field Filtered Sample (Yes or No)</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Perform MS/MSD (Yes or No)</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Total / Isotopic Uranium</div> </div> | | | | | | |
| Address: 1066 Commerce Park Drive | | Due Date Requested: <u>—</u> | | | | | | | | |
| City: Oak Ridge | | TAT Requested (days): <u>Standard</u> | | | | | | | | |
| State, Zip: TN, 37830 | | PO #: <u>—</u> | | | | | | | | |
| Phone: <u>865.766.8547</u> | | WO #: <u>—</u> | | | | | | | | |
| Email: mcaldwell@xceleng.com | | Project #: <u>—</u> | | | | | | Preservation Codes: <div style="display: flex; justify-content: space-between;"> <div> A - HCL B - NaOH C - Zn Acetate D - Nitric Acid E - NaHSO4 F - MeOH G - Amchlor H - Ascorbic Acid I - Ice J - DI Water K - EDTA L - EDA </div> <div> M - Hexane N - None O - AsNaO2 P - Na2O4S Q - Na2SO3 R - Na2S2O3 S - H2SO4 T - TSP Dodecahydrate U - Acetone V - MCAA W - pH 4-5 Z - other (specify) </div> </div> | | |
| Project Name: <u>5315-03</u> | | SSOW#: <u>—</u> | | | | | | | | |
| Site: <u>JPG - DU Impact Area</u> | | | | | | | | Other: | | |
| Sample Identification | | Sample Date | Sample Time | Sample Type (C=Comp, G=grab) | Matrix (W=water, S=solid, O=waste/soil, BT=Tissue, A=Air) | Field Filtered Sample (Yes or No) | Perform MS/MSD (Yes or No) | Total / Isotopic Uranium | Total Number of containers | Special Instructions/Note: |
| | | | | | | | | | | |
| <u>SS - DU - 001</u> | | <u>5-7-19</u> | <u>0912</u> | <u>G</u> | <u>S</u> | <u>NN</u> | <u>I</u> | | | <u>All samples are consolidated into three (3) coolers. One (1) COC for all samples.</u> |
| <u>001 - DUP</u> | | <u>5-7-19</u> | <u>0912</u> | <u>I</u> | <u>I</u> | <u>I</u> | <u>I</u> | | | |
| <u>002</u> | | <u>5-7-19</u> | <u>1156</u> | <u>I</u> | <u>I</u> | <u>I</u> | <u>I</u> | | | |
| <u>003</u> | | <u>5-7-19</u> | <u>1053</u> | <u>I</u> | <u>I</u> | <u>I</u> | <u>I</u> | | | |
| <u>004</u> | | <u>5-6-19</u> | <u>1536</u> | <u>I</u> | <u>I</u> | <u>I</u> | <u>I</u> | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | |
| <u>—</u> | | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | <u>—</u> | | | |
| Possible Hazard Identification | | | | | | Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) | | | | |
| <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input type="checkbox"/> Radiological | | | | | | <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input checked="" type="checkbox"/> Archive For <u>1</u> Months | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) | | | | | | Special Instructions/QC Requirements: | | | | |
| Empty Kit Relinquished by: | | Date: | | Time: | | Method of Shipment: | | | | |
| Relinquished by: <u>Mark Caldwell</u> | | Date/Time: <u>5-7-19/1503</u> | | Company: <u>XCEL</u> | | Received by: | | Date/Time: | | Company: |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | | Company: |
| Relinquished by: | | Date/Time: | | Company: | | Received by: | | Date/Time: | | Company: |
| Custody Seals Intact: | | Custody Seal No.: | | | | Cooler Temperature(s) °C and Other Remarks: | | | | |
| Δ Yes Δ No | | | | | | | | | | |

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FALL 2019 FIELD LOGBOOK AND SAMPLING FORMS

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Well Identification: MW-1
Project Location: Madison, IN
Date: 10-14-19
Date: 10-22-19
Date: _____

6" I.D., K=1.469 gal/ft
8" I.D., K=2.61 gal/ft
10" I.D., K=4.08 gal/ft

$$\text{Purge Rate (gpm)} \times (\text{min}) = 3 \text{ Well Volume}$$

Time / Date Started: 0830 | 10-22-19
 Sampled by: Lewis & Farmer
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2 - 1000 ml
 Bottle Preservatives: none
 Recovering WL: —
 Duplicate Sampling: no
 Laboratory: TA
 COC Form: yes

Background: 28 cpm
Sample: 39 cpm



GROUNDWATER SAMPLE LOG

Project Name: Jefferson Proving Ground
 Project Number: ERM Sampling
 Purged by: D. Lawson & M. Sherman
 Sampled by: Lawson & Farmer
 Checked by: _____ & _____

Well Identification: MW-6
 Project Location: Madison, IN
 Date: 10-14-19
 Date: 10-22-19
 Date: _____

WELL VOLUME CALCULATION:

Circle diameter and K used below: 1" I.D., K=0.041 gal/ft
 2" I.D., K=0.163 gal/ft
 4" I.D., K=0.653 gal/ft
 6" I.D., K=1.469 gal/ft
 8" I.D., K=2.61 gal/ft
 10" I.D., K=4.08 gal/ft

1 Well Volume:

Total Depth (42.78 ft) - Depth to Water (20.73 ft) = Height of water column (22.05 ft)
 Height of water column (22.05 ft) x K value (0.163 gal/ft) = 1 Well Volume (3.59 gal)

Purge Volume:

1 Well Volume (3.59 gallons) x 3 = 3 Well Volumes (10.78 gallons)
 Purge Rate (_____ gpm) x (_____ min) = 1 Well Volume
 Purge Rate (_____ gpm) x (_____ min) = 3 Well Volume

| Time | Temp °C | pH | Cond mS/cm | Turbidity NTU | D.O. mg/l | ORP mv | Purged Quantity | Well Volume | Depth to Water | Purge Rate |
|------|---------|------|------------|---------------|-----------|--------|-----------------|-------------|----------------|------------|
| 0911 | 11.83 | 7.27 | 0.549 | 153 | 10.70 | 156 | — | 33.86' | 33.86' | — |
| | | | | | | | | MC | | |
| | | | | | | | | 10-22-19 | | |
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PURGE INFORMATION:

Time / Date Started: 1401 | 10-14-19
 Time Purge End: 1408
 Purge Method: Pump _____ Bailer X
 Depth to Intake: _____ NA _____ (ft)
 Pump Type and ID: NA
 Purge Rate: _____ NA _____ (gpm)
 Purged Volume: _____ (gal)
 Water Quality Meter: Horiba U-22#
 How was yield measured? _____ NA
 Was well cavitating? Yes _____ No _____
 Water containerized/Amount _____
 Grunfos controller set @ _____ NA _____ (Hertz)

SAMPLING INFORMATION:

Time / Date Started: 0911 | 10-22-19
 Sampled by: Lawson & Farmer
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2-1000ml
 Bottle Preservatives: none
 Recovering WL: _____
 Duplicate Sampling: no
 Laboratory: IA
 COC Form: yes

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.)

