Intended for
Illinois Power Generating Company

Date
September 4, 2025

Project No.
1940110241-001

ADDENDUM TO THE GROUNDWATER MONITORING PLAN REVISION 1

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

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ADDENDUM TO THE GROUNDWATER MONITORING PLAN REVISION 1 COFFEEN POWER PLANT ASH POND NO. 2

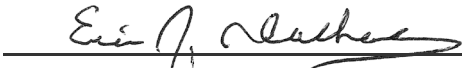
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LICENSED PROFESSIONAL CERTIFICATIONS

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Addendum to the Groundwater Monitoring Plan, Revision 1, Coffeen Power Plant Ash Pond No. 2), meets the intent of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the IEPA approved Hydrogeologic Site Characterization Report submitted with the IEPA approved Closure and Post Closure Care Plan.



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Date: September 4, 2025

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Addendum to the Groundwater Monitoring Plan, Revision 1, Coffeen Power Plant Ash Pond No. 2), meets the intent of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the IEPA approved Hydrogeologic Site Characterization Report submitted with the IEPA approved Closure and Post Closure Care Plan.



Brian G. Hennings
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Date: September 4, 2025

DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	October 21, 2021	Original Document
Revision 1	September 4, 2025	• Throughout: Updated language referring to 35 I.A.C. § 845; updated "monitoring well network" to "monitoring system" for consistency with 35 I.A.C. § 845 language; updated relevant acronyms and abbreviations. • Section 1.2: Updated to reflect initiation of sampling for compliance determination in 2023. • Section 2.2: Updated to represent the current 40 C.F.R. § 257 monitoring system and remove reference to the Sampling and Analysis Plan. • Section 2.3.1: Added definition for "LCU". Updated description of sampling attempts at well G1003. • Section 2.3.3: Described removal of SG04 from proposed monitoring system. • Section 3.2: Clarified that the statistical method chosen for analysis of background groundwater quality was the tolerance interval procedure. • Section 3.3: Clarified language describing the method of evaluating for exceedances. • Section 4, 4.1.1, and 4.2: Updated language regarding closure monitoring under the Compliance Commitment Agreement. • Section 4.1.2: Clarified that the 40 C.F.R. § 257 groundwater monitoring system will be updated per any future changes to the 35 I.A.C. § 845 system. • Section 4.1.3: Removed SG04 from proposed monitoring system. • Section 4.2: Updated language to refer to Table F and updated Table F to reflect initiation of sampling for compliance determination in 2023. • Sections 4.3 through 4.6: Added references to up-to-date quality control documents and removed redundant information. • Section 4.6: Added details regarding replacement well installation and agency communication. • Table 2-1 and Figure 2-1: Removed SG04. • Table 3-1: Added additional information regarding statistical calculations. • Tables 4-1 and 4-2: Deleted due to redundancy with quality control documents. • Updated Appendix B to the Multi-Site Statistical Analysis Plan. • Included the Multi-Site Sampling and Analysis Plan as Appendix C. • Included the Multi-Site Quality Assurance Project Plan as Appendix D.

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ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
77 I.A.C.	Title 77 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
AP2	Ash Pond No. 2
ASD	Alternate Source Demonstration
bgs	below ground surface
CCA	Compliance Commitment Agreement
CCR	coal combustion residuals
Closure Plan	*Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2*
cm/s	centimeters per second
CPP	Coffeen Power Plant
GMF	Gypsum Management Facility
GMP	Groundwater Monitoring Plan Revision 1
GWPS	Groundwater Protection Standard
ID	Identification
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company
LCL	lower confidence limit
LCU	lower confining unit
mg/L	milligrams per liter
NA	not applicable
NID	National Inventory of Dams
No.	Number
NRT	Natural Resource Technology, Inc.
PMP	potential migration pathway
QA/QC	quality assurance/quality control
QAPP	Multi-Site Quality Assurance Project Plan
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RL	Reporting Limit
SAP	Multi-Site Sampling and Analysis Plan
SW	surface water
TDS	total dissolved solids
UA	uppermost aquifer
USEPA	United States Environmental Protection Agency
WLO	water level only

1. INTRODUCTION

1.1 Overview

In accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments, Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Addendum to the Groundwater Monitoring Plan Revision 1 (GMP) on behalf of Coffeen Power Plant (CPP) (**Figure 1-1**), operated by Illinois Power Generating Company (IPGC). This Addendum applies specifically to the coal combustion residuals (CCR) Unit referred to as Ash Pond Number (No.) 2 (AP2; CCR Unit identification [ID] No. 102, Illinois Environmental Protection Agency (IEPA) ID No. W1350150004-02, and National Inventory of Dams [NID] No. IL50723) (**Figure 1-2**). AP2 is a closed, unlined CCR surface impoundment that was previously used to manage CCR and non-CCR waste streams at the CPP.

AECOM submitted the *Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2* (Closure Plan) dated January 26, 2017, which was approved by the IEPA on January 30, 2018. The Groundwater Monitoring Plan (Natural Resource Technology, Inc. [NRT], 2017a) defined groundwater monitoring for AP2 following approval of the Closure Plan. Closure of AP2 was completed on November 17, 2020.

On April 21, 2021, 35 I.A.C. § 845 became effective, and for CCR units closed prior to the effective date the following section was included (35 I.A.C. § 845.100(i)):

> *If a CCR surface impoundment has completed an Agency-approved closure before April 21, 2021, this Part does not require the owner or operator of the CCR surface impoundment to resubmit to the Agency any closure plan, closure report, or closure certification for that completed closure.*

This Addendum includes modifications to the previously approved GMP (NRT, 2017a) to provide content required by 35 I.A.C. § 845.630 (Groundwater Monitoring System), 35 I.A.C. § 845.640 (Groundwater Sampling and Analysis), and 35 I.A.C. § 845.650 (Groundwater Monitoring Program) for AP2. Specifically, this Addendum incorporates additional monitoring wells and monitoring parameters specified in 35 I.A.C. § 845.600.

1.2 Purpose and Scope

The purpose of this Addendum is to provide updated GMP text, tables, and figures to incorporate modifications made to the existing monitoring program to comply with 35 I.A.C. § 845. Following issuance of the 35 I.A.C. § 845 Operating Permit, the application for which was submitted to IEPA in 2021, groundwater monitoring at AP2 will include the following:

- Monitoring required by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257 Subpart D (pre-existing with no modifications)
- 35 I.A.C. § 845 Monitoring (proposed)

Details of the monitoring programs (schedules and parameters), monitoring well system, and analysis (statistical methods) are included in this Addendum. No changes are proposed to the monitoring system utilized for the current 40 C.F.R. § 257 Subpart D monitoring; however, those details have been included for completeness. Additional information regarding the hydrogeology

and groundwater quality were included with the Closure Plan and are not reproduced in this Addendum.

Evaluation of background groundwater quality has been completed as part of this GMP, and compliance with 35 I.A.C. § 845 will be determined following the first round of groundwater sampling. The first round of groundwater sampling for compliance was completed in the second quarter of 2023 in accordance with the Compliance Commitment Agreement (CCA) entered on December 28, 2022, for the CPP.

2. GROUNDWATER MONITORING SYSTEMS

The 35 I.A.C. § 845 groundwater monitoring system for AP2 was developed to monitor post-closure groundwater quality and trends and demonstrate compliance with the applicable groundwater quality standards identified in **Section 3**. The existing and proposed groundwater monitoring systems consist of a sufficient number of wells, installed at appropriate locations and depths, to monitor post-closure compliance with groundwater quality standards for 40 C.F.R. § 257 and 35 I.A.C. § 845.600.

The monitoring wells are designed and constructed in a manner consistent with the standards of 40 C.F.R. § 257 and Title 77 of the Illinois Administrative Code (77 I.A.C.) § 920.170, as required by 35 I.A.C. § 845.630(e), including the following:

- All monitoring wells are cased in a manner that maintains the integrity of the boreholes.
- Wells are screened to allow sampling only at the specified interval.
- All wells are covered with vented caps, unless located in flood-prone areas, and equipped with devices to protect against tampering and damage.

Consistent with applicable standards, the monitoring systems described below fulfill the following goals:

- Enable the collection of groundwater samples that represent the quality of background water that has not been affected by AP2.
- Enable the collection of groundwater samples that represent the quality of downgradient groundwater.
- Include wells that are located within the stratigraphic unit(s) that may serve as potential chemical migration pathways.

Groundwater monitoring at AP2 is currently being performed in accordance with the GMP that was approved in the Closure Plan. The Closure Plan specified one monitoring system, that complies with both the IEPA Closure Plan monitoring requirements and the 40 C.F.R. § 257 monitoring requirements. This Addendum proposes additions to that system which were developed to comply with the requirements of 35 I.A.C. § 845. It is anticipated that upon acceptance and approval of the Operating Permit application (and by extension the GMP) for the CPP and upon acceptance and approval of 35 I.A.C. § 845 by the United States Environmental Protection Agency (USEPA) as a State CCR Permit Program, the 35 I.A.C. § 845 monitoring program will supersede the Closure Plan and 40 C.F.R. § 257 monitoring program.

2.1 IEPA Closure Plan Monitoring Program

The approved IEPA Closure Plan monitoring well system consists of fourteen groundwater monitoring wells used to monitor the uppermost aquifer, including three background wells (G270, G280, and G281) and eleven compliance wells (G154, G279, G401, G402, G403, G404, G405, G406, G407, G410, and G411). These wells are monitored in accordance with Water Pollution Control Permit 2020-EA-65027-1 Special Condition No. 6. The well locations are shown on **Figure 2-1**.

The GMP established a monitoring program that meets the requirements of 35 I.A.C. § 620.410 and groundwater samples are collected quarterly and analyzed for the parameters listed in **Table A** below.

Table A. IEPA Closure Plan Groundwater Monitoring Program Parameters

Field Parameters		
pH	Temperature	Turbidity
Dissolved Oxygen	Oxidation/Reduction Potential	Specific Conductance
Static Water Elevation	Depth of Well	Depth to Water
Elevation of Groundwater Surface		
Inorganics (Total, except Total Dissolved Solids [TDS])		
Chloride	Fluoride	Sulfate
Cyanide	Nitrate-Nitrogen	TDS
Metals (Total)		
Antimony	Cadmium	Lithium
Arsenic	Calcium	Mercury
Barium	Chromium	Molybdenum
Beryllium	Cobalt	Selenium
Boron	Lead	Thallium
Metals (Dissolved)		
Aluminum	Iron	Silver
Arsenic	Lead	Vanadium
Boron	Manganese	Zinc
Copper	Nickel	
Other (Total)		
Radium 226 and 228 combined		

2.2 40 C.F.R. § 257 Monitoring Program

The 40 C.F.R. § 257 monitoring well system consists of seven of the same groundwater monitoring wells used to monitor the uppermost aquifer and is aligned with the 35 I.A.C. § 845 monitoring system. The AP2 40 C.F.R. § 257 monitoring system includes two background wells (G270 and G281) and five compliance wells (G401, G402, G403, G404, and G405).

Assessment monitoring in accordance with 40 C.F.R. § 257.95 was initiated on April 9, 2018.

Groundwater samples are collected semiannually and analyzed for the following laboratory and field parameters from Appendix III and Appendix IV of 40 C.F.R. § 257, summarized in **Table B** on the following page.

Table B. 40 C.F.R. § 257 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH		
Appendix III Parameters (Total, except TDS)			
Boron	Chloride	Sulfate	
Calcium	Fluoride	TDS	
Appendix IV Parameters (Total)			
Antimony	Cadmium	Lithium	Selenium
Arsenic	Chromium	Mercury	Thallium
Barium	Cobalt	Molybdenum	Radium 226 and 228 combined
Beryllium	Lead		

[1]Dissolved oxygen, temperature, specific conductance, oxidation/reduction potential, and turbidity are recorded during sample collection.

2.3 Proposed 35 I.A.C. § 845 Monitoring System

2.3.1 Proposed Additional Wells to the Current IEPA Closure Plan Monitoring

The land between AP2 and the Unnamed Tributary underwent significant improvement during closure construction which made areas that were previously inaccessible available for monitoring well construction. In 2021, additional monitoring wells G1001 and G1003 were completed between the eastern edge of AP2 and the Unnamed Tributary (**Figure 2-1**) targeting the uppermost aquifer (Hagarstown Member), which is classified as primarily sandy to gravelly silts and clays with thin beds of sands. No sand layers were observed in the soil boring at G1001 (**Appendix A**); however, a well was screened from 6 to 11 feet below ground surface (bgs) within the lower confining unit (LCU) and yields water. Sand layers were observed in the soil boring at G1003 (**Appendix A**) and the well was screened across sandy deposits from 8 to 12 feet bgs; however, this well has yielded measurable groundwater during only two of 18 sampling attempts since construction in May of 2021. Well G1001 is proposed as an additional well to the monitoring system for monitoring groundwater downgradient of AP2. Well G1003 will continue to be monitored for the presence of groundwater.

2.3.2 Proposed Reduction of Wells from Current IEPA Closure Plan Monitoring

Monitoring wells G154, G279, G407, G410, and G411 were included in the IEPA groundwater monitoring plan to monitor sulfate in groundwater that could be attributed to AP2. With the exception of well G407, these wells are proposed for removal from the AP2 monitoring system as described below:

- Monitoring wells G154, G410, and G411. Groundwater elevation measurements collected from these wells confirm the presence of a groundwater divide located west of AP2 (**Figure 2-2**). Groundwater on the east side of the divide flows toward the Unnamed Tributary while groundwater on the west side of the divide flows toward the western lobe of Coffeen Lake. AP2 is located on the eastern side of the divide; therefore, these wells on the west side of the divide are not downgradient of AP2. Additionally, minimum, maximum, and median sulfate concentrations observed from March 2018 to August 2021 in wells (G154, G410, and G411)

have not had concentrations greater than the groundwater protection standard (GWPS) of 400 milligrams per liter (mg/L) as presented in **Table C** below.

- Monitoring well G279. This well is located along the eastern edge of another CCR unit, the Gypsum Management Facility [GMF] Recycle Pond (Vistra ID No. 104, IEPA ID No. W1350150004-04, and NID No. IL50578). G279 is part of the 40 C.F.R. § 257 monitoring system and the proposed 35 I.A.C. § 845 monitoring system for the GMF Recycle Pond; therefore, this well will be removed from the AP2 monitoring system.

Table C. Summary of Sulfate Concentrations for Wells G154, G407, G410, and G411 from March 2018 through August 2021.

Location	Count	Minimum (mg/L)	Maximum (mg/L)	Median (mg/L)
G154	16	74	160	79
G407	16	400	1600	1100
G410	16	31	55	41
G411	16	110	300	250

Groundwater monitoring well G407 is also located on the east side of the groundwater divide and sulfate concentrations have been steadily decreasing since the well was installed; however, this well will be retained in the proposed monitoring system to continue to monitor potential sulfate exceedances consistent with the existing permit.

2.3.3 Proposed Monitoring System

The groundwater monitoring system proposed in this plan will include eleven wells screened in the uppermost aquifer, or the LCU where the uppermost aquifer is absent (G270, G280, G281, G401, G402, G403, G404, G405, G406, G407, and G1001) and one well (G1003) monitored for the presence of groundwater. The proposed monitoring system is summarized in **Table D** below and displayed on **Figure 2-3**. Eleven wells (three background and eight compliance) will be used to monitor groundwater concentrations within the uppermost aquifer, or the LCU where the uppermost aquifer is absent. Surface water elevations will be monitored at two staff gauges: SG02, monitoring the former discharge flume and SG03, monitoring the eastern lobe of Coffeen Lake. Staff gage SG04 was used to monitor the surface water elevation in the Unnamed Tributary from April 2021 to May 2023, when it was destroyed by surface water during spring runoff.

The groundwater samples collected from the eleven wells will be used to monitor and evaluate groundwater quality and demonstrate compliance with the groundwater quality standards listed in 35 I.A.C. § 845.600(a). The proposed monitoring wells will yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary including all potential migration pathways (PMPs) (as required in 35 I.A.C. § 845.630(a)(2)). 35 I.A.C. § 845.620(b)(11) requires the HCR must identify all PMPs, and 35 I.A.C. § 845.630(a)(2) requires that all potential contaminant pathways be monitored. Wells monitoring the PMP (as identified in the HCR and summarized in **Section 1.3**) are considered to monitor the potential contaminant pathways. The term 'PMP' is therefore used in this GMP document for consistency with the HCR. Monitoring well depths and construction details are listed in **Table 2-1** and summarized in **Table D** on the following page.

Table D. Proposed 35 I.A.C. § 845 Monitoring System

Well ID	Monitored Unit	Well Screen Interval (feet bgs)	Well Type [1]
G270	UA	13.1-17.9	Background
G280	UA	12.8-17.6	Background
G281	UA	15.5-20.2	Background
G401	UA	14.4-18.8	Compliance
G402	UA	10-20	Compliance
G403	UA	13.1-17.8	Compliance
G404	UA	6.4-11.2	Compliance
G405	UA	9.0-13.8	Compliance
G406	UA	13.6-18.4	Compliance
G407	UA	13.8-18.6	Compliance
G1001	PMP	6-11	Compliance
G1003	PMP	8-12	WLO
SG02	SW	NA	WLO
SG03	SW	NA	WLO

[1] Well type refers to the role of the well in the monitoring system.
bgs = below ground surface
PMP = potential migration pathway
NA = not applicable
SW = surface water
UA = uppermost aquifer
WLO = water level only

2.4 Well Abandonment

No wells are currently proposed for abandonment.

3. APPLICABLE GROUNDWATER QUALITY STANDARDS

3.1 Groundwater Classification

The 35 I.A.C. § 620 groundwater classification at AP2 was presented in the GMP (NRT, 2017a) and is summarized here. Groundwater at AP2 meets the definition of Class I - Potable Resource Groundwater (35 I.A.C. § 620.210) based on the following criteria:

- Groundwater in the uppermost aquifer is located 10 feet or more below the land surface and within,
- A geologic material which is capable of a hydraulic conductivity of 1 x 10^{-4} centimeters per second (cm/s) or greater using a slug test.

3.2 Statistical Evaluation of Background Groundwater Data

A Multi-Site Statistical Analysis Plan (**Appendix B**) has been developed to describe procedures that will be used to establish background conditions and implement compliance monitoring as necessary and required by 35 I.A.C. §§ 845.640 and 845.650. The Multi-Site Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance*; USEPA, 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring.

In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality was the tolerance interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). A comparison of the statistical background concentrations and groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) and the resulting GWPSs are summarized in **Table 3-1**.

3.3 Applicable Groundwater Protection Standards

The applicable GWPS will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The results of the statistical analysis of background groundwater data (**Table 3-1**) indicate that background concentrations in the uppermost aquifer are less than the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) with the exception of lead. Therefore, for these parameters, the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) will be applied to the results from the proposed groundwater monitoring system. The background concentration for lead will be applied to the lead results from the proposed groundwater monitoring system.

Under most circumstances, the GWPS will be compared to the lower confidence limit (LCL) for the observed concentrations for each constituent in each compliance well in accordance with the Multi-Site Statistical Analysis Plan (**Appendix B**). Consistent with the Unified Guidance, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Evaluation of the applicable standards will occur in conjunction with the analysis of groundwater quality results. Background calculations and the resulting concentrations may be updated as appropriate, in accordance with the Multi-Site Statistical Analysis Plan included in **Appendix B**.

4. GROUNDWATER MONITORING PLAN

The groundwater monitoring plan will monitor and evaluate groundwater quality to demonstrate compliance with the groundwater quality standards included in 40 C.F.R. § 257.94(e), 40 C.F.R. § 257.95(h), and 35 I.A.C. § 845.600(a). The groundwater monitoring program will include sampling and analysis procedures that are consistent and provide an accurate representation of groundwater quality at the background and compliance wells as required by 35 I.A.C. § 845.630. As discussed within **Section 2**, three monitoring programs specific to AP2 exist, the Closure Plan monitoring program, the 40 C.F.R. § 257 monitoring program, and the proposed 35 I.A.C. § 845 monitoring program. It is expected that upon acceptance and approval of the Operating Permit applications (and by extension the GMPs) for the CPP and upon acceptance and approval of 35 I.A.C. § 845 by the USEPA as a State CCR Permit Program, the proposed 35 I.A.C. § 845 monitoring program will supersede the 40 C.F.R. § 257 monitoring program. As specified in the CCA, groundwater monitoring performed under the approved Closure Plan ceased with initiation of the 35 I.A.C. § 845 monitoring program in the second quarter of 2023.

4.1 Monitoring Systems and Parameters

4.1.1 IEPA Closure Plan Monitoring

The existing IEPA-approved Closure Plan monitoring program was discussed in detail in **Section 2.1**. In accordance with the CCA, groundwater monitoring performed under approved Closure Plan ceased with initiation of the 35 I.A.C. § 845 monitoring program in the second quarter of 2023.

4.1.2 40 C.F.R. § 257 Monitoring

The existing 40 C.F.R. § 257 monitoring program was discussed in detail in **Section 2.2**. Well locations and parameters will continue to be monitored and reported as required by 40 C.F.R. § 257 until USEPA approves 35 I.A.C. § 845. Any future changes to the groundwater monitoring system as approved by the IEPA under 35 I.A.C. § 845 will also be incorporated into the 40 C.F.R. § 257 monitoring system.

4.1.3 35 I.A.C. § 845 Groundwater Monitoring

The proposed 35 I.A.C. § 845 monitoring system will consist of eleven monitoring wells, three background monitoring wells (G270, G280, and G281), eight compliance wells (G401, G402, G403, G404, G405, G406, G407, and G1001), to monitor potential impacts from AP2 (**Figure 2-2**). These monitoring wells are screened within the uppermost aquifer, or the LCU where the uppermost aquifer is absent, along the perimeter of or near AP2 and include G407, located west of AP2, which is retained to continue monitoring sulfate as described in **Sections 2.3.1** and **2.3.2**. Two staff gauges (SG02 and SG03) will be used to monitor surface water elevations adjacent to AP2. Groundwater samples will be collected and analyzed for the laboratory and field parameters summarized in **Table E** below.

Table E. 35 I.A.C. § 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH	Turbidity	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Chloride	Fluoride	Sulfate	TDS
Other (Total)			
Radium 226 and 228 combined			

[1] Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential will be recorded during sample collection.

4.2 Sampling Schedule

Groundwater sampling for the 35 I.A.C. § 845 monitoring system will initially be performed quarterly according to the schedule in **Table F** below.

Table F. 35 I.A.C. § 845 Sampling Schedule

Frequency	Duration
Monthly (groundwater elevations only)	Began: Second quarter of 2023.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).
Quarterly (groundwater quality)	Began: Second quarter of 2023.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii), or upon IEPA approval of an alternate schedule as allowed by 35 I.A.C. § 845.650(b)(4).
Semiannual (groundwater quality)	Begins: Following 5 years of quarterly groundwater monitoring and IEPA approval of a demonstration that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and not exhibiting statistically-significant increasing trends, monitoring effectiveness is not compromised by a semiannual schedule, and sufficient data has been collected to characterize groundwater.
	Ends: Following detection of a statistically-significant increasing trend in groundwater concentrations or an exceedance of the standards in 35 I.A.C. § 845.600 (quarterly monitoring shall be resumed in these circumstances), or following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).

Groundwater monitoring for the 40 C.F.R. § 257monitoring system will continue to follow a schedule in accordance with the requirements of 40 C.F.R. § 257.94 and 40 C.F.R. § 257.95. Upon USEPA approval of 35 I.A.C. § 845 as a State CCR Permit Program, the 40 C.F.R. § 257.94 monitoring will be discontinued, and replaced by the 35 I.A.C. § 845 monitoring.

4.3 Groundwater Sample Collection

Groundwater sampling procedures have been developed in the Multi-Site Sampling and Analysis Plan (SAP; **Appendix C**) and the collection of groundwater samples is being implemented to meet the requirements of 35 I.A.C. § 845.640. In addition to groundwater well samples, quality assurance samples will be collected as described in the Multi-Site Quality Assurance Project Plan (QAPP; **Appendix D**).

4.4 Laboratory Analysis

Laboratory analysis will be performed consistent with the requirements of 35 I.A.C. § 845.640(j) by a state-certified laboratory using methods approved by IEPA and USEPA. Laboratory methods may be modified based on laboratory equipment availability or procedures, but the Reporting Limit (RL) for all parameters analyzed, regardless of method, will be lower than the applicable groundwater quality standard as summarized in the QAPP (**Appendix D**). Concentrations lower than the RL will be reported as less than the RL.

4.5 Quality Assurance Program

Consistent with the requirements of 35 I.A.C. § 845.640(a)(5), the QAPP (**Appendix D**) includes procedures and techniques for laboratory quality assurance/quality control (QA/QC) and the SAP (**Appendix C**) includes requirements for field data collection QA/QC.

4.6 Groundwater Monitoring System Maintenance Plan

Consistent with the requirements of 35 I.A.C. § 845.630(e)(2), the SAP (**Appendix C**) includes procedures for maintenance to be performed as needed to assure that the monitoring wells provide representative groundwater samples.

If wells are damaged or become otherwise inoperable, they will be replaced by wells screened at the same elevation and as close to the original well as possible (ideally within 10 feet) and notification will be provided to IEPA. If a replacement well cannot be installed within approximately 10 feet of the original well location, notification will be sent to IEPA and a monitoring well will be installed as close as possible to the original monitoring well and given a new well identification number. Any well replacement activities will also be documented in the Annual Groundwater Monitoring and Corrective Action Report.

4.7 Statistical Analysis

Statistical analysis will be consistent with procedures listed in 35 I.A.C. § 845.640(f). A Multi-Site Statistical Analysis Plan, provided in **Appendix B**, has been developed to summarize the statistical procedures that will be used to evaluate the groundwater results.

4.8 Data Reporting

Data reporting for the 40 C.F.R. § 257 monitoring program will be consistent with recordkeeping, notification, and internet posting requirements described in 40 C.F.R. § 257.105 through 40 C.F.R. § 257.107.

Groundwater monitoring and analysis completed as part of the 35 I.A.C. § 845 monitoring under an approved monitoring program will be reported to IEPA within 60 days after completion of sampling and place the data in the facility's operating record as required by 35 I.A.C. § 845.610(b)(3)(D). Within 14 days of posting to the operating record, information will be posted to the publicly accessible internet site "Illinois CCR Rule Compliance Data and Information" as required by 35 I.A.C. § 845.810(d). Information will also be provided to IEPA annually, by January 31 for data collected the preceding year. The report will include the status of the groundwater monitoring and corrective action plan for the CPP AP2 in addition to other requirements detailed in 35 I.A.C. § 845.610(e).

4.9 Compliance with Applicable On-site Groundwater Quality Standards

In accordance with 35 I.A.C. § 845.600(a)(1), the groundwater protection standard at the waste boundary will be the higher of either the 35 I.A.C. § 845.600 standard or the concentration determined by background groundwater monitoring.

As provided in 35 I.A.C. § 845.780(c)(2), at the end of the 30-year post-closure care period, groundwater monitoring will continue to be conducted in post-closure care until the groundwater results show the concentrations are:

- Below the GWPS in 35 I.A.C. § 845.600; and
- Not increasing for those constituents over background, using the statistical procedures and performance standards in 35 I.A.C. § 845.640(f) and (g), provided that:
  - Concentrations have been reduced to the maximum extent feasible; and
  - Concentrations are protective of human health and the environment.

Following detection of an exceedance of the GWPS, an Alternate Source Demonstration (ASD) will be evaluated as described in **Section 4.10**.

4.10 Alternate Source Demonstrations

As allowed in 35 I.A.C. § 845.650(e), following detection of an exceedance of the GWPS, an ASD will be evaluated and, if completed, submitted to IEPA within 60 days. The ASD will provide lines of evidence that a source other than AP2 caused the contamination and AP2 did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction.

The ASD will include information and analysis that supports the conclusions and a certification of accuracy by a qualified professional engineer. Once the ASD is approved by IEPA, the 35 I.A.C. § 845 groundwater monitoring will continue as defined in **Section 4.1.3**.

If an ASD is not completed and submitted, or IEPA does not approve the ASD, a notification of the exceedance will be provided to IEPA and placed in the operating record. Additional actions will also be completed as required by 35 I.A.C § 845.650(d)(1) through (3), including initiation of an assessment of corrective measures under 35 I.A.C § 845.660. As allowed in 35 I.A.C § 845.650(e)(7), a petition for review of IEPA's non-concurrence under 35 I.A.C. § 105 may also be filed.

5. REFERENCES

Code of Federal Regulations, Title 40, Chapter I, Subchapter I, Part 257, Subpart D, *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments*, effective April 17, 2015.

AECOM, 2017. *Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company, Coffeen Power Station, 134 Cips Lane, Coffeen, IL 62107*, January 26, 2017.

Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal Of Coal Combustion Residuals In Surface Impoundments, effective April 21, 2021.

Natural Resource Technology, Inc. (NRT), 2017a. *Groundwater Monitoring Plan, Ash Pond No. 2, Coffeen Power Station*, January 24, 2017.

United States Environmental Protection Agency (USEPA), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*. Office of Resource Conservation and Recovery, Program Implementation and Information Division, United States Environmental Protection Agency, Washington D.C. EPA/530/R-09/007. March.

TABLES

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
35 I.A.C. § 845 GROUNDWATER MONITORING PLAN, REVISION 1
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, IL

Well Number	Type	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G1001	C	LCU	2021-04-05	597.51	597.68	Top of Casing	594.84	6.00	11.00	588.84	583.84	11.00	562.84	5.0	4.0	39.063332	-89.391242
G1003	WLO	LCU	2021-05-25	610.95	610.95	Top of Casing	608.05	8.00	12.00	600.05	596.05	12.00	587.05	4.0	—	39.060778	-89.391451
G270	B	UA	2008-02-26	625.50	625.67	Top of Casing	623.76	13.13	17.92	610.63	605.84	18.27	605.49	4.8	2.0	39.066572	-89.397409
G280	B	UA	2008-02-26	625.22	625.39	Top of Casing	623.56	12.79	17.63	610.77	605.93	17.98	605.58	4.8	2.0	39.067223	-89.394997
G281	B	UA	2015-09-08	626.53	626.70	Top of Casing	625.42	15.51	20.16	609.91	605.26	20.30	605.12	4.7	2.0	39.065412	-89.399329
G401	C	UA	2015-09-14	628.57	628.57	Top of Casing	625.57	14.36	18.79	611.21	606.78	19.29	606.27	4.4	2.0	39.060267	-89.395301
G402	C	UA	2010-08-27	613.03	613.20	Top of Casing	610.60	10.00	20.00	600.60	590.60	20.40	590.20	10.0	2.0	39.060215	-89.391718
G403	C	UA	2015-09-11	628.06	628.23	Top of Casing	625.05	13.11	17.78	611.94	607.27	18.15	606.90	4.7	2.0	39.063173	-89.398785
G404	C	UA	2007-05-01	615.46	615.63	Top of Casing	613.54	6.42	11.17	607.12	602.37	11.62	601.54	4.8	2.0	39.064336	-89.392499
G405	C	UA	2007-05-01	623.32	623.49	Top of Casing	621.25	9.01	13.76	612.24	607.49	14.21	607.04	4.8	2.0	39.064352	-89.396239
G406	C	UA	2016-08-19	626.51	626.68	Top of Casing	623.90	13.56	18.37	610.34	605.53	18.75	605.15	4.8	2.0	39.060317	-89.398513
G407	C	UA	2016-08-16	620.89	621.06	Top of Casing	618.57	13.78	18.61	604.79	599.96	19.04	598.57	4.8	2.0	39.061581	-89.402009
SG-02	WLO	SW	—	605.77	605.77	Top of Casing	—	—	—	—	—	—	—	—	—	39.059696	-89.391435
SG-03	WLO	SW	—	—	585.93	Top of Prot Casing	594.94	—	—	—	—	—	—	—	—	39.059092	-89.390342

Notes:
— = Not available
BGS = below ground surface
ft = foot or feet
HSU = hydrostratigraphic unit:
LCU = Lower Confining Unit
SW = Surface Water
UA = Uppermost Aquifer
PVC = polyvinyl chloride
Type = role of the well in the monitoring network:
B = Background
C = Compliance
WLO = Water Level Only

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TABLE 3-1
BACKGROUND GROUNDWATER QUALITY AND STANDARDS
35 I.A.C. § 845 GROUNDWATER MONITORING PLAN, REVISION 1
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, IL

Parameter	Date Range	Sample Count	Percent Non-Detects	Statistical Calculation	Statistical Background Value (LTL/UTL)	845 Limit	Groundwater Protection Standard
Antimony (mg/L)	11/20/2015 - 07/18/2017	24	100	DQR	DQR	0.006	0.006
Arsenic (mg/L)	11/20/2015 - 07/18/2017	24	75	Non-parametric UTL	0.00660	0.010	0.010
Barium (mg/L)	11/20/2015 - 07/18/2017	24	0	Parametric UTL (log-transformed)	0.140	2.0	2.0
Beryllium (mg/L)	11/20/2015 - 07/18/2017	24	100	DQR	DQR	0.004	0.004
Boron (mg/L)	11/20/2015 - 07/18/2017	24	79	Non-parametric UTL	0.0290	2	2
Cadmium (mg/L)	11/20/2015 - 07/18/2017	24	100	DQR	DQR	0.005	0.005
Chloride (mg/L)	11/20/2015 - 07/18/2017	24	0	Non-parametric UTL	75.0	200	200
Chromium (mg/L)	11/20/2015 - 07/18/2017	24	88	Non-parametric UTL	0.0190	0.1	0.1
Cobalt (mg/L)	11/20/2015 - 07/18/2017	24	92	Non-parametric UTL	0.00590	0.006	0.006
Fluoride (mg/L)	11/20/2015 - 07/18/2017	24	0	Parametric UTL	0.513	4.0	4.0
Lead (mg/L)	11/20/2015 - 07/18/2017	24	62	Non-parametric UTL	0.0120	0.0075	0.0120
Lithium (mg/L)	11/20/2015 - 07/18/2017	24	92	Non-parametric UTL	0.0190	0.04	0.04
Mercury (mg/L)	11/20/2015 - 07/18/2017	24	100	DQR	DQR	0.002	0.002
Molybdenum (mg/L)	11/20/2015 - 07/18/2017	24	54	Non-parametric UTL	0.00450	0.1	0.1
pH (field) (SU)	11/20/2015 - 07/18/2017	24	0	Parametric LTL/UTL	6.6/7.5	6.5/9.0	6.5/9.0
Radium 226 + Radium 228 (pCi/L)	11/20/2015 - 07/18/2017	24	0	Parametric UTL	1.89	5	5
Selenium (mg/L)	11/20/2015 - 07/18/2017	24	58	Non-parametric UTL	0.00480	0.05	0.05
Sulfate (mg/L)	11/20/2015 - 07/18/2017	24	0	Non-parametric UTL	370	400	400
Thallium (mg/L)	11/20/2015 - 07/18/2017	24	100	DQR	DQR	0.002	0.002
Total Dissolved Solids (mg/L)	11/20/2015 - 07/18/2017	24	0	Non-parametric UTL	840	1,200	1,200

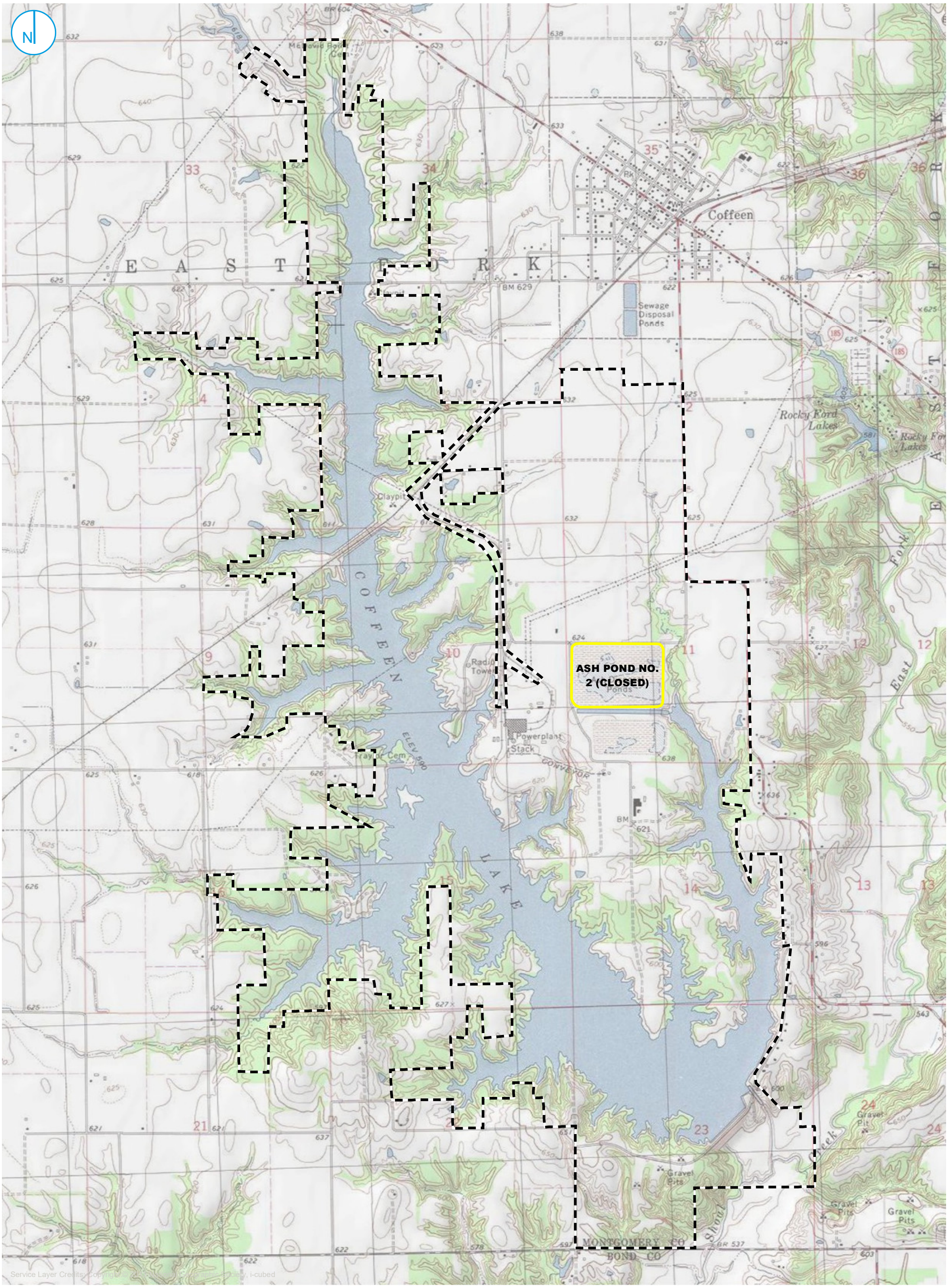
Notes:
DQR = double quantification rule
LTL = lower tolerance limit (applicable for pH only)
mg/L = milligrams per liter
SU = standard units
UTL = upper tolerance limit

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FIGURES

PROJECT: 169000XXXX | DATED: 10/13/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\AP2_GMP\Figure 1-1_Site Location Map AP2.mxd



PART 845 REGULATED UNIT (SUBJECT UNIT)

PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1-1

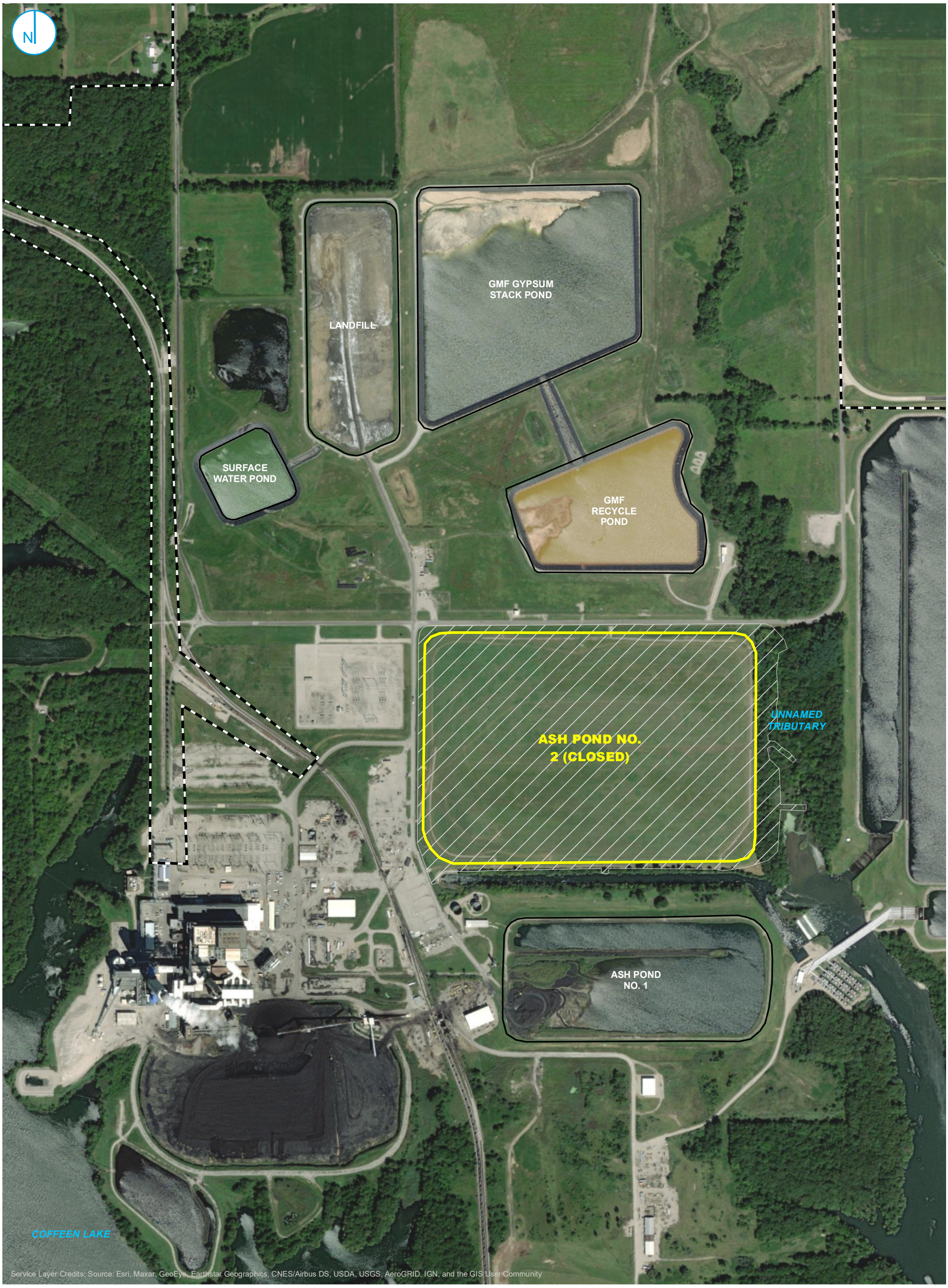
ADDENDUM TO THE GROUNDWATER MONITORING PLAN
ASH POND NO.2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 169000XXXX | DATED: 10/6/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\AP2_GMP\Figure 1-2_Site Map AP2.mxd



PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

SITE MAP

FIGURE 1-2

ADDENDUM TO THE GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



IEPA MONITORING WELL
MONITORING WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 200 400 Feet

IEPA MONITORING WELL LOCATIONS AND WELLS G1001 AND G1003

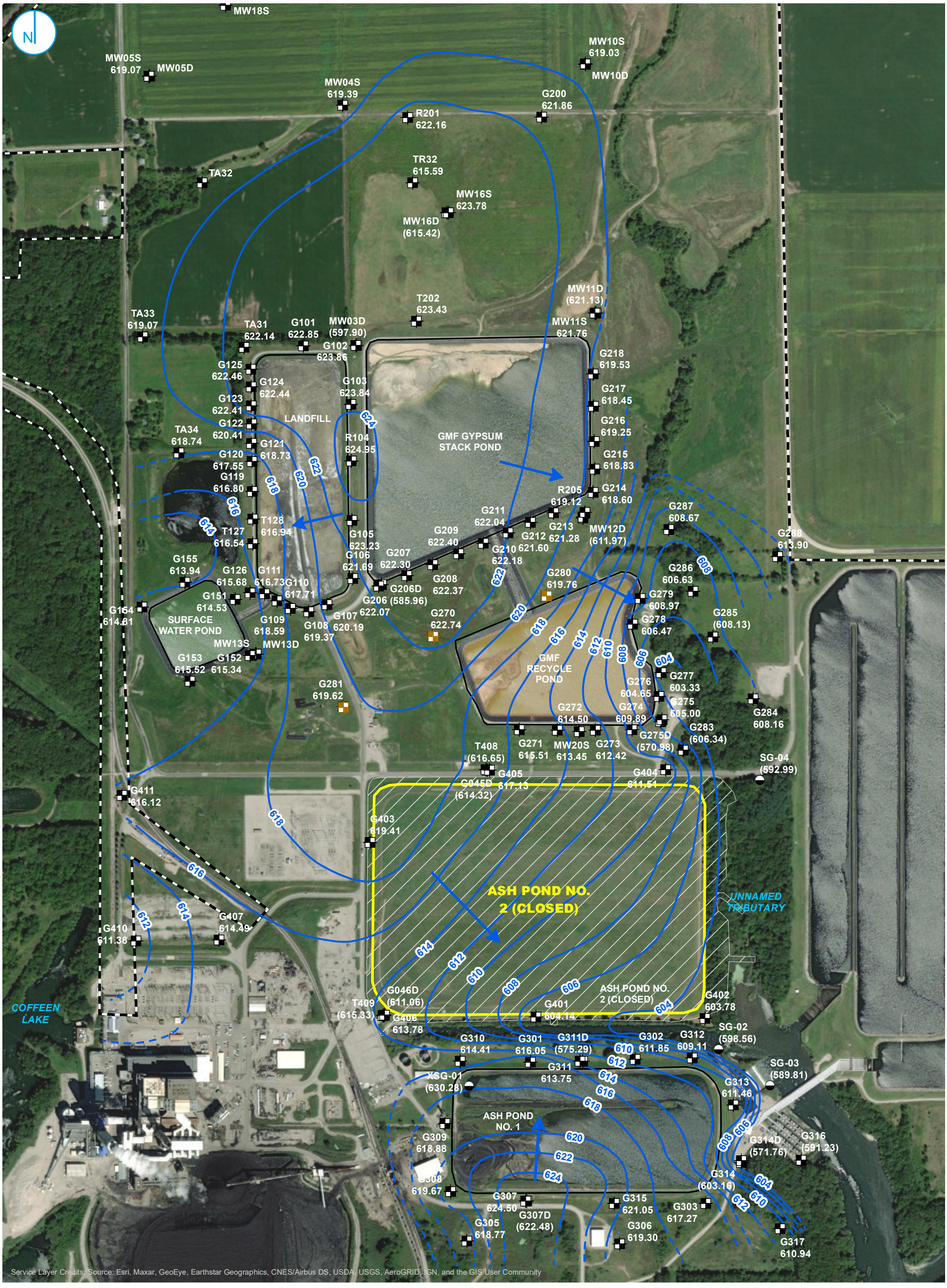
ADDENDUM TO THE GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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Y:\Mapping\Projects\222285\MXD\845_Operating_Permit\Coffeen\AP2_GMP\Figure 2-1_IEPA Program.mxd
PROJECT: 169000XXXX | DATED: 10/6/2021 | DESIGNER: STOLZSD



BACKGROUND WELL
MONITORING WELL
STAFF GAGE
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

NOTE:
ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
NM = NOT MEASURED

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 20, 2021

FIGURE 2-2

ADDENDUM TO THE GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\AP2_GMP\Figure 2-1_Proposed Monitoring Well Network.mxd

PROJECT: 169000XXXX | DATED: 10/6/2021 | DESIGNER: STOLZSD

COMPLIANCE WELL
BACKGROUND WELL
MONITORING WELL
STAFF GAGE

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 200 400 Feet

PROPOSED 845 GROUNDWATER MONITORING WELL NETWORK

ADDENDUM TO THE GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

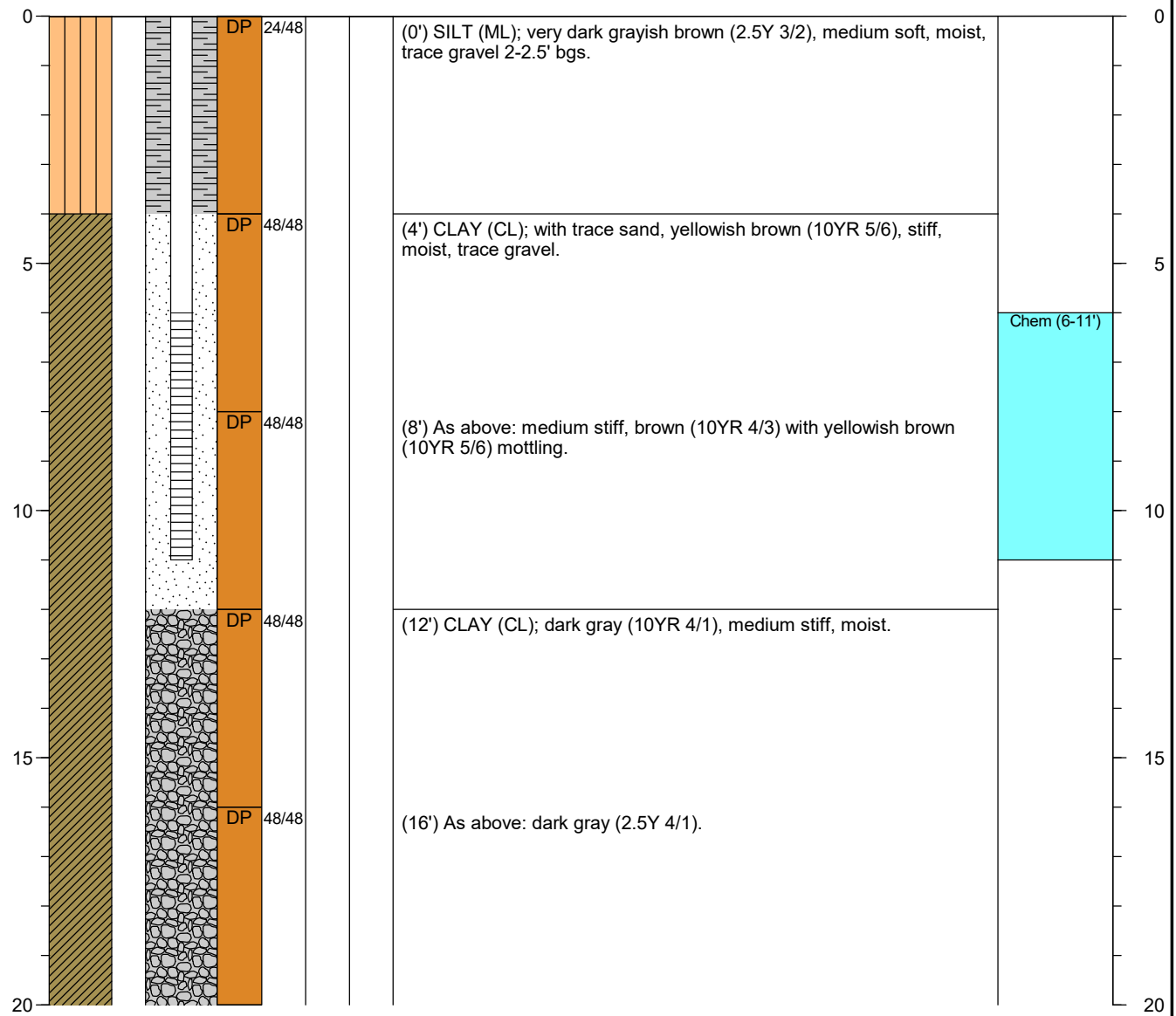
APPENDIX A
G1001 & G1003 BORING AND WELL CONSTRUCTION LOGS

Geosyntec consultants
engineers | scientists | innovators

Client: Dynegy
Project: GLP8005, Coffeen Power Station
Address: Coffeen, IL 62017

WELL LOG
Well No. G1001
Page: 1 of 2

Drilling Start Date:	04/05/2021	Boring Depth (ft):	32	Well Depth (ft):	12
Drilling End Date:	04/05/2021	Boring Diameter (in):	6	Well Diameter (in):	1
Drilling Company:	Roberts Drilling	DTW During Drilling (ft):		Screen Slot (in):	0.010
Drilling Method:	Direct Push	DTW After Drilling (ft):		Riser Material:	Sch 40 PVC
Drilling Equipment:	Geoprobe	Top of Casing Elev. (ft)		Screen Material:	Sch 40 PVC Slotted
Driller:		Ground Elev. (ft):		Seal Material(s):	Bentonite Chips
Logged By:	A. Toye	Northing, Easting (NAD83):		Filter Pack:	Sand



NOTES: No groundwater encountered.

Geosyntec consultants
engineers | scientists | innovators

Client: Dynegy
Project: GLP8005, Coffeen Power Station
Address: Coffeen, IL 62017

WELL LOG
Well No. G1001
Page: 2 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
20				DP	48/48			(20') As above: gravel at 1 ft.		20
25				DP	48/48			(24') As above: dry pocket at 2.8 ft.		25
30				DP	18/48			(28') As above: trace gravel and silt at 2 ft.		30
35								(32') End of Boring.		35

NOTES: No groundwater encountered.

Geosyntec consultants

SOIL BORING LOG

BORING NUMBER: G1002-2

PROJECT: GLP8005	PROJECT NO.: Coffeen MWA	E —	N —
LOCATION: Coffeen, IL	PHASE NO.: 2	G. S. ELEVATION: —	
CLIENT: Vistra	TASK NO.: —	BORING DEPTH: 21.0'	
DRILLING CO: Roberts Env	DRILLER:	DRILLING METHOD: DP	
LOGGED BY: A Toye	STARTED: 5/25/21	COMPLETED: 5/25/21	

Depth (ft)	Elevation (ft)	Sample No.	Recovery / Attempted	Strata Change	Soil/Rock Description	Notes Blow Count N	Unit Weight (pcf)	Q_p (tsf)	Q_u (tsf)	w_c (%)
			16/36"		1.3' of SILTY CLAY, med grey, soft, moist					
2										
3										
4		Chem Sample	36/36"		24" of CLAYEY SAND, orange brown to light grey, soft, moist	← Slugged to split spoon				
6										
8		Chem Sample			12" of CLAY w SOME SAND, orange brown w light grey mottling, low Plastic, dry		Sce n	8		
10		Chem Sample	36/36		0.6' of Sand, orange, fine grained, slightly moist					
					3.7' of SAND w SOME SILT, greyish brown, dry					
12		Chem Sample			0.7' of SAND, orange, slightly moist			12		
13										
14		Chem Sample	14/24		1.5' of SILTY SAND, orange w grey mottling, dry					
16			0/24"		NO RECOVERY					
18			20/24"		1.8' SILT w SAND & CLAY, grey, low Plastic, dry					
19										
20			24/24"		2' CLAY, grey, med Plastic, moist					
21					EOB 21'					
22										

MONITORING WELL CONSTRUCTION DETAIL

Geosyntec consultants

1420 Kensington Rd., Suite 103
Oak Brook, Illinois 60523
(630) 203-3340

Well ID: G1001
Site Location: Coffeen, IL
Project Name: Coffeen Power Station
Field Personnel: A Toye, C Luttrell
Project Number: GLP8005
Recorded By: A Toye

Permit Number:
Installation Date(s): 4-05-2021
Drilling Method: Direct Push
Borehole Diameter: 6.00"
Drilling Contractor: Roberts Environmental
Driller:
Drilling Fluid: N/A
Fluid Loss During Drilling: N/A Gallons

Materials Used

Riser Pipe: Diameter 4 inches
Construction
- ☑ PVC schedule 40
- ☐ Stainless Steel
- ☐ Other

Slotted Area: Length 5.00 feet
Diameter 4.00 inches
Slot Size .010 inches
Construction
- ☑ PVC schedule 40
- ☐ Stainless Steel
- ☐ Other

Silt Trap Used ☐ Yes ☐ No

Bottom End Cap: ☐ Male ☐ Female ☐ Slip
- ☐ PVC
- ☐ Stainless Steel
- ☐ Other

Top Cap: ☐ Male ☐ Female ☐ Slip ☐ J Plug
- ☐ PVC
- ☐ Stainless Steel
- ☐ Other

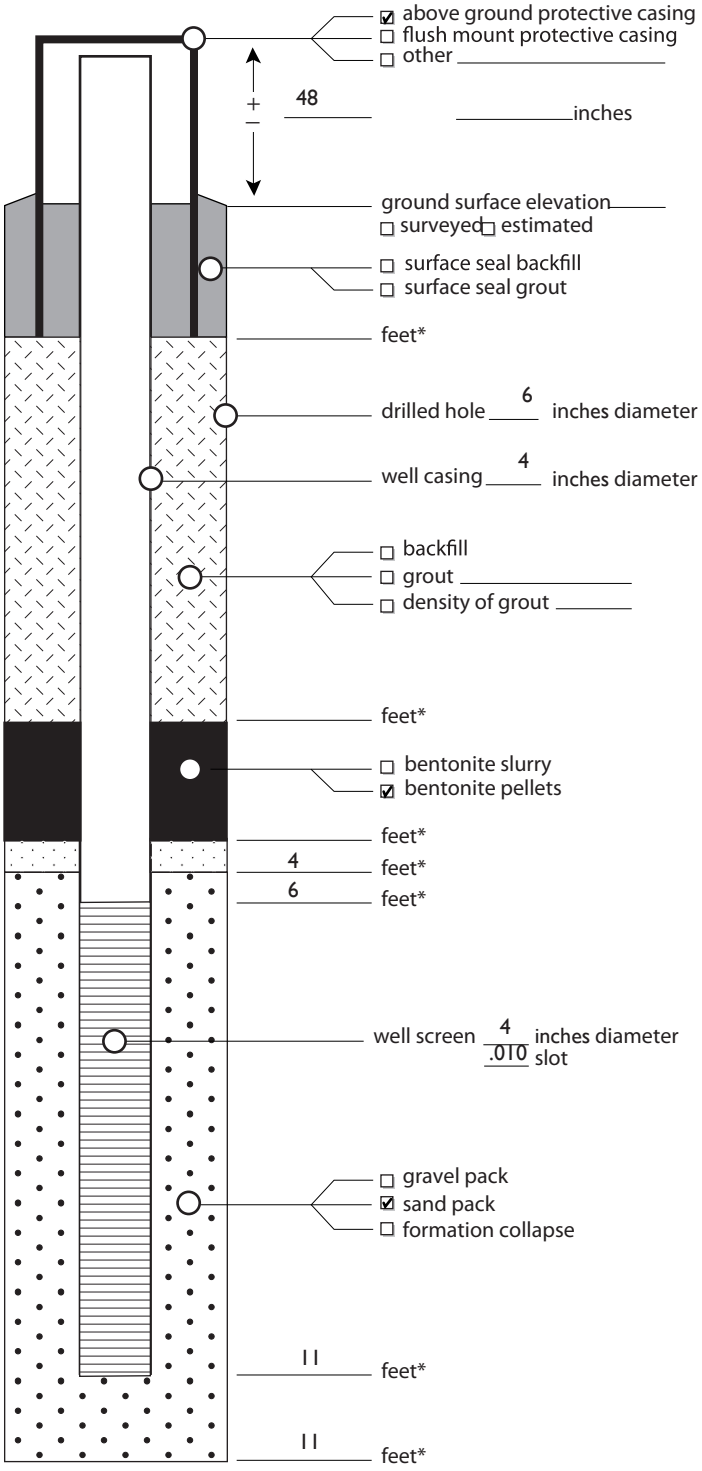
Protective Casing: Length 5 feet
Diameter 6 inches
Construction ☐ Cast Aluminum ☑ Cast Steel ☐ Other

Casing Installation: Length 11 feet
Diameter 4 inches
Material PVC

Sandpack: Filter Sil
Coarse Sand: bags of lb per bag Size
Fine Sand: 4 bags of 50 lb per bag Size

Seal:
Bentonite Pellets: 2 bags of 50 lb per bag Type Bentonite Plug
Bentonite Slurry: bags of lb per bag Type

Grout:
Cement: bags of lb per bag Type
Bentonite: bags of lb per bag Type



Measuring Point is Top of Well Casing Unless Otherwise Noted

* Depth Below Ground Surface

Geosyntec consultants

SOIL BORING LOG

BORING NUMBER: GI002-2

PROJECT: GLP8005	PROJECT NO.: Coffeen MWA	E —	N —
LOCATION: Coffeen, IL	PHASE NO.: 2	G. S. ELEVATION: —	
CLIENT: Vistra	TASK NO.: —	BORING DEPTH: 21.0'	
DRILLING CO: Roberts Env	DRILLER:	DRILLING METHOD: DP	
LOGGED BY: A Toye	STARTED: 5/25/21	COMPLETED: 5/25/21	

Depth (ft)	Elevation (ft)	Sample No.	Recovery / Attempted	Strata Change	Soil/Rock Description	Notes Blow Count N	Unit Weight (pcf)	Q_p (tsf)	Q_u (tsf)	wc (%)
			16/36"		1.3' of SILTY CLAY, med grey, ~~soft~~, moist					
2										
3										
4		Chem Sample	36/36"		24" of CLAYEY SAND, orange brown to light grey, soft, moist	← Slugged to Split Spoon				
6										
8		Chem Sample			12" of CLAY w SOME SAND, orange brown w light grey mottling, low Plastic, dry		Screen	8		
10		Chem Sample	36/36		0.6' of Sand, orange, fine grained, slightly moist					
					3.7' of SAND w SOME SILT, greyish brown, dry					
12		Chem Sample			0.7' of SAND, orange, slightly moist			12		
13										
14		Chem Sample	14/24		1.5' of SILTY SAND, orange w grey mottling, dry					
16			0/24"		NO RECOVERY					
18			20/24"		1.8' SILT w SAND & CLAY, ~~grey, dry~~ grey, low Plastic, dry					
19										
20			24/24"		2' CLAY, grey, med Plastic, moist					
21					EOB 21'					
22										

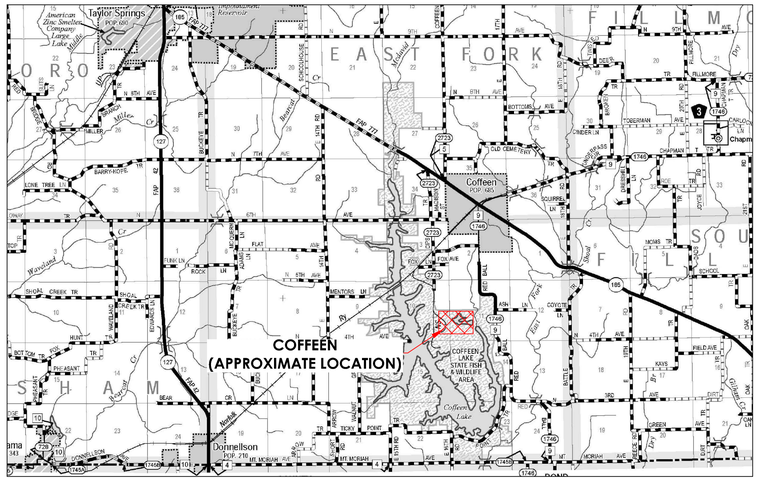
Luminant

ILLINOIS POWER GENERATING COMPANY
COFFEEN POWER STATION
DECEMBER 2020 TOPOGRAPHY

COFFEEN, ILLINOIS

ADDRESS
134 CIPS LANE
COFFEEN, ILLINOIS 62017

VISTRA ENERGY



PROJECT LOCATION MAP
N.T.S.



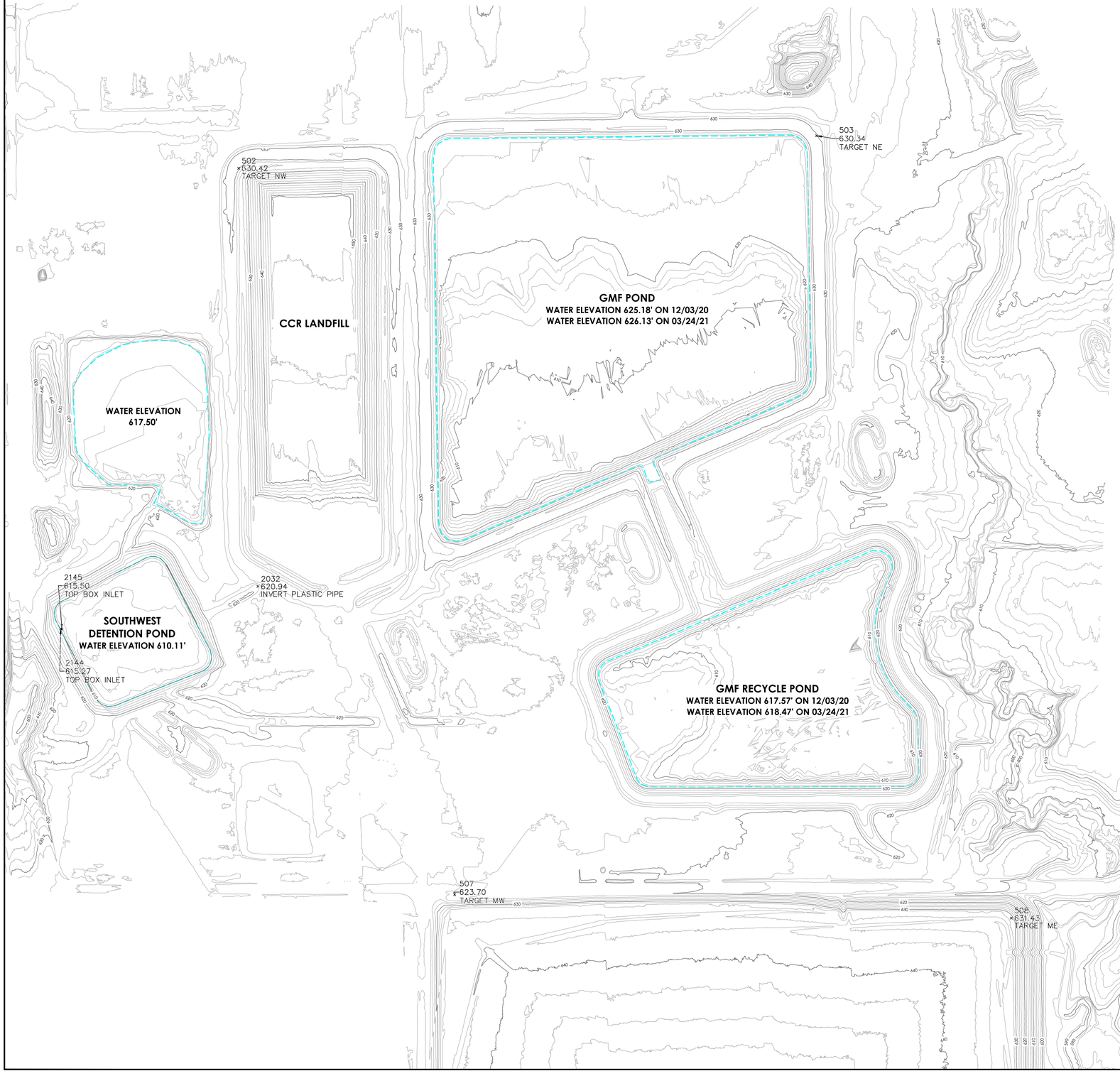
VICINITY MAP
N.T.S.

LIST OF DRAWINGS

1 - COVER SHEET
2 - EXISTING TOPOGRAPHY NORTH
3 - EXISTING TOPOGRAPHY SOUTH
4 - AERIAL TOPOGRAPHY NORTH
5 - AERIAL TOPOGRAPHY SOUTH

PREPARED BY:

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Earth City, MO 63045
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N

0' 175' 350'

LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- LIMITS OF BATHYMETRIC SURVEY
- PIPING
- CONCRETE
- MANHOLE
- INLET

NOTES:

1. THIS EXHIBIT REPRESENTS A TOPOGRAPHIC FIELD SURVEY AND IS NOT INTENDED TO BE A BOUNDARY SURVEY.
2. EXISTING CONTOURS SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/03/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 12/03/2020 & 12/04/2020. ASH POND 1 BATHYMETRIC SURVEY WAS COMPLETED BY INGENAE ON 04/15/2020.
3. NO UNDERGROUND OR OVERHEAD UTILITIES WERE LOCATED DURING THIS SURVEY.
4. THE ACCUMULATED DATA FROM AERIAL DRONE SURVEYS, GROUND TRUTHING FIELD DATA COLLECTION SURVEYS AND TOPOGRAPHIC/BATHYMETRIC SURVEYS USED TO PRODUCE THE TOPOGRAPHIC DRAWING AS SHOWN HEREON IS BASE ON ILLINOIS STATE PLANE COORDINATE-ZONE WEST NAD 1983 AND NAVD 88 ELEVATION DATUM.

TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
502	876457.9	2513942.9	630.43	TARGET NW
503	876570.4	2515939.4	630.34	TARGET NE
504	871464.3	2515211.1	637.22	TARGET SW
505	871534.1	2516666.1	635.99	TARGET SE
507	873944.5	2514681.3	623.70	TARGET MW
508	873867.4	2516612.2	631.43	TARGET ME

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Submissions / Revisions: Date:

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Luminant

Project Name & Location:

COFFEEN
POWER STATION

134 CIPS Lane
Coffeen, IL 62017

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Drawing Name:

EXISTING TOPOGRAPHY NORTH

Date: 5/28/2021	Project No.
Type: SITE	Drawing No. 2
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	



LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- LIMITS OF BATHYMETRIC SURVEY
- PIPING
- CONCRETE
- MANHOLE
- INLET
- WELL
- SOIL BEARING
- MNA WELL

N

0' 175' 350'

NOTES:

1. EXISTING AERIAL SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/03/2020.
2. THE WELL LOCATIONS AND ELEVATIONS, BORING LOCATIONS AND BENCHMARK DATA WAS RETRIEVED IN A SUBSEQUENT SURVEY DONE BY INGENAE DATED MARCH 24, 2021.

TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
502	876457.9	2513942.9	630.43	TARGET NW
503	876570.4	2515939.4	630.34	TARGET NE
504	871464.3	2515211.1	637.22	TARGET SW
505	871534.1	2516666.1	635.99	TARGET SE
507	873944.5	2514681.3	623.70	TARGET MW
508	873867.4	2516612.2	631.43	TARGET ME

SOIL BORING TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1075	876525.9	2515953.9	630.82	SB-289 GROUND

WELL LOCATION POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1071	875111.4	2514684.6	631.41	G-206D GROUND
1072	875111.4	2514684.6	634.35	G-206D TOP METAL CASING
1074	875111.4	2514684.6	634.14	G-206D TOP PVC WELL
1082	874285.3	2516366.5	637.52	G-275D GROUND
1083	874285.3	2516366.5	620.69	G-275D TOP METAL CASING
1084	874285.3	2516366.5	620.31	G-275D TOP PVC WELL
1105	874113.0	2516503.0	608.30	G-283 GROUND
1106	874113.0	2516503.0	611.07	G-283 TOP METAL CASING
1107	874113.0	2516503.0	610.75	G-283 TOP PVC WELL
1086	874423.6	2516922.9	615.33	G-284 GROUND
1087	874423.6	2516922.9	618.66	G-284 TOP METAL CASING
1088	874423.6	2516922.9	618.42	G-284 TOP PVC WELL
1094	874795.0	2516680.4	610.54	G-285 GROUND
1095	874795.0	2516680.4	613.90	G-285 TOP METAL CASING
1097	874795.0	2516680.4	613.52	G-285 TOP PVC WELL
1098	875072.2	2516561.8	609.97	G-286 GROUND
1099	875072.2	2516561.8	613.57	G-286 TOP METAL CASING
1100	875072.2	2516561.8	613.33	G-286 TOP PVC WELL
1078	875442.8	2516415.5	614.34	G-287 GROUND
1079	875442.8	2516415.5	617.88	G-287 TOP METAL CASING
1080	875442.8	2516415.5	617.45	G-287 TOP PVC WELL
1090	875279.6	2517071.4	617.08	G-288 GROUND
1091	875279.6	2517071.4	620.37	G-288 TOP METAL CASING
1092	875279.6	2517071.4	620.07	G-288 TOP PVC WELL
1009	872235.1	2515583.1	620.88	G-301 GROUND
1010	872235.1	2515583.1	623.18	G-301 TOP METAL CASING
1011	872235.0	2515588.0	622.99	G-301 TOP PVC COUPLING WELL
1003	872252.9	2516214.1	618.52	G-302 GROUND
1017	872252.9	2516214.1	620.53	G-302 TOP METAL CASING
1018	872252.9	2516214.1	620.34	G-302 TOP PVC COUPLING WELL
1047	871382.1	2516693.5	619.33	G-303 GROUND
1048	871382.1	2516693.5	622.38	G-303 TOP METAL CASING
1049	871382.1	2516693.5	622.18	G-303 TOP PVC WELL COUPLING
1068	871156.4	2515199.5	623.23	G-305 GROUND
1069	871156.4	2515199.5	626.06	G-305 TOP METAL CASING
1070	871156.4	2515199.5	625.67	G-305 TOP PVC WELL
1056	871140.9	2516120.4	623.57	G-306 GROUND
1057	871140.9	2516120.4	626.38	G-306 TOP METAL CASING
1058	871140.9	2516120.4	625.91	G-306 TOP PVC WELL
1067	871398.6	2515553.4	624.73	G-307 GROUND
1066	871398.6	2515553.4	624.91	G-307 TOP METAL CASING
1065	871398.6	2515553.4	624.60	G-307 TOP PVC WELL
1062	871397.2	2515560.3	622.51	G-307D GROUND
1063	871397.2	2515560.3	625.29	G-307D TOP METAL CASING
1064	871397.2	2515560.3	624.88	G-307D TOP PVC WELL
1027	871454.7	2515101.4	621.59	G-308 GROUND
1028	871454.7	2515101.4	624.96	G-308 TOP METAL CASING
1029	871454.7	2515101.4	624.59	G-308 TOP PVC WELL
1030	871865.8	2515067.1	622.77	G-309 GROUND
1031	871865.8	2515067.1	626.20	G-309 TOP METAL CASING
1032	871865.8	2515067.1	625.88	G-309 TOP PVC WELL
1006	872239.4	2515159.4	619.80	G-310 GROUND
1007	872239.4	2515159.4	623.32	G-310 TOP METAL CASING
1008	872239.4	2515159.4	622.87	G-310 TOP PVC WELL
1012	872238.7	2515881.8	618.32	G-311 GROUND
1015	872238.7	2515881.8	618.39	G-311 GROUND
1013	872238.7	2515881.8	621.55	G-311 TOP METAL CASING
1014	872238.7	2515881.8	621.04	G-311 TOP PVC WELL
1016	872238.8	2515896.2	621.75	G-311D TOP METAL CASING
1002	872238.8	2515896.2	621.24	G-311D TOP PVC WELL
1019	872260.9	2516557.4	616.92	G-312 GROUND
1020	872260.9	2516557.4	620.11	G-312 TOP METAL CASING
1021	872260.9	2516557.4	619.78	G-312 TOP PVC WELL
1038	871976.8	2516803.7	611.51	G-313 GROUND
1039	871976.8	2516803.7	614.62	G-313 TOP METAL CASING
1040	871976.8	2516803.7	614.30	G-313 TOP PVC WELL
2015	871630.2	2516852.1	611.11	G-314 GROUND
2014	871630.2	2516852.1	614.28	G-314 TOP METAL CASING
2013	871630.2	2516852.1	613.88	G-314 TOP PVC WELL
2010	871642.0	2516853.9	610.87	G-314D GROUND
2011	871642.0	2516853.9	614.10	G-314D TOP METAL CASING
2012	871642.0	2516853.9	613.70	G-314D TOP PVC WELL
1059	871385.0	2516086.6	620.94	G-315 GROUND
1060	871385.0	2516086.6	623.80	G-315 TOP METAL CASING
1061	871385.0	2516086.6	623.52	G-315 TOP PVC WELL
1050	871643.1	2517211.6	599.64	G-316 GROUND
1051	871643.1	2517211.6	603.06	G-316 TOP METAL CASING
1052	871643.1	2517211.6	602.59	G-316 TOP PVC WELL
1053	871234.2	2517087.4	638.85	G-317 GROUND
1054	871234.2	2517087.4	642.26	G-317 TOP METAL CASING
1055	871234.2	2517087.4	641.93	G-317 TOP PVC WELL
1023	872312.0	2516714.4	605.87	SG-02 TOP METAL WELL
1022	872095.1	2517025.0	594.94	SG-03 TOP METAL WELL
1085	873935.3	2516963.3	599.52	SG-04 TOP METAL WELL
1024	871638.7	2515366.3	631.85	XPW-01 GROUND
1025	871638.7	2515366.3	634.92	XPW-01 TOP METAL CASING
1026	871638.7	2515366.3	634.57	XPW-01 TOP PVC WELL
1001	871987.1	2515627.3	636.64	XPW-02 GROUND
1101	871987.1	2515627.3	640.02	XPW-02 TOP METAL
1102	871987.1	2515627.3	639.69	XPW-02 TOP PVC WELL
1004	872095.3	2515211.8	635.52	XSG-01 TOP PVC WELL

MNA WELLS

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
1113	873636.91	2516757.78	594.82	G-1001 GROUND
1112	873636.91	2516757.78	597.95	G-1001 TOP METAL CASING
1111	873636.91	2516757.78	597.61	G-1001 TOP PVC WELL
1121	872676.88	2516735.78	607.02	G-1002 GROUND
1119	872676.88	2516735.78	610.47	G-1002 TOP METAL CASING
1120	872676.88	2516735.78	609.97	G-1002 TOP PVC WELL
1116	872510.86	2515601.43	625.77	SB-401A GROUND
1101	874781.00	2515020.93	623.53	SB-270A GROUND

AS SURVEY BY INGENAE 4/20/21

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Project Name & Location:

COFFEEN
POWER STATION

134 CIPS Lane
Coffeen, IL 62017

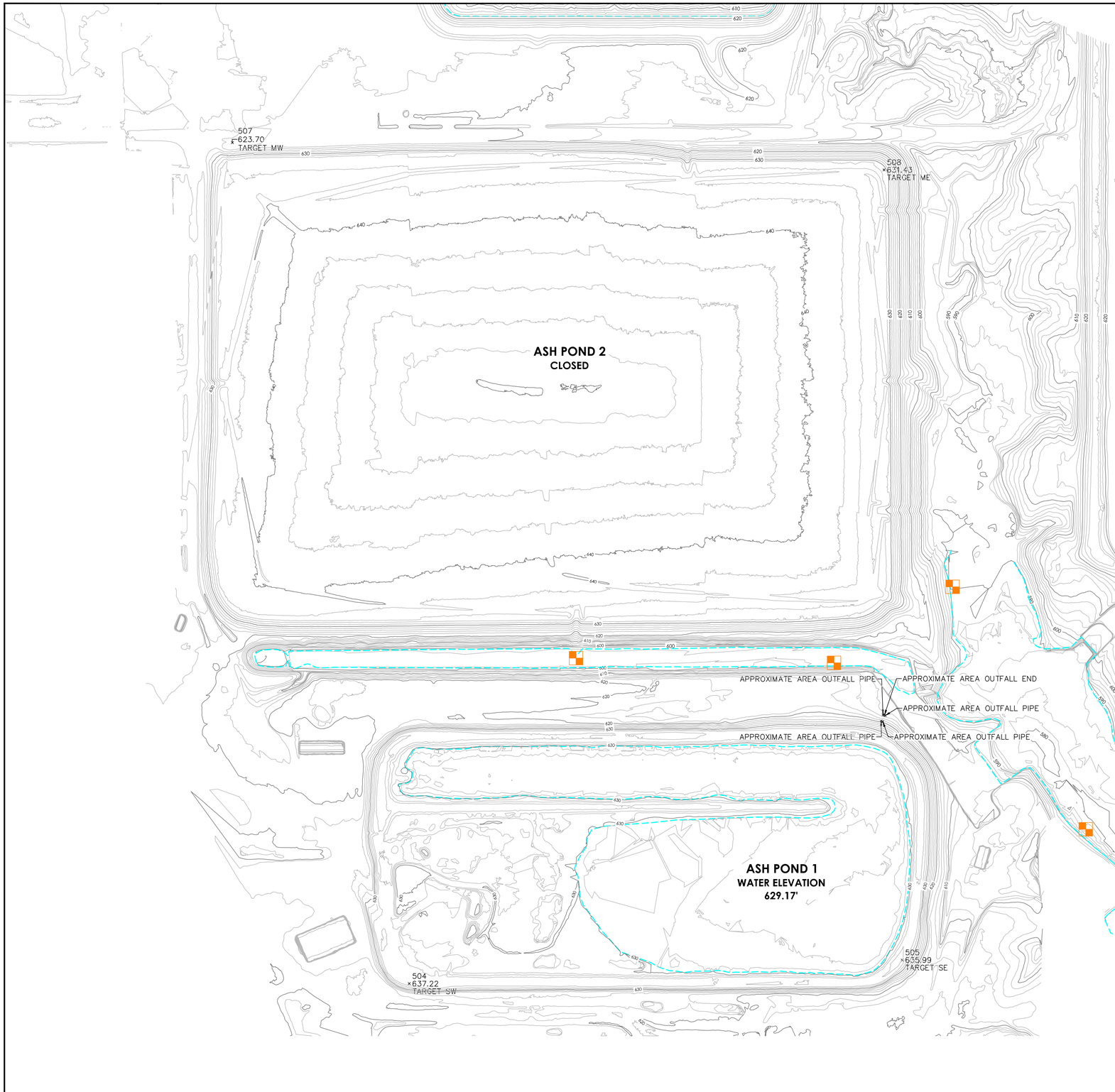
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Drawing Name:

AERIAL PHOTOGRAPHY NORTH

Date: 5/28/2021	Project No.
Type: SITE	Drawing No. 3
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	



N

0' 150' 300'

LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- LIMITS OF BATHYMETRIC SURVEY
- PIPING
- CONCRETE
- MANHOLE
- INLET
- PROPOSED MNA SAMPLE SITE

NOTES:

1. THIS EXHIBIT REPRESENTS A TOPOGRAPHIC FIELD SURVEY AND IS NOT INTENDED TO BE A BOUNDARY SURVEY.
2. EXISTING CONTOURS SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/03/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 12/03/2020 & 12/04/2020. ASH POND 1 BATHYMETRIC SURVEY WAS COMPLETED BY INGENAE ON 04/15/2020.
3. NO UNDERGROUND OR OVERHEAD UTILITIES WERE LOCATED DURING THIS SURVEY.
4. THE ACCUMULATED DATA FROM AERIAL DRONE SURVEYS, GROUND TRUTHING FIELD DATA COLLECTION SURVEYS AND TOPOGRAPHIC/BATHYMETRIC SURVEYS USED TO PRODUCE THE TOPOGRAPHIC DRAWING AS SHOWN HEREON IS BASE ON ILLINOIS STATE PLANE COORDINATE-ZONE WEST NAD 1983 AND NAVD 88 ELEVATION DATUM.
5. ADDITIONAL MNA SAMPLING SITES GROUND BATHYMETRIC SURVEY PERFORMED ON 04/22/2021.

TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
502	876457.9	2513942.9	630.43	TARGET NW
503	876570.4	2515939.4	630.34	TARGET NE
504	871464.3	2515211.1	637.22	TARGET SW
505	871534.1	2516666.1	635.99	TARGET SE
507	873944.5	2514681.3	623.70	TARGET MW
508	873867.4	2516612.2	631.43	TARGET ME

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Project Name & Location:

COFFEEN
POWER STATION

134 CIPS Lane
Coffeen, IL 62017

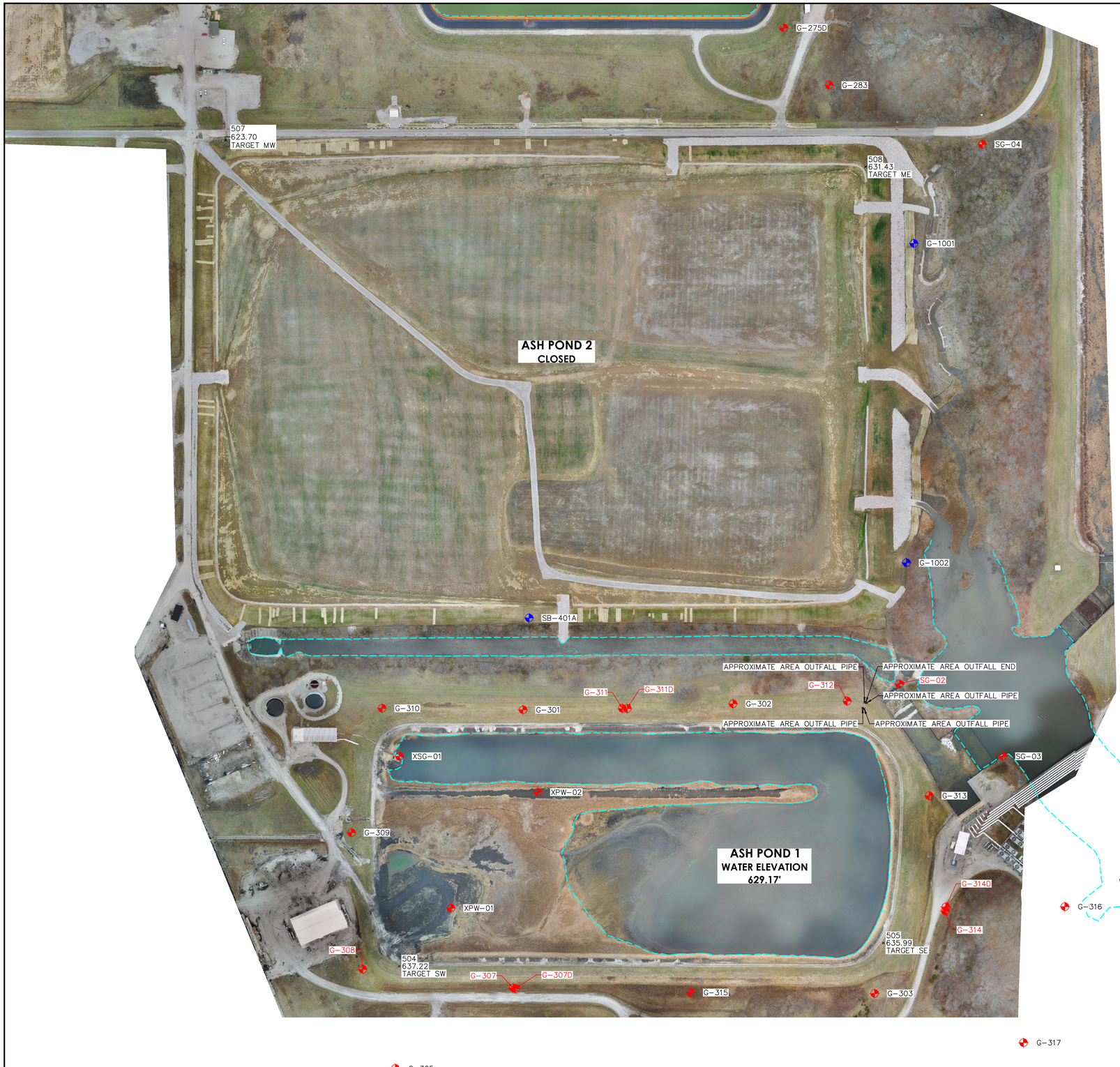
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Drawing Name:

EXISTING TOPOGRAPHY SOUTH

Date: 5/28/2021	Project No.
Type: SITE	Drawing No. 4
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	



N

0' 150' 300'

LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- LIMITS OF BATHYMETRIC SURVEY
- PIPING
- CONCRETE
- MANHOLE
- INLET
- WELL
- MNA WELL

NOTES:

1. EXISTING AERIAL SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/03/2020.
2. APPROXIMATE LOCATION OF OUTFALL PIPE LOCATED BY OTHERS.
3. THE WELL LOCATIONS AND ELEVATIONS, BORING LOCATIONS AND BENCHMARK DATA WAS RETRIEVED IN A SUBSEQUENT SURVEY DONE BY INGENAE DATED MARCH 24, 2021.

TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
502	876457.9	2513942.9	630.43	TARGET NW
503	876570.4	2515939.4	630.34	TARGET NE
504	871464.3	2515211.1	637.22	TARGET SW
505	871534.1	2516666.1	635.99	TARGET SE
507	873944.5	2514681.3	623.70	TARGET MW
508	873867.4	2516612.2	631.43	TARGET ME

MNA WELLS				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
1113	873636.91	2516757.78	594.82	G-1001 GROUND
1112	873636.91	2516757.78	597.95	G-1001 TOP METAL CASING
1111	873636.91	2516757.78	597.61	G-1001 TOP PVC WELL
1121	872676.88	2516735.78	607.02	G-1002 GROUND
1119	872676.88	2516735.78	610.47	G-1002 TOP METAL CASING
1120	872676.88	2516735.78	609.97	G-1002 TOP PVC WELL
1116	872510.86	2515601.43	625.77	SB-401A GROUND
1101	874781.00	2515020.93	623.53	SB-270A GROUND

AS SURVEY BY INGENAE 4/20/21

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Luminant

Project Name & Location:

COFFEEN
POWER STATION

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Coffeen, IL 62017

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Drawing Name:

AERIAL PHOTOGRAPHY SOUTH

Date:	Project No.
5/28/2021	
Type: SITE	Drawing No. 5
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	

APPENDIX B
MULTI-SITE STATISTICAL ANALYSIS PLAN

Date
April 1, 2025

Project No.
1940110241

35 I.A.C § 845 MULTI-SITE STATISTICAL ANALYSIS PLAN

RAMBOLL Bright ideas. Sustainable change.

35 I.A.C § 845 MULTI-SITE STATISTICAL ANALYSIS PLAN

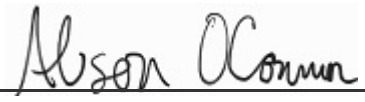
Project no.	**1940110241**
Recipient	**Vistra Corp**
Document type	**Statistical Analysis Plan**
Revision	**FINAL**
Date	**April 1, 2025**
Prepared by	**Rachel Banoff and Alison O'Connor**
Checked by	**Eric J. Tlachac, PE**
Approved by	**Brian G. Hennings, PG**

Ramboll
234 W. Florida Street
Fifth Floor
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USA

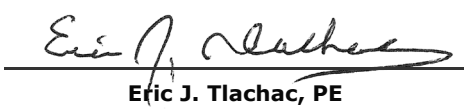
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LICENSED PROFESSIONAL CERTIFICATIONS

This certification is based on the description of the statistical methods selected to evaluate groundwater as presented in the following 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan. The procedures described in the plan will be used to establish background conditions and implement compliance and corrective action monitoring as necessary and required by 35 I.A.C. § 845.640, § 845.650, and § 845.680. The 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in the United States Environmental Protection Agency (USEPA)'s *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* USEPA 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring. In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality is the tolerance interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). Groundwater Protection Standards (GWPS) will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The GWPS will be compared to the appropriate confidence interval for the observed concentrations for each constituent in each compliance well. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Description of the statistical methods chosen for analysis of groundwater monitoring data and application of these methods for determining exceedances of the GWPS identified in 35 I.A.C. § 845.600(a) is provided in this 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan.

35 I.A.C. § 845.640 Statistical Analysis (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the statistical methods summarized above and described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: April 1, 2025



35 I.A.C. § 845.640 Statistical Analysis (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the statistical methods described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: April 1, 2025



35 I.A.C. § 845.640 Statistical Analysis

I, Rachel A. Banoff, a qualified professional, certify that the statistical methods described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan), are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Rachel A. Banoff, EIT
Project Statistician
Date: April 1, 2025

DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	April 1, 2025	• Original Document

DOCUMENT APPLICABILITY BY FACILITY OWNER

Table A. Document Applicability by Facility Owner

Facility & Owner	Unit ID	Unit Name
Baldwin Power Plant Dynegy Midwest Generation, LLC	601	Bottom Ash Pond
	605	Fly Ash Pond System
Coffeen Power Plant Illinois Power Generating Company	101	Ash Pond No. 1
	102	Ash Pond No. 2
	103	GMF Gypsum Stack Pond
	104	GMF Recycle Pond
Duck Creek Power Plant Illinois Power Resources Generating, LLC	201/202	Ash Pond No. 1 Ash Pond No. 2
	203	GMF Pond
	205	Bottom Ash Basin
Edwards Power Plant Illinois Power Resources Generating, LLC	301	Ash Pond
Hennepin Power Plant Dynegy Midwest Generation, LLC	802	Ash Pond No. 2
	803	East Ash Pond
	804	Old West Ash Pond
	802/805	Ash Pond No. 2 Ash Pond No. 4
Joppa Power Plant Electric Energy, Inc.	401	East Ash Pond
	403	West Ash Pond
Kincaid Power Plant Kincaid Generation, LLC	141	Ash Pond
Newton Power Plant Illinois Power Generating Company	501	Primary Ash Pond
Vermilion Power Plant Dynegy Midwest Generation, LLC	910	North Ash Pond
	911/912	Old East Ash Pond New East Ash Pond

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ACRONYMS AND ABBREVIATIONS

%	percent
35 I.A.C.	Title 35 of the Illinois Administrative Code
CCR	coal combustion residuals
CI	confidence interval
DQR	Double Quantification Rule
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCL	lower confidence limit
LTL	lower tolerance limit
MDL	method detection limit
PQL	practical quantitation limit
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
SAP	Sampling and Analysis Plan
SI	surface impoundment
UCL	upper confidence limit
Unified Guidance	Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance (USEPA, 2009)
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit

1. INTRODUCTION

In April 2021, the Illinois Environmental Protection Agency (IEPA) issued a final rule for the regulation and management of coal combustion residuals (CCR) in surface impoundments (SIs) under the Standards for the Disposal of CCR in Surface Impoundments: Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845. Facilities regulated under 35 I.A.C. § 845 are required to develop and sample a groundwater monitoring well system to evaluate whether impounded CCR materials are impacting groundwater quality. The groundwater quality evaluation must include certification from a qualified professional engineer that the selected statistical method is appropriate for evaluating groundwater monitoring data for the CCR surface impoundment. The procedures described in the evaluation will be used to establish background conditions and implement Compliance and Corrective Action Monitoring as necessary and required by 35 I.A.C. § 845.640, § 845.650, § 845.680, and § 845.780. This Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in United States Environmental Protection Agency's (USEPA's) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (Unified Guidance) (USEPA, 2009).[1]

1.1 Statistical Analysis Objectives

This Multi-Site Statistical Analysis Plan provides a framework for conducting the statistical analyses of groundwater data collected during operation, post-closure care, and corrective action monitoring (if required). This Multi-Site Statistical Analysis Plan does not include procedures for groundwater sample collection and analysis conducted in accordance with the Multi-Site Sampling and Analysis Plan (SAP; Ramboll, 2022) or data quality evaluation conducted in accordance with the Multi-Site Quality Assurance Project Plan (QAPP; Ramboll, 2022).[2]

1.2 Statistical Analysis Plan Approach

The analyses described in this document are intended to support monitoring programs described in detail in the CCR unit-specific Operating Permit Groundwater Monitoring Plans (GMPs), Closure Construction Permit GMPs, and Corrective Action GMPs. When necessary and contingent upon equivalent statistical power, an alternative test consistent with the performance standards in 35 I.A.C. § 845.640(g), not included in this Statistical Analysis Plan, may be chosen due to site-specific data requirements.

35 I.A.C. § 845 outlines three phases of groundwater monitoring:

- Baseline Monitoring in accordance with 35 I.A.C. § 845.650(b)(1)
- Compliance Monitoring in accordance with 35 I.A.C. § 845.650 and 35 I.A.C. § 845.780(b)
- Corrective Action Monitoring in accordance with 35 I.A.C. § 845.680(a)

Each phase of the groundwater monitoring program requires specific statistical procedures to accomplish the intended purpose. During the first phase, background groundwater quality will be established, utilizing upgradient and background wells. Compliance Monitoring, which

[1] Despite being currently archived on USEPA's website, the Unified Guidance remains a valid reference for developing a statistical analysis plan (personal communication with Alison O'Connor, February 11, 2025).

[2] The Multi-Site Sampling and Analysis Plan and Multi-Site Quality Assurance Project plan are living documents which are subject to routine evaluation and updates in accordance with USEPA recommended best practices (USEPA 2020; USEPA 2023).

encompasses data collection and statistical evaluation conducted during unit operation and the post-closure care period, will then evaluate whether exceedances occur for 20 required constituents (per 35 I.A.C. § 845.600(a)(1)) relative to the groundwater protection standard (GWPS) established by 35 I.A.C. § 845.600. Corrective Action Monitoring evaluates remedy progress and completion and will be initiated upon implementation of the Corrective Action GMP.

2. GROUNDWATER DATA EVALUATION AND STATISTICAL ASSUMPTIONS

The following subsections outline the statistical tests and procedures utilized to evaluate data collected for consistency with statistical assumptions and evaluate data distribution. These methods may be used in any phase of groundwater monitoring.

2.1 Sample Independence

Independence of sample results is a major assumption for most statistical analyses. To ensure physical independence of groundwater sampling results, the minimum time between sampling events must be longer than the time required for groundwater to move through the monitoring well. Therefore, the minimum time interval between sampling events is a function of the groundwater velocity and well bore volume (diameter of the well and surrounding filter pack). The sampling schedules for Baseline Monitoring, Compliance Monitoring, and Corrective Action Monitoring are specified in 35 I.A.C. § 845 and may conflict with the statistical assumption of independence of sample results.

2.2 Non-Detect Data Processing

Groundwater sample analysis results below the reporting limit (RL), also referred to as the practical quantitation limit (PQL), will not be used in statistical calculations due to the inherent uncertainty in results that are estimated between the method detection limit (MDL) and RL/PQL, and error assumptions inherent to the statistical calculations. Results below the RL/PQL will be considered non-detect data. For statistical characterization evaluations (*e.g.*, distribution testing, and trend analysis), non-detects were replaced with the half of the RL for the analysis. For statistical test procedures that involve the calculation of a mean and standard deviation (as described in **Section 3**):

- If the frequency of non-detect data are less than or equal to 15 percent (%), half of the RL will be substituted for these data.
- If the non-detect frequency is greater than 15% and less than or equal to 50% and the data are normally or log-normally distributed (**Section 2.3**), the Kaplan-Meier method will be used to estimate the mean and standard deviation adjusted for the presence of left-censored values.
- If the non-detect frequency is greater than 50% or data are not normally or log-normally distributed (**Section 2.3**), a non-parametric test or calculation will be used.

2.3 Testing for Normality

In accordance with 35 I.A.C. § 845.640(g)(1), "the statistical method used to evaluate groundwater monitoring data must be appropriate for the distribution of constituents". The Unified Guidance document recommends the Shapiro-Wilk normality test for sample sizes of 50 or less, and the Shapiro-Francia normality test for sample sizes greater than 50. Log-transformation of datasets to achieve normal distributions is preferred to using non-parametric methods. However, if data normality cannot be achieved through log transformation, a non-parametric method is used.

2.4 Outlier Evaluation and Management

Groundwater analytical data may be screened for the existence of outliers using methods described by the Unified Guidance. Outliers are extreme data points that may represent an anomaly or erroneous data point. To test for outliers, one or more of the following outlier tests will be utilized:

- Dixon's test, for well-constituent pairs with less than 25 samples, assumes normally distributed data.
- Rosner's test, for well-constituent pairs with more than 20 samples, assumes normally distributed data.
- Grubb's test for well-constituent pairs with seven or more samples, assumes normally distributed data.

In addition, time series, box-whisker plots, and probability plots will be used to provide visual tools to identify potential outliers, and evaluation of seasonal, spatial, or temporal variability for both normally and non-normally distributed data.

When necessary, a confirmatory sample will be collected to allow the facility to distinguish between an outlier and a true release from the facility (35 I.A.C. § 845.650(d)). If re-sampling is necessary, this sample will be collected within 60 days following outlier identification. Rigorous data validation and review is preferred to formal outlier testing and exclusion to ensure that all data used in statistical evaluations is representative of field conditions. Quality control/quality assurance data are collected and data verification is completed in accordance with the QAPP. Project staff familiar with the site and historical data will review the data generated each quarter and facilitate additional validation as needed. Data quality control, groundwater geochemistry, and sampling procedures will be evaluated as potential sources of error leading to an outlier result. Exclusion of potential outliers without an identified source of error may be considered only for data that could cause extremely elevated background concentrations.

2.5 Trend Analysis

Statistical analyses confirming the lack of trend are a fundamental step to confirm the assumption that groundwater quality values (*i.e.,* constituent means) are stationary or constant over time. These analyses allow for evaluation of variation in the background and compliance data for each constituent over time. A statistically significant increasing trend in the background data could indicate an existing release from the CCR unit or alternative source, requiring further investigation. In addition, statistically significant trending background data can result in increased standard deviation and, therefore, greater prediction or tolerance limits. Consequently, the increased prediction or tolerance limit will have less statistical power or ability to identify a release from a CCR unit.

A linear regression, coupled with a t-test for slope significance at a 95% confidence level (or 0.05 significance level), may be used on datasets for each constituent with few non-detects and a normally distributed variance of the mean to evaluate time trends. The Theil-Sen trend line, coupled with the Mann-Kendall test for slope significance at a 95% confidence level (or 0.05 significance level), may be used for datasets with frequent non-detects or non-normal variance. Similarly, trend analyses could also be used on compliance data to evaluate a possible release from the CCR unit.

2.6 Spatial Variation

Spatial trends and/or variation between background wells could indicate an existing release from a CCR unit. If the spatial variability is not due to an existing release, intrawell comparisons in compliance wells may be used to account for spatial variability and monitor for a future release. However, the CCR units being monitored have been placed into service prior to the start of groundwater monitoring and it is unknown whether a previous release has occurred. Accordingly, intrawell comparisons in compliance wells cannot be used to determine the occurrence of a future release, and interwell comparisons between compliance wells and background wells will be used.

2.7 Temporal Variation

Time series plots can be used to identify temporal dependence. Potentially significant temporal components of variability can be identified by graphing single constituent data from multiple wells together on a time series plot. With temporal dependence, the time series plot has a pattern of parallel traces, in which the individual wells will tend to rise and fall together across the sequence of sampling dates. Time series plots can be helpful by plotting multiple constituents over time for the same well, or averaging values for each constituent across wells on each sampling event and then plotting the averages over time. In either case, the plots can signify whether the general concentration pattern over time is simultaneously observed for different constituents. If so, it may indicate that a group of constituents is highly correlated in groundwater or that the same artifacts of sampling and/or lab analysis impacted the results of several monitoring parameters.

2.8 Updating Background

Updating the background dataset periodically by adding recent results to an existing background dataset can improve the statistical power and accuracy of the statistical analysis, especially for non-parametric prediction intervals. The Unified Guidance recommends updating statistical limits (background) when at least four to eight new measurements (every 2 to 4 years under a semiannual monitoring program or 1 to 2 years under a quarterly monitoring program) are available for comparison to historical data. Methods discussed in **Section 2.4** and professional judgement will be used to evaluate whether any individual data points appear to drive an anomalously high background level. A t-test for equal means (if normal data distribution) or a Mann-Whitney or Wilcoxon test for equal medians (if non-normal data distribution) will be conducted to verify that the two groups of background sample populations are statistically different prior to updating any background datasets. A 0.05 significance level will be utilized when evaluating the two populations, with the null hypothesis that the two populations have equal means or medians. In addition, time series graphs or other trend evaluation statistics (such as a Mann-Kendall test) will be conducted on the new background dataset to verify the absence of a release or changing groundwater quality. If the tests indicate that there are no statistical differences between the two background populations, the new data will be combined with the existing dataset. If the two populations are found to be different, the data will be reviewed to evaluate the cause of the difference. If the differences appear to be caused by a release (*i.e.,* if the new data are significantly higher, or lower for pH), then the previous background dataset may continue to be used. Furthermore, verified outliers will not be added to an existing background dataset. Spatial variability among background wells will also be assessed when background datasets are updated to determine whether pooling data is appropriate.

3. COMPLIANCE MONITORING PROGRAM

Compliance Monitoring encompasses data collection and statistical evaluation conducted during unit operation (35 I.A.C. § 845.640 and 845.650) and the post-closure care period (35 I.A.C. § 845.780). Compliance Monitoring is designed to evaluate whether concentrations of constituents listed in 35 I.A.C. § 845.600(a)(1) in compliance wells exceed GWPS or background in a statistically significant manner.

3.1 Monitoring Program Outline

3.1.1 Establish Background and GWPS

A site-specific GWPS will be established for constituents listed in 35 I.A.C. § 845.600(a)(1) for each CCR unit. The GWPS will be the concentration specified in 35 I.A.C. § 845.600(a)(1), unless the background concentration is greater. For this exception, background concentrations will be used to define the GWPS. Background concentrations will be calculated using a parametric or non-parametric upper tolerance limit (UTL), depending on the data distribution, consistent with 35 I.A.C. § 845.640(f)(1)(C). The procedure for calculating a UTL is outlined in **Figure 1** and described in **Section 3.2**. If only one background result is detected, that value will be used as the UTL.

3.1.2 Evaluate Background and GWPS Exceedances

Per 35 I.A.C. § 845.610(b)(3), groundwater monitoring data from compliance monitoring wells will be evaluated for statistically significant exceedances over background and the site-specific GWPS. In accordance with recommendation in the Unified Guidance for compliance monitoring, exceedances are evaluated by comparing a confidence interval (CI) to a fixed standard. The null hypothesis of this comparison is that compliance well groundwater concentrations do not exceed the standard unless the statistical test indicates otherwise.

GWPS exceedances will be determined by comparing the lower confidence limit (LCL) of the compliance well concentrations to the GWPS, except for pH where the LCL will be compared to the upper end of the GWPS range, and the upper confidence limit (UCL) compared to the low end of the GWPS range. A GWPS exceedance is determined if the LCL is greater than the GWPS, and, for pH, either the LCL is greater than the upper end of the GWPS range or the UCL is less than the low end of the GWPS range. The method of calculating the CI (outlined in **Figure 2** and described in **Section 3.3**) will be determined by sample size, trends in the data, and data normality. The significance level (alpha) for this calculation will be fixed at 0.01 (99% confidence) as recommended by Unified Guidance. If there are too few data points to calculate an LCL (a minimum of four data points is typically required), the most recent data point will be compared to the GWPS.

In the event that statistical analyses identify an exceedance of the GWPS for one or more parameters, the exceedance parameters and wells of concern may be immediately re-sampled. Compliance Monitoring statistics will be updated using the verification resample. If the Compliance Monitoring statistics using the compliance verification resample data result in an exceedance of the GWPS, the exceedance is confirmed.

Comparison of groundwater monitoring data to background is required by 35 I.A.C. § 845.610(3)(B), but these background "exceedances" do not carry any compliance implications.

Background exceedances will be determined by comparing the LCL of the compliance well concentrations to the background UTL, with the exception of pH where the UCL of the compliance well concentrations will also be compared to the background lower tolerance limit (LTL). A background exceedance is determined if the LCL is greater than the background UTL, or, for pH, either the LCL is greater than the UTL or the UCL is less than the LTL. If there are too few data points to calculate an LCL (a minimum of four data points is required), the most recent data point will be compared to the background UTL (and LTL for pH).

Additionally, an exceedance of either background or GWPS will be identified if the constituent monitored was not detected in all previous samples at a compliance well and the two most recent samples have both detections and exceed the GPWS (or are less than the low end of the GWPS range for pH) or background UTL (or are less than the LTL for pH).

3.2 Upper Tolerance Limit

The method for calculating a UTL depends primarily on the proportion of non-detects and the data distribution (**Figure 1**). A parametric UTL will be used to calculate the GWPS when the background data are normally distributed and have a non-detect frequency of 50% or less. The Unified Guidance recommends 95% confidence level and 95% coverage (95/95 tolerance interval). When the non-detect frequency is 15% or less, half the RL will be substituted for non-detects (simple substitution), and the normal mean and standard deviation will be calculated. The Kaplan-Meier method will be used when the detection frequency is between 15% and 50%. The Kaplan-Meier method assesses the linearity of a censored probability plot to determine whether the background sample can be approximately normalized. If so, then the Kaplan-Meier method will be used to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. The Kaplan-Meier estimate of the mean and standard deviation will be substituted for the sample mean and standard deviation.

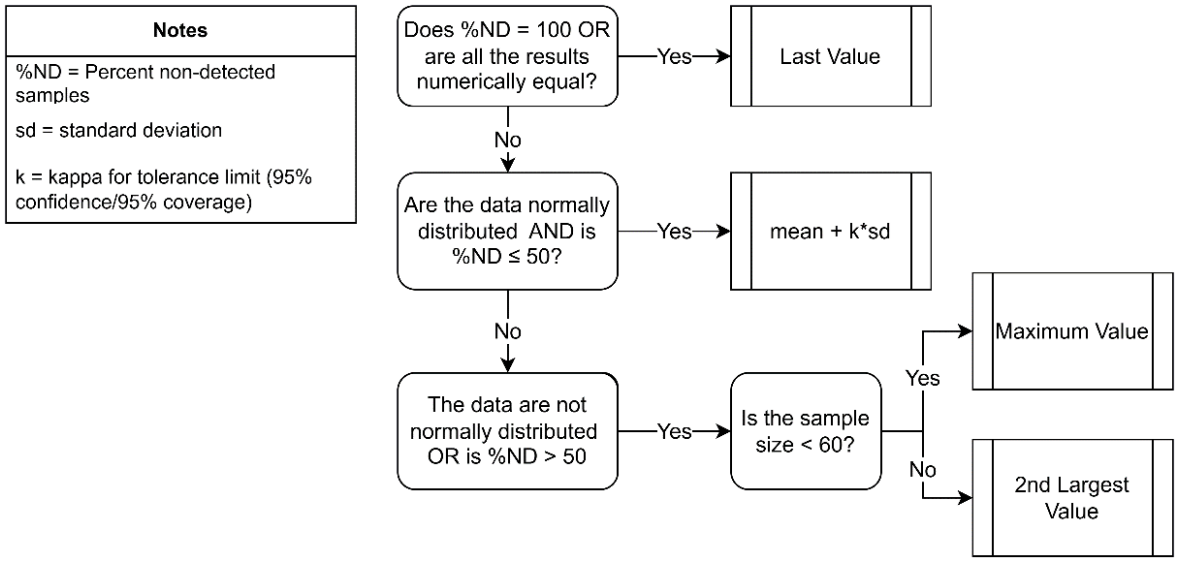


Figure 1. Flow chart illustrating the statistical methods used for calculating background under Compliance Monitoring.

The parametric UTL on a future mean will be calculated from the background dataset as follows:

$$UTL = \overline{x} + \kappa\,(n, \gamma, \alpha - 1) \cdot s$$

$\overline{x}$ = background sample mean

s = background sample standard deviation

$\kappa\,(n, \gamma, \alpha - 1)$ = one-sided normal tolerance factor based on the chosen coverage (γ) and confidence level (α -1) and the size of the background dataset (n). Values may be calculated per Millard (2013) or looked up in Table 17-3 in Appendix D of the Unified Guidance.

If the UTL is constructed on the logarithms of original observations to achieve normality, where $\overline{y}$ and s_y are the log-mean and log-standard deviation, the limit will be exponentiated for back-transformation to the concentration scale as follows:

$$TL = \exp\left[\overline{y} + \kappa\,(n, \gamma, \alpha - 1) \cdot s_y\right]$$

$\overline{y}$ = background sample log-mean

s_y = background sample log-standard deviation

If the background data set is non-parametric or has a non-detect frequency greater than 50%, a non-parametric UTL is used. The maximum concentration is used as the non-parametric UTL for sample sizes less than 60 and the second largest concentration is used as the non-parametric UTL for sample sizes greater than or equal to 60. As described in the Unified Guidance, the advantages include the resulting UTL reflecting actual concentration magnitudes, and the UTL more likely representing a detected concentration (unless all the data were non-detect).

3.3 Confidence Intervals

The method for calculating a CI depends on whether or not there is a trend in the data, the proportion of non-detects, and the data distribution (**Figure 2**). The following sections describe the procedure for calculating the CI in each case.

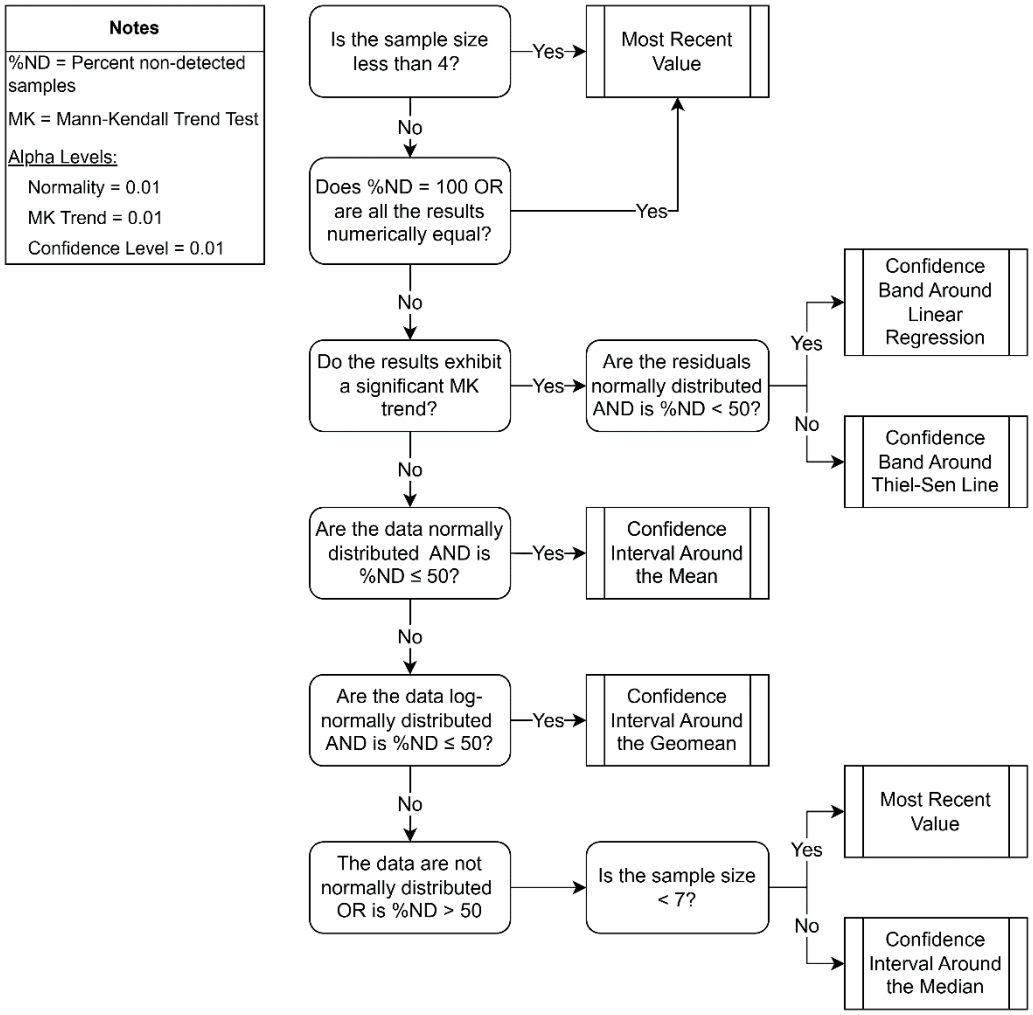


Figure 2. Flow chart illustrating the statistical methods used for calculating confidence intervals in Compliance Monitoring.

3.3.1 Confidence Intervals Around Trending Data

If compliance data exhibit a statistically significant trend based on results from a Mann-Kendall trend test and consists of a sufficient sample size (see below), CIs accounting for trends will be constructed to account for the trend-induced variation. If this is not accounted for, a wider CI will inevitably be calculated for a given confidence level and sample size (n). A wider CI will result in less statistical power, or ability to demonstrate an exceedance or return to compliance. When a linear trend line has been estimated, a series of CIs is estimated at each point along the trend. This creates a simultaneous confidence band that follows the trend line. As the underlying population mean increases or decreases, the confidence band also increases to reflect this change at that point in time.

Linear regression will be used when the compliance data set consists of at least eight samples, the frequency of non-detects is below 50%, and residuals around the trend line are normally distributed. The linear regression of concentration against sampling date (time) will be computed as follows:

$$\hat{b} = \sum_{i=1}^{n} (t_i - \overline{t}) \cdot x_i / (n-1) \cdot s_t^2$$

x_i = i^{th} concentration value and

t_i = i^{th} sampling date

$\overline{t}$ = sampling mean date

s_t^2 = variance of the sampling dates

This estimate leads to the following regression equation:

$$\hat{x} = \overline{x} + \hat{b} \cdot (t - \overline{t})$$

$\overline{x}$ = mean concentration level

$\hat{x}$ = estimated mean concentration at time t

The regression residuals will also be computed at each sampling event to ensure uniformity and lack of significant skewness. Regression residuals will be computed at each sampling event as follows:

$$r_i = x_i - \hat{x}_i$$

The estimated variance around the regression line, or mean squared error, will be computed as follows:

$$s_e^2 = \frac{1}{n-2} \sum_{i=1}^{n} r_i^2$$

The CI around a linear regression trend line given confidence level (1-α) and a point in time (t_0), will be computed as follows:

$$LCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,n-1} \cdot \left[\frac{1}{n} + \frac{(t_0 - \overline{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$$UCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,n-2} \cdot \left[\frac{1}{n} + \frac{(t_0 - \overline{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$\hat{x}_0$ = estimated mean concentration from the regression equation at time t_0

$F_{1-2\alpha,2,n-2}$ = upper (1-2α)th percentage point from an *F*-distribution with 2 and (*n*-2) degrees of freedom

If the compliance data set consists of at least seven samples but has a non-detect frequency greater than 50% or the residuals are not normally distributed, the Thiel-Sen trend line will be used as a non-parametric alternative to linear regression for calculation of the CI. The Thiel-Sen trend line estimates the median concentration over time by combining the median pairwise slope with the median concentration value and the median sample date. To compute the Thiel-Sen line,

the data will first be ordered by sampling event x_1, x_2, x_n. All possible distinct pairs of measurements (x_i, x_j) for $j > i$ will be considered and the simple pairwise slope estimate will be computed for each pair as follows:

$$m_{ij} = (x_j - x_i)/(j - i)$$

With a sample size of n, there will be a total of $N = n(n\text{-}1)/2$ pairwise estimates m_{ij}. If a given observation is a non-detect, half the RL will be substituted. The N pairwise slope estimates (m_{ij}) will be ordered from least to greatest (renamed $m_{(1)}$, $m_{(2)}$,..$m_{(N)}$). The Thiel-Sen estimate of slope (Q) will be calculated as the median value of the list depending on whether N is even or odd as follows:

$$Q = \begin{cases} m_{([N+1]/2)} \; if \; N \; is \; odd \\ (m_{(N/2)} + m_{([N+2]/2)})/2 \; if \; N \; is \; even \end{cases}$$

The sample concentration magnitude will be ordered from least to greatest, $x_{(1)}$, $x_{(2)}$, to $x_{(n)}$ and the median concentration will be calculated as follows:

$$\tilde{x} = \begin{cases} x_{([n+1]/2)} \; if \; n \; is \; odd \\ (x_{(n/2)} + x_{([n+2]/2)})/2 \; if \; n \; is \; even \end{cases}$$

The median sampling date ($\tilde{t}$) with ordered times ($t_{(1)}$, $t_{(2)}$, to $t_{(n)}$) will also be determined in this way. The Thiel-Sen trend line will then be computed for an estimate at any time (t) of the expected median concentration (x) as follows:

$$x = \tilde{x} + Q \cdot (\mathrm{t} - \tilde{t}) = (\tilde{x} - Q \cdot \tilde{t}) + Q \cdot \mathrm{t}$$

To construct a confidence band around the Thiel-Sen line, sample pairs (t_i, x_i) will be formed with a sample date (t_i) and the concentration measurement from that date (x_i). Bootstrap samples (B) will be formed by repeatedly sampling n pairs at random with replacement from the original sample pairs. This will be repeated 500 times. For each bootstrap sample, a Thiel-Sen trend line will be constructed using the equation above. A series of equally spaced t_j values will be identified along the range of sampling dates represented in the original sample, j=1 to m. The Thiel-Sen trend line associated with each bootstrap replicate will be used to compute an estimated concentration ($\hat{x}_j^B$). A CI will be constructed for the lower αth percentile $\hat{x}_j^{[\alpha]}$from the distribution of estimated concentrations at each time point (t_j). For a UCL, compute the upper (1-α)th percentile, $\hat{x}_j^{[1-\alpha]}$ at each t_j; for an LCL, compute the lower αth percentile, $\hat{x}_j^{[\alpha]}$ at each t_j.

3.3.2 Parametric Confidence Intervals around a Mean

If compliance data do not show a trend and are normal or log-normal, one-sided parametric CIs around a sample mean will be constructed for each constituent and well pair. The LCL will be calculated as:

$$LCL_{1-\alpha} = \overline{x} - t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

The UCL will be calculated as:

$$UCL_{1-\alpha} = \overline{x} + t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

$\overline{x}$ = compliance sample mean

s = compliance sample standard deviation

n = compliance sample size

$t_{1-\alpha,n-1}$ = obtained from a Student's t-table with (n–1) degrees of freedom at the chosen alpha level (0.01) (Table 16-1 in Appendix D of the Unified Guidance)

If compliance data are distributed lognormally, the LCL will be computed around the lognormal geometric mean as:

$$LCL_{1-\alpha} = \exp\left(\overline{y} - t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

The UCL will be computed around the lognormal geometric mean as:

$$UCL_{1-\alpha} = \exp\left(\overline{y} + t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

$\overline{y}$ = compliance sample log-mean

s_y = compliance sample log-standard deviation

3.3.3 Non-Parametric Confidence Intervals around a Median

Non-parametric confidence intervals around the median will be computed if the compliance data do not show a trend and contain greater than 50% non-detects or are non-normally distributed. The mathematical algorithm used to construct non-parametric CIs is based on the probability p that any randomly-selected measurement in a sample of n concentration measurements will be less than an unknown p x 100th percentile of interest (where P is between 0 and 1). Then the probability that the measurement will exceed the p x 100th percentile is (1–p). The number of sample values falling below the p x 100th percentile out of a set of n should follow a binomial distribution with parameters n and success probability p, where 'success' is defined as the event that a sample measurement is below the p x 100th percentile. The probability that the interval formed by a given pair of order statistics will contain the percentile of interest will then be determined by a cumulative binomial distribution *Bin(x;n,p)*, representing the probability of x or fewer successes occurring in n trials with success probability p. P will be set to 0.50 for an interval around the median. In accordance with the Unified Guidance, a confidence interval around the median will only be calculated if at least seven data points are available.

The sample size n will be ordered from least to greatest. Given p = 0.50, candidate interval endpoints will be chosen by ordered data values with ranks rounded upward to the next higher integers. The ranks of the endpoint will be denoted L^* and U* and are calculated using the following equations (Conover, 1999, p. 144):

$$L^* = np - Z_{1-\alpha}\sqrt{np(1-p)}$$

$$U^* = np + Z_{1-\alpha}\sqrt{np(1-p)}$$

4. CORRECTIVE ACTION MONITORING PROGRAM

Corrective Action Monitoring is performed after a corrective action remedy has been selected and implemented. 35 I.A.C. § 845.680(a)(1) specifies that the corrective action groundwater monitoring program must meet the requirements listed in 35 I.A.C. § 845.650 (*i.e.*, Compliance Monitoring), document the effectiveness of the selected remedy, and demonstrate compliance with the GWPS. Post-Closure Care monitoring as described in **Section 3** will operate concurrently with Corrective Action Monitoring, fulfilling the requirements of 35 I.A.C. § 845.650. This document describes the statistical methods used to document the progress of the selected remedy and demonstrate compliance with the GWPS.

Evaluation of corrective action remedy effectiveness will occur in three phases: remedy progress evaluation, stability evaluation, and attainment evaluation (USEPA, 1992).

1. Remedy progress evaluation occurs after implementation of corrective actions to assess if the remedy is functioning as anticipated.
2. The stability evaluation, which occurs after treatment has been concluded and a re-equilibration period has elapsed, assesses if a new post-treatment steady state in the groundwater has been reached.
3. Attainment evaluation occurs after a new steady state has been achieved and assesses if COC concentrations are below the GWPS.

In accordance with the Unified Guidance, these evaluations only apply to constituents which have previous exceedances of the GWPS. Constituents without previous GWPS exceedances continue to be evaluated according to Compliance Monitoring (per **Section 3**). The Corrective Action GMP for each unit describes the detailed approach to remedy effectiveness evaluation and reporting. Statistical evaluations used in each of these three phases are described below.

4.1 Remedy Progress Evaluation

The goal of remedy progress evaluation is to determine if a groundwater remedy is on track to achieve cleanup standards within the proposed time frame and to inform adaptive management decisions if performance metrics are not achieved. Evaluations of remedy effectiveness include:

- Comparison of the central tendency (*i.e.*, mean or median) of data from corrective action monitoring wells to the GWPS
- Trend analysis of average concentrations in individual wells and in a plume

Unlike Compliance Monitoring, remedy progress evaluation does not result in the determination of exceedances. Instead, the results from these analyses are used to evaluate performance metrics described in the site-specific Corrective Action GMP.

4.1.1 Central Tendency

The two most common central tendency measures of a data set are the sample mean and sample median. The sample mean best represents the central tendency of normally-distributed data; therefore, the mean will be used to represent the tendency if the data are approximately normally distributed and the frequency of non-detects is below 50%. The sample mean is given by the arithmetic average of each value in the sample:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ = sample mean

n = sample count

x_i = i^{th} observation of x

The sample median is the 50th percentile of values in a sample and represents the midpoint of the ordered list of values. Because it is based on rank-order, the sample median is insensitive to data distribution; therefore, the median will be used if the data are not normally distributed or the frequency of non-detects is 50% or greater. The sample median is determined by arranging all values in order and selecting the middle value (or, if an even number of values exists, the mean of the two middle values).

4.1.2 Trend of Average Concentration in Individual Wells and in a Plume

Insight into remedy progress can be gained by evaluating changes in concentration at both the individual well and plume levels.

Trends at the individual well level are evaluated according to **Section 2.5**. To evaluate trends at the plume level, the trend on quarterly average concentrations is evaluated (per **Section 4.1.1**). Quarterly average concentrations in the plume are generated by calculating the mean or median as appropriate based on distribution (**Section 4.1.1**) of concentrations collected during a single sample event. Trend is then evaluated as described in **Section 2.5**. The magnitude of the trend (*i.e.*, slope) may be evaluated according to methods in **Section 3.3.1**.

4.2 Stability Evaluation

In order to evaluate ultimate effectiveness of the remedy, it is critical to evaluate if a new stable equilibrium has been reached after the implementation of corrective action (e.g., completion of source control or conclusion of groundwater extraction). Stability evaluation will be completed using trend analysis as described in **Section 2.5**.

4.3 Attainment Evaluation

Per 35 I.A.C. § 845.680(c), corrective action is considered complete when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years". Accordingly, attainment of the GWPS will be evaluated for well-constituent pairs previously determined to exceed the GWPS. This evaluation will include data collected after groundwater conditions have stabilized (**Section 4.2**).

The Unified Guidance recommends comparing a CI to the fixed GWPS to evaluate attainment of corrective action. The null hypothesis of this test is the reverse of that in Compliance Monitoring: corrective action well groundwater concentrations are assumed to exceed the GWPS unless the statistical test indicates otherwise. The CI will be calculated according to methods presented in **Section 3.3**. For pH, the only parameter with an upper and lower background and GWPS, the GWPS will be attained (*i.e.*, the null hypothesis rejected) when the CI falls within the range of the GWPS (*i.e.*, if the LCL of the CI is above the lower limit and the UCL is below the upper limit). For all other parameters, the GWPS will be attained when the UCL is below the GWPS. Once this

statistical evaluation indicates that GWPS has been met for three years (*i.e.*, that the null hypothesis is rejected), corrective action will be concluded.

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APPENDIX C
MULTI-SITE SAMPLING AND ANALYSIS PLAN

Date
September 4, 2025

Project No.
1940112376

MULTI-SITE SAMPLING AND ANALYSIS PLAN REVISION 2

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MULTI-SITE SAMPLING AND ANALYSIS PLAN REVISION 2

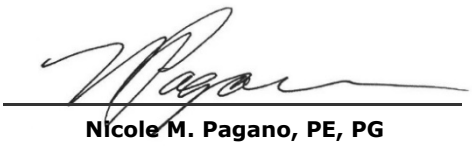
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DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	December 28, 2022	Original Document
Revision 1	October 10, 2023	Update Table A to include the following units to document applicability for the 40 C.F.R. § 257 program: • Coffeen Power Plant Landfill • Duck Creek Power Plant Landfill • Hennepin Power Plant Landfill • Joppa Power Plant Landfill • Miami Fort Power Plant Landfill • Miami Fort Power Plant Pond System • Newton Power Plant Landfill 2 • Zimmer Power Plant Landfill
Revision 2	September 4, 2025	• The document has been restructured to align with typical field project workflows. • Existing text has been edited for clarity and/or expanded with additional content. • The following content has been added: – Advancement of soil borings; rock coring; monitoring well construction, development and abandonment; aquifer testing; and other investigative procedures. – Surface and subsurface soil sampling, surface water sampling, and source water sampling procedures. • Table A – Zimmer Power Plant Units 121, 124, and 125 have been closed and are no longer monitored under 40 C.F.R. § 257; therefore, these units have been removed from Table A • Appendix A – Field Procedures (formerly Standard Operating Procedures) associated with new and existing content have been added or updated as Appendix A. • Appendix B contains Field and Data Forms

DOCUMENT APPLICABILITY BY FACILITY OWNER

Table A. Document Applicability by Facility Owner

Facility & Owner	Unit ID	Unit Name	40 C.F.R. § 257	35 I.A.C. § 845
Baldwin Power Plant Dynegy Midwest Generation, LLC	601	Bottom Ash Pond	X	X
	605	Fly Ash Pond System	X	X
Coffeen Power Plant Illinois Power Generating Company	101	Ash Pond No. 1	X	X
	102	Ash Pond No. 2	X	X
	103	GMF Gypsum Stack Pond	X	X
	104	GMF Recycle Pond	X	X
	105	Landfill	X	
Duck Creek Power Plant Illinois Power Resources Generating, LLC	201/202	Ash Pond No. 1 Ash Pond No. 2		X
	203	GMF Pond	X	X
	204	Landfill	X	
	205	Bottom Ash Basin	X	X
Edwards Power Plant Illinois Power Resources Generating, LLC	301	Ash Pond	X	X
Hennepin Power Plant Dynegy Midwest Generation, LLC	801	Landfill	X	
	802	Ash Pond No. 2	X	
	803	East Ash Pond	X	X
	804	Old West Ash Pond	X	X
	802/805	Ash Pond No. 2 Ash Pond No. 4		X
Joppa Power Plant Electric Energy, Inc.	401	East Ash Pond	X	X
	402	Landfill	X	
Kincaid Power Plant Kincaid Generation, LLC	141	Ash Pond	X	X
Miami Fort Power Plant Dynegy Miami Fort, LLC	113	Landfill	X	
	115	Pond System	X	
Newton Power Plant Illinois Power Generating Company	501	Primary Ash Pond	X	X
	502	Landfill 2	X	
Vermilion Power Plant Dynegy Midwest Generation, LLC	910	North Ash Pond		X
	911	Old East Ash Pond		X
	912	New East Ash Pond		X
Zimmer Power Plant Zimmer Power Company, LLC	122	Landfill	X	

Notes:
35 I.A.C. = Title 35 of the Illinois Administrative Code
40 C.F.R. = Title 40 of the Code of Federal Regulations

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Table 1 Sample Preservation, Containers, and Holding Times
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Figure 1 Organization and Communication Flow Chart

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FP No. 5.09 – Field Soil Boring Log Preparation
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FP No. 5.17 – Rock Core Logging
FP No. 6.01 – Permanent Overburden Well Installation
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Appendix B Field and Data Forms

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%	percent
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
ASTM	American Society for Testing and Materials
CCR	coal combustion residuals
COC	chain of custody
CSM	conceptual site model
DI	deionized
DQO	Data Quality Objective
DPT	direct push technology
EB	equipment blank
FB	field blank
FD	field duplicate
FP	field procedure
GMP	Groundwater Monitoring Plan
HASP	Health and Safety Plan
HBL	Health-Based Level
HNO_3	nitric acid
HSA	hollow-stem auger
HSU	Hydrostratigraphic Unit
IATA	International Air Transport Association
ID	Identifier
IDW	Investigative Derived Waste
MCL	maximum contaminant level
mg/L	milligrams per Liter
mL	milliliters
mL/min	milliliters per minute
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
NAVD88	North American Vertical Datum of 1988
NELAP	National Environmental Laboratory Accreditation Program
NTU	nephelometric turbidity units
ORP	oxidation-reduction potential
POC	point-of-contact
PPE	personal protective equipment
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance and Quality Control
QC	Quality Control
Ramboll	Ramboll Americas Engineering Solutions, Inc.
Ramboll PgM	Ramboll Program Manager

Ramboll PM	Ramboll Project Manager
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SAR	sampling and analysis request
SHP	Vistra Corp's Facility 35 I.A.C. § 845 Safety and Health Plan
SU	standard units
TDS	total dissolved solids
µS/cm	microSiemens per centimeter
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Vistra	Vistra Corp.
Vistra PgM	Vistra Program Manager
VWP	vibrating wire piezometer

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) outlines the tasks typically described in a workplan, Groundwater Monitoring Plan (GMP), Sampling and Analysis Request (SAR), or other project specific scope of work documents collectively referred to as the workplan herein. This document includes procedures to support project objectives. In case of discrepancies, the workplan takes precedence.

1.1 Background

This SAP specifies the procedures and techniques to be used to meet the sampling and analysis requirements set by the United States Environmental Protection Agency (USEPA) under the Final Rule for regulating the disposal of coal combustion residuals (CCR) as solid waste, in accordance with Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257). This SAP also adheres to the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845) for the monitored units listed in **Table A**.

1.2 Objectives

This SAP is intended to ensure that sample collection and analytical activities are conducted in accordance with acceptable protocols that meet Data Quality Objectives (DQOs) as described in the Quality Assurance Project Plan (QAPP; Ramboll Americas Engineering Solutions, Inc. [Ramboll], 2025). The information presented in this SAP will enable field personnel to collect field samples and measurements in a manner that meet the project DQOs.

1.3 Communication Strategy and Project Personnel

The project organization, and roles and responsibilities of the individuals involved in performing the work described within this SAP, are defined in the QAPP. Key project positions relate to project oversight, project management, sampling and analytical data acquisition management, data validation management, and database management are presented in **Figure 1**. Delegation of responsibilities is permitted, but accountability remains with the designated role holder.

2. FIELD PROJECT INITIATION AND EXECUTION

The following subsections provide information on preparing and executing field projects. Field project initiation tasks begin prior to mobilization and include tasks such as arranging for site access and communicating with the facility personnel. Routine procedures for executing work include entry/exit procedures, obtaining daily work permits and communicating with facility personnel.

2.1 Project-Specific Document Review Guidelines

- The following documents should be reviewed prior to mobilization:
- Workplan
- SAP (this document) emphasis on Sections 2 and 3, the applicable text in Sections 4, 5, 6 and 7
- Vistra Corp's (Vistra) Facility 35 I.A.C. § 845 Safety and Health Plan (SHP)
- Health and Safety Plan (HASP)
  - Ramboll personnel should review the Ramboll Multi-Site HASP and the plant-specific information located at the beginning of the document
  - Project personnel not employed by Ramboll, should review the HASP developed by their company

2.2 Site Safety

Field activities will be conducted in accordance with the applicable safety plan(s). The HASP is not part of this SAP and the personnel performing field activities have the responsibility to perform in accordance with health and safety regulations for Vistra, federal, state, and local regulations.

2.3 Site Access and Entry Procedures

The point-of-contact (POC) identified in the SHP should be notified at least 24 hours before the field personnel and subcontractors arrive at the facility. Inquiries should be made as to the conditions at the facility, such as access, weather, or operations that may affect the work. Submit site-specific forms (*e.g.,* Business Partner Badge Form) at least 24 hours in advance of arrival at the facility, if applicable.

Each day the field personnel and subcontractors must check in with security. An appropriate government-issued form of identification (*e.g.*, Driver's License) will be needed to access the facility. Visitor information (*e.g.*, affiliation, reason for visit, etc.) will be documented in the sign-in/out form maintained at the facility. Field personnel and subcontractors will be required to complete the site orientation and/or health and safety briefings required by the facility. Prior to beginning work at any Vistra site, all personnel must also review and acknowledge the Fleet-Wide Contractor Safety Orientation Training. This action must be taken annually.

Field personnel and subcontractors must check in with the facility POC upon initial entry and each subsequent day to obtain a Vistra Work Permit prior to commencing work. Field personnel and subcontractors entering the field activity area will review and act in accordance with the applicable safety plan(s).

Receive authorization from Vistra to access privately and/or publicly owned properties, if required, to perform off-property investigations. Where feasible, off-property access will be coordinated within schedule constraints, such as limiting activities during school hours, peak business hours, etc.

2.4 Pre-Mobilization Activities

The following activities should typically be performed prior to mobilization, if applicable:

- Hold a kick-off meeting with the project team prior to mobilization to review scope of work, schedule, and discuss special equipment needs.
- Secure appropriate equipment to perform the scope of work.
- Acquire proper personal protective equipment (PPE).
- Coordinate subcontractors that may include drillers, laboratories, surveyors, etc.
- Coordinate the management/disposal of investigative derived waste (IDW).
- If applicable to the scope of work, review analytical requirements, request appropriate sample containers from the analytical laboratories, and discuss delivery/pickup of coolers, including weekend deliveries.
- Request proposed locations be surveyed and staked prior to arrival, if necessary.
- Depending on the scope of work, review scope of work with POC identified in the SHP prior to mobilization.

2.5 Mobilization Activities

The following mobilization activities, some of which may also be performed as part of pre-mobilization, should typically be performed on the first day, if applicable:

- Review scope of work, schedule, and discuss conditions that may affect safe execution of the scope of work.
- Evaluate accessibility of sampling locations with proposed equipment.
- Verify the operational status of field instruments following the manufacturer's guidelines and their respective FPs.
- Coordinate subcontractors that may include drillers, laboratories, surveyors, etc.
- Coordinate the management/disposal of IDW.
- Prepare equipment staging areas.

2.6 Demobilization Activities

Demobilization activities may include:

- Site restoration
- Field team lead will meet with the POC prior to departure to summarize work completed and identify any tasks that need to be addressed prior to departure
- Documentation of the number and contents of any IDW containers left on site

- Upon exit from the facility, the field personnel and subcontractors must check out with security. Facility visitor badges should be returned to security on the last day of field activities upon exit from the facility.
- Deliver analytical samples
- Return rental equipment

3. FIELD DOCUMENTATION

Execution of tasks will be documented according to **Field Procedure (FP) No. 1.01** - Field Records and Notes **(Appendix A)**, using forms or logbooks in either written or digital format.

Data generated in the field will be reduced and validated, as appropriate, before reporting. Hardcopy data, including field data forms, notes, and Chain of Custodies (COCs), should be scanned as PDFs using a document setting (not photo mode), ideally in black and white or grayscale, at approximately 150–200 DPI. The Laboratory PM should transmit field data to the Laboratory Liaison within 5 days.

4. INVESTIGATIVE METHODS

This section details procedures used for site investigations, focusing on data collection methods such as drilling, monitoring well installation and aquifer test methods. These methods are designed to gather high quality data (*e.g.,* soil properties and hydraulic conductivities) for use in environmental assessments and/or remediation plans and support informed decision-making.

4.1 Soil Boring and Classification

Soil borings may be advanced by multiple drilling techniques as detailed in **FP No. 5.07** - Subsurface Soil Sampling - Direct Push Technology**, FP No. 5.08** - Subsurface Soil Sampling – Split Spoon and Shelby Tube, **FP No. 6.01** - Permanent Overburden Well Installation (**Appendix A**) and/or the workplans and may include:

- Direct push technology (DPT)
- Hollow-stem auger (HSA)
- Rock coring, typically wire-line
- Sonic drilling
- Air rotary drilling
- Mud rotary drilling
- Dual-wall reverse circulation

Prior to drilling, the drill operator and field team verify that each proposed location can be reached safely, maintain the required clearance from overhead utilities or other structures, and complete subsurface clearance in accordance with the applicable work plans, SHP, and the Multi-Site HASP. Careful planning and implementation are essential to ensure efficient soil recovery and minimize cross-contamination.

Soil samples will be collected at an increment and frequency necessary to meet project objectives. Samples will be logged by a field engineer, geologist, or qualified geotechnical/geophysical equipment operator, where required. Notes will include information described in **FP No. 5.01** - Soil Classification and documented in accordance with **FP No. 5.09** - Field Soil Boring Log Preparation (**Appendix A**). This standardized classification and description procedure for soil logging provides consistency across phases of field work, as well as across sites as it provides for a clear and complete summary of subsurface field conditions observed during the implementation of soil investigation activities.

The visual identification techniques detailed **FP No. 5.01** - Soil Classification are consistent with the Unified Soil Classification System (USCS). The USCS is based on grain size and response to physical manipulation at various water contents to define plasticity and texture. This system is commonly used for classifying soils encountered in boreholes, test pits and surface sampling. Detailed classification criteria are summarized in **FP No. 5.01** - Soil Classification, however, these criteria may not be applicable to all projects. Workplans may specify modifications or additional criteria.

All boreholes will be abandoned in accordance with the workplan, **FP No. 6.11** - Environmental Well Decommissioning (**Appendix A**), state specific regulations (if applicable) and regulatory

approval, if required. The appropriate state, and/or local borehole abandonment form(s) must also be completed to document abandonment activities. Abandonment documentation will be provided to the appropriate state and county agency.

4.2 Test Pits

Test pits are typically excavated using either an excavator or backhoe as detailed in **FP No. 5.02** - Subsurface Soil Sampling – Test Pits and Excavations (**Appendix A**) and/or the workplans. Prior to excavation, the excavator operator and field team will verify that each proposed location can be reached safely, maintain the required clearance from overhead utilities or other structures, and complete subsurface clearance in accordance with the applicable work plans, Vistra's SHP, and the Multi-Site HASP.

During excavation, excavated materials and the open pit will be visually inspected and described by a field engineer, geologist, or qualified geotechnical/geophysical equipment operator in accordance with **FP No. 5.01** - Soil Classification (**Appendix A**). Once the target depth specified in the workplan is reached, the operator will lower the excavator bucket to obtain a bulk soil sample from the bottom and/or sidewall(s). When the bucket is brought to the ground surface, the soil will be screened and/or collected by the field technician as directed in the workplan

After excavation, the depth and lateral dimensions of the test pit will be measured, photographed, and documented. The pit will then be backfilled with the excavated material (or imported fill, if required) in lifts not exceeding 12 inches and compacted with the excavator bucket, unless otherwise specified in the workplan.

Personnel shall not enter an excavation at any time unless the workplan and Multi-Site HASP specifically authorize entry and the excavation has been properly sloped, shored, or benched in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926 Subpart P and deemed safe by a competent person. Excavations 5 feet deep or greater shall be benched, shored, and/or sloped per these OSHA requirements.

4.3 Rock Coring and Core Logging

Bedrock investigations are typically advanced through wireline coring methods as detailed in **FP No. 5.17 -** Rock Core Logging (**Appendix A**) and/or the workplans. These drilling methods may be utilized for the construction of monitoring wells or for collecting intact rock core for testing. Prior to drilling, the drill operator and field team shall verify that each proposed location can be reached safely, maintain the required clearance from overhead utilities or other structures, and complete subsurface clearance in accordance with the applicable work plans, Vistra's SHP, and the Multi-Site HASP. Careful planning and implementation are essential to ensure efficient core recovery and minimize cross-contamination. For instance, coreholes through contaminated areas should include a surface casing that is firmly seated in a confining layer to prevent cross-contamination. The coring pressure should be adjusted to maximize core recovery, and coring with worn or damaged bits should be avoided.

Rock cores will be logged by a field engineer, geologist, or qualified geotechnical/geophysical equipment operator, where required. Characteristics like fractures, voids, weathered zones, changes in lithology, and rig reactions during drilling as specified in **FP No. 5.17 -** Rock Core Logging (**Appendix A**) should be noted. This standardized classification and description procedure for core logging provides consistency across phases of field work, as well as across

sites as it provides for a clear and complete summary of subsurface field conditions observed during the implementation of bedrock investigation activities.

All coreholes will be abandoned in accordance with the workplan, **FP No. 6.11** - Environmental Well Decommissioning (**Appendix A**), state specific regulations (if applicable) and regulatory approval, if required. The appropriate state, and/or local borehole abandonment form(s) must also be completed to document abandonment activities. Abandonment documentation will be provided to the appropriate state and county agency.

4.4 Monitoring Well Installation, Maintenance and Water Level Monitoring

Monitoring wells may be installed to characterize the aquifer, develop a conceptual site model (CSM) or establish a groundwater monitoring system.

4.4.1 Construction

The workplan will provide the drilling method to be used in advancing the borehole or corehole.

Overburden and bedrock monitoring wells will be constructed in accordance with **FP No. 6.01** - Permanent Overburden Well Installation (**Appendix A**) and state and county requirements. Screen interval and length will be based on the existing CSM and information obtained from subsurface samples and drilling.

Wells will typically consist of the following:

- 2-inch inner diameter Schedule 40 polyvinyl chloride (PVC) riser with a 0.01-inch machine slotted well screen
- Filter-pack sand extending 2 feet above the screen top.
- Filter-pack seal extending 2 feet above the filter-pack sand consisting of bentonite in the form of time-release pellets (preferred), chips or bentonite grout. If necessary, a transition sand layer can be used which consists of a smaller grain size than the filter-pack, and it is placed on top of the filter-pack to protect against grout intrusion, particularly for deep well installations. The thickness of the transition sand typically varies from one or two feet. An alternative to transition sands is to use a longer interval of filter-pack seal material such as bentonite pellets.
- Annular space seal extending to no less than 2 feet below ground surface (bgs) consisting of bentonite chips (shallow wells only), bentonite grout or neat Portland cement. At least an additional 2 feet of filter-pack seal may be placed prior to placement of Portland cement. The remaining annular space will be filled with concrete during installation of the protective casing and pad.
- Well surface seal (well pad) is constructed by filling the remainder of the annular space (following setup of the annular space seal) and the pad form with concrete. Pads will be approximately 2 feet by 2 feet and 8-inches deep and will be slightly raised in the center and sloped to the sides to allow positive drainage, away from the well. Well pads will be completed with either an aboveground surface completion (preferred) or a flushmount completion.
  - An aboveground completion typically utilizes a 4-inch by 4-inch metal casing to protect the PVC well riser stick-up. The protective casing will be placed such that the bottom of the protective casing is within the annular space and below the bottom of the pad. The protective casing should extend above the pad approximately 30 inches, no more than

36 inches. The PVC well riser will be cut level to the protective casing hasp. The annular space between the PVC riser and protective casing can be filled with coarse sand to prevent spiders and other insects from nesting within the casing. A weep hole should be drilled into the protective casing to allow water to drain. The well should be locked using a like-keyed padlock designated for Vistra sites.

  - A flushmount completion typically utilizes a 1-foot diameter vault to protect the well from damage and surface water infiltration. The interior of the vault should be cleared of concrete 4- to 5- inches below the top of the vault prior to allow for a separation of 2-inches from the bottom of the vault to the top of the PVC riser and installation of a locking expansion plug and lock using a like-keyed padlock designated for Vistra sites.

- Four 5-foot steel bollards will be installed into holes no less than 2 feet bgs. The annular space around the bollard, and the inside of the bollard, will be filled with concrete.

The following will be documented throughout the well construction process:

- Details and quality of well materials used *(e.g., casing integrity, O-rings, etc.)*.
- The ease or difficulty of drilling progress and note any potential influence on well construction integrity, if applicable.
- Issues encountered during well construction and their potential impact on well construction integrity, if applicable.
- Joints are threaded properly and tightened securely.
- Methods for casing and well material installation and their positions within the borehole.
- Measurements of material depths and the frequency of these measurements during well construction.
- Volumes of materials placed match calculated material volumes and note any significant discrepancies.
- Well integrity confirmation following construction using a downhole camera advanced within the casing and screen to identify potential issues with joints, if applicable.

It may be necessary to install a surface casing to isolate a water-bearing zone, or to seal off a contaminated zone, prior to installing the monitoring well. When a surface casing is used followed by installation of a monitoring well screened below the limits of the surface casing at depth the result is a double-cased monitoring well. The annular space seal should occupy the space between the PVC well casing and the surface casing and the annular space seal should be constructed as described above.

Paired monitoring wells constructed to evaluate the vertical extent of impact and vertical flow should be constructed within 5 feet of each other. This distance can be increased if the drill rig cannot be set up within 5 feet, or it would result in an unsafe working environment for the drill crew.

Monitoring well construction and variations due to field conditions (*e.g.,* borehole refusal) will be documented in accordance with **FP No. 6.15** - Well Construction Record (**Appendix A**). The appropriate state, and/or local well construction form(s) will be completed and submitted to the appropriate agency.

4.4.2 Development

Monitoring wells will be developed, and details will be recorded in accordance with **FP No. 6.07** - Well Development (**Appendix A**)**.** The primary method for well development is a pump. Bailers may be used for development for low yielding wells or wells with a significant amount of sediment to remove excess sediment.

4.4.3 Abandonment

Monitoring wells will be abandoned in accordance with the workplan, **FP No. 6.11** - Environmental Well Decommissioning (**Appendix A**), state specific regulations (if applicable) and regulatory approval, if required. The appropriate state, and/or local borehole abandonment form(s) must also be completed to document abandonment activities. Abandonment documentation will be provided to the appropriate state and county agency.

4.4.4 Water Level Monitoring

Groundwater level measurements will be collected prior to the start of each sample collection event as outlined in the workplan. Water level measurements will be collected within the same day, or at least within 24 hours prior to commencement of groundwater sampling. Dedicated sampling equipment (pumps and tubing) will be placed within the water column in a manner that allows water levels to be measured without removing this dedicated equipment, when feasible. The equipment will remain in place during water level measurements. Groundwater level measurements will be collected to the hundredth of a foot in accordance with **FP No. 6.04** - Groundwater and Free Product Level Measurements (**Appendix A**).

4.4.5 Monitoring Well Maintenance

Monitoring well inspection reports will be used to identify maintenance needs. Maintenance activities will be conducted to preserve the integrity of the well and to ensure the collection of representative samples. Any corrective actions that could impact the surrounding habitat—such as vegetation removal or surface pad repairs—will be coordinated with facility personnel prior to initiation. Well inspection procedures are described in **Section 5.3.1**.

4.5 Aquifer Characterization

There are a variety of procedures that can be employed to characterize an aquifer. Field methods for collecting hydraulic conductivity data are detailed in **FP No. 6.03** - Estimation of Hydraulic Properties – In-Situ Hydraulic Conductivity (Slug) Testing and **FP No. 6.08** - Estimation of In-Situ Hydraulic Properties – Aquifer Tests (**Appendix A**).

4.5.1 Single-Well Tests

Hydraulic conductivity can be determined in the field using a variety of single-well test methods (**FP No. 6.03** - Estimation of In-Situ Hydraulic Properties – Hydraulic Conductivity [Slug] Tests [**Appendix A**]), each addressing specific conditions, and/or data collection objectives. These methods are commonly referred to as bail down or slug tests and are performed by removing a slug (known volume) of water from a well and observing the recovery of the water surface to its original level (rising head test). Similar results can be achieved by removing a cylindrical "slug" of inert solid material, pressurizing the well casing, depressing the water level, and suddenly releasing the pressure to simulate removal of water from the well. Hydraulic conductivity can be determined in monitoring wells with well screens below the water table using the falling head

test. The falling head tests are performed by adding a known volume of water or inserting a cylindrical "slug" of inert solid into the well and observing the recovery of the water surface to its original level.

Observation wells in which the well screen intersects the water table (*e.g.,* water table wells) will be tested by methods involving the use of a solid slug or removal of water from the well in order to minimize the potential for well screen filter-pack interference. Addition of water to any monitoring well shall be avoided whenever possible. In cases where addition of water to a well is unavoidable, it should be of documentable known quality and 3 times the volume of water added should be removed upon completion of the test.

In high hydraulic conductivity aquifers (*i.e.,* where heads in the well recover to pre-test levels within 60 seconds), a pneumatic slug test can be used (**FP No. 6.03** - Estimation of In-Situ Hydraulic Properties – Hydraulic Conductivity [Slug] Tests [**Appendix A**]). Pneumatic slug testing includes sealing the wellhead and applying air pressure to displace (lower) the water column until the pressure exerted by the water and air are equal, at the point the water level stabilizes. A release valve is then quickly opened, instantaneously releasing the air pressure. The water level recovers, providing a rising head slug test. A pressure transducer and data logger are utilized to record the changes in water level and time. A pneumatic slug test cannot be performed on a well with a partially saturated screen/open interval (*i.e.,* screened/open interval that crosses the water table).

4.5.2 Packer Testing

Packer pressure tests are controlled field tests in which specific intervals within a corehole are isolated using inflatable packer assemblies, and the hydraulic response to constant pressure injection is monitored. The data obtained from these tests can be used to estimate site-specific hydraulic properties of the bedrock aquifer, evaluate well performance, and identify hydraulic characteristics such as fracture conductivity and bedrock competency.

Packer testing parameters will be described in the project workplan. These tests and subsequent data analysis should be performed under the direction of a field engineer, geologist, or qualified geotechnical/geophysical equipment operator with experience in conducting packer pressure tests. Ramboll oversight personnel should understand and be familiar with the operation of the equipment and materials that are required for packer pressure tests.

Significant packer pressure test strategy decisions will be approved by the Ramboll Project Manager (Ramboll PM) before the initiation of associated field activities and documented in the workplan. The workplan will be designed for the collection of quality data to meet the objectives of the packer pressure test program and will include some discretion in the field depending on the conditions encountered; however, significant departure from prescribed testing activities should be discussed with and approved by the Ramboll PM.

