Department of Energy
Portsmouth/Paducah Project Office
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November 17, 2021

Ms. Lauren Linehan
Division of Waste Management
Kentucky Department for Environmental Protection
625 Hospital Drive
Madisonville, Kentucky 42431

PPPO-02-10018370-22B

Ms. April Webb
Hazardous Waste Branch Manager
Division of Waste Management
Kentucky Department for Environmental Protection
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Linehan and Ms. Webb:

C-404 HAZARDOUS WASTE LANDFILL NOVEMBER 2021 SEMIANNUAL GROUNDWATER REPORT (APRIL–SEPTEMBER 2021), PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, FRNP-RPT-0190/V2, HAZARDOUS WASTE MANAGEMENT FACILITY PERMIT NO. KY8-890-008-982, AGENCY INTEREST ID NO. 3059

Enclosed is the subject report for the second reporting period of fiscal year 2021. This report is required in accordance with Part II, Specific Condition II.K.6.d, of Hazardous Waste Management Facility Permit No. KY8-890-008-982 (Permit).

Results of the statistical analyses indicate that compliance well concentrations of permit-required parameters are not statistically different from those in background wells for the current monitoring period.

In the previous semiannual reporting period (October 2020–March 2021), statistical analysis of technetium-99 (Tc-99) detections in downgradient compliance well MW84A indicated a statistically significant exceedance over background well concentrations. An alternate source demonstration investigation for Tc-99 in MW84A was performed in June 2021 and indicated that the observed trend of the increase in Tc-99 detection in MW84A was not a result of contamination introduced into the well boring during drilling and well installation; however, the increase is indicative of dissolved Tc-99 contamination found in the Regional Gravel Aquifer. Quarterly compliance monitoring for Tc-99 and other radionuclides is currently being conducted at the C-404 Landfill. The current semiannual sampling conducted on July 14, 2021, also serves as the first quarterly compliance monitoring and is included in this report. The next semiannual

report will contain results from additional quarterly sampling conducted in October 2021 and January 2022.

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

Jennifer R. Woodard

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Date: 2021.11.17 12:10:58 -06'00'

Jennifer Woodard
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Certification Page
2. *C-404 Hazardous Waste Landfill November 2021 Semiannual Groundwater Report (April–September 2021), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0190/V2

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CERTIFICATION

Document Identification: ***C-404 Hazardous Waste Landfill November 2021 Semiannual Groundwater Report (April–September 2021), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0190/V2, Permit No. KY8-890-008-982, Agency Interest ID No. 3059, dated November 2021**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Four Rivers Nuclear Partnership, LLC

MYRNA REDFIELD
(Affiliate)

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(Affiliate)
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11/17/2021

Myrna E. Redfield, Program Manager
Four Rivers Nuclear Partnership, LLC

Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy

Jennifer R. Woodard

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Jennifer Woodard, Paducah Site Lead
Portsmouth/Paducah Project Office
U.S. Department of Energy

Date Signed

C-404 Hazardous Waste Landfill November 2021 Semiannual Groundwater Report (April–September 2021), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

This document is approved for public release per review by:

David Hayden
FRNP Classification Support

11-11-2021
Date

C-404 Hazardous Waste Landfill November 2021 Semiannual Groundwater Report (April–September 2021), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—November 2021

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,
managing the
Deactivation and Remediation Project at the
Paducah Gaseous Diffusion Plant
under Contract DE-EM0004895

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CONTENTS

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TABLES

FIGURE

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ACRONYMS

AKGWA	Assembled Kentucky Groundwater
KDWM	Kentucky Division of Waste Management
MW	monitoring well
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
UCRS	Upper Continental Recharge System
URGA	Upper Regional Gravel Aquifer

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EXECUTIVE SUMMARY

This report, *C-404 Hazardous Waste Landfill November 2021 Semiannual Groundwater Report (April–September 2021), Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* FRNP-RPT-0190/V2, is being submitted by the U.S. Department of Energy in accordance with requirements in Kentucky Division of Waste Management Hazardous Waste Management Facility Permit, KY8-890-008-982 (Permit). This second reporting period 2021 covers April through September 2021 and includes analytical data from the July 2021 sampling of monitoring wells located in the vicinity of the closed C-404 Hazardous Waste Landfill (C-404 Landfill).

The groundwater monitoring analytical data were subjected to statistical analyses. The analyses were conducted in accordance with the Hazardous Waste Management Facility Permit. There were no statistically significant differences between concentrations in the compliance versus background wells for the current reporting period.

The leachate in the C-404 Landfill leachate collection system is monitored at least monthly and at a minimum, is removed and sampled when the level exceeds 3 ft in depth. During this reporting period of April through September 2021, the maximum depth of the leachate was 36 inches, as measured on April 7, 2021. Subsequently, 1,000 gal of leachate was removed and sampled. The depth of the leachate has not exceeded 3 ft during any of the monthly monitoring events within the reporting period of April through September 2021.

The annual leachate sump integrity test, as required by Section 1.2 of Appendix I2 of the Permit, was conducted between August 10, 2021, and September 14, 2021. Data was collected at a known depth at 1-hour increments to determine the change in leachate levels over time. Results of the integrity test were within normal limits.

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1. INTRODUCTION

This report contains the statistical evaluation of data from groundwater sampling and analysis for the closed C-404 Hazardous Waste Landfill (C-404 Landfill) at the U.S. Department of Energy Paducah Site (Paducah Site), Paducah, Kentucky. This semiannual report is required by the Kentucky Division of Waste Management Hazardous Waste Management Facility Permit, KY8-890-008-982 (Permit) (KDWM 2020), Specific Condition II.K.6.d—Recordkeeping, Reporting, and Response. The period covered by this report is April through September 2021.

Groundwater analytical results are provided in Appendix A. The statistical analyses and qualification statement are provided in Appendix B. Landfill leachate analytical results are provided in Appendix C. The annual groundwater flow rate and direction determination is provided in Appendix D.

1.1 BACKGROUND

The closed C-404 Landfill is located in the west-central portion of the Paducah Site secured area. The 1.2-acre facility operated as a surface impoundment from approximately 1952 until early 1957. During this time, influents to the impoundment originated from the C-400 Cleaning Building. In 1957, the impoundment was converted to a solid waste disposal facility for uranium-contaminated solid waste. When the impoundment was converted into a disposal facility, a sump was installed at the former weir to collect the leachate from the facility. Leachate is pumped from the sump, as needed, into a mobile tank. The leachate then is transferred to a permitted hazardous waste storage facility on-site prior to characterization and transferred off-site for treatment.

In 1986, the disposal of waste at the C-404 Landfill was halted, and a portion of the disposed-of waste was found to be Resource Conservation and Recovery Act (RCRA)-hazardous. The landfill was covered with a RCRA multilayered cap and certified closed in 1987. It currently is regulated under RCRA as a land disposal unit and compliance is monitored under the current Hazardous Waste Management Facility Permit (KDWM 2020).

Previous groundwater monitoring documented that concentrations in compliance wells were statistically different from background wells for trichloroethene (TCE). The *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* (PRS 2007a) documented that the source of the TCE in compliance wells is not from the C-404 Landfill, but rather, the source is located upgradient/crossgradient of the C-404 Landfill.

Regional Gravel Aquifer (RGA) compliance monitoring well (MW) 90 was abandoned and replaced by MW90A in 2001. RGA compliance well MW420 was installed in 2007 to better assess groundwater quality at the C-404 Landfill (PRS 2007b). The Burial Grounds Operable Unit evaluated the MW network at the C-404 Landfill relative to the prevailing groundwater flow direction and concluded that the additional RGA well was needed to assess upgradient groundwater quality.

Previous groundwater monitoring of RGA compliance well MW87 documented that concentrations in the compliance well were statistically different from background wells for lead and uranium (FRNP 2018). The *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Lead and Uranium in MW87 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, (FRNP 2019) concluded that the statistical differences were a result of infiltration of Upper Continental Recharge System (UCRS) groundwater into the RGA well due to compromised integrity of the well. The integrity of the well had deteriorated to a point that it no longer was suitable for its intended purpose. RGA compliance wells MW84, MW87, and background well MW93 were abandoned and replaced with MW84A, MW87A, and MW93A in 2019.

RGA wells MW84 and MW93 were abandoned and replaced because they were the same age (installed in 1988) as MW87. MW84A and MW87A were placed 10 ft north of MW84 and MW87, respectively, and screened at the same depth intervals. MW93A was placed 6 ft west of MW93 and screened at the same depth interval.

1.2 MONITORING PERIOD ACTIVITIES

1.2.1 Groundwater Monitoring

There are nine MWs sampled under the Permit for the C-404 Landfill: four UCRS wells and five Upper Regional Gravel Aquifer (URGA) wells. A map of the MW locations is provided in Figure 1.

Table 1 presents the well number for URGA wells located upgradient and downgradient of the C-404 Landfill. Table 1 also presents the well numbers for the UCRS wells located in proximity to the URGA wells. This table refers to the UCRS wells as being adjacent to an upgradient or downgradient URGA well location and are identified relative to URGA groundwater flow direction. The conceptual model for the C-404 Landfill indicates that groundwater in the UCRS wells flows primarily vertically downward until it reaches the URGA; therefore, UCRS wells are not considered "upgradient" or "downgradient" of other UCRS wells in the area.

Table 1. Monitoring Well Locations

UCRS	
Located south of C-404 Landfill, adjacent to upgradient URGA background well MW93A	MW94
Located north of C-404 Landfill, adjacent to downgradient URGA compliance wells	MW85, MW88, MW91A*
URGA	
Upgradient background wells	MW93A*, MW420
Downgradient compliance wells	MW84A*, MW87A*, MW90A*

*MW90 was abandoned in 2001 and replaced with MW90A. MW91 was abandoned in 2017 and replaced with MW91A. MW84, MW87, and MW93 were abandoned in 2019 and replaced with MW84A, MW87A, and MW93A.

Table 2 presents the Assembled Kentucky Groundwater (AKGWA) numbers for each MW.

Table 2. Assembled Kentucky Groundwater Numbers

Paducah Site Well Number	AKGWA Number
MW84A	8007-4849
MW85	8000-5234
MW87A	8007-4850
MW88	8000-5237
MW90A	8004-0357
MW91A	8007-2917
MW93A	8007-4851
MW94	8000-5103
MW420	8005-3263

