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August 9, 2021

Mr. Brian Begley
Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

PPPO-02-10015361-21

Mr. Victor Weeks
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Begley and Mr. Weeks:

TRANSMITTAL OF THE TRICHLOROETHENE AND TECHNETIUM-99 GROUNDWATER CONTAMINATION IN THE REGIONAL GRAVEL AQUIFER FOR CALENDAR YEAR 2020 AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, FRNP-RPT-0175

Please find enclosed a courtesy copy of the subject document, *Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for Calendar Year 2020 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* FRNP-RPT-0175. This report presents the methodology used to develop the trichloroethene (TCE) and technetium-99 (Tc-99) groundwater plume maps from groundwater sampling data from wells completed in the Regional Gravel Aquifer and collected through the end of Calendar Year 2020. The plume maps are used to depict and understand better the progress of groundwater cleanup and optimize planning of groundwater cleanup at the Paducah Gaseous Diffusion Plant.

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

Sincerely,

Tracey L. Duncan

Digitally signed by Tracey L. Duncan
Date: 2021.08.09 10:10:37 -05'00'

Tracey Duncan
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosure:
Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for Calendar Year 2020 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, FRNP-RPT-0175

Administrative Record File—ARF ARR

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FRNP-RPT-0175

Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for Calendar Year 2020 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

This document is approved for public release per review by:

K L Beasley — FRNP Classification Support

7-1-2021 — Date

Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for Calendar Year 2020 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—July 2021

Prepared for the
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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ACRONYMS

AIP	agreement in principle
amsl	above mean sea level
CY	calendar year
DOE	U.S. Department of Energy
EMP	environmental monitoring plan
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FRNP	Four Rivers Nuclear Partnership, LLC
MCL	maximum contaminant level
MW	monitoring well
OREIS	Oak Ridge Environmental Information System
PEGASIS	Portsmouth/Paducah Project Office Environmental Geographic Analytical Spatial Information System
PGDP	Paducah Gaseous Diffusion Plant
RGA	Regional Gravel Aquifer
SWMU	solid waste management unit
USGS	U.S. Geological Survey

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1. INTRODUCTION

Four Rivers Nuclear Partnership, LLC, (FRNP) has evaluated groundwater analytical data as of the end of calendar year (CY) 2020 to produce revised groundwater plume maps for both trichloroethene (TCE) and technetium-99 (Tc-99) within the Regional Gravel Aquifer (RGA) associated with the U.S. Department of Energy (DOE) Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky. The two primary groundwater plume constituents are TCE and Tc-99. This report presents the analytical data sets taken from the Paducah Oak Ridge Environmental Information System (OREIS) data system, methods used to develop these maps, and changes to the contaminant plumes over time. These plume maps are intended to show the most recent sample result from each location as of the end of CY 2020. For wells that were not sampled in 2020, the most recent sample result from 2019 has been used. Because these plume maps are based on the most recent values for 2020 or 2019, they may not reflect the maximum or minimum value observed during the reporting period for all locations. An alternate interpretation showing the maximum values observed during 2019 to 2020 is available in Appendix A.

The plume maps depict the general footprint of the TCE and Tc-99 contamination in the RGA and convey the general magnitude and distribution of contamination at or above the TCE and Tc-99 maximum contaminant levels (MCLs)[1] within the plumes. These maps show the full extent of the TCE and Tc-99 plumes, with plots of isoconcentration lines and measured contaminant levels. Maps of TCE degradation products are not included because their detection often is masked by higher TCE concentrations in groundwater samples and the plumes of TCE degradation products are overlain by the TCE plumes. In the 2019–2020 dataset, no TCE degradation product was detected at a concentration above its MCL outside the area overlain by the TCE plumes. Any calculation of human health risk estimates based upon mapped contaminant levels should be performed by a qualified risk assessor because of the uncertainties in the levels of TCE breakdown products, some of which are unknown due to the inability to measure these levels in areas where TCE concentrations are very high.

The PGDP groundwater plume maps are revised every two years to: (i) provide a basis for timely incorporation of routine groundwater monitoring and characterization data, (ii) demonstrate the progress of groundwater cleanup to date, and (iii) facilitate planning to optimize the site groundwater cleanup. The plume maps also complement the reporting of environmental monitoring plan results and activities in the Paducah Site Annual Site Environmental Report. These plume maps are used, along with additional information, to further evaluate specific areas of groundwater contamination at PGDP in more detail for decision-making purposes based on individual project needs. More specific project evaluations are discussed in applicable documents, which are available through the DOE Environmental Information Center (i.e., https://eic.pad.pppo.gov).

The data tables (including charts of TCE and Tc-99 sampling results collected for the last 10 years) used to generate maps presented in this document are included in the appendices. TCE and Tc-99 analyses of groundwater samples collected by DOE that were rejected during data validation, verification, or assessment were not used in development of this report. These analyses are generated following the quality assurance project plan in the applicable environmental monitoring plan (EMP) (FRNP 2019a;

[1] For Tc-99, 900 pCi/L defines the lower plume limit. The value derived by the U.S. Environmental Protection Agency (EPA) from the 4 mrem/year MCL for Tc-99 is 900 pCi/L (see https://www.epa.gov/reg-flex/radionuclides-drinking-water-small-entity-compliance-guide-february-2002). An alternate value derived by the EPA from the 4 mrem/year MCL is 3,790 pCi/L and was proposed in the July 18, 1991, Federal Register, http://nepis.epa.gov (document number 570-Z-91-049). Table A.9 of the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plan, Paducah, Kentucky, Volume 1, Human Health* (DOE 2021) includes the Tc-99 dose-based groundwater screening levels resulting in a 4 mrem/year dose based upon more recent dosimetry.

FRNP 2019b). Appendix A contains tables and trend charts of TCE and Tc-99 sampling results collected for the last 10 years and plume maps showing the maximum values observed during 2019 and 2020. Appendix B contains the most recent TCE and Tc-99 values from 2019 and 2020 from PGDP RGA monitoring wells (MWs). These concentrations were used to develop Figure 1 through Figure 10 as well as the large-scale maps of the 2020 plume maps showing most recent concentrations in 2019 and 2020 provided in Appendix C.

The isoconcentration contours of contaminant levels depicted on the maps presented in Section 4 and the large scale plume maps in Appendix C are based on the distribution of contaminant concentrations most recently observed in 2019 and 2020 and knowledge of the site conceptual model. The magnitude and distribution of contamination within the plumes will vary slightly over time based on contaminant trends and variations in hydrologic influences.

The Kentucky Division of Waste Management conducts independent environmental monitoring activities at the Paducah Site under a DOE Agreement in Principle (AIP) grant. AIP data are used semiquantitatively in the preparation of the report. In general, the MW and residential well sampling conducted under the AIP program has produced results that are similar to those obtained by DOE. For the reporting period, the AIP program sampled seven MWs for TCE and three MWs for Tc-99 that were not sampled by DOE. The Tc-99 analyses of MW257 (not sampled by DOE), with the latest result for the reporting period of 833 pCi/L, are an example of AIP data that significantly influence the interpretation of the plumes.

To support interpretation of plume geometries, potentiometric surface maps for the RGA were developed using synoptic water level measurements collected in August 2019 and August 2020 to evaluate groundwater flow direction. These potentiometric maps are presented in Section 5.

2. DATA ANALYSIS METHODOLOGY

The TCE and Tc-99 data used in these maps were extracted from the Paducah OREIS database. Paducah OREIS is the centralized, standardized, quality assured, and configuration-controlled data management system that is the long-term repository of environmental data (i.e., measurements, geographic) for Paducah projects. See Table B.1 in Appendix B for the 2019 to 2020 TCE and Tc-99 results in RGA wells used to create the 2020 TCE and Tc-99 plume maps. Data collected by DOE contractors, following consistent quality assurance and sampling protocols, are used so that the data are comparable to previous reports. Data are made available to the public through the DOE Portsmouth/Paducah Project Office Environmental Geographic Analytical Spatial Information System (PEGASIS) (i.e., https://pegasis.pad.pppo.gov/). The maps for CY 2020 are based on analytical results from the most recent sampling event (primarily January 2020–December 2020). Where co-located MWs (i.e., clustered wells, multiport wells) provide analytical results for the CY from screened intervals at multiple elevations within the RGA (e.g., upper, middle, and/or lower RGA), the maps use the value from the interval that has the highest concentration. For wells that were not sampled in 2020, the most recent data from 2019 have been used.

Mapping involved first plotting the selected data on Geographic Information System-generated maps and then comparing those data to the contouring performed for the 2018 TCE and Tc-99 plume maps. Plume contours were adjusted to accommodate more recent data. The impact of the changes from 2018 to 2020 is discussed in Section 4. On the 2020 plume maps shown in Section 4 of the main text, dashed lines show the contour lines from the 2018 plume maps for comparison.

For TCE, the Safe Drinking Water Act MCL of 5 µg/L is the isoconcentration contour that defines the limit of the plume. Subsequent isoconcentration contours of 100 µg/L, 1,000 µg/L, 10,000 µg/L, and

100,000 µg/L are provided based on concentration data for the period. For Tc-99, 900 pCi/L defines the plume limit.[2] Subsequent isoconcentration contours of 1,930 pCi/L and 3,790 pCi/L are provided based on concentration data for the period.

3. 2020 PLUME MAPS

As identified in the "Screened Zone" column of Appendix B, Well Program Inventory, in the EMP, there are 284 active wells (including MWs, piezometers, and extraction wells) and 24 residential wells that can be used to monitor the RGA (FRNP 2019b). The PGDP deactivation and remediation prime contractor monitored a subset of this well network in 2020, as discussed below, in accordance with the EMPs (FRNP 2019a; FRNP 2019b).

Figures C.1 and C.2 of Appendix C provide the 2020 TCE and Tc-99 plume maps, respectively. Section 4 includes an explanation for the interpretation of these maps. Table 1 presents a summary of some characteristics of these plumes in areas outside the PGDP boundary and off DOE property.[3] Because these plumes are based on interpretation, plume lengths outside the DOE property and plume areas are approximate.

Table 1. PGDP Groundwater Plumes, CY 2020

Plume	Approximate Maximum Contaminant Levels Outside PGDP Boundary	Approximate Maximum Contaminant Levels Off DOE Property	Off DOE Property Plume Length	Approximate Total Area[a]
		TCE		
Northwest	336 µg/L	68.6 µg/L	1.8 miles	603 acres
C-746-S&T Area	14 µg/L	N/A[a]	N/A[b]	89 acres
Northeast	309 µg/L	96.4 µg/L	1.7 miles	821 acres
Southwest	< 5 µg/L	< 5 µg/L	N/A	84 acres
		Tc-99		
Northwest	< 900 pCi/L	< 900 pCi/L	N/A	20 acres

[a] The approximate total areas are the areas of the respective plumes inside and outside the PGDP boundary and off DOE property.
[b] The C-746-S&T plume does not leave DOE property as currently interpreted.

3.1 TRICHLOROETHENE

During the reporting period of 2019 to 2020, 235 RGA MWs[4] and 13 residential wells were sampled by DOE, analyzed for TCE, and included in the development of the revised groundwater TCE plume map. Of the 235 RGA MWs included in the development of the TCE plume map, 186 were sampled most recently in 2020. Of the residential wells used for monitoring the RGA, 13 residential wells were sampled in 2020

[2] For Tc-99, 900 pCi/L defines the lower plume limit. The value derived by the EPA from the 4 mrem/year MCL for Tc-99 is 900 pCi/L (see https://www.epa.gov/reg-flex/radionuclides-drinking-water-small-entity-compliance-guide-february-2002). An alternate value derived by the EPA from the 4 mrem/year MCL is 3,790 pCi/L and was proposed in the July 18, 1991, Federal Register, http://nepis.epa.gov (document number 570-Z-91-049). Table A.9 of the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plan, Paducah, Kentucky, Volume 1. Human Health* (DOE 2021) includes the Tc-99 dose-based groundwater screening levels resulting in a 4 mrem/year dose based upon more recent dosimetry.
[3] For purposes of this report, the "PGDP boundary" is defined as the revised 229 Boundary, per *FR* Notices, Vol. 83, No. 213, dated November 2, 2018.
[4] Of these RGA MWs, some have multiple sampling ports.

for TCE and the results were included in the development of the TCE plume map. The sample collection was based on the applicable EMP, which summarizes the compliance sampling and sampling by other regulatory programs conducted at the site (FRNP 2019a; FRNP 2019b). These results are supplemented by 49 RGA MWs sampled and analyzed for TCE in 2019, but were not sampled in 2020. A summary of the approximate maximum levels of TCE outside the PGDP boundary and off DOE property in RGA wells is shown in Table 1. Appendix B lists the most recent sample data that was used to develop the 2020 plume maps.

Appendix C contains the 2020 TCE plume map (Figure C.1). Generally, the plume interpretation is based on the following:

- In 2019 and 2020, 1,339 groundwater samples were collected by DOE from RGA MWs and residential wells and analyzed for TCE from 2019 to 2020.

- TCE results from 2019 to 2020 used to develop the plume maps, along with the date sampled, are posted adjacent to the well label. The basis for data posting is as follows:

  — If the well was sampled only once in 2020, the sample result is posted.

  — If the well was sampled multiple times, the most recent result was posted. If the most recent data are from duplicate samples or include more than one sample per day, the highest concentration value was posted.

  — For well clusters with completions screened in the upper, middle, and lower horizons of the RGA, each value is posted where practical and where space was not available, the maximum value from the well cluster was used in mapping and is posted.

- The results are posted as reported by the laboratory, with "U," "J," and "Y1" laboratory qualifiers, if applicable.[5]

- Groundwater extraction well locations are labeled on the map; however the concentrations from the wells are not posted.

- For some wells that were not sampled in 2020 but sampled in 2019, TCE results from 2019 were used to develop the plume map using the same rules as for the 2020 TCE results. These results and the date sampled are posted on the map.

- The contour intervals selected were 5 µg/L, 100 µg/L, 1,000 µg/L, 10,000 µg/L, and 100,000 µg/L. This order of magnitude interval approach for contour interval selection is consistent with the contour interval selection used in the prior mapping for the site.

- Contouring was produced by hand, using interpolation between observed concentrations. The contouring also incorporated historical source information and previous plume interpretations.

[5] A "U" qualifier indicates a result is not detected at a reporting limit of 1 µg/L. A "J" qualifier indicates a result is reported at a value less than the reporting limit. A "Y1" qualifier indicates MS/MSD recovery outside acceptance criteria.

3.2 TECHNETIUM-99

During the reporting period of 2019 to 2020, 198 RGA MWs[6] and 7 residential wells were sampled by DOE, analyzed for Tc-99, and included in the development of the revised groundwater Tc-99 plume map. Of the 198 RGA MWs included in the development of the Tc-99 plume map, 163 were sampled most recently in 2020. Of the residential wells used for monitoring the RGA, seven residential wells were sampled in 2020 for Tc-99 and the results were included in the development of the Tc-99 plume map. The sample collection was based on the applicable EMP, which summarizes the compliance sampling and sampling by regulatory programs being conducted at the site (FRNP 2019a; FRNP 2019b). These results are supplemented by 37 RGA MWs sampled and analyzed for Tc-99 in 2019, but were not sampled in 2020. Tc-99 was not detected above 900 pCi/L outside the PGDP boundary in either 2019 or 2020. The highest Tc-99 concentration in RGA wells outside the PGDP boundary was 339 pCi/L at MW500, located adjacent to extraction well EW233. Appendix B lists the most recent sample data that were used to develop the 2020 plume maps.

Appendix C contains the 2020 Tc-99 plume map (i.e., Figure C.2). Generally, the plume interpretation is based upon the following:

- A total of 1,092 groundwater samples was collected by DOE from RGA MWs and residential wells and analyzed for Tc-99 from 2019 to 2020.

- Tc-99 results from 2020 used to develop the plume map, along with the date sampled, are posted adjacent to the well. The logic for data posting was the same as described for TCE in Section 3.1.

- The results are posted as reported by the laboratory, with "U" laboratory qualifiers, if applicable.[7]

- For some wells that were not sampled in 2020, but were sampled in 2019, the Tc-99 results from 2019 used to develop the plume map were selected using the same rules as for the 2020 Tc-99 results. These results and the date sampled are posted on the map.

- The contour intervals selected were 900 pCi/L, 1,930 pCi/L, and 3,790[8] pCi/L. The interval selection is based on EPA's 1976 and 1991 derived MCL activities of 900 pCi/L and 3,790 pCi/L, respectively, and the derived concentration standard of 1,930 pCi/L (DOE 2021). The contour intervals of 900 pCi/L and 3,790 pCi/L are consistent with the contour interval selection used in recent mapping for the site; the contour interval of 1,930 pCi/L has been added.

- Contouring was produced by hand, using interpolation between observed concentrations. The contouring also incorporated historical source information and previous plume interpretations.

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[6] Of these RGA MWs, some have multiple sampling ports.

[7] A "U" qualifier indicates a result is reported less than the minimum detectable activity and/or total propagated uncertainty. Negative results may be reported due to a statistical determination of the counts seen by a detector, minus a background count.

[8] For Tc-99, 900 pCi/L defines the lower plume limit. The value derived by the EPA from the 4 mrem/year MCL for Tc-99 is 900 pCi/L (see https://www.epa.gov/reg-flex/radionuclides-drinking-water-small-entity-compliance-guide-february-2002). An alternate value derived by the EPA from the 4 mrem/year MCL is 3,790 pCi/L and was proposed in the July 18, 1991, Federal Register, http://nepis.epa.gov (document number 570-Z-91-049). Table A.9 of the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plan, Paducah, Kentucky, Volume 1. Human Health* (DOE 2021) includes the Tc-99 dose-based groundwater screening levels resulting in a 4 mrem/year dose based upon more recent dosimetry.

