CP2-ES-0400/FR0

Project Management Plan for the Groundwater Strategy Project, Fiscal Year 2022, 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

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Project Management Plan for the Groundwater Strategy Project, Fiscal Year 2022, Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—December 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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APPROVALS

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Groundwater Strategy Project, Fiscal Year 2022,
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky**

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December 2021

Approved by:

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FIGURES

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	conceptual site model
CSOU	Comprehensive Site Operable Unit
D&R	deactivation and remediation
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DQO	data quality objective
EI	environmental indicator
EMP	environmental monitoring plan
EMS	environmental management system
EPA	U.S. Environmental Protection Agency
ES	environmental services
EW	extraction well
FFA	Federal Facility Agreement
FRNP	Four Rivers Nuclear Partnership, LLC
FY	fiscal year
GWOU	Groundwater Operable Unit
GWSP	groundwater strategy project
IRA	interim remedial action
ISMS	integrated safety management system
KAR	*Kentucky Administrative Regulations*
LUC	land use control
MW	monitoring well
MWG	modeling working group
NE	northeast
NEPCS	Northeast Plume Containment System
NW	northwest
NWPGS	Northwest Plume Groundwater System
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
PM	project manager
PMP	project management plan
PZ	piezometer
QA	quality assurance
QAPP	quality assurance project plan
RDSI	remedial design support investigation
RGA	Regional Gravel Aquifer
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SMP	site management plan
SW	southwest
SWMU	solid waste management unit
TVA	Tennessee Valley Authority

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EXECUTIVE SUMMARY

This *Project Management Plan for the Groundwater Strategy Project, Fiscal Year 2022, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, CP2-ES-0400/FR0, (PMP) defines the plans, organization, responsibilities, and systems for managing the Paducah Site Groundwater Strategy Project (GWSP) at the U.S. Department of Energy Paducah Site, which includes the former Paducah Gaseous Diffusion Plant. The activities included in this PMP will be performed consistent with the Paducah Site Environmental Monitoring Plan (EMP) and the Paducah Site EMP Quality Assurance Project Plan, which typically are updated annually. The GWSP also interfaces with a number of projects currently ongoing at the Paducah Site, which includes the Water Policy Program, Pump-and-Treat Operations for the Northeast Plume Containment System and the Northwest Plume Groundwater System, and the Groundwater Modeling Working Group. Additionally, these activities could also support other projects on-site, including those that may be performed for the Waste Disposal Alternatives Operable Unit (OU), Soils OU, Surface Water OU, etc.

The prior PMP focused on activities planned for 2019 through 2020 and extending into 2021 based on the overlapping scopes and overall sequence of work. This PMP describes the activities being added to the program for fiscal year 2022. Other activities may be added to this PMP, or a separate PMP may be developed as planning for other activities is initiated.

This PMP is a living, field-level plan documenting agreements, roles and responsibilities, and management processes used in the execution of the GWSP. This PMP may be updated, as appropriate, to facilitate management of the project (e.g., scope refinement or revision, changes to roles and responsibilities, etc.).

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1. INTRODUCTION

Four Rivers Nuclear Partnership, LLC, (FRNP) is the prime contractor to the U.S. Department of Energy (DOE) to achieve the current site goals for deactivation and remediation (D&R) of the Paducah Gaseous Diffusion Plant (PGDP) facilities at the Paducah Site and prepare the facilities for surveillance and maintenance. The extent and nature of support provided by FRNP to DOE at the Paducah Site, as well as the terms and conditions under which FRNP provides support, are defined in the D&R Project Contract DE-EM0004895.

This Project Management Plan (PMP) defines the plans, organization, responsibilities, and systems for managing the Paducah Site Groundwater Strategy Project (GWSP) at the Paducah Site. The PMP is a living, field-level plan documenting agreements, roles and responsibilities, and management processes used in the execution of the project. This PMP will be updated, as appropriate, to facilitate management of the project (e.g., scope refinement or revision, changes to roles and responsibilities, etc.).

This PMP is organized as follows.

- Section 2 includes the project objectives.
- Section 3 provides regulatory framework and project interfaces.
- Section 4 describes prior actions.
- Section 5 describes the project scope and end points for each activity.
- Section 6 includes the project organization and communications.
- Section 7 discusses quality assurance (QA).
- Section 8 covers health and safety.
- Section 9 includes a project schedule.
- Section 10 details the project risks.
- Section 11 includes references.
- Appendix A includes a description of each activity.
- Appendix B includes a summary of field data collected in fiscal year (FY) 2020 through FY 2021.
- Appendix C includes a summary of field data collection planned for FY 2022.

The activities included in this PMP will be performed consistent with the Environmental Monitoring Plan (EMP) and the EMP Quality Assurance Project Plan (QAPP), which typically are updated annually. FRNP procedures, manufacturer's recommendations, other appropriate guidance, and sound engineering principles, as applicable and relevant to the scope of work, also will be followed.

The GWSP also interfaces with a number of projects currently ongoing at the Paducah Site, which includes the Water Policy Program, Pump-and-Treat Operations for the Northeast Plume Containment System (NEPCS) and the Northwest Plume Groundwater System (NWPGS), and the Groundwater Modeling Working Group (MWG). Additionally data collected for GWSP activities could also support other projects on-site, including those that may be performed for the Waste Disposal Alternatives Operable Unit (OU), Soils OU, Surface Water OU, etc.

This PMP builds upon the scope described in the prior PMP (FRNP 2020) and includes activities to be performed in FY 2022 (see Appendix A for more information on each activity).

2. PROJECT OBJECTIVES

The Sitewide GWSP is being performed proactively and programmatically by DOE to provide more information to refine the conceptual site model (CSM) in preparation for the final remedy for the Groundwater Operable Unit (GWOU) Dissolved-Phase Plumes, to provide additional data to support changing the status of the Environmental Indicators (EIs) to "Yes," and to address recommended maintenance and updates from the groundwater MWG meetings.

U.S. Environmental Protection Agency (EPA) and Kentucky EIs are used to measure performance and to communicate progress made in protecting human health and the environment, and sites are designated as Insufficient Data, Under Control, or Not Under Control. The EIs for the Paducah Site are summarized in Table 1. A key goal of the GWSP is to determine what information is needed or what additional information is to be collected to change the status of the first two EIs for the Paducah Site to a "Yes." The other two EIs, Construction Complete and Sitewide Ready for Anticipated Use, currently are not applicable for the Paducah Site.

Table 1. Paducah Site EIs

EI	EPA Status[a]	Kentucky Status[b]
Human Exposure Under Control	Insufficient Data	Yes
Groundwater Migration Under Control	No	No[c]
Construction Complete	No	No
Sitewide Ready for Anticipated Use	No	No

[a] PGDP EIs [from EPA Site Profile—Paducah Gaseous Diffusion Plant (USDOE), Paducah, KY, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Healthenv&id=0404794].
[b] November 2009 Kentucky Division of Waste Management EI Update—2008
[c] Based on Kentucky's determination that the migration of trichloroethene (TCE)-contaminated groundwater on the west side of the Northeast (NE) Plume is not stabilized (Kentucky's EI Determination 2008).

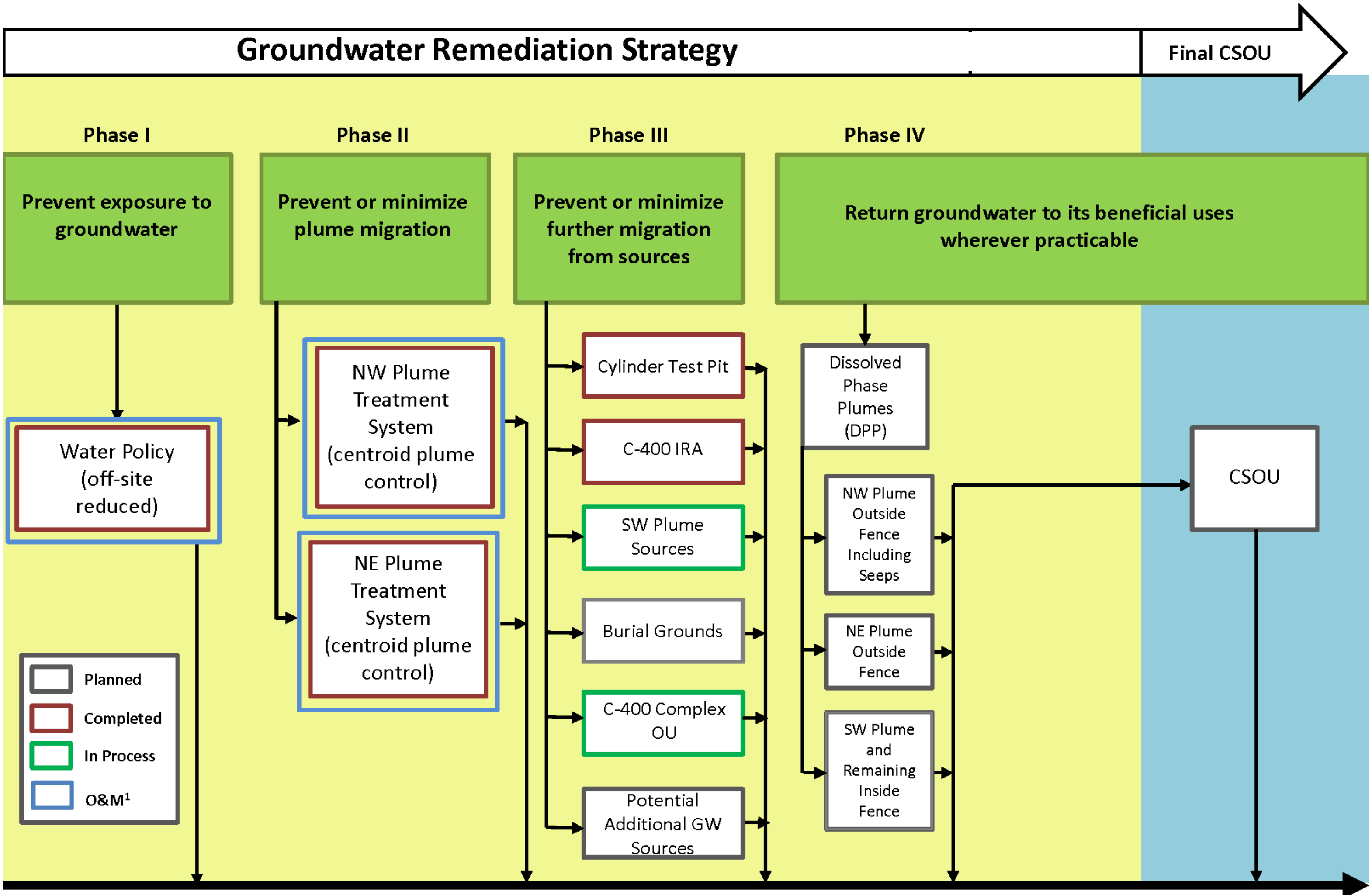
Other project goals include the following:

- Collect data to support the goals to prevent exposure to groundwater, prevent or minimize plume migration, and prevent/minimize further migration from sources;
- Resolve data needs in various portions of the dissolved-phase TCE NE, Northwest (NW), and Southwest (SW) Plumes; and
- Provide inputs to maintenance and updates to the groundwater model.

The GWSP is integrated with the strategy for the GWOU, as described in the *Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision—FY 2021* (SMP) (DOE 2020). The GWOU is being implemented in a phased approach to accomplish the following goals.

1. Prevent human exposure to contaminated groundwater;
2. Prevent or minimize further migration of contaminant plumes;
3. Prevent, reduce, or control contaminant sources contributing to groundwater contamination; and
4. Restore the groundwater to its beneficial uses wherever practicable.

The overall sequencing of response actions to accomplish these goals is shown in Figure 1.



Ongoing environmental monitoring program and 5-year reviews, as appropriate

[1] **Other than environmental monitoring**

Source: DOE 2020

CSOU = Comprehensive Site Operable Unit

Figure 1. Groundwater Remediation Strategy

3. REGULATORY FRAMEWORK AND OTHER PROJECT INTERFACES

3.1 REGULATORY FRAMEWORK

The Paducah Site, including PGDP, is located within the Jackson Purchase region of western Kentucky. PGDP is a former uranium enrichment facility that is owned by DOE. PGDP initially was owned and managed by the Atomic Energy Commission and the Energy Research and Development Administration, DOE's predecessors.

PGDP (CERCLIS# KY8-890-008-982) was placed on the National Priorities List on May 31, 1994. In accordance with Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE entered into a Federal Facility Agreement (FFA) with EPA and the Kentucky Department for Environmental Protection on February 13, 1998 (EPA 1998). The FFA established one set of consistent requirements for achieving comprehensive site remediation in accordance with the Resource Conservation and Recovery Act and CERCLA, including stakeholder involvement.

3.2 OTHER PROJECT INTERFACES

The GWSP has overlap and interface with several ongoing projects at the Paducah Site, which includes the Water Policy Program; Pump-and-Treat Operations (i.e., the NEPCS and NWPGS); and the Groundwater MWG. Each of these projects is described briefly below, and information on project integration/communication is included in Section 5.

3.2.1 Water Policy Program

In areas where the groundwater either is known to be contaminated or has the potential to become contaminated in the future, DOE has provided water hookups to the West McCracken County Water District and pays water bills for affected residences and businesses as part of the *Action Memorandum for the Water Policy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1994a). Residential wells have been capped and locked, including those that are used by DOE for monitoring (per license agreement between DOE and each resident, renewed every five years). The Action Memorandum provided the sampling strategy only at the time the document was prepared and referred future sampling to the sampling and analysis plan addendum, which subsequently was superseded by the EMP. Groundwater monitoring frequencies and parameters are detailed in the EMP.

As part of its contract, FRNP evaluated the footprint of the Water Policy area (FRNP 2021). Based on the technical evaluation of existing groundwater data and in consideration of the ongoing data collection efforts, FRNP recommended the following:

- Continue with the current Water Policy Program with no near-term change to the Water Policy Box at this time;
- Continue collecting additional data under the EMP, GWSP, and the operations and maintenance plans for the NEPCS and NWPCS;
- Evaluate the need and location for new monitoring well (MW) installation in the future based on the additional data collected under the ongoing groundwater programs; and

- Reevaluate the Water Policy Box area in the future as additional data become available, and as part of the CERCLA Five-Year Review process.

Groundwater levels or analytical samples collected as part of the Water Policy Program may be used to satisfy one or more data needs as defined in the activities, or the data obtained as part of the GWSP may be used as inputs to the Water Policy program. Activities 1 and 2 in this PMP most directly overlap with the Water Policy Evaluation. The data collection for these activities began in September 2020 and currently consist of colloidal borescope testing, manual water level measurements, and pressure transducer data collection. Other GWSP activities that can be integrated with a future Water Policy Box evaluation include activities 4, 5, 7, 8, 11, 13, 14, and 18.

3.2.2 Pump-and-Treat Operations

The NWPGS includes two extraction wells (EWs), EW232 and EW233, located east of the original southern extraction field. Activities 6, 7, 14, and 15 in this PMP overlap most directly with the NWPGS project.

Two new EWs (EW234 and EW235), 14 MWs, and 8 piezometers (PZs) were installed as part of optimization of Pump-and-Treat Operations for the NEPCS from July 2016 through August 2017. Included in this system of 14 MWs with single screens were 7 new Regional Gravel Aquifer (RGA) MWs in a north-south transect located approximately 600 ft east of the C-400 Cleaning Building. As part of the optimization, groundwater levels and samples are being collected, as defined in the EMP; these groundwater levels may be used as inputs to one or more activities in the GWSP or may be used to satisfy one or more data needs defined in the activities.

Activities 2, 8, 13, 14, and 15 in this PMP most directly overlap with the NEPCS optimization project.

3.2.3 Groundwater MWG

The Groundwater MWG is made up of representatives from DOE; the D&R Contractor, FRNP; EPA; Kentucky; and Kentucky Research Consortium for Energy and the Environment. The primary responsibility of the Groundwater MWG is to develop and maintain the sitewide groundwater model for PGDP. Data collected as part of the GWSP will be provided to the Groundwater MWG, as appropriate, for evaluation for inclusion in the sitewide groundwater model.

Activities 12, 13, 14, 15, 16, and 19 in this PMP overlap most directly with the Groundwater MWG.

3.2.4 C-400 Complex Operable Unit Remedial Investigation

The C-400 Complex (i.e., the C-400 Cleaning Building and area bounded by adjacent streets) contains numerous solid waste management units (SWMUs) and contaminated environmental media/debris (e.g., groundwater, soils, concrete slabs) and is the primary source of off-site TCE groundwater contamination at the Paducah Site. The C-400 Complex OU is intended to characterize fully the nature and extent of contamination and take the necessary actions to address all environmental contamination in order to achieve a final remedial action for the entire C-400 Complex. The combined remedial investigation/feasibility study (RI/FS) for the C-400 Complex area includes an investigation of all remaining building structure(s) (e.g., slab, subsurface structures) and releases of any hazardous substances to the soil and/or groundwater associated with the C-400 Cleaning Building and C-400 Complex area operations [which includes, but is not limited to, TCE dense nonaqueous-phase liquid (DNAPL) and high concentration areas considered principal threat waste]. As part of the project, RI/FS characterization will be performed to define the full nature and extent of all contamination within the C-400 Complex from the surface down through the RGA and to include the upper McNairy Formation. Data collected during the C-400 Complex RI may be used as inputs to one or more activities in the GWSP (e.g., Activity 9) or may be used to satisfy one or more data needs defined in the activities.

3.2.5 Other Projects

Data collected as part of other projects that are relevant to the GWSP and this PMP (e.g., implementation of the EMP, the C-400 Cleaning Building RI, the plant industrial area vapor intrusion project) will be considered as part of the data assessment process. As part of evaluating all data inputs, FRNP will consider the results of the expected independent evaluation of the Paducah Site MW network and contaminant trends conducted by EarthCon.

4. PRIOR GROUNDWATER ACTIONS

4.1 PADUCAH SITE PHASED APPROACH TO GROUNDWATER OPERABLE UNIT DISSOLVED-PHASE PLUMES

A phased approach to the groundwater remediation is being employed at the Paducah Site. This phased approach is consistent with EPA guidance (see Figure 1) and includes the following:

1. Performed emergency and interim remedial actions (IRAs) to provide water to local residences with private wells contaminated with TCE and technetium-99 (Tc-99) and to conduct hydraulic containment and treatment of high concentrations of off-site TCE contamination;

2. Completed, in progress, and planned remediation of areas contributing to groundwater contamination (i.e., source areas);

3. Current and planned focused data collection to further define the GWOU Dissolved-Phase Plumes CSM, also referred to as the Sitewide GWSP; and

4. Remediation of future GWOU Dissolved-Phase Plumes.

These phases are illustrated, as shown in Figure 1, where Phase 1 corresponds to Phase I in Figure 1, Phase 2 corresponds to Phase II, Phase 3 overlaps with Phases III and IV, and Phase 4 corresponds to Phase IV.

4.2 EMERGENCY AND INTERIM REMEDIAL ACTIONS

Interim and immediate actions to control groundwater TCE and Tc-99 migration have been performed as described below. These actions are documented in the SMP (DOE 2020).

- Local Residences (the Water Policy Box):
  - An emergency removal action provided temporary water to local residences where private wells were contaminated by TCE and/or Tc-99.
  - A 1994 removal action extended municipal water line to residences affected by off-site groundwater contamination. DOE has provided license agreements to these residences and continues to pay for municipal water for these residences.

- Additional actions for vapor intrusion (the Water Policy Screening Study) were performed in 2015 as part of the CERCLA 2013 Five-Year Review (DOE 2016).

- NW Plume:
  - An IRA was implemented to provide hydraulic containment and treatment of high concentrations of off-site TCE contamination in the NW Plume. The Record of Decision (ROD) for this action was signed in 1993, and construction for the remedial action was completed in 1995. The NWPGS has been operational since this time.
  - An optimization of the NWPGS was performed in 2011 through placing existing southern EWs on standby and installing two new EWs east of the original southern extraction field.

- NE Plume:
  - An IRA was implemented to provide hydraulic containment and treatment of high concentrations of off-site TCE contamination in the NE Plume. The ROD for this action was signed in 1995, and construction for the remedial action was completed in 1996. The NEPCS has been operational since this time.
  - An optimization of the NEPCS was performed from 2016 through 2017 by placing existing EWs on standby and installing two new EWs in the upgradient high concentration area of the NE Plume near the eastern edge of the PGDP facility. The system became fully operational in 2017.