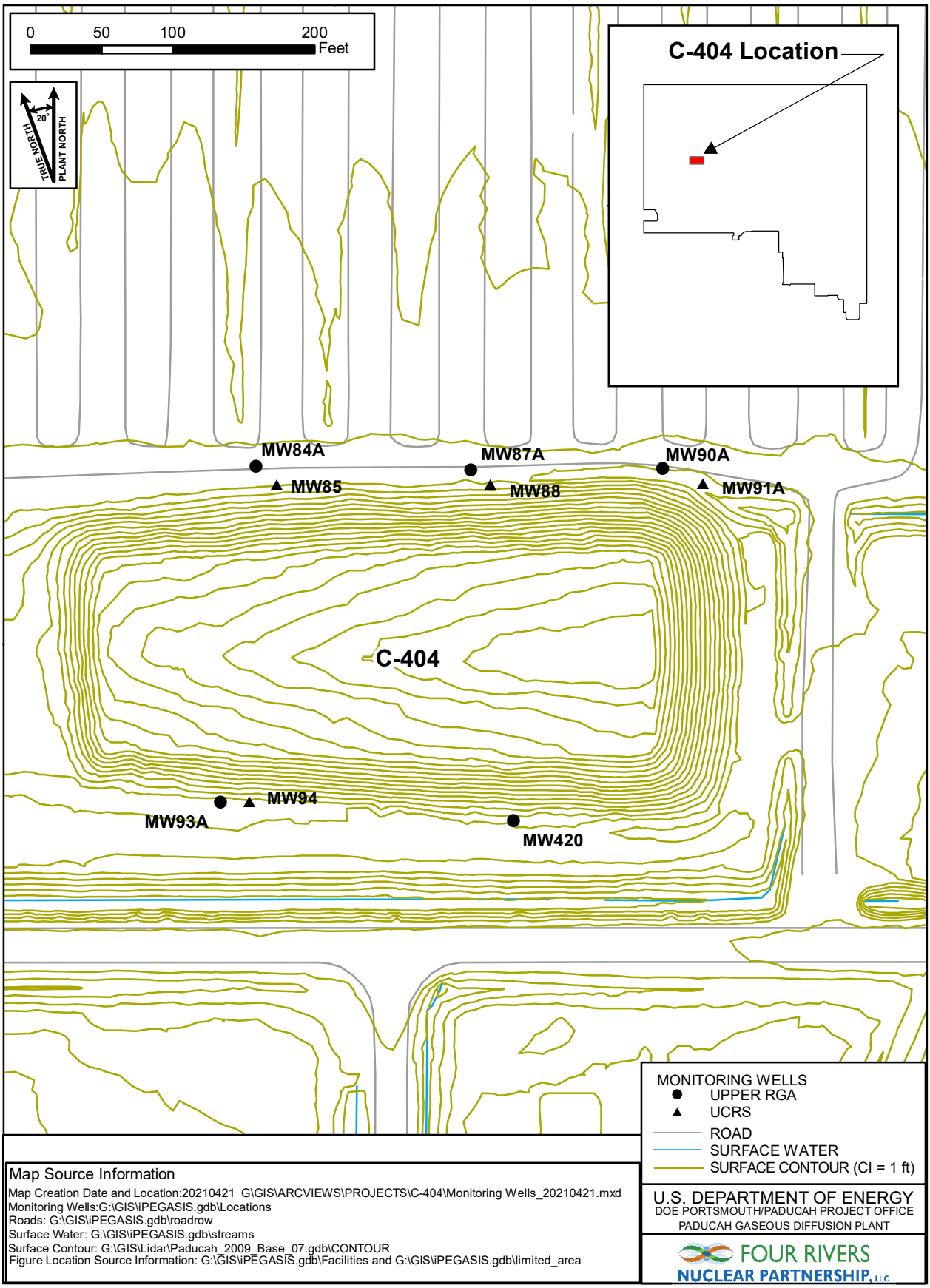

Figure 1. Monitoring Wells

All nine MWs were sampled in July 2021 during this reporting period, and the samples were analyzed for parameters required by Part VIII.E of the Permit. Groundwater sampling was conducted using procedure CP4-ES-2101, *Groundwater Sampling*. Appropriate sample containers and preservatives were used. The laboratory that performed the analyses used U.S. Environmental Protection Agency-approved methods, as applicable. Appendix A of this report contains the analytical results. Appendix B of this report contains the statistical analyses.

1.2.2 Landfill Leachate

In accordance with Appendix I2, C-404 Landfill Closure Plan, Section 1.2 of the Permit, the quantity of liquid in the leachate collection system is monitored (at least monthly) and, at a minimum, will be "removed when the quantity exceeds 3 ft in depth." Once the leachate depth reaches 3 ft, the leachate is pumped into a mobile tank. The leachate then is transferred to a permitted hazardous waste storage facility on-site prior to characterization and transferred off-site for treatment. During this reporting period of April through September 2021, the maximum depth of the leachate was 36 inches, as measured on April 7, 2021. Subsequently, a total of 1,000 gal of leachate was removed and sampled. The depth of the leachate did not exceed 3 ft during any of the monthly monitoring events within the reporting period. Results of the leachate analysis have been included in Appendix C of this report.

The annual leachate sump integrity test, as required by Section 1.2 of Appendix I2 of the Permit, was conducted between August 10, 2021, and September 14, 2021. Data was collected at a known depth at 1-hour increments to determine the change in leachate levels over time. Results of the integrity test were within normal limits.

2. STATISTICAL SYNOPSIS

The statistical analyses conducted on the data collected from the C-404 Landfill were performed in accordance with procedures in the Permit, Part VIII.E, reissued in February 2020. Appendix B of this report contains the statistical analyses performed for this reporting period. Statistical analyses utilized data from the URGA background wells, MW93A and MW420, and URGA compliance wells, MW84A, MW87A, and MW90A. For these statistical analyses, the reporting period data set includes data from July 2019, January 2020, July 2020, January 2021, and July 2021.

Appendix B provides a summary of the statistical analyses performed. The statistical tests on all wells and parameters showed no statistical difference between concentrations in the compliance and background wells.

In the previous semiannual reporting period (October 2020–March 2021), statistical analysis of technetium-99 (Tc-99) detections in downgradient compliance well MW84A indicated a statistically significant exceedance over background concentrations. Notification of the statistically significant difference for Tc-99 in MW84A was submitted, pursuant to Part II, Specific Condition II.K.6.a, to the Kentucky Department of Waste Management (KDWM).

An alternate source demonstration investigation for Tc-99 in MW84A was performed in June 2021. The *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Technetium-99 in MW84A at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* FRNP-RPT-0206, consisted of redevelopment and over pumping of MW84A, and documentation review of the lines of evidence relating redevelopment of MW84A and the associated Tc-99 levels (FRNP 2021). The lines of evidence concluded that the observed trend of increasing Tc-99 in MW84A is not a result of contamination introduced into the well boring during drilling and well installation, but it is indicative of dissolved Tc-99 contamination in the RGA. Quarterly compliance monitoring for Tc-99 and other radionuclides is currently being conducted at the C-404 Landfill. The current semiannual sampling conducted on July 14, 2021, also serves as the first quarterly compliance monitoring and is included in this report. The next semiannual report will contain results from additional quarterly sampling conducted in October 2021 and January 2022.

In accordance with Permit Specific Condition II.K.6.d, development and submittal of an engineering feasibility plan for a corrective action program is not required when a statistically significant exceedance has been confirmed for radionuclides (i.e., Tc-99).

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3. DATA VALIDATION AND QA/QC SUMMARY

The data and the data validation qualifiers for the July 2021 data set are provided in Appendix A. All data for this data set were considered useable as reported. Data validation was performed on the analytical data by an independent, third-party validator.

Field quality control samples are collected during each semiannual sampling event. Equipment rinseate blanks, field blanks, field duplicates, and trip blanks are obtained to ensure quality control and are reported in the analytical results in Appendix A. Laboratory quality control samples, such as matrix spikes, matrix spike duplicates, and method blanks, are performed by the laboratory and reported in the laboratory report. Both field and laboratory quality control sample results are reviewed as part of the data validation process.

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4. PROFESSIONAL GEOLOGIST AUTHORIZATION

DOCUMENT IDENTIFICATION: *C-404 Hazardous Waste Landfill*
November 2021 Semiannual Groundwater Report
(April–September 2021),
Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(FRNP-RPT-0190/V2)

Stamped and signed pursuant to my authority as a duly registered geologist under the provisions of *KRS* Chapter 322A.

PG113927
Kenneth R. Davis
November 11, 2021

Kenneth R. Davis
Kenneth R. Davis

PG113927

November 11, 2021
Date

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5. REFERENCES

FRNP (Four Rivers Nuclear Partnership, LLC) 2018. *C-404 Hazardous Waste Landfill November 2018 Semiannual Groundwater Report (April 2018—September 2018), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0026/V2, U.S. Department of Energy, Paducah, KY, November.

FRNP 2019. *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Lead and Uranium in MW87 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0078, Four Rivers Nuclear Partnership, LLC, Kevil, KY.

FRNP 2021. *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Technetium-99 in MW84A at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0206, Four Rivers Nuclear Partnership, LLC, Kevil, KY, August.

KDWM (Kentucky Division of Waste Management) 2020. Hazardous Waste Management Facility Permit for the U.S. Department of Energy, Paducah Gaseous Diffusion Plant, KY8-890-008-982, effective February 21.

PRS (Paducah Remediation Services, LLC) 2007a. *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2, Paducah Remediation Services, LLC, Kevil, KY.

PRS 2007b. *Well Plan for Addition of Wells for C-404 Monitoring Well Network, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS/PROJ/0028, Paducah Remediation Services, LLC, Kevil, KY, July.

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APPENDIX A

C-404 HAZARDOUS WASTE LANDFILL GROUNDWATER ANALYTICAL RESULTS

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Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW84A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4849

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.0284	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved		0.0218	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.21	Inches/Hg		7/14/2021				X
Cadmium	J	0.000317	mg/L	0.001	7/14/2021			SW846-6020	J
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		453	umho/cm		7/14/2021				X
Depth to Water		47.3	ft		7/14/2021				X
Dissolved Oxygen		2.61	mg/L		7/14/2021				X
Lead	J	0.000874	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.7	Std Unit		7/14/2021				X
Redox		286	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	17.1	mg/L	2	7/14/2021			SW846-9056	J
Technetium-99		229	pCi/L	9.51	7/14/2021	15.8	30.5	HASL 300, Tc-02-RC M	=
Temperature		69.7	deg F		7/14/2021				X
Trichloroethene	HY1	5290	ug/L	100	7/14/2021			SW846-8260B	J
Turbidity		307	NTU		7/14/2021				X
Uranium		0.000229	mg/L	0.0002	7/14/2021			SW846-6020	U
Uranium-234	U	-1.01	pCi/L	2.45	7/14/2021	0.738	0.739	HASL 300, U-02-RC M	=
Uranium-235	U	-0.247	pCi/L	1.7	7/14/2021	0.573	0.574	HASL 300, U-02-RC M	=
Uranium-238	U	-0.642	pCi/L	2.17	7/14/2021	0.712	0.712	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00531	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved	J	0.00494	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.18	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	J	0.00307	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		302	umho/cm		7/14/2021				X
Depth to Water		8.65	ft		7/14/2021				X
Dissolved Oxygen		2.64	mg/L		7/14/2021				X
Lead	J	0.000711	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	J	0.000584	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.92	Std Unit		7/14/2021				X
Redox		438	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	11.4	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99		57.2	pCi/L	9.83	7/14/2021	9.33	11.4	HASL 300, Tc-02-RC M	=
Temperature		67.1	deg F		7/14/2021				X
Trichloroethene	UY1	1	ug/L	1	7/14/2021			SW846-8260B	UJ
Turbidity		307	NTU		7/14/2021				X
Uranium		0.00146	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.575	pCi/L	1.73	7/14/2021	0.461	0.462	HASL 300, U-02-RC M	=
Uranium-235	U	-0.167	pCi/L	1.42	7/14/2021	0.504	0.505	HASL 300, U-02-RC M	=
Uranium-238	U	0.015	pCi/L	1.51	7/14/2021	0.689	0.69	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 FR Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00557	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved	J	0.00474	mg/L	0.005	7/14/2021			SW846-6020	=
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Lead	J	0.00078	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	J	0.000508	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	11.3	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99		53.3	pCi/L	10.9	7/14/2021	9.63	11.4	HASL 300, Tc-02-RC M	=
Trichloroethene	UY1	1	ug/L	1	7/14/2021			SW846-8260B	UJ
Uranium		0.0015	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.939	pCi/L	2.34	7/14/2021	0.71	0.71	HASL 300, U-02-RC M	=
Uranium-235	U	0.19	pCi/L	1.2	7/14/2021	0.712	0.713	HASL 300, U-02-RC M	=
Uranium-238	U	-0.129	pCi/L	1.81	7/14/2021	0.761	0.762	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW87A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4850

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00793	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved		0.00571	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.21	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		333	umho/cm		7/14/2021				X
Depth to Water		47.43	ft		7/14/2021				X
Dissolved Oxygen		3.06	mg/L		7/14/2021				X
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.72	Std Unit		7/14/2021				X
Redox		358	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	6.84	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99	U	9.56	pCi/L	11.5	7/14/2021	7.13	7.21	HASL 300, Tc-02-RC M	=
Temperature		64.7	deg F		7/14/2021				X
Trichloroethene	Y1	2410	ug/L	50	7/14/2021			SW846-8260B	J
Turbidity		2.1	NTU		7/14/2021				X
Uranium	U	0.0002	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.108	pCi/L	1.75	7/14/2021	0.758	0.759	HASL 300, U-02-RC M	=
Uranium-235	U	-0.265	pCi/L	1.55	7/14/2021	0.502	0.503	HASL 300, U-02-RC M	=
Uranium-238	U	-0.157	pCi/L	1.65	7/14/2021	0.678	0.678	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW88 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5237