4.5.3 Multiple-Well Tests

Multiple-well tests (*e.g.,* step-drawdown test, constant-rate aquifer test [drawdown test or recovery test]), controlled pumping tests, collectively referred to as pumping tests, are performed by pumping water from one well and observing the resulting drawdown in nearby wells (**FP No. 6.08** - Estimation of In-Situ Hydraulic Properties –Aquifer Tests [**Appendix A]**). Tests conducted with wells screened in the same water-bearing formation provide hydraulic

conductivity data. Tests conducted with wells screened in different water-bearing zones furnish information concerning hydraulic communication between units. Multiple-well tests for hydraulic conductivity are advantageous because they characterize a greater proportion of the subsurface and thus provide a greater amount of detail. Multiple-well tests are subject to similar constraints to those listed above for single-well tests. Some additional problems that should be considered in conducting a multiple-well test include: (1) storage of potentially contaminated water, (2) impact on existing plumes, (3) monitoring a greater area which may include recharge/discharge zones, (4) well spacing and placement, and (5) pump rate stability.

4.6 Transducer Installation and Monitoring

A single transducer equipped with a data logger (*e.g.,* HOBO® MX2001 or similar), preferably vented (*i.e.,* capable of auto-compensating for barometric pressure), may be installed in select wells to measure groundwater elevation. If a non-vented (absolute) transducer is used, a continuous recording barometer may also be required. The barometric data will be used to correct for potential water level changes in confined or semi-confined aquifers resulting from atmospheric pressure variations.

The transducer and barometer should be installed and calibrated following similar methods as outlined in **FP No. 6.08** - Estimation of In-Situ Hydraulic Properties – Aquifer Tests (**Appendix A**) and specific installation requirements will be outlined in the workplan.

Manufacturer's guidelines should be consulted before beginning the calibration process, and technical support should be contacted if any issues arise. Data loggers and transducers susceptible to damage from site environmental conditions may require additional housing and protection. Special installation requirements for the data logger and transducer will be detailed in the workplan.

During episodic depth to water collection at a well containing a transducer, two depth-to-groundwater measurements will be collected: a manual measurement and an instantaneous reading from the transducer, with stored data downloaded using the appropriate software (*e.g.,* HOBOconnect®).

4.7 Vibrating Wire Piezometer Installation and Monitoring

A vibrating wire piezometer measures pore water pressure by detecting changes in the tension of a steel wire attached to a flexible diaphragm. When water pressure increases, it deflects the diaphragm, which in turn changes the tension in the wire. An electromagnetic coil excites the wire, causing it to vibrate, and the instrument measures the wire's natural frequency of vibration. Since the frequency is directly related to the wire's tension, and thus to the applied pressure, the system converts this frequency into an accurate pressure reading using calibration data. The pressure reading is then converted to feet of water to calculate the groundwater elevation.

Vibrating wire piezometers (VWP) are typically installed in 3-inch diameter boreholes or coreholes drilled using an appropriate drilling method as outlined in **Sections 4.1 and 4.3**. The depth of the borehole should intersect each hydrostratigraphic unit (HSU) to be monitored. Once drilling is completed, the borehole depth is measured and recorded along with the barometric pressure, and zero readings from each of the VWPs sensors (pressure and temperature) with a handheld readout prior to installation.

The VWP sensors must be completely saturated prior to recording zero readings. Refer to the manufacturer's manual on recording zero readings. To install the VWPs, a tremie pipe string, made of 1-inch diameter schedule 40 PVC fitted with a tee at the bottom, is assembled at the surface and marked with the desired depth bgs for each sensor. The pipe string is then lowered into the borehole, and each VWP sensor is attached to the outside of the pipe with zip ties at each marked location. One or multiple VWP sensors can be deployed in each borehole.

A cement/bentonite slurry is pumped into the tremie pipe string to backfill the borehole from the bottom to top. The tremie pipe string is grouted in place with a cement/bentonite slurry to mimic the subsurface lithology. VWP manufacturers (*i.e.,* GEOKON) recommend using one grout mix applicable to the entire length of the borehole for cost effectiveness and practicality. Refer to the manufacturer's recommendations for the appropriate grout mix for specific lithology. Grout mix decisions will be approved by the Ramboll PM before the installation of the VWPs and documented in the workplan. If the grout mix needs to vary based on lithology, the appropriate mix will be specified by the Ramboll PM or detailed in the workplan. After grouting, additional pore pressure and temperature readings should be collected with a handheld readout to confirm that the sensors and cables were not damaged during installation.

Data can be recorded at the desired frequency (*e.g.*, hourly, daily) using a datalogger, or manually with a handheld readout device. Manufacturer software (*e.g.,* GEOKON Agent) is used to configure the datalogger and download the data. In addition to hydraulic pore pressure, required data includes temperature (typically collected from a thermistor embedded in the VWP sensor) and barometric pressure. This data will be used to correct for potential water level changes resulting from atmospheric pressure variations. The barometer should be installed, calibrated, and data should be collected following similar methods as outlined in **FP No. 6.08** - Estimation of In-Situ Hydraulic Properties – Aquifer Tests (**Appendix A**) and specific installation requirements described in the workplan. Manufacturer's guidelines should be consulted before beginning the calibration process, and technical support should be contacted if any issues arise.

4.8 Geophysical Methods

Geophysical data collection provides quantitative and qualitative data on physical properties of the subsurface materials, such as conductivity/resistivity, and density, etc. Geophysical data may be collected and evaluated as surface surveys, surface to borehole, borehole-to-borehole, single borehole, and water-born methods. For many surface, and some borehole survey methods, interpretation requires geophysical data be calibrated with nearby physical data to accurately describe subsurface characteristics. Data may be presented as graphs, plan view contour maps, two-dimensional cross-sections, or in some cases, three-dimensional imaging software.

Geophysical data resolution and accuracy depends on the degree of interpolation between measured points, depth (resolution generally decreases with depth), and the degree of physical property contrast between geologic structure(s) and targets in the subsurface. These tests and subsequent data analysis should be overseen by an experienced field engineer, geologist, or qualified geotechnical/geophysical equipment operator, skilled in conducting geophysical methods and interpreting their results. These characteristics will be integrated into geophysical field method evaluation. Geophysical data may be used to begin data gathering or enhance existing data on:

- Geologic lithology, thicknesses, and bedrock surface elevations
- Aquifer characterization (depth to water table, water quality, fracture mapping)

- Buried structure location and depth
- Bathymetry
- Sediment thickness
- Sediment surface structures and morphology

4.9 Surface Water Level Monitoring

Staff gages can indicate known elevations in several ways: by visual readings from marked signs or structures, by physically measuring the water depth from a reference point of known elevation, or by using a pressure transducer installed within a pipe attached to a nearby structure. When possible, surface water levels should be monitored using site-specific staff gages. The location must be safely accessible for field staff and will preferably be away from areas of turbulent flow, which may cause inaccurate surface water elevation readings or dislodge the staff gage from the structure.

A 2-inch diameter PVC pipe, preferably Schedule 80, or steel pipe is attached vertically to a stationary structure using corrosion-resistant brackets and fasteners. The bottom of the pipe should be installed deep enough that water will still be present within the pipe during average low water periods, but high enough that the bottom of the pipe will not become obstructed by sediment and/or debris.

Once an appropriate location is established, and the staff gage is installed, the location should be surveyed to establish a benchmark reading and a transducer should be installed at the staff gage location. For the development of contour maps, staff gage elevation data will be obtained, preferably during collection of episodic water levels. If it is not possible to install a site-specific staff gage in a surface water body (or bodies), gaging data available through the United States Geological Survey (USGS) and/or the appropriate state-specific agency will be used. River stage data will be converted to elevation in the same datum used for groundwater elevations (North American Vertical Datum of 1988 [NAVD88]).

5. SAMPLING METHODS

5.1 Sample Naming, Labeling, Handling, Shipping, and Chain of Custody

Sample labeling, handling, and COC requirements are described in **FP No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**).

5.1.1 CCR Unit (or Multi-Unit) Identification

Each CCR unit (or multi-unit) will be identified with a 3-digit CCR unit (or multi-unit) identification code (Unit Identifier [ID] or Multi-Unit ID) provided in the workplan.

5.1.2 Sample Identification

Each sample collected will be assigned a Unique Sample ID which includes the Unique Location ID (*e.g.,* XPW-01). Solid phase samples collected will be assigned a Unique Sample ID which consists of the Unique Location ID followed by the depth of the sample in parenthesis, for example, XPW-01(10-12) is a solid phase sample collected from boring location XPW-01 at a depth between 10 to 12 feet bgs. All samples will be labeled in a clear and precise way for proper identification in the field, laboratory, and progress reports.

5.1.3 Sample Container, Volume, Preservation and Holding Times

Aqueous samples will be containerized, preserved, and stored in accordance with **FP No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**). Sample containers, volumes, preservatives, and holding times for aqueous samples are summarized on **Table 1**. Prior to initiating sampling activities, the analytical laboratory will verify sample container, volume, preservation, and holding times. The laboratory will provide the appropriate sample containers with preservatives.

Solid phase samples will be containerized, preserved, and stored in accordance with **FP No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**). Sample containers, volumes, preservatives, and holding times for soil samples should be specified in the workplan and/or by the analytical laboratory. Prior to initiating sampling activities, the analytical laboratory will verify sample container, volume, preservation, and holding times. The laboratory will provide the appropriate sample containers with preservatives

5.1.4 Sample Shipping

Transportation and shipping requirements are detailed in **FP No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**). Deviations from the packing and shipment FP are allowable if the samplers deliver the samples to the laboratory themselves, or a laboratory courier picks up the samples; however, alternate packing and shipment methods must preserve sample integrity and COC, as well as follow applicable United States Department of Transportation (USDOT), International Air Transport Association (IATA), and carrier-specific regulations and requirements. Samples collected during field investigations must be classified prior to shipment, as either environmental or dangerous goods samples.

As it pertains to groundwater sampling the shipment of the following preserved samples is also not regulated provided the amount of preservative used does not exceed the amounts specified in 40 C.F.R. § 136.3. Specifically, 40 C.F.R. § 136.3(e) Table II, note 3, states: "For the

preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials:"

- "Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater)"
- Pre-preserved sample containers received from a laboratory do not exceed this amount of preservative. As related to this groundwater monitoring, the aforementioned preservative (HNO_3) pertain to metals in groundwater samples.

5.1.5 Sample Custody

COC procedures are required by USEPA guidance and will be conducted in accordance with FP **No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**).

Samples collected must be maintained under secure conditions and documented through COC procedures. A sample is under a person's custody if the following requirements are met:

- The sample is in the person's possession
- The sample is in the person's view after being in the person's possession
- The sample is in a secured location after being in the person's possession

Field personnel are responsible for the custody of samples until custody is transferred. Sample containers will be properly identified, labeled, handled, and transported in accordance with **FP No. 1.02** - Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix A**). The COC will be created for the site-specific sampling event for use in tracking custody of the physical samples from the field to analysis. Each program to be monitored will be listed in the Requested Analyses section, rather than parameters for routine sampling events. An example COC is provided in **Appendix B**.

When transferring the possession of samples, the individual relinquishing the sample will sign the "relinquished from" line on the COC. If a team is involved in the sample collection, only one team member is required to sign the COC. The receiving individual will then sign the COC, noting the date and time the samples were received. This record documents the transfer of sample custody from the sampler to another person. The original COC will accompany the sample shipment. A copy of the COC will be retained to document the transfer of custody. The hard copy will be scanned and saved in the project file.

5.2 Soil Sampling

A field engineer, geologist, or qualified geotechnical/geophysical equipment operator will classify soils utilizing the United Soil Classification System (USCS) in accordance with ASTM International (ASTM) Standard Procedure ASTM D2488 and will record soil sampling data, field conditions, sampling depths and other sampling details in accordance with the QAPP (Ramboll, 2025), **FP No. 5.01** - Soil Classification, **FP No. 5.02** - Subsurface Soil Sampling Test Pits and Excavations, **FP No. 5.04** - Surface Soil Sampling, **FP No. 5.07** - Subsurface Soil Sampling - Direct Push Technology, **FP No. 5.08** - Subsurface Soil Sampling – Split Spoon and Shelby Tube, **FP No. 5.09** - Field and Soil Boring Log Preparation, **FP No. 5.15** - Stockpile Sampling, **FP No. 5.17** - Rock Core Logging (**Appendix A**), and the workplan.

5.2.1 Surface Soil Samples

Surface soil samples may be collected from soil borings, soil probes, test pits, hand augers, hand tools (shovel, trowel, spatulas, etc.), or similar apparatus in accordance with **FP No. 5.04** - Surface Soil Sampling (**Appendix A**). Surface soil samples may be collected as a composite sample, consisting of an appropriate number of sub-samples or increments over an appropriate area (as determined on a site-specific basis) or as discrete samples when collected from soil boring locations. The use of composite versus discrete samples will be identified in the workplan. If gravel or cobbles are encountered at the surface, the sample will be collected from soil just below the gravel/cobbles. If the surface is vegetated, the surface soil sample will be collected just below the root zone.

5.2.2 Subsurface Soil Samples

Subsurface soil samples may be collected from soil borings, soil probes, test pits, hand augers, hand tools (shovel, trowel, spatulas, etc.), or similar apparatus (**FP No. 5.02** - Subsurface Soil Sampling - Test Pits and Excavations, **FP No. 5.07** - Subsurface Soil Sampling - Direct Push Technology, **FP No. 5.08** - Subsurface Soil Sampling – Split Spoon and Shelby Tube, **FP No. 5.15** - Stockpile Sampling; **Appendix A**). Subsurface soil samples will generally be collected as discrete samples, typically over a 6-inch interval or as determined based on observed soil horizons, indications of CCR or other materials of interest.

5.3 Groundwater Sampling

This section describes groundwater sampling collection methods and requirements. The methods listed here are consistent with requirements of 40 C.F.R. § 257 and 35 I.A.C. § 845. Groundwater sampling locations will be provided in the workplan and will be sampled by low flow methods. Sampling activity details will be recorded on field and data forms (**Appendix B**). General field operations are outlined in the FPs described herein and presented in **Appendix A**.

All activities described below that include sample and equipment handling will be conducted by qualified field staff trained in the use of the associated equipment. The staff will be equipped with appropriate PPE including disposable nitrile gloves during the handling of samples and any equipment that comes in contact with samples so as to preserve the integrity of the sample and avoid cross contamination between wells and other introduced interferences.

Groundwater samples will be collected using low flow sampling techniques in accordance with USEPA guidelines. Well sampling will be conducted with dedicated equipment to limit the possibility of cross-contamination. However, non-dedicated equipment which comes into contact with well water will be cleaned according to **FP 14.01** - Sampling Equipment Decontamination (**Appendix A**). Downhole equipment (*i.e.,* transducer and cable) should be removed prior to deploying non-dedicated sampling equipment.

5.3.1 Well Integrity

Each monitoring well will be inspected for integrity prior to sampling, and the findings—including any deficiencies—will be recorded on the Well Evaluation Form (**Appendix B**). Maintenance activities will be conducted to preserve the integrity of the well and to ensure the collection of representative samples. Any corrective action that could affect the surrounding habitat (*e.g.,* vegetation clearing or surface-pad repairs) will be coordinated with facility personnel before work

begins. During a well integrity inspection, the following items must be observed and documented:

- Accessibility and visibility of the well: condition of identification markers, vegetation encroachment, and general site access
- Well-pad integrity: evidence of cracking, spalling, heaving/settlement, or inadequate slope for drainage
- Protective-casing condition: dents, corrosion, paint condition, and confirmation that locks are present and functional
- Well-cap condition: intact vs. damaged, vented vs. non-vented (as appropriate for the location)
- Evidence of sediment build-up: turbidity, reduced yield, or other indications that siltation may be restricting flow into the screened interval
- Presence of internal obstructions: debris, fallen equipment, or other materials that could interfere with sampling or instrumentation

Significantly compromised monitoring wells must not be sampled. Photographs of the well will be taken, and the issues immediately communicated to the Vistra Program Manager (Vistra PgM) and the Ramboll Program Manager (Ramboll PgM) for evaluation, repair, and/or abandonment.

5.3.2 Calibration of Low Flow Sampling Equipment

Multiparameter water quality meters should be tested and calibrated before each field event according to the manufacturer's specifications to minimize erroneous data. If possible, calibration should be done in a sheltered area away from wind, dust, and temperature fluctuations. Field staff should follow the manufacturer's guidelines for calibration and contact technical support if needed. Before calibration, ensure sensors are properly installed and batteries are sufficiently charged.

Water quality meters for pH and turbidity should be calibrated daily before sampling and checked for accuracy at least once during and after each sampling day. Flag and evaluate any unusual or suspect pH measurements, with additional calibration performed if necessary. Turbidity meters should be checked daily before and after sampling. Flag and assess erratic measurements for data impact before reporting.

Perform calibration or verification daily prior to sampling. Ensure correct units are selected (**Table B**) and clean sensors with distilled water before and between calibrations.

Daily calibrations, calibrations verifications, and bump checks performed during a sampling event should be recorded on either the calibration form provided in **Appendix B,** or a manufacturer provided calibration form for every day that sampling occurs. In addition, rental vendor calibrations should be provided for each instrument used during a sampling event.

5.3.3 Low flow Sampling Equipment and Process

Low flow sampling is synonymous with low-stress sampling; personnel conducting low flow sampling must consider this and should be familiar with this sampling technique. The purpose of low flow sampling is to collect samples that are representative of ambient groundwater conditions in the aquifer. This is accomplished through use of low discharge pumping rates that equate to

the groundwater infiltration into the well. Pump discharge rates between 100 and 500 milliliters per minute (mL/min) are typical. Higher rates are possible in highly permeable formations. Pump intakes should be located within the middle of the screened interval. Low flow sampling conditions have been reached when the following conditions have been met:

- The water level within the well has stabilized during pumping.
- The water being removed is from the middle of the screened interval.
- The measurements of water quality indicators have stabilized.

The following equipment should be used when low flow sampling:

- Dedicated positive displacement bladder pumps capable of withdrawal at a constant rate between 100 and 500 mL/min and can meet the designed lift requirements.
- Multiprobe water quality meter equipped with a flow-through cell. Utilizing a two-detector optical turbidimeter (HACH™) or equivalent to measure turbidity is preferable.
- All necessary tubing required to connect the pump to the flow-through cell.
- Electric water level indicator(s) capable of measurement to the hundredth of a foot and long enough to record water levels at all monitoring wells on site (which may be greater than 100 feet below the measuring point).
- A graduated cylinder to measure flow rate and a calibrated bucket to collect and quantify the volume purged.
- Low flow sampling field forms (Appendix B), pens, and field book.

Low flow groundwater sampling will be conducted in accordance with **FP No. 6.20** - Groundwater Sampling - Low Flow (**Appendix A**). During well purging and throughout sample collection, field parameters are continually monitored and recorded using probes in a flow-through cell. The groundwater quality meter will be calibrated, operated, and maintained according to manufacturer's specifications and as described in **FP No. 6.20** - Groundwater Sampling - Low Flow (**Appendix A**) and **Section 5.3.2**. Measurements will be recorded at a rate equivalent to the time required to fill the flow-through cell volume. For example, if the volume of the flow through cell is 500 milliliters (mL) and the pumping rate is 250 mL/min; one reading should be taken every 2 minutes. Stabilization criteria measurement time intervals are dependent on the flow rate. Stabilization is achieved when three consecutive readings have fallen within the ranges of the parameters in **Table B** below. Exceptions for one or more stabilization parameters are allowable under some sampling conditions (*i.e.*, extreme heat or cold, very high turbidity, etc.).

Table B. Groundwater Stabilization Parameters

Field Parameter	Stabilization Criterion
Specific Conductance	± 3 percent (%) microSiemens per centimeter (µS/cm) at 25 degrees Celsius (°C)
pH	± 0.1 Standard Units (SU)
Temperature	± 3 % ºC
Dissolved Oxygen	± 10% or ± 0.2 milligrams per liter (mg/L), whichever is greater
Eh or oxidation reduction potential (ORP)	± 10 millivolts (mV)
Turbidity	<10 nephelometric turbidity units (NTUs) or ± 10% when turbidity is greater than 10 NTUs
Depth to Water	<0.3 feet total drawdown from static (during pump start-up, drawdown may exceed the 0.3-feet target and then recover as flow-rate adjustments are made)

When stabilization is achieved the sample may be collected through the pump tubing after the flow-through cell has been disconnected. The flow rate should not be adjusted following parameter stabilization or during sample collection.

Additional goals for the data quality indicators (DQIs; defined in QAPP [Ramboll, 2025]) precision and accuracy are provided in **Table 2**.

5.3.4 Sample Collection

Once low flow sampling conditions are met, sample collection may begin. Without turning the pump off, or changing the flow rate, the flow-through cell is removed, and the samples are collected directly from the pump discharge tubing at the same flow rate that was used during well purge and stabilization. Only one sample will be collected per well per sampling event and analyzed for all parameters specified in the SAR, or in lieu of a SAR, the workplan. Samples will be placed in appropriate laboratory supplied containers and preserved in accordance with the analytical method requirements listed in **Table 1**. Samples will be collected in order of analyte stability, as summarized below.

- Non-filtered, non-preserved samples (sulfate, total dissolved solids [TDS], fluoride, chloride)
- Non-filtered, preserved samples (total metals)
- Non-filtered, non-preserved samples (combined radium 226 and 228)
- Filtered (samples collected for other monitoring purposes)

During each sampling event, quality control samples will be collected as described in the QAPP (Ramboll, 2025).

In the event that sample turbidity is not below 10 NTUs a filtered sample (*e.g.,* 0.45-micron) may be collected for metals analysis in addition to the unfiltered sample. Both filtered and unfiltered samples will be submitted for metals analyses.

In cases where a well has been purged dry during stabilization (low-yield wells), or there is insufficient water to fill all bottles once stabilization criteria has been met, it will be necessary to

let the well recover. A sample may be collected once there is sufficient water, and enough time has elapsed to allow settlement of suspended solids. It is recommended that a low-yield well should be visited early in the sampling event, purged, monitored for recovery, and sampled prior to demobilization from the site. If the well does not recharge after purging to allow the collection of representative samples, a sample should not be collected. All samples shall be collected after the well has sufficiently recovered. If a subset of sample jars were collected prior to the well going dry, those samples are not to be submitted. Only post-purge samples will be analyzed.

5.3.5 Potable Wells

Residential water well samples will be collected from the tap that is closest to the well pump as practical. Preferably, the faucet should be in the water supply line after the wellhead and before pressure tanks, water heaters, water softeners, iron filters, etc. Aerators and filters will be removed from the tap prior to sampling. Water will be discharged at the faucet or a nearby sink for at least two minutes after the pump is activated. The period after pump activation should allow for at least one full pump cycle and ensure formation water is sampled.

After flushing, the faucet or spigot should be disinfected. A freshly prepared 10-50 ppm chlorine solution (bleach) or alcohol swab will be used to wipe the faucet thoroughly, ensuring all surfaces that will come in contact with the sample are covered. After disinfecting, the faucet will be flushed for another two to three minutes to remove any residual disinfectant. Field data, such as sampling locations, discharge volume, and time will be recorded.

If a sample is collected from a faucet after the pressure tank or other appliances, the water discharged prior to sample collection should be two to three times the volume of water in each appliance. Variation in sample collection will be documented.

5.4 Source Water Sampling

Source water sampling, including collection of aqueous samples from porewater wells, sumps, leachate collection pipes, borings, or other subsurface infrastructure that collects liquid will be performed in accordance with **FP No. 6.20** - Groundwater Sampling - Low Flow (**Appendix A**). Porewater wells will be sampled using low flow methods unless the well purges dry during sampling. Source locations shall be the last locations sampled on site.

5.5 Surface Water Sampling

Surface water sampling will follow procedures outlined in the workplan and **FP No. 7.01** - Surface Water Sampling (**Appendix A**). Water samples will be collected using a discrete depth sampler such as a Kemmerer or Van Dorn-type sample bottle, as a grab sample, or using a pump. Sample depths will be established in the workplan (*e.g.,* mid-water or 0.2 and 0.8 times the total depth) depending on site-specific conditions (*e.g.,* total water depth). At the time of sample collection field measurements of temperature, conductivity, pH, ORP, and dissolved oxygen will also be made at all locations. Samples will be placed in appropriate laboratory supplied containers and preserved in accordance with the analytical method requirements listed in **Table 1**.

5.6 Field Sampling Quality Control

Field Quality Assurance and Quality Control (QA/QC) samples that will be collected as described below and described in the QAPP (Ramboll, 2025) include field duplicate (FD) samples, field blanks (FBs), trip blanks (TBs), equipment blanks (EBs), and matrix spike/matrix spike duplicates

(MS/MSDs). The description and purpose of these samples is discussed in this section. The frequency of analysis of field QA/QC samples for aqueous and solid phase samples are summarized in **Table 3**. The laboratory QA/QC program includes performing analytical methods according to prescribed protocols and analyzing laboratory QA/QC samples to measure precision and accuracy of laboratory methods and equipment, instrument calibration, and preventive maintenance and is described in detail in the QAPP (Ramboll, 2025).

5.6.1 Field Duplicates

The FD is a replicate sample collected by sequentially alternating filling between the primary sample container and the FD sample container and is used to document representativeness and precision. FD samples will be labeled and packaged in the same manner as primary samples but with "-Dup" appended to the Unique Sample ID. Aqueous FDs will be collected at a frequency of one in every 10 primary samples and will be analyzed for the same suite of parameters as the primary sample. Solid phase FDs will be collected at the discretion of the Vistra PgM and the Ramboll PgM. The relative percent difference (RPD) between the field duplicate sample and the primary sample is evaluated to assess the homogeneity of the sample matrix and to assess the reproducibility of laboratory and field sample collection techniques.

5.6.2 Field Blanks

FB samples are used to assess the presence of contaminants arising from field sampling procedures. FB samples are obtained by filling a clean sampling container with analyte-free DI water, in the field at a sample location. The sample then is analyzed in the same manner as the primary sample. FB samples will be analyzed for the same suite of parameters as the primary sample to assess potential background contamination, contamination due to bottles and preservatives, or errors in the sampling process. If specified by the Vistra PgM and the Ramboll PgM, one FB will be collected per sampling event.

5.6.3 Equipment Blanks

EB samples are used to assess the effectiveness of decontamination procedures. EB samples are obtained by filling decontaminated sampling equipment with analyte-free DI water and sampling this water. Alternatively, DI water can be poured over or through the decontaminated sampling equipment and then collected. EBs will only be collected from equipment that comes in contact with non-dedicated, multiple use sampling materials. If required, EBs will be collected at a frequency of one per day and will be analyzed for the same suite of parameters as the primary sample to assess the effectiveness of decontamination procedures.

5.6.4 Trip Blanks

TB samples are used to assess the potential for cross-contamination of volatile organic compounds (VOCs) between samples during storage and shipment. TB samples are only necessary when VOCs are being analyzed. A TB sample consists of one or more sample containers that are prepared at the analytical laboratory by filling with reagent-grade DI water. The TB sample is added to the sample cooler or other shipping container as soon as the first primary sample is collected. The TB sample accompanies the primary samples to the laboratory and is analyzed using the same analytical method as the primary samples. TB samples will be prepared and accompany any cooler or shipment that holds VOC samples.

5.6.5 Matrix Spike/Matrix Spike Duplicates

MS/MSD samples are collected to evaluate the effect of sample matrix on analytical results and the precision and accuracy of laboratory procedures. As with field duplicate samples, MS/MSD samples should be collected at the same time, using the same procedures and equipment, and in the same types of containers as the parent samples. They shall also be preserved in the same manner and submitted for the same analyses as the parent samples. Aqueous MS/MSD samples will be collected at a ratio of one MS/MSD sample per twenty parent samples collected. Solid phase MS/MSD samples will be collected at the discretion of the Vistra PgM and the Ramboll PgM.

6. DECONTAMINATION

Decontamination procedures will be performed to remove chemical constituents from non-dedicated sampling equipment used during groundwater monitoring/sampling and soil sampling activities. Proper decontamination procedures prevent chemical constituents from being transferred between sampling locations and being transported out of controlled areas. However, the use of dedicated or disposable sampling equipment significantly reduces the chances of sample impacts from re-use of equipment.

6.1 Decontamination of Heavy Equipment

This section describes procedures for decontamination of heavy equipment (*e.g.,* drill rigs, excavators, or other machinery) that may be used as part of site investigations or remedial actions. Cleaning and decontamination of equipment shall occur at a designated field activity area, downgradient, and downwind from the clean equipment drying and storage areas. Decontamination procedures will be performed in accordance with **FP No. 14.02** - Heavy Equipment Decontamination (**Appendix A**).

6.2 Sampling Equipment

Non-dedicated sampling equipment will be washed with a solution of Alconox™ and potable water and then rinsed with distilled water or ultrapure/deionized (DI) water and allowed to air dry. Equipment decontamination procedures will be minimized through the use of either dedicated or disposable sampling equipment. However, some sampling equipment may require decontamination, and these include:

- Water level meter
- Flow through cell
- Split-spoon

Equipment decontamination procedures are described in **FP No. 14.01** - Sampling Equipment Decontamination (**Appendix A**).

7. MANAGEMENT OF INVESTIGATIVE DERIVED WASTES

IDW (*i.e.,* purge water and soil cuttings) will be produced during field activities. The methodology for the management, storage, and disposal of the wastes is described below. Groundwater (purge water) and soil cutting handling, storage, and disposal procedures will ensure that potential adverse environmental impacts associated with the waste do not occur, and that all wastes are transported and disposed in accordance with local, state, and/or federal regulations and in coordination with the facility.

7.1 Water and Decontamination Solutions

Water and decontamination solutions likely to be produced during monitoring activities include the following:

- Water from monitoring well development, low flow sampling well purging, and sampling activities
- Decontamination solutions from field equipment, sampling equipment, and PPE
- Disposal of water generated during well installation, development and sampling will be coordinated with the facility.

7.2 Soil Cuttings

Disposal of soil cuttings generated during drilling activities will be coordinated with the facility and in accordance with **FP No. 15.01** - Waste Handling (**Appendix A**) and workplan

7.3 Personal Protective Equipment

Waste PPE will be stored in plastic garbage bags and disposed of in a dumpster with general refuse, unless otherwise specified by the facility.

8. LABORATORY ANALYTICAL PROCEDURES AND QUALITY ASSURANCE/QUALITY CONTROL

Groundwater will be analyzed by a National Environmental Laboratory Accreditation Program (NELAP) certified laboratory using methods that provide the required reporting limits for the requested analytes as outlined in the QAPP (Ramboll, 2025). 40 C.F.R. § 257 and 35 I.A.C. § 845 define the parameters to be analyzed and include the following[1]:

Table C. 40 C.F.R. § 257 and 35 I.A.C. § 845 Groundwater Monitoring Program Parameters

Field Parameters			
Groundwater Elevation[3,6]	pH[1,4]	Dissolved Oxygen	Temperature
ORP	Specific Conductance	Turbidity[5]	
Metals (Total)			
Antimony[2,4]	Boron[1,4]	Cobalt[2,4]	Molybdenum[2,4]
Arsenic[2,4]	Cadmium[2,4]	Lead[2,4]	Selenium[2,4]
Barium[2,4]	Calcium[1,5]	Lithium[2,4]	Thallium[2,4]
Beryllium[2,4]	Chromium[2,4]	Mercury[2,4]	
Inorganics (Total)			
Fluoride[1,2,4]	Sulfate[1,4]	Chloride[1,4]	TDS[1,4]
Other (Total)			
Radium 226 and 228 combined[2,4]			

Notes:

[1] Listed in Appendix III to 40 C.F.R. § 257 – Constituents for Detection Monitoring.

[2] Listed in Appendix IV to 40 C.F.R. § 257 – Constituents for Assessment Monitoring.

[3] 40 C.F.R. § 257.23 Ground-water sampling and analysis requirements. Specifically, 40 C.F.R. § 257.23(d).

[4] Listed in 35 I.A.C. § 845.600 – Groundwater Protection Standards. Specifically, 35 I.A.C. § 845.600(a)(1).

[5] Required per 35 I.A.C. § 845.650(a).

[6] Required per 35 I.A.C. § 845.650(b)(2).

The Aqueous Analytical Methods and Analytical Performance Criteria for 40 C.F.R. § 257 and 35 I.A.C. § 845 Sampling are provided on **Table 4**. Analytical methods were selected based on providing Reporting Limits (RLs) which are at or below the USEPA Maximum Contaminant Level (MCL) and Health-Based Level (HBL), and Illinois Groundwater Protection Standards established in 35 I.A.C. § 620 Subpart D (Illinois Environmental Protection Agency, 2012). Refer to the QAPP (Ramboll, 2025) for laboratory methodology and additional laboratory QC requirements including measurement performance criteria for calibration, blanks, MS/MSDs, inorganics, metals, mercury, organics, and radium 226 and 228 analyses.

[1] See state program permits for parameters required by those permits

9. REFERENCES

Illinois Environmental Protection Agency, 2012. *Groundwater Quality Standards*: Title 35 of the Illinois Administrative Code § 620, Subpart D. October 5, 2012.

Illinois Environmental Protection Agency, 2021. *Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845.* April 15, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2025. *Multi-Site Quality Assurance Project Plan*. September 4, 2025.

United States Environmental Protection Agency (USEPA), 2015. *Title 40 of the Code of Federal Regulations, Part 257*.

TABLES

TABLE 1. SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

MATRIX	ANALYTES	ANALYTICAL METHOD	PRESERVATION	CONTAINER [1, 2]	TAT	HOLD TIME [3]	
						Prior to Extraction	After Extraction
Water	VOCs	8260B, 8011	HCl to pH <2; no headspace; cool to ≤6 °C	3 x 40 mL glass VOA vials	10d	14d	
Water	SVCOs	8270C	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Phenols	9066 or 420.4 Rev1	H_2SO_4; Cool to ≤6 °C	2 x 500 mL amber glass		28d	
Water	Ammonia as Nitrogen, dissolved	350.1 REV2 or M4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrate nitrogen, dissolved	300.0 or E353.2	Cool to ≤6 °C	500 mL HDPE	10d	48h	
Water	Nitrate nitrogen, total	300.0, 353.2, or SM 4500-NO3 F	Cool to ≤6 °C	500 mL HDPE	10d	48h	
Water	Nitrite + Nitrate	E353.2	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrite nitrogen, dissolved	M4500-NO2 B	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrite nitrogen, total	M4500-NO2 B	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, Ammonia	350.1 or SM 4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, kjeldahl, total	350.1 or SM 4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, total	351.2/353.2	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Phosphorus, dissolved	6020A	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Phosphorus, total	6020A or 6010B or SM 4500P F 1999	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Sulfide, dissolved	SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfide, Reactive	SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfide, total	M4500-S D or SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfur, total	6010B	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Herbicides	8151A, 515.3 REV1, or 8321B	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Organochlorine Pesticides	8081A, 8081B	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	PCBs	8082A	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Metals	6020, Li - EPA 200.7	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Mercury	7470A or 6020	HNO_3 to pH <2	500 mL HDPE	10d	28d	
Water	Alkalinity and Carbonate	SM 2320 B	Cool to ≤6 °C	500 mL HDPE	10d	14d	
Water	Chloride, Fluoride, Sulfate	9056A, 9251 or EPA 300	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Total Dissolved Solids (TDS)	SM 2540 C	Cool to ≤6 °C	1 L HDPE	10d	7d	
Water	Radium 226	9315 or EPA 903	None	2 x 1 L HDPE	22d	180d	
Water	Radium 228	9320 or EPA 904	None	2 x 1 L HDPE	22d	180d	
Water	Bacteria (Fecal Coliform)	SM 9222B or D	$Na_2S_20_3$; Cool to ≤6 °C	120 mL HDPE	10d	24hr	
Water	Biochemical Oxygen Demand (5 day - 20 deg C)	SM 5210B 2001	Cool to ≤6 °C	1 L HDPE	10d	48hr	
Water	Carbon, dissolved organic	SM 5310C 2000	HCl to pH <2; cool to ≤6 °C	2 x 1 L amber glass	10d	28d	
Water	Carbon, total organic	9060 or M5310C or SM 5310C 2000	HCl to pH <2; cool to ≤6 °C	2 x 1 L amber glass	10d	28d	
Water	Chemical Oxygen Demand	SM 5220 D 1997	H_2SO_4 to pH <2; ≤6 °C	250 mL glass	10d	28d	
Water	Cyanide, dissolved	9012A (TCN) Aqueou	NaOH to pH >10; ≤6 °C	250 mL HDPE	10d	14d	

TABLE 1. SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

MATRIX	ANALYTES	ANALYTICAL METHOD	PRESERVATION	CONTAINER [1, 2]	TAT	HOLD TIME [3]	
						Prior to Extraction	After Extraction
Water	Cyanide, Reactive	9012A REV1 7.3.3	NaOH to pH >10; ≤6 ˚C	250 mL HDPE	10d	14d	
Water	Cyanide, total	335.4 REV1 or 9012A or ASTM D7511-09e2	NaOH to pH >10; ≤6 ˚C	250 mL HDPE	10d	14d	
Water	Flashpoint, Pensky-Martens Closed Cup	1020B	Cool to ≤6 °C	250 mL HDPE	10d	14d	
Water	Fraction of Oragnic Carbon (FOC)	ASTM-D2974 (FOC & OM)	HCl to pH <2; cool to ≤6 ˚C	2 x 1 L amber glass	10d	28d	
Water	Oil & grease (soxhlet ext)	1664A	H_2SO_4 to pH <2; ≤6 ˚C	2 x 1 L amber glass	10d	28d	
Water	Perchlorate	E314	Cool to ≤6 °C	250 mL HDPE	10d	28d	
Water	Temperature (Celsius)	Field or M2550B					
Water	Temperature (Fahrenheit)	Field or M2550B					
Water	Total Suspended Solids	SM 2540 D 1997	Cool to ≤6 °C	1 L HDPE	10d	7d	

Notes:
ASTM = American Society for Testing and Materials
d = day(s)
h = hours
HCL = Hydrochloric Acid
HDPE = high-density polyethylene
HNO_3 = Nitric Acid
H_2SO_4 = Sulfuric Acid
L = liter
mL = milliliters
NaOH = Sodium Hydroxide
SM = Standard Method
TAT = Turnaround Time
y = year
1. Additional volume will be collected for MS/MSD samples.
2. Laboratory may provide alternate containers as long as the containers meet the requirements of the method and allow the collection of sufficient volume to perform the analysis.
3. Holding time begins from date of sample collection.

TABLE 2. PROJECT GOALS FOR PRECISION AND ACCURACY OF FIELD MEASUREMENTS
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

Field Parameter	Precision Goal	Accuracy Goal
Water Level	± 0.01 foot	± 0.01 foot
pH	± 0.1 s.u.	± 0.1 s.u.
Specific Conductance	± 100 µS/cm	± 100 µS/cm
Temperature	± 10%	± 10%
Oxidation/Reduction Potential	± 1.0 mV	± 1.0 mV
Dissolved Oxygen	± 0.3 mg/L	± 0.3 mg/L
Turbidity	± 0.1 NTU	± 5% of reading ± 1 NTU

Notes:
± = plus or minus
% = percent
µS/cm = Micro Siemens per centimeter
mg/L = Milligrams per liter
mV = Millivolt
NTU = nephelometric turbidity unit
s.u. = standard pH units

TABLE 3. SUMMARY OF QA/QC SAMPLES
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

Quality Control Sample Type	Frequency of Analysis		Measurement Performance Criteria
	Aqueous Samples	Solid Samples[1]	
Contamination Control Samples			
Laboratory Method Blank	One per each analytical method. One in every batch of samples (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	No target analyte concentrations ≥ RL
Trip Blank	One per cooler/shipment if VOCs are tested; analyze for VOCs only.	NA	No target analyte concentrations ≥ RL
Equipment Blank	One per each analytical method. One per day, if required. Equipment blanks will not be collected when dedicated or single-use equipment is used for sample collection.	NA	No target analyte concentrations ≥ RL
Field Blank	As requested.	As requested.	No target analyte concentrations ≥ RL
Accuracy Control Samples			
Laboratory Control Samples	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Surrogate Spiked Samples	For methods that use surrogate(s), the surrogate(s) will be spiked and analyzed in all samples and in all batch quality control samples.	NA	Laboratory's statistically derived control limits
Matrix Spike Samples	Analyzed in each batch, where applicable to the method (not to exceed 20 samples).	NA	Laboratory's statistically derived control limits
Precision Control Samples			
Field Duplicate Sample	One per each analytical method. One per every 10 field samples collected.	As requested.	RPD ≤ 30% when analyte is detected in both sample and field duplicate above the RL. For sample results that are less than or equal to five times the RL, the criterion of plus or minus two times the RL will be applied to evaluate field duplicates.
Laboratory Control Sample Duplicates	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Laboratory Duplicate Sample	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Matrix Spike Duplicate Samples	Analyzed in each batch, where applicable to the method (not to exceed 20 samples).	NA	Laboratory's statistically derived control limits

Notes:
1. See Table 7 for relevant soil methods.
QA/QC = quality assurance/quality control
RL = Reporting limit
RPD = Relative percent difference

TABLE 4. GROUNDWATER ANALYTICAL METHODS AND ANALYTICAL PERFORMANCE CRITERIA FOR 40 C.F.R. § 257 AND 35 I.A.C. § 845 SAMPLING
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

Constituent	CAS	Unit	Analytical Methods [1]	40 C.F.R. § 257 MCL [2] or HBL	35 I.A.C. § 845 Groundwater Protection Standard	35 I.A.C. § 620 Groudwater Protection Standard	Target RL [4]	Target MDL [4]	LCS/LCSD Recovery Control Limits	LCS/LCSD Control RPD	MS/MSD Recovery Control Limits	MS/MSD or Lab Duplicate RPD Control Limits
Metals												
Antimony	7440-36-0	µg/L	6020A	6	6	6	1	0.25	80-120	20	75-125	20
Arsenic	7440-38-2	µg/L	6020A	10	10	10	1	0.25	80-120	20	75-125	20
Barium	7440-39-3	µg/L	6010B or 6020A	2,000	2,000	2,000	1	0.4	80-120	20	75-125	20
Beryllium	7440-41-7	µg/L	6010B or 6020A	4	4	4	1	0.5	80-120	20	75-125	20
Boron	7440-42-8	µg/L	6010B or 6020A	NS	2,000	2,000	25	10	80-120	20	75-125	20
Cadmium	7440-43-9	µg/L	6010B or 6020A	5	5	5	1	0.25	80-120	20	75-125	20
Calcium	7440-70-2	µg/L	6010B or 6020A	NS	NS	NS	125	100	80-120	20	75-125	20
Chromium	7440-47-3	µg/L	6010B or 6020A	100	100	100	1	0.3	80-120	20	75-125	20
Cobalt	7440-48-4	µg/L	6020A	6	6	1000	1	0.25	80-120	20	75-125	20
Copper		µg/L	6010B or 6020A	NS	NS	650	5	1	80-120	20	75-125	20
Iron		µg/L	6010B or 6020A	NS	NS	5000	100	10	80-120	20	75-125	20
Lead	7439-92-1	µg/L	6020A	15	7.5	7.5	1	0.25	80-120	20	75-125	20
Lithium	7439-93-2	µg/L	6020A	40	40	NS	1	0.5	80-120	20	75-125	20
Magnesium	7439-95-4	µg/L	6010B or 6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Manganese		µg/L	6010B or 6020A	NS	NS	150	5	1	80-120	20	75-125	20
Mercury	7439-97-6	µg/L	7470A or 6020A	2	2	2	0.2	0.051	80-120	20	75-125	20
Molybdenum	7439-98-7	µg/L	7470A or 6020A	100	100	NS	1	0.25	80-120	20	75-125	20
Nickel		µg/L	6010B or 6020A	NS	NS	100	5	0.5	80-120	20	75-125	20
Potassium	7440-09-7	µg/L	6010B or 6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Selenium	7782-49-2	µg/L	6020A	50	50	50	1	0.9	80-120	20	75-125	20
Sodium	7440-23-5	µg/L	6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Thallium	7440-28-0	µg/L	6020A	2	2	2	1	0.25	80-120	20	75-125	20
Vanadium		µg/L	6010B or 6020A	NS	NS	49	5	3	80-120	20	75-125	20
Zinc		µg/L	6010B or 6020A	NS	NS	5000	10	6	80-120	20	75-125	20
Inorganics												
Alkalinity, bicarbonate	--	mg/L	SM 2320 B	NS	NS	NS	NS	NS	80-120	20	--	20
Alkalinity, carbonate	--	mg/L	SM 2320 B	NS	NS	NS	NS	NS	80-120	20	--	20
Chloride	16887-00-6	mg/L	9056A, 9251 or EPA 300	250 [3]	200	200	5	1	80-120	20	80-120	20
Fluoride	7681	mg/L	9056A, 9251 or EPA 300	4	4	4	0.1	0.05	80-120	20	80-120	20
Nitrate		mg/L	SM 4500-NO3, EPA 300, or EPA 353.2	NS	NS	10	0.05	0.01	80-120	20	80-120	20
Sulfate	18785-72-3	mg/L	9056A, 9251 or EPA 300	250 [3]	400	400	10	5	80-120	20	80-120	20
Total Dissolved Solids	-	mg/L	SM 2540 C	500 [3]	1,200	1,200	20	10	90-110	10	90-110	10
Other												
Combined Radium 226/228	7440-14-4	pCi/L	9315 and 9320; or EPA 903 and 904	5	5	20 [5]	-- [6]	-- [7]	70-130	30	60-140	40

Notes:
EPA = United States Environmental Protection Agency
HBL = Health-based level
MDL = Method detection limit as established by the laboratory
LCS/LCSD = Laboratory Control Sample/Laboratory Control Sample Duplicate
MS/MSD = Matrix Spike/Matrix Spike Duplicate
µg/L = micrograms per liter
mg/L = milligrams per liter
NS = No standard
pCi/L = picoCuries per liter
RL = Reporting limit as established by the laboratory
RPD = Relative Percent Difference
SM = Standard Method

1. Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.
2. USEPA MCL = United States Environmental Protection Agency Maximum Contaminant Level.
3. USEPA SMCL = United States Environmental Protection Agency Secondary Maximum Contaminant Level.
4. Reporting limits and method detection limits will vary depending on the laboratory performing the work.
5. The Groundwater Protection Standards for radium 226 and radium 228 individually are 20 pCi/L.
6. All radium results will be reported (values may be positive or negative) and will include uncertainty and the calculated minimum detectable concentration (MDC).
7. Laboratories calculate a minimum detectable concentration (MDC) based on the sample.

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FIGURES

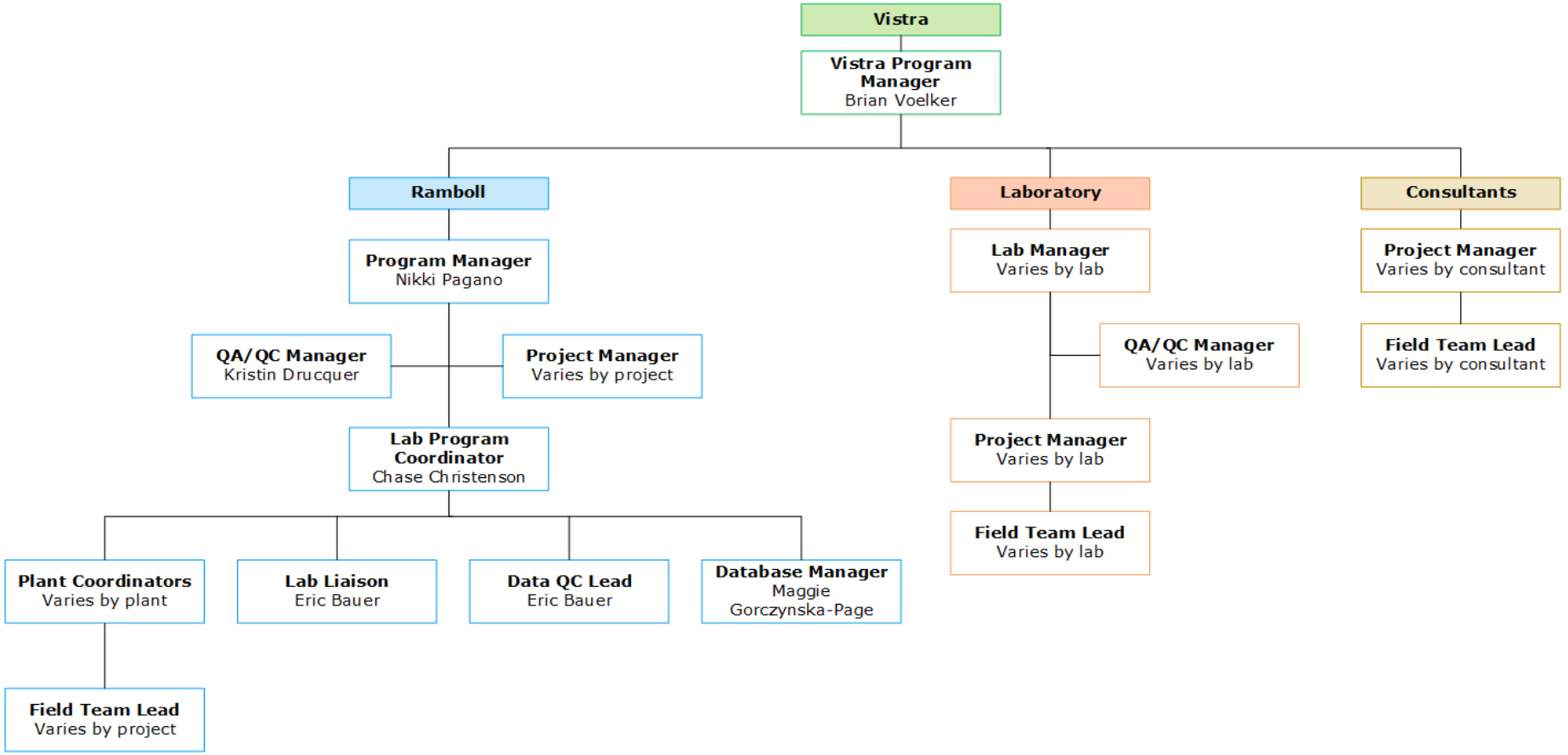


FIGURE 1. ORGANIZATION FLOW CHART

APPENDIX A
FIELD PROCEDURES

FP NO. 1.01	FIELD RECORDS AND NOTES
FP NO. 1.02	SAMPLING NAMING, LABELING, HANDLING, SHIPPING AND CHAIN OF CUSTODY
FP NO. 5.01	SOIL CLASSIFICATION
FP NO. 5.02	SUBSURFACE SOIL SAMPLING – TEST PITS AND EXCAVATIONS
FP NO. 5.04	SURFACE SOIL SAMPLING
FP NO. 5.07	SUBSURFACE SOIL SAMPLING – DIRECT PUSH TECHNOLOGY
FP NO. 5.08	SUBSURFACE SOIL SAMPLING – SPLIT SPOON AND SHELBY TUBE
FP NO. 5.09	FIELD SOIL BORING LOG PREPARATION
FP NO. 5.15	STOCKPILE SAMPLING
FP NO. 5.17	ROCK CORE LOGGING
FP NO. 6.01	PERMANENT OVERBURDEN WELL INSTALLATION
FP NO. 6.02	GROUNDWATER PURGING AND SAMPLING
FP NO. 6.03	ESTIMATION OF HYDRAULIC PROPERTIES – IN-SITU HYDRAULIC CONDUCTIVITY (SLUG) TESTING
FP NO. 6.04	GROUNDWATER AND FREE PRODUCT LEVEL MEASUREMENTS
FP NO. 6.07	WELL DEVELOPMENT
FP NO. 6.08	ESTIMATION OF IN-SITU HYDRAULIC PROPERTIES – AQUIFER TESTS
FP NO. 6.11	ENVIRONMENTAL WELL DECOMMISSIONING
FP NO. 6.15	WELL CONSTRUCTION RECORD
FP NO. 6.20	GROUNDWATER SAMPLING – LOW FLOW
FP NO. 7.01	SURFACE WATER SAMPLING
FP NO. 14.01	SAMPLING EQUIPMENT DECONTAMINATION
FP NO. 14.02	HEAVY EQUIPMENT DECONTAMINATION
FP NO. 15.01	WASTE HANDLING

FIELD PROCEDURE DOCUMENT NO. 1.01

FIELD RECORDS AND NOTES
VISTRA PROJECT
PROJECT NO. 1940112376

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FIELD PROCEDURE DOCUMENT NO. 1.01

FIELD RECORDS AND NOTES

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document No. 1.01 "Field Records and Notes" last revised February 17, 2025.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for recording and maintaining field notes associated with field activities, site visits, and sampling efforts.

This FP was prepared to document the procedures and techniques that will be used to fulfill the groundwater sampling and analysis program requirements of the United States Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC)/Project Office (PO) and/or Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT AND MATERIALS

The list below provides an overall summary of equipment and materials that may be necessary for recording field records and notes, but the list should not be considered exhaustive.

- Digital data collector (laptop or tablet) with uploaded forms indicated in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. Refer to **Section 4.4** for further information.
- Bound notebook – lined high-grade 50 percent rag paper with a hard-cover and water-resistant surface (e.g., "Rite-in-the-Rain"). Soft-bound field books are acceptable for limited duration projects.
- All Weather Pens or (weather permitting) other indelible ballpoint pens with black or blue ink.
- Field Log Forms (preferably produced on "Rite-in-the-Rain" water-resistant paper).
- Ruler/Straight Edge.
- Stop-Watch (or other time-keeping device).

- Calculator.
- Lookup tables for well volume calculation, tank size estimation, etc.
- Clipboard/field case.
- Gallon-size or larger plastic zip top bag or other clear plastic to cover note book and forms in wet weather.

In some cases, such as those involving long-term construction management activities, project specific daily reports, may be produced from the field notes and maintained electronically in portable document format (PDF, see **Section 4.4**).

3. PROCEDURES REFERENCED

The following FPs and Standard Work Practices (SWPs) are related to this FP and should be reviewed prior to fieldwork, as needed:

- **SWP**, Subsurface Utility Clearance.
- All field sampling and installation FP categories.

The list above is not intended to be all inclusive. Other SPIs and FPs may need to be referenced based on the specific requirements of the project-specific Work Plan, Field Sampling Plan, and/or QAP (e.g., field screening FPs, FPs for sampling).

4. PROCEDURES

4.1 General Information

Information from all pertinent field activities, site visits, and sampling efforts should be recorded in a field book during each day of field activities. The following information should be considered when recording field notes:

- Field notes should present a complete record of the field activities observed. The author of the field notes, project manager (PM) or others may need to refer to the field notes at a later date to confirm facts and/or field interpretations. Thus, the notes should be complete enough to enable reviewers to reconstruct the field activities and observations.
- Field books are part of the official project record, and could become legal records; therefore, a separate bound field book should be used for each project.
- Records should be kept in ink (waterproof ink, when necessary). Indelible ballpoint pens with black or blue ink should be used. Felt tip or red pens, erasable ink, and pencil are unacceptable being neither permanent nor archival.
- When an entry to the field book needs to be corrected, a single line should be drawn through the error, initialed and dated. Never erase or obliterate any field notes.
- The ownership information should be provided inside the front cover of the field book as follows: “If found, please return to Ramboll.” Include the office address and general

phone number as well as case/project number and name. This increases the chances of the notebook being returned if lost.

- Generally, each page of the notes should be numbered, and initialed or signed by the author (or authors). If multiple individuals are involved in activities at the site or for projects involving long-term construction management activities, multiple logbooks may be maintained.
- Pages left intentionally blank should be marked with an "X" and labeled "left intentionally blank".
- Blank spaces at the bottom of a field book page should be stricken across the page.
- Data entries should be recorded in the field book immediately upon obtaining the data. Avoid making temporary notes in other locations for later transfer to the field book, as this increases the potential for transcription errors or loss of data.
- If using field forms to record data, note in the field book which forms are being used and the number of forms. All pages of forms should be numbered sequentially and cross-referenced in the field book. Each page of the forms should be signed and dated. Finally, ensure that forms are securely filed in the project file upon return to the office each day.
- If using a tablet. ensure that is connected to the network or cloud to upload records continuously.
- If not directly uploading to the network or cloud, scan, photograph and/or photocopy the field notes and field forms daily if possible.
- Descriptions of activities should be factual and objective, not subjective, and should not include unsubstantiated opinions.
- Descriptions should be consistent with the level of certainty of the observation, for example record "odor like gasoline," rather than a definitive note such as gasoline odor.
- Explain any deviations or omissions from the work specified in the work plan, especially when such deviations result in measurements/samples not being collected, or additional measurements/samples being collected.
- Avoid writing extraneous commentary in the field book.
- The use of certain words requires careful consideration as noted below:

Words to Use with Careful Consideration	**Suggested Alternative Words**
Approve	General conformance
Inspect, Inspection	Observe, Observation
Final, All, Any, None, Every	Refer to actual number
Guarantee, Warrant, Certify, Ensure, Ensure	None. Use only if specified in scope

4.2 Organization of Field Notes

- Field notes should generally be kept in chronological order throughout the day.
- Use military time (e.g., 0900 for 9:00 am or 1645 for 4:45 pm).
- Start each new day on a new page.
- Sign and date your notes at the end of each day and draw a line through any remaining blank lines. Initial each page.
- If collecting a large number of samples, prepare a summary at the end of each day including a list of samples collected and reference to the chain-of-custody form or airbill number, as appropriate.
- To help easily locate information for subsequent reference and report preparation, consider including a sketch and designating a separate page or pages for certain items such as:
  - Photograph Log
  - Water Level Measurements
  - Groundwater purging/sampling information and related field measurements for each well
  - Drum Log that would include drum number (which corresponds to number presented on each drum), date filled, contents, percent full and location on site (including photographs and a sketch map). Note that drums should not be given numbers such as D001, D002, etc., as these designations could be confused with hazardous waste codes (refer to **FP 15.01** - Waste Handling and Management Procedures).
- Refer to sampling plans or if unavailable or deviating from a plan, include sketches of sampling locations or photograph locations/directions to reflect actual locations.

4.3 Daily Entries

At a minimum, daily entries in a field book should include:

- Project name, number.
- Pagination and date on each page of the notes.
- Date and time of starting work.
- Names of all field people on-site and their titles (field supervisor, etc.).
- Record of the daily "tailgate" health and safety briefing, including attendees and their affiliation and a list of topics discussed. Note that detailed information can be included on a form in the HASP but the meeting should be documented in the field book as well.
- Names and affiliations of all contractors, subcontractors, clients, agency representatives and visitors.
- Visitors to the site – when they came, when they left, who they represent, and purpose for their visit on-site.

- Subcontractor (if used). Include company name, names of any personnel and their role (e.g., driller's helper).
- General weather conditions – add additional notes if weather changes during the day (i.e., starts/stops raining, snowing, changes in temperature).
- General purpose of proposed work effort (e.g. "to collect groundwater samples from all on-site monitoring wells"). Do not add information on the legal strategies or implications of the work unless specifically directed to do so by the PM or PIC.
- Description of work area including direction of and information on photographs taken.
- Location of work area including map references (include a sketch map in field book).
- Detail of work effort, particularly any deviation from the sampling plan or standard operating procedures, including why the deviation was made and responsible person who approved the deviation.
- Objective field observations.
- Field measurements (e.g., pH, PID readings, Health and Safety monitoring data).
- Field analysis results (results from any field test kits used).
- Type of equipment used in sampling, type and model of PID, pH meter, other meters, etc. and calibration information (e.g., calibrated OVM Model 580B PID using 100 ppm isobutylene).
- Personnel and equipment decontamination procedures (describe the method once and state that it will always be used unless otherwise noted. Then note when there are deviations and the reason for each deviation.)
- Records of conversations/decisions made with others in the field such as the PM, on-site personnel, or regulatory personnel.

In addition to the General Information and Daily Entries (**Sections 4.1 and 4.3** above), specific details for each type of work should be included in the field notes as indicated on the FP corresponding to the activity performed. Typical field activities for Ramboll personnel fall into the following major categories of field activities:

- Drilling of Soil Borings.
- Soil and Sediment Sample Collection.
- Monitoring Well Installation and Development.
- Surface water and Groundwater Sampling.
- Oversight of Remedial Activities.
- Vapor Intrusion Sampling/Soil Gas Sampling.
- Indoor Air/Ambient Air Sampling.

4.4 Electronic Files

Electronic documentation can be used in certain circumstances when digital collectors (e.g., laptop computers, tablets or other electronic documentation devices) are readily available

allowing for completion of documentation as events are happening or soon after observation. The digital data collector should be uploaded with standard or project specific forms indicated in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. Contact the QNOPY product owner or Digital Hub Manager to obtain the most recent standard forms or to develop project-specific forms (refer to E&H Innovation and Digital Transformation (IDT) Collaboration Page).

Regardless of the program used to record the information, once completed, electronic documentation should be saved in a non-editable Adobe Acrobat (PDF) format, or similarly secure format. The following information should be included in each electronic documentation file, at a minimum:

- General Project Information: Project name, number, and physical location.
- Weather Conditions: General conditions, wind magnitude/direction, precipitation, etc.
- All personnel on site and the role/affiliation of each person.

The following general guidelines apply to electronic documentation:

- Documentation for each day should be in a separate file.
- The top of each page should include the project name, number, location, and date, and pages should be sequentially numbered.
- General activity documentation entries should be made as soon as possible after the observation, following the guidelines in **Section 4.3** above, and proceed chronologically.
- The bottom of the last page should include the names and positions of all personnel who assisted in preparation of the electronic document, and a location to apply an electronic certification signature.
- Once completed, electronic documents should be secured using appropriate means such as the "Sign & Certify" tool in Adobe Acrobat. Project personnel not familiar with this process should consult their administrative staff.
- Completed certified documentation should be stored in the project file and marked "Final."

4.5 Utility Clearance

In accordance with – SWP Subsurface Utility Clearance, where available, public and private utility clearance is required for all work that will involve ground disturbance. For each field activity that includes ground disturbance, certain information must be recorded in the field book as discussed below and in this SWP. In addition, the subsurface clearance worksheet and field checklist included in this SWP should be completed and included as part of the project-specific HASP.

4.5.1 Public Utility Locating

- If a subcontractor contacted the One-Call Service to request a public utility location, obtain the file/ticket number issued by the One-Call Service from the subcontractor.
- Verify and record completion and closure of the ticket before proceeding with work.
- Include a sketch map of the work area and/or entire site and show locations of marked and suspected utilities in relation to the work area. If appropriate, photograph the area before ground disturbance.

4.5.2 Private Utility Locating

- A private utility locator is typically a subcontractor to Ramboll. Record the name of the company and individuals performing this service.
- Record utility clearance findings as above for the public locate.

4.5.3 Site Reconnaissance

- After a site reconnaissance is performed to identify possible utilities in the area, record pertinent information regarding site reconnaissance findings in the field notebook.

4.5.4 Documenting a Health and Safety or Utility Incident

- After attending to emergency needs, notify and document all pertinent information as required in the site-specific HASP.

4.6 Oversight of Remedial Activities

While record keeping requirements for remedial or construction projects must remain consistent with the procedures of this FP, additional information may need to be tracked and recorded. Discuss the specific requirements with the PM or PIC/PO prior to going to the field to understand the context of the oversight role and what types of information may be critical to the oversight. In some cases, such as those involving long-term construction management activities, in addition to field books, project specific daily reports should be completed and maintained electronically in portable document format (pdf). Alternatively, a specialized construction reporting system such as Autodesk Construction Cloud (ACC) should be used.

4.7 Photographs

If photographs are taken, the following information should be recorded in the field book for each photograph:

- Date and time.
- Name of site and field task.
- General orientation and description of the subject.
- Location on-site.
- Sequential number of the photograph. Image number if using a digital camera.

- When appropriate, include a person or object for scale (a coin, tape measure, vehicle, etc.) and consider using a whiteboard to describe or summarize pertinent information shown in the photograph.

Cameras with meta data recording options should be used where available to embed information within the photograph electronic file. If taking a large number of photographs, designate one or more pages of the field book as a photo-log and record photograph information in that log format. In addition, include a sketch of the relative photograph locations and directions. Upload photographs to the networked files for that project with a copy of the photo-log table.

5. PRECAUTIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while recording the required information.

- It is important to always remain alert and aware of your surroundings.
- Avoid walking while recording information. Sites may have excavations, equipment, debris and other obstacles that pose slip, trip or fall hazards.
- Step away from roadways and high traffic areas before commencing note-taking. Do not assume that drivers can see you standing on the shoulder of a road, especially in bad weather. Many workplace traffic accidents involve distracted drivers hitting a worker standing/working on the shoulder of a roadway. Wear a safety vest or brightly colored (yellow or orange) clothing and remain alert at all times.
- Stand a safe distance away from the driller or excavator when taking notes. Be aware that the operator may not be able to see you, equipment/cable accidents can happen very quickly, and you need to be alert and ready to move.

6. RECORDKEEPING

Field books, forms, and electronic files should be managed in accordance with Ramboll's Document Retention Policy and project-specific requirements. For ongoing projects, field notes should be copied periodically (at least weekly), including a digital copy saved to the project folder on the office's secure network. Upon upload, a network link to the digitized field notes should be provided to the Project Manager (PM) to facilitate review. When an individual field book is complete, the book should be submitted to the administrative staff for final cataloging and filing. The field books should be stored in the Project File.

If additional details or modifications are necessary after completion of field activities, such changes should be made in contrasting color ink and signed and dated. Upon completion of the work, the field book should be kept in a secure location on company property (i.e. local office) with previous field books from the designated project.

FIELD PROCEUDRE NO. 1.02

SAMPLE NAMING, LABELING, HANDLING, SHIPPING AND CHAIN OF CUSTODY

VISTRA – PROJECT

PROJECT NO. 1940112376

FIELD PROCEDURE NO. 1.02

SAMPLE NAMING, LABELING, HANDLING, SHIPPING AND CHAIN OF CUSTODY

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document NO. 1.02 "Sample Naming, Labeling, Handling, Shipping, and Chain of Custody" last revised June 1, 2016.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for sample management including identification, labeling, handling/packaging, chain-of-custody, and transport. A sampling event could be dismissed if sample containers are broken in transport, samples are improperly labeled and unable to be reconciled, or chain-of-custody practices are not followed. Therefore, proper sample management is essential to the production of data of reliable quality that can be used for decision-making.

This FP was prepared to document the procedures and techniques that will be used to fulfill the groundwater sampling and analysis program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in surface Impoundments (title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

Similarly, these guidelines may not be applicable to ongoing projects with a previously established sample nomenclature that does not correspond to the naming conventions outlined in this FP, which may be important to adhere to for the sake of continuity and consistency. Specific requirements for these types of projects and activities will be reviewed by the Ramboll Principal in Charge / Project Director (PIC/PD) and/or Project Manager (PM) and any additional requirements will be defined in a project-specific Work Plan, sampling plan and/or project-specific FPs. It should be emphasized that these guidelines are not meant to be project-specific work plans but rather a general reference for developing project specific requirements. In addition, PICs and PMs are encouraged to provide additional direction or training to junior scientists and engineers for the implementation of the procedures outlined in this FP.

Procedures discussed herein are primarily for the most common types of sampling conducted – soil, water, sediment, soil vapor, and/or air. Other types of sampling events (e.g., sampling of concrete, biota, etc.) may require additional steps to those described in this FP. For media that are not as commonly sampled, this FP should be reviewed in the context of project-specific sampling requirements, and modified as applicable.

It should be noted that this FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail.

2. EQUIPMENT/MATERIALS

Equipment and materials necessary to conform to this FP include:

2.1 Sample Labeling/Chain-of-Custody

- Paper towels.
- Laboratory Sample Label.
- Bound Field Notebook – lined high-grade 50 percent rag paper with a hard-cover and water-resistant surface (e.g., "Rite-in-the-Rain") or appropriate field forms.
- All Weather Pens or (weather permitting) other indelible ballpoint pens with black or blue ink.
- Watch (or other time keeping device).
- Clear tape.
- Laboratory Chain-of-Custody (COC) Forms.
- Gallon-size or larger plastic zip top bags or other clear plastic to insert the COC form.

2.2 Sample Packaging/Transport

- Coolers (or original Summa canister shipping container for air or soil vapor sampling).
- Ice.
- Ice scoop.
- Gallon-size or larger plastic zip top bags or other clear plastic to fill with ice.
- Quart and gallon-size plastic zip top bags for sample containers (solids or aqueous).
- Padding (bubble wrap, Styrofoam packing material, etc.).
- Packing tape.
- Scissors.
- Custody seals.
- Black indelible ink pen.
- Post-it notes.
- Tape, zip tie, or other items to attach COC to coolers/sample shipping containers.
- Shipping air bill (FedEx pre-filled forms with Ramboll's account info are available).

3. PROCEDURES REFERENCED

- Field sampling FP categories.
- **FP 1.01**, Field Notes and Records.
- **FP 1.03**, Data Management.

4. PROCEDURES

After collection, samples will be managed in conformance with the provisions outlined in the following sections. After sample shipment, copies of the final signed COC should be kept in the project file. A completed COC (inclusive of signatures from the laboratory), which should be provided with the laboratory data deliverables, should also be kept in the project file. An example completed COC is included in **Attachment A**.

In general, a standard sample naming convention should be used. The sample identification scheme should ensure that samples, including quality control samples (e.g., trip blanks), will be uniquely identified between events. Thus, in developing the sample identification scheme, historical data and reports should be reviewed to establish a location identification scheme which ensures that locations will be uniquely identified.

4.1 Sample Identification

Every sample collected must be associated with a unique identifier. Prior to mobilization, field personnel should confirm with the PM or PIC the sample name format to be used since there may be occasions when the standard sample identification (ID) format detailed in this FP is not applicable. For example, an ongoing project with a previously established sample nomenclature that does not correspond to the naming conventions outlined in this FP, which may be important to adhere to for the sake of continuity and consistency. Similarly, field personnel should confirm with the laboratory any limitations on the number of characters that can be used to identify a sample (a partial list of the analytical laboratories typically used by Ramboll is provided in Attachment B of **FP 1.03**, Data Management). In the absence of project specific instructions, the following scheme, which limits the sample ID to 18 characters, is recommended.

The recommended sample name or ID will consist of an alphanumeric describer that will identify the site name, sample type, sample location, sample depth (if applicable), and sample collection date using the following convention:

- The first three identifiers in the sample name will consist of a three-letter acronym for the study site (e.g., samples collected from an ABC Industries site might have ABC as the first three identifiers in the sample ID) or alternatively, if the name of the study site is too long or the borings are being advanced on properties adjacent to the study site, the first three identifiers could also be RE (short for Ramboll n).
- Following the site name portion of the sample ID will be a dash and one of the following modifier designating the type of sample:
  - Outdoor Air – OA;
  - Duplicate Sample – DS;
  - Effluent – EF;
  - Indoor Air – IA;
  - Influent – IN;
  - Injection Well – IW;

  - Midfluent – MD;
  - Monitoring Well (permanent) – MW;
  - Monitoring Well (temporary) – TW;
  - Hydropunch HP;
  - Piezometer – PZ;
  - Production Well – PW;
  - Recovery or Extraction Well – RW or EW;
  - Rinse Blanks – RB;
  - Sediment Sample – SE;
  - Soil Boring – SB;
  - Soil Vapor (i.e., outside of a building) – SV;
  - Sub-Slab Soil Vapor – SSV;
  - Surface Soil – SS;
  - Surface Water – SW;
  - Trip Blank – TB;
  - Waste Characterization – WC; or
  - Investigation-Derived Waste - IDW.

- Following the sample location code will be a two or three digit numeric designation indicating a unique location for that type of sample. For example, a soil sample collected from boring number 3 would have a sample type code of SB and a two digit numeric designation of 03. Thus, samples from this location would be referred to as SB03 or SB003, rather than SB3).
- For aqueous media (i.e., groundwater, surface water, QA/QC samples), and soil vapor sampling (i.e., indoor air, ambient air, soil vapor) the depth code will be followed by a six digit numeric code indicating the date the sample was collected (yymmdd). Non-aqueous samples such as soil and sediment samples will utilize a four digit acronym designating the top of the sampling interval in feet (e.g., 07.5 representing a sample collected from 7.5 feet below the ground surface or 10.5 representing a sample collected from 10.5 feet below the ground surface).
- Field duplicates will be labeled as ordinary field samples with a unique identification number. Duplicate samples should not be identifiable by sample ID alone so as to reduce the potential for bias and allow the laboratory to analyze them as "blind" quality control samples. Thus, in the event that multiple samples are collected on the same day from the same location (i.e., a duplicate sample), the designation "DS" (duplicate sample) will be used in place of the parent sample's sample type code and a sequential numeric designation will be assigned in place of the numeric location code. This sequential numeric designation will be "01" for the first duplicate sample collected that day, "02" for the second duplicate sample collected that day (from another sample location, media, etc.), and so on. Subsequent duplicate samples collected on multi-day

sampling events should be numbered sequentially (e.g., -"03" from the previous day's sampling).Since obvious links between the parent and duplicate samples in the Sample ID are to be avoided, it is very important to document in the field logbook or field notes which sample is the parent sample to each duplicate.

- Additional sample volumes collected for matrix spike (MS) and matrix spike duplicate (MSD) analysis will be noted on the COC forms, and no special designations will be used in the sample container labels.

For aqueous media (i.e., groundwater, surface water, QA/QC samples), the sample location code can also be followed by a single-letter acronym designating the well depth (e.g., bedrock (B), deep (D), intermediate (I) or shallow (S)) or the approximate depth the sample was collected.

Following are some sample name examples:

- A shallow soil sample collected from 3.5 feet collected from soil boring location 12 at ABC Industries on March 22, 2012 would be designated as "ABC-SB012-03.5". The complete depth sample range would be recorded in the field logbook or field notes.
- Groundwater samples collected from three different intervals at temporary well point location 3 at ABC Industries on March 22, 2012 could be designated as "ABC-TW003S-120322," "ABC-TW003I-120322," and "ABC-TW003D-120322" depending on the requirements of the project-specific Work Plan, sampling plan and/or project-specific FPs.
- Paired indoor air and sub-slab soil vapor samples collected from location 3 at ABC Industries on March 22, 2012 would be designated as "ABC-IA03-120322" and "ABC-SSV03-120322", respectively.
- A duplicate of the groundwater sample collected from temporary well point location 3 at ABC Industries on March 22, 2012 (see example above), which is the second duplicate sample collected that day, would be designated as "ABC-DS02-120322". Document in the field logbook or field notes which sample is the parent sample to each duplicate.

4.2 Sample Labeling

Sample labels shall be attached or otherwise adhered to all sample containers. If multiple containers comprise a sample, the label should identify the container number relative to the total number of containers (e.g., 3/4 or 3 of 4). The following procedures should be followed when labeling samples:

- Properly label samples immediately before or immediately following sample collection. Record the following information on each label in indelible black or blue ink (non-Sharpie):
  - Project/Site name;
  - Sample location/sample ID;
  - Sampling date;
  - Sampling time (except for Quality Assurance/Quality Control "QA/QC" samples);

  - Analyses to be performed;
  - Preservative;
  - Ramboll as the company name; and
  - Sampler initials.
- Wipe sample containers clean of any debris/water to allow the label to be attached.
- Double-check the label information to make sure it is correct. Remove the backing from the label and apply the label to the sample container. Cover label with clear tape.
- Bag the sample and place it in the designated sample cooler. Make sure there is plenty of ice in the cooler at all times. Maintain the samples at 4±2°C from the time of sample collection until delivery to the laboratory.
- Summa canisters and regulators should be returned to their original shipping container (e.g., typically cardboard boxes).
- Sampling information, including the QA/QC sampling time, should be reflected in the field notebook or on field forms, along with the following information:
  - The location of the sample in relation to reference points.
  - Field screening measurements (e.g., photoionization detector [PID] readings), when appropriate.
  - Whether the sample is a QC sample (e.g., split sample, field duplicate, or rinse sample).
  - Any unusual or pertinent observations (oily sheen on groundwater sample, odors).
  - For soil vapor samples record the summa canister and corresponding regulator serial numbers, building interior and outdoor temperatures, sample start and stop times, negative pressure start and stop readings, summa canister size, and atmospheric pressure.

4.3 Sample Packaging

While samples should be kept in the sampling cooler(s) at 4±2°C from the time of collection, it is not always feasible during sampling to pack samples as required for transport to the laboratory. At the end of the sampling day, sample packaging for transport to the laboratory should be conducted in an organized and clean area (free of potential cross-contaminants). The following procedure should be followed to prepare the sample(s) and cooler(s) for transport:

- Gather coolers/sample shipping containers, ice, zip-lock bags, and padding, as appropriate.
- Containerize ice in zip-lock bags (double bag) and place a layer of ice bags on the bottom of the cooler.
- Place a layer of padding on top of the ice bags and then begin placing the properly labeled samples in the cooler. Do not bulk pack – be sure to provide padding between sample bottles.