Water level at 33.86' below top of casing on 10-22-19
RAD: Dose: 5 uR/h
Background: 40 cpm
Sample: 36 cpm



Well Identification: MW-11
Project Location: Madison, IN
Date: ^{MS} 10-14-19 ~~4-10-14-19~~
Date: 10-21-19
Date: _____

Circle diameter and K used below: 1" I.D., K=0.041 gal/ft
2" I.D., K=0.163 gal/ft
4" I.D., K=0.653 gal/ft

6" I.D., K=1.469 gal/ft
8" I.D., K=2.61 gal/ft
10" ID, K=4.08 gal/ft

Total Depth (42.38 ft) - Depth to Water (12.64 ft) = Height of water column (29.66 ft)
Height of water column (29.66 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.83 gal)

1 Well Volume (4.83 gallons) x 3 = 3 Well Volumes (14.50 gallons)

Purge Rate (_____ gpm) x (_____ min) = 1 Well Volume

Purge Rate (gpm) x (min) = 3 Well Volume

PURGE INFORMATION:

| | | | |
|----------------------------|---------------------|-----------|-----------------|
| Time / Date Started: | <u>1448</u> | | <u>10-14-19</u> |
| Time Purge End: | <u>1458</u> | | |
| Purge Method: Pump | | Bailer | <u>X</u> |
| Depth to Intake: | <u>NA</u> | | <u>(ft)</u> |
| Pump Type and ID: | <u>NA</u> | | |
| Purge Rate: | <u>NA</u> | | <u>(gpm)</u> |
| Purged Volume: | | | <u>(gal)</u> |
| Water Quality Meter: | <u>Horiba U-22#</u> | | |
| How was yield measured? | | <u>NA</u> | |
| Was well cavitated? | <u>Yes</u> | <u>No</u> | |
| Water containerized/Amount | | | |
| Grunfos controller set @ | <u>NA</u> | | <u>(Hertz)</u> |

Time / Date Started: 1503 | 10-21-19
 Sampled by: Lawson & Farmer
 Sample Method: Bailer X Other _____
 Grab X Composite _____
 # of Bottles Collected: 2 - 1000 ml
 Bottle Preservatives: none
 Recovering WL: -
 Duplicate Sampling: no
 Laboratory: TA
 COC Form: 4c5

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.)

Water level at 29.66' below top of casing on 10-21-19.

RAD: Dose: 6 mR/h

Background: 39 cpm

Sample: 41 cpm

SAMPLE LOG SHEET

PROJECT NAME: JPG Fall '19 ERM PROJECT NO: -

SAMPLE ID NUMBER: SW-DU-001 DATE COLLECTED (MM/DD/YY): 10/21/19
SD-DU-001 TIME: 1419

SAMPLING LOCATION CODE: -
 DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: -
 DESCRIPTION: -

NORTHING: - EASTING: - ELEVATION: -

SAMPLE DEPTH CODE: - : - TO - BLS
 SAMPLE MEDIA CODE: - DESCRIPTION: -

WEATHER: - ACTIVITIES IN AREA: -
 FIELD OBSERVATIONS: -

Background Rad: 37 cpm
Sample Rad : 35 cpm (SW)
" " : 43 cpm (SD)
Dose: 5 μ R/h

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-----------------------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>15.35</u> | <u>°C</u> | | |
| pH: | <u>8.60</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.370</u> | <u>mS/cm</u> | | |
| REDOX: | <u>48</u> | <u>mV</u> | | |
| DO: | <u>17.43</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>-</u> | <u>-</u> | | |
| TURBIDITY: | <u>3.1</u> | <u>NTU</u> | | |
| OTHER _____: | <u>-</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) _____

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
 IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Dose: 5 μ R/h
Background: 37 cpm
Sediment: 43 cpm
Water: 35 cpm

Recorded By: _____ QC Checked By: _____
 (Signature) (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG Fall '19 ERM PROJECT NO: -

SAMPLE ID NUMBER: SW-DU-002 DATE COLLECTED (MM/DD/YY): 10/21/19
SW-DU-002-DUP TIME: 1435
SD-DU-002

SAMPLING LOCATION CODE: -
 DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: -
 DESCRIPTION: -

NORTHING: - EASTING: - ELEVATION: -

SAMPLE DEPTH CODE: - : - TO - BLS
 SAMPLE MEDIA CODE: - DESCRIPTION: -

WEATHER: - ACTIVITIES IN AREA: -
 FIELD OBSERVATIONS: -

Background Rad: 20 cpm
Sample Rad : 35 cpm (SW)
" " : 30 cpm (SD)
Dose: 5 mR/h

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|---------|-------|------------|-------------|
| RADIOACTIVITY: | 5 | mR/hr | | |
| TEMPERATURE: | 16.53 | °C | | |
| pH: | 7.37 | pH | | |
| CONDUCTIVITY: | 0.272 | nS/cm | | |
| REDOX: | 143 | mV | | |
| DO: | 12.76 | mg/l | | |
| ORGANIC VAPORS: | - | - | | |
| TURBIDITY: | 3.4 | NTU | | |
| OTHER _____: | - | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) _____

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
 IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Duplicate surface water sample collected.

Recorded By: _____ QC Checked By: _____
 (Signature) (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG Fall '19 ERM PROJECT NO: -

SAMPLE ID NUMBER: SW-DU-007 DATE COLLECTED (MM/DD/YY): 10-22-19
SD-DU-007 TIME: 0856

SAMPLING LOCATION CODE: -
DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: -
DESCRIPTION: -

NORTHING: - EASTING: - ELEVATION: -

SAMPLE DEPTH CODE: - : - TO - BLS
SAMPLE MEDIA CODE: - DESCRIPTION: -

WEATHER: - ACTIVITIES IN AREA: -
FIELD OBSERVATIONS: -

Background Rad: 40 cpm
Sample Rad : 36 cpm (SW)
" " : 32 cpm (SD)
Dose: 5 mR/h

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|--------------|------------|-------------|
| RADIOACTIVITY: | <u>5</u> | <u>mR/hr</u> | | |
| TEMPERATURE: | <u>10.71</u> | <u>°C</u> | | |
| pH: | <u>7.55</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.315</u> | <u>mS/cm</u> | | |
| REDOX: | <u>145</u> | <u>mV</u> | | |
| DO: | <u>43.68</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>-</u> | <u>-</u> | | |
| TURBIDITY: | <u>1.4</u> | <u>NTU</u> | | |
| OTHER _____: | <u>-</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) _____

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Recorded By: _____ QC Checked By: _____
(Signature) (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG Fall '19 ERM PROJECT NO: -

SAMPLE ID NUMBER: SW-DU-008 DATE COLLECTED (MM/DD/YY): 10-21-19
SD-DU-008 TIME: 1518
SD-DU-008-DUP

SAMPLING LOCATION CODE: -
 DESCRIPTION: Surface water and sediment

SAMPLING POINT CODE: -
 DESCRIPTION: -

NORTHING: - EASTING: - ELEVATION: -

SAMPLE DEPTH CODE: - : - TO - BLS
 SAMPLE MEDIA CODE: - DESCRIPTION: -

WEATHER: - ACTIVITIES IN AREA: -
 FIELD OBSERVATIONS: -

Background Rad: 38 cpm
Sample Rad : 37 cpm (SW)
" " : 35 cpm (SD)
Dose: 6 μ R/h

| FIELD MEASUREMENTS | READING | UNITS | SERIAL NO. | LAST CALIB. |
|--------------------|--------------|-------------------------------|------------|-------------|
| RADIOACTIVITY: | <u>6</u> | <u>μR/hr</u> | | |
| TEMPERATURE: | <u>15.83</u> | <u>$^{\circ}$C</u> | | |
| pH: | <u>8.22</u> | <u>pH</u> | | |
| CONDUCTIVITY: | <u>0.514</u> | <u>mS/cm</u> | | |
| REDOX: | <u>127</u> | <u>mV</u> | | |
| DO: | <u>6.43</u> | <u>mg/l</u> | | |
| ORGANIC VAPORS: | <u>-</u> | <u>-</u> | | |
| TURBIDITY: | <u>2.3</u> | <u>NTU</u> | | |
| OTHER _____: | <u>-</u> | | | |

SAMPLE TYPE: ☒ GRAB ☐ SPATIAL COMPOSITE ☐ TIME COMPOSITE
☐ QC TRIP BLANK ☐ QC RINSATE ☐ QC FIELD BLANK
☐ OTHER (SPECIFY) _____

SAMPLE COLLECTED: ☒ YES ☐ NO SAP SAMPLING PROCEDURE WAS FOLLOWED: ☒ YES ☐ NO
 IF SAP WAS NOT FOLLOWED, SPECIFY WHAT DEVIATIONS WERE NECESSARY AND WHY:

Duplicate sediment sample collected.