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00782	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved		0.00534	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.2	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	J	0.00459	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		638	umho/cm		7/14/2021				X
Depth to Water		8.19	ft		7/14/2021				X
Dissolved Oxygen		0.47	mg/L		7/14/2021				X
Lead		0.00201	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	L	0.000297	mg/L	0.0002	7/14/2021			SW846-7470A	J
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.6	Std Unit		7/14/2021				X
Redox		367	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	129	mg/L	4	7/14/2021			SW846-9056	J
Technetium-99		27.7	pCi/L	9.76	7/14/2021	7.49	8.13	HASL 300, Tc-02-RC M	=
Temperature		65.6	deg F		7/14/2021				X
Trichloroethene	Y1	1.94	ug/L	1	7/14/2021			SW846-8260B	J
Turbidity		552	NTU		7/14/2021				X
Uranium		0.000222	mg/L	0.0002	7/14/2021			SW846-6020	U
Uranium-234	U	-0.18	pCi/L	2.22	7/14/2021	0.994	0.994	HASL 300, U-02-RC M	=
Uranium-235	U	0.177	pCi/L	1.12	7/14/2021	0.663	0.664	HASL 300, U-02-RC M	=
Uranium-238	U	-0.12	pCi/L	1.68	7/14/2021	0.709	0.709	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW90A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8004-0357

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.19	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		213	umho/cm		7/14/2021				X
Depth to Water		46.53	ft		7/14/2021				X
Dissolved Oxygen		3.98	mg/L		7/14/2021				X
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.73	Std Unit		7/14/2021				X
Redox		429	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	4.5	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99		24.3	pCi/L	10.6	7/14/2021	7.71	8.19	HASL 300, Tc-02-RC M	=
Temperature		63.5	deg F		7/14/2021				X
Trichloroethene	HY1	148	ug/L	4	7/14/2021			SW846-8260B	J
Turbidity		376	NTU		7/14/2021				X
Uranium	U	0.0002	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.624	pCi/L	1.79	7/14/2021	0.474	0.475	HASL 300, U-02-RC M	=
Uranium-235	U	0.234	pCi/L	0.702	7/14/2021	0.657	0.658	HASL 300, U-02-RC M	=
Uranium-238	U	0.431	pCi/L	1.16	7/14/2021	0.763	0.765	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW91A REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8007-2917

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.014	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved	J	0.0036	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.21	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	J	0.00786	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		870	umho/cm		7/14/2021				X
Depth to Water		11.95	ft		7/14/2021				X
Dissolved Oxygen		1.33	mg/L		7/14/2021				X
Lead	J	0.000567	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.9	Std Unit		7/14/2021				X
Redox		221	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	87.5	mg/L	4	7/14/2021			SW846-9056	J
Technetium-99		42.8	pCi/L	10.3	7/14/2021	8.79	10.1	HASL 300, Tc-02-RC M	=
Temperature		65.7	deg F		7/14/2021				X
Trichloroethene	HY1	274	ug/L	10	7/14/2021			SW846-8260B	J
Turbidity		221	NTU		7/14/2021				X
Uranium		0.000234	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.818	pCi/L	2.9	7/14/2021	0.816	0.818	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	1.25	7/14/2021	0.841	0.845	HASL 300, U-02-RC M	=
Uranium-238	U	-0.486	pCi/L	2.5	7/14/2021	0.784	0.786	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW93A REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4851

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00806	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved		0.0102	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.2	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		377	umho/cm		7/14/2021				X
Depth to Water		50.26	ft		7/14/2021				X
Dissolved Oxygen		2.19	mg/L		7/14/2021				X
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.67	Std Unit		7/14/2021				X
Redox		365	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	7.62	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99		20.5	pCi/L	10.3	7/14/2021	7.3	7.66	HASL 300, Tc-02-RC M	=
Temperature		65.6	deg F		7/14/2021				X
Trichloroethene	Y1	3170	ug/L	50	7/14/2021			SW846-8260B	J
Turbidity		214	NTU		7/14/2021				X
Uranium	J	0.000079	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-1.05	pCi/L	2.36	7/14/2021	0.699	0.699	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.719	7/14/2021	0.483	0.484	HASL 300, U-02-RC M	=
Uranium-238	U	-0.132	pCi/L	1.5	7/14/2021	0.596	0.597	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW94 REG Upgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5103

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.2	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		835	umho/cm		7/14/2021				X
Depth to Water		12.79	ft		7/14/2021				X
Dissolved Oxygen		0.29	mg/L		7/14/2021				X
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		6.08	Std Unit		7/14/2021				X
Redox		358	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	79.3	mg/L	2	7/14/2021			SW846-9056	J
Technetium-99		922	pCi/L	10.4	7/14/2021	31.6	110	HASL 300, Tc-02-RC M	=
Temperature		66.5	deg F		7/14/2021				X
Trichloroethene	Y1	3.48	ug/L	1	7/14/2021			SW846-8260B	J
Turbidity		63.4	NTU		7/14/2021				X
Uranium		0.00135	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	0.622	pCi/L	2.27	7/14/2021	1.29	1.29	HASL 300, U-02-RC M	=
Uranium-235	U	-0.129	pCi/L	2.16	7/14/2021	0.888	0.889	HASL 300, U-02-RC M	=
Uranium-238	U	0.322	pCi/L	2.12	7/14/2021	1.11	1.11	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW420 REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8005-3263

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00859	mg/L	0.005	7/14/2021			SW846-6020	=
Arsenic, Dissolved		0.00633	mg/L	0.005	7/14/2021			SW846-6020	=
Barometric Pressure Reading		30.2	Inches/Hg		7/14/2021				X
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Conductivity		367	umho/cm		7/14/2021				X
Depth to Water		49.25	ft		7/14/2021				X
Dissolved Oxygen		0.92	mg/L		7/14/2021				X
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Mercury, Dissolved	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
pH		5.57	Std Unit		7/14/2021				X
Redox		370	mV		7/14/2021				X
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Sulfate	W	6.53	mg/L	0.4	7/14/2021			SW846-9056	J
Technetium-99	U	0.507	pCi/L	10.6	7/14/2021	5.86	5.86	HASL 300, Tc-02-RC M	=
Temperature		67	deg F		7/14/2021				X
Trichloroethene	HY1	1790	ug/L	50	7/14/2021			SW846-8260B	J
Turbidity		55.7	NTU		7/14/2021				X
Uranium	U	0.0002	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-0.584	pCi/L	1.76	7/14/2021	0.468	0.469	HASL 300, U-02-RC M	=
Uranium-235	U	0.179	pCi/L	1.13	7/14/2021	0.67	0.671	HASL 300, U-02-RC M	=
Uranium-238	U	0.342	pCi/L	1.33	7/14/2021	0.777	0.779	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: FB **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Technetium-99	U	-0.716	pCi/L	11.3	7/14/2021	6.14	6.14	HASL 300, Tc-02-RC M	=
Trichloroethene	UY1	1	ug/L	1	7/14/2021			SW846-8260B	UJ
Uranium	U	0.0002	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	-1.27	pCi/L	3.04	7/14/2021	1.06	1.06	HASL 300, U-02-RC M	=
Uranium-235	U	0.692	pCi/L	1.52	7/14/2021	1.1	1.1	HASL 300, U-02-RC M	=
Uranium-238	U	0.24	pCi/L	1.79	7/14/2021	0.925	0.926	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: RI **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Cadmium	U	0.001	mg/L	0.001	7/14/2021			SW846-6020	=
Chromium	U	0.01	mg/L	0.01	7/14/2021			SW846-6020	=
Lead	U	0.002	mg/L	0.002	7/14/2021			SW846-6020	=
Mercury	UL	0.0002	mg/L	0.0002	7/14/2021			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/14/2021			SW846-6020	=
Technetium-99	U	-1.79	pCi/L	9.75	7/14/2021	5.17	5.17	HASL 300, Tc-02-RC M	=
Trichloroethene	UY1	1	ug/L	1	7/14/2021			SW846-8260B	UJ
Uranium	U	0.0002	mg/L	0.0002	7/14/2021			SW846-6020	=
Uranium-234	U	0.0067	pCi/L	1.92	7/14/2021	0.88	0.88	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.778	7/14/2021	0.523	0.524	HASL 300, U-02-RC M	=
Uranium-238	U	0.327	pCi/L	1.55	7/14/2021	0.863	0.864	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: TB **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Trichloroethene	UY1	1	ug/L	1	7/14/2021			SW846-8260B	UJ

QUALIFIER Codes

U Analyte analyzed for, but not detected at or below the lowest concentration reported.
J Estimated quantitation.
W Post-digestion spike recovery out of control limits.
L LCS or LCSD recovery outside of control limits.
H Analysis performed outside holding time requirement.
Y1 MS/MSD recovery outside acceptance criteria.

SAMPLING POINT Codes

UCRS Upper Continental Recharge System
URGA Upper Regional Gravel Aquifer

SAMPLE TYPE Codes

FB Field Blank
FR Field Duplicate as defined in sampling procedure.
REG Regular
RI QC Equipment Rinseate/Decon
TB Trip Blank

VALIDATION Codes

= Validated result, no qualifier is necessary.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
X Not validated.

APPENDIX B

C-404 HAZARDOUS WASTE LANDFILL STATISTICAL ANALYSES

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GROUNDWATER STATISTICAL SUMMARY

INTRODUCTION

The statistical analyses conducted on the data collected from the C-404 Hazardous Waste Landfill (C-404 Landfill) were performed in accordance with procedures provided in Appendix E of the Hazardous Waste Management Facility Permit, reissued by the Kentucky Division of Waste Management (KDWM) in February 2020. The percent of censored (nondetected) data points for individual parameters was calculated for the combined analytical data from the most recent five sampling events. The percent of censored data was used to select the types of statistical analyses to determine whether compliance well concentrations differed from background well concentrations. Data points were used in the statistical analysis for analyte results close to the sample quantitation limit that were judged to be below that limit by the data validator. For the second reporting period 2021 semiannual report, the reporting period data set includes data from July 2019, January 2020, July 2020, January 2021, and July 2021.

STATISTICAL ANALYSIS PROCESS

Utilizing the current data set and four previous data sets, the type of statistical test conducted for each chemical data set is a function of the number of samples and proportion of censored data (nondetects) to uncensored data (detects) in each group. The percent of censored (nondetected) data points for individual parameters was calculated for the combined analytical data. The statistical procedures applied to the data are summarized below.

- Determine the percentage of the censored data using the reporting period data set.
- Group by percentage of censored data where the following apply:
  - — If censored data are greater than or equal to 90%, determine the limit of detection (LOD) and half of the LOD (1/2 LOD). This is Statistical Test 1.
  - — If censored data are between 50% and 90%, perform a Test of Proportions. If the analysis indicates a significant proportional difference in compliance wells, further analyze through nonparametric Analysis of Variance (ANOVA) Test. This is Statistical Test 2.
  - — If censored data are between 15% and 50%, perform nonparametric ANOVA Test. If results exceed the critical value, compute the critical difference used to identify individual well concentrations, which are significantly elevated compared with background. This is Statistical Test 3.
  - — If censored data are less than 15%, actual data values are analyzed using parametric ANOVA procedures. If the wells exhibit equal variances, then the data are used as presented. If the wells do not exhibit equal variances, then the log of the data is taken and then used in the calculations. Where statistical testing indicates elevated compliance well concentrations, Bonferroni's Test of Contrasts is performed. This is Statistical Test 4. Statistical Test 4 is found in Section 5.2.1 of EPA guidance

document, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (April 1989).

If the statistical method above indicates no statistical difference between concentrations in downgradient wells and concentrations in background wells, then there are no indications of statistically significant impacts on the groundwater from the C-404 Landfill. If the tiered statistical method above identifies a statistically significant difference between concentrations in downgradient wells and concentrations in background wells, then the data will be evaluated further to determine if the concentrations in downgradient wells are within the statistically developed upper tolerance limit (UTL) for background concentrations or are consistent with the findings of the 2007 Alternate Source Demonstration (ASD), as follows:

(1) Compare the most recent downgradient sample results to a 95% UTL using the five most recent sets of data for each upgradient well as described below. If downgradient concentrations are lower than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

(2) Evaluate results using paired ANOVA of wells in the same direction relative to the landfill (e.g., compare upgradient westernmost well results to downgradient westernmost well results). If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

(3) If results show downgradient wells have statistically significant higher concentrations than upgradient wells, even when evaluated with respect to the ASD, additional intra-well evaluation of trend will be performed using the Mann-Kendall test for trend. If concentrations do not show an increasing trend, then there is no confirmed exceedance attributable to C-404.

(4) Review other Regional Gravel Aquifer (RGA) well results in vicinity to determine if they are consistent with ASD.