4. CHANGES FROM 2018 PLUME MAPS

PGDP groundwater plume maps for 2014 to 2020 are presented in Figures 1 and 2 for TCE and Tc-99, respectively. The previous comprehensive plume maps summarized data collected through 2018 (FRNP 2019c). In an effort to understand the changes in the plume areas and contaminant concentrations at PGDP, FRNP compared the 2020 maps with the 2018 plume maps for both TCE and Tc-99. For discussion purposes, the plumes have been divided into northwest, northeast, and central portions, including the Southwest Plume. Figures in this section show the 2020 TCE plume overlaid with the 2018 plume isoconcentration lines. Similarly, a figure showing the 2020 Tc-99 Plume overlaid with the 900 pCi/L and 3,790 pCi/L contours from the 2018 plume map is also included in this report. The Tc-99 plume, as defined by the 900 pCi/L activity level, is limited to the central part of the site, and is discussed in that subsection. A comparison of isoconcentration contours for the 2018 and 2020 plumes indicates that the footprints for each plume are generally similar. Exceptions to the general observation are discussed in the following sections.

4.1 NORTHWEST PLUME

Figure 3 provides an enlargement of the north portion of the Northwest Plume, including TCE contamination found in the vicinity of the C-746-S&T Landfills, which is not part of the Northwest Plume, and is discussed here for convenience. Three areas are described in this subsection: the northern distal margin (Area A), the area in the vicinity of extraction wells of the Northwest Plume Pump-and-Treat System (Area B), and the vicinity of the C-746-S&T Landfills (Area C). In addition, Figure 3 includes temporal TCE concentration plots for selected wells illustrating the observations made in this subsection.

Area A

- The northern extent of the 5 µg/L TCE isoconcentration contour now is defined by well cluster MW445/MW447, in which TCE was not detected above 5 µg/L during this reporting period. TCE analyses for MW439/MW441, the most downgradient wells, were 1.41 µg/L in the May 2019 sampling event at MW439 and 1.45 µg/L in the November 2020 sampling event at MW441.

- Also of note is the seep that is sampled in Little Bayou Creek. LBCSP5 has declined from 47.5 µg/L TCE in June 2014 to 0.63J µg/L in its most recent sampling event in August 2020. The plume contours have not been defined based on seep data because they are not as reliable as MW data; however, the declining TCE trend at the seeps support shrinking the plume length.

- TCE trends in MW491/MW492 and MW135 fell below 100 µg/L in 2017 and remain below 100 µg/L during the 2019 to 2020 monitoring events.

- The western boundary of the Northwest Plume was adjusted in the vicinity of the former northern extraction well field, EW228 and EW229,[9] based on results for MW236 (1.6 µg/L in May 2020) and MW240 (0.99J in May 2020). Similarly, the western boundary of the Northwest Plume was also adjusted in the vicinity of residential well R2 based on results for this well in November 2020 (3.72 µg/L).

[9] The original north EWs, EW228 and EW229, were taken out of service as part of the Northwest Plume Optimization Project.

Figure 1. TCE Plumes as Interpreted for 2014, 2016, 2018, and 2020

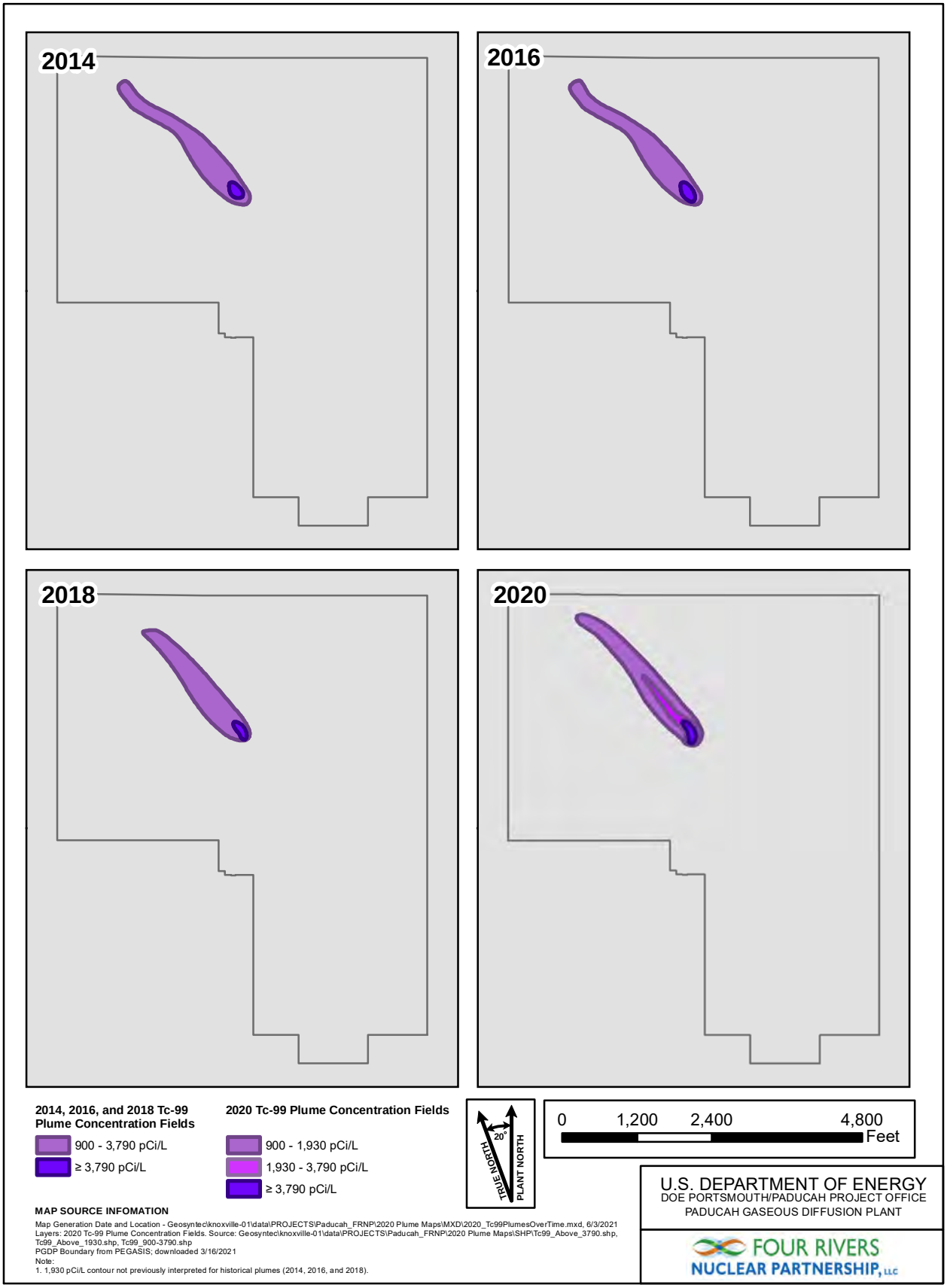
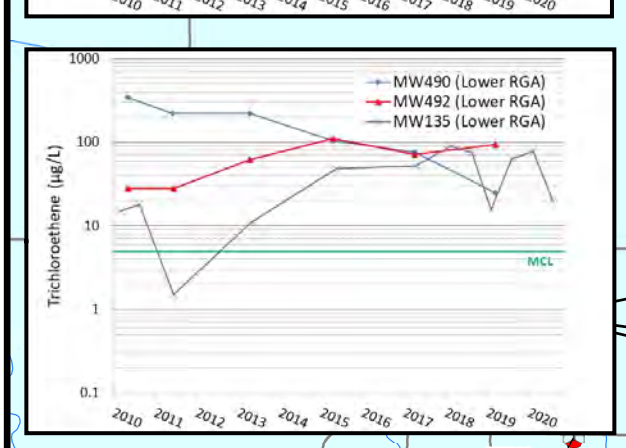
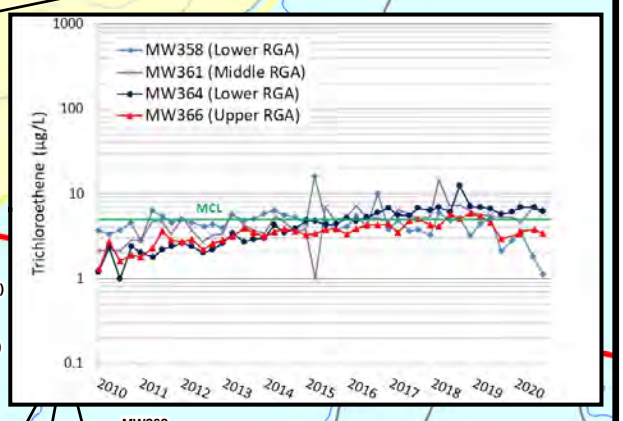


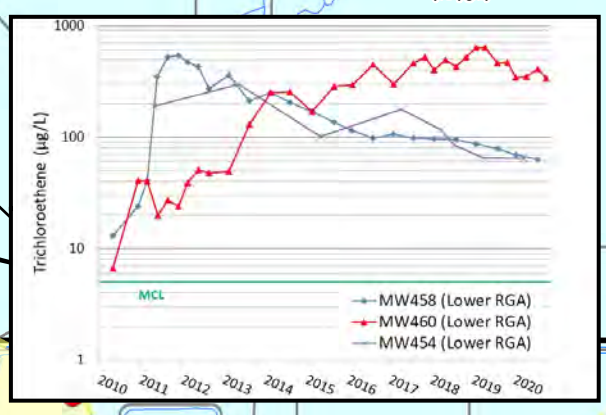
Figure 2. Tc-99 Plumes as Interpreted for 2014, 2016, 2018, and 2020

Notes:
1. Data from the most recent sampling event in 2019 or 2020 was used except where noted.
2. For co-located wells completed at multiple depths, the highest value for the period was mapped.

General Direction of RGA Flow for Northwest Portion of Plume







MW146 11/19/2020 (1U µg/L)
MW435 11/19/2020 (1U µg/L)
MW433 11/19/2020 (1U µg/L)
MW441 11/19/2020 (1.45 µg/L)
MW439 5/6/2019 (1.41 µg/L)
MW443 5/6/2019 (0.95J µg/L)
MW442 5/6/2019 (2.59 µg/L)
LBCSP5 8/20/2020 (0.63J µg/L)
MW444 5/6/2019 (0.91J µg/L)
MW448 5/6/2019 (1.81 µg/L)
MW445 5/6/2019 (1.26 µg/L)
MW447 5/6/2019 (1.36 µg/L)
MW450 5/6/2019 (9.62 µg/L)
A
MW201 11/19/2020 (0.52J µg/L)
MW135 9/17/2020 (20.2 µg/L)
MW489 4/30/2019 (33.4 µg/L)
MW490 4/30/2019 (24.5 µg/L)
MW491 5/1/2019 (85.9 µg/L)
MW236 5/13/2020 (1.6 µg/L)
MW492 5/1/2019 (93.2 µg/L)
MW202 11/19/2020 (1U µg/L)
EW228
MW240 5/13/2020 (0.99J µg/L)
EW229
MW98 9/16/2020 (0.48J µg/L)
MW493 5/1/2019 (1.03 µg/L)
MW494 5/1/2019 (1.2 µg/L)
MW125 5/13/2020 (68.6 µg/L)
MW357 10/15/2020 (3.7 µg/L)
MW363 10/15/2020 (1U µg/L)
MW358 10/15/2020 (1.13 µg/L)
MW364 10/15/2020 (6.26 µg/L)
MW139 5/13/2020 (4.45 µg/L)
MW361 10/15/2020 (5.84 µg/L)
MW367 10/21/2020 (0.5J µg/L)
MW360 10/15/2020 (1U µg/L)
MW366 10/21/2020 (3.38 µg/L)
MW373 10/12/2020 (4.28 µg/L)
MW372 10/12/2020 (2.85 µg/L)
MW370 10/12/2020 (0.66J µg/L)
MW391 10/14/2020 (9.53 µg/L)
MW369 10/12/2020 (0.73J µg/L)
MW392 10/14/2020 (14 µg/L)
MW200 4/30/2019 (11.1 µg/L)
MW452 11/19/2020 (1U µg/L)
MW451 4/30/2019 (1U µg/L)
R2 11/19/2020 (3.72 µg/L)
MW388 10/13/2020 (0.6J µg/L)
MW387 10/13/2020 (0.88J µg/L)
MW418 5/14/2020 (7.42 µg/L)
MW419 5/14/2020 (11.9 µg/L)
MW221 10/14/2020 (1U µg/L)
MW384 10/13/2020 (0.66J µg/L)
MW222 10/14/2020 (1U µg/L)
MW134 11/19/2020 (1U µg/L)
MW454 5/13/2020 (64.7 µg/L)
MW453 5/13/2020 (24.9 µg/L)
MW385 10/13/2020 (0.58J µg/L)
MW223 10/14/2020 (1U µg/L)
MW224 10/14/2020 (1U µg/L)
MW394 10/22/2020 (3.35 µg/L)
C
MW395 10/22/2020 (2.27 µg/L)
MW220 10/14/2020 (1U µg/L)
MW397 10/22/2020 (1U µg/L)
B
MW197 9/16/2020 (35 µg/L)
MW501 9/15/2020 (1UY1 µg/L)
MW456 9/14/2020 (109 µg/L)
MW458 9/14/2020 (62.9 µg/L)
MW460 12/1/2020 (337 µg/L)
MW502 9/15/2020 (1.98Y1 µg/L)
MW455 9/14/2020 (15.2 µg/L)
MW457 9/14/2020 (36.7 µg/L)
MW459 9/14/2020 (66.4 µg/L)
MW462 9/14/2020 (38.9 µg/L)
A
A'
MW461 9/14/2020 (5.17 µg/L)
MW243 9/15/2020 (27.9 µg/L)
MW242 9/14/2020 (31.8 µg/L)
MW244 9/15/2020 (2.65 µg/L)
EW230
MW248 9/15/2020 (5.37Y1 µg/L)
MW497 9/15/2020 (386Y1 µg/L)
MW482 5/1/2019 (58.7 µg/L)
MW481 5/1/2019 (1U µg/L)
MW250 9/15/2020 (3.03Y1 µg/L)
EW231
MW504 9/15/2020 (0.71J µg/L)
MW173 9/14/2020 (2.44 µg/L)
MW106A 11/19/2020 (3.37 µg/L)
MW66 9/14/2020 (488 µg/L)
EW233
EW232
MW245 9/15/2020 (12Y1 µg/L)
MW498 9/15/2020 (109Y1 µg/L)
MW500 9/15/2020 (529 µg/L)
MW503 9/15/2020 (8.38 µg/L)
MW496 10/8/2020 (134 µg/L)
MW63 9/14/2020 (2.28 µg/L)
MW65 9/14/2020 (1.26 µg/L)
MW499 9/15/2020 (650Y1 µg/L)
MW145 10/8/2020 (44.1 µg/L)
MW144 10/8/2020 (101 µg/L)
MW431 12/1/2020 (2.91 µg/L)
MW169

MAP SOURCE INFORMATION
Map Generation Date and Location: 6/1/2021 \\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\MXD\Fig_03_2020PlumesTCE_NW R1.mxd
Monitoring Well Layer Location: \\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP\2019-2020_TCE.shp
2020 TCE Plume Layers Location: \\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP
Water Policy Area, PGDP Boundary, Roadways, and Streams from PEGASIS, downloaded 3/16/2021
DOE Property Boundary, and Cross section lines provided by FRNP 2/4/2021

2020 TCE Plume Concentration Fields
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L

2018 TCE Plume Isoconcentration Lines
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L

- Lower RGA Well
- Middle RGA Well
- Upper RGA Well
- Multizone RGA Well
- Active Extraction Well
- Inactive Extraction Well
- Seep Monitoring Location

A–A' - Location of Cross-Section
A - Area A
B - Area B
C - Area C

- Water Policy Area
- DOE Property Boundary
- PGDP Boundary
- Roadways
- Streams

MW100 8/17/2020 (1U µg/L) - Monitoring Well (MW) Identification, or Residential (R) Well Identification
Date of Sample & Sample Value
U = not detected at a reporting limit of 1 µg/L
J = reported at a value less than the reporting limit
Y1 = MS/MSD recovery outside acceptance criteria

TRUE NORTH
20°
PLANT NORTH

Feet
500 250 0 500 1,000

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\MXD\Fig_03_2020PlumesTCE_NW R1.mxd 6/1/2021

Figure 3. 2020 Northwest Portion of the TCE Plume Regional Gravel Aquifer

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Area B

In August 2010, extraction wells EW232 and EW233 began operations. Because EW232 and EW233 are located slightly upgradient and crossgradient of the former extraction wells, EW230 and EW231, changes in TCE concentrations at some downgradient locations continue to reflect trends associated with changes in pumping stress in the area. Observations related to changes in TCE distribution within the plume and plume configuration for this area are as follows:

MW455 through MW462, MW501, and MW502 were installed, and sampling began in 2009. These wells form a transect perpendicular to the direction of groundwater flow, downgradient of the current extraction well field for the Northwest Plume Pump-and-Treat System, and provide a monitoring network to evaluate the efficacy of the pump-and-treat system. Figure 4 provides a cross section showing the interpretation of TCE concentrations within the RGA along this transect, which is denoted as A-A' on Figure 3. During this reporting period, TCE concentrations varied from nondetect to 336 µg/L along this transect. The highest TCE concentrations along this transect continue to shift to the east from well MW458 (a lower RGA well in which TCE has declined from 540 µg/L in 2011 to 62.9 µg/L in the most recent sampling in September 2020) to well MW460 (a lower RGA well, which recorded its highest TCE concentration in March 2019 at 636 µg/L). An evaluation of TCE trends in MW460 was completed in 2018 and is included in *Compilation of Meeting Summaries and White Papers (2017–2018)* (DOE 2019).