- Once the layer of padded sample containers is full (but not over-packed), place another layer of padding material on top of the sample containers.
- An additional layer of double-bagged ice can be added on top of the padding layer for additional cooling.
- Use multiple coolers if one cooler does not provide sufficient capacity to hold all samples along with appropriate amounts of padding and ice. It is preferable to use more coolers and more padding rather than over-packing and crowding the samples, as sample integrity may be compromised during transport.
- Confirm that each cooler used contains a temperature blank.
- Confirm that a trip blank has been included with the samples if the sampling plan and analyses (e.g., volatile organic compounds [VOCs]) call for use of a trip blank. Ensure that all samples to be analyzed for VOCs are placed in the same cooler as the associated trip blank. If necessary, use more than one trip blank.
- Close coolers/shipping containers and group them together for transport.

4.4 Sample Chain-of-Custody

Sample Chain-of-Custody (COC) forms shall be filled out as soon as practicable after collection of the samples, but can also be cross-checked during the packaging of the samples for transport to confirm that all samples/blanks have been accounted for on the COC. COCs are legal documents and should be filled out carefully and accurately.

- The following information should be provided when completing the COC (use indelible black or blue ink ball-point):
  - Project Manager Name and Contact information for report submittal.
  - Sampler's name.
  - Analyses Turn-Around Time (typically standard unless otherwise directed).
  - Project/Site name and location (municipality/state). Try to use a consistent Project/Site Name when re-visiting a site for multiple sampling events.
  - Regulatory Program.
  - Sample ID for each sample.
  - Sample collection date and time for each sample.
  - Sample matrix for each sample.
  - Number of sample containers for each sample.
  - Analyses requested for each sample.
  - Sample matrix and air sample volume, if appropriate.
  - Sample preservation method.
  - Indicate whether samples are field filtered or require filtering in the laboratory.

  - Special instructions or notes to the laboratory (for example, expedited turnaround or holding samples for analysis pending results of other samples).
  - Signatory information when relinquishing samples (signature, company, date and time of recipient and sample releaser) – see below.
  - Note Delivery Service (e.g., laboratory courier or Federal Express) and air bill Number (if applicable).
  - For vapor samples, record the summa canister and regulator serial numbers, building interior and outdoor temperatures, sample start and stop times, negative pressure start and stop readings, summa canister size, and atmospheric pressure, if required by the laboratory, a project-specific Work Plan, sampling plan and/or project-specific FPs.

- If a minor mistake is made when filling out the COC, cross out the error with a single line and write your initials and date next to the error. Major errors in transcription require that a new COC form be completed to ensure legibility of information on the original and carbon copy pages of the COC form.
- The use of quotation marks or other terms to indicate repetitive information within a column should be avoided. If several entries in a row are repetitive, place a continuous vertical arrow through the cells from the first entry to the next different entry.
- If additional instructions or information is necessary to provide to the laboratory, provide these details on the COC (usually within the "remarks" section) – do not enclose additional pages of instructions.
- If more than one COC form is necessary to accommodate all of the samples being transported to the laboratory use consecutive numbers to identify the additional COC forms (i.e., Page 1 of ___, Page 2 of ___, etc.).

4.5 Sample Transport

Maintaining the chain-of-custody is just as important during sample transport as it is during sampling activities. Note that a sample is considered to be in custody if:

- It is in the actual possession of an investigator (sampler);
- It is in the view of an investigator (sampler), after being in their physical possession;
- It was in the physical possession of an investigator (sampler) and then they secured it to prevent tampering; and/or
- It is placed in a designated secure area.

Option 1

The preferred method of transporting the collected samples under chain-of-custody to the laboratory is for the sampler/field personnel to hand-deliver the cooler(s)/container(s) of samples to the laboratory. When this transport method is possible, the following procedure must be followed:

- Once you have finished completing the COC, place it in a zip-lock bag without signing the "relinquished by"/"received by" (or equivalent) signatory boxes. Keep this outside of, but with, the packaged cooler(s).
- Place two (2) custody seals on opposite corners of each packaged sample cooler (across the opening) and sign/date each custody seal.
- Transport the properly packed and padded cooler(s) and the COC to the laboratory.
- The sampler/field staff must meet with the laboratory representative that accepts sample drop-offs (it is unacceptable to leave samples at a front desk or anywhere without having a laboratory representative sign off on receipt).
- Upon meeting the laboratory representative, sign your name on the COC in the "relinquished by" signatory block. Write the current date and time next to your signature.
- The laboratory representative will then sign their name in the "received by" signatory block using the same date and time. The samples are no longer under the sampler/field staff's custody and chain-of-custody will continue with the laboratory throughout analysis of the samples.
- The laboratory representative will provide you with one of the carbon copies of the COC, which you should maintain with the project files/field logbooks.

Option 2

The second most preferred method of transporting samples to the laboratory is to arrange a laboratory courier pick-up at the site at the end of the sampling day. The arrangements should be made with the laboratory in advance (usually during the ordering of sampling containers) to plan when and where the laboratory courier service will meet the field staff at the site. When this transport method is used, the following procedure must be followed:

- Once you have finished completing the COC, place it in a zip-lock bag without signing the "relinquished by"/"received by" (or equivalent) signatory boxes. Keep this outside of, but with, the packaged cooler(s).
- Take the properly packaged cooler(s) and COC and meet with the laboratory courier service representative at the predetermined time and location at the site.
- Upon meeting the laboratory courier representative, sign your name on the COC in the "relinquished by" signatory block. Write the current date and time next to your signature.
- Place two (2) custody seals on opposite corners of each packaged sample cooler (across the opening) and sign/date each custody seal.
- The laboratory courier representative will then sign their name in the "received by" signatory block using the same date and time. The samples are no longer under the sampler/field staff's custody and chain-of-custody will continue with the laboratory courier service and the laboratory throughout transport and analysis of the samples.
- The laboratory courier representative will provide you with one of the carbon copies of the COC, which you should maintain with the project files/field logbooks.

Option 3

If it is not possible for the field staff to drop off the samples at the laboratory or a laboratory courier service to pick up the samples on the same day of collection at the project site, arrangements can be made for the laboratory courier service to pick up the samples the following day at the Ramboll office (assuming next day pick up is consistent with the stipulated hold time for all samples). The courier pickup arrangements should be made with the laboratory in advance (usually during the ordering of sampling containers), if possible. When this third transport method is used, the following procedure must be followed:

- Once you have finished completing the COC, place it in a zip-lock bag without signing the "relinquished by"/"received by" (or equivalent) signatory boxes. Keep this outside of, but with, the packaged cooler(s).
- Place two (2) custody seals on opposite corners of each packaged sample cooler (across the opening) and sign/date each custody seal.
- Transport the properly packaged coolers/shipping containers and COC from the site back to the Ramboll office.
- Place the properly packaged coolers/shipping containers in the field room (a locked, secure space).
- Remove the COC from the zip-lock bag and sign your name on the COC in the "relinquished by" signatory block. Write the current date and time next to your signature.
- Do not write anything else or sign anywhere else in the "relinquished by" or "received by" signatory spaces.
- Place a post-it note on the COC that indicates the number of coolers/shipping containers (if more than one) that should accompany that COC. Return the COC to the zip-lock bag.
- Leave the COC with the coolers in a fashion that will ensure the COC does not get separated from the coolers. For example, the COC could be taped to the cooler/shipping container; a zip-tie could be placed through the zip-lock bag and attached to the handle of a cooler, etc.
- If there are multiple cooler/shipping containers that will be left with the one COC, place notes or some other indicator on each of the coolers to denote which coolers/shipping containers belong to the same group.
- Leave coolers/shipping containers and COC in secure field room, ensuring that the door to the field room is locked behind you.
- For sampling events that require leaving more than one cooler/shipping container in the field room with the COC, the sampler should notify and send photo-documentation of the sample locations to office personnel (those that might possibly get called when the laboratory courier arrives for pick-up the following day) to alert them to the group of coolers/shipping containers and any marks/notes placed on the coolers to group them together.
- When the pre-arranged laboratory courier pickup occurs, it is possible that another field staff member (other than the original sampler) will receive the call to transfer the

samples to the laboratory courier. Whoever receives a call to meet with the laboratory courier should meet the courier at the field room if the original sampler is not able to.

- The Ramboll staff member meeting the courier should review the COC/post-it note to confirm how many coolers/shipping containers should be included in the grouping. This staff member should also confirm that the correct number of coolers/shipping containers are grouped together with the COC. If the staff member is unsure or has any questions about what coolers correspond to the COC, the staff member should call the original sampler.
- Once the staff member has confirmed that all the coolers/shipping containers are accounted for with the COC, they should remove the COC from the zip-lock bag.
- The staff member then signs the "received by" signatory block next to the original sampler's signature. The staff member should put the date and time next to their signature that was used by the original sampler on the previous day. For example, if Sampler A signed the COC at 17:55 on 3/22/12 and Staff Member B met with the courier the following day, Staff Member B signs the COC as "received by" on the same line as Sampler A signed "relinquished by" and Staff Member B also puts the date and time of their signature as 17:55 and 3/22/12. This accounts for the samples being in a secured Ramboll space after the original sampler placed them there (i.e., in Ramboll's custody) and Staff Member B signs off at the same time/date as the original sampler because they are acting as a representative of Ramboll.
- The staff member then signs off on the second line in the "relinquished by" signatory block and writes the CURRENT date and time (current as of when the courier is there for pick-up).
- The laboratory courier representative will then sign in the "received by" block on the second line and will use the same current date/time. At this time, the samples are no longer under Ramboll's custody and the chain-of-custody will continue with the laboratory courier and the laboratory through transport and analysis of the samples.
- The laboratory courier representative will provide you with one of the carbon copies of the COC, which you should maintain with the project files/field logbooks.

Option 4

Some sampling events may take place at sites that are not in the same general geographic region or that require analyses that are only performed at laboratories that are not located within driving distance. In these cases, samples may need to shipped to the laboratory from the project site (or the Ramboll office). Due to the variations in out-of-state laboratories and transportation requirements based on preservatives and sample material, a specific plan for sample transport should be discussed between the sampling field team and the project's PM or PIC to ensure that all laboratory and Federal/State transportation requirements are met. In general, the following steps should be considered when planning sample transport using a shipping service (e.g., FedEx, UPS, etc.):

- Package samples with more padding than would normally be used in field vehicle/ laboratory courier road transport.
- Consider the amount of ice required to keep samples cool for the duration of the trip to the laboratory.

- Samplers should sign the "relinquished by" signatory block of the COC with the date and time when they drop off the samples for shipment. Then place the COC in a zip-lock bag and place it in the cooler to be shipped. Place signed custody seals on the cooler and then secure the cooler closed with tape around the entire seal of the opening and then around the cooler (perpendicular to the opening) to ensure the cooler is secure during shipping.
- Consider the preservatives used with the samples. Based on United States Environmental Protection Agency (USEPA) research and subsequent negotiation with the US Department of Transportation (USDOT), environmental samples do not need to be declared as "hazardous materials" when they (or the preservative used with them) fall below a certain weight percent limit for certain acids/bases. The concentration of constituents expected in samples and preservatives should be compared to regulations to see if special hazardous materials handling applies.
- Consider USDOT, International Air Transport Association (IATA), and any other Federal/State transportation regulations governing the shipment of hazardous materials or dangerous goods.
- Shipping papers need to be retained with the COC, and sampling staff must confirm tracking to receipt by lab. The sampler must verify that all of the containers shipped arrived at the lab.

5. PRECAUTIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while preparing samples for shipment and recording the required information.

- It is important to always remain alert and aware of your surroundings and wear a high visibility safety vest. Activities associated with the labeling and preparation of samples for shipment should be performed away from active work areas or traffic areas, preferably in a field office or on the back of a field truck.
- To prevent laboratory bias in analysis of QA/QC samples (e.g., field duplicates), do not name or assign times to quality control samples with a similar sample ID as the parent sample. Since the duplicate sample's sample ID will not have a direct indication of what parent sample it is related to, the parent and quality control sample information should be recorded in field logbooks or forms.
- Should samples need to be preserved over longer time periods (e.g., weekend), replenish ice in the cooler as needed to ensure that the samples are preserved at 4±2°C until delivery to the laboratory. Avoid placing samples in refrigerators or freezers.
- Consider potential for hazardous materials within sample media or sample preservatives. Consult Federal and State regulations to determine if special hazardous materials handling procedures must be followed on a project by project basis.

6. RECORDKEEPING

Record all information related to the release of samples in accordance with **FP 1.01**, Field Notes and Records. After the COC is signed, by both the

he samples are transferred, obtain a copy of the signed COC. A completed COC (inclusive of signatures from the laboratory) should be provided with the laboratory data deliverables. Maintain both copies of the COC with the project files along with copies of associated shipping air bills (if used) and other sampling documentation.

Records should be managed in accordance with Ramboll's Document Retention Policy, with copies of COCs, air bills, lab bottle order documentation, and sampling plans specific to a sampling event maintained together within the project files.

FIELD PROCEDURE NO. 5.01

SOIL CLASSIFICATION

VISTRA – PROJECT

PROJECT NO. 1940112376

RAMBØLL

FIELD PROCEDURE NO. 5.01

SOIL CLASSIFICATION

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document NO. 5.01 "Soil Classification" last revised November 16, 2015.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the field classification and description of soils using manual tests for geologically logging soil borings. Soil types and properties may vary significantly at a site and accurate soil(s) identification and geologic logging is an essential element of the site characterization process. A standardized classification and description procedure for soil logging is provides for consistency across phases of field work, as well as across sites as it provides for a clear, accurate, and complete summary of subsurface field conditions observed during the implementation of soil investigation activities. Consistent soil classification is imperative as it allows the use of logs created by one or multiple field staff in developing accurate conceptual site models developed to support characterization of the nature and extent of contamination, performing hydrogeological modeling, conducting site specific risk evaluations, evaluating the feasibility of remedial alternatives, and/or preparing remedial design specifications. Accurate soil classification is also necessary for estimating engineering properties of materials.

The visual identification techniques detailed herein are generally consistent with the Unified Soil Classification System (USCS). The USCS is based on grain size and response to physical manipulation at various water contents to define plasticity and texture. This system is commonly used for classifying soils encountered in boreholes, test pits and surface sampling. As a matter of background, this soil logging system was initially developed by Arthur Casagrande in the 1940s. The Airfield Classification System, as it was then known, was adopted with minor modifications by the United States Bureau of Reclamation and the United States Corps of Engineers in 1952. In 1969, the American Society for Testing and Materials (ASTM) adopted the system and it is currently designated as D-2488-09a.

This FP was prepared to document the procedures and techniques that will be used to fulfill the groundwater sampling and analysis program requirements of the United States Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this FP. The Ramboll Principal in Charge (PIC) and/or Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file. The signatures of the PIC and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

A general checklist of equipment that may be required for typical soil classification procedures is provided below. Note that soil logging procedures are covered under **FP 5.09**. This checklist only suggests general materials and equipment that may be necessary for a project or task and should not be considered an exhaustive compilation. More specialized equipment or materials may be required when describing soils in the field in conjunction with soil sample collection, completion of field soil boring logs, or installation of wells.

- Field notebook or pertinent field log forms and all-weather or permanent pens as outlined in FP 1.01 - Field Notes and Records.
- Measuring Tape.
- Knife (for cleaning exposed soil surfaces).
- Plastic sheeting.
- Magnifying Glass.
- Digital Camera.
- Water.

Based on the field activity and project, the following may also be needed:

- Munsell Soil Color Book.
- Field sieves.
- Geotechnical Gauge (as manufactured by W. F. McCollough or equivalent).

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- FP 1.01 - Field Notes and Records,
- FP 2.02 - Site Preparation, Inspection and Housekeeping, and
- FP 5.09 - Soil Boring Log Preparation.

4. PROCEDURES

4.1 General Information

Information regarding all activities related to the classification of soil samples should be recorded in the Field Notebook or on a Soil Boring Log form (a comprehensive example is provided as Attachment A in FP 5.09). The Field Notes or Soil Boring Log form should be populated concurrently with soil classification activities, and the person completing the log should pay close attention to the drilling activities when boreholes are advanced (refer to FP 5.09 - Soil Boring Field Log Preparation).

Most generally, the primary soil grain size can be identified by assigning a group symbol and name or, in the case of soils with properties that do not distinctly place it into a single group, borderline symbols and names. For accurate description and identification of soils, the following key physical properties should be field-determined and recorded in the following order:

- Color including color variations within the same sample.
- Soil particle size identification name (synonymous with ASTM D2488-09a Group Name) with appropriate particle size modifiers. It is suggested that percentage by volume of each particle size be recorded).
- Soil description modifiers (as appropriate for the scope of work – discuss with the project manager ahead of time) including:
  - For coarse grained materials:
    - Gradation.
    - Grain shape and angularity.
    - Cementation.
    - Range of grain or particle sizes (sorting).
    - Maximum particle size.
    - Relative density (of sands).
  - For fine grained materials:
    - Consistency.
    - Dry strength.
    - Dilatancy.
    - Toughness and plasticity.
- Moisture content.
- Relative density or consistency.
- Signs of potential contamination (discoloration, odor, staining, etc.).
- Other general observations (micaceous, calcification, presence of shells, roots, iron-oxide staining, etc.).

4.2 Field Determination of the Soil Identification Name

Soils are generally subdivided into three types: coarse-grained soils, fine-grained soils and organic soils. Coarse-grained soils (also referenced as granular or non-cohesive) include gravel and sand. Fine-grained soils (also known as cohesive soils) include silts and clays. Soils that do not behave like a coarse- or fine-grained material and that have a high content of decaying vegetative matter are considered organic soils. Soil types are further subdivided into soil groups in accordance with the USCS.

4.2.1 Predominant Soil Classification

USCS soil identification is based on the portion of the soil sample that will pass a 3-inch sieve. The larger than 3-inch particles (i.e., cobbles and boulders) must be removed, manually for a loose sample or accounted for in an intact sample, before classifying the soil. The percentages by volume of cobbles and boulders or other debris should be estimated and recorded, and description of these materials recorded. Of the fraction of soil smaller than 3-inches, estimate and note the percentage of the gravel, sand and fines using the procedures outlined herein. The percentages shall be estimated to the closest 5% and the percentages of gravel, sand and fines must add up to 100%. If one of the components is present but not in sufficient quantity to be considered 5% of the smaller than 3-inch portion, indicate its presence by the term "trace" (e.g., fine to medium gravel with trace fines). A trace is not to be considered in the total of 100% for the components.

The following procedures outline how to determine the predominant soil type in the material

- Spread a representative soil sample on a flat surface.
- Determine whether or not the predominant size fraction is discernible with the naked eye or using the Geotechnical Gauge (also refer to **Table 1** below).
  - If the material contains less than 50% fines (i.e., clay, silt) it is considered a coarse-grained soil. Procedures and definitions for describing and identifying properties of coarse grained soils are presented in **Section 4.2.2**.
  - If the soil contains greater than 50% fines, it is a fine grained soil. Procedures and definitions for describing and identifying properties of fine grained soils are presented in **Section 4.2.3**.

If the material has a high content (greater than 50%) of decaying vegetative matter and does not behave like a silt or clay, it is classified as an organic soil (refer to **Section 4.2.4**). Soils containing moderate amounts of organic matter that still retain the properties of silts and clays should be described as fine-grained soils.

Table 1: Soil Types and Particle Sizes

Principal Soil Type	Descriptive Term	Size	U.S. Standard Sieve	Familiar Example Range
Coarse-grained (individual grains can be seen with the naked eye - see Section 4.2.2)	Boulder	Greater than 305 mm	Greater than 12 in.	Bigger than a basketball
	Cobble	76 to 305 mm	3 to 12 in.	Fist sized to basketball
	Coarse gravel	19 to 76 mm	3/4-in. to 3 in.	Thumb to fist sized
	Fine gravel	5 to 19 mm	#4 to 3/4-in.	Pea to thumb sized
	Coarse sand	2 to 5 mm	#10 to #4	Rock salt to pea sized
	Medium sand	0.4 to 2 mm	#40 to #10	Sugar to rock salt
	Fine sand	0.074 to 0.4 mm	#200 to #40	Fine sugar to table salt
Fine-grained (individual grains not visible - see Section 4.2.3)	Silt or clay	Microscopic	Passing No. 200	Flour sized and smaller
Organic (see Section 4.2.4)	Peat or muck	Microscopic	--	Decaying vegetable matter

Once the predominant soil type has been defined, proceed to the corresponding subsection for further guidance.

4.2.2 Coarse-grained Soils

If the soil has been determined to be predominantly coarse-grained, further examination is required to determine the grain size distribution, the grain shape, and the density of the in situ deposits (if applicable) so the materials can be classified into groups in accordance with the USCS. The procedure for field classifying coarse-grained soils is described below.

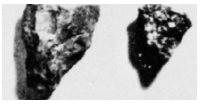
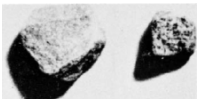
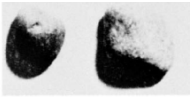
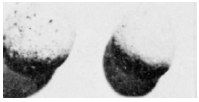
- Define the soil type based on the most prevalent particle size as follows:
  - The soil is gravel if the percentage of gravel is estimated to be more than the percentage of sand.
  - The soil is sand if the percentage of sand is estimated to be equal to or more than the percentage of gravel.
- Describe the gradation of coarse-grained soils as well graded, poorly graded or gap graded (note for geologists: this may be contrary to the terms well sorted or poorly sorted). A summary of the descriptive gradation of coarse-grained soils is provided in **Table 2**.

Table 2: Description of Gradation of Coarse-Grained Soils

Description	Meaning
Well graded/Poorly sorted	A good representation of all grain sizes is present.
Uniformly or poorly graded/sorted	All grains are approximately the same size.
Gap graded/Well sorted	Intermediate grain sizes are absent.
Note: Source ASTM D2488	

- If particles are sufficiently large, describe the particles according to a characteristic shape, which may vary from angular to rounded to flat or elongated. Appropriate descriptive terms are listed in **Table 3**.

Table 3: Description of Grain Shape of Coarse-Grained Soils

Descriptive Term	Criteria	Example
Angular	Irregular with sharp edges such as freshly broken rock	
Subangular	Irregular with smooth edges	
Subrounded	Irregular but smooth like a lump of molding clay	
Rounded	Marble- or egg-shaped; very smooth	
Flaky	Sheet of paper or flake of mica	
Flat	Ratio of width to thickness greater than 3	
Elongated	Ratio of length to width greater than 3	
Note: Adapted from ASTM D2488		

- Describe the cementation of intact coarse-grained soils as weak, moderate or strong, in accordance with the criteria defined in **Table 4**.

Table 4: Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure
Note: Source ASTM D2488	

- If the coarse-grained material is determined to be sand, describe its relative density in accordance with the criteria defined in **Table 5** based on blow counts. If you have not collected blow counts using standard ASTM procedures, it is recommended that you either not include density descriptions or clearly indicate in the field notes that the estimated density is not based on standard penetration tests (SPTs).

Table 5: Criteria for Describing Relative Density

Description	Uncorrected SPT N-Value (blows/foot)
Very Loose	4
Loose	4 to 10
Medium Dense	10-30
Dense	30-50
Very Dense	50 or greater
Note: SPT: Standard Penetration Test (ASTM D1586)	

4.2.3 Fine-grained Soils

If the soil has been determined to be predominantly fine-grained, manual tests need to be performed to classify the fine-grained material because the soil grains cannot be seen with the naked eye. One of the primary means of classifying fine-grained soil is to determine its plasticity. Plasticity generally increases with clay content so, for the purpose of field classification, one can estimate whether the fine fraction of a soil stratum is primarily silt or clay by determining the relative plasticity of the soil. Note, however, that this is a generalization which may lead to erroneous classification of plastic silts as clays.

An additional field test is to wet the soil and rub it between your fingers. If the soil feels gritty, the fines likely include a significant proportion of silt; if the soil feels smooth and can be spread into a thin ribbon without breaking, the soil likely contains a greater percentage of clay. Similar to estimates of plasticity, this is a generalization. If the distinction between silt

and clay is important on a project, a sample should be submitted to a soils laboratory for a hydrometer analysis (ASTM D422) to accurately classify the fine-fraction of the soil. The primary field tests for classifying fine-grained soils are consistency, dry strength, dilatancy (mobility of pore water), toughness, and plasticity. However, these field tests may not be required for all projects (refer to the project-specific Work Plan or Sampling Plan). The field-manual procedures are described below.

- Prior to manual testing a sample, remove particles that are medium sand-size and larger.
- Materials that had to be removed from the samples to perform the test should be described.

To perform the consistency test, push thumb onto a relatively undisturbed portion of the soil sample and describe the density/consistency of soils as very soft, soft, firm, hard or very hard, in accordance with the criteria in **Table 6**.

Table 6: Field Criteria for Describing Consistency

Description	Criteria	Uncorrected SPT N-Value (blows/foot)
Very Soft	Thumb will penetrate soil more than 1-inch	Less than 2
Soft	Thumb will penetrate soil approximately 1-inch	2 to 4
Firm	Thumb will indent soil approximately ¼-inch	4 to 15
Hard	Thumb will not indent soil but readily indented with thumbnail	15 to 30
Very Hard	Thumbnail will not indent soil	Greater than 30
Note: Adapted from ASTM D2488		

- To perform the dry strength test, select enough soil to mold material into a ball measuring approximately 1-inch in diameter.
  - Mold the material until it has the consistency of putty, adding water if necessary.
  - From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½-inch in diameter. If the test specimen contains natural dry lumps, those that are about ½-inch in diameter may be used in place of the molded balls.
  - Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 140°F.
  - Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accordance with the criteria in **Table 7**.

- Upon completion of the test, if the specimen is easy to crush it is probably a silt and if it is hard to crush it is probably a clay.

Table 7: Criteria For Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into a powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between thumb and a hard surface.
Note: Source ASTM D2488	

- To perform the dilatancy test, select enough soil to mold material into a ball about ½-inch in diameter.
  - Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
  - Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula.
  - Shake horizontally, tapping the underside of the hand vigorously with the palm of other hand several times. Note the reaction of water appearing on the surface of the soil.
  - Squeeze the sample by closing the hand or pinching the soil between the fingers and note the reaction as none, slow, or rapid in accordance with the criteria in **Table 8**. The reaction is the speed with which water appears while shaking, and disappears while squeezing.
  - Upon completion of the test, if the specimen has a glassy, wet look it is probably a silt and if it has a dry look it is probably a clay.

Table 8: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear, or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.
Note: Source ASTM D2488	

- To perform the toughness test, the test specimen used in the dilatancy test is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about 1/8-inch. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.
  - Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8-inch. The thread will crumble at a diameter of 1⁄8-inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread as none, low, medium, high, or very high in accordance with the criteria in **Table 7**.
  - After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in the **Table 9**.
  - Upon completion of the test if a thread cannot be rolled it is probably a silt and if the specimen can be rolled into a thin thread it is probably a clay. Note: some silts are plastic (i.e., able to be rolled into a thread) so this generalization should be confirmed by other tests.

Table 9: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.
Note: Source ASTM D2488	

- On the basis of the observations made during the toughness test above, describe the plasticity of the material in accordance with the criteria provided in **Table 10**.

Table 10: Criteria for Describing Plasticity

Description	Criteria
Non-plastic	A 1/8 inch thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.
Note: Source ASTM D2488	

4.2.4 Organic Soils

If the material does not behave like a silt or clay and has a high content of decaying vegetative matter, it is classified as an organic soil and not subjected to the identification procedures detailed in the FP. Following are some typical attributes of organic soil:

- Organic soils are composed primarily of vegetative matter in various stages of decomposition and have a fibrous to amorphous texture.
- Organic soil is usually dark brown or black and may have an organic odor.
- Often organic soil will change color (e.g., black to brown) when exposed to air. Some organic soil will lighten in color significantly when air-dried.
- Organic soil normally will not have a high toughness or plasticity.

Organic soils can be broadly grouped into two categories:

- Topsoil: a surficial organic soil layer that may contain organic matter. Note that topsoil may be encountered below the surface if buried by geological processes or man-made fill.
- Peat: an organic soil composed primarily of plant remains in various stages of decomposition. There are no standardized criteria for describing peat, however, It is generally described in terms of its degree of decomposition and strength:
  - Firm - the soil matrix is comprised of fibers that are compressed into a layer.
  - Spongy - the soil is very compressible and has an open structure.

- Plastic - the soil can be molded like a clay and smears on surfaces.
- Fibrous - the plant remains are recognizable and have retained some strength.
- Amorphous - plant remains are not recognizable.

4.2.5 Soil Name Designation

The basic name of a soil should be consistent with the ASTM D2488-09 Group Name, based on visual estimates of gradation and plasticity, and should be capitalized. The acceptable soil names for coarse and fine grained soils are those listed in **Figures 1, 2 and 3**. Note that, if the soil appears to be fill material (e.g., fragments of brick, glass, slag, etc.), the soil grain sizes should be described, but the soil type should be identified as "FILL" rather than using one of the other two letter identifiers.

- As detailed in **Figure 1**, for coarse grained materials,
  - If the percentage fines is less than or equal to 5%, the coarse-grained material is considered to be "clean" and the following USCS symbols are applicable:
    - GW for well graded gravel;
    - SW for well graded sand;
    - GP for poorly graded or gap-graded gravel; and
    - SP for poorly graded or gap-graded sand.
  - If the percentage fines is more than or equal to 15%, the coarse-grained material is considered to be "with fines" and the following USCS symbols are applicable:
    - GC if the predominant soil type is gravel and the fines are determined to be clayey;
    - SC if the predominant soil type is sand and the fines are determined to be clayey;
    - GM if the predominant soil type is gravel and the fines are determined to be silty; and
    - SM if the predominant soil type is sand and the fines are determined to be silty.
  - If the percentage fines is more than 5% or less than 15%, dual USCS symbols are applicable. The first group symbol would correspond to the "clean" coarse-grained material designation and the second group symbol would correspond to the "coarse-grained material "with fines: designation (e.g., poorly graded SAND with silt would be SP-SM). If dual USCS cannot be assigned, the soil should be only described in terms of the percentage of each soil group (e.g., 85% sand and 15 % silt).

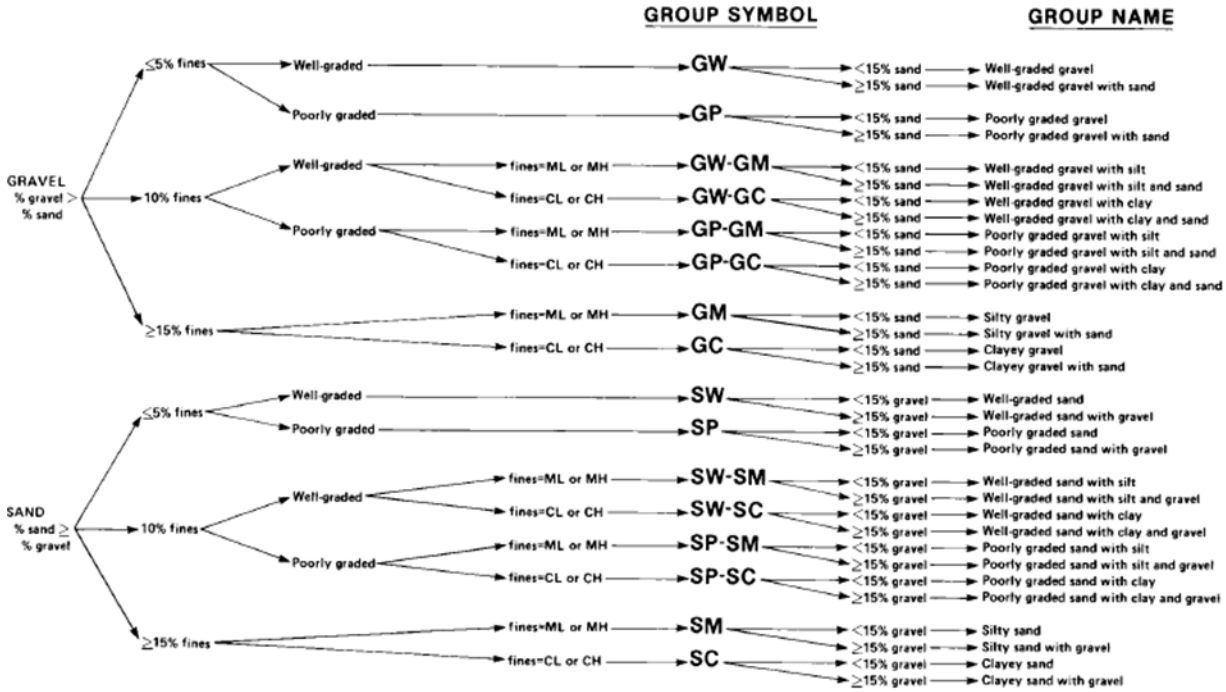


Figure 1:

Flow Chart for Identifying Coarse-Grained Soil (Source ASTM D2488-09)

- For fine grained inorganic materials,
  - On the basis of the manual tests, identify the inorganic fine grained soils in accordance with the criteria provided in **Table 11**.
  - Expand the group name description as detailed in **Figure 2** based on the percent sand or gravel that the fine-grained material contains.

Table 11: Identification of Inorganic Fine-Grained Soils from Manual Tests

USCS Symbol	Soil Description	Dry Strength	Dilatancy	Toughness and Plasticity
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean clay	Medium to high	None to slow	Medium
MH	Elastic silt	Low to medium	None to slow	Low to medium
CH	Fat clay	High to very high	None	High

Note:
Source ASTM D2488

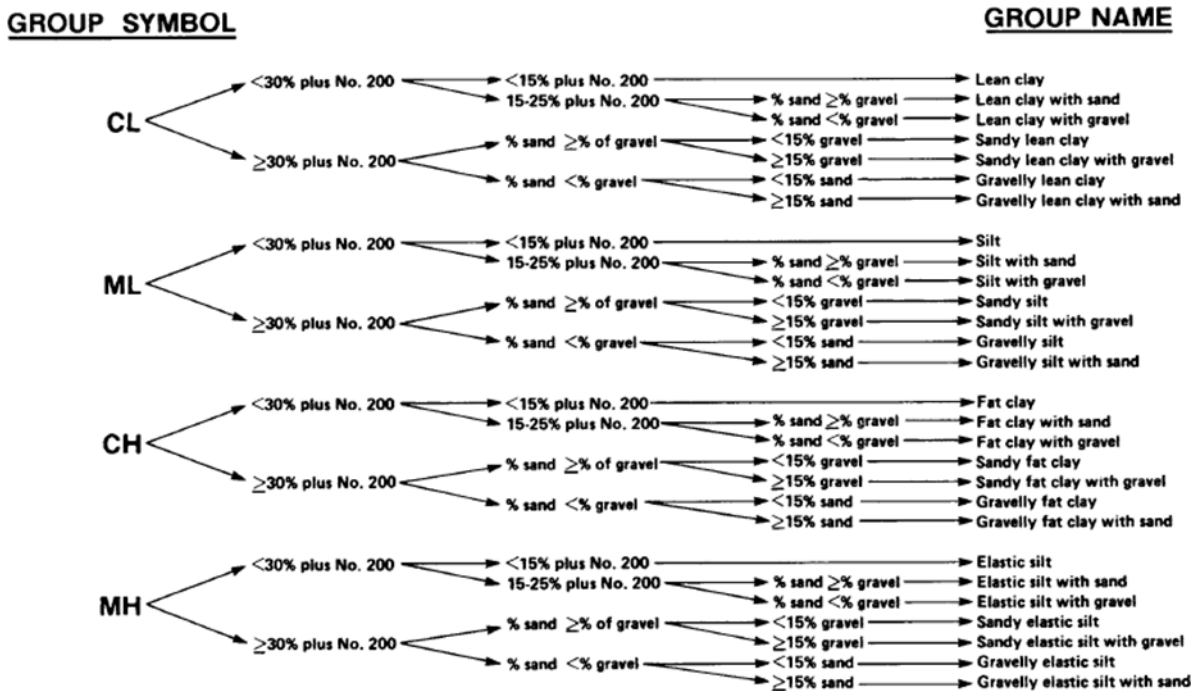


Figure 2:

Flow Chart for Identifying Inorganic Fine-Grained Soil (Source ASTM D2488-09)

If the soil contains enough organic particles to influence the soil properties the soil should be identified as an organic soil (OL/OH), expanding the group name description as detailed in **Figure 3** based on the percent sand or gravel that the organic material contains.

- It is not necessary to characterize organic soils using the full identification procedures for fine grained materials as detailed above in **Section 4.2.3**.
- Organic soils shall be identified as top soil or peat (PT).
- However, description of the other relevant observable properties of the organic soils should be given (color, odor, moisture content).

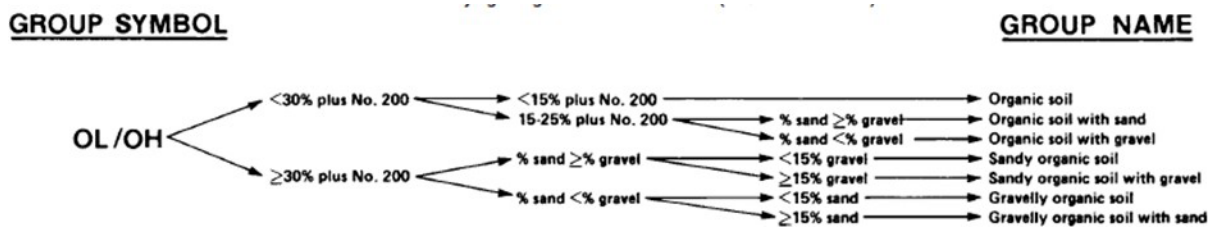


Figure 3:

Flow Chart for Identifying Organic Fine-Grained Soil (Source ASTM D2488-09)

In designating soil names and descriptions, it is customary to list the primary grain size first, followed by modifiers and secondary grain sizes. Common modifiers include:

- Trace: Particles are estimated to be less than 5% by volume.
- Few: 5 to 10% by volume.
- Little: 15 to 25% by volume.
- Some: 30 to 45% by volume.
- Mostly: 50 to 100% by volume.

4.3 Color

Color is probably the most obvious feature of soil and is an important soil property that should be included in its description. An experienced observer can often relate soil color to specific chemical, physical and/or biological properties of the soils in that area. Some broad generalizations are also possible. For example, inorganic soils typically have clean, bright colors (e.g., light gray, olive green, brown, red, yellow, white), whereas organic soils have dark or drab shades (e.g., dark gray, dark brown, black). Red colors may indicate the presence of free iron oxides common in well-oxidized soil and white or pinkish colors may be indicative of silica, calcium carbonate or aluminum compounds. Materials of similar geologic origin could also be identified based on color.

Mottling or spots or streaks of a particular color within a predominant background color is indicative of soil that has experienced a variety of conditions that affect the soil color. Thus, mottling in soil is a clue that should be evaluated in terms of depositional environments, groundwater fluctuations, or contaminant transport. Mottling is described in terms of three basic characteristics:

- Abundance (few, common, many),
- Contrast (faint, distinct, prominent), and
- Size (fine, medium, coarse).

In expressing color, it is customary to list the dominant color first, followed by a description of abundance, contrast, and size of the other colors in the mottled pattern. When describing the color of a soil:

- Color should be described as accurately as possible using the Geotechnical Gauge. For example, rather than "brown," consider gray-brown, brownish-orange, tan, dark brown, etc. If use of a Munsell color chart is required, both the code and associated color should be listed. Note, however, that it is generally not necessary to get overly-specific in naming a particular shade.
- Note whether the sample contains layers, patches or mottling of varying colors, and describe all of the representative colors.
- Indicate whether the color represents dry conditions.

It is customary to use the color description of the soil in lower case before the soil name and appropriate modifiers.

4.4 Moisture

Soil moisture is an important indicator of soil conditions and should be included in the description of a soil. For example, visible or free water from a soil sample can infer the proximity of the water table or perched water zones. Soil moisture conditions should be described using the criteria provided in **Table 12**.

Table 12: Criteria for Describing Soil Moisture

Description	Criteria	Granular Soil	Cohesive Soils
Dry	Absence of moisture, dusty, dry to the touch	Soil runs freely though hands	Hard, powdery or friable
Moist	Moisture present but no free water	Soil particles will begin to adhere	Soil has weakened structure but free water does not form when handling
Wet	Visible free water; usually soil is at or below water table	Color darkens, soil particles will adhere and free water is present	Color darkens, soil has weakened structure and/or free water forms when handling
Note: Adapted from ASTM D2488			

It is customary to describe the soil's moisture in lower case and within parenthesis following the soil name and appropriate modifiers.

4.5 Visual Indications of Potential Contamination

During environmental sampling, visual indications of potential contamination (e.g., discoloration) and/or the presence of anthropogenic materials (e.g., glass, wood, brick, plastic, slag, gravel fill, etc.) may be encountered. Record observations of any potential field evidence of environmental impacts and/or the presence of anthropogenic materials in the soil description. Anthropogenic materials are commonly used as fill and could indicate a non-native source of contamination. Notable observations of potentially contaminated soils include: staining, sheens, unusual discolorations, unusual crystals, and odors. When describing visual indications of contamination, describe how they are present, such as a sheen, staining along joints or root casts, residual or free-phase product seeping from the sample; however, do not attempt to infer what chemical may be present. For larger investigation projects with well-defined contaminants of concern and release mechanisms, it is advisable to prepare guidelines for screening and describing contaminated soils.

Soils having a significant amount of organic matter typically have a distinctive, pungent musty odor of decaying vegetation. In addition, soils impacted with organic contamination may exhibit unusual odors; some contaminants that may give a noticeable odor include petroleum hydrocarbons, solvents, ammonia, mineral spirits, turpentine, phenols and cresol, and organic pesticides. Odors may generally be described using the criteria provided in **Table 13** and descriptions of the odor characteristics (e.g., rotten egg odor, sweet chemical

odor); however, do not attempt to infer the specific chemical that may be present. If field activities are being conducted as part of a litigation project or potential litigation project, always check with the PIC/PM prior to including descriptors for odors as it may be preferable to simply note the presence of an odor without classifying it as strong, slight, etc.

Table 13: Criteria for Describing Odor

Description	Criteria
Strong	Distinct or sharp odor is noticed
Moderate to Slight	Less distinct to faint odor
None	No detectable odor is noted
Note: Adapted from USEPA EPA/600/4-91/029	

When inspecting soils for signs of contamination, adhere to the requirements of the HASP and, before monitoring soil odors, the sample should be screened with field screening equipment. Under no circumstance should odors be vigorously inhaled from any soils as they could contain potential biological or chemical hazards.

It is customary to describe the signs of potential contamination in lower case and within parenthesis following the soil name and appropriate modifiers.

4.6 Example Soil Descriptions

In summary, a soil is identified by assigning a group symbol and name with a description of the following key physical properties:

- USCS soil name (synonymous with ASTM D2488-09a Group Name) with appropriate modifiers,
- Color,
- Moisture content,
- Relative density or consistency, and
- Field evidence of potential contamination.

The above-noted naming convention generally follows the format described by the USCS classification system as described in ASTM D2488-09a. For reference purposes, examples of soil descriptions are provided in **Table 14**.

Table 14: Example Soil Classification

Detailed Field Observations	Basic Field Observations	Soil Classification
About 70% fine, hard round dark gray (N3) sand, 10% fine sub-angular, hard gray (N5) gravel, and 20% light gray (N7) silt low dry strength, slow dilatancy and no plasticity; trace of reddish brown silty clay; SPT-N = 8; wet, maximum size fine sand	70% fine gray sand, 10% fine gravel, and 20% light gray silt with trace of reddish brown silty clay (wet, loose)	Dark gray silty fine SAND (SM) with trace of reddish brown silty clay (wet, loose) Or Dark gray (N3) silty fine SAND (SM) with trace of reddish brown (10R3/6) silty clay (wet, loose)
About 65% fine to coarse, hard subangular reddish brown (10R3/6) sand, and 20% fine sub-angular, hard gray gravel with 15% coal fragments and cinders; SPT-N = 35; moist, maximum size 1- inch		Reddish brown well graded SAND (SW) with little sub-angular fine gravel and little fill (coal fragments, cinders) (moist, dense) Or Reddish brown (10R3/6) well graded SAND (SW) with little sub-angular fine gravel and little fill (coal fragments, cinders) (moist, dense)
Dark brown (10YR3/3) to dark gray (N3) spongy fibrous organic soil, many fine roots, trace of fine to coarse sand; SPT-N = 2; wet, very soft to soft, maximum size 5 mm; Discolored, moderate sweet chemical smell		Dark brown to dark gray peat (PT) with trace of fine to coarse sand (wet, very soft to soft) (discolored, moderate sweet chemical smell) Or Dark brown (10YR3/3) to dark gray (N3) peat (PT) with trace of fine to coarse sand (wet, soft) (discolored, moderate sweet chemical smell)
About 30% coarse, hard angular yellowish red (10YR6/8) sand with weak cementation, 5% fine sub-angular, hard brown (10YR5/3) gravel, and 65% greenish gray (5G6/1) silt, firm, medium dry strength, slow dilatancy and medium plasticity; SPT-N = 16; wet, maximum size ½-inch. Strong petroleum odor and black staining		Greenish gray elastic SILT with some yellowish red (10YR6/8) angular coarse sand a few sub-angular brown gravel (wet, firm) (stained, strong petroleum odor) Or Greenish gray (5G6/1) elastic SILT (MH) with some yellowish red (10YR6/8) angular coarse sand a few sub-angular brown (10YR5/3) gravel (wet, firm) (stained, strong petroleum odor)

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Accurate soil classification requires the collection of sufficiently detailed information throughout the logging process. Certain precautions should be taken to while recording the required information.

- Sunglasses should not be worn when describing soil colors.
- Note that samples from split-spoons and small-diameter core tools are not always representative of coarse-grained strata. Be sure to check driller's logs (when available) and soil cuttings for boulders, cobbles, gravels or other materials that may be encountered during advancement of the boring.
- Fill may be encountered during site characterization activities. Fill material can be determined from historical information or from the identification of man-made materials, such as concrete, brick, glass, plastic, cinders, and/or wood. If the soil boring being described is determined to be fill material, "fill" should be included in the soil description. Materials designated as "fill" should still be classified according to the USCS analysis methods provided above. Additional descriptors should be added if the materials making up the fill can be explicitly identified.
- If there are odor or color descriptors that are significant to a project (e.g., prussian blue at an MGP site or solvent-like odors at petroleum site), these should be discussed with the PIC/PM and understood prior to implementing field activities.

6. RECORDKEEPING

This FP specifically pertains to recordkeeping during soil sampling projects. All information should be recorded in accordance with FP 1.01 (Field Notes and Records) and FP 5.09 (Soil Boring Field Log). In general, draft field forms should be scanned and saved electronically immediately following the completion of the soil sampling activities. Following review of draft documents by the PIC and/or PM, field forms should be finalized and final versions may be included in project reports, if necessary. Draft and final versions of the field form should be managed in accordance with Ramboll's Document Retention Policy and project-specific requirements, and copies should be maintained in the project file.

FIELD PROCEDURE NO. 5.02

SUBSURFACE SOIL SAMPLING – TEST PITS AND EXCAVATIONS

VISTRA – PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 5.02

SUBSURFACE SOIL SAMPLING – TEST PITS AND EXCAVATIONS

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document 5.02 "Subsurface Soil Sampling – Test Pits and Excavations" last revised January 15, 2018.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for collection of subsurface soil samples from test pits and excavations. Test pits and excavations conducted as part of environmental investigations or remedial actions:

- Provide a larger perspective of the existing subsurface materials than other subsurface sampling techniques that rely on small diameter borings or probes;
- Allow visual evaluation of the condition of the exposed subsurface soils;
- Enable selection of soil sample intervals based on visual evaluations; and
- Can be used to support evaluation remedial needs in certain portions of the site.

Although this FP provides guidelines for collection of subsurface soil samples using test pits or excavations associated with typical field activities and projects, it should be understood that for certain projects more specific sampling procedures, including state-specific or regulatory program-specific guidelines, requirements or procedures, may be applicable. Specific requirements for these types of projects and activities will be reviewed by the Ramboll Principal-in-Charge / Project Director (PIC) and Project Manager (PM), and any additional requirements will be defined in the project-specific Work Plan, sampling plan and/or FPs. These guidelines are not meant to be project-specific Work Plans but rather a general reference for developing project-specific requirements.

This FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this FP. The Ramboll PIC and PM shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT AND MATERIALS

Below is a general checklist of equipment that may be required for typical test pit or excavation sampling efforts. Additional equipment may be specified in the project-specific Work Plan and/or HASP. This checklist only suggests general equipment that may be necessary for a project or task and should not be considered exhaustive. Equipment and materials necessary for conforming to this FP include:

2.1 General Sampling Equipment Checklist

- Excavator or backhoe. The type and size of the excavator should be defined based on project-specific needs (e.g., tire-mounted excavator for use in paved areas or long-reach excavator for excavations greater than about 15 feet);

- Field screening equipment as required by the site-specific Work Plan or Sampling Plan and the site-specific HASP;
- Plastic sheeting;
- Measuring tape (small excavations)/surveyor's direct reading laser rod (for larger excavations where dimension control is important) for measuring depth of excavation;
- Soils classification guidance chart as outlined on **FP 5.01** (Soil and Rock Classification);
- Spade, Shovel, Trowel, Slide Hammer (with sleeves), or bucket auger with extensions for collecting soil samples;
- Surveyors stakes/pickets/flags for marking confirmation sample locations;
- If soil samples are to be analyzed for Volatile Organic Compounds (VOCs) refer to **FP 5.05** (Soil Sampling for VOC Analysis);
- If soil samples are to be analyzed or screened for Non-aqueous Phase Liquid (NAPL) refer to **FP 5.11** (Soil Sampling - NAPL Dye Tests) and/or **FP 5.12** (Soil Sampling - NAPL Ultraviolet Light Tests) for additional equipment requirements;
- If soil samples are to be analyzed for Polychlorinated biphenyl (PCBs) refer to **FP 5.16** (Soil Sampling for PCB Analysis) for additional equipment requirements;
- Trash Bags - used to dispose of Personal Protective Equipment (PPE) and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling);
- 55-gallon steel drums, Department of Transportation-rated (for legal waste hauling), or other appropriate waste container – for disposal of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling), unless these can be disposed of within the test pit or excavation, or taken from the site with the waste stream;
- Labeling materials for IDW containers as outlined in **FP 15.01** (Waste Handling);
- Camera with extra batteries and storage card;
- PPE and field screening equipment in accordance with the site-specific HASP, including sterile gloves which must always be worn when handling and using sample equipment;
- Buckets, tap/distilled water, and Liquinox (or Alconox) – used for the decontamination of sampling and monitoring equipment (refer to **FP 14.01**, Sampling Equipment Decontamination);
- Roller tape for measuring larger excavation and stockpile dimensions to assist in preparing site sketches;
- Site information (e.g., maps, contact numbers, previous field logs);
- Field notebook, gridded paper, tracing vellum, and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records); and
- For longer term excavations, setting up a field station is recommended, which might include a portable chair, work table, canopy, first aid station, water, etc.

2.2 Miscellaneous Additional Suggested Equipment

- Extra vehicle keys.
- Mobile phone.
- Credit card for gas and emergencies.
- Road and site maps.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody.
- **FP 1.04**, Documenting Sampling Locations.
- **FP 1.05**, Field Quality Control Samples.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 5.01**, Soil Classification.
- **FP 5.04**, Surface Soil Sampling.
- **FP 5.09**, Soil Boring Logs.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 14.02**, Equipment Decontamination.
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPIs) may need to be referenced based on the specific requirements of the site- specific Work Plan/ Field Sampling Plan (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant sampling strategy decisions will be approved by the PIC and/or PM before the initiation of associated field activities, including, but not limited to, the selection of excavating equipment (e.g., consideration of reach limitations), and the potential need for shoring and/or dewatering of excavations. The Work Plan/Sampling Plan will be designed for the collection of quality data that will best answer the questions and meet the goals or objectives of the study/monitoring program and will include the number of samples, locations, depths, number of sampling sites, and analyses to be performed on each sample. The Work Plan/Sampling Plan should include provisions for encountering water in the excavation, such as sample collection method or water management. The Work Plan/Sampling Plan will generally provide for some discretion in the field, depending on encountered conditions; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PIC and/or PM.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. In addition, to the extent that non-dedicated sampling equipment is to be used (e.g., trowel, shovel, auger), to minimize potential cross-contamination of samples, such sampling equipment should be decontaminated after collection of each sample as described in **FP 14.01** (Sampling Equipment Decontamination), project-specific Work Plan/sampling plan and/or QAPP. Used dedicated sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01**, Waste Handling, following the sampling event.

At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Review any permits and permit conditions that may be required for the planned site work including air, dust, sound monitoring, and restricted operating hours;
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work;
- Coordinate and obtain permission for site access;
- Complete a subsurface clearance (refer to **SPI 27**);
- Review project-specific Work Plan/Sampling Plan, where applicable;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with the PIC and/or PM the proposed Work Plan/Sampling Plan or sampling strategy;
- Review the standard instruction manual provided by the manufacturer of the specific sampling equipment being used for sampling;
- Contact the laboratory to provide advance warning when samples are anticipated; and

- Ensure that all equipment/materials required to complete the work have been packed prior to mobilization.

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that will be used to take field measurements Pre-labeling sample containers in advance of field efforts may increase productivity (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody).

4.3 General Test Pit or Excavation Sampling Guidelines

The following provides a recommended list of practices for soil sampling activities by means of test pits or excavations:

- Where applicable, contact the identified key site personnel upon arrival to the Site and visually assess proposed work areas.
- Review the physical location of each test pit or excavation with the excavator or backhoe operator (Contractor) before breaking ground. Ensure that the proposed location has been cleared in accordance with SPI-27 and that the equipment can operate safely while maintaining minimum clearance from overhead power lines, or damaging other property (e.g., equipment, building foundations, fences, etc.). Discuss the expected dimensions of the excavation, where excavated materials are to be stockpiled, and how the excavation will be backfilled. Materials stockpiles shall not be closer than 3 feet from the edge of the excavation.
  - Prior to start of the excavation activities, the Contractor should place plastic sheeting at the location of the proposed excavated material stockpile to prevent potential contamination of underlying soil/asphalt/concrete;
  - Unless specifically authorized by the Work Plan/Sampling Plan, site specific HASP, and/or the PIC and after the excavation has been sloped, shored or benched per OSHA guidelines, and deemed "safe" on that basis, Ramboll personnel shall not enter the excavation or work under lifted loads or loads being moved by heavy equipment.
- Show the Contractor where soil samples are to be collected (i.e., depth and location). Ramboll personnel shall stand a safe distance, or at least two feet, from the edge of the excavation and maintain eye contact with the operator of the excavator or backhoe.
  - Excavated materials should, at a minimum, be placed on polyethylene sheeting and, as necessary, covered with polyethylene sheeting at the end of each work day.
  - If excavated materials such as surface cover soils are deemed clean and can be reused (e.g., backfill), these materials should be segregated and stockpiled separately from the non-clean materials.
  - If excavations are 5 feet deep or greater, the excavation should be benched, shored, and/or sloped according to the procedures and requirements set forth by OSHA 1926 Subpart P, Appendix B.
- During test pit excavation, Ramboll personnel should periodically:
  - Visually inspect the excavated materials and open excavation, and note soil type in accordance with **FP 5.01** (Soil Classification);

  - Screen the excavated soil and work area as required by the site-specific Work Plan or sampling plan and the site-specific HASP;
  - Inspect the surface area adjacent to the excavation for signs of tension cracks, underground structures, water seeping from the sidewalls, slumping soil caused by vibrating machinery, undercutting, movement in adjacent structures, or similar conditions;
  - Measure or approximate the depth of sampling intervals; and
  - Document stratigraphy changes.

- Once the target sampling location has been reached, the Contractor will use the excavator bucket to collect a bulk sample by lowering the excavator bucket and scraping material from the target depth, whether a sidewall or bottom of excavation.
- Once the excavator bucket comes to rest on the ground surface, screen the soil sample with the field screening equipment if required by the site-specific Work Plan or Sampling Plan and the site-specific HASP, then collect the sample using appropriate sampling equipment as if it were a surface soil sample –refer to **FP 5.04** (Surface Soil Sampling).
- Following sample collection, transfer the sample from the sampling device to appropriate sample container(s) provided by the analytical laboratory, and store in an ice-filled insulated cooler pending transport to the analytical laboratory, or the laboratory courier (see sample container guidelines in **Section 4.5** and sample transport and storage guidelines in **Section 4.6**).
- If multiple samples are to be collected, decontaminate non-dedicated sampling equipment between sampling locations as described in the **FP 14.01** (Sampling Equipment Decontamination), project-specific Work Plan/Sampling Plan and/or QAPP.
- Upon completion of the excavation activities,
  - The excavation shall be backfilled using the excavated materials or imported fill (as required in the project-specific Work Plan). All imported materials should be evaluated as per applicable regulations or guidelines to demonstrate their suitability for the intended use; this may include chemical analysis to demonstrate the materials meet specific regulatory limits or geotechnical testing to define compaction requirements.
  - Unless otherwise specified, materials should be placed in lifts not exceeding 12 inches and compacted with the excavator bucket.

  - If the existing surface materials were segregated for reuse (e.g., cover materials in a landfill), these stockpiled materials should be used to reconstruct the surface and match to adjoining grades.
  - If surfaces are to be restored (e.g., pavement, concrete, vegetation), reconstruct the surface and match to adjoining grades in accordance with the project-specific Work Plan.
- If required by the project-specific Work Plan or Sampling Plan, decontaminate equipment prior to demobilization from the Site in accordance with **FP 14.02** (Equipment Decontamination).

4.4 Test Pit or Excavation Documentation

The following provides a recommended list of information that should be recorded when sampling soils by means of test pits or excavations:

- Specific details with respect to the test pit sampling activities, including:
  - Excavation identification, start and end time, test pit excavation equipment, contractor information.
  - Field screening methods and results, including calibration results.
  - Soil sampling methods and soil sampling documentation (refer to **FP 1.04** - Documenting Sampling Locations).
  - Observations during test pit excavation (e.g., caving of the excavation walls, tension cracks, seeping water from sidewalls).
  - Depth where water was encountered during excavation, if applicable.
  - Difficulties encountered during the excavating process.
  - Sampling equipment decontamination procedures implemented.
- Photographs of each sidewall and the bottom of the test pit or excavation.
- Scaled field sketch of the location and dimensions (length, width and depth) of each test pit at the Site in relation to permanent site features that have been identified on the Site plan (i.e. building corners, light posts, manholes, etc.).
- Field logs classifying the encountered materials (refer to **FP 5.01** –Soil Classification, and **FP 5.09** – Soil Boring Logs).
- Scaled field sketches and photographs of each sidewall and the bottom of the test pit, depicting:
  - The occurrence and thickness of observed soils and/or fill materials.
  - General observations (i.e. staining, odors, fill materials, etc.).
  - The depth of observed groundwater within the excavation, including depth at which saturation of soils occurs, and a description of the groundwater (e.g., presence of a sheen, floating product, and color).
  - Locations of collected samples.

- The location of observed structures within the excavation, including foundations, pipes, and underground storage tanks.
- The characteristics of the soils within the zone of investigation. For example, if the excavation area is a former 10,000 gallon UST, define the characteristics of shallow soils (0 to 4 feet deep) above the tank and the soils underlying the tank (10 to 12 feet deep).

4.5 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected soil samples should be constructed of inert materials that will not affect the concentration of constituents in the sample (i.e., stainless steel or Teflon). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the sample and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan/ Field Sampling Plan or QAPP.

The laboratory will provide appropriate sample containers appropriate for each predetermined sample analysis. The sample volume is a function of the analytical requirements and will be specified in the Work Plan/ Field Sampling Plan or QAPP. If possible, jars should be filled to capacity allowing no headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion). Appropriate sample containers for each predetermined geotechnical test will be defined in the project-specific Work Plan/ Field Sampling Plan.

4.6 Sample Transport and Storage

Sample containers shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). All samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration. If the cooler size allows for space between sample bottles, bubble wrap should be used to fill annular space and prevent breakage during travel. Glass bottleware should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample vials in laboratory issue foam packing cartons.

4.7 QA/QC

Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific Work Plan/ Field Sampling Plan and/or QAPP must be followed throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while conducting investigations using test pits and excavations.

- It is important to always remain alert and aware of your surroundings. Sampling using test pits and excavations involves the use of heavy equipment, and is subject to hazards posed by equipment, open excavations, potentially unstable sidewalls, vehicle traffic,

industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.

- Prior to mobilization, determine the location of test pits and evaluate the need for security, barricading, and/or traffic control (e.g., when test pits are located near the right of way).
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the excavation. Stay upwind of the excavation and ensure that air monitoring is conducted and personal protective equipment is used in accordance with the site-specific HASP.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should ensure that the project-specific HASP includes safety measures and procedures.
- If the Work Plan or Field Sampling Plan involves analyses requiring field preservation), be sure to avoid direct contact with laboratory-provided preservative chemicals.
- Avoid walking while recording information, especially when there are open excavations, that pose slip, trip or fall hazards.
- Stand a safe distance away from the excavator when taking notes. Be aware that the operator may not be able to see you, equipment accidents can happen very quickly, and you need to be alert and ready to move.
- If the Work Plan/Sampling Plan requires metals analysis, the sample can be collected from the central portion of the sampling device (i.e., not touching the metal part of the sampler) with a clean glass, high density polyethylene, or stainless steel spoon, and the rest of the sample discarded.

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information related to soil and groundwater sampling in accordance with **FP 1.01** (Field Notes and Records). In addition, for each test pit ensure that a test pit log is prepared providing the recorded information (refer to **FP 5.09** – Soil Boring Logs).

FIELD PROCEDURE NO. 5.04

SURFACE SOIL SAMPLING

VISTRA – PROJECT

PROJECT NO. 1940112376

FIELD PROCEDURE NO. 5.04

SURFACE SOIL SAMPLING

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document NO 5.04 "Surface Soil Sampling" last revised January 15, 2028.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the collection of surface soil samples. Surface soil sampling is typically conducted as part of initial site characterization of potential contaminant release/discharge areas, areas of potential environmental concern, to establish site-specific constituent background concentrations, or for ecological risk assessment purposes. In general, surface soil samples refer to soils present between the ground surface and 6 inches below ground surface (bgs); however, project-specific requirements or state- or federal-specific programs may classify surface soils as shallow as 3 inches and up to 5 feet bgs. For the purpose of this FP, surface soil will be classified as the 0 to 6 inches interval bgs and not within the area of an excavation. For collection of samples from an excavation floor or wall, refer to **FP 5.02**, Subsurface Soil Sampling: Test Pits & Excavations.

This FP was prepared to document the procedures and techniques that will be used to fulfill the groundwater sampling and analysis program requirements of the United States Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845) herein referred to as Part 845.

This FP does not supersede Ramboll Health and Safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those recommended in this FP. The Ramboll Principal in Charge and/or Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file for the duration of the project. The signatures of the PIC and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT AND MATERIALS

A general checklist of equipment that may be required for typical surface soil sampling procedures is provided below. This checklist includes an overall summary of general equipment typically required for surface soil sampling and should not be considered an exhaustive compilation. More specialized sampling equipment may be required depending on project specific needs.

2.1 General Surface Soil Sampling Equipment Checklist

- Site information (e.g., maps, contact numbers, previous field logs).
- A GPS or other locating device as outlined in **FP 1.04** (Documenting Sampling Locations).
- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Appropriate waste container – used to dispose of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- Labels for Investigation Derived Waste (IDW) containers as outlined in **FP 15.01** (Waste Handling).
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Soils classification guidance chart as outlined on **FP 5.01** (Soil Classification).
- Color chart as outlined on **FP 5.01** (Soil Classification).

2.2 Project or Task Specific Surface Soil Sampling Equipment Checklist

- Measuring tapes (both long weighted cloth type and small measuring tape, preferably marked in tenths and hundredths of a foot) and/or measuring wheel.
- Laboratory supplied certified-clean sample containers (appropriate for various analyses to be performed), as may be required in the Work Plan.
- Labels, packing materials, etc., for sampling containers as outlined in **FP 1.02** (Sample Handling, Shipping, and Chain of Custody).
- Field screening equipment, as may be required in the Work Plan.
- PPE and field monitoring equipment as required by the HASP and/or the project-specific Work Plan.
- Spade, shovel, trowel, spoon, drive sampler or hand auger (typically stainless steel)- used for collecting surface soil samples from shallow locations.
- Knife (for cleaning exposed surfaces).
- Equipment appropriate tools for adjusting samplers (pliers, wrench, etc.).
- Mixing bowl/bucket and spoons (typically stainless steel unless metal analysis will be performed) for composite sample preparation.
- Plastic sheeting.
- Cooler with ice.
- Survey stakes or flags.

2.3 Miscellaneous Additional Suggested Equipment

- Extra vehicle keys.
- First aid kit.
- Mobile phone.
- Credit card for gas and emergencies.
- Road and site maps.
- Fire extinguisher.
- Camera and extra batteries.
- Retractable canopy.

3. PROCEDURES REFERENCED

The following Standard Work Practice (SWPs) and FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **SWP**, Subsurface Clearance.
- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sample Handling, Shipping, and Chain of Custody.
- **FP 1.04**, Documenting Sampling Locations.
- **FP 1.05**, Field Quality Control Samples.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 5.01**, Soil Classification.
- **FP 5.02**, Subsurface Soil Sampling: Test Pits & Excavations.
- **FP 5.09**, Soil Boring Log Preparation.
- **FP 5.15**, Stockpile Sampling.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 15.01**, Waste Handling.

4. PROCEDURES

4.1 Planning and Design Considerations

All significant sampling strategy decisions shall be approved by the PIC and/or PM before the initiation of associated field activities. The Work Plan/Sampling Plan should be designed for the collection of quality data that meet the goals or objectives of the study/monitoring program and should include the number of sampling locations, number of samples per location, depths/depth intervals of samples, and the laboratory analyses to be performed on each sample. The Work Plan/Sampling Plan will generally provide some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities shall be discussed with approved by the PIC and/or PM prior to implementation.

Surface soil samples are typically collected using stainless steel (or in some cases plastic) hand held tools/samplers (spade, shovel, trowel, spoon, bucket or hand augers, or drive samplers).

- *Spades, Hand Trowels, Shovels, and Spoons*. These hand held tools are available in different sizes and makes, and can be used for the sampling of either coarse or fine grained material; however, surface areas disturbed by sampling will tend to be larger, especially when sampling at greater depths.
- *Bucket or Hand Auger*. These tools consists of an enclosed or partially enclosed stainless steel cylindrical body with sharpened spiral blades on the bottom. The top of the auger has a stainless steel frame that allows installation of threaded extension rods and a T-handle. The auger cylinder diameter varies, but the length is generally 6 to 12 inches. Samples are collected in the cylindrical body by rotating the auger clockwise by its T-handle. This motion moves loosened soil upward within the auger barrel as it cuts into the soil. Hand augers are best suited for sampling of non-granular soils as the coarser material will tend to get caught on the auger blades preventing advancement of the auger or will fall out of the auger upon retrieval.
- *Drive or Shelby Tube Samplers*. These samplers consist of a 5-inch long thin walled and bevelled sampler with a 2 to 4 inch diameter that is used to collect shallow relatively undisturbed samples by sliding a weighted hammer on a driving head to which the stainless steel sampler is attached. These samplers are suitable for use in fine-grained or poorly graded coarse soils, as uniform sands or gravels may fall out of the sampler upon retrieval. These types of samplers are sometimes equipped with disposable acetate sleeves and baskets to retain the soils during removal.

In addition to considerations of the advantages and limitations of each sampler type, when planning a surface soil sampling event, the following should also be considered:

- *Materials of Construction*. Non-coated or non-plated stainless steel and/or plastic tools should be used to collect samples for analytical testing (if appropriate for the analysis to be conducted). Devices plated with chrome or other materials commonly used in garden tools should be avoided to prevent potential metals contamination of the collected samples. Tools should be selected or constructed such that they allow for thorough decontamination or they should be utilized as single-use sampling devices.

- • *Soil Properties*. Sampling of very hard fine-grained materials, materials containing gravel or that consist of poorly graded sand or gravel may be challenging if using hand augers or drive samplers.
- *Sampling Objectives*. Sampling objectives may require collection of undisturbed surface soil samples or collection of surface samples over a specified area. In such cases, procedures and sampling equipment should be defined in the Work Plan/Sampling Plan.

Lastly, when surface soil sampling is being performed to establish site-specific background concentrations of certain analytes, the sampling locations relative to areas of known or suspected contamination and sampling intervals should be defined in the Work Plan/Sampling Plan and/or be approved by the PIC and/or PM before the initiation of the sampling activities.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Comply with **SWP 27** (e.g., subsurface clearance would be required if sampling is to extend beyond the 6-inch surface sample);
- Coordinate and obtain permission for site access;
- Review project-specific Work Plan/Sampling Plan, where applicable;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with the PIC and/or PM the proposed work plan/sampling plan or sampling strategy;
- Review the standard instruction manual provided by the manufacturer of the specific field monitoring and sampling equipment being used for the sampling activity; and
- Confirm sampling locations.

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements Pre-labelling sample containers in advance of field efforts may increase productivity (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody).

4.3 General Surface Soil Sampling Guidelines

Surface soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, required analytical method, sampling objectives, and the soil type. The following provides a recommended list of practices for surface soil sampling activities using hand held equipment:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- Prior to collecting surface soil samples, remove vegetation, rocks, twigs, gravel, grass and matted root zones, and any other non-soil material present above the soil horizon using decontaminated tools (e.g., spade, trowel, shovel).
- In general, surface soil samples will be collected by using a hand held device such as a spade, trowel, shovel, spoon, drive sampler or hand auger.
  - Unless single-use disposable sampling equipment is being utilized, ensure that the sampling tools have been decontaminated prior to sample collection (refer to **FP 14.01**, Sampling Equipment Decontamination, and the project-specific Work Plan/Sampling Plan and/or QAPP).
  - Spade, trowel, shovel, or spoon sampling
    - Using the decontaminated or replacement stainless steel spoon, spade, trowel, shovel, or plastic spoon, collect the sample from the target depth.
  - Hand Auger
    - Position the decontaminated or replacement sampling auger barrel on the surface to be sampled and turn in a clockwise motion until the auger is full; pull the auger out of the hole, and if the target sampling depth has not been reached empty the cuttings out of the auger and repeat this process until the bottom of the target sampling depth is reached.
- Screen and classify material from each sampling location as required by the Work Plan (**FP 5.01**, Soil Classification).
- Place material from each sampling location in a laboratory-provided certified-clean sample container ensuring that the thin layer of soil that came in contact with the steel tools is not placed in the container.
- Label and seal the sample containers in accordance with **FP 1.02**, Sample Handling, Shipping, and Chain of Custody.
- Fill the void left from the sampling with remaining unused soil and restore sampling surfaces, if necessary.
- Document the sampling location in accordance with **FP 1.04**, Documenting Sampling Locations, and place a stake or flag at the sampling location for future reference.
- Prepare composite samples in accordance with the homogenization procedures provided in **Section 4.4**.

If dedicated sampling equipment was used during the sampling event, it should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling) following the collection sampling event.

4.4 Sample Homogenization Procedures

Homogenization refers to the complete mixing of materials to obtain uniform color and consistency throughout the sample prior to analyses. Homogenization is typically performed on discrete samples (e.g., several intervals within a sampling location or several sampling locations within a specific sampling interval) to create composite samples. Compositing may be performed either in the field or the laboratory. Generally, discrete individual samples should not be homogenized in the field. In addition, homogenization should not be performed for samples designated for volatile organic compounds (VOCs) analysis – refer to **Section 5**.

A. Place grab samples to be homogenized into a large, decontaminated or dedicated container constructed of inert material (i.e., glass, Teflon, or stainless steel) appropriate for the analyses requested. Grab samples should be approximately equal in volume or appropriately representative of the area being sampled.

B. Prior to homogenization, remove large, unrepresentative materials such as twigs, leaves, stones, wood chips, and debris and document the presence of this material in field log.

C. Mix materials as quickly and efficiently as possible using a clean glass, high density polyethylene, or stainless steel spoon until textural, color, and moisture homogeneity are achieved.

D. When mixing large amount of soil, mechanical mixers can be used as long as they are made of stainless steel and decontaminated between samples.

4.5 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with soil should be constructed of materials that will not affect the concentration of constituents in the soil sample. The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the soil and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan/Sampling Plan or QAPP.

The laboratory should provide appropriate sample containers, prefilled with preservatives appropriate for each predetermined sample analysis. However, if not provided, pre-cleaned wide-mouth glass jars with Teflon-lined caps could be used for surface soil samples. The sample volume is a function of the analytical requirements and will be specified in the Work Plan/Sampling Plan or QAPP. If possible, jars should be filled to capacity minimizing headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion).

4.6 Sample Transport and Storage

Samples shall be handled, transported and stored to maintain structural and chemical qualities of soil samples. Sampling jars shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). All samples should be kept in an ice-filled transport container during fieldwork and covered to limit exposure to light. If the cooler size allows for space between sample containers, bubble wrap should be used to fill annular space and prevent breakage during transport. Glass bottles should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample jars in laboratory-issue foam packing cartons

4.7 QA/QC

Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific Work Plan/Sampling Plan and/or QAPP must be followed throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while sampling.

- It is important to always remain alert and aware of your surroundings. Surface soil sampling can involve the use of field trucks and associated equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, determine the sampling locations and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located on the right of way).
- When working out of sight of the general public or site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the "buddy system" and should ensure that the project-specific HASP includes safety measures and procedures.
- If the sampling plan requires metals analysis, the sample can be collected from the central portion of the sampling device (i.e., not touching the metal part of the sampler) with a clean glass, high density polyethylene, or stainless steel spoon, and the rest of the sample discarded.
- Due to the tendency for sluffing or for the hand auger bucket to scrape soil from the sides of the auger hole, the top few inches of soil in the auger bucket should be discarded.
- The homogenization procedure should not be used if samples will be analyzed for VOCs or would otherwise have the potential to be altered in some fashion by homogenization.

- Each sample attempt should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information in accordance with **FP 1.01** (Field Notes and Records).

FIELD PROCEDURE NO. 5.07

SUBSURFACE SOIL SAMPLING – DIRECT PUSH TECHNOLOGY (DPT)

VISTRA – PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 5.07

SUBSURFACE SOIL SAMPLING – DIRECT PUSH TECHNOLOGY (DPT)

Documents Used as Reference During Preparation:	Ramboll Field Guidance Document NO. 5.07 Subsurface Soil Sampling – Direct Push Technology (DPT)" last revised June 8, 2022.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for collection of subsurface soil samples using direct push technologies (DPT). DPT is commonly used for soil sample collection at sites where there is an advantage to using a drill rig with a smaller footprint that can quickly penetrate soils while reducing the generation of investigation derived waste (IDW) (EPA, 2005). Subsurface soil sampling via DPT may be conducted as part of environmental investigations or remedial actions to:

- Collect soil samples for biological, chemical and/or geotechnical testing[1] and assess hydrogeological conditions including, but not limited to, sampling to support source identification, characterize nature and extent of contamination in soils, assess background conditions, and conduct confirmatory sampling; and
- Allow visual, odor, and volatile vapor screening of subsurface soils.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal in Charge (PIC) and/or Project Manager (PM) shall verify that project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC and/or PM indicate approval of the methods and precautions outlined in the site-specific HASP.

[1] Note that direct push sampling does not allow collection of undisturbed samples required for certain geotechnical testing (e.g., strength, consolidation, hydraulic conductivity).

2. EQUIPMENT AND MATERIALS

A general list of equipment that may be necessary for typical subsurface soil sampling using DPT is provided below.

- Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points, previous field logs).
- The DPT rig, and other drilling equipment, such as rods, samplers, liners (e.g., PVC, polyethylene, acrylic, Lexan), and caps, which should be supplied by the drilling contractor.
- Appropriate tools for adjusting samplers and opening liners (dual longitudinal liner ripping blade, hacksaw (with clean blades), pliers, wrench, etc.), which should be supplied by the drilling contractor.
- Pin flags or wooden stakes, or in paved areas, spray paint or nails with flagging tape, to mark sample location(s). Care should be taken not to use materials that may interfere with sampling/analytical results. Refer to **FP 1.04** (Documenting Sampling Locations).
- Plastic sheeting.
- Folding worktable, half-pipe, or half-sheet of corrugated roofing plastic to hold and keep the samplers organized.
- Soils classification guidance chart as outlined on **FP 5.01** (Soil Classification).
- Color chart (e.g., Munsell) as outlined on **FP 5.01** (Soil Classification).
- Measuring tape (both long-weighted cloth type and small measuring type, preferably marked in tenths and hundredths of a foot) for measuring sample recovery and subsample intervals.
- Spatula, knife or spoon (typically stainless steel) used for splitting soil cores and collecting soil samples.
- Mixing bowl/bucket and spoons (typically stainless steel unless metal analysis will be performed) for composite sample preparation.
- Laboratory supplied certified-clean sample containers (appropriate for various analyses to be performed), as may be required in the Work Plan.

- Sample shipment containers, labels, chain of custody forms and packing materials for sampling containers as outlined in **FP 1.02** (Sample Handling, Shipping, and Chain of Custody).
- Trash Bags - used to dispose of gloves and other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Appropriate waste container and labelling materials – used to dispose of IDW and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- Field screening equipment (e.g., PID, XRF) as required by the site-specific Work Plan, Field Sampling Plan, QAPP and/or the site-specific HASP.
- Zip-loc® bags and/or glass jars and aluminum foil (used for field screening purposes).
- Personal Protective Equipment (PPE) in accordance with the site-specific HASP, including protective gloves which must always be worn when handling and using sample equipment.
- Field notebook and test boring and well construction field log forms (if required), and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Mobile phone and camera.
- For long-term drilling projects, setting up a field station is recommended. The field station might include portable chair(s), worktable, canopy, and a first aid station/kit.