If the statistical analysis identifies downgradient well concentrations that are increasing, are higher than UTL, are higher than the upgradient well concentrations even when the ASD results are taken into account, this evaluation will identify a confirmed, statistically significant exceedance (in a compliance well) over background.

DATA ANALYSIS

Data from the upgradient background wells in the Upper Regional Gravel Aquifer (URGA) are included for comparison with three downgradient URGA wells. Figure 1 of this C-404 Landfill Groundwater Report provides a map of the well locations associated with the C-404 Landfill. Upper Continental Recharge System (UCRS) wells in Figure 1 are provided for reference only. Data from wells that are in the UCRS are not included in the statistical analyses.

Table B.1 presents the C-404 Landfill upgradient or background wells and downgradient or compliance wells from the URGA. Data from the URGA compliance wells were compared with data from the URGA background wells.

Table B.1. Monitoring Well Locations

URGA	
Upgradient background wells	MW93A*, MW420
Downgradient compliance wells	MW84A*, MW87A*, MW90A*

*MW90 was abandoned in 2001 and replaced with MW90A. MW84, MW87, and MW93 were abandoned in 2019 and replaced with MW84A, MW87A, and MW93A, respectively.

For the second reporting period 2021 semiannual report, the reporting period data set from July 2019 through July 2021 consists of five sets of data.

Table B.2 lists the number of analyses (observations), nondetects (censored observations), detects (uncensored observations), and missing observations by parameter. When field duplicate data are available from a well, the higher of the two readings was retained for further evaluation.

Table B.2. Summary of Missing, Censored, and Uncensored Data Collected

Parameters	Observations	Missing Observations*	Censored Observations (Nondetects)	Uncensored Observations (Detects)
URGA				
Arsenic	25	0	3	22
Cadmium	25	0	22	3
Chromium	25	0	24	1
Lead	25	0	23	2
Mercury	25	0	25	0
Selenium	25	0	25	0
Technetium-99	25	0	18	7
Trichloroethene	25	0	0	25
Uranium (Metals)	25	0	17	8
Uranium-234	25	0	22	3
Uranium-235	25	0	25	0
Uranium-238	25	0	23	2

Censoring Percentage and Statistical Analysis

The type of statistical test set applied to the data is a function of the number of nondetects (censored) versus detects (uncensored) in each of the parameter groups and among the wells. Table B.3 presents the percentage of censored data and type of statistical test chosen for each of the parameters required by Part VIII.E of the Permit.

Table B.3. Percent Censored Report and Statistical Test Set Selected

Parameter	Total Samples (Nonmissing)	Uncensored (Detects)	Censored (Nondetects)	Percent Censored	Statistical Test Set*
URGA					
Arsenic	25	22	3	12	4
Cadmium	25	3	22	88	2
Chromium	25	1	24	96	1
Lead	25	2	23	92	1
Mercury	25	0	25	100	1
Selenium	25	0	25	100	1
Technetium-99	25	7	18	72	2
Trichloroethene	25	25	0	0	4
Uranium (Metals)	25	8	17	68	2
Uranium-234	25	3	22	88	2
Uranium-235	25	0	25	100	1
Uranium-238	25	2	23	92	1

*A list of the constituents with greater than or equal to 90% censored data is included in Table B.4, which summarizes the results of Statistical Test 1.

SUMMARY OF CONCLUSIONS

The results for Statistical Test 1, LOD, are summarized in Table B.4. Table B.5 provides the summary of conclusions for the C-404 Landfill statistical analyses for the second reporting period 2021, including the statistical tests performed, the attachment number, well type, parameter, and results of each statistical test. Results of Statistical Test 2, Statistical Test 3, and Statistical Test 4 are presented in Attachments B1 through B6. The statistician qualification statement is presented in Attachment B7.

Table B.4. Statistical Test 1: Limit of Detection

Parameter	LOD Values	½ LOD Values
URGA		
Chromium	0.01	0.005
Lead	0.002	0.001
Mercury (mg/L)	0.0002	0.0001
Selenium (mg/L)	0.005	0.0025
Uranium-235 (pCi/L)	1.7	0.85
Uranium-238 (pCi/L)	2.17	1.085

Table B.5. Summary of Conclusions from the C-404 Hazardous Waste Landfill Statistical Analyses for the Second Reporting Period 2021

Attachment	RGA Well Type	Parameter	Applied Statistical Test	Results
B1	URGA	Arsenic	Statistical Test 4, Parametric ANOVA, Statistical Test 3, Nonparametric ANOVA with 95% UTL, paired ANOVA (MW84A vs. MW93A), and Mann-Kendall	Because equality of variance could not be confirmed, Statistical Test 4 was abandoned and Statistical Test 3, Nonparametric ANOVA, was performed. Nonparametric ANOVA indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells, a comparison to the 95% UTL, paired ANOVA, and Mann-Kendall trend analysis were performed, as required by the Hazardous Waste Management Facility Permit. The 95% UTL indicated a statistically significant difference between concentrations in compliance well MW84A and concentrations in background wells. Results of the paired ANOVA identified a significant difference between upgradient (MW93A) and downgradient (MW84A) wells. The Mann-Kendall trend analysis identified no trend in MW84A.
B2	URGA	Cadmium	Statistical Test 2, Test of Proportions	No statistically significant difference between concentrations in downgradient wells and concentrations in background wells.
B3	URGA	Technetium-99	Statistical Test 2, Test of Proportions	No statistically significant difference between concentrations in downgradient wells and concentrations in background wells.
B4	URGA	Trichloroethene	Statistical Test 4, Parametric ANOVA, with 95% UTL, paired ANOVA (MW84A vs. MW93A)	Because Parametric ANOVA indicated a statistically significant difference between concentrations in background wells and compliance well MW84A, a comparison to the 95% UTL was performed. The 95% UTL indicated a statistically significant difference between concentrations in compliance well MW84A and concentrations in background wells; therefore, a paired ANOVA (MW84A versus MW93A) was performed that indicated no statistically significant difference between the wells.
B5	URGA	Uranium	Statistical Test 2, Test of Proportions	No statistically significant difference between concentrations in downgradient wells and concentrations in background wells.
B6	URGA	Uranium-234	Statistical Test 2, Test of Proportions	No statistically significant difference between concentrations in downgradient wells and concentrations in background wells.

In summary, Statistical Test 2, Test of Proportions, for cadmium, technetium-99, uranium, and uranium-234 in the URGA indicated no statistically significant difference between concentrations in downgradient wells and concentrations in background wells.

Statistical Test 4, parametric ANOVA, for arsenic in the URGA could not be performed because equality of variance could not be confirmed. Statistical Test 4 was abandoned and Statistical Test 3, nonparametric ANOVA, was performed. Statistical Test 3, nonparametric ANOVA, identified a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, the data were evaluated further by comparing results to the UTL. The 95% UTL indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells. Based on these results, the data were evaluated using paired (parametric) ANOVA of wells in the same direction relative to the landfill [e.g., performed a comparison of downgradient well (MW84A) results to upgradient westernmost well (MW93A) results]. Results of the paired (parametric) ANOVA identified a statistically significant difference between upgradient and downgradient wells. A Mann-Kendall test was performed to evaluate the data further, and no trend was identified for arsenic in MW84A.

Statistical Test 4, parametric ANOVA, for trichloroethene in the URGA indicated statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, the data were evaluated further by comparing results to the UTL. The 95% UTL indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, paired (parametric) ANOVA was performed on upgradient well MW93A and downgradient well MW84A. Paired (parametric) ANOVA did not identify a statistically significant difference between the upgradient and downgradient wells.

ATTACHMENT B1

ARSENIC
STATISTICAL TEST 4

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Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Arsenic (As, mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**0.00602**	**0.00359**	**0.0168**	**0.00723**	0.0025
Jan-20	**0.00817**	**0.00518**	**0.0202**	**0.00928**	**0.00211**
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0.0025
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0.0025
n_i	10		5	5	5
Sum	0.0796		0.1088	0.0428	0.0117
(x_i)avg	0.008		0.022	0.009	0.002

mg/L = milligrams per liter
Bolded values indicate a detected result.

Overall mean x.. =	0.01	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	0.24	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	-0.002	-0.004	-0.005	-0.001	0.000
Jan-20	0.000	-0.003	-0.002	0.001	0.000
Jul-20	0.003	-0.003	0.000	0.000	0.000
Jan-21	0.007	0.000	-0.001	0.001	0.000
Jul-21	0.000	0.001	0.007	-0.001	0.000

X: Mean Value =	3.64E-19	
S: Standard Deviation =	0.0	
K* Factor =	2.292	(for n = 25)
CV = S/X =	7.46E+15	> 1, data are not normally distributed

Data are not normally distributed (i.e.,>1)
*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Determine Equality of Variance of Dataset

p = number of well groups
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total number of samples
$(x_{avg})_{..} =$ the mean of the total number of samples

$x_{..} =$ 0.24
$(x_{avg})_{..} =$ 0.01

p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.003	0.00	-11.387	10	0.0	-102.5
0.004	0.00	-10.930	5	0.000	-43.7
0.001	0.00	-13.942	5	0.000	-55.8
0.000	0.00	-16.903	5	0.000	-67.6

$\sum(S_i^2) =$ 0.00 $\sum f_i\ln(S_i^2) =$ -269.6

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 0.000
$\ln Sp^2 =$ -11.682
$c^2 =$ 24.269 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. **(i.e., $c^2 > c^2_{crit}$)**

Variances are not equal, transform the original data to lognormal (i.e., since $c^2 > c^2_{crit}$).

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Lognormal Data for As

ln[As (mg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	-5.11	-5.63	-4.09	-4.93	-5.99
Jan-20	-4.81	-5.26	-3.90	-4.68	-6.16
Jul-20	-4.52	-5.23	-3.81	-4.72	-5.99
Jan-21	-4.17	-4.79	-3.85	-4.67	-6.16
Jul-21	-4.82	-4.76	-3.56	-4.84	-5.99
Mean x_i	-4.69	-5.13	-3.84	-4.77	-6.06
Background Mean	-4.91		NA	NA	NA
Grand Mean	-4.90				
x_i^2	26.14	31.69	16.70	24.30	35.90
	23.11	27.70	15.23	21.90	37.96
These values needed for ANOVA	20.42	27.38	14.50	22.24	35.90
	17.42	22.94	14.85	21.79	37.96
	23.24	22.63	12.68	23.40	35.90
Sum x_i^2	614				

mg/L = milligrams per liter

Determine Normality of Dataset

Coefficient of Variability Test

Table of ln[As (mg/L)] Data

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	-5.11	-5.63	-4.09	-4.93	-5.99
Jan-20	-4.81	-5.26	-3.90	-4.68	-6.16
Jul-20	-4.52	-5.23	-3.81	-4.72	-5.99
Jan-21	-4.17	-4.79	-3.85	-4.67	-6.16
Jul-21	-4.82	-4.76	-3.56	-4.84	-5.99

X: Mean Value =	-4.90E+00	
S: Standard Deviation =	0.77	
K* Factor =	2.292	(for n = 25)
CV = S/X =	-1.57E-01	<1, data are normally distributed

Data are normally distributed (i.e.,<1)

*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Determine Equality of Variance of Dataset for Lognormal Data

p = number of wells (background wells considered as one group)
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total lognormal dataset
$(x_{avg})_{..}$ = the mean of the lognormal dataset

$x_{..} = -122.44$
$(x_{avg})_{..} = -4.90$
$n_i = 5$
$p = 4$
$N = 25$

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.414	0.171	-1.766	10	1.539	-15.9
0.189	0.036	-3.328	5	0.143	-13.3
0.113	0.013	-4.357	5	0.051	-17.4
0.093	0.009	-4.753	5	0.035	-19.0

$\sum(S_i^2) =$ 0.23 $\sum f_i\ln(S_i^2) =$ -65.6

Equality of Variance: Bartlett's Test

$f =$ 21
$Sp^2 =$ 0.084
$\ln Sp^2 =$ -2.474
$c^2 =$ 13.683 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
$c^2_{crit} * =$ 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. (i.e., $c^2 \le c^2_{crit}$)

Because variances are not equal, Statistical Test 3, Nonparametric ANOVA is performed.**

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

**Section 5.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B1: Arsenic URGA, Statistical Test Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**0.00602**	**0.00359**	**0.0168**	**0.00723**	0.0025
Jan-20	**0.00817**	**0.00518**	**0.0202**	**0.00928**	**0.00211**
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0.0025
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0.0025
Sum	0.0796		0.10880	0.04278	0.0117
n_i	10		5	5	5
$(x_i)_{avg}$	0.00796		0.02176	0.00856	0.0023

mg/L = milligrams per liter
BG = background
DL = detection limit
All data sets represent 1/2 DL values for nondetects.
Bolded values indicate a detected result.