Area C

Area C is located in the vicinity of the C-746-S&T and C-746-U Landfills and is not a part of the Northwest Plume. These locations are monitored frequently to support the solid waste permit for the C-746-S&T and C-764-U Landfills.

- During 2020, TCE concentrations in MW366 and MW357/MW358 dropped below 5 µg/L. Consequently, the 5 µg/L contour delineating the northwest toe of the plume was retracted southward. TCE concentrations in MW372 and MW373 dropped to below 5 µg/L. Consequently, the 5 µg/L contour delineating the western extent of the plume in this area was retracted. MW394/MW395, located at the southern end of this plume, and MW139, located at the northeastern end of this plume, remained below 5 µg/L; the 5 µg/L contour delineating the plume extent in 2018 remains unchanged in 2020.

4.2 NORTHEAST PLUME

Figure 5 provides an enlargement of the Northeast Plume. Three areas are described in this subsection: the northern distal margin (Area D); the area in the vicinity of the former Northeast Plume Pump-and-Treat extraction wells (Area E); and the vicinity of the industrial site (Area F). Figure 5 also includes temporal TCE concentration plots for selected wells to illustrate the observations made in this subsection.

Area D

- Wells MW463 through MW476 provide definition of the northern extent of the 5 µg/L TCE isoconcentration contour. The interpreted distal extent is between well clusters MW463 through MW468 and clusters MW473 through MW476. In 2019, TCE concentrations MW465/MW466 dropped below 5 µg/L. Consequently, the contour defining the northern extent of the 5 µg/L TCE isoconcentration contour from 2018 was retracted. Well cluster MW469/MW470, with the most recent groundwater TCE concentrations below the laboratory detection limit, defines the eastern edge of the plume.

- TCE concentration for MW464 (96.4 µg/L) in the lower RGA identifies a higher concentration field within the north end of the Northeast Plume.

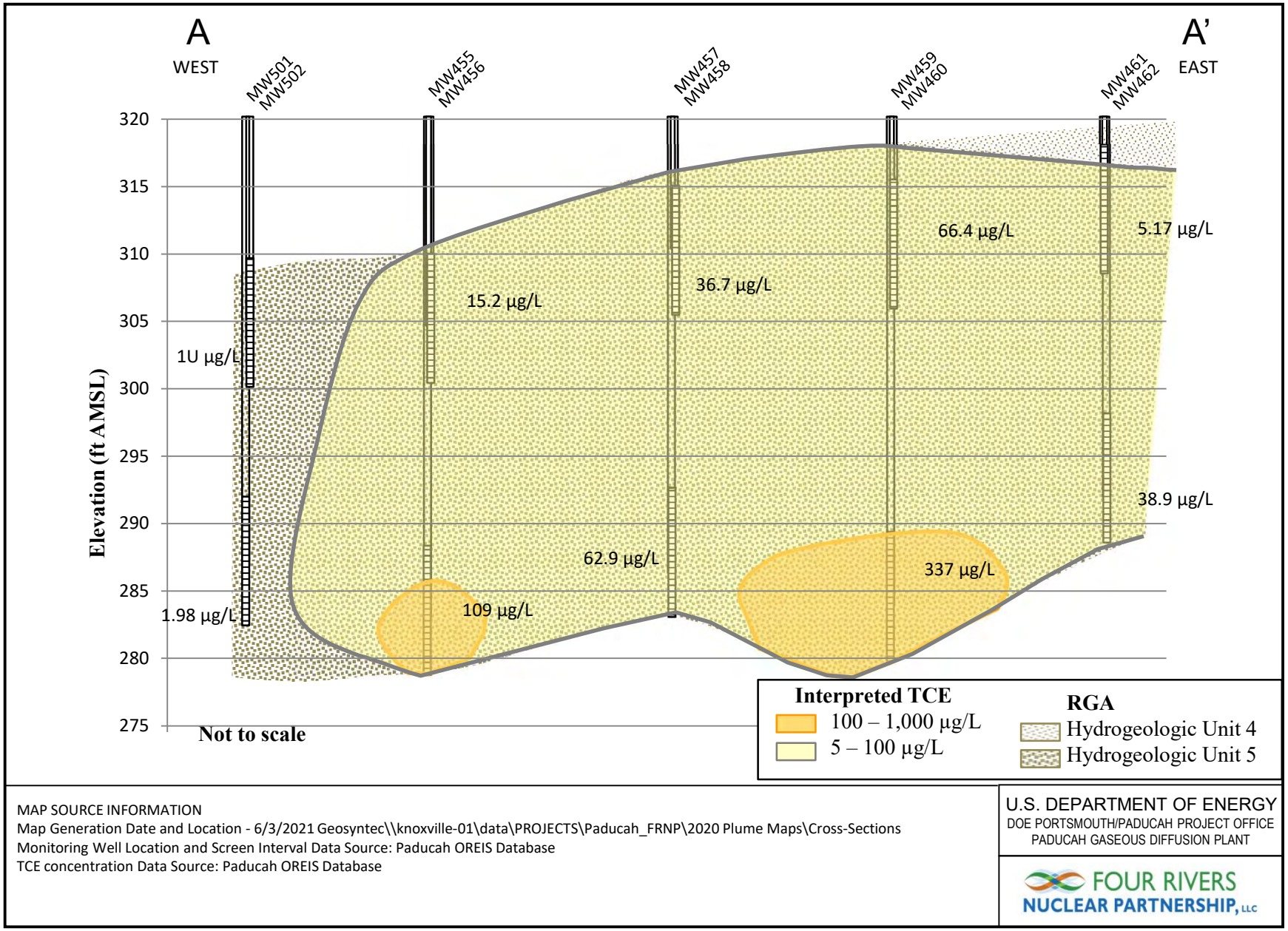

Figure 4. 2019–2020 TCE Plume Regional Gravel Aquifer Cross Section A-A'

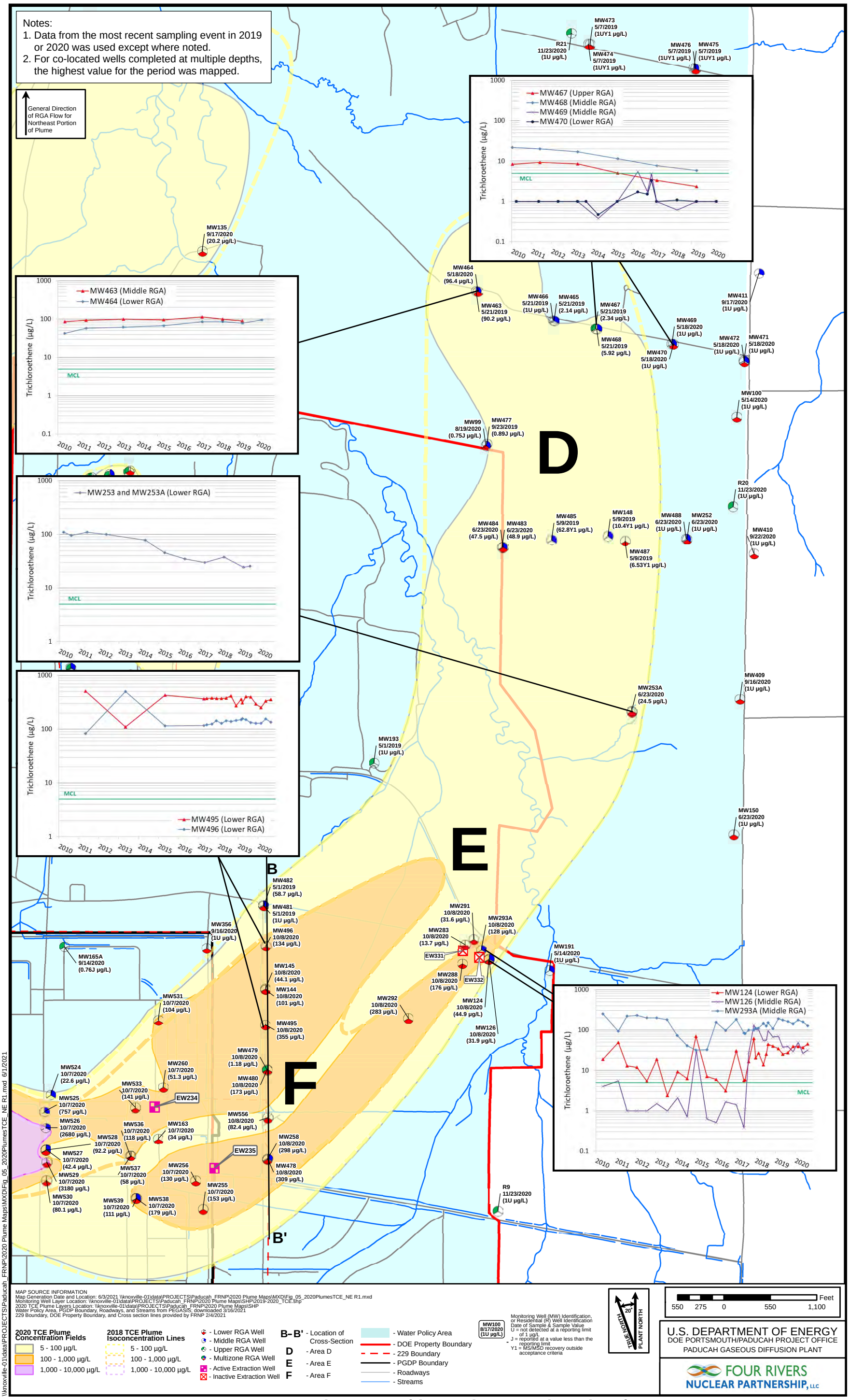

Figure 5. 2020 Northeast Portion of the TCE Plume Regional Gravel Aquifer

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Area E

- With cessation of pumping in EW331 and EW332[10] as part of the Northeast Plume Optimization project, the western lobe of > 100 µg/L TCE no longer hooks eastward but now dissipates near its former northern extent.

- Results of the 2020 monitoring continue to show an overall decline in TCE concentration since 2011 at MW253 and its replacement well MW253A, which are located north of the old extraction wells that currently are in standby.

- TCE concentrations in the east side of the former extraction well field, EW331 and EW332, which increased significantly in the 2017 to 2018 sampling period, are demonstrating stable or, in the case of MW126, decreasing trends in the 2019 to 2020 sampling period. In MW126, TCE concentrations decreased from 134 µg/L in January 2018 to 31.9 µg/L in October 2020. In MW293A, which previously appeared to have decreasing TCE concentrations over the 2013–2015 period, TCE concentrations rebounded from a low of 82 µg/L to a high of 152 µg/L during late 2017 and 2018. In 2019 and 2020, TCE concentrations in MW293A were between 108 µg/L and 191 µg/L. These trends reflect flow of residual TCE, downgradient of the current extraction wells, through a high hydraulic conductivity zone in the RGA.

Area F

- The 100 to 1,000 µg/L boundary in this area, similar to the 2018 interpretation, is split into two separate concentration fields downgradient of the MW478 to MW481 transect. A cross section showing the interpretation of TCE concentrations within the RGA along this transect is denoted as B-B' in Figures 5 and 6.

- TCE concentrations are highest along the south end of the B-B' transect (i.e., 298 µg/L in MW258, 309 µg/L in MW478) and within the lower half of the RGA (i.e., 355 µg/L in MW495). A zone of 5 to 100 µg/L is depicted around MW556, which decreased from 147 µg/L in October 2018 to 82.4 µg/L in October 2020.

4.3 CENTRAL SITE AREA INCLUDING SOUTHWEST PLUME

TCE

The TCE plume in the industrialized section of the PGDP is presented in Figure 7. The overall footprint in 2020 is similar to previous years; differences are noted below. Figure 7 includes temporal TCE concentration plots for selected wells, illustrating the observations made in this subsection.

- The extent of the Southwest Plume north of Solid Waste Management Unit (SWMU) 4 included a small, isolated 10,000 µg/L contour indicated by TCE values in MW333 that were > 10,000 µg/L in January 2015 and June 2015 and January 2016. The most recent value for MW333 (i.e., 2,560 µg/L in July 2020) is shown on the map (designated as Area G on Figure 7).

[10] EW331 and EW332 are currently inactive but are being kept in good working condition until the Federal Facility Agreement parties agree that maintenance no longer is necessary, and final disposition (including well abandonment) has been determined.

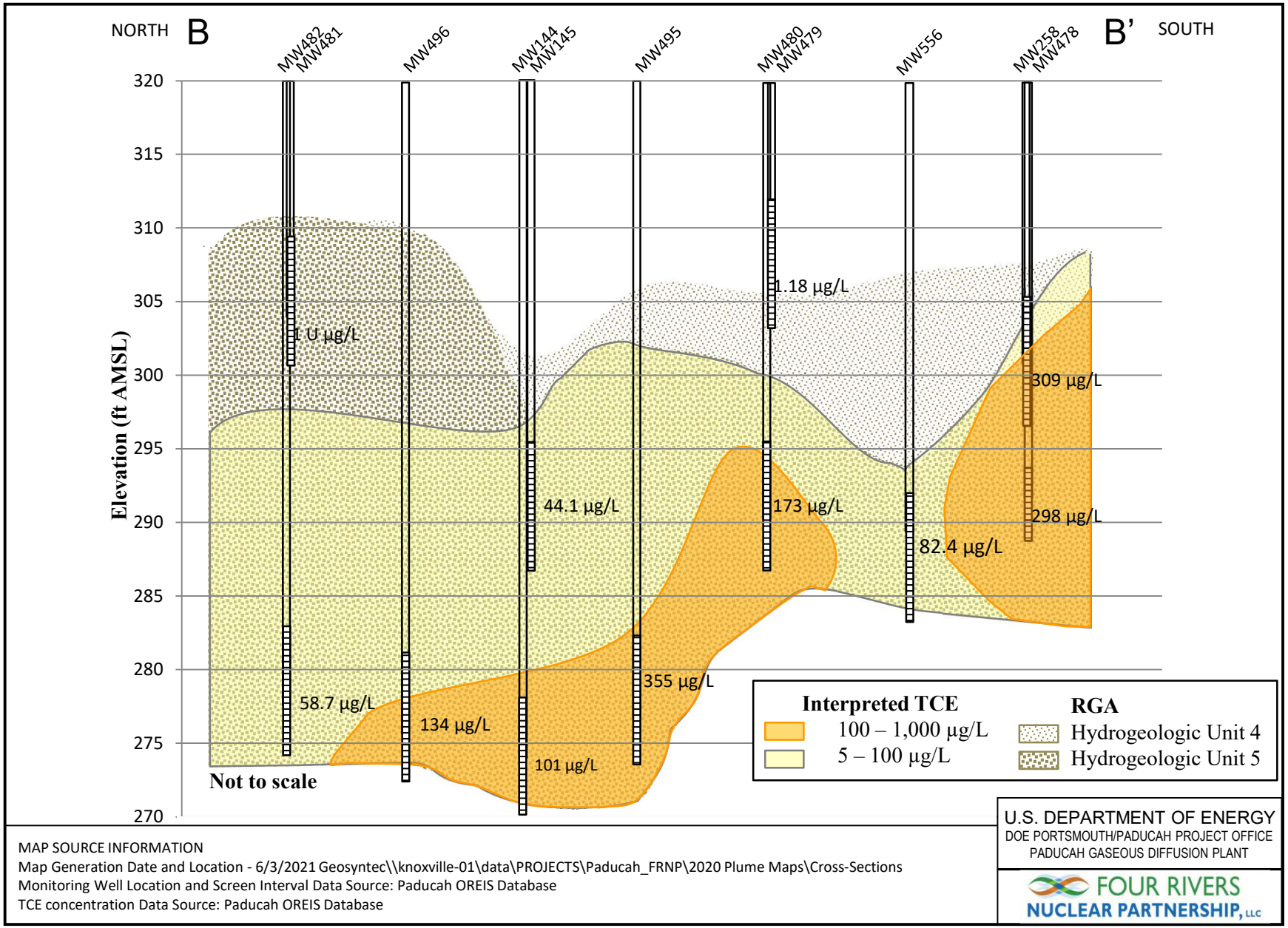
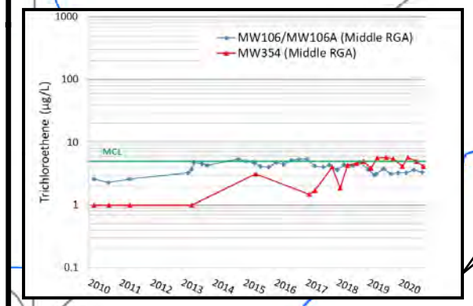
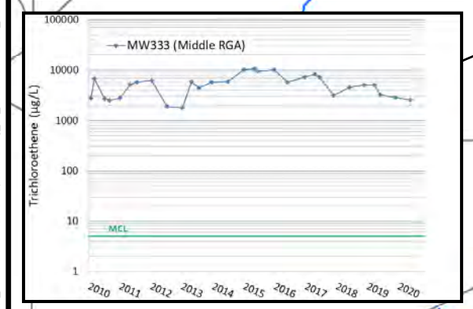


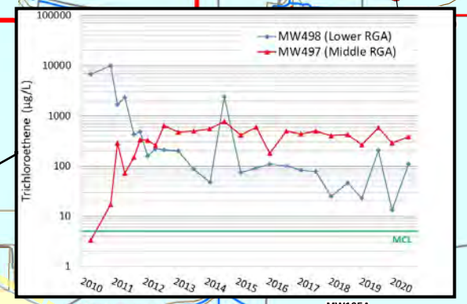
Figure 6. 2019–2020 TCE Plume Regional Gravel Aquifer Cross Section B-B'

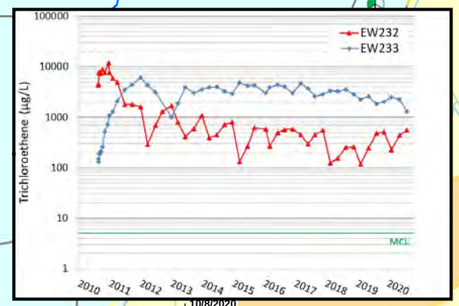
Notes:
1. Data from the most recent sampling event in 2019 or 2020 was used except where noted.
2. For co-located wells completed at multiple depths, the highest value for the period was mapped.