4.2.1 Source Area Remediation

- SWMU 91:
  - An IRA was implemented for the *in situ* treatment of TCE-contaminated soils using the LASAGNA™ technology. The ROD for this action was signed in 1998, and the remedial action was completed in 2001.

- C-400 Complex OU:
  - An IRA was implemented for the *in situ* treatment of TCE-source areas in the Upper Continental Recharge System and RGA located in the southeast and southwest corners of the C-400 Cleaning Building, using electrical-resistance heating technology. Field operations for Phase I were completed in 2011. Phase IIa operations began in 2013 and ceased in 2014. A treatability study for steam-enhanced extraction was conducted and completed in 2015. The Treatability Study Report was approved in 2016.
  - Additional actions for vapor intrusion (the C-400 Cleaning Building Vapor Intrusion Study) were performed in 2018 as part of the CERCLA 2013 Five-Year Review.
  - The C-400 Cleaning Building is the subject of an ongoing RI/FS. The RI/FS work plan was completed and approved in 2019, with field investigation starting in November 2019 and continuing into FY 2022.

- SW Plume Sources:
  - SWMU 1—The remedial action for SWMU 1 consisted of *in situ* source treatment using deep soil mixing with interim land use controls (LUCs). The ROD for this action was signed in 2012 and the action was completed in 2015.
  - SWMU 211-A—The Remedial Action for SWMU 211-A is *in situ* source treatment using enhanced *in situ* bioremediation with interim LUCs or long-term monitoring with interim LUCs based upon remedial design support investigation (RDSI) results. The final characterization report addendum and letter notification proposing remedy for 211-A and 211-B have been evaluated by the FFA parties. The FFA parties have agreed to move forward with a bioremediation remedy at 211-A.
  - SWMU 211-B—The Remedial Action for SWMU 211-B is *in situ* source treatment using enhanced *in situ* bioremediation with interim LUCs or long-term monitoring with interim LUCs based upon RDSI results. The final characterization report addendum and letter notification proposing remedy for 211-A and 211-B were evaluated by the FFA parties. The FFA parties have agreed to determine an appropriate remedial action for 211-B based on a revised CSM consistent with the data in the final characterization report.

5. PROJECT SCOPE

During the prior contracts and continuing under the D&R Contract, several data needs or inputs related to the sitewide groundwater CSM have been identified. These data needs have been grouped into four categories: Human Exposure Under Control Data Needs, Groundwater Migration Under Control Data Needs, Groundwater MWG Inputs, and Additional Activities. In many cases, activities to address these data needs are overlapping, and efforts have been made to combine and collect information for multiple activities concurrently and efficiently, as possible.

5.1 HUMAN EXPOSURE UNDER CONTROL DATA NEEDS

The discrete areas associated with the Human Exposure Under Control Data Needs are shown in Figure 2. The two areas outlined in green are related to the nature and extent of dissolved-phase TCE contamination associated with the west side of the Water Policy area (Activity 1) and the east side of the Water Policy area (Activity 2). The data needs also consider potential impacts to Ohio River and the McNairy Formation. The area outlined in red represents a data need associated with stream conditions downgradient of groundwater seeps (Activity 4). Human Exposure Under Control Data Needs associated with vapor intrusion are being addressed through separate ongoing actions. The results of addressing these data needs may be incorporated into addressing other data needs identified for the GWSP.

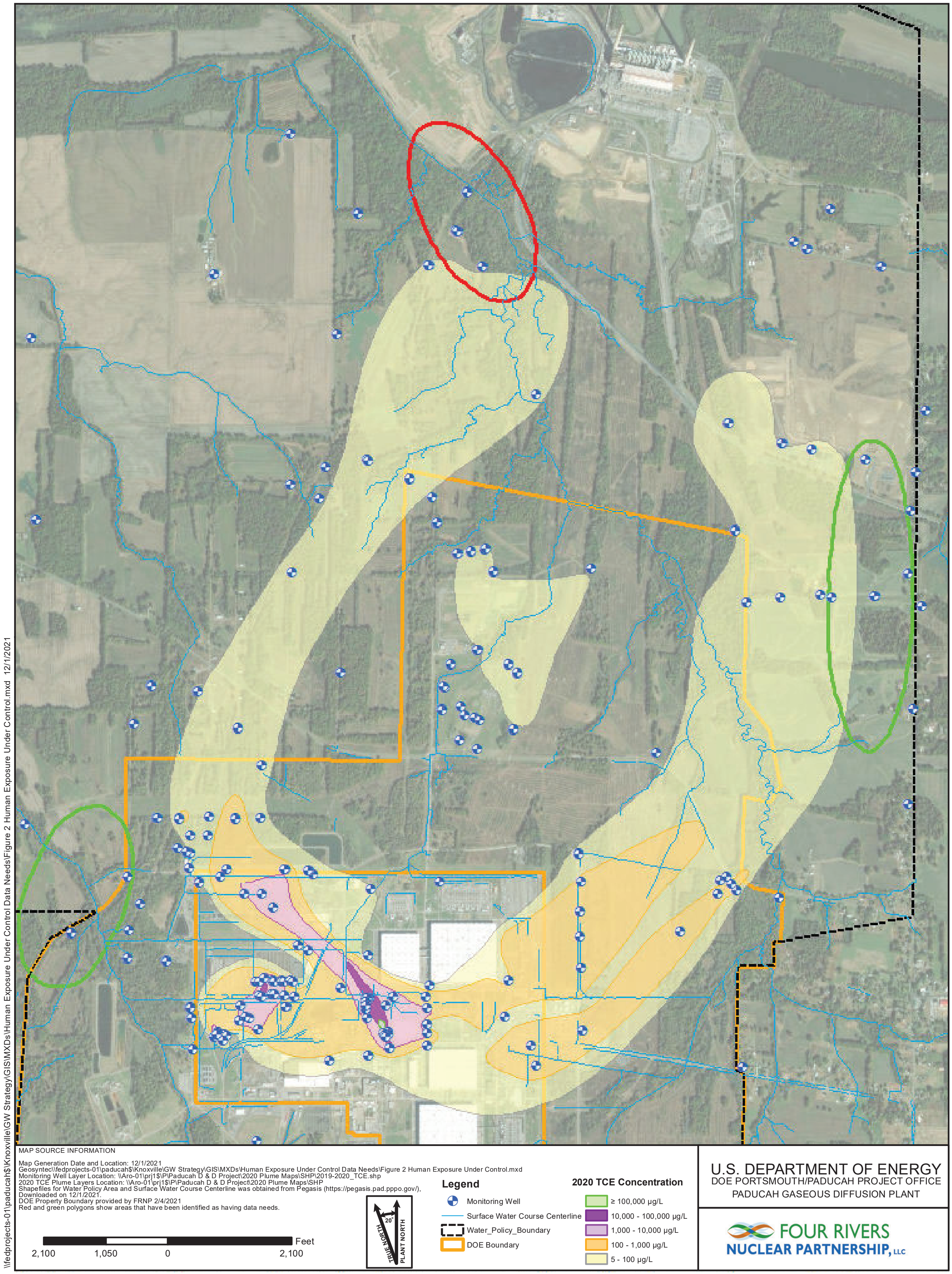


Figure 2. Human Exposure Under Control Data Needs

5.2 GROUNDWATER MIGRATION UNDER CONTROL DATA NEEDS

The discrete areas associated with the Groundwater Migration Under Control Data Needs are shown in Figure 3. The area outlined in red represents a data need associated with the extent of TCE in groundwater in the portion of the NW Plume downgradient of the NW Plume EWs (Activity 6), the area outlined in green represents a data need associated with the extent of TCE in groundwater on the east side of the downgradient NW Plume (Activity 7), and the area outlined in blue represents a data need associated with the extent of TCE in groundwater on the west side of the downgradient NE Plume (Activity 8). The results of addressing these data needs may be incorporated into addressing other data needs identified for the GWSP.

5.3 GROUNDWATER MWG INPUTS

As part of the regular Groundwater MWG meetings, a number of recommendations for further discussion or development have been identified, including the following that were selected based on their overlap with other activities included in this PMP.

- Characterize the McNairy Formation CSM (i.e., faulting) and potential contaminant impacts (Acitivty 9).
- Characterize Underflow from Terrace Area to identify significant sources of upgradient recharge in the model domain (Activity 10).
- Expand Groundwater Monitoring Network to reduce uncertainty regarding groundwater flow direction, contaminant distribution, and potential source areas (Activity 11).
- Evaluate water balance across the Site (Activity 12).
- Monitor continuous RGA Water Level in the vicinity of the Ohio River and along a transect of wells extending back to the PGDP industrial area to better understand hydraulic properties of the RGA (Activity 13).
- Measure Synoptic Water Level during different seasons and associated with the Olmsted Locks and Dam operational changes to document RGA hydraulic potential during different hydraulic stress periods (Activity 14).
- Prepare Water Level Divide Study to assess water level and water quality data collected from the newly installed transect of MWs located east of the C-400 Cleaning Building (Activity 15).
- Measure Hydraulic Conductivity to characterize hydraulic conductivity across the model domain better (Activity 16).

5.4 ADDITIONAL ACTIVITIES

During the course of the GWSP, three additional activities have been identified and added to the project based on their importance to the site groundwater CSM. These activities include Activity 17 (i.e., MW Survey Study), Activity 18 (i.e., Groundwater Chemical Trends Evaluation), and Activity 19 (i.e., TCE Degradation Rates). The results from addressing these data needs may be incorporated into addressing other data needs identified for the GWSP.

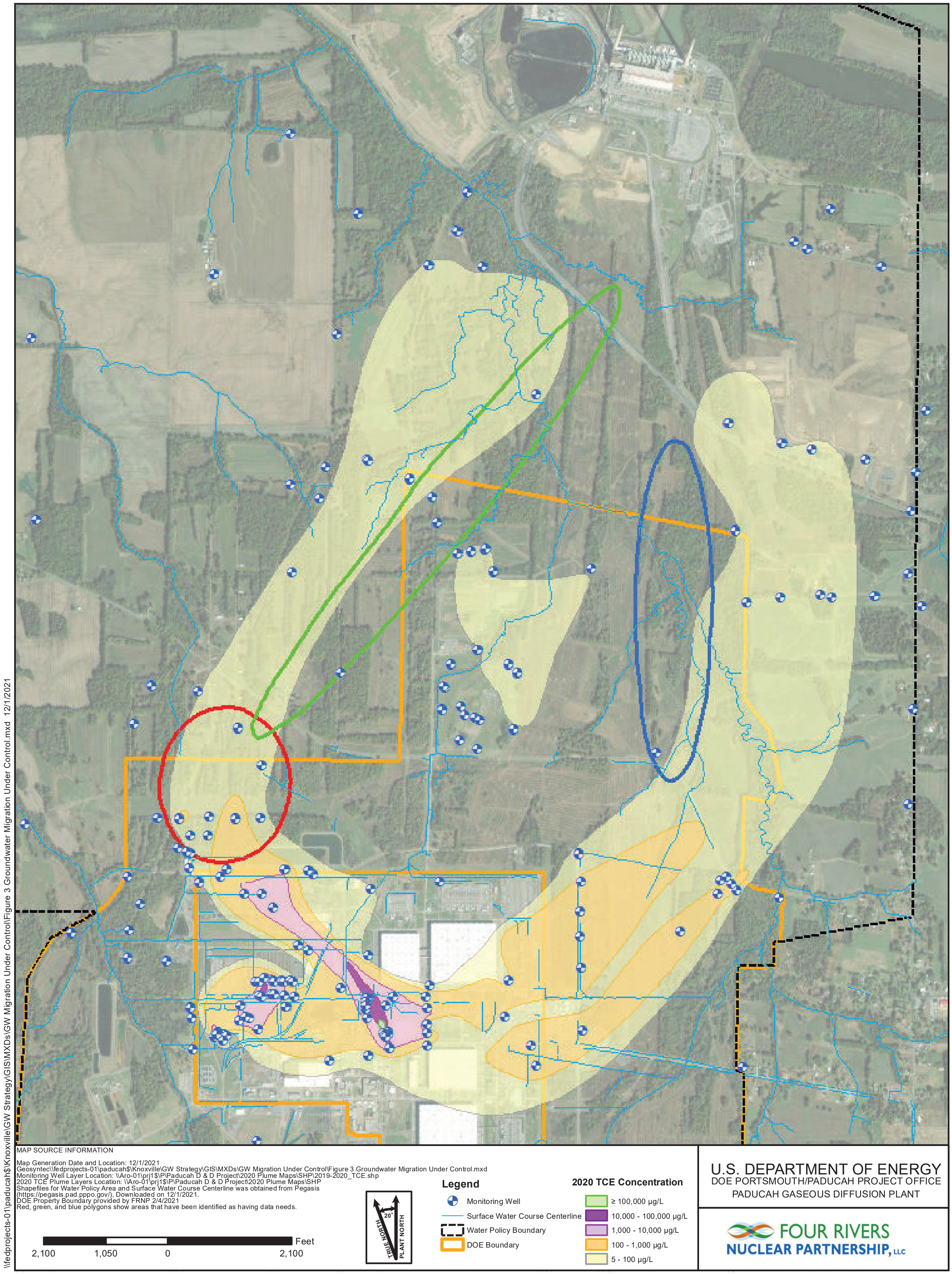


Figure 3. Groundwater Migration Under Control Data Needs

5.5 GROUNDWATER STRATEGY SUMMARY

The GWSP includes the 16 activities described above (five activities associated with the Human Exposure Under Control Data Needs, four activities associated with the Groundwater Migration Under Control Data Needs, and seven associated with the Groundwater MWG Inputs) as well as three additional activities identified during the development of the GWSP. The 19 activities are summarized in Table 2. Other

Table 2. Summary of Activities Considered for the Groundwater Strategy

Activity No.	Issue of Concern
Human Exposure Under Control	
1	TCE Extent West of PGDP (SW Plume)
2	TCE Extent East of PGDP (Downgradient NE Plume)
3	North Extent of PGDP TCE Plumes (Impact to Ohio River)
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps
5	Nature and Extent of Dissolved-Phase Contaminants Other than TCE and technetium-99 (Tc-99)
Groundwater Migration Under Control	
6	Capture Efficiency of NW Plume EWs
7	TCE Extent and Trends in East Side of Downgradient NW Plume
8	TCE Extent and Trends in West Side of Downgradient NE Plume
9	RGA Dissolved-Phase and DNAPL Contaminant Impacts to the McNairy Formation
Groundwater MWG Inputs	
10	Characterize Underflow from the Terrace Area
11	Expansion of Groundwater Monitoring Network
12	Water Balance Study
13	Continuous RGA Water Level Monitoring
14	Synoptic Water Level Measurement
15	Water Level Divide Study
16	Hydraulic Conductivity
Additional Activities	
17	MW Survey Study
18	Groundwater Chemical Trend Evaluation
19	TCE Degradation Rates

activities may be added to this PMP, or a separate PMP may be developed as planning for each activity is initiated.

A systematic approach is being used to address data needs and will evolve throughout the site remediation.

- Identify potential data needs collectively with stakeholders.
  - Evaluate potential known data needs for future action(s).
  - Evaluate potential uncertainties as they are identified.
  - Predict changes in the dissolved-phase plume.
- Begin the data quality objective (DQO) process for data needs for further evaluation.
- Evaluate the need for follow-on actions in these areas based on outcome of DQO process.
- Budget and schedule considerations.

Both near-term (defined as 0–3 years) and long-term (greater than 3 years) solutions were considered.

- Near-Term Solutions:

  - Optimize groundwater monitoring (considering EarthCon analysis).

  - Change sampling approach of existing wells.

  - Optimize locations/potentially add new wells or include Tennessee Valley Authority (TVA) wells.

  - Expand water level monitoring (existing and new equipment).

- Evaluate well pumping rates and pump depths at NW Plume pump-and-treat system.

- Modeling studies.

  - Dilution attenuation factor (decisions for protection of groundwater at source areas).
  - NE Plume transect well information and pump-and-treat information.
  - Anthropogenic recharge (from PGDP operations).

- Update CSM.

- Long-Term Solutions:

  - Complete miscellaneous source areas and dissolved-phase RIs.
  - Optimize groundwater monitoring.
  - Groundwater Phase V (e.g., drive point sampling to site additional wells).
  - Revise/optimize groundwater flow model.
  - Update CSM.

5.6 PROJECT DQOS

Development of DQOs follows a series of steps. The seven steps in the process are shown in a flowchart found in EPA QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006). Similar steps are found in DOE guidance, *Institutionalizing the Data Quality Objectives Process for EM's Environmental Data Collection Activities* (DOE 1994b). The purpose and goal of each step are described in the text in EPA QA/G-4, accompanying the flowchart. EPA QA/G-4 also includes a summary of key elements that may be used in developing DQOs for specific investigations.

The overall GWSP has a defined set of DQOs (Table 3) that are supported further by the DQOs for each activity (see Appendix A).

Table 3. DQOs for the GWSP

DQO	PGDP Groundwater Strategy
1. State the Problem	Data needs and uncertainties limit the site's ability to document completion of the first two GWSP objectives (i.e., revise the EIs for Human Exposure Under Control and Migration Under Control to "yes") and to document better completion of overall sitewide groundwater strategy • Preventing human exposure to contaminated groundwater/human exposure under control and • Preventing or minimizing further migration of the contaminant plume/groundwater migration under control.
2. Identify the Decision	Develop a groundwater strategy with actionable objectives that • Closes out documentation of the objectives, • Increases understanding of the dissolved-phase plume, and • Cross-references with scheduled projects to align data gathering.

Table 3. DQOs for the GWSP (Continued)

DQO	PGDP Groundwater Strategy
3. Identify Inputs to the Decision	• DOE policies • Previous PGDP groundwater strategies • Source unit and plume investigations • Remedial actions • Monitoring data • Modeling results and uncertainties • CSM • Follow-on actions to be defined
4. Define the Study Boundaries	• Nature and extent of dissolved-phase contamination — West DOE property boundary (Water Policy area concern) — Immediate downgradient of NW Plume EWs — East side of downgradient NW Plume — East and west side of downgradient NE Plume • Streams downgradient of groundwater seeps • Vapor intrusion • Source actions and returning groundwater to beneficial use are out of scope • EM Program • Budget and schedule • Present to 5/10 years out
5. Develop a Decision Rule	**IF** an uncertainty regarding the completion of the first two objectives of the GWSP is significant, **THEN** perform directed investigation(s) to reduce/close the uncertainty.
6. Specify Limits on Decision Errors	• Consider regulatory and public concerns. • Can be addressed, in part, through iterative monitoring and modeling process.
7. Optimize the Design for Obtaining Data	• Perform data needs analysis to determine what additional information is needed to address the first two objectives of the GWSP. • Near-term solution is to optimize groundwater monitoring (helps with Water Policy Evaluation).

A summary of each activity with specific tasks and subtasks and a summary of the elements needed to complete the tasks is included in Table 4.

5.7 GROUNDWATER STRATEGY PILOT STUDIES

Two colloidal borescope pilot studies were performed prior to initiating the monthly data collection activities in the 2020 PMP.

- A 24-hour duration data collection period was performed at MW472 in the NE portion of the water policy box and MW429A in the SW portion of the water policy box (not on residential property) to evaluate whether a 24-hour duration or a shorter duration (e.g., 8 or 12 hours) was appropriate to meet the DQOs for the activities. The results of this pilot study indicated that a minimum data collection interval of 6 hours should be employed.

- Flow interval logging was performed in each of the wells that were planned to have colloidal borescopes deployed. This flow interval logging consisted of obtaining measurements at 2-ft intervals within the well screen. The purpose of this pilot study was to identify the interval within the well screen with the highest velocity. This interval was used for placement of the colloidal borescope for each activity for each data collection event.

Table 4. Summary of Groundwater Strategy Activities

Activity	Area of Concern	Task(s)	Subtask(s)	Elements Required to Complete Task	Reporting
Human Exposure Under Control Data Needs					
1	TCE Extent West of PGDP (SW Plume)	Optimize existing groundwater monitoring network	Review frequency of sampling and analysis and synoptic sampling and analysis	Desktop Study	N/A
1	TCE Extent West of PGDP (SW Plume)	RGA potentiometric trend investigation	Water level/colloidal borescope investigation	Field Data Collection (See Appendix A for details)	N/A
1	TCE Extent West of PGDP (SW Plume)	RGA potentiometric trend investigation	Transient groundwater flow model	Desktop Study	White Paper
1	TCE Extent West of PGDP (SW Plume)	Develop/revise CSM	Review geology, hydrology, and contaminant trends	Desktop Study	White Paper
2	TCE Extent East of PGDP (Downgradient NE Plume)	RGA potentiometric trend investigation	Map sitewide synoptic water level data	Desktop Study	See Activity 14
2	TCE Extent East of PGDP (Downgradient NE Plume)	RGA potentiometric trend investigation	NE Plume synoptic water level measurements	Field Data Collection (See Appendix A for details)	See Activity 14
2	TCE Extent East of PGDP (Downgradient NE Plume)	RGA potentiometric trend investigation	Continuous water level measurements	Field Data Collection (See Appendix A for details)	See Activity 14
2	TCE Extent East of PGDP (Downgradient NE Plume)	RGA potentiometric trend investigation	Colloidal borescope investigation	Field Data Collection (See Appendix A for details)	See Activity 14
2	TCE Extent East of PGDP (Downgradient NE Plume)	NE Plume optimization hydraulics analysis	N/A	Desktop Study	White Paper: Regional and Localized Groundwater Flow and TCE Trends, East Side of Downgradient Northeast Plume
3	North Extent of PGDP TCE Plumes (Impact to Ohio River)	Develop/revise CSM	N/A	Desktop Study	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Hydraulic trends investigation	Civil survey of creek bottom	Field Data Collection (See Appendix A for details)	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Hydraulic trends investigation	Review of area RGA water level data	Desktop Study	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Hydraulic trends investigation	Water level/colloidal borescope investigation	Field Data Collection (See Appendix A for details)	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Develop/revise CSM	N/A	Desktop Study	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Stream flow gain/loss in the seeps area	Stream gauge surveys	Field Data Collection (See Appendix A for details)	White Paper
4	Nature and Extent of Contaminants Currently Contributed by Little Bayou Creek Seeps	Stream water sampling	Surface water sampling	Field Data Collection (See Appendix A for details)	White Paper
5	Nature and Extent of Dissolved-Phase Contaminants Other than TCE and Tc-99	Develop/revise CSM	N/A	Desktop Study	White Paper
5	Nature and Extent of Dissolved-Phase Contaminants Other than TCE and Tc-99	Review/summarize analytical data	N/A	Desktop Study	White Paper
Groundwater Migration Under Control Data Needs					
6	Capture Efficiency of NW Plume EWs	Develop/revise CSM	Review existing information	*Revised Evaluation of TCE Trends in MW460* included in the *Compilation of Meeting Summaries and White Papers (2017-2018)* (DOE 2019) FRNP-RPT-0013, *Assessment of Sitewide Groundwater Flow Model Using Data from the Northeast Plume Optimization Project*	N/A
6	Capture Efficiency of NW Plume EWs	Optimize EW pumping rates and pump depths	Near-field groundwater flow model	Desktop Study	White Paper
6	Capture Efficiency of NW Plume EWs	Optimize EW pumping rates and pump depths	Optimize EW pumping rates and pump depths	Desktop Study	White Paper
6	Capture Efficiency of NW Plume EWs	Optimize groundwater monitoring network	Optimize groundwater monitoring network	Desktop Study	White Paper
6	Capture Efficiency of NW Plume EWs	Optimize groundwater monitoring network	Colloidal borescope measurements	Field Data Collection (See Appendix A for details)	White Paper
6	Capture Efficiency of NW Plume EWs	Optimize groundwater monitoring network	Monitoring well installation	Field Data Collection (See Appendix A for details)	White Paper
6	Capture Efficiency of NW Plume EWs	Update NW Plume EW capture zone assessment	N/A	Desktop Study	White Paper

Table 4. Summary of Groundwater Strategy Activities (Continued)

Activity	Area of Concern	Task(s)	Subtask(s)	Elements Required to Complete Task	Reporting
7	TCE Extent and Trends in East Side of Downgradient NW Plume	RGA potentiometric trend investigation	Map site-wide synoptic water level data	Desktop Study	White Paper
			NW Plume synoptic water level measurements	Field Data Collection (See Appendix A for details)	
			Continuous water level measurements		
			Colloidal borescope measurements		
		Optimize groundwater monitoring network	Drive point geology/TCE investigation	Field Data Collection (See Appendix A for details)	White Paper
			Monitoring well/piezometer installation		
8	TCE Extent and Trends in West Side of Downgradient NE Plume	RGA potentiometric trend investigation	Map sitewide synoptic water level data	Desktop Study	See Activity 14
			NE Plume synoptic water level measurements	Field Data Collection (See Appendix A for details)	
			Continuous water level measurements		White Paper: Regional and Localized Groundwater Flow and TCE Trends, West Side of Downgradient Northeast Plume
9	RGA Dissolved-Phase and DNAPL Contaminant Impacts to the McNairy Formation	Develop/revise CSM	Data collected for the C-400 RI/FS Work Plan fieldwork will support future investigations and/or decisions.	Desktop Study	White Paper
		Review/summarize analytical data	N/A		
Groundwater MWG Inputs					
10	Characterize Underflow from the Terrace Area	Assess installation of additional MWs to collect water level and soil boring information in the contact area between the terrace gravel and the UCRS	Conceptual site plan	Desktop Study	White Paper
			Piezometer installation	Field Data Collection (See Appendix A for details)	
			Terrace Area synoptic water level measurements		
		Evaluation of a more accurate method to quantify Terrace underflow to the RGA	N/A	Desktop Study	
11	Expansion of Groundwater Monitoring Network	Installation of additional monitoring wells, located inside and outside of the plant's industrial area to reduce uncertainty regarding GW flow direction, contaminant distribution, and potential source areas	Review of EarthCon evaluation	Desktop Study	White Paper
			Well Installation	Field Data Collection (See Appendix A for details)	
			Civil Survey		
		Compilation and verification (especially datums) of the TVA monitoring system data	N/A	Desktop Study	
12	Water Balance Study	Gauging of flows in various portions of area creeks to determine where and in what quantities water enters and exits the creeks (coordinated with groundwater synoptic water level measurement events)	Flow gauge transects of Bayou Creek and Little Bayou Creek	Field Data Collection (See Appendix A for details)	White Paper
		Monitoring and documentation of the ongoing utility optimization program	N/A	Desktop Study	
		Compilation of available information regarding the chronology of roof drain repair to understand temporal variability better and reduce uncertainty in recharge estimates	N/A	Desktop Study	
		Expanded assessment of the water supply and storm water systems	N/A	Desktop Study	
13	Continuous RGA Water Level Monitoring	Continuous RGA water level records over a period of a year in the vicinity of the Ohio River and along a transect of wells extending back to the PGDP industrial area	Review existing information	White Paper: FRNP-RPT-0009, *Continuous Regional Gravel Aquifer Water Level Monitoring at the Paducah Site*	N/A
			Continuous and manual water level measurements	Field Data Collection (See Appendix A for details)	White Paper: Regional Influence of the Ohio River Stage on Groundwater Flow and Recharge at PGDP
		Deployment of continuous water level recorders in select MWs/PZs within the plant area to assess recharge better and its impact on nearby water levels	Continuous water level measurements	Field Data Collection (See Appendix A for details)	

Table 4. Summary of Groundwater Strategy Activities (Continued)

Activity	Area of Concern	Task(s)	Subtask(s)	Elements Required to Complete Task	Reporting
14	Synoptic Water Level Measurement	Increased water level measurement events conducted during different seasons, including measurement of the water level elevation at Metropolis Lake	Seasonal water level measurements	Field Data Collection (See Appendix A for details)	Potentiometric Maps White Paper: Comparison of Regional Groundwater Flow Pre- and Post-Construction and Operation of Olmsed Dam
		A synoptic data set collected under steady conditions at the higher river stage anticipated to start in 2018 when the Olmsted Locks and Dam are scheduled to be operational	Synoptic data set before operation begins at Olmsted lock and dam	Field Data Collection (See Appendix A for details)	
			Synoptic data set after operation begins at Olmsted lock and dam		
15	Water Level Divide Study	Assessing water level and water quality data collected from the newly installed transect of MWs located east of the C-400 Cleaning Building	Review existing information	Desktop Study FRNP-RPT-0013, *Assessment of Sitewide Groundwater Flow Model Using Data from the Northeast Plume Optimization Project*	N/A
			N/A	Field Data Collection (See Appendix A for details)	White Paper
		Colloidal borescope study in the vicinity of the apparent groundwater divide located east of the C-400 Cleaning Building to refine understanding of groundwater flow in the area	N/A	Field Data Collection (See Appendix A for details)	
16	Hydraulic Conductivity	Additional slug testing in a selection of appropriate monitoring wells to better define hydraulic conductivity across the model domain	Slug testing not recommended as documented in White Paper	White Paper: FRNP-RPT-0010, *Measurement of Hydraulic Conductivity in the Regional Gravel Aquifer Using Monitoring Wells at the Paducah Site*	N/A
		Characterization of the thickness and hydraulic conductivity of the bottom sediments in Metropolis Lake	Sonic survey of bottom of lake	Field Data Collection (See Appendix A for details)	White Paper
			Sample/analyze lake bottom sediments		
Additional Activities					
17	MW Survey Study	Review existing MW survey information	Evaluate need for closed loop survey for main PGDP area and perform surveying	Field Data Collection (See Appendix A for details)	Survey White Paper 1: FRNP-RPT-0165, *Summary of Survey Activities Associated with Updating the Reference Measuring Point Elevations for the Groundwater Monitoring Well Network at the Paducah Site, Paducah, Kentucky*
			Identify scopes, activities, reports that are sensitive to the measurement and that are being used for decision making or to demonstrate compliance	Desktop Study	Survey White Paper 2: Evaluation of the 2016 Groundwater Model with Updated Reference Point Elevation for the Groundwater Monitoring Network at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
		Assessment of confidence on plume map depiction	N/A		
18	Groundwater Chemical Trend Evaluation	Assess existing groundwater analytical data for trends and decide whether analyses should be revised	N/A	Desktop Study	White Paper
19	TCE Degradation Rates	Review existing information	N/A	Desktop Study	White Paper

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The second pilot study of flow interval logging will be performed for each well identified for colloidal borescope data collection in 2022.

5.8 FIELD DATA COLLECTION METHODS

The field actions and field data collection associated with the activities included in this PMP involve multiple types of data collection:

- Manual water level measurements collected using water level meters;
- Continuous water level measurements collected using pressure transducers;
- Groundwater flow and velocity measurements collected using colloidal borescopes;
- Surface water or seep sampling;
- Stream gauging;
- MW or PZ installation;
- Groundwater sampling; and
- Civil survey of stream bottoms and other groundwater or surface water-related features.

As discussed in Section 1, the activities included in this PMP will be performed consistent with the EMP and the EMP QAPP, which typically are updated annually. FRNP procedures, manufacturers' recommendations, other appropriate guidance, and sound engineering principles, as applicable and relevant to the scope of work, also will be followed. QA is discussed in Section 7.

5.8.1 Regional and Localized Groundwater Flow

The manual water level data, pressure transducer data, and colloidal borescope data provide both regional and localized data that facilitate the understanding of localized instances of concentration behavior that do not align with regional flow model and/or the current understanding of the regional groundwater flow as determined by potentiometric measurements/maps. The localized information is provided by the colloidal borescopes, while the manual water level measurements and continuous water level measurements provide regional patterns. Combining the colloidal borescopes and potentiometric maps provides a more robust data set that supports making better informed decision for future investigations and actions.

Manual water level measurements are collected using a water level meter. Pressure transducers are deployed in select wells throughout the data collection period associated with select activities to provide continuous water level measurements. These data will be used to develop an understanding of RGA potentiometric trends.

Colloidal borescopes are used to collect well-specific measurements of groundwater flow (both direction and rate) to compare to the hydraulic gradient as measured locally (in the test well and two adjacent wells) and regionally, as well as to compare to potential sources of recharge and discharge. Measurements will be collected over multiple seasons and at multiple depths in the aquifer where collocated wells are present. The colloidal borescope measurements are especially valuable near the perimeter of well coverage where the downgradient flow direction cannot be interpolated and where the greatest uncertainty exists. Colloidal borescope measurements are scheduled most frequently in the perimeter wells.

The wells planned for colloidal borescope deployment will be assessed for access. If needed, replacement well heads will be procured and installed. Additionally, the well surface casings may require modification to allow the borescope data cable access. Modification of the well surface casings, if needed, will be completed under the supervision of a Kentucky certified well driller and appropriate documentation will be submitted to the Kentucky Division of Water (401 *KAR* 6:350[10]).

Manual water level measurements will be paired with colloidal borescope deployments to provide a basis of comparison of groundwater flow direction measurements. Water level measurements in the well with the colloidal borescope and, at least, two other nearby well locations will be used to determine the hydraulic gradient between the wells using the three-point problem method. Where the colloidal borescope measurement of groundwater flow direction is consistent with the derived intra-well gradient, the aquifer can be assumed to be practically homogenous. Where the measurements diverge, significant heterogeneity of the aquifer matrix or a nearby point source of groundwater recharge are potential explanations. The colloidal borescope record also will provide indications of sub-day length variation in groundwater flow rate and direction, which may be due to the operation of a well pump. The colloidal borescope and continuous and manual water level measurements will be used to focus future field investigation, as needed, to understand contaminant migration and the potential for off-site contaminant migration.

5.9 OFF-PROPERTY WELL ACCESS

A subset of the wells that will be used for data collection in this PMP are located off-property on residential properties as well as on the TVA reservation. Access to these wells will require transportation of sampling equipment and waste streams associated with the activities on public roads, will require personnel to have TVA training and site access credentials, and also will require notification to residential landowners prior to accessing property.

5.10 COMPLETION CRITERIA

Each activity has a specified duration of monitoring, number of laboratory analyses, or completion of soil borings. These data provide the inputs into a white paper for each activity, as applicable. The white papers will contain a summary of the field components, summary of data collected during the activity, and a brief interpretation of the data. The white papers also may provide recommendations for follow-on investigation or additional data analysis. Any follow-on investigation or additional data analysis, including analysis across multiple activities, is not part of the GWSP described by this PMP. Completion criteria or end points for each activity are summarized in Table 4.

6. PROJECT ORGANIZATION AND COMMUNICATIONS

6.1 PROJECT ORGANIZATION

This project will be managed by the FRNP Environmental Services (ES) organization. Within the ES organization, the Environmental Stewardship group will have the overall responsibility for implementing the project, project budget, and project schedule. Other organizations and groups will provide support to the project as shown in Figures 4 and 5.

The GWSP has overlap and interface with several ongoing projects at the Paducah Site, including Pump-and-Treat Operations, which include the NEPCS and NWPGS, the Water Policy Program, C-400 RI/FS, and the Groundwater MWG. These and other projects that may be identified as having overlap or requiring interface with the GWSP will be coordinated through the GWSP Manager (project manager [PM]) (Figure 5).

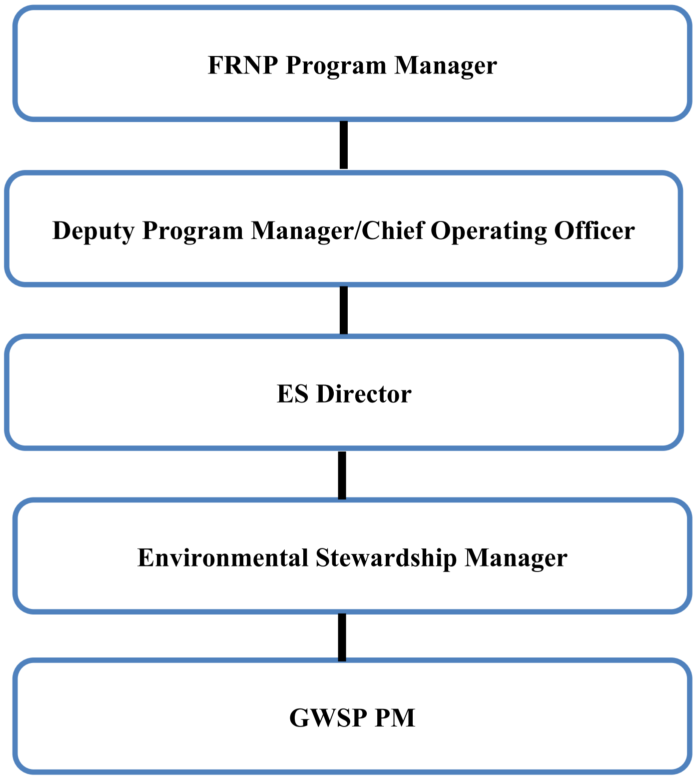

Figure 4. FRNP Senior Management Organization for the GWSP

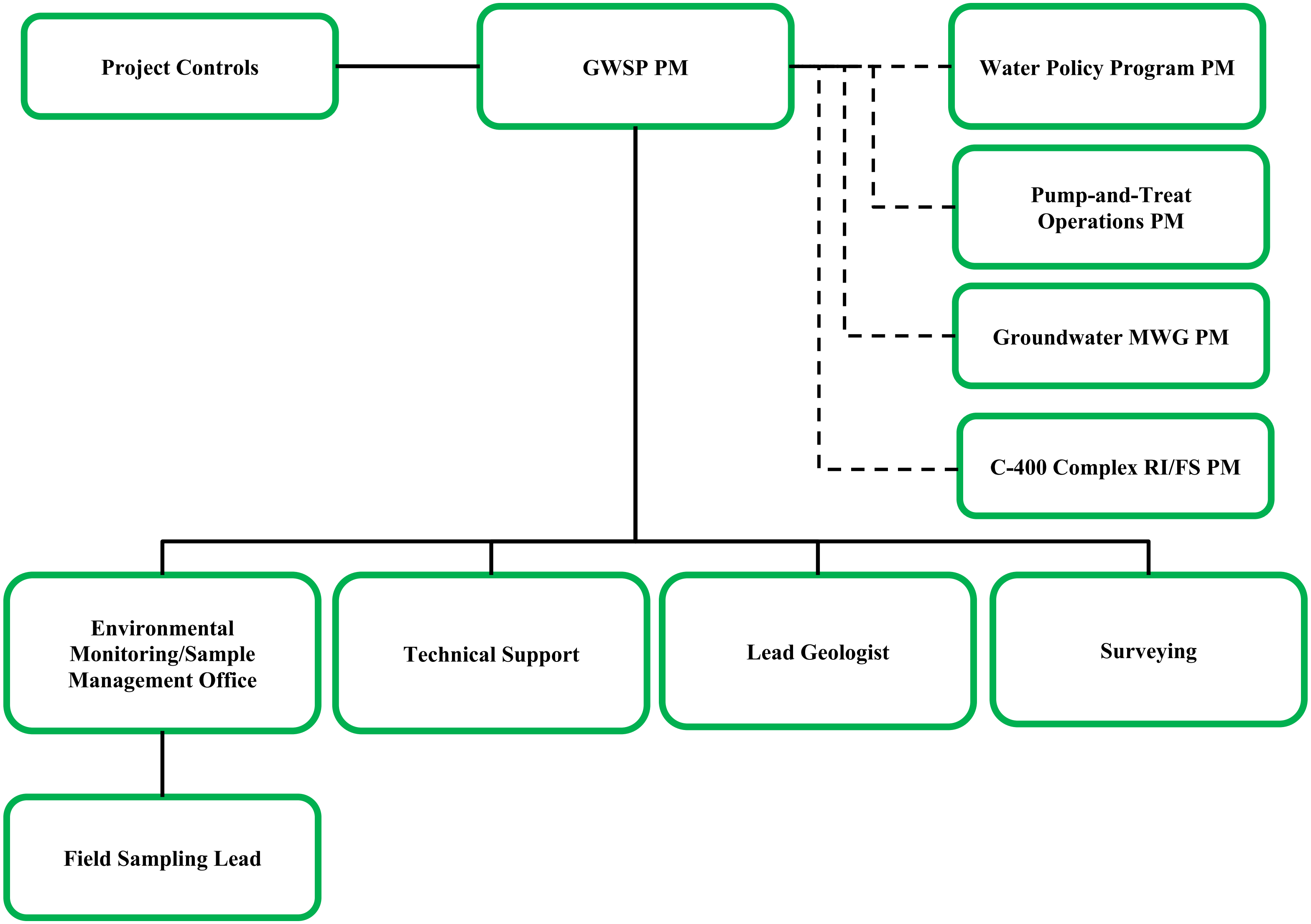

Figure 5. GWSP Organization

6.2 COMMUNICATION

Project communications will be managed by the GWSP PM or designee. The following communications will be approved in advance.

- Communications between the GWSP and different projects or organizations that involve direction, instruction, decisions, or authorization of work associated with this GWSP will be approved by the Environmental Stewardship Manager or ES Director or designee, in advance.

- All communication between the GWSP and external stakeholders (e.g., EPA, Kentucky, the public, etc.) will be approved in advance by the GWSP PM or designees and DOE.

Records associated with the GWSP will be managed as appropriate and as described in FRNP's record management process.

7. QUALITY ASSURANCE AND RECORDS

7.1 QUALITY ASSURANCE PROGRAM

The activities in this PMP will be performed in accordance with the FRNP QA Program, CP2-QA-1000. Performance documents necessary to implement requirements for the QA Program and the applicable QA requirements mandated by regulations and the FRNP Contract are contained in project execution and support organization performance documents (e.g., procedures, policies, and directives) and QAPPs.

7.2 QUALITY ASSURANCE PROJECT PLAN

The EMP QAPP will be amended and used for the activities in this PMP, as applicable. The QAPP includes information on data assessment, data validation, data handling, and data storage.

7.3 SOFTWARE QUALITY ASSURANCE

The equipment and software needed for the performance of the GWSP are commercially available and will be evaluated per FRNP procedures, as applicable.

7.4 RECORDS AND DATA MANAGEMENT

The QA program is designed in accordance with FRNP CP3-ES-5003, *Quality Assured Data,* and EPA's *Guidance on Systematic Planning using the Data Quality Objectives Process* (EPA/240/B-06/001) (EPA 2006). The following QA records are generated by the activities in this PMP.

- DQOs
- Field logbooks and/or sample data forms
- Chain-of-custody records
- Sample and field measurement data
- Field change from this GWSP
- Data validation

Data collected as part of the GWSP will be managed consistent with the EMP, *Environmental Monitoring Data Management Plan at the Paducah Gaseous Diffusion Plant, Paducah Kentucky*, CP2-ES-0063; and *Developing, Implementing, and Maintaining Data Management Implementation Plans*, CP3-ES-1003.

7.4.1 Field Logbook/Sample Data Forms

Samplers and other project personnel shall maintain a field logbook and/or sample data forms in accordance with the EMP QAPP, as appropriate. This procedure provides guidelines for the minimum entries to be made in field logbooks and/or sample data forms to ensure that day-to-day events are documented properly during the preparation, performance, and closure of field activities. Field logbook/sample data form entries shall be made in a manner that provides a defensible record of the work that has been performed with sufficient data and observations to enable participants to reconstruct events that occurred during work execution. All entries shall be factual, detailed, and objective.

7.4.2 Chain-of-Custody

Samplers shall maintain custody, document transfer, and ship or transfer samples in accordance with chain-of-custody protocols. The EMP QAPP includes the protocol for documenting possession (i.e., custody, transfer, and shipment) of samples from the point of collection to the point of acceptance by the designated laboratory to ensure integrity of the samples. This procedure includes requirements for generation, use, and completion of chain-of-custody forms.

7.4.3 Change Control

Any changes to the activity scopes will be documented through field change. Field changes could impact the number, quality, or collection of planned field or analytical data.

8. HEALTH AND SAFETY AND WASTE MANAGEMENT

8.1 HEALTH AND SAFETY

FRNP maintains a Worker Safety and Health Program established to reduce or prevent occupational injuries, illnesses, and accident losses by providing FRNP employees with a safe and healthful workplace. This Worker Safety and Health Program is defined in CP2-HS-2000, *Worker Safety and Health Program for the Paducah Gaseous Diffusion Plant*. It is anticipated that most, if not all, field activities associated with the GWSP are addressed by CP2-ES-0061, *Site-Specific Health and Safety Pan for the Environmental Monitoring Project at the Paducah Gaseous Diffusion Plant*. During implementation of the project, specific work instruction and hazard controls will be developed at the activity level for use by the personnel performing the work in accordance with CP2-SM-1000, *Activity Level Work Planning and Control Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*.

FRNP is committed to implementing an Integrated Safety Management System (ISMS) and an Environmental Management System (EMS) that join together personnel and environmental safety into management and work practices at all levels so that missions are accomplished while protecting the public, the workers, and the environment. The concepts of ISMS/EMS will be utilized to provide a formal, organized process to ensure the safe performance of work. The ISMS/EMS Plan identifies the methodologies that will be used to address previously recognized hazards and how the hazards are mitigated using FRNP-accepted practices.

8.2 WASTE MANAGEMENT

The GWSP generates minimal waste—primarily protective clothing associated with sampling. Waste is handled and disposed of in accordance with CP2-WM-0001, *Four Rivers Nuclear Partnership, LLC, Paducah Deactivation and Remediation Project Waste Management Plan*. This waste management plan addresses the management of minor waste streams produced by the GWSP from the point of generation until custody is relinquished from the GWSP. Minor waste streams may include bag filters, personal protective equipment, sampling materials, etc.

9. SCHEDULE

A draft schedule for the overall GWSP is provided in Figure 6. Activities initiated in 2020 are denoted in blue, activities planned for FY 2022 are indicated in purple, and activities to be developed at a later date are indicated in green. This schedule is intended to show the interrelationship between different activities and general sequencing. Activity and task start dates and durations will be adjusted as appropriate and will be managed in a field execution schedule.

10. PROJECT RISKS

Project risk identification, documentation, management, reviews, and reporting are described in CP3-PO-0100, *Risk Management*. Project team members are responsible for identifying project risks; participation in the risk assessment process, including identifying handling strategies, review of project risk assessments, and providing input to cost and schedule impact estimates. These inputs are evaluated as part of CP3-PO-0100 and added as appropriate to FRNP's Risk Management Plan.

Project risks may involve uncertainty, schedule, and technical-based risk and may change over the course of the project. Table 5 summarizes the project risks for the GWSP activities included in this PMP. The project risks may be revised, added, or deleted as the project progresses or as information becomes available.

Figure 6. Draft Schedule

Activity	Task Name	CY2018	CY2019	CY 2020	FY2021 Q1	FY2021 Q2	FY2021 Q3	FY2021 Q4	FY2022 Q1	FY2022 Q2	FY2022 Q3	FY2022 Q4	CY2023+
Environmental Indicator - Human Exposure Under Control													
1	**#1 - TCE Extent West of PGDP (SW Plume)**												
	Optimize Existing GW Monitoring Network	Complete											
	Procure Colloidal Borescopes		Complete										
	Procure Groundwater Level Data Loggers		Complete										
	Calibrate On-Site Groundwater Data Loggers		Complete										
	Water Level/Colloidal Borescope Investigation												
	Develop/Revise Conceptual Site Model												
	Reporting												
2	**#2 - TCE Extent East of PGDP (Downgradient NE Plume)**												
	NE Plume Optimization Hydraulic Assessment	Complete											
	Map Sitewide Synoptic Water Level Data	Complete											
	Water Level/Colloidal Borescope Investigation (1 Year of Data Collection)							Complete					
	Review Data and Prepare Map(s)												
	Reporting												
3	**#3 - North Extent of PGDP TCE Plumes (Impacts to Ohio River)**												
	Develop/Revise Conceptual Site Model												
	Reporting												
4	**#4 - Nature and Extent of Dissolved-Phase Contaminants Currently Contributed by Little Bayou Creek Seeps**												
	Hydraulic Trend Investigation												
	Develop/Revise Conceptual Site Model												
	Stream Flow Gain/Loss in the Seeps Area and Stream Sampling												
	Reporting												
5	**#5 - Nature and Extent of Dissolved-Phase Contaminants Other than TCE and Tc-99**												
	Develop/Revise Conceptual Site Model												
	Review/Summary of Analytical Data												
	Reporting												
Environmental Indicator - Groundwater Migration Under Control													
6	**#6 - Capture Efficiency of NW Plume Extraction Wells**												
	White Paper: *Revised Evaluation of TCE Trends in MW460* (DOE 2019)		Complete										
	Develop/Revise Conceptual Site Model												
	Optimize Extraction Well Pump Rates and Pump Depths												
	Colloidal Borescope Investigation												
	Optimize Groundwater Monitoring Network												
	Monitoring Well Installation												
	Update NW Plume Extraction Well Capture Zone Assessment												
	Reporting												
7	**#7 - TCE Extent and Trends in East Side of Downgradient NW Plume**												
	Map Sitewide Synoptic Water Level Data												
	Water Level/Colloidal Borescope Investigation (1 Year of Data Collection)												
	Drive Point Geology/TCE investigation												
	Monitoring Well/Piezometer Installation												
	Reporting												
8	**#8 - TCE Extent and Trends in West Side of Downgradient NE Plume**												
	Map Sitewide Synoptic Water Level Data	Complete											
	Water Level/Colloidal Borescope Investigation												
	Drive Point Geology/TCE Investigation												
	Monitoring Well/Piezometer Installation												
	Reporting												
9	**#9 - RGA Dissolved-phase and DNAPL contaminant impacts to the McNairy formation**												
	Develop/Revise Conceptual Site Model												
	Review/Summary of Analytical Data												
	Reporting												
Modeling Working Group - Recommendations and Data Needs													
10	**#10 - Characterize Underflow from the Terrace Area**												
	Conceptual Site Plan												
	Piezometer Installation												
	Terrace Area Synoptic Water Level Measurements												
	Reporting												

Figure 6. Draft Schedule (Continued)

Activity	Task Name	CY2018	CY2019	CY 2020	FY2021				FY2022				CY2023+
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
11	**#11 - Expansion of GW Monitoring Network**												
	Review of Earthcon evaluation												
	Monitoring Well Installation												
	Civil Survey of Creek Bottom												
	Reporting												
	Obtain and Review TVA Monitoring System Data		**Complete**										
12	**#12 - Water Balance Study**												
	Monitoring and Documentation of the Ongoing Utility Optimization Program												
	Compilation of Available Information Regarding the Chronology of Roof Drain Repairs												
	Expanded Assessment of the Water Supply and Storm Water Systems												
	Reporting												
13	**#13 - Continuous RGA Water Level Monitoring**												
	White Paper: *Continuous Regional Gravel Aquifer Water Level Monitoring at the Paducah Site*		**Complete**										
	Water Level Investigation (1 Year of Data Collection)							**Complete**					
	Reporting												
14	**#14 - Synoptic Water Level Events**												
	Field Synoptic Water Level Measurement Pre-Olmstead Dam Operation	**Complete**											
	Field Synoptic Water Level Measurement Post-Olmstead Dam Operation												
	Reporting												
15	**#15 - Water Level Divide Study**												
	White Paper: *Assessment of Sitewide Groundwater Flow Model Using Monitoring Wells at the Paducah Site*		**Complete**										
	Water Level/Colloidal Borescope Investigation (1 Year of Data Collection)												
	Reporting												
16	**#16 - Hydraulic Conductivity**												
	White Paper: *Measurement of Hydraulic Conductivity in the Regional Gravel Aquifer Using Monitoring Wells at the Paducah Site*		**Complete**										
	Characterization of Bottom Sediments in Metropolis Lake												
	Slug Testing to Better Define Hydraulic Conductivity Across the Model Domain												
	Reporting												
	Additional Activities												
17	**#17 - Monitoring Well Survey Study**												
	Review Existing Monitoring Well Survey Information			**Complete**									
	Survey of Monitoring Wells			**Complete**									
	Survey White Paper 1				**Complete**								
	Survey White Paper 2												
18	**#18 - Groundwater Chemical Trend Evaluation**												
	Review Existing Groundwater Analytical Data												
	Reporting												
19	**#19 - TCE Degradation Half-Life**												
	Review Existing Degradation Rate Data												
	Reporting												

Notes

- Activity/Task Previously Initiated or Completed
- Planned FY 2022 Activity
- Future Activity/Task Pending Scope Development

Table 5. Project Risks

Risk Item	Description	Probability of Occurrence	Mitigation	Risk to Project
1	Missing a planned sample or groundwater level measurement	Low	• Review of monthly activities at the beginning of each month by PM or designee • Review of collected data each week by PM or designee	Low
2	Equipment malfunction	Moderate	• Maintain spare equipment • Target measurements early in month to allow for installation of replacement equipment in time to collect planned data • Install data logger as per CP4-ES-2100, *Groundwater Level Measurement* • Develop procedure or work controls for installation of colloidal borescopes to CP4-ES-2100	Moderate
3	Sample shipment delayed, samples not intact upon arrival at off-site laboratory, or otherwise not received in appropriate condition at the off-site laboratory	Low	• Target collection of samples early in month to allow for resampling if needed • Target measurements early in month to allow for installation of replacement equipment in time to collect planned data • Prepare sample shipments as required by procedure CP4-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling*.	Low
4	Laboratory data rejected during data assessment or validation	Low	• Use DOE Consolidated Audit Program-audited and accepted off-site laboratories • Follow QAPP requirements	Low
5	Error in manual groundwater level measurements	Low	• Perform measurements per CP4-ES-2100, *Groundwater Level Measurement* • Use reference point as indicated by Project Environmental Measurements System form; any deviation is to be discussed with the PM prior to measurement	Low
6	Changing weather conditions influence groundwater level measurements	High	• Review weather forecast prior to initiating manual groundwater level measurements for any given activity; do not perform groundwater level measurements if weather patterns are anticipated to change during the days planned for measurements • Collect manual groundwater level measurements for any given activity in 4 days or less	Low
7	Equipment theft	Moderate	• Secure equipment (e.g., computers, generators, etc.) with chains, locks, locked boxes, etc., as appropriate • Provide signage for equipment external to the well	Moderate

Table 5. Project Risks (Continued)

Risk Item	Description	Probability of Occurrence	Mitigation	Risk to Project
8	Inconclusive colloidal borescope dataset	High	• Target deployment early in each month to allow for retesting in time to collect planned data • Evaluate data collected each following day to facilitate changing of software settings and retesting during the same week or month	Moderate

11. REFERENCES

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APPENDIX A

GROUNDWATER STRATEGY ACTIVITY DESCRIPTIONS

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CONTENTS

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FIGURE

TABLES

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ACRONYMS

CB	colloidal borescope
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	conceptual site model
DNAPL	dense nonaqueous-phase liquid
DQO	data quality objective
EI	environmental indicator
EMP	environmental monitoring plan
FRNP	Four Rivers Nuclear Partnership, LLC
FY	fiscal year
GPS	global positioning system
GWSP	Groundwater Strategy Project
MW	monitoring well
NEPCS	Northeast Plume Containment System
NWPGS	Northwest Plume Groundwater System
OREIS	Oak Ridge Environmental Information System
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
PT	pressure transducer
RGA	Regional Gravel Aquifer
RI	remedial investigation
TVA	Tennessee Valley Authority
UCRS	Upper Continental Recharge System

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A.1. GROUNDWATER STRATEGY PROJECT ACTIVITIES

The following eight activities were developed in the Four Rivers Nuclear Partnership, LLC, (FRNP) document, *Project Management Plan for Groundwater Strategy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0094, based on their overlapping scopes and overall sequence of work for initial implementation. Updates to these activity descriptions, as appropriate based on encountered field conditions, are incorporated for each activity. Follow-on scopes for each activity, where appropriate, are also described as follows:

- Activity 1: Trichloroethene (TCE) extent west of Paducah Gaseous Diffusion Plant (PGDP) (i.e., Southwest Plume);
- Activity 2: TCE extent east of PGDP (i.e., downgradient NE Plume);
- Activity 8: TCE extent and trends on west side of downgradient NE Plume;
- Activity 13: Continuous Regional Ground Aquifer (RGA) water level monitoring;
- Activity 14: Synoptic water level measurement;
- Activity 15: Water level divide study;
- Activity 17: Monitoring well (MW) survey study; and
- Activity 18: Groundwater chemical trend evaluation.

The remaining activities have been partially developed in this update to the Groundwater Strategy Project (GWSP) project management plan to support field data collection and desktop studies intended to be performed in fiscal year (FY) 2022.

- Activity 3: North extent of PGDP TCE plumes (i.e., impacts to Ohio River);
- Activity 4: Nature and extent of dissolved-phase contaminants currently contributed by Little Bayou Creek seeps;
- Activity 5: Nature and extent of dissolved-phase contaminants other than TCE and technetium-99 (Tc-99);
- Activity 6: Capture efficiency of NW Plume extraction wells;
- Activity 7: TCE extent and trends on east side of downgradient NW Plume;
- Activity 9: RGA dissolved-phase and dense nonaqueous-phase liquid (DNAPL) contaminant impacts to the McNairy Formation;
- Activity 10: Characterize underflow from the terrace area;
- Activity 11: Expansion of groundwater monitoring network;

- Activity 12: Water balance study;
- Activity 16: Hydraulic conductivity; and
- Activity 19: TCE degradation rates.

Figure A.1 provides a summary of the monitoring well network included in the FY 2022 planned scope of work. Appendix B includes the coordinated summary of field data collection performed for FY 2020–2021, and Appendix C includes the coordinated summary of field data collection planned for FY 2022.

A.1.1 A-ACTIVITY 1: TCE EXTENT WEST OF PGDP (SW PLUME)

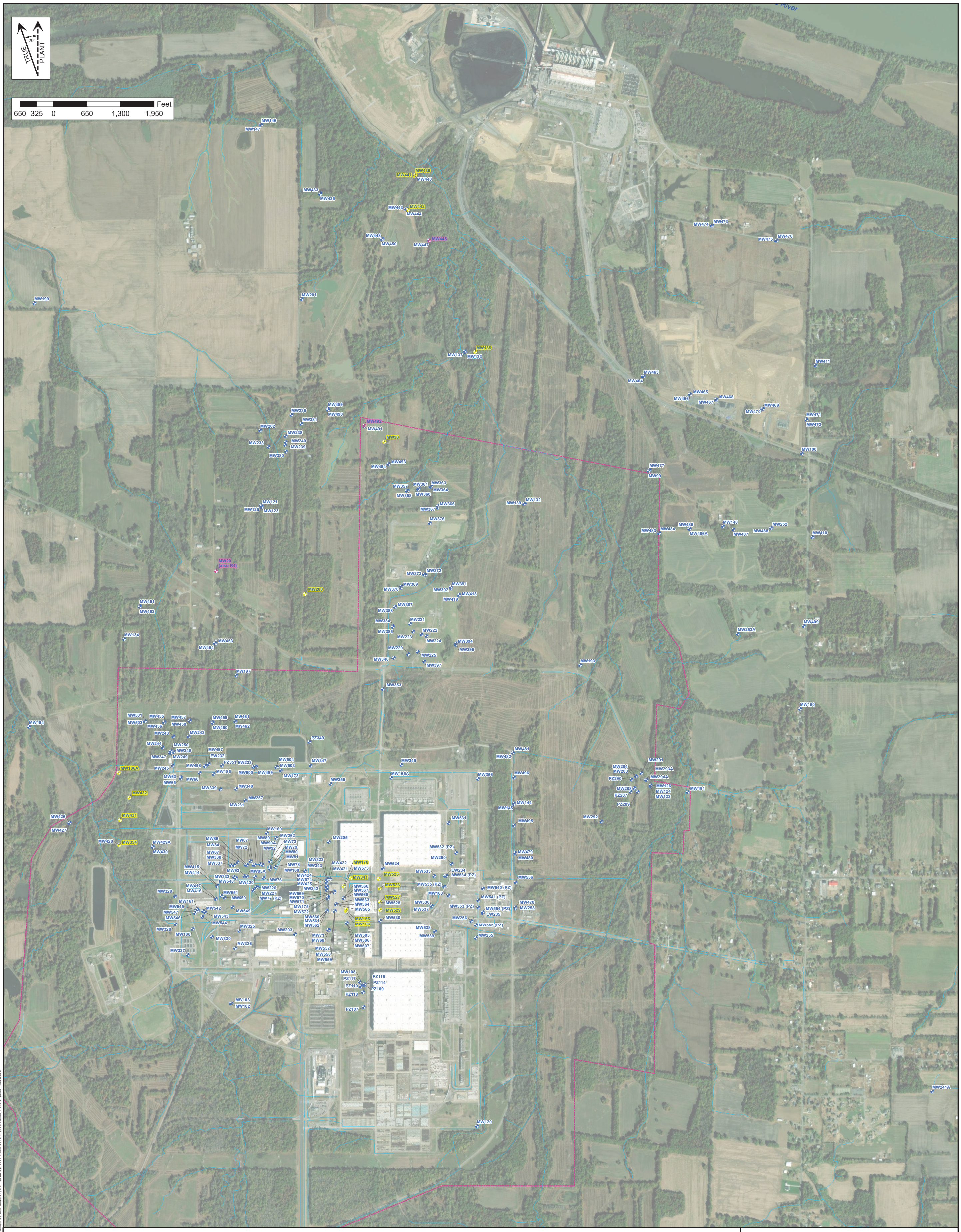
Activity 1 was developed in FRNP-RPT-0094 and consists of three tasks: (1) optimize the existing groundwater monitoring network, (2) perform an RGA potentiometric trend investigation, and (3) develop/revise the conceptual site model (CSM)[1] and optimize the well network (e.g., drive point, well installation). Data quality objectives (DQOs) for this activity are included in Table A.1. The field component of Activity 1 for FY 2020–2021 is summarized in Table A.2.

Data collection for Activity 1 will continue during FY 2022 (Table A.3) and includes the following:

- Re-develop MW106A and MW354 and then conduct two colloidal borescope (CB) tests in each well;
- Conduct two CB tests in MW431 and MW432;
- Perform hydrogeologic study using existing nearby MWs [e.g., hydrogeologic cross-sections (develop a conceptual model), pressure transducer (PT) data, water level measurements, and review of TCE trends]; and

Additional MWs will be installed in the vicinity of the Water Policy Boundary, if appropriate, based on results of the hydrogeologic study.

[1] Questions regarding the McNairy Formation CSM may need to be addressed in the near-term based on current regulatory discussions.



MAP SOURCE INFORMATION

Map Generation Date and Location - 10/20/2021 Geosyntec\\fedprojects-01\paducah$\Knoxville\GW Strategy\GIS\MXDs\2022 Potentiometric Surface Maps
Map Layer Location: Geosyntec\\fedprojects-01\paducah$\Knoxville\GW Strategy\GIS\MXDs\2022 Potentiometric Surface Maps\Figure 1 2022 Synoptic Water Level Measurement Wells DY.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.
Northing and easting of wells obtained from Pegasis, downloaded on 10/5/2021. Northing and easting of MW557 through MW574 wells provided by FRNP.

Legend

- Well For Pressure Transducer and Colloidal Borescope Deployment
- Well For Pressure Transducer Deployment
- Well For Synoptic Water Level Measurement
- Surface Water Course Centerline
- DOE Boundary

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

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

Figure A.1. Well Location Map

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Table A.1. DQOs for Activity 1

1. State the Problem	MW results adjacent to the Water Policy Boundary and to the north of the C-611 Water Treatment Plant, indicate dissolved-phase TCE is potentially migrating outside the Water Policy area in RGA groundwater.	
2. Identify the Decision	Are additional actions (e.g., drive point investigation, installation of new wells, etc.) required to control access to TCE-contaminated groundwater downgradient of the area?	
3. Identify Inputs to the Decision	• TCE extent and trends upgradient and downgradient of the west Water Policy area • Groundwater flow directions upgradient and downgradient of the west Water Policy area • Aquifer— properties • Current MW distribution • Location of closest, potentially impacted water wells	
4. Define the Study Boundaries	• Spatial: SW Plume area • Temporal: One year	• Regulatory: — Water Policy Interim Remedial Action • Environmental indicators (EIs)
5. Develop a Decision Rule	**IF** dissolved-phase TCE is migrating in the RGA to outside the Water Policy area to the north of the C-611 Water Treatment Plant, **THEN** define further studies and/or actions to control access to the contamination.	
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE	
7. Optimize the Design for Obtaining Data	• Adjust RGA MW sampling frequency [documented in the environmental monitoring plan (EMP)] • RGA water level monitoring program • CB investigation • Develop/review/revise conceptual model	

Table A.2 FY 2020-2021 MWs for Activity 1

MW	Month											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
MW20 (also R4)	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW106A	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2
MW121[a]	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW134	PT+M2	CB+PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2
MW194	CB+M2	M2	CB+M2	M2	CB+M2	M2	CB+M2	M2	CB+M2	M2	CB+M2	M2
MW199	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW201	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW202	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW329	PT+M2	PT+M2	PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	PT+M2	PT+M2	PT+M2	CB+PT+M2
MW354	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2
MW426	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2
MW427	M2	CB+M2	M2	M2	CB+M2	M2	M2	CB+M2	M2	M2	CB+M2	M2
MW428	M2	M2	CB+M2	M2	M2	CB[b]+M2	M2	M2	CB+M2	M2	M2	CB+M2
MW429A	M2	CB+M2	M2	M2	M2	CB+M2	M2	CB+M2	M2	M2	M2	M2
MW430	CB+M2	M2	M2	M2	M2	M2	CB+M2	M2	M2	M2	M2	M2
MW431	M2	M2	M2	CB+M2	M2	M2	M2	M2	M2	CB+M2	M2	M2
MW432	M2	M2	M2	CB+M2	M2	M2	M2	M2	M2	CB+M2	M2	M2

M2—manual well water level measurements twice per month.
[a] CB not able to be deployed for data collection due to pump being stuck in the well.
[b] CB at MW429A substituted for month 6 CB at MW428.

Table A.3. FY 2022 MWs for Activity 1

MW	Month											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
MW106A	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW354	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW431	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW432	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT

M1—manual well water level measurements once per month.
Green color-coding is used to show this CB data collection group.

A.1.2 ACTIVITY 2: TCE EXTENT EAST OF PGDP (DOWNGRADIENT NE PLUME)

Activity 2 was developed in FRNP-RPT-0094 and consists of two tasks: (1) perform an RGA potentiometric trend investigation and (2) optimize the groundwater monitoring network. DQOs for this activity are included in Table A.4.

Table A.4. DQOs for Activity 2

1. State the Problem	MW results along the edge of the NE Plume indicate dissolved-phase TCE is potentially migrating outside the Water Policy area in RGA groundwater.	
2. Identify the Decision	Are additional actions (e.g., drive point investigation, installation of new wells) required to control access to TCE-contaminated groundwater downgradient of the area?	
3. Identify Inputs to the Decision	• TCE extent and trends close upgradient and downgradient of the east Water Policy area • Groundwater flow directions close upgradient and downgradient of the east Water Policy area • Aquifer properties • Current monitoring of MWs potentially impacted water wells	
4. Define the Study Boundaries	• Spatial: East side of NE Plume • Temporal: One year	• Regulatory: — Water Policy Interim Remedial Action — EIs
5. Develop a Decision Rule	**IF** dissolved-phase TCE is migrating in the RGA to the Water Policy eastern boundary in the vicinity of the NE Plume, **THEN** define further studies and/or actions to control access to the contamination.	
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE	
7. Optimize the Design for Obtaining Data	• Adjust RGA MW sampling frequency (documented in the EMP) • Robust RGA water level monitoring program • CB investigation • Develop/review/revise conceptual model	

The field component for FY 2020–2021 for Activity 2 is summarized in Table A.5 and includes monitoring of 42 wells. No additional data collection for Activity 2 is planned for FY 2022. A white paper regarding the regional groundwater flow, localized groundwater flow, and TCE trends to the east side of downgradient NE Plume is planned for development in FY 2022.

Table A.5. FY 2020-2021 MWs for Activity 2

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW99	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1
MW100	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW126	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW132	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW135	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW139	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW148	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW150	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW193	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW252	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1	M1
MW253A	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW291	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW366	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW394	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW409	PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW410	CB+PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1
MW411[a]	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1
MW418	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW463	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW464	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1
MW465	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1
MW466	M1	M1	M1	CB+M1	M1	CB+M1	M1	M1	M1	CB+M1	M1	CB+M1
MW467	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW468	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW469	CB+M1	M1	M1	M1	CB[b]+M1	M1	CB+M1	M1	M1	M1	CB+M1	M1
MW470	M1	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1
MW471	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW472	M1	CB+M1	M1	CB+M1	CB+M1	M1	M1	CB+M1	M1	CB+M1	M1	M1
MW473	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1
MW474	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1
MW475	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW476	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1
MW477	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1

Table A.5. FY 2020-2021 MWs for Activity 2 (Continued)

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW481	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW482	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW483	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW484	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1
MW485	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW486A	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1
MW487	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW488	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW496	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1

PT—continuous data logger
M1—manual water level measurement once per month
Pink shading indicates the well is part of the east side of Activity 2.
Blue shading indicates the well is part of the west side of Activity 2.
Orange shading indicates the well is part of the east side and west side of Activity 2.
Grey shading indicates data collection could not be performed due to access constraints.
[a] MW411 removed from CB data collection scope due to access constraints.
[b] CB at MW472 substituted for month 5 CB at MW469.

A.1.3 ACTIVITY 3: NORTH EXTENT OF PGDP TCE PLUMES (IMPACT TO OHIO RIVER)

Activity 3 consists of one task: develop/revise the CSM for the northern extent of PGDP TCE groundwater and potential impacts to the Ohio River. DQOs for this activity are included in Table A.6.

Table A.6. DQOs for Activity 3

1. State the Problem	MW results along the edge of the NE and NW Plumes indicate dissolved-phase TCE is potentially migrating in RGA groundwater to the Ohio River.	
2. Identify the Decision	Is TCE migrating in the RGA from the Paducah Site to the Ohio River?	
3. Identify Inputs to the Decision	• TCE extent and trends in the RGA close upgradient and downgradient of the NE and NW Plumes' distal lobes • RGA groundwater flow directions upgradient and downgradient of the NE and NW Plumes' distal lobes • Aquifer properties • Tennessee Valley Authority (TVA) construction activities	
4. Define the Study Boundaries	• Spatial: Area downgradient from the Paducah Site to the Ohio River • Temporal: Last five years of analytical data	• Regulatory: — NE Plume Interim Remedial Action — NW Plume Interim Remedial Action • EIs
5. Develop a Decision Rule	**IF** dissolved-phase TCE is migrating in the RGA to the Ohio River, **THEN** define further studies.	
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE	
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Identify significant changes in concentration trends • Identify whether additional RGA monitoring locations are needed	

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.4 ACTIVITY 4: NATURE AND EXTENT OF CONTAMINANTS CURRENTLY CONTRIBUTED BY LITTLE BAYOU CREEK SEEPS

Activity 4 consists of four tasks: (1) perform a hydraulic trends investigation; (2) develop/revise the CSM; (3) collect field data to assess stream flow/loss in the vicinity of the seeps on Little Bayou Creek; and (4) perform stream water sampling. DQOs for this activity are included in Table A.7.

Table A.7. DQOs for Activity 4

1. State the Problem	Historical analytical results from seeps in Little Bayou Creek have indicated that TCE has migrated from the RGA to the surface water in the creek; more recent analytical results for TCE have been lower or nondetect.
2. Identify the Decision	Is dissolved phase TCE in the RGA migrating to the Little Bayou Creek through seeps?

Table A.7. DQOs for Activity 4 (Continued)

<table>
<tr><td>3. Identify Inputs to the Decision</td><td colspan="2">• TCE extent and trends in the RGA close upgradient and downgradient of Little Bayou Creek between the Paducah Site and the Ohio River
• Aquifer properties
• TVA construction activities
• Flow and TCE concentrations in Little Bayou Creek seeps
• Site screening levels and background concentrations for surface water (defined in the risk methods document)
• Burial Grounds Operable Unit (OU) remedial investigations (RIs)
• Surface Water OU Plume RI</td></tr>
<tr><td>4. Define the Study Boundaries</td><td>• Spatial: Area upgradient and downgradient of Little Bayou Creek between the Paducah Site and the Ohio River
• Temporal: Last five years of analytical data</td><td>• Regulatory:
— NE Plume Interim Remedial Action
— NW Plume Interim Remedial Action
• EIs</td></tr>
<tr><td>5. Develop a Decision Rule</td><td colspan="2">IF dissolved-phase TCE is migrating from the RGA to the Little Bayou Creek seeps at levels that are above screening levels or background concentrations for surface water, THEN define further studies to understand the impact to Little Bayou Creek.</td></tr>
<tr><td>6. Specify Limits on Decision Errors</td><td colspan="2">• TCE analytical precision
• Groundwater flow direction
• Stream flow gain/loss</td></tr>
<tr><td>7. Optimize the Design for Obtaining Data</td><td colspan="2">• Identify significant changes in concentration trends
• Identify any new seeps
• Develop/review/revise conceptual model
• Evaluate seep sampling and flow gauging based on findings of FY 2022 walkdowns</td></tr>
</table>

Field data collection for FY 2022 is planned to include quarterly walkdowns of portions of Little Bayou Creek between the Paducah Site and the Ohio River to identify any new seeps, surveys of any new seeps, sampling of any new seeps (if possible) for TCE, and an estimation of seep flow (if possible). Any TCE data collected as part of Activity 7 will be reviewed in conjunction with TCE data from LBCSP5 data (sampled quarterly as part of the EMP).

Additionally, Activity 4 includes CB testing in the vicinity of the known seeps along Little Bayou Creek at MW439, MW441, and MW442 (Table A.8).

Table A.8 FY 2022 MWs for Activity 4

MWs	Month											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
MW439	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT
MW441	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT
MW442	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT

PT—continuous data logger
M1—manual water level measurement once per month
Purple color-coding is used to show this CB data collection group.

A.1.5 ACTIVITY 5: NATURE AND EXTENT OF DISSOLVED-PHASE CONTAMINANTS OTHER THAN TCE AND TC-99

DQOs for this activity are included in Table A.9.

Table A.9. DQOs for Activity 5

1. State the Problem	A holistic review of analytes monitored in groundwater and their extents has not been performed.	
2. Identify the Decision	Is the current chemical monitoring for the groundwater monitoring program sufficient for supporting ongoing and future remedial decisions?	
3. Identify Inputs to the Decision	• Current and historical analytical data in Oak Ridge Environmental Information System (OREIS) • Site screening levels for groundwater (defined in the risk methods document)	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical data through present	• Regulatory: — Environmental permits, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) projects, groundwater modeling working group • EIs
5. Develop a Decision Rule	**IF** sufficient groundwater concentration data for analytes other than Tc-99 or TCE are not available to understand nature and extents in the RGA **THEN** define further studies to obtain groundwater concentration data for analytes of potential concern.	
6. Specify Limits on Decision Errors	• Groundwater concentration distributions (nature and extents)	
7. Optimize the Design for Obtaining Data	• Review of available groundwater analytical data • Develop/review/revise conceptual model • Identify whether additional analytes should be sampled for and on what frequency	

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.6 ACTIVITY 6: CAPTURE EFFICIENCY OF NW PLUME EXTRACTION WELLS

DQOs for this activity are included in Table A.10.

Table A.10. DQOs for Activity 6

1. State the Problem	Assess and confirm the capture efficiency of the Northwest Plume Groundwater System (NWPGS).
2. Identify the Decision	Is the NWPGS effectively controlling the migration of the NW Plume, as demonstrated by either a stable or decreasing TCE plume configuration?

Table A.10. DQOs for Activity 6 (Continued)

3. Identify Inputs to the Decision	• NW Plume extraction well capture zone assessment included in *Remedial Action Work Plan for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0339&D1, May 2010 • *Operation and Maintenance Plan for the Northwest Plume Groundwater System Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2469&D1, June 2021 • *Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/LX/07-0343&D2, December 2010 • NWPGS influent data (e.g., rates, concentrations) • CERCLA Five-Year Reviews • TCE and Tc-99 plume maps and MW concentration time-trends
4. Define the Study Boundaries	• Spatial: NW Plume • Temporal: NWPGS influent data and NW Plume TCE concentration data from the optimization in 2010 through present • Regulatory: — NW Plume Interim Remedial Action • EIs
5. Develop a Decision Rule	**IF** the NW Plume is not either stable or decreasing, **OR** if efficiency in control cannot be demonstrated using available data, **THEN** define further studies to obtain the needed data or perform modeling to optimize the system extraction rates.
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE and TCE time-trends
7. Optimize the Design for Obtaining Data	• Literature review • Develop/review/revise conceptual model • Plume metrics (e.g., concentration levels, aerial footprints, plume length)

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.7 ACTIVITY 7: TCE EXTENT AND TRENDS IN EAST SIDE OF DOWNGRADIENT NW PLUME

DQOs for this activity are included in Table A.11.

Table A.11. DQOs for Activity 7

1. State the Problem	The extent of dissolved-phase TCE in the RGA along the east side of the downgradient NW Plume requires additional documentation.
2. Identify the Decision	Is additional monitoring needed to define the extent of the downgradient to the east of the NW Plume?
3. Identify Inputs to the Decision	• MW locations in the area of the downgradient NW Plume • TCE trends in MWs in the area of the downgradient NW Plume • Conceptual model of trends in the downgradient NW Plume • TCE plume maps
4. Define the Study Boundaries	• Spatial: East side of NW Plume • Temporal: 1 Year • Regulatory: — NW Plume Interim Remedial Action • EIs

Table A.11. DQOs for Activity 7 (Continued)

5. Develop a Decision Rule	**IF** additional control is required to define the west extent of the NW Plume dissolved-phase TCE groundwater contamination, **THEN** determine type and location of required additional monitoring.
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE
7. Optimize the Design for Obtaining Data	• Optimize existing RGA MW network • Robust RGA water level monitoring program • CB investigation • Develop/review/revise conceptual model • Potential for additional RGA MW(s) (location and number to be determined at a later date)

Data collection for Activity 7 during FY 2022 (Table A.12) consists of the following:

- Two rounds of CB testing in MW98, MW135, and MW200; and
- PT data collection in MW20, MW98, MW135, MW200, and MW492.

Also planned for FY 2022 is a desktop study that consists of data review and evaluation.

Table A.12 FY 2022 MWs for Activity 7

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW20 (also R4)	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW98	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW135	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW200	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
MW492	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT

M1—manual well water level measurements once per month
Blue color-coding is used to show this CB data collection group.

A.1.8 ACTIVITY 8: TCE EXTENT AND TRENDS IN WEST SIDE OF DOWNGRADIENT NE PLUME

Activity 8 was developed in FRNP-RPT-0094 and consists of three tasks to be performed following completion of Activity 2: (1) perform an RGA potentiometric trend investigation, (2) perform a drive point investigation, and (3) optimize the groundwater monitoring network. DQOs for this activity are included in Table A.13.

Table A.13. DQOs for Activity 8

<table>
<tr><td>1. State the Problem</td><td colspan="2">The extent of dissolved-phase TCE in the RGA along the west side of the downgradient NE Plume requires additional documentation.</td></tr>
<tr><td>2. Identify the Decision</td><td colspan="2">Is additional monitoring needed to define the west extent of the downgradient NE Plume?</td></tr>
<tr><td>3. Identify Inputs to the Decision</td><td colspan="2">• MW locations in the area of the downgradient NE Plume
• TCE trends in MWs in the area of the downgradient NE Plume
• Conceptual model of trends in the downgradient NE Plume
• TCE plume map reporting requirements</td></tr>
<tr><td>4. Define the Study Boundaries</td><td>• Spatial: West side of NE Plume
• Temporal: One year</td><td>• Regulatory:
— NE Plume Interim Remedial Action
• EIs</td></tr>
<tr><td>5. Develop a Decision Rule</td><td colspan="2">IF additional control is required to define the west extent of the NE Plume dissolved-phase TCE groundwater contamination, THEN determine type and location of required additional monitoring.</td></tr>
<tr><td>6. Specify Limits on Decision Errors</td><td colspan="2">• TCE analytical precision
• Groundwater flow direction
• Extent of dissolved-phase TCE</td></tr>
<tr><td>7. Optimize the Design for Obtaining Data</td><td colspan="2">• Optimize existing RGA MW network (documented in draft 2018 EMP)
• Robust RGA water level monitoring program
• CB investigation
• Develop/review/revise conceptual model
• Additional RGA MW(s) (location and number to be determined at a later date)</td></tr>
</table>

Data collection for Activity 8 during FY 2022 (Table A.14) consists of two rounds of CB testing in MW193. Additionally, a white paper regarding the regional groundwater flow, localized groundwater flow, and TCE trends to the west side of downgradient NE Plume is planned for development in FY 2022.

Future work associated with Activity 8 is anticipated to include a drive point investigation and also the installation and monitoring of up to eight new MWs, following the collection of the water level data and a drive point investigation. At present, it is assumed that the well construction activity will consist of subcontractor installation of 8 borings to 100 ft (i.e., 4 MWs to approximately 100 ft and 4 MWs to approximately 70 ft). Additionally, the MWs from Activity 2 and the MWs installed as part of this task are planned to be sampled for TCE and Tc-99.

Table A.14. FY 2022 MWs for Activity 8

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW99		M1			M1			M1			M1	
MW193		M1			M1	M1+CB		M1	M1+CB		M1	
MW463		M1			M1			M1			M1	
MW483		M1			M1			M1			M1	

M1—manual well water level measurements once per month
Yellow color-coding is used to show this CB data collection group.

A.1.9 ACTIVITY 9: RGA DISSOLVED-PHASE AND DNAPL CONTAMINANT IMPACTS TO THE MCNAIRY FORMATION

DQOs for this activity are included in Table A.15.

Table A.15. DQOs for Activity 9

1. State the Problem	Dissolved phase or DNAPL in the RGA may have impacted the McNairy Formation.	
2. Identify the Decision	Is there dissolved phase or DNAPL contamination in the McNairy Formation?	
3. Identify Inputs to the Decision	• McNairy groundwater and soil data collected during the C-400 Complex OU RI • Historical McNairy groundwater data (e.g., WAG 6 RI, Phase IV groundwater investigation) • Site screening levels and background concentrations for groundwater (defined in the risk methods document) • White paper: Detailed correlations between lithologic units in the McNairy Formation across the Paducah Site	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical data through present	• Regulatory: — Environmental permits, CERCLA projects, groundwater modeling working group
5. Develop a Decision Rule	**IF** an analyte is found in the McNairy groundwater at a concentration greater than its background concentration, **THEN** identify the analyte as a contaminant.	
6. Specify Limits on Decision Errors	• TCE analytical precision • Groundwater flow direction • Extent of dissolved-phase TCE	
7. Optimize the Design for Obtaining Data	• Literature review • Develop/review/revise conceptual model • Review/summarize analytical data	

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.10 ACTIVITY 10: CHARACTERIZE UNDERFLOW FROM THE TERRACE AREA

DQOs for this activity are included in Table A.16.

Table A.16. DQOs for Activity 10

1. State the Problem	As documented in the 2016 sitewide groundwater flow model, significant underflow is expected in Terrace drainage basins to the west and east of the upper Bayou Creek basin due to the following uncertainties. • seasonal variability is not well quantified because most sitewide groundwater monitoring events at PGDP have occurred during the dry season; and • characterization of the contact area between the Terrace Gravel and the Upper Continental Recharge System (UCRS) in the vicinity of the southern model boundary is based on a limited number of MWs.	
2. Identify the Decision	Do the recent quarterly synoptic water level events performed as part of Activity #14 provide sufficient data to understand the seasonal variability of underflow from the Terrace needed for the sitewide groundwater flow model?	
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • Historical groundwater investigations performed at the site • Quarterly synoptic water level events collected as part of Activity #14	
4. Define the Study Boundaries	• Spatial: Terrace area groundwater and transition from the Porters Creek Clay/Terrace Gravel to the RGA • Temporal: Existing synoptic depth to water data	• Regulatory: — Groundwater monitoring working group
5. Develop a Decision Rule	**IF** recent quarterly synoptic water level events do not provide sufficient information to represent seasonal variability in underflow from the Terrace, **THEN** develop a more accurate approach to quantify Terrace underflow to the RGA.	
6. Specify Limits on Decision Errors	Spatial distribution of the MW network in the vicinity of the Terrace.	
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Additional MW installation may be considered to collect water level and soil boring information in the contact area between the Terrace Gravel and the UCRS	

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.11 ACTIVITY 11: EXPANSION OF GROUNDWATER MONITORING NETWORK

DQOs for this activity are included in Table A.17.

Table A.17. DQOs for Activity 11

1. State the Problem	As documented in the 2016 sitewide groundwater flow model, there are uncertainties in the MW network coverage and density to adequately represent the relevant site features and operations that could impact the sitewide groundwater flow model.	
2. Identify the Decision	Are additional MWs needed inside and outside of the plant industrial area to reduce uncertainty regarding groundwater flow direction, contaminant distribution, and potential source areas?	
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • 2017 EarthCon Consultants, Inc. evaluation • Compilation and verification (especially datums) of the TVA monitoring system data	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical water level data through present	• Regulatory: — Groundwater MWG

Table A.17. DQOs for Activity 11 (Continued)

5. Develop a Decision Rule	**IF** areas of significant uncertainties exist in groundwater flow direction, contaminant distribution, and potential source areas are not anticipated to be addressed through other GWSP activities, **THEN** identify locations for installation of additional MWs to address these uncertainties.
6. Specify Limits on Decision Errors	• Groundwater plume maps • Groundwater time-trends
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Additional MW installation, inside and outside of the plant industrial area, may be considered to reduce uncertainty regarding groundwater flow direction, contaminant distribution, and potential source areas

The planned focus of this activity for FY 2022 is a desktop study consisting of data review and evaluation.

A.1.12 ACTIVITY 12: WATER BALANCE STUDY

DQOs for this activity are included in Table A.18.

Table A.18. DQOs for Activity 12

1. State the Problem	As documented in the 2016 sitewide groundwater flow model, a water balance study to identify significant sources of anthropogenic recharge in the model domain may provide a better understanding of key components of anthropogenic recharge and reduce uncertainty in recharge estimates for future model updates.	
2. Identify the Decision	Has additional information on anthropogenic recharge become available or have anthropogenic recharge sources changed significantly since the 2016 sitewide groundwater flow model update?	
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • Inventory and estimated volumes of significant sources of anthropogenic recharge in the model domain • Monitoring and documentation of the utility optimization program • Compilation of available information regarding the chronology of roof drain repair	
4. Define the Study Boundaries	• Spatial: Paducah Site industrial area and nearby creeks • Temporal: Current anthropogenic recharge sources	• Regulatory: — Groundwater monitoring working group
5. Develop a Decision Rule	**IF** significant changes to the anthropogenic recharge sources have occurred since the 2016 sitewide groundwater flow model update or are anticipated to change based on future planned work at the site, **THEN** prepare a summary of these sources for inclusion in the next sitewide groundwater flow model.	
6. Specify Limits on Decision Errors	• Groundwater flow direction • Surface water flows in Bayou Creek and Little Bayou Creek • Groundwater recharge	
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Gauging of flows in various portions of area creeks to determine where and in what quantities water enters and exits the creeks (coordinated with groundwater synoptic water level measurement events) may be considered • Expanded assessment of the water supply and storm-water systems may be considered	

Field data collection planned for FY 2022 consists of performing a walkdown along areas of interest along Bayou Creek to identify potential sampling and/or gauging locations.

Also planned for this activity for FY 2022 is a desktop study that consists of data review and evaluation.

A.1.13 ACTIVITY 13: CONTINUOUS RGA WATER LEVEL MONITORING

Activity 13 was developed in FRNP-RPT-0094 and consists of two tasks: (1) perform a continuous RGA potentiometric trend investigation over the course of one year in the vicinity of the Ohio River and along a transect of wells extending back to the Paducah Site industrial area and (2) perform continuous water level measurements within the plant area to assess recharge and its impact on nearby wells. DQOs for this activity are included in Table A.19.

Table A.19. DQOs for Activity 13

1. State the Problem	Prior groundwater modeling results have indicated uncertainty in the temporal flows between the Ohio River and the Paducah Site and the need for increased data on recharge rates.	
2. Identify the Decision	Are additional data required to update the groundwater model to support completion of other activities (e.g., new wells) and act as an input for the overall increase in understanding of the site?	
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • Groundwater flow directions close upgradient and downgradient of the Paducah Site • Aquifer properties • Current MW distribution	
4. Define the Study Boundaries	• Spatial: Between the Ohio River and the Paducah Site • Temporal: One year	• Regulatory: — Groundwater monitoring working group
5. Develop a Decision Rule	**IF** temporal conditions or changes to recharge assumptions are different from what the groundwater model currently employs in such a way as to change the model outputs, **THEN** define actions to update the groundwater model.	
6. Specify Limits on Decision Errors	• Groundwater flow direction • Groundwater recharge	
7. Optimize the Design for Obtaining Data	• Continuous RGA water level records over a period of a year in the vicinity of the Ohio River and along a transect of wells extending back to the PGDP industrial area • Deployment of continuous water level recorders in select MWs/piezometers within the plant area to better assess recharge and its impact on nearby water levels • Adjust RGA MWs monitoring program • Develop/review/revise conceptual model	

A white paper regarding the installation of piezometers to characterize roof drain leaks to gravel sub base of process buildings is planned for development in FY 2022 as part of the groundwater monitoring working group. This paper will summarize available data on the process building foundation construction and observations of the foundation underlying the C-400 Cleaning Building. This paper will also provide a recommendation regarding the consideration for the installation of piezometers equipped with continuous water level monitors beneath the process buildings to better define the thickness of the sub-slab gravel base and the temporal water level fluctuations.

The FY 2020–2021 field component of Activity 13 is summarized in Table A.20 and includes the monitoring of 15 wells. No additional data collection for Activity 13 is planned for FY 2022. A white paper

Table A.20. FY 2020-2021 MWs for Activity 13

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW71	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW137	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW145	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW147	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW152*	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW199	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1
MW262	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW353	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW445	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1
MW459	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
MW465	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1
MW471	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW473	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1
MW485	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1
MW491	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1

PT—continuous data logger
M1—manual water level measurement once per month
*MW152 was abandoned by TVA in October 2018 and therefore was not available for data collection in FY 2020-2021.

regarding the regional influence of the Ohio River stage on groundwater flow and recharge is planned for development following completion of the white paper on piezometer installation in process buildings.

A.1.14 ACTIVITY 14: SYNOPTIC WATER LEVEL MEASUREMENT

Activity 14 was developed in FRNP-RPT-0094 and consists of two tasks: (1) seasonal water level measurement events conducted during different seasons[2] and (2) water level measurements to understand the impact to the plumes in response to changes resulting from the change in operations at the Olmstead Dam. DQOs for this activity are included in Table A.21.

Table A.21. DQOs for Activity 14

1. State the Problem	Prior groundwater modeling results have indicated uncertainty in the temporal flows during different seasons and the need for information on how operational changes at the Olmstead Dam may affect site groundwater.
2. Identify the Decision	Are additional data required to update the groundwater model?
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • Groundwater flow directions close upgradient and downgradient of the Paducah Site • Aquifer properties • Current MW distribution
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: One year • Regulatory: — Groundwater monitoring working group
5. Develop a Decision Rule	**IF** temporal conditions, either seasonal or as a result of changing operations at the Olmstead Dam are different from what the groundwater model currently employs in such a way as to change the model outputs, **THEN** define actions to update the groundwater model.
6. Specify Limits on Decision Errors	• Groundwater flow direction • Groundwater recharge
7. Optimize the Design for Obtaining Data	• Increased water level measurement events conducted during different seasons, including measurement of the water level elevation at Metropolis Lake • A synoptic data set collected under steady conditions at the higher river stage is anticipated to start in 2018 • Develop/review/revise conceptual model

Prior to operational changes at the Olmstead Dam, one synoptic water level measurement event was conducted using the MWs used for synoptic water level events (as detailed in the FY 2020 EMP), in the McNairy Formation, and Rubble Zone wells shown in Table A.22.

Following operational changes at the Olmstead Dam, synoptic water level measurements were conducted using the MWs used for synoptic water level events (as detailed in the FY 2020 EMP), in the McNairy Formation, and Rubble Zone wells shown in Table A.22. Collection of quarterly synoptic water levels will continue to be conducted during FY 2022; the 18 new MWs installed as part of the C-400 RI will be included in the synoptic events.

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[2] Measurement of the water level elevation at Metropolis Lake is currently being considered by the groundwater monitoring working group and will be added to this scope, as appropriate.

A white paper that compares regional groundwater flow preconstruction and post construction for the operation of the Olmsted Dam is planned for development in FY 2022.

Table A.22. McNairy Formation and Rubble Zone MWs/Locations for Activity 14

Monitoring Well	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW102	MQ	MQ	MQ	MQ
MW120	MQ	MQ	MQ	MQ
MW121	MQ	MQ	MQ	MQ
MW122	MQ	MQ	MQ	MQ
MW133	MQ	MQ	MQ	MQ
MW239	MQ	MQ	MQ	MQ
MW247	MQ	MQ	MQ	MQ
MW356	MQ	MQ	MQ	MQ
MW345	MQ	MQ	MQ	MQ
MW346	MQ	MQ	MQ	MQ
MW347	MQ	MQ	MQ	MQ
Monitoring Location	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Metropolis Lake*	MQ	MQ	MQ	MQ

MQ—manual water level measurement once per quarter
*Measurement of the water level elevation at Metropolis Lake is currently being considered by the groundwater monitoring working group and will be added to this scope, as appropriate.

A.1.15 ACTIVITY 15: WATER LEVEL DIVIDE STUDY

Activity 15 was developed in FRNP-RPT-0094 and consists of two tasks: (1) assessing water level and water quality data collected from the newly installed transect of MWs located east of the C-400 Cleaning Building and (2) conducting a CB study in the vicinity of the apparent groundwater divide, located east of the C-400 Cleaning Building, to refine understanding of groundwater flow in the area and inform the operation of the Northeast Plume Containment System (NEPCS) extraction wells. DQOs for this activity are included in Table A.23.

Table A.23. DQOs for Activity 15

1. State the Problem	Provide a better understanding of the apparent groundwater divide, located east of the C-400 Cleaning Building, to refine understanding of groundwater flow in the area.	
2. Identify the Decision	Are additional data required to update the groundwater model or revise the operation of the NEPCS extraction wells?	
3. Identify Inputs to the Decision	• Groundwater monitoring working group actions and findings • Groundwater flow directions close to the C-400 Cleaning Building • Aquifer properties • Current MW distribution • Data collected during the NEPCS optimization	
4. Define the Study Boundaries	• Spatial: Vicinity of the C-400 Cleaning Building • Temporal: One year	• Regulatory: — Groundwater monitoring working group • NEPCS

Table A.23. DQOs for Activity 15 (Continued)

5. Develop a Decision Rule	**IF** temporal conditions are different from current conceptual model in such a way as to change the groundwater model outputs or operation of the NEPCS, **THEN** define actions to update the groundwater model and evaluate operational changes to the NEPCS extraction wells.
6. Specify Limits on Decision Errors	• Groundwater flow direction • Groundwater recharge
7. Optimize the Design for Obtaining Data	• Assess water level and water quality data collected from the newly installed transect of MWs located east of the C-400 Cleaning Building • Tracer tests in the vicinity of the apparent groundwater divide located east of the C-400 Cleaning Building to refine understanding of groundwater flow in the area may be considered • Revise conceptual model • Operation of the NEPCS extraction wells

The FY 2020–2021 field component of Activity 15 is summarized in Table A.24 and includes monitoring of 46 wells.

Table A.24. FY 2020-2021 MWs for Activity 15

MW	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW145	PT+MQ	PT+MQ	PT+MQ	PT+MQ
MW155	MQ	MQ	MQ	MQ
MW156	MQ	MQ	MQ	MQ
MW163	MQ	MQ	MQ	MQ
MW165A	MQ	MQ	MQ	MQ
MW175	MQ	MQ	MQ	MQ
MW177*	MQ	MQ	MQ	MQ
MW205	MQ	MQ	MQ	MQ
MW255	MQ	MQ	MQ	MQ
MW256	MQ	MQ	MQ	MQ
MW258	MQ	MQ	MQ	MQ
MW260	MQ	MQ	MQ	MQ
MW288	MQ	MQ	MQ	MQ
MW292	MQ	MQ	MQ	MQ
MW341	MQ	MQ	MQ	MQ
MW355	MQ	MQ	MQ	MQ
MW421	MQ	MQ	MQ	MQ
MW425	MQ	MQ	MQ	MQ
MW480	MQ	MQ	MQ	MQ
MW495	MQ	MQ	MQ	MQ
MW496	MQ	MQ	MQ	MQ
MW505	MQ	MQ	MQ	MQ
MW506	MQ	MQ	MQ	MQ

Table A.24. FY 2020-2021 MWs for Activity 15 (Continued)

MW	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW507	MQ	MQ	MQ	MQ
MW524	PT+MQ	MQ	MQ	MQ
MW525	MQ	CB+PT+MQ	MQ	MQ
MW526	MQ	MQ	CB+PT+MQ	MQ
MW527	CB+PT+MQ	MQ	MQ	MQ
MW528	MQ	MQ	MQ	MQ
MW529	MQ	PT+MQ	MQ	MQ
MW530	MQ	MQ	PT+MQ	MQ
MW531	MQ	MQ	MQ	MQ
MW533	MQ	MQ	MQ	MQ
MW537	MQ	MQ	MQ	MQ
MW539	MQ	MQ	MQ	MQ
MW556	MQ	MQ	MQ	MQ
MW71	PT+MQ	PT+MQ	PT+MQ	PT+MQ
PZ110	MQ	MQ	MQ	MQ
PZ532	MQ	MQ	MQ	MQ
PZ534	MQ	MQ	MQ	MQ
PZ535	MQ	MQ	MQ	MQ
PZ540	MQ	MQ	MQ	MQ
PZ541	MQ	MQ	MQ	MQ
PZ553	MQ	MQ	MQ	MQ
PZ554	MQ	MQ	MQ	MQ
PZ555	MQ	MQ	MQ	MQ

PT—continuous data logger
MQ—manual water level measurement once per quarter
*MW177 is a UCRS well that traditionally has insufficient water to obtain a water level measurement.

Data collection for Activity 15 will continue during FY 2022 (Table A.25) and will include the following:

- Perform two rounds of CB measurements at MW525, MW526, MW527, MW529, MW155, MW156, MW178, MW341; and
- Collect PT measurements during the months of CB testing.

Table A.25. FY 2022 MWs for Activity 15

MW	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MW155	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW156	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW178	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW341	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW525	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW526	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW527	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
MW529	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT

M1—manual well water level measurements once per month
Grey color-coding is used to show this CB data collection group.

A.1.16 ACTIVITY 16: HYDRAULIC CONDUCTIVITY

DQOs for this activity are included in Table A.26.

Table A.26. DQOs for Activity 16

1. State the Problem	As documented in the 2016 sitewide groundwater flow model, additional slug testing performed on a selection of appropriate MWs will better define hydraulic conductivity across the model domain	
2. Identify the Decision	Do the hydraulic conductivity studies conducted after the 2016 sitewide groundwater flow model update address uncertainties in the distribution of hydraulic conductivity across the model domain?	
3. Identify Inputs to the Decision	• Historical hydraulic conductivity studies • Hydraulic conductivity studies performed since the 2016 model update • Groundwater monitoring working group actions and findings • Groundwater flow directions close to the C-400 Cleaning Building • Hydraulic conductivity results from the C-400 OU RI • Aquifer properties	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical data through present	• Regulatory: — Groundwater monitoring working group
5. Develop a Decision Rule	**IF** the hydraulic conductivity studies conducted after the 2016 sitewide groundwater flow model do not address uncertainties in the distribution of hydraulic conductivity across the model domain, **THEN** develop an approach to collect data to address the remaining areas of uncertainty.	
6. Specify Limits on Decision Errors	Groundwater flow rates	
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Additional slug testing in a selection of appropriate MWs to better define hydraulic conductivity across the model domain may be considered • Selection of an appropriate slug test method and criteria for selecting test wells will be performed if additional slug testing is proposed • Characterization of the thickness and hydraulic conductivity of the bottom sediments in Metropolis Lake may be considered	

There are no tasks planned for FY 2022 associated with this activity as part of GWSP. Hydraulic conductivity will be obtained from newly installed MWs as part of the C-400 OU RI.

A.1.17 ACTIVITY 17: MONITORING WELL SURVEY STUDY

Activity 17 was developed in FRNP-RPT-0094 and consists of two tasks: (1) a review of existing MW survey information and (2) a review of survey data as it relates to the plume maps. DQOs for this activity are included in Table A.27.

Table A.27. DQOs for Activity 17

1. State the Problem	In 2018, an issue with selection of MW measurement point(s) was identified as part of C-404 Landfill permit required reporting. Additionally, a review of 2017 MW survey data was performed during the NE Plume optimization project and, compared to previous MW survey data, indicated a need for additional review of MW elevation data.	
2. Identify the Decision	Is the current survey information for the MWs of appropriate tolerance for decision making and required reporting; are measurement points understood?	
3. Identify Inputs to the Decision	• Current and historical survey data in OREIS and working databases or files maintained by staff • History of repairs made to MWs that would affect survey data • Scopes, activities, reports that are sensitive to the measurement and that are being used for decision making or to demonstrate compliance • Procedures for collecting and managing survey data • Plume maps	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Less than one year	• Regulatory: — Environmental permits, CERCLA projects, groundwater monitoring working group
5. Develop a Decision Rule	**IF** survey tolerances for MWs are not acceptable for the decisions and reporting, **THEN** define actions to resolve the tolerances and audit the use of the survey data.	
6. Specify Limits on Decision Errors	• Groundwater flow direction • Groundwater recharge • Groundwater plume maps	
7. Optimize the Design for Obtaining Data	• Review of available well survey data and techniques used to obtain the data • Identify scopes, activities, and reports that are sensitive to the measurement and that are being used for decision making or to demonstrate compliance • Identify significant differences, in an effort to understand the root cause of differences, and evaluate impact of differences • Understand structure and data available in OREIS • Review tools/files used to qualify the usefulness of the data	

The small hydraulic gradient across the Paducah Site (on the order of 0.1 inch vertically/100 ft horizontally) means that small changes in the MW elevations used to calculate groundwater elevations can result in different interpreted flow directions. Differences up to 3.5 inches (0.29 ft) have been observed between global positioning system (GPS) elevation data and level loop surveys performed at the Paducah Site. Both GPS and level loop surveying are commonly employed at the Paducah Site; the selection of survey method is based on the DQOs, scale of the project, and the distance between points.

The findings and actions from the MW survey study will ensure the MW elevation survey data used to perform the other activities in the GWSP, permit-required reporting, and other decisions regarding sitewide groundwater will be of the appropriate quality.

To understand if the two datasets may be used as a single dataset, a GPS survey on a subset of MWs in the main plant area was performed after a level loop survey was conducted, the two sets of elevations were compared afterward. Additionally, the previous GPS survey for the 26 MWs near the main plant area were compared to the level loop survey elevations performed for these MWs.

Other aspects of Activity 17 include the following:

- Understand if any of the repairs to MWs have resulted in measurement point changes; identify any other differences that could be related to measurement error.

- Identify scopes, activities, and reports that are sensitive to the measurement and whether they are being used for decision making or to demonstrate compliance, including a review of major decisions that have been made in the last five years based on well survey data and a review of compliance reporting.

- Revisit water level calculations and compare differences in results for selected periods from the previous scope and identify significant differences, attempt to understand the root cause of differences, and evaluate the impact of differences.

- Understand structure and data available in OREIS, including database management approach (e.g., written procedure) and historical datasets.

- Evaluate the development of a survey procedure that identifies tolerances, techniques, and record management.

- Review tools/files that practitioners use to qualify the usefulness of the data, including the use of judgmental data/points that are used for mapping.

- Review communication between data collection, data use, and data management; evaluate standardization of data and data processes.

A white paper, *Summary of Survey Activities Associated with Updating the Reference Measuring Point Elevations for the Groundwater Monitoring Well Network at the Paducah Site, Paducah, Kentucky*, FRNP-RPT-0165, was developed in FY 2021 and was also included as Appendix F to the FY 2020 update of the *Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan*, DOE/LX/07-2446&D1. This white paper provides a summary of survey activities to update reference measurement point elevations for the groundwater MW network.

A second white paper, *Evaluation of the 2016 Groundwater Model with Updated Reference Point Elevation for the Groundwater Monitoring Network at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, is planned for development in FY 2022 to assess impacts to model calibration and subsequent model-based conclusions.

A.1.18 ACTIVITY 18: GROUNDWATER CHEMICAL TREND EVALUATION

Activity 18 was developed in FRNP-RPT-0094 and consists of a review of existing groundwater analytical data. DQOs for this activity are included in Table A.28.

Table A.28. DQOs for Activity 18

1. State the Problem	A holistic review of analytes monitored in groundwater and their time-trends has not been performed.
2. Identify the Decision	Is the current chemical monitoring for groundwater monitoring program sufficient to support ongoing and future remedial decisions?
3. Identify Inputs to the Decision	• Current and historical analytical data in OREIS • Scopes, activities, and reports that are being used for decision making or to demonstrate compliance • Plume maps • 2017 EarthCon Consultants, Inc. evaluation Site screening levels and background concentrations for groundwater (defined in the risk methods document)

Table A.28. DQOs for Activity 18 (Continued)

4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical data through present	• Regulatory: — Environmental permits, CERCLA projects, groundwater monitoring working group
5. Develop a Decision Rule	**IF** sufficient groundwater concentration data for analytes other than Tc-99 or TCE are not available to understand nature and extent concentration trends in the RGA, **THEN** define further studies to obtain groundwater concentration data for analytes of potential concern.	
6. Specify Limits on Decision Errors	• Groundwater plume maps • Groundwater concentration time-trends	
7. Optimize the Design for Obtaining Data	• Develop/review/revise conceptual model • Review of available groundwater analytical data • Identify scopes, activities, and reports that are being used for decision making or to demonstrate compliance • Identify significant changes in concentration trends • Identify whether additional analytes should be sampled for and on what frequency	

The planned focus of this activity for FY 2022 is a desktop study consisting of data review and evaluation.

A.1.19 ACTIVITY 19: TCE DEGRADATION RATES

Activity 19 is focused on understanding the information available for TCE degradation rates—both in the UCRS (saturated and unsaturated) and in the RGA. DQOs for this activity are included in Table A.29.

Table A.29. DQOs for Activity 19

1. State the Problem	Summarize the information available regarding natural attenuation of TCE in portions of the dissolved-phase TCE plume.	
2. Identify the Decision	Is natural attenuation of dissolved-phase TCE occurring in the RGA or UCRS, or could the system be enhanced to promote TCE degradation?	
3. Identify Inputs to the Decision	• Site-specific degradation rate information • Distribution and types of bacteria present in the UCRS and RGA • Biogeochemical conditions of the UCRS and RGA	
4. Define the Study Boundaries	• Spatial: Paducah Site • Temporal: Historical data through present	• Regulatory: — CERCLA projects, groundwater monitoring working group
5. Develop a Decision Rule	**IF** a comparison of the available (site and literature) biodegradation rate(s) indicate the potential for natural attenuation in the UCRS or RGA, **THEN** document those rates in a white paper for future modeling and project planning **OR** provide recommendations in a white paper for future data collection to further define natural attenuation rates at the site.	
6. Specify Limits on Decision Errors	Natural attenuation rates sufficient to support TCE remedial alternatives	
7. Optimize the Design for Obtaining Data	• Literature review • Review available site-specific TCE degradation rate information • Develop/review/revise conceptual model	

The planned focus of this activity for FY 2022 is a desktop study that consists of data review and evaluation.

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APPENDIX B

FY 2020–2021 FIELD DATA COLLECTION SUMMARY

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		Month												
		Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
Activity	Well Number	1	2	3	4	5	6	7	8	9	10	11	12	Comments
1, 14	MW20 (also R4)	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2+M1	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	
14	MW63			M1	M1		M1			M1			M1	
14	MW65			M1	M1		M1			M1			M1	
14	MW66			M1	M1		M1			M1			M1	
14	MW67			M1	M1		M1			M1			M1	
14	MW68			M1	M1		M1			M1			M1	
13, 14, 15	MW71	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW72			M1	M1		M1			M1			M1	
14	MW73			M1	M1		M1			M1			M1	
14	MW76			M1	M1		M1			M1			M1	
14	MW77 (PZ)			M1	M1		M1			M1			M1	
14	MW78			M1	M1		M1			M1			M1	
14	MW79			M1	M1		M1			M1			M1	
14	MW80			M1	M1		M1			M1			M1	
14	MW81			M1	M1		M1			M1			M1	
14	MW84			M1	M1		M1			M1			M1	MW84 abandoned and replaced by MW84A
14	MW86			M1	M1		M1			M1			M1	
14	MW87			M1	M1		M1			M1			M1	MW87 abandoned and replaced by MW87A
14	MW89			M1	M1		M1			M1			M1	
14	MW90A			M1	M1		M1			M1			M1	
14	MW92			M1	M1		M1			M1			M1	
14	MW93			M1	M1		M1			M1			M1	MW93 abandoned and replaced by MW93A
14	MW95A			M1	M1		M1			M1			M1	
14	MW98			M1	M1		M1			M1			M1	
2, 14	MW99	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1	Month 3: Manual water levels/CB not able to be collected due to wet conditions Month 5: TVA restricted access Month 6: Manual water level not able to be collected due to wet conditions Month 8: Manual water level not able to be collected due to wet conditions
2, 14	MW100	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW102			M1	M1		M1			M1			M1	
14	MW103			M1	M1		M1			M1			M1	
1, 14	MW106A	CB+PT+M2	PT+M2	PT+M2+M1	CB+PT+M2+M1	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	
14	MW108			M1	M1		M1			M1			M1	
14	MW120			M1	M1		M1			M1			M1	
1, 14	MW121	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2+M1	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	All months: Colloidal borescope not able to be deployed due to pump being stuck in the well
14	MW122			M1	M1		M1			M1			M1	
14	MW123			M1	M1		M1			M1			M1	
14	MW124			M1	M1		M1			M1			M1	
14	MW125			M1	M1		M1			M1			M1	
2, 14	MW126	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW132	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW133			M1	M1		M1			M1			M1	
1, 14	MW134	PT+M2	CB+PT+M2	PT+M2+M1	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	
2, 14	MW135	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
13, 14	MW137	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW139	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW144			M1	M1		M1			M1			M1	
13, 14, 15	MW145	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW146			M1	M1		M1			M1			M1	
13, 14	MW147	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW148	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	

		Month												
		Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
Activity	Well Number	1	2	3	4	5	6	7	8	9	10	11	12	Comments
2, 14	MW150	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
13, 14	MW152	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	MW152 was abandoned in October 2018 by TVA
14, 15	MW155			M1	M1		M1			M1			M1	
14, 15	MW156			M1	M1		M1			M1			M1	
14	MW161			M1	M1		M1			M1			M1	
14, 15	MW163			M1	M1		M1			M1			M1	
14, 15	MW165A			M1	M1		M1			M1			M1	
14	MW168			M1	M1		M1			M1			M1	
14	MW169			M1	M1		M1			M1			M1	
14	MW173			M1	M1		M1			M1			M1	
14, 15	MW175			M1	M1		M1			M1			M1	
15	MW177			M1	M1		M1			M1			M1	Months 3 and 6: MW177 is a UCRS well that traditionally has insufficient water to obtain a water level; insufficient water to obtain measurement
14	MW178			M1	M1		M1			M1			M1	
14	MW185			M1	M1		M1			M1			M1	
14	MW188			M1	M1		M1			M1			M1	
14	MW191 (in EMP not PrP)	PT	PT+M1	M1+PT	M1+PT	PT+M1	M1+PT	PT+M1	PT+M1	M1			M1	Added to program for Water Policy Box Project
2, 14	MW193	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
1, 14	MW194	CB+M2	M2	CB+M2+M1	M2	CB+M2	M2	CB+M2	M2	CB+M2	M2	CB+M2	M2	
14	MW197			M1	M1		M1			M1			M1	
1, 13, 14	MW199	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	
14	MW200			M1	M1		M1			M1			M1	
1, 14	MW201	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	
1, 14	MW202	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	
14	MW203			M1	M1		M1			M1			M1	
14, 15	MW205			M1	M1		M1			M1			M1	
14	MW220			M1	M1		M1			M1			M1	
14	MW221			M1	M1		M1			M1			M1	
14	MW222			M1	M1		M1			M1			M1	
14	MW223			M1	M1		M1			M1			M1	
14	MW224			M1	M1		M1			M1			M1	
14	MW225			M1	M1		M1			M1			M1	
14	MW226			M1	M1		M1			M1			M1	
14	MW227			M1	M1		M1			M1			M1	
14	MW233			M1	M1		M1			M1			M1	
14	MW236			M1	M1		M1			M1			M1	
14	MW238			M1	M1		M1			M1			M1	
14	MW239			M1	M1		M1			M1			M1	
14	MW240			M1	M1		M1			M1			M1	
14	MW241A			M1	M1		M1			M1			M1	
14	MW242			M1	M1		M1			M1			M1	
14	MW243			M1	M1		M1			M1			M1	
14	MW244			M1	M1		M1			M1			M1	
14	MW245			M1	M1		M1			M1			M1	
14	MW247			M1	M1		M1			M1			M1	
14	MW248			M1	M1		M1			M1			M1	
14	MW249			M1	M1		M1			M1			M1	
14	MW250			M1	M1		M1			M1			M1	
2, 14	MW252	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1	M1	
2, 14	MW253A	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14, 15	MW255			M1	M1		M1			M1			M1	
14, 15	MW256			M1	M1		M1			M1			M1	
14	MW257			M1	M1		M1			M1			M1	
14, 15	MW258			M1	M1		M1			M1			M1	

		Month												
		Sep-20	**Oct-20**	**Nov-20**	**Dec-20**	**Jan-21**	**Feb-21**	**Mar-21**	**Apr-21**	**May-21**	**Jun-21**	**Jul-21**	**Aug-21**	
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Comments**
14, 15	MW260			M1	M1		M1			M1			M1	
14	MW261			M1	M1		M1			M1			M1	
13, 14	MW262	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW283			M1	M1		M1			M1			M1	
14	MW284			M1	M1		M1			M1			M1	
14, 15	MW288			M1	M1		M1			M1			M1	
2, 14	MW291	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14, 15	MW292			M1	M1		M1			M1			M1	
14	MW293A			M1	M1		M1			M1			M1	
14	MW294A			M1	M1		M1			M1			M1	
14	MW325			M1	M1		M1			M1			M1	
14	MW326			M1	M1		M1			M1			M1	
14	MW327			M1	M1		M1			M1			M1	
14	MW328			M1	M1		M1			M1			M1	
1, 14	MW329	PT+M2	PT+M2	PT+M2+M1	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	PT+M2	PT+M2	PT+M2	CB+PT+M2	
14	MW330			M1	M1		M1			M1			M1	
14	MW333			M1	M1		M1			M1			M1	
14	MW337			M1	M1		M1			M1			M1	
14	MW338			M1	M1		M1			M1			M1	
14	MW339			M1	M1		M1			M1			M1	
14	MW340			M1	M1		M1			M1			M1	
14, 15	MW341			M1	M1		M1			M1			M1	
14	MW342			M1	M1		M1			M1			M1	
14	MW343			M1	M1		M1			M1			M1	
14	MW345			M1	M1		M1			M1			M1	
14	MW346			M1	M1		M1			M1			M1	
14	MW347			M1	M1		M1			M1			M1	
13, 14	MW353	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
1, 14	MW354	PT+M2	PT+M2	CB+PT+M2+M1	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	
14, 15	MW355			M1	M1		M1			M1			M1	
14	MW356			M1	M1		M1			M1			M1	
14	MW357			M1	M1		M1			M1			M1	
14	MW358			M1	M1		M1			M1			M1	
14	MW360			M1	M1		M1			M1			M1	
14	MW361			M1	M1		M1			M1			M1	
14	MW363			M1	M1		M1			M1			M1	
14	MW364			M1	M1		M1			M1			M1	
2, 14	MW366	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW367			M1	M1		M1			M1			M1	
14	MW369			M1	M1		M1			M1			M1	
14	MW370			M1	M1		M1			M1			M1	
14	MW372			M1	M1		M1			M1			M1	
14	MW373			M1	M1		M1			M1			M1	
14	MW376			M1	M1		M1			M1			M1	
14	MW380			M1	M1		M1			M1			M1	
14	MW381			M1	M1		M1			M1			M1	
14	MW384			M1	M1		M1			M1			M1	
14	MW385			M1	M1		M1			M1			M1	
14	MW387			M1	M1		M1			M1			M1	
14	MW388			M1	M1		M1			M1			M1	
14	MW391			M1	M1		M1			M1			M1	
14	MW392			M1	M1		M1			M1			M1	
2, 14	MW394	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW395			M1	M1		M1			M1			M1	
14	MW397			M1	M1		M1			M1			M1	

		Month												
		Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
Activity	Well Number	1	2	3	4	5	6	7	8	9	10	11	12	Comments
14	MW401			M1			M1			M1			M1	Unable to obtain water levels due to well head configuration
14	MW402			M1			M1			M1			M1	Unable to obtain water levels due to well head configuration
2, 14	MW409	PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW410	CB+PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	CB+PT+M1	PT+M1	PT+M1	
2, 14	MW411	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	MW411 removed from the colloidal borescope (CB) data collection portion of the GWSP
14	MW414			M1	M1		M1			M1			M1	
14	MW415			M1	M1		M1			M1			M1	
14	MW416			M1	M1		M1			M1			M1	
14	MW417			M1	M1		M1			M1			M1	
2, 14	MW418	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW419			M1	M1		M1			M1			M1	
14	MW420			M1	M1		M1			M1			M1	
14, 15	MW421			M1	M1		M1			M1			M1	
14	MW422			M1	M1		M1			M1			M1	
14	MW423			M1	M1		M1			M1			M1	
14	MW424			M1	M1		M1			M1			M1	
14, 15	MW425			M1	M1		M1			M1			M1	
1, 14	MW426	PT+M2	CB+PT+M2	PT+M2+M1	PT+M2+M1	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	PT+M2	CB+PT+M2	PT+M2	
1, 14	MW427	M2	CB+M2	M2+M1	M2+M1	CB+M2	M2	M2	CB+M2	M2	M2	CB+M2	M2	
1, 14	MW428	M2	M2	CB+M2+M1	M2+M1	M2	CB+M2	M2	M2	CB+M2	M2	M2	CB+M2	Month 6: Switched with MW429A
1, 14	MW429 A	M2	CB+M2	M2+M1	M2+M1	M2	M2+CB	M2	CB+M2	M2	M2	M2	M2	Month 6: Switched with MW428
1, 14	MW430	CB+M2	M2	M2+M1	M2+M1	M2	M2	CB+M2	M2	M2	M2	M2	M2	
1, 14	MW431	M2	M2	M2+M1	CB+M2+M1	M2	M2	M2	M2	M2	CB+M2	M2	M2	
1, 14	MW432	M2	M2	M2+M1	CB+M2+M1	M2	M2	M2	M2	M2	CB+M2	M2	M2	
14	MW433			M1	M1		M1			M1			M1	
14	MW435			M1	M1		M1			M1			M1	
14	MW439			M1	M1		M1			M1			M1	
14	MW440			M1	M1		M1			M1			M1	
14	MW441			M1	M1		M1			M1			M1	
14	MW442			M1	M1		M1			M1			M1	
14	MW443			M1	M1		M1			M1			M1	
14	MW444			M1	M1		M1			M1			M1	
13, 14	MW445	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW447			M1	M1		M1			M1			M1	
14	MW448			M1	M1		M1			M1			M1	
14	MW450			M1	M1		M1			M1			M1	
14	MW451			M1	M1		M1			M1			M1	
14	MW452			M1	M1		M1			M1			M1	
14	MW453			M1	M1		M1			M1			M1	
14	MW454			M1	M1		M1			M1			M1	
14	MW455			M1	M1		M1			M1			M1	
14	MW456			M1	M1		M1			M1			M1	
14	MW457			M1	M1		M1			M1			M1	
14	MW458			M1	M1		M1			M1			M1	
13, 14	MW459	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW460			M1	M1		M1			M1			M1	
14	MW461			M1	M1		M1			M1			M1	
14	MW462			M1	M1		M1			M1			M1	
2, 14	MW463	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW464	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	
2, 13, 14	MW465	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	

Activity	Well Number	Month												Comments
		Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
		1	2	3	4	5	6	7	8	9	10	11	12	
2, 14	MW466	M1	M1	M1	CB+M1	M1	CB+M1	M1	M1	M1	CB+M1	M1	CB+M1	
2, 14	MW467	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW468	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW469	CB+M1	M1	M1	M1	CB+M1	M1	CB+M1	M1	M1	M1	CB+M1	M1	Month 4: Unable to access due to TVA road construction activities Month 5: MW469 is not accessible for colloidal borescope deployment due to TVA road construction activities and was substituted with MW472 (collocated with MW471)
2, 14	MW470	M1	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	M1	M1	Month 4: Unable to access for manual water level measurement due to TVA road construction activities
2, 13, 14	MW471	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW472	M1	CB+M1	M1	CB+M1	M1+CB	M1	M1	CB+M1	M1	CB+M1	M1	M1	Month 5: MW472 was substituted for MW469 colloidal borescope
2, 13, 14	MW473	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	
2, 14	MW474	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	
2, 14	MW475	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW476	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	
2, 14	MW477	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	Month 3: Manual water levels were not able to be collected due to wet conditions Month 5: TVA restricted access for Jan M1 Month 6: MW477 was not accessible due to wet conditions Month 8: MW477 was not accessible due to wet conditions
14	MW478			M1	M1		M1			M1			M1	
14	MW479			M1	M1		M1			M1			M1	
14, 15	MW480			M1	M1		M1			M1			M1	
2, 14	MW481	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW482	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW483	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW484	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	
2, 13, 14	MW485	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
2, 14	MW486A	M1	M1	M1	M1	M1	CB+M1	M1	M1	M1	M1	M1	CB+M1	
2, 14	MW487	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
2, 14	MW488	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	CB+PT+M1	PT+M1	PT+M1	PT+M1	
14	MW489			M1	M1		M1			M1			M1	
14	MW490			M1	M1		M1			M1			M1	
13, 14	MW491	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	PT+M1	
14	MW492			M1	M1		M1			M1			M1	
14	MW493			M1	M1		M1			M1			M1	
14	MW494			M1	M1		M1			M1			M1	
14, 15	MW495			M1	M1		M1			M1			M1	
2, 14, 15	MW496	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	
14	MW497			M1	M1		M1			M1			M1	
14	MW498			M1	M1		M1			M1			M1	
14	MW499			M1	M1		M1			M1			M1	
14	MW500			M1	M1		M1			M1			M1	
14	MW501			M1	M1		M1			M1			M1	
14	MW502			M1	M1		M1			M1			M1	
14	MW503			M1	M1		M1			M1			M1	
14	MW504			M1	M1		M1			M1			M1	
14, 15	MW505			M1	M1		M1			M1			M1	
14, 15	MW506			M1	M1		M1			M1			M1	
14, 15	MW507			M1	M1		M1			M1			M1	
14, 15	MW524			PT+M1	M1		M1			M1			M1	
14, 15	MW525			M1	M1		CB+PT+M1			M1			M1	
14, 15	MW526			M1	M1		M1			CB+PT+M1			M1	

Activity	Well Number	Month												Comments
		Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
		1	2	3	4	5	6	7	8	9	10	11	12	
14, 15	MW527			CB+PT+M1	M1		M1			M1			M1	
14, 15	MW528			M1	M1		M1			M1			M1	
14, 15	MW529			M1	M1		PT+M1			M1			M1	
14, 15	MW530			M1	M1		M1			PT+M1			M1	
14, 15	MW531			M1	M1		M1			M1			M1	
14, 15	MW532 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW533			M1	M1		M1			M1			M1	
14, 15	MW534 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW535 (PZ)			M1	M1		M1			M1			M1	
14	MW536			M1	M1		M1			M1			M1	
14, 15	MW537			M1	M1		M1			M1			M1	
14	MW538			M1	M1		M1			M1			M1	
14, 15	MW539			M1	M1		M1			M1			M1	
14, 15	MW540 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW541 (PZ)			M1	M1		M1			M1			M1	
14	MW542			M1	M1		M1			M1			M1	
14	MW543			M1	M1		M1			M1			M1	
14	MW544			M1	M1		M1			M1			M1	
14	MW545			M1	M1		M1			M1			M1	
14	MW546			M1	M1		M1			M1			M1	
14	MW547			M1	M1		M1			M1			M1	
14	MW548			M1	M1		M1			M1			M1	
14	MW549			M1	M1		M1			M1			M1	
14	MW550			M1	M1		M1			M1			M1	
14	MW551			M1	M1		M1			M1			M1	
14, 15	MW553 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW554 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW555 (PZ)			M1	M1		M1			M1			M1	
14, 15	MW556			M1	M1		M1			M1			M1	
14	PZ107			M1	M1		M1			M1			M1	Month 3: Location inaccessible due to wet conditions
14	PZ109			M1	M1		M1			M1			M1	
14, 15	PZ110			M1	M1		M1			M1			M1	
14	PZ114 (if not abandoned)			M1	M1		M1			M1			M1	
14	PZ115 (if not abandoned)			M1	M1		M1			M1			M1	
14	PZ117			M1	M1		M1			M1			M1	
14	PZ118			M1	M1		M1			M1			M1	
14	PZ287			M1	M1		M1			M1			M1	
14	PZ289			M1	M1		M1			M1			M1	
14	PZ290			M1	M1		M1			M1			M1	
14	PZ349			M1	M1		M1			M1			M1	
14	PZ351			M1	M1		M1			M1			M1	
14	EW232			M1	M1		M1			M1			M1	
14	EW233			M1	M1		M1			M1			M1	
14	EW234			M1	M1		M1			M1			M1	
14	EW235			M1	M1		M1			M1			M1	

Notes:
CB=Colloidal Borescope Deployment
PT=Pressure Transducer Deployment
M1=Manual Water Level Collected Once per Month
M2= Manual Water Level Collected Twice per Month

APPENDIX C

FY 2022 FIELD DATA COLLECTION SUMMARY

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Table C.1. FY 2022 Field Data Collection Summary

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
7, 14	MW20 (also R4)	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
14	MW63		M1			M1			M1			M1	
14	MW65		M1			M1			M1			M1	
14	MW66		M1			M1			M1			M1	
14	MW67		M1			M1			M1			M1	
14	MW68		M1			M1			M1			M1	
14	MW71		M1			M1			M1			M1	
14	MW72		M1			M1			M1			M1	
14	MW73		M1			M1			M1			M1	
14	MW76		M1			M1			M1			M1	
14	MW77 (PZ)		M1			M1			M1			M1	
14	MW78		M1			M1			M1			M1	
14	MW79		M1			M1			M1			M1	
14	MW80		M1			M1			M1			M1	
14	MW81		M1			M1			M1			M1	
14	MW84		M1			M1			M1			M1	
14	MW86		M1			M1			M1			M1	
14	MW87		M1			M1			M1			M1	
14	MW89		M1			M1			M1			M1	
14	MW90A		M1			M1			M1			M1	
14	MW92		M1			M1			M1			M1	
14	MW93		M1			M1			M1			M1	
14	MW95A		M1			M1			M1			M1	
7, 14	MW98	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
8, 14	MW99		M1			M1			M1			M1	
14	MW100		M1			M1			M1			M1	
14	MW102		M1			M1			M1			M1	
14	MW103		M1			M1			M1			M1	
1, 14	MW106A	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
14	MW108		M1			M1			M1			M1	
14	MW120		M1			M1			M1			M1	
14	MW121		M1			M1			M1			M1	
14	MW122		M1			M1			M1			M1	
14	MW123		M1			M1			M1			M1	
14	MW124		M1			M1			M1			M1	
14	MW125		M1			M1			M1			M1	
14	MW126		M1			M1			M1			M1	
14	MW132		M1			M1			M1			M1	
14	MW133		M1			M1			M1			M1	
14	MW134		M1			M1			M1			M1	
4, 7, 14	MW135	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
4, 14	MW137		M1			M1			M1			M1	
14	MW139		M1			M1			M1			M1	
14	MW144		M1			M1			M1			M1	
14	MW145		M1			M1			M1			M1	
4, 14	MW146		M1			M1			M1			M1	
14	MW147		M1			M1			M1			M1	
14	MW148		M1			M1			M1			M1	
14	MW150		M1			M1			M1			M1	
14, 15	MW155	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14, 15	MW156	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14	MW161		M1			M1			M1			M1	
14	MW163		M1			M1			M1			M1	
14	MW165A		M1			M1			M1			M1	
14	MW168		M1			M1			M1			M1	
14	MW169		M1			M1			M1			M1	
14	MW173		M1			M1			M1			M1	
14	MW175		M1			M1			M1			M1	

Table C.1. FY 2022 Field Data Collection Summary (Continued)

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
14, 15	MW178	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14	MW185		M1			M1			M1			M1	
14	MW188		M1			M1			M1			M1	
14	MW191		M1			M1			M1			M1	
8, 14	MW193		M1			M1	M1+CB		M1	M1+CB		M1	
14	MW194		M1			M1			M1			M1	
14	MW197		M1			M1			M1			M1	
14	MW199		M1			M1			M1			M1	
7, 14	MW200	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
4, 14	MW201		M1			M1			M1			M1	
14	MW202		M1			M1			M1			M1	
14	MW203		M1			M1			M1			M1	
14	MW205		M1			M1			M1			M1	
14	MW220		M1			M1			M1			M1	
14	MW221		M1			M1			M1			M1	
14	MW222		M1			M1			M1			M1	
14	MW223		M1			M1			M1			M1	
14	MW224		M1			M1			M1			M1	
14	MW225		M1			M1			M1			M1	
14	MW226		M1			M1			M1			M1	
14	MW227		M1			M1			M1			M1	
14	MW233		M1			M1			M1			M1	
14	MW236		M1			M1			M1			M1	
14	MW238		M1			M1			M1			M1	
14	MW239		M1			M1			M1			M1	
14	MW240		M1			M1			M1			M1	
14	MW241A		M1			M1			M1			M1	
14	MW242		M1			M1			M1			M1	
14	MW243		M1			M1			M1			M1	
14	MW244		M1			M1			M1			M1	
14	MW245		M1			M1			M1			M1	
14	MW247		M1			M1			M1			M1	
14	MW248		M1			M1			M1			M1	
14	MW249		M1			M1			M1			M1	
14	MW250		M1			M1			M1			M1	
14	MW252		M1			M1			M1			M1	
14	MW253A		M1			M1			M1			M1	
14	MW255		M1			M1			M1			M1	
14	MW256		M1			M1			M1			M1	
14	MW257		M1			M1			M1			M1	
14	MW258		M1			M1			M1			M1	
14	MW260		M1			M1			M1			M1	
14	MW261		M1			M1			M1			M1	
14	MW262		M1			M1			M1			M1	
14	MW283		M1			M1			M1			M1	
14	MW284		M1			M1			M1			M1	
14	MW288		M1			M1			M1			M1	
14	MW291		M1			M1			M1			M1	
14	MW292		M1			M1			M1			M1	
14	MW293A		M1			M1			M1			M1	
14	MW294A		M1			M1			M1			M1	
14	MW325		M1			M1			M1			M1	
14	MW326		M1			M1			M1			M1	
14	MW327		M1			M1			M1			M1	
14	MW328		M1			M1			M1			M1	
14	MW329		M1			M1			M1			M1	
14	MW330		M1			M1			M1			M1	
14	MW333		M1			M1			M1			M1	

Table C.1. FY 2022 Field Data Collection Summary (Continued)

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
14	MW337		M1			M1			M1			M1	
14	MW338		M1			M1			M1			M1	
14	MW339		M1			M1			M1			M1	
14	MW340		M1			M1			M1			M1	
14, 15	MW341	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14	MW342		M1			M1			M1			M1	
14	MW343		M1			M1			M1			M1	
14	MW345		M1			M1			M1			M1	
14	MW346		M1			M1			M1			M1	
14	MW347		M1			M1			M1			M1	
14	MW353		M1			M1			M1			M1	
1, 14	MW354	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
14	MW355		M1			M1			M1			M1	
14	MW356		M1			M1			M1			M1	
14	MW357		M1			M1			M1			M1	
14	MW358		M1			M1			M1			M1	
14	MW360		M1			M1			M1			M1	
14	MW361		M1			M1			M1			M1	
14	MW363		M1			M1			M1			M1	
14	MW364		M1			M1			M1			M1	
14	MW366		M1			M1			M1			M1	
14	MW367		M1			M1			M1			M1	
14	MW369		M1			M1			M1			M1	
14	MW370		M1			M1			M1			M1	
14	MW372		M1			M1			M1			M1	
14	MW373		M1			M1			M1			M1	
14	MW376		M1			M1			M1			M1	
14	MW380		M1			M1			M1			M1	
14	MW381		M1			M1			M1			M1	
14	MW384		M1			M1			M1			M1	
14	MW385		M1			M1			M1			M1	
14	MW387		M1			M1			M1			M1	
14	MW388		M1			M1			M1			M1	
14	MW391		M1			M1			M1			M1	
14	MW392		M1			M1			M1			M1	
14	MW394		M1			M1			M1			M1	
14	MW395		M1			M1			M1			M1	
14	MW397		M1			M1			M1			M1	
14	MW409		M1			M1			M1			M1	
14	MW410		M1			M1			M1			M1	
14	MW411*		M1			M1			M1			M1	
14	MW414		M1			M1			M1			M1	
14	MW415		M1			M1			M1			M1	
14	MW416		M1			M1			M1			M1	
14	MW417		M1			M1			M1			M1	
14	MW418		M1			M1			M1			M1	
14	MW419		M1			M1			M1			M1	
14	MW420		M1			M1			M1			M1	
14	MW421		M1			M1			M1			M1	
14	MW422		M1			M1			M1			M1	
14	MW423		M1			M1			M1			M1	
14	MW424		M1			M1			M1			M1	
14	MW425		M1			M1			M1			M1	
14	MW426		M1			M1			M1			M1	
14	MW427		M1			M1			M1			M1	
14	MW428		M1			M1			M1			M1	
14	MW429A		M1			M1			M1			M1	
14	MW430		M1			M1			M1			M1	

Table C.1. FY 2022 Field Data Collection Summary (Continued)

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1, 14	MW431	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
1, 14	MW432	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
4, 14	MW433		M1			M1			M1			M1	
14	MW435		M1			M1			M1			M1	
4, 14	MW439	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT
4, 14	MW440		M1			M1			M1			M1	
4, 14	MW441	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT
4, 14	MW442	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT
4, 14	MW443		M1			M1			M1			M1	
4, 14	MW444		M1			M1			M1			M1	
4, 14	MW445	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
4, 14	MW447		M1			M1			M1			M1	
4, 14	MW448		M1			M1			M1			M1	
4, 14	MW450		M1			M1			M1			M1	
14	MW451		M1			M1			M1			M1	
14	MW452		M1			M1			M1			M1	
14	MW453		M1			M1			M1			M1	
14	MW454		M1			M1			M1			M1	
14	MW455		M1			M1			M1			M1	
14	MW456		M1			M1			M1			M1	
14	MW457		M1			M1			M1			M1	
14	MW458		M1			M1			M1			M1	
14	MW459		M1			M1			M1			M1	
14	MW460		M1			M1			M1			M1	
14	MW461		M1			M1			M1			M1	
14	MW462		M1			M1			M1			M1	
8, 14	MW463		M1			M1			M1			M1	
14	MW464		M1			M1			M1			M1	
14	MW465		M1			M1			M1			M1	
14	MW466		M1			M1			M1			M1	
14	MW467		M1			M1			M1			M1	
14	MW468		M1			M1			M1			M1	
14	MW469		M1			M1			M1			M1	
14	MW470		M1			M1			M1			M1	
14	MW471		M1			M1			M1			M1	
14	MW472		M1			M1			M1			M1	
14	MW473		M1			M1			M1			M1	
14	MW474		M1			M1			M1			M1	
14	MW475		M1			M1			M1			M1	
14	MW476		M1			M1			M1			M1	
14	MW477		M1			M1			M1			M1	
14	MW478		M1			M1			M1			M1	
14	MW479		M1			M1			M1			M1	
14	MW480		M1			M1			M1			M1	
14	MW481		M1			M1			M1			M1	
14	MW482		M1			M1			M1			M1	
8, 14	MW483		M1			M1			M1			M1	
14	MW484		M1			M1			M1			M1	
14	MW485		M1			M1			M1			M1	
14	MW486A		M1			M1			M1			M1	
14	MW487		M1			M1			M1			M1	
14	MW488		M1			M1			M1			M1	
14	MW489		M1			M1			M1			M1	
14	MW490		M1			M1			M1			M1	
14	MW491		M1			M1			M1			M1	
7, 14	MW492	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT
14	MW493		M1			M1			M1			M1	
14	MW494		M1			M1			M1			M1	

Table C.1. FY 2022 Field Data Collection Summary (Continued)

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
14	MW495		M1			M1			M1			M1	
14	MW496		M1			M1			M1			M1	
14	MW497		M1			M1			M1			M1	
14	MW498		M1			M1			M1			M1	
14	MW499		M1			M1			M1			M1	
14	MW500		M1			M1			M1			M1	
14	MW501		M1			M1			M1			M1	
14	MW502		M1			M1			M1			M1	
14	MW503		M1			M1			M1			M1	
14	MW504		M1			M1			M1			M1	
14	MW505		M1			M1			M1			M1	
14	MW506		M1			M1			M1			M1	
14	MW507		M1			M1			M1			M1	
14	MW524		M1			M1			M1			M1	
14, 15	MW525	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14, 15	MW526	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14, 15	MW527	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14	MW528		M1			M1			M1			M1	
14, 15	MW529	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT	M1+PT+CB	M1+PT
14	MW530		M1			M1			M1			M1	
14	MW531		M1			M1			M1			M1	
14	MW532 (PZ)		M1			M1			M1			M1	
14	MW533		M1			M1			M1			M1	
14	MW534 (PZ)		M1			M1			M1			M1	
14	MW535 (PZ)		M1			M1			M1			M1	
14	MW536		M1			M1			M1			M1	
14	MW537		M1			M1			M1			M1	
14	MW538		M1			M1			M1			M1	
14	MW539		M1			M1			M1			M1	
14	MW540 (PZ)		M1			M1			M1			M1	
14	MW541 (PZ)		M1			M1			M1			M1	
14	MW542		M1			M1			M1			M1	
14	MW543		M1			M1			M1			M1	
14	MW544		M1			M1			M1			M1	
14	MW545		M1			M1			M1			M1	
14	MW546		M1			M1			M1			M1	
14	MW547		M1			M1			M1			M1	
14	MW548		M1			M1			M1			M1	
14	MW549		M1			M1			M1			M1	
14	MW550		M1			M1			M1			M1	
14	MW551		M1			M1			M1			M1	
14	MW553 (PZ)		M1			M1			M1			M1	
14	MW554 (PZ)		M1			M1			M1			M1	
14	MW555 (PZ)		M1			M1			M1			M1	
14	MW556		M1			M1			M1			M1	
14	PZ107		M1			M1			M1			M1	
14	PZ109		M1			M1			M1			M1	
14	PZ110		M1			M1			M1			M1	
14	PZ114		M1			M1			M1			M1	
14	PZ115		M1			M1			M1			M1	
14	PZ117		M1			M1			M1			M1	
14	PZ118		M1			M1			M1			M1	
14	PZ287		M1			M1			M1			M1	
14	PZ289		M1			M1			M1			M1	
14	PZ290		M1			M1			M1			M1	
14	PZ349		M1			M1			M1			M1	
14	PZ351		M1			M1			M1			M1	
14	EW232		M1			M1			M1			M1	

Table C.1. FY 2022 Field Data Collection Summary (Continued)

		Month											
Activity	**Well Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
14	EW233		M1			M1			M1			M1	
14	EW234		M1			M1			M1			M1	
14	EW235		M1			M1			M1			M1	
14	MW557		M1			M1			M1			M1	
14	MW558		M1			M1			M1			M1	
14	MW559		M1			M1			M1			M1	
14	MW560		M1			M1			M1			M1	
14	MW561		M1			M1			M1			M1	
14	MW562		M1			M1			M1			M1	
14	MW563		M1			M1			M1			M1	
14	MW564		M1			M1			M1			M1	
14	MW565		M1			M1			M1			M1	
14	MW566		M1			M1			M1			M1	
14	MW567		M1			M1			M1			M1	
14	MW568		M1			M1			M1			M1	
14	MW569		M1			M1			M1			M1	
14	MW570		M1			M1			M1			M1	
14	MW571		M1			M1			M1			M1	
14	MW572		M1			M1			M1			M1	
14	MW573		M1			M1			M1			M1	
14	MW574		M1			M1			M1			M1	

Notes:
CB=Colloidal Borescope Deployment
PT=Pressure Transducer Deployment
M1=Manual Water Level Collected Once per Month
Color coding is used to show CB data collection groups
*Collect manual water level measurement when accessible
The scheduled months for synoptic water level measurement may change within the quarter based on precipitation and surface water elevation in the Ohio Rive