3. PROCEDURES REFERENCED

In addition to the reference and Procedures cited above, the following Safe Work Practices (SWPs) and FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **SWP** Subsurface Utility Clearance
- **FP 1.01,** Field Notes and Records
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody
- **FP 1.04**, Documenting Sampling Locations
- **FP 1.05**, Field Quality Control Samples
- **FP 2.02**, Site Preparation, Inspection and Housekeeping
- **FP 5.01**, Soil Classification
- **FP 5.04**, Surface Soil Sampling

- **FP 5.09**, Soil Boring Log Preparation
- **FP 5.10**, Borehole Decommissioning
- **FP 14.01**, Sampling Equipment Decontamination
- **FP 14.02**, Heavy Equipment Decontamination
- **FP 15.01**, Waste Handling

4. PROCEDURES

4.1 Planning and Design Considerations

Strategic decisions including, but not limited to, the selection of the direct push drill rig (e.g., access limitations), and the potential need to adjust boring locations (e.g., subsurface utilities), will be approved by the PIC and/or PM before the initiation of associated field activities and will be documented in the Work Plan, Field Sampling Plan, and/or QAPP. The Work Plan, Field Sampling Plan, and/or QAPP will be designed for the collection of quality data to meet the objectives of the sampling program and will include information such as the number of borings, depth, number of samples per boring, and the laboratory analyses to be performed on each sample as well as quality assurance/quality control (QA/QC) requirements. The Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion in the field, depending on encountered conditions; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PIC and/or PM.

When planning a DPT sampling event, the following should be considered:

- *Type of Direct Push Rig*. DPT uses hydraulically powered rigs that utilize both hydraulic force and percussion to advance soil sampling equipment into the subsurface. Some direct push rigs are also equipped with a rotational drive that will allow the use of augers. Direct push rigs can be mounted on pickup trucks, skid loaders, tracked carriers, skids or other vehicles. The type and size of the direct push rig and associated equipment will depend on project -specific needs such as the boring depth and access limitations. The type of direct push rig and associated equipment should be specified in the work plan and discussed with the drilling contractor prior to mobilization.

- *Sampling Locations*. Consideration for placement of sampling locations should be given to the objectives of the sampling effort. However, accessibility and potential hazards (e.g., subsurface utilities, overhead clearance [including utilities, ceilings or other obstructions] traffic, surface stability, soil strength), and need to precut surfaces (e.g., asphalt or concrete) should be considered when selecting sampling locations as they could limit DPT equipment use and/or require additional controls (e.g., traffic control, clearing of vegetation, temporary mats for protection of landscaping, or delicate surfaces).
- *Sampler Type*. DPT samples can be collected using either single barrel or double tube configurations.The dual tube system is preferable as it provides a casing that isolates the media to be sampled from the formation, thereby preventing potential cross-contamination or potential sloughing of the borehole walls. A single barrel sampler may be suitable for discrete shallow (i.e., less than 10 feet) sampling in the unsaturated zone provided that the barrel sampler is used in a sealed or closed configuration. The sampler barrel is typically five feet in length.
- *Subsurface Soils*. DPT is most suitable for sampling cohesive overburden soils that contain a low percentage of gravel and are not dense or highly compacted, or contain cobbles or weathered rock. In cases where soils to be sampled may lack cohesiveness and may fall out of the sampler, core catchers at the leading end of the sampler may help retain the sample until retrieval at the surface.
- *Liner Type*. DPT soil sampling uses a liner to facilitate sample retrieval from the barrel. Liner materials include brass, stainless steel, cellulose acetate butyrate, polyethylene terephthalate glycol, polyvinyl chloride, and Teflon. Potential interferences between the liner materials and the contaminants of concern must be evaluated when selecting the liner materials. When low reporting limits are required, use of the more inert liner materials (e.g., stainless steel) is recommended.
- *Liner Dimensions*. Liners vary in diameter (from about 1 to 3 inches) and length (from about 2 to 5 feet). Metal liners can also be obtained in shorter lengths (2-6 inches) to allow ready collection of discrete intervals. Selection of the liner dimensions should consider: (a) volume requirements for sample analyses; (b) quantity of samples and sampling intervals (ideally the sampler would be positioned at the top of the interval on interest); and (c) enhanced recovery (typically larger diameter borings will be less affected by presence of small subsurface obstructions like pebbles).
- *Borehole backfilling approach.* Factors to be considered in selecting the approach for backfilling the borehole include potential contamination of drill cuttings, local permit regulations and guidance, and client specific requirements. DPT boreholes can be backfilled using several methods, including retraction grouting with a tremie tube and a bentonite and/or Portland cement grout, gravity filling with bentonite and/or Portland cement grout, filling with hydrated bentonite pellets, or backfilling with drill cuttings.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). In addition, to the extent that non-dedicated sampling equipment is to be used (e.g., spatula, knife or spoon, mixing bowls), such sampling equipment should be decontaminated before collection of each

sample to minimize potential cross-contamination between samples, as described in **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP. Used disposable sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling), following the sampling event.

At a minimum, the following tasks should be completed (as applicable) as field staff prepare for implementation of the work:

- Coordinate and obtain permission for site access;
- Review and sign the site-specific HASP;
- Review applicable permits and permit conditions that may affect site work including backfill requirements, air, dust or sound monitoring, agency notifications, and restricted operating hours;
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work;
- Confirm soil boring/sampling locations;
- Complete subsurface clearance activities (refer to **SWP** Subsurface Utility Clearance);
- Review project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable;
- Review and discuss with the PIC and/or PM the proposed Work Plan, Field Sampling Plan or sampling strategy;
- Identify the type of sampler and drilling equipment required for project-specific tasks and review the standard instruction manual provided by the manufacturer of the specific sampling equipment being used for sampling;
- Contact the drilling contractor to verify scope and confirm sampling equipment is available and appropriately decontaminated prior to mobilization;
- Contact the laboratory to provide advance notice when sample delivery is anticipated; and
- Verify that all equipment/materials and sampleware required to complete the work have been packed prior to mobilization.

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that will be used to take field measurements). To increase productivity in the field, it is recommended
that prior to mobilization the laboratory-provided sampleware quantities are checked, sample containers are pre-labeled (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody) and non-dedicated sampling equipment is decontaminated and packaged (refer to **FP 14.01,** Sampling Equipment Decontamination).

4.3 Direct Push Sampling Guidelines

The following provides a recommended list of practices for soil sampling using DPT.

- Where applicable, contact the identified key site personnel upon arrival to the Site and visually assess proposed work areas and decide where containerized soil cuttings and other IDW should be staged and stored.
- Review the physical location of each soil boring with the driller before initiating subsurface work. Verify that the proposed locations have been cleared in accordance with **SWP** Subsurface Utility Clearance and that the drill rig can operate safely while maintaining minimum clearance from overhead power lines, or damaging other property (e.g., equipment, fences, etc.).
- Inspect the backfill material provided by the drillers to verify it complies with potential permit requirements.
- Discuss the following with the driller:
  - Expected depth and diameter of the borings;
  - Amount and depth of the soil samples to be collected;
  - Approximate anticipated depth of groundwater;
  - Borehole backfilling procedure and materials;
  - Staging locations for soil cuttings and other IDW;
  - Location for conducting equipment decontamination; and
  - Surface materials and the need to predrill or core prior to DPT. If the surface material is asphalt, the direct push drill rig tooling may be able to penetrate the asphalt (verify with driller prior to initiating field work). However, if the surface is covered with concrete, a concrete corer or saw may be required to provide access to the subsurface.
- Prior to start of the DPT sampling, set up the sample processing/field station area, which may include placing plastic sheeting on the ground surface to prevent potential contamination of underlying soil/asphalt/concrete, setting up a worktable, core cradle, or corrugated sheets to hold the samplers, and installing a canopy.
- Although equipment will be decontaminated between uses to further limit potential cross-contamination between sampling locations, sampling should progress from suspected areas of lowest to highest concentration.
- The driller will advance the DPT sampler to the target sampling depth. The sampler will be advanced using hydraulic pressure and percussion hammering on the driving head of the sampling assembly at a constant rate. The sampler will be advanced to a depth that is equal to its length (typically 24-inch inner sampling barrel), or less if sampler refusal is encountered (i.e., limited or no advancement of the sampler, altering the robe alignment or bending of the rod). Refusal can result from tip resistance (i.e., distinct unconsolidated deposits overlying bedrock or presence of cobbles in the subsurface), sleeve friction (i.e., the interaction of the sampler with cohesive soils, which can "grab" the outside of the sampler and limit depth penetration), subsurface heterogeneity, or

operator error (e.g., advancing the probe off vertical, which will cause the probe to bend).

- During direct push sampling, Ramboll personnel should:
  - Maintain a safe distance from the drill rig and maintain eye contact with the operator if approaching the drill rig.
  - Monitor ambient air in the work area as required by the site-specific Work Plan or Field Sampling Plan and the site-specific HASP.
  - Communicate with the operator regarding observed changes in subsurface conditions during drilling (e.g., increased or decreased resistance to DPT, groundwater first encountered) and depths where these occur.
- Have the drilling contractor retrieves the sampler from the borehole, place the sampler on the sample processing work area, and remove the liner from the sample barrel.
- Upon delivery, Ramboll personnel will
  - Don a pair of new clean nitrile gloves immediately prior to handling each core.
  - If the liner will be used as a sample container, use a decontaminated (refer to **FP 14.01,** Sampling Equipment Decontamination) tool to cut the portion of the liner that will be used for the sample, and cover it with liner caps, which should be taped to the liner to prevent sample loss (Teflon or other tape without potential VOC-containing adhesives for VOC samples). Then cut the remainder of the liner as described below.
  - If the liner will not be used as the sample container, cut it lengthwise on either side with a decontaminated (refer to **FP 14.01,** Sampling Equipment Decontamination) tool to separate the halves and allow for sample screening and collection. If sampling for VOCs is being performed, do not cut the liner until immediately prior to field screen/sample to minimize VOC loss.
- Once the liner is open, Ramboll personnel should:
  - Place a measuring tape alongside the liner, photo-document the core, and measure and record the soil recovery in the core. If poor soil recovery is experienced or anticipated, then evaluate the possible causes for poor recovery. Consider (a) advancing the core to the top of the desired sample interval and then advancing the core to obtain the desired interval; (b) using a catcher; (c) extending the sampler to a cohesive layer, if present; (d) using a larger split spoon barrel; and/or (e) advancing a second adjacent soil boring to target the necessary interval. Alternatively, review and discuss with the PIC and/or PM other sampling approaches.
  - When the sample recovery is less than 100%, the recorded retrieved interval corresponds to the top of the target sampling interval. For example, if recovering 18 inches from the 10 to 12 feet below ground surface (bgs) sampling interval, the sampling interval recorded is 10 to 11.5 feet bgs. Exceptions may include presence of slough in the top of the sampler, when sampling compressible soils (e.g., peat), or if a rock temporarily prevents sample collection. If any of these conditions are

observed during drilling, discuss appropriate recording of the sample recovery with the PIC and/or PM.

- Use a decontaminated (refer to **FP 14.01,** Sampling Equipment Decontamination) spatula, knife or spoon to split the soil cores and to expose soil for sampling, field screening, and photo-documentation.
- Screen the soil with field instruments (e.g., PID, XRF) as required by the site-specific Work Plan, Field Sampling Plan, and/or QAPP and in accordance with instrument manufacturer recommendations and pertinent FPs.
- Classify the soil in accordance with **FP 5.01** (Soil Classification) and document related drilling activities in accordance with **FP 5.09** (Field Soil Boring Log Preparation).
- Don a new pair of clean nitrile gloves immediately prior to collecting samples that will be sent for laboratory analyses.
- Collect samples as required by the site-specific Work Plan, Field Sampling Plan, and/or QAPP as follows:
  - Homogenize sample in accordance with the homogenization procedures provided in **Section 4.4**.
  - If multiple samples are to be collected from a single liner, don a pair of new clean nitrile gloves and use a decontaminated (refer to **FP 14.01,** Sampling Equipment Decontamination) spatula, knife or spoon to collect and prepare each sample.
- Transfer the sample to appropriate sample container(s) provided by the analytical laboratory, label and seal the sample containers, and store in an ice-filled insulated cooler pending transport to the analytical laboratory, or the laboratory courier in accordance with sample container guidelines in **Section 4.5** and sample transport and storage guidelines in **Section 4.6** and **FP 1.02** (Sample Handling, Shipping, and Chain of Custody).

- If multiple samples are to be collected, decontaminate non-dedicated, non-disposable sampling equipment between sampling locations as described in the **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP.
- If the Work Plan or Sampling Plan requires continuous sampling, have the driller advance the sampler to a depth equal to the base of the last sample interval. If sampling is

discontinuous, have the driller advance the sampler to just above the next sample target depth.

- Upon completion of the drilling and soil sampling activities:
  - The boring shall be backfilled as required in the project-specific Work Plan, Field Sampling Plan, and/or permit(s).
  - If surfaces are to be restored (e.g., pavement, concrete, vegetation), reconstruct the surface and match to adjoining grades in accordance with the project-specific Work Plan and/or Field Sampling Plan.
  - Document the sampling location in accordance with **FP 1.04** (Documenting Sampling Locations) and place a stake or flag at the sampling location for future reference if these do not interfere with site activities (e.g., in a parking lot or driveway).
- If required by the project-specific Work Plan or Field Sampling Plan, decontaminate the drilling rig and equipment prior to demobilization from the Site in accordance with **FP 14.02** (Heavy Equipment Decontamination).
- If dedicated, disposable sampling equipment was used during the sampling event, it should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling) following the collection sampling event.

4.4 Sample Homogenization Procedures

Homogenization refers to the complete mixing of materials to obtain uniform color and consistency throughout the sample prior to analyses. Homogenization is typically performed on discrete samples (e.g., several intervals within a sampling location or several sampling locations within a specific sampling interval) to create composite samples. Compositing may be performed either in the field or at the laboratory. Homogenization should not be performed for samples designated for VOC analysis (refer to **FP 5.05,** Soil Sampling for VOC Analysis).

- Place samples to be homogenized into a large, decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) or dedicated container constructed of inert material (e.g., glass, Teflon, or stainless steel) appropriate for the analyses requested.
- Prior to homogenization, remove large, unrepresentative materials such as twigs, leaves, stones, wood chips, and debris and document this encountered material in the field log.
- Mix materials as quickly and efficiently as possible using a decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) glass, high density polyethylene, or stainless-steel spoon until textural, color, and moisture homogeneity are achieved.
- When mixing large amounts of materials, mechanical mixers can be used as long as they are made of stainless steel, and have been decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination).

4.5 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected soil samples should be constructed of inert materials that will not affect the concentration of constituents in the sample (i.e., stainless steel or Lexan®). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the sample and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan, Field Sampling Plan and/or QAPP.

When the liners will not be used for sample collection, the laboratory will provide appropriate sample containers appropriate for each predetermined sample analysis. The sample volume is a function of the analytical requirements and will be specified in the Work Plan, Field Sampling Plan and/or QAPP. If possible, jars should be filled to capacity allowing no headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion).

4.6 Sample Transport and Storage

Sample containers shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). Samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration.

If the liners will be used for sample collection, they should be properly capped/sealed at both ends and stored to minimize sample disturbance.

4.7 QA/QC

Follow QA/QC procedures described in the project-specific Work Plan, Field Sampling Plan and/or QAPP throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. Certain precautions should be taken to work safely while collecting soil samples via DPT. Additionally, implementation of the work may face some difficulties, including the following:

- Direct push drilling is only suitable in unconsolidated shallow sediments. If the lithology at the site contains large amounts of gravel/cobbles, dense clay, caliche or bedrock, alternative drilling techniques may have to be considered.
- Only drillers licensed in the State where the work is being performed should be subcontracted to perform the work, if applicable. Most states have specific licensing requirements.

- In some States or local jurisdictions, drilling permits are to be procured by the driller and/or consultant prior to mobilization. In addition, boring logs and other documentation may need to be submitted to the permitting entity by the driller and/or consultant after completion of the drilling and sampling. Local Ramboll offices should be consulted to determine if specific reporting requirements apply. If the driller obtains the drilling permits, Ramboll should obtain copies of the required permits prior to mobilization. When applicable, Ramboll should also obtain copies of the driller's soil boring records after completion.
- Prior to mobilization, identify the location of soil borings and evaluate the need for security, barricading, and/or traffic control (e.g., when borings are located near the right of way).
- It is important to always remain alert and aware of your surroundings. Sampling using a direct push rig involves the use of heavy equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Stand a safe distance away from the direct push rig when taking notes. Be aware that the operator may not be able to see you, equipment accidents can happen very quickly, and you need to be alert and ready to move. Be sure to wear a high-visibility vest or clothing.
- Keep direct push equipment out of high-traffic areas and properly stored when not in use to limit trip, spill and fall hazards onsite. Use marking tools when necessary to flag or mark off possibly dangerous areas.
- If the borehole cannot be completed by the end of the day, leave the drill rig over the borehole. Where not possible (e.g., public right of way), cover the borehole and secure the area to prevent accidents and unauthorized access.
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may migrate from the borehole to the surface. Field staff should perform air monitoring and confirm that PPE is used in accordance with the site-specific HASP.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), field staff should use the "buddy system" and ensure that the project-specific HASP includes safety measures and procedures for work in isolated areas.
- When the liners are removed from the sampler tubes, it is important to track the proper orientation of the sample and to precisely and liberally mark the depths (e.g., top of run, labeled footage marks along the length of the sample, total depth of run) at which the sample was collected. Different liner cap colors can be used to distinguish the top from the bottom of the core or the orientation can be marked on the exterior of the liner with a permanent marker. When, say a six-inch sample is cut out of a sample run from a 5-foot sleeve, the remaining sleeve portions should be sufficiently labeled so that the boring can continue to be properly logged and to avoid confusion.
- If the Work Plan or Field Sampling Plan specifies analyses requiring field preservation, be sure to avoid direct contact with laboratory-provided preservative chemicals.

- The sample processing area should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).
- Background soil samples should be kept isolated from samples collected from potentially contaminated soil samples and IDW. When possible, sampling should progress from areas of lowest to highest suspected concentrations.
- When possible, designated roles should be established so that the soil sampling and logging is performed by the same person and the recording and documentation is completed by the same person throughout the sampling process.
- When backfilling boreholes below the water table, bentonite pellets or coated bentonite chips are generally easier to place than standard bentonite chips because pellets do not hydrate as quickly, hence pellets or coated bentonite chips are the preferred method for small backfill jobs where significant confining zones have not been breached. Note, however, that some pellet coatings have been known to contain acetone, which may interfere with groundwater VOC analysis. If used, samples of the coated bentonite pellets may be collected and held for future analysis if acetone is detected in the groundwater sample.

6. RECORDKEEPING

Document sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record information related to soil sampling in accordance with **FP 1.01** (Field Notes and Records). In addition, for each soil boring a soil boring log with the recorded information should be prepared and saved in the project file (refer to **FP 5.09** – Field Soil Boring Log Preparation).

FIELD PROCEDURE NO. 5.08

SUBSURFACE SOIL SAMPLING – SPLIT SPOON AND SHELBY TUBE

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 5.08

SUBSURFACE SOIL SAMPLING – SPLIT SPOON AND SHELBY TUBE

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 5.08 "Subsurface Soil Sampling – Split Spoon and Shelby Tube" last revised October 24, 2022.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for collection of subsurface soil samples using split spoons or Shelby tubes (i.e., thin wall). Split spoon and Shelby tube sampling methods are primarily used to collect subsurface soil samples using hollow stem auger drilling (refer to **FP 6.01**, Permanent Overburden Well Installation, for a general description of drilling methods). Given the thin wall thickness and large diameter of the Shelby Tube sampler, which allows for minimal disturbance of the soil matrix, Shelby tube samples are considered undisturbed. However, they are most suitable for small grain-size, cohesive materials and are primarily used for geotechnical investigations. By comparison, the split spoon sampler produces disturbed samples and are not generally appropriate for geotechnical laboratory testing purposes. Subsurface soil sampling using split spoons and Shelby tubes may be conducted as part of environmental investigations or remedial actions to:

- Collect soil samples for biological, chemical and/or geotechnical testing and assess hydrogeological conditions including, but not limited to, sampling to support source identification, characterize nature and extent of contamination in soils, assess background conditions, and conduct confirmatory sampling; and
- Allow visual, odor, and volatile vapor screening of subsurface soils.

This FP provides guidance for subsurface soil sampling using split spoons and Shelby tubes associated with typical field activities and projects, however, for certain projects, other sampling procedures or alternative methods may be required, including methods specified by state-specific or regulatory program-specific guidelines, requirements or procedures. Site-specific and state/regulatory requirements will be reviewed by the Ramboll Principal-in-Charge / Project Director (PIC / PD) and/or Project Manager (PM), and additional requirements will be defined in the project-specific Work Plan, Field Sampling Plan, Quality Assurance Project Plan (QAPP) and/or FPs. It should be emphasized that these guidelines are not meant to be project-specific work plans, but rather a reference for developing project specific procedures.

This FP was prepared to document the procedures and techniques that will be used to fulfill the groundwater sampling and analysis program requirements of the United States Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal in Charge (PIC) and/or Project Manager (PM) shall verify that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC and/or PM indicate approval of the methods and precautions outlined in the site-specific HASP.

2. EQUIPMENT/MATERIALS

A general list of equipment that may be necessary for typical subsurface soil sampling using split spoon or Shelby tube samplers is provided below. This list provides an overall summary of general equipment which may be required for soil sampling using split spoons and Shelby tubes but should not be considered exhaustive. Additional equipment may be specified in the project specific Work Plan and/or HASP.

- Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points, previous field logs).
- Drilling rig equipped with safety hammer and drop system that can produce a clean borehole and also provide relatively rapid continuous driving (e.g., hollow-stem auger; supplied by drilling contractor).
- Equipment appropriate tools provided by the drilling contractor for advancing samplers and collecting soil samples, including but not limited to:
  - Drill rods.
  - Split spoon sampler.
  - Split spoon sampler liners (e.g., brass, steel or other inert material), if specified in the Work Plan or Sampling Plan, or locally required.
  - Retainers or catchers (e.g., basket, spring, adapter ring, or flap valve).
  - Split spoon barrel.
  - Split spoon drive shoe and drive head.
  - Shelby tube samplers.
  - Sampler head with a ball check valve and a venting area.
  - Shelby tube expansion packers (O-ring packers) or non-shrinking wax.
  - Sample extruding device such as a hydraulic cylinder (if specified in the Work Plan or Sampling Plan).
  - Tube caps and/or seals (usually provided by the drilling contractor).
- Pin flags or wooden stakes, or in paved areas, spray paint or nails with flagging tape, to mark sample location(s). Care should be taken not to use materials that may interfere with sampling results. Refer to **FP 1.04**, Documenting Sampling Locations.
- Plastic sheeting.
- Folding work table, half-pipe or half-sheet of corrugated roofing plastic to hold and keep the samplers organized.
- Soils classification guidance chart as outlined in **FP 5.01** (Soil Classification).
- Color chart (e.g., Munsell) as outlined on **FP 5.01** (Soil Classification).

- Measuring tape (both long-weighted cloth type and small measuring type, preferably marked in tenths and hundredths of a foot) for measuring sample recovery and subsample intervals.
- Spatula, knife or spoon (typically stainless steel) used for splitting soil cores and collecting soil samples.
- Mixing bowl/bucket and spoons (typically stainless steel unless metal analysis will be performed) for composite sample preparation.
- Laboratory supplied certified-clean sample containers (appropriate for various analyses to be performed), as may be required in the Work Plan.
  - for poly and perfluoralkyl substances (PFAS), refer to **FP 1.07** (PFAS Sampling).
- Sample shipment containers, labels, chain of custody forms and packing materials for sampling containers as outlined in **FP 1.02** (Sample Handling, Shipping, and Chain of Custody).
- Trash bags - used to dispose of gloves and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Appropriate waste container and labelling materials – used to dispose of investigation-derived waste (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- Field screening equipment (e.g., PID, XRF) as required by the site-specific Work Plan, Field Sampling Plan, QAPP and/or the site-specific HASP.
- Ziploc® bags and/or glass jars and aluminum foil (used for field screening purposes).
- Personal Protective Equipment (PPE) in accordance with the site-specific project HASP, including protective gloves which must always be worn when handling and using sample equipment.
- Field notebook and test boring and well construction field log forms (if required) and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Mobile phone and camera.
- For long-term drilling projects, setting up a field station is recommended. The field station might include portable chair(s), worktable, canopy, and a first aid station/kit.

3. REFERENCED FIELD PROCEDUREFIELD PROCEDURES

In addition to the reference and Field Procedures cited above, the following Safe Work Practices (SWPs) and FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **SWP** Subsurface Utility Clearance;
- **FP 1.01**, Field Notes and Records;
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody;
- **FP 1.04**, Documenting Sampling Locations;
- **FP 1.05**, Field Quality Control Samples;
- **FP 2.02**, Site Preparation, Inspection and Housekeeping;
- **FP 5.01**, Soil Classification;
- **FP 5.04**, Surface Soil Sampling;
- **FP 5.09**, Field Soil Boring Log Preparation;
- **FP 5.10**, Borehole Decommissioning;
- **FP 14.01**, Sampling Equipment Decontamination;
- **FP 15.01**, Waste Handling; and
- **FP 14.02**, Heavy Equipment Decontamination.

4. PROCEDURES

4.1 Planning and Design Considerations

Strategic decisions including, but not limited to, the selection of the drill rig (e.g., access limitations), and the potential need to adjust boring locations (e.g., subsurface utilities), will be approved by the PIC and/or PM before the initiation of associated field activities and will be documented in the Work Plan, Field Sampling Plan, and/or QAPP. The Work Plan, Field Sampling Plan, and/or QAPP will be designed for the collection of quality data to meet the objectives of the sampling program and will include information such as the number of borings, depth, number of samples per boring, and the laboratory analyses to be performed on each sample as well as quality assurance/quality control (QA/QC) requirements. The Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion in the field, depending on encountered conditions; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PIC and/or PM.

When planning a split spoon or Shelby tube sampling event, the following should be considered:

- *Type of Drill Rig*. A drill rig equipped with a safety hammer and drop system capable of driving a split spoon sampler, and/or hydraulic rams capable of pushing the Shelby tube will need to be used. Typically, these are rotary or hollow-stem auger rigs, although the hydraulic ram of other rig types can also be used to push the Shelby Tube or split-spoon sampler. Hollow stem auger rigs can be mounted on pickup trucks, skid loaders, tracked carriers, skids or other vehicles. The type and size of the hollow stem auger rig and associated equipment will depend on project-specific needs such as the boring depth and access limitations. The type of drill rig and associated equipment should be discussed with the drilling contractor prior to mobilization.
- *Sampling Locations*. Consideration for placement of sampling locations should be given to the objectives of the sampling effort. However, accessibility and potential hazards (e.g., subsurface utilities, overhead clearance [including utilities, ceilings or other obstructions], traffic, surface stability, soil strength) and need to precut surfaces (e.g., asphalt or concrete) should be considered when selecting sampling locations as they could limit drilling equipment use and/or require additional controls (e.g., traffic control, clearing of vegetation, temporary mats for protection of landscaping, or delicate surfaces).
- *Sampler Type*. Split spoon samplers can have different dimensions depending on the intended use of the sampled material, and can include thin-walled and thick-walled samplers (e.g., Modified California samplers). If estimates of the geotechnical engineering properties of subsurface soils (i.e., N-value[1]) are needed, then a standard penetration test (SPT) sampler must be used (split spoon with a 1.375-inch internal diameter and a 2.0-inch outer diameter) along with a 140 lb. safety hammer using a 30-inch drop (refer to ASTM D1586). Shelby tube samplers are thin-walled tubes with a tapered cutting edge that typically have a 2- or 3-inch outside diameter and are used to

[1] The "N" value is the number of blows to drive the sampler, expressed in blows per foot, and is commonly used to estimate the in-situ relative density of cohesionless soils and approximate shear strength parameters of soils.

collect relatively undisturbed samples (refer to ASTM D1587). Because Shelby tube sampling does not allow for visual inspection of the collected samples, unless extruded, the intervals where these samples are collected are typically based on information from prior investigations or adjacent borings.

- *Subsurface Soils*. Both split spoons and Shelby tubes are most suitable for sampling cohesive overburden soils that contain a low percentage of gravel and are not dense or highly compacted, or contain cobbles or weathered rock. Shelby tubes are most appropriate in soils that contain silt and clay and are cohesive in nature.
  - In cases where soils to be sampled may lack cohesiveness and may fall out of the split spoon sampler, core catchers at the leading end of the split spoon sampler may help retain the sample until retrieval at the surface.
  - In cases where soils to be sampled may lack cohesiveness and may fall out of the Shelby tube, an alternate sampling method should be used.
  - Alternate sampling methods may be required if the sampler encounters refusal (see **Section 4.3.1**) due to:
    - Large sized granular soils (without fines), cobbles, boulders or other subsurface obstructions. Thin-walled Shelby tubes are easily deformed when encountering dense soil, gravel, or cobbles.
    - "Running sands" that fill the boring from the bottom of the auger preventing the sampler from advancing. This condition typically occurs when transitioning from a low permeable layer to a higher permeable layer (i.e., sand) and the groundwater level outside the casing is higher than within the casing.
- *Borehole Backfilling Approach*. Factors to be considered in selecting the approach for backfilling the borehole include potential contamination of drill cuttings, local permit regulations and guidance, and client specific requirements. Boreholes can be backfilled using several methods, including retraction grouting with a tremie tube and a bentonite and/or Portland cement grout, gravity filling with bentonite and/or Portland cement grout, filling with hydrated bentonite pellets, or backfilling with drill cuttings (refer to **FP 5.10**, Borehole Decommissioning).

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. In addition, to the extent that non-dedicated sampling equipment is to be used (e.g., spatula, knife or spoon, mixing bowls, split spoon sampler), to minimize potential cross-contamination between samples, such sampling equipment should be decontaminated before collection of each sample as described in **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP. Used disposable sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling) following the sampling event.

At a minimum, the following tasks should be completed (as applicable) as field staff prepare for implementation of the work:

- Coordinate and obtain permission for site access;
- Review and sign the site-specific HASP;
- Review permits and permit conditions that may affect site work including backfill requirements, air, dust or sound monitoring, agency notifications, and restricted operating hours;
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work;
- Confirm soil boring/sampling locations;
- Complete a subsurface clearance (refer to **SWP** Subsurface Utility Clearance);
- Review project-specific Work Plan, Field Sampling Plan or QAPP, where applicable;
- Review and discuss with the PIC/PD and/or PM the proposed Work Plan or Field Sampling Plan or sampling strategy;
- Identify the type of sampler and drilling equipment required for project-specific tasks and review the standard instruction manual provided by the manufacturer of the specific sampling equipment being used for sampling;
- Contact the laboratory to provide advance warning when samples are anticipated;
- Contact the drilling contractor to verify scope and confirm sampling equipment is available and appropriately decontaminated prior to mobilization; and
- Verify that equipment/materials and sampleware required to complete the work have been packed prior to mobilization.

Prior to the commencement of the field effort, Ramboll field sampling personnel should inspect, test, and/or calibrate equipment that will be used to take field measurements.To increase productivity in the field, it is recommended that prior to mobilization the laboratory-provided sampleware quantities are checked, sample containers are pre-labeled (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody) and non-dedicated sampling equipment is decontaminated and packaged (refer to **FP 14.01**, Sampling Equipment Decontamination).

4.3 Subsurface Soil Sampling Guidelines

The following provides a recommended list of practices for subsurface soil sampling using split spoon and Shelby tube samplers.

- Where applicable, contact the identified key site personnel upon arrival to the site and assess proposed work areas and decide where containerized soil cuttings and other IDW should be staged and stored.
- Review the physical location of each soil boring with the driller before initiating subsurface work. Verify that the proposed locations have been cleared in accordance with **SWP** Subsurface Utility Clearance and that the drill rig can operate safely while

maintaining minimum clearance from overhead power lines, or damaging other property (e.g., equipment, fences, etc.).

- Inspect the backfill material provided by the drillers to verify it complies with Work Plan and any related permit requirements.
- Discuss the following with the driller:
  - Expected depth and diameter of the borings;
  - Amount, depth and type (e.g., split spoon or Shelby tube) of the soil samples to be collected;
  - Approximate anticipated depth of groundwater;
  - Borehole backfilling procedure and materials;
  - Staging locations for soil cuttings and other IDW;
  - Location for conducting equipment decontamination; and
  - Surface materials that need to be predrilled or cored prior to sampling. If the surface material is asphalt, the drill rig tooling should be able to penetrate the asphalt (verify with driller prior to initiating field work). However, if the surface is covered with concrete, a concrete corer or saw may be required to provide access to the subsurface.
- Prior to start of the sampling, set up the sample processing/field station area, which may include placing plastic sheeting on the ground surface to prevent potential contamination of underlying soil/asphalt/concrete, setting up a work table, core cradle, or corrugated sheets to hold the samplers, and installing a canopy.
- Although equipment will be decontaminated between uses to further limit potential cross-contamination between sampling locations, sampling should progress from suspected areas of lowest to highest concentration.
- The driller will use the approved drilling equipment (e.g., hollow-stem auger) to advance the boring incrementally to just above the target sampling depth. The driller will then advance the split spoon or Shelby tube sampler to the target sampling depth.
- Once the top of the sampling target depth is reached, have the drilling contractor remove the drill tip from the drill rod and clean the borehole to the top of the sampling interval.
- Sampling should be performed as described in **Sections 4.3.1** and **4.3.2**, as appropriate.
- During drilling and sampling, Ramboll personnel should:
  - Maintain a safe distance from the drill rig and maintain eye contact with the operator if approaching the drill rig.
  - Monitor ambient air in the work area as required by the site-specific Work Plan or Field Sampling Plan and the site-specific HASP.

  - Communicate with the operator regarding observed changes in subsurface conditions during drilling (e.g., increased or decreased resistance to drilling, groundwater first encountered) and depths where these occur.

- Upon completion of the drilling and soil sampling activities:
  - The boring shall be backfilled as required in the project-specific Work Plan, Field Sampling Plan, and/or permit(s).
  - If surfaces are to be restored (e.g., pavement, concrete, vegetation), reconstruct the surface and match to adjoining grades in accordance with the project-specific Work Plan and/or Field Sampling Plan.
  - Document the sampling location in accordance with **FP 1.04** (Documenting Sampling Locations) and place a stake or flag at the sampling location for future reference if these do not interfere with site activities (e.g., in a parking lot or driveway).
- If required by the project-specific Work Plan or Field Sampling Plan, decontaminate the drilling rig and equipment prior to demobilization from the Site in accordance with **FP 14.02** (Heavy Equipment Decontamination).
- If dedicated, disposable sampling equipment was used during the sampling event, it should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling) following the collection sampling event.

4.3.1 Split Spoon Sampling

If using a split spoon sampler to collect soil samples:

- The driller will assemble the split spoon sampler using proper attachments to connect the drive shoe, drive head, and split barrel, and attach liners and retainers if needed. The driller will then attach the split spoon sampler to the drill rod and lower the assembly into the borehole. The sampler should not be dropped onto, or otherwise disturb the soil to be sampled.
- To confirm that the sampler is at the target sampling depth, the driller should measure the drill rod stickup. If the rod stickup measurement indicates that the sampler cannot be seated at target sampling depth, excessive soil cuttings or sloughed materials are likely present, which would require that the sampler be retrieved, the borehole cleaned out, and this step repeated.
- Once sampler is in place, the driller will mark the drill rods with chalk to indicate 6-inch sampler increments so the advance of the sampler under the impact of the hammer can be easily observed for each increment and to assist tracking blow counts if requested of the driller.
- The driller will then position the drop hammer and drop system above the sampler assembly and use it to drive the split spoon sampler into the soil at the bottom of the borehole. The split spoon will be advanced by repeatedly dropping the 140-pound hammer 30 inches on the driving head of the sampling assembly at a constant rate. The sampler will be advanced to a depth that is equal to the split spoon sampler length (typically 24-inch inner sampling barrel), or less if sampler refusal is encountered (e.g.,

defined as greater than 50 blows per 6 inches, a total of 100 blows have been applied, or if no sampler movement is observed after 10 successive blows).

- Count and record number of blows needed by the hammer to drive the sampler for each 6-inch depth interval (e.g., 5-4-10-15). For soft materials, note the depth of penetration into the sampling interval by the weight of the rod (e.g., WOR/6.0). For hard materials record the number of blows over the number of inches penetrated (e.g., 50/4.5).
- Have the drilling contractor retrieve the sampler from the borehole, unscrew the sampler ends (drive shoe and drive head), and once the sampler is placed on the sample processing work area, pry open the sampler along the barrel split. If the spoon is too tight to insert a prying implement (spatula or screwdriver) it can be loosened by tapping the split spoon against the table, or with a hammer, mallet or other hard implement, on the split. This should be done carefully to avoid spilling the contents, and to avoid damage to the sampler.
- Don a pair of new clean nitrile gloves immediately prior to handling each sampler.
- Inspect the recovered sample before removing any portion for sampling and assess whether any portion should be discarded (e.g., the top several inches of material in the spoon may consist of sloughed borehole wall material collected during insertion and removal of sampler from the borehole). If any material is discarded, document the basis for such decision.
- Place a measuring tape alongside the sampler, photo-document the sample, and measure and record the recovered sample length and calculate the percent recovery (recovered sample length divided by sampler length). If poor soil recovery is experienced or anticipated, then evaluate the possible causes for the poor recovery. Consider (a) advancing the auger to the top of the desired sample interval and then advancing the sampler to obtain the desired interval; (b) using a catcher; (c) extending the sampler to a cohesive layer, if present; (d) using a larger split spoon barrel; and/or (e) advancing a second adjacent soil boring to target the necessary interval Alternatively, review and discuss with the PIC/PD and/or PM other sampling approaches.
- When the sample recovery is less than 100%, the recorded retrieved interval corresponds to the top of the target sampling interval. For example, if recovering 18 inches from the 10 to 12 feet below ground surface (bgs) sampling interval, the sampling interval recorded is 10 to 11.5 feet bgs. Exceptions may include presence of slough in the top of the sampler, when sampling compressible soils (e.g., peat), or if a rock temporarily prevents sample collection. If any of these conditions are observed during drilling, discuss appropriate recording of the sample recovery with the PIC/PD and/or PM.
- If using interior sleeves or liners, the liner will need to be sliced open lengthwise using an appropriate cutting tool to access the soil. In some states (e.g., California), segmented sleeves are used to contain the soil. In these instances, use the spatula to separate the sleeves and process the sample in accordance with the site-specific Work Plan, Field Sampling Plan, and/or QAPP, which will define how each sleeve will be handled.
- Use a decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) spatula, knife or spoon to split the soil sample and to expose soil for sampling, field screening, and photo-documentation.

- Screen the soil with field instruments (e.g., PID, XRF) as required by the site-specific Work Plan, Field Sampling Plan, and/or QAPP and in accordance with instrument manufacturer recommendations and pertinent FPs.
- Classify the soil in accordance with **FP 5.01** (Soil Classification) and document related drilling activities in accordance with **FP 5.09** (Field Soil Boring Log Preparation).
- Don a new pair of clean nitrile gloves immediately prior to collecting samples that will be sent for laboratory analyses.
- Collect samples as required by the site-specific Work Plan, Field Sampling Plan, and/or QAPP as follows:
  - Homogenize sample in accordance with the homogenization procedures provided in **Section 4.4**.
  - If multiple samples are to be collected from a single liner, don a pair of new clean nitrile gloves and use a decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) spatula, knife or spoon to collect and prepare each sample.
- Transfer the sample to appropriate sample container(s) provided by the analytical laboratory, label and seal the sample containers, and store in an ice-filled insulated cooler pending transport to the analytical laboratory, or the laboratory courier in accordance with sample container guidelines in **Section 4.5** and sample transport and storage guidelines in **Section 4.6** and **FP 1.02** (Sample Handling, Shipping, and Chain of Custody). If using interior sleeves or liners and not analyzing for VOCs, cap the sleeve with Teflon liners and end caps and secure with tape in accordance with the site-specific Work Plan, Field Sampling Plan, and/or QAPP.
- If multiple samples are to be collected, decontaminate non-dedicated, non-disposable sampling equipment (e.g., the split spoon, catcher, drive shoe, spatula, knife or spoon, mixing bowl) between sampling locations as described in the **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP.
- If the Work Plan or Sampling Plan requires continuous sampling, have the driller advance the augers to a depth equal to the base of the last sample interval. If sampling is discontinuous, have the driller advance the augers to just above the next sample target depth.

4.3.2 Shelby Tube Sampling

If using a Shelby tube sampler to collect soil samples:

- The driller will assemble the Shelby tube sampler using proper screws to attach the sampler push head on the drill rod to the thin-wall Shelby tube and lower the assembly into the borehole. The sampler should not be dropped onto or disturb the soil to be sampled. The driller should verify that the check valve on the sampler head is unobstructed (e.g., clear of soil or other obstructions) to allow water to pass through from the sampling head to the drilling rods during sampling.
- Once sampler is in place, the driller will use the drill rig to hydraulically advance it slowly and at a constant rate to a distance into the soil that is equal to the length of the Shelby tube minus 3 inches (to accommodate slough that may accumulate at the bottom of the borehole). Record the hydraulic pressure applied to advance the Shelby tube. The sampler should not be driven with the hammer. If the soil is too hard to advance the sampler without hammering, review and discuss with the PIC/PD and/or PM other sampling approaches.
- The driller should leave the sampler in the borehole at least 10 minutes to allow the sample to swell and stabilize in the tube and maximize the recovery.
- To shear off the sample, the driller should rotate the entire assembly two revolutions and then slowly and carefully retrieve the Shelby tube sampler from the borehole to minimize sample disturbance.
- Don a pair of new clean nitrile gloves immediately prior to handling each sampler. Immediately upon retrieval, place a driller supplied tube cap on the bottom end of the tube and hold the base of the sampler to ensure the sample does not wash out.
- Measure and record the length of the sample in the tube. Remove disturbed material at the upper end of the tube and measure/record sample length again.
- Remove a maximum of one inch of material from the lower end of the tube to classify the soil in accordance with **FP 5.01** (Soil Classification). Document related drilling activities in accordance with **FP 5.09** (Field Soil Boring Log Preparation)
- Keeping the Shelby tube in an upright position as much as possible, have the driller (a) seal both ends of the tube with at least 1-inch thick layer of non-shrinking wax or an expansion (O-ring) packer to protect the ends of the sample; (b) cap the ends of the tubes with the tube caps; (c) secure the cap and cover the Shelby tube screw holes with electrical tape; and (d) dip the ends in non-shrinking wax. Clearly mark the exterior of the tube with the boring number, depth range, recovery, and which end is the top (shallowest) and bottom (deepest) of the sampling interval.
- Shelby tubes should be stored and transported in an upright position standing on the bottom end of the core (i.e., with the shallowest depth interval on top) to limit sample disturbance.
- If sampling for chemical analysis, have the driller don a pair of new clean nitrile gloves and then field-extrude the sample in the sample processing/field station area taking care to preserve the sample integrity and avoid potential cross-contamination during handling. Prior to receipt of the sample from the driller, don a pair of new clean nitrile

gloves and then proceed to inspect, measure, classify, photo-document, field test, and collect sample(s) for analyses as described above for the split spoon sampling.

4.4 Sample Homogenization Procedures

Homogenization refers to the complete mixing of materials to obtain uniform color and consistency throughout the sample prior to analyses. Homogenization is typically performed to combine discrete samples (e.g., several intervals within a sampling location or several sampling locations within a specific sampling interval) to create composite samples. Compositing may be performed either in the field or the laboratory. Homogenization should not be performed for samples designated for VOC analysis, nor when the laboratory analysis requires an undisturbed sample (e.g., not appropriate for samples collected with Shelby tubes).

- Place samples to be homogenized into a large, decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) or dedicated container constructed of inert material (e.g., glass, Teflon, or stainless steel) appropriate for the analyses requested.
- Prior to homogenization, remove large, unrepresentative materials such as twigs, leaves, stones, wood chips, and debris and document materials removed from the sample in the field log.
- Mix materials as quickly and efficiently as possible using a decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination) glass, high density polyethylene, or stainless steel spoon until textural, color, and moisture homogeneity are achieved.
- When mixing a large amounts of material, mechanical mixers can be used as long as they are made of stainless steel, and have been decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination).

4.5 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected soil samples should be constructed of inert materials that will not affect the concentration of constituents in the soil sample (e.g., stainless steel or Lexan®). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the sample and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan, Field Sampling Plan and/or QAPP.

The laboratory will provide appropriate sample containers. The sample volume is a function of the analytical requirements and will be specified in the Work Plan, Field Sampling Plan and/or QAPP. If possible, jars should be filled to capacity allowing no headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion).

4.6 Sample Transport and Storage

Sample containers shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). Samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration.

The Shelby tubes should be stored and transported in an upright position (i.e., with the shallowest depth interval on top) to limit sample disturbance.

4.7 Quality Assurance/Quality Control

Follow QA/QC procedures described in the project-specific Work Plan, Field Sampling Plan and/or QAPP throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. Certain precautions should be taken to ensure safety while collecting soil samples using split spoons and/or Shelby tubes. Additionally, implementation of the work may face some difficulties, including the following:

- If the lithology at the site contains large amounts of gravel/cobbles, dense clay, or bedrock, alternative soil sampling techniques may have to be considered.
- If the driller has difficulty withdrawing the split spoon sampler from the subsurface, it may be necessary to remove it by hitting the drive head upward with short length hammer strokes.
- Careful and precise measurement of sampler, rods, augers and/or casings will provide the greatest means for sampling depth control.
- Debris and other material that accumulate at the base of the borehole during drilling should be removed periodically to prevent re-deposition into the borehole and possible cross-contamination.
- Only drillers licensed in the State where the work is being performed should be subcontracted to perform the work, if applicable. Most states have specific licensing requirements.
- In some States or local jurisdictions, drilling permits are to be procured by the driller and/or consultant prior to mobilization. In addition, boring logs and other documentation may need to be submitted to the permitting entity by the driller and/or consultant after completion of the drilling and sampling. Local Ramboll offices should be consulted to determine if specific reporting requirements apply. The driller obtains the drilling permits, Ramboll should obtain copies of the required permits prior to mobilization. When applicable, Ramboll should also obtain copies of the driller's soil boring records after completion.

- Prior to mobilization, identify the location of soil borings and evaluate the need for security, barricading, and/or traffic control (e.g., when borings are located near the right of way).
- It is important to always remain alert and aware of your surroundings. Sampling using a drill rig involves the use of heavy equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Stand a safe distance away from the drill rig when taking notes. Be aware that the operator may not be able to see you, equipment accidents can happen very quickly, and you need to be alert and ready to move. Be sure to wear a high-visibility vest or clothing.
- Keep drilling equipment out of high-traffic areas and properly stored when not in use to limit trip, spill and fall hazards onsite. Use marking tools when necessary to flag or mark off possibly dangerous areas.
- If the borehole cannot be completed by the end of the day, leave the drill rig over the borehole. Where not possible (e.g., public right of way), cover the borehole and secure the area to prevent accidents and unauthorized access.
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may migrate from the borehole to the surface. Field staff should perform air monitoring and confirm that PPE is used in accordance with the site-specific HASP.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should use the "buddy system" and ensure that the project-specific HASP includes safety measures and procedures for work in isolated areas.
- When the Shelby tubes are removed from the sampler, it is important to track the proper orientation of the sample and to precisely and liberally mark the depths (e.g., top of run, labeled footage marks along the length of the sample, total depth of run) at which the sample was collected. Different cap colors can be used to distinguish the top from the bottom of the tube or the orientation can be marked on the exterior of the tube with a permanent marker.
- If the Work Plan or Field Sampling Plan involves analyses requiring field preservation, be sure to avoid direct contact with laboratory-provided preservative chemicals.
- The sample processing area should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).
- Background soil samples should be kept isolated from samples containing high concentrations of contaminants or IDW. When possible, sampling should progress from areas of lowest to highest suspected concentration.
- When possible, designated roles should be established so that the soil sampling and logging is performed by the same person and the recording and documentation is completed by the same person throughout the sampling process.

- If the Work Plan, Field Sampling Plan or QAPP requires metals analysis, the sample can be collected from the central portion of the sampling device (e.g., not touching the metal part of the sampler) with a clean glass, HDPE, or stainless-steel spoon, and the rest of the sample discarded.
- When backfilling boreholes below the water table, bentonite pellets or coated bentonite chips are generally easier to place than standard bentonite chips because pellets do not hydrate as quickly, hence pellets or coated bentonite chips are the preferred method for small backfill jobs where significant confining zones have not been breached. Note, however, that some pellet coatings have been known to contain acetone, which may interfere with groundwater VOC analysis. If used, samples of the coated bentonite pellets may be collected and held for future analysis if acetone is detected in the groundwater sample.

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information in accordance with **FP 1.01** (Field Notes and Records). In addition, for each soil boring a soil boring log with the recorded information should be prepared and saved in the project file (refer to **FP 5.09**, Field Soil Boring Log Preparation).

FIELD PROCEDURE NO. 5.09

FIELD SOIL BORING LOG PREPARATION

VISTRA PROJECT

PROJECT NO. 1940112376

FIELD PROCEDURE NO. 5.09

FIELD SOIL BORING LOG PREPARATION

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 5.09 "Field Soil boring Log Preparation" last revised November 16, 2015.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for logging geologic information gathered from soil borings through unconsolidated materials[1]; and completing field logs as part of environmental field investigations. Soil logs serve to document soil types, field instrument measurements, field observations and field test results. Soil types and properties may vary at a site and accurate soil(s) identification and geologic logging is essential to the successful completion of projects. Detailed soil boring logs are critical to developing accurate conceptual site models to support characterization of the nature and extent of contamination, performing hydrogeological modeling, conducting site specific risk evaluations, evaluating the feasibility of remedial alternatives, and/or preparing remedial design specifications.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that this FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail.

2. EQUIPMENT/MATERIALS

A general checklist of equipment and materials that may be required for logging soil borings is provided below. This checklist includes an overall summary of general equipment typically required for documenting soil boreholes and should not be considered an exhaustive compilation. Additional equipment may be specified in the project-specific work plan, other referenced FPs and/or the HASP.

- Field notebook and all-weather pens or permanent as outlined in **FP 1.01** (Field Notes and Records).

[1] Unconsolidated materials refers to natural soils, fill, and unconsolidated deposits below the soil horizon. Throughout this FP references to soils should be understood as any unconsolidated material encountered in the subsurface during boring activities.

- Field log forms (preferably produced on *Rite in the Rain*® water-resistant paper):
  - Blank Field Boring Log form
  - Blank Field Well Completion Log form (if required).
- Geotechnical Gauge (as manufactured by W. F. McCollough or equivalent) as outlined on **FP 5.01** (Soil Classification) and **FP 5.17** (Rock Core Logging).
- Color chart, as outlined on **FP 5.01** (Soil Classification) and **FP 5.17** (Rock Core Logging).
- Spatula or other instrument for splitting soil cores.
- Measuring tape or ruler.
- Plastic Sheeting to go under the cores while logging.
- Decontamination supplies.
- Digital Camera.
- Clipboard.

Based on the field activity and project, the following also may be needed:

- Field screening equipment (as required by Work Plan and/or HASP).
- Electronic water level indicator or interface probe.
- A portable table or other stable working surface.
- Duct tape to secure plastic sheeting to table.
- Stacking sieves (as required by Work Plan).
- Time keeping device.
- Water Spray bottle (to wet the soil if needed and/or wipe down surfaces).
- Paper towels.
- Corrugated roofing plastic sheet.
- Zip lock bags (used for PID readings).

3. REFERENCED PROCEDURES

The following FPs are related to this FP and should be referenced, as needed:

- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody.
- **FP 1.04**, Documenting Sampling Locations.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.

- **FP 4.01**, Field Screening - Combustible Gas.
- **FP 4.02**, Field Screening - Volatile Gas.
- **FP 5.01**, Soil Classification.
- **FP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations.
- **FP 5.04**, Surface Soil Sampling.
- **FP 5.07**, Subsurface Soil Sampling – Geoprobe®.
- **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
- **FP 5.15**, Stockpile Sampling.
- **FP 5.17**, Rock Core Logging.
- **FP 6.01**, Permanent Overburden Well Installation.
- **FP 6.05**, Permanent Bedrock Well Installation.
- **FP 6.15**, Well Construction Record.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site- specific sampling plan (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 General Information

During borehole drilling, information regarding all activities related to the soil boring should be recorded in the Field Notebook or on a Field Boring Log form. The Field Notes or Field Boring Log form should be populated concurrently with the soil borehole drilling activities, and the person completing the log should pay close attention to the drilling activities. The following guidelines should be considered when recording information:

- Pertinent information will be recorded in the field notebook or on the Field Boring Log form for each borehole and will include the information specified in **Section 4.2** of this FP.
- Where applicable, field personnel should indicate in the field log book and on the Soil Boring Log form if the borehole is completed as a monitoring well, soil gas probe, or if it is backfilled and abandoned (refer to the corresponding FP for additional information and construction details to be recorded).
- Borehole drilling activities may also require that additional forms, such as a Field Well Completion Log form (refer to **FP 6.15**, Well Construction Record), or equipment calibration log forms (refer to field screening FPs), also be completed. Alternatively, based on project-specific requirements, information may be recorded in the project-specific Field Logbook, as long as all information identified in the form(s) is recorded in the logbook (refer to **FP 1.01**, Field Notes and Records).
- Any free forms or field sketches, such as Field Boring Log form, or borehole location sketches, should be appropriately referenced in the field notebook (refer to **FP 1.01**, Field Notes and Records) and collectively, should present a complete record of the field activities observed. Thus, these records should be thorough enough to enable reviewers to reconstruct the field activities, rationales for decisions made, and observations.
- Records should be recorded in accordance with **FP 1.01**, Field Notes and Records.
- Soil samples should be collected for field logging in accordance with the developed project-specific Work Plan and the following FPs:
  - **FP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations.
  - **FP 5.04**, Surface Soil Sampling.
  - **FP 5.07**, Subsurface Soil Sampling - Geoprobe®.
  - **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
  - **FP 5.15**, Stockpile Sampling.
  - **FP 14.01**, Sampling Equipment Decontamination.
  - **FP 15.01**, Waste Handling.

4.2 Requirements for Soil Boring Log Form

The Soil Boring Log summarizes and presents all data gathered during lithological sampling of soils and is a critical component of the overall record of an investigation. Field personnel should be aware of and record in the field log book or on the Soil Boring Log form the following general soil boring details:

- Soil boring unique identification number (ID).
- Name of Ramboll Environ oversight personnel completing the log.
- PIC or PM of the project.
- Project number.
- Drilling contractor and master/head driller's name.
- Date and the start and end time of drilling.
- A description of the boring location including a map depicting the boring location relative to fixed site features (e.g., building corners, utility poles, gates/fences, etc.).
- Drilling method used (e.g., hand auger, hollow stem auger, air rotary, mud rotary, direct-push [i.e., Geoprobe]) and nominal outside diameter(s) of drill string equipment.
- Drilling equipment (i.e., rig make and model).
- Borehole diameter. Note that some boreholes will have "telescoping" intervals of larger or smaller diameter (e.g., if installing a double-cased well to seal off specific water-bearing zones).
- Detailed description of ground surface conditions (e.g., 4 inches of concrete overlying 6 inches of ¾ inch stone).
- The type of soil sampling performed (e.g., split spoon, Shelby tube, direct-push) and the length of the sampler device.
- Intervals over which soil cores are being collected (e.g., continuous soil cores, one split spoon every 5 feet, etc.).
- Hammer weight and drop, if collecting split spoon samples.
- Total borehole depth (note the depth of the borehole before and after backfilling).
- Depth at which water is first encountered during drilling and any subsequent water-bearing zones.
- Depth and intervals of any drilling refusal or cavities.
- Description of fluids added during drilling and associated quantities.
- Depth of water at completion of soil boring.
- Depth of boring after cave-in (if applicable).
- Method and materials used to abandon, backfill or convert the boring to a well or monitoring probe.
- A description of any problems encountered during the drilling process and corrective actions, as applicable. For example, record if borings must be relocated during the site

inspection due to the presence of subsurface utilities or other obstructions, or if borings must be off-set to an alternative, pre-cleared location due to refusal. This information should also be recorded in the field notebook.

- A description of any notable features encountered during drilling, including depth or depth range encountered below ground surface. This information may include changes in characteristics indicated by the driller (e.g., drill chatter, softer drilling, more difficult drilling, loss of water).

For each sampling interval, field personnel should be aware of and record in the field log book or on the Soil Boring Log form the following details:

- Blow counts (when drilling and/or sampling methods allow). Record the number of blow counts per six-inch interval of the Standard Penetration Test (SPT) to provide an estimate of relative density of the penetrated material. Blow counts shall be recorded for each six-inch interval (i.e. four measurements for each 2-foot interval or three measurements for each 18-inch interval). The final log should include the N- value (the sum of the second and third blow counts over a 2-foot interval). If the blows do not represent SPT data (for example, if a 3-inch diameter split spoon is used in lieu of the standard 2-inch diameter split-spoon), this should be noted. Blow counts should only be collected in accordance with the methods set forth in ASTM D1586, which specifies a 30-inch drop of a 140 pound hammer using a 2-inch diameter sampler.
- Soil recovery, recorded as the portion of sample (in feet or inches) that is recovered out of the entire length of the coring tool utilized. The recovery must be recorded for each advanced interval and should be correlated to the size of the sample apparatus. For example, if a split-spoon sampler was driven 24 inches, but only 8 inches of material was found inside the sampler, the amount of recovery would be recorded as 8”/24”.
- Sample designation and sampling depth interval in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).
- Description of the materials sampling in accordance with **FP 5.01** (Soil Classification) and **FP 5.17** (Rock Core Logging) if appropriate. The log should clearly indicate that “Unless otherwise noted, soil classifications are based on field observations and have not been confirmed by laboratory testing.”
- Depth below ground surface corresponding to any changes in stratigraphy or notable features. When describing underlying samples, use the following where applicable:
  - (same) … if underlying materials are identical to prior sampling interval.
  - (same with _____) … when soil classification remains constant, but specific qualifiers (e.g., organics, no glass) are no longer applicable.
  - (grades to _____) when soil classification remains constant, but there is a change in color, moisture content, or relative density or consistency.
- Field screening results (e.g., photoionization detector screening), if performed. If the collection of vapor readings or other field parameters is required in the Work Plan, refer to the Work Plan for appropriate intervals over which measurements should be collected and the pertinent field screening FPs.

- Field test results (e.g., portable chemical-specific test kits, pocket penetrometer or pocket torvane strength tests), if performed. If field testing is required in the Work Plan, refer to the pertinent field testing FPs.
- Identification of samples submitted for laboratory analysis, as may be required in the Work Plan.
- Identification of samples sent for geotechnical testing or supplemental analysis of physical properties, as may be required in the Work Plan.
- Record of whether debris, or large particle sizes were encountered in collection of or excluded from any sample including description of those material.
- Difficulties encountered during the sample collection process, as applicable (e.g., caving of borehole, subsurface obstructions, equipment failure).

Where applicable, field personnel should record in the field notebook or on the Soil Boring Log form the following additional information:

- Whether the borehole is logged using soil cuttings descriptions rather than whole samples.
- Whether information from an adjacent boring log is used to identify depth intervals for sampling. In such case, reference should be made to the adjacent boring log.
- Whether a boring was logged based on a collocated boring. For example, if two borings are adjacent and one was formally logged and the other not formally logged (or logged in less detail) the name of the more detailed boring log should be referenced on the less detailed boring log (e.g. boring log B-1S may include the description: "Boring B-1S advanced without logging soils, adjacent boring B-1D logged").
- Whether the borehole remained open overnight and the precautions taken to secure the borehole and the overall area.
- Time, date, and type of materials used to backfill the borehole.

If appropriate and/or required by the project, data recorded in a field log book or field Soil Boring Log form should be transferred to a final Soil Boring Log form within two weeks after the boring was drilled. Where required, a Professional Geologist and/or Professional Engineer should review the soil boring log before its finalized.

4.3 Additional Soil Boring Documentation

Upon completion of the soil boring, its location relative to fixed and reproducible landmarks should be defined in the field book or site map. A detailed dimensioned sketch should be prepared in accordance with **FP 1.04** (Documenting Sampling Locations).

In addition to documenting field activities in a logbook, photographs (if allowed) should be taken to document each soil sample, and details of each photograph (file name, date, time, direction, and subject) should be recorded in accordance with **FP 1.01** (Field Notes and Records).

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Soil boring log preparation requires recording sufficiently detailed information throughout the borehole advancement process. Certain precautions should be taken to ensure safety while recording the required information.

- Proper personal protective equipment (PPE) must be worn and subsurface materials handled in accordance with the project HASP.
- If soil borings are discontinuous (e.g., two foot samples at five foot intervals) and differing materials are encountered in consecutive samples, approximate the transition from one layer to another by:
  - Discussing with the driller any noted changes in the advancement of the soil boring which would allow an approximation of the transition depth.
  - Estimating the transition point as the midpoint between sampling intervals.

  In either case, the approximated transition depth/elevation should be shown with a dashed rather than a solid line in the boring log to convey uncertainty in the boundary between the strata.
- It is not uncommon for sample recoveries to represent a fraction of the sampling interval. In those instances there should be some consideration to the materials immediately above and below the sampling interval, the presence of coarse grained materials, potential sloughing within the borehole, and/or potential obstructions in the sampling device which may have contributed to the reduced recovery. If additional guidance is needed, discuss with the PM and/or PIC the specific procedures to be followed in logging the specific sampling interval.
- If samples for analysis are to be collected, the field soil log should be prepared after samples collection to minimize losses due to volatilization or cross-contamination due to excessive handling of the soil.

6. RECORDKEEPING

This FP specifically pertains to recordkeeping for soil boring drilling projects. In addition to the soil boring log preparation guidelines provided above, all information should be recorded in accordance with **FP 1.01** (Field Notes and Records). In general, draft field forms should be scanned and saved electronically immediately following the completion of the field activities. Following review of draft documents by the PIC and/or PM, field documentation forms should be finalized and final versions may be included in project reports, if necessary. Draft and final versions of the boring logs should be managed in accordance with Ramboll Environ's Document Retention Policy and project-specific requirements, and a copy should be maintained in the Project File.

FIELD PROCEDURE NO. 5.15

STOCKPILE SAMPLING
VISTRA PROJECT
PROJECT NO. 1940112376

FIELD PROCEDURE DOCUMENT NO. 5.15

STOCKPILE SAMPLING

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 5.15 "Stockpile Sampling" last revised February 21, 2014.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the collection of soil or soil-like material samples from stockpiles. Analysis of stockpile samples may be used to characterize materials as clean fill, for waste characterization purposes, or to evaluate potential beneficial reuse alternatives.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP is does not supersede Ramboll Health and Safety procedures or Site- Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in site-specific HASP followed by any procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

Below is a general checklist of materials that may be required for typical stockpile sampling efforts. This checklist only suggests general equipment that may be necessary for a project or task and should not be considered exhaustive.

2.1 General Stockpile Sampling Equipment Checklist

- Site map showing locations and dimensions of stockpiles.
- GPS or other locating device.
- Previous field logs.
- Other monitoring equipment and Personal Protective Equipment (PPE) as specified in the HASP.
- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Appropriate waste container – used to dispose of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).

- Labels for Investigation Derived Waste (IDW) containers as outlined in **FP 15.01** (Waste Handling).
- Soils classification guidance chart as outlined on **FP 5.01** (Soil Classification).
- Color chart as outlined on **FP 5.01** (Soil Classification).
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).

2.2 Project- or Task-Specific Stockpile Sampling Equipment Checklist

- Measuring tapes (both long weighted cloth type and small measuring tape, preferably marked in tenths and hundredths of a foot) and/or measuring wheel.
- Certified-clean sample containers and samplers, as may be required in the Work Plan.
- Labels for sampling containers as outlined in **FP 1.02**, Sample Handling, Shipping, and Chain of Custody.
- Field screening equipment, as may be required in the Work Plan.
- Chemical protective gloves and other PPE as required by the HASP.
- Spade, shovel, trowel or hand auger - used for collecting stockpile samples from shallow locations (deeper samples may require the excavation of test pits or advancement of borings – refer to **FP 5.02**, **FP 5.07**, and **FP 5.08**).
- Equipment appropriate tools for adjusting samplers (pliers, wrench, etc.).
- Mixing bowl/bucket and spoons (stainless steel unless metal analysis will be performed) for composite sample preparation.
- Cooler with ice.
- Decontamination supplies/equipment (e.g. non-ionic detergent, tub, brushes, etc.).
- Wash bottles/bucket.

2.3 Miscellaneous Additional Suggested Equipment

- Extra vehicle keys.
- First aid kit.
- Mobile phone.
- Credit card for gas and emergencies.
- Road and site maps.
- Camera and extra batteries.

3. PROCEDURES REFERENCED

The following Standard Practice Instruction (SPIs) and FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **SPI 27**, Subsurface Clearance.
- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sample Handling, Shipping, and Chain of Custody.
- **FP 1.04**, Documenting Sampling Locations.
- **FP 1.05**, Field Quality Control Samples.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 4.06**, Equipment Calibration.
- **FP 5.01**, Soil and Rock Classification.
- **FP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations.
- **FP 5.03**, Soil Screening.
- **FP 5.04**, Surface Soil Sampling.
- **FP 5.07**, Subsurface Soil Sampling – Direct Push.
- **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other SPIs and FPs may need to be referenced based on the specific requirements of the site-specific sampling plan (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Pre-Field Work Preparation Procedures

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the a site-specific HASP;
- Comply with **SPI 27** (e.g., complete an overhead clearance);

- Coordinate and obtain permission for site access;
- Review project-specific sampling plan;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with PIC and/or PM the proposed sampling plan or sampling strategy; and
- Review the standard instruction manual provided by the manufacturer of the specific field monitoring and sampling equipment being used for the sampling activity.

All significant sampling strategy decisions shall be approved by the PIC and/or PM before the initiation of field activities. The sampling plan should be designed for the collection of quality data that will meet the goals of the study/monitoring program and should include the number of sampling locations, number of samples per location, and depths of samples, and the analyses to be performed on each sample. The sampling plan should generally provide for some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities should be approved by the PIC and/or PM.

Prior to the commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements. Pre- labeling sample containers in advance of field efforts may increase productivity (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody).

4.2 General Stockpile Sampling Guidelines

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required, and the soil type. The procedure outlined in this FP is for stockpile sampling using hand held equipment (refer to the appropriate FP if stockpile samples are collected by other means). The following provides a recommended list of practices for stockpile sampling activities using hand held equipment:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- If the stockpile has not been previously dimensioned, measure its footprint, top footprint, and height using a measuring tape and/or measuring wheel. Use these dimensions to estimate the stockpile volume.
- Prior to collecting stockpile samples, scrape away 3 to 6 inches of surface soil materials.
- In general, stockpile samples will be collected by using a hand held device such as a shovel, trowel, or hand auger.
  - Spade, trowel or shovel sampling:
    - Unless single-use disposable sampling equipment is being utilized, ensure that the steel spade, trowel, or shovel has been decontaminated prior to sample collection (refer to **FP 14.01**, Sampling Equipment Decontamination).
    - Using the cleaned stainless steel spade, trowel, or shovel remove sample from the scraped stockpile surface.

- Hand Auger:
  - Ensure that the hand auger has been decontaminated prior to sample collection (refer to **FP 14.01**, Sampling Equipment Decontamination).
  - Remove rocks, twigs, and other non-soil materials from selected sampling area.
  - Position auger barrel on the scared stockpile surface and turn in a clockwise motion to collect the sample at the target depth.

- Screen and classify material from each sampling location as required by the Work Plan (refer to **FP 5.03**, Soil Screening, and **FP 5.01**, Soil and Rock Classification).
- Place material from each sampling location in a certified-clean sample container and label in accordance with **FP 1.02**, Sample Handling, Shipping, and Chain of Custody.
- Document the sampling location in accordance with **FP 1.04**, Documenting Sampling Locations
- Prepare composite samples in accordance with the homogenization procedures provided in **Section 4.3**.

4.3 Sample Homogenization Procedures

Homogenization refers to the complete mixing of materials to obtain uniform color and consistency throughout the sample prior to analyses. Homogenization is typically performed on discrete samples (e.g., several intervals within a sampling location or several sampling locations within a specific sampling interval) to create composite samples. Compositing may be performed either in the field or the laboratory. Generally, discrete individual samples should not be homogenized in the field. In addition, homogenization should not be performed for samples designated for volatile organic compounds (VOCs) analysis – refer to **Section 5.0**.

A. Place grab samples to be homogenized into a large, decontaminated or dedicated container constructed of inert material (i.e., glass, Teflon, or stainless steel) appropriate for the analyses requested.

B. Prior to homogenization, remove large, unrepresentative materials such as twigs, leaves, stones, wood chips, and debris and document this encountered material in field log.

C. Mix materials as quickly and efficiently as possible using a clean glass, high density polyethylene, or stainless steel spoon until textural, color, and moisture homogeneity are achieved.

D. When mixing large amount of stockpiled materials, mechanical mixers can be used as long as they are made of stainless steel.

4.4 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected stockpile materials should be constructed of materials that will not affect the concentration of constituents in the stockpile material sample. The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the stockpile materials and the

quality assurance needs and study goals. This should be outlined in the project-specific sampling plan or QAPP.

The laboratory will provide appropriate sample containers, however if not provided, pre-cleaned wide-mouth glass jars with Teflon-lined caps are standard for stockpile materials samples. The sample volume is a function of the analytical requirements and will be specified in the sampling plan or QAPP. If possible, jars should be filled to capacity allowing no headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion). Sample Transport and Storage

Samples shall be handled, transported and stored to maintain structural and chemical qualities of sediment samples. Sampling jars shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). All samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration.

4.5 QA/QC

Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific sampling plan and/or QAPP must be followed throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while sediment sampling.

- If the sampling plan requires metals analysis, the sample can be collected from the central portion of the sampling device (i.e., not touching the metal part of the sampler) with a clean glass, high density polyethylene, or stainless steel spoon, and the rest of the sample discarded.
- The homogenization procedure should not be used if samples will be analyzed for VOCs or would otherwise have the potential to be altered in some fashion by homogenization.

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information in accordance with **FP 1.01** (Field Notes and Records) and **FP 1.03** (Data Management).

FIELD PROCEDURE NO. 5.17

ROCK CORE LOGGING
VISTRA PROJECT
PROJECT NO. 1940112376

RAMBOLL

FIELD GUIDANCE DOCUMENT NO. 5.17

ROCK CORE LOGGING

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 5.17 "Rock Core Logging" last revised July 16, 2018.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the field classification and description of rock cores collected during environmental investigations. Rock properties may vary significantly and accurate identification and geologic logging is an essential element of the site characterization process that is needed to define subsurface conditions to facilitate effective geologic, remedial and engineering decision making. A standardized classification and description procedure for rock logging provides for consistency across all phases of field work, as well as across sites as it provides for a clear, accurate, and complete summary of subsurface conditions observed during the implementation of bedrock investigation activities. Consistent rock classification is imperative as it allows the use of logs, created by staff geologists, during the development of accurate conceptual site models to support characterizing the nature and extent of contamination; estimating the engineering properties of the subsurface media; performing hydrogeological modeling; conducting site specific risk evaluations; evaluating the feasibility of remedial alternatives; and/or preparing the design of remedial treatment or control systems.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that this FP does not supersede Ramboll's Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file and are available to all site personnel for the duration of the project.

2. EQUIPMENT / MATERIALS

A general checklist of equipment required for rock core logging is provided below. This checklist includes the equipment and supplies typically required; however, it should not be considered exhaustive. Additional equipment may be specified in the project-specific Work Plan.

- Field book or pertinent field logs/forms and all-weather or permanent pens as outlined in **FP 1.01** - Field Notes and Records.
- Folding tape measure or measuring tape (Metric/English [marked in tenths of a foot]).

- Protractor for measuring dip angle.
- Digital camera.
- Permanent markers.
- Magnifying glass or 10x hand lens.
- Spray bottle with water.
- Watch or clock.
- Leather or other type of protective gloves.
- Geologic pick/hammer.
- Pocket knife or soil knife.
- 10% HCL Acid solution (if testing for the presence of carbonate rocks is necessary or anticipated).
- Munsell Rock Color Chart.
- Core boxes and spacers (blocks to insert for any missing intervals).
- Reference manuals and reports.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **SPI 27**, Subsurface Clearance;
- **FP 1.01**, Field Notes and Records; and
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site-specific work plan/sampling plan (e.g., field screening FPs, FPs for sampling of media, etc.).

4. PROCEDURES

4.1 General Information

There are two fundamental rock-coring methods: drill string, and wireline coring. Because wireline coring is generally faster and less costly than drill string coring, it is the preferred method, and therefore, the most common method employed. Wireline coring techniques use a cable to lower and/or raise the coring tools through the borehole. Tube-type coring tools are the most common wireline coring tools. While tube-type coring tools can be either a single or double-tube design, most rock coring operations associated with groundwater remedial investigation work are completed using double-tube coring tools. Double-tube

coring tools consist of a rotating outer sleeve with a circular diamond coring bit and a swivel-mounted stationary inner sleeve (i.e., core barrel) to collect the rock core.

Tube-type coring provides a continuous vertical section of the formation being drilled. During the coring procedure the outer sleeve simultaneously drills the borehole and cuts the core sample. As the coring tool descends, the core sample is pushed into the stationary inner barrel. The core sample is held in place by a core retaining device (a.k.a. core lifter). When the inner sleeve is full, the coring tool is pulled from the borehole to permit core recovery by wireline methods.

4.2 Planning Considerations

The Work Plan/Sampling Plan will be designed for the collection of quality data that will best meet the goals or objectives of the study/monitoring program and will include the number of samples, locations, depths, number of sampling sites, and analyses to be performed on each sample. The Work Plan/Sampling Plan will generally provide some discretion in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PIC and/or PM.

When planning and implementing a bedrock investigation, the following should be considered:

- When advancing the core through areas of know contamination the borehole shall be double cased and firmly seated or embedded in confining layer and/or bedrock such that the potential cross-contamination is minimized.
- The coring pressure of the drilling rig shall be adjusted to maximize core recovery.
- Coring shall not be conducted with worn or damaged bits and core lifters.
- Only potable water should be used as a drilling fluid. In some instances, the potable water source will need to be subject to chemical analyses. In such cases, the Work Plan/Sampling Plan will define the sampling and testing requirements.
- To prevent possible damage to the core sample, a full core run should not be drilled if it is suspected that a part of a core from a previous run is still in the borehole. The next run shall be shortened by the length of any core still remaining in the borehole.

4.3 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. Further, to the extent that non-dedicated sampling equipment is to be used (e.g., water level indicator), to minimize potential cross-contamination of samples, such sampling equipment should be decontaminated between wells as described in **FP 14.01** (Sampling Equipment Decontamination), project-specific Work Plan/Sampling Plan and/or QAPP. Used dedicated sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01**, Waste Handling, following the sampling event. At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;

- Coordinate and obtain permission for site access;
- Complete a subsurface clearance (refer to SPI-27);
- Review project-specific Work plan/Sampling Plan, where applicable;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with the PIC and/or PM the proposed Work Plan/Sampling Plan or sampling strategy; and
  Prior to the commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements.

4.4 Rock Core Logging

Information regarding all activities related to the classification of rock core samples should be recorded in the Field Notebook or on a Rock Core Log form. In addition to logging the rock cores retrieved, field staff should observe the drilling activities while boreholes are being advanced to gain additional information regarding formation characteristics, such as fractures, voids, weathered zones, changes in lithology, etc., by noting the rate of coring advancement (ft/min), loss of water circulation while coring, and rig reaction (e.g. rig "chatter") during drilling.

The Field Notes or Rock Core Log form should be completed concurrently with classification activities. For accurate description and classification of rock cores, the following key physical properties should be field-determined and recorded:

- Penetration and Recovery.
- Rock Quality Designation (RQD).
- Rock Type including mineralogy, grain size & texture.
- Color.
- Mineralogy/Grain Size.
- Bedding.
- Fractures.
- Fracture Dip Magnitude.
- Size range of core pieces.
- Hardness.
- Weathering.
- Additional observations, including iron staining and observations made of the core drilling.

The following sections outline the process for classifying rock encountered during a bedrock drilling program.

4.4.1 Penetration and Recovery/Percent Recovery

The total length of penetration for each core run and the actual length of core recovered in each run, known as recovery, should be recorded. Units should be defined consistent with those used for recording depth (feet or meters) and the length recorded in the RECOVERY column of the Rock Core Log within the defined core run interval. Lengths should be recorded in tenths of a foot/meter and the recovery should be recorded in percent (the ratio of length of the core recovered to the length of the core run (penetration), multiplied by 100). Areas where loss is likely to have occurred (soft seams, fractures with edges that don't match, zones of decay, etc.) should be noted.