Overall mean x.. = 0.00971

N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	0.24	x.. = the sum of the total number of samples

Attachment B1: Arsenic URGA, Statistical Test Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Nonparametric ANOVA

Ranking of Observations

Sequence	Arsenic (mg/L)	Adjusted Rank	Tie Number
1	0	2	Tie 1
2	0	2	
3	0	2	
4	**0.00211**	4.5	Tie 2
5	**0.00211**	4.5	
6	**0.00359**	6	
7	**0.00518**	7	
8	**0.00534**	8	
9	**0.00602**	9	
10	**0.00723**	10	
11	**0.00793**	11	
12	**0.00806**	12	
13	**0.00817**	13	
14	**0.00832**	14	
15	**0.00859**	15	
16	**0.00895**	16	
17	**0.00928**	17	
18	**0.00939**	18	
19	**0.0109**	19	
20	**0.0154**	20	
21	**0.0168**	21	
22	**0.0202**	22	
23	**0.0212**	23	
24	**0.0222**	24	
25	**0.0284**	25	

mg/L = milligrams per liter
BG = background
DL = detection limit
Bolded values indicate a detected result.
NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

n_{tie}		
3	Tie 1 =	24
2	Tie 2 =	6
	$\sum T_i$ =	30

Attachment B1: Arsenic URGA, Statistical Test Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Sums of Ranks and Averages

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**0.00602**	**0.00359**	**0.0168**	**0.00723**	0
Jan-20	**0.00817**	**0.00518**	**0.0202**	**0.00928**	**0.00211**
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0

Observation Ranks for Arsenic					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	9	6	21	10	2
Jan-20	13	7	22	17	4.5
Jul-20	19	8	24	16	2
Jan-21	20	14	23	18	4.5
Jul-21	12	15	25	11	2
R_i	123		115	72	15
$(R_i)_{avg}$	12.3		23.0	14.4	3.0
R_i^2/n_i	1512.9		2645.0	1036.8	45.0

$\Sigma R_i^2/n_i$ = 5239.7

K = 4

N = 25

mg/L = milligrams per liter

BG = background

DL = detection limit

K = the number of n_i groups

N = the total number of samples

Bolded values indicate a detected result.

NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

Calculation of Kruskal-Wallis Statistic

H = 18.733 Kruskal-Wallis Statistic $H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$

H' = 18.769 Corrected Kruskal-Wallis $H' = H/[1-(\sum T_i/N^3-N)]$

χ^2_{crit}* = 7.815 3 degrees of freedom at the 5% significance level

NOTE: $H' > \chi^2_{crit}$

If $H' \leq \chi^2_{crit}$, the data from each well come from the same continuous distribution and hence have the same median concentrations of a specific constituent.

If $H' > \chi^2_{crit}$, reject the null hypothesis and calculate the critical difference for well comparisons to the background.

K-1 = 3 $\alpha/(K-1)$ = 0.01667 $Z(\alpha/(K-1))$** = 2.1280

α = 0.05 $1-(\alpha/K-1)$ = 0.983

NOTE: *Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

**Table 4, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Calculate Critical Values

Average Background Ranking = 12.3

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.578	10.7	**evidence of contamination**
	MW87A	8.578	2.1	not contaminated
	MW90A	8.578	-9.3	not contaminated

mg/L = milligrams per liter
BG = background
DL = detection limit

CONCLUSION: If $(R_i)_{avg} - (R_b)_{avg} > C_i$, then there is evidence that the compliance well is contaminated.

If $(R_i)_{avg} - (R_b)_{avg} < C_i$ for wells, there is no evidence of a statistically significant difference between concentrations in downgradient compliance test wells and background wells.

Since $(R_i)_{avg} - (R_b)_{avg} > C_i$ for MW84A, there is a statistically significant difference between downgradient compliance test wells and background wells in MW84A from the C-404 Landfill.

Because nonparametric ANOVA indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, the 95% UTL was performed.

Since $(R_i)_{avg} - (R_b)_{avg} < C_i$ for MW87A and MW90A, there is no statistically significant difference between background wells and these downgradient compliance test wells; however, the negative value indicates that background wells have elevated concentrations.

Section 5.2.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

95% Upper Tolerance Limit (UTL)

Compare the most recent downgradient sample results to a calculated 95% UTL using the five most recent sets of data for each upgradient well, as described below. If downgradient concentration is less than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

January 2021 Data, First Reporting Period
Arsenic Observations (mg/L)

Well No.						
MW93A	**0.00602**	**0.00817**	**0.01090**	**0.01540**	**0.00806**	**Upgradient Well[!]**
MW420	**0.00359**	**0.00518**	**0.00534**	**0.00832**	**0.00859**	**Upgradient Well[!]**
						Current Data
MW84A						**0.0284**
	X: Mean Value =		0.0080			
	S: Standard Deviation =		0.0034			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		0.4232	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =		**0.0178**	(mg/L)		

! = Data from previous 5 sampling events.
CV = coefficient of variation
* = Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Result: **MW84A exceeded the UTL, which is statistically significant evidence that this compliance well has elevated concentration with respect to background data.**

Because the 95% UTL indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, the paired ANOVA was performed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Paired (Parametric) ANOVA - MW93A and MW84A

Evaluate results using paired ANOVA of wells in the same direction relative to the landfill [e.g., compare upgradient westernmost well results to downgradient westernmost well results]. If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

Arsenic (mg/L)				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-19	**0.00602**	**0.0168**	0.00004	0.00028
Jan-20	**0.00817**	**0.0202**	0.00007	0.00041
Jul-20	**0.0109**	**0.0222**	0.00012	0.00049
Jan-21	**0.0154**	**0.0212**	0.00024	0.00045
Jul-21	**0.00806**	**0.0284**	0.00006	0.00081
Sum (x_i)	0.0486	0.1088	0.15735	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	0.0097	0.0218		
$(x_i)^2$	0.0024	0.0118		

mg/L = milligrams per liter
Bolded values indicate a detected result.

Overall mean x.. =	0.0157	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..} =$	0.1574	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals ($x_i - x_{iavg}$)

Date	Background	Compliance
	MW93A	MW84A
Jul-19	-0.0037	-0.0050
Jan-20	-0.0015	-0.0016
Jul-20	0.0012	0.0004
Jan-21	0.0057	-0.0006
Jul-21	-0.0017	0.0066

X: Mean Value =	0.00E+00	
S: Standard Deviation =	0.004	
K* Factor =	2.911	(for n = 10)
CV = S/X =	#ΔIç/0!	#DIV/0!

†The Coefficient of Variability Test was not performed due to mean = 0 (i.e., division by 0 not possible).

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 0.1574
n_i = number of data points per well	$(x_{avg})_{..} =$ 0.0157
N = total sample size	$n_{i} =$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (groups)	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$†	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$†
0.0036	0.0000	-11.241	5	0	-45.0
0.0042	0.0000	-10.930	5	0	-43.7

$\sum(S_i^2) =$ 0 $\sum f_i\ln(S_i^2) =$ -89

Equality of Variance: Bartlett's Test

f =	8			
Sp^2 =	0.0000			
ln Sp^2 =	-11.074			
χ^2 =	0.096	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).		
χ^2_{crit} * =	3.841	at a 5% significance level with	1	degrees of freedom (p-1)

NOTE: The variances are equal. (i.e., calculated $\chi^2 \leq \chi^2_{crit}$)

Since calculated $\chi^2 \leq \chi^2_{crit}$, then the analysis can proceed as normal.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, First Reporting Period 2021

Between Well Sum of Squares

Source of Variation	Sums of Squares		Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} =	0.0004	1	0.00036	23.39	5.32
Error	SS_{Error} =	0.0001	8	0.00002		
Total	SS_{Total} =	0.0005	9			

If calculated F > F statistic, then reject the hypothesis of equal well means. If calculated F is less than or equal to F statistic, it can be concluded that there is no significant difference between concentrations; therefore, there is no evidence of well contamination.

CONCLUSION: **Calculated F > F statistic; therefore, ANOVA has identified a significant difference between upgradient and downgradient wells.**

Because the paired ANOVA for the two wells indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, a Mann-Kendall statistical analysis was performed.

**Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989). F statistic taken at the 5% significance level.

Mann-Kendall Trend Test Analysis
MW84A Arsenic July 2021

User Selected Options	
Date/Time of Computation	ProUCL 5.19/23/2021 10:19:56 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

MW84A Arsenic July 2021

Input Data

Date Collected	Result (µg/L)
Jan-18	**18.5**
Aug-18	**28.9**
Jan-19	**27.5**
Jul-19	**16.8**
Jan-20	**20.2**
Jul-20	**22.2**
Jan-21	**21.2**
Jul-21	**28.4**

Bolded values indicate a detected result.

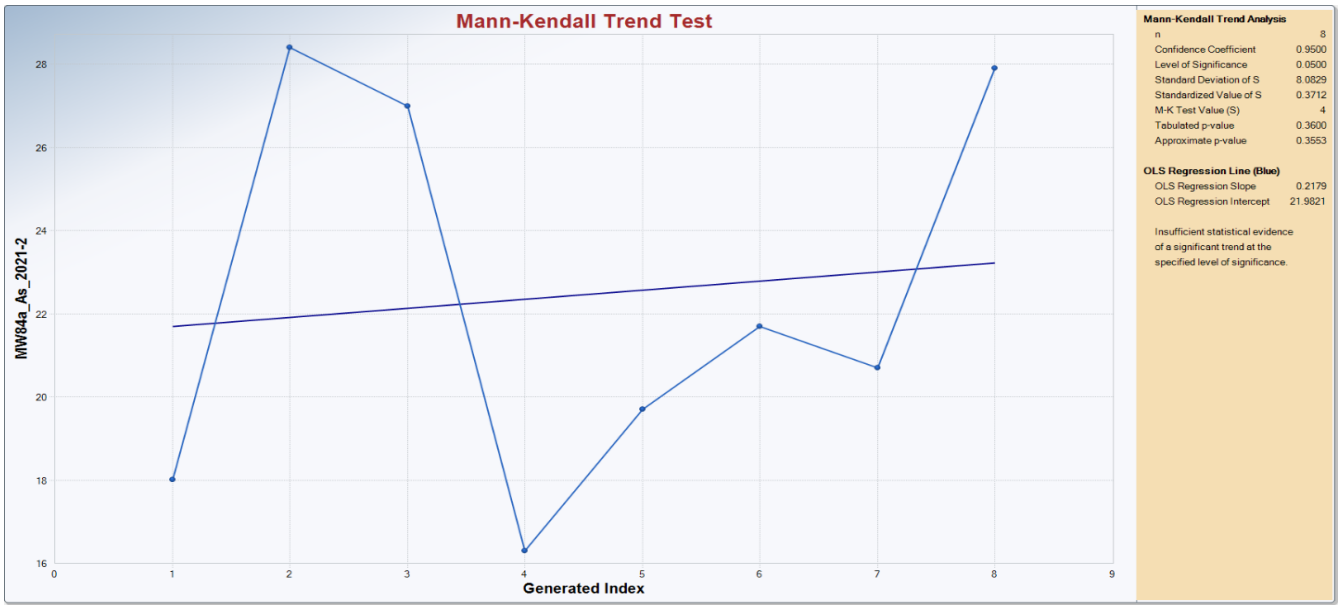
General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	8
Number Values Reported (n)	8
Minimum	16.8
Maximum	28.9
Mean	22.96
Geometric Mean	22.54
Median	21.7
Standard Deviation	4.7
Coefficient of Variation	0.205

Mann-Kendall Test	
M-K Test Value (S)	4
Tabulated p-value	0.36
Standard Deviation of S	8.083
Standardized Value of S	0.371
Approximate p-value	0.355

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Test Analysis
MW84A Arsenic July 2021



ATTACHMENT B2

CADMIUM
STATISTICAL TEST 2

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Attachment B2: Cadmium URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2021

Cadmium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	0.0005	0.0005	0.0005	0.0005	0.0005
Jan-20	0.0005	0.0005	**0.000385**	**0.000503**	0.0005
Jul-20	0.0005	0.0005	0.0005	0.0005	0.0005
Jan-21	0.0005	0.0005	0.0005	0.0005	0.0005
Jul-21	0.0005	0.0005	**0.000317**	0.0005	0.0005

mg/L = milligrams per liter
BG = background
DL = detection limit
All data sets represent 1/2 DL values for nondetects.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	0	X = number of samples above DL in background wells
Y =	3	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.120	P = (x+y)/n
nP =	3	$n = n_b+n_c$
n(1-P) =	22	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used; however, because nP < 5 and/or n(1-P) < 5, the test was continued to determine if the conclusion, along with a simple evaluation of the data would be similar.