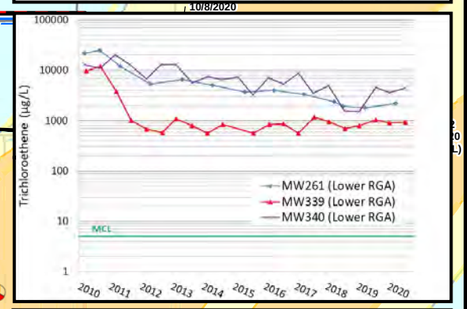
MW194 11/19/2020 (1U µg/L)
R53 11/23/2020 (1U µg/L)
MW106A 11/19/2020 (3.37 µg/L)
MW427 11/19/2020 (0.45J µg/L)
MW426 11/19/2020 (1U µg/L)
MW428 9/15/2020 (2.29Y1 µg/L)
MW502 9/15/2020 (1.98Y1 µg/L)
MW501 9/15/2020 (1UY1 µg/L)
MW456 9/14/2020 (109 µg/L)
MW455 9/14/2020 (15.2 µg/L)
MW458 9/14/2020 (62.9 µg/L)
MW460 12/1/2020 (337 µg/L)
MW457 9/14/2020 (36.7 µg/L)
MW459 9/14/2020 (66.4 µg/L)
MW461 9/14/2020 (5.17 µg/L)
MW462 9/14/2020 (38.9 µg/L)
MW197 9/16/2020 (35 µg/L)
MW243 9/15/2020 (27.9 µg/L)
MW244 9/15/2020 (2.65 µg/L)
MW242 9/14/2020 (31.8 µg/L)
MW498 9/15/2020 (109Y1 µg/L)
EW230
EW231
EW232
MW250 9/15/2020 (3.03Y1 µg/L)
MW248 9/15/2020 (5.37Y1 µg/L)
MW245 9/15/2020 (12Y1 µg/L)
MW500 9/15/2020 (529 µg/L)
MW499 9/15/2020 (650Y1 µg/L)
MW63 9/14/2020 (2.28 µg/L)
MW497 9/15/2020 (386Y1 µg/L)
EW233
MW504 9/15/2020 (0.71J µg/L)
MW503 9/15/2020 (8.38 µg/L)
MW173 9/14/2020 (2.44 µg/L)
MW355 9/14/2020 (5.57 µg/L)
MW165A 9/14/2020 (0.76J µg/L)
MW432 11/19/2020 (0.56J µg/L)
MW65 9/14/2020 (1.26 µg/L)
MW66 9/14/2020 (488 µg/L)
MW339 9/14/2020 (933 µg/L)
MW340 9/14/2020 (4420 µg/L)
MW261 5/20/2020 (2200 µg/L)
MW431 12/1/2020 (2.91 µg/L)
MW86 7/15/2020 (3760 µg/L)
MW84A 7/14/2020 (3230 µg/L)
MW169 5/8/2019 (281Y1 µg/L)
MW262 5/8/2019 (342Y1 µg/L)
MW205 5/8/2019 (0.41JY1 µg/L)
MW343 9/21/2020 (15300 µg/L)
MW423-PRT3 9/21/2020 (26700 µg/L)
MW422-PRT3 9/21/2020 (30300 µg/L)
MW421-PRT3 9/21/2020 (57900 µg/L)
MW260 10/7/2020 (51.3 µg/L)
MW354 12/1/2020 (4.15 µg/L)
MW67 7/13/2020 (1380Y1 µg/L)
MW338 7/15/2020 (403 µg/L)
MW337 7/15/2020 (452 µg/L)
MW87A 7/14/2020 (3090 µg/L)
MW89 7/13/2020 (120Y1 µg/L)
MW90A 7/14/2020 (52 µg/L)
MW168 5/7/2019 (62.8Y1 µg/L)
MW429A 9/22/2020 (0.5J µg/L)
MW333 7/13/2020 (2560Y1 µg/L)
MW548 7/13/2020 (3700Y1 µg/L)
MW92 7/15/2020 (5.56 µg/L)
MW430 9/22/2020 (1.37 µg/L)
MW415 5/7/2019 (1980Y1 µg/L)
MW414 5/7/2019 (1310Y1 µg/L)
MW76 7/13/2020 (265Y1 µg/L)
MW341 12/9/2020 (6300 µg/L)
MW524 10/7/2020 (22.6 µg/L)
MW403-PRT3 12/1/2020 (3.16 µg/L)
MW424-PRT3 9/21/2020 (9560 µg/L)
MW178 12/9/2020 (356 µg/L)
MW525 10/7/2020 (757 µg/L)
MW404-PRT4 4/30/2019 (2.4 µg/L)
MW420 7/14/2020 (1340 µg/L)
MW526 10/7/2020 (2680 µg/L)
MW329 4/30/2019 (1U µg/L)
MW425-PRT3 9/24/2020 (3540 µg/L)
MW155 12/2/2020 (3030 µg/L)
MW527 10/7/2020 (42.4 µg/L)
MW226 7/13/2020 (235Y1 µg/L)
MW342 9/24/2020 (3600 µg/L)
MW528 10/7/2020 (92.2 µg/L)
MW549 5/7/2019 (3530Y1 µg/L)
MW227 7/13/2020 (320Y1 µg/L)
MW175 9/21/2020 (3430 µg/L)
MW156 12/2/2020 (3380 µg/L)
MW529 10/7/2020 (3180 µg/L)
MW163 10/7/2020 (34 µg/L)
MW550 5/13/2019 (6840 µg/L)
MW95A 7/13/2020 (1790Y1 µg/L)
MW71 6/8/2020 (0.37J µg/L)
MW530 10/7/2020 (80.1 µg/L)
MW328 4/30/2019 (0.4J µg/L)
MW551 5/13/2019 (821 µg/L)
MW93A 7/14/2020 (2220 µg/L)
MW68 6/8/2020 (96.6 µg/L)
MW505/MW506/MW507 12/2/2020 (8220 µg/L)
MW416 5/7/2019 (1010Y1 µg/L)
MW203 5/20/2020 (69.5 µg/L)
MW408-PRT5 12/9/2020 (145 µg/L)
MW417 5/7/2019 (126Y1 µg/L)
MW405-PRT5 12/9/2020 (296 µg/L)
MW407-PRT4 12/9/2020 (7470 µg/L)
MW406-PRT5 12/9/2020 (473 µg/L)
MW103 4/30/2019 (1U µg/L)
MW161 12/2/2020 (315 µg/L)
MW545 12/2/2020 (0.733 µg/L)
MW547 12/2/2020 (1190 µg/L)
MW542 12/2/2020 (0.94J µg/L)
MW546 12/2/2020 (61.5 µg/L)
MW543 12/2/2020 (1.79 µg/L)
MW544 12/2/2020 (236 µg/L)
SWMU 1
SWMU 4
C-400 Source Area
G
H
C
C'
D
D'
EW234

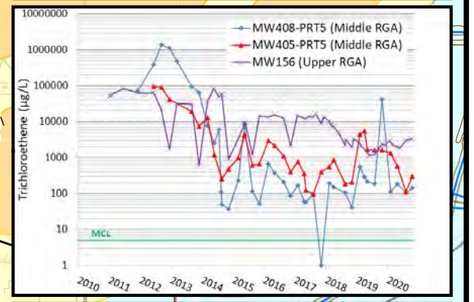


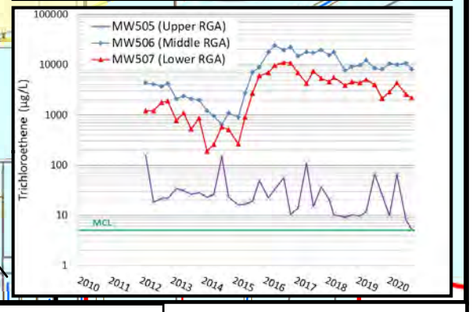












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2020 TCE Plume Layers Location: \\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP
Water Policy Area, SWMUs, PGDP Boundary, Roadways, and Streams from PEGASIS; downloaded 3/16/2021
229 Boundary, DOE Property Boundary, and Cross section lines provided by FRNP 2/4/2021

1,000 500 0 1,000 Feet

2020 TCE Plume Concentration Fields
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L
- 10,000 - 100,000 µg/L
- ≥ 100,000 µg/L

2018 TCE Plume Isoconcentration Lines
- 5 - 100 µg/L
- 100 - 1,000 µg/L
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- 10,000 - 100,000 µg/L
- ≥ 100,000 µg/L

Note: Contours defining plume cores are based on historical records.

- Lower RGA Well
- Middle RGA Well
- Upper RGA Well
- Multizone RGA Well
- Active Extraction Well
- Inactive Extraction Well

C–C' - Locations of Cross-Sections
D–D'
G - Area G
H - Area H

- Water Policy Area
- SWMU
- DOE Property Boundary
- 229 Boundary
- PGDP Boundary
- Roadways
- Streams

MW100 8/17/2018 (1U µg/L) - Monitoring Well (MW) Identification, or Residential (R) Well Identification
Date of Sample & Sample Value
U = not detected at a reporting limit of 1 µg/L
J = reported at a value less than the reporting limit

TRUE 20° PLANT

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\MXD\Fig_07_2020PlumesTCE_Central R1.mxd 6/1/2021

Figure 7. 2020 Central Portion of the TCE Plume Regional Gravel Aquifer

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- The upgradient extent of the 1,000 µg/L contour in the SWMU 1 area is defined by MW161 and MW545 (see inset at lower left of Figure 7). In MW161 (i.e., lower RGA), TCE concentrations have declined from a high of 12,200 µg/L in 2016 to 315 µg/L in December 2020 (designated as Area G on Figure 7).

- The second area (designated as Area H on Figure 7) is on the northern margin of the industrial footprint. The highest concentrations of TCE extend from C-400 Building toward the Northwest Plume groundwater extraction wells. Overall, TCE concentrations in this area have remained stable since 2018.

- The C-400 Building source area shows a 100,000 µg/L contour, though none of the current MWs detected TCE in this range in 2020. The presence of this contour is based on historical data (e.g., MW156, which recorded up to 550,000 µg/L in 1991; Waste Area Grouping 6 angled boring, which recorded over 100,000 µg/L beneath C-400 in 1997) and consideration of the conceptual site model. The majority of the contamination at C-400 migrates to the northwest. A cross section showing the interpretation of TCE concentrations within the RGA along this transect is in Figure 8. The location of the cross section is denoted as C-C' on Figure 7.

- The area near the southeast corner of C-400 has been subject to remedial action, using electrical resistance heating in the Upper Continental Recharge System and upper RGA (DOE 2011a; DOE 2013) and a steam treatability study in the RGA (DOE 2016). MW156, MW408-PRT5, and MW405-PRT5, located near the southeast corner of C-400, have shown declines in TCE concentration from 2012 to 2018. Most notably, TCE in MW408-PRT5 has decreased from its high of 1,400,000 µg/L in September 2012, to 41.2 µg/L in 2018. In 2019 to 2020, TCE concentrations remained stable at MW156 and MW408-PRT5, with most recent concentrations reported in December 2020 of 3,380 µg/L and 145 µg/L, respectively. A notable exception is the December 2019 sample from MW408-PRT5, with a TCE concentration of 41,600 µg/L. In MW405-PRT5, TCE concentrations rebounded in May 2019 to 5,530 µg/L; however, concentrations declined steadily to 296 µg/L in December 2020.

- The 10,000 µg/L contour to the south of the C-400 Building source area has been migrated northward. All of the most recent samples from the MW505/MW506/MW507 well nest contained TCE concentrations that were < 10,000 µg/L.

- A cross section in Figure 9 shows the 5 µg/L and 1,000 µg/L concentration field in the MW524–MW530 line of wells, which is connected with similar concentrations east of the C400 Cleaning Building. The location of the cross section is denoted as D-D' on Figure 7.

- Wells MW354 and MW106A have observed TCE concentrations near 5 µg/L. These wells are not directly downgradient of the Southwest Plume source area (designated as G on Figure 7) based on the potentiometric surface in the RGA, shown in Figures 11 and 12. The location of the source responsible for the detections of TCE in MW354 and MW106A is uncertain.

Tc-99

There were 1,092 analyses for Tc-99 in RGA groundwater at PGDP in 2019 and 2020, with only 68 results above 900 pCi/L and 46 results above 1,930 pCi/L. Figure 10 presents the results of Tc-99 analyses near the central area of the plant, where the groundwater samples collected in 2020 (supplemented with samples collected in 2019) contained Tc-99 at activities > 900 pCi/L and 1,930 pCi/L. Figure 10 also presents temporal concentration plots for selected wells illustrating the observations made in this subsection.

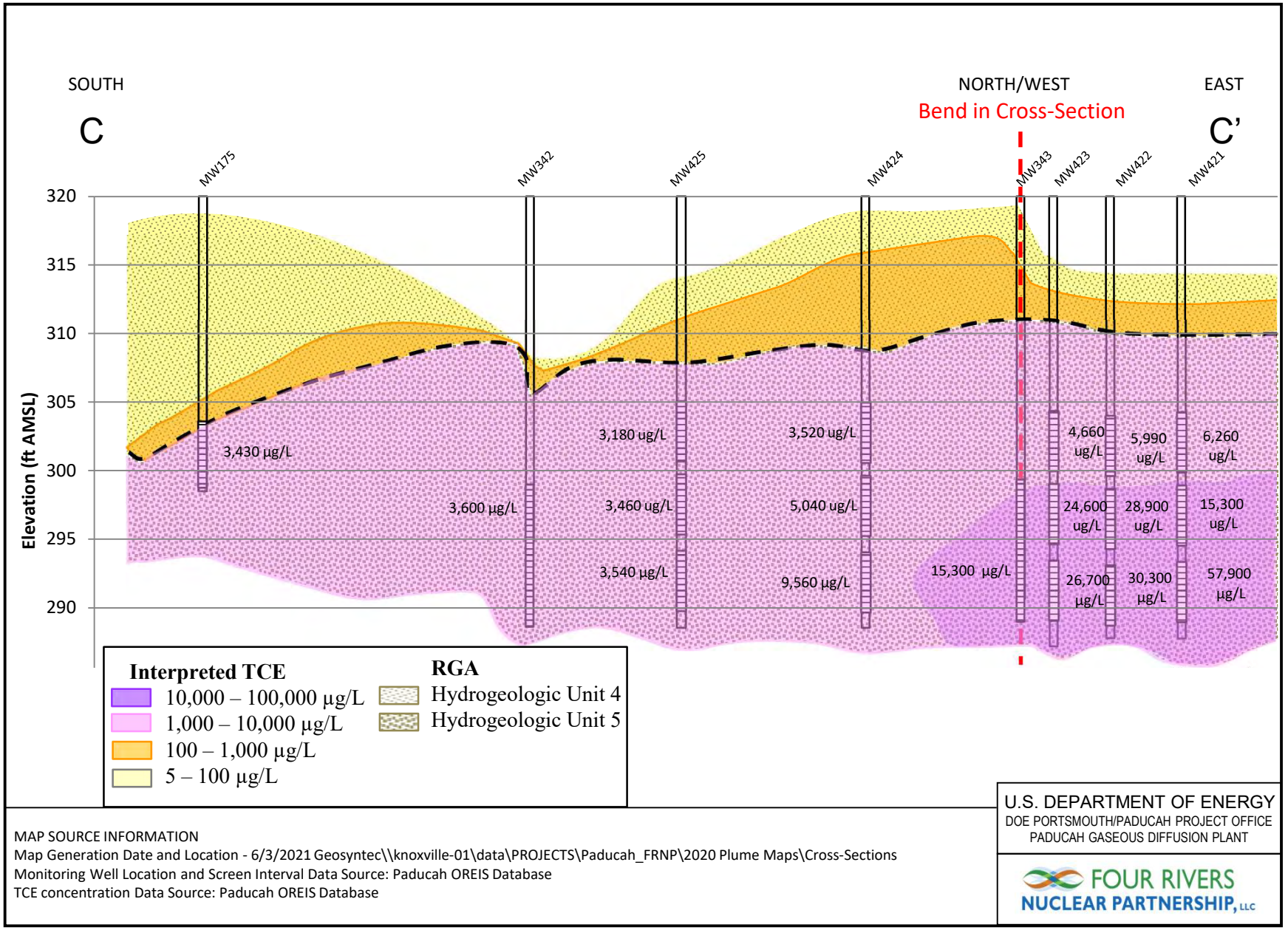

Figure 8. 2019-2020 TCE Plume Regional Gravel Aquifer Cross Section C-C'