4.4.2 Rock Quality Designation (RQD)

The Rock Quality Designation (RQD) is a modified measure of recovery, calculated in order to estimate the quality of the intact rock mass. The RQD (in percent) is computed by dividing the sum of all the recovered pieces of core equal to or greater than 4-inches (10 cm) in length by the total length of the core run, then multiplying by 100. In effect, the RQD is a measure of the spacing of the discontinuities (bedding, fractures, faults, joints, shear zones, etc.) in the rock mass. When calculating RQD, it is important to try to distinguish between naturally occurring discontinuities and mechanical breaks that occur during coring procedure by noting visual evidence of weathering, staining, water flow, etc. Only naturally occurring discontinuities will be considered when calculating RQD. When there is uncertainty about a break, it should be considered as natural in order to be conservative in the calculation of RQD.

4.4.3 Rock Type

The overall general rock type(s) encountered should be recorded on the log. Geologists divide rocks into three groups based on origin and then subdivide them into smaller groups on the basis of composition and texture.

A. Igneous Rocks:

Igneous rocks are those formed from the solidification of molten material (magma or lava). Igneous rocks can be intrusive (solidifying below the earth's surface from magma) or extrusive (solidifying at the earth's surface from lava).

Intrusive igneous rocks are generally composed or larger crystals/grains (coarser texture) while extrusive igneous rocks are generally composed of smaller crystals/grains (finer texture).

In general, individual igneous rocks tend to have an interlocking, crystalline texture with little to no appearance of layering, banding or bedding.

B. Metamorphic Rocks:

Metamorphic rocks are Igneous and/or Sedimentary rocks whose textures and/or mineral content have been changed by heat, pressure and/or chemically active solutions (invading gasses and/or liquids). In some instances, metamorphic rocks have been re-metamorphosed into other higher and lower grade metamorphic rocks.

Metamorphic rocks can appear either as crystalline in texture or banded or layered, also known as foliated, due to the alignment of platy, tabular, or elongated mineral grains or the concentration of different minerals into distinct bands.

C. Sedimentary Rocks:

Sedimentary rocks are formed by lithification of accumulated sediments that were transported and deposited by water, wind, ice, biological activity and/or chemical precipitation (in the case of carbonates [i.e. limestone/dolostone] and evaporates [i.e. salt and gypsum]). In general, sedimentary rocks are composed of the weathering products of pre-existing rocks.

Sedimentary rocks usually, but not always, have a layered appearance due to the presence of bedding planes. The grains of sedimentary rocks can range from sharply angular to well-rounded and from very fine to very coarse. Sedimentary rocks may contain fossils.

4.4.4 Color

The basic color of the bedrock core should be observed when the core is wet, so a water spray bottle should be available during core logging. Different colors, such as brown, red, yellow, gray or black, should be described on the log. If necessary, the color should be modified by using adjectives such as light, dark, mottled, or mixed. As an alternate, Munsell Rock Color Chart designations may be used. Variations in color, if considered important, should be noted.

Note that sunglasses should not be worn when describing soil colors.

4.4.5 Mineralogy, Grain Size & Texture

Provide a description and percentages of the major minerals composing the rock, if possible. If visible, the size of the individual grains/crystals and the texture of the rock (very fine to coarse) should be noted. The grain size and shape should be described where possible.

4.4.6 Bedding

Table 1 lists the categories of bedding used in describing sedimentary rock. For igneous and metamorphic rocks, any observable planar features (foliation, banding, etc.) should be recorded using the same thickness designations as sedimentary bedding. Additionally, contacts between different rock types should be noted.

Table 1: Sedimentary Rock Bedding

Bedding	Description
Very Thick-Bedded	Greater than 4 feet (>121 cm)
Thick-Bedded	12 inches to 4 feet (30 cm to 121 cm)
Medium-Bedded	4 inches to 12 inches (10 cm to 30 cm)

Table 1: Sedimentary Rock Bedding	
Bedding	**Description**
Thin-Bedded	1.2 inches to 4 inches (3 cm to 10 cm)
Very Thin-Bedded	0.5 inches to 1.2 inches (1.2 cm to 3 cm)
Thickly Laminated	0.1 inches to 0.5 inches (0.3 cm to 1.2 cm)
Thinly Laminated	Less than 0.1 inches (<0.3 cm)
None	

4.4.7 Fracturing

The spacing, orientation, filling, and degree of healing of the fractures is important in determining the properties of the rock mass, as well as potential hydraulic properties of the formation. **Tables 2** and **3** lists the fracture density and fracture healing categories:

Table 2: Fracture Density	
Degree of Fracturing	**Description**
Unfractured	No observed fractures.
Very slightly fractured	Core recovered in lengths greater than 3 feet (1 m).
Slightly to very fractured	Core recovered in lengths from 1 to 3 feet (300 to 1000 mm).
Slightly fractured	Core recovered mostly in lengths from 1 to 3 feet (300 to 1000 mm) with few scattered lengths less than 1 foot (300 mm) or greater than 3 feet (1000 mm).
Moderately to slightly fractured	Core recovered mostly in lengths averaging 1 foot (300 mm).
Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 foot (4 to 12 inches, 100 to 300 mm) with most lengths about 0.5 foot (6 inches, 150 mm).
Intensely to moderately fractured	Core recovered mostly in lengths from 0.1 to 0.67 foot (1 to 8 inches, 100 to 300 mm) with most lengths about 0.5 foot (6 inches, 150 mm).
Intensely fractured	Core recovered mostly in lengths from 0.1 to 0.33 foot (1 to 4 inches, 30 to 100 mm) with most lengths less than 0.33 foot (4 inches, 100 mm) and with fragmented intervals.
Very intensely fractured to intensely fractured	Core recovered as short core lengths averaging less than 0.1 foot (1 inch, 30 mm).
Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Table 3: Fracture Healing

Degree of Healing	Description
Totally Healed	Fracture is completely healed or re-cemented to a degree at least as hard as surrounding rock.
Moderately Healed	Greater than 50% of fracture material, fracture surfaces or filling is healed or re-cemented and/or strength of the healing agent is less hard than surrounding rock.
Partly Healed	Less than 50% fracture material, filling or fracture surface is healed or re-cemented.
Not Healed	Fracture surface(s), fracture zone, or filling is not healed or re-cemented.

4.4.8 Fracture Dip Magnitude

The magnitude of the dip of the discontinuity (fracture or other break or notable feature of the intact core such as bedding) should be described using the USBR (2001) standard, as indicated below in **Figure 1**.

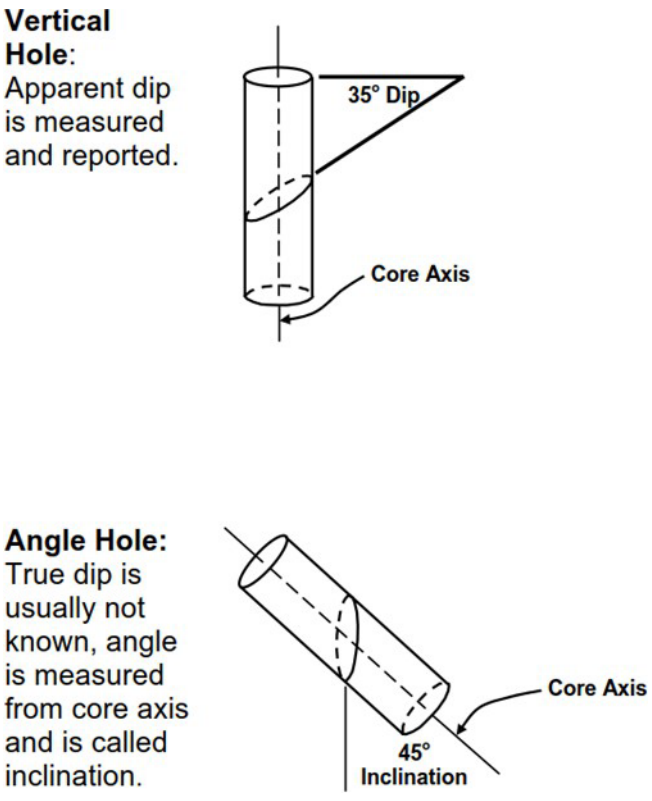


Figure 1: Measurement of Dip Magnitude

4.4.9 Size Range of Core Pieces

Measure and record the length of all core pieces (in feet or meters) in each run and the range of size of the core pieces recovered. The size may range from fragments too small to measure, up to a single piece of rock the entire length of the run. Also note the locations of significant fragmented zones observed in the core or during drilling.

4.4.10 Hardness

Table 4 lists the rock hardness categories that should be recorded in the field notes:

Table 4: Rock Hardness

Description	Long Description
Very soft rock	Can be scratched with fingernail. Slight indentation produced by light blow of point of geologic pick. Requires power tools for excavation.
Soft rock	Hand-held size specimen crumbles under firm blows with point of geologic pick/hammer. Do not test this while actually holding the specimen in your hand.
Moderately soft rock	Shallow indentation (1 to 3 mm) can be made by firm blows with point of geologic pick/hammer. Can be peeled with pocket knife with difficulty.
Moderately hard rock	Cannot be peeled or scraped with knife. Can be distinctly scratched with a steel nail.
Hard rock	Intact hand-held size specimen requires more than one hammer blow to break it. Do not test this while actually holding the specimen in your hand. Can be faintly scratched by steel nail.
Very hard rock	Cannot be scratched with a steel nail. Intact specimen breaks only by repeated, heavy blows, with geologic hammer.
Extremely hard rock	Intact specimen can only be chipped, not broken, by repeated, heavy blows of a geologic hammer.

4.4.11 Weathering

The degree of rock weathering should be noted in the field book. **Table 5** lists the weathering categories:

Table 5: Weathering Categories

Degree of Weathering	Detailed Description
Residual soil	Advanced state of decomposition resulting in plastic soils. Rock fabric structure completely destroyed. Large decrease in volume compared to parent rock.
Completely weathered	Minerals decomposed to soil but fabric and structure preserved (saprolite). Specimens easily crumbled or penetrated.

Table 5: Weathering Categories

Degree of Weathering	Detailed Description
Highly weathered	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.
Moderately weathered	Discoloration throughout. Strength somewhat less than fresh rock but cores cannot be broken by hand or scraped with knife. Texture observed.
Slightly weathered	Slight discoloration inwards from open fractures.
Fresh	No visible sign of decomposition or discoloration. Rings under hammer impact.

4.4.12 Additional Observations

Additional observations that may be necessary to accurately describe the core should also be recorded on the Corehole Log or in the field book. These observations should include zones where the core is very broken, where grinding of the core is apparent, cementation and/or friability, zones of mineralization indicating the minerals present, intervals where core has been taken for laboratory testing, etc.

In addition, iron staining, odors/discoloration, PID readings or other features related to potential impacts from contamination should be noted on the Corehole Log or in the field book (e.g., prussian blue at an MGP site or solvent-like or petroleum odors).

5. PRECAUTIONS

Accurate rock core classification requires the collection of sufficiently detailed information throughout the logging process. Certain precautions should be taken while recording the required information. Always wear adequate protective gloves (leather or similar) and eye protection when testing the physical characteristics of rock specimens to prevent injury.

6. RECORDKEEPING

In the process of classification, the actual rock cores pieces should be re-assembled into a coherent core and placed in wooden core boxes constructed with partitions designed to hold core samples. The cores should be stored in stratigraphic order and labelled with a permanent marker in such a way that indicates stratigraphically up direction. Wooden blocks should be placed in the storage boxes between each core run sample. The blocks shall be marked with appropriate depths and run number. Use two blocks to mark segments of no recovery and label with the depth interval that they represent. Each box should be labelled with the facility name and location, boring identification number, depth box number and RQD. In addition, photographs of all core runs should be collected for electronic documentation.

This FP specifically pertains to recordkeeping during rock coring. All information should be recorded in accordance with **FP 1.01** (Field Notes and Records).In general, draft field forms should be scanned and saved electronically immediately following the completion of the rock core sampling activities.

Following review of draft documents by the PIC and/or PM, field forms should be finalized and final versions may be included in project reports, if necessary. Draft and final versions of the field form should be managed in accordance with Ramboll's Document Retention Policy and project-specific requirements, and copies should be maintained in the project file.

FIELD PROCEDURE NO. 6.01

PERMANENT OVERBURDEN WELL INSTALLATION
VISTRA PROJECT
PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 6.01

PERMANENT OVERBURDEN WELL INSTALLATION

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 6.01 "Permanent Overburden Well Installation" last revised July 8, 2016.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for installation of permanent wells for environmental purposes in unconsolidated overburden materials using standard drilling techniques. Well installation using direct-push technologies (e.g., Geoprobe®) are discussed in **FP 6.06** – Direct Push Overburden Well Installation and Sampling. Permanent overburden wells are a part of many environmental and hydrogeologic applications including groundwater wells, and wells for remedial purposes, including injections, soil vapor extraction, air sparging, and other applications.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that this FP does not supersede Ramboll Environ Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll Environ employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

Well construction materials shall consist of new, factory-sealed, commercially available well screen and casing. Where materials to be used in well construction are not factory-sealed, their use and cleaning requirements must be previously approved by the PIC and PM prior to installation. Well screens and casing will typically be constructed of polyvinyl chloride (PVC), but may also be constructed of stainless steel or polytetrafluoroethylene (PTFE or Teflon®), or other suitable materials, depending on subsurface conditions, expected contaminants and concentrations, or other site-specific factors. Regardless of material of construction, casing and screen should be generally consistent with applicable standards for use in groundwater monitoring wells (e.g., ASTM F480 *Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios [SDR], SCH 40 and SCH 80* and NSF International/ANSI Standard Number 14: *Plastics Piping System Components and Related*

Materials). Evidence of compliance shall be included in the current NSF listing and display of the NSF seal and markings in accordance with the requirements of ASTM Standard F480 on each section of casing. Plastic well casing must be rated by standard dimension ratio (SDR-rated) and conform to the minimum requirements of ASTM F480.

A general checklist of equipment that may be required for typical installation of groundwater wells is provided below. This checklist includes an overall summary of general equipment typically required for well installation efforts and should not be considered exhaustive. The drilling contractor will generally supply the equipment and materials necessary for drilling and installing the well, and field staff should confirm ahead of time that the driller will supply such materials. Additional equipment may be specified in the project-specific HASP. Ramboll oversight personnel should understand the equipment and materials that are required for the driller to complete the scope of work.

1. General Well Installation Equipment Checklist:
   - Drilling rig and associated equipment (supplied by drilling contractor);
   - Well construction materials (supplied by drilling contractor);
   - Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during well installation (refer to **FP 15.01**, Waste Handling);
   - 55-gallon steel drums, Department of Transportation-rated (for legal waste hauling), or other appropriate waste containers (may be supplied by drilling contractor unless specialized containers are required) - for disposal of Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling);
   - Personal Protective Equipment (PPE) and field screening equipment in accordance with the site-specific HASP;
   - Site information (e.g., maps, contact numbers, previous field logs);
   - Well construction specifications and diagrams;
   - Field notebook and test boring and well construction field log forms (if required) and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records);
   - Weighted, calibrated measuring tape or line for depth measurements during well construction (typically provided by driller);
   - Tremie pipe (typically provided by driller);
   - Measuring tape;
   - Electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements); and
   - Labeling materials for Investigation Derived Waste (IDW) containers as outlined in **FP 15.01** (Waste Handling).

2. Additional Suggested Equipment:
   - Extra vehicle keys.
   - Credit card for gas and emergencies.

- Road and site maps.
- Camera and extra batteries.
- If boreholes are to be logged, soils classification guidance chart as outlined on **FP 5.01** (Soil and Rock Classification).
- If boreholes are to be logged, color chart as outlined on **FP 5.01** (Soil Classification).
- If samples are to be collected, sample containers (appropriate for various analysis to be performed), cooler(s), labels, and COCs

3. PROCEDURES REFERENCED

The following Standard Practice Instruction (SPIs) and FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **SPI 27**, Subsurface Clearance.
- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sampling Handling, Shipping and Chain of Custody**.**
- **FP 1.04**, Documenting Sampling Locations.
- **FP 1.05**, Field Quality Control Samples.
- **FP 1.06**, Field Surveying and Monitoring Well Installation.
- **FP 5.01**, Soil Classification.
- **FP 5.09**, Field Soil Boring Log Preparation.
- **FP 6.04**, Groundwater and Free Product Level Measurements.
- **FP 6.07**, Well Development.
- **FP 6.15**, Well Construction Record.
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site-specific work plans/sampling plan (e.g., field screening FPs, FPs for sampling of media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

Wells are designed to (a) enable measurement of the potentiometric surface; (b) allow sampling of a specific water-bearing zone; (c) measure or otherwise evaluate the hydraulic and/or physical properties of the water-bearing zone; and/or (d) assist with the remediation of subsurface media. Specific well design and installation procedures depend on state-specific or regulatory program-specific requirements or guidelines, project-specific

objectives, site access constraints, and/or subsurface conditions. Field personnel should understand the reasoning behind the selected screen length, which will help to inform potential field modifications.

During the planning of a well installation, the following should be determined:

- *Anticipated Depth to Water and Subsurface Geology/Overburden Stratigraphy*.
- *Borehole Drilling Method*.
- *Borehole Diameter and Well Diameter.* In general, the borehole diameter is three (3) to five (5) inches greater than the outside diameter of the well screen or well riser pipe. This requirement ensures that sufficient annular space is available to install the filter pack and grout seal around the well screen and well riser, respectively. Other borehole requirements may apply depending on state-specific or regulatory program-specific guidelines or requirements, the type of drilling to be performed (e.g., direct-push Geoprobe®) and the subsurface conditions to be encountered.
- *Well Depth*.
- *Sampling and Logging of Boreholes Requirements.* Refer to soil sampling (**FP 5.08**: Subsurface Soil Sampling – Split Spoon and Shelby Tube) and borehole logging FPs (e.g., **FP 5.01**: Soil Classification and **FP 5.09**: Field Soil Boring Log Preparation).
- *Well Construction Materials.* As described above, well casings and screens shall be constructed of non-corrosive and non-reactive material for the chemicals to be encountered.
- *Filter Pack Thickness, Gradation, and Composition.* Ideally, the well screen and filter pack should be designed based on the results of a sieve analysis conducted on samples collected from the aquifer or the formation that will be monitored. However, for formations consisting primarily of fine grained materials, commercial filter pack designed for a specific screen size could be used (refer to Table 1 below). If you do not have pre-existing knowledge of soil grain size at your site, consider conferring with a local driller to determine an appropriate filter pack size.

Table 1. Commercial Filter Pack

Screen Opening (in)	Typical U.S. Standard Sieve Size for Filter Pack	1% Passing Size (in)	10% Passing Size (in)	30% Passing Size (in)	60% Passing Size (in)	Uniformity Coefficient
0.005 to 0.006	No. 100	0.0035 to 0.0047	0.0055 to 0.0067	0.0067 to 0.0083	0.0085 to 0.0134	1.3 to 2.0
0.010	20 to 40	0.0098 to 0.0138	0.0157 to 0.0197	0.0197 to 0.0236	0.0200 to 0.0315	1.1 to 1.6

Notes:

Source: USEPA, 2013

The filter pack should be the only material in contact with the well screen as it limits subsurface materials from penetrating through the filter pack, and prevents the sand or filter pack from entering the well. It should consist of chemically inert, clean, well-sorted, well-rounded, and dimensionally stable, silica (quartz) sand of which the 80 to 90 percent retained size is greater than the screen aperture. The filter pack material should arrive bagged and labeled. The filter pack material shall be free of clay, dust, and organic material; and shall not consist of any other material that will adversely affect the performance of the well.

- *Transition Sand Layer and Thickness.* If necessary, the transition sand layer consists of a smaller grain size than the filter pack, and it is placed on top of the filter pack to protect against grout intrusion, particularly for deep well installations (greater than 200 feet deep). The thickness of the transition sand can vary from one or two feet to as thick as 10 to 20 feet and can increase the effective aquifer interval sampled by the well. An alternative to transition sands is to use a longer interval of annular seal material such as bentonite pellets.
- *Screen Length and Interval to be Screened*. The well assembly should be designed so that the well screen is placed within the formation target zone. The specific screen length and interval within the zone to be monitored will be selected based on project objectives and regulatory requirements or guidance, and may vary depending on project requirements. For water table wells, well screens should be placed such that a sufficient length of the screened interval is above the water table (typically 2 to 3 feet) throughout seasonal water table fluctuations, and the remainder of the screen is below the water table (typically 7 to 8 feet). Therefore, the total screen length will be dependent on the magnitude of the seasonal water table fluctuations.
- *Screen Slot Type and Size.* Screen slot type and size will be dependent on the gradation of the formation in which the screen will be constructed.
- *Location, Thickness, and Composition of Divider Seal to be Placed Directly Above the Filter Pack.* A divider seal will be placed immediately above the filter pack to separate the filter pack from the grout seal. Divider seal material shall be chemically compatible with anticipated contaminants. Chemically inert, hydrated bentonite chips or pellets are typically used as a divider seal.
- *Thickness and Composition of Annular Seal.* The typical cement-bentonite grout mixture consists of one sack (94 pounds) of Portland Type I/II cement, approximately 2 to 5 percent by weight powdered bentonite, and approximately 6 to 8.5 gallons of water. Additives to accelerate curing times are sometimes added (e.g., calcium chloride).
- *Well Completion and Protection Requirements.* Depending on the location, wells may be completed at the surface with a flush-mounted or stick-up (i.e., extend above the ground surface) protective cover. Local ordinances, well installation codes, and project requirements will often dictate the type of surface completion. Wells located in landscaped areas or asphalt or concrete covered surfaces, especially in areas of vehicular traffic, will typically be finished at the surface with a flush-mounted surface completion. Wells located in unpaved areas, especially in areas where there is little or no vehicular traffic, will typically be finished at the surface with a stick-up surface completion.

It should be noted that the specific well construction details, particularly the screen intervals and depth of each well, may need to be field-determined after consultation with the PIC and PM, and where applicable, a State-licensed Professional Geologist (PG) or Professional Engineer (PE). In addition, where applicable, ASTM D5092 *Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers* or other applicable regulations or guidance documents should be referenced. Factors that should be considered in finalizing the well screen interval include boring lithology, distribution of contaminants (if known), and/or subsurface conditions encountered during drilling. For wells to be completed in a contaminated aquifer above a confining layer, particular care must be taken to avoid penetrating the confining layer during drilling and creating a potential pathway for vertical cross-contamination. If this situation should occur due to unexpected field conditions or any other reason, contact the PIC or PM immediately to determine how best to seal the confining layer interval or entire borehole before proceeding with additional field activities.

4.2 Pre-Field Work Preparation Guidelines

Some states require that only drilling contractors licensed as a water or environmental well driller in the State where the work is being performed should perform well installations. Prior to mobilization, Ramboll or the licensed driller shall procure the required groundwater well permits from the appropriate agency, as necessary. Copies of such permits shall be maintained in the project file for the duration of the project. In addition, depending on the proposed well location(s), other types of permits (encroachment, excavation, and wetlands), or property access agreements may be required.

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Coordinate and obtain permission for site access and visit the site to identify any access constraints that could affect drilling;
- Complete subcontracts with drillers, utility locators, surveyors, etc.;
- Complete a subsurface clearance checklist (refer to **SPI-27**) - note, this typically requires 2 to 3 business days' notice for completion of public subsurface utility mark-outs;
- Review project-specific work plan/sampling plan, where applicable;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable; and
- Review and discuss with the PIC and/or PM the proposed work plan/sampling plan and sampling objectives.

4.3 General Description of Drilling Methods

Groundwater well installation requires the drilling of a borehole in which to set the well. Boreholes can be advanced using a variety of drilling techniques, but each has limitations and is generally best suited for specific applications. Selection of the drilling method employed for well installation will depend on the physical nature of the subsurface materials

at the site (e.g., unconsolidated materials or consolidated materials, subsurface lithology), the depth to groundwater and depth of the well, as well as the nature of the drilling site in general (e.g., access constraints). The following is a general description of three common drilling methods for installation of wells in unconsolidated formations and a description of some limitations for each method.

- *Hollow Stem Augers*. Drilling using hollow-stem augers (HSA) relies on continuous auger flights with a cutting head at the lowermost end. The augers are rotated and advanced downward by the drill rig, which results in the soil cuttings being carried up to the surface by the auger flights. The augers act as a temporary casing for the borehole, preventing borehole wall material from collapsing into the open borehole. Small diameter drill rods with samplers (e.g., split spoons or Shelby tubes) can be used for sampling of soils below the continuous flight of augers (refer to **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube). HSA drilling is typically used in unconsolidated materials, but could be used to drill into the top of weathered bedrock. While HSA boreholes can be advanced to depths of 150 feet or greater in certain soils, the diameter of the borehole and hydrogeologic/geologic conditions will ultimately determine drilling depths.
- *Sonic Drilling.* Sonic drilling relies on a combination of rotation, vibration and pushing to advance concentric hollow drill stems by significantly reducing the friction between the sampling equipment and the surrounding soils. The drill head includes the mechanism necessary for rotary motion as well as a high frequency oscillator. Typically, an inner core barrel is initially advanced and a casing is then installed over the core barrel to protect the integrity of the borehole during sample retrieval. During drilling, the drill bit is vibrating up and down, as well being rotated and pushed. The vibration causes soil particles immediately around the drilling assembly to lose its structure, making soils in the unsaturated fluidize and soils in the saturated zone to behave like a slurry. In bedrock, the drill bit causes fractures at the rock face. Sonic drilling can be effectively used in unconsolidated soils, poorly consolidated materials (e.g., running sands, areas of coarse materials that may bind augers) and consolidated rock. Sonic drilling can typically be used to advance borehole diameters as large as 12 inches to depths of 250 feet. In comparison with other drilling methods, sonic drilling generates minimal soil cuttings and can reduce smearing of formation materials on the borehole walls. Since sonic drilling requires continuous recovery of cores, its main limitation is the lower production with increased sample depth, as each core must be retrieved before a subsequent interval is sampled.
- *Air Rotary Drilling*. Air rotary drilling relies on air pressure to remove soil cuttings. Drilling is accomplished by a roller-cone bit or down-hole percussion hammer, with pressurized air delivered to the roller-cone bit or down-hole percussion hammer through the drill pipe. Cuttings are mobilized by the air circulation and returned to the surface typically through dual-wall well casing. Cuttings are channeled at the surface through a diverter to a cyclone, where the cuttings are able to drop into drums or a roll-off type waste container. Pressurized air helps cool down the drill bit. Air rotary drilling is generally recommended for consolidated rock because of borehole wall stability issues or

  for strata where boulders or large obstructions are anticipated. Where unconsolidated materials overlie a consolidated formation, surface casings through the unconsolidated materials are typically employed to avoid short-circuiting of the air flow. When using air rotary drilling, precautions should be exercised to minimize and control the release of solid particles by the air drilling action and/or the air stream volatilizing or dispersing

contaminants at the surface. To minimize dust generation, a fine water mist may be introduced at the cyclone. Alternately, a shroud is placed over the borehole and sometimes water is added when drilling above the water table to limit the generation of dust.

- *Mud Rotary Drilling*. Mud rotary drilling relies on a formulated mud slurry (e.g., bentonite) as a drilling fluid to lubricate the drill bit, stabilize the borehole wall, remove soil cuttings, and prevent or limit flow of groundwater or sand into the borehole. As the drill is rotated and advanced downward, drilling mud is pumped through the cutting head to the base of the borehole. As fresh mud is pumped, mud within the borehole circulates back to the surface through the annular space between the borehole and drilling rods, where it may move through some combination of a baffled tank, across a screened shaker table, or pit to allow cuttings to settle and cuttings-reduced mud to be re-circulated. The outflow of this pit feeds a suction pit, where the drilling fluid can be mixed with fresh mud, as necessary, and reintroduced to the borehole. Formation logging during mud rotary drilling is accomplished by monitoring rig chatter, observing sediment output at the shaker table, and/or by frequent sieving of the mud return. While a split spoon or Shelby tube could be used for sampling of soils using this method, the recirculation of mud must be halted and the drill string tripped out and retooled for the sampler to collect the samples (refer to **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube). Mud rotary drilling is suitable for poorly consolidated material where running sands or areas of coarse materials that may bind augers are encountered, or where very deep boreholes are required. It should be noted that the mud circulated during mud rotary drilling could adversely affect the hydraulic properties of the filter pack, the quality of water samples, and hydrogeologic properties of the formation in the vicinity of the well. To mitigate these potential adverse effects, a dispersing agent may be used and/or more intense well development efforts are typically required.

4.4 Well Installation Procedures

The following provides a recommended list of practices for well installation following completion of the borehole:

- Prior to initiating well construction, the driller and/or Ramboll 's oversight personnel should measure the depth to the bottom of the borehole to ensure the target depth has been met. The depth to water should be estimated from recovered soil samples, drilling conditions, and/or measured and recorded in accordance with the project-specific Work Plan and/or sampling plan, which may require waiting for water levels to equilibrate over time (refer to **FP 6.04**, Groundwater and Free Product Level Measurements).
- If it is necessary to backfill the borehole to the appropriate well installation depth, or to repair a breached aquitard/confining layer, Ramboll oversight personnel should consult with the PM or PIC to define procedures to be followed. Generally, the driller

may use bentonite pellets, or bentonite chips. Filter pack sand could be used if there is no concern for a breached aquitard/confining layer.

- Selection of the backfill material will depend on site conditions, lithology, and project-specific requirements.
- If the bottom of the borehole requires complete sealing of the underlying layers, bentonite chips, or bentonite pellets are typically used. Using neat cement or bentonite grout may impose difficulties in controlling the placement to discrete depths.
  - The vertical interval and volume of backfill should be calculated based on depth measurements and recorded.
  - When bentonite pellets or chips are used as backfill, the materials should be installed carefully and slowly into the borehole to minimize the risk of pellets/chips sticking to the side of the borehole and causing bridging when installed through the water column.
  - If backfilling the borehole is required, the total borehole depth should be measured frequently when adding backfill materials to the bottom of the borehole to minimize the potential for overfilling. Also, note that bentonite products can swell significantly during hydration potentially resulting in an over-fill condition.
  - If a borehole has been overfilled, it may require reaming of the base of the borehole to remove the overfilled material, or re-drilling of the borehole. Ramboll oversight personnel should consult with the PM or PIC to define procedures to be followed.
- The curing time may be defined by state-specific or regulatory program-specific guidelines or requirements. Typically, the curing time is approximately of 24 to 48 hours for neat cement, overnight for bentonite grout, and 1 hour for properly hydrated bentonite pellets, unless approved additives are mixed into the grout to accelerate the curing time. Well construction should not be initiated before the backfill has been allowed to cure.
- The driller and/or Ramboll 's oversight personnel should re-measure and verify that the bottom of the borehole is at the target depth where the well should be set before proceeding with well construction. If it is not, the process described above should be repeated.

- To minimize errors and provide for clear communication of final well construction design based on site conditions encountered at the well site, Ramboll recommends preparation of a one-page hand-drawn field diagram depicting final well construction design including target depths for well screen, centralizers, filter pack, seals, and grout; the diagram also can show important strata such as aquitards, water-bearing zones, or confining layers. A copy of the diagram can be provided to the driller, and a photograph of the diagram should be emailed to the PM or PIC for review and approval prior to well construction.
- Upon completion of the well borehole, the boring should be measured to verify the total depth, and the well casing assembled and lowered into the borehole. If using HSA

drilling for well installation, the well casing is lowered through the open center of the augers.

- Prior to lowering into the borehole, the length of well casing materials, screen, and end cap should be measured to the nearest 0.1 foot.
- Casing and screen materials must be clean, free of rust, grease, oil, or contaminants and be composed of materials that will not affect the quality of the water sample.
- The well casing shall be watertight and well screens shall be permanently joined to the well casing.
  - Casing and screens shall be connected by flush-threaded or coupled joints and shall be completed with a bottom cap.
  - When using plastic casing and screen, the materials shall be constructed using flush threaded joints equipped with suitable O-rings.
  - Solvent, glue, or anti-seize compounds shall not be used to fasten the well casing joints, well screen joints, or end caps.
  - A collection sump may be installed below the screen. Its length will vary depending on lithology and project needs. The collection sump and bottom cap shall be connected to the well screen by flush threaded equipped with suitable O-rings.
- The casing shall be centered in the borehole, be free of any obstructions, and allow sampling devices to be lowered into the well.

- Throughout the well installation process, the driller should make provisions to support the screen and riser pipe to prevent them from sinking into the backfill and/or ensuring that the well casing is installed plumb and straight. The well casing may be hung by a wireline in the borehole prior to filter pack placement so that the well can be situated at the desired depth interval and ensure that the well is sufficiently plumbed and straight after completion. For deep wells (greater than approximately 100 feet below grade), centralizers should be used to stabilize the casing and keep the well plumb and straight in the borehole. The number of centralizers should be minimized to facilitate measurement of the top of backfill layers. Extra care should be taken during installation of filter pack and divider seal materials to avoid bridging around wells equipped with centralizers.
- The screen should not be set immediately over the formation soils (i.e., borehole bottom) or top of backfill; rather, up to six (6) inches of fine sand shall be used as a buffer unless this distance would result in a breach of a confining layer, or the well screen requires setting directly on the impermeable zone due to site requirements.
- Once the well has been situated at the desired depth, filter pack sand should be emplaced in a calculated quantity sufficient to fill the annular space from the bottom of the boring to the design level, two to three feet above the top of the well screen. Prior to placing filter pack materials around the well, the top of the well casing should be covered using a well cap or other means to prevent material from entering the well.
  - The filter pack material may be placed in the well by pouring the sand into the open annulus, or placed as a slurry using a tremie pipe.

  - The filter pack material should be added carefully with continuous depth to filter pack measurements by the driller and/or Ramboll oversight personnel to prevent bridging of the filter pack material.
  - If building the well inside a casing or HSA, as the filter pack material is added, the driller should gradually withdraw the HSA, allowing the sand to settle into the annular space of the borehole. As the augers are withdrawn, filter pack material should always be present within the lower portion of the bottom auger, such that the borehole annular space is filled concurrently with the withdrawal of the augers. This will prevent formation collapse into the annular space. Nonetheless, the driller should be careful not to allow the level of filter pack material to rise too high within the augers, as this may cause bridging or binding of the filter pack material and well casing within the augers. The well level should be carefully monitored with the removal of each length/section of HSA. If the well pulls up as augers are removed, contact the PM or PIC to determine whether the filter pack material should be removed and the well re-set.
  - After the filter pack has been added, and before the seal is placed in the annular space, the driller may gently surge the well with a surge block or submersible development pump to compact or help settle the filter pack. A surge block consists of a plunger made of PVC or rubber attached to a heavy rod or pipe and connected to a cable of sufficient length to reach the bottom of the screen. The top of the filter pack will need to be measured after surging and additional filter pack material may need to be added if settling has occurred. The amount of time spent surging the filter pack will be proportional to the length of saturated screen and continued at the discretion of field staff; however, surging should continue if the filter pack continues to drop. When required for a specific well installation (e.g., well depths greater than 200 feet), the driller may then place a layer of fine grained transition sand above the filter pack.

- Following installation of the filter pack, the annular space surrounding a well above the filter pack must be sealed a minimum of two feet above the filter pack to mitigate the migration of fluids into the well from the ground surface and from other water-bearing zones. This is most typically accomplished by adding bentonite; if chips or pellets are used, the material must be hydrated prior to grouting the remaining annular space. Only potable water should be used to hydrate the bentonite. Ideally, if the divider seal can be set adjacent to a low-permeability stratum (e.g. clay), this will minimize the likelihood that grout or water from higher groundwater zones, can impact the target screen interval. Divider seals emplaced entirely in coarse gravels are unlikely to prevent grout from flowing around the seal and compromising the well.
- After placement of the divider seal the remaining annular space must be filled (i.e., grouted) from the divider seal to within two feet of the ground surface to further mitigate the migration of fluids into the well from the surface and from other water-bearing zones. If pre-approved by the PM or PIC, it may be appropriate to use un-impacted native materials from the borehole as backfill above the divider seal in the unsaturated zone.
  - Only potable water shall be used to prepare the grout.

  - Cement or cement-bentonite grout is typically placed using a tremie pipe so that the grout fills the annular space from the bottom to the surface without allowing air- or water-filled pockets to form.
  - Extreme care should be exercised when using tremie pipe to pump in grout, especially in deeper wells, where hydraulic jetting can quickly penetrate the bentonite seal.
  - No work (e.g., development, water level measurement, sampling) shall be done on the well until after the grout has set overnight to 48 hours, unless otherwise required by state-specific or regulatory program-specific guidelines or requirements.
  - Alternatively, bentonite chips may be used to fill the annular space for shallow wells.
- During and after completion of the annular seal, a water-tight locking cap shall be placed at the open end of the well casing during installation of the well's protective casing.
- The well's protective casing shall then be installed by the driller.
  - For above-ground well completions (i.e., stick-ups), the well casing will typically extend two to three feet above the ground surface and a steel protective casing with a vented lockable cap will be installed. At some sites, the steel casing may be painted to conform to client or project well identification protocol. Any such painting should be done prior to installation and sufficient time should be allowed for paint to dry.
    - The driller will set the steel protective casing at least two feet below grade set in a typically four to six inch deep concrete pad (typically two foot square), poured over the cured annular fill. In geographic areas where heaving may occur due to freezing and thawing of the ground, the concrete pad should extend 18 inches below ground surface. In some instances, the protective casing can be set into the annular grout seal and capped with a concrete surface seal. The concrete pad constructed around the well casing and protective steel casing will serve as a surface seal; thus, it should be sloped slightly away from the well to prevent surface water from accumulating on the pad. The top of the concrete pad is typically constructed so it is approximately four inches off the ground.
    - After the protective steel casing and concrete pad are in place, the annular space between the well casing and the protective steel casing is typically filled with an inert material such as cement or grout up to the height of the pad; and filled to approximately 6 inches below the top of casing with pea gravel or coarse sand.
    - A "weep" hole may be drilled on the side of the protective steel pipe one to two inches above the cement pad, particularly in areas where freezing may occur, in order to prevent water from freezing within the protective pipe and potentially damaging the well casing. Often a small tube or pipe is inserted into the weep hole to direct water flow away from the concrete pad.
    - Bollards (i.e., protective posts) should be installed in areas where the well has the potential to be struck by vehicles or heavy equipment.
    - Upon installation of the protective casing, a "V" notch or other permanent physical mark should be made at the north edge of the top of the well casing. The permanent physical mark or notch should not interfere with the functionality

of the expanding cap. This permanent mark will be used as the reference point for well elevation surveying and water level monitoring.

- The well name/identifier should be marked by scoring it into the concrete well pad (before the concrete sets), by using stencils and spray paint on the outside of the protective casing, by attaching an inscribed metal identification plate onto the protective casing, and/or imprinting onto the cap of the protective casing.

– For at-grade well completions (i.e., flush mounts), the well casing will terminate at or just below the ground surface and will be completed with a traffic-rated, gasketed (sealed), well box/vault or bolt-down manhole that is cemented into place around the well head.

  - The driller will set the well box/vault within a one- to two-foot deep concrete pad (typically one foot square), or manhole within a four- to six-inch deep concrete pad (typically two feet square) poured over the cured annular fill. In geographic areas where heaving may occur due to freezing and thawing of the ground, the concrete pad should extend 18 inches below ground surface. The concrete pad constructed around the well casing and well box/vault or manhole will serve as a surface seal; thus, it should be constructed just above the surrounding grade in order to provide positive drainage away from, and prevent ponding of water around the well. In traffic areas and sidewalks, extra care should be taken when setting the well box above the surrounding grade which should be minimized to prevent physical hazards (e.g., tripping) and to prevent snow plows from damaging the well.

  - After the well box/vault or manhole and concrete pad are in place, the annular space between the well casing and the well box should be filled with an inert sealing material such as cement. However, the well casing should extend approximately 3 inches above the sealant within the well box/vault or manhole while also leaving enough space for the locking well cap.

During the well installation process, all well construction details should be completely documented in the project field book or approved well installation field form in accordance with the procedures detailed in **FP 6.15**, Well Construction Record.

4.5 Investigation-Derived Waste

Drill cuttings and decontamination fluids generated during well installation and subsequent decontamination activities shall be containerized pending analytical results and determination of disposal options as outlined in **FP 15.01**, Waste Handling*,* unless project-specific requirements specify otherwise. Waste containment and disposal will occur in a manner that will not result in contamination of the site or other areas, or result in a hazard to individuals who may come in contact with containerized waste materials.

4.6 Well Development

For groundwater monitoring wells and remedial wells screened within the saturated zone, well development (refer to **FP 6.07**, Well Development) should occur no sooner than 24 hours (48 hours preferred) following completion of the well (i.e., placement of the divider and annular seals), in order to allow the cement to set. If only bentonite chips are used in

the divider/annular seal, well development may commence prior to 24-hours following well installation.

4.7 Well Location Surveying

Following well development, newly constructed monitoring wells shall be surveyed (refer to **FP 1.06**, Field Surveying and Monitoring Well Elevation Surveying). Some states or regulatory programs may require that the survey be conducted by a surveyor licensed in the State where the well has been installed. The "V" notch cut on the top of each well casing shall be used as the surveyor's reference mark and as a reference for future water level measurements.

4.8 Well Construction Reporting

After well installation and surveying, well completion report(s) shall be completed and filed with the appropriate agency, as required by State and local law and/or the well construction permit. If this documentation is to be submitted by the driller, copies of such documentation shall be obtained for the project file. Reporting requirements for some States are provided in Attachment A of **FP 6.15**, Well Construction Record. Project personnel should also consult with State and local laws or contact the local Ramboll office to determine if specific reporting requirements apply.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while installing wells. Additionally, implementation of the work may face some difficulties and may require compliance with State-specific or regulatory program-specific requirements.

- It is important to always remain alert and aware of your surroundings. Well installation involves the use of drilling rigs and associated equipment, and is subject to hazards posed by heavy equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- A cable winch on the drilling rig is generally used during well installation, which subjects the cable to tension. Ramboll field personnel should confirm that the driller has inspected the cables and winches on the drilling rig prior to the start of work. When cables are being used or when drilling is underway, it is recommended that personnel maintain a distance from the drilling rig of at least the height of the drilling rig mast or any tooling (e.g., drill string/rod) extending above the top of the mast. Prior to approaching the drill rig, be sure that the equipment is secure and that the driller is aware that you are approaching. Also, compressors and compressed air can be extremely dangerous when connectors and seals fail, so ample distance from such equipment, hoses and connectors is advised.
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the well as it is being installed. Stay upwind of well installation activities and ensure that air monitoring is conducted and personal protective equipment is used in accordance in the site-specific HASP.

- Dust may be produced during the emplacement of sand filter pack material and mixing of cement and/or bentonite powder, and may be harmful if inhaled. Stay upwind of cement mixing activities and instruct drillers to pour powders gradually into water while mixing, in order to reduce dust.
- Only drillers licensed in the State where the work is being performed should be subcontracted to perform the work, if applicable. Most states have specific licensing requirements.
- In some States, drilling permits are to be procured by the driller prior to mobilization. In addition, well construction forms and documentation are to be submitted to the permitting entity by the driller (refer to Attachment A of **FP 6.15**, Well Construction Record for requirements for some States). Local Ramboll offices should also be consulted to determine if specific reporting requirements apply. Ramboll should obtain from the driller copies of the required permits prior to mobilization and of the driller's well construction records after well installation.
- The drilling contractor should be informed of the anticipated well construction design, and requirements as part of the contracting process so they can ensure that the appropriate and sufficient equipment, personnel, and materials are mobilized. The driller should define the specific equipment that will be used for well installation, so field personnel can prepare accordingly.
- When backfilling boreholes below the water table, bentonite pellets or coated bentonite chips are generally easier to place than standard bentonite chips because pellets do not hydrate as quickly, hence pellets or coated bentonite chips are the preferred method for small backfill jobs where significant confining zones have not been breached. Note, however, that some pellet coatings have been known to contain acetone, which may interfere with groundwater analysis. If used, samples of the coated bentonite pellets may be collected and held for future analysis if acetone is detected in the groundwater sample.
- At sites where the water table is very deep, the heat of neat cement annular seal curing could potentially warp the solid PVC well casing where it extends through the vadose zone. In these instances, the plumbness of the grouted well may be tested by lowering and raising a 10-foot length of pipe or a bailer along the entire depth of the well prior to acceptance of the completed well. Alternatively, the well could be constructed using a steel casing and stainless steel well screen. It may also be permissible to use bentonite chips/pellets to avoid the heat of curing problem.

6. RECORDKEEPING

Document all well construction details in accordance with **FP 6.15** (Well Construction Record) and record all information in accordance with **FP 1.01** (Field Notes and Records).

FIELD PROCEDURE NO. 6.02

GROUNDWATER PURGING AND SAMPLING

VISTRA PROJECT

PROJECT NO. 1940112376

FIELD PROCEDURE NO. 6.02

GROUNDWATER PURGING AND SAMPLING

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 6.02 "Groundwater Purging and Sampling" last revised May 23, 2016.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the collection of groundwater samples for laboratory analysis following well purging (other than low-flow sampling techniques which are described in **FP 6.20**, Groundwater Sampling – Low Flow). Groundwater sampling is conducted to characterize the quality of groundwater as part of environmental investigations (e.g., investigation of potential contaminant sources, delineation of contamination, evaluation of migration pathways), remedial actions and/or monitoring programs. To ensure that groundwater samples collected are representative of the groundwater zone being investigated, samples should only be collected after appropriate purging and field parameter monitoring has been conducted. Groundwater purging and sample collection using bladder pumps is preferable, as the use of bailers or vacuum systems can result in excessive disturbance to the water column in the well and potentially affect sample quality. Nonetheless, in certain cases (e.g., for collection of groundwater samples for VOC analysis when a peristaltic pump is used for groundwater sampling, when the water column is small, or when the saturated zone is very deep), groundwater purging and sampling could require the use of a bailer.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that this FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

A general checklist of equipment that may be required for typical groundwater well purging and sampling is provided below. Additional equipment may be specified in the project-specific HASP and/or Field Sampling Plan. This checklist includes an overall summary of general equipment typically required for groundwater sampling but should not be considered exhaustive. More specialized sampling equipment may be required depending on project-

specific preferences. Ramboll oversight personnel should understand the equipment and materials that are required for groundwater sampling.

1. General Groundwater Sampling Equipment Checklist
   - Pump and associated equipment (e.g., generator, batteries, control box, compressor, tubing, CO2 or nitrogen compressed gas cylinders);
   - Bailers (if needed) constructed of material (e.g., fluorocarbon resin, Teflon®, stainless steel, HDPE, or PVC) which minimizes potential chemical alteration of groundwater or may cause a loss of analytes via sorption;
   - Water quality meter with flow-through cell that, at a minimum, measures temperature, pH, dissolved oxygen (DO), oxygen reduction potential (ORP), and specific electric conductance, and associated manuals. Turbidity measurements can be made using a separate turbidity meter;
   - Measuring container (e.g., one-gallon plastic water jug, graduated measuring cup or graduated cylinder);
   - Plastic sheeting;
   - 5-gallon buckets, preferably with graduations for accurate purge volume estimation;
   - Dedicated suspension line or tether constructed of material which minimizes interactions or alterations when in contact with groundwater or which may cause loss of analytes via sorption (e.g., poly twine, nylon string, stainless-steel, Teflon-coated stainless-steel wire, etc.) - for lowering and raising pump/bailer (pump tubing does not constitute a dedicated suspension line and should not be used for lowering and raising pump/bailer);
   - Electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements);
   - Trash bags - for disposal of gloves, tubing and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling);
   - 55-gallon steel drums, Department of Transportation-rated (for legal waste hauling), or other appropriate waste container – for disposal of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling);
   - Labeling materials for IDW containers as outlined in **FP 15.01** (Waste Handling);
   - Personal Protective Equipment (PPE) and field screening equipment in accordance with the site-specific HASP;
   - Site information (e.g., maps, contact numbers, previous field logs);
   - Well construction specifications and diagrams; and
   - Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).

2. Project or Task Specific Groundwater Sampling Equipment Checklist
   - Bucket, water, and Liquinox® (or Alconox) – used for the decontamination of sampling and monitoring equipment (refer to **FP 14.01**, Sampling Equipment Decontamination);
   - Cable ties;
   - Well keys;
   - Sample containers (appropriate for various analysis to be performed);
   - Sample shipment containers and ancillary materials (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody);
   - Sample labels and clear tape;
   - Chain of custody forms (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody); and
   - Field measurement equipment/kits for confirmation of parameters (temperature, dissolved oxygen, Fe 2+, etc.).

3. Additional Suggested Equipment
   - Tool set: socket set, socket wrench, screw driver, multi-tool, tubing cutters, "turkey baster" and/or cup for water removal from flush mounted well vaults;
   - Spare/replacement parts: gripper plug/well cap, well lid bolts;
   - Road and site maps;
   - Mobile phone; and
   - Camera and extra batteries.

A description of groundwater purging and sampling equipment is provided in **Attachment A**.

3. REFERENCED GUIDANCE DOCUMENTS

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01**, Field Notes and Records.
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody.
- **FP 1.05**, Field Quality Control Samples.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 6.04**, Groundwater and Free Product Level Measurements.

- **FP 6.20**, Groundwater Sampling - Low Flow Purge.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPIs) may need to be referenced based on the specific requirements of the site-specific Work Plan/Field Sampling Plan (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant sampling strategy decisions will be approved by the PIC and/or PM before the initiation of associated field activities. The Work Plan/Field Sampling Plan will be designed for the collection of quality data to meet the goals of the study/monitoring program and will include the number of samples, locations, depths, number of sampling sites, analyses and analyte detection limits to be performed on each sample as well as quality control/quality assurance samples. The Work Plan/Field Sampling Plan will generally provide for some discretion in the field depending on conditions encountered; however, any significant departure from prescribed sampling activities should be approved by the PIC and/or PM.

When planning a groundwater sampling event for a well that will be purged, the following should be considered:

- *Purge Method*. Purging is the process of removing potentially stagnant water from a well immediately prior to sampling and allowing water from the surrounding formation that is representative of actual aquifer conditions to enter the well. This process involves the removal of several well/casing volumes of water by use of pumps or bailers. The specific purging/sampling approach to be used depends on site-specific conditions, project objectives, and/or regulatory requirements.
- *Bailer/Pump Choice*. The equipment needed for groundwater purging/sample collection can vary greatly depending on specific site conditions and project objectives. As such, bailer/pump selection should take into consideration a variety of well characteristics, including but not limited to: depth of well; diameter of well; depth to water; analytes of interest; expected recharge rate of well; and sampling objectives. For example, a peristaltic pump is not recommended for collection of groundwater samples for VOC analysis as it is a negative pressure pump.
- *Sampling Interval*. Before conducting groundwater sampling, an appropriate well sample depth interval must be determined. Boring and well construction logs, along with historical sample collection depth and groundwater elevation data (if available), should be reviewed to determine the screen interval and relative water column status of each targeted well. For example, if the screen interval is fully submerged, the midpoint of the well screen would be considered the most representative sample depth. If the water elevation consistently falls below the top of the well screen, the midpoint between the

groundwater surface elevation and the bottom of the well screen should generally be targeted as the representative sample depth. This can also be calculated during the sampling event based on current groundwater elevations.

- *Other Considerations*. Additional requirements (e.g., targeted aquifer zones) may be defined in project-specific Work Plan, sampling plan and/or FPs and, as such, may determine alternative sample depths from those provided by the guidelines set above.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. To the extent that non-dedicated sampling equipment is to be used (e.g., submersible pumps, water level indicator, or bailer), such sampling equipment should be decontaminated between wells as described in **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan/Field Sampling Plan and/or Quality Assurance Project Plan (QAPP) to minimize potential cross-contamination of samples among wells. Used dedicated sampling equipment is considered IDW and should be managed in accordance with **FP 15.01**, Waste Handling following the sampling event.

At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP. Clean, chemical protective, dedicated gloves must always be worn when handling and using sample equipment;
- Coordinate and obtain permission for site access;
- Review project-specific Work Plan/ Field Sampling Plan/QAPP, where applicable;
- Review and discuss with the PIC and/or PM the proposed Work Plan/Field Sampling Plan or sampling strategy. Note that site geology and expected contaminants should be reviewed to determine if unpreserved bottles may be needed (e.g., anticipated effervescence due to high levels of dissolved calcium carbonate in groundwater reacting with acid preservatives);
- When contractors are used to perform the sampling or in states where sampling can only be performed by personnel licensed or certified by the State, discuss the Work Plan/Field Sampling Plan with the contractor;
- Review the standard instruction manual provided by the manufacturer of the specific equipment being used for groundwater sampling;
- Obtain the glassware/bottles in advance and check against sampling numbers to confirm that the appropriate containers and quantities are provided prior to mobilizing; and
- Ensure that all equipment/materials required to complete the work have been packed prior to travel.

In addition, prior to initiating the well sampling activities, Ramboll oversight personnel should field-verify the well identity and construction against available documentation (Site Plans, Well Construction Logs, etc.). It is imperative that a positive well identification be made prior to sampling using measured total well depth, well labels, site

plans, and well construction records to ensure that the correct well is sampled (refer to **FP 6.04**, Groundwater and Free Product Level Measurements). If total well depth is measured, proper decontamination of the water level indicator tape must be conducted before deploying the water level indicator into another well (refer to **FP 14.01**, Sampling Equipment Decontamination).

Further, prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements. Pre-measuring the pump suspension line and/or discharge tubing to the individualized targeted well depths and/or pre-labeling sample containers in advance of field efforts may increase productivity (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody). However, special care should be taken to ensure that the correct pre-labeled containers are used to collect each groundwater sample.

Unless otherwise required by the project-specific Work Plan/Field Sampling Plan, sampling should begin with monitoring wells with the lowest expected groundwater contamination and proceed systematically to monitoring wells with the highest expected groundwater contamination.

4.3 General Groundwater Purging and Sampling Guidelines

Groundwater samples are generally collected from monitoring wells, piezometers, or boreholes using pumps or bailers. The following provides a general recommended list of practices for groundwater sampling activities:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- All wells to be sampled should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- Lay polyethylene sheeting around the well for placement of monitoring and sampling equipment and contain any accidental groundwater spilled during purging or sampling.
- Remove the well cover or equivalent protective casing cover (refer to **FP 6.04**, Groundwater and Free Product Measurements) and measure gas concentrations in accordance with the applicable manufacturer instructions and field screening FPs (e.g., **FP 4.01** - Field Screening - Combustible Gas). Record field screening readings in field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling plan.
- As detailed in **FP 6.04**, Groundwater and Free Product Measurements, record the condition of the well, noting any damage to the well, plug, and/or protective casing, and record any evidence of pressure (positive or negative).

- Complete all depth-to-water or free product measurements prior to any planned groundwater and/or product withdrawals, sampling or disturbance of groundwater activities unless otherwise specified in the Work Plan/Field Sampling Plan (refer to **FP 6.04**, Groundwater and Free Product Measurements).
- If using a bailer for groundwater sampling:
  - Calculate the well volume in gallons (V_w) using the following equation:

$$V_{ww} = 7.48(\pi \frac{d_{ww}^2}{4} h_{ww})$$

Where:

d_w is the well diameter (feet)
h_w is the height of water in the well (feet)

In general, the volume of a 2-inch diameter well is 0.163 gallons per foot and the volume of a 4-inch diameter well is 0.653 gal/ft.

  - To prepare the bailer suspension line, measure the correct amount needed such that the bailer intake is positioned at the target depth in the well. The measurements should account for the additional length needed at ground surface to appropriately anchor the suspension line. If the suspension line and tubing were premeasured in advance of field efforts, make any necessary alterations based on field observations (e.g., unanticipated groundwater elevations).
  - Secure the tether to the eye on the upper side of the bailer.
  - Lower the bailer slowly into the well to minimize sample agitation associated with degassing, aeration, and turbidity and to the extent possible, avoid hitting the sides or bottom of the well. The bailer will fill with water when lowered into the well and should only be submerged to the depth necessary for bailer intake to be positioned at target sampling depth.
  - When the bailer is filled, slowly raise the bailer, minimizing contact with the sides of the well to the extent possible. The bailer will self-seal when raised back out of the well.
  - When transferring the sample from a bailer to a container, use a bottom emptying device to allow the water to slowly drain from the bailer. The sample should be allowed to run down the sides of the container to avoid excessive agitation of the sample.
- If using a pump for groundwater sampling
  - In the case that a dedicated pump is not used for groundwater sampling:
    - Prepare the pump suspension line and discharge tubing, measure the correct amount needed such that the pump intake or bottom of discharge tubing rests at the target depth in the well. The measurements should account for the additional length needed at ground surface to appropriately anchor the suspension line and connect discharge tubing to water quality monitoring equipment. If the suspension line and tubing were premeasured or ordered to

premeasured lengths in advance of field efforts, make any necessary alterations based on field observations (e.g., unanticipated groundwater elevations). Assemble the pump, suspension line, and tubing. Inspect all sampling equipment prior to deployment, making certain that all connections are secure and equipment is in working condition. Troubleshooting is generally easier if the pump and tubing assembly are inspected prior to deployment. If not using dedicated sampling equipment, ensure all materials are properly decontaminated prior to conducting sampling (refer to **FP 14.01**, Sampling Equipment Decontamination).

- Slowly lower the assembly into the well using the suspension line to achieve minimal water column disturbance until the location of the tubing or pump intake reaches the predetermined depth within the well. Anchor the assembly in place by securing the suspension line at the surface and/or clamping the tubing in place via spring clamp.
- Measure and record the depth to water following insertion of the pump and tubing assembly.

– Once the pump (whether a dedicated pump or not) is ready for use, allow the water level to return to its static level prior to initiating purging.

- Calculate the well volume in gallons (V_w) using the following equation:

$$V_{ww} = 7.48 \left(\pi \frac{d_{ww}^2}{4} h_{ww}\right)$$

Where:

d_w is the well diameter (feet)
h_w is the height of water in the well (feet)

In general, the volume of a 2-inch diameter well is 0.16 gallons per foot and the volume of a 4-inch diameter well is 0.65 gal/ft.

– Assemble the water quality meter sensor probe and flow through cell in accordance with the manufacturer's specifications.

– Carefully connect the pump's discharge tubing to the influent of the flow-through cell of the water quality meter and connect a section of clean tubing to the effluent of the cell. The influent and effluent connections to the flow-through cell are unique and based on each meter's design; orientation of flow matters and influent/effluent ports should be marked on the flow cell.

– When water fills the cell, check for leaks and make the necessary adjustments. If water is particularly turbid at the beginning of the purge it can be helpful to disassemble the water quality meter sensor probe and flow through cell and rinse them with DI water to remove any residual particulates once the turbidity decreases.

- For the standard purging method, evacuate at least three well volumes and until the water quality parameters specified (e.g., pH, DO, ORP, temperature, specific conductance, and turbidity) in the project-specific Work Plan, Field Sampling Plan, QAPP and/or FPs developed based on state-specific or regulatory program-specific guidelines,

requirements or procedures have stabilized. In the absence of specific stabilization guidance, the following parameters or any combination thereof established by USEPA should be monitored to determine when well stability has been achieved.

pH	± 0.1 unit
Specific Conductance	± 3%
Temperature	[See Note 1]
Dissolved Oxygen	± 0.3 mg/L
Turbidity	± 10% (when turbidity is greater than 10 NTUs)
ORP/Eh	± 10 millivolts

Note 1: Temperature generally tends to stabilize rapidly and is considered a relatively insensitive indicator of stability. Nonetheless, temperature stability can be defined as ± 3%.

- Collect measurements approximately once every 5 minutes or a period defined by the time it takes for purge water to adequately replace the water quality meter's flow-through cell.
  - If the purge rate decreases, the time required for purge water replacement will increase.
  - It is generally accepted that when the measurements of the monitored parameters fall within the stated range for three consecutive readings, chemical parameter stabilization has been achieved.
  - If the anticipated "third" reading of any individual parameter does not fall within the stated range, then the process to achieve three consecutive readings for that parameter must be restarted.
- In some situations, even with slow purge rates, a well may be pumped or bailed dry. In these situations, under certain regulatory programs this constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). In such cases, it is not necessary that the well be evacuated three times or that chemical parameters stabilize before it is sampled. Nonetheless, the pH, specific conductance, temperature, and turbidity should be measured and recorded during collection of the sample from the recovered volume. These data would serve as the field measurements of record for the sampling event.
- If flow rates are to be measured when using pump and a flowmeter is not available, the discharge from the effluent of the flow-through cell could be collected in a container of known volume (i.e. one gallon plastic water jug or a graduated cylinder) and the time to fill the container noted. When flow rate measurements are complete, redirect the discharge as detailed above and dispose the contents of the graduated cylinder into 5-gallon buckets or directly into 55-gallon drums.
- Containerize purge water in accordance with **FP 15.01**, Waste Handling. The discharge tubing should be secured such that all purge water is collected in 5-gallon buckets or directly into labeled Department of Transportation (DOT)-rated 55-gallon drums, depending on site conditions and purge volumes.

- Upon purge completion, reduce the pumping rate and disconnect the water quality meter from the discharge tubing.
- Wells should be sampled as soon as possible after purging. Collect the groundwater sample from the primary discharge tubing connected directly to the pump with no remaining purging appurtenances (e.g., fittings, flow diverters, flow-through cell). Laboratory-supplied sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside wall of the container. Record the sample time on the sample bottle-ware and in the field notebook (refer to **FP 1.01**, Field Records and Notes). Regarding sample collection note that:
  - The ideal order of sampling (from first to last) should be VOCs, SVOCs, TPH, pesticides/herbicides, PCBs, metals, general chemistry analytes (e.g., TDS, TSS, nitrate, etc.), and filtered metals, although this order may be modified based on pump characteristics and/or site-specific or well-specific considerations (see below).
  - When collecting VOC samples, the volatile organic analysis (VOA) vials should be filled slowly to minimize agitation. Upon filling, a meniscus should be present at the top of the vial and absolutely no bubbles or headspace should be present in the vial after it is capped. After the cap is securely tightened, the vial should be inverted and tapped on the palm of one hand to see if any undetected bubbles are dislodged. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus.
  - Samples collected for dissolved gases or VOC analyses must ensure that the tubing is completely full of groundwater to prevent aeration. If groundwater contains air bubbles throughout the entire purge, consult pump manual to remedy pumping issues and discuss with PIC and/or PM.
  - Filtered (dissolved) samples should be collected after all other samples are collected using the pump.
  - If using a peristaltic pump, collect a groundwater sample for VOC analysis using a bailer as described above after groundwater sampling for all other parameters has been completed.
- Effervescence (e.g., high levels of dissolved calcium carbonate in groundwater reacting with acid preservatives) observed during filling of the laboratory supplied containers should be recorded in the field notebook. Discuss with the PIC and/or PM whether samples should be collected in unpreserved containers and include a notation in the chain-of-custody.
- If a field-filtered (dissolved) sample is to be collected, an inline filter is fitted at the end of the discharge tubing and the sample is collected after the filter. The inline filter must first be flushed in accordance with manufacturer's recommendations. If there are no recommendations for flushing, a minimum of 0.5 to 1.0 liter of groundwater from the monitoring well must pass through the filter prior to sampling.
  - Groundwater filter cartridges are dedicated sampling equipment and are thus considered IDW and should be managed accordingly. A new cartridge must be used at each sampling location.

  - If the filter becomes clogged or groundwater flow is too slow, remove and replace with a new filter cartridge.

- Withdraw the sampling equipment from the well, replace the well cap, and re-secure the well. For non-dedicated equipment that has come in contact with groundwater, following sampling completion, remove the equipment from the monitoring well and decontaminate in accordance with **FP 14.01**, Sampling Equipment Decontamination. For dedicated equipment that has come in contact with groundwater, disconnect from the non-dedicated equipment and manage as IDW.
- Record in the field book or appropriate field forms any abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.). Inform the PIC or PM so necessary maintenance, redevelopment or repairs are conducted before the next planned water sampling event.

4.4 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected groundwater should be constructed of inert materials that will not affect the concentration of constituents in the water sample (i.e., glass, stainless steel or Teflon). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the groundwater and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan/Field Sampling Plan or QAPP.

The laboratory will provide appropriate sample containers, prefilled with preservatives appropriate for each predetermined sample analysis. The sample volume is a function of the analytical requirements and will be specified in the Work Plan/Field Sampling Plan or QAPP. Sample VOCs first to prevent loss of volatiles due to disturbance of the water and be sure to fill VOA vials to zero headspace, as described above in Section 4.3.

4.5 Sample Transport and Storage

Samples shall be handled, transported and stored to maintain structural and chemical qualities of groundwater samples. Sampling bottles shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). All samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration. If the cooler size allows for space between sample bottles, bubble wrap should be used to fill annular space and prevent breakage during travel. Glass bottleware should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample vials in laboratory issue foam packing cartons. If shipping groundwater samples with preservatives, confirm the sample shipments, packaging, and labeling are performed in accordance with applicable DOT-requirements.

4.6 QA/QC

Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific Work Plan/ Field Sampling Plan and/or QAPP must be followed throughout the purging, sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while groundwater sampling. Additionally, implementation of the work may face some difficulties.

- Some states require that only personnel licensed or certified in the State where the work is being performed perform the sampling. Therefore, State regulations and guidance governing groundwater should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements.
- It is important to always remain alert and aware of your surroundings. Groundwater sampling could involve the use of generators and associated equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, determine the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located on the right of way).
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the well as it is being sampled. Stay upwind of the well and ensure that air monitoring is conducted and personal protective equipment is used in accordance in the site-specific HASP.
- Keep any sampler, tether, or suspension lines untangled. Use a plastic winder or spool winder to retrieve the sampler/pump to keep the line from tangling.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the "buddy system" and should ensure that the project-specific HASP includes safety measures and procedures.
- Care should be taken when opening well protective covers for the presence of spiders and insects such as wasps or hornets.
- For some wells, well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well sampling. Do not use petroleum based solvent sprays to free seized locks as it may impact water quality in the well.
- Wells with a water-tight cap may experience a buildup of pressure. Keep your face and body away from the top of the well when loosening or removing the cap.
- Certain sampling equipment configurations have tubing without a pump at the sample intake depth (e.g., peristaltic pump or a bladder pump with drop-tubing). Without a weight on the end of the tubing, the tubing can easily get caught on the joints between sections of the PVC well casing or on the open borehole wall due to the natural curl in the tubing from being stored in rolls while lowering the tubing into the well. To remedy this, fasten a stainless steel rod as a splint against the bottom few feet of tubing or simply secure a stainless steel weight to the bottom of the tubing to straighten the curl in the tubing and keep it from getting stuck. Some sampling equipment will include a

weight for this purpose. Proper decontamination of the stainless steel rod or weight is required prior to deployment into a subsequent well (refer to **FP 14.01**, Sampling Equipment Decontamination).

- It can be helpful to utilize Microsoft Excel to simplify purge stabilization calculations in the field and eliminate the need to transcribe purge notes into electronic form for reporting purposes. An Excel-based purge sheet can also reduce potential mistakes; however, a thorough understanding of the stabilization criteria calculations is necessary prior to use in the field. An example of a low-flow sampling purge sheet with auto-calculations is presented on **Figure 1**.

21	Well Evacuation Data										
23	Stabilization Criteria			± 0.1 SU	± 3 %	± 10 %	± 3 %	± 10 mV	± 10 %	0.3 ft	
24	Time	Vol.	Rate	pH	Cond.	Turb.	Temp.	ORP	DO	DTW	Appearance or
25		L	mL/min	Std	ms/cm	NTU	C	mV	mg/L	ft	Comments
27	9:54	--	550	9.86	0.240	78.9	10.18	16	11.89	23.80	Slightly silty
28	9:59	0.0	320	7.89	0.360	70.4	11.17	77	9.98	23.50	Slightly silty
29	10:04	1.6	250	7.71	0.364	58.2	11.14	93	9.84	23.30	Slightly silty
30	10:09	2.8	250	7.68	0.361	48.6	11.04	100	9.64	23.30	Clear
31	10:14	4.1	250	7.68	0.360	30.3	10.96	107	9.59	23.30	Clear
32	10:19	5.3	250	7.66	0.360	16.0	11.11	107	9.50	23.30	Clear
33	10:24	6.6	250	7.68	0.362	9.3	11.09	111	9.87	23.30	Clear
34	10:29	7.8	250	7.69	0.363	5.7	11.26	114	9.49	23.30	Clear
35	10:34	9.1	250	7.64	0.362	5.8	11.21	115	9.50	23.30	Clear
36	10:39	10.4	250	7.65	0.362	5.6	11.20	118	9.52	23.30	Clear
37	10:44	11.6	100	7.66	0.363	5.5	11.32	118	8.82	23.30	Clear

Figure 1: Groundwater Purge Sheet

As each parameter stabilizes for three readings within its specified criteria, cells activate green. Purge rate and depth to water cells help guide adjustments needed to comply with low flow guidance.

- Pumping issues, particularly for deep wells using low-flow or intermittent-flow pumps, can be difficult to troubleshoot. A small cup of deionized (DI) water can be used to test for flow. Place the end of the discharge tubing into the DI water cup during pumping to see if there is a discharge (i.e., bubbles occur). As purge water fills the tubing at depth, air is displaced and forced out the top, causing bubbles in the water. If bubbles are observed, the pump is operating and there is flow.
- Bladder pumps have several O-rings and check balls that are necessary for its operation. If bubbles are observed in the DI water during compressor discharge, but water is suctioned back into the tubing during the refill cycle, the pump check ball is not working properly or may be missing. Air bubbles in the discharge water that do not go away after purging for a few minutes are usually indicative of a failed O-ring.
- A small cup of DI water can be used to monitor the purge rate of intermittent-flowing bladder pumps before having water at the surface by observing the duration and/or speed of bubbles. Monitoring the duration and speed of bubbles at the beginning of the

purge will allow the operator to make adjustments and fine-tune the air controls (refill, discharge and pressure) to bring water to the surface.

- Stabilization of parameters when pumping at low flow rates can be difficult. Several adjustments can help make stabilization easier and enhance the rate of stabilization:
  - Minimizing the length of extra tubing at ground surface can help minimize the effect of atmospheric temperatures on purge water.
  - Insulating the tubing with tin foil and/or shading from direct sunlight can help minimize the effect of atmospheric temperatures on purge water.
  - Increasing the flow rate to the maximum allowable rate (based on drawdown and regulatory requirements) will help replace water in the flow-through cell more frequently, thus reducing the severity of parameter fluctuations.
- When purging with intermittently-flowing pumps (i.e., bladder pumps), collection of readings should occur during the same portion of the flow cycle (ideally at the end of a discharge cycle, so measurements are based on fresh water entering the flow-through cell) to minimize parameter fluctuations between cycles.
- For wells with slow recovery, attempts should be made to avoid purging them dry as it may affect the quality of the sample. For example, as water enters a well that has been purged dry, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column. A possible remedy to purging the well dry is to reduce the purge rate.
- If possible, sampling of wells which have a slow recovery should be scheduled so that they can be purged and sampled in the same day, after adequate volume has recovered. These types of wells should, unless it is unavoidable, not be purged at the end of one day and sampled the following day.
- Sampling equipment (e.g., air compressors) are temperature sensitive and sampling in extremely cold temperatures can complicate even trivial tasks. When sampling in these conditions, keeping sampling equipment and discharge tubing from freezing is critical. Insulating the compressor from freezing temperatures and keeping it warm between use (within a vehicle, field trailer, etc.) will help keep it functioning properly. Any interruption of flow could cause purge water in the discharge tubing to freeze; insulating the tubing and maintaining higher flow rates (within regulatory guidelines) will help keep purge water from freezing.
- Adequate preparation prior to sampling each well will save time in the long run. Make sure the generator/air compressor has fuel or that spare batteries/air canisters are available in the event that stabilization takes longer than anticipated. Stopping mid-purge to refuel or acquire additional air canisters will disrupt stabilization, increasing the time required to sample a well.
- Each sampling effort should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular or generator exhaust). Ensure equipment and vehicles release exhaust downwind from the sampling location, especially if sampling for VOCs.
- While purging, the time between water quality measurements can be used to organize bottle-ware and confirm well-specific information (e.g., sample analyses, bottles appropriately labeled, duplicate collection, field filtering).

- If the Work Plan/Field Sampling Plan involves analyses requiring field preservation, be sure to avoid direct contact with laboratory-provided preservative chemicals.

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information related to groundwater sampling in accordance with **FP 1.01** (Field Notes and Records).

FIELD PROCEDURE NO. 6.03

ESTIMATION OF IN-SITU HYDRAULIC PROPERTIES – HYDRAULIC CONDUCTIVITY (SLUG) TESTS

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 6.03

ESTIMATION OF IN-SITU HYDRAULIC PROPERTIES – HYDRAULIC CONDUCTIVITY (SLUG) TESTS

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 6.03 "Estimation of In-Situ Hydraulic Properties – Hydraulic Conductivity (Slug) Tests" last revised January 7, 2020.
Application	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for conducting in-situ hydraulic conductivity (slug) tests to estimate the hydraulic properties of confined and unconfined aquifers. The hydraulic conductivity of an aquifer is a key parameter used for the evaluation of groundwater flow and contaminant transport. The use of slug tests to estimate aquifer hydraulic conductivity is widely accepted and should be performed under the direction of an experienced hydrogeologist or engineer.

Slug tests are a means to estimate the hydraulic conductivity (K) of an aquifer immediately surrounding a test well/piezometer. Slug tests generally consist of inducing a near instantaneous head change (ΔH) in a well (relative to the water level in the formation surrounding the well) and monitoring the time required for the head (H) within the well to recover to the static water level/equilibrium with the surrounding aquifer. The timing of the head response in the well is a function of the differential head created and the hydraulic conductivity and coefficient of storage of the aquifer.

Analysis of the head data, with an appropriate theoretical model provides an estimate of the saturated hydraulic conductivity of subsurface geologic strata for a limited radius surrounding the tested well. By performing slug tests for a group of wells in the same hydrogeologic unit, the hydraulic conductivity range of the unit may be estimated over a larger area and with a higher degree of certainty.

Hydraulic conductivity values calculated from in situ hydraulic conductivity tests are estimates for the material immediately surrounding the open interval of the test well, thereby only providing hydraulic conductivity estimates for a very small portion of the geologic formation of interest. To assess variability in hydraulic conductivity across a site, a typical slug testing program will generally include multiple slug tests in multiple representative wells screened in each geologic unit to provide robust hydraulic conductivity averages or ranges. Near-well conditions such as the filter pack design and condition, quality of well development, skin effects (e.g. borehole smearing), and wellbore storage may affect the representativeness of test results. Slug tests are used when a high degree of accuracy is not needed, provide approximate values of hydraulic conductivity, and do not produce values of storage coefficients. Slug test hydraulic conductivity estimates are generally not considered sufficient to evaluate aquifer behavior to stresses imposed across a large area or over long periods (e.g. for groundwater extraction system design, etc.) and should not be exclusively relied upon for designing a groundwater recovery system or other system. Aquifer pumping tests (refer to **FP 6.08**, Estimation of Hydraulic Properties-Pumping Tests) and hydraulic pulse tests (refer to **FP 6.18**, Estimation of Hydraulic Properties-Hydraulic Pulse Tests) are recommended to estimate the bulk hydraulic properties (e.g. hydraulic conductivity, transmissivity, storage/storativity etc.) of an aquifer for applications like groundwater extraction system design or dewatering systems.

The guidelines presented in this FP cover the initiation of slug tests using physical/solid objects or pneumatic pressure. Tests initiated with an instantaneous rise in head will be referred to as falling head tests while those initiated by an instantaneous drop in head will be referred to as rising head test because of the direction of the head change being monitored.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC) and/or Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll's document handling and retention policies. The signatures of the PIC and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

A checklist of equipment generally required for a typical slug test at contaminated sites is provided below. Additional equipment may be specified in the project-specific HASP and/or Work Plan/Field Sampling Plan and the following list should not be considered exhaustive. More specialized sampling equipment may be required depending on project-specific needs. Ramboll oversight personnel should understand and be familiar with the operation and safe handling of the equipment and materials that are required for slug testing.

2.1 General Equipment Checklist:

- Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points);
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Plastic sheeting;
- Measuring tape;
- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during testing (refer to **FP 15.01**, Waste Handling);
- 55-gallon steel drums, Department of Transportation-rated (for legal waste hauling), or other appropriate waste container – for disposal of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling);
- Labels for Investigation Derived Waste (IDW) containers as outlined in **FP 15.01** (Waste Handling) and indelible pen or sharpie;

- Bucket, spray bottle, distilled/deionized water, and Liquinox (or Alconox) – used for the decontamination of equipment (refer to **FP 14.01**, Sampling Equipment Decontamination); and
- Personal Protective Equipment (PPE) and field screening equipment in accordance with the site-specific HASP, including sterile gloves which must always be worn when handling and utilizing sample equipment.