P_b =	0.000	P_b = proportion of detects in background wells
P_c =	0.200	P_c = proportion of detects in compliance wells
S_D =	0.133	S_D = standard error of difference in proportions
Z =	-1.508	$Z = (P_b-P_c)/S_D$
absolute value of Z =	1.508	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: **Because the absolute value of Z is less than 1.96, there is no statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples.**

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

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ATTACHMENT B3

TECHNETIUM-99
STATISTICAL TEST 2

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Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2021

Technetium-99 (pCi/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	10.1	10.25	**126**	9.95	9.7
Jan-20	10.25	10.6	**297**	10.5	11.7
Jul-20	10.35	10.7	**332**	9.85	10.25
Jan-21	9.15	8.8	**353**	9.55	8.8
Jul-21	**20.5**	5.3	**229**	5.75	**24.3**

pCi/L = picocuries per liter
BG = background
DL = detection limit
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	1	X = number of samples above DL in background wells
Y =	6	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.280	P=(x+y)/n
nP =	7	$n=n_b+n_c$
n(1-P) =	18	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used.

P_b =	0.100	P_b = proportion of detects in background wells
P_c =	0.400	P_c = proportion of detects in compliance wells
S_D =	0.183	S_D = standard error of difference in proportions
Z =	-1.637	$Z = (P_b-P_c)/S_D$
absolute value of Z =	1.637	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: Because the absolute value of Z is less than 1.96, there is no statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples.

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

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ATTACHMENT B4

TRICHLOROETHENE
STATISTICAL TEST 4

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Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

Trichloroethene (TCE, µg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**789**	**600**	**2000**	**1850**	**55.7**
Jan-20	**1360**	**1090**	**2930**	**2580**	**92.9**
Jul-20	**2220**	**1340**	**3230**	**3090**	**52**
Jan-21	**3120**	**1690**	**2630**	**2570**	**99.6**
Jul-21	**3170**	**1790**	**5290**	**2410**	**148**
n_i	10		5	5	5
Sum	17169		16080	12500	448.20
(x_i)avg	1716.90		3216.00	2500.00	89.64

µg/L = micrograms per liter
Bolded values indicate a detected result.

Overall mean x.. =	1847.89	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	46197.20	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	-927.90	-1116.90	-1216.00	-650.00	-33.94
Jan-20	-356.90	-626.90	-286.00	80.00	3.26
Jul-20	503.10	-376.90	14.00	590.00	-37.64
Jan-21	1403.10	-26.90	-586.00	70.00	9.96
Jul-21	1453.10	73.10	2074.00	-90.00	58.36

X: Mean Value =	-2.39E-14	
S: Standard Deviation =	766.8	
K* Factor =	2.292	(for n = 25)
CV = S/X =	-3.21E+16	< 1, data are normally distributed

Data are normally distributed (i.e.,<1)
*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

Determine Equality of Variance of Dataset

p = number of well groups
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total number of samples
$(x_{avg})_{..} =$ the mean of the total number of samples

$x_{..} =$ 46197.20
$(x_{avg})_{..} =$ 1847.89

p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_i S_i^2$	$f_i \ln(S_i^2)$
888.836	790029.43	13.580	10	7110264.9	122.2
1245.544	1551380.00	14.255	5	6205520.000	57.0
444.410	197500.00	12.193	5	790000.000	48.8
39.001	1521.10	7.327	5	6084.412	29.3

$\sum(S_i^2) =$ 2540430.54 $\sum f_i \ln(S_i^2) =$ 257.3

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 671993.777
$\ln Sp^2 =$ 13.418
$c^2 =$ 24.458 (If $c^2 \leq c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. **(i.e., $c^2 > c^2_{crit}$)**

Variances are not equal, transform the original data to lognormal (i.e., since $c^2 > c^2_{crit}$).

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

Lognormal Data for TCE

ln[TCE (µg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	6.67	6.40	7.60	7.52	4.02
Jan-20	7.22	6.99	7.98	7.86	4.53
Jul-20	7.71	7.20	8.08	8.04	3.95
Jan-21	8.05	7.43	7.87	7.85	4.60
Jul-21	8.06	7.49	8.57	7.79	5.00
Mean x_i	7.54	7.10	8.02	7.81	4.42
Background Mean	7.32		NA	NA	NA
Grand Mean	6.98				
x_i^2	44.50	40.92	57.77	56.59	16.16
	52.06	48.92	63.72	61.71	20.53
These values needed for ANOVA	59.37	51.85	65.29	64.58	15.61
	64.73	55.24	62.01	61.65	21.17
	64.99	56.10	73.51	60.64	24.97
Sum x_i^2	1265				

µg/L = micrograms per liter

Determine Normality of Dataset

Coefficient of Variability Test

Table of ln[TCE (µg/L)] Data

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	6.67	6.40	7.60	7.52	4.02
Jan-20	7.22	6.99	7.98	7.86	4.53
Jul-20	7.71	7.20	8.08	8.04	3.95
Jan-21	8.05	7.43	7.87	7.85	4.60
Jul-21	8.06	7.49	8.57	7.79	5.00

X: Mean Value =	6.98E+00	
S: Standard Deviation =	1.40	
K* Factor =	2.292	(for n = 25)
CV = S/X =	2.00E-01	<1, data are normally distributed

Data are normally distributed (i.e.,<1)

*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

Determine Equality of Variance of Dataset for Lognormal Data

p = number of wells (background wells considered as one group)
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total lognormal dataset
$(x_{avg})_{..}$ = the mean of the lognormal dataset

$x_{..} = 174.48$
$(x_{avg})_{..} = 6.98$
$n_i = 5$
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	ni	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.545	0.297	-1.215	10	2.671	-10.9
0.356	0.127	-2.063	5	0.508	-8.3
0.186	0.034	-3.369	5	0.138	-13.5
0.435	0.190	-1.663	5	0.758	-6.7

$\sum(S_i^2) =$ 0.65 $\sum f_i\ln(S_i^2) =$ -39.3

Equality of Variance: Bartlett's Test

f = 21
Sp^2 = 0.194
$\ln Sp^2$ = -1.640
c^2 = 4.881 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are equal. (i.e., $c^2 \le c^2_{crit}$)

Because variances are equal, the Parametric ANOVA for the lognormal dataset will proceed.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

**Section 5.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

Parametric ANOVA

Between Well Sum of Squares[1]

Source of Variation	Sums of Squares	df	Mean Squares	$F_{calculated}$
Between Wells (SS wells)	42.81	3	14.270	73.53
Error within wells (SS error)	4.08	21	0.194	
Total (SS total)	46.89	24		

If $F_{calculated} > F_{tabulated}$, then reject the hypothesis of equal well means. If $F_{calculated}$ is less than or equal to $F_{tabulated}$, it can be concluded that there is no significant difference between concentrations, therefore, there is no evidence of well contamination.

$F_{tabulated} = 3.07$**

CONCLUSION: $F_{calculated} > F_{tabulated}$; therefore, evidence of well contamination. Additional comparisons must be made.

NOTE: ** Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* , USEPA, 1989. $F_{tabulated}$ taken at the 5% significance level.

Comparison of Compliance Wells to Background Wells (Bonferroni Test)

n_b =	10	N-p =	21	α =	0.05
$(x_b)_{avg}$ =	7.32	m =	3	1-α/m =	0.9833

n_b = total sample size of all background wells

$(x_b)_{avg}$ = average concentration from all background wells

Well No.	Well Mean	Differences of Avg.	Standard Error	Bonferroni's t[2]	D_i	Conclusion
	$(x_b)_{avg}$	$(x_i)_{avg}$-$(x_b)_{avg}$	SE_i	$t_{(N-p),(\alpha/m)}$		
MW93A						
MW420						
MW84A	8.02	0.70	0.24	2.27	0.55	evidence of contamination
MW87A	7.81	0.49	0.24	2.27	0.55	not contaminated
MW90A	4.42	-2.90	0.24	2.27	0.55	not contaminated

CONCLUSION: If the "Differences of Averages" is greater than D_i, then the well is contaminated. After performing Bonferroni's t calculation, the following can be concluded: MW84A shows statistically significantly levels of contamination as compared background wells. MW87A and MW90A do not show statistically significant levels of contamination.

[1]Section 5.2.1, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* , (EPA, 1989).

[2]Appendix B, Table 3 (EPA, 1989).

A 95% UTL comparison is performed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2021

95% Upper Tolerance Limit (UTL)

Compare the most recent downgradient sample results to a calculated 95% UTL using the five most recent sets of data for each upgradient well, as described below. If downgradient concentration is less than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

July 2021 Data, First Reporting Period
TCE Observations (µg/L)

Well No.						
MW93A	**789**	**1360**	**2220**	**3120**	**3170**	**Upgradient Well!**
MW420	**600**	**1090**	**1340**	**1690**	**1790**	**Upgradient Well!**
						Current Data
MW84A						**5290**
	X: Mean Value =		1717			
	S: Standard Deviation =		889			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		0.5177	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =		**4304**	(µg/L)		

! = Data from previous 5 sampling events.
CV = coefficient of variation
* = Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Result: **MW84A exceeded the 95% UTL, which is statistically significant evidence that this compliance well has elevated TCE concentrations with respect to background data.**

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2020

Paired (Parametric) ANOVA - MW93A and MW84A

Evaluate results using paired ANOVA of wells in the same direction relative to the landfill [e.g., compare upgradient westernmost well results to downgradient westernmost well results]. If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

TCE (µg/L)				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-19	**789**	**2000**	622521	4000000
Jan-20	**1360**	**2930**	1849600	8584900
Jul-20	**2220**	**3230**	4928400	10432900
Jan-21	**3120**	**2630**	9734400	6916900
Jul-21	**3170**	**5290**	10048900	27984100
Sum (x_i)	10659	16080	26739	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	2132	3216		
$(x_i)^2$	113614281	258566400		

µg/L = micrograms per liter
Bolded values indicate a detected result.

Overall mean x.. =	2674	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..=}$	26739	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals ($x_i - x_{iavg}$)

Date	Background	Compliance
	MW93A	MW84A
Jul-19	-1343	-1216
Jan-20	-772	-286
Jul-20	88	14
Jan-21	988	-586
Jul-21	1038	2074

X: Mean Value =	0.00E+00	
S: Standard Deviation =	1089	
K* Factor =	2.911	(for n = 10)
CV = S/X =	#ΔIς/0!	#DIV/0!

†The Coefficient of Variability Test was not performed due to mean = 0 (i.e., division by 0 not possible).

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2020

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 26739
n_i = number of data points per well	$(x_{avg})_{..} =$ 2674
N = total sample size	$n_{i=}$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (groups)	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$†	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$†
1056	1115241	13.925	5	4460965	55.7
1246	1551380	14.255	5	6205520	57.0

$\sum(S_i^2)$ = 2,666,621 $\sum f_i\ln(S_i^2)$ = 113

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	1333311	
ln Sp^2 =	14.103	
χ^2 =	0.108	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.841	at a 5% significance level with 1 degrees of freedom (p-1)

NOTE: The variances are equal. (i.e., calculated $\chi^2 \leq \chi^2_{crit}$)

Since calculated $\chi^2 \leq \chi^2_{crit}$, then the analysis can proceed as normal.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2020

Between Well Sum of Squares

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} = 2938724.10	1	2938724.1	2.20	5.32
Error	SS_{Error} = 10666484.80	8	1333310.6		
Total	SS_{Total} = 13605208.90	9			

If calculated F > F statistic, then reject the hypothesis of equal well means. If calculated F is less than or equal to F statistic, it can be concluded that there is no significant difference between concentrations; therefore, there is no evidence of well contamination.

CONCLUSION: **Calculated F < F statistic; therefore, ANOVA has not identified a significant difference between upgradient and downgradient wells.**

**Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989). F statistic taken at the 5% significance level.

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ATTACHMENT B5

URANIUM
STATISTICAL TEST 2

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Attachment B5: Uranium URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2021

Uranium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**0.00056**	0.0001	**0.00089**	0.0001	0.0001
Jan-20	0.0001	0.0001	**0.000305**	0.0001	0.0001
Jul-20	**0.000089**	0.0001	**0.000219**	0.0001	0.0001
Jan-21	**0.0001**	0.0001	**0.000156**	0.0001	0.0001
Jul-21	**0.000079**	0.0001	0.0001	0.0001	0.0001

mg/L = milligrams per liter
BG = background
DL = detection limit
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	4	X = number of samples above DL in background wells
Y =	4	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.320	P=(x+y)/n
nP =	8	$n=n_b+n_c$
n(1-P) =	17	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used.

P_b =	0.400	P_b = proportion of detects in background wells
P_c =	0.267	P_c = proportion of detects in compliance wells
S_D =	0.190	S_D = standard error of difference in proportions
Z =	0.700	$Z = (P_b-P_c)/S_D$
absolute value of Z =	0.700	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: **Because the absolute value of Z is less than 1.96, there is no statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples.**

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

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ATTACHMENT B6

URANIUM-234
STATISTICAL TEST 2

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Attachment B6: Uranium-234 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2021

Uranium-234 (pCi/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-19	**2.38**	0.71	**1.77**	1.01	**1.67**
Jan-20	0.755	0.56	0.695	0.675	0.655
Jul-20	0.83	0.955	0.94	0.825	0.92
Jan-21	0.595	0.57	0.64	0.63	0.7
Jul-21	1.18	0.88	1.225	0.875	0.895

pCi/L = picocuries per liter
BG = background
DL = detection limit
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	1	X = number of samples above DL in background wells
Y =	2	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.120	P=(x+y)/n
nP =	3	$n=n_b+n_c$
n(1-P) =	22	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used; however, because nP < 5 and/or n(1-P) < 5, the test was continued to determine if the conclusion, along with a simple evaluation of the data would be similar.

P_b =	0.100	P_b = proportion of detects in background wells
P_c =	0.133	P_c = proportion of detects in compliance wells
S_D =	0.133	S_D = standard error of difference in proportions
Z =	-0.251	$Z = (P_b-P_c)/S_D$
absolute value of Z =	0.251	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: **Because the absolute value of Z is less than 1.96, there is no statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples.**

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

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ATTACHMENT B7

STATISTICIAN STATEMENT

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Four Rivers Nuclear Partnership, LLC
5511 Hobbs Road
Kevil, KY 42053
www.fourriversnuclearpartnership.com

October 14, 2021

Mr. Dennis Greene
Four Rivers Nuclear Partnership, LLC
5511 Hobbs Road
Kevil, KY 42053

Dear Mr. Greene:

I am submitting this statement as a supplementary document to the completed statistical analysis I performed on the groundwater data for the C-404 Hazardous Waste Landfill at the Paducah Site.

As an Environmental Scientist, with a bachelor's degree in Earth Sciences/Geology, I have over 30 years of experience in reviewing and assessing laboratory analytical results associated with environmental sampling and investigation activities.

For this project, the statistical analyses on groundwater data from July 2019 through July 2021 were performed in accordance with the Hazardous Waste Management Facility Permit, Appendix E using Microsoft Excel 2016 and U.S. Environmental Protection Agency's (EPA's) ProUCL 5.1. The spreadsheets include the results for the following statistical tests:

- Test of Proportions
- Parametric Analysis of Variance (ANOVA)
- Nonparametric ANOVA
- 95% Upper Tolerance Limit
- Paired (parametric) ANOVA
- Mann-Kendall

The statistical analyses procedures were based on EPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance* (1989).

Sincerely,

Bryan Smith

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APPENDIX C

C-404 HAZARDOUS WASTE LANDFILL LEACHATE ANALYTICAL RESULTS

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Paducah OREIS Report for 404L21-02

L1404L2-21 from: C404L on 4/7/2021 Media: WW SmpMethod: GR

Comments: Water level was 5.06'. CH 4-7-21

Analysis	Results	Units	Result Qual	Foot Note	Reporting Limit	Counting Error	TPU**	Method	LabCode	V/V/A*
ANION										
Fluoride	6.82	mg/L	W		0.2			SW846-9056	GEL	I / X /
FS										
Conductivity	436.4	umho/cm						FS	FS	/ /
Dissolved Oxygen	9.49	mg/L						FS	FS	/ /
pH	8.06	Std Unit						FS	FS	/ /
Redox	428.2	mV						FS	FS	/ /
Temperature	60.3	deg F						FS	FS	/ /
METAL										
Arsenic	0.005	mg/L	U		0.005			SW846-6020	GEL	/ X /
Barium	0.073	mg/L			0.004			SW846-6020	GEL	/ X /
Cadmium	0.001	mg/L	U		0.001			SW846-6020	GEL	/ X /
Chromium	0.01	mg/L	U		0.01			SW846-6020	GEL	/ X /
Copper	0.0095	mg/L			0.002			SW846-6020	GEL	/ X /
Iron	0.0507	mg/L	J		0.1			SW846-6020	GEL	/ X /
Lead	0.002	mg/L	U		0.002			SW846-6020	GEL	/ X /
Mercury	0.0002	mg/L	U		0.0002			SW846-7470A	GEL	/ X /
Nickel	0.00355	mg/L			0.002			SW846-6020	GEL	/ X /
Selenium	0.005	mg/L	U		0.005			SW846-6020	GEL	/ X /
Silver	0.001	mg/L	U		0.001			SW846-6020	GEL	/ X /
Uranium	44.3	mg/L	B		0.004			SW846-6020	GEL	I / X /
Zinc	0.02	mg/L	U		0.02			SW846-6020	GEL	/ X /
PPCB										
PCB-1016	0.0945	ug/L	U		0.0945			SW846-8082	GEL	/ X /
PCB-1221	0.0945	ug/L	U		0.0945			SW846-8082	GEL	/ X /
PCB-1232	0.0945	ug/L	U		0.0945			SW846-8082	GEL	/ X /
PCB-1242	0.0945	ug/L	U		0.0945			SW846-8082	GEL	/ X /
PCB-1248	0.655	ug/L			0.0945			SW846-8082	GEL	/ X /
PCB-1254	0.325	ug/L			0.0945			SW846-8082	GEL	/ X /
PCB-1260	0.0709	ug/L	J		0.0945			SW846-8082	GEL	/ X /
Polychlorinated biphenyl	1.05	ug/L			0.0945			SW846-8082	GEL	I / X /
RADS										
Cesium-137	0.249	pCi/L	U		13	6.41	6.41	EPA-901.1	GEL	/ X /
Neptunium-237	1.32	pCi/L	U		1.92	1.41	1.42	ASTM-1475-00M	GEL	/ X /
Plutonium-239/240	-0.0212	pCi/L	U		1.68	0.761	0.761	HASL 300, Pu-11-RC M	GEL	/ X /
Technetium-99	191	pCi/L			17	17	27.2	HASL 300, Tc-02-RC M	GEL	/ X /
Thorium-230	0.58	pCi/L	U		1.39	0.854	0.861	HASL 300, Th-01-RC M	GEL	/ X /
Uranium-234	1480	pCi/L			35.2	114	184	HASL 300, U-02-RC M	GEL	/ X /
Uranium-235	176	pCi/L			21.1	44.5	47.7	HASL 300, U-02-RC M	GEL	/ X /
Uranium-238	15800	pCi/L			21.4	368	1580	HASL 300, U-02-RC M	GEL	/ X /
VOA										
Trichloroethene	1	ug/L	U		1			SW846-8260B	GEL	/ X /
WETCHEM										
Ammonia as Nitrogen	0.154	mg/L			0.05			EPA-350.1	GEL	/ X /

*Verification/Validation/Assessment ** TPUs reported at 1.96 sigma

Paducah OREIS Report for 404L21-02

TB404L2-21 from: QC on 4/7/2021 Media: WQ SmpMethod:

Comments:

Analysis	Results	Units	Result Qual	Foot Note	Reporting Limit	Counting Error	TPU**	Method	LabCode	V/V/A*
VOA										
Trichloroethene	1	ug/L	U		1			SW846-8260B	GEL	/ X /

*Verification/Validation/Assessment ** TPUs reported at 1.96 sigma

APPENDIX D

2021 ANNUAL REPORT OF THE C-404 LANDFILL HYDRAULIC FLOW RATE AND DIRECTION

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2021 ANNUAL REPORT OF THE C-404 LANDFILL HYDRAULIC FLOW RATE AND DIRECTION

The Hazardous Waste Management Facility Permit, KY8-890-008-982, (Permit) requires annual determination of average hydraulic flow rate and direction of flow in the uppermost aquifer at the C-404 Hazardous Waste Landfill (C-404 Landfill). The uppermost aquifer below the C-404 Landfill is the Regional Gravel Aquifer (RGA). Water level measurements currently are taken from several wells at the perimeter of the C-404 Landfill on a semiannual basis. The water levels used for this analysis (taken on January 28, 2021, and July 14, 2021) were measured as closely as possible and within a 24-hour period to ensure the comparability of the data. Table D.1 documents the datums used for the water level measurements. These measurements were used to plot the potentiometric surface of the upper RGA for the January and July 2021 semiannual sampling events.

Table D.1. Measurement Control Datums Used for Upper Regional Gravel Aquifer C-404 Monitoring Wells During 2021

Well		Datum Point Elevation (ft amsl)
MW84A	Top of Outside Casing	375.29
MW87A	Top of Outside Casing	375.30
MW90A	Top of Inside Casing	374.15
MW93A	Top of Outside Casing	378.67
MW420	Top of Inside Casing	377.55

Contours for each potentiometric surface were drawn after water level data were corrected for barometric pressure; groundwater hydraulic gradients then are calculated from the contours. The average of the gradients measured during this reporting period is the annual average groundwater hydraulic gradient for the upper RGA and is calculated at 1.97×10^{-3} ft/ft.

The hydraulic conductivity (K) values reported in the *Resource Conservation and Recovery Act (RCRA) Part B Permit Modification for Inclusion of C-404 Low-Level Radioactive/Hazardous Waste Landfill* (June 1992) were determined by multi-well testing and range from 21 to 140 ft/day (7.41×10^{-3} to 4.94×10^{-2} cm/s).

Multiplication of the hydraulic gradient (i) and the hydraulic conductivity (K) yields the specific discharge (q) for a unit area of the RGA. Annual average linear-flow velocity (v) is calculated by multiplying the hydraulic conductivity by the gradient and dividing by the porosity (n). It is assumed that the porosity equals 25 percent in the RGA beneath the C-404 Landfill.

Table D.2 summarizes the annual average results of the calculations. Table D.3 presents the calculation information for the annual groundwater flow rate. The January and July potentiometric surface data of the upper RGA are presented in Tables D.4 and D.5, and potentiometric surface maps are presented in Figures D.1 and D.2.

The potentiometric contours depict the directions of hydraulic flow during each sampling event. Hydraulic flow direction beneath the C-404 Landfill generally trends northeastward, but commonly varies from northeast to north.

Table D.2. C-404 Landfill Annual Average Groundwater Flow Rate for 2021

Hydraulic Conductivity (K) Range	Annual Average Specific Discharge (q) ft/day (cm/s)	Annual Average Linear Flow Velocity (v) ft/day (cm/s)
Low K	0.0413 (1.46×10^{-5})	0.165 (5.83×10^{-5})
High K	0.275 (9.71×10^{-5})	1.10 (3.88×10^{-4})

Table D.3. Calculation Information for the C-404 Landfill Annual Groundwater Flow Rate 2021

Upper RGA K = 21 ft/d					
	i (ft/ft)	q (ft/d)	q (cm/s)	v (ft/d)	v (cm/s)
January 2021	-1.81×10^{-3}	0.0379	1.34×10^{-5}	0.152	5.35×10^{-5}
July 2021	-2.13×10^{-3}	0.0446	1.57×10^{-5}	0.179	6.30×10^{-5}
Annual Average	**-1.97×10^{-3}**	**0.0413**	**1.46×10^{-5}**	**0.165**	**5.83×10^{-5}**
Upper RGA K = 140 ft/d					
	i (ft/ft)	q (ft/d)	q (cm/s)	v (ft/d)	v (cm/s)
January 2021	-1.81×10^{-3}	0.253	8.92×10^{-5}	1.01	3.57×10^{-4}
July 2021	-2.13×10^{-3}	0.298	1.05×10^{-4}	1.19	4.20×10^{-4}
Annual Average	**-1.97×10^{-3}**	**0.275**	**9.71×10^{-5}**	**1.10**	**3.88×10^{-4}**

$q = K*i$

where:
q = specific discharge
K = hydraulic conductivity
i = hydraulic gradient (from potentiometric map)

$v = q/n$

where:
v = average linear velocity
q = specific discharge
n_e = porosity (assumed to be 25%)

ft/ft = foot per foot
ft/d = foot per day
cm/s = centimeter/second

Table D.4. January 2021 RGA Potentiometric Surface Data

C-404 Landfill (January 2021) Water Levels									
						Raw Data		*Corrected Data	
Date	Time	Well	Datum Elev (ft amsl)	BP (in Hg)	Delta BP (ft H20)	DTW (ft)	Elev (ft amsl)	DTW (ft)	Elev (ft amsl)
1/28/2021	7:55	MW67	374.89	30.66	-0.02	50.45	324.44	50.43	324.47
1/28/2021	7:35	MW76	376.56	30.64	0.00	52.00	324.56	52.00	324.56
1/28/2021	7:50	MW84A	375.29	30.64	0.00	51.05	324.24	51.05	324.24
1/28/2021	7:40	MW87A	375.30	30.64	0.00	51.00	324.30	51.00	324.30
1/28/2021	8:28	MW90A	374.15	30.66	-0.02	49.86	324.29	49.84	324.31
1/28/2021	7:27	MW93A	378.67	30.64	0.00	53.95	324.72	53.95	324.72
1/28/2021	7:05	MW227	378.81	30.64	0.00	54.01	324.80	54.01	324.80
1/28/2021	7:30	MW333	377.20	30.64	0.00	52.37	324.83	52.37	324.83
1/28/2021	8:19	MW337	374.39	30.66	-0.02	49.81	324.58	49.79	324.61
1/28/2021	8:22	MW338	374.85	30.66	-0.02	50.14	324.71	50.12	324.73
1/28/2021	7:23	MW420	377.55	30.64	0.00	52.94	324.61	52.94	324.61
Reference Barometric Pressure			**30.64**						
Elev = elevation									
amsl = above mean sea level									
BP = barometric pressure									
DTW = depth to water in feet below datum									
*Assumes a barometric efficiency of 1.0									

Table D.5. July 2021 RGA Potentiometric Surface Data

C-404 Landfill (July 2021) Water Levels									
						Raw Data		*Corrected Data	
Date	Time	Well	Datum Elev (ft amsl)	BP (in Hg)	Delta BP (ft H20)	DTW (ft)	Elev (ft amsl)	DTW (ft)	Elev (ft amsl)
7/14/2021	11:22	MW67	374.89	30.20	0.00	46.71	328.18	46.71	328.18
7/14/2021	11:19	MW76	376.56	30.20	0.00	48.28	328.28	48.28	328.28
7/14/2021	9:28	MW84A	375.29	30.21	-0.01	47.30	327.99	47.29	328.01
7/14/2021	9:45	MW87A	375.30	30.21	-0.01	47.43	327.87	47.42	327.88
7/14/2021	8:18	MW90A	374.15	30.19	0.01	46.53	327.62	46.54	327.61
7/14/2021	10:55	MW93A	378.67	30.20	0.00	50.26	328.41	50.26	328.41
7/14/2021	11:27	MW227	378.81	30.20	0.00	50.21	328.60	50.21	328.60
7/14/2021	11:14	MW333	377.20	30.20	0.00	48.64	328.56	48.64	328.56
7/14/2021	7:28	MW337	374.39	30.18	0.02	46.26	328.13	46.28	328.11
7/14/2021	7:38	MW338	374.85	30.18	0.02	46.52	328.33	46.54	328.31
7/14/2021	10:22	MW420	377.55	30.21	-0.01	49.25	328.30	49.24	328.32
Reference Barometric Pressure			**30.20**						
Elev = elevation									
amsl = above mean sea level									
BP = barometric pressure									
DTW = depth to water in feet below datum									
*Assumes a barometric efficiency of 1.0									

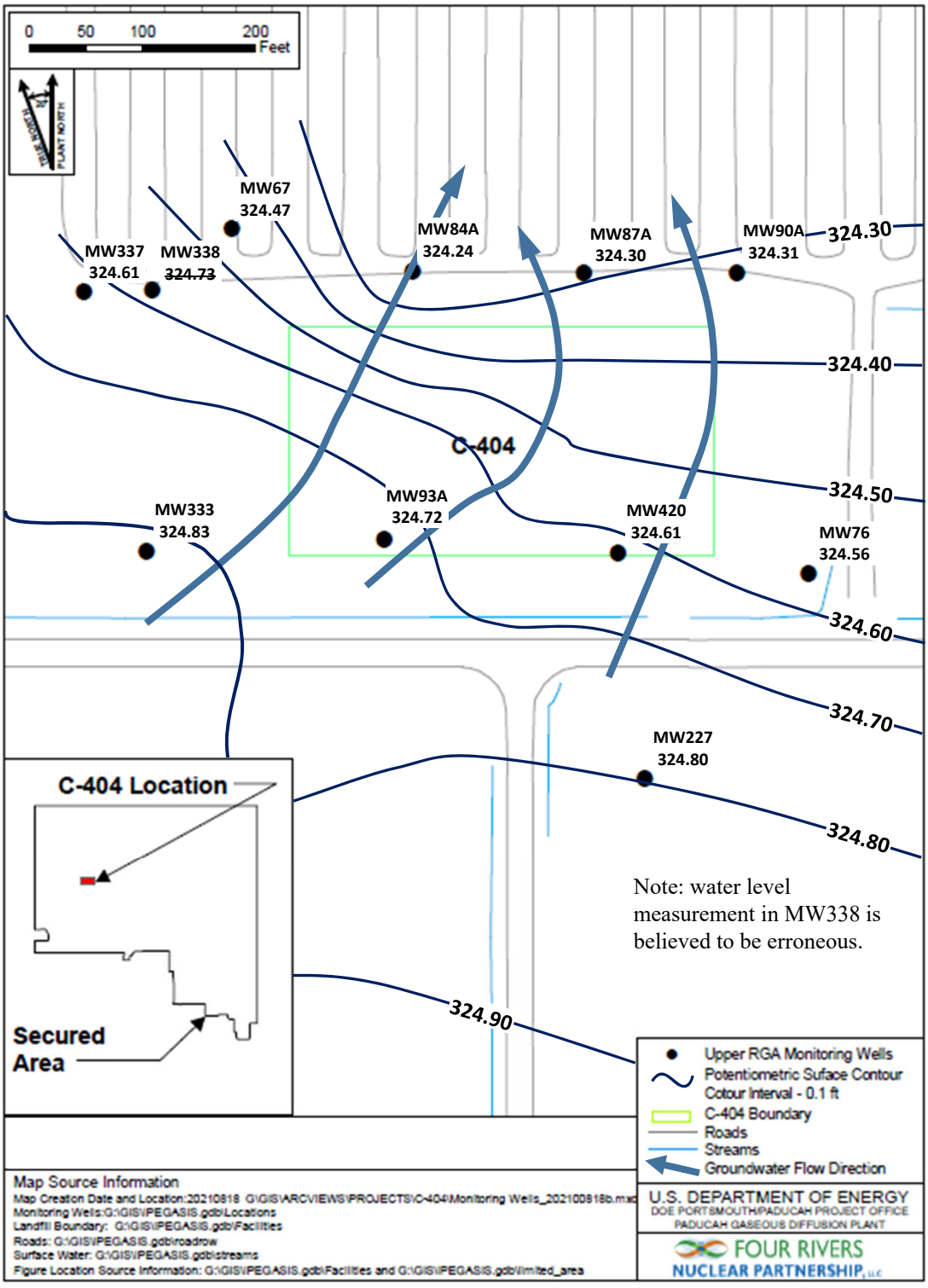

Figure D.1. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, January 28, 2021

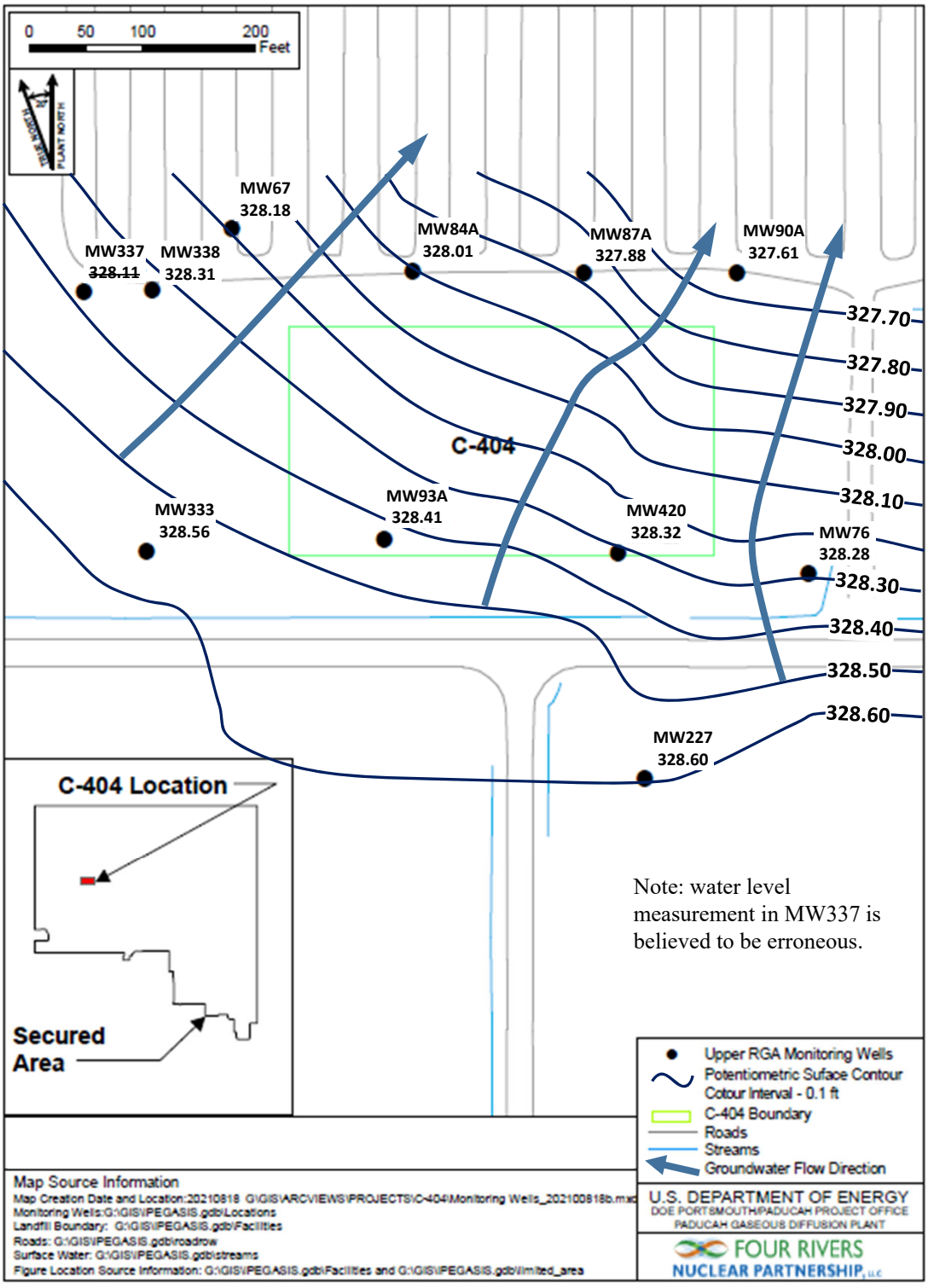

Figure D.2. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, July 14, 2021

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