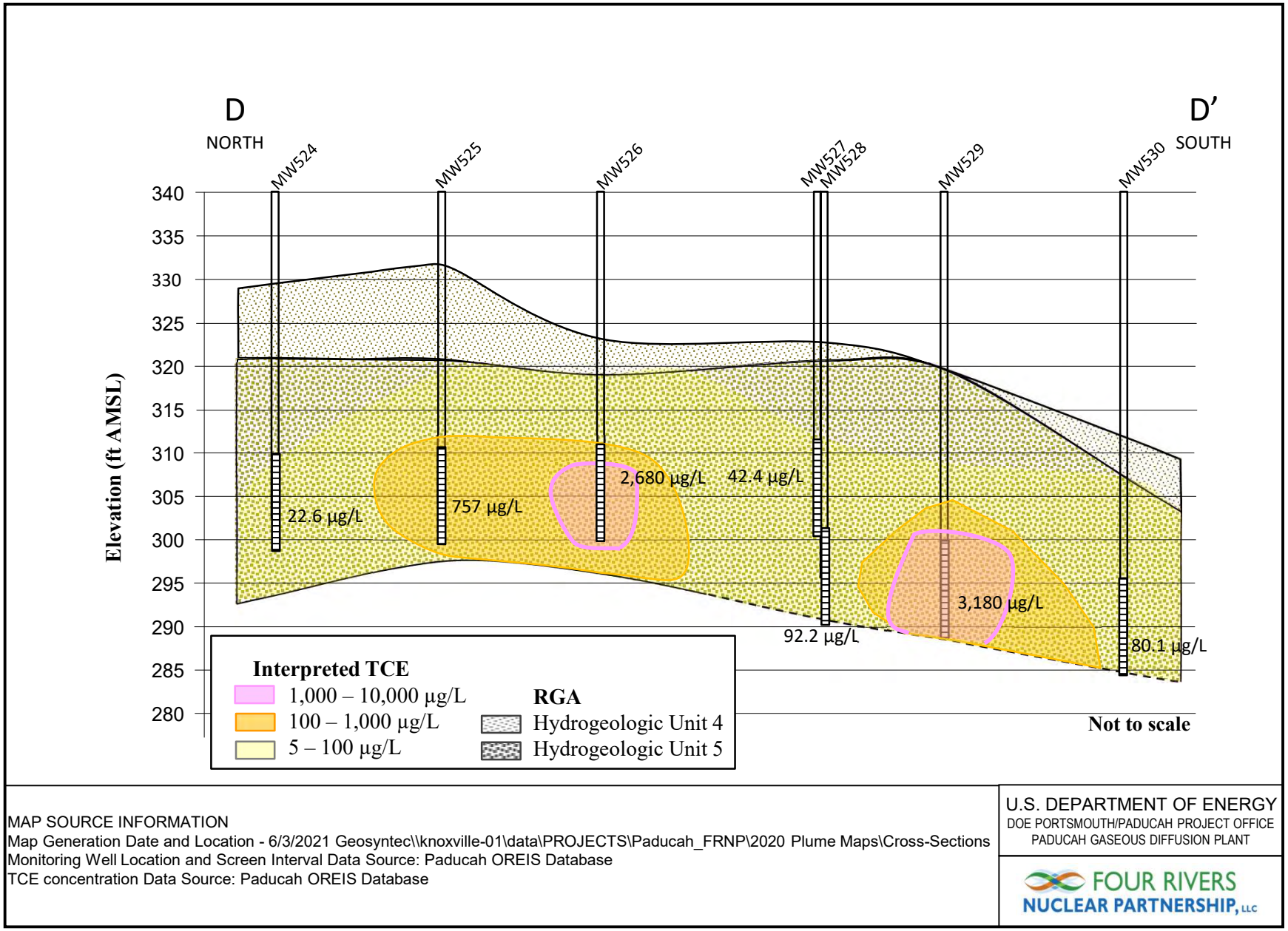

Figure 9. 2019–2020 TCE Plume Regional Gravel Aquifer Cross Section D-D'

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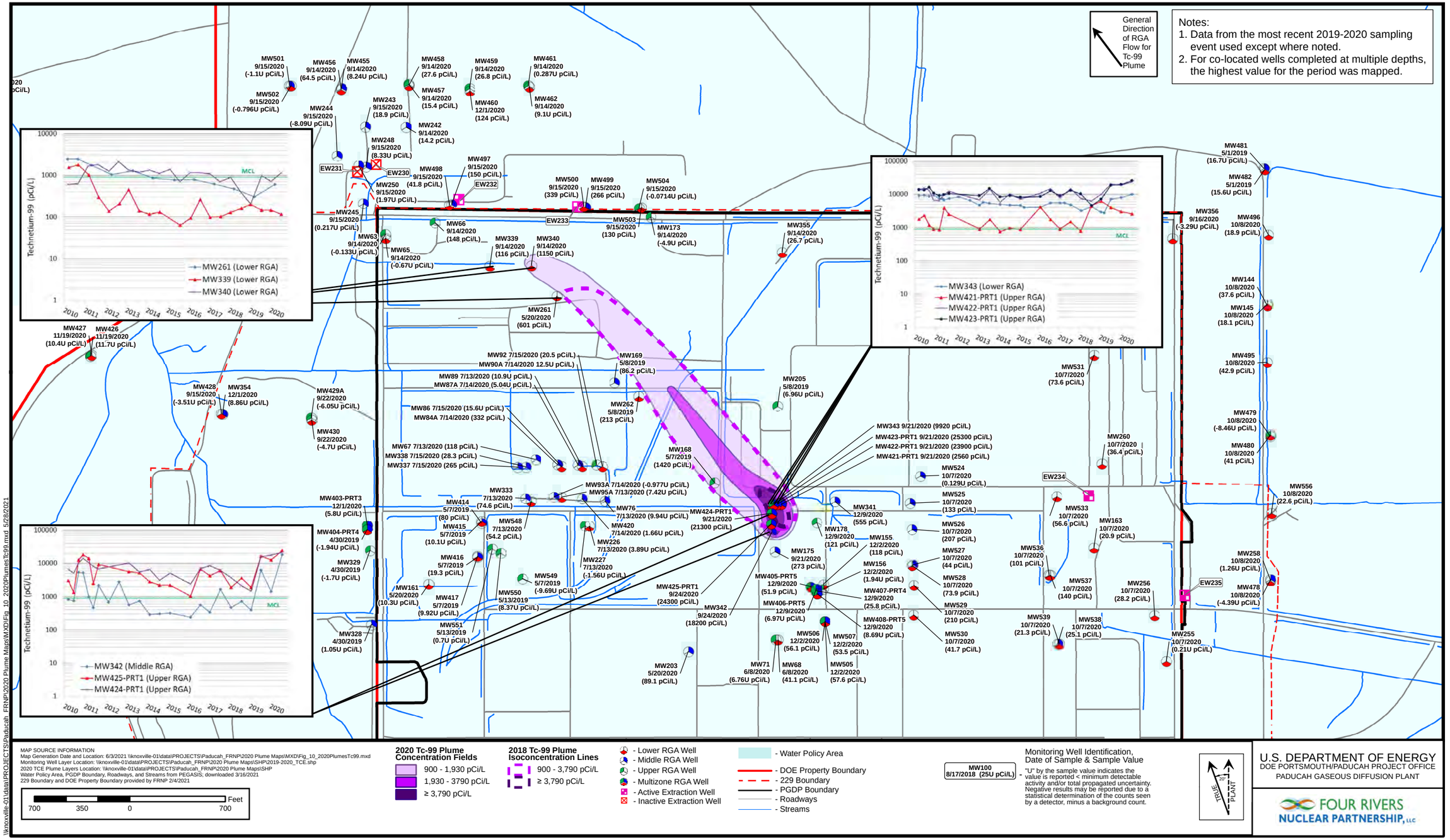
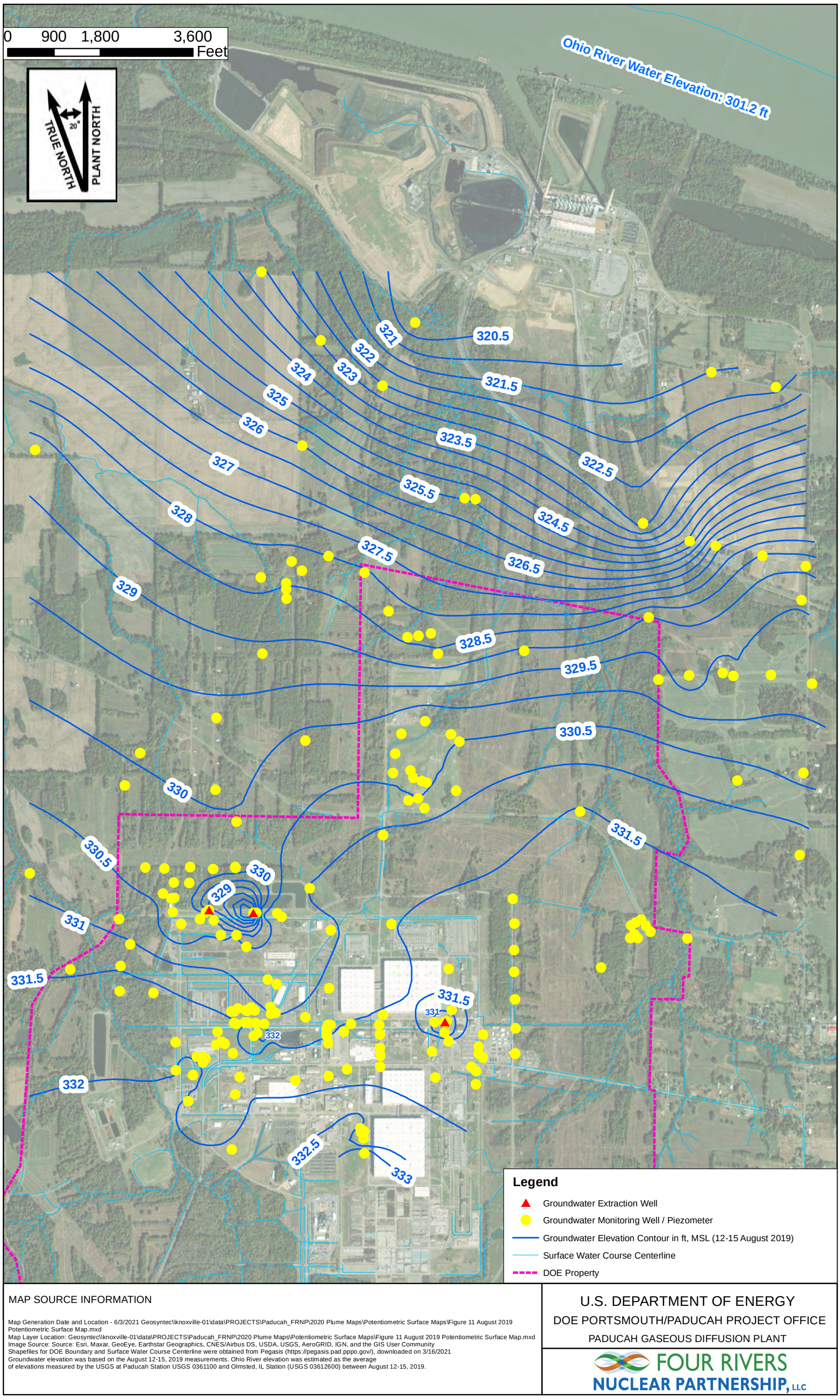


Figure 10. 2020 Tc-99 Plume—Regional Gravel Aquifer



MAP SOURCE INFORMATION

Map Generation Date and Location - 6/3/2021 Geosyntec\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\Potentiometric Surface Maps\Figure 11 August 2019 Potentiometric Surface Map.mxd
Map Layer Location: Geosyntec\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\Potentiometric Surface Maps\Figure 11 August 2019 Potentiometric Surface Map.mxd
Image Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Shapefiles for DOE Boundary and Surface Water Course Centerline were obtained from Pegasis (https://pegasis.pad.pppo.gov/), downloaded on 3/16/2021
Groundwater elevation was based on the August 12-15, 2019 measurements. Ohio River elevation was estimated as the average of elevations measured by the USGS at Paducah Station USGS 0361100 and Olmsted, IL Station (USGS 03612600) between August 12-15, 2019.

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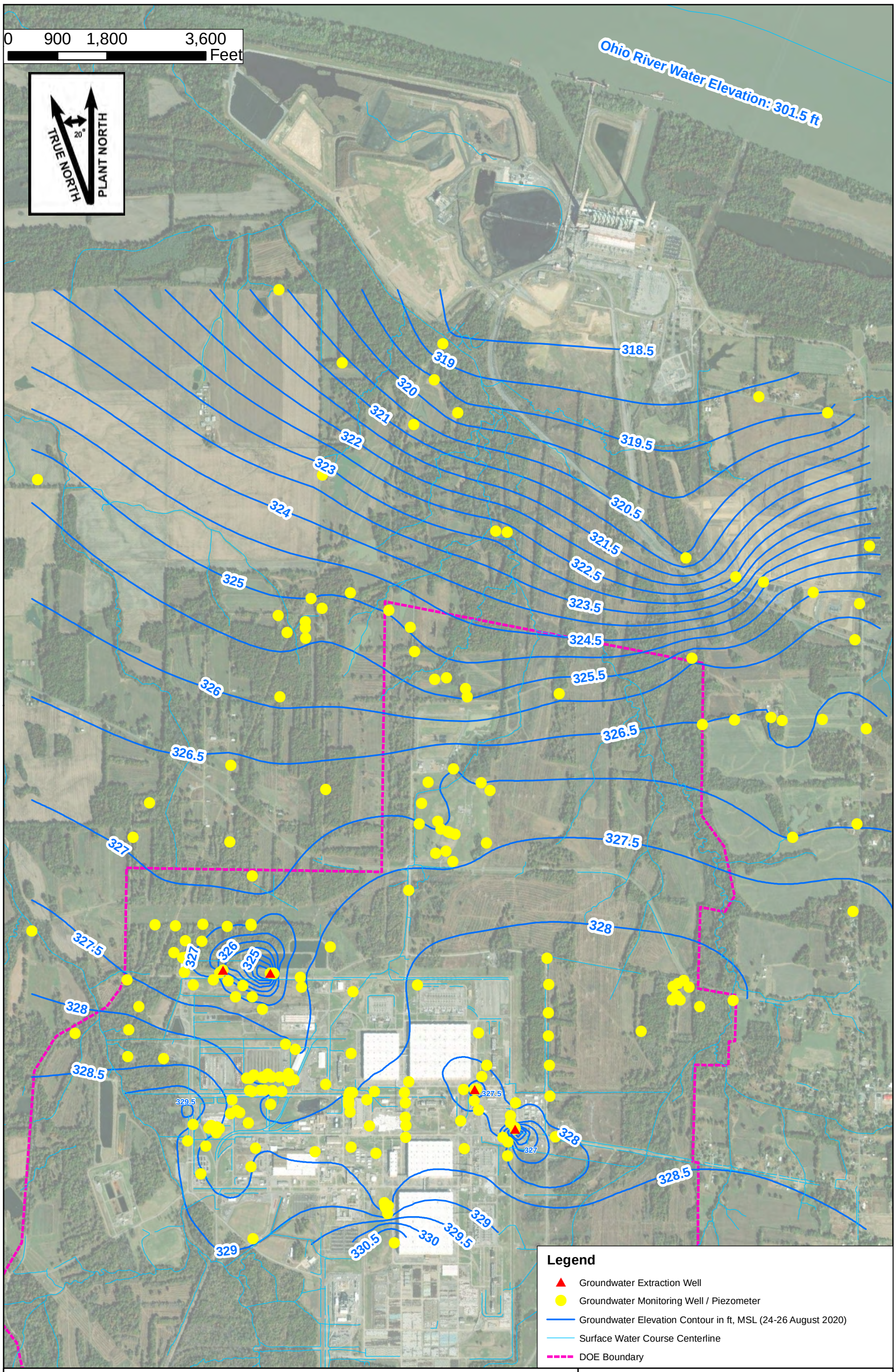
Figure 11. August 2019 RGA Potentiometric Surface Map



MAP SOURCE INFORMATION

Map Generation Date and Location - 6/3/2021 Geosyntec\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\Potentiometric Surface Maps\Figure 12 August 2020 Potentiometric Surface Map
Map Layer Location: Geosyntec\\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\Potentiometric Surface Maps\Figure 12 August 2020 Potentiometric Surface Map.mxd
Image Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Shapefiles for DOE Boundary and Surface Water Course Centerline were obtained from Pegasis (https://pegasis.pad.pppo.gov/), Downloaded on 3/16/2021.
Groundwater elevation was based on the August 24-26, 2020 measurements. Ohio River elevation was estimated as the average of elevations measured by the USGS at Paducah Station USGS 0361100 and Olmsted, IL Station (USGS 03612600) between August 24-26, 2020.

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Figure 12. August 2020 RGA Potentiometric Surface Map

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The area exceeding 900 pCi/L for Tc-99 lies within the TCE footprint on Figure 7 (i.e., the area encompassed by the 1,000–10,000 µg/L isocontour), with the exception of MW168. From the 2018 interpreted contour, the 900 pCi/L contour was moved northward to include MW340 because the Tc-99 levels in MW340 increased from 382 pCi/L in September 2018 to 1,150 pCI/L in September 2020. Tc-99 activities in nearby MW261 and MW339 remained below 900 pCi/L.

The highest level of Tc-99 occurs in the area of MW422 through MW425. This is consistent with historical releases at the C-400 Building. The 3,790 pCi/L isoconcentration contour was moved slightly to the west to exclude MW421, whose Tc-99 activity decreased from 4,500 pCi/L in September 2018 to 2,560 pCi/L in September 2020. The southern extent of the 900 pCi/L and the 3,790 pCi/L contours were moved southward to include MW342, whose activity increased from 714 pCi/L in September 2018 to 18,200 pCi/L in September 2020. In 2019 and 2020, MW425-PRT1 and MW424-PRT1 also showed increases in Tc-99 activity from 2018 levels.

The 1,930 pCi/L isocontour, not previously defined on the 2018 Plume Map, represents the derived concentration standard corresponding to standards for public consumption of drinking water that equate to an effective dose of 4 mrem/year (DOE 2011b; DOE 2021). The northern extent of the area exceeding 1,930 pCi/L is delineated by downgradient MW340, whose activity was 1,150 pCi/L in September 2020.

The southern extent of the Tc-99 plume is delineated between MW342 and MW175, with reported Tc-99 activity in September 2020 of 18,200 pCi/L and 273 pCi/L, respectively.

Northeast Plume transect wells, MW524 to MW530, installed as part of the Northeast Plume Optimization project, all contain < 900 pCi/L Tc-99 (ranging from nondetect to 219 pCi/L).

5. POTENTIOMETRIC MAPS

Synoptic water level measurements were collected in August 2019 and August 2020 to evaluate groundwater flow direction. In 2019, water level measurements in wells screened in the RGA were made in 269 extraction wells, MWs, residential wells, and piezometers during a 4-day period between August 12, 2019, and August 15, 2019. Similarly, in 2020, groundwater level measurements were conducted in 278 extraction wells, MWs and piezometers during a 3-day period. These water level measurements (Table 2) are the basis for the August 2019 and August 2020 potentiometric surface maps of the RGA, presented as Figures 11 and 12, respectively. The contours of the potentiometric surface map define lines of equal hydraulic potential. The local direction of hydraulic gradient is perpendicular to the hydraulic potential lines. These potentiometric surface contours help explain the plume geometries. In addition to groundwater flow direction, other factors affecting the plume geometries include temporal changes to the RGA hydraulic potential field; source zone characteristics, anisotropy of the hydraulic conductivity within the RGA; near-field recharge effects; recharge sources not associated with the PGDP; and advection, dispersion, and natural attenuation of the contaminants.

Table 2. RGA Water Levels Measurement Events during CY 2019 and 2020

Event Dates	Number of Wells/Piezometers	Ohio River Stage (ft amsl)	Barometric Pressure (in/Hg)	Rainfall during the event (inches)
August 12–15, 2019	269	301.2	29.95	0.0
August 24–26, 2020	278	301.5	30.08	0.39

Notes: Ohio River elevation was estimated as the average of elevations measured by the U.S. Geological Survey (USGS) at Paducah Station USGS 0361100 and Olmsted, IL Station (i.e., USGS 03612600). Rainfall data was obtained from the Paducah, Barkley Regional Airport office of the National Weather Service (i.e., https://w1.weather.gov/data/obhistory/KPAH.html).

A dominant control on the hydraulic potential field of the RGA is the stage of the Ohio River, which is the primary discharge zone of the RGA. The Ohio River stage controls the base hydraulic potential in the RGA (e.g., water levels rise in the RGA when the river stage is high). During August 2019, the Ohio River stage near the Paducah Site was approximately 301.2 ft above mean sea level (amsl); in August 2020, the stage of the Ohio River was approximately 301.5 ft amsl. In addition, the Northeast Plume and Northwest Plume Pump-and-Treat Systems form local cones of depression in the RGA potentiometric surface.

Operation of the Olmsted Locks and Dam on the Ohio River, located approximately 19 miles downstream of the Paducah Site, began in September 2018. The dam maintains a higher base level stage on the Ohio River and will impact the river stage during the operational life of the dam. As such, the August 2019 and August 2020 maps documented RGA hydraulic potential contours during a higher river stage (301.2 ft amsl and 301.5 ft amsl, respectively) compared with the August 2017 and August 2018 maps (290 ft amsl and 298 ft amsl, respectively).

RGA water level measurements were converted to elevation and corrected to a standard barometric pressure that was common during the period of the water level measurements: 29.95 inches of mercury for the August 2019 measurements and 30.08 inches of mercury for the 2020 measurements. Rainfall was minimal during both periods of water level measurements: 0.0 inches of precipitation during the August 2019 water level measurements and 0.39 inches on August 26, 2020.

A data quality review of the RGA water level measurements identified a few measurements that were rejected for mapping the RGA potentiometric surface (Table 3).[11] In the 2019 data set, 5 out of 269 measurements were rejected. In the 2020 data set, 2 out of 278 measurements was rejected. Where co-located MWs and piezometers occur (i.e., those located within 50-ft distance), a single map location was defined and assigned a representative water level based on the co-located well and piezometer measurements. The resulting map for the August 2019 data set include RGA water level elevations for 189 wells, piezometers, co-located MWs and piezometers, and 3 extraction wells.[12] The resulting map for the August 2020 data set include 196 wells, piezometers, co-located wells and piezometers, and 4 extraction wells.

Table 3. RGA Water Levels Measurements (Total and Useable) from Events during CY 2019 and 2020

Event	Total Number of Measurements	Number of acceptable measurements
August 12–15, 2019	269	264
August 24–26, 2020	278	276

[11] A measurement was rejected when the derived elevation was inconsistent with other measurements in the area; no explanation for the discrepancy was apparent.
[12] EW235 was not operational during the RGA water level measurement event.

The RGA hydraulic potential contours first were generated by computer using a Surfer® software (i.e., version 12.8.1009 from 2015) and ArcGIS (i.e., version 10.8). The Surfer® software created contours using kriging, based on the well coordinates and water level elevations of the August 2019 and August 2020 synoptic water measurements events. The resulting contours then were exported into ArcGIS for the presentation of the contours together, with relevant site features and smoothed manually in ArcGIS where site knowledge provided bias to understanding the hydraulic potential field.

The available wells and piezometers for both the 2019 and 2020 data sets provide a robust monitoring network for defining the RGA hydraulic potential within the DOE property. For the region included in Figures 11 and 12, the primary areas of uncertainty are (1) the northwest corner, where no monitoring point is present; (2) the western edge of the contoured expanse, where few wells and piezometers are available to refine the contour spacing; and (3) the zone parallel to the Ohio River, which includes the Tennessee Valley Authority Shawnee Fossil Plant. It remains uncertain if the RGA hydraulic potential in the area adjacent to the Ohio River uniformly slopes to the Ohio River or steeply declines near the edge of recent Ohio River bank deposits.

6. INTERNAL REVIEW PROCESS

The map contours generated for 2020 plumes were developed by consensus by FRNP subject matter experts and were reviewed by hydrogeologists familiar with the site. DOE subsequently reviewed, provided comments and, after resolution of comments, concurred on the maps.

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APPENDIX A

ELECTRONIC COPIES OF TABLES AND GRAPHS AND ALTERNATE INTERPRETATION OF PLUMES WITH MAXIMUM RESULTS (CD)

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APPENDIX A

ELECTRONIC COPIES OF TABLES AND GRAPHS (CD)

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APPENDIX B

TABLE OF DATA USED TO PREPARE THE 2020 PLUME MAPS

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Table B.1. 2019 and 2020 TCE and Tc-99 Data Used to Create Plume Maps

Station	RGA Monitored Zone	Screened Interval (ft amsl)[a]	Date TCE Sample Collected	TCE (µg/L)[b]	Date Tc-99 Sample Collected	Tc-99 (pCi/L)[c]	Notes
MW100	Lower	283–293	5/14/2020	1U	Not Sampled		
MW103	Middle	293–303	4/30/2019	1U	4/30/2019	2.75U	
MW106A	Middle	295–305	11/19/2020	3.37	11/19/2020	18.8U	
MW124	Lower	270–280	10/8/2020	44.9	10/8/2020	0.361U	
MW125	Lower	285–295	5/13/2020	68.6	5/13/2020	24.8	
MW126	Middle	298–308	10/8/2020	31.9	10/8/2020	1.45U	
MW134	Lower	272–282	11/19/2020	1U	11/19/2020	5.85U	
MW135	Lower	283–293	9/17/2020	20.2	9/17/2020	80.7	
MW139	Middle	294–304	5/13/2020	4.45	5/13/2020	3.12U	
MW144	Lower	263–273	10/8/2020	101	10/8/2020	37.6	
MW145	Lower	283–293	10/8/2020	44.1	10/8/2020	18.1	
MW146	Lower	283–293	11/19/2020	1U	11/19/2020	16.1U	
MW148	Middle	281–311	5/9/2019	10.4Y1	Not Sampled		
MW150	Lower	278–308	6/23/2020	1U	6/23/2020	-5.63U	
MW155	Lower	287–292	12/2/2020	3030	12/2/2020	118	
MW156	Upper	310–317	12/2/2020	3380	12/2/2020	1.94U	
MW161	Lower	289–294	12/2/2020	315	5/20/2020	10.3U	
MW163	Lower	285–290	10/7/2020	34	10/7/2020	20.9	
MW165A	Upper	310–315	9/14/2020	0.76J	9/14/2020	7.03U	
MW168	Upper	307–312	5/7/2019	62.8Y1	5/7/2019	1420	
MW169	Middle	301–306	5/8/2019	281Y1	5/8/2019	86.2	
MW173	Upper	314–319	9/14/2020	2.44	9/14/2020	-4.9U	
MW175	Middle	299–304	9/21/2020	3430	9/21/2020	273	
MW178	Upper	309–314	12/9/2020	356	12/9/2020	121	
MW191	Middle	297–302	5/14/2020	1U	Not Sampled		
MW193	Upper	298–303	5/1/2019	1U	Not Sampled		
MW194	Middle	302–307	11/19/2020	1U	11/19/2020	2.94U	
MW197	Upper	303–308	9/16/2020	35	9/16/2020	37	
MW199	Lower	292–297	11/19/2020	1U	11/19/2020	5.93U	
MW200	Middle	298–303	4/30/2019	11.1	4/30/2019	85.2	
MW201	Middle	297–302	11/19/2020	0.52J	11/19/2020	6.57U	
MW202	Lower	289–294	11/19/2020	1U	11/19/2020	2.87U	
MW203	Middle	299–304	5/20/2020	69.5	5/20/2020	89.1	
MW205	Upper	307–312	5/8/2019	0.41JY1	5/8/2019	6.96U	
MW220	Upper	310–320	10/14/2020	1U	10/14/2020	16.7U	
MW221	Upper	304–314	10/14/2020	1U	10/14/2020	4.94U	
MW222	Upper	314–324	10/14/2020	1U	10/14/2020	4.98U	
MW223	Upper	309–319	10/14/2020	1U	10/14/2020	7.93U	
MW224	Upper	310–320	10/14/2020	1U	10/14/2020	12.8U	
MW226	Lower	287–297	7/13/2020	235Y1	7/13/2020	3.89U	
MW227	Upper	301–311	7/13/2020	320Y1	7/13/2020	-1.56U	
MW236	Lower	290–300	5/13/2020	1.6	5/13/2020	9.3U	
MW240	Middle	290–300	5/13/2020	0.99J	5/13/2020	12.2U	
MW242	Middle	295–305	9/14/2020	31.8	9/14/2020	14.2	
MW243	Middle	293–303	9/15/2020	27.9	9/15/2020	18.9	
MW244	Middle	291–301	9/15/2020	2.65	9/15/2020	-8.09U	
MW245	Middle	294–304	9/15/2020	12Y1	9/15/2020	0.217U	
MW248	Middle	289–299	9/15/2020	5.37Y1	9/15/2020	8.33U	
MW250	Middle	293–303	9/15/2020	3.03Y1	9/15/2020	1.97U	
MW252	Lower	283–288	6/23/2020	1U	Not Sampled		
MW253A[n]	Lower	268–273	6/23/2020	24.5	Not Sampled		
MW255	Lower	286–291	10/7/2020	153	10/7/2020	0.21U	
MW256	Lower	279–284	10/7/2020	130	10/7/2020	28.2	
MW258	Lower	287–292	10/8/2020	298	10/8/2020	1.26U	
MW260	Lower	284–289	10/7/2020	51.3	10/7/2020	36.4	
MW261	Lower	276–281	5/20/2020	2200	5/20/2020	601	

Table B.1. 2019 and 2020 TCE and Tc-99 Data Used to Create Plume Maps (Continued)

Station	RGA Monitored Zone	Screened Interval (ft amsl)[a]	Date TCE Sample Collected	TCE (µg/L)[b]	Date Tc-99 Sample Collected	Tc-99 (pCi/L)[c]	Notes
MW262	Lower	278–283	5/8/2019	342Y1	5/8/2019	213	
MW283	Lower	288–298	10/8/2020	13.7	10/8/2020	0.314U	
MW288	Lower	280–290	10/8/2020	176	10/8/2020	27.4	
MW291	Lower	288–298	10/8/2020	31.6	10/8/2020	-7.13U	
MW292	Lower	276–286	10/8/2020	283	10/8/2020	17.1	
MW293A	Middle	289–299	10/8/2020	128	10/8/2020	3.35U	
MW328	Middle	301–306	4/30/2019	0.4J	4/30/2019	1.05U	
MW329	Upper	303–308	4/30/2019	1U	4/30/2019	-1.7U	
MW333	Middle	296–305	7/13/2020	2560Y1	7/13/2020	74.6	
MW337	Middle	297–307	7/15/2020	452	7/15/2020	265	
MW338	Middle	298–308	7/15/2020	403	7/15/2020	28.3	
MW339	Lower	277–286	9/14/2020	933	9/14/2020	116	
MW340	Lower	277–286	9/14/2020	4420	9/14/2020	1150	
MW341	Middle	293–303	12/9/2020	6300	12/9/2020	555	
MW342	Middle	292–302	9/24/2020	3600	9/24/2020	18200	
MW343	Lower	290–300	9/21/2020	15300	9/21/2020	9920	
MW354	Middle	301–306	12/1/2020	4.15	12/1/2020	8.86U	
MW355	Lower	285–290	9/14/2020	5.57	9/14/2020	26.7	
MW356	Lower	257–262	9/16/2020	1U	9/16/2020	-3.29U	
MW357	Upper	304–314	10/15/2020	3.7	10/15/2020	22.7	
MW358	Lower	285–295	10/15/2020	1.13	10/15/2020	-0.703U	
MW360	Upper	310–320	10/15/2020	1U	10/15/2020	1.26U	
MW361	Middle	294–304	10/15/2020	5.84	10/15/2020	47.3	
MW363	Upper	301–311	10/15/2020	1U	10/15/2020	-8.53U	
MW364	Lower	283–293	10/15/2020	6.26	10/15/2020	51.7	
MW366	Upper	304–314	10/21/2020	3.38	10/21/2020	63.5	
MW367	Lower	284–294	10/21/2020	0.5J	10/21/2020	-6.74U	
MW369	Upper	311–321	10/12/2020	0.73J	10/12/2020	18.6U	
MW370	Middle	292–302	10/12/2020	0.66J	10/12/2020	72.3	
MW372	Upper	301–311	10/12/2020	2.85	10/12/2020	83.4	
MW373	Lower	288–298	10/12/2020	4.28	10/12/2020	19.2U	
MW384	Upper	287–297	10/13/2020	0.66J	10/13/2020	36.9	
MW385	Lower	303–313	10/13/2020	0.58J	10/13/2020	56.5	
MW387	Upper	304–314	10/13/2020	0.88J	10/13/2020	321	
MW388	Middle	291–301	10/13/2020	0.6J	10/13/2020	27.7	
MW391	Middle	297–307	10/14/2020	9.53	10/14/2020	6.89U	
MW392	Lower	273–283	10/14/2020	14	10/14/2020	11.3U	
MW394	Upper	302–312	10/22/2020	3.35	10/22/2020	1.28U	
MW395	Middle	295–305	10/22/2020	2.27	10/22/2020	-1.04U	
MW397	Lower	290–300	10/22/2020	1U	10/22/2020	8.46U	
MW403	Multizone[d]	272–274	12/1/2020	3.16	12/1/2020	5.8U	
MW404	Multizone[e]	284–286	4/30/2019	2.4	4/30/2019	-1.94U	
MW405	Multizone[f]	296–298	12/9/2020	296	12/9/2020	51.9	
MW406	Multizone[g]	296–298	12/9/2020	473	12/9/2020	6.97U	
MW407	Multizone[h]	304–306	12/9/2020	7470	12/9/2020	25.8	
MW408	Multizone[i]	296–298	12/9/2020	145	12/9/2020	8.69U	
MW409	Lower	280–290	9/16/2020	1U	Not Sampled		
MW410	Lower	278–288	9/22/2020	1U	Not Sampled		
MW411	Middle	294–304	9/17/2020	1U	Not Sampled		
MW414	Middle	297–307	5/7/2019	1310Y1	5/7/2019	80	
MW415	Lower	273–283	5/7/2019	1980Y1	5/7/2019	10.1U	
MW416	Middle	300–310	5/7/2019	1010Y1	5/7/2019	19.3	
MW417	Lower	272–282	5/7/2019	126Y1	5/7/2019	9.92U	
MW418	Middle	296–306	5/14/2020	7.42	5/14/2020	9.92U	
MW419	Lower	281–291	5/14/2020	11.9	5/14/2020	10.6U	

Table B.1. 2019 and 2020 TCE and Tc-99 Data Used to Create Plume Maps (Continued)

Station	RGA Monitored Zone	Screened Interval (ft amsl)[a]	Date TCE Sample Collected	TCE (µg/L)[b]	Date Tc-99 Sample Collected	Tc-99 (pCi/L)[c]	Notes
MW420	Middle	299–309	7/14/2020	1340	7/14/2020	1.66U	
MW421	Multizone[j]	291–305	9/21/2020	57900	9/21/2020	2560	
MW422	Multizone[j]	290–304	9/21/2020	30300	9/21/2020	23900	
MW423	Multizone[j]	290–305	9/21/2020	26700	9/21/2020	25300	
MW424	Multizone[j]	292–306	9/21/2020	9560	9/21/2020	21300	
MW425	Multizone[j]	292–306	9/24/2020	3540	9/24/2020	24300	
MW426	Upper	304–314	11/19/2020	1U	11/19/2020	11.7U	
MW427	Lower	273–283	11/19/2020	0.45J	11/19/2020	10.4U	
MW428	Lower	277–287	9/15/2020	2.29Y1	9/15/2020	-3.51U	
MW429A	Upper	302–312	9/22/2020	0.5J	9/22/2020	-6.05U	
MW430	Lower	281–291	9/22/2020	1.37	9/22/2020	-4.7U	
MW431	Lower	285–295	12/1/2020	2.91	Not Sampled		
MW432	Middle	292–302	11/19/2020	0.56J	11/19/2020	15.1U	
MW433	Middle	302–305	11/19/2020	1U	11/19/2020	2.73U	
MW435	Lower	274–284	11/19/2020	1U	11/19/2020	8.1U	
MW439	Middle	295–297	5/6/2019	1.41	Not Sampled		
MW441	Lower	277–279	11/19/2020	1.45	11/19/2020	11.6U	
MW442	Lower	288–291	5/6/2019	2.59	5/6/2019	-12.3U	
MW443	Lower	274–277	5/6/2019	0.95J	5/6/2019	-9.46U	
MW444	Lower	259–264	5/6/2019	0.91J	5/6/2019	-5.23U	
MW445	Middle	297–300	5/6/2019	1.26	5/6/2019	-7.76U	
MW447	Lower	261–266	5/6/2019	1.36	5/6/2019	-5.83U	
MW448	Middle	303–305	5/6/2019	1.81	5/6/2019	-12.6U	
MW450	Lower	276–286	5/6/2019	9.62	5/6/2019	1.83U	
MW451	Upper	304–314	4/30/2019	1U	4/30/2019	3.82U	
MW452	Lower	280–290	11/19/2020	1U	11/19/2020	7.7U	
MW453	Upper	306–316	5/13/2020	24.9	5/13/2020	18.3U	
MW454	Lower	284–294	5/13/2020	64.7	5/13/2020	17.2U	
MW455	Middle	300–310	9/14/2020	15.2	9/14/2020	8.24U	
MW456	Lower	278–288	9/14/2020	109	9/14/2020	64.5	
MW457	Upper	305–315	9/14/2020	36.7	9/14/2020	15.4	
MW458	Lower	282–292	9/14/2020	62.9	9/14/2020	27.6	
MW459	Upper	306–316	9/14/2020	66.4	9/14/2020	26.8	
MW460	Lower	279–289	12/1/2020	337	12/1/2020	124	
MW461	Upper	307–317	9/14/2020	5.17	9/14/2020	0.287U	
MW462	Lower	287–297	9/14/2020	38.9	9/14/2020	9.1U	
MW463	Middle	298–308	5/21/2019	90.2	Not Sampled		
MW464	Lower	267–277	5/18/2020	96.4	Not Sampled		
MW465	Middle	302–307	5/21/2019	2.14	Not Sampled		
MW466	Middle	295–300	5/21/2019	1U	Not Sampled		
MW467	Upper	300–310	5/21/2019	2.34	Not Sampled		
MW468	Middle	294–299	5/21/2019	5.92	Not Sampled		
MW469	Middle	297–307	5/18/2020	1U	Not Sampled		
MW470	Lower	292–297	5/18/2020	1U	Not Sampled		
MW471	Middle	292–302	5/18/2020	1U	Not Sampled		
MW472	Lower	286–291	5/18/2020	1U	Not Sampled		
MW473	Lower	289–299	5/7/2019	1UY1	Not Sampled		
MW474	Lower	275–285	5/7/2019	1UY1	Not Sampled		
MW475	Middle	293–303	5/7/2019	1UY1	Not Sampled		
MW476	Lower	267–277	5/7/2019	1UY1	Not Sampled		
MW477	Lower	282–292	9/23/2019	0.89J	Not Sampled		
MW478	Middle	295–305	10/8/2020	309	10/8/2020	-4.39U	
MW479	Upper	301–311	10/8/2020	1.18	10/8/2020	-8.46U	
MW480	Lower	283–293	10/8/2020	173	10/8/2020	41	
MW481	Middle	298–308	5/1/2019	1U	5/1/2019	16.7U	

Table B.1. 2019 and 2020 TCE and Tc-99 Data Used to Create Plume Maps (Continued)

Station	RGA Monitored Zone	Screened Interval (ft amsl)[a]	Date TCE Sample Collected	TCE (µg/L)[b]	Date Tc-99 Sample Collected	Tc-99 (pCi/L)[c]	Notes
MW482	Lower	269–279	5/1/2019	58.7	5/1/2019	15.6U	
MW483	Middle	294–304	6/23/2020	48.9	Not Sampled		
MW484	Lower	278–288	6/23/2020	47.5	Not Sampled		
MW485	Middle	295–305	5/9/2019	62.8Y1	Not Sampled		
MW487	Lower	282–292	5/9/2019	6.53Y1	Not Sampled		
MW488	Middle	299–309	6/23/2020	1U	6/23/2020	-10.6U	
MW489	Middle	300–310	4/30/2019	33.4	4/30/2019	3U	
MW490	Lower	290–300	4/30/2019	24.5	4/30/2019	10.8U	
MW491	Upper	301–311	5/1/2019	85.9	5/1/2019	82.5	
MW492	Lower	286–296	5/1/2019	93.2	5/1/2019	63.5	
MW493	Upper	302–312	5/1/2019	1.03	5/1/2019	59.7	
MW494	Middle	290–300	5/1/2019	1.2	5/1/2019	59.7	
MW495	Lower	268–278	10/8/2020	355	10/8/2020	42.9	
MW496	Lower	267–277	10/8/2020	134	10/8/2020	18.9	
MW497	Middle	300–310	9/15/2020	386Y1	9/15/2020	150	
MW498	Lower	276–286	9/15/2020	109Y1	9/15/2020	41.8	
MW499	Middle	297–307	9/15/2020	650Y1	9/15/2020	266	
MW500	Lower	278–288	9/15/2020	529	9/15/2020	339	
MW501	Middle	299–309	9/15/2020	1UY1	9/15/2020	-1.1U	
MW502	Lower	282–292	9/15/2020	1.98Y1	9/15/2020	-0.796U	
MW503	Lower	282–287	9/15/2020	8.38	9/15/2020	130	
MW504	Upper	315–320	9/15/2020	0.71J	9/15/2020	-0.0714U	
MW505	Upper	312–317	12/2/2020	5.33	12/2/2020	57.6	
MW506	Middle	300–305	12/2/2020	8220	12/2/2020	56.1	
MW507	Lower	287–292	12/2/2020	2220	12/2/2020	53.5	
MW524	Middle	299–309	10/7/2020	22.6	10/7/2020	0.129U	
MW525	Middle	301–311	10/7/2020	757	10/7/2020	133	
MW526	Middle	302–312	10/7/2020	2680	10/7/2020	207	
MW527	Middle	302–311	10/7/2020	42.4	10/7/2020	44	
MW528	Lower	291–301	10/7/2020	92.2	10/7/2020	73.9	
MW529	Lower	289–299	10/7/2020	3180	10/7/2020	210	
MW530	Lower	285–295	10/7/2020	80.1	10/7/2020	41.7	
MW531	Lower	267–277	10/7/2020	104	10/7/2020	73.6	
MW533	Lower	282–292	10/7/2020	141	10/7/2020	56.6	
MW536	Lower	288–298	10/7/2020	118	10/7/2020	101	
MW537	Lower	277–287	10/7/2020	58	10/7/2020	140	
MW538	Middle	294–304	10/7/2020	179	10/7/2020	25.1	
MW539	Lower	281–291	10/7/2020	111	10/7/2020	21.3	
MW542	Upper	305–310	12/2/2020	0.94J	Not Sampled		
MW543	Upper	304–309	12/2/2020	1.79	Not Sampled		
MW544	Upper	308–313	12/2/2020	236	Not Sampled		
MW545	Upper	309–314	12/2/2020	0.73J	Not Sampled		
MW546	Upper	305–310	12/2/2020	61.5	Not Sampled		
MW547	Upper	305–310	12/2/2020	1190	Not Sampled		
MW548	Lower	287–297	7/13/2020	3700Y1	7/13/2020	54.2	
MW549	Upper[k]	303–313	5/7/2019	3530Y1	5/7/2019	-9.69U	
MW550	Upper[k]	297–307	5/13/2019	6840	5/13/2019	8.37U	
MW551	Upper[k]	298–308	5/13/2019	821	5/13/2019	0.7U	
MW556	Lower	279–289	10/8/2020	82.4	10/8/2020	22.6	
MW63	Upper	307–312	9/14/2020	2.28	9/14/2020	-0.133U	
MW65	Lower	279–284	9/14/2020	1.26	9/14/2020	-0.67U	
MW66	Upper	308–313	9/14/2020	488	9/14/2020	148	
MW67	Middle	302–307	7/13/2020	1380Y1	7/13/2020	118	
MW68	Lower	275–280	6/8/2020	96.6	6/8/2020	41.1	
MW71	Upper	306-310	6/8/2020	0.37J	6/8/2020	6.76U	
MW76	Middle	295–305	7/13/2020	265Y1	7/13/2020	9.94U	

Table B.1. 2019 and 2020 TCE and Tc-99 Data Used to Create Plume Maps (Continued)

Station	RGA Monitored Zone	Screened Interval (ft amsl)[a]	Date TCE Sample Collected	TCE (µg/L)[b]	Date Tc-99 Sample Collected	Tc-99 (pCi/L)[c]	Notes
MW84A	Middle	297–307	7/14/2020	3230	7/14/2020	332	
MW86	Lower	287–298	7/15/2020	3760	7/15/2020	15.6U	
MW87A	Middle	298–308	7/14/2020	3090	7/14/2020	5.04U	
MW89	Lower	285–295	7/13/2020	120Y1	7/13/2020	10.9U	
MW90A	Upper	301–311	7/14/2020	52	7/14/2020	12.5U	
MW92	Lower	282–293	7/15/2020	5.56	7/15/2020	20.5	
MW93A	Middle	296–306	7/14/2020	2220	7/14/2020	-0.977U	
MW95A	Lower	288–298	7/13/2020	1790Y1	7/13/2020	7.42U	
MW98	Middle	293–303	9/16/2020	0.48J	9/16/2020	49.7	
MW99	Middle	295–305	8/19/2020	0.75J	Not Sampled		
R114	Residential[l]	—	11/23/2020	1U	Not Sampled		East of map extent
R13	Residential[l]	—	11/23/2020	1U	11/23/2020	-13.5U	
R14	Residential[l]	—	11/23/2020	1U	11/23/2020	-11.5U	
R20	Residential[l]	—	11/23/2020	1U	Not Sampled		
R21	Residential[l]	—	11/23/2020	1U	Not Sampled		
R245	Residential[l]	—	11/19/2020	1U	11/19/2020	0.337U	
R26	Residential[l]	—	11/23/2020	1U	11/23/2020	-15.9U	West of map extent
R2	Residential[l]	—	11/19/2020	3.72	11/19/2020	8.75U	
R424	Middle[m]	304–306	12/17/2020	3.82	12/17/2020	2.51U	
R53	Residential[l]	—	11/23/2020	1U	11/23/2020	-7.39U	
R83	Residential[l]	—	11/23/2020	1U	Not Sampled		
R90	Residential[l]	—	11/23/2020	1U	Not Sampled		East of map extent
R9	Residential[l]	—	11/23/2020	1U	Not Sampled		

[a] Screened intervals are approximate.

[b] TCE results of "1U" indicate the sample was analyzed and not detected at a reporting level of 1 µg/L; J indicates the reported value was detected at less than the reporting limit; Y1 indicates MS/MSD recovery outside acceptance criteria.

[c] Tc-99 results with "U" indicate the sample was analyzed, but is reported at a level less than the minimum detectable activity and/or total propagated uncertainty. Negative results may be reported due to a statistical determination of the counts seen by a detector, minus a background count.

[d] MW403 was sampled from Port 3 during 2019–2020. Port 3 screen interval is shown.

[e] MW404 was sampled from Port 4 during 2019–2020. Port 4 screen interval is shown.

[f] MW405 was sampled from Port 5 during 2019–2020. Port 5 screen interval is shown.

[g] MW406 was sampled from Port 5 during 2019–2020. Port 5 screen interval is shown.

[h] MW407 was sampled from Port 4 during 2019–2020. Port 4 screen interval is shown.

[i] MW408 was sampled from Port 5 during 2019–2020. Port 5 screen interval is shown.

[j] MW422–MW425 were sampled from all three ports during 2019–2020. The screen interval shown encompasses all three ports.

[k] MW549–MW551 were sampled from the uppermost port during 2019–2020. The uppermost screen interval is shown.

[l] Residential wells are assumed to be completed in the Upper RGA unless known to be otherwise.

[m] R424 was sampled from Ports 1 and 3 during 2019-2020. Consistent with the 2018 Plume Map, only data from Port 1 are included in this analysis to support comparison with historical data interpretation. In 2019-2020, TCE concentrations were higher in Port 1 and Tc-99 was not detected in Port 1 or Port 3.

[n] MW253A RGA monitored zone and screened interval zone are assumed to be the same as the original well, MW253.

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APPENDIX C

2020 PLUME MAPS

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FIGURES

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Notes:
1. Data from the most recent 2020 sampling event used except where noted.
2. For co-located wells completed at multiple depths, the highest value for the period was mapped.

Ohio River

MW146 11/19/2020 (1U)
MW439 5/6/2019 (1.41)
MW441 11/19/2020 (1.45)
MW433 11/19/2020 (1U)
MW435 11/19/2020 (1U)
MW443 5/6/2019 (0.95J)
MW442 5/6/2019 (2.59)
LBCSP5 8/20/2020 (0.63J)
MW444 5/6/2019 (0.91J)
MW450 5/6/2019 (9.62)
MW445 5/6/2019 (1.26)
MW448 5/6/2019 (1.81)
MW447 5/6/2019 (1.36)
R83 11/23/2020 (1U)
R21 11/23/2020 (1U)
MW474 5/7/2019 (1UY1)
MW473 5/7/2019 (1UY1)
MW475 5/7/2019 (1UY1)
MW476 5/7/2019 (1UY1)
R245 11/19/2020 (1U)
MW199 11/19/2020 (1U)
MW201 11/19/2020 (0.52J)
R14 11/23/2020 (1U)
MW135 9/17/2020 (20.2)
MW463 5/21/2019 (90.2)
MW464 5/18/2020 (96.4)
MW465 5/21/2019 (2.14)
MW467 5/21/2019 (2.34)
MW466 5/21/2019 (1U)
MW468 5/21/2019 (5.92)
MW469 5/18/2020 (1U)
MW470 5/18/2020 (1U)
MW472 5/18/2020 (1U)
MW471 5/18/2020 (1U)
MW411 9/17/2020 (1U)
MW236 5/13/2020 (1.6)
MW490 4/30/2019 (24.5)
MW489 4/30/2019 (33.4)
MW202 11/19/2020 (1U)
EW228
EW229
MW240 5/13/2020 (0.99J)
MW492 5/1/2019 (93.2)
MW491 5/1/2019 (85.9)
MW98 9/16/2020 (0.48J)
MW493 5/1/2019 (1.03)
MW494 5/1/2019 (1.2)
MW360 10/15/2020 (1U)
MW361 10/15/2020 (5.84)
MW364 10/15/2020 (6.26)
MW357 10/15/2020 (3.7)
MW358 10/15/2020 (1.13)
MW363 10/15/2020 (1U)
MW367 10/21/2020 (0.5J)
MW366 10/21/2020 (3.38)
MW139 5/13/2020 (4.45)
MW477 9/23/2019 (0.89J)
MW99 8/19/2020 (0.75J)
MW100 5/14/2020 (1U)
R13 11/23/2020 (1U)
MW125 5/13/2020 (68.6)
MW485 5/9/2019 (62.8Y1)
MW483 6/23/2020 (48.9)
MW484 6/23/2020 (47.5)
MW148 5/9/2019 (10.4Y1)
MW487 5/9/2019 (6.53Y1)
MW488 6/23/2020 (1U)
MW252 6/23/2020 (1U)
R20 11/23/2020 (1U)
MW410 9/22/2020 (1U)
MW372 10/12/2020 (2.85)
MW373 10/12/2020 (4.28)
MW370 10/12/2020 (0.66J)
MW369 10/12/2020 (0.73J)
MW388 10/13/2020 (0.6J)
MW387 10/13/2020 (0.88J)
MW392 10/14/2020 (14)
MW391 10/14/2020 (9.53)
MW419 5/14/2020 (11.9)
MW418 5/14/2020 (7.42)
MW221 10/14/2020 (1U)
MW222 10/14/2020 (1U)
MW224 10/14/2020 (1U)
MW384 10/13/2020 (0.66J)
MW385 10/13/2020 (0.58J)
MW223 10/14/2020 (1U)
MW395 10/22/2020 (2.27)
MW394 10/22/2020 (3.35)
MW220 10/14/2020 (1U)
MW397 10/22/2020 (1U)
MW253A 6/23/2020 (24.5)
MW409 9/16/2020 (1U)
MW193 5/1/2019 (1U)
MW200 4/30/2019 (11.1)
MW451 4/30/2019 (1U)
R2 11/19/2020 (3.72)
MW452 11/19/2020 (1U)
MW134 11/19/2020 (1U)
MW454 5/13/2020 (64.7)
MW453 5/13/2020 (24.9)
MW197 9/16/2020 (35)
MW150 6/23/2020 (1U)
MW456 9/14/2020 (109)
MW455 9/14/2020 (15.2)
MW458 9/14/2020 (62.9)
MW459 9/14/2020 (66.4)
MW457 9/14/2020 (36.7)
MW460 12/1/2020 (337)
MW501 9/15/2020 (1UY1)
MW502 9/15/2020 (1.98Y1)
MW461 9/14/2020 (5.17)
MW462 9/14/2020 (38.9)
MW194 11/19/2020 (1U)
MW243 9/15/2020 (27.9)
MW242 9/14/2020 (31.8)
MW244 9/15/2020 (2.65)
MW248 9/15/2020 (5.37Y1)
MW498 9/15/2020 (109Y1)
MW500 9/15/2020 (529)
MW499 9/15/2020 (650Y1)
MW250 9/15/2020 (3.03Y1)
EW230
EW232
EW233
MW504 9/15/2020 (0.71J)
MW106A 11/19/2020 (3.37)
MW245 9/15/2020 (12Y1)
EW231
MW497 9/15/2020 (386Y1)
MW503 9/15/2020 (8.38)
MW173 9/14/2020 (2.44)
MW355 9/14/2020 (5.57)
MW165A 9/14/2020 (0.76J)
MW496 10/8/2020 (134)
MW481 5/1/2019 (1U)
MW482 5/1/2019 (58.7)
MW291 10/8/2020 (31.6)
MW283 10/8/2020 (13.7)
MW293A 10/8/2020 (128)
MW124 10/8/2020 (44.9)
MW126 10/8/2020 (31.9)
EW331
EW332
MW288 10/8/2020 (176)
MW191 5/14/2020 (1U)
R53 11/23/2020 (1U)
MW63 9/14/2020 (2.28)
MW65 9/14/2020 (1.26)
MW432 11/19/2020 (0.56J)
MW66 9/14/2020 (488)
MW339 9/14/2020 (933)
MW340 9/14/2020 (4420)
MW356 9/16/2020 (1U)
MW145 10/8/2020 (44.1)
MW144 10/8/2020 (101)
MW531 10/7/2020 (104)
MW495 10/8/2020 (355)
MW292 10/8/2020 (283)
MW426 11/19/2020 (1U)
MW427 11/19/2020 (0.45J)
MW431 12/1/2020 (2.91)
MW261 5/20/2020 (2200)
MW169 5/8/2019 (281Y1)
MW262 5/8/2019 (342Y1)
MW205 5/8/2019 (0.41JY1)
MW480 10/8/2020 (173)
MW479 10/8/2020 (1.18)
MW429A 9/22/2020 (0.5J)
MW430 9/22/2020 (1.37)
MW428 9/15/2020 (2.29Y1)
MW354 12/1/2020 (4.15)
MW524 10/7/2020 (22.6)
MW533 10/7/2020 (141)
MW260 10/7/2020 (51.3)
EW234
MW525 10/7/2020 (757)
MW526 10/7/2020 (2680)
MW556 10/8/2020 (82.4)
MW403-PRT3 12/1/2020 (3.16)
MW404-PRT4 4/30/2019 (2.4)
MW329 4/30/2019 (1U)
MW161 12/2/2020 (315)
MW542 12/2/2020 (0.94J)
MW527 10/7/2020 (42.4)
MW163 10/7/2020 (34)
MW536 10/7/2020 (118)
MW537 10/7/2020 (58)
MW528 10/7/2020 (92.2)
EW235
MW478 10/8/2020 (309)
MW258 10/8/2020 (298)
MW545 12/2/2020 (0.73J)
MW547 12/2/2020 (1190)
MW549 5/7/2019 (3530Y1)
MW543 12/2/2020 (1.79)
MW544 12/2/2020 (236)
MW546 12/2/2020 (61.5)
MW529 10/7/2020 (3180)
MW539 10/7/2020 (111)
MW256 10/7/2020 (130)
MW530 10/7/2020 (80.1)
MW538 10/7/2020 (179)
MW255 10/7/2020 (153)
MW328 4/30/2019 (0.4J)
MW203 5/20/2020 (69.5)
MW68 6/8/2020 (96.6)
MW71 6/8/2020 (0.37J)
MW103 4/30/2019 (1U)
R9 11/23/2020 (1U)
MW155 12/2/2020 (3030)
MW156 12/2/2020 (3380)
MW405-PRT5 12/9/2020 (296)
MW407-PRT4 12/9/2020 (7470)
MW408-PRT5 12/9/2020 (145)
MW406-PRT5 12/9/2020 (473)
MW505/MW506/MW507 12/2/2020 (8220)

Inset A
MW67 7/13/2020 (1380Y1)
MW84A 7/14/2020 (3230)
MW86 7/15/2020 (3760)
MW87A 7/14/2020 (3090)
MW338 7/15/2020 (403)
MW337 7/15/2020 (452)
MW89 7/13/2020 (120Y1)
MW90A 7/14/2020 (52)
MW92 7/15/2020 (5.56)
MW420 7/14/2020 (1340)
MW333 7/13/2020 (2560Y1)
MW548 7/13/2020 (3700Y1)
MW95A 7/13/2020 (1790Y1)
MW76 7/13/2020 (265Y1)
MW415 5/7/2019 (1980Y1)
MW414 5/7/2019 (1310Y1)
MW93A 7/14/2020 (2220)
MW227 7/13/2020 (320Y1)
MW226 7/13/2020 (235Y1)
MW417 5/7/2019 (126Y1)
MW551 5/13/2019 (821)
MW550 5/13/2019 (6840)
MW416 5/7/2019 (1010Y1)

Inset B
MW168 5/7/2019 (62.8Y1)
MW423-PRT3 9/21/2020 (26700)
MW422-PRT3 9/21/2020 (30300)
MW341 12/9/2020 (6300)
MW343 9/21/2020 (15300)
MW424-PRT3 9/21/2020 (9560)
MW421-PRT3 9/21/2020 (57900)
MW425-PRT3 9/24/2020 (3540)
MW342 9/24/2020 (3600)
MW178 12/9/2020 (356)
MW175 9/21/2020 (3430)

See Inset A
See Inset B

TRUE
20°
PLANT

Feet
600 300 0 600 1,200 1,800

LEGEND

2020 TCE Plume Concentration Fields
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L
- 10,000 - 100,000 µg/L
- ≥ 100,000 µg/L

Note: Contours defining plume cores are based on historical records

MW100 5/14/2020 (1U) - Monitoring Well Identification, Date of Sample, and Sample Value (in µg/L)
1U = not detected at a reporting limit of 1 µg/L
J indicates detected at a value less than the reporting limit
Y1 indicates MS/MSD recovery outside acceptance criteria

- Lower RGA Well
- Middle RGA Well
- Upper RGA Well
- Multizone RGA Well
- Active Extraction Well
- Inactive Extraction Well
- RGA Well outside Plume Concentration Field showing TCE > 1 µg/L
- Seep Monitoring Location
- DOE Property Boundary
- Roadways
- Streams
- 229 Boundary
- PGDP Boundary
- Water Policy Area

MAP SOURCE INFOMATION
Map Generation Date and Location - Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\MXD\Fig_C01_2020PlumesTCER1.mxd, 6/3/2021
Monitoring Well Layer Location: Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP\2019-2020_TCE.shp
2020 TCE Plume Concentration Fields: Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP\TCE_100000.shp, TCE_10000-100000.shp, TCE_1000-10000.shp, TCE_100-1000.shp, TCE_5-100.shp
Active Extraction Well, Inactive Extraction Well, RGA Well outside Plume Concentration Field showing TCE > 1 µg/L, Seep Monitoring Location, Water Policy Area, DOE Property Boundary, Roadways, Streams, 229 Boundary, and PGDP Boundary from PEGASIS; downloaded 3/16/2021

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Figure C.1. 2020 TCE Plume—Regional Gravel Aquifer

Notes:
1. Data from the most recent 2020 sampling event used except where noted.
2. For co-located wells completed at multiple depths, the highest value for the period was mapped.

Ohio River

MW146 11/19/2020 (16.1U)
MW441 11/19/2020 (11.6U)
MW433 11/19/2020 (2.73U)
MW435 11/19/2020 (8.1U)
MW442 5/6/2019 (-12.3U)
MW443 5/6/2019 (-9.46U)
MW444 5/6/2019 (-5.23U)
MW450 5/6/2019 (1.83U)
MW445 5/6/2019 (-7.76U)
MW448 5/6/2019 (-12.6U)
MW447 5/6/2019 (-5.83U)
R245 11/19/2020 (0.337U)
MW199 11/19/2020 (5.93U)
MW201 11/19/2020 (6.57U)
MW135 9/17/2020 (80.7)
R14 11/23/2020 (-11.5U)
MW489 4/30/2019 (3U)
MW202 11/19/2020 (2.87U)
MW236 5/13/2020 (9.3U)
MW490 4/30/2019 (10.8U)
MW492 5/1/2019 (63.5)
MW240 5/13/2020 (12.2U)
EW228
MW98 9/16/2020 (49.7)
MW491 5/1/2019 (82.5)
EW229
MW493 5/1/2019 (59.7)
MW360 10/15/2020 (1.26U)
MW361 10/15/2020 (47.3)
MW494 5/1/2019 (59.7)
MW364 10/15/2020 (51.7)
MW357 10/15/2020 (22.7)
MW363 10/15/2020 (-8.53U)
MW358 10/15/2020 (-0.703U)
MW367 10/21/2020 (-6.74U)
MW139 5/13/2020 (3.12U)
MW366 10/21/2020 (63.5)
MW125 5/13/2020 (24.8)
MW488 6/23/2020 (-10.6U)
R13 11/23/2020 (-13.5U)
MW372 10/12/2020 (83.4)
MW370 10/12/2020 (72.3)
MW373 10/12/2020 (19.2U)
MW369 10/12/2020 (18.6U)
MW391 10/14/2020 (6.89U)
MW200 4/30/2019 (85.2)
MW387 10/13/2020 (321)
MW392 10/14/2020 (11.3U)
MW419 5/14/2020 (10.6U)
MW388 10/13/2020 (27.7)
MW418 5/14/2020 (9.92U)
MW221 10/14/2020 (4.94U)
MW384 10/13/2020 (36.9)
MW222 10/14/2020 (4.98U)
MW385 10/13/2020 (56.5)
MW224 10/14/2020 (12.8U)
MW451 4/30/2019 (3.82U)
R2 11/19/2020 (8.75U)
MW452 11/19/2020 (7.7U)
MW134 11/19/2020 (5.85U)
MW454 5/13/2020 (17.2U)
MW453 5/13/2020 (18.3U)
MW223 10/14/2020 (7.93U)
MW395 10/22/2020 (-1.04U)
MW394 10/22/2020 (1.28U)
MW220 10/14/2020 (16.7U)
MW397 10/22/2020 (8.46U)
MW197 9/16/2020 (37)
MW457 9/14/2020 (15.4)
MW456 9/14/2020 (64.5)
MW458 9/14/2020 (27.6)
MW459 9/14/2020 (26.8)
MW455 9/14/2020 (8.24)
MW460 12/1/2020 (124)
MW150 6/23/2020 (-5.63U)
MW502 9/15/2020 (-0.796U)
MW461 9/14/2020 (0.287U)
MW194 11/19/2020 (2.94U)
MW501 9/15/2020 (-1.1U)
MW462 9/14/2020 (9.1U)
MW242 9/14/2020 (14.2)
MW500 9/15/2020 (339)
MW243 9/15/2020 (18.9)
MW481 5/1/2019 (16.7U)
MW291 10/8/2020 (-7.13U)
MW248 9/15/2020 (8.33U)
MW499 9/15/2020 (266)
MW244 9/15/2020 (-8.09U)
MW283 10/8/2020 (0.314U)
MW482 5/1/2019 (15.6U)
MW293A 10/8/2020 (3.35U)
MW250 9/15/2020 (1.97U)
EW230
EW232
EW233
MW504 9/15/2020 (-0.0714U)
MW106A 11/19/2020 (18.8U)
MW245 9/15/2020 (0.217U)
EW231
MW497 9/15/2020 (150)
MW503 9/15/2020 (130)
MW355 9/14/2020 (26.7)
MW165A 9/14/2020 (7.03U)
MW496 10/8/2020 (18.9)
EW331
MW63 9/14/2020 (-0.133U)
MW498 9/15/2020 (41.8)
MW356 9/16/2020 (-3.29U)
R53 11/23/2020 (-7.39U)
MW65 9/14/2020 (-0.67U)
MW145 10/8/2020 (18.1)
MW288 10/8/2020 (27.4)
MW124 10/8/2020 (0.361U)
MW432 11/19/2020 (15.1U)
MW66 9/14/2020 (148)
MW339 9/14/2020 (116)
MW173 9/14/2020 (-4.9U)
EW332
MW126 10/8/2020 (1.45U)
MW426 11/19/2020 (11.7U)
MW427 11/19/2020 (10.4U)
MW340 9/14/2020 (1150)
MW144 10/8/2020 (37.6)
MW292 10/8/2020 (17.1)
MW261 5/20/2020 (601)
MW262 5/8/2019 (213)
MW495 10/8/2020 (42.9)
MW428 9/15/2020 (-3.51U)
MW205 5/8/2019 (6.96U)
MW531 10/7/2020 (73.6)
MW429A 9/22/2020 (-6.05U)
MW169 5/8/2019 (86.2)
MW480 10/8/2020 (41)
MW354 12/1/2020 (8.86U)
MW430 9/22/2020 (-4.7U)
MW524 10/7/2020 (0.129U)
MW260 10/7/2020 (36.4)
MW479 10/8/2020 (-8.46U)
MW525 10/7/2020 (133)
MW533 10/7/2020 (56.6)
EW234
MW556 10/8/2020 (22.6)
MW403-PRT3 12/1/2020 (5.8U)
MW526 10/7/2020 (207)
MW329 4/30/2019 (-1.7U)
MW404-PRT4 4/30/2019 (-1.94U)
MW527 10/7/2020 (44)
MW163 10/7/2020 (20.9)
MW536 10/7/2020 (101)
MW478 10/8/2020 (-4.39U)
MW528 10/7/2020 (73.9)
MW537 10/7/2020 (140)
MW256 10/7/2020 (28.2)
EW235
MW258 10/8/2020 (1.26U)
MW549 5/7/2019 (-9.69U)
MW161 5/20/2020 (10.3U)
MW529 10/7/2020 (210)
MW538 10/7/2020 (25.1)
MW255 10/7/2020 (0.21U)
MW328 4/30/2019 (1.05U)
MW530 10/7/2020 (41.7)
MW539 10/7/2020 (21.3)
MW203 5/20/2020 (89.1)
MW71 6/8/2020 (6.76U)
MW68 6/8/2020 (41.1)
MW103 4/30/2019 (2.75U)

See Inset A
See Inset B

Inset A
MW67 7/13/2020 (118)
MW84A 7/14/2020 (332)
MW86 7/15/2020 (15.6U)
MW87A 7/14/2020 (5.04U)
MW338 7/15/2020 (28.3)
MW337 7/15/2020 (265)
MW89 7/13/2020 (10.9U)
MW90A 7/14/2020 (12.5U)
MW92 7/15/2020 (20.5)
MW333 7/13/2020 (74.6)
MW420 7/14/2020 (1.66U)
MW95A 7/13/2020 (7.42U)
MW415 5/7/2019 (10.1U)
MW548 7/13/2020 (54.2)
MW76 7/13/2020 (9.94U)
MW93A 7/14/2020 (-0.977U)
MW414 5/7/2019 (80)
MW227 7/13/2020 (-1.56U)
MW417 5/7/2019 (9.92U)
MW226 7/13/2020 (3.89U)
MW551 5/13/2019 (0.7U)
MW550 5/13/2019 (8.37U)
MW416 5/7/2019 (19.3)

Inset B
MW168 5/7/2019 (1420)
MW423-PRT1 9/21/2020 (25300)
MW343 9/21/2020 (9920)
MW421-PRT1 9/21/2020 (2560)
MW424-PRT1 9/21/2020 (21300)
MW422-PRT1 9/21/2020 (23900)
MW341 12/9/2020 (555)
MW425-PRT1 9/24/2020 (24300)
MW178 12/9/2020 (121)
MW342 9/24/2020 (18200)
MW175 9/21/2020 (273)
MW405-PRT5 12/9/2020 (51.9)
MW155 12/2/2020 (118)
MW156 12/2/2020 (1.94U)
MW407-PRT4 12/9/2020 (25.8)
MW406-PRT5 12/9/2020 (6.97U)
MW408-PRT5 12/9/2020 (8.69U)
MW505/MW506/MW507 12/2/2020 (57.6)

TRUE
20°
PLANT

600 300 0 600 1,200 1,800 Feet

LEGEND

2020 Tc-99 Plume Concentration Fields
- 900 - 1,930 pCi/L
- 1,930 - 3790 pCi/L
- ≥ 3790 pCi/L

MW100 8/17/2018 (20U) – Monitoring Well Identification, Date of Sample, and Sample Value (in pCi/L)
"U" by the sample value indicates the value is reported < minimum detectable activity and/or total propagated uncertainty. Negative results may be reported due to a statistical determination of the counts seen by a detector, minus a background count.

- Lower RGA Well
- Middle RGA Well
- Upper RGA Well
- Multizone RGA Well
- Active Extraction Well
- Inactive Extraction Well
- Water Policy Area
- DOE Property Boundary
- Roadways
- Streams
- 229 Boundary
- PGDP Boundary

MAP SOURCE INFOMATION
Map Generation Date and Location - Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\MXD\Fig_C02_2020PlumesTc99R1.mxd, 6/3/2021
Layers: Monitoring Well Layer Location: Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP\2019-2020_Tc99.shp
2020 Tc-99 Plume Concentration Fields : Geosyntec\knoxville-01\data\PROJECTS\Paducah_FRNP\2020 Plume Maps\SHP\Tc99_Above_3790.shp, Tc99_Above_1930.shp, Tc99_900-3790.shp
Active Extraction Well, Inactive Extraction Well, Water Policy Area, DOE Property Boundary, Roadways, Streams, 229 Boundary, and PGDP Boundary from PEGASIS; downloaded 3/16/2021

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Figure C.2. 2020 Tc-99 Plume—Regional Gravel Aquifer