2.2 Project- or Task-Specific Slug Testing Equipment Checklist:

- Well construction specifications and/or diagrams;
- Cable ties;
- Well keys;
- Electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements);
- Electronic data logging, water level/pressure transducer (transducer) (e.g. In-Situ Troll family or equivalent). For longer duration tests consider gauged or vented transducers (i.e., can auto-compensate for barometric pressure); otherwise, in addition to the absolute (or non-vented) transducer, a barometric transducer may also be required;
- Field computer (such as a Rugged Reader or equivalent) and/or field laptop computer with applicable software selected for the appropriate water-level transducer;
- Slug Testing Data Acquisition Form(s);
- Communication cables for the transducer and computer equipment;
- An initiation device
  - For physical slug test initiation:
    - Solid cylinders of polyvinyl chloride (PVC), stainless steel, or other relatively inert material of appropriate diameter and various lengths are recommended.
    - Disposable suspension line or tether constructed of material that minimizes interactions or alterations when in contact with groundwater or that may cause loss of analytes via sorption (e.g., poly twine, nylon string, stainless-steel, Teflon-coated stainless-steel wire, etc.) for lowering and raising slug.
    - Slug suspension stand - used to control placement of the slug in deep wells or large-diameter wells requiring large slugs.
  - For pneumatic test initiations pneumatic slug testing equipment:
    - A wellhead assembly (well coupler, pressure gauge, regulator and ball valve) and a pressure source (e.g., hand pump [bicycle pump], air compressor, or compressed gas cylinder).
    - Air fittings (e.g., check valves, pressure gauges, ball valves, strain-relief compression fittings) constructed of materials that will not affect groundwater quality (e.g., stainless steel).
- Tool set: socket set, socket wrench, screw driver, multi-tool, safety shears, "turkey baster" and/or cup for water removal from flush-mounted well vaults;

- Spare/replacement parts: gripper plugs/well caps, well lid bolts; and
- Folding work table.

A Slug Testing Data Acquisition Form is provided in **Attachment B** and information on the typical equipment used for Slug Testing and Pneumatic Slug Testing is provided in **Attachments C** and **D**, respectively.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01**, Field Notes and Records;
- **FP 2.02**, Site Preparation, Inspection and Housekeeping;
- **FP 6.04**, Groundwater and Free Product Level Measurements
- **FP 6.07**, Well Development
- **FP 6.15**, Well Construction Record
- **FP 14.01**, Sampling Equipment Decontamination; and
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site- specific Work Plan/Sampling Plan (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

Significant test strategy decisions will be approved by the PIC and/or PM before the initiation of associated field activities and documented in the Work Plan/Field Sampling Plan. The Work Plan/Field Sampling Plan will be designed for the collection of quality data to meet the objectives of the study/monitoring program and will include the well locations and depths, number of tests per well, initiation and data logging methods, as well as quality assurance/quality control requirements. The Work Plan for slug testing will specify whether any extraction wells in the project vicinity require shut-down before the start of testing. The Work Plan/Field Sampling Plan will generally provide some discretion in the field depending on the conditions encountered; however, significant departure from prescribed testing activities should be discussed with and approved by the PIC and/or PM.

When planning the slug testing, the following should be considered:

- *Type of Slug Test* - There are two types of slug test recovery responses: falling-head and rising-head tests. Both tests measure the recovery of heads to pre-test/static conditions in a well after the initiation of a near instantaneous change in head. Falling-head tests are initiated by inserting a slug of known volume into the water column (of a well with a fully saturated well screen / open interval) that should result in a head increase that is proportional to the volume of the slug used. After a falling-head test is initiated, the heads are measured in the well to monitor the fall/decline from the initial maximum displacement (H_o) to pre-test/static conditions. Rising-head tests are initiated by removing a slug of known volume from the water column that should result in a head drop that is proportional to the volume of the slug used. After a rising-head test is initiated, the heads are measured in the well to monitor the rise/increase from the initial maximum displacement (H_o) water to static conditions (i.e. equilibrium with the surrounding aquifer).

  In high hydraulic conductivity aquifers (i.e., where heads in the well recover to pre-test levels within 60 seconds), a pneumatic slug test can be used. Pneumatic slug tests require an air-tight seal between the top of the well and the apparatus that is used to seal, pressurize, and vent the well casing. The well casing is pressurized (with air or an inert gas) to lower the head inside the well to the desired displacement/well casing pressure. Once heads in the well are stable, a valve is opened to release the air pressure within the well casing and start a rising-head test. A pneumatic slug test cannot be performed on a well with a partially saturated screen/open interval (i.e. screened/open interval that crosses the water table).

  Rising-head slug tests tend to have less noise in the data compared to falling-head tests, because the slug insertion for the latter can create anomalous data points. However, to perform a rising-head slug test the slug must be initially placed in the well (as would be required for a falling-head test), and a duplicate test (i.e., falling-head test followed by a rising-head test) is typically performed. The duplicate test is used to confirm slug test results and is preferred by some regulatory programs (USEPA, 1994).

- *Multiple Slug Tests* – Depending on the duration of each test, consideration should be given to performing multiple rising and falling head slug tests on individual wells to allow accurate test analysis. Repeating slug tests in a well with the same slug will yield information about the accuracy and reproducibility of the hydraulic conductivity obtained from the tests, while repeat slug tests conducted with different size slugs may be used to evaluate whether the observed aquifer responses are dependent upon the initial displacement used for each test. Butler (1998) suggests that a minimum of three tests be completed per well with initial displacements (H_o) that vary from 0.66 to 6 feet (e.g., Test 1 – H_o = 1 ft, Test 2 – H_o = 3 ft, and Test 3 – H_o = 5 ft) and that the directionality of flow for one of the tests be different (e.g. Test 1 – falling head [flow from the well to the formation], Test 2 – rising head [flow from the formation to the well], Test 3 – falling head).

- *Well Construction Details* – Review of well construction details is important for test method selection and as input parameters for analysis of test data. At a minimum, the following information should be gathered prior to planning a slug test event:
  - Aquifer lithology and expected hydraulic characteristics of screened aquifer material;
  - Casing (inside) radius;
  - Well screen (inside) radius;
  - Borehole radius;
  - Screen length;
  - Filter pack material;
  - Depth to top of screen from water table (or depth to water table from top of screen for partially saturated wells);
  - Predicted initial displacement for each slug;
  - Static (pre-test) depth to water in well; and
  - Saturated thickness of aquifer.
- *Slug Properties* – The slug may consist of a variety of materials including plastic, PVC, stainless steel, or air (rental companies typically offer solid slugs). If transducers are being used to monitor head changes in the well, the diameter of the slug should allow room for the transducer cable and the movement of the slug without disrupting the transducer. The size of slug will depend on the well diameter and required minimum volume to be displaced. Initial displacement should produce a reasonable signal to noise ratio. For recommendations on initial displacement refer to Butler (1998). When using solid slugs, at a minimum, the slug radius and length inserted below the water level should be recorded on the Slug Testing Data Acquisition Form. For pneumatic slug initiations, the stabilized well casing pressure should be measured and recorded.
- *Well Condition* - Slug tests should not be performed in newly constructed wells prior to development or existing wells that are otherwise silted due to inactivity. Hydraulic conductivity estimates from undeveloped or poorly developed wells will be lower than the formation hydraulic conductivity due to the impact of drilling debris. The Work Plan should identify whether existing wells require development prior to slug testing.
- *Well Design* - The well installation method, the type and length of well screen, grain size distribution of the well filter pack, and/or nature of the well development can affect the results of a slug test. Slug tests should only be completed in developed wells. If the filter pack grain size is smaller than that of the natural formation, then the results of a slug test will not reflect the hydraulic conductivity of the natural formation.
- *Partially Saturated Screened Interval* - For rising-head slug tests conducted in wells that are screened across the water table with a filter pack that is coarser than the formation, the response data typically displays two distinct linear slopes when normalized head is plotted relative to time. An initial slope reflecting drainage from the filter pack followed by a second distinct slope reflecting the formation response. Prior to testing such wells, an evaluation should be made following procedures described in Butler (2014) to predict the amount of displacement head response that can be attributed to filter-pack drainage

and confirm that the formation head response to the remaining displacement can be separated from the transducer noise.

- *Pre-Test Groundwater Level Monitoring* – The need for and duration of groundwater level monitoring before initiating the slug testing should be defined based on (a) the duration of the slug test compared to the background water level change time period (e.g., where wells are known to recover very quickly [less than 10 seconds], no pre-test groundwater level monitoring may be required); (b) the potential for tidal influence; (c) potential for unknown local groundwater level changes due to extraction or infiltration; (d) water level recovery due to opening a previously air-tight sealed well; and (e) the depth of the aquifer (to allow sufficient time for thermal equilibration of equipment and the cable to stretch). The water level in the well must be static prior to initiating the test. A background changing water level that occurs during the test will affect the test results.

4.2 Pre-Field Work Preparation Procedures

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. Further, for sites with contaminated groundwater any non-dedicated, non-disposable equipment (e.g., water level indicator, transducer) should be decontaminated before use and between wells as described in **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan/Field Sampling Plan, and/or Quality Assurance Project Plan (QAPP) to minimize potential cross-contamination between wells. Used disposable equipment (e.g., tethers) that is considered IDW should be managed in accordance with **FP 15.01**, Waste Handling, following the testing event.

At a minimum, the following tasks should be completed to prepare field staff for implementation of the work:

- Review and sign the site-specific HASP.
- Coordinate and obtain permission for site access and extraction well pump shutdowns (as necessary).
- Review the project-specific Work Plan/Field Sampling Plan/QAPP, where applicable.
- Review and discuss with the PIC and/or PM the proposed Work Plan/Field Sampling Plan or sampling/testing strategy.
- Review the standard instruction manual(s) provided by the manufacturer of the specific equipment being used for logging changes in heads during slug testing.
- Document that equipment/materials required to complete the work have been secured and packed prior to travel.

Prior to initiating the slug testing activities, Ramboll oversight personnel should field-verify the well identity and construction against available documentation (site plans, well construction logs, etc.). Prior to testing, it is imperative that a positive well identification be made using measured total well depth, well labels, site plans, and well construction records to document that the correct well is tested (refer to **FP 6.04**, Groundwater and Free Product Level Measurements). If total well depth is measured on a site with groundwater contamination, proper decontamination of the water level indicator tape must be conducted

before deploying the water level indicator into another well (refer to **FP 14.01**, Sampling Equipment Decontamination).

Further, prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements. Pre-measuring the slug suspension line(s) to the individualized targeted depths, in advance of field efforts will increase productivity.

Unless otherwise required by the project-specific Work Plan/Field Sampling Plan, for sites with groundwater contamination, slug testing should begin with wells with the lowest expected groundwater contaminant concentrations and proceed systematically to wells with the highest expected groundwater contaminant concentrations.

4.3 General Slug Testing Guidelines

The guidelines in this section provide the recommended practices for rising- and falling-head slug tests to be performed on properly constructed and developed wells installed in confined or unconfined aquifers at contaminated sites.

4.3.1 Pre-Test Preparation

Before initiating a slug test,

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- Wells to be tested should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- Place polyethylene sheeting around the well for placement of slug testing equipment and to contain any accidental spillage during testing.
- Remove the well cover or equivalent protective casing cover (refer to **FP 6.04**, Groundwater and Free Product Measurements) and measure head space concentrations in accordance with the applicable manufacturer instructions and field screening FPs (e.g., **FP 4.01**, Field Screening - Combustible Gas). Record field screening readings in the field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling/testing plan.
- As detailed in **FP 6.04**, Groundwater and Free Product Measurements, record the condition of the well, noting any damage to the well, plug, and/or protective casing, and record any evidence of air pressure (positive or negative) when removing the well cap;
- Complete depth-to-water measurements prior to any planned slug testing activities unless otherwise specified in the Work Plan/ Field Sampling Plan (refer to **FP 6.04**, Groundwater and Free Product Measurements). If the gripper plug sealing the well casing was under pressure or vacuum when removed, manual water level measurements should be collected until the change in water level is less than 0.01 feet over a period of

30 seconds before recording the static water level. If unanticipated free product is detected in a well, consult with the PIC and/or PM before proceeding further.

- Measure the total well depth to the nearest 0.1 foot.
- Measure the inner and outer diameter of the well casing or confirm the existing well construction log information.
- Slowly lower the transducer to a depth below the static water level and as close to the top of the water column but deep enough that the transducer will not be disturbed during insertion and removal of the slug.
- Secure the transducer to the well casing to ensure when the slug is added to the well it will not disturb the transducer.
- Allow the transducer to thermally equilibrate with the water temperature in the well prior to establishing a reference level on the transducer. Record the transducer depth reading.
- Properly program the transducer to fit well conditions and expected slug test response. Record the model and serial number of each data logging transducer and synchronize units with the field computer or mobile device that will be used during the slug tests. As the default, set the Rugged Reader/computer to collect readings every second. The highest measurement frequency (typically 0.25 seconds) is recommended for pneumatic tests or for tests in high-conductivity material such as sand and gravel.
- Record a second depth-to-water measurement to confirm the head is at static conditions.
- Record the initial pressure (height of water column above the transducer), barometric pressure, and temperature (if available) measurements from the transducer and confirm they represent static conditions. Ideally, the transducer should record heads for a sufficient period of time (specified in the Work Plan/ Field Sampling Plan) prior to test initiation to assess whether the aquifer is at static conditions and equipment has stabilized, and whether there are external influences on heads that could affect the response data (refer to Section 4.1).
- The measured head and pressure reading will act as the baseline and be used to confirm the head has recovered (dropped after slug-in or risen after slug-out) to the initial value.

4.3.2 Falling Head Test (Physical Slug-In)

After baseline conditions have been established, the falling-head slug test is performed as follows:

- Lower slug to just above the water (during data analysis an assumption is that water is displaced instantaneously by "quickly" and uniformly lowering the slug into the water to maximize the initial displacement).
- Start the transducer recording and then rapidly lower the slug into the water.
- Record time the test started in the field notebook or Slug Testing Data Acquisition Form.
- Secure the slug to the well casing or other secure feature adjacent to the well. Be careful not to move slug up or down in the well or bump the transducer cable during the test.

- Once the slug is secure, record head measurements frequently (every second) during the early stages of the test. The recording interval may be increased over the course of the test as heads begin to stabilize. Record the time interval used to collect readings in the field notebook or Slug Testing Data Acquisition Form.
- The test is considered completed when the head has recovered 95% of the initial displacement (5% of the initial displacement above the static head) or if readings change less than 0.01 feet every 10 minutes. For very low conductivity formations, it may not be practical to record the entire recovery period as the time to completion is related to the type of material being tested.
- Once the head has stabilized, prepare to repeat the process for the slug-out (rising head) test. The recovery from the falling head test should be at least 95% of the initial displacement before initiating a rising head test. A repeat test should not be performed if heads have not recovered to pre-test static head (or 95%).
- If a regional water level trend was identified during the pre-test period, continue logging heads during the post-test period to provide additional data for trend correction.

4.3.3 Rising Head Test (Physical Slug-Out)

Typically, a rising head test is initiated by rapidly pulling the slug out of the water after recovery (i.e., at least 95% of the initial displacement) from a falling head test. The rising head test is performed as follows:

- Once the head has stabilized, start the transducer log and then immediately remove the solid slug from the water.
- Record time the test started in the field notebook or Slug Testing Data Acquisition Form.
- Once the test has been initiated, record head measurements frequently (every second) during the early stages of the test. The recording interval may be increased over the course of the test as heads begin to stabilize. Record the time interval used to collect readings in the field notebook or Slug Testing Data Acquisition Form.
- The test is considered completed when the head is equal to the initial value or if readings change less than 0.01 feet every 10 minutes. For very low conductivity formations, it may not be practical to record the entire recovery period as the time to completion is related to the type of material being tested. If repeated testing is part of the workplan, then 95% recovery to the original head should be achieved prior to conducting an additional test.
- If a regional water level trend was identified during the pre-test period, continue logging water levels during the post-test period to provide additional data for trend correction.

4.3.4 Pneumatic Rising Head Test

A pneumatic slug testing device may be used to perform rising-head tests on wells with water levels that are a minimum of 5 feet above the top of the well screened interval

. The pneumatic method is typically used for tests in high hydraulic conductivity formations and after baseline conditions have been established, as follows:

- Install the wellhead assembly on the well casing and secure as recommended by the manufacturer (e.g., with metal bank clamps, Fernco coupler with hose clamps and a ratcheting strap). Position the pneumatic slug test manifold on the well so that there is an air tight seal.
- Insert the transducer through the wellhead assembly and at least 5 feet into the water or to the top of the well screen. Secure transducer cable to well to prevent movement and allow the transducer to thermally equilibrate with the water temperature in the well prior to establishing a reference level on the transducer. Record the transducer depth reading.
- Close the pressure release valve and start the transducer log. Pressurize the well to the desired displacement using a hand pump (e.g., bicycle pump) or compressed air tank. Monitor the applied pressure using the gauge and control it using the regulator to ensure that the head is not depressed below the top of the well screen or below the transducer.
- Once the transducer readings and air pressure readings have stabilized, immediately release the air pressure in the well by releasing the vent valve on the well head assembly.
- Record time the test started in the field notebook or Slug Testing Data Acquisition Form.
- The test is considered completed when the transducer head reading is at the pre-test initial value. If repeated testing is part of the workplan, then 95% recovery to the original head should be achieved prior to conducting an additional test. If 95% recovery to the original head is not achieved, consult with the PIC and/or PM before proceeding further.
- If a regional water level trend that could affect water levels during the test period was identified during the pre-test period, continue logging water levels during the post-test period to provide additional data for trend correction.

4.3.5 Slug Test Completion

Following completion of the slug test(s) in each well:

- If possible, use a field computer to download the data from the transducer, confirm the test results, and evaluate whether repeat tests are needed.
- Withdraw the testing equipment from the well, replace the gripper plug and well cap, and secure the well.
- Properly decontaminate non-dedicated, non-disposable equipment prior to use and after use at each well. For non-dedicated equipment that has come in contact with groundwater, remove the equipment from the monitoring well and decontaminate in accordance with **FP 14.01**, Sampling Equipment Decontamination.
- Record in the field book or Slug Testing Data Acquisition Form:
  - Deviations from procedures defined in the project-specific Work Plan, Sampling Plan and/or FP (i.e., ceasing testing prior to stabilization);

  - The rationale for any modifications or deviations from the procedures; and
  - Abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.).

  Inform the Ramboll PIC and/or PM so necessary maintenance, redevelopment or repairs are conducted before the next planned groundwater sampling or testing event.

- Following completion of the field tests and prior to demobilizing, the parameters necessary for data analysis should be confirmed. These include the well name, test date, test type (rising vs falling head), well construction details, slug used and its dimensions, predicted initial displacement, and pre-test water level measurements. The transducer records from slug tests must also be processed prior to performing analysis. These data will be inspected to identify the test initiation points and static water levels.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work; however, certain precautions should be taken to ensure safety while conducting slug testing. Additionally, implementation of the work may face some difficulties, including the following:

- It is important to always remain alert and aware of your surroundings. Slug testing could involve the use of generators and associated equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, identify the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located in driveways or on the right of way).
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the well as it is being tested. Stay upwind of the well and ensure that air monitoring is conducted, and personal protective equipment is used in accordance in the site-specific HASP.
- Keep any tether, or suspension lines untangled. Use a plastic winder or spool winder to retrieve the slug to keep the line from tangling.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), field staff should use the "buddy system" and should ensure that the project-specific HASP includes safety measures and procedures for work in isolated areas.
- Care should be taken when opening well protective covers and removing well caps for the presence of venomous spiders and insect nests, such as wasps or hornets.
- For some wells, well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well

testing. Do not use petroleum-based solvent sprays to free seized locks as it may impact water quality in the well. Replace any damaged locks.

- Wells with a water-tight cap may experience a buildup of pressure or may be under vacuum. Keep your face and body away from the top of the well when loosening or removing the cap and allow the water level to stabilize before recording the static depth to water.
- Operate electronic water level meters and transducers in accordance with the manufacturer's instructions and recommendations.
- When multiple transducers are used, recording the model and serial number of each transducer and synchronizing their time encoding with the field computer or mobile device can help identify problems with a specific unit during data processing should they arise.
- Do not delete the data from the transducer until the presence of a copy of the slug test data is confirmed. Practice using the program in the office by taking measurements and downloading data before setting up on the well in the field.
- At sites where the density of water may vary or may be denser than fresh water, the effects of water density should be considered in the slug test design.
- Any movement of the slug or the transducer once it has been lowered into the well will create erroneous data and may give inaccurate results.
- Confirm each well was properly developed, especially wells within clay units. During well installation, the clay unit can smear, and reduce the effective hydraulic conductivity.
- If the well has not been sampled or developed in a long time, discuss the necessity to redevelop wells prior to commencing the slug test. Allow wells 48 hours to equilibrate prior to slug testing.
- Note any odors, staining, organic matter, or sediment on the slug or other equipment prior to decontaminating equipment. These may cause a change in the measured conductivity.
- Be aware of active wells or pump areas which could influence the measured conductivity.
- Be aware of the local geology when estimating how much time a slug test may take. For example, a test in a clay soil environment may take an entire field day to complete. Alternatively, a test conducted in a well set in a sand and gravel aquifer may be completed in less than one minute.

6. RECORDKEEPING

Document all testing locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information related to slug testing in accordance with **FP 1.01** (Field Notes and Records).

FIELD PROCEDURE NO. 6.04

GROUNDWATER AND FREE PRODUCT LEVEL MEASUREMENTS

VISTRA PROJECT
PROJECT NO. 1940112376

RAMBOLL

FIELD GUIDANCE DOCUMENT NO. 6.04

GROUNDWATER AND FREE PRODUCT LEVEL MEASUREMENTS

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 6.04 "Groundwater and Free Product Level Measurements" last revised July 12, 2016.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for groundwater level measurements (depth to water) and free product level measurements (depth of free product) in groundwater monitoring wells or piezometers. These guidelines may also be applicable for measuring the depth to water or free product in other types of wells (potable and non-potable) or boreholes as applicable.

Groundwater level measurements are collected to determine the depth to groundwater within a well relative to ground surface, top of the well casing, and/or an established elevation datum. Similarly, free product measurements are collected to determine the depth to non-aqueous phase liquid (NAPL) accumulated within a well relative to an established elevation datum. The accumulated thickness of NAPL within a well can be determined if the bottom of the free product can be additionally measured. Properly collected and recorded measurements can be utilized for generation of potentiometric surface maps to establish groundwater flow direction, define horizontal and vertical hydraulic gradients, evaluate variations in groundwater elevations over time, evaluate NAPL mobility or recovery, and other project specific tasks.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

Below is a general checklist of equipment that may be required for typical groundwater level measurement efforts. This checklist only suggests general equipment that may be necessary for a project or task and should not be considered exhaustive.

2.1 General Water and Free Product Level Measurement Equipment Checklist

- Electronic water level indicator;
- Electronic oil/water interface probe for wells containing known or suspected NAPL;
- GPS or other locating device;
- Site map showing locations of wells; and
- Well construction records and previous water level measurements.

2.2 Project- or Task-Specific Water and Free Product Level Measurement Equipment Checklist

- Well lock keys;
- Steel tape measure or submersible water level meter for use in measuring total well depth;
- Decontamination supplies /equipment (non-ionic detergent, tub, brushes, etc.);
- Wash bottles/bucket;
- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during sampling;
- Appropriate waste container – used to dispose of any Investigation Derived Wastes (IDW) and/or decontamination wastes;
- Socket wrench (manhole bolt sizes vary; most commonly require a 9/16” socket);
- Water valve gate box key (for older style flush-mounted wells);
- Pry bar (or other equivalent tool to assist in the removal of the flush mounted well cover or handhole);
- Syringe (or other equivalent tool such as a turkey baster to assist in removing standing water in flush mounted wells); and
- Extra batteries for the water level meter (usually 9-volt).

2.3 Miscellaneous Additional Suggested Equipment

- Extra vehicle keys;
- Metal locator (to find buried/obstructed flush mounted wells);
- First aid kit;
- Mobile phone;
- Credit card for gas and emergencies;
- Road and site maps;
- Chemical protective gloves and other personal protective equipment (PPE) as required by the HASP;
- Field notebook and field data sheets;
- Waterproof pens;

- Bolt cutters (to remove rusted padlocks);
- Replacement padlocks; and
- Camera and extra batteries.

3. REFERENCED GUIDANCE DOCUMENTS

The following FPs are related to this FP and should be referenced, as needed:

- **FP 1.01**, Field Notes and Records;
- **FP 1.06**, Field Surveying and Monitoring Well Elevation Surveying;
- **FP 2.02**, Site Preparation, Inspection and Housekeeping;
- **FP 6.15**, Well Construction Record; and
- **FP 14.01**, Sampling Equipment Decontamination.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site- specific Work Plans/sampling plan (e.g., field screening FPs, FPs for sampling of media, etc.).

4. PROCEDURES

4.1 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Coordinate and obtain permission for site access;
- Review project-specific Work Plan/sampling plan;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with PIC and/or PM the proposed activities or Work Plan/sampling plan;
- Review the standard instruction manual provided by the manufacturer of the specific equipment being used for water level monitoring and field screening;
- Inspect the water level meter(s) for any signs of damage and test for proper operation;
- Identify well locations and any specific order in which they are to be collected (refer to Section 4.2 and Section 5.0), and confirm the measurement datum on each well casing;

- Obtain copies of recent or historic (i.e., same season) water or free product level data to be able to anticipate the approximate depth of water or free product minimizing unnecessary wetting of the tape and as a check of the measured levels;
- Obtain copies of well construction records (refer to **FP 6.15**, Well Construction Record), as these can be used to confirm the well identification if not clearly identifiable; and
- Identify wells that are known or suspected to contain NAPL or other free product. An electronic oil/water interface meter must be used in these wells in lieu of an electronic water level indicator.

All significant field activity decisions will be approved by the PIC and/or PM before the initiation of field activities. The sampling plan should be designed for the collection of quality data that meet the goals of the study/monitoring program. The work plan/sampling plan should generally provide for some discretion in the field depending on encountered conditions; however, any significant departure from prescribed field activities shall be approved by the PIC and/or PM.

Prior to the commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements**.**

4.2 General Water Level Measurement Guidelines

Water level measurements are generally taken in monitoring wells, piezometers, or boreholes using electronic water level indicators. There are different manufacturers of electronic water level indicators including Solinst, Keck, and Heron. Electronic water level indicators consist of a reel of dual conductor wire embedded within a pre-marked tape, a probe with an insulating gap between the wire attached to the end of the tape, and an indicator on the reel. Generally, tapes are marked every 1/100th of a foot and/or millimeter. When the probe comes into contact with water, the circuit is closed and the indicator signals this contact with an audible buzzer and/or an optical light. The meters typically run on 9-volt batteries located within the reel as a power source. Many water level meters include a sensitivity adjustment on the indicator. The sensitivity adjustment diminishes potential short circuiting of the probe in moist environments such as those encountered in a well.

The following provides a recommended list of practices for water and/or free product level measurement activities:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- All wells to be gauged should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Because groundwater or free product depth can vary due to natural fluctuations in ambient conditions (e.g., barometric pressure), all measurements for a specific sampling event should be collected within as short of a time frame as possible.

- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- All depth to water or free product measurements should be completed prior to any planned groundwater and/or product withdrawals, sampling or disturbance of groundwater unless otherwise specified in the work plan/sampling plan.
- All water or free product level measurements should be made relative to an established reference datum and should be recorded in the field notes. The reference datum is usually marked, notched or etched on the well or casing at the time of installation on the north side of the inner casing. In the absence of a marked, notched or etched reference datum take water level and depth measurements from the north side of the inner casing and mark or etch it for future reference. In the case of a casing notched or etched at a distinct angle, the measurements should be made from the highest point in the casing. Note this procedure in the field book.
- Record in the field book the model name, number, and serial number of the electronic water level meter or interface probe being used.
- Identify the well to be measured and confirm by checking for proper identification markings on the well, comparing to a site map, and if needed historical water and/or product level measurements and well construction records. If the well cannot be positively identified, contact the PIC or PM before proceeding. It may be possible to identify the well by comparison of the total well depth with the well construction records; however, such measurement should be discussed with the PIC or PM before proceeding in cases where the well is to be sampled after water level/free product measurements are collected.
- Decontaminate the water level meter probe, interface probe, and/or tape (if total well depth measurements are being conducted with a tape) prior to each use.
- Remove well cover or equivalent protective casing cover. Inspect the interior of the well box for insects, etc., that could present a biological hazard. If there is water in the well box, remove all water (at least to a level below the top of the inner well casing) prior to removing the well cap or plug. Indicate that water was removed from the well box and identify possible causes (e.g., missing bolts, damaged well cover, etc.).
- Remove the well cap or plug, noting well identification, time of day, and date in field book. Also note any abnormal conditions in the well (e.g., damaged inner casing, limited clearance between the bottom of the well box and the top of the inner well casing, absence of reference datum, etc.) If the top of the well casing has been damaged, the reference datum may no longer be accurate.
- If the wells are outfitted with expansion caps, these should be removed and the wells allowed to equilibrate for an appropriate period of time prior to the collection of water level measurements. This is especially critical for wells screened below the water table or in confined units. There are no set guidelines and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives.
- Record observance of positive or negative pressure in the well upon removal of the well cap. The presence of pressure/vacuum in the well could be qualitatively assessed during

loosening and removal of an expansion cap (resulting in air either being audibly pushed out or drawn in to the well casing) or using a piece of paper or other light object (i.e., easily moved or displaced by light air flow) placed immediately above the inner well casing and observing its movement (i.e., if it adheres to well casing, there is a negative pressure in the well; if it moves from the well casing, there is a positive pressure in the well). If pressure was observed, the water level should be measured multiple times over a 5 to 10 minute period to allow time for equilibration and confirm that the water level has reached static conditions.

- Monitor the headspace of well with a field screening device in accordance with the applicable manufacturer instructions and FP. Record field screening readings in field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling plan.
- Check that the indicator on the water level probe is working properly by pushing the test button on the reel. Replace batteries in the electronic water level meter or product interface probe if testing or operation of indicates the battery is not providing sufficient power. If the battery is replaced during a field measurement event this must be recorded in a field log book.
- Lower the probe slowly into the well taking care to minimize contact with the well casing. If significant kinks are observed in the tape, attempt to straighten manually and record observations in project field book or log.
- When a strong and steady signal from the indicator signals water or free product has been encountered slowly pull the tape up until the signal ceases.
- Manually lower and raise the probe to exactly locate the water or free product interface.
- At the point where the signal indicates free water surface or free product has been encountered, measure and record the depth of the probe using the marked tape.
- If free product is encountered, continue to manually lower the probe into the well until a strong and steady signal from the indicator signals that water has been encountered. Lower and raise the probe to exactly locate the water or free product interface. Measure and record the depth of the probe using the marked tape.
- Measurements should be referenced to the established reference datum.
- Repeat the measurement to verify accuracy. Measurement should be recorded to the nearest 1/100th of a foot or to the nearest millimeter.
- If total well depth measurements are required, these should be made in reference to the top of casing as well as the ground surface. These measurements should be performed after sampling.
- Withdraw the probe from the well, replace the well cap, and re-secure the well.
- Record in the field book any abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.). Inform the PIC or PM so necessary maintenance, redevelopment or repairs are conducted before the next planned water level measurement event.

To minimize potential cross-contamination across wells, decontaminate the probe and portions of the tape that made contact with water and/or product as described in the

FP 14.01 (Sampling Equipment Decontamination), project-specific sampling plan and/or QAPP.

4.3 QA/QC

Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific Work Plan/sampling plan and/or QAPP must be followed throughout the water level measurement process.

5. PRECAUTIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. Additionally, implementation of the work may be faced some difficulties. However, certain precautions should be taken to ensure safety while conducting water level measurements.

- Operate electronic water level meters and product interface probes in accordance with the manufacturer's instructions and recommendations.
- The protective casing of flush-mount wells often fills with run-off surface water. If upon removing the well cover, the top of inner well casing is submerged, utilize a syringe, turkey baster, or equivalent tool to remove the excess water before removing the well cap in order to avoid surface water flow into the well.
- Well keys may not work with rusted/outdated well locks; bolt cutters may be used to remove the lock, which should be replaced upon completion of water level measurement. Do not use petroleum based solvent sprays to free seized locks as this may impact water quality in the well.
- Wells with a water-tight cap may experience a buildup of pressure, especially if they are screened below the static water level. Keep your face and body away from the top of the well when loosening or removing the cap.
- Ensure that the water level has reached the static level prior to recording the depth to water. Should the water level be in a state of flux due to pressure buildup, allow ample time for the water level to stabilize to static conditions before recording measurement (refer to Section 4.2).
- Water level probe indicator response may be indicative of potential faults that could be corrected in the field:
  - If the signal from the indicator is intermittent or weak it may be necessary to decrease the sensitivity since it may be short circuiting prior to encountering free water.
  - If there is no signal it may be necessary to increase the sensitivity since some groundwater is less conductive and may not complete the circuit.
  - If the signal is still intermittent, weak, or absent then replace the battery and reattempt the measurement.
- Cascading water may interfere with the measurement of free water; particularly in open boreholes or rock wells.

- Some well casings have sharp edges; care should be taken when lowering or withdrawing the tape to avoid damaging the tape and water level probe.
- Oil or other product floating on the water column may insulate the contacts of the probe resulting in a misleading indication of the depth to free water. A separate oil/water level indicator should be used if there is known or suspected product in a well (refer to Section 4.2).
- It should be noted that some water level indicators will have a 2 to 3 inch weight on the tip of the probe which can displace water in a well before the water indicator detects it. These models also make it difficult to detect small amounts of water in wells, i.e. less than 3 inches. If this is expected to be a potential issue, then request a model with the water indicator located on the tip of the probe.
- Meters should be inspected periodically to ensure accurate readings. Electronic water level meters and interface probes may not function properly if the electric wire is broken, cut, or if insulation is removed exposing the wire (resulting in short circuiting). Repaired meters may have had sections of the tape removed and/or spliced and may not meet data quality objectives. Damaged tapes or tapes suspected of being damaged should be repaired by the manufacturer or replaced.
- If using the water level meter for total depth measurements, confirm that the probe is designed for total immersion and the maximum acceptable depth of immersion.
- Tape lengths can be confirmed using a calibrated steel tape as necessary to adhere to data quality objectives. Discrepancies in tape length must be noted in the field log book and/or field sheet.
- For high conductivity groundwater (brine) decreasing the sensitivity control prevents bridging so a moist probe is not detected as being in water.

6. RECORDKEEPING

Document all water level measurement locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information in accordance with **FP 1.01** (Field Notes and Records)**.**

FIELD PROCEDURE DOCUMENT NO. 6.07

WELL DEVELOPMENT
VISTRA PROJECT
PROJECT NO. 1940112376

RAMBØLL

FIELD PROCEDURE DOCUMENT NO. 6.07

WELL DEVELOPMENT

Documents Used as Reference During Preparation:	Ramboll Field guidance Document NO 6.07 "Well Development" last revised December 9, 2024.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the development of newly constructed groundwater wells and existing wells being rehabilitated. Well development is a critical step in the construction of a well and is necessary before the well can be used in environmental and hydrogeologic investigations (e.g., groundwater sampling, water level monitoring, withdrawal tests, and injection tests). Well development is also used in the rehabilitation of wells which may have been in disuse over long periods of time and/or have accumulated silt.

Well development refers to the process of clearing the well and formation around the screen of fine-grained materials such as fine sands, silts, and clays, produced during drilling or naturally occurring in the formation to reduce turbidity. Well development is conducted to create an effective filter pack, allowing for establishment of a good hydraulic connection between the well and the formation to allow water to flow more freely to the well.

Typical well development methods include bailing or purging, overpumping, mechanical surging, air-lift surging, and water jetting or a combination of purging and surging techniques. The appropriate well development method is selected based on well design, well depths, lithology, and other project requirements. The simplest method of removing fines from water-bearing formations is by a process of overpumping during which water is removed from the well at a higher rate than used for normal service of the well (e.g., purging prior to sampling). Effective development should cause reversals of flow through the well screen so as to agitate the sediment, remove the finer fraction from the well pack, and to rearrange the well pack. This FP focuses on the most common well development method-mechanical surging with bailing and pumping to force water into and out of the well screen interval by operating a plunger up and down in the casing, similar to a piston in a cylinder.

This FP provides guidance for well development using mechanical surging with bailing and pumping. However, for certain projects other location or sampling procedures or alternative methods may be required. For example, other well development methods may be more appropriate for specific site conditions or types of wells (e.g., bedrock wells, multiple nested wells installed within a single borehole, artesian wells, deep water production wells with more than one screened interval, and wells with the potential presence of a Non-Aqueous Phase Liquid [NAPL]). These projects may specify state-specific or regulatory program-specific guidelines, requirements, or procedures. In general, well development procedures that include adding water or other fluids to the well and have the potential to impact groundwater quality are not recommended. Sometimes, depending upon well type depth and lithology, a combination of different methods may be needed.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC)/Project Officer (PO) and/or Project Manager (PM) shall verify that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT AND MATERIALS

This list below provides an overall summary of equipment that may be necessary for well development, but the list should not be considered exhaustive. Where licensed drillers are required to develop wells, the drilling contractor will generally supply the equipment and materials necessary for well development; however, Ramboll oversight personnel should understand the equipment and materials that are required for the driller to complete the well closure. Additional equipment may be specified in the project-specific Work Plan, Field Sampling Plan, QAPP, and/or HASP. More specialized equipment and materials may be required depending on depending on the on the type of well closure to be performed (refer to **Section 4.1**).

- Site information (e.g., figures/maps, contact numbers, previous field logs, utility maps).
- Well keys.
- Well design and construction information such as well logs, construction specifications, and diagrams.
- Digital data collector or field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Field screening equipment (e.g., photoionization detector [PID]) as required by the project-specific Work Plan, Field Sampling Plan, QAPP and/or the site-specific HASP.
- Personal Protective Equipment (PPE) in accordance with the site-specific HASP. Sterile gloves must always be worn when handling and utilizing sample equipment.
- Either a surge block and cable, bailer or Waterra® inertial lift development valve and tubing (or similar). Generally, this equipment can be supplied by the drilling contractor. A surge block consists of a plunger made of PVC or rubber attached to a rod or pipe and connected to a cable of sufficient length to reach the bottom of the screen. Bailers are typically non-dedicated, bottom suction bailers constructed of stainless steel and attached to the cable in the same manner as the surge block.
- Appropriate pump and associated polyethylene tubing and power source, such as a marine battery or portable generator.
- Electronic water level indicator or interface probe (refer to **FP 6.04**, Groundwater and Free Product Level Measurements).
- Turbidimeter, multi-probe water quality meter, and flow-through cell.
- Decontamination supplies (refer to **FP 14.02**, Equipment Decontamination).
- Heavy duty trash bags for disposal of gloves, towels/rags and any other non-hazardous waste generated during well development (refer to **FP 15.01**, Waste Handling).
- Appropriate waste container and labelling materials (supplied by drilling contractor unless specialized containers are required) used to dispose of Investigation Derived Wastes (IDW) including well development water and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- Plastic sheeting.

- General hand tools for opening and closing protective well covers and 55-gallon drums.
- Weighted, calibrated measuring tape.

3. PROCEDURES REFERENCED

In addition to the reference and guidance documents cited above, the following FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **FP 1.01**, Field Records and Notes
- **FP 6.01**, Permanent Overburden Well Installation
- **FP 6.04**, Groundwater and Free Product Level Measurements
- **FP 6.15**, Well Construction Record
- **FP 14.01**, Sampling Equipment Decontamination
- **FP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other FPs and Safe Work Practices (SWPs) may need to be referenced based on the specific requirements of the project-specific Work Plan, Field Sampling Plan, and/or QAPP (e.g., field screening FPs, FPs for sampling of media).

4. PROCEDURES

4.1 Planning Considerations

Well development is a critical step in the installation of a well (refer to well installation FPs) and is also used in the rehabilitation of wells. Strategic decisions will be approved by the PIC/PO and/or PM before the initiation of associated field activities and will be documented in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. The project-specific Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities/procedures should be discussed with and approved by the PIC/PO and/or PM.

When planning a well closure event, the following should be considered:

- *Regulatory Requirements*. In certain States, the development or rehabilitation of a well is to be performed by contractors licensed as a water or environmental well driller (as appropriate) in the State where the work is being performed. Therefore, State regulations and guidance governing well development should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements.
- *Well Development Method*. The method used to develop wells is dependent upon site-specific subsurface conditions, equipment availability, well design and well accessibility. Similarly, the volume of water to be removed for well development can depend on the radius or zone of influence of the well and how the well was constructed (e.g., duration and drilling method). Thus, prior to well development, available well construction details and information on the local geology and hydrogeology should be compiled and reviewed.

  The complexity of the well construction, the local geology, and the presence and the risk of aquifer contamination are also factors to consider in planning the development of a well. For example,

  - If water or other fluids were added to the well during construction (e.g. rock coring or fluid rotary), at least the amount of water lost to the borehole during drilling shall be removed from the well during development.
  - If the well was installed via mud-rotary drilling methods, well development should occur immediately following well installation, if possible, otherwise removal of a mudcake filter pack may be problematic.
  - For other drilling methods, well development should occur at least 48 hours after well installation to allow the grout sufficient time to cure. However, if grout is not used to seal the well (e.g., hydrated bentonite chips), well development could occur within several hours of well installation.

  Generally, pumping a well until the water runs clear is not an effective or proper well development method, since the one-directional high-stress flow may cause bridging of formation soils and filter pack materials. Appropriate well development methods include mechanical surging with bailing or pumping, over pumping, air lift pumping, and jetting.

Following are general guidelines for the most common well development method, mechanical surging with bailing and pumping.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review, and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). To the extent that non-dedicated equipment is to be used (e.g., pumps), to minimize potential cross-contamination of samples among sampling locations, such equipment should be decontaminated before use as described in **FP 14.02** (Heavy Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP. Used disposable equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling), following the sampling event.

In addition, at a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP. Clean, chemical protective, dedicated gloves must always be worn when handling soil and using sample equipment.
- Coordinate and obtain permission for site access.
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work.
- Confirm well locations.
- Review project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable.
- Review and discuss with PIC/PO and/or PM the project-specific Work Plan, Field Sampling Plan or sampling strategy.
- Review the well construction records (refer to **FP 6.15**, Well Construction Record) to ensure equipment/materials are adequately sized.
- Ensure that equipment/materials required to complete the work have been secured and packed prior to travel. If equipment is being shipped to an alternate location, arrange for delivery at least one day prior to the start of the field work and confirm receipt at the delivery location (e.g., hotel or site).

4.3 General Well Development Guidelines Using Mechanical Surging with Bailing and Pumping

The following provides a recommended list of practices for well development activities:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- Prior to initiating the well development activities, review the well construction records (refer to **FP 6.15**, Well Construction Record) and confirm the location and construction details (materials, diameter, depth, etc.).
- Confirm that all non-dedicated (i.e. reusable) equipment and instruments that will come in contact with the well have been decontaminated (refer to **FP 14.01**, Sampling Equipment Decontamination).

- Prior to commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements and background levels recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records).

- Although equipment will be decontaminated between uses to further limit potential cross-contamination between sampling locations, well development activities should be conducted from areas of least suspected to most suspected impacted locations.
- During the well development process record all equipment and materials used including times and quantities. Observations and field data should be recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records). Ramboll personnel should record any problems encountered and communicate with the PM or PIC/PO. Initial records should include:
  - Well designation.
  - Date of well installation.
  - Well diameter, well depth, screen depth and length, and height of well casing above or below ground surface.
  - Date of development and start and end times of development.
  - Calculation of the well volume (see equation below), including source of well construction information (e.g., well record, field measurement).
  - Details in the equipment used for well development (i.e., type and size/capacity of pump, description of surge equipment, such as surge block, bailer, Waterra® or pump).
  - Name of well developer and drilling company (if applicable).
- Verify the correct well has been located based on well tag/identifier on the outer casing.
- Unlock and open the protective steel casing or well box.
- Unlock and remove the inner casing cap (or water-tight locking cap on the well casing in the case of a flush mounted well) and, when required, use the field screening equipment (refer to field screening equipment FPs) to measure organic vapor/gas concentrations in the well box. Record all field measurements in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- If appropriate based on surface conditions, polyethylene plastic sheeting should be placed around the well casing.
- Measure and record in the field notebook the depth to water and total well depth before development using an electronic water level indicator or interface probe (if NAPL is expected to be present) (refer to **FP 6.04**, Groundwater and Free Product Level Measurements). If NAPL is present, contact the PIC/PO and/or PM to discuss alternate well development procedures.

- Calculate the well volume in gallons (V_{ow}) using the following equation:

$$V_{ww} = 7.48(\pi \frac{d_{ww}^2}{4} h_{ww})$$

Where:

d_w is the well diameter (feet)
h_w is the height of water in the well (feet)

In general, the volume of a 2-inch diameter well is 0.16 gallons per foot and the volume of a 4-inch diameter well is 0.65 gal/ft.

- Prior to starting development record initial water quality parameters (temperature, pH, and specific conductance or electrical conductivity) and initial characteristics of the discharge water (i.e., color, odor, and sheens/free product).
- Well development should begin by assembling the equipment for well development and withdrawing at least two well volumes of water from the well and storing it into 55-gallon steel drums or other appropriate waste containers (refer to **FP 15.01**, Waste Handling). During the initial water withdrawal, water level drawdown in the well and purge/water removal rate should be measured and recorded in the project field book. However, if the well runs dry during the initial well volume removal, if initial water level monitoring indicates that the well will run dry, or existing nearby wells in the same formation have been identified as running dry during development or purging, the well development activities should be temporarily halted and the Ramboll oversight personnel should contact the PIC/PO and/or PM to discuss alternate well development procedures.
- The entire screened interval should be developed from the top of the well screen down, dividing the screened interval into sections (typically 2 to 5 feet) as necessary. This will prevent the buildup of fines grained materials on the surge block, which in turn could bind the surge block to the well casing.
- Following initial water withdrawal, the well should then be surged by lowering the surge block or other surge device (Waterra®) to the top of the well screen and manually pumping the surge block with a stroke of less than 3 feet. The pulling and pushing action on the surge block will force water into and out of the well screen, thereby removing any drilling or formation fine grained materials from the well screen and suspending them in the development water. After surging, the surge block should be removed and development water removed using the pump and tubing. A bailer may be used prior to pumping to remove water with high turbidity to avoid damage to pumping equipment. Turbidity and other water quality parameters (e.g., conductivity, temperature, and pH) should be measured during removal of the development water to evaluate the geochemical characteristics of the purge water. Alternatively, if allowed by the well configuration, a low-capacity pump can be installed above the surge block to simultaneously surge and discharge, thereby ensuring a gradient is maintained towards the well.
- The above surging and removal action is performed at depths corresponding to the entire screened interval until drilling or formation fine grained materials are no longer produced or until turbidity has decreased and other water quality parameters (e.g., conductivity, temperature, and pH) have stabilized. Typically, well development should proceed until monitored parameters (especially turbidity) have stabilized or a minimum of five well volumes of water have been removed. The stabilization metrics should be defined in the Work Plan/sampling plan. The surging and removal action sequence may be repeated at higher extraction rates to achieve the desired well development. Some wells may be

incapable of achieving non-turbid water quality and well development should be suspended after a reasonable well development effort has been undertaken and results have been communicated to the PIC/PO and/or PM.

- Describe in the field notebook the details of the well surging process (e.g., equipment used, depths surged, surge depth increments, and speed, length and frequency rates.) Record the drawdown in the well, the purge rate during each pumping cycle, and the water quality parameters per well volume removed. In addition, provide descriptions of the physical character of removed water, including changes in clarity, color, particulate matter, and odor.
- The following guidelines improve the effectiveness of well surging:
  - The manual surging rate should initially be gentle, with gradual increases during the development process (i.e., increases in rate with depth of surging). The manual surging rate is controlled by the speed, length and frequency of the pushing and pulling action.
  - The energy of surging is gradually increased at each depth of surging until drilling or formation fine grained materials are no longer produced from surging at that depth.
  - The depth of surging is incrementally increased from top to bottom of the well screen.
- Measure and record in the field notebook the depth to water, drawdown and total well depth after each removal of development water and at the completion of development using an electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements).
- Measure the purge rates during each cycle and record in the field notebook.
- If the well runs dry during development or if it is suspected that the well will run dry, the well development activities should be temporarily. Contact the PIC/PO and/or PM to discuss alternate well development procedures. In some cases, well recharge may span from hours to more than a day.
- Record in the field notebook the total amount of water removed during well development and the rationale for terminating the development of the well (e.g., water quality parameters stabilized, five well volumes removed, well ran dry).
- All equipment shall be decontaminated upon completion of well development (refer to **FP 14.01**, Sampling Equipment Decontamination) and dedicated equipment (e.g., non-reusable tubing) should be removed and managed as investigation-derived waste (refer to **FP 15.01**, Waste Handling).

4.4 Management of Investigation-Derived Waste

All IDW, including well development and decontamination fluids, generated during well development should be sealed, labeled, stored in a safe location, and profiled for appropriate off-site disposal as outlined **FP 15.01** (Waste Handling), unless project-specific requirements specify otherwise.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while conducting well development activities. Additionally, implementation of the work may require compliance with state-specific or regulatory program-specific requirements.

- Some States may have specific licensing requirements for installing monitoring wells. Where required, only drillers licensed in the State where the work is being performed should be subcontracted to perform the work. Each State may have specific licensing requirements.
- If the State requires that the well be developed by the drilling contractor, the drilling contractor should be informed of the well construction design as part of the contracting process so they can ensure that the appropriate equipment, personnel, and materials are mobilized. The driller should define the specific equipment that will be used for well development, so field personnel can prepare accordingly.
- It is important to always remain alert and aware of your surroundings. Well development involves the use of drilling rigs or other heavy equipment, and field activities may be subject to hazards posed by nearby equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and other physical, biological, mechanical, and chemical hazards.
- Prior to mobilization, determine the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located on the right of way).
- At sites with certain contaminants and/or subsurface conditions (e.g., landfills, non-aqueous phase liquids), potentially toxic and/or explosive gases may accumulate at and around the well as it is being developed. Stay upwind of well development activities and ensure that air monitoring is conducted, and PPE is used in accordance with the site-specific HASP.
- Water shall not be added to the well to aid in development as this can affect the natural groundwater chemistry, unless previously approved by the PIC/PO and PM and/or regulatory agency. If potable water is added, chemical analysis of a sample of this water may be necessary to document the quality of the water used for development.
- The use of chemicals (e.g., detergents, chlorine, acids, or other chemicals) to increase or restore the yield of a monitoring well/piezometer is not acceptable.
- For existing wells being rehabilitated through development, well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well rehabilitation. Do not use petroleum based solvent sprays to free seized locks as it may impact water quality in the well.
- Wells with a water-tight cap may experience a buildup of pressure. Keep your face and body away from the top of the well when loosening or removing the cap.
- When working out of sight of the general public or site employees are in potentially hazardous areas (e.g., wooded habitats), field staff should utilize the “buddy system” and should ensure that the site-specific HASP includes safety measures and procedures.

6. RECORDKEEPING

Document well development details in accordance with **FP 1.01** (Field Notes and Records) and **FP 1.03** (Data Management).

FIELD PROCEDURE NO. 6.08

ESTIMATION OF IN-SITU HYDRAULIC PROPERTIES – AQUIFER TESTS

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBØLL

FIELD PROCEDURE NO. 6.08

ESTIMATION OF IN-SITU HYDRAULIC PROPERTIES – AQUIFER TESTS

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 6.08 "Estimation of In-Situ Hydraulic Properties – Aquifer Tests" last revised June 25, 2020.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for conducting aquifer tests (also known as aquifer performance tests) to estimate the hydraulic properties of a groundwater-bearing zone at contaminated sites.[1]

The hydraulic properties of a water bearing unit are key components for the evaluation of groundwater flow and contaminant transport, thereby are critical for predictive fate and transport modelling, assessment of remediation strategies, and the design of in-situ treatment and/or groundwater extraction and treatment systems. Characterizing representative hydraulic properties of a subsurface hydraulic unit is an integral part of groundwater investigation programs. Aquifer tests are controlled field tests in which a well is pumped at a controlled rate and the water level responses (head change) in the pumping well and associated observation wells or piezometers are monitored. The well water level response data can be used in conjunction with appropriate analytical equations and computer models to estimate site-specific hydraulic properties of aquifers, evaluate well performance, and identify aquifer boundaries. This FP covers the following types of aquifer tests:

- Step-drawdown test (often referred to as a stepped-discharge or step test). These tests are performed to estimate the specific capacity of a well at varying discharge rates, to select pumping rates for constant-rate aquifer tests, and to evaluate extraction well performance (including well efficiency, head loss due to laminar groundwater flow, and well loss due to turbulence and other well inefficiencies[2]). Step tests cannot be used to calculate the well efficiency but do provide information regarding the efficiency of wells and for selecting discharge rates for constant-rate aquifer tests. If other information is available to determine sustainable flow rates, a step test may not be necessary.
- Constant-rate aquifer test (comprising both drawdown and recovery tests):
  - Drawdown Test. The constant rate drawdown portion of the aquifer test consist of pumping a well at a constant rate and measuring water level response (head change) at the pumping well and observation wells. These tests are used to estimate aquifer transmissivity, hydraulic conductivity, storativity, and hydraulic boundaries.
  - Recovery Test. Groundwater measurements are obtained during the recovery portion of the aquifer test after the pump is shut down. These tests provide data for an independent evaluation of the aquifer transmissivity and storativity and should be used in conjunction with calculations obtained from the drawdown test to estimate the hydraulic properties of the zone(s) of interest. Results of a recovery test can be more reliable or simpler to analyze than the constant rate test results because recovery is not influenced by fluctuations in flow rate that can be characteristic of pumping (e.g., no discharge fluctuations occur, pump-induced turbulence is not a concern).

[1] For noncontaminated sites, certain equipment and procedures outlined in the FP (e.g., water management) will not be applicable.

[2] Head loss at different pumping rates around a well attributable to laminar and turbulent groundwater flow.

This FP is intended to provide a reference for performing an aquifer test program for estimating site-specific hydraulic properties of aquifers, evaluate well performance, and identify aquifer boundaries. These tests and subsequent data analysis should be performed under the direction of a hydrogeologist or engineer with aquifer test experience.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PI) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll's document handling and retention policies. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

A general checklist of equipment that may be required for a typical aquifer test is provided below. Additional equipment may be specified in the project-specific HASP and/or FSP. This checklist includes a summary of equipment typically required for aquifer tests and should not be considered exhaustive. More specialized equipment may be required depending on project-specific needs. Note that aquifer tests can be conducted at contaminated or non-contaminated sites, and equipment needs should be adjusted accordingly. Ramboll oversight personnel should understand and be familiar with the operation of the equipment and materials that are required for aquifer tests.

2.1 General Equipment Checklist

- Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points);
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Plastic sheeting;
- Measuring tape;

- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during testing (refer to **FP 15.01**, Waste Handling);
- Water discharge equipment according to permit conditions, possibly including:
  - 55-gallon steel drums, Department of Transportation-rated (for legal waste hauling), or other appropriate waste container, such as a frac tank – for disposal of any pumped groundwater, Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling);
  - On-site groundwater remediation system to treat contaminated groundwater prior to discharge to a location where it cannot infiltrate back into the well being tested.
  - Discharge lines to a sewer system. if permitted.
  - Discharge lines to ground surface, stormwater system or adjacent surface water bodies if permitted.
- For contaminated sites:
  - Labels for Investigation Derived Waste (IDW) containers as outlined in **FP 15.01** (Waste Handling) and indelible pen or sharpie;
  - Bucket, spray bottle, distilled/deionized water, and Liquinox (or Alconox) – used for the decontamination of equipment (refer to **FP 14.01**, Sampling Equipment Decontamination); and
  - Personal Protective Equipment (PPE) and field screening equipment in accordance with the site-specific HASP, including sterile gloves which must always be worn when handling and utilizing sample equipment.

2.2 Project- or Task-Specific Aquifer Test Equipment Checklist

- Well construction specifications, well survey data, and diagrams;
- Data collection forms and appropriate graph (either full logarithmic or semi-logarithmic) or computer program to review test progress and assess timing for completion of each test phase;
- Aquifer Test Data Acquisition Form (refer to);
- Cable ties;
- Keys for wells;
- Electronic water level indicator (refer to **FP 6.04**, Groundwater and Free-Product Level Measurements);
- Equipment to confirm depth to bottom of the well;
- Electronic water-level data logger or transducer (e.g. In-Situ Troll family or equivalent), preferably gauged or vented (i.e., can auto-compensate for barometric pressure); otherwise, in addition to the absolute (or non-vented) water level data logger, a continuous recording barometer may also be required. Note that for wells with non-aqueous phase liquids (NAPLs) transducers should not be used unless they are dedicated to the site and the change in NAPL thickness should be measured during the testing;

- Field computer (such as a Rugged Reader or equivalent) and/or field laptop computer with applicable software selected for the appropriate water-level data logger;
- Communication cables for the data logger and computer equipment;
- Stilling pipe for purposes of measuring water levels within the pumping well: A long, open-bottomed section of small diameter solid pipe or tube hung within the well casing that provides an unagitated water level surface), appropriately sized for the pumping well where it will be used (where applicable);
- If Ramboll is providing and operating the pump for the tests:
  - Appropriately sized and powered pump, electrical cables and suction/discharge hoses;
  - Dedicated suspension line or tether constructed of material that minimizes interactions or alterations when in contact with groundwater or that may cause loss of analytes of interest via sorption (e.g., poly twine, nylon string, stainless-steel, Teflon-coated stainless-steel wire, etc.) for lowering and raising pump;
  - Plumbing fittings – check valves, flow control valves, barbed "T" or "Y" fittings, stainless-steel needle valves or stainless-steel/Teflon ball valves; and
  - Tripod-mounted winch system or hoist - used to control placement of the pump in deep wells or large-diameter wells requiring large pumps; appropriately sized generator, if needed, with sufficient fuel and secondary containment system to capture potential spills.
- Flow meter, weir, or calibrated container(s) (e.g. graduated cylinder or bucket) of suitable size;
- Stop watch;
- Tool set: socket set, socket wrench, screw driver, multi-tool, tubing cutters, "turkey baster" and/or cup for water removal from flush-mounted well vaults;
- Spare/replacement parts: gripper plugs/well caps, well lid bolts;
- Folding work table; and
- Lighting for night operation.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01**, Field Notes and Records;
- **FP 2.02**, Site Preparation, Inspection and Housekeeping;
- **FP 6.04**, Groundwater and Free Product Level Measurements;

- **FP 6.07**, Well Development;
- **FP 6.14**, Determination of Hydraulic Properties - Packer Pressure Test;
- **FP 6.15**, Well Construction Record;
- **FP 14.01**, Sampling Equipment Decontamination;
- **FP 15.01**, Waste Handling; and
- **FP 15.02**, Waste Sampling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site-specific Work Plan/FSP (e.g., field screening FPs, FPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

Aquifer test strategy decisions will be approved by the PIC and/or PM before the initiation of associated field activities and documented in the Work Plan/FSP. The Work Plan/FSP will be designed for the collection of quality data to meet the objectives of the aquifer test program and will include the locations, depths, number of test and observation wells, and testing methods, as well as quality assurance/quality control (QA/QC) sample requirements. The Work Plan/FSP for aquifer tests will specify whether any extraction wells in the project vicinity require shut-down before the start of testing. The Work Plan/FSP will provide some discretion in the field depending on the conditions encountered; however, significant departure from prescribed testing activities should be discussed with and approved by the PIC and/or PM.

A number of design considerations should be evaluated when planning an aquifer test program. All of these design considerations are relevant for constant rate pumping tests, while a subset are relevant for step-drawdown tests. The following provides a brief description of these design considerations.

A. *Understanding of Aquifer Conditions* - Designing constant rate aquifer tests that provide suitable data to evaluate hydrologic system parameters (transmissivity, hydraulic conductivity, storage coefficient, leakage, boundaries, anisotropy) requires a general understanding of the local hydrologic system and contaminant conditions. This understanding, regardless of how extensive or limited, is key for the development of a conceptual site model to support the test design development. This conceptual site model is then used during the implementation of the aquifer test to evaluate whether the test is proceeding as designed or whether the test procedures should be altered.

   Although these design considerations generally support test success, strictly adhering to them may produce conflicting test designs. Resolving these design conflicts requires aquifer test experience and is based on a clear understanding of the test priorities and

an appropriate knowledge of the local groundwater system and site environmental conditions.

B. *Estimating Aquifer Parameters* - Although the constant rate aquifer test objective is to estimate principal aquifer hydraulic parameters, a preliminary estimate of these properties is required to develop the test design scope, such as test well pumping rates, pumping test duration, and observation well spacing. Step-drawdown tests primarily require aquifer information to estimate test well pumping rates. Available background information for the aquifer may provide an estimate of the aquifer hydraulic properties.

C. *Pumping Well Selection* - The selection of the pumping well location for constant-rate aquifer tests should consider both aquifer hydraulic conditions as well as the accessibility and safety of possible pumping well locations in the context of achieving the test objectives. The aquifer contaminant distribution should also be considered because of the impact of pumping on the contaminant migration and the need to manage the test discharge. Existing site wells may provide acceptable pumping and observation well locations for meeting program objectives. Step-drawdown tests should consider the accessibility and safety of the test well locations. In addition, proper development of the selected pumping well should be confirmed as gradually decreasing aquifer communication in a pumping well by infilling of the well screen significantly complicates test data analysis (refer to **FP 6.07** - Well Development).

D. *Pumping Well Design/Development* – For constant-rate aquifer tests, the selection of an existing pumping well and the design of a new pumping well should consider the selection of well depth, well screen and casing diameter, screen intervals and slot size, type of sand pack, drilling method, and well development. For designing a new pumping well, a test boring should be completed with soil samples collected from the possible well screen depth intervals and subjected to grain size analysis. Proper well development is critical for an effective pumping well, whether it is newly installed or existing.

E. *Estimate the Casing and Filter Pack Storage Effects* – Wellbore storage effects, caused by large well diameter and/or low pumping rates, affect analysis of early-time drawdown data for both constant-rate aquifer tests and step-drawdown tests. These potential effects should be estimated during the design of tests.

F. *Select the Number of Observation Wells* – Head change (drawdown) measurements from observation wells quantify the size, shape, position, and rate of change of the cone of depression formed by a constant-rate aquifer test. These data provide the basic information used to estimate the aquifer hydraulic parameters. The number and location of observation wells needs to balance the test objectives with the cost of constructing and monitoring the wells.

G. *Observation Well Design/Configuration* - Observation well design, including well diameter and screen interval, along with the accessibility and safety of the well, should be considered during the design of a constant-rate aquifer test to provide for a test program that will produce the required data in a safe and cost-effective manner.

H. *Location of the Observation Wells* - For constant-rate aquifer tests, observation well locations, whether existing wells or proposed new wells, should consider the spacing of the wells and the lateral and vertical distribution of the observation wells. The lateral distribution and spacing of observation wells affect the ability to document the size, shape, position, and rate of change of the test's cone of depression. Vertical anisotropy

and the hydraulic interaction of multiple aquifers and aquitards requires a vertical distribution of observations wells.

I. *Establish the Aquifer Test Duration* - The duration of constant-rate aquifer tests can range from a few hours to a few weeks depending upon the nature of the formation and the test objectives. Evaluating the test duration, such as by forward-modeling of anticipated test rates and duration, should be completed so that the test design is expected to provide the data necessary to meet the test objectives. The selection of the test duration should not only consider aquifer hydraulic parameters, but also the variability of background aquifer conditions and the economics associated with completing the test. Step-drawdown tests durations are more limited, the total test period is often completed in one day, but the number of pumping rates and the potential time for the test well drawdown to stabilize should be considered in the test duration design.

J. *Selecting the Appropriate Pumping Rate* - A constant-rate aquifer test should stress the aquifer sufficiently to obtain a measurable and substantive response in the observation wells. The selected pumping rate should achieve this aquifer stress to the extent possible given the design of the pumping well, the pump, and discharge constraints. Associated with the selection of the pumping rate, the method that will be used to monitor and manage the pumping rate during the test should be selected. Step-drawdown tests are often completed to facilitate the selection of the pumping rate for a constant-rate aquifer test.

K. *Pump Selection* - For a step-drawdown and constant-rate aquifer tests, the pump should be capable of pumping the proposed rate(s) considering the combined head (drawdown, pipe friction, and discharge pressures) it will be working against. The pump and the power source should be capable of constantly maintaining the pumping rate(s) for the duration of the test. The pump should be equipped with a check valve so that water in the piping does not siphon back into the well following pump shut off.

L. *Water Level Measuring Device(s) Selection* – Devices to measure water levels (head) in the pumping and observation wells should be selected to provide reliable data that meets the QA/QC accuracy identified for the project. Reliable use by field personnel, safety, data recording frequency, and post-test data management should be considered in the selection process. The use of backup measurement methods and consideration of external influences, such as barometric pressure changes and inclement weather should be included in the selection process.

M. *Pre-Test Groundwater Level Monitoring* – The head measured in an aquifer can change due to a variety of non-test influences, such as other pumping wells, weather, tides, river fluctuations, and even trains. Characterizing the external head influences is necessary so that they can be managed in a manner to provide aquifer test data is as accurate and representative as possible. Monitoring observation wells and background site water levels prior to the implementation of the test can characterize these external influences and provide a basis to manage their impact on the test data. If the external head influences necessitate it, monitoring of background wells during the test and post-test monitoring can also be incorporated in the test program design.

N. *Identifying Groundwater Quality Monitoring Requirements* - Monitoring the pump discharge water quality may provide information regarding variability of groundwater quality during an aquifer test. Monitoring can be used to enhance the characterization of the aquifer, such as indicating proximity to a contaminant source, documenting a hydraulic connection with surface water bodies, or evaluating long-term water treatment requirements. Monitoring may be required for discharge water permits. Water quality monitoring can include the use of field instrumentation and sample collection for laboratory analysis. The type and frequency of water quality monitoring depends on the location of the pumping well relative to suspected water-quality influences, disposal permit requirements, and cost considerations.

O. *Plan for Pumped Water Management Plan* - An aquifer test should have a plan for the management of the pumped water. This plan should consider applicable regulatory requirements, the use of treatment technology, water handling methods, and health and safety. The discharge of the pumped water should not occur in a manner that could affect the aquifer head measurements within the aquifer test's zone of influence.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. Further, to the extent that non-dedicated equipment is to be used (e.g., pump, water level indicator, transducer), to minimize potential cross-contamination of samples among wells, such sampling equipment should be decontaminated between wells as described in **FP 14.01** (Sampling Equipment Decontamination), project-specific Work Plan/FSP, and/or Quality Assurance Project Plan (QAPP). Used dedicated equipment (e.g., tethers) that is considered IDW should be managed in accordance with **FP 15.01**, Waste Handling, following the testing event.

At a minimum, the following tasks should be completed to prepare field staff for implementation of the work:

- Review and sign the site-specific HASP.
- Coordinate and obtain permission for site access and extraction well pump shutdowns (as necessary).
- Review project-specific Work Plan/FSP/QAPP, where applicable.
- Review and compile and bring to the site copies of relevant well construction logs, well survey information, and associated soil boring logs.
- Review and discuss with the PIC and/or PM the proposed Work Plan/FSP or sampling/testing strategy;
- Review state and local regulations related to aquifer testing; in some jurisdictions licensed drillers perform aquifer testing on wells.
- Procure applicable permits or public notification, if necessary, prior to initiating the test.
- Review the standard instruction manual(s) provided by the manufacturer of the specific equipment being used.

- Ensure that equipment/materials required to complete the work have been secured and packed prior to travel.

Prior to initiating the aquifer test activities, Ramboll oversight personnel should field-verify the well identity and construction against available documentation (Site Plans, Well Construction Logs, etc.). Prior to testing, it is imperative that a positive well identification be made using measured total well depth, well labels, Site Plans, and well construction records to ensure that the correct well is sampled (refer to **FP 6.04**, Groundwater and Free Product Level Measurements). If total well depth is measured, proper decontamination of the water level indicator tape must be conducted before deploying the water level indicator into another well (refer to **FP 14.01**, Sampling Equipment Decontamination).

Further, prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements. Pre-measuring the equipment suspension line to the individualized targeted depths, in advance of field efforts will increase productivity.
Similarly, recording required background information on appropriate forms before starting the test will facilitate field activities.

4.3 General Aquifer Test Guidelines

The methods provided in this section are for properly constructed and developed pumping and observation wells installed in a confined or unconfined aquifer. To avoid potential errors, project personnel obtaining manual water-level measurements should understand the units of measurement on the devices they will use and where to measure the depth to groundwater from on the well casing or surveyed point. Due to the length of a typical aquifer test, it is recommended that time be recorded in 24-hour time notation (i.e., military time). The following subsections provide general recommended list of practices for aquifer testing activities.

4.3.1 Pre-Test Preparation

Before initiating an aquifer test:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- Wells to be tested should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Label wells to be used for the test for consistent identification throughout the test.
- Unless previously verified, measure the distance of observation wells from the pumping well to the nearest foot.
- Equipment should be decontaminated between uses to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- Place polyethylene sheeting (or garbage bags) around the observation wells for placement of testing equipment and to contain any accidental spillage during testing.

- Review weather forecast for the site, if possible, arrange schedule to avoid performing the test just after or during a rainfall event. If the test must be completed during a rainfall event, arrange to obtain precipitation data from a local station or install a rain gauge and monitor daily and during rainfall events.[3]
- Protect wells to prevent rainfall and runoff from entering the well throughout the duration of the monitoring.
- Remove the well cover or equivalent protective casing cover (refer to **FP 6.04**, Groundwater and Free Product Measurements) and measure head space concentrations in accordance with the applicable manufacturer instructions and field screening FPs (e.g., **FP 4.01**, Field Screening - Combustible Gas). Record field screening readings in the field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling/testing plan.
- As detailed in **FP 6.04**, Groundwater and Free Product Measurements, record the condition of the well, noting any damage to the well, plug, and/or protective casing, and record any evidence of air pressure (positive or negative) when removing the well cap.
- Verify the accuracy of all pressure transducers and data loggers using a single reliable standard method, which should be used throughout the test.
  - Pressure transducers and data logger readings can be tested using a bucket or barrel filled with water by submerging each transducer, accurately measuring the water head above the transducer with a steel tape and comparing the measurement to the data-logger reading. Check the transducer response to changing heads by raising the transducer a certain distance, observing the change in the data-logger reading, and then measuring the distance with a standard measuring device. Be sure to check manufacturer's requirements as pressure transducers may require adjustment for barometric pressure.
  - Also, verify the initial conditions for the pressure transducers prior to initiating the test period. Some transducers, such as non-vented, need to be setup and programmed prior to submersion; a beginning reference point for groundwater elevation should then be measured. Other vented pressure transducers, such as the In-Situ "MiniTroll", may require setup with a vented cable while submerged.
- At each well, establish the position of the selected reference point (often the north side of the top of the well casing). Note the elevation of the reference point, which should have been determined from a topographical survey following well construction. This elevation is important to establish the position of the piezometric surface.
- Complete depth-to-water measurements prior to any planned aquifer test activities unless otherwise specified in the Work Plan/FSP (refer to **FP 6.04**, Groundwater and Free Product Measurements).

[3] Heavy precipitation can result in substantially increased water table elevations in shallow aquifers. However, rainfall data from nearby weather stations or airports may not be representative because precipitation patterns may vary greatly over short distances and storm sewers can rapidly channel large volumes of water to shallow aquifers.

- Measure the total well depth to the nearest 0.1 foot. Compare the total well depth measurement with the well construction log to determine if any aquifer material accumulated in it during the development. If sand or other material has accumulated in the well, it may be necessary to redevelop the pumping well to minimize infilling of the screens during the aquifer test and the aquifer test may need to be postponed.
- Properly program the data logger to fit current well conditions and expected water level (head) changes during the test. As the default, set the Rugged Reader/computer to collect readings every second. If the lithology of the well is primarily sand and gravel the Rugged Reader or computer may need to be set on a logarithmic scale to collect water level measurements more frequently early in the test to properly measure the initial change in water level.
- If an absolute (or non-vented) pressure transducer is used, install a barometer in a secure location at the site or obtain barometric data from a nearby weather station. This data will be used to correct for potential water level changes in confined or semi-confined aquifers resulting from atmospheric pressure changes.
- Measure the inner and outer diameter of the well casing or confirm the existing well construction log information.
- Verify that the depth at which the transducer will be placed at each well is within the transducer's pressure range (refer to manufacturer's recommendations). Slowly lower the data logger to a depth below the water column such that the data logger will remain submerged throughout the aquifer test and secure it to the well's protective casing or at the ground surface to ensure it will not be disturbed during testing. Mark a reference point on transducer cables and check regularly to detect slippage.
- Record a second depth-to-water measurement to confirm the water level is at static conditions and start the data logger.
- Record the initial pressure (length of water column above the transducer), barometric pressure and temperature (if available) measurements from the data logger and confirm they represent static/background conditions. Ideally, the data logger should record this data for a period of time that is at least equal to the duration of the aquifer test (specified in the Work Plan/FSP) prior to test initiation to assess initial conditions - whether the aquifer is at steady-state conditions, or whether there are external influences on water levels that could affect the response data (refer to Section 4.1).
- Setup lighting, as needed, to allow for nighttime instrument readings.

4.3.2 Conduct a Step Drawdown Test (or Stepped-Discharge or Step Test)

After initial/background conditions have been established, prepare to perform the step test:

- Connect power and discharge lines and other appurtenances (check valve, flow meter) to the pump in accordance with manufacturer instructions. The discharge line should drain to an appropriately sized container with sufficient capacity to store the anticipated volume of water to be pumped or as designated in the discharge permit.
- Slowly lower the pump to a depth below the water column such that the pump will remain submerged throughout the aquifer test secure it to the well's protective casing or at the ground surface to ensure it will not be disturbed during testing. The pump intake

must be above the screen interval to prevent burning out the pump motor or cause cavitation issues. Alternatively, the pump can be installed with a protective shroud if it must be installed within or below the screen interval. Mark a reference point on pump cables and check regularly to detect slippage.

- Start the pump and set the pumping rate to the lowest target flow rate for the step test defined in the project-specific Work Plan/FSP and start pumping.
- Measure and record water levels in the pumping well during each individual step of the step test.
- Measure and record flow rate from the well using a bucket or a flow gauge installed along the discharge line.
- If the pumping rate cannot be maintained for the lowest flow rate, the step test should be stopped and re-initiated at a lower pumping rate after reviewing and discussing with the PIC and/or PM and allowing water level to re-equilibrate.
- Maintain the pumping rate and monitor the change in water levels being recorded by the data logger as required in the project-specific Work Plan/FSP or for a minimum period of 30 minutes.
- If allowing the aquifer to recover between steps, allow the aquifer to recover as required in the project-specific Work Plan/FSP or at least 90 percent of the pre-test water level measured in the pumping well before increasing the pumping rate for the next step test. During this time, review data logged by the transducer to ensure data has been recorded and that decreasing groundwater elevations are observed.
- Repeat this process for each step test flow rate defined in the project-specific Work Plan/FSP taking care that the water level does not fall below the pump intake before ending the test. If the pumping rate cannot be maintained for the step test flow rate, then terminate the test (the prior step test flow rate will be the maximum sustainable pumping rates).
- At the end of the step test (i.e., when maximum sustainable pumping rates have been identified), shut power to the pump and mark the corresponding setting of the discharge control valve. This flow rate will be used for the constant-rate test.
- Allow sufficient time after the step test is completed for drawdown to return to static levels. Although the time may vary, allow at least 1 day of recovery before starting the constant-rate test.

The specific capacity value for each pumping rate may be calculated by dividing the pumping rate by the final total drawdown value in the pumping well at the end of the test (e.g., 2.0 gpm/4.0 feet = 0.50 gpm/ft specific capacity at the particular time at which the step test ended).

4.3.3 Conduct a Constant-Rate Test (or Aquifer Test or Well Performance Test)

After initial/background conditions have been reestablished or at least 24 hours since the step-down tests (to allow for sufficient recovery), prepare to perform the constant-rate test:

- Prior to initiating the constant-rate test, watches or other devices used for time measurements should be synchronized so that the time of each reading can be

referenced to the exact minute and hour that pumping is initiated. Ensure that field personnel are aware of the predetermined aquifer test start time.

- Check water levels in pumping and observation wells to document static water level (head).
- Verify that the flow control valve is at the predetermined setting (as defined by the step test or in the project-specific Work Plan/FSP.
- Start the pump and timing devices simultaneously.
- Measure drawdown in the pumping well and observations wells at established times. Drawdown increases with the logarithm of time, therefore, measure drawdown with logarithmic frequency. As such, rapid-frequency readings will be obtained early in the test, and the interval between measurements will gradually increase as pumping proceeds. The recording frequency may vary depending on site hydrogeologic conditions, objectives of the aquifer testing, or capability of the data logger. The schedule of measurements in **Tables 1** through **3** for transducer and manual measurements is satisfactory for most pumping and observation wells. Measurements should be performed in accordance with **FP 6.04** (Groundwater and Free Product Level Measurements).

Table 1: Transducer Water Level Measurement Schedule

Time Interval (steps)	Recording Frequency
0 to 1 hour	Every 1 second
1 to 4 hours	Every 1 minute
4 to the end of the test	Every 5 minutes

Table 2: Manual Water Level Measurement Schedule – Pumping Well

Elapsed Time (minutes)	Interval Between Measurements (minutes)
0 to 15	1
15 to 60	5
60 to 120	10
120 to 300	30
300 to 1440	60
1440 to end of test	240

Table 3: Manual Water Level Measurement Schedule – Observation Wells

Elapsed Time (minutes)	Interval Between Measurements (minutes)
0 to 15	1*
15 to 60	5
60 to 120	10
120 to 300	30
300 to 1440	60
1440 to end of test	240

Notes:

* Intervals of 2 minutes or longer are sufficient for more distant observation wells.