Recorded By: _____ QC Checked By: _____
 (Signature) (Signature)

Chain of Custody Record

| Client Information Client Contact: Mr. Mark Caldwell Company: XCEL Engineering Inc. Address: 1066 Commerce Park Drive City: Oak Ridge State, Zip: TN, 37830 Phone: 865.766.8547 Email: mcaldwell@xceleng.com Project Name: Fall '19 ERM Site: JPC - DU Impact Area | | | Sampler: Lawson / Farmer Lab PM: Ivan Vania Phone: 865.481.3200 E-Mail: | | Carrier Tracking No(s): COC No: 160-8496-4307.1 Page: 2 Page Total: 2 MC 10-22-14 Job #: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|-------------|-------------|--|--|--|---------------------------------|--|-----------------------------------|----------------------------|--------------------------|----------------------------|-----------|----------|------|---|---|---|---|--|--|-----------|----------|------|--|--|--|--|--|--|-----------|----------|------|--|--|--|--|--|--|-----------|----------|------|--|--|--|--|--|--|---------------|----------|------|--|--|--|--|--|--|---|---|---|---|---|---|---|--|--|---|---|---|---|---|---|---|--|--|---|---|---|---|---|---|---|--|--|---|---|---|---|---|---|---|--|--|---|---|---|---|---|---|---|--|--|--|--|--|
| Due Date Requested: _____ TAT Requested (days): _____ PO #: _____ WO #: _____ Project #: _____ SSOW#: _____ | | | Analysis Requested | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Sample Identification</th> <th>Sample Date</th> <th>Sample Time</th> <th>Sample Type (C=Comp, G=grab)</th> <th>Matrix (W=water, S=solid, O=other, A=air)</th> <th>Field Filtered Sample (Yes or No)</th> <th>Perform MS/MSD (Yes or No)</th> <th>Total / Isotopic Uranium</th> <th>Total Number of Containers</th> </tr> </thead> <tbody> <tr> <td>SD-DU-001</td> <td>10-21-14</td> <td>1419</td> <td>G</td> <td>S</td> <td>N</td> <td>N</td> <td></td> <td></td> </tr> <tr> <td>SD-DU-002</td> <td>10-21-14</td> <td>1435</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SD-DU-007</td> <td>10-22-14</td> <td>0856</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SD-DU-008</td> <td>10-21-14</td> <td>1518</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SD-DU-008-DUP</td> <td>10-21-14</td> <td>1518</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td></td> <td></td> </tr> </tbody> </table> | | | Sample Identification | Sample Date | Sample Time | Sample Type (C=Comp, G=grab) | Matrix (W=water, S=solid, O=other, A=air) | Field Filtered Sample (Yes or No) | Perform MS/MSD (Yes or No) | Total / Isotopic Uranium | Total Number of Containers | SD-DU-001 | 10-21-14 | 1419 | G | S | N | N | | | SD-DU-002 | 10-21-14 | 1435 | | | | | | | SD-DU-007 | 10-22-14 | 0856 | | | | | | | SD-DU-008 | 10-21-14 | 1518 | | | | | | | SD-DU-008-DUP | 10-21-14 | 1518 | | | | | | | — | — | — | — | — | — | — | | | — | — | — | — | — | — | — | | | — | — | — | — | — | — | — | | | — | — | — | — | — | — | — | | | — | — | — | — | — | — | — | | | Special Instructions/Note: All sample are consolidated into two (2) coolers. One (1) coc for all samples. | | |
| Sample Identification | Sample Date | Sample Time | Sample Type (C=Comp, G=grab) | Matrix (W=water, S=solid, O=other, A=air) | Field Filtered Sample (Yes or No) | Perform MS/MSD (Yes or No) | Total / Isotopic Uranium | Total Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SD-DU-001 | 10-21-14 | 1419 | G | S | N | N | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SD-DU-002 | 10-21-14 | 1435 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SD-DU-007 | 10-22-14 | 0856 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SD-DU-008 | 10-21-14 | 1518 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SD-DU-008-DUP | 10-21-14 | 1518 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Possible Hazard Identification <input type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input checked="" type="checkbox"/> Radiological | | | Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input checked="" type="checkbox"/> Archive For _____ Months | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) _____ | | | Special Instructions/QC Requirements: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Empty Kit Relinquished by: _____ Date: _____ | | | Method of Shipment: UPS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Relinquished by: _____ Date/Time: _____ | | | Received by: _____ Date/Time: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Relinquished by: _____ Date/Time: _____ | | | Received by: _____ Date/Time: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Relinquished by: _____ Date/Time: _____ | | | Received by: _____ Date/Time: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Custody Seals Intact: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> | | | Cooler Temperature(s) °C and Other Remarks: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Chain of Custody Record

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|--|--|--|--|--|--|
| Client Information Client Contact: Mr. Mark Caldwell Company: XCEL Engineering Inc. Address: 1066 Commerce Park Drive City: Oak Ridge State, Zip: TN, 37830 Phone: 865.766.8547 Email: mcaldwell@xceleng.com Project Name: Fall '19 ERM Site: JPC - DU Impact Area | | Sampler: Lawson / Farmer Phone: 865.481.3200 Lab PM: I. Varia E-Mail: — | | Carrier Tracking No(s): COC No: 160-8496-4307.2 Page: 1 of 2 Job #: MC 10-22-19 | |
| Analysis Requested | | | | | |
| Due Date Requested: — TAT Requested (days): Standard PO #: — WO #: — Project #: — SSOW #: — | | Preservation Codes: A - HCL B - NaOH C - Zn Acetate D - Nitric Acid E - NaHSO4 F - MeOH G - Amchlor H - Ascorbic Acid I - Ice J - DI Water K - EDTA L - EDA M - Hexane N - None O - AsNaO2 P - Na2O4S Q - Na2SO3 R - Na2SO3 S - H2SO4 T - TSP Dodecahydrate U - Acetone V - MCAA W - pH 4-5 X - EDA Y - other (specify) Other: | | | |
| Sample Identification MW-DU-001 MW-DU-005 MW-DU-005-DUP MW-DU-006 MW-DU-011 SW-DU-001 SW-DU-002 SW-DU-002-DUP SW-DU-007 SW-DU-008 | | Sample Date 10-22-19 10-21-19 10-21-19 10-22-19 10-21-19 10-21-19 10-21-19 10-22-19 10-21-19 | | Sample Time 0830 1533 1533 0911 1503 1419 1435 1435 0856 1518 | |
| Sample Type (C=comp, G=grab) G — — — — — — — — — | | Matrix (W=water, S=solid, O=organic, A=air) W — — — — — — — — — | | Field Filtered Sample (Yes or No) — — — — — — — — — — | |
| Perform MS/MSD (Yes or No) — — — — — — — — — — | | Total Number of Containers — — — — — — — — — — | | Special Instructions/Note: All samples are consolidated into two (2) coolers. One (1) COC for all samples. | |
| Possible Hazard Identification <input type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Polson B <input type="checkbox"/> Unknown <input checked="" type="checkbox"/> Radiological | | | | | |
| Deliverable Requested: I, II, III, IV, Other (specify) | | | | | |
| Empty Kit Relinquished by: | | | | | |
| Relinquished by: | | | | | |
| Relinquished by: | | | | | |
| Relinquished by: | | | | | |
| Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | | |

Location Former JAG - Madison, IN Date Oct 21, 2019Project / Client Fall '19 ERM - USACEWeather: 50s-60s, rain

1153: Mark Caldwell (Field book author) and Terry Farmer, both with XCEL Engineering, are at Army/Big Oaks HQ (Bldg 125). We will conduct the Fall '19 ERM sampling this week. The sampling for this ERM has been changed compared to previous events. Groundwater will be collected from four (4) wells. Sediment and surface water sample will be collected in four (4) locations. Details of water-level measurements, water-quality measurements, radiological reading, etc. will be recorded on individual sample-log forms and will not be recorded in this log book.

1211: Tom Rancich of VRH at Bldg 125. Tom will be providing UXO avoidance.

1217: Calibrating the Horiba U-52, ^{MC 10-21-19 HGS} ~~HGS~~ HGS & RESN2 JPV.

1253: David Lawson at Leidos on site. Calibrating rad meters.

Mark Caldwell

10-21-19

Location Former JAG - Madison, IN Date 10-21-19Project / Client Fall '19 ERM - USACE

1322: Tom with VRH completing the site-specific radiological training. Radiological instruments used: Micro R Model 19
Serial number: 243118 and Model 3/449
Serial numbers: 211669 (meter) & 222376 (44.9).

1356: Conducting safety briefing.

1419: Collecting samples at SW-001 & SD-001.

1435: Collecting samples at SW-002 & SD-002. Also collecting a surface-water duplicate.

1459: Collecting sample at MW-011

1503: MC 10-21-19

1518: Collecting samples at SW-008 & SD-008. Also collecting a sediment duplicate sample.

~~to~~ MC 10-21-19

1533: Collecting sample at MW-005. Also collected duplicate sample.

1604: At Bldg 125. Leaving site.

MC 10-21-19

Mark Caldwell

10-21-19

Location Former JAG - Madison, IN Date 10-22-19Project / Client Fall 'M ERM - USACE

0739: Caldwell & Farmer at Bldg. 125.

Lawson already here. We are
calibrating instruments.0800: Tom on site. Conducting safety
briefing.

0830: Collecting sample at MW-001.

0856: Collecting samples at SW-007 &
SD-007.

0911: Collecting sample at MW-006

0932: At Bldg 125. Scanning equipment
and packaging samples ¹⁰⁻²²⁻¹⁹0951: Brooks Evans ^{with} ~~and~~ USACE on
site.1029: Sealed sample bottles into coolers
and scanned all coolers and equipment
for radiological concerns.

1044: Caldwell & Farmer leaving site

MC
10-22-19

Mark Caldwell

10-22-19

Location _____ Date _____

Project / Client _____

APPENDIX C
DATA VALIDATION SUMMARY

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SPRING 2019 DATA VALIDATION

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C. DATA VALIDATION SUMMARY

C.1 TestAmerica SDG 160-34100

This report contains the results from the data validation technical review for the Jefferson Proving Ground (JPG) Environmental Radiation Monitoring (ERM) May 2019 samples and analyses that are associated with the above-referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation, and the sample data summary sheets on the following pages specifically identify the samples and analyses associated with this validation review.

The JPG validation technical review was conducted in accordance with the U.S. Environmental Protection Agency (USEPA) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (July 2002) and Leidos' Quality Assurance Technical Procedure (QATP) ESE DM-05, *Data Verification and Validation* (Revision 0, 1/2015). The validation technical review was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the JPG data quality requirements.

The attachment to this report provides the sample data summary sheets for the samples associated with the above-referenced SDG. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. The attachment also outlines the validation qualifiers and reason codes used in the validation of the data. Sample SD-DU-004 was received broken at the laboratory, and the analyses were not completed.

| Report Summary | |
|--|------|
| Total Number of Samples | 34 |
| Total Number of Data Points* | 136 |
| Total Number of Rejected Data Points | 0 |
| Percent Completeness (approval to rejection ratio) | 100% |

*Includes 60 Alpha Spectrometry results and 12 ICP-MS results.

C.1.1 Analytical Category: Radiochemical and ICP-MS

- Uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238) were determined by alpha spectrometry (U.S. Department of Energy Health and Safety Laboratory [DOE HASL]-300 Methods Compendium A-01-R) with SDG 160-28187-1. Total uranium was calculated using a published specific activity value for U-238 and assuming all of the mass originates from U-238.
 - All total/isotopic uranium samples were analyzed by DOE A-01-R-MOD with SDG 160-28187.
 - No samples were reanalyzed for total uranium via inductively coupled plasma-mass spectrometry (ICP-MS).
1. The following items (as applicable) have been addressed during the validation review:
 - Sample custody, integrity, and preservation
 - Sample handling and preparation
 - Holding times
 - Instrument calibration and performance
 - Dilution factors
 - Detection limits
 - Laboratory background and carry-over
 - Overall assessment of the data

- Alpha spectrometry quality control (QC)
 - Calibration checks and background
 - Preparation blanks
 - Uncertainty/detected value comparison
 - Laboratory control samples
 - Field blanks (if available)
 - Chemical yield (tracer recovery)
 - Laboratory duplicates
 - Sample holding times.
2. The above items were found to be acceptable, except as follows:
- ***Overall Assessment of Data***—U-234, U-235, and U-238 radiochemical sample data with results greater than the minimum detectable concentration (MDC) were qualified as estimated, J, reason code 37 in instances where the associated error was greater than 50 percent of the sample result.
 - ***Sample Duplicate Relative Percent Difference (RPD) Precision***—The U-238 result was qualified as estimated, J, with reason code 19 for which the RPD was affected by the elevated parent result.

The attached sample data summary for soil and water samples provides the qualifiers and the appropriate validation code for all samples.

| SAMPLE INDEX | |
|---|-------------------------------|
| <i>Laboratory:</i> Test America Laboratories, Inc. | <i>SDG #s:</i> 160-34100-1 |

| Client I.D. | Sample I.D.* | Laboratory Sample I.D. | Date Collected | Analyses Performed |
|-------------|--------------|------------------------|----------------|----------------------------|
| MW-DU-001 | LDOS31E | 160-34100-1 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-002 | LDOS31E | 160-34100-2 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-003 | LDOS31E | 160-34100-3 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-004 | LDOS31E | 160-34100-4 | 5/6/2019 | Total and Isotopic Uranium |
| MW-DU-005 | LDOS31E | 160-34100-5 | 5/6/2019 | Total and Isotopic Uranium |
| MW-DU-006 | LDOS31E | 160-34100-6 | 5/6/2019 | Total and Isotopic Uranium |
| MW-DU-007 | LDOS31E | 160-34100-7 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-008 | LDOS31E | 160-34100-8 | 5/6/2019 | Total and Isotopic Uranium |
| MW-DU-008 | LDOS31DE | 160-34100-9 | 5/6/2019 | Total and Isotopic Uranium |
| MW-DU-009 | LDOS31E | 160-34100-10 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-010 | LDOS31E | 160-34100-11 | 5/7/2019 | Total and Isotopic Uranium |
| MW-DU-011 | LDOS31E | 160-34100-12 | 5/7/2019 | Total and Isotopic Uranium |
| SD-DU-001 | LDOS31E | 160-34100-22 | 5/6/2019 | Total and Isotopic Uranium |
| SD-DU-002 | LDOS31E | 160-34100-23 | 5/6/2019 | Total and Isotopic Uranium |
| SD-DU-003 | LDOS31E | 160-34100-24 | 5/7/2019 | Total and Isotopic Uranium |
| SD-DU-005 | LDOS31E | 160-34100-26 | 5/7/2019 | Total and Isotopic Uranium |
| SD-DU-006 | LDOS31E | 160-34100-27 | 5/7/2019 | Total and Isotopic Uranium |
| SD-DU-006 | LDOS31DE | 160-34100-28 | 5/7/2019 | Total and Isotopic Uranium |
| SD-DU-007 | LDOS31E | 160-34100-29 | 5/6/2019 | Total and Isotopic Uranium |
| SD-DU-008 | LDOS31E | 160-34100-30 | 5/7/2019 | Total and Isotopic Uranium |
| SW-DU-001 | LDOS31E | 160-34100-13 | 5/6/2019 | Total and Isotopic Uranium |
| SW-DU-002 | LDOS31E | 160-34100-14 | 5/6/2019 | Total and Isotopic Uranium |
| SW-DU-003 | LDOS28E | 160-34100-15 | 5/7/2019 | Total and Isotopic Uranium |
| SW-DU-004 | LDOS31E | 160-34100-16 | 5/7/2019 | Total and Isotopic Uranium |
| SW-DU-005 | LDOS31E | 160-34100-17 | 5/7/2019 | Total and Isotopic Uranium |
| SW-DU-006 | LDOS30E | 160-34100-18 | 5/7/2019 | Total and Isotopic Uranium |
| SW-DU-007 | LDOS31E | 160-34100-19 | 5/6/2019 | Total and Isotopic Uranium |
| SW-DU-007 | LDOS31DE | 160-34100-20 | 5/6/2019 | Total and Isotopic Uranium |
| SW-DU-008 | LDOS31E | 160-34100-21 | 5/7/2019 | Total and Isotopic Uranium |
| SS-DU-001 | LDOS31E | 160-34100-31 | 5/7/2019 | Total and Isotopic Uranium |
| SS-DU-001 | LDOS31DE | 160-34100-32 | 5/7/2019 | Total and Isotopic Uranium |
| SS-DU-002 | LDOS31E | 160-34100-33 | 5/7/2019 | Total and Isotopic Uranium |
| SS-DU-003 | LDOS31E | 160-34100-34 | 5/7/2019 | Total and Isotopic Uranium |
| SS-DU-004 | LDOS31E | 160-34100-35 | 5/6/2019 | Total and Isotopic Uranium |

* The Leidos sample I.D. (LDOS31E) is a unique designation that provides a tracking procedure in the electronic database for data retrieval.

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ATTACHMENT

**JEFFERSON PROVING GROUND
SAMPLE DATA SUMMARY**

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| Water Sample Summary | | | | | | | | | | |
|----------------------|-------------|----------------|---------------|---------|-------|--------|--------|------------|---------------|---------------|
| Site I.D. | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code 1 | Reason Code 2 |
| MW-DU-001 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.477 | µg/L | NA | NA | | | |
| MW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.341 | pCi/L | 0.126 | 0.0824 | | | |
| MW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.00742 | pCi/L | 0.0276 | 0.0703 | U | | |
| MW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.159 | pCi/L | 0.0832 | 0.0564 | J | 37 | 19 |
| MW-DU-002 | LDOS31E | DOE A-01-R MOD | Total Uranium | 1.2 | µg/L | NA | NA | | | |
| MW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 1.11 | pCi/L | 0.233 | 0.0566 | | | |
| MW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0382 | pCi/L | 0.0442 | 0.0382 | J | 37 | |
| MW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.398 | pCi/L | 0.132 | 0.0306 | | | |
| MW-DU-003 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.893 | µg/L | NA | NA | | | |
| MW-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.95 | pCi/L | 0.21 | 0.0297 | | | |
| MW-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0246 | pCi/L | 0.0349 | 0.0369 | U | | |
| MW-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.296 | pCi/L | 0.111 | 0.0296 | | | |
| MW-DU-004 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.849 | µg/L | NA | NA | | | |
| MW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.441 | pCi/L | 0.141 | 0.0672 | | | |
| MW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0254 | pCi/L | 0.036 | 0.0382 | U | | |
| MW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.281 | pCi/L | 0.111 | 0.0564 | | | |
| MW-DU-005 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.701 | µg/L | NA | NA | | | |
| MW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.993 | pCi/L | 0.222 | 0.0693 | | | |
| MW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0547 | pCi/L | 0.0609 | 0.0863 | U | | |
| MW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.227 | pCi/L | 0.101 | 0.0582 | | | |
| MW-DU-006 | LDOS31E | DOE A-01-R MOD | Total Uranium | 4.61 | µg/L | NA | NA | | | |
| MW-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 2.34 | pCi/L | 0.358 | 0.0287 | | | |
| MW-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.114 | pCi/L | 0.0765 | 0.0657 | J | 37 | |
| MW-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 1.53 | pCi/L | 0.274 | 0.0527 | | | |
| MW-DU-007 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.11 | µg/L | NA | NA | | | |
| MW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 1.74 | pCi/L | 0.3 | 0.0294 | | | |
| MW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0853 | pCi/L | 0.0649 | 0.0366 | J | 37 | |
| MW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.696 | pCi/L | 0.176 | 0.0643 | | | |
| MW-DU-008 | LDOS31DE | DOE A-01-R MOD | Total Uranium | 0.896 | µg/L | NA | NA | | | |
| MW-DU-008 | LDOS31DE | DOE A-01-R MOD | Uranium-234 | 0.896 | pCi/L | 0.219 | 0.0851 | | | |
| MW-DU-008 | LDOS31DE | DOE A-01-R MOD | Uranium-235 | 0.0861 | pCi/L | 0.0707 | 0.043 | J | 37 | |
| MW-DU-008 | LDOS31DE | DOE A-01-R MOD | Uranium-238 | 0.288 | pCi/L | 0.118 | 0.0345 | | | |
| MW-DU-008 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.445 | µg/L | NA | NA | | | |
| MW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.521 | pCi/L | 0.157 | 0.0593 | | | |
| MW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0267 | pCi/L | 0.0378 | 0.04 | U | | |
| MW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.145 | pCi/L | 0.0815 | 0.0592 | J | 37 | |
| MW-DU-009 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.471 | µg/L | NA | NA | | | |
| MW-DU-009 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.635 | pCi/L | 0.175 | 0.0705 | | | |
| MW-DU-009 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0133 | pCi/L | 0.0267 | 0.04 | U | | |
| MW-DU-009 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.156 | pCi/L | 0.0844 | 0.0592 | J | 37 | |
| MW-DU-010 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.13 | µg/L | NA | NA | | | |
| MW-DU-010 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 2.18 | pCi/L | 0.348 | 0.0556 | | | |
| MW-DU-010 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.145 | pCi/L | 0.0881 | 0.0691 | J | 37 | |
| MW-DU-010 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.692 | pCi/L | 0.177 | 0.0301 | | | |
| MW-DU-011 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.087 | µg/L | NA | NA | | | |
| MW-DU-011 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.206 | pCi/L | 0.0963 | 0.0326 | | | |
| MW-DU-011 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.00789 | pCi/L | 0.0293 | 0.0747 | U | | |
| MW-DU-011 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.028 | pCi/L | 0.0387 | 0.0599 | U | | |
| SW-DU-001 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.165 | µg/L | NA | NA | | | |
| SW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.309 | pCi/L | 0.116 | 0.0309 | | | |

| Water Sample Summary | | | | | | | | | | |
|----------------------|-------------|----------------|---------------|---------|-------|--------|--------|------------|---------------|---------------|
| Site I.D. | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code 1 | Reason Code 2 |
| SW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0256 | pCi/L | 0.0363 | 0.0384 | U | | |
| SW-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.0514 | pCi/L | 0.0461 | 0.0308 | J | 37 | |
| SW-DU-002 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.49 | µg/L | NA | NA | | | |
| SW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.206 | pCi/L | 0.0939 | 0.031 | | | |
| SW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0 | pCi/L | 0.0107 | 0.0385 | U | | |
| SW-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.165 | pCi/L | 0.0835 | 0.0309 | J | 37 | |
| SW-DU-003 | LDOS28E | DOE A-01-R MOD | Total Uranium | 0.121 | µg/L | NA | NA | | | |
| SW-DU-003 | LDOS28E | DOE A-01-R MOD | Uranium-234 | 0.342 | pCi/L | 0.119 | 0.0293 | | | |
| SW-DU-003 | LDOS28E | DOE A-01-R MOD | Uranium-235 | 0.0365 | pCi/L | 0.0422 | 0.0365 | J | 37 | |
| SW-DU-003 | LDOS28E | DOE A-01-R MOD | Uranium-238 | 0.035 | pCi/L | 0.04 | 0.0539 | U | | |
| SW-DU-004 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.323 | µg/L | NA | NA | | | |
| SW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.191 | pCi/L | 0.0889 | 0.0538 | | | |
| SW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0 | pCi/L | 0.0101 | 0.0363 | U | | |
| SW-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.108 | pCi/L | 0.0689 | 0.0639 | J | 37 | |
| SW-DU-005 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.752 | µg/L | NA | NA | | | |
| SW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.38 | pCi/L | 0.131 | 0.0574 | | | |
| SW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0258 | pCi/L | 0.0366 | 0.0387 | U | | |
| SW-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.249 | pCi/L | 0.104 | 0.0311 | | | |
| SW-DU-006 | LDOS30E | DOE A-01-R MOD | Total Uranium | 0.153 | µg/L | NA | NA | | | |
| SW-DU-006 | LDOS30E | DOE A-01-R MOD | Uranium-234 | 0.394 | pCi/L | 0.131 | 0.0303 | | | |
| SW-DU-006 | LDOS30E | DOE A-01-R MOD | Uranium-235 | 0.0325 | pCi/L | 0.0449 | 0.0695 | U | | |
| SW-DU-006 | LDOS30E | DOE A-01-R MOD | Uranium-238 | 0.0462 | pCi/L | 0.0461 | 0.0558 | U | | |
| SW-DU-007 | LDOS31DE | DOE A-01-R MOD | Total Uranium | 0.262 | µg/L | NA | NA | | | |
| SW-DU-007 | LDOS31DE | DOE A-01-R MOD | Uranium-234 | 0.767 | pCi/L | 0.201 | 0.0354 | | | |
| SW-DU-007 | LDOS31DE | DOE A-01-R MOD | Uranium-235 | 0.0673 | pCi/L | 0.067 | 0.0811 | U | | |
| SW-DU-007 | LDOS31DE | DOE A-01-R MOD | Uranium-238 | 0.0775 | pCi/L | 0.0634 | 0.0651 | J | 37 | |
| SW-DU-007 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.147 | µg/L | NA | NA | | | |
| SW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.291 | pCi/L | 0.115 | 0.0324 | | | |
| SW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0 | pCi/L | 0.0112 | 0.0403 | U | | |
| SW-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.0494 | pCi/L | 0.0492 | 0.0595 | U | | |
| SW-DU-008 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.723 | µg/L | NA | NA | | | |
| SW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.708 | pCi/L | 0.184 | 0.0322 | | | |
| SW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.00779 | pCi/L | 0.0289 | 0.0738 | U | | |
| SW-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.242 | pCi/L | 0.105 | 0.0592 | | | |

| Soil/Sediment Sample Summary | | | | | | | | | |
|------------------------------|-------------|----------------|---------------|----------|-------|--------|--------|------------|-------------|
| Site I.D. | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code |
| SD-DU-001 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.61 | µg/g | NA | NA | | |
| SD-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.234 | pCi/g | 0.0697 | 0.034 | | |
| SD-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-235 | -0.00144 | pCi/g | 0.0142 | 0.0424 | U | |
| SD-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.205 | pCi/g | 0.0643 | 0.0255 | | |
| SD-DU-002 | LDOS31E | DOE A-01-R MOD | Total Uranium | 1.18 | µg/g | NA | NA | | |
| SD-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.358 | pCi/g | 0.0894 | 0.0435 | | |
| SD-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.027 | pCi/g | 0.0269 | 0.0326 | U | |
| SD-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.393 | pCi/g | 0.0929 | 0.0311 | | |
| SD-DU-003 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.04 | µg/g | NA | NA | | |
| SD-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.564 | pCi/g | 0.114 | 0.0308 | | |
| SD-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0384 | pCi/g | 0.0314 | 0.0323 | J | 37 |
| SD-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.679 | pCi/g | 0.126 | 0.014 | | |
| SD-DU-005 | LDOS31E | DOE A-01-R MOD | Total Uranium | 1.69 | µg/g | NA | NA | | |
| SD-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.327 | pCi/g | 0.0833 | 0.026 | | |
| SD-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.00438 | pCi/g | 0.0186 | 0.0431 | U | |
| SD-DU-005 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.568 | pCi/g | 0.114 | 0.0308 | | |
| SD-DU-006 | LDOS31DE | DOE A-01-R MOD | Total Uranium | 0.912 | µg/g | NA | NA | | |
| SD-DU-006 | LDOS31DE | DOE A-01-R MOD | Uranium-234 | 0.326 | pCi/g | 0.0836 | 0.0144 | | |
| SD-DU-006 | LDOS31DE | DOE A-01-R MOD | Uranium-235 | 0.0298 | pCi/g | 0.0268 | 0.0179 | J | 37 |
| SD-DU-006 | LDOS31DE | DOE A-01-R MOD | Uranium-238 | 0.302 | pCi/g | 0.0807 | 0.0314 | | |
| SD-DU-006 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.886 | µg/g | NA | NA | | |
| SD-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.351 | pCi/g | 0.0895 | 0.0397 | | |
| SD-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0327 | pCi/g | 0.0341 | 0.0493 | U | |
| SD-DU-006 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.293 | pCi/g | 0.0801 | 0.0272 | | |
| SD-DU-007 | LDOS31E | DOE A-01-R MOD | Total Uranium | 1.8 | µg/g | NA | NA | | |
| SD-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.453 | pCi/g | 0.0738 | 0.0167 | | |
| SD-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.038 | pCi/g | 0.0219 | 0.0208 | J | 37 |
| SD-DU-007 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.6 | pCi/g | 0.0883 | 0.0166 | | |
| SD-DU-008 | LDOS31E | DOE A-01-R MOD | Total Uranium | 0.68 | µg/g | NA | NA | | |
| SD-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.245 | pCi/g | 0.0704 | 0.0253 | | |
| SD-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.00332 | pCi/g | 0.0123 | 0.0314 | U | |
| SD-DU-008 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.228 | pCi/g | 0.0673 | 0.0137 | | |
| SS-DU-001 | LDOS31DE | DOE A-01-R MOD | Total Uranium | 2.31 | µg/g | NA | NA | | |
| SS-DU-001 | LDOS31DE | DOE A-01-R MOD | Uranium-234 | 0.709 | pCi/g | 0.131 | 0.0352 | | |
| SS-DU-001 | LDOS31DE | DOE A-01-R MOD | Uranium-235 | 0.0237 | pCi/g | 0.0238 | 0.0178 | J | 37 |
| SS-DU-001 | LDOS31DE | DOE A-01-R MOD | Uranium-238 | 0.772 | pCi/g | 0.138 | 0.0383 | | |
| SS-DU-001 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.41 | µg/g | NA | NA | | |
| SS-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.711 | pCi/g | 0.13 | 0.0345 | | |
| SS-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.099 | pCi/g | 0.0488 | 0.0175 | | |
| SS-DU-001 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.794 | pCi/g | 0.139 | 0.014 | | |
| SS-DU-002 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.08 | µg/g | NA | NA | | |
| SS-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.723 | pCi/g | 0.123 | 0.0278 | | |
| SS-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0942 | pCi/g | 0.0443 | 0.0287 | | |
| SS-DU-002 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.683 | pCi/g | 0.118 | 0.0116 | | |
| SS-DU-003 | LDOS31E | DOE A-01-R MOD | Total Uranium | 2.36 | µg/g | NA | NA | | |
| SS-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.663 | pCi/g | 0.128 | 0.0472 | | |
| SS-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0445 | pCi/g | 0.0379 | 0.0489 | U | |
| SS-DU-003 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.785 | pCi/g | 0.142 | 0.0554 | | |
| SS-DU-004 | LDOS31E | DOE A-01-R MOD | Total Uranium | 1.66 | µg/g | NA | NA | | |

| Soil/Sediment Sample Summary | | | | | | | | | |
|------------------------------|-------------|----------------|-------------|--------|-------|--------|--------|------------|-------------|
| Site I.D. | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code |
| SS-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-234 | 0.553 | pCi/g | 0.112 | 0.0415 | | |
| SS-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-235 | 0.0225 | pCi/g | 0.0226 | 0.0169 | J | 37 |
| SS-DU-004 | LDOS31E | DOE A-01-R MOD | Uranium-238 | 0.554 | pCi/g | 0.111 | 0.039 | | |

NA = Not applicable

Data Validation Reason Code

- 37 Associated error was greater than 50 percent of the sample result.
19 Inorganic laboratory duplicate or MS/MSD RPD outside QC limits

FALL 2019 DATA VALIDATION

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C. DATA VALIDATION SUMMARY

C.1 TestAmerica SDG 160-36108

This report contains the results from the data validation technical review for the Jefferson Proving Ground (JPG) Environmental Radiation Monitoring (ERM) October 2019 samples and analyses that are associated with the above-referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation, and the sample data summary sheets on the following pages specifically identify the samples and analyses associated with this validation review.

The JPG validation technical review was conducted in accordance with the U.S. Environmental Protection Agency (USEPA) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (July 2002) and Leidos' Quality Assurance Technical Procedure (QATP) ESE DM-05, *Data Verification and Validation* (Revision 0, 1/2015). The validation technical review was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the JPG data quality requirements.

The attachment to this report provides the sample data summary sheets for the samples associated with the above-referenced SDG. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. The attachment also outlines the validation qualifiers and reason codes used in the validation of the data.

| Report Summary | |
|--|------|
| Total Number of Samples | 15 |
| Total Number of Data Points* | 72 |
| Total Number of Rejected Data Points | 0 |
| Percent Completeness (approval to rejection ratio) | 100% |

*Includes 60 Alpha Spectrometry results and 12 ICP-MS results.

C.1.1 Analytical Category: Radiochemical and ICP-MS

- Uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238) were determined by alpha spectrometry (U.S. Department of Energy Health and Safety Laboratory [DOE HASL]-300 Methods Compendium A-01-R) with SDG 160-36108-1. Total uranium was calculated using a published specific activity value for U-238 and assuming all of the mass originates from U-238.
 - All total/isotopic uranium samples were analyzed by DOE A-01-R-MOD with SDG 160-36108-1.
 - Two samples were reanalyzed for total and isotopic uranium by Method SW846 6020A with SDG 160-36108-2. All data quality objectives were met for the SW846 Method 6020A analysis.
1. The following items (as applicable) have been addressed during the validation review:
 - Sample custody, integrity, and preservation
 - Sample handling and preparation
 - Holding times
 - Instrument calibration and performance
 - Dilution factors
 - Detection limits
 - Laboratory background and carry-over
 - Overall assessment of the data

- Alpha spectrometry quality control (QC)
 - Calibration checks and background
 - Preparation blanks
 - Uncertainty/detected value comparison
 - Laboratory control samples
 - Field blanks (if available)
 - Chemical yield (tracer recovery)
 - Laboratory duplicates
 - Sample holding times
- Inductively coupled plasma/mass spectrometry (ICP/MS) QC
 - Initial and continuing calibration verification
 - Reporting limit check standard
 - Preparation blanks
 - Initial and continuing calibration blanks
 - Laboratory control samples
 - Interference check standards
 - Serial dilution
 - Internal standard performance
 - Sample holding times.

2. The above items were found to be acceptable, except as follows:

- ***Overall Assessment of Data***—U-234, U-235, and U-238 radiochemical sample data with results greater than the minimum detectable concentration (MDC) were qualified as estimated, J, reason code 37 in instances where the associated error was greater than 50 percent of the sample result.
- ***Continuing Calibration Blank***—U-238 and total uranium ICP/MS sample data were qualified as non-detect, U, with reason code 17 where the sample result was below the continuing calibration blank action level.

The attached sample data summary for soil and water samples provides the qualifiers and the appropriate validation code for all samples.

| SAMPLE INDEX | |
|---|--|
| <i>Laboratory:</i> Test America Laboratories, Inc. | <i>SDG #s:</i> 160-36108-1, 160-36108-2 |

| Client I.D. | Sample I.D.* | Laboratory Sample I.D. | Date Collected | Analyses Performed |
|---------------|--------------|------------------------|----------------|----------------------------|
| MW-DU-001 | LDOS32E | 160-36108-01 | 10/22/2019 | Total and Isotopic Uranium |
| MW-DU-005 | LDOS32E | 160-36108-02 | 10/21/2019 | Total and Isotopic Uranium |
| MW-DU-005-DUP | LDOS32DE | 160-36108-03 | 10/21/2019 | Total and Isotopic Uranium |
| MW-DU-006 | LDOS32E | 160-36108-04 | 10/22/2019 | Total and Isotopic Uranium |
| MW-DU-011 | LDOS32E | 160-36108-05 | 10/21/2019 | Total and Isotopic Uranium |
| SW-DU-001 | LDOS32E | 160-36108-06 | 10/21/2019 | Total and Isotopic Uranium |
| SW-DU-002 | LDOS32E | 160-36108-07 | 10/21/2019 | Total and Isotopic Uranium |
| SW-DU-002-DUP | LDOS32DE | 160-36108-08 | 10/21/2019 | Total and Isotopic Uranium |
| SW-DU-007 | LDOS32E | 160-36108-09 | 10/22/2019 | Total and Isotopic Uranium |
| SW-DU-008 | LDOS32E | 160-36108-10 | 10/21/2019 | Total and Isotopic Uranium |
| SD-DU-001 | LDOS32E | 160-36108-11 | 10/21/2019 | Total and Isotopic Uranium |
| SD-DU-002 | LDOS32E | 160-36108-12 | 10/21/2019 | Total and Isotopic Uranium |
| SD-DU-007 | LDOS32E | 160-36108-13 | 10/22/2019 | Total and Isotopic Uranium |
| SD-DU-008 | LDOS32E | 160-36108-14 | 10/21/2019 | Total and Isotopic Uranium |
| SD-DU-008-DUP | LDOS32DE | 160-36108-15 | 10/21/2019 | Total and Isotopic Uranium |

* The Leidos sample I.D. (LDOS32E) is a unique designation that provides a tracking procedure in the electronic database for data retrieval.

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ATTACHMENT

**JEFFERSON PROVING GROUND
SAMPLE DATA SUMMARY**

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| Water Sample Summary | | | | | | | | | |
|----------------------|-------------|----------------|---------------|---------|-------|--------|--------|------------|-------------|
| Site I.D. | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code |
| MW-DU-001 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.736 | µg/L | NA | NA | | |
| MW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.472 | pCi/L | 0.113 | 0.0324 | | |
| MW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.0115 | pCi/L | 0.0215 | 0.0403 | U | |
| MW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.246 | pCi/L | 0.0786 | 0.0175 | | |
| MW-DU-005 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.554 | µg/L | NA | NA | | |
| MW-DU-005 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.478 | pCi/L | 0.112 | 0.0416 | | |
| MW-DU-005 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.0181 | pCi/L | 0.025 | 0.0388 | U | |
| MW-DU-005 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.183 | pCi/L | 0.0666 | 0.0311 | | |
| MW-DU-005-DUP | LDOS32DE | DOE A-01-R MOD | Total Uranium | 0.714 | µg/L | NA | NA | | |
| MW-DU-005-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-234 | 0.353 | pCi/L | 0.0938 | 0.0307 | | |
| MW-DU-005-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-235 | 0.0109 | pCi/L | 0.0204 | 0.0382 | U | |
| MW-DU-005-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-238 | 0.238 | pCi/L | 0.0754 | 0.0166 | | |
| MW-DU-006 | LDOS32E | DOE A-01-R MOD | Total Uranium | 4.47 | µg/L | NA | NA | | |
| MW-DU-006 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 1.8 | pCi/L | 0.264 | 0.0479 | | |
| MW-DU-006 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.0936 | pCi/L | 0.0569 | 0.0447 | J | 37 |
| MW-DU-006 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 1.49 | pCi/L | 0.234 | 0.0478 | | |
| MW-DU-011 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.381 | µg/L | NA | NA | | |
| MW-DU-011 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.626 | pCi/L | 0.13 | 0.037 | | |
| MW-DU-011 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.028 | pCi/L | 0.0281 | 0.021 | J | 37 |
| MW-DU-011 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.124 | pCi/L | 0.0537 | 0.0169 | | |
| SW-DU-001 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.375 | µg/L | NA | NA | | |
| SW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.154 | pCi/L | 0.0586 | 0.0288 | | |
| SW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.00378 | pCi/L | 0.014 | 0.0358 | U | |
| SW-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.126 | pCi/L | 0.0533 | 0.0341 | | |
| SW-DU-002 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.557 | µg/L | NA | NA | | |
| SW-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.116 | pCi/L | 0.0587 | 0.0386 | J | 37 |
| SW-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.0138 | pCi/L | 0.0256 | 0.048 | U | |
| SW-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.185 | pCi/L | 0.0743 | 0.0385 | | |
| SW-DU-002-DUP | LDOS32DE | DOE A-01-R MOD | Total Uranium | 0.738 | µg/L | NA | NA | | |
| SW-DU-002-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-234 | 0.128 | pCi/L | 0.0646 | 0.0425 | J | 37 |
| SW-DU-002-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-235 | 0.0152 | pCi/L | 0.0282 | 0.0529 | U | |
| SW-DU-002-DUP | LDOS32DE | DOE A-01-R MOD | Uranium-238 | 0.246 | pCi/L | 0.0892 | 0.023 | | |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Total Uranium | 0.62 | µg/L | NA | 0.01 | U | 17 |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Uranium-233 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Uranium-234 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Uranium-235 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Uranium-236 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-002-DUP | LDOS32DE | SW846 6020A* | Uranium-238 | 0.62 | µg/L | NA | 0.03 | U | 17 |
| SW-DU-007 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.247 | µg/L | NA | NA | | |
| SW-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.186 | pCi/L | 0.0807 | 0.0454 | | |
| SW-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.00597 | pCi/L | 0.0222 | 0.0565 | U | |
| SW-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.082 | pCi/L | 0.0523 | 0.0246 | J | 37 |
| SW-DU-008 | LDOS32E | DOE A-01-R MOD | Total Uranium | 1.15 | µg/L | NA | NA | | |
| SW-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium-234 | 0.181 | pCi/L | 0.0687 | 0.0187 | | |
| SW-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium-235 | 0.00775 | pCi/L | 0.0155 | 0.0232 | U | |
| SW-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium-238 | 0.385 | pCi/L | 0.103 | 0.0186 | | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Total Uranium | 1.4 | µg/L | NA | 0.01 | | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Uranium-233 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Uranium-234 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Uranium-235 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Uranium-236 | 0.03 | µg/L | NA | 0.03 | U | |
| SW-DU-008 | LDOS32E | SW846 6020A* | Uranium-238 | 1.4 | µg/L | NA | 0.03 | | |

| Sediment Sample Summary | | | | | | | | | |
|-------------------------|-------------|----------------|---------------|--------|-------|--------|--------|------------|-------------|
| Site ID | Sample I.D. | Method | Analyte | Value | Units | Error | MDC | Final Qual | Reason Code |
| SD-DU-001 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.568 | µg/g | NA | NA | | |
| SD-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium 234 | 0.208 | pCi/g | 0.0645 | 0.0139 | | |
| SD-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium 235 | 0.0115 | pCi/g | 0.0163 | 0.0173 | U | |
| SD-DU-001 | LDOS32E | DOE A-01-R MOD | Uranium 238 | 0.189 | pCi/g | 0.0612 | 0.0138 | | |
| SD-DU-002 | LDOS32E | DOE A-01-R MOD | Total Uranium | 0.561 | µg/g | NA | NA | | |
| SD-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium 234 | 0.123 | pCi/g | 0.0525 | 0.0289 | | |
| SD-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium 235 | 0.0038 | pCi/g | 0.0141 | 0.036 | U | |
| SD-DU-002 | LDOS32E | DOE A-01-R MOD | Uranium 238 | 0.188 | pCi/g | 0.0646 | 0.0157 | | |
| SD-DU-007 | LDOS32E | DOE A-01-R MOD | Total Uranium | 1.84 | µg/g | NA | NA | | |
| SD-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium 234 | 0.618 | pCi/g | 0.121 | 0.0264 | | |
| SD-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium 235 | 0.0628 | pCi/g | 0.04 | 0.0328 | J | 37 |
| SD-DU-007 | LDOS32E | DOE A-01-R MOD | Uranium 238 | 0.609 | pCi/g | 0.119 | 0.0143 | | |
| SD-DU-008 | LDOS32E | DOE A-01-R MOD | Total Uranium | 1.62 | µg/g | NA | NA | | |
| SD-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium 234 | 0.372 | pCi/g | 0.0937 | 0.0157 | | |
| SD-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium 235 | 0.0196 | pCi/g | 0.0226 | 0.0196 | J | 37 |
| SD-DU-008 | LDOS32E | DOE A-01-R MOD | Uranium 238 | 0.542 | pCi/g | 0.116 | 0.0289 | | |
| SD-DU-008-DUP | LDOS32DE | DOE A-01-R MOD | Total Uranium | 1.25 | µg/g | NA | NA | | |
| SD-DU-008-DUP | LDOS32DE | DOE A-01-R MOD | Uranium 234 | 0.285 | pCi/g | 0.0806 | 0.0156 | | |
| SD-DU-008-DUP | LDOS32DE | DOE A-01-R MOD | Uranium 235 | 0.0323 | pCi/g | 0.029 | 0.0194 | J | 37 |
| SD-DU-008-DUP | LDOS32DE | DOE A-01-R MOD | Uranium 238 | 0.414 | pCi/g | 0.099 | 0.0155 | | |

*The sample specific detection limit value is shown in the MDC column for SW-846 6020A results.

NA = Not applicable

Data Validation Reason Code

37 Associated error was greater than 50 percent of the sample result.

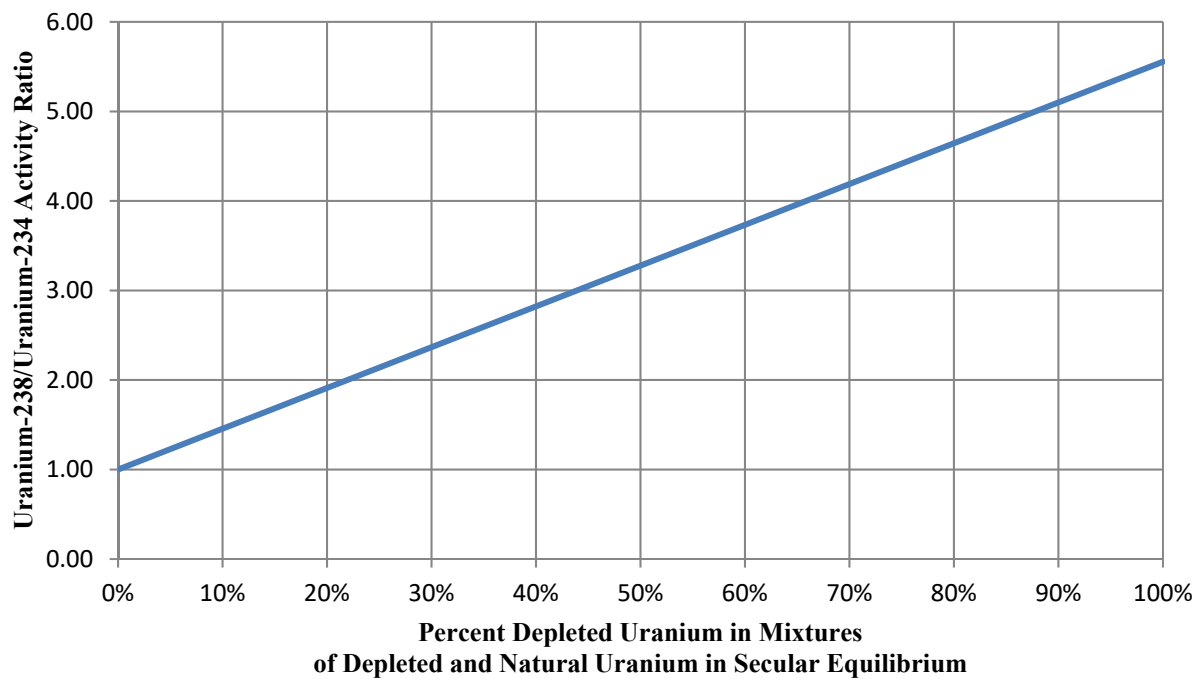
17 ICB and/or CCB contamination.

APPENDIX D

RELATIVE URANIUM-238/URANIUM-234 ACTIVITY RATIOS FOR MIXTURES OF DEPLETED AND NATURAL URANIUM

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Figure D-1. Relative Uranium-238/Uranium-234 Activity Ratios for Mixtures of Depleted and Natural Uranium



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