DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
2405 GUN SHED ROAD
JOINT BASE SAN ANTONIO FORT SAM HOUSTON, TX 78234-1223

REPLY TO
ATTENTION OF

April 26, 2019

ATTN: Document Control Desk
Deputy Director, Division of Decommissioning, Uranium Recovery and Waste Programs
Office of Nuclear Material Safety and Safeguards
Mailstop T8 F5
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Deputy Director:

Reference US Nuclear Regulatory Commission (NRC) license number SUB-1435 (docket 040-08838) issued to the US Army Garrison-Rock Island Arsenal, Illinois for possession for decommissioning of residual depleted uranium at Jefferson Proving Ground, Indiana.

License condition 12 requires us to perform periodic environmental radiation monitoring. I enclose a summary report of the results of our calendar year 2018 environmental radiation monitoring program for your information and to make it available to the public on your web-based ADAMS.

You may reach me at (210) 466-0368 or robert.n.cherry.civ@mail.mil.

Sincerely,

Robert N. Cherry
License Radiation Safety Officer

Enclosure

NMSS01

RADIATION MONITORING REPORT
FOR LICENSE SUB-1435
JEFFERSON PROVING GROUND

Summary of Results for the April/May and October 2018 Sampling Events

FINAL

Submitted by:

U.S. Department of Army
U.S. Army Garrison, Rock Island Arsenal
Rock Island, Illinois

Submitted to:

U.S. Nuclear Regulatory Commission
Office of Federal and State Materials and Environmental Management Programs
Division of Waste Management and Environmental Protection
Decommissioning and Uranium Recovery Licensing Directorate
Materials Decommissioning Branch
Washington, DC

April 2019

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
µR/hr	Microroentgens 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 April/May and October 2018 sampling events, which were the two planned sampling events in 2018 for this biannual program. 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. The plan has been approved by NRC and is described in an SOP, which is provided in Appendix A. The Army has executed the plan and reports the findings in an effort to fulfill the responsibilities for monitoring under NRC 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 30 April 2018 to 01 May 2018 and 22 to 23 October 2018. 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 2018 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 0.49[1], then the sample result is suggestive of natural uranium, otherwise DU is suggested.

If ICP-MS results for U-235 are non-detect, then 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

[1] $0.49 = 0.56 \times 0.72 + 0.44 \times 0.20$, 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.

lower comparison value is suggestive of natural uranium. A total uranium sample result exceeding the upper 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, then the U-235 result would exceed the MDL). The upper comparison value is calculated as follows:

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

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 2018 SAMPLING RESULTS

Sections 3.1.1 through 3.1.4 summarize the spring 2018 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 April/May 2018 groundwater samples ranged from 0.43 ± 0.14 pCi/L for MW-DU-001 to 3.4 ± 0.3 pCi/L for MW-DU-006. The average total uranium concentration, computed using the average value for duplicates, was 1.4 ± 0.8 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 0.22 ± 0.10 for MW-DU-009 to 1.2 ± 0.8 for MW-DU-001. 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 1.2 ± 0.8, 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 0.32 ± 0.12 pCi/L for SW-DU-003 to 2.0 ± 0.3 pCi/L for SW-DU-001 with an average concentration of 0.82 ± 0.55 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 to 0.68 ± 0.37 for SW-DU-005. Given that the maximum U-238/U-234 ratio was 0.68 ± 0.37, 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 0.30 ± 0.08 pCi/g for SD-DU-008 to 1.4 ± 0.2 pCi/g for SD-DU-003 with an average concentration of 0.7 ± 0.4 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 0.69 ± 0.31 for SD-DU-004 to 1.9 ± 0.8 for SD-DU-005. Given that the maximum U-238/U-234 ratio was 1.9 ± 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.

3.1.4 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 1.0 ± 0.2 pCi/g for SS-DU-004 to 1.7 ± 0.2 pCi/g for SS-DU-001, SS-DU-002, and SS-DU-002D. The average total uranium concentration of 1.4 ± 0.3 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 0.92 ± 0.27 for SS-DU-003 to 1.2 ± 0.3 for SS-DU-001 and SS-DU-002D. Given that all surface soil samples exhibited U-238/U-234 ratios less than the investigation level of 3.0, confirmatory analysis by ICP-MS was not needed.

3.2 FALL 2018 SAMPLING RESULTS

Sections 3.2.1 through 3.2.4 summarize the fall 2018 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 11 monitoring wells plus 1 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 2018 groundwater samples ranged from 0.54 ± 0.13 pCi/L for MW-DU-011 to 3.7 ± 0.4 pCi/L for MW-DU-006. The average total uranium concentration, computed using the average value for duplicates, was 1.4 ± 0.7 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 0.18 ± 0.08 for MW-DU-009 to 0.82 ± 0.16 for MW-DU-006. Given that the maximum U-238/U-234 ratio was 0.82 ± 0.16, 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 eight 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 0.26 ± 0.08 pCi/L for SW-DU-003 to 1.0 ± 0.2 pCi/L for SW-DU-008 with an average concentration of 0.57 ± 0.35 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. 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-008 exceeded this selection criterion. ICP-MS results for SW-DU-008 equated to 1.9, non-detect, non-detect, and 1.9 micrograms per liter (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-008 of 1.9 µg/L 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 4.1 µg/L based on a U-235 MDL of 0.2 µg/L. Since the total uranium result of 1.9 µg/L for SW-DU-008 is less than the upper comparison value of 4.1 µg/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 eight 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 0.40 ± 0.09 pCi/g for SD-DU-004 to 1.7 ± 0.2 pCi/g for SD-DU-003 with an average concentration of 0.96 ± 0.43 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 0.82 ± 0.20 for SD-DU-007 to 1.3 ± 0.6 for SD-DU-005. 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 1.3 ± 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.

3.2.4 Soils

The concentrations of total and isotopic uranium in surface soils at four sample locations plus one duplicate sample are presented in Table 3-13. 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 1.8 ± 0.2 pCi/g for SS-DU-002. 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 3-13 presents the U-238/U-234 ratios for each sample. The U-238/U-234 ratio ranged from 0.99 ± 0.29 for SS-DU-004 to 1.2 ± 0.3 for SS-DU-002. Given a maximum U-238/U-234 ratio of 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.

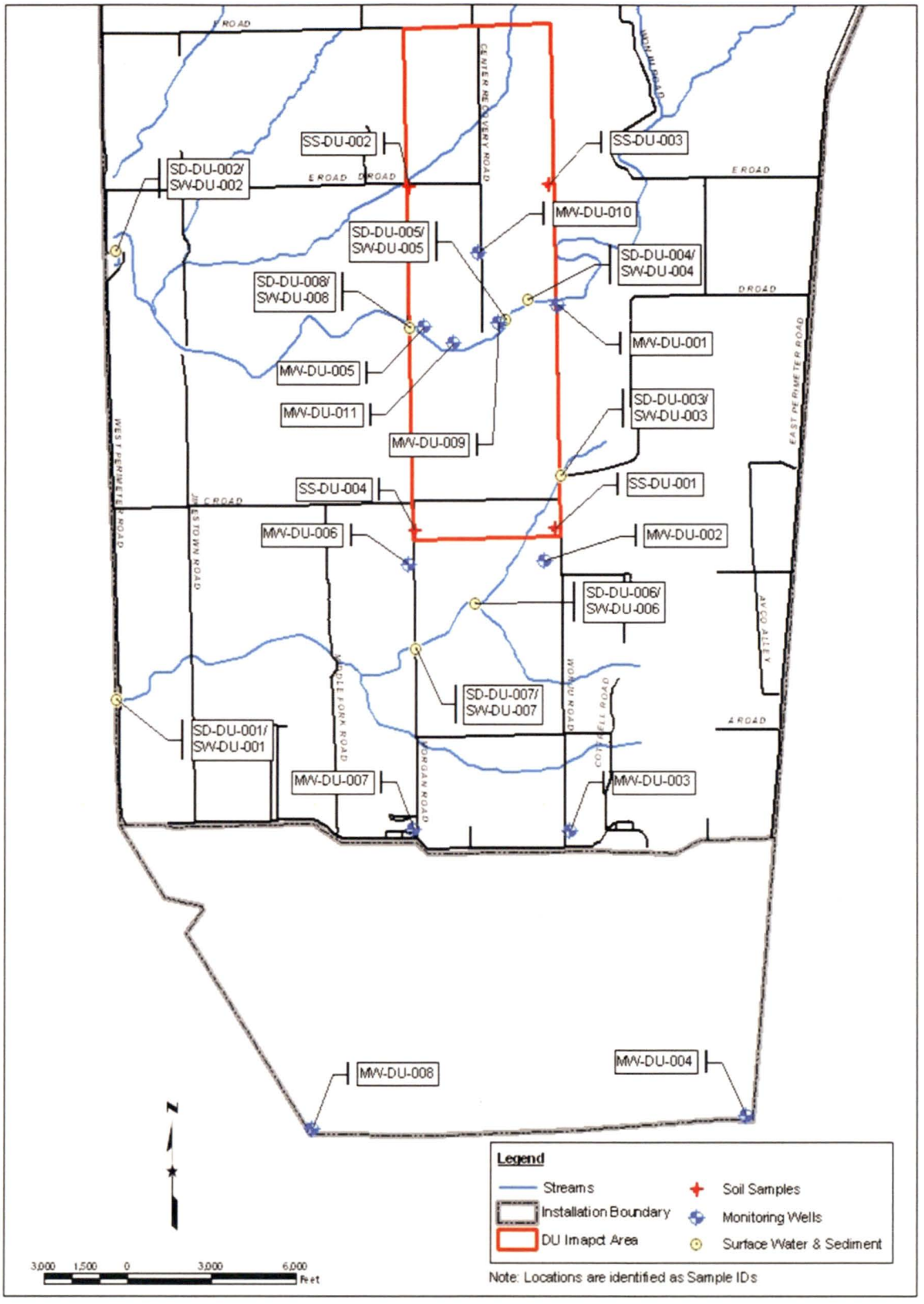

Figure 3-1. Sampling Locations

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 2018)
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	0.18 ± 0.09	0.04 ± 0.05	0.21 ± 0.10	0.43 ± 0.14	1.2 ± 0.8
MW-DU-002	0.65 ± 0.16	0.02 ± 0.03 U	0.38 ± 0.12	1.1 ± 0.2	0.59 ± 0.24
MW-DU-003[d]	0.83 ± 0.20	0.04 ± 0.06 U	0.35 ± 0.13	1.2 ± 0.2	0.41 ± 0.18
MW-DU-003D[d]	1.1 ± 0.2	0.05 ± 0.05	0.43 ± 0.14	1.6 ± 0.3	0.39 ± 0.15
MW-DU-004	0.78 ± 0.19	0.05 ± 0.06 U	0.28 ± 0.11	1.1 ± 0.2	0.36 ± 0.16
MW-DU-005	0.67 ± 0.17	0.02 ± 0.03 U	0.23 ± 0.10	0.93 ± 0.20	0.34 ± 0.17
MW-DU-006	1.9 ± 0.3	0.02 ± 0.04 U	1.5 ± 0.2	3.4 ± 0.3	0.77 ± 0.15
MW-DU-007	1.4 ± 0.3	0.09 ± 0.07	0.87 ± 0.21	2.3 ± 0.4	0.63 ± 0.20
MW-DU-008	0.74 ± 0.14	0.06 ± 0.04	0.19 ± 0.07	0.99 ± 0.16	0.26 ± 0.10
MW-DU-009	0.71 ± 0.13	0.06 ± 0.04	0.16 ± 0.06	0.92 ± 0.15	0.22 ± 0.10
MW-DU-010	1.7 ± 0.3	0.11 ± 0.08	0.75 ± 0.19	2.6 ± 0.4	0.44 ± 0.13
MW-DU-011	0.45 ± 0.15	0.05 ± 0.05	0.18 ± 0.09	0.69 ± 0.18	0.40 ± 0.23

[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-003 and its duplicate are 1.4 ± 0.4 pCi/L and 0.40 ± 0.24, 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 2018)
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	7.59	13.41	0.340	14.24	5
MW02	MW-DU-002	7.56	11.64	0.438	18.42	5
MW03	MW-DU-003	7.72	11.90	0.434	14.69	5
MW04	MW-DU-004	7.18	15.17	0.483	4.38	5
MW05	MW-DU-005	7.84	15.91	0.465	8.42	5
MW06	MW-DU-006	7.27	18.63	0.339	9.01	4
MW07	MW-DU-007	7.10	16.12	0.405	8.74	5
MW08	MW-DU-008	6.91	16.30	0.404	10.56	5
MW09	MW-DU-009	7.73	16.77	5.52	10.91	5
MW10	MW-DU-0010	7.03	16.97	0.394	9.82	5
MW11	MW-DU-0011	7.70	15.99	0.197	11.0	5

[a] Represents sample designation developed in previous sampling programs.
[b] Dose rate data were collected using Ludlum Model 19, serial number 205706, which was calibrated on 27 December 2017.

Table 3-4. Uranium in Surface Water (Spring 2018)
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	1.7 ± 0.3	0.09 ± 0.06	0.20 ± 0.09	2.0 ± 0.3	0.12 ± 0.06
SW-DU-002	0.84 ± 0.20	0.07 ± 0.06	0.32 ± 0.12	1.2 ± 0.2	0.38 ± 0.17
SW-DU-003	0.28 ± 0.11	0.01 ± 0.03 U	0.03 ± 0.04 U	0.32 ± 0.12	ND
SW-DU-004	0.37 ± 0.13	0.0 ± 0.01 U	0.18 ± 0.09	0.55 ± 0.15	0.50 ± 0.29
SW-DU-005	0.36 ± 0.13	0.04 ± 0.04	0.25 ± 0.10	0.65 ± 0.17	0.68 ± 0.37
SW-DU-006[d]	0.26 ± 0.10	0.007 ± 0.025 U	0.10 ± 0.06	0.37 ± 0.12	0.39 ± 0.28
SW-DU-006D[d]	0.24 ± 0.08	0.03 ± 0.03	0.09 ± 0.05	0.35 ± 0.10	0.37 ± 0.23
SW-DU-007	0.26 ± 0.08	-0.002 ± 0.030 U	0.13 ± 0.05	0.38 ± 0.10	0.48 ± 0.25
SW-DU-008	0.67 ± 0.18	0 ± 0.01 U	0.42 ± 0.14	1.1 ± 0.2	0.63 ± 0.27

[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-006 and its duplicate were 0.36 ± 0.16 pCi/L and 0.38 ± 0.36, 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 2018)
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	8.53	18.99	0.185	19.49	5
SWS02	SW-DU-002	6.90	20.56	0.113	15.53	5
SWS03	SW-DU-003	7.83	13.51	0.090	7.66	5
SWS04	SW-DU-004	8.04	14.08	0.170	23.59	5
SWS05	SW-DU-005	8.42	18.54	0.174	20.27	5
SWS06	SW-DU-006	8.19	11.83	0.156	11.14	5
SWS07	SW-DU-007	7.49	20.60	0.104	10.41	4
SWS08	SW-DU-008	8.57	20.25	0.166	10.55	5

[a] Represents sample designation developed in previous sampling programs.
[b] Dose rate data were collected using Ludlum Model 19, serial number 205706, which was calibrated on 27 December 2017.

Table 3-6. Uranium in Sediment (Spring 2018)
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	0.31 ± 0.08	0.04 ± 0.03	0.29 ± 0.08	0.64 ± 0.12	0.95 ± 0.36
SD-DU-002	0.22 ± 0.07	-0.01 ± 0.03 U	0.32 ± 0.08	0.53 ± 0.11	1.5 ± 0.6
SD-DU-003	0.62 ± 0.12	0.02 ± 0.02	0.72 ± 0.13	1.4 ± 0.2	1.2 ± 0.3
SD-DU-004	0.24 ± 0.07	0.003 ± 0.012 U	0.17 ± 0.06	0.42 ± 0.09	0.69 ± 0.31
SD-DU-005	0.21 ± 0.07	0.01 ± 0.02 U	0.40 ± 0.09	0.62 ± 0.12	1.9 ± 0.8
SD-DU-006	0.42 ± 0.10	0.04 ± 0.03	0.42 ± 0.10	0.88 ± 0.14	1.0 ± 0.3
SD-DU-007[d]	0.40 ± 0.10	0.03 ± 0.03	0.32 ± 0.08	0.76 ± 0.13	0.80 ± 0.28
SD-DU-007D[d]	0.39 ± 0.09	0.01 ± 0.02 U	0.38 ± 0.09	0.79 ± 0.13	1.0 ± 0.3
SD-DU-008	0.13 ± 0.05	0.02 ± 0.02	0.15 ± 0.06	0.30 ± 0.08	1.2 ± 0.7

[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-007 and its duplicate are 0.77 ± 0.18 pCi/g and 0.88 ± 0.43, 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 3-7. Uranium in Surface Soil (Spring 2018)
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	0.73 ± 0.14	0.04 ± 0.03	0.9 ± 0.2	1.7 ± 0.2	1.2 ± 0.3
SS-DU-002[d]	0.83 ± 0.14	0.04 ± 0.03	0.85 ± 0.14	1.7 ± 0.2	1.0 ± 0.2
SS-DU-002D[d]	0.79 ± 0.14	0.02 ± 0.02	0.90 ± 0.15	1.7 ± 0.2	1.2 ± 0.3
SS-DU-003	0.57 ± 0.12	0.04 ± 0.03	0.53 ± 0.11	1.1 ± 0.2	0.92 ± 0.27
SS-DU-004	0.49 ± 0.11	0.03 ± 0.03	0.48 ± 0.10	1.0 ± 0.2	0.98 ± 0.30

[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-002 and its duplicate are 1.7 ± 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 2018)
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	0.32 ± 0.09	0.01 ± 0.02 U	0.21 ± 0.07	0.55 ± 0.12	0.66 ± 0.29
MW-DU-002	1.2 ± 0.2	0.05 ± 0.04	0.52 ± 0.11	1.8 ± 0.2	0.44 ± 0.12
MW-DU-003	0.62 ± 0.13	0.02 ± 0.03 U	0.22 ± 0.07	0.86 ± 0.15	0.36 ± 0.14
MW-DU-004[d]	0.29 ± 0.08	0.01 ± 0.02 U	0.24 ± 0.07	0.54 ± 0.11	0.85 ± 0.35
MW-DU-004D[d]	0.44 ± 0.10	0.04 ± 0.03 U	0.25 ± 0.07	0.73 ± 0.13	0.57 ± 0.21
MW-DU-005	0.74 ± 0.14	0.03 ± 0.03 U	0.21 ± 0.07	0.98 ± 0.16	0.29 ± 0.11
MW-DU-006	2.0 ± 0.3	0.11 ± 0.05	1.6 ± 0.2	3.7 ± 0.35	0.82 ± 0.16
MW-DU-007	1.3 ± 0.2	0.04 ± 0.04 U	0.83 ± 0.14	2.2 ± 0.2	0.62 ± 0.14
MW-DU-008	0.46 ± 0.10	0.02 ± 0.02	0.26 ± 0.08	0.73 ± 0.13	0.56 ± 0.21
MW-DU-009	0.95 ± 0.17	0.04 ± 0.04 U	0.17 ± 0.07	1.2 ± 0.2	0.18 ± 0.08
MW-DU-010	1.6 ± 0.3	0.06 ± 0.05	0.67 ± 0.17	2.4 ± 0.3	0.41 ± 0.13
MW-DU-011	0.43 ± 0.11	0.02 ± 0.02 U	0.09 ± 0.05	0.54 ± 0.13	0.21 ± 0.13

[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-004 and its duplicate are 0.64 ± 0.17 pCi/L and 0.71 ± 0.41, 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 2018)
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	7.81	13.65	0.646	8.67	6
MW02	MW-DU-002	8.15	11.05	0.548	8.95	5
MW03	MW-DU-003	7.79	13.37	0.596	6.29	5
MW04	MW-DU-004	7.66	16.05	0.647	12.96	5
MW05	MW-DU-005	8.10	14.56	1.36	13.69	5
MW06	MW-DU-006	8.00	14.75	0.686	30.70	5
MW07	MW-DU-007	7.96	16.70	0.693	20.07	5
MW08	MW-DU-008	6.77	13.47	0.605	13.74	5
MW09	MW-DU-009	7.46	13.14	8.87	20.75	7
MW10	MW-DU-0010	8.16	15.53	0.664	8.87	6
MW11	MW-DU-0011	8.34	14.33	0.503	12.58	7

[a] Represents sample designation developed in previous sampling programs.
[b] Dose rate data were collected using Ludlum Model 19, serial number 209723, which was calibrated on 10 May 2018.

Table 3-10. Uranium in Surface Water (Fall 2018)
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	0.27 ± 0.08	0.004 ± 0.013 U	0.21 ± 0.07	0.49 ± 0.10	0.78 ± 0.33
SW-DU-002	0.31 ± 0.09	0.008 ± 0.020 U	0.33 ± 0.09	0.65 ± 0.13	1.1 ± 0.4
SW-DU-003	0.18 ± 0.06	0.001 ± 0.014 U	0.08 ± 0.04	0.26 ± 0.08	0.47 ± 0.30
SW-DU-004	0.25 ± 0.08	0.01 ± 0.02 U	0.16 ± 0.06	0.42 ± 0.10	0.64 ± 0.31
SW-DU-005	0.29 ± 0.09	-0.002 ± 0.017 U	0.55 ± 0.12	0.83 ± 0.15	1.9 ± 0.7
SW-DU-006	0.32 ± 0.09	0.009 ± 0.023 U	0.14 ± 0.06	0.47 ± 0.11	0.44 ± 0.23
SW-DU-007[d]	0.22 ± 0.07	0.01 ± 0.02 U	0.16 ± 0.06	0.39 ± 0.10	0.73 ± 0.38
SW-DU-007D[d]	0.22 ± 0.07	0.03 ± 0.03	0.19 ± 0.06	0.44 ± 0.10	0.87 ± 0.40
SW-DU-008	0.28 ± 0.08	0.04 ± 0.03 U	0.71 ± 0.14	1.0 ± 0.2	2.5 ± 0.9

[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 0.42 ± 0.14 pCi/L and 0.80 ± 0.55, 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 2018)
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	8.71	11.25	0.368	22.06	4
SWS02	SW-DU-002	8.74	12.95	0.346	21.18	4
SWS03	SW-DU-003	8.05	8.68	0.216	35.96	5
SWS04	SW-DU-004	8.41	8.79	0.330	12.12	6
SWS05	SW-DU-005	8.67	11.09	0.409	14.42	7
SWS06	SW-DU-006	8.55	6.79	0.314	11.59	5
SWS07	SW-DU-007	8.68	14.33	0.317	33.73	5
SWS08	SW-DU-008	8.61	12.64	0.325	12.01	5

[a] Represents sample designation developed in previous sampling programs.
[b] Dose rate data were collected using Ludlum Model 19, serial number 209723, which was calibrated on 10 May 2018.

Table 3-12. Uranium in Sediment (Fall 2018)
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[d]	0.29 ± 0.07	0.02 ± 0.02 U	0.25 ± 0.07	0.55 ± 0.10	0.85 ± 0.32
SD-DU-001D[d]	0.34 ± 0.09	0.01 ± 0.02 U	0.30 ± 0.08	0.66 ± 0.12	0.89 ± 0.32
SD-DU-002	0.38 ± 0.09	0.03 ± 0.03 U	0.33 ± 0.08	0.74 ± 0.13	0.86 ± 0.30
SD-DU-003	0.73 ± 0.13	0.04 ± 0.03	0.90 ± 0.15	1.7 ± 0.2	1.2 ± 0.3
SD-DU-004	0.21 ± 0.07	-0.004 ± 0.015 U	0.20 ± 0.06	0.40 ± 0.09	0.92 ± 0.41
SD-DU-005	0.22 ± 0.07	0.02 ± 0.02	0.30 ± 0.08	0.54 ± 0.11	1.3 ± 0.6
SD-DU-006	0.82 ± 0.14	0.03 ± 0.03 U	0.74 ± 0.13	1.6 ± 0.2	0.90 ± 0.23
SD-DU-007	0.89 ± 0.15	0.02 ± 0.02	0.73 ± 0.13	1.6 ± 0.2	0.82± 0.20
SD-DU-008	0.22 ± 0.07	0.03 ± 0.03 U	0.22 ± 0.07	0.47 ± 0.10	1.0 ± 0.4

[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-001 and its duplicate are 0.60 ± 0.16 pCi/g and 0.87 ± 0.46, 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 3-13. Uranium in Surface Soil (Fall 2018)
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	0.74 ± 0.13	0.01 ± 0.02 U	0.76 ± 0.13	1.5 ± 0.2	1.0 ± 0.3
SS-DU-002	0.80 ± 0.14	0.06 ± 0.04	0.94 ± 0.16	1.8 ± 0.2	1.2 ± 0.3
SS-DU-003[d]	0.64 ± 0.12	0.04 ± 0.03	0.65 ± 0.13	1.3 ± 0.2	1.0 ± 0.3
SS-DU-003D[d]	0.57 ± 0.12	0.03 ± 0.03 U	0.62 ± 0.12	1.2 ± 0.2	1.1 ± 0.3
SS-DU-004	0.55 ± 0.12	0.02 ± 0.03 U	0.54 ± 0.11	1.1 ± 0.2	0.99± 0.29

[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-003 and its duplicate are 1.3 ± 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.

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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 ERM. The SOP 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 µg/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 2018 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 346 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 2018 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.

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 with new groundwater data and re-examined in this report. All total uranium results at each groundwater sampling location for the April/May and October 2018 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 3.3 ± 1.2 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 on 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 April/May and October 2018 sampling event was 3.7 ± 0.4 pCi/L.

Notably, U-238/U-234 activity ratios for April/May and October 2018 groundwater sampling range from 0.18 ± 0.08 pCi/L (MW-DU-009) to 1.2 ± 0.8 pCi/L (MW-DU-001), 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 254 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 2018 sampling event, the average total uranium activity-concentration is 0.69 pCi/L, the standard deviation is 1.90 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.

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, 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 April/May and October 2018 sampling efforts were within the cited control limits with the exception of SW-DU-001, which was 1.97 as compared to the UCL of 1.64. 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 6.34 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 April/May and October 2018 sampling event was 2.0 ± 0.2 pCi/L.

Results for SW-DU-008 from the October 2018 sampling event represent the only surface water sample location with the potential to exceed the threshold of 3.0 with a U-238/U-234 activity ratio of 2.5 ± 0.9. During further investigation through reanalysis by ICP-MS of this sample 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-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 2.0 pCi/L is approximately equal to 10 percent of the U.S. Environmental Protection Agency's (USEPA's) uranium primary drinking water standard of 30 µg/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 of the ERMP. 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 259 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 2018 sampling event, the average total uranium activity-concentration is 0.94 pCi/g, the standard deviation is 0.48 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.

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 all sediment sampling locations exhibit negative trend lines such that total uranium results generally exhibit decreasing activity. 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 April/May and October 2018 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 2.37 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 April/May and October 2018 sampling event was 1.7 ± 0.20 pCi/g.

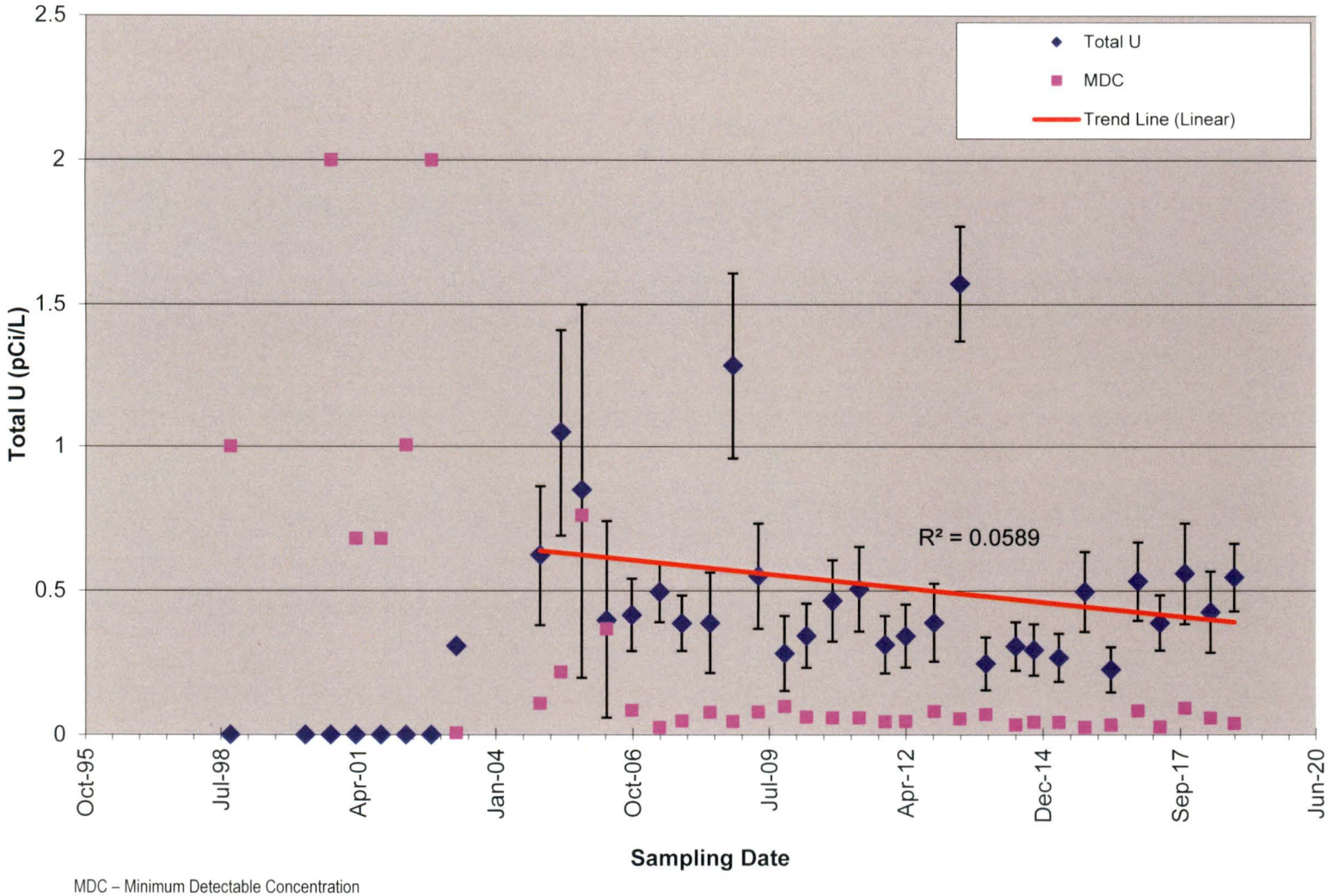
U-238/U-234 activity ratios for April/May and October 2018 sediment sampling range from 0.69 ± 0.31 pCi/g (SD-DU-004) to 1.9 ± 0.8 pCi/g (SD-DU-005), suggesting that significant concentrations of DU were not encountered.

4.4 SOILS

For 151 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 October 2018 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.

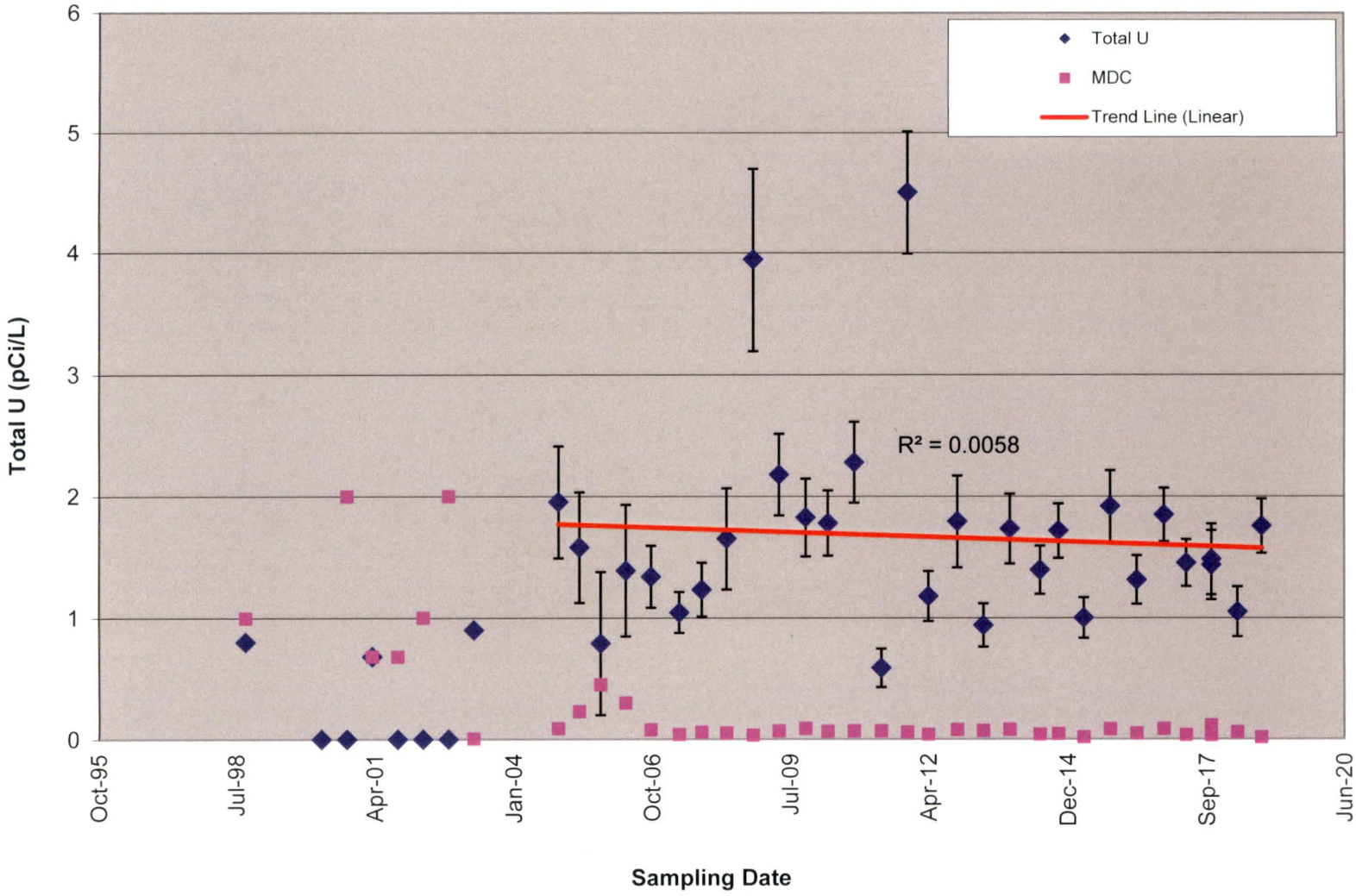
Data for each surface soil sampling location are summarized in run charts, as shown on Figures 4-32 through 4-35. Total uranium results are displayed along with each measurement's associated error bars. The error bars are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. 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 April/May and October 2018 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.



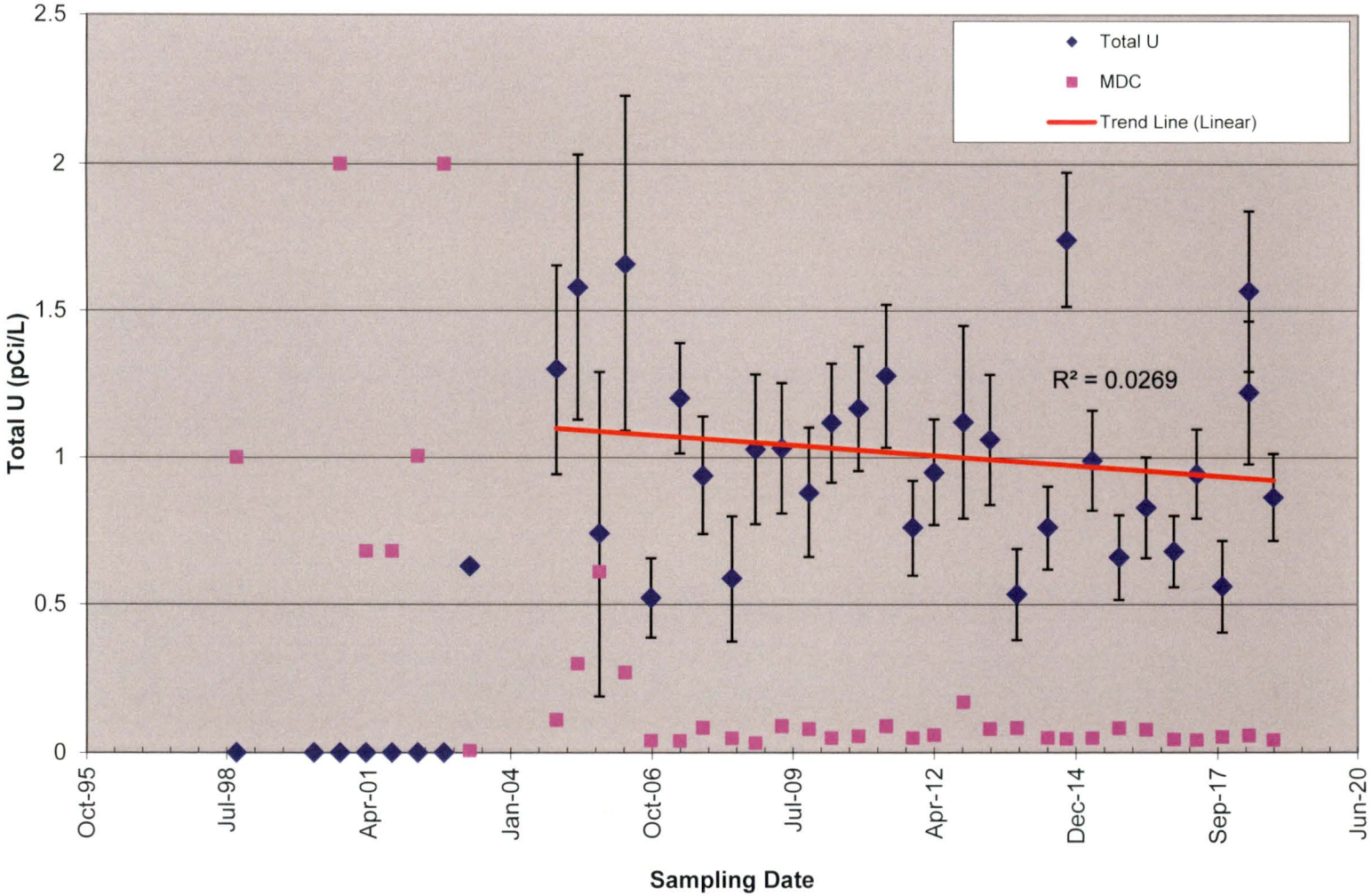
MDC – Minimum Detectable Concentration

Figure 4-1. Total Uranium in MW-DU-001 (1998-2018)



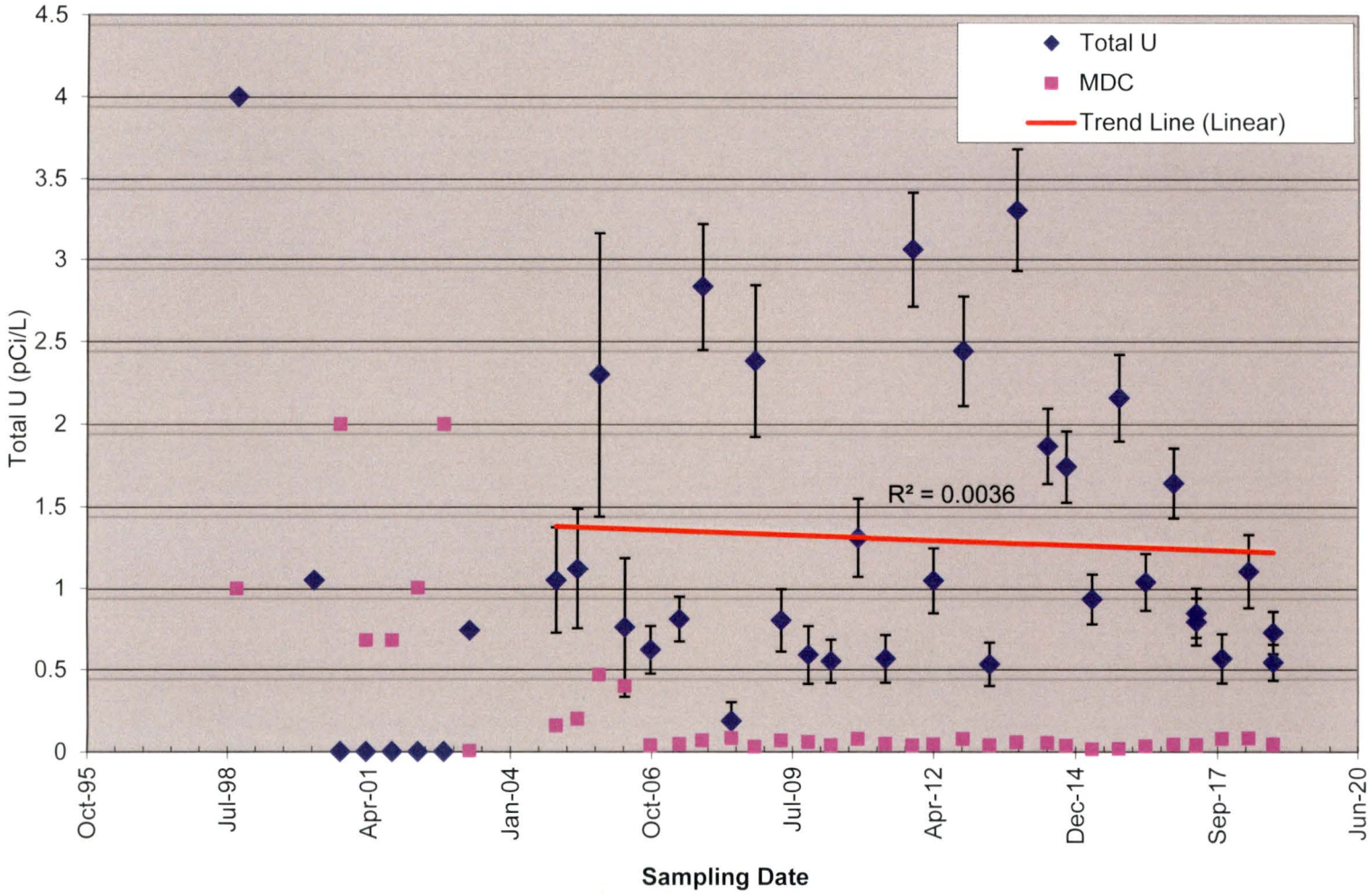
MDC – Minimum Detectable Concentration

Figure 4-2. Total Uranium in MW-DU-002 (1998-2018)



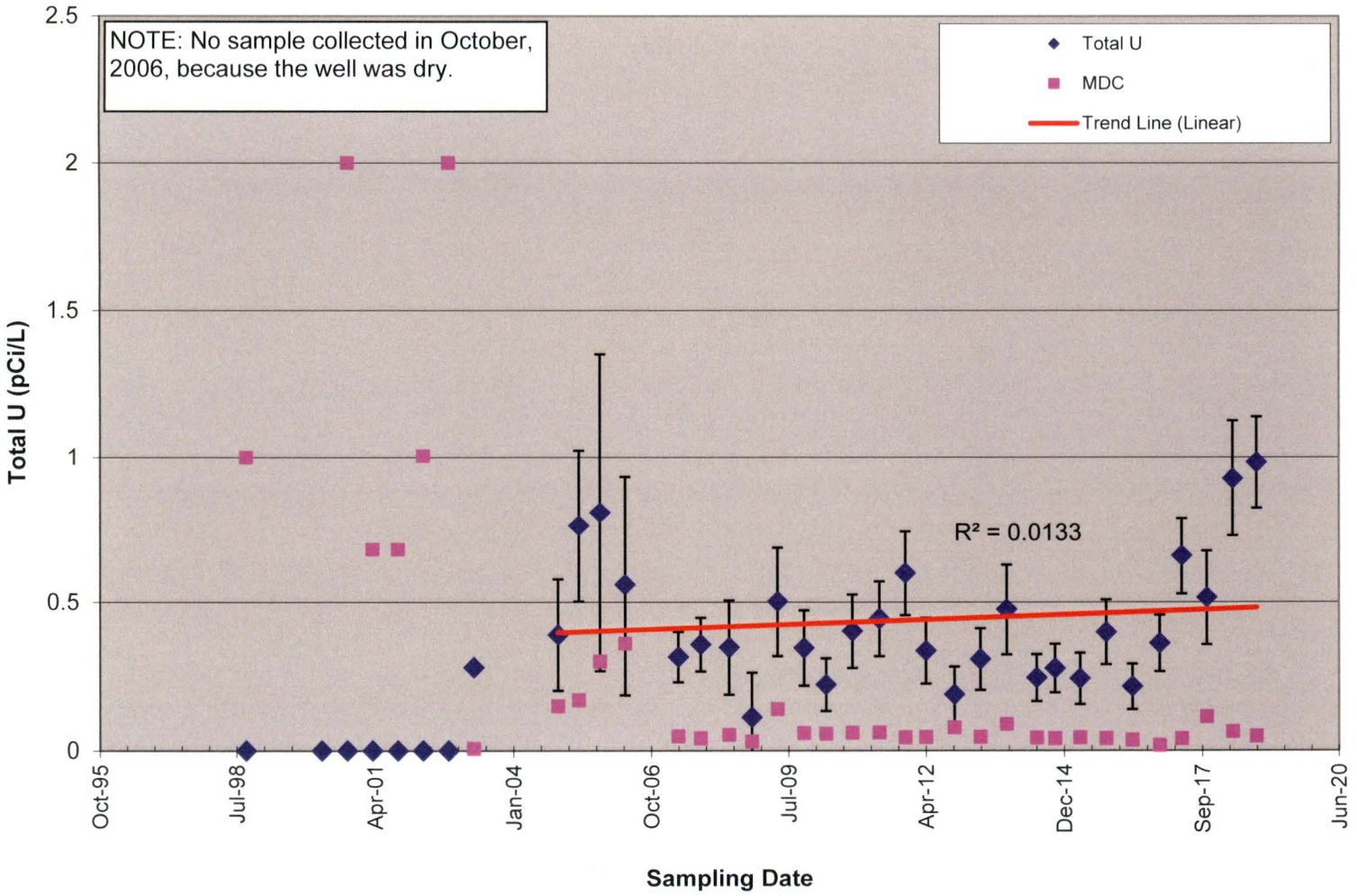
MDC – Minimum Detectable Concentration

Figure 4-3. Total Uranium in MW-DU-003 (1998-2018)



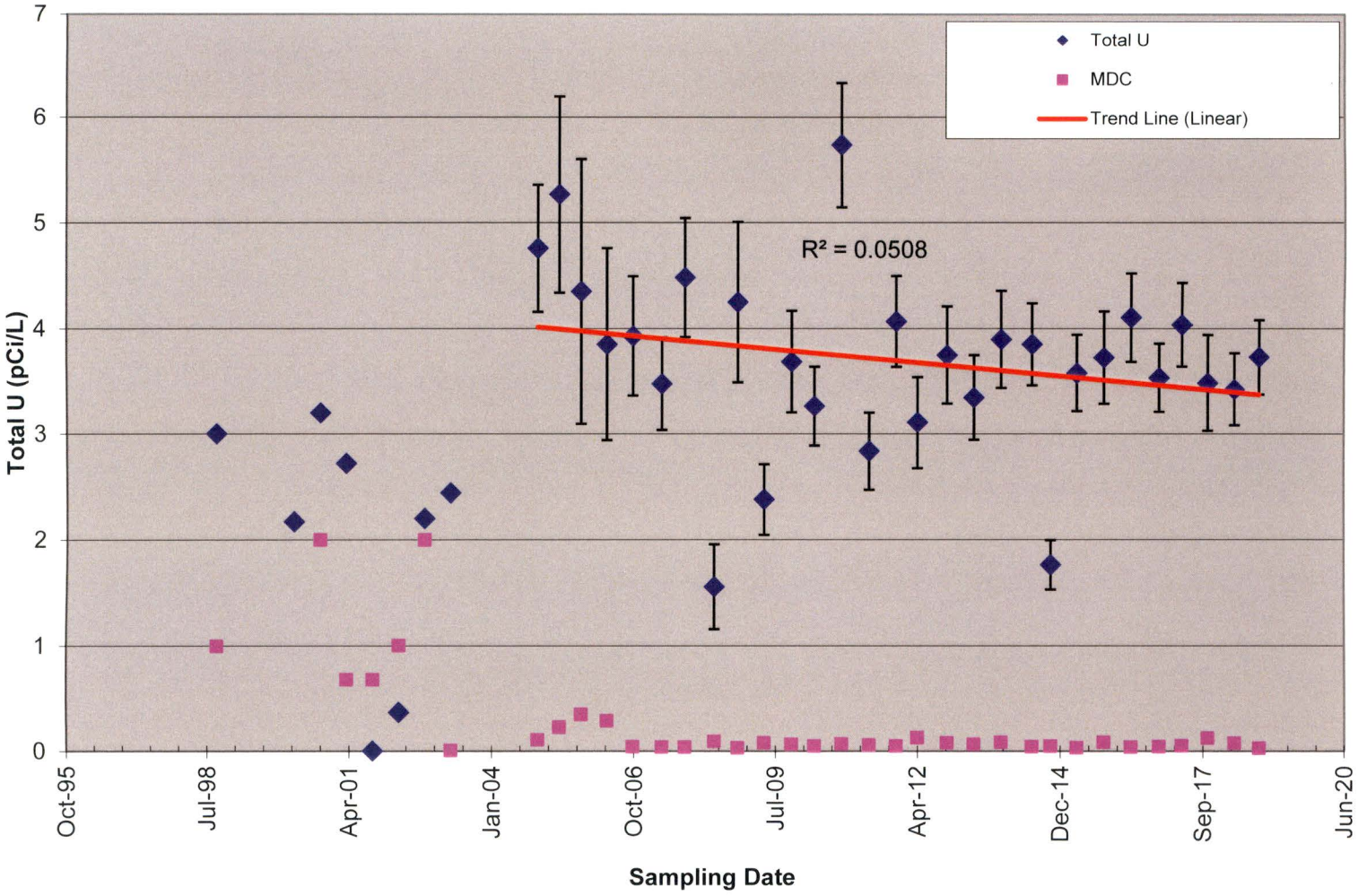
MDC – Minimum Detectable Concentration

Figure 4-4. Total Uranium in MW-DU-004 (1998-2018)



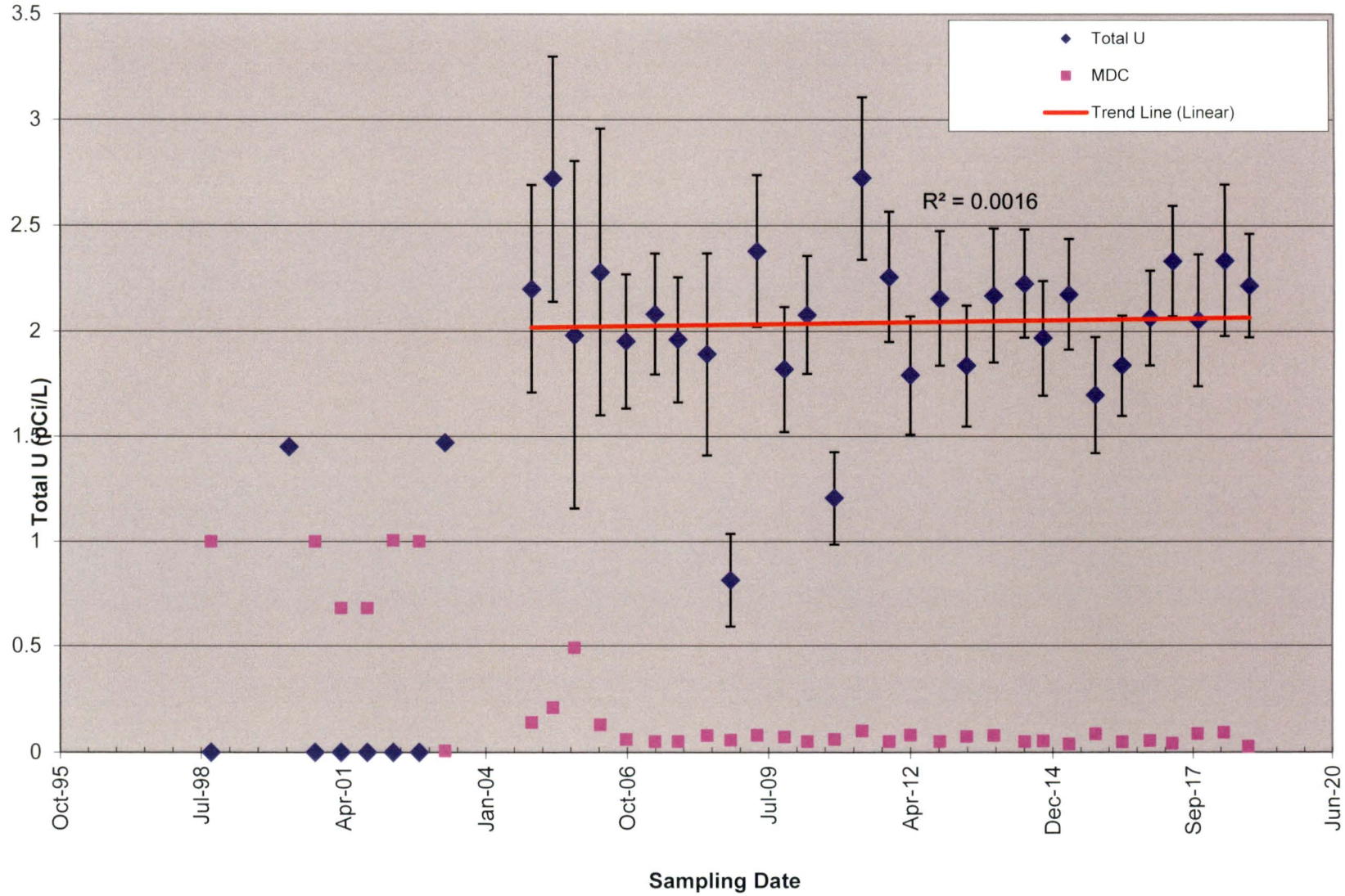
MDC – Minimum Detectable Concentration
NOTE: No sample was collected in October 2006 because the well was dry.

Figure 4-5. Total Uranium in MW-DU-005 (1998-2018)



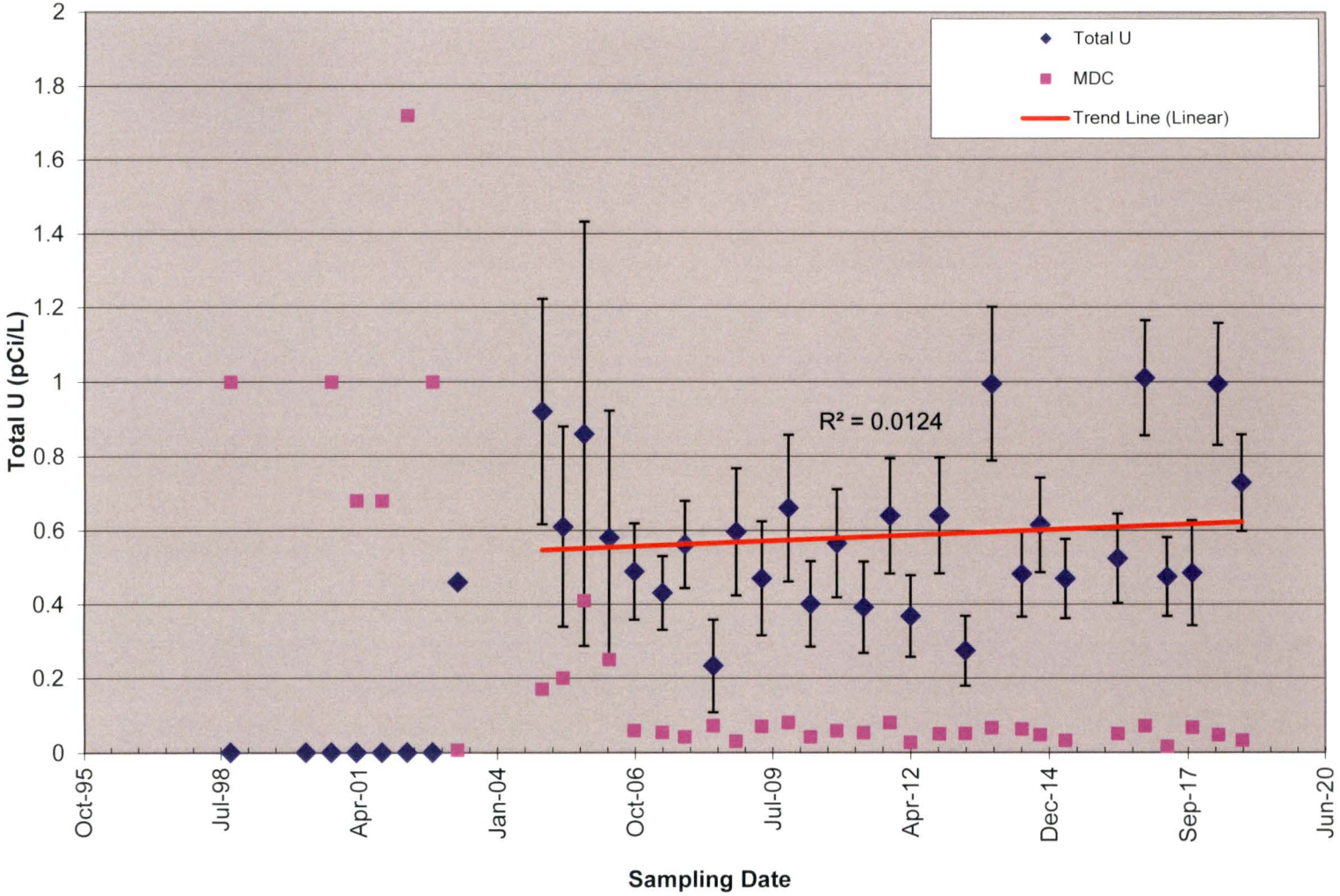
MDC – Minimum Detectable Concentration

Figure 4-6. Total Uranium in MW-DU-006 (1998-2018)



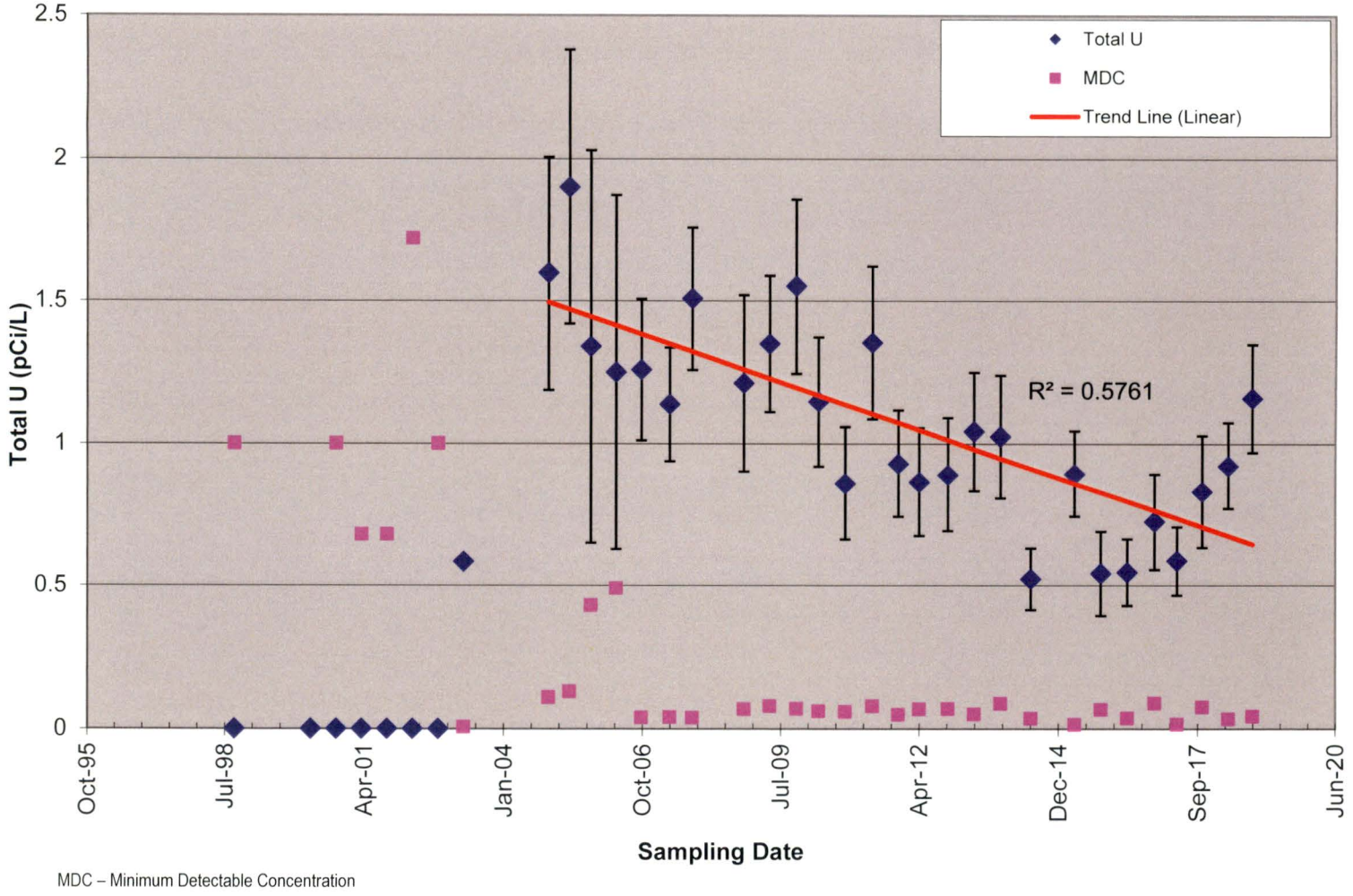
MDC – Minimum Detectable Concentration

Figure 4-7. Total Uranium in MW-DU-007 (1998-2018)



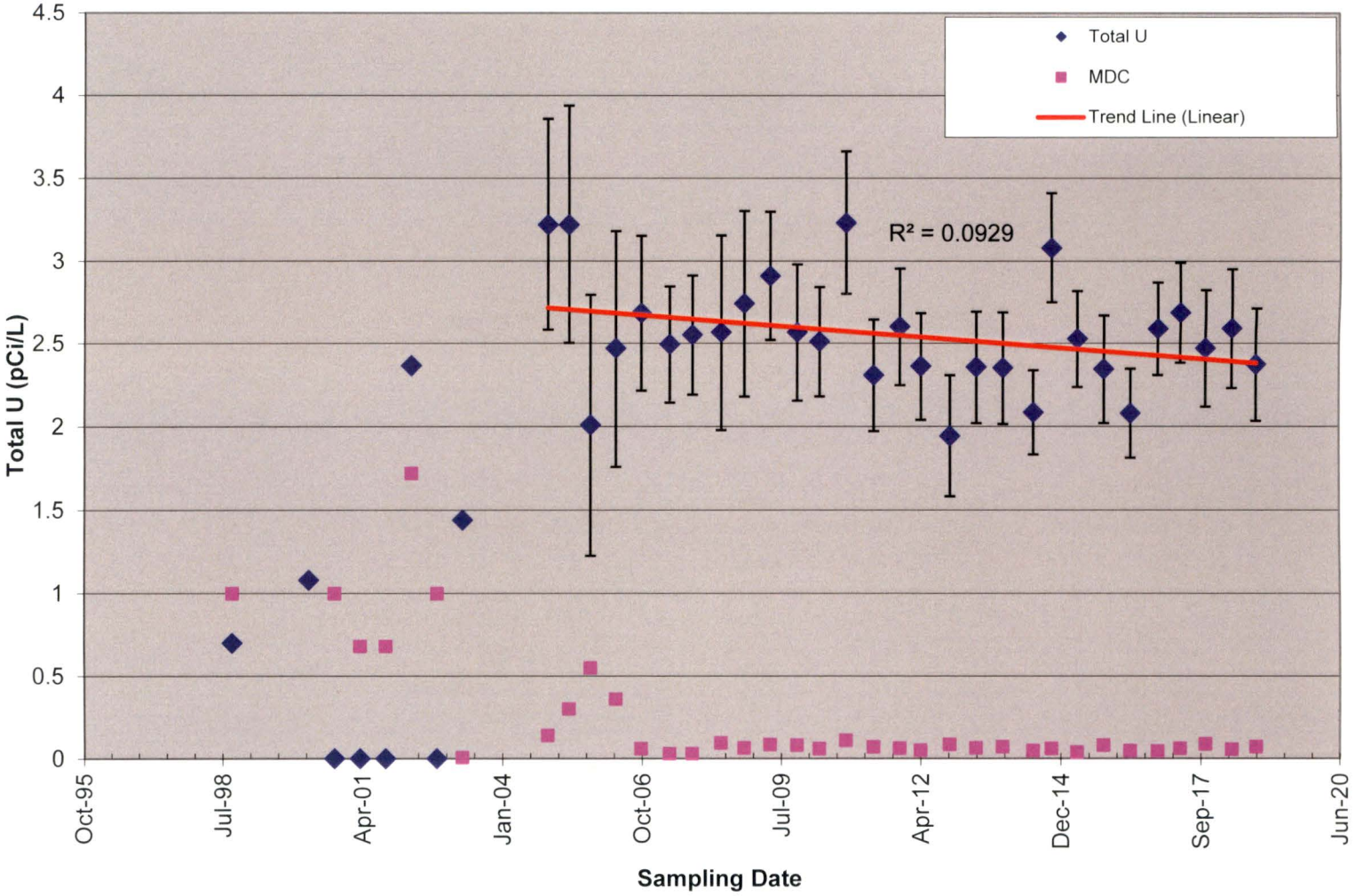
MDC – Minimum Detectable Concentration

Figure 4-8. Total Uranium in MW-DU-008 (1998-2018)



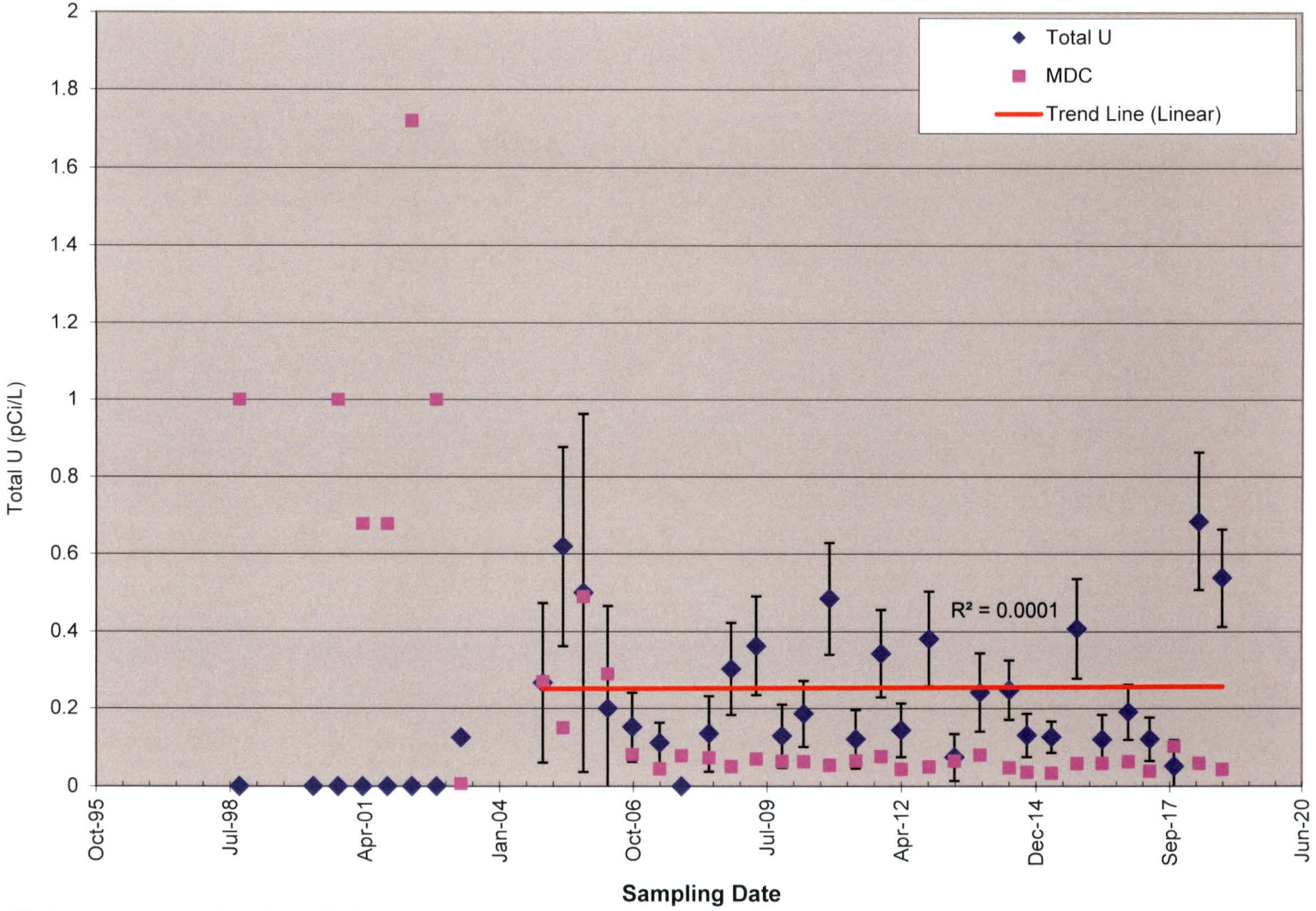
MDC – Minimum Detectable Concentration

Figure 4-9. Total Uranium in MW-DU-009 (1998-2018)



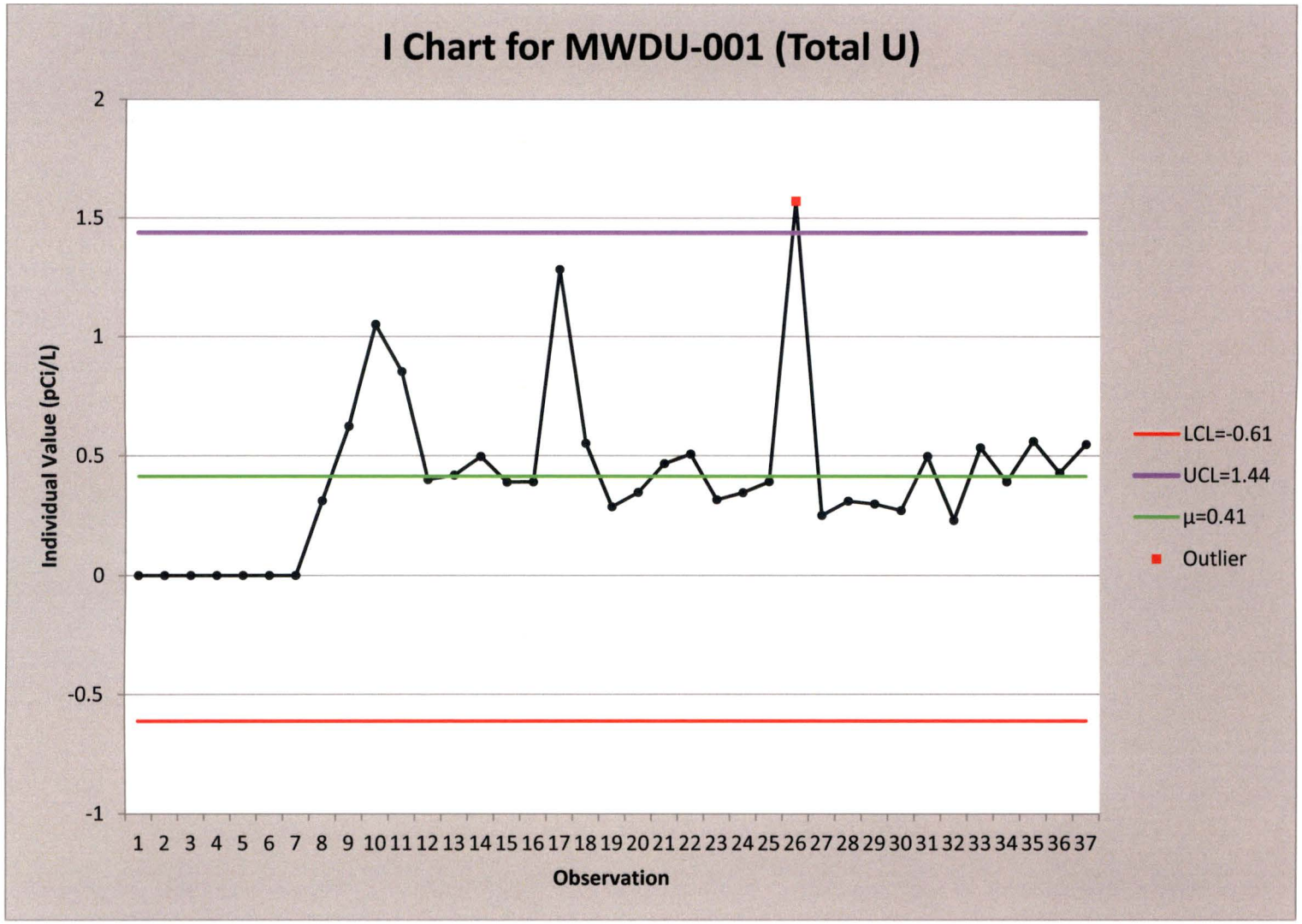
MDC – Minimum Detectable Concentration

Figure 4-10. Total Uranium in MW-DU-010 (1998-2018)



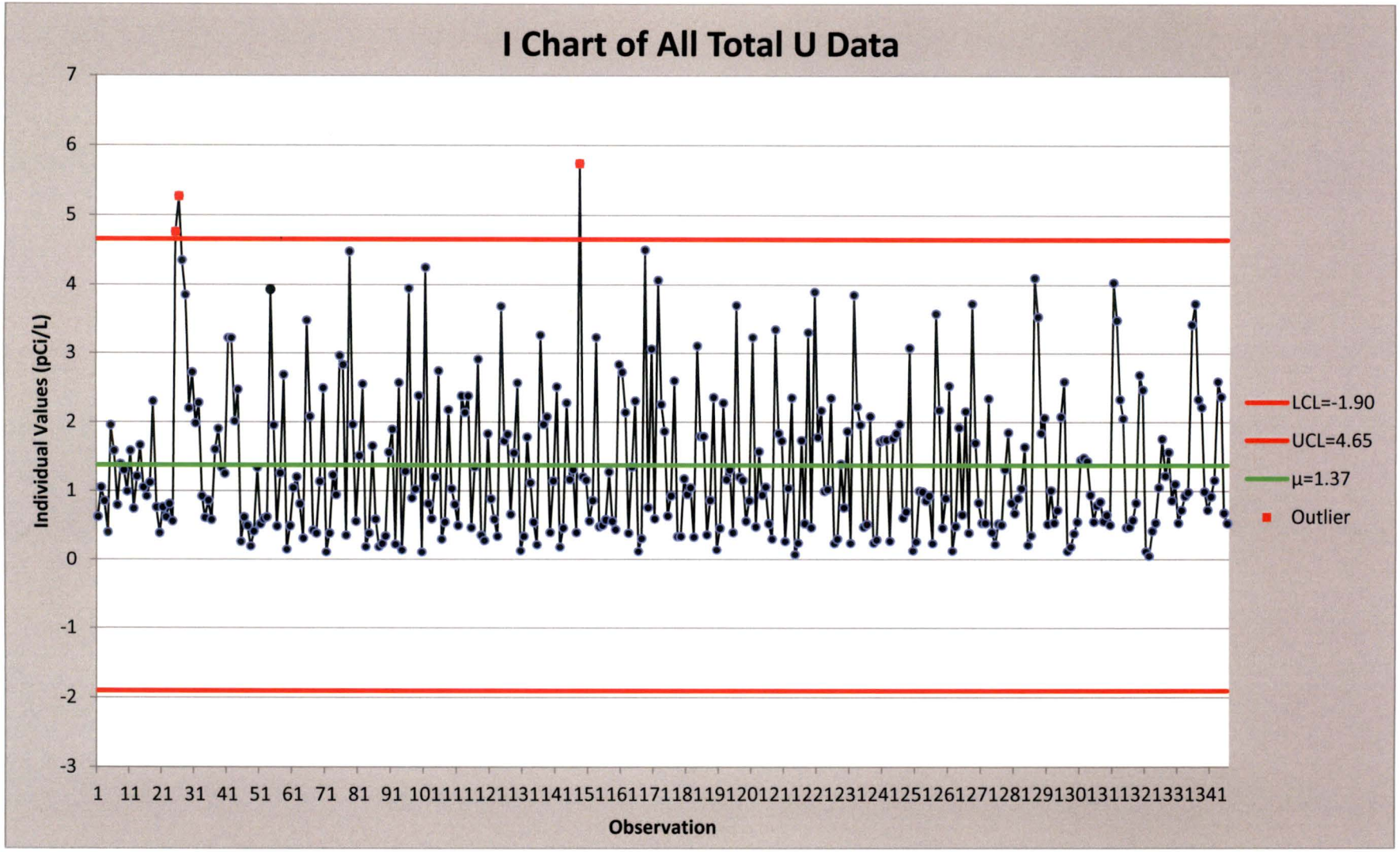
NOTE: Uranium was not detected in the October 2007 sample.

Figure 4-11. Total Uranium in MW-DU-011 (1998-2018)



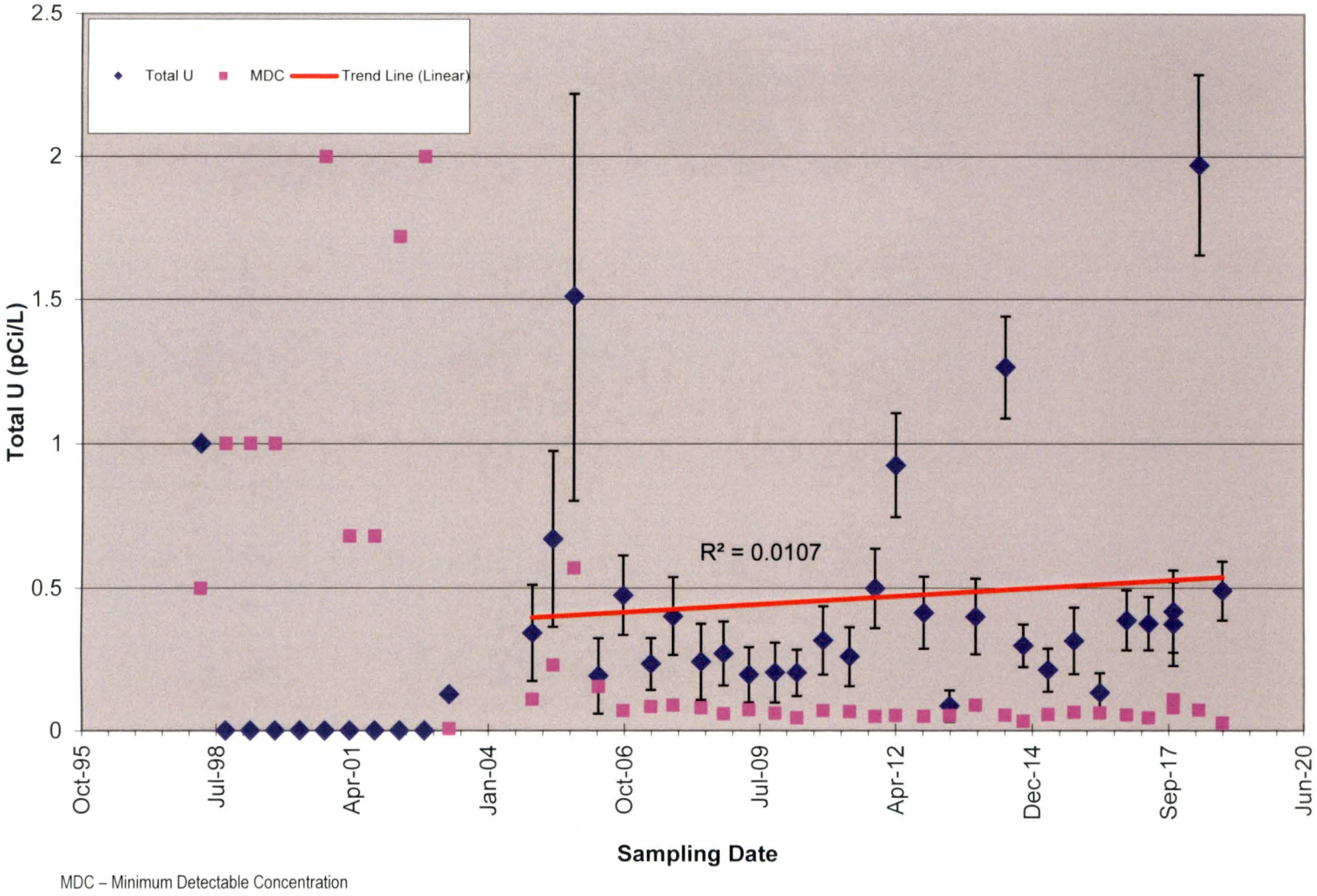
NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares.

Figure 4-12. Variable Control Chart for Total Uranium in MW-DU-001 (2004-2018)



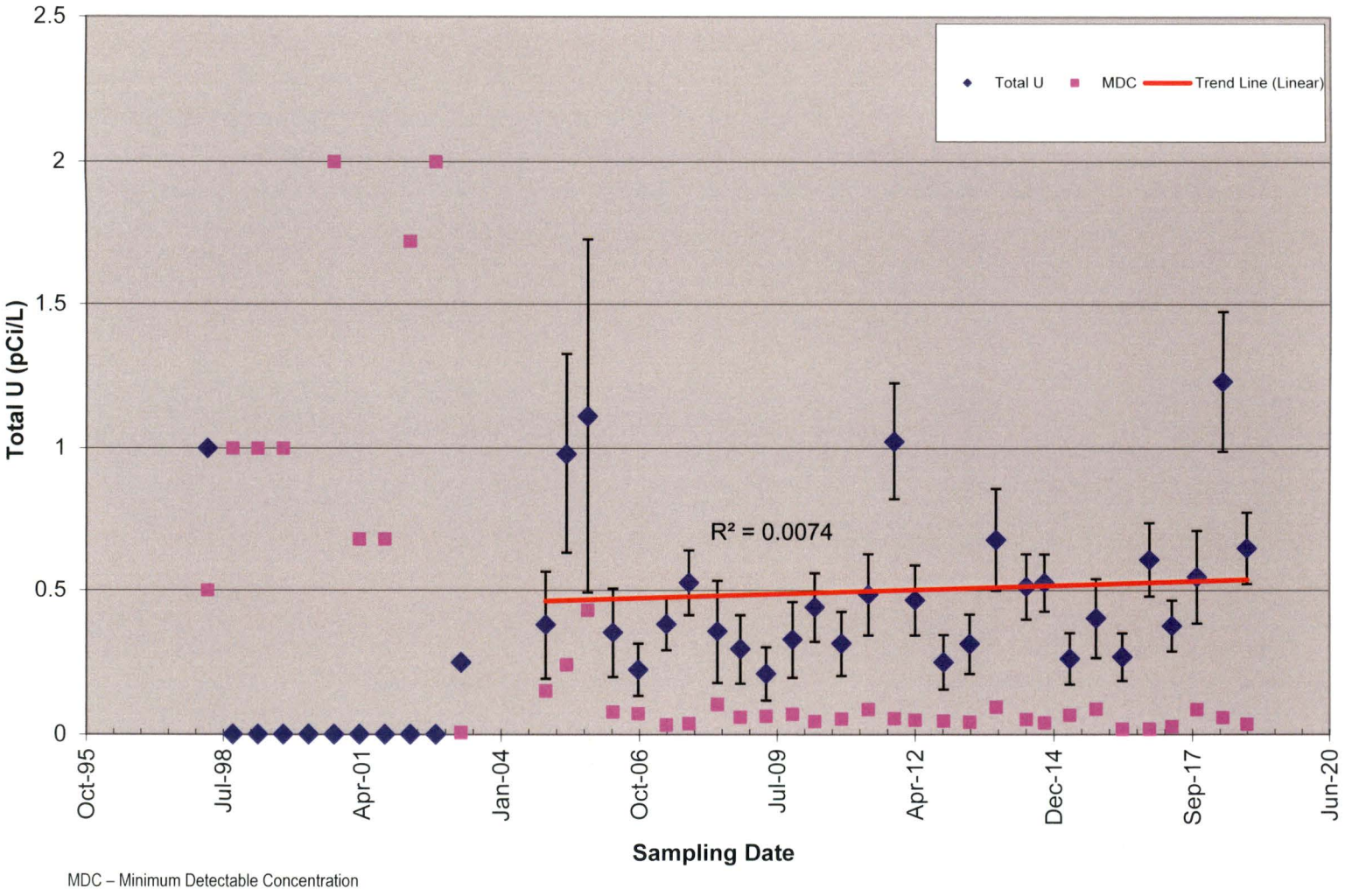
NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares.

Figure 4-13. Control Chart for All Monitoring Well Data (2004-2018)



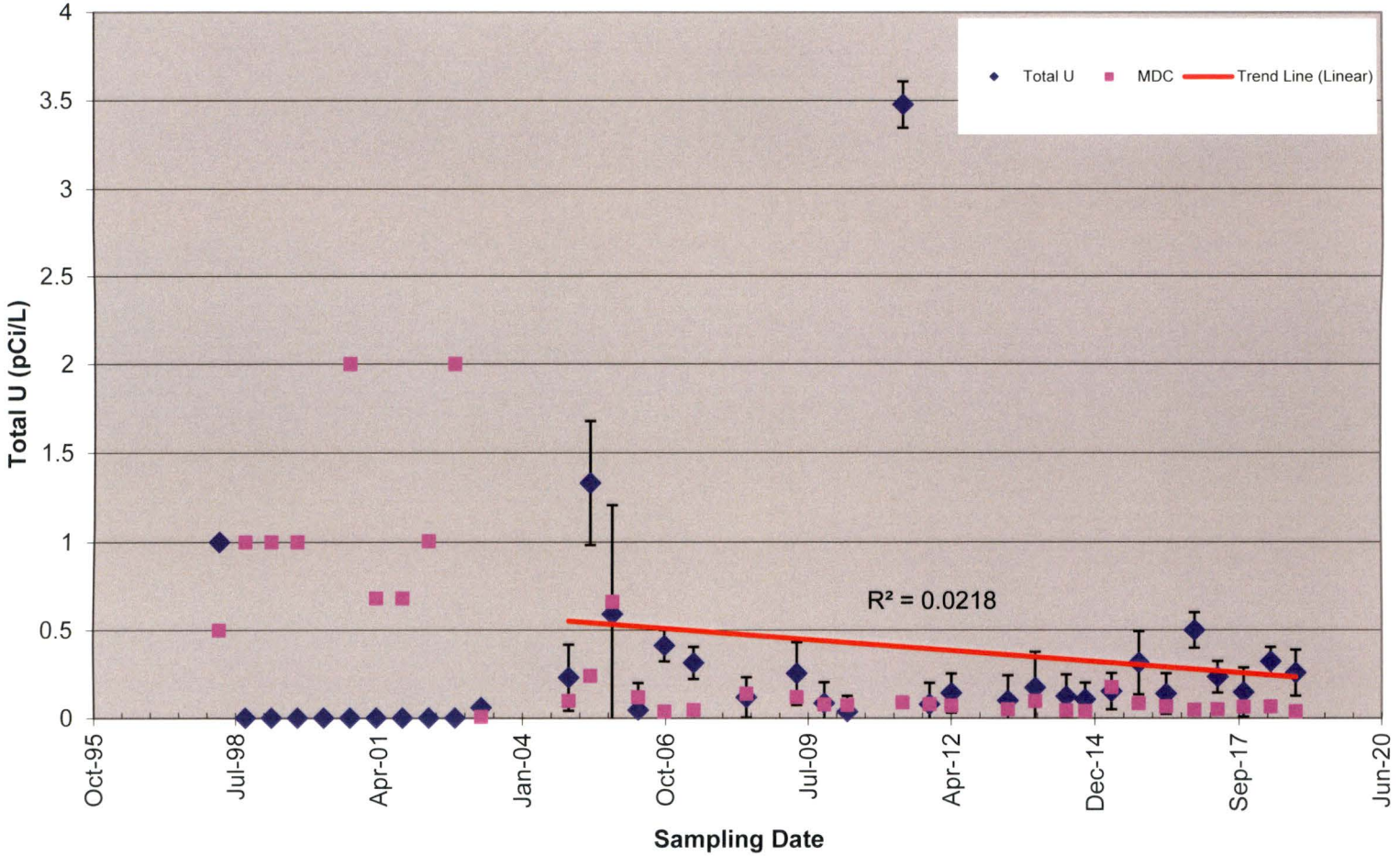
MDC – Minimum Detectable Concentration

Figure 4-14. Total Uranium in SW-DU-001 (1998-2018)



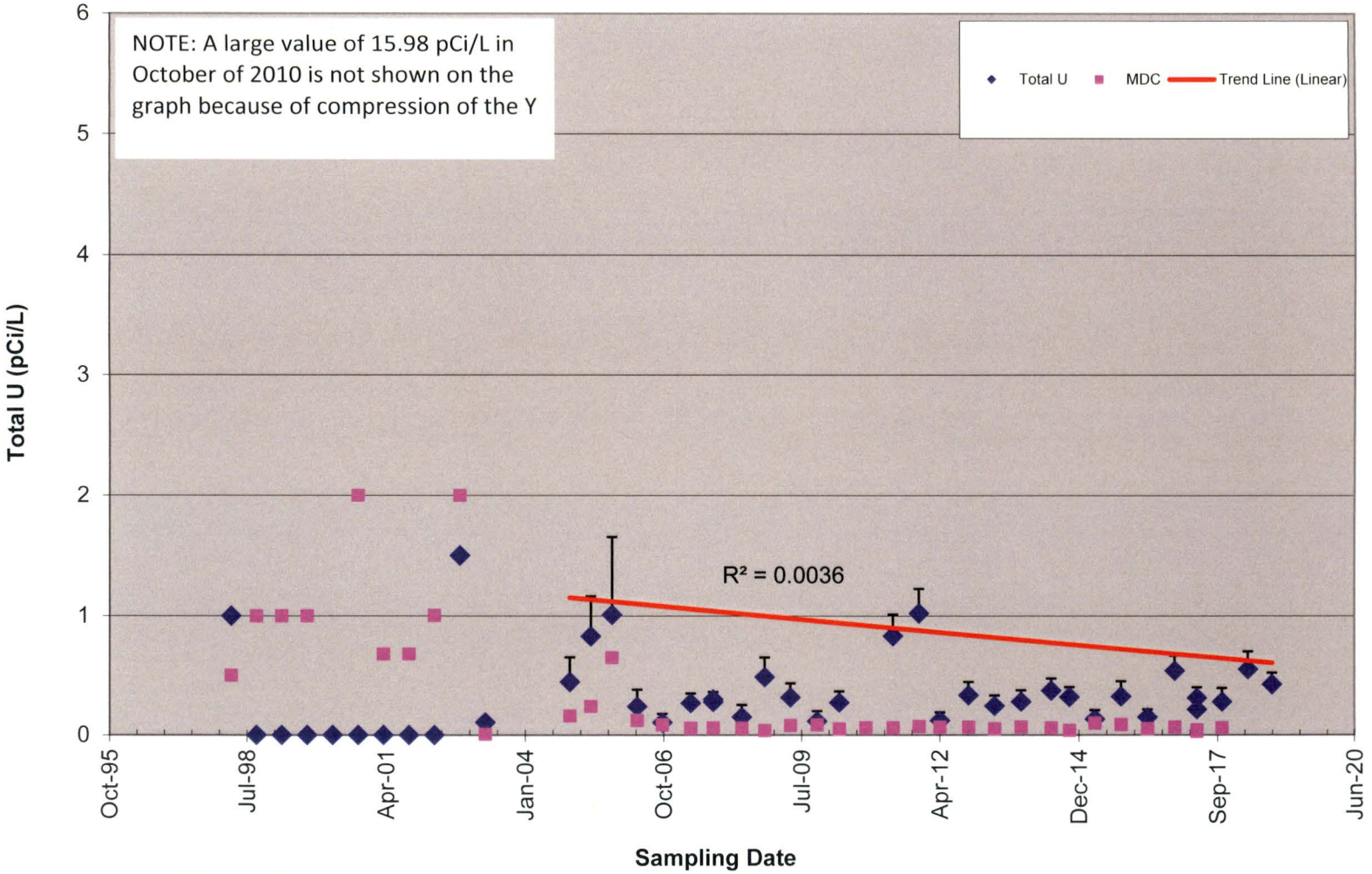
MDC – Minimum Detectable Concentration

Figure 4-15. Total Uranium in SW-DU-002 (1998-2018)



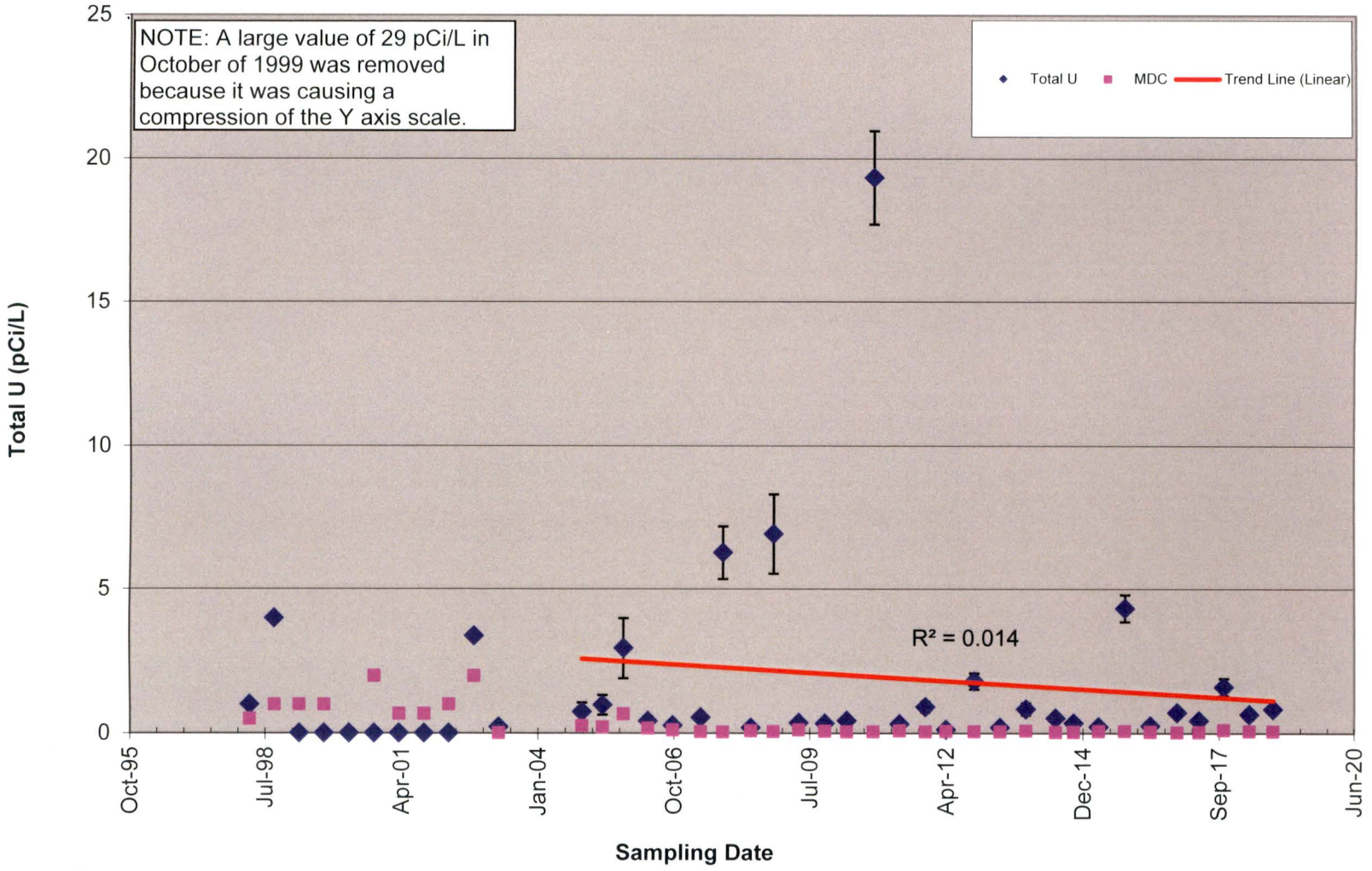
MDC – Minimum Detectable Concentration
NOTE: No sample was collected in October 2007, October 2008, October 2010, or October 2012 as the creek was dry during each of these sampling events.

Figure 4-16. Total Uranium in SW-DU-003 (1998-2018)



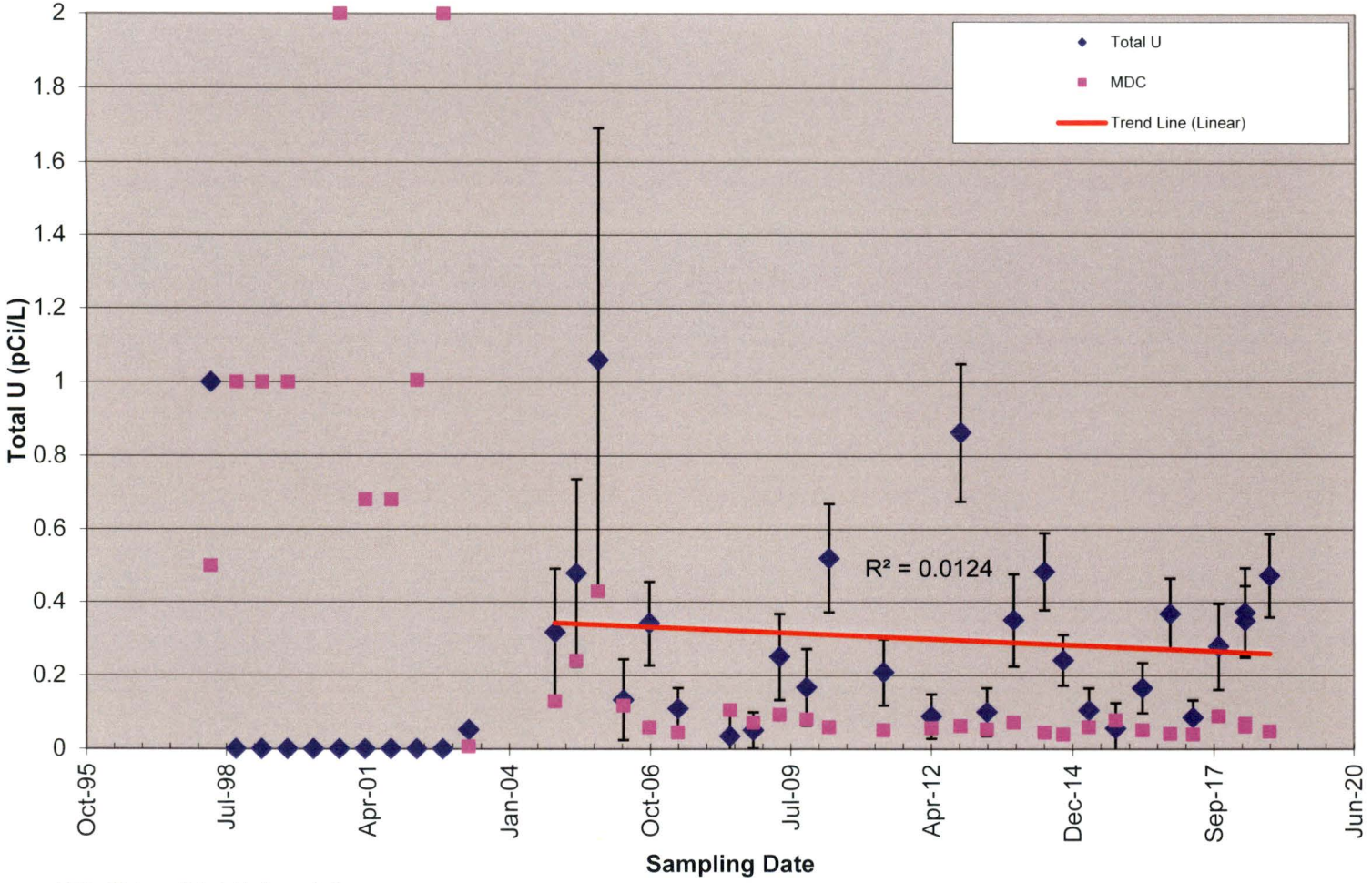
MDC – Minimum Detectable Concentration
NOTE: A large value of 15.98 pCi/L in October 2010 is not shown on the graph because it was causing a compression of the Y axis scale.

Figure 4-17. Total Uranium in SW-DU-004 (1998-2018)



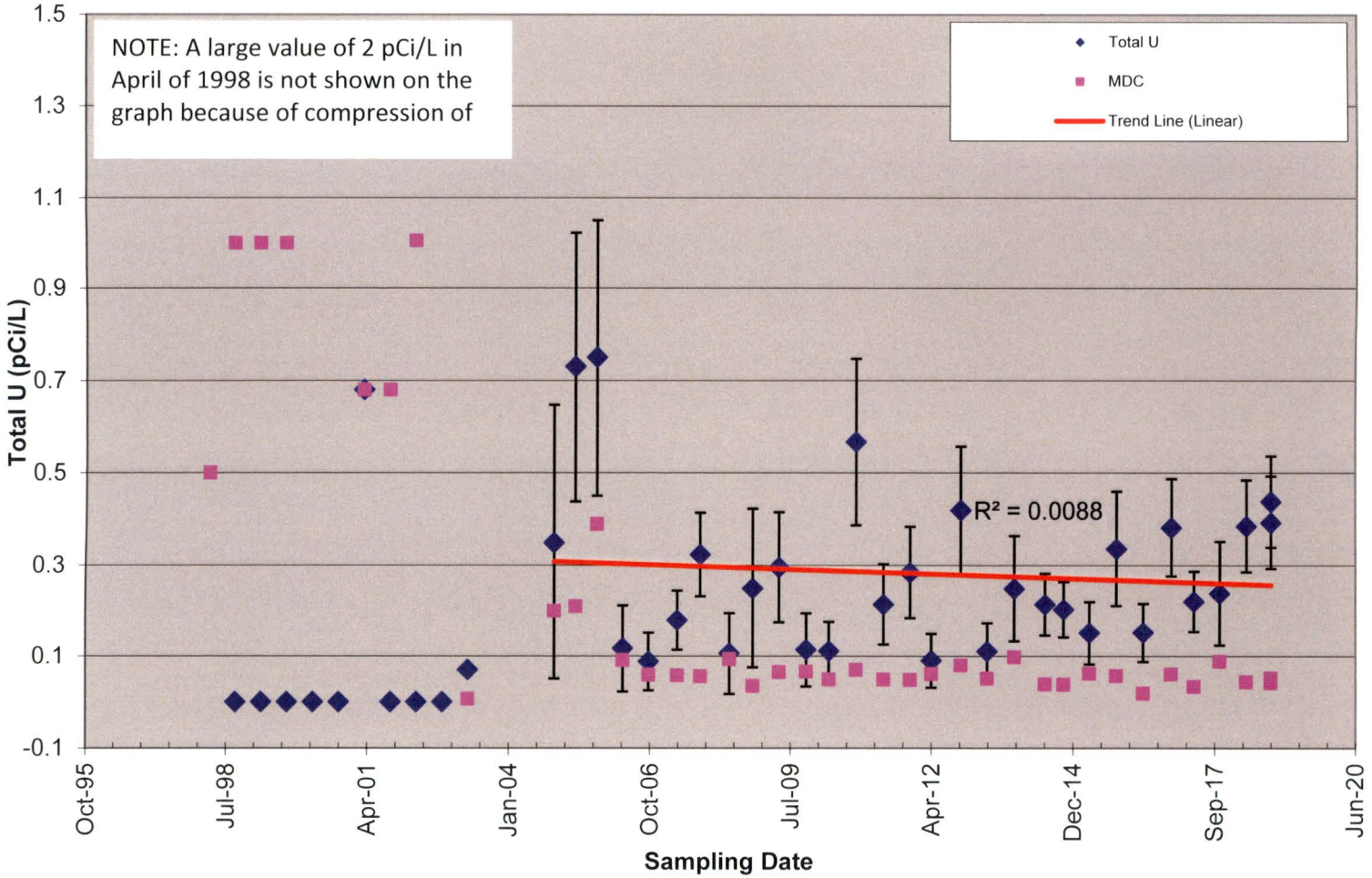
MDC – Minimum Detectable Concentration
NOTE: A large value of 29 pCi/L in October 1999 is not shown on the graph because it was causing a compression of the Y axis scale.

Figure 4-18. Total Uranium in SW-DU-005 (1998-2018)



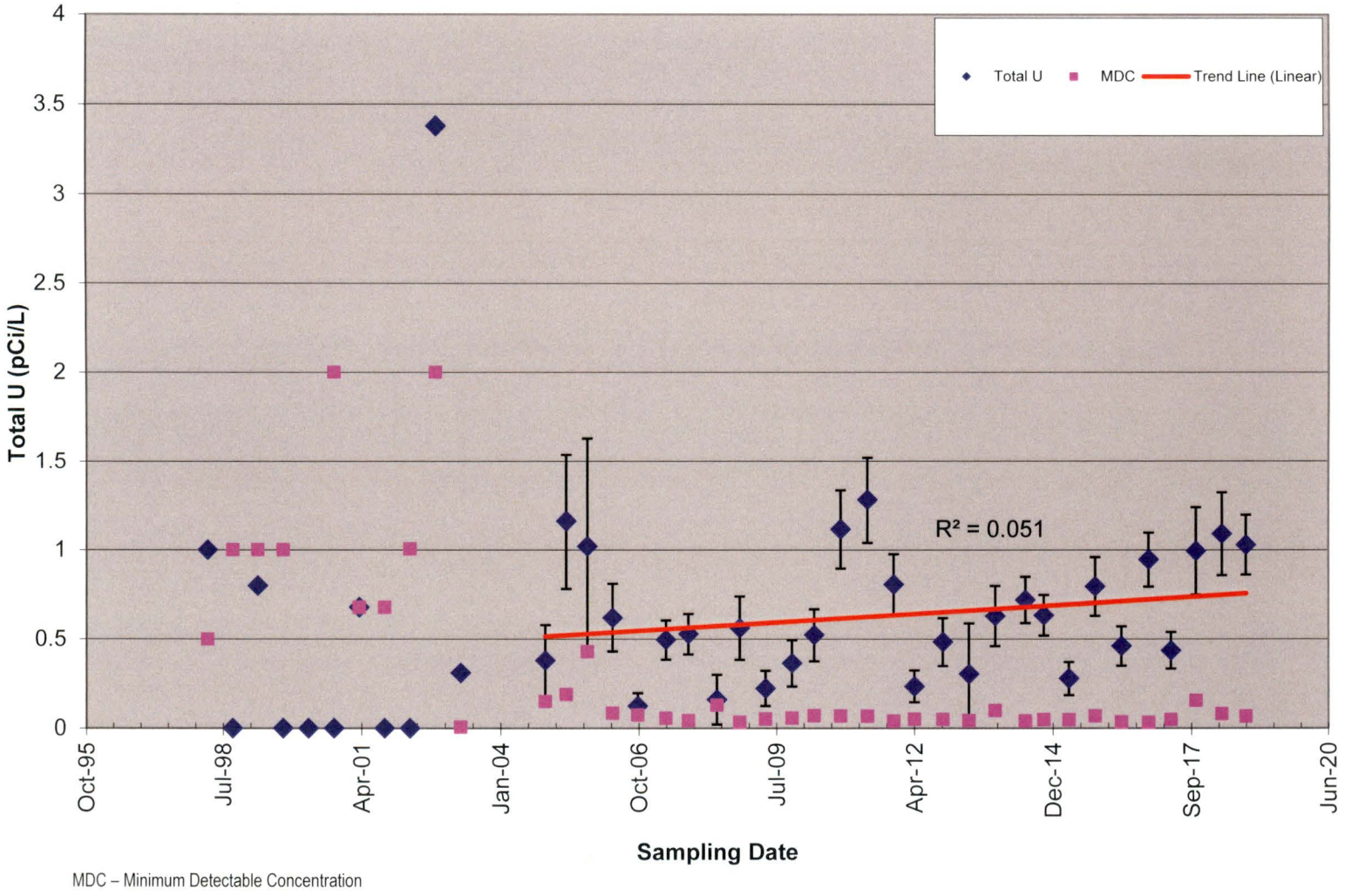
MDC – Minimum Detectable Concentration
NOTE: No sample was collected in October 2007 or October 2010 as the creek was dry.

Figure 4-19. Total Uranium in SW-DU-006 (1998-2018)



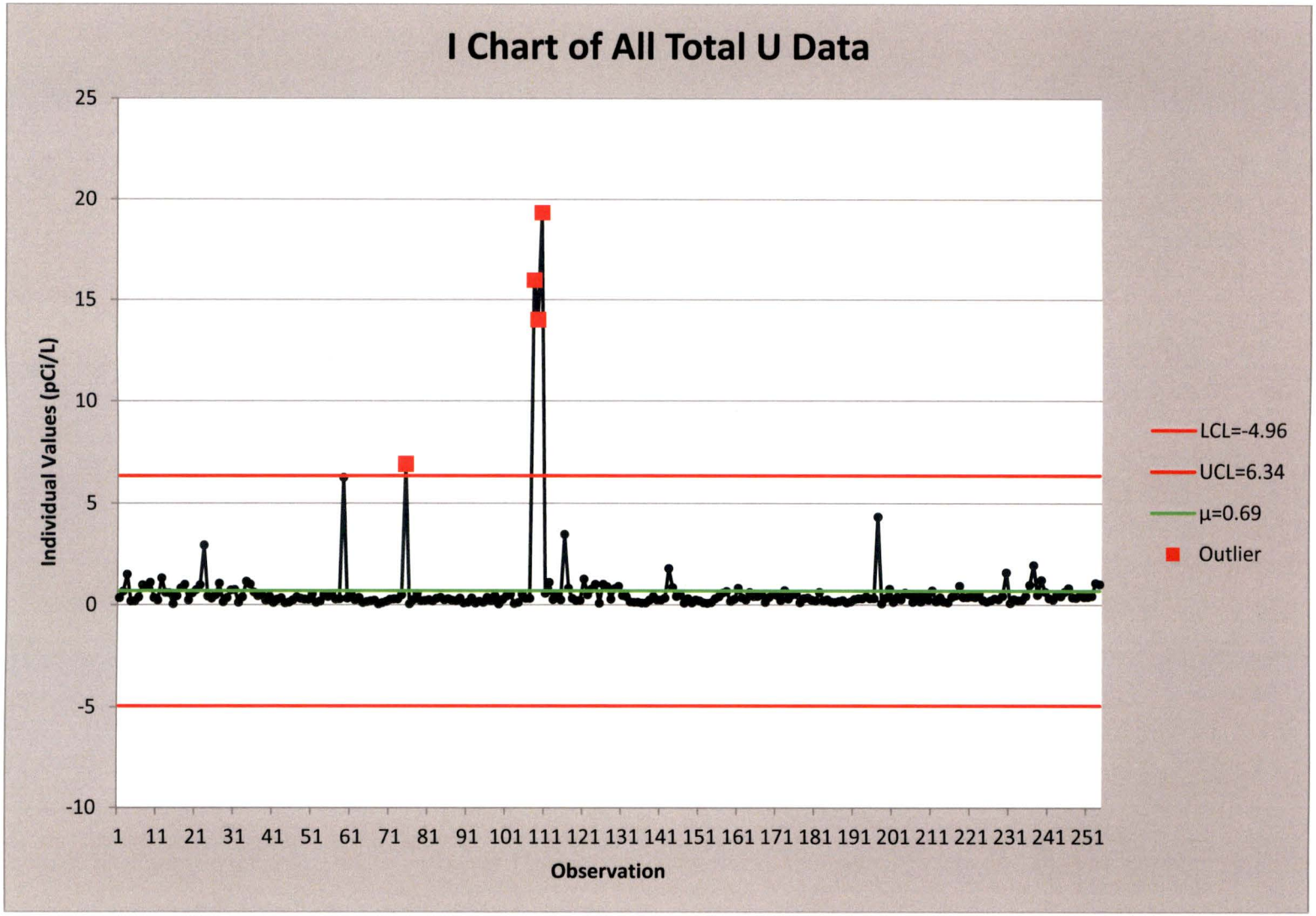
MDC – Minimum Detectable Concentration
NOTE: A large value of 2 pCi/L in April 1998 is not shown on the graph because it was causing a compression of the Y axis scale.

Figure 4-20. Total Uranium in SW-DU-007 (1998-2018)



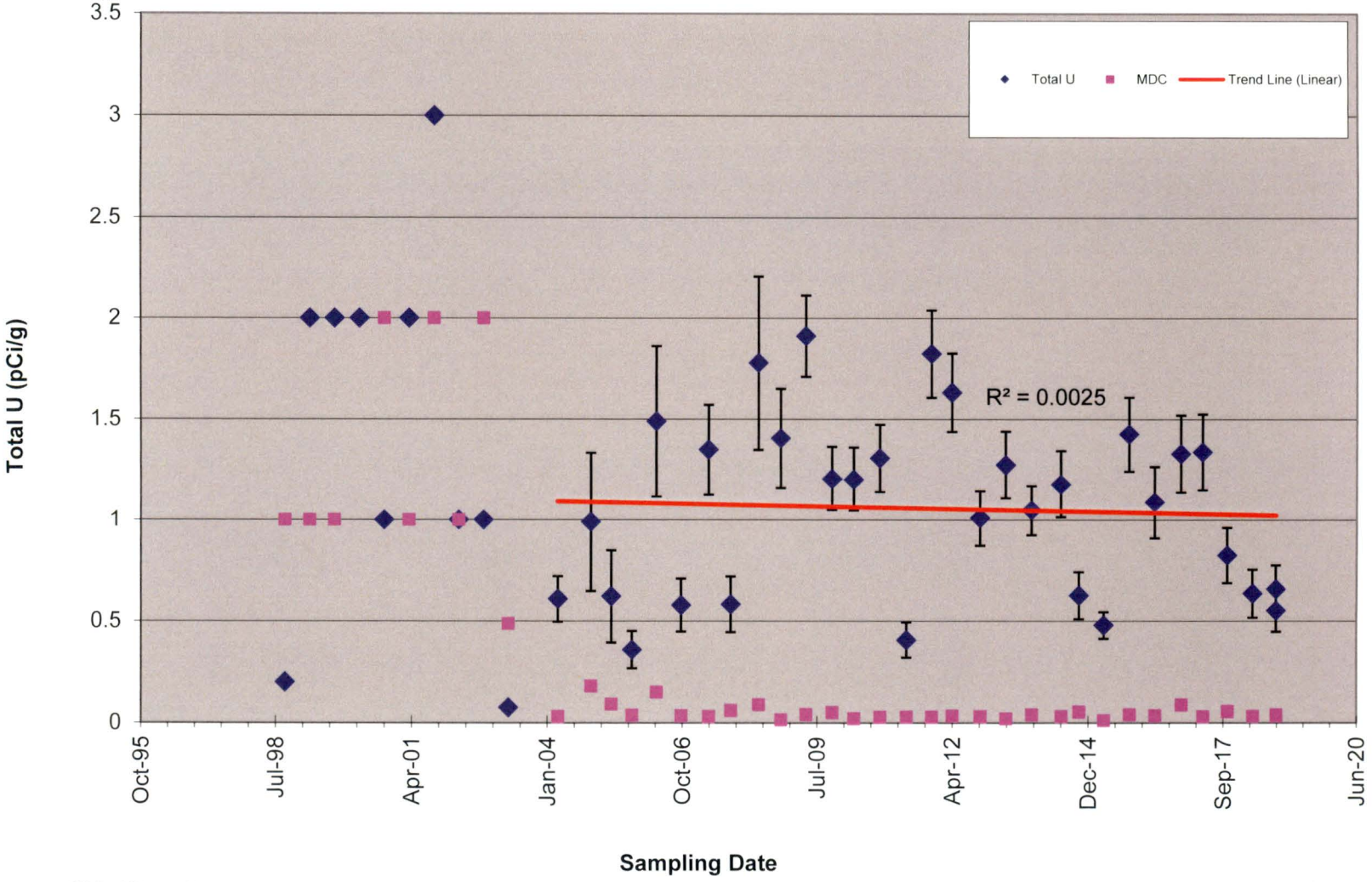
MDC – Minimum Detectable Concentration

Figure 4-21. Total Uranium in SW-DU-008 (1998-2018)



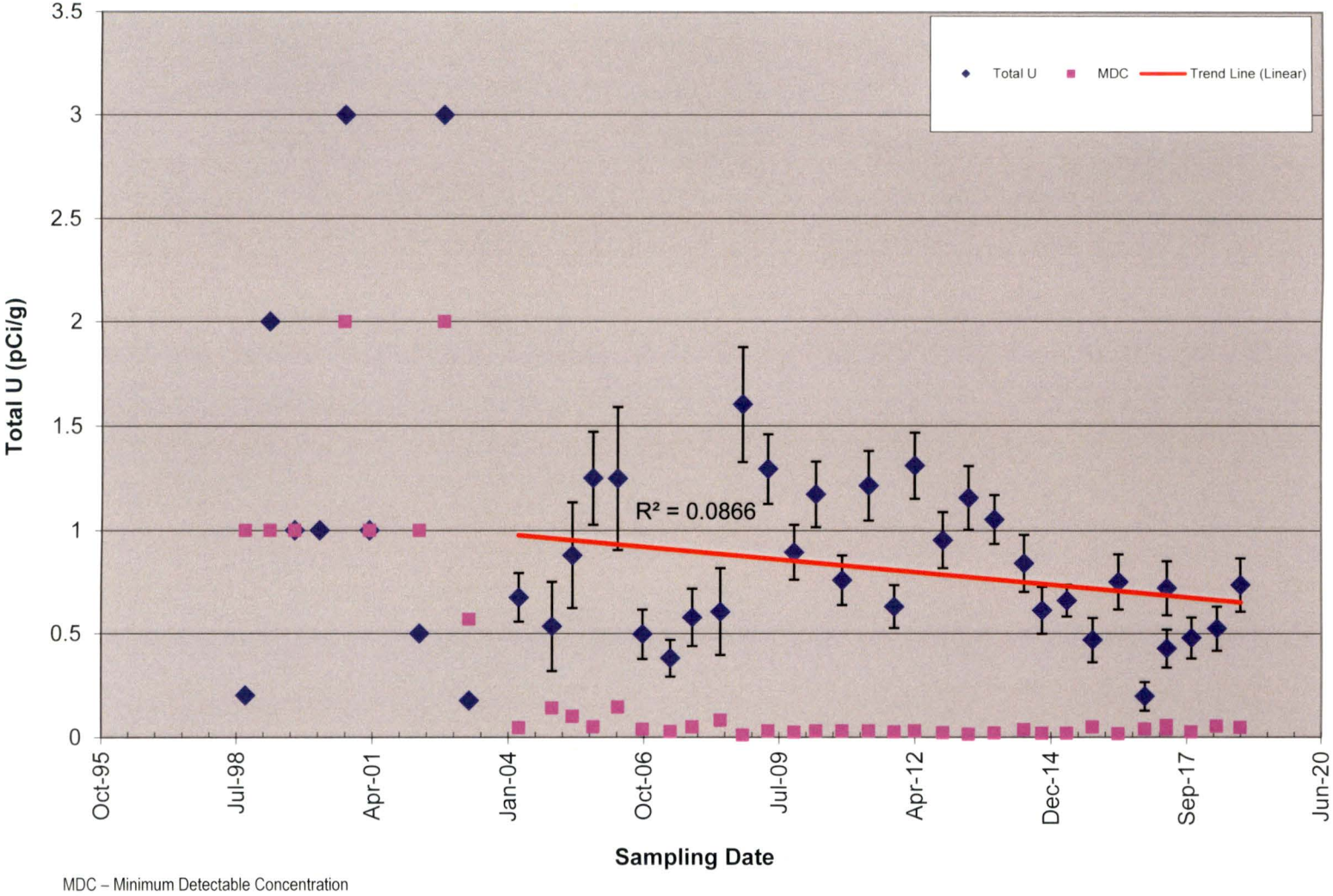
NOTE: Results that exceed the UCL or fall below the LCL are reflected in red squares

Figure 4-22. Control Chart for All Surface Water Data (2004-2018)



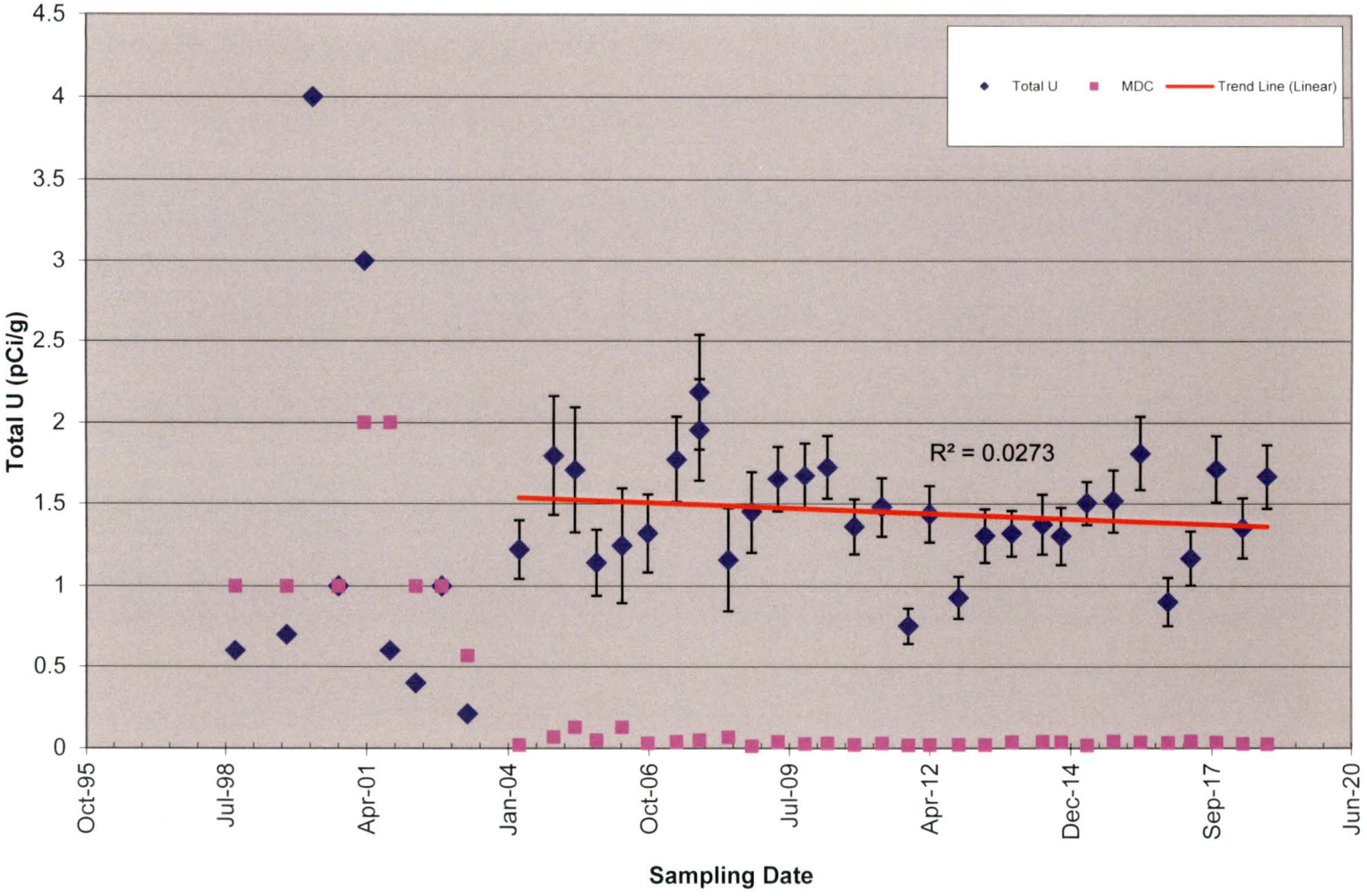
MDC – Minimum Detectable Concentration

Figure 4-23. Total Uranium in SD-DU-001 (1998-2018)



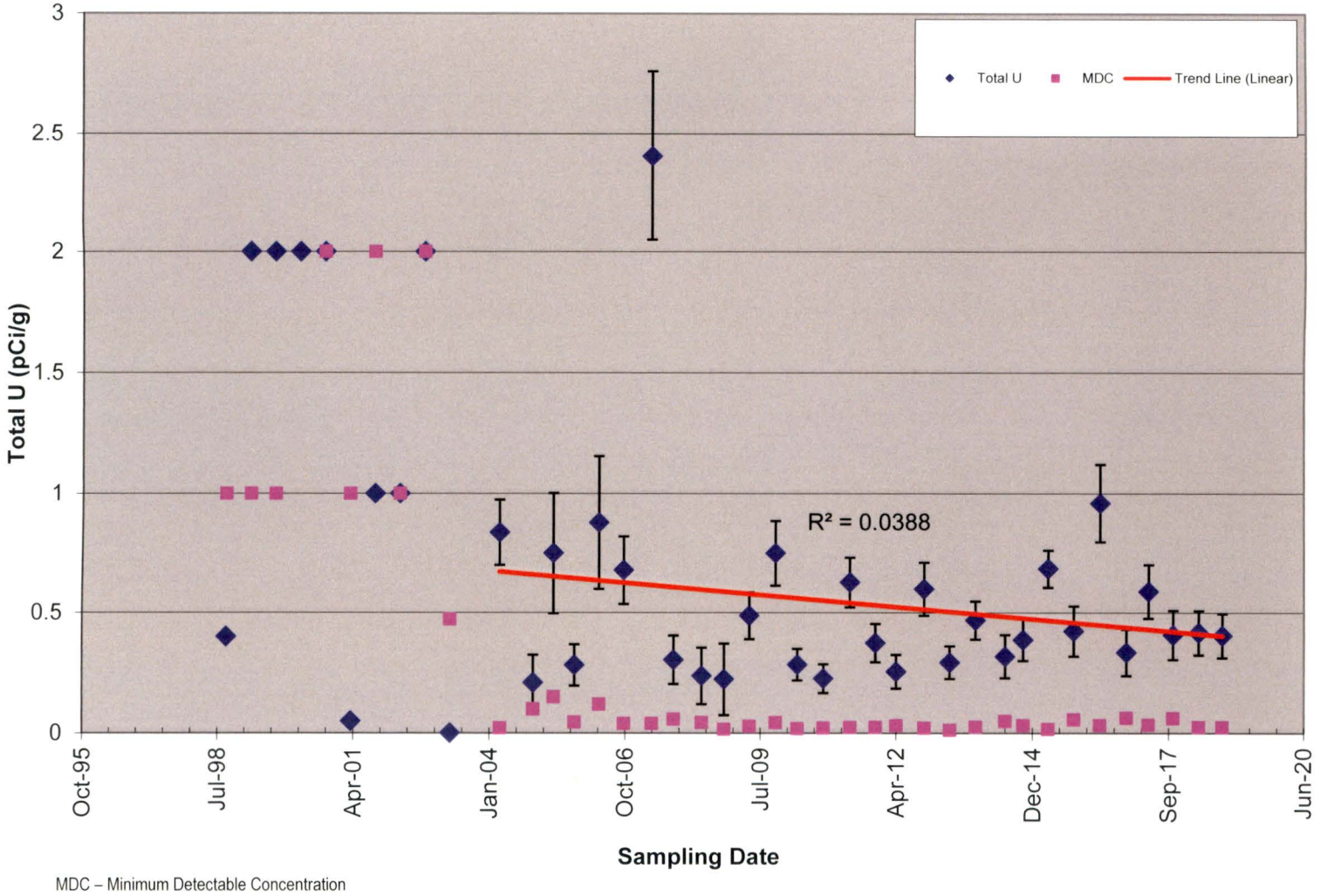
MDC – Minimum Detectable Concentration

Figure 4-24. Total Uranium in SD-DU-002 (1998-2018)



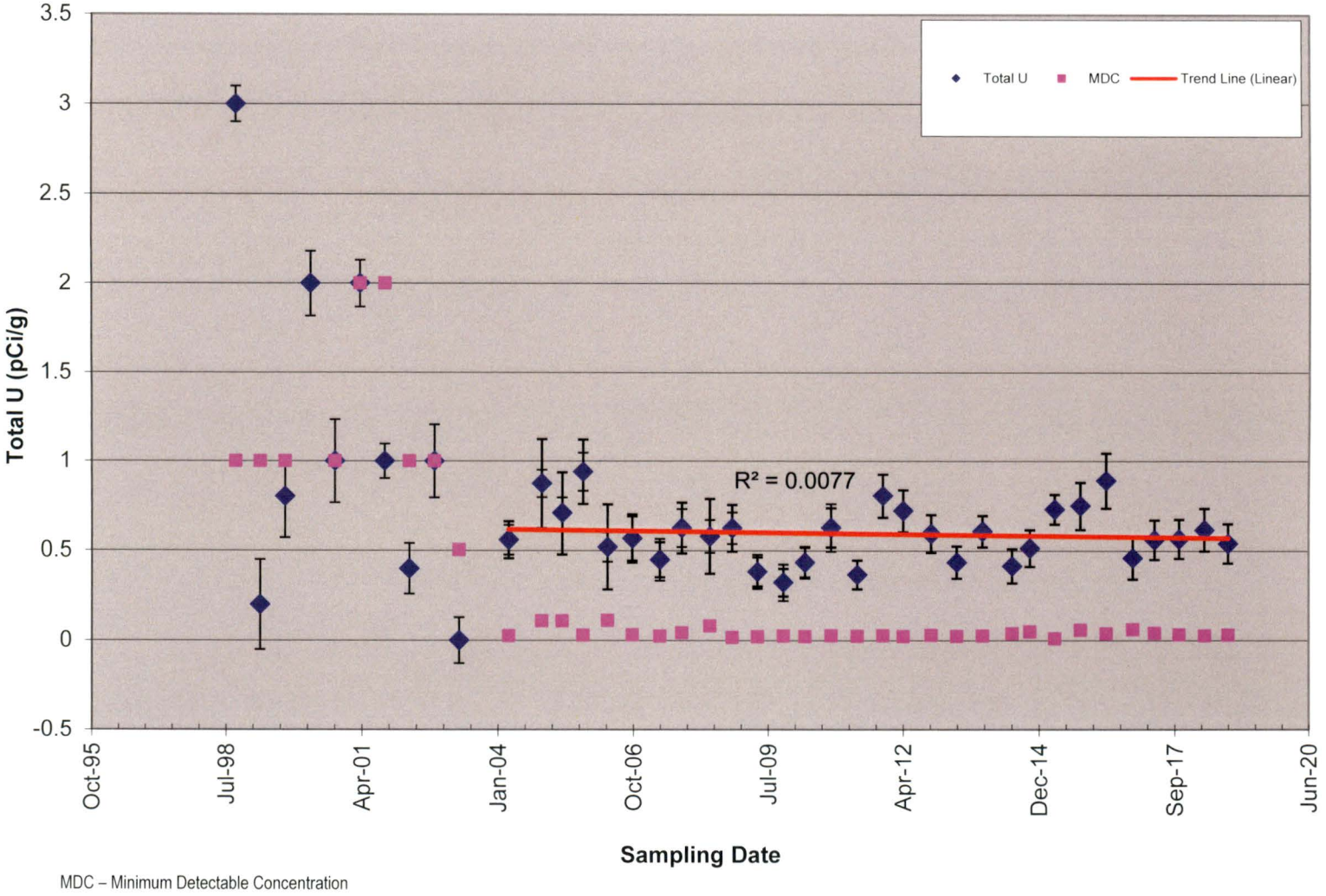
MDC – Minimum Detectable Concentration

Figure 4-25. Total Uranium in SD-DU-003 (1998-2018)



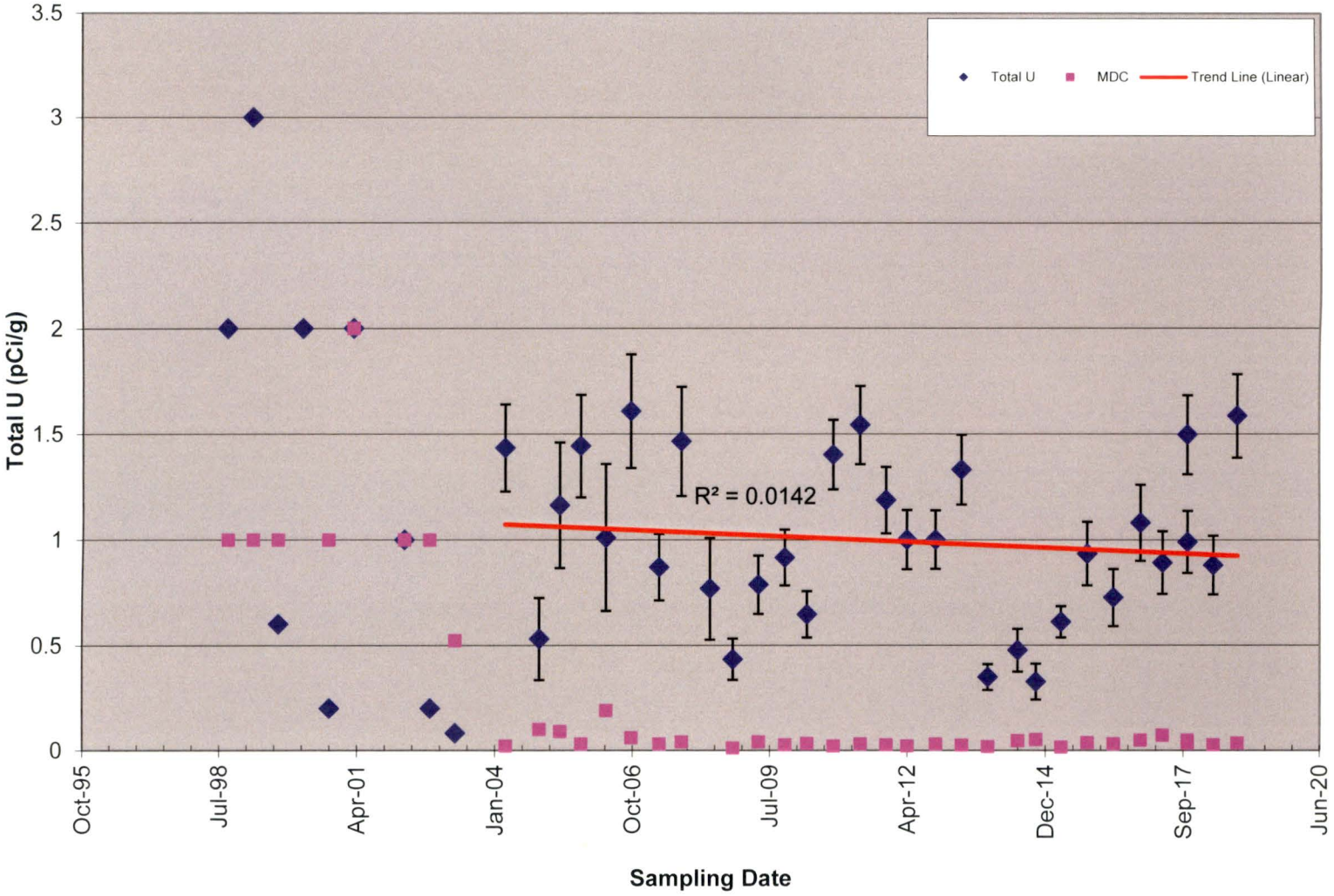
MDC – Minimum Detectable Concentration

Figure 4-26. Total Uranium in SD-DU-004 (1998-2018)



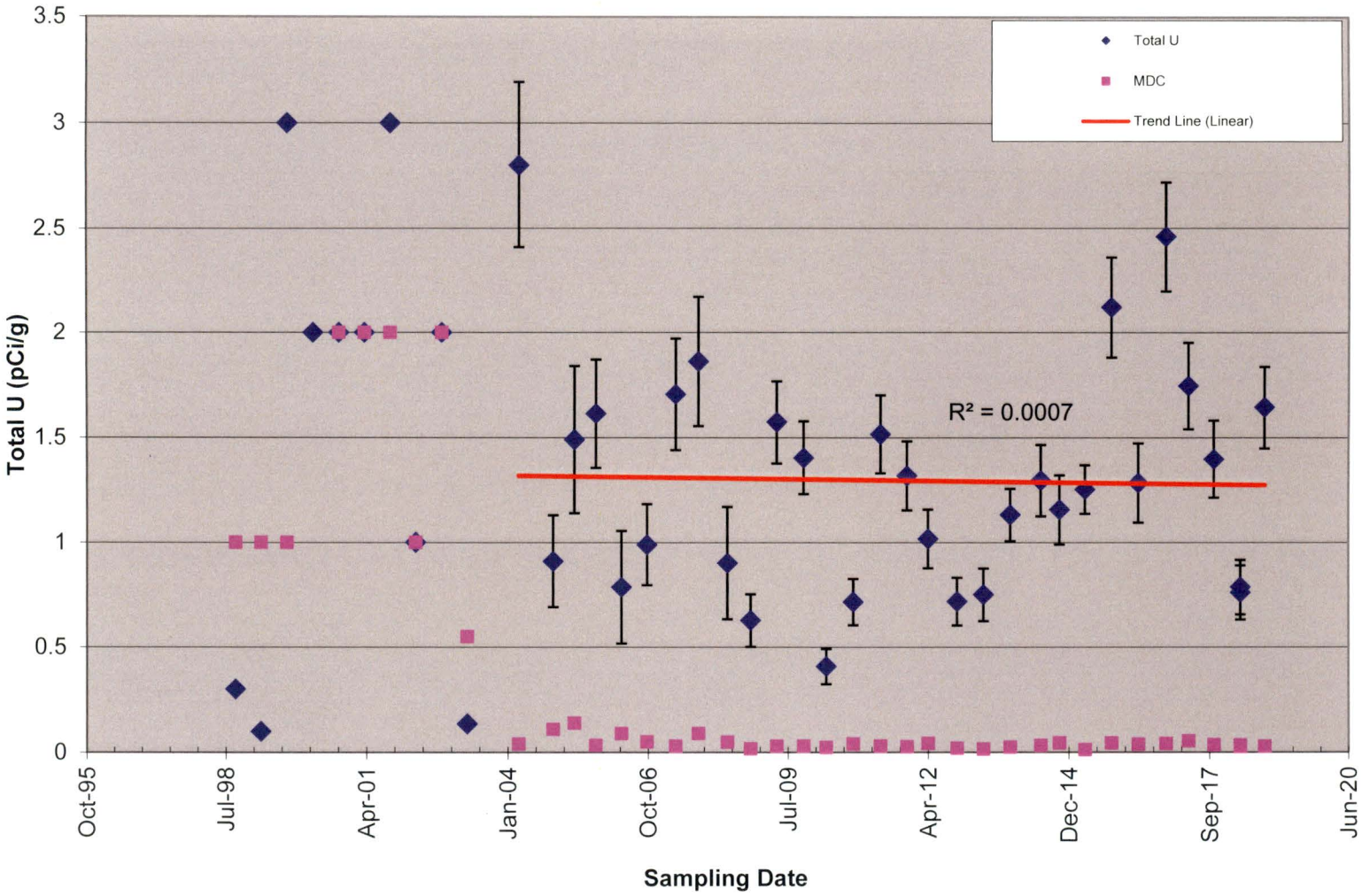
MDC – Minimum Detectable Concentration

Figure 4-27. Total Uranium in SD-DU-005 (1998-2018)



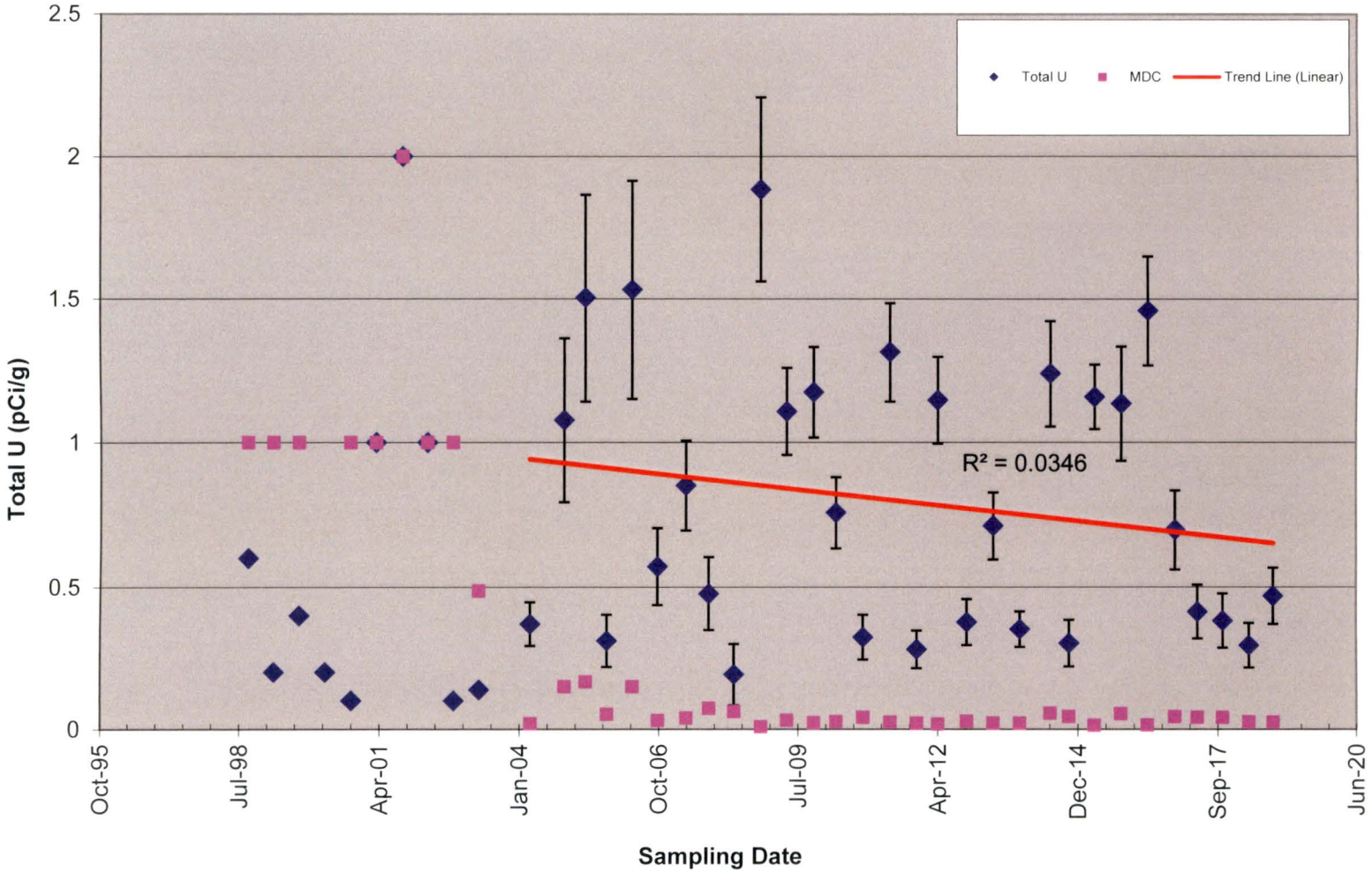
MDC – Minimum Detectable Concentration

Figure 4-28. Total Uranium in SD-DU-006 (1998-2018)



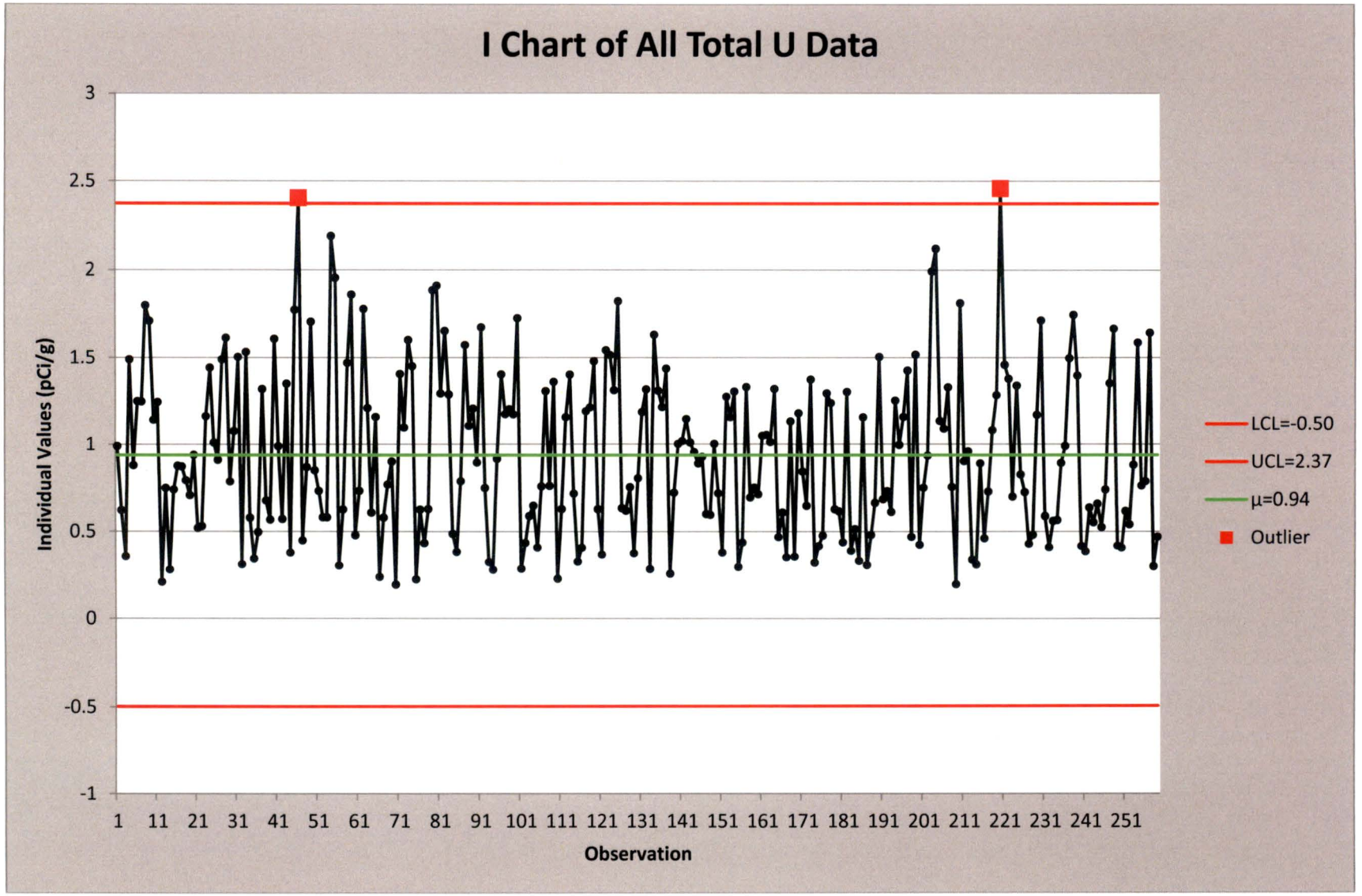
MDC – Minimum Detectable Concentration

Figure 4-29. Total Uranium in SD-DU-007 (1998-2018)



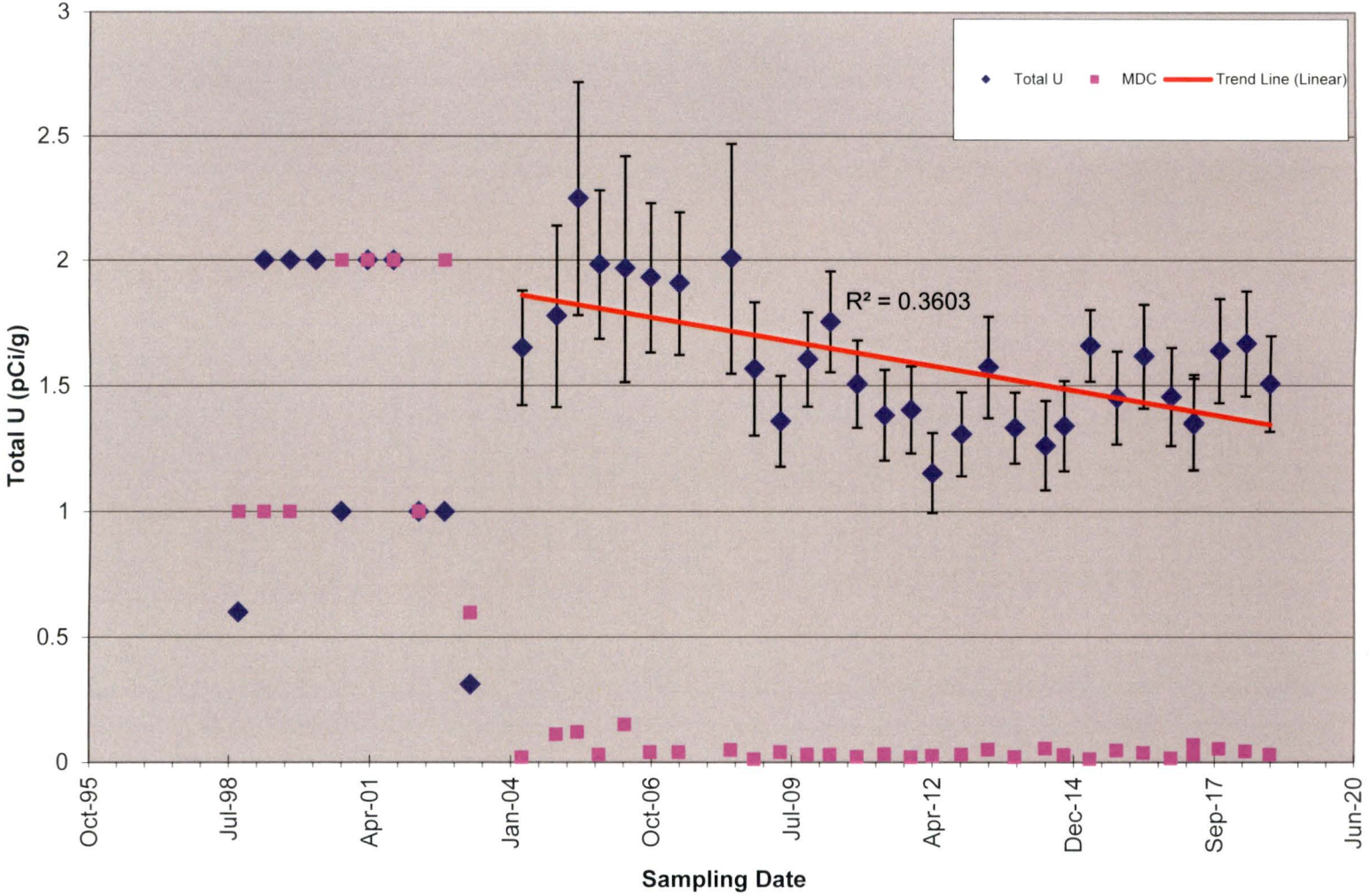
MDC – Minimum Detectable Concentration

Figure 4-30. Total Uranium in SD-DU-008 (1998-2018)



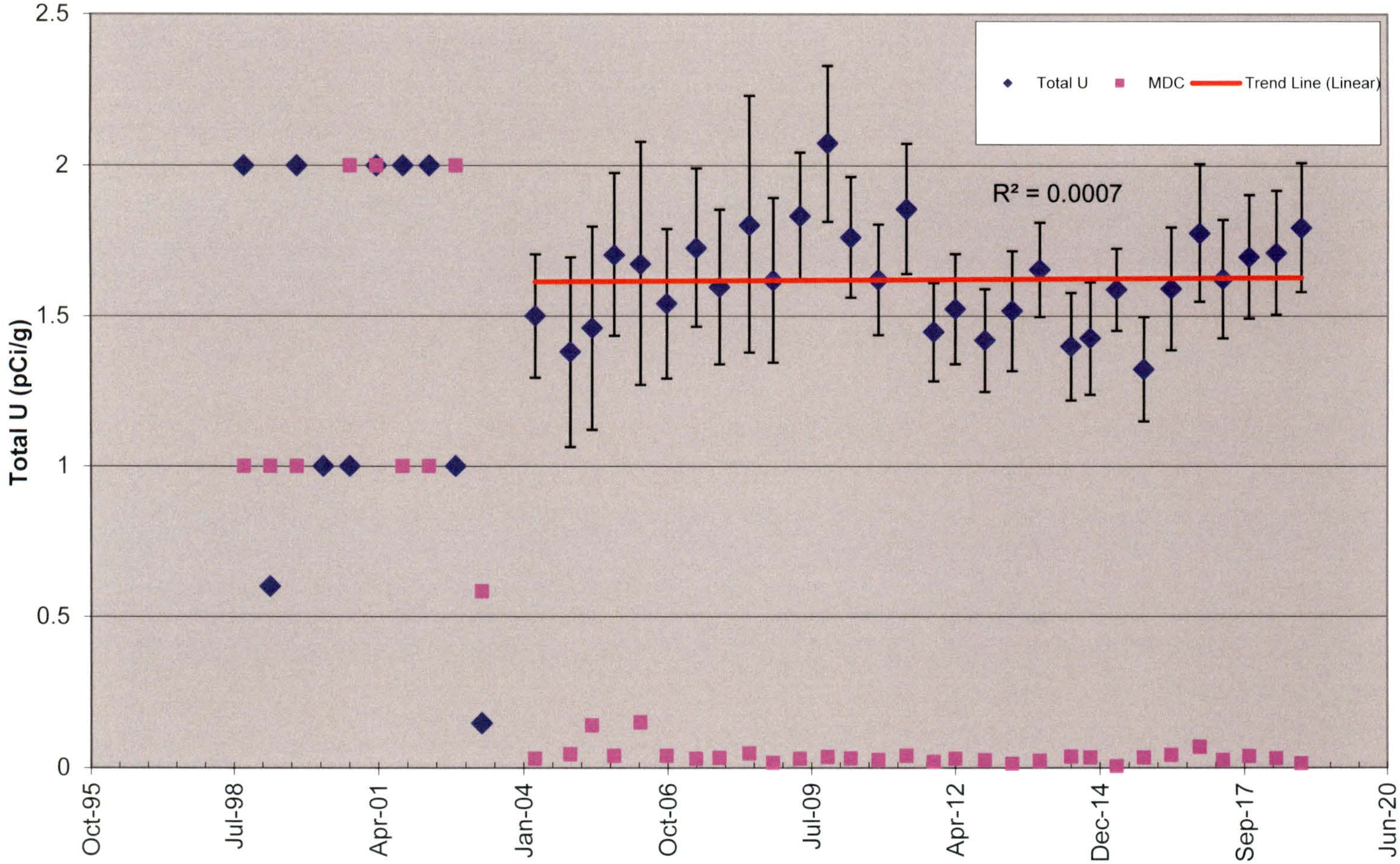
NOTE: Results that exceed the UCL or fall below the LCL are reflected in the red square.

Figure 4-31. Control Chart for All Sediment Data (2004-2018)



MDC – Minimum Detectable Concentration

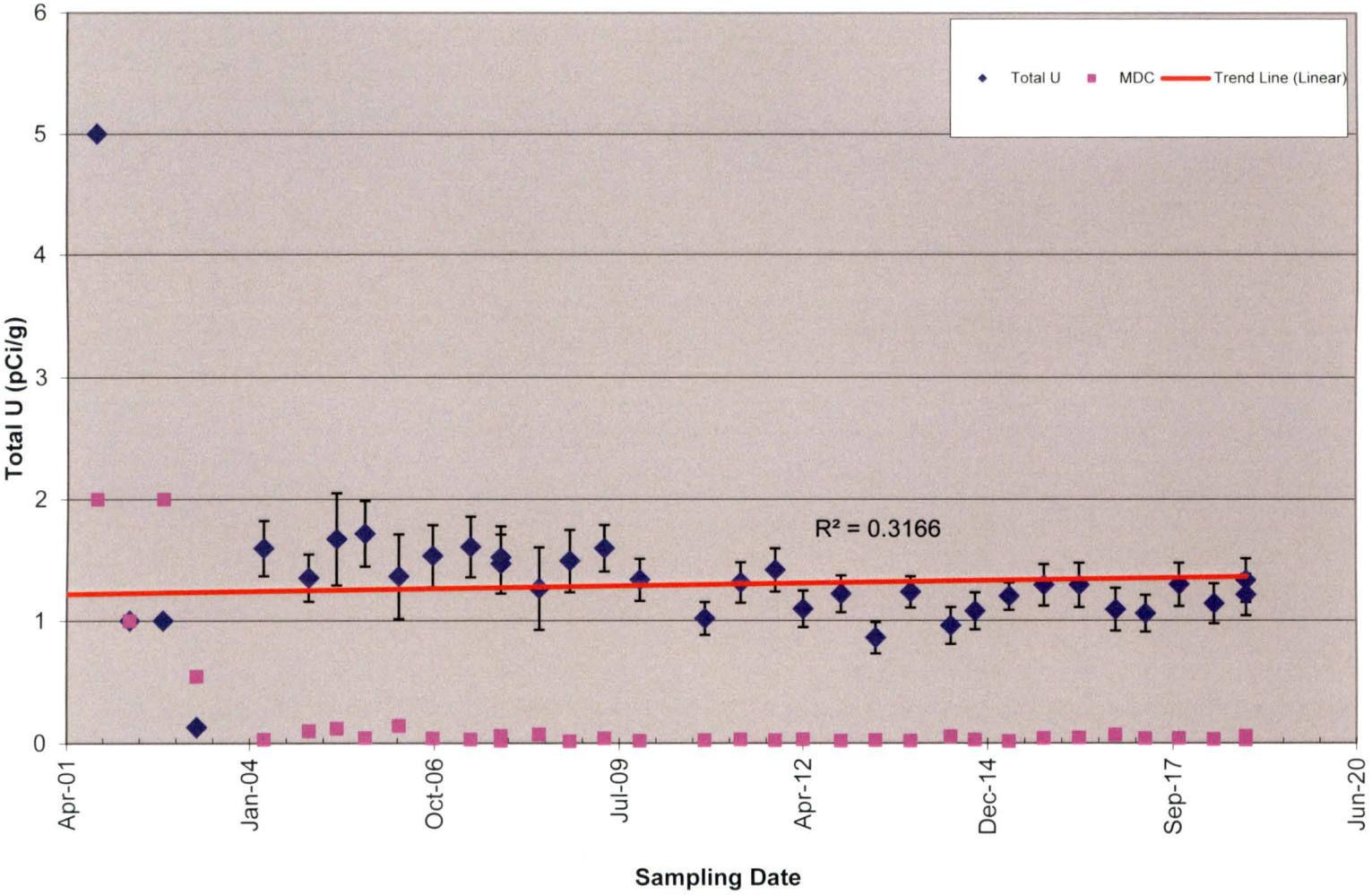
Figure 4-32. Total Uranium in SS-DU-001 (1998-2018)



Sampling Date

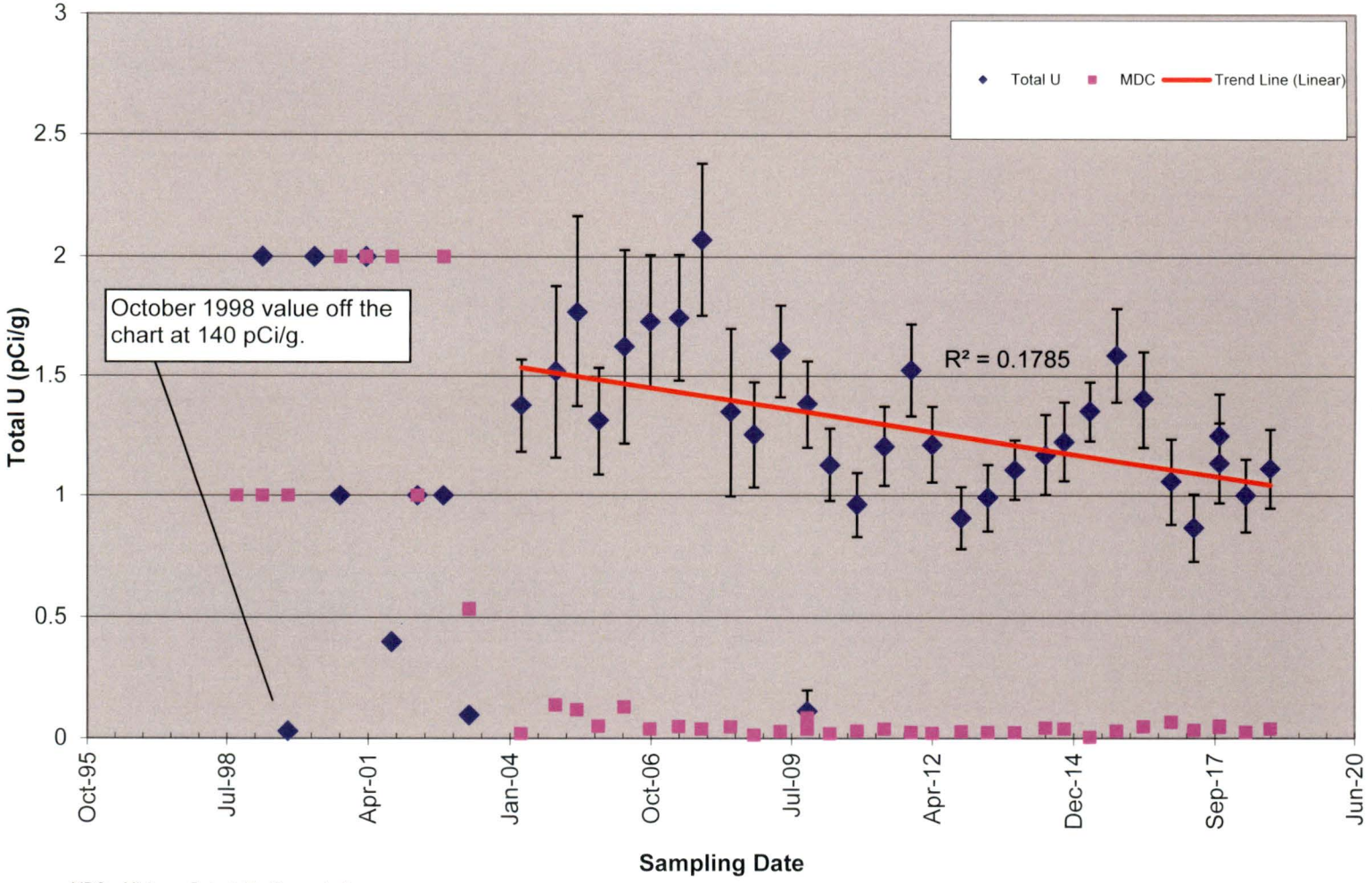
MDC – Minimum Detectable Concentration

Figure 4-33. Total Uranium in SS-DU-002 (1998-2018)



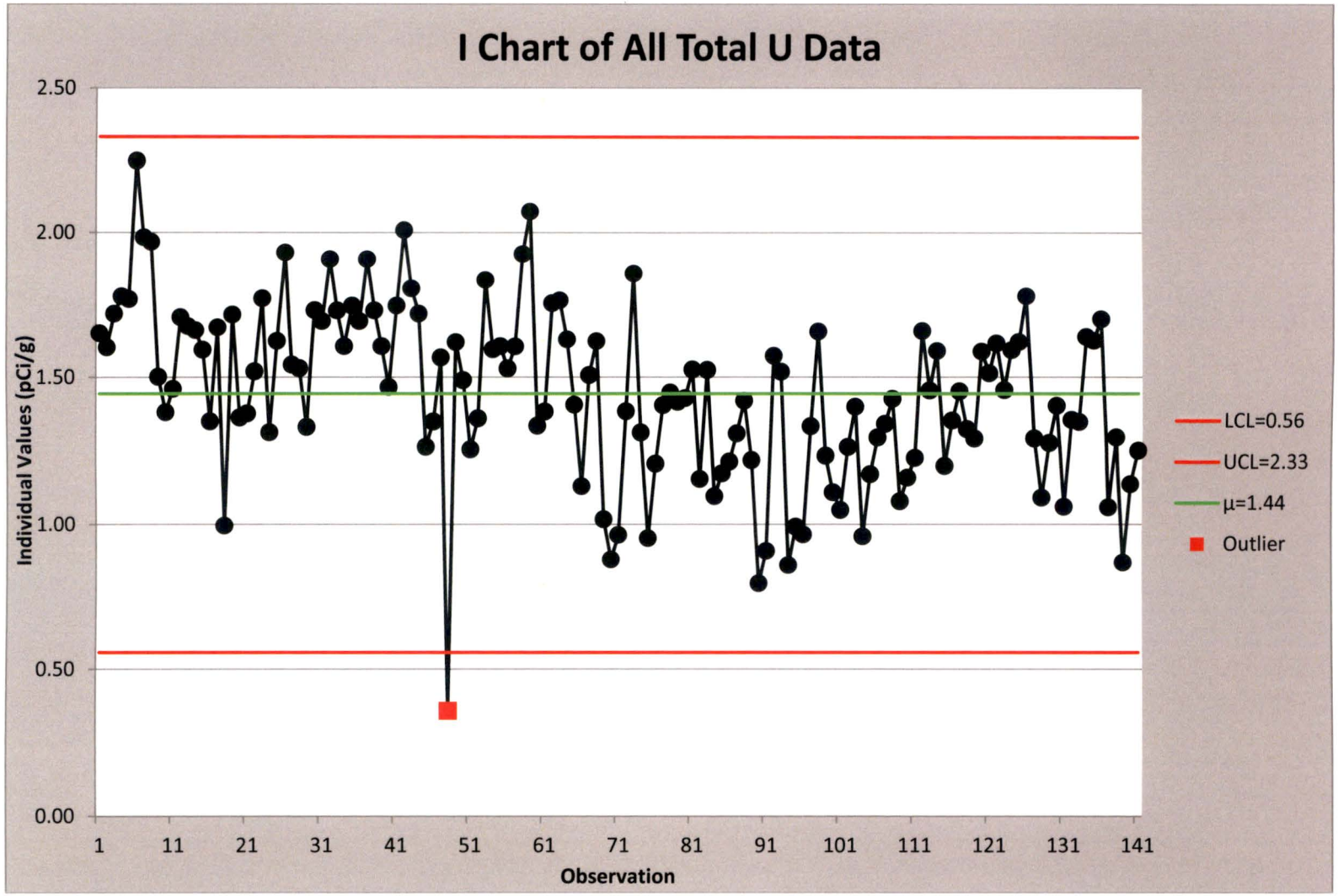
MDC – Minimum Detectable Concentration

Figure 4-34. Total Uranium in SS-DU-003 (1998-2018)



MDC – Minimum Detectable Concentration
NOTE: The October 1998 value of 140 pCi/g is not shown on the graph because it was causing a compression of the Y axis scale.

Figure 4-35. Total Uranium in SS-DU-004 (1998-2018)



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 (2004-2018)

5. CONCLUSIONS AND RECOMMENDATIONS

The April/May and October 2018 sampling events were conducted in accordance with the SOP (CHPPM 2000), 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) established in the SOP.

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 sample for which the U-238/U-234 ratio could exceed 3.0 was SW-DU-008 (2.5 ± 0.9 pCi/L) from the October 2018 sampling event.

ICP-MS results for SW-DU-008 equated to 1.9, non-detect, non-detect, and 1.9 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-008 of 1.9 µg/L 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 4.1 µg/L based on a U-235 MDL of 0.2 µg/L. Since the total uranium result of 1.9 µg/L for SW-DU-008 is less than the upper comparison value of 4.1 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 monitoring well sample MW-DU-009. The samples from this location reflected an R^2 value of 0.59. The total uranium concentrations for samples from MW-DU-009 continue to exhibit a decreasing trend.

In conclusion, no action levels defined in the Army's license were exceeded, and future environmental monitoring will continue to be completed in accordance with the SOP.

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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.

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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.

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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.

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APPENDIX A

STANDARD OPERATING PROCEDURE

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SOP No. OHP 40-2

Effective Date 10 Mar 00
Date Removed from Service _____

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

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.

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

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, Anne 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.

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).

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

  < 1.5×10^{-1} pCi/ml - no corrective action.

  > 1.5×10^{-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.

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

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

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

ANNEX B

FORMS, LABELS AND WORKSHEETS

Request for Laboratory Services

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 4: PROJECT COORDINATION INFORMATION

1. DATE SAMPLES TO ARRIVE AT DLS: 12/04/2000

(Note: Prior Arrangements Must Be Made with SML for Samples That Will Arrive Outside of Routine Duty Hours which are M-F 0730 -1700)

Special Comments: Samples will arrive from the field without preservation or filtration.

2. SPECIAL HANDLING REQUIREMENTS:

- [x] CHAIN-OF-CUSTODY (COC)
- [ ] SAFETY CONSIDERATION/HAZARDOUS MATERIALS (Specify):
- [x] ANALYSES WITH SHORT-HOLDING TIMES (List Specific Analyses):
  Filter water samples and test for dissolved U-238, No preservative add in the field.
- [ ] OTHER (Specify):

3. SAMPLE COLLECTION KIT:

DATE REQUIRED: 07/04/2000

CHECK PREFERENCE:

- [ ] 1. TO BE PICKED UP AT DLS BY PROJECT OFFICER
- [x] 2. SHIP TO:
  (Please include Bldg # and Phone #)

3 large coolers and bags for soil samples need to be shipped to site
U.S. Army Hefferson Proving Ground
1661 West J.P.G. Niblo Road (Bldg 125)
Madison, IN 47250
(812) 273-2551

PART 5: SAMPLE ANALYSIS INFORMATION

DLS TEST CODE	PROCEDURE DESCRIPTION	STD METHOD	MATRIX	NUMBER OF SAMPLES	SPECIAL REQUIREMENTS/COMMENTS (REQUESTS FOR EXTRA BLANKS OR
803	Uranium in Soil	G-002	Soil	5	Soil
586	Uranium in Water	U-002	Water	9	Surface Water (1 gal Cubitainer)
803	Uranium in Soil	G-002	Soil	9	Sediment
586	Uranium in Water	U-002	Water	12	Ground Water (1 gal Cubitainer)

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

Figure B-1b

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 (μR/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 (µR/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)

ANNEX C

SAMPLE LOCATION MAPS

SOP No. OHP 40-2

Effective Date _____
Date Removed from Service _____

Jefferson Proving Ground: DU Sampling
GROUNDWATER MONITORING WELLS

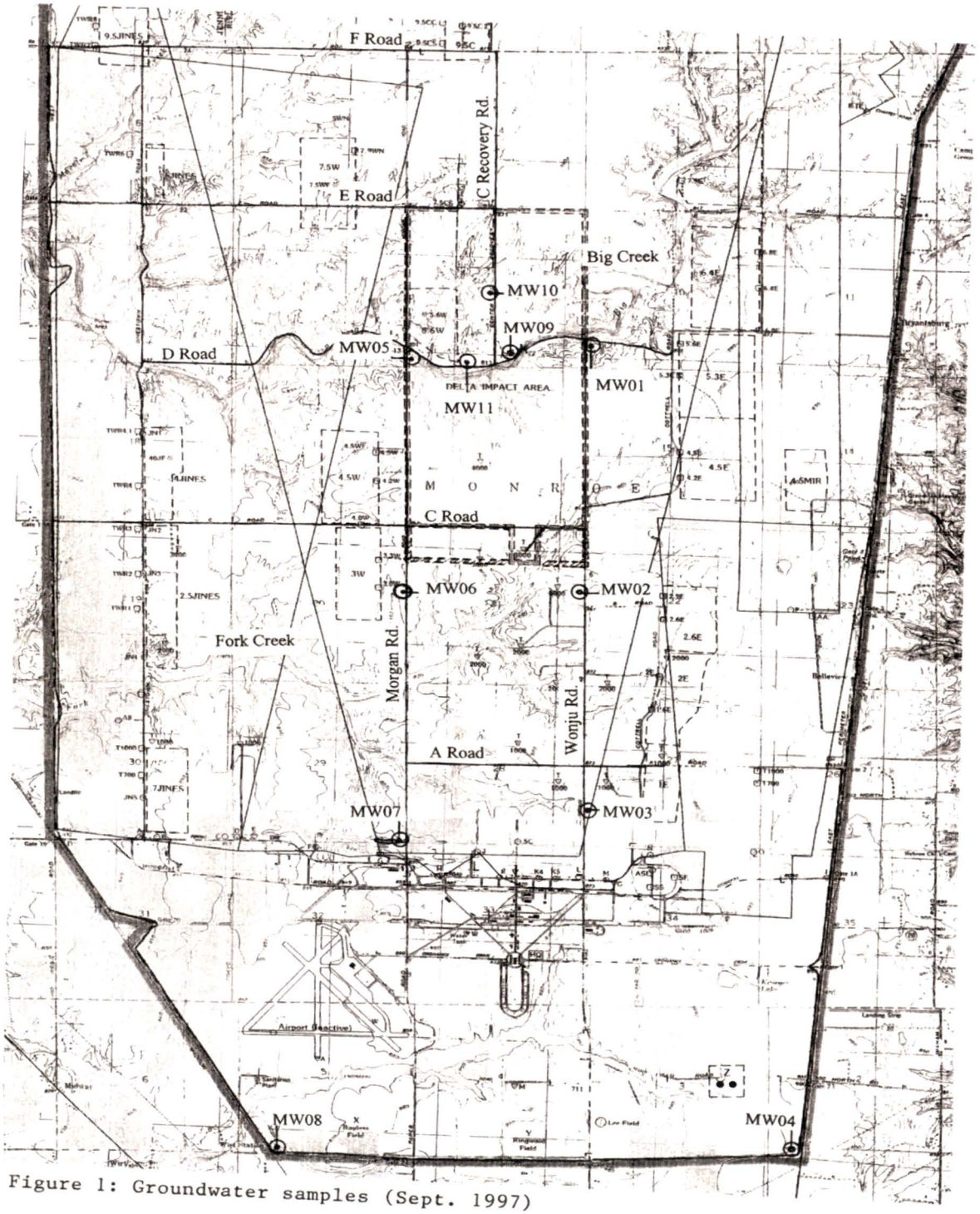

Figure 1: Groundwater samples (Sept. 1997)

Jefferson Proving Ground: DU Sampling
SOIL SAMPLES

Figure 2: Soil Samples (Sept. 1997)

Jefferson Proving Ground: DU Sampling
SURFACEWATER & SEDIMENT SAMPLES

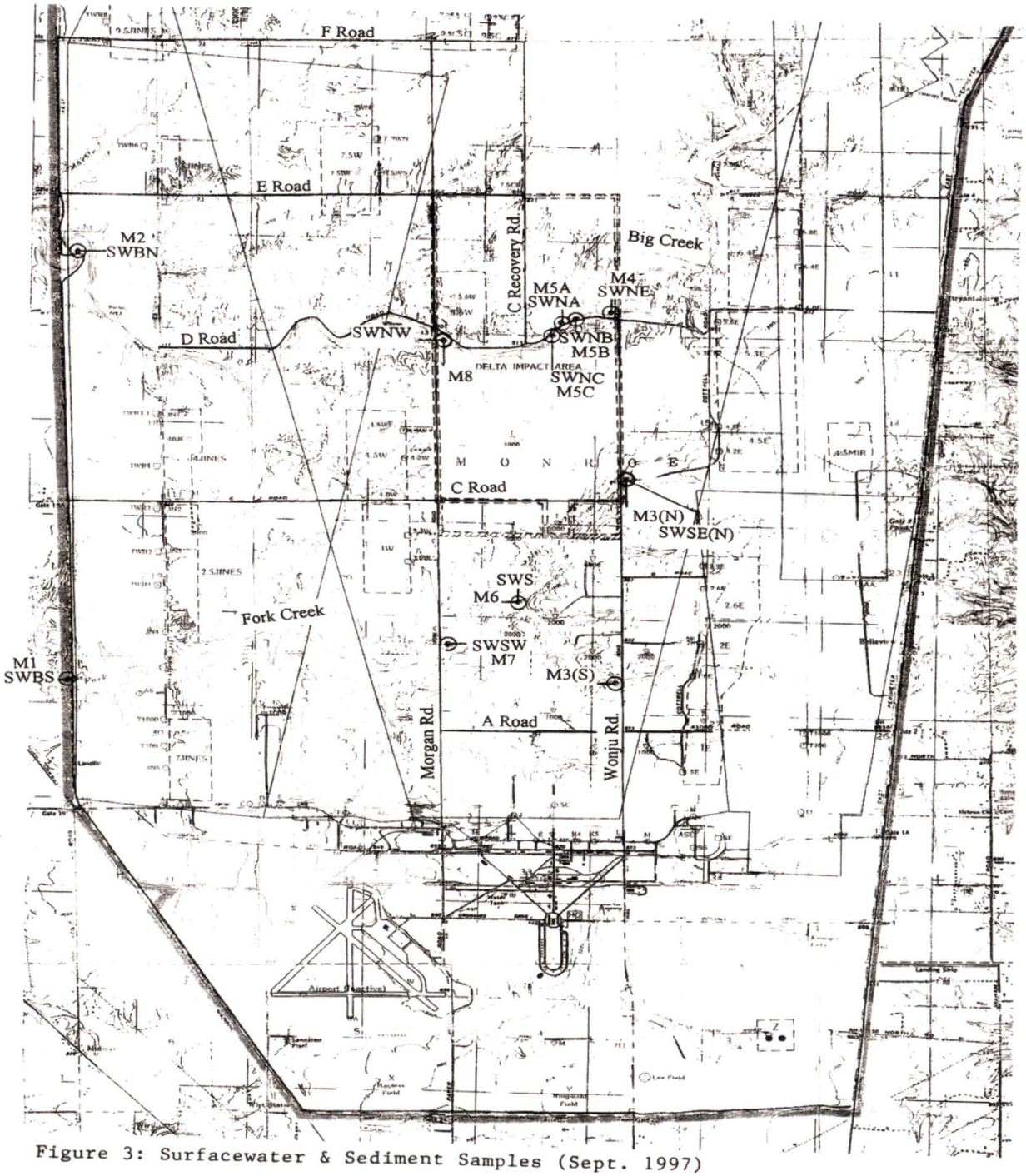

Figure 3: Surfacewater & Sediment Samples (Sept. 1997)

APPENDIX B

FIELD LOGBOOK AND SAMPLING FORMS

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SPRING 2018 FIELD LOGBOOK AND SAMPLING FORMS

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-1
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
Checked by:	&	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 (35.03 ft) - Depth to Water (9.82 ft) = Height of water column (25.21 ft)

Height of water column (25.21 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.11 gal)

Purge Volume:

1 Well Volume (4.11 gallons) x 3 = 3 Well Volumes (12.33 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
5-1-18 0947	13.41	7.59	0.340	1.5	14.24	298	—	—	10.12'	—

PURGE INFORMATION:

Time / Date Started: 1359 | 4-18-18

Time Purge End: 1405

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: 0947 | 5-1-18

Sampled by: D. Lawson & T. 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

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

Water level at 10.12' below TOC on 5-1-18

RAD: Dose: 5 µR/h

Background: 35 cpm

Sample: 31 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-2
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
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 (25.94 ft) - Depth to Water (9.68 ft) = Height of water column (16.26 ft)

Height of water column (16.26 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.65 gal)

Purge Volume:

1 Well Volume (2.65 gallons) x 3 = 3 Well Volumes (7.95 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
5-1-18 0846	11.64	7.56	0.438	1.4	18.42	285	—	—	9.96'	—

PURGE INFORMATION: MS 4-18-18

Time / Date Started: 1346 | 4-18-18

Time Purge End: 1350

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: 0846 | 05-01-18

Sampled by: D. Lawson & T. 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

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

NM III Water level at 9.96' below TOC on 5-1-18

RAD: Dose: 5 μR/h

Background: 40 cpm

Sample: 33 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-3
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	5-01-18
Checked by:	_____ & _____	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 (45.48 ft) - Depth to Water (5.18 ft) = Height of water column (40.3 ft)

Height of water column (40.3 ft) x K value (0.163 gal/ft) = 1 Well Volume (6.57 gal)

Purge Volume:

1 Well Volume (6.57 gallons) x 3 = 3 Well Volumes (19.71 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18 ↓

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
5-1-18 0741	11.90	7.72	0.434	20.1	14.69	183	—	—	5.56'	—

PURGE INFORMATION:

Time / Date Started:	1328 | 4-18-18
Time Purge End:	1340
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:	0741 | 5-01-18
Sampled by:	D. Lawson & T. Farmer
Sample Method: Bailer	X Other _____
Grab	X Composite _____
# of Bottles Collected:	2 - 1000 ml
Bottle Preservatives:	none
Recovering WL:	—
Duplicate Sampling:	Yes
Laboratory:	TA
COC Form:	Yes

Duplicate taken.

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

NN NN NN NN Water level at 5.56' bctoc on 05-01-18

RAD: Dose: 5 μR/hr

Background: 40 cpm

Sample: 31 cpm

leidos

GROUNDWATER SAMPLE LOG

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

Well Identification: MW-4
Project Location: Madison, IN
Date: 4-18-18
Date: 4-30-18
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 (31.27 ft) - Depth to Water (3.68 ft) = Height of water column (27.59 ft)
Height of water column (27.59 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.50 gal)

Purge Volume:

1 Well Volume (4.50 gallons) x 3 = 3 Well Volumes (13.49 gallons)
Purge Rate (_____gpm) x (_____min) = 1 Well Volume
Purge Rate (_____gpm) x (_____min) = 3 Well Volume

4-30-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
4-30-18 1413	15.17	7.18	0.483	11.9	4.38	115	—	—	4.15'	—

PURGE INFORMATION:

Time / Date Started: 1657 | 4-18-18
Time Purge End: 1703
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: 1413 | 4-30-18
Sampled by: T. Farmer & M. Caldwell
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

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

4-30-18: Water level at 4.15' below TOC.

RAD: Dose: 5 μR/hr
Background: 40cpm
Sample: 33 cpm

leidos

GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-5
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & A. Bennett	Date:	05-01-18
Checked by:	_____ & _____	Date:	1207

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 (35.85 ft) - Depth to Water (17.73 ft) = Height of water column (18.12 ft)

Height of water column (18.12 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.95 gal)

Purge Volume:

1 Well Volume (2.95 gallons) x 3 = 3 Well Volumes (8.86 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
1207	15.91	7.84	0.465	0.0	8.42	205	—	—	19.02'	—

PURGE INFORMATION:

Time / Date Started:	1448	4-18-18	
Time Purge End:	1452		
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:	1207	5-1-18	
Sampled by:	D. Lawson &	A. Bennett	
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		

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

NM 1111 Water level at below TOC on 5-1-18

RAD: Desc: 5 uR/h

Background: 38 cpm

Sample: 38 cpm

leidos

GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-6
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
Checked by:	&	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 (42.78 ft) - Depth to Water (15.44 ft) = Height of water column (27.34 ft)

Height of water column (27.34 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.46 gal)

Purge Volume:

1 Well Volume (4.46 gallons) x 3 = 3 Well Volumes (13.37 gallons)

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

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

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
5-1-18 1430	18.63	7.27	0.339	20.6	9.01	347	—	—	30.36'	—

PURGE INFORMATION:

Time / Date Started:	1428 | 4-18-18
Time Purge End:	1437
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:	1430 | 5-1-18
Sampled by:	D. Lawson & T. 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

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

MW MW 1111 Water level at 30.36' below TOC on 5-1-18

RAD Dose: 4 μR/h

Background: 20 cpm

Sample: 50 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-7
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
Checked by:	&	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 (56.41 ft) - Depth to Water (8.21 ft) = Height of water column (48.20 ft)

Height of water column (48.20 ft) x K value (0.163 gal/ft) = 1 Well Volume (7.86 gal)

Purge Volume:

1 Well Volume (7.86 gallons) x 3 = 3 Well Volumes (23.57 gallons)

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

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

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
1458	16.12	7.10	0.405	20.1	8.74	347	—	—	8.59'	—

PURGE INFORMATION:

Time / Date Started: 1627 | 4-18-18

Time Purge End: 1640

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: 1458 | 05-01-18

Sampled by: D. Lawson & T. 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

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

RAD: Dose: 5 µR/h

Background: 36 cpm

Sample: 48 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-8
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	T. Farmer & M. Caldwell	Date:	4-30-18
Checked by:	&	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 (30.51 ft) - Depth to Water (23.44 ft) = Height of water column (7.07 ft)

Height of water column (7.07 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 (3.46 gallons)

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

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

4-30-18

	Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
4-30-18	1345	16.30	6.91	0.464	0.0	10.56	245	—	—	23.60'	—

PURGE INFORMATION:

Time / Date Started: 1714 | 4-18-18

Time Purge End: 1719

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: 1345 | 4-30-18

Sampled by: T. Farmer & M Caldwell

Sample Method: Bailer X Other _____

Grab X Composite _____

# of Bottles Collected: 2 - 1000 ml plastic

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.)

1111 Water level at 23.60' below toc

RAD: Dose: 5 μR/hr

Background: 40 cpm

Sample: 44 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-9
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	_____ & _____	Date:	05-1-18
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 (38.11 ft) - Depth to Water (24.85 ft) = Height of water column (13.26 ft)

Height of water column (13.26 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.16 gal)

Purge Volume:

1 Well Volume (2.16 gallons) x 3 = 3 Well Volumes (6.48 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
1251	16.77	7.73	5.52	2.3	10.91	238	—	—	28.01'	—

PURGE INFORMATION:

Time / Date Started:	1535 | 4-18-18
Time Purge End:	1540
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:	1251 | 5-1-18
Sampled by:	D. Lawson & T. 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

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

TNL 11 Water level at 28.01' below TOC on 5-1-18

RAD: Dose: 5 μR/hr

Background: 38 cpm

Sample: 32 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-10
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
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 (41.53 ft) - Depth to Water (1.74 ft) = Height of water column (39.79 ft)

Height of water column (39.79 ft) x K value (0.163 gal/ft) = 1 Well Volume (6.49 gal)

Purge Volume:

1 Well Volume (6.49 gallons) x 3 = 3 Well Volumes (19.46 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
5-1-18 1301	16.97	7.03	0.394	29.6	9.82	317	—	—	2.56'	—

PURGE INFORMATION:

Time / Date Started: ~~4-18-18 11:53~~ MS 1550 | 4-18-18

Time Purge End: 1559

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: 1301 | 5-1-18

Sampled by: D. Lawson & T. 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

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

TNI TNI TNI TNI Water level at 2.56' below TOC on 5-1-18

Rad: Dose: 5 μR/h

Background: 46 cpm

Sample: 54 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-11
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. Lawson & M. Sherman	Date:	4-18-18
Sampled by:	D. Lawson & T. Farmer	Date:	05-01-18
Checked by:	&	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 (42.36 ft) - Depth to Water (7.01 ft) = Height of water column (35.29 ft)

Height of water column (35.29 ft) x K value (0.163 gal/ft) = 1 Well Volume (5.75 gal)

Purge Volume:

1 Well Volume (5.75 gallons) x 3 = 3 Well Volumes (17.26 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

5-1-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv.	Purged Quantity	Well Volume	Depth to Water	Purge Rate
1223	15.99	7.70	0.197	11.3	11.0	249	—	—	7.34'	—

PURGE INFORMATION:

Time / Date Started:	1516	|	4-18-18
Time Purge End:	1527		
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:	1223	|	05-01-18
Sampled by:	D. Lawson	&	T. 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		

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

Water level at 7.34' below TOC on 5-1-18

Rad: Dose: 5 µR/h

Background: 34 cpm

Sample: 38 cpm

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-001
SD-DU-001

DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 1349

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 36 cpm
Sample Rad : 28 cpm (SW)
" " : 31 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—	μR/hr		
TEMPERATURE:	18.99	°C		
pH:	8.53	pH		
CONDUCTIVITY:	0.185	mS/cm		
REDOX:	255	mV		
DO:	19.49	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	6.0	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-002
SD-DU-002

DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 1333

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 36 cpm
Sample Rad : 29 cpm (SW)
" " : 46 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—	μR/hr		
TEMPERATURE:	20.56	°C		
pH:	6.90	pH		
CONDUCTIVITY:	0.113	mS/cm		
REDOX:	255	mV		
DO:	15.53	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	45.5	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-003
SD-DU-003

DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 0908

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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 — 39 cpm
Sample Rad : ~~27~~ cpm (SW) MC 5-1-18
" " : 41 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—	μR/hr		
TEMPERATURE:	13.51	°C		
pH:	7.83	pH		
CONDUCTIVITY:	0.090	mS/cm		
REDOX:	277	mV		
DO:	7.66	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	16.0	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-004 SD-DU-004 DATE COLLECTED (MM/DD/YY): 05-01-18 TIME: 0935

SAMPLING LOCATION CODE: — DESCRIPTION: —

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 : 31 cpm (SW)
" " : 35 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	14.08	°C		
pH:	8.04	pH		
CONDUCTIVITY:	0.170	mS/cm		
REDOX:	278	mV		
DO:	23.59	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	4.4	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-005 (005) SD-DU-005 DATE COLLECTED (MM/DD/YY): 05-01-18 TIME: 1239

SAMPLING LOCATION CODE: — DESCRIPTION: —

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 : 32 cpm (SW)
" " : 46 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING MC 5-1-18	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	~~18.54~~	μR/hr		
TEMPERATURE: 18.54	~~8.42~~	°C		
pH:	8.42	pH		
CONDUCTIVITY:	0.174	mS/cm		
REDOX:	218	mV		
DO:	20.27	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	2.4	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-006
SD-DU-006
SW-DU-006-DUP

DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 0816

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 30 cpm
Sample Rad : 48 cpm (SW)
" " : 38 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	11.83	°C		
pH:	8.19	pH		
CONDUCTIVITY:	0.156	mS/cm		
REDOX:	227	mV		
DO:	11.14	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	5.9	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:

Surface water & sediment samples
Duplicate surface-water sample collected

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

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

DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 1444

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 36 cpm
Sample Rad : 42 cpm (SW)
" " : 46 cpm (Sed)
Dose: 4 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	4	μR/hr		
TEMPERATURE:	20.60	°C		
pH:	7.49	pH		
CONDUCTIVITY:	0.104	mS/cm		
REDOX:	322	mV		
DO:	10.41	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	27.8	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:

Surface water & sediment samples
Duplicate sediment sample collected

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area PROJECT NO: Spring '18 ERM

SAMPLE ID NUMBER: SW-DU-008 SD-DU-008 DATE COLLECTED (MM/DD/YY): 05-01-18 TIME: 1152

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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 : 34 cpm (SW)
" " : 42 cpm (Sed)
Dose : 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	20.25	°C		
pH:	8.57	pH		
CONDUCTIVITY:	0.166	mS/cm		
REDOX:	175	mV		
DO:	10.55	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	1.1	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG- DU Impact Area PROJECT NO: ERM Spring '18

SAMPLE ID NUMBER: SS-DU-001 DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 0855

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad: 33 cpm
Sample Rad: 52 cpm

Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—			
TEMPERATURE:	—			
pH:	—			
CONDUCTIVITY:	—			
REDOX:	—			
DO:	—			
ORGANIC VAPORS:	—			
TURBIDITY:	—			
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:

Soil Sample

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

SAMPLE LOG SHEET

PROJECT NAME: JPG- DU Impact Area PROJECT NO: ERM Spring '18

SAMPLE ID NUMBER: SS-DU-002 DATE COLLECTED (MM/DD/YY): 05-01-18
SS-DU-002-DUP TIME: 1316

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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: 52 cpm
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—			
TEMPERATURE:	—			
pH:	—			
CONDUCTIVITY:	—			
REDOX:	—			
DO:	—			
ORGANIC VAPORS:	—			
TURBIDITY:	—			
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:

Soil Sample / Duplicate collected

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

SAMPLE LOG SHEET

PROJECT NAME: JPG- DU Impact Area PROJECT NO: ERM Spring '18

SAMPLE ID NUMBER: SS-DU-003 DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 1023

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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: 39 cpm

Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—			
TEMPERATURE:	—			
pH:	—			
CONDUCTIVITY:	—			
REDOX:	—			
DO:	—			
ORGANIC VAPORS:	—			
TURBIDITY:	—			
OTHER _____:	—			

SAMPLE TYPE: [X] GRAB [ ] SPATIAL COMPOSITE [ ] TIME COMPOSITE
[ ] QC TRIP BLANK [ ] QC RINSATE [ ] QC FIELD BLANK
[ ] OTHER (SPECIFY) _____

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

Soil Sample

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

SAMPLE LOG SHEET

PROJECT NAME: JPG- DU Impact Area PROJECT NO: ERM Spring '18

SAMPLE ID NUMBER: SS-DU-004 DATE COLLECTED (MM/DD/YY): 05-01-18
TIME: 1407

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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: 43 cpm

Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	—			
TEMPERATURE:	—			
pH:	—			
CONDUCTIVITY:	—			
REDOX:	—			
DO:	—			
ORGANIC VAPORS:	—			
TURBIDITY:	—			
OTHER _____:	—			

SAMPLE TYPE: [X] GRAB [ ] SPATIAL COMPOSITE [ ] TIME COMPOSITE
[ ] QC TRIP BLANK [ ] QC RINSATE [ ] QC FIELD BLANK
[ ] OTHER (SPECIFY) _____

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

Soil Sample

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

Location Former JPG - Madison, IN Date 4-30-18

Project / Client Spring '18 ERM / USACE

Sunny, some clouds, 50s-70s

1148: Mark Caldwell (field book author) and Terry Farmer, both of XCEL Engineering, at Army / Big Oak HQ (Bldg 125). Spring '18 ERM sampling will be conducted this week. Details regarding water-level measurements, water-quality measurements, radiological measurements, etc. will be recorded on individual sample-log forms and not also recorded in this field book.

1206: Calibrating the Horiba (water-quality instrument). Model: U-52, MGS No.: AMFMS502, Date: Jan 2012

1237: Watching the Big Oaks safety video.

1314: Andy Bennett of URH & David Lawson of leidos at Bldg 125.

1345: At MW-08 collecting sample. Water level at 23.60' below top of casing (toc).

1413: At MW-04 collecting sample. Water level at 4.15' below TOC.

1438: Back at Bldg 125. Lawson is scanning equipment.

Mark Caldwell 4-30-18

Location Former JPG - Madison, IN Date 4-30-18

Project / Client Spring '18 ERM / USACE

1506: Water-level meter: Solinst Model 101, 238276.

1523: Conducting site-specific radiological training. Conducting general health & safety briefing.

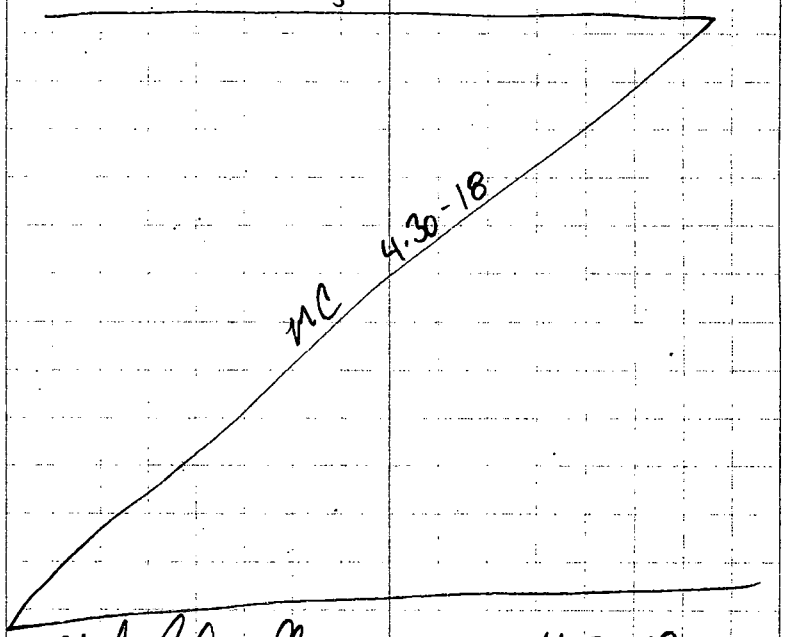
1548: Rad instruments used:

→ Micro R Model 19 Serial # 205706

→ 2221/44-9 Serial # 212129/197792

1602: Completed training successfully.

1634: Crew leaving site.



Mark Caldwell 4-30-18

Location [illegible], Madison, IN Date 5-1-18

Project / Client Spring '18 ERM / USACE

Sunny, upper 40s - 70s

0659: All crew members at Bldg 125. Preparing for sampling.

0741: Collecting sample at MW-03. Duplicate sample collected.

0816: Collecting SW-006, SW-006-DUP, & SD-006.

0846: Collecting sample at MW-002.

0855: Collecting sample at SS-001.

0908: Collecting samples SD-003 & SW-003.

0935: Collecting samples SD-004 & SW-004

0947: Collecting sample MW-001.

1023: Collecting sample SS-003.

1131: Breaking for lunch at D Road & Morgan Rd.

1152: Collecting SW-008 & SD-008

1207: Collecting MW-005

1223: Collecting sample MW-011.

1239: Collecting samples SW-005 & SD-005

1251: Collecting sample MW-009.

1301: Collecting sample MW-010.

1312: D. Lawson & A. Bennett are returning to Bldg 125. A. Bennett is not feeling well.

Mark Caldwell 5-1-18

Location Former JPG - Madison, IN Date 05-01-18

Project / Client Spring '18 ERM / USACE

1316: Sampling SS-002 & SS-002-DUP

1333: Sampling SW-002 & SD-002

1349: Sampling SW-001 & SD-001

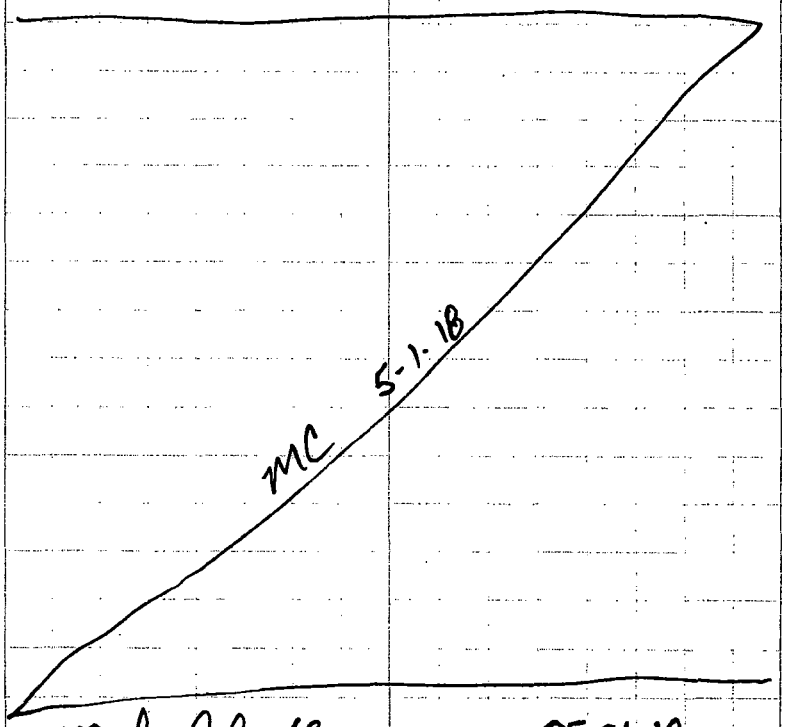
1407: Sampling SS-004.

1430: Sampling MW-006.

1444: Sampling SW-007, SD-007, & SD-007-DUP

1458: Sampling MW-007.

1522: Crew leaving Bldg 125.



Mark Caldwell 05-01-18

Location Former JPG - Madison, IN Date 05-02-18

Project / Client Spring '18 ERM / USACE

0721: Crew at Bldg. 126. Preparing samples and conducting rad survey of equipment, supplies, coolers, & vehicles.

0839: Scanning / Survey completed. Samples are packaged. Crew leaving site.

MC 5-2-18

Mark Caldwell 5-2-18

Location _____ Date _____

Project / Client _____

MC 5-2-18

13715 Rider Trail North
Earth City, MO 63045
Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record

THE LEADER IN ENVIRONMENTAL TESTING

Client Information	Sampler: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 1 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			
Email: mcaldwell@xceleng.com	WO #: —			Other:
Project Name:	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
MW-DU-001	5-1-18	0947	G	W	N	N	2		
002		0846							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
003		0741							
003-DUP		0741							
004	4-30-18	1413							
005	5-1-18	1207							
006		1430							
007		1458							
008	4-30-18	1345							
009	5-1-18	1251							
010		1301							

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	5-2-18 / 0822	XCEL			

Custody Seals Intact: Δ Yes Δ 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: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 2 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			
Email: mcaldwell@xceleng.com	WO #: —			Other:
Project Name:	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
MW-DU-011	5-1-18	1223	G	W	N	N	2		
SW-DU-001		1349							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
002		1333							
003		0908							
004		0935							
005		1239							
006		0816							
006-DUP		0816							
007		1444							
008		1152							
—	—	—	—	—	—	—	—		

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	5-2-18 / 0822				
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

13715 Rider Trail North
Earth City, MO 63045
Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record

THE LEADER IN ENVIRONMENTAL TESTING

Client Information	Sampler: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 3 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			
Email: mcaldwell@xceleng.com	WO #: —			Other:
Project Name:	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
SD-DU-001	5-1-18	1349	G	S	N	N	1		
002		1333							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
003		0908							
004		0935							
005		1239							
006		0816							
007		1444							
007-DUP		1444							
008		1152							
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	5-2-18 / 0822	XCEL			
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ 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: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 4 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			Other:
Email: mcaldwell@xceleng.com	WO #: —			
Project Name:	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=wastefoil, 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:
			Preservation Code:						
SS-DU-001	5-1-18	0855	G	S	N	N	1		
002		1316							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
002-DUP		1316							
003		1023							
004		1407							

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	5-2-18 / 0822	XCEL			
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

FALL 2018 FIELD LOGBOOK AND SAMPLING FORMS

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground		Well Identification:	MW-1	
Project Number:	ERM Sampling		Project Location:	Madison, IN	
Purged by:	D. LAWSON	& J. Bradford	Date:	10-15-18	
Sampled by:	D. Lawson	& T. Farmer	Date:	10-23-18	
Checked by:		&	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 (35.03 ft) - Depth to Water (10.45 ft) = Height of water column (24.58 ft)

Height of water column (24.58 ft) x K value (0.163 gal/ft) = 1 Well Volume (4.01 gal)

Purge Volume:

1 Well Volume (4.01 gallons) x 3 = 3 Well Volumes (12.02 gallons)

Purge Rate (_____gpm) x (_____min) = 1 Well Volume

Purge Rate (_____gpm) x (_____min) = 3 Well Volume

MC 10-23-18

Time	Temp °C	pH	Cond mS/cm	Turbidity NTU	D.O. mg/l	ORP mv	Purged Quantity	Well Volume	Depth to Water	Purge Rate
0947	13.65	7.81	0.646	2.5	8.67	234	—	~~11.26~~	11.26'	—

PURGE INFORMATION:

Time / Date Started: 1338 | 10-15-18

Time Purge End: 1346

Purge Method: Pump _____ Bailer X

Depth to Intake: NA (ft)

Pump Type and ID: NA

Purge Rate: NA (gpm)

Purged Volume: 13 (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: 0947 | 10-23-18

Sampled by: D. Lawson & T. 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

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

~~THL THL~~ III Water level at 11.26' below top of casing on 10-23-18

RAD: Dose: 6 μR/h

Background: 48 cpm

Sample: 27 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-2
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & T. Dadford	Date:	10/15/18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
Checked by:	&	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 (25.94 ft) - Depth to Water (10.40 ft) = Height of water column (15.54 ft)

Height of water column (15.54 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.53 gal)

Purge Volume:

1 Well Volume (2.53 gallons) x 3 = 3 Well Volumes (7.6 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
0913	11.05	8.15	0.548	15.2	8.95	241	—	—	10.0'	—

PURGE INFORMATION:

Time / Date Started: 1326 | 10/15/18

Time Purge End: 1330

Purge Method: Pump _____ Bailer X

Depth to Intake: NA (ft)

Pump Type and ID: NA

Purge Rate: NA (gpm)

Purged Volume: 8 (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: 0913 | 10-23-18

Sampled by: D. Lawson & T. 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

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

NAD 1983 Water level at 10.0' below top of casing on 10-23-18

RAD: Dose: 5 µR/h

Background: 61 cpm

Sample: 42 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground		Well Identification:	MW-3	
Project Number:	ERM Sampling		Project Location:	Madison, IN	
Purged by:	D. LAWSON	& T. Radford	Date:	10/15/18	
Sampled by:	D. Lawson	& T. Farmer	Date:	10/23/18	
Checked by:		&	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 (45.48 ft) - Depth to Water (7.38 ft) = Height of water column (38.1 ft)

Height of water column (38.1 ft) x K value (0.163 gal/ft) = 1 Well Volume (6.21 gal)

Purge Volume:

1 Well Volume (6.21 gallons) x 3 = 3 Well Volumes (18.63 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
0759	13.37	7.79	0.596	9.2	6.29	92	—	—	7.681	—

PURGE INFORMATION:

Time / Date Started:	1300	|	10/15/18
Time Purge End:	1315		
Purge Method: Pump		Bailer X	
Depth to Intake:	NA	(ft)	
Pump Type and ID:	NA		
Purge Rate:	NA	(gpm)	
Purged Volume:	19	(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:	0759	|	10-23-18
Sampled by:	D. Lawson	&	T. 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		

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

MW MW MW 1111 Water level at 7.68' below top of casing on 10-23-18

RAD: Dose: 5 µR/h

Background: 52cpm

Sample: 36cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-4
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & J. Bradford	Date:	10-15-18
Sampled by:	T. Farmer & M. Caldwell	Date:	10-22-18
Checked by:	_____ & _____	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 (31.27 ft) - Depth to Water (7.44 ft) = Height of water column (23.83 ft)

Height of water column (23.83 ft) x K value (0.163 gal/ft) = 1 Well Volume (3.88 gal)

Purge Volume:

1 Well Volume (3.88 gallons) x 3 = 3 Well Volumes (11.65 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
1428	16.05	7.66	0.647	25.2	12.96	248	—	—	7.46'	—

PURGE INFORMATION:

Time / Date Started: 1641 | 10-15-18

Time Purge End: 1650

Purge Method: Pump _____ Bailer X

Depth to Intake: NA (ft)

Pump Type and ID: NA

Purge Rate: NA (gpm)

Purged Volume: 12 (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: 1428 | 10-22-18

Sampled by: T. Farmer & M. Caldwell

Sample Method: Bailer X Other _____

Grab X Composite _____

# of Bottles Collected: 2 - 1,000 ml

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.)

HH HH II Water level @ 7.46' below top of casing on 10-22-18.

RAD: dose: 5 μR/h

Background: 54 cpm

Sample: 43 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-5
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & T. Bedford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
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 (35.85 ft) - Depth to Water (16.00 ft) = Height of water column (19.85 ft)

Height of water column (19.85 ft) x K value (0.163 gal/ft) = 1 Well Volume (3.24 gal)

Purge Volume:

1 Well Volume (3.24 gallons) x 3 = 3 Well Volumes (9.71 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
1314	14.56	8.10	1.36	1.4	13.69	249	—	—	16.07	—

PURGE INFORMATION:

Time / Date Started:	1434	|	10-15-18
Time Purge End:	1437		
Purge Method: Pump	_____	Bailer X	
Depth to Intake:	NA	(ft)	
Pump Type and ID:	NA		
Purge Rate:	NA	(gpm)	
Purged Volume:	10	(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:	1314	|	10-23-18
Sampled by:	D. Lawson	&	T. 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		

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

TNTC TNTC Water level at 16.07' below top of casing on 10-23-18

RAD: Dose: 5 μR/h

Background: 22 cpm

Sample: 41 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-6
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D LAWSON & J. Bradford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
Checked by:	_____ & _____	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 (42.78 ft) - Depth to Water (18.65 ft) = Height of water column (24.13 ft)
Height of water column (24.13 ft) x K value (0.163 gal/ft) = 1 Well Volume (3.93 gal)

Purge Volume:

1 Well Volume (3.93 gallons) x 3 = 3 Well Volumes (11.8 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
1431	14.75	8.00	0.686	56.0	30.70	188	—	—	32.38'	—

PURGE INFORMATION:

Time / Date Started: 1404 | 10-15-18
Time Purge End: 1415
Purge Method: Pump _____ Bailer X
Depth to Intake: NA (ft)
Pump Type and ID: NA
Purge Rate: NA (gpm)
Purged Volume: 12 (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: 1431 | 10-23-18
Sampled by: D. Lawson & T. 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

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

HH HH II Water level @ 32.38' below top of Casing on 10-23-18

RAD: Dose: 5 mR/h
Background: 42 cpm
Sample: 64 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-7
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & T. Bradford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
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 (56.41 ft) - Depth to Water (9.30 ft) = Height of water column (47.11 ft)

Height of water column (47.11 ft) x K value (0.163 gal/ft) = 1 Well Volume (7.68 gal)

Purge Volume:

1 Well Volume (7.68 gallons) x 3 = 3 Well Volumes (2304 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
1458	16.70	7.96	0.693	16.8	20.07	201	—	—	9.47'	—

PURGE INFORMATION:

Time / Date Started:	1610 | 10-15-18
Time Purge End:	1623
Purge Method: Pump	Bailer X
Depth to Intake:	NA (ft)
Pump Type and ID:	NA
Purge Rate:	NA (gpm)
Purged Volume:	24 (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:	1458 | 10-23-18
Sampled by:	D. Lawson & T. 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

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

~~HHT HHT HHT HHT~~ IIII Water level at 9.47' below top of casing on 10-23-18.

RAD: Dose: 5 µR/h

Background: 46 cpm

Sample: 70 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-8
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D LAWSON & T. Bradford	Date:	10-15-18
Sampled by:	T. Farmer & M. Caldwell	Date:	10-22-18
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 (23.65 ft) = Height of water column (6.86 ft)

Height of water column (6.86 ft) x K value (0.163 gal/ft) = 1 Well Volume (1.12 gal)

Purge Volume:

1 Well Volume (1.12 gallons) x 3 = 3 Well Volumes (3.35 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
1349	13.47	6.77	0.605	7.3	13.74	257	—	—	23.69'	-

MC 10-22-18

PURGE INFORMATION:

Time / Date Started:	1703	|	10-15-18
Time Purge End:	1708		
Purge Method: Pump		Bailer X	
Depth to Intake:	NA	(ft)	
Pump Type and ID:	NA		
Purge Rate:	NA	(gpm)	
Purged Volume:	4	(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:	~~1702~~ 1349	|	10-22-18
Sampled by:	T. Farmer	&	M. Caldwell
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		

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

1111 Water level @ 23.69' below top of casing.

RAD: dose 5 μR/h

Background: 54 cpm

Sample: 61 cpm

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GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-9
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & J. Bradford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
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 (38.11 ft) - Depth to Water (24.52 ft) = Height of water column (13.59 ft)

Height of water column (13.59 ft) x K value (0.163 gal/ft) = 1 Well Volume (2.22 gal)

Purge Volume:

1 Well Volume (2.22 gallons) x 3 = 3 Well Volumes (6.65 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
1222	13.14	7.46	0.87	10.3	20.75	260	—	—	30.34'	—

PURGE INFORMATION:

Time / Date Started:	1515	|	10-15-18
Time Purge End:	1523		
Purge Method: Pump		Bailer X	
Depth to Intake:	NA	(ft)	
Pump Type and ID:	NA		
Purge Rate:	NA	(gpm)	
Purged Volume:	7	(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:	1222	|	10-23-18
Sampled by:	D. Lawson	&	T. 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		

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

MH II Water level @ 30.34' below top of casing on 10.23-18

RAD: Dose: 7 µR/h

Background: 47 cpm

Sample: 44 cpm

leidos

GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-10
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & T. Bradford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
Checked by:	&	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 (41.53 ft) - Depth to Water (3.40 ft) = Height of water column (38.13 ft)

Height of water column (38.13 ft) x K value (0.163 gal/ft) = 1 Well Volume (6.22 gal)

Purge Volume:

1 Well Volume (6.22 gallons) x 3 = 3 Well Volumes (18.65 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
1206	15.53	8.16	0.664	14.5	8.87	234	—	—	3.88'	—

PURGE INFORMATION:

Time / Date Started:	1530	|	10-15-18
Time Purge End:	1544		
Purge Method: Pump		Bailer X	
Depth to Intake:	NA	(ft)	
Pump Type and ID:	NA		
Purge Rate:	NA	(gpm)	
Purged Volume:	19	(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:	1206	|	10-23-18
Sampled by:	D. Lawson	&	T. 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		

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

MH MH MH MH Water level at 3.88' below top of casing on 10-23-18

RAD: Dose: 6 μR/h

Sample: 64 cpm

Background: 51 cpm

leidos

GROUNDWATER SAMPLE LOG

Project Name:	Jefferson Proving Ground	Well Identification:	MW-11
Project Number:	ERM Sampling	Project Location:	Madison, IN
Purged by:	D. LAWSON & T. Bedford	Date:	10-15-18
Sampled by:	D. Lawson & T. Farmer	Date:	10-23-18
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 (42.30 ft) - Depth to Water (7.55 ft) = Height of water column (34.75 ft)

Height of water column (34.75 ft) x K value (0.163 gal/ft) = 1 Well Volume (5.66 gal)

Purge Volume:

1 Well Volume (5.66 gallons) x 3 = 3 Well Volumes (16.99 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
1252	14.33	8.34	0.503	9.9	12.58	252	—	—	14.95'	—

PURGE INFORMATION:

Time / Date Started:	1455 | 10-15-18
Time Purge End:	1506
Purge Method: Pump	Bailer X
Depth to Intake:	NA (ft)
Pump Type and ID:	NA
Purge Rate:	NA (gpm)
Purged Volume:	17 (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:	1252 | 10-23-18
Sampled by:	D. Lawson & T. 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

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

MH MH MH 11 Water level at 14.95' below top of casing on 10-23-18

RAD: Dose: 7 μR/h

Background: 53 cpm

Sample: 34 cpm

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-001
SD-DU-001
SD-DU-001-DUP

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1350

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 30 cpm
Sample Rad : 42 cpm (SW)
" " : 31 cpm (Sed)
Dose: 4 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	4	μR/hr		
TEMPERATURE:	11.25	°C		
pH:	8.71	pH		
CONDUCTIVITY:	0.368	mS/cm		
REDOX:	230	mV		
DO:	22.06	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	0.0	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:

Surface water & sediment samples
Duplicate sediment sample

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

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-002
SD-DU-002

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1336

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 39 cpm
Sample Rad : 50 cpm (SW)
" " : 46 cpm (Sed)
Dose: 4 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	4	μR/hr		
TEMPERATURE:	12.95	°C		
pH:	8.74	pH		
CONDUCTIVITY:	0.346	mS/cm		
REDOX:	216	mV		
DO:	21.18	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	0.9	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:

Surface water & sediment samples.

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-003
SD-DU-003

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 0934

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 43 cpm
Sample Rad : 46 cpm (SW)
" " : 66 cpm (Sed)
Dose : 5 qR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	qR/hr		
TEMPERATURE:	8.68	°C		
pH:	8.05	pH		
CONDUCTIVITY:	0.216	mS/cm		
REDOX:	253	mV		
DO:	35.96	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	12.0	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:

Surface water and sediment samples.

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

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU - Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-004
SD-DU-004

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1006

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 48 cpm
Sample Rad : 50 cpm (SW)
" " : 31 cpm (Sed)
Dose : 6 µR/hr mc
10-23-18

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	6	µR/hr		
TEMPERATURE:	8.79	°C		
pH:	8.41	pH		
CONDUCTIVITY:	0.330	mS/cm		
REDOX:	227	mV		
DO:	12.12	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	3.9	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:
Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-005
SD-DU-005

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1239

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 47 cpm
Sample Rad : 55 cpm (SW)
" " : 59 cpm (Sed)
Dose : 7 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	7	μR/hr		
TEMPERATURE:	11.09	°C		
pH:	8.67	pH		
CONDUCTIVITY:	0.409	mS/cm		
REDOX:	228	mV		
DO:	14.42	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	0.6	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:

Surface water & sediment samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-006
SD-DU-006

DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 0841

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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 : 69 cpm (SW)
" " : 76 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	6.79	°C		
pH:	8.55	pH		
CONDUCTIVITY:	0.314	mS/cm		
REDOX:	218	mV		
DO:	11.59	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	3.3	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:

Sediment & surface-water samples

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG-DU Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SW-DU-007 DATE COLLECTED (MM/DD/YY): 10-23-18
SW-DU-007-DUP TIME: 1443
SD-DU-007
SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 46 cpm
Sample Rad : 53 cpm (SW)
" " : 37 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	14.33	°C		
pH:	8.68	pH		
CONDUCTIVITY:	0.317	mS/cm		
REDOX:	166	mV		
DO:	33.73	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	1.0	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:

Surface water and sediment samples.
Duplicate surface-water sample.

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

SAMPLE LOG SHEET

PROJECT NAME: JPG - DU Impact Area **PROJECT NO:** Fall '10 ERM

SAMPLE ID NUMBER: SW-DU-008
SD-DU-008

DATE COLLECTED (MM/DD/YY): 10-23-10
TIME: 1304

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 22 cpm
Sample Rad : 37 cpm (SW)
" " : 41 cpm (Sed)
Dose: 5 μR/hr

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	12.64	°C		
pH:	8.61	pH		
CONDUCTIVITY:	0.325	mS/cm		
REDOX:	241	mV		
DO:	12.01	mg/l		
ORGANIC VAPORS:	—	—		
TURBIDITY:	0.0	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:

Surface water & Sediment samples.

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG-DU-Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SS-DU-001 DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 0919

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 78 cpm
Sample Rad : 56 cpm ~~(SW)~~ Soil
" " : ~~cpm (Sed)~~ MC
Dose: 6 μR/hr 10-23-18

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	6	μR/hr		
TEMPERATURE:	—	°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:

Soil sample

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

SAMPLE LOG SHEET

PROJECT NAME: JPG-DU-Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SS-DU-002 DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1150

SAMPLING LOCATION CODE: —
DESCRIPTION: —

SAMPLING POINT CODE: —
DESCRIPTION —

NORTHING: — EASTING: — ELEVATION: —

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

WEATHER: — ACTIVITIES IN AREA: —
FIELD OBSERVATIONS:

Background Rad : 30 cpm
Sample Rad : 56 cpm ~~(SW)~~ Soil
" " : cpm ~~(Sed)~~ mc
Dose: 6 μR/hr 10-23-18

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	6	μR/hr		
TEMPERATURE:	—	°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:

Soil sample

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

SAMPLE LOG SHEET

PROJECT NAME: JPG-DU-Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SS-DU-003 DATE COLLECTED (MM/DD/YY): 10-23-18
SS-DU-003-DUP TIME: 1052

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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 : 77 cpm ~~(Soil)~~ Soil
~~"~~ : ~~cpm (Soil)~~ mc
Dose: 5 qR/hr 10-23-18

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	qR/hr		
TEMPERATURE:	—	°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:

Soil sample
Duplicate sample collected

Recorded By: Mark Caldwell (Signature) QC Checked By: ____ (Signature)

SAMPLE LOG SHEET

PROJECT NAME: JPG-DU-Impact Area **PROJECT NO:** Fall '18 ERM

SAMPLE ID NUMBER: SS-DU-004 DATE COLLECTED (MM/DD/YY): 10-23-18
TIME: 1419

SAMPLING LOCATION CODE: —
DESCRIPTION: —

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 : 37 cpm ~~(SW)~~ Soil
" " : ~~cpm (Sed)~~ mc
Dose: 5 μR/hr 10-23-18

FIELD MEASUREMENTS	READING	UNITS	SERIAL NO.	LAST CALIB.
RADIOACTIVITY:	5	μR/hr		
TEMPERATURE:	—	°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:

Soil sample

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

Location Former JPG - Madison, IN Date 10-22-18

Project / Client Fall '18 ERM / USACE

Sunny, 50's

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 Fall '18 ERM this week. Details of water-level measurements, water-quality measurements, etc. will be recorded on individual sample log forms and not recorded in this log book.

1244: Calibrating the Horiba, Model: U-52, MGS No.: AMFMS502, Date: Jan 2012

1349: Collecting sample at MW-08. Water level @ 23.69' below top of casing

1428: Collecting sample and duplicate sample at MW-04.

1451: Back at Bldg 125. Collecting rad readings of samples.

1539: Leaving site for day.

MC 10-22-18

M Caldwell 10-22-18

Location Former JPG - Madison, IN Date 10-23-18

Project / Client Fall '18 ERM / USACE

Projected sunny / partly cloudy 30's-60's

0701: Mark Caldwell & Terry Farmer at Bldg 125. David Lawson here. Calibrating Horiba. Rad instruments used: Micro R Model 19 Serial # 209723 Model ~~221~~ 3 / 44-9 Serial # 212044 / 214839

MC 10-23-18

0725: Andy Bennett of URH at Bldg 125. Conducting safety briefing.

0759: Sampling at MW-3.

0841: Sampling at SW-006 / SD-006

0913: Sampling at MW-002

0919: Sampling at SS-001

0934: Sampling at SW-003 / SD-003

0947: Sampling at MW-001.

1006: Sampling at SW-004 / SD-004

1052: Sampling at SS-003. Duplicate collected.

1150: Sampling at SS-002.

1206: Sampling at MW-010.

1222: Sampling at MW-009.

1239: Sampling at SW-005 / SD-005

1252: Sampling at MW-011.

1304: Sampling at SW-008 / SD-008

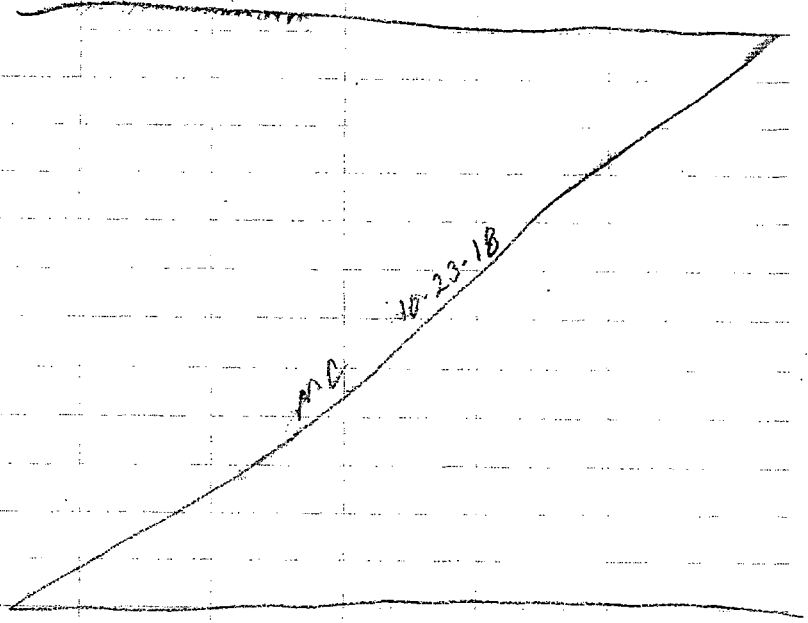
1314: Sampling at MW-005

Mark Caldwell 10-23-18

Location Former JPG - Madison, IN Date 10-23-18

Project / Client Fall '18 ERM / USACE

1336: Sampling at SW-002 / SD-002.
1350: Sampling at SW-001 / SD-001. Collecting duplicate sediment sample.
1419: Sampling at SS-004.
1431: Sampling at MW-006.
1443: Sampling at SW-007 / SD-007. Collecting a duplicate surface-water sample.
1458: Sampling at MW-007.
1512: At Bldg 125.
1549: Leaving site for day.

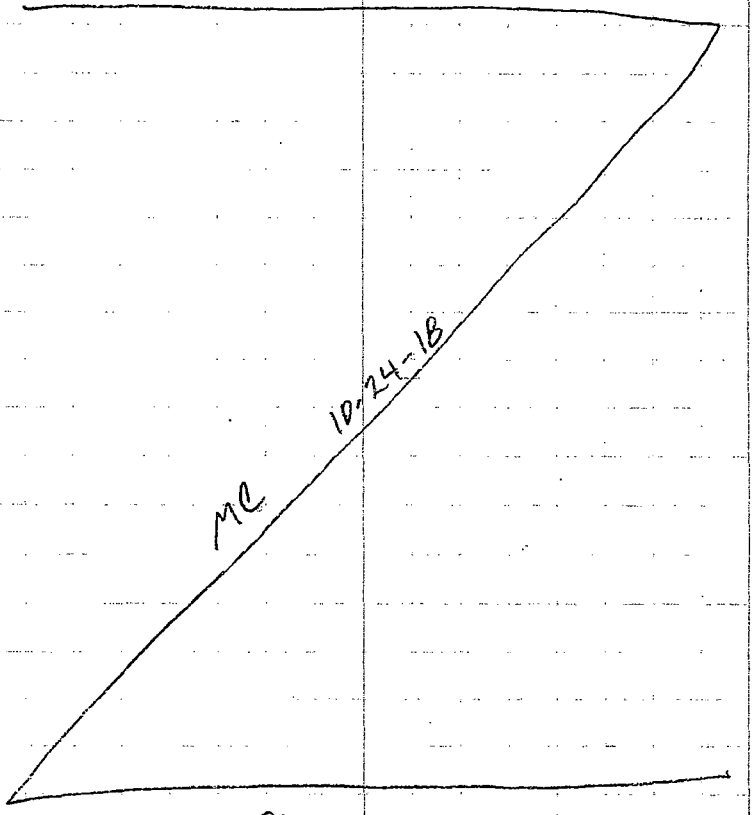


Mark Caldwell 10-23-18

Location Former JPG - Madison, IN Date 10-24-18

Project / Client Fall '18 ERM / USACE

0652: Mark Caldwell and Terry Farmer are at Bldg 125. David Lawson already here. Scanning equip
0823: Bottles packed with COC. All equipment scanned. All parties are leaving site.



Mark Caldwell 10-24-18

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: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 1 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			Other:
Email: mcaldwell@xceleng.com	WO #: —			
Project Name: Fall '18 ERM	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
MW-DU-001	10-23-18	0947	G	W	N	N	2	2	
002	↓	0913							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
003	↓	0759							
004	10-22-18	1428							
004-DUP	10-22-18	1428							
005	10-23-18	1314							
006	↓	1431							
007	↓	1458							
008	10-22-18	1349							
009	10-23-18	1222							
010	↓	1206	↓	↓	↓	↓	↓	↓	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	10-24-18 / 0811	XCEL			
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

13715 Rider Trail North
Earth City, MO 63045
Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record

THE LEADER IN ENVIRONMENTAL TESTING

Client Information	Sampler: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 2 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			Other:
Email: mcaldwell@xceleng.com	WO #: —			
Project Name: Fall '18 ERM	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
		Preservation Code:							
MW-DU-011	10-23-18	1252	G	W	N	N	2	2	
SW-DU-001		1350							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
002		1336							
003		0934							
004		1006							
005		1239							
006		0841							
007		1443							
007-DUP		1443							
008		1304							
—	—	—	—	—	—	—	—	—	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	10-24-18 / 0811	XCEL			
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ 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: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —	—	Page: 3 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			Preservation Codes:
City: Oak Ridge	TAT Requested (days): Standard			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)
State, Zip: TN, 37830				
Phone: 865.766.8547	PO #: —			Other:
Email: mcaldwell@xceleng.com	WO #: —			
Project Name: Fall '18 ERM	Project #: —			
Site: JPG - DU Impact Area	SSOW#: —			

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
SD-DU-001	10-23-18	1350	G	S	N	N	1	—	
001-DUP		1350							All samples are consolidated into three (3) coolers. One (1) COC for all samples.
002		1336							
003		0934							
004		1006							
005		1239							
006		0841							
007		1443							
008		1304							
—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	10-24-18 / 0811	XCEL			
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

13715 Rider Trail North
Earth City, MO 63045
Phone (314) 298-8566 Fax (314) 298-8757

Chain of Custody Record

Client Information	Sampler: Farmer / Caldwell	Lab PM: Ivan Vania	Carrier Tracking No(s): —	COC No: —
Client Contact: Mr. Mark Caldwell	Phone: 865.481.3200	E-Mail: —		Page: 4 of 4
Company: XCEL Engineering Inc.		Analysis Requested		Job #: —
Address: 1066 Commerce Park Drive	Due Date Requested: —			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)
City: Oak Ridge	TAT Requested (days): Standard			
State, Zip: TN, 37830	PO #: —			
Phone: 865.766.8547	WO #: —			Other:
Email: mcaldwell@xceleng.com	Project #: —			
Project Name: Fall '18 ERM	SSOW#: —			
Site: JPG - DU Impact Area				

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 / Isotopic Uranium	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
SS-DU-001	10-23-18	0919	G	S	N	N	1	1	All samples are consolidated into three (3) coolers. One (1) COC for all samples.
002	↓	1150	↓	↓	↓	↓	↓	1	
003		1052						1	
003-DUP		1052						1	
004	↓	1419	↓	↓	↓	↓	↓	1	
								—	
								—	
								—	
								—	
								—	
								—	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements: —

Empty Kit Relinquished by: —	Date: —	Time: —	Method of Shipment: USP

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Mark Caldwell	10-24-18 / 0811				
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

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APPENDIX C

DATA VALIDATION SUMMARY

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SPRING 2018 DATA VALIDATION

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C. DATA VALIDATION SUMMARY

C.1 TESTAMERICA SDG 160-28187

This report contains the results from the data validation technical review for the Jefferson Proving Ground (JPG) Environmental Radiation Monitoring (ERM) April 2018 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* (CLP) *National Functional Guidelines for Inorganic Data Review* (July 2002) and Leidos Quality Assurance Technical Procedure (QATP) Environmental Science and Engineering (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	35
Total Number of Data Points*	140
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100%

*Includes 140 alpha spectrometry 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 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.
   - ***Method Blank Uncertainty***—U-234 results were qualified as estimated, *J*, with reason code 6 where the sediment sample result is less than 10 times the concentration found in the associated method blank.
   - ***Sample Duplicate RPD Precision***—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	
Laboratory: **Test America Laboratories, Inc.**	*SDG #s:* **160-28187-1**

Client I.D.	Sample I.D.*	Laboratory Sample I.D.	Date Collected	Analyses Performed
MW-DU-001	LDOS29E	160-28187-01	4/29/2018	Total and Isotopic Uranium
MW-DU-002	LDOS29E	160-28187-02	4/29/2018	Total and Isotopic Uranium
MW-DU-003	LDOS29E	160-28187-03	4/29/2018	Total and Isotopic Uranium
MW-DU-003	LDOS29DE	160-28187-04	4/29/2018	Total and Isotopic Uranium
MW-DU-004	LDOS29E	160-28187-05	4/28/2018	Total and Isotopic Uranium
MW-DU-005	LDOS29E	160-28187-06	4/29/2018	Total and Isotopic Uranium
MW-DU-006	LDOS29E	160-28187-07	4/29/2018	Total and Isotopic Uranium
MW-DU-007	LDOS29E	160-28187-08	4/29/2018	Total and Isotopic Uranium
MW-DU-008	LDOS29E	160-28187-09	4/28/2018	Total and Isotopic Uranium
MW-DU-009	LDOS29E	160-28187-10	4/29/2018	Total and Isotopic Uranium
MW-DU-010	LDOS29E	160-28187-11	4/29/2018	Total and Isotopic Uranium
MW-DU-011	LDOS29E	160-28187-12	4/29/2018	Total and Isotopic Uranium
SD-DU-001	LDOS29E	160-28187-22	4/29/2018	Total and Isotopic Uranium
SD-DU-002	LDOS29E	160-28187-23	4/29/2018	Total and Isotopic Uranium
SD-DU-003	LDOS29E	160-28187-24	4/29/2018	Total and Isotopic Uranium
SD-DU-004	LDOS29E	160-28187-25	4/29/2018	Total and Isotopic Uranium
SD-DU-005	LDOS29E	160-28187-26	4/29/2018	Total and Isotopic Uranium
SD-DU-006	LDOS29E	160-28187-27	4/29/2018	Total and Isotopic Uranium
SD-DU-007	LDOS29E	160-28187-28	4/29/2018	Total and Isotopic Uranium
SD-DU-007	LDOS29DE	160-28187-29	4/29/2018	Total and Isotopic Uranium
SD-DU-008	LDOS29E	160-28187-30	4/29/2018	Total and Isotopic Uranium
SW-DU-001	LDOS29E	160-28187-13	4/29/2018	Total and Isotopic Uranium
SW-DU-002	LDOS29E	160-28187-14	4/29/2018	Total and Isotopic Uranium
SW-DU-003	LDOS26E	160-28187-15	4/29/2018	Total and Isotopic Uranium
SW-DU-004	LDOS29E	160-28187-16	4/29/2018	Total and Isotopic Uranium
SW-DU-005	LDOS29E	160-28187-17	4/29/2018	Total and Isotopic Uranium
SW-DU-006	LDOS28E	160-28187-18	4/29/2018	Total and Isotopic Uranium
SW-DU-006	LDOS28DE	160-28187-19	4/29/2018	Total and Isotopic Uranium
SW-DU-007	LDOS29E	160-28187-20	4/29/2018	Total and Isotopic Uranium
SW-DU-008	LDOS29E	160-28187-21	4/29/2018	Total and Isotopic Uranium
SS-DU-001	LDOS29E	160-28187-31	4/29/2018	Total and Isotopic Uranium
SS-DU-002	LDOS29E	160-28187-32	4/29/2018	Total and Isotopic Uranium
SS-DU-002	LDOS29DE	160-28187-33	4/29/2018	Total and Isotopic Uranium
SS-DU-003	LDOS29E	160-28187-34	4/29/2018	Total and Isotopic Uranium
SS-DU-004	LDOS29E	160-28187-35	4/29/2018	Total and Isotopic Uranium

* The Leidos sample I.D. (LDOS29E) 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	Error	MDC	Final Qual	Reason Code
MW-DU-001	LDOS29E	DOE A-01-R MOD	Total Uranium	0.65	0.144	0		
MW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 234	0.176	0.0894	0.0588	J	37
MW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0397	0.046	0.0397	J	37
MW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 238	0.212	0.0967	0.0319		
MW-DU-002	LDOS29E	DOE A-01-R MOD	Total Uranium	1.15	0.182	0		
MW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 234	0.648	0.163	0.059		
MW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0223	0.0317	0.0335	U	
MW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 238	0.382	0.122	0.0495		
MW-DU-003	LDOS29DE	DOE A-01-R MOD	Total Uranium	1.29	0.207	0		
MW-DU-003	LDOS29DE	DOE A-01-R MOD	Uranium 234	1.09	0.232	0.0572		
MW-DU-003	LDOS29DE	DOE A-01-R MOD	Uranium 235	0.0515	0.0517	0.0386	J	37
MW-DU-003	LDOS29DE	DOE A-01-R MOD	Uranium 238	0.425	0.139	0.0679		
MW-DU-003	LDOS29E	DOE A-01-R MOD	Total Uranium	1.05	0.187	0		
MW-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 234	0.834	0.201	0.0587		
MW-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0418	0.0552	0.0868	U	
MW-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 238	0.345	0.125	0.0585		
MW-DU-004	LDOS29E	DOE A-01-R MOD	Total Uranium	0.855	0.162	0		
MW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 234	0.779	0.188	0.0833		
MW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 235	0.045	0.0565	0.0884	U	
MW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 238	0.28	0.109	0.0632		
MW-DU-005	LDOS29E	DOE A-01-R MOD	Total Uranium	0.696	0.143	0		
MW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 234	0.674	0.172	0.0632		
MW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0239	0.0339	0.0359	U	
MW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 238	0.23	0.0959	0.0288		
MW-DU-006	LDOS29E	DOE A-01-R MOD	Total Uranium	4.42	0.324	0		
MW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 234	1.92	0.261	0.0773		
MW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0243	0.0415	0.0738	U	
MW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 238	1.48	0.218	0.0466		
MW-DU-007	LDOS29E	DOE A-01-R MOD	Total Uranium	2.63	0.317	0		
MW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 234	1.38	0.279	0.0918		
MW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0851	0.0698	0.0425	J	37
MW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 238	0.871	0.213	0.0629	J	19
MW-DU-008	LDOS29E	DOE A-01-R MOD	Total Uranium	0.606	0.102	0		
MW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 234	0.739	0.142	0.0471		
MW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0613	0.0441	0.0473	J	37
MW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 238	0.194	0.0679	0.0379		
MW-DU-009	LDOS29E	DOE A-01-R MOD	Total Uranium	0.499	0.0913	0		
MW-DU-009	LDOS29E	DOE A-01-R MOD	Uranium 234	0.708	0.133	0.0347		
MW-DU-009	LDOS29E	DOE A-01-R MOD	Uranium 235	0.055	0.0369	0.0183	J	37
MW-DU-009	LDOS29E	DOE A-01-R MOD	Uranium 238	0.159	0.0611	0.0492		
MW-DU-010	LDOS29E	DOE A-01-R MOD	Total Uranium	2.29	0.276	0		
MW-DU-010	LDOS29E	DOE A-01-R MOD	Uranium 234	1.73	0.3	0.0553		
MW-DU-010	LDOS29E	DOE A-01-R MOD	Uranium 235	0.107	0.0759	0.0688	J	37
MW-DU-010	LDOS29E	DOE A-01-R MOD	Uranium 238	0.754	0.185	0.0551		
MW-DU-011	LDOS29E	DOE A-01-R MOD	Total Uranium	0.561	0.133	0		
MW-DU-011	LDOS29E	DOE A-01-R MOD	Uranium 234	0.453	0.145	0.0588		
MW-DU-011	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0529	0.0531	0.0397	J	37
MW-DU-011	LDOS29E	DOE A-01-R MOD	Uranium 238	0.18	0.0888	0.0318		
SW-DU-001	LDOS29E	DOE A-01-R MOD	Total Uranium	0.62	0.133	0		
SW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 234	1.69	0.295	0.0721		
SW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0851	0.0647	0.0365	J	37

Water Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
SW-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 238	0.195	0.0888	0.0293		
SW-DU-002	LDOS29E	DOE A-01-R MOD	Total Uranium	0.992	0.181	0		
SW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 234	0.843	0.202	0.0585		
SW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0659	0.0592	0.0395	J	37
SW-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 238	0.323	0.121	0.0584		
SW-DU-003	LDOS26E	DOE A-01-R MOD	Total Uranium	0.0829	0.0536	0		
SW-DU-003	LDOS26E	DOE A-01-R MOD	Uranium 234	0.283	0.111	0.0661	J	37
SW-DU-003	LDOS26E	DOE A-01-R MOD	Uranium 235	0.0125	0.025	0.0375	U	
SW-DU-003	LDOS26E	DOE A-01-R MOD	Uranium 238	0.0259	0.0358	0.0554	U	
SW-DU-004	LDOS29E	DOE A-01-R MOD	Total Uranium	0.545	0.127	0		
SW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 234	0.368	0.125	0.0635		
SW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 235	0	0.01	0.036	U	
SW-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 238	0.183	0.0854	0.0289		
SW-DU-005	LDOS29E	DOE A-01-R MOD	Total Uranium	0.754	0.154	0		
SW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 234	0.363	0.128	0.0679		
SW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0386	0.0447	0.0386	J	37
SW-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 238	0.248	0.103	0.0309		
SW-DU-006	LDOS28DE	DOE A-01-R MOD	Total Uranium	0.269	0.068	0		
SW-DU-006	LDOS28DE	DOE A-01-R MOD	Uranium 234	0.236	0.0806	0.0694		
SW-DU-006	LDOS28DE	DOE A-01-R MOD	Uranium 235	0.0267	0.0268	0.02	J	37
SW-DU-006	LDOS28DE	DOE A-01-R MOD	Uranium 238	0.0864	0.0455	0.0378	J	37
SW-DU-006	LDOS28E	DOE A-01-R MOD	Total Uranium	0.308	0.0929	0		
SW-DU-006	LDOS28E	DOE A-01-R MOD	Uranium 234	0.263	0.103	0.0613		
SW-DU-006	LDOS28E	DOE A-01-R MOD	Uranium 235	0.00677	0.0252	0.0641	U	
SW-DU-006	LDOS28E	DOE A-01-R MOD	Uranium 238	0.102	0.0623	0.0279	J	37
SW-DU-007	LDOS29E	DOE A-01-R MOD	Total Uranium	0.375	0.0809	0		
SW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 234	0.261	0.0775	0.0437		
SW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 235	-0.00207	0.0299	0.0692	U	
SW-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 238	0.126	0.0542	0.0436		
SW-DU-008	LDOS29E	DOE A-01-R MOD	Total Uranium	1.25	0.212	0		
SW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 234	0.67	0.182	0.0801		
SW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 235	0	0.0113	0.0405	U	
SW-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 238	0.42	0.142	0.0799		

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

Soil/Sediment Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
SD-DU-001	LDOS29E	DOE A-01-R MOD	Total Uranium	0.886	0.118	0		
SD-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 234	0.305	0.0815	0.0317	J	6
SD-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0395	0.0323	0.0332	J	37
SD-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 238	0.291	0.0791	0.0266		
SD-DU-002	LDOS29E	DOE A-01-R MOD	Total Uranium	0.956	0.118	0		
SD-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 234	0.216	0.0676	0.0526	J	6
SD-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 235	-0.014	0.0274	0.0689	U	
SD-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 238	0.323	0.0795	0.0311		
SD-DU-003	LDOS29E	DOE A-01-R MOD	Total Uranium	2.14	0.198	0		
SD-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 234	0.617	0.122	0.0272		
SD-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0183	0.0212	0.0183	J	37
SD-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 238	0.717	0.133	0.0322		
SD-DU-004	LDOS29E	DOE A-01-R MOD	Total Uranium	0.504	0.0863	0		
SD-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 234	0.244	0.07	0.0251	J	6
SD-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0033	0.0123	0.0313	U	
SD-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 238	0.169	0.058	0.0299		
SD-DU-005	LDOS29E	DOE A-01-R MOD	Total Uranium	1.19	0.141	0		
SD-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 234	0.207	0.0668	0.0275	J	6
SD-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0124	0.0175	0.0185	U	
SD-DU-005	LDOS29E	DOE A-01-R MOD	Uranium 238	0.397	0.0947	0.0149		
SD-DU-006	LDOS29E	DOE A-01-R MOD	Total Uranium	1.28	0.144	0		
SD-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 234	0.422	0.0967	0.0263		
SD-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0356	0.0292	0.0178	J	37
SD-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 238	0.423	0.0965	0.0143		
SD-DU-007	LDOS29DE	DOE A-01-R MOD	Total Uranium	1.14	0.134	0		
SD-DU-007	LDOS29DE	DOE A-01-R MOD	Uranium 234	0.393	0.0924	0.0342		
SD-DU-007	LDOS29DE	DOE A-01-R MOD	Uranium 235	0.0125	0.0212	0.038	U	
SD-DU-007	LDOS29DE	DOE A-01-R MOD	Uranium 238	0.38	0.0897	0.0139		
SD-DU-007	LDOS29E	DOE A-01-R MOD	Total Uranium	0.975	0.124	0		
SD-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 234	0.404	0.0946	0.0264		
SD-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0332	0.0297	0.0329	J	37
SD-DU-007	LDOS29E	DOE A-01-R MOD	Uranium 238	0.323	0.0833	0.0264		
SD-DU-008	LDOS29E	DOE A-01-R MOD	Total Uranium	0.462	0.0838	0		
SD-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 234	0.126	0.0507	0.0263	J	6
SD-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0177	0.0205	0.0177	J	37
SD-DU-008	LDOS29E	DOE A-01-R MOD	Uranium 238	0.153	0.0562	0.0312		
SS-DU-001	LDOS29E	DOE A-01-R MOD	Total Uranium	2.69	0.229	0		
SS-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 234	0.731	0.136	0.0431		
SS-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0356	0.0341	0.0457	U	
SS-DU-001	LDOS29E	DOE A-01-R MOD	Uranium 238	0.9	0.154	0.0326		
SS-DU-002	LDOS29DE	DOE A-01-R MOD	Total Uranium	2.7	0.224	0		
SS-DU-002	LDOS29DE	DOE A-01-R MOD	Uranium 234	0.785	0.139	0.0309		
SS-DU-002	LDOS29DE	DOE A-01-R MOD	Uranium 235	0.0234	0.0235	0.0175	J	37
SS-DU-002	LDOS29DE	DOE A-01-R MOD	Uranium 238	0.904	0.151	0.0141		
SS-DU-002	LDOS29E	DOE A-01-R MOD	Total Uranium	2.54	0.213	0		
SS-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 234	0.827	0.141	0.03		
SS-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0397	0.0302	0.017	J	37
SS-DU-002	LDOS29E	DOE A-01-R MOD	Uranium 238	0.847	0.143	0.0137		
SS-DU-003	LDOS29E	DOE A-01-R MOD	Total Uranium	1.58	0.163	0		
SS-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 234	0.572	0.116	0.0315		

Soil/Sediment Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
SS-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0418	0.0318	0.0179	J	37
SS-DU-003	LDOS29E	DOE A-01-R MOD	Uranium 238	0.525	0.11	0.0265		
SS-DU-004	LDOS29E	DOE A-01-R MOD	Total Uranium	1.44	0.155	0		
SS-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 234	0.491	0.106	0.0265		
SS-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 235	0.0308	0.0301	0.0392	U	
SS-DU-004	LDOS29E	DOE A-01-R MOD	Uranium 238	0.48	0.104	0.0264		

Data Validation Reason Code

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

FALL 2018 DATA VALIDATION

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C. DATA VALIDATION SUMMARY

C.1 TESTAMERICA SDG 160-31536

This report contains the results from the data validation technical review for the Jefferson Proving Ground (JPG) Environmental Radiation Monitoring (ERM) October 2018 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* (CLP) *National Functional Guidelines for Inorganic Data Review* (July 2002) and Leidos Quality Assurance Technical Procedure (QATP) Environmental Science and Engineering (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	35
Total Number of Data Points*	144
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100%

*Includes 140 alpha spectrometry results and 4 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 160-31536-1. Total uranium was calculated using a published specific activity value for U-238 and assuming all the mass originates from U-238.
- Uranium-233 (U-233), U-234, U-235, uranium-236 (U-236), and U-238 were reanalyzed on one surface water sample by inductively coupled plasma-mass spectrometry (ICP-MS) (SW846 6020A) per client request with SDG 160-31536-2. All results were reported.
- All total/isotopic uranium samples were analyzed by DOE A-01-R-MOD with SDG 160-31536-1.
- One surface water sample was reanalyzed for total uranium by Method SW846 6020A with SDG 160-31536-2. 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
- ICP/MS QC
  - Initial and continuing calibration verification
  - Reporting limit check standard
  - Preparation blanks
  - Initial and continuing calibration blanks
  - Laboratory control samples
  - Interference check standard
  - 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.

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

SAMPLE INDEX	
Laboratory: **Test America Laboratories, Inc.**	*SDG #s:* **160-531536-1, 160-531536-2**

Client I.D.	Sample I.D.*	Laboratory Sample I.D.	Date Collected	Analyses Performed
MW-DU-001	LDOS30E	160-531536-01	10/23/2018	Total and Isotopic Uranium
MW-DU-002	LDOS30E	160-531536-02	10/23/2018	Total and Isotopic Uranium
MW-DU-003	LDOS30E	160-531536-03	10/23/2018	Total and Isotopic Uranium
MW-DU-004	LDOS30E	160-531536-04	10/23/2018	Total and Isotopic Uranium
MW-DU-004	LDOS30DE	160-531536-05	10/23/2018	Total and Isotopic Uranium
MW-DU-005	LDOS30E	160-531536-06	10/23/2018	Total and Isotopic Uranium
MW-DU-006	LDOS30E	160-531536-07	10/23/2018	Total and Isotopic Uranium
MW-DU-007	LDOS30E	160-531536-08	10/23/2018	Total and Isotopic Uranium
MW-DU-008	LDOS30E	160-531536-09	10/23/2018	Total and Isotopic Uranium
MW-DU-009	LDOS30E	160-531536-10	10/23/2018	Total and Isotopic Uranium
MW-DU-010	LDOS30E	160-531536-11	10/23/2018	Total and Isotopic Uranium
MW-DU-011	LDOS30E	160-531536-12	10/23/2018	Total and Isotopic Uranium
SW-DU-001	LDOS30E	160-531536-13	10/23/2018	Total and Isotopic Uranium
SW-DU-002	LDOS30E	160-531536-14	10/23/2018	Total and Isotopic Uranium
SW-DU-003	LDOS27E	160-531536-15	10/23/2018	Total and Isotopic Uranium
SW-DU-004	LDOS30E	160-531536-16	10/23/2018	Total and Isotopic Uranium
SW-DU-005	LDOS30E	160-531536-17	10/23/2018	Total and Isotopic Uranium
SW-DU-006	LDOS29E	160-531536-18	10/23/2018	Total and Isotopic Uranium
SW-DU-007	LDOS30E	160-531536-19	10/23/2018	Total and Isotopic Uranium
SW-DU-007	LDOS30DE	160-531536-20	10/23/2018	Total and Isotopic Uranium
SW-DU-008	LDOS30E	160-531536-21	10/23/2018	Total and Isotopic Uranium
SD-DU-001	LDOS30E	160-531536-22	10/23/2018	Total and Isotopic Uranium
SD-DU-001	LDOS30DE	160-531536-23	10/23/2018	Total and Isotopic Uranium
SD-DU-002	LDOS30E	160-531536-24	10/23/2018	Total and Isotopic Uranium
SD-DU-003	LDOS30E	160-531536-25	10/23/2018	Total and Isotopic Uranium
SD-DU-004	LDOS30E	160-531536-26	10/23/2018	Total and Isotopic Uranium
SD-DU-005	LDOS30E	160-531536-27	10/23/2018	Total and Isotopic Uranium
SD-DU-006	LDOS30E	160-531536-28	10/23/2018	Total and Isotopic Uranium
SD-DU-007	LDOS30E	160-531536-29	10/23/2018	Total and Isotopic Uranium
SD-DU-008	LDOS30E	160-531536-30	10/23/2018	Total and Isotopic Uranium
SS-DU-001	LDOS30E	160-531536-31	10/23/2018	Total and Isotopic Uranium
SS-DU-002	LDOS30E	160-531536-32	10/23/2018	Total and Isotopic Uranium
SS-DU-003	LDOS30E	160-531536-33	10/23/2018	Total and Isotopic Uranium
SS-DU-003	LDOS30DE	160-531536-34	10/23/2018	Total and Isotopic Uranium
SS-DU-004	LDOS30E	160-531536-35	10/23/2018	Total and Isotopic Uranium

* The Leidos sample I.D. (LDOS30E) 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	Error	MDC	Final Qual	Reason Code
SW-DU-001	LDOS30E	DOE A-01-R MOD	Total Uranium	0.64	0.0999	0		
SW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 234	0.273	0.0764	0.0266		
SW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0035	0.013	0.0331	U	
SW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 238	0.214	0.0671	0.0266		
SW-DU-002	LDOS30E	DOE A-01-R MOD	Total Uranium	0.983	0.132	0		
SW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 234	0.312	0.0866	0.0352		
SW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 235	0.00778	0.0204	0.0438	U	
SW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 238	0.329	0.0887	0.0296		
SW-DU-003	LDOS27E	DOE A-01-R MOD	Total Uranium	0.243	0.0648	0		
SW-DU-003	LDOS27E	DOE A-01-R MOD	Uranium 234	0.175	0.0619	0.0389		
SW-DU-003	LDOS27E	DOE A-01-R MOD	Uranium 235	0.001	0.014	0.0395	U	
SW-DU-003	LDOS27E	DOE A-01-R MOD	Uranium 238	0.0815	0.0435	0.0417	J	37
SW-DU-004	LDOS30E	DOE A-01-R MOD	Total Uranium	0.484	0.0897	0		
SW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 234	0.25	0.076	0.0291		
SW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0131	0.0186	0.0197	U	
SW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 238	0.161	0.0602	0.029		
SW-DU-005	LDOS30E	DOE A-01-R MOD	Total Uranium	1.62	0.176	0		
SW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 234	0.288	0.0876	0.0651		
SW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 235	-0.00167	0.0165	0.0494	U	
SW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 238	0.546	0.118	0.0396		
SW-DU-006	LDOS29E	DOE A-01-R MOD	Total Uranium	0.426	0.0932	0		
SW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 234	0.323	0.0934	0.0478		
SW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 235	0.00862	0.0226	0.0486	U	
SW-DU-006	LDOS29E	DOE A-01-R MOD	Uranium 238	0.142	0.0626	0.0513		
SW-DU-007	LDOS30DE	DOE A-01-R MOD	Total Uranium	0.575	0.0941	0		
SW-DU-007	LDOS30DE	DOE A-01-R MOD	Uranium 234	0.216	0.0691	0.0417		
SW-DU-007	LDOS30DE	DOE A-01-R MOD	Uranium 235	0.0335	0.0299	0.0331	J	37
SW-DU-007	LDOS30DE	DOE A-01-R MOD	Uranium 238	0.188	0.0631	0.0316		
SW-DU-007	LDOS30E	DOE A-01-R MOD	Total Uranium	0.483	0.0938	0		
SW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 234	0.221	0.0747	0.0521		
SW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0106	0.0197	0.037	U	
SW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 238	0.161	0.063	0.0464		
SW-DU-008	LDOS30E	DOE A-01-R MOD	Total Uranium	2.13	0.207	0		
SW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 234	0.282	0.0843	0.0663		
SW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0369	0.0349	0.0471	U	
SW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 238	0.71	0.139	0.0837		
SW-DU-008	LDOS30E	SW846 6020A	Total Uranium	1.9	0	0.025		
SW-DU-008	LDOS30E	SW846 6020A	Uranium 234	0.02	0	0.05	U	
SW-DU-008	LDOS30E	SW846 6020A	Uranium 235	0.02	0	0.05	U	
SW-DU-008	LDOS30E	SW846 6020A	Uranium 238	1.9	0	0.05	D	
MW-DU-001	LDOS30E	DOE A-01-R MOD	Total Uranium	0.641	0.111	0		
MW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 234	0.322	0.0854	0.0396		
MW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0107	0.023	0.0452	U	
MW-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 238	0.214	0.0745	0.0674		
MW-DU-002	LDOS30E	DOE A-01-R MOD	Total Uranium	1.57	0.17	0		

Water Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
MW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 234	1.19	0.189	0.0161		
MW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0467	0.0355	0.02	J	37
MW-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 238	0.519	0.114	0.0161		
MW-DU-003	LDOS30E	DOE A-01-R MOD	Total Uranium	0.674	0.109	0		
MW-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 234	0.62	0.127	0.0426		
MW-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0208	0.0275	0.0432	U	
MW-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 238	0.223	0.0729	0.0425		
MW-DU-004	LDOS30DE	DOE A-01-R MOD	Total Uranium	0.757	0.111	0		
MW-DU-004	LDOS30DE	DOE A-01-R MOD	Uranium 234	0.44	0.102	0.0428		
MW-DU-004	LDOS30DE	DOE A-01-R MOD	Uranium 235	0.038	0.0335	0.0405	U	
MW-DU-004	LDOS30DE	DOE A-01-R MOD	Uranium 238	0.249	0.0747	0.0398		
MW-DU-004	LDOS30E	DOE A-01-R MOD	Total Uranium	0.731	0.109	0		
MW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 234	0.287	0.0808	0.047		
MW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0121	0.0171	0.0181	U	
MW-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 238	0.244	0.0732	0.039		
MW-DU-005	LDOS30E	DOE A-01-R MOD	Total Uranium	0.648	0.103	0		
MW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 234	0.738	0.138	0.0483		
MW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0321	0.0314	0.0408	U	
MW-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 238	0.213	0.0688	0.0367		
MW-DU-006	LDOS30E	DOE A-01-R MOD	Total Uranium	4.9	0.339	0		
MW-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 234	1.99	0.262	0.0282		
MW-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 235	0.108	0.0531	0.019		
MW-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 238	1.63	0.228	0.0335		
MW-DU-007	LDOS30E	DOE A-01-R MOD	Total Uranium	2.5	0.215	0		
MW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 234	1.34	0.195	0.0262		
MW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0433	0.0369	0.0475	U	
MW-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 238	0.834	0.144	0.0311		
MW-DU-008	LDOS30E	DOE A-01-R MOD	Total Uranium	0.766	0.115	0		
MW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 234	0.455	0.103	0.0328		
MW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0186	0.0216	0.0186	J	37
MW-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 238	0.255	0.0771	0.0483		
MW-DU-009	LDOS30E	DOE A-01-R MOD	Total Uranium	0.522	0.101	0		
MW-DU-009	LDOS30E	DOE A-01-R MOD	Uranium 234	0.947	0.171	0.044		
MW-DU-009	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0427	0.0409	0.0548	U	
MW-DU-009	LDOS30E	DOE A-01-R MOD	Uranium 238	0.169	0.0675	0.048		
MW-DU-010	LDOS30E	DOE A-01-R MOD	Total Uranium	2.03	0.257	0		
MW-DU-010	LDOS30E	DOE A-01-R MOD	Uranium 234	1.64	0.287	0.0707		
MW-DU-010	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0596	0.0536	0.0358	J	37
MW-DU-010	LDOS30E	DOE A-01-R MOD	Uranium 238	0.673	0.173	0.077		
MW-DU-011	LDOS30E	DOE A-01-R MOD	Uranium 234	0.433	0.113	0.043		
MW-DU-011	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0163	0.0231	0.0244	U	
MW-DU-011	LDOS30E	DOE A-01-R MOD	Uranium 238	0.0898	0.052	0.0482	J	37

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

Soil/Sediment Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
SD-DU-001	LDOS30DE	DOE A-01-R MOD	Total Uranium	0.907	0.118	0		
SD-DU-001	LDOS30DE	DOE A-01-R MOD	Uranium 234	0.342	0.0851	0.039		
SD-DU-001	LDOS30DE	DOE A-01-R MOD	Uranium 235	0.0122	0.0205	0.0369	U	
SD-DU-001	LDOS30DE	DOE A-01-R MOD	Uranium 238	0.303	0.0793	0.0362		
SD-DU-001	LDOS30E	DOE A-01-R MOD	Total Uranium	0.742	0.102	0		
SD-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 234	0.289	0.0747	0.0336		
SD-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0164	0.0217	0.0341	U	
SD-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 238	0.247	0.0686	0.0335		
SD-DU-002	LDOS30E	DOE A-01-R MOD	Total Uranium	0.985	0.126	0		
SD-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 234	0.381	0.093	0.0461		
SD-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0306	0.0299	0.0389	U	
SD-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 238	0.326	0.0843	0.035		
SD-DU-003	LDOS30E	DOE A-01-R MOD	Total Uranium	2.69	0.217	0		
SD-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 234	0.732	0.129	0.024		
SD-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0378	0.0288	0.0162	J	37
SD-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 238	0.898	0.146	0.0285		
SD-DU-004	LDOS30E	DOE A-01-R MOD	Total Uranium	0.581	0.0933	0		
SD-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 234	0.212	0.065	0.0251		
SD-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 235	-0.00377	0.0147	0.0456	U	
SD-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 238	0.196	0.0627	0.0299		
SD-DU-005	LDOS30E	DOE A-01-R MOD	Total Uranium	0.892	0.121	0		
SD-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 234	0.221	0.0683	0.0314		
SD-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0238	0.0239	0.0178	J	37
SD-DU-005	LDOS30E	DOE A-01-R MOD	Uranium 238	0.296	0.0815	0.0462		
SD-DU-006	LDOS30E	DOE A-01-R MOD	Total Uranium	2.21	0.2	0		
SD-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 234	0.821	0.143	0.0349		
SD-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0279	0.0301	0.0434	U	
SD-DU-006	LDOS30E	DOE A-01-R MOD	Uranium 238	0.738	0.134	0.038		
SD-DU-007	LDOS30E	DOE A-01-R MOD	Total Uranium	2.19	0.19	0		
SD-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 234	0.894	0.145	0.028		
SD-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0159	0.0184	0.0159	J	37
SD-DU-007	LDOS30E	DOE A-01-R MOD	Uranium 238	0.734	0.128	0.0313		
SD-DU-008	LDOS30E	DOE A-01-R MOD	Total Uranium	0.67	0.099	0		
SD-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 234	0.222	0.0666	0.0252		
SD-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 235	0.026	0.0259	0.0314	U	
SD-DU-008	LDOS30E	DOE A-01-R MOD	Uranium 238	0.221	0.0665	0.0252		
SS-DU-001	LDOS30E	DOE A-01-R MOD	Total Uranium	2.26	0.2	0		
SS-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 234	0.738	0.132	0.0303		
SS-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0124	0.021	0.0377	U	
SS-DU-001	LDOS30E	DOE A-01-R MOD	Uranium 238	0.757	0.134	0.0254		
SS-DU-002	LDOS30E	DOE A-01-R MOD	Total Uranium	2.83	0.233	0		
SS-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 234	0.797	0.141	0.0146		
SS-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0579	0.0389	0.0334	J	37
SS-DU-002	LDOS30E	DOE A-01-R MOD	Uranium 238	0.941	0.157	0.0145		

Soil/Sediment Sample Summary								
Site I.D.	Sample I.D.	Method	Analyte	Value	Error	MDC	Final Qual	Reason Code
SS-DU-003	LDOS30DE	DOE A-01-R MOD	Total Uranium	1.85	0.179	0		
SS-DU-003	LDOS30DE	DOE A-01-R MOD	Uranium 234	0.566	0.116	0.0569		
SS-DU-003	LDOS30DE	DOE A-01-R MOD	Uranium 235	0.0277	0.0299	0.0431	U	
SS-DU-003	LDOS30DE	DOE A-01-R MOD	Uranium 238	0.617	0.12	0.0346		
SS-DU-003	LDOS30E	DOE A-01-R MOD	Total Uranium	1.95	0.187	0		
SS-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 234	0.637	0.124	0.0272		
SS-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0428	0.0325	0.0183	J	37
SS-DU-003	LDOS30E	DOE A-01-R MOD	Uranium 238	0.65	0.126	0.0271		
SS-DU-004	LDOS30E	DOE A-01-R MOD	Total Uranium	1.62	0.17	0		
SS-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 234	0.551	0.115	0.0395		
SS-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 235	0.0193	0.0255	0.0401	U	
SS-DU-004	LDOS30E	DOE A-01-R MOD	Uranium 238	0.543	0.114	0.0424		

Data Validation Reason Code

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

APPENDIX D

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

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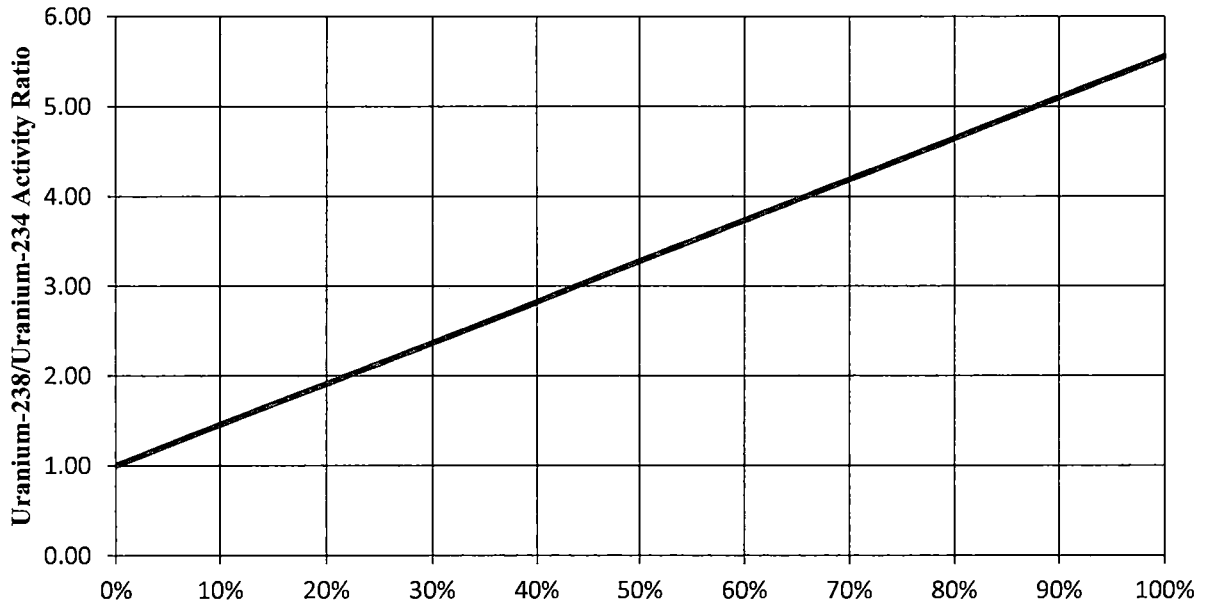
Figure D-1. Relative Uranium-238/Uranium-234 Activity Ratios for Mixtures of Depleted and Natural Uranium



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