Drawdown measurements may be difficult to record at the exact time indicated in the schedules provided in **Tables 1 and 2** above. If the designated time for a drawdown reading is missed, a reading should nonetheless be obtained, and the actual time recorded. However, the established schedule should be followed as closely as possible to facilitate data plotting.

- Check the flow measuring device and record the discharge rate on an approximate hourly basis, except during the first hour of the test when the discharge rate should be monitored every 5 minutes. This information can be used to identify fluctuations in the pumping well discharge rate, which can complicate data interpretation.
- As water levels decline the discharge rate may decrease, such that a pumping rate adjustment may be required (the objective is to maintain a constant rate of discharge, and the setting on the pump is not sufficient to determine if pumping rate is constant). Whenever adjusting the flow rate, water levels in the pumping well before and after each adjustment should be recorded.
- Download and conduct periodic evaluation of transducer readings to ensure data has been recorded and that decreasing groundwater elevations are observed.
- When using liquid-fuel engines or generators, monitor and refill fuel tanks as needed to prevent premature termination of the test.
- Begin to calculate the elapsed time and drawdown as early as possible in the test, usually after the first hour of testing, by plotting test data on appropriate graph (either full logarithmic or semi-logarithmic) after generating several data points. Compare these plots to the expected response based on the conceptual site model. Update the plots throughout the test as this information supports appropriate decisions regarding progress of the test and may identify anomalies such as equipment malfunctions or unacceptable flow rate variations. Analysis of these plots may lead to the conclusion that additional data is needed to substantiate conclusions regarding the groundwater system.
- The use of derivative analysis should be considered during the test. Derivative analysis greatly improves the interpretation and evaluation of the drawdown data from aquifer

testing and facilitates the identification of boundary conditions (wellbore storage, recharge, etc.) and the establishment of the radial flow (horizontal radial flow from the aquifer before the boundary effects (refer to Bourdet at al. 1983 and Spane and Wurster, 1993). When radial flow is identified, the hydraulic parameters of the aquifer can be determined. Aquifer testing software, such as AquiferWin32 and AQTESOLV pro, uses derivative analysis in their application.

- Collect samples of the pump discharge and measure groundwater field parameters as required by the project-specific Work Plan/FSP and in accordance with applicable sampling FPs and permit requirements.
- Continue measuring and recording the atmospheric pressure throughout the test, if necessary (e.g., when using non-vented transducers) .
- Confirm the accuracy of electronic water-level sounders before shutting off the pump and starting the recovery portion of the test. This can be checked by use of a spare electronic water-level sounder.
- Terminate the constant-rate test once the pre-determined test duration has been achieved (as discussed in Section 4.1), or preliminary analysis of aquifer test data during the test using the appropriate test method for site conditions indicates adequate test duration.
- Do not remove the pump until the recovery test is completed.

4.3.4 Transition into the Recovery Test

- Manually measure water levels in the pumping well and observations wells following the drawdown measurement schedule used during pumping (refer to **Tables 1 and 2** above).
- Subsequent to the last hourly reading for the pumping phase, the data loggers should be reprogrammed to collect the recovery data at the same programmed time intervals as during the pumping phase (**Table 1** above). Start the data collection for the transducers immediately prior to shut-down of the pump.
- With the transducers continue to record groundwater levels, surface water levels, and barometric pressure data for several days after test completion (if possible until water levels have stabilized or returned to pre-aquifer test conditions). This information may reveal trends or relationships undetected prior to or during the test.
- At the completion of monitoring, compare watches, stopwatches and other time-measurement devices for agreement and note any discrepancies and identify the devices and where they were used.
- Sound the pumping well to determine if any aquifer material accumulated in it during the test. Sand or other material accumulating in the well during the test progressively blocks screened areas, reducing effective hydraulic communication between the aquifer and the well screen. If the effect of this condition is not considered, aquifer parameters calculated from test data will be erroneous. However, gradually decreasing aquifer communication in a pumping well significantly complicates test data analysis. It is therefore important to minimize infilling of screens by sufficient initial development of the pumping well.

- Withdraw the testing equipment from the well, replace the well cap, and secure the well.
- Properly decontaminate all equipment prior to and between each well. For non-dedicated equipment that has come in contact with groundwater, remove the equipment from the monitoring well and decontaminate in accordance with **FP 14.01**, Sampling Equipment Decontamination.
- Record in the field book or Aquifer Test Data Acquisition Form :
  - Deviations from procedures defined in the project-specific Work Plan, FSP and/or FP (i.e., ceasing testing prior to stabilization);
  - The rationale for those modifications; and
  - Abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.).
- Inform the Ramboll PIC and/or PM so necessary maintenance, redevelopment or repairs are conducted before the next planned groundwater sampling or testing event.
- Following completion of the field tests and prior to demobilizing, the parameters necessary for data analysis should be confirmed. These include the include the well name, test date, test type (step-drawdown vs constant-rate), well construction details (including well diameter, well depth, well screen and gravel pack), and pre-test water level measurements. The transducer records from the aquifer tests must also be processed prior to performing analysis. These data will be inspected to identify the test initiation points and static water levels.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while conducting aquifer tests. Additionally, implementation of the work may face some difficulties, including the following:

- It is important to always remain alert and aware of your surroundings. Aquifer tests often involve the use of generators and associated equipment, and are subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, identify the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located in driveways or on the right of way).
- Prior to mobilization consider the need for backup equipment for key items such as data loggers, generators, and electronic sounders.
- Keep sensitive electronic equipment away from devices that generate significant magnetic fields. For example, do not place data loggers near electric power generators or electric pump motors.

- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the well as it is being tested. Stay upwind of the well and ensure that air monitoring is conducted and personal protective equipment is used in accordance in the site-specific HASP.
- Keep any tether, or suspension lines untangled. Use a plastic winder or spool winder to retrieve the in-well equipment to keep the line from tangling.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should use the "buddy system" and should ensure that the project-specific HASP includes safety measures and procedures.
- Care should be taken when opening well protective covers and removing well caps for the presence of venomous spiders and insect nests, such as wasps or hornets.
- For some wells, well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well testing. Do not use petroleum-based solvent sprays to free seized locks as it may impact water quality in the well. Replace any damaged locks.
- Wells with a water-tight cap may experience a buildup of pressure. Keep your face and body away from the top of the well when loosening or removing the cap.
- Operate electronic water level meters and data loggers in accordance with the manufacturer's instructions and recommendations.
- Review proper operation and reading of the measurement device from the top of the surveyed point on the casing to the groundwater surface. A steel tape or electronic meter should be read in feet (or meters) below the top of the surveyed point, which is generally the top of the inner casing of the well.
- Do not delete the data from the data logger until the presence of a copy of the aquifer test data is confirmed. Practice using the program in the office by taking measurements and downloading data before setting up on the well in the field.
- Any movement of the pump or the transducer once it has been lowered into the well will create erroneous data and may give inaccurate results. Monitor for slippage of equipment regularly by measuring relative to a marked reference point on the transducer cables.
- Confirm each well was properly developed, especially wells within clay units. During well installation, the clay unit can smear, and reduce the effective hydraulic conductivity.
- If the well has not been sampled or developed in a long time, discuss the necessity to redevelop wells prior to commencing the aquifer test. Allow wells 48 hours to equilibrate prior to the aquifer test.
- Note any odors, staining, organic matter, or sediment on the equipment prior to decontaminating equipment. These may cause a change in the measured conductivity.

6. RECORDKEEPING

Document measurements in accordance with **FP 1.04** (Documenting Sampling Locations) and record information related to aquifer testing in accordance with **FP 1.01** (Field Notes and Records). In addition, record any unusual events occurring just before or during the test that may affect test data, such as:

- Weather changes (including precipitation);
- Heavy equipment (such as trains) traveling through test vicinity;
- Operation times of other wells;
- Changes in pumping rate;
- Equipment problems; and
- Earthquakes.

FIELD PROCEDURE NO. 6.11

ENVIRONMENTAL WELL DECOMMISSIONING
VISTRA PROJECT
PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 6.11

ENVIRONMENTAL WELL DECOMMISSIONING

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 6.11 "Environmental Well Decommissioning" last revised December 9, 2024.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for decommissioning (also referred to as abandoning, sealing or closing) of environmental monitoring wells. The purpose of well abandonment or closure is to properly remove and seal unsuitable, damaged or unused wells to prevent surface water or contamination from impacting the aquifer and prevent cross- contamination of aquifers that may have been penetrated by the well borehole. Environmental well decommissioning is typically required as part of the site closure process.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC)/Project Officer (PO) and/or Project Manager (PM) shall verify that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT AND MATERIALS

The list below provides an overall summary of equipment that may be required for typical abandonment of environmental wells using pressure grouting and overdrilling methods but the list should not be considered exhaustive. This list provides an overall summary of general equipment which may be required for well closure. The drilling contractor generally will supply the equipment and materials necessary for well closure; however, Ramboll oversight personnel should understand the equipment and materials that are required for the driller to complete the well closure. Additional equipment may be specified in the project-specific Work Plan, Field Sampling Plan and/or HASP. More specialized equipment and materials may be required depending on depending on the on the type of well closure to be performed (refer to **Section 4.1**).

- Site information (e.g., figures/maps, contact numbers, previous field logs, utility maps).
- Depending on the State, Permit for Well Abandonment/Decommissioning.
- Well keys.
- Well Construction Logs.
- Digital data collector or field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements).
- Field screening equipment (e.g., photoionization detector [PID]) as required by the site-specific Work Plan or Field Sampling Plan and HASP.
- Personal Protective Equipment (PPE) in accordance with the site-specific HASP Sterile gloves must always be worn when handling and using sampling equipment.
- Heavy duty trash bags for disposal of gloves, towels/rags and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.02**, Equipment Decontamination).
- Appropriate waste container and labelling materials used to dispose of Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- Drilling rig and associated equipment, such as tremie pipe, and grout mixing and pumping equipment to allow overdrilling of well casing and removal of filter pack materials (supplied by drilling contractor).
- Appropriate sealing materials (supplied by drilling contractor), which should be selected based on specific state rules or guidance documents, well type, well condition and groundwater quality. Appropriate sealing materials may consist of:
  - Neat Portland cement,
  - Sand cement grout,
  - Bentonite/cement grout,

  - Bentonite slurry, or
  - Hydrated bentonite chips

- Local and/or State regulations or guidance may define proper mixing ratios or limitations to create the above sealing materials. It should also be noted that in some states, sealing materials and procedures need to be approved by regulatory agencies before actual decommissioning of certain wells (e.g. wells with no records, wells that are contaminated with hazardous constituents, wells that are affected by salt intrusion, wells installed in unconsolidated formations that are screened in more than one aquifer, wells which cannot be cleared of all obstructions throughout the entire length and diameter of the well, multiple cased wells).
- Potable water source.
- Tools and equipment to remove surface completion (i.e., flush mount or stickup) and expose and remove the upper three to five feet of well casing.
- Pressure grouting fittings and equipment if double-cased wells are to be decommissioned in place (supplied by drilling contractor).
- Equipment to contain displaced groundwater if double-cased wells to be decommissioned in place (supplied by drilling contractor).

3. PROCEDURES REFERENCED

In addition to the reference and guidance documents cited above, the following Safe Work Practices (SWPs) and FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- SWP: Subsurface Utility Clearance
- **FP 1.01**, Field Notes and Records
- **FP 1.04**, Documenting Sampling Locations
- **FP 6.01**, Permanent Overburden Well Installation
- **FP 6.04**, Groundwater and Free Product Level Measurements
- **FP 6.15**, Well Construction Record
- **FP 14.02**, Equipment Decontamination
- **FP 15.01**, Waste Handling

The list above is not intended to be all inclusive. Other SWPs and FPs may need to be referenced based on the specific requirements of the project-specific Work Plan, Field Sampling Plan, and/or QAPP (e.g., field screening FPs, FPs for sampling of media).

4. PROCEDURES

Environmental monitoring wells are typically decommissioned either by sealing the well casing and filter pack materials using grout or another appropriate sealing material applied by gravity (tremie pipe) or under pressure (pressure grouting), or by overdrilling the well casing to remove filter pack materials, followed by complete removal of the well casing and subsequent sealing of the borehole using grout or another appropriate sealing material. In some instances, it is acceptable to perforate the well casing and well screen in-place followed by pressure grouting. Following are general guidelines for the closure of wells using these two methods, as well as planning and general activities applicable to well closure.

4.1 Regulatory Requirements and Planning Considerations

Strategic decisions including, but not limited to, the selection of the decommissioning method and the sealing materials and procedures, will be approved by the PIC/PO and/or PM before the initiation of associated field activities and will be documented in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. The project-specific Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities/procedures should be discussed with and approved by the PIC/PO and/or PM.

When planning a well closure event, the following should be considered:

- *Regulatory Requirements*. For sites managed under a regulatory program or where registration of the wells was required for installation, agency approval may be necessary prior to abandoning the well. In many cases, a permit must be obtained for the decommissioning of a groundwater well and the decommissioning is to be performed by contractors licensed as a water or environmental well driller (as appropriate) in the State where the work is being performed. The permit may also specify the decommissioning method. Prior to mobilization, Ramboll or the licensed driller, as required by local or State requirements, shall procure the required well closure or abandonment permits from the appropriate agency, as necessary. Copies of such permits shall be maintained in the project file for the duration of the project. In addition, depending on the well(s) location, other permits (such as an encroachment or wetlands permit) may be required to access the work area.
- *Well Construction Records*. Prior to decommissioning of groundwater wells, available well construction details and information on the local geology and hydrogeology should be compiled and reviewed. The complexity of the well construction, the local geology, and the presence or risk of aquifer contamination are factors to consider in planning the closure of a well.
- *Soil and Groundwater Quality*. It is important to understand whether the well (water or soil) is impacted with contaminants at the time of removal to aid in evaluating whether soil cuttings or well water that is displaced during the abandonment process needs to be containerized for future characterization and disposal. For wells installed as part of a site investigation where no contaminant impacts were identified, some states may permit drill cuttings or displaced groundwater to be returned to the ground; the state

regulations and guidance should be consulted for requirements specific to the work location.

- *Equipment Installed in Well.* Wells containing pumps or other electrical equipment are subject to safe work practices for electrical safety and control of hazardous energy sources.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). To the extent that non-dedicated equipment is to be used (e.g., tremie pipe, augers), to minimize potential cross-contamination, such equipment should be decontaminated before use as described in **FP 14.02** (Heavy Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan and/or QAPP. Used disposable equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling), following the sampling event.

In addition, at a minimum, the following tasks should be completed (as applicable) to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP.
- Coordinate and obtain permission for site access.
- Review permits and permit conditions that may affect site work including backfill requirements, air, dust or sound monitoring, agency notifications, and restricted operating hours.
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work.
- Confirm well locations.
- Identify any electrical components installed in wells and associated electrical safety requirements.
- Complete subsurface utility clearance and excavation safety requirements, if overdrilling or other intrusive methods will be used (refer to Subsurface Utility Clearance Safe Work Practice).
- Review project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable.
- Review and discuss with PIC/PO and/or PM the project-specific Work Plan, Field Sampling Plan or sampling strategy.
- Ensure that all equipment/materials required to complete the work have been secured and packed prior to travel. If equipment is being shipped to an alternate location, arrange for delivery at least one day prior to the start of the field work and confirm receipt at the delivery location (e.g., hotel or site).

4.3 General Pre-Well Decommissioning Activities

The following provides a recommended list of practices for well abandonment.

- Prior to initiating the well closure activities, Ramboll oversight personnel should field verify the well identity and construction against available documentation (Site Plans, Well Construction Logs, etc.). It is imperative that a positive well identification be made prior to decommissioning using well labels, Site Plans, and well construction records to ensure that the correct well is decommissioned. Field measurements will be defined in the project-specific Work Plan, Field Sampling Plan, or QAPP and may include:
  - Water level and total depth measurements using an electronic water level indicator (refer to **FP 6.04**, Groundwater and Free Product Level Measurements); and/or
- The field data and findings of the pre-well closure activities should be recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records).

4.4 In-Place Well Decommissioning by Gravity Grouting

When well construction details are known and installation records are readily available, in-place well decommissioning by gravity grouting may be acceptable to local regulatory agencies. Gravity grouting refers to the process of sealing the well casing and filter pack materials by pouring grout or another appropriate sealing material using a tremie or conveyance pipe. Gravity grouting is often used to decommission shallow environmental wells with simple construction details

In certain cases, additional measures may be required to properly place sealing materials. These cases include wells with long screens across multiple water-bearing zones; wells having an annular seal that was improperly placed during construction; and wells with void spaces present (or potentially present) in the unscreened or double cased interval of the well. In such cases, the driller may perforate the casing using a cutting tool prior to grouting to ensure that the sealing material fills the annular space outside the well casing.

The general steps for in-place well decommissioning by gravity grouting are outlined below.

- During well decommissioning, Ramboll oversight personnel should communicate regularly with the driller to remain informed on progress and any problems encountered. Ramboll oversight personnel should be present during well decommissioning to observe and record all procedures and materials used including times, quantities, and depths. Observations and field data should be recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- The well shall be cleared of any dedicated pump, pipe, debris, and other obstructions.
- Generally, the above ground protective casing or vault box should be removed and the upper portion of the well casing (e.g., three to five feet below ground surface depending on permit requirements) should be severed and removed prior to grouting. In certain cases (presence of coarse-grained materials in the upper five feet), the above ground protective casing or vault box should be removed immediately after the completion of grouting.

- The driller will assemble the grout delivery system (i.e., tremie or conveyance pipe with a funnel), set the containment system for displaced groundwater (if needed), and insert the tremie or conveyance pipe to the bottom of the well. The driller will begin pouring grout into the well through the funnel and proceeding upward from the bottom of the well to the surface by rising the tremie pipe in one continuous operation to allow some of the groundwater within the casing to flow through the screened interval into the surrounding formation. During grouting and raising of the tremie pipe, the driller should (a) ensure that the bottom of the tremie pipe remains submerged in grout, and (b) prevent freefall, bridging, and dilution of sealing material.
- As the level of the grout nears the surface, displaced groundwater that has not flowed into the surrounding formation will flow up the well casing. Displaced groundwater should be captured by a containment system and pumped into 55-gallon drums or other appropriate container for management in accordance with **FP 15.01** (Waste Handling), unless the groundwater is not impacted, and state or regulatory program requirements do not require that displaced groundwater be contained. Once the grout level has reached the surface, grouting should be halted.
- Ramboll oversight personnel should compare the volume of grout used to seal the well to the well casing volume to ensure that no void spaces have been created within the casing. The volume of grout used should exceed the well casing volume.
- The driller should place additional grout into the well borehole if significant settlement occurs as the grout sets. In some states, it is required that the driller returns to the well no sooner than 24 hours nor later than 72 hours and fill all settling in the well with additional grouting materials.
- After the wellhead is removed, it is typical to install a "cap" composed of the grouting material over the borehole that is greater than the diameter of the borehole after which the area should be backfilled with clean fill material, compacted as necessary, and the surface should be restored to match the surrounding ground surface (both elevation and surface cover).

4.5 In-Place Well Decommissioning by Pressure Grouting

When well construction details are known and installation records are readily available, in-place well decommissioning by pressure grouting may be acceptable to local regulatory agencies. Pressure grouting refers to the process of sealing the well casing and filter pack materials using grout or another appropriate sealing material applied under pressure. Pressure grouting is often used to decommission the following types of wells:

- Shallow and/or small-diameter cased environmental wells with simple construction details;
- Deep cased wells with one screened interval;
- Open borehole (uncased) bedrock wells. In such case where well materials are installed in the bedrock borehole, it is common to destroy or ream the borehole prior to pressure grouting. Consult the PIC/PO and/or PM for direction during the planning stage on these additional requirements and procedures; and
- Inclined or horizontal wells.

Deep cased wells may be double cased (i.e., constructed with larger diameter steel conductor casing in the upper part of the formation) to seal off shallow aquifer zones penetrated by the original well boring. Unless there is evidence of leakage through the double casing seal, well decommissioning procedures address the screened interval below the double cased portion of the well.

In certain cases, additional measures may be required to properly place sealing materials. These cases include wells with long screens across multiple water-bearing zones; wells having an annular seal that was improperly placed during construction; and wells with void spaces present (or potentially present) in the unscreened or double cased interval of the well. In such cases, the driller may perforate the casing using a cutting tool prior to grouting to ensure that the sealing material fills the annular space outside the well casing.

The general steps for in-place well decommissioning by pressure grouting are outlined below.

- During well decommissioning, Ramboll oversight personnel should communicate regularly with the driller to remain informed on progress and any problems encountered. Ramboll oversight personnel should be present during well decommissioning to observe and record all procedures and materials used including times, quantities, and depths. Observations and field data should be recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- The well shall be cleared of any dedicated pump, pipe, debris, and other obstructions.
- Generally, the above ground protective casing or vault box should be removed and the upper portion of the well casing (e.g., three to five feet below ground surface depending on permit requirements) should be severed and removed prior to grouting. In certain cases (presence of coarse-grained materials in the upper five feet), the above ground protective casing or vault box should be removed immediately after the completion of grouting.
- The driller will assemble the grout delivery system (pumping device, tremie pipe, a grout mixer), set the containment system for displaced groundwater (if needed), and insert the tremie pipe to the bottom of the well. The driller will begin delivering grout into the well at a relatively low pressure and flow rate and proceeding upward from the bottom of the well by rising the tremie pipe to allow some of the groundwater within the casing to flow through the screened interval into the surrounding formation., During grouting and raising of the tremie pipe, the driller should (a) ensure that the bottom of the tremie pipe remains submerged in grout, and (b) prevent freefall, bridging, and dilution of sealing material.
- As the level of the grout nears the surface, displaced groundwater that has not flowed into the surrounding formation will flow up the well casing. Displaced groundwater should be captured by a containment system and pumped into 55-gallon drums or other appropriate container for management in accordance with **FP 15.01** (Waste Handling), unless the groundwater is not impacted, and state or regulatory program requirements do not require that displaced groundwater be contained. Once the grout level has reached the surface, grouting should be halted.
- The driller will then assemble the required fittings around the top of the well casing to allow for a water-tight seal and monitoring of grout pressure from the top of the well

casing. Grouting will then resume under pressure. Although regulatory program specific guidelines and requirements or well decommissioning permit requirements may provide specific pressure requirements, typically the pressure grouting is performed at a pressure of at least 25 pounds per square inch (psi) for a minimum of 5 minutes or until pump refusal. This delivery generally ensures that the grout is forced through the screened interval, thereby filling voids in the filter pack and sealing the borehole into the surrounding formation.

- The driller will take appropriate precautions prior to line breaking or depressurization of grout piping, including use of depressurization valves and appropriate PPE (e.g., goggles and face shield).
- Ramboll oversight personnel should compare the volume of grout used to seal the well to the well casing volume to ensure that no void spaces have been created within the casing. The volume of grout used should exceed the well casing volume.
- The driller should place additional grout into the well borehole if significant settlement occurs as the grout sets. In some states, it is required that the driller returns to the well no sooner than 24 hours nor later than 72 hours and fill all settling in the well with additional grouting materials.
- After the wellhead is removed, it is typical to install a "cap" composed of the grouting material over the borehole that is greater than the diameter of the borehole after which the area should be backfilled with clean fill material, compacted as necessary, and the surface should be restored to match the surrounding ground surface (both elevation and surface cover).

4.6 Well Decommissioning by Overdrilling and Removal of Well Materials

When well construction details are not well understood and/or installation records are not readily available, in-place well decommissioning may not be acceptable to regulatory agencies. Further, in some cases there is also a preference to remove all well materials from the subsurface. In these cases, wells are typically decommissioned by overdrilling the well casing to remove the filter pack materials, followed by removal of the well casing and subsequent sealing of the borehole using grout or another appropriate sealing material. Overdrilling and removal of well materials most commonly require use of a hollow-stem auger (HSA) drill rig (refer to **FP 6.01**, Permanent Overburden Well Installation). While HSA is usually the most appropriate and cost-effective drilling method, depending on site conditions, other methods such as mud or air rotary drilling can be used. In general, overdrilling with HSA is preferred because it allows the filter pack materials to be drilled out and contained, followed by removal of the intact well casing. Overdrilling with mud or air rotary drilling breaks up the well casing, the annular seal and the filter pack, and removes the well materials from borehole with the circulating drilling fluid.

Note that overdrilling of wells installed with cement grout annular seals requires larger diameter tooling than the original borehole and special attention to ensure the tooling remains plumb over the borehole and successfully removes all of the well components.

Since HSA is the most commonly used method for decommissioning by overdrilling, the general steps for this method of well decommissioning are outlined below.

- During well decommissioning, Ramboll oversight personnel should communicate regularly with the driller to understand and document significant changes in material penetrated, drilling conditions, hydraulic pressure, and drilling action. Ramboll oversight personnel should be present during drilling and removal of the well casing and screen to observe and record materials as they are removed and/or added to the borehole, including times, quantities, and depths. Observations and field data should be recorded in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- Prior to overdrilling, the above ground protective casing or vault box should be removed.
- The driller will use the drill rig to insert rods into the well casing to the terminal depth of the well. The rod within the casing is intended to limit damage to the well casing or screen by the rotating drill bit and augers.
- Once the rod has been inserted the full length of the well casing and screen, overdrilling the total depth of the well can commence. Note that the HSA must be of sufficient diameter to provide clearance for the well casing and avoid twisting, breaking, or otherwise damaging the well materials, which can result in delays; it is recommended that the inside auger diameter be 2 inches larger than the well diameter. Should damage to the casing or screen be observed (e.g., presence of PVC shavings in soil cuttings); this should be noted in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- During overdrilling soil cuttings brought to the surface by the auger should be noted by Ramboll oversight personnel. The driller shall place the materials into 55-gallon drums or other appropriate container for management in accordance with **FP 15.01** (Waste Handling). If the soils and groundwater are not impacted (e.g., a Phase II investigation showed no evidence of impacts), state or regulatory program requirements should be consulted to determine if soil cuttings must be contained.
- Once the HSA has been advanced to the total depth of the well, the driller will remove the rod and clear the borehole. Often the removal of the rod will facilitate or take place concurrently with the removal of the well casing and screen.
- The driller will remove the entire length of screen and casing and Ramboll oversight personnel should measure and record the length of well screen and casing removed in the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- If the casing and screen are not easily removed with the use of the rod, the driller may place a slip-cap on the end of the well casing, secure it with bolts, and lift it with the aid of the drill rig.
- Should a well casing break during removal and not be recoverable, regulatory program specific guidelines and requirements or well decommissioning permit requirements should be followed. This may include communications with the PIC/PO or PM, regulators and/or the client. Ultimately, any casing left in-place should be completely surrounded by sealing material so the closed well will not act as a potential vertical conduit for contaminants from the surface or from surrounding aquifer formations. Alternatives for completing the closure of the broken well casing include:
    - Breaking-up or grinding up the in-place casing using a smaller diameter drill bit or auger, solid stem auger with a carbide auger head, drag bit or roller cone bit with the wet rotary method, or

- Pressure grouting the in-place casing and open borehole.

- Following removal of the well casing and screen, the well borehole will be sealed by grouting with Portland cement or other appropriate sealing material, in accordance with the well decommissioning permit conditions or regulatory program specific guidelines and requirements. This should be accomplished by placing grout in continuous lifts from the bottom of well borehole to the ground surface. Depending on the well decommissioning permit conditions or regulatory program specific guidelines and requirements, grout may be poured through the auger, from the surface (typically if the well is dry and no deeper than approximately 30 feet), or through a tremie pipe; the PIC/PO and/or PM should be consulted during the planning stage for direction on this matter. When using a tremie pipe, it is generally recommended that the tip of the tremie pipe remain below the surface of the grout throughout the grouting process to prevent freefall, bridging, and dilution of sealing materials.
- If a tremie pipe is used, the driller will assemble the grout delivery system (tremie pipe, grout mixer), set the containment system for displaced groundwater (if needed), and insert the tremie pipe to the bottom of the well borehole. The driller will begin delivering grout into the well at a relatively low pressure and flow rate, to allow some of the groundwater within the casing to flow through the screened interval into the surrounding formation, proceeding upward from the bottom of the well.
- As the level of the grout nears the surface, displaced groundwater that has not flowed into the surrounding formation may flow up the well casing. Displaced groundwater should be captured in the containment system (if necessary) and pumped into 55-gallon drums or other appropriate container for management in accordance with **FP 15.01** (Waste Handling). Once the grout level has reached the surface, grouting should be halted.
- The driller should place additional grout into the well borehole if significant settlement occurs as the grout sets. In some states, it is required that the driller returns to the well no sooner than 24 hours nor later than 72 hours and fill all settling in the well with appropriate grouting materials.
- Ramboll oversight personnel should calculate the well borehole volume and compare it to the volume of grout used to seal the well borehole to ensure that no bridging or void spaces have been created. The volume of grout used should exceed the calculated well borehole volume. These calculations and the actual volume of grout used should be noted on the field notebook in accordance with **FP 1.01** (Field Notes and Records).
- The top three to five feet of the hole will be backfilled with cement, native soil or other suitable fill material up to one to two feet below ground surface. The uppermost one to two feet should be backfilled with clean fill material, compacted as necessary, and the surface repaired to match the surrounding ground surface (both elevation and surface cover). Note that if the area has heavy traffic use and/or the former well locations need to be permanently marked, then a protective surface pad and/or steel bumper guards may be installed. The concrete surface plug also can be recessed below ground surface if the potential for construction activities exists.

4.7 General Post-Well Decommissioning Activities

- Equipment should be decontaminated in accordance with **FP 14.02** (Equipment Decontamination
- All equipment that has come into contact with soil, groundwater, and/or grout should be decontaminated in accordance with **FP 14.02** (Equipment Decontamination). Decontamination liquids and solids should be collected and contained in appropriate containers for management in accordance with **FP 15.01** (Waste Handling).
- Any containers of displaced groundwater or decontamination water generated during this process should be sealed, labeled, stored in a safe location, and profiled for appropriate off-site disposal as outlined in **FP 15.01** (Waste Handling).

5. PRECAUTIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while decommissioning wells.

- There are a number of variables associated with decommissioning activities due to the range in well construction and geologic environments. Completion of the work is often challenging and may require interpretation of state-specific or regulatory program-specific requirements.
- Only drillers licensed in the State where the work is being performed should be subcontracted to perform the work. Each State may have specific licensing requirements.
- In some States or local jurisdictions, drilling and/or well abandonment permits are to be procured by the driller prior to mobilization. In addition, well abandonment or closure forms and documentation are to be submitted to the permitting entity by the driller. Ramboll should obtain from the driller copies of the driller's well abandonment records after well decommissioning. In addition, some states require that well tags affixed to the wells be removed from the wells and submitted to the regulatory agency along with the well abandonment forms.
- The drilling contractor should be informed of the well construction design and abandonment requirements as part of the contracting process so they can ensure that the appropriate equipment, personnel and materials are mobilized. The driller should define the specific equipment that will be used for well decommissioning, so field personnel can prepare accordingly.
- It is important to always remain alert and aware of your surroundings. Well closure involve the use of drilling rigs or other heavy equipment, and field activities may be subject to hazards posed by nearby equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, biological, mechanical, and chemical hazards.
- Ramboll field personnel should confirm that the driller has inspected the cables and winches on the drilling rig and that emergency stop functions are operational and readily accessible prior to the start of work.
- When well closure activities are underway, Ramboll field personnel should make observations from a distance greater than the height of the drilling rig mast (from the drill rig). Prior to approaching the drill rig, be sure that the equipment is secure and that the driller is aware that you are approaching.
- At sites with certain contaminants and/or subsurface conditions (e.g., landfills, non-aqueous phase liquids), potentially toxic and/or explosive gases may accumulate at and around the well as it is being decommissioned. Stay upwind of well closure activities and ensure that air monitoring is conducted, and PPE is used in accordance with the site-specific HASP.

- When working out of sight of the general public or site employees are in potentially hazardous areas (e.g., wooded habitats), field staff should utilize the "buddy system" and should ensure that the site-specific HASP includes safety measures and procedures.
- Dust may be produced during the mixing of cement and/or bentonite powder, and may be harmful if inhaled. Ramboll field personnel should stay upwind of cement mixing activities and instruct drillers to pour powders gradually into water while mixing, in order to reduce dust.

6. RECORDKEEPING

Document well abandonment and closure details in accordance with **FP 1.01** (Field Notes and Records). The well closure details should reference the corresponding well construction record (refer to **FP 6.15**, Well Construction Record). Further, the plans shall be updated in accordance with **FP 1.04** (Documenting Sampling Locations).

In addition to the typical information that should be recorded in the field notebook (**FP 1.01**), information specific to well abandonment that should be included in the field notebook includes:

- Well ID.
- Positive well identification procedures.
- Name of licensed well driller and license number.
- Well borehole volume.
- Brief description of well abandonment procedures (e.g., pressure grouting, overdrilling).
- Type of material used to abandon the well and volume used.
- Casing removed/left in place.
- Any problems encountered and how they were addressed.
- An inventory of IDW generated during the abandonment.
- A description of any surface reparations made.

Many states provide state-specific well abandonment forms.

FIELD PROCEDURE NO. 6.15

WELL CONSTRUCTION RECORD
VISTRA PROJECT
PROJECT NO. 1940112376

FIELD PROCEDURE NO. 6.15

WELL CONSTRUCTION RECORD

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 6.15 "Well construction Record" last revised September 16, 2014.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for documenting groundwater well construction activities. These records provide critical information gathered in the field with respect to the installation of wells used as part of environmental and hydrogeological investigations.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that this FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in site-specific HASP, followed by procedures recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information is maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

Below is a general checklist of equipment that may be required for documenting the construction of groundwater wells. This checklist includes an overall summary of general equipment typically required for documenting well installation efforts and should not be considered exhaustive. Additional equipment may be specified in the project-specific work plan and/or HASP.

- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records);
- Field log forms (preferably produced on *Rite in the Rain*® water-resistant paper);
  - Blank Field Well Completion Log form
  - Blank Field Boring Log form (if required).
- All-weather pens or (weather permitting) other indelible ballpoint pens with black or blue ink;
- Calculator; and
- Digital Camera.

Based on the field activity and project, the following also may be needed:

- Tape measure and/or weighted, calibrated measuring tape;
- Electronic water level indicator or interface probe;
- State-specific monitoring well report form(s), as necessary;
- Field monitoring equipment such as a photoionization detector;
- Tables for well volume calculation; and
- Clipboard/field case.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01,** Field Notes and Records.
- **FP 1.04**, Documenting Sampling Locations.
- **FP 5.01**, Soil and Rock Classification.
- **FP 5.09**, Field Soil Boring Log Preparation.
- **FP 6.01**, Permanent Overburden Well Installation.
- **FP 6.04**, Groundwater and Free Product Level Measurements.
- **FP 6.05**, Permanent Bedrock Well Installation.
- **FP 6.07**, Well Development.
- **FP 6.11**, Environmental Well Decommissioning.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of the site-specific work plans/sampling plan (e.g., field screening FPs, FPs for sampling of media, etc.).

4. PROCEDURES

4.1 General Information

During well construction, information regarding all activities related to the installation of wells should be recorded in the Field Notebook or on a Field Well Completion Log form during each day of field activities. The Field Notes or Field Well Completion Log form should be populated concurrently with well installation activities, and the person completing the log should pay close attention to the type and quantity of every component that is used by the driller when constructing the well. The following guidelines should be considered when recording information:

- Pertinent information will be recorded in the field notebook or on the Field Well Completion Log form
- Well construction activities may also require that additional forms, such as a Soil Boring Log form (refer to **FP 5.09**, Field Soil Boring Log Preparation), Well Development Log form (refer to **FP 6.07**, Well Development), or equipment calibration log forms (refer to field screening FPs), also be completed. Alternatively, based on project-specific requirements, information may be recorded in the project-specific Field Logbook, as long as all information identified in the form(s) is recorded in the logbook (refer to **FP 1.01**, Field Notes and Records).
- Any free forms or field sketches, such as Field Well Completion Log forms, or well construction diagrams, should be appropriately referenced in the field notebook (refer to **FP 1.01**, Field Notes and Records) and collectively, should present a complete record of the field activities observed. Thus, these records should be thorough enough to enable reviewers to reconstruct the field activities, rationales for decisions made, and observations.
- Records should be made with writing implements (pens, markers) that use permanent, archival-grade ink (waterproof ink, when necessary). Black or blue ink should be used. Erasable ink and pencil are unacceptable being neither permanent nor archival.
- If using Field Well Completion Log forms:
  - The forms should be signed by the author (or authors).
  - Information intentionally left blank should be marked with an "X" or labeled "intentionally left blank."
  - Data entries should be recorded in the Field Well Completion Log form immediately upon obtaining the data. Avoid making temporary notes in other locations for later transfer to the Field Well Completion Log form, as this increases the potential for transcription errors and/or loss of information or data.
  - Note in the field book which forms are being used and the number of forms. All pages of forms should be numbered sequentially and cross-referenced in the field book. Each page of the forms should be signed and dated. Finally, ensure that forms are securely filed in the project file upon return to the office each day in accordance with **FP 1.01** (Field Notes and Records).

- Explain any deviations or omissions from the work specified in the work plan, especially when such deviations result in measurements not being collected, or additional measurements being collected.

4.2 Requirements for Field Well Completion Log Form

The information recorded on the Field Well Completion Log form is a critical component of the overall record of a well installation. As-built well dimensions (e.g., total borehole depth at start of well construction; depth intervals of sand pack, well seal, and annular fill material/grout; height of casing stick-up, etc.) should be measured and recorded on the Field Well Completion Log form as the installation progresses. This serves to verify that the construction adheres to the well design and that any field modifications to the design are properly justified and documented.

The following information should be recorded during well installation in the field notebook or on the Field Well Completion Log form.

- Monitoring well's unique identification number (ID);
- Name of Ramboll oversight personnel completing the log;
- Drilling company and driller name;
- Date and time of installation;
- Drilling method and nominal outside diameter(s) of drilling equipment;
- Borehole depth (note the depth of the borehole before and after backfilling, if backfilling is performed to bring the base of the borehole to the desired depth);
- Borehole diameter(s): Note that some boreholes will have "telescoping" intervals of larger or smaller diameter (e.g., if installing a double-cased well to seal off specific water-bearing zones);
- Bottom cap type;
- Well sump dimensions and depth to top and bottom of well sump (if used);
- Casing type(s) and diameter(s), identifying the type of material (e.g., Schedule 40 or Schedule 80 PVC, PTFE/Teflon©, steel, etc.) and the inside diameter (ID) of all casing materials installed in the well;
- Screen type (e.g., PVC, stainless steel, etc.), diameter, slot type (e.g., milled, louvered, wire-wrapped, etc.), and slot size (e.g., 0.010-inch, 0.020-inch, etc.);
- Dimensions of the screen and depth to top and bottom of the screened interval;
- Dimensions of the casing and depth to top and bottom of the casing interval. If the casing extends above the ground surface, height of casing above ground surface;
- Depth to top and bottom of the filter pack interval. Well surging should be considered prior to making these measurements as it enhances filter pack quality by inducing particle settlement;
- Filter pack manufacturer, grain size, and material (e.g., Lapis Lustre© No. 3 Monterey silica sand);

- Filter pack placement method (e.g., free-fall, tremie pipe, etc.);
- Quantity of filter pack material used (number of sacks and pounds per sack);
- Dimensions of the annular seal and depth to top and bottom of the seal interval;
- Annular seal placement method (e.g., free-fall, tremie pipe, etc.);
- Type and manufacturer of annular seal material (e.g., CETCO© 3/8-inch bentonite chips, etc.);
- Quantity or volume of annular seal material (i.e., number of 5-gallon pails [e.g., pellets] or sacks and pounds per sack);
- Volume of water for hydrating annular seal (must be potable water);
- Well seal hydration time;
- Depth to top and bottom of the annular seal/fill (e.g., grout) interval;
- Grout manufacturer and type (e.g., Lehigh Portland Type I/II Cement, CETCO© Powder Bentonite);
- Quantity and/or volume of grout material (i.e., number of sacks and pounds per sack);
- Grout mixture ratio (i.e., quantity of powdered bentonite [if any] and cement per gallon of water);
- Water source for annular seal hydration and grout mixing (must be potable water);
- Grout placement method (e.g., tremie pipe);
- Surface completion type and design (e.g., diameter and height of above-grade protective casing, diameter of flush-mount well box, diameter and below-grade depth of protective pipe, dimensions of concrete pad, number and type of protective bollards, etc.);
- Type, manufacturer, depth, and quantity of surface completion sealant (i.e., concrete);
- Type of well seal/cap;
- Well lock type(s) and key blank or combination number(s);
- Depth to water after well construction (before well development);
- Date and time of depth to water measurement;
- The reference datum marked, notched or etched on the well or casing, which will be surveyed and used for depth to water or free product measurements; and
- A description of any problems encountered during installation and corrective actions.

Note that unless specified elsewhere, well construction as-built dimensions should be measured to the nearest 0.1 ft., and depths to groundwater are measured to the nearest 0.01 ft. If a Field Well Completion Log form is not used, a detailed drawing of the well with the information listed above should be included in the field notebook.

4.3 Additional Well Construction Documentation

Upon completion of the well, its location relative to fixed and reproducible landmarks should be defined in the field book or site map. A detailed dimensioned sketch should be prepared in accordance with **FP 1.04** (Documenting Sampling Locations).

In addition to documenting field activities in a logbook, photographs (if allowed) should be taken to document each step of the well installation process, and details of each photograph (file name, date, time, direction, and subject) should be recorded in accordance with **FP 1.01** (Field Notes and Records). Further, all materials used should be clearly and completely described as appropriate including, but not limited to, type, manufacturer, size, and quantity.

4.4 Well Construction Reporting

After well installation, the as-built location and elevation of the constructed well shall be surveyed and documented in accordance with **FP 1.04** (Documenting Sampling Locations), **FP 1.06** (Field Surveying and Monitoring Well Elevation Surveying), and **FP 6.12** (Monitoring Well Inventories and Management). In addition, as required by state and local law and/or the well construction permit, well completion report(s) will be completed and filed with the appropriate agency. Although the filing of well construction reports may be the responsibility of the licensed well driller in certain states, Ramboll has a responsibility to ensure our subcontractors are submitting the appropriate permits, forms, and documentation to State agencies. Record keeping requirements are discussed in **Section 6**.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Well construction activities require recording sufficiently detailed information throughout the installation process. Certain precautions should be taken to ensure safety while recording the required information.

- It is important to always remain alert and aware of your surroundings. Well installation involves the use of drilling rigs and associated equipment, and well sites may be subject to hazards posed by heavy equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and other physical, mechanical, and chemical hazards.
- Avoid walking while recording information. Sites may have excavations, equipment, debris, and other obstacles that pose slip, trip or fall hazards.
- Step away from roadways and high traffic areas before commencing note-taking. Do not assume that drivers can see you standing on the shoulder of a road, especially in bad weather. Many workplace traffic accidents involve distracted drivers hitting a worker standing/working on the shoulder of a roadway. Wear a safety vest or brightly colored (yellow or orange) clothing and remain alert at all times.
- Stand a safe distance away from the drill rig when taking notes.

6. RECORDKEEPING

This FP specifically pertains to recordkeeping during well installation projects. In addition to the well construction record guidelines provided above, all information should be recorded in accordance with **FP 1.01** (Field Notes and Records). In general, draft field forms should be scanned and saved electronically immediately following the completion of the well installation activities. Following review of draft documents by the PIC and/or PM, field documentation forms should be finalized and final versions may be included in project reports, if necessary. Draft and final versions of the well construction record should be managed in accordance with Ramboll's Document Retention Policy and project- specific requirements, and a copy should be maintained in the Project File.

FIELD PROCEDURE NO. 6.20

GROUNDWATER SAMPLING - LOW FLOW
VISTRA PROJECT
PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 6.20

GROUNDWATER SAMPLING - LOW FLOW

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 6.20 "Groundwater Sampling – Low Flow" last revised December 5, 2024.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for collection of groundwater samples for laboratory analysis using low-flow purging and sampling techniques. The purpose of Low- Flow Purging and Sampling (LFPS) is to collect groundwater samples that are representative of ambient groundwater conditions in the aquifer and are most appropriate for: (a) monitoring wells that have an inner casing diameter of 2.0 inches or greater; and (b) aqueous samples (i.e., does not apply to collection of light or dense non-aqueous phase liquid [LNAPL or DNAPL]) that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, microbiological and other contaminants. This is accomplished by adjusting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. LFPS has several benefits over conventional purging:

- It minimizes disturbance of sediment in the bottom of the well, thereby producing a less turbid sample.
- It minimizes turbulence and aeration of the groundwater sample during sample collection.
- The amount of groundwater purged from the well is usually reduced as compared to conventional groundwater purging and sampling methods, thereby reducing water management requirements.
- Groundwater samples tend to be more representative of actual aquifer conditions with respect to mobile contaminants and turbidity as LFPS causes minimal disturbance of the formation adjacent to the screened interval.
- It is generally less prone to sampling variability, increases sample consistency, and reproducibility of data.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by approved site-specific procedures, which may include those in this FP. The Ramboll PIC/PO and/or PM shall verify that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and

retention policies. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

The list below provides an overall summary of equipment that may be necessary for LFPS, but the list should not be considered exhaustive. Additional equipment may be specified in the project-specific Work Plan, Field Sampling Plan, QAPP, and/or HASP. More specialized sampling equipment and materials may be required depending on depending on the on the type of sampling to be performed (refer to **Section 4.1**). Ramboll personnel should understand and be familiar with the operation of the equipment and materials that are required for low-flow groundwater sampling.

- Site information (e.g., figures/maps, contact numbers, previous field logs, utility maps).
- Digital data collector or field notebook and all-weather or permanent pens as outlined in FP 1.01 (Field Notes and Records).
- Plastic or polyethylene sheeting.
- Cable ties.
- Keys for wells.
- Measuring tape.
- Electronic water level indicator (refer to FP 6.04, Groundwater and Free-Product Level Measurements).
- Field screening equipment (e.g., photoionization detector [PID]) as required by the project-specific Work Plan, Field Sampling Plan, QAPP and/or the site-specific HASP.
- Pump and associated equipment (e.g., generator, extension cords, batteries, control box, compressor, CO2 or nitrogen compressed gas cylinders).
- Tubing – Used to discharge water from pump, material based on sampling parameters (poly, Teflon®, etc.). The tubing should be appropriate for the parameters being analyzed. For example, when sampling for metals analysis only, the tubing may be constructed of flexible polypropylene or polyethylene. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water quality meter with flow-through cell that, at a minimum, measures temperature, pH, dissolved oxygen (DO), oxygen reduction potential (ORP), and specific electric conductance, and associated manuals. Turbidity measurements can be made using a separate turbidity meter. Total capacity of the cell must be small (i.e., less than 300 mL).
- Measuring container (e.g., one-gallon plastic water jug, graduated measuring cup, or graduated cylinder) and stopwatch and/or in-line flowmeter.
- Plumbing fittings – check valves, barbed “T” or “Y” fittings, stainless-steel needle valves or stainless-steel/Teflon ball valves.

- Dedicated suspension line or tether constructed of material that minimizes interactions or alterations when in contact with groundwater or that may cause loss of analytes via sorption (e.g., poly twine, nylon string, stainless-steel, Teflon-coated stainless-steel wire, etc.) for lowering and raising pump (pump tubing does not constitute a dedicated suspension line and should not be used for lowering and raising pump).
- Tool set: socket set, socket wrench, screwdriver, multi-tool, tubing cutters, "turkey baster" and/or cup for water removal from flush-mounted well vaults.
- Spare/replacement parts: gripper plugs/well caps, well lid bolts.
- Personal Protective Equipment (PPE) in accordance with the site-specific HASP,. Sterile gloves must always be worn when handling and using sampling equipment.
- Laboratory supplied certified-clean sample containers (appropriate for various analyses to be performed), as may be required in the Work Plan.
- Sample labels and chain of custody forms.
- Sample shipment containers, ice, labels, and packing materials for sampling containers as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody).
- Heavy duty trash bags for disposal of gloves, towels/rags and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Appropriate waste container and labelling materials – used to dispose of Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- For long-term projects, setting up a field station is recommended. The field station may include portable chair(s), worktable, canopy, and first aid station/kit.

3. REFERENCED GUIDANCE DOCUMENTS

In addition to the reference and guidance documents cited above, the following FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **FP 1.01**, Field Records and Notes
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody
- **FP 1.05**, Field Quality Control Samples
- **FP 2.02**, Site Preparation, Inspection and Housekeeping

- **FP 6.02**, Groundwater Purging and Sampling
- **FP 6.04**, Groundwater and Free Product Measurements
- **FP 14.01**, Sampling Equipment Decontamination
- **FP 15.01**, Waste Handling
- **FP 15.02**, Waste Sampling

The list above is not intended to be all inclusive. Other FPs and Safe Work Practices (SWPs) may need to be referenced based on the specific requirements of the project-specific Work Plan, Field Sampling Plan, and/or QAPP (e.g., field screening FPs, FPs for sampling of other media).

4. PROCEDURES

4.1 Planning Considerations

Strategic decisions including, but not limited to, pump selection, will be approved by the PIC/PO and/or PM before the initiation of associated field activities and will be documented in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. The project-specific Work Plan, Field Sampling Plan and/or QAPP will be designed to facilitate the collection of quality data that meet the objectives of the sampling program and will include information such as the number of sampling locations, number of samples per location, depths/depth intervals of samples (or guidance on selecting appropriate sampling locations at various properties), number of sampling sites, the analyses appropriate for each sample as well as quality assurance/quality control (QA/QC) samples. The project-specific Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities/procedures should be discussed with and approved by the PIC/PO and/or PM.

When planning a low-flow sampling event, the following should be considered:

- *Well Integrity* – The presence of obstructions, bent or broken casing (risers), and accumulated sediment in the bottom of the well will prevent or affect lowering pumps or other equipment into the well. Damage to monitoring wells should be repaired prior to sampling and allowing sufficient time for the formation to stabilize should the repairs include well redevelopment.
- *Pump Selection* - The equipment needed for groundwater LFPS purging/sample collection can vary greatly depending on specific site conditions and project objectives. LFPS is generally conducted at flow rates of 500 mL/minute or less. Pumps used for LFPS must be submersible, positive-displacement pumps. In specific cases, peristaltic pumps may be appropriate and could be used for LFPS when previously approved by the PIC/PO and/or PM or defined in project-specific work plans. The more commonly used positive-displacement pumps include bladder, variable-speed submersible-centrifugal, and gear pumps. As such, pump selection should take into consideration a variety of well characteristics, including but not limited to: depth to water; analytes of interest; chemical incompatibilities; suspended solids concentrations; ease of

decontamination; and availability of a power source.

- *Tubing* - The preferred inside diameter (ID) of tubing is one quarter inch (1/4-in), and should be no greater than three-eighths of an inch (3/8-in). Larger tubing diameters reduce flow velocity resulting in a corresponding increase of pump **speeds** to maintain flow. Increased pump speed will, in turn, elevate the potential for turbulent flow across the screened interval and this may affect the quality of the water being sampled. Conversely, any reduction in flow velocity may allow air to become trapped in the tubing, which may ultimately affect air-sensitive parameters or allow particulates to settle, which may affect turbidity values.
- *Flow-through Cell (flow cell)* - Typical flow-through cell design is not complicated and almost all on the market today share common features. Cells should be transparent in order to "see" the physical condition of the purge water or air bubbles passing through the system. For example, highly turbid or iron bacteria-laden water can be visually monitored for change as the purge progresses. The cell must also be sealed against unwanted exposure to the atmosphere, thus ensuring accurate measurement of air-sensitive parameters (dissolved oxygen, pH, etc.). The total capacity of the cell must be small (i.e., less than 300 mL) in order to maintain a desirable turnover rate of water coming into the cell to ensure real-time data integrity. The in-line design of the cell must also allow for purge water to enter the flow cell from a bottom port and exit at the top. The intake and discharge of the flow cell may be fitted with a check valve.
- *Pump Intake Location* – The pump intake is typically located at the midpoint of the saturated well screen. When LFPS is performed correctly, the data being collected should be reflective of water quality within a discrete interval along a length of well screen or fracture in an open borehole. It should be noted that the pump intake location can be adjusted to reflect site-specific conditions such as areas of low recharge or zones of highest contaminant concentration or contaminant flux along the screened/open-hole interval. This is particularly important in wells constructed with more than ten feet of well screen.
- Information to be considered when selecting the pump intake depth should include: (a) evidence of soil contamination from boring logs and field screening techniques; (b) soil sampling analytical results; (c) vertical groundwater quality profiles; and (d) areas of high permeability as identified from drilling operations (i.e., water or drilling fluid injection/discharge rate changes, observation of fractures or staining on rock cores, etc.) or geotechnical laboratory testing results.
- *Other Considerations* - Additional sampling objectives (e.g., targeted aquifer zones) may be defined in the project-specific Work Plan, Field Sampling Plan and/or FPs and may determine different sample depths than those that would be defined based on the pump intake considerations above.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review, and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). In addition, because samples will be collected from existing groundwater monitoring wells, field staff should review and complete pertinent tasks identified in **FP 6.02** (Groundwater Purging and Sampling). Further, to the extent that non-dedicated sampling equipment is to be used (e.g., water level indicator, purge pump, water quality instrumentation), to minimize potential cross- contamination of samples among wells, such sampling equipment should be decontaminated between wells as described in **FP 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan, and/or QAPP. Used disposable sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling) following the sampling event. Since groundwater samples will be collected, staff should review the complete pertinent tasks identified in relevant FPs (e.g., **FP 1.02**, Sample Handling, Shipping, and Chain of Custody, **FP 1.05**, Field Quality Control Samples).

In addition, at a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP. Clean, chemical protective, dedicated gloves must always be worn when handling groundwater and using sample equipment.
- Coordinate and obtain permission for site access.
- Review applicable permits and permit conditions that may affect site work including agency notifications, and restricted operating hours.
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work.
- Review project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable.
- Review and discuss with the PIC/PO and/or PM the proposed project-specific Work Plan, Field Sampling Plan or sampling strategy. Note that site geology and expected contaminants should be reviewed to determine if unpreserved bottles may be needed (e.g., anticipated effervescence due to high levels of dissolved calcium carbonate in groundwater reacting with acid preservatives).
- When contractors are used to perform the sampling or in states where sampling can only be performed by personnel licensed or certified by the State, discuss the Work Plan, Field Sampling Plan and/or QAPP with the contractor.
- Review the standard instruction manual(s) provided by the manufacturer of the specific equipment being used for groundwater sampling.
- Obtain the glassware/bottles in advance and check against sampling numbers to confirm that the appropriate containers and quantities are provided prior to mobilization. Contact the laboratory and provide advance notice when sample delivery is anticipated.
- Ensure that all equipment/materials required to complete the work have been secured and packed prior to travel. If equipment is being shipped to an alternate location, arrange for delivery at least one day prior to start of field work and confirm receipt at

the delivery location (e.g., hotel or site). Sampleware is assumed to be damaged if lids/containers are cracked or liquid has leaked from a container. If, upon receipt, damaged containers are observed, such should be returned to the laboratory and new containers obtained.

Prior to initiating the well sampling activities, Ramboll oversight personnel should field-verify the well identity and construction against available documentation (Site Plans, Well Construction Logs, etc.). Prior to sampling, it is imperative that a positive well identification be made using measured total well depth, well labels, Site Plans, and well construction records to ensure that the correct well is sampled (refer to **FP 6.04**, Groundwater and Free Product Level Measurements). If total well depth is measured, proper decontamination of the water level indicator tape must be conducted before deploying the water level indicator into another well (refer to **FP 14.01**, Sampling Equipment Decontamination).

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that will be used to take field measurements. To increase productivity in the field, it is recommended that prior to mobilization (a) the laboratory-provided sampleware quantities are checked, (b) sample containers are pre-labeled (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody), (c) pump suspension line and/or discharge tubing to the individualized targeted well depths be premeasured, and (d) non-dedicated sampling equipment is decontaminated and packaged (refer to **FP 14.01,** Sampling Equipment Decontamination).

Unless dedicated pumps are used or otherwise required by the project-specific Work Plan, Field Sampling Plan, and/or QAPP sampling should begin with monitoring wells with the lowest expected groundwater contaminant concentrations and proceed systematically to monitoring wells with the highest expected groundwater contaminant concentrations.

4.3 General LFPS Guidelines

The purpose of LFPS is to collect groundwater samples that are representative of ambient groundwater conditions in the aquifer by adjusting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. The following provides a general recommended list of practices for LFPS activities:

- Where applicable, contact the identified key site personnel upon arrival to the Site and assess proposed work areas.
- All wells to be sampled should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- Place polyethylene sheeting (or garbage bags) around the well for placement of monitoring and sampling equipment and to contain any accidental spillage during purging or sampling.
- Remove the well cover or equivalent protective casing cover (refer to **FP 6.04**, Groundwater and Free Product Measurements) and measure head space concentrations in accordance with the applicable manufacturer instructions and field

screening FPs. Record field screening readings in the field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and Work Plan, Field Sampling Plan and/or QAPP.

- As detailed in **FP 6.04**, Groundwater and Free Product Measurements, record the condition of the well, noting any damage to the well, plug, and/or protective casing, and record any evidence of air pressure (positive or negative) when removing the well cap.
- Complete all well depth, depth-to-water or free product measurements prior to any planned groundwater and/or product withdrawals, sampling or disturbance of groundwater activities unless otherwise specified in the Work Plan, Field Sampling Plan and/or QAPP (refer to **FP 6.04**, Groundwater and Free Product Measurements).
- To prepare the pump suspension line and discharge tubing, measure the correct length needed so that the pump intake or bottom of discharge tubing rests at the target depth in the well. The measurements should account for the additional length needed at ground surface to appropriately anchor the suspension line and connect discharge tubing to water quality monitoring equipment. The length of tubing, from the top of the well casing to the flow-through chamber, should be the shortest length manageable to minimize: (a) exposure to ambient temperature, direct sunlight, and air bubble formation; and (b) the likelihood of deposited solids or air bubbles being trapped in tubing bends and re-mobilized. If the suspension line and tubing were premeasured or ordered to premeasured lengths in advance of field efforts, make any necessary alterations based on field observations (e.g., unanticipated groundwater elevations).
- Assemble the pump, suspension line, and tubing. Inspect all sampling equipment prior to deployment, making certain that all connections are secure and equipment is in working condition. Troubleshooting pump issues is generally easier if the pump and tubing assembly are inspected prior to deployment. If not using dedicated sampling equipment, ensure all materials are properly decontaminated prior to conducting sampling (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Slowly lower the assembly into the well using the suspension line to achieve minimal water column disturbance until the location of the tubing or pump intake reaches the predetermined depth within the well. Anchor the assembly in place by securing the suspension line at the surface and/or clamping the tubing in place via spring clamp.
- Measure and record depth to water following insertion of the pump and tubing assembly. Allow the water level to return to its static level prior to initiating purging. Leave the water level measuring device in the well.
- Assemble the water quality meter sensor probe and flow through cell in accordance with the manufacturer’s specifications.
- During initial pump startup, do not connect the pump discharge line to the flow-through cell. Monitor drawdown and adjust the flowrate as necessary to stabilize it and prevent fouling of probes by bacteria, sediment, or NAPL.

- Once drawdown measurements indicate a relatively constant flow rate has been achieved, continue to run the pump for a few minutes to clear any unwanted material before connecting the pump discharge line to the flow cell.
- Carefully connect the pump discharge tubing to the influent port of the flow-through cell of the water quality meter and connect a section of clean tubing to the effluent port of the cell. The influent and effluent connections to the flow-through cell are unique and based on each meter's design; orientation of flow matters and influent/effluent ports should be marked on the flow cell.
- When water fills the cell, ensure the tubing is completely full of water, check for leaks and make any necessary adjustments. If water is particularly turbid at the beginning of the purge, once the turbidity decreases it can be helpful to disassemble the water quality meter sensor probe and flow through cell and rinse them with DI water to remove any residual particulates.
- For low-flow purging, evacuate groundwater at a flow rate of 100 to 500 mL/min and until the water quality parameters (e.g., pH, DO, ORP, temperature, specific conductance, and turbidity) specified in the Work Plan, Field Sampling Plan, QAPP and/or FPs developed based on state-specific or regulatory program-specific guidelines, requirements or procedures have stabilized. In the absence of specific stabilization guidance, the following parameters or any combination thereof established by USEPA should be monitored to determine when parameter stability has been achieved.

  pH ± 0.1 unit
  Specific Conductance ± 3%
  Temperature ± 3% [See Note 1]
  Dissolved Oxygen ± 0.3 mg/L [See Notes 2 and 3]
  Turbidity ± 10% (when turbidity is greater than 10 NTUs) [See Note 4]
  ORP/Eh ± 10 millivolts
  Water Level Drawdown < 0.3 ft from static [See Note 5]

  Note 1: Temperature generally tends to stabilize rapidly and is considered a relatively insensitive indicator of stability.

  Note 2: Under some regulatory programs, the DO stability is defined in terms of percent change (e.g., in New Jersey, less than ± 10% change in DO indicates parameter stability).

  Note 3: If there is a significant discrepancy between the DO and the ORP results, for example, if the DO result is greater than 2 mg/L and the ORP measurement is negative millivolts (<-100 millivolts), then either the DO and/or the ORP meter may not be appropriately calibrated or operating correctly. Recalibrate both meters and check the DO and ORP measurements again. If the issues with the DO measurements continue, consider using an in-situ probe (e.g. YSI) or Chemetrics sampler approach.

  Note 4: Although turbidity greater than 10 NTU can be natural and unavoidable if turbidity has stabilized greater than 50 NTU consider additional purging to try to achieve a turbidity less than 50 NTU.

Note 5: During pump start-up, drawdown may exceed the 0.3-ft target and then recover as flow-rate adjustments are made.

- Collect measurements approximately once every five minutes or periodically as defined by the time it takes for purge water to adequately replace the water quality meter's flow-through cell.
  - If the purge rate decreases, the time required for purge water replacement will increase.
  - It is generally accepted that when the measurements of the monitored parameters fall within the stated range for three consecutive readings, chemical parameter stabilization has been achieved.
  - If the anticipated "third" reading of any individual parameter does not fall within the stated range, then the process to achieve three consecutive readings for that parameter must be restarted.
- In some situations, even with slow purge rates, a well may not recharge and be pumped dry. In these situations, under certain regulatory programs this constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). In such cases, it is not necessary that the well be evacuated three times or that chemical parameters stabilize before it is sampled. Nonetheless, the pH, specific conductance, temperature, and turbidity should be measured and recorded during collection of the sample from the recovered volume. These data would serve as the field measurements of record for the sampling event.
- If flow rates are to be measured and a flowmeter is not available, the discharge from the effluent of the flow-through cell can be collected in a container of known volume (i.e., one-gallon plastic water jug or a graduated cylinder) and the time to fill the container noted. When flow-rate measurements are complete, redirect the discharge as detailed above and dispose the contents of the jug or graduated cylinder into five-gallon buckets or directly into 55-gallon drums.
- Containerize purge water in accordance with **FP 15.01**, Waste Handling. The discharge tubing should be secured such that all purged groundwater is collected in five-gallon buckets or directly into labeled Department of Transportation (DOT)-rated 55-gallon drums, depending on site conditions and purge volumes.
- Upon completion of well purging, reduce the pumping rate to less than or equal to 100 mL/min (or as specified in the project-specific Work Plan, Field Sampling Plan or QAPP) and disconnect the water quality meter from the discharge tubing.
- Wells should be sampled as soon as possible after purging. Refer to **FP 6.02**, Groundwater Sampling, for guidance on groundwater sample collection procedures. If sampling for volatile organics, collect the sample for VOCs first to prevent loss of volatiles due to disturbance of the water, and be sure to fill VOA vials to zero headspace, as described in **FP 6.02**, Groundwater Sampling. Sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Withdraw the sampling equipment from the well, replace the well cap, and re-secure the well. For reusable non-dedicated equipment that has come in contact with

groundwater, remove the equipment from the monitoring well and decontaminate in accordance with **FP 14.01**, Sampling Equipment Decontamination. Used disposable non-dedicated tubing should not be reused and should be managed in accordance with **FP 15.01** (Waste Handling).

- Record in the field book or appropriate field forms any deviations from standard procedures (i.e., sample collection prior to stabilization), the rationale for those modifications, and any abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.). Inform the PIC/PO or PM so necessary maintenance, redevelopment or repairs are conducted before the next planned water sampling event.

4.4 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected groundwater should be constructed of inert materials that will not affect the concentration of constituents in the water sample (i.e., glass, stainless steel). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the groundwater and the quality assurance needs and study goals. This should be outlined in the project-specific Work Plan, Field Sampling Plan or QAPP.

The laboratory will provide appropriate sample containers, some pre-filled with method-specific preservatives appropriate for each predetermined sample analysis. The sample volume is a function of the analytical requirements and the laboratory-specific equipment and will be specified in the project-specific Work Plan, Field Sampling Plan or QAPP.

4.5 Sample Transport and Storage

Samples shall be handled, transported, and stored to maintain structural and chemical qualities of the soil samples. Sampling containers shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). Samples should be kept in an ice-filled transport container during fieldwork and covered to limit exposure to light. If the cooler size allows for space between sample containers, bubble wrap should be used to fill annular space and prevent breakage during transport. Glass bottles should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample vials in laboratory-issued foam packing cartons. If shipping groundwater samples with preservatives, confirm the sample shipments, packaging, and labelling are performed in accordance with applicable US Department of Transportation (DOT) and/or International Air Transportation Association (IATA) requirements. Retain shipping documents (e.g., air bills, bills of lading) in the project file.

4.6 QA/QC

Follow QA/QC procedures described in the project-specific Work Plan, Field Sampling Plan and/or QAPP throughout the sample purging, collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while groundwater sampling.

- Some states require that only personnel licensed or certified in the State where the work is being performed perform the sampling. Therefore, State regulations and guidance governing groundwater should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements.
- It is important to always remain alert and aware of your surroundings. Groundwater sampling could involve the use of generators and associated equipment, may be conducted on proximity to heavy equipment, and can be subject to hazards posed by nearby equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, biological, mechanical, and chemical hazards.
- Prior to mobilization, determine the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located in driveways or on the right of way).
- At sites with certain contaminants and/or subsurface conditions (e.g., landfills, non-aqueous phase liquids), potentially toxic and/or explosive gases may accumulate at and around the well as it is being sampled. Stay upwind of the sampling location and ensure that air monitoring is conducted and PPE is used in accordance with the site-specific HASP.
- Keep any sampler, tether, or suspension lines untangled. Use a plastic winder or spool winder to retrieve the sampler/pump to keep the line from tangling.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the "buddy system" and should ensure that the site-specific HASP includes safety measures and procedures.
- Care should be taken when opening well protective covers and removing well caps for the presence of insect nests such as wasps or hornets.
- For some wells, well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well sampling. Do not use petroleum based solvent sprays to free seized locks as it may impact water quality in the well. Replace any damaged locks.
- Wells with a water-tight cap may experience a buildup of pressure. Keep your face and body away from the top of the well when loosening or removing the cap.
- Certain sampling equipment configurations have tubing without a pump at the sample intake depth (e.g., a bladder pump with drop-tubing). Without a weight on the end of the tubing, while lowering the tubing into the well it can easily get caught on the joints between sections of the PVC well casing or on the open borehole wall due to the natural curl in the tubing from being stored in rolls. To remedy this, a stainless-steel rod can be fastened as a splint along the bottom few feet of tubing or a stainless-steel weight can

be secured to the end of the tubing to remove the curl and keep the tubing from getting stuck. Some sampling equipment will include a weight for this purpose. Proper decontamination of the stainless-steel rod or weight is required prior to deployment into a subsequent well (refer to **FP 14.01**, Sampling Equipment Decontamination).

- It can be helpful to utilize electronic worksheet to simplify purge stabilization calculations in the field and eliminate the need to transcribe purge notes into electronic form for reporting purposes. An MSExcel®-based purge sheet can also reduce potential mistakes; however, a thorough understanding of the stabilization criteria calculations is necessary prior to use in the field. An example of a low-flow sampling purge sheet with auto-calculations is presented on **Figure 1**.

21	Well Evacuation Data										
23	Stabilization Criteria			± 0.1 SU	± 3 %	± 10 %	± 3 %	± 10 mV	± 10 %	0.3 ft	
24	Time	Vol.	Rate	pH	Cond.	Turb.	Temp.	ORP	DO	DTW	Appearance or Comments
25		L	mL/min	Std	ms/cm	NTU	C	mV	mg/L	ft	
27	9:54	--	550	9.86	0.240	78.9	10.18	16	11.89	23.80	Slightly silty
28	9:59	0.0	320	7.89	0.360	70.4	11.17	77	9.98	23.50	Slightly silty
29	10:04	1.6	250	7.71	0.364	58.2	11.14	93	9.84	23.30	Slightly silty
30	10:09	2.8	250	7.68	0.361	48.6	11.04	100	9.64	23.30	Clear
31	10:14	4.1	250	7.68	0.360	30.3	10.96	107	9.59	23.30	Clear
32	10:19	5.3	250	7.66	0.360	16.0	11.11	107	9.50	23.30	Clear
33	10:24	6.6	250	7.68	0.362	9.3	11.09	111	9.87	23.30	Clear
34	10:29	7.8	250	7.69	0.363	5.7	11.26	114	9.49	23.30	Clear
35	10:34	9.1	250	7.64	0.362	5.8	11.21	115	9.50	23.30	Clear
36	10:39	10.4	250	7.65	0.362	5.6	11.20	118	9.52	23.30	Clear
37	10:44	11.6	100	7.66	0.363	5.5	11.32	118	8.82	23.30	Clear

Figure 1: Groundwater Purge Sheet

As each parameter stabilizes for a minimum of three consecutive readings within its specified criteria, cells activate green. Purge rate and depth to water cells help guide adjustments needed to comply with low-flow guidance. To see a report-ready completed sheet, see

- Pumping issues, particularly at deep wells using low-flow or intermittent-flow pumps, can be difficult to troubleshoot. A small cup of deionized (DI) water can be used to test for flow. Place the end of the discharge tubing into the DI water cup during pumping to see if there is a discharge (i.e., bubbles occur). As purge water fills the tubing at depth, air is displaced and forced out the top, causing bubbles in the water. If bubbles are observed, the pump is operating and there is flow.
- Bladder pumps have several O-rings and check balls that are necessary for proper operation. If bubbles are observed in the DI water during compressor discharge, but water is suctioned back into the tubing during the refill cycle, the pump check ball is not working properly or may be missing. Air bubbles in the discharge water that do not disappear after purging for a few minutes are usually indicative of a failed O-ring.
- A small cup of DI water can be used to monitor the purge rate of intermittent-flowing bladder pumps before water arrives at the surface by observing the duration and/or speed of bubbles. Monitoring the duration and speed of bubbles at the beginning of the purge will allow the operator to make adjustments and fine tune the air controls (refill, discharge and pressure) to bring water to the surface.
- Stabilization of parameters when pumping at low flow rates can be difficult. Several adjustments can help make stabilization easier and enhance the rate of stabilization:
  - Minimizing the length of extra tubing at ground surface can help minimize the effect of atmospheric temperature on purge water;

  - Insulating the tubing with tin foil and/or shading from direct sunlight can help minimize the effect of atmospheric temperature on purge water; and
  - Increasing the flow rate to the maximum allowable rate (based on drawdown and regulatory requirements) will help replace water in the flow-through cell more frequently, thus reducing the severity of parameter fluctuations.
- If one or more key parameters fails to stabilize after 2 hours of purging, one of the following options should be considered after consulting with the PIC/PO and/or PM:
  - continue purging in an attempt to achieve stabilization;
  - discontinue purging, do not collect samples, and document attempts to reach stabilization in the field notes;
  - discontinue purging, collect samples, and document attempts to reach stabilization in the field notes; or
  - secure the well, purge and collect samples the next day.
- Various injected chemicals, such as in situ chemical oxidation (ISCO) or in situ chemical reduction (ISCR) products will significantly impact the DO and ORP measurements and may lead to inconsistencies in the DO and ORP data, likewise, dissolved hydrogen concentrations are significantly affected by ISCO and ISCR.
- When purging with intermittently-flowing pumps (i.e., bladder pumps), collection of readings should occur during the same portion of the flow cycle (ideally at the end of a discharge cycle, so measurements are based on fresh water entering the flow-through cell) to minimize parameter fluctuations between cycles.
- For wells with slow recovery, attempts should be made to avoid purging them dry as it may affect the quality of the sample. For example, as water enters a well that has been purged dry, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column. A possible remedy to purging the well dry is to reduce the purge rate.
- If possible, sampling of wells that have a slow recovery should be scheduled so that they can be purged and sampled in the same day, after adequate volume has recovered. Unless it is unavoidable, these types of wells should not be purged at the end of one day and sampled the following day.
- Sampling equipment (e.g., air compressors) are temperature sensitive and sampling in extremely cold temperatures can complicate even trivial tasks. When sampling in these conditions, keeping sampling equipment and discharge tubing from freezing is critical. Insulating the compressor and keeping it warm between use (within a vehicle, field trailer, etc.) will help keep it functioning properly. Any interruption of flow could cause purge water in the discharge tubing to freeze; insulating the tubing and maintaining higher flow rates (within regulatory guidelines) will help keep purge water from freezing.
- Adequate preparation prior to sampling each well will save time in the long run. Make sure the generator/air compressor has fuel or that spare batteries/air canisters are available in the event that stabilization takes longer than anticipated. Stopping mid-purge to refuel or acquire additional air canisters will disrupt stabilization, greatly

increasing the time required to sample a well. In addition, adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

- Each sampling effort should attempt to minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).
- If the Work Plan, Field Sampling Plan and/or QAPP requires volatile organic or metals analysis (or other analysis requiring field preservation), be sure to avoid direct contact with laboratory-provided preservative chemicals and don appropriate PPE as identified in the project-specific Work Plan and HASP. Additionally, care should be taken to not overfill preserved sample containers so as to maintain the appropriate ratio of preservative to sample, and to avoid spilling the chemical preservative.
- While purging, the time between water quality measurements can be used to organize bottle-ware and confirm well-specific information (e.g., sample analyses, bottles appropriately labeled, duplicate collection, field filtering).
- If the Work Plan, Field Sampling Plan and/or QAPP specify analyses requiring field preservation, be sure to avoid direct contact with laboratory-provided preservative chemicals.

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record all information related to groundwater sampling in accordance with **FP 1.01** (Field Notes and Records).

If possible, one sampler should be responsible for documenting field observations and information in the field notebook, sampling forms, and chain-of-custody forms, while the second sampler is responsible for handling of the sample containers and collection of the sample.

FIELD PROCEDURE NO. 7.01

SURFACE WATER SAMPLING
VISTRA PROJECT
PROJECT NO. 1940112376

FIELD PROCEDURE NO. 7.01

SURFACE WATER SAMPLING

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 7.01 "Surface Water Sampling" last revised June 13, 2024.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for collection of surface water samples. Surface water is often a critical route of exposure that must be considered in environmental investigations and human health and ecological risk assessments. For example, important and sensitive natural resources such as benthic macroinvertebrates, water column zooplankton, fish and wildlife depend on surface water for many life-cycle functions. Surface water also provides routes of chemical exposure to humans via drinking water and recreational swimmers and boaters via incidental surface water ingestion and/or dermal contact.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the project specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules and procedures contained in the project specific HASP followed by approved project specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC)/Project Owner (PO) and/or Project Manager (PM) shall verify that project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the project specific HASP.

2. EQUIPMENT AND MATERIALS

The list below provides an overall summary of general equipment typically required for surface water sampling, but the list should not be considered exhaustive. Additional equipment may be specified in the project-specific Work Plan, FSP or HASP. More specialized sampling equipment may be required depending on the type of sampling to be performed (refer to **Section 4.1**).

- Site information (e.g., maps [aerial and/or bathymetric], contact numbers, keys or lock codes for gates or access points, previous field logs).
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).

- Personal protective equipment (PPE), including Personal Flotation Device (PFD), in accordance with the site-specific HASP.
- If necessary, appropriately equipped, United States Coast Guard (USCG) certified sampling platform or vessel (e.g., boat or barge equipped with oars, anchor, motor, marine radio, gas tank, tow vehicle, trailer, sampling davit, a-frame, moon pool, etc., as may be required), as outlined in Safe Work Practice (**SWP)** Water Work.
- Hip Waders.
- A Global Positioning System (GPS) receiver (with real-time kinematic [RTK], as necessary) or other locating device as outlined in **FP 1.04** (Documenting Sampling Locations).
- Survey stakes, flags, or buoys and anchors. Refer to **FP 1.04** (Documenting Sampling Locations).
- Surface water sampling equipment (refer to **Attachment A** for brief descriptions), such as:
  - Dip sampler (e.g., pole or mechanical device to hold or extend sample container)
  - Bailers
  - Kemmerer or Van Dorn samplers with line and messengers
  - Peristaltic or submersible pump and tubing
  - Automatic samplers or "autosamplers"
- Equipment-appropriate tools for adjusting samplers (pliers, wrench, etc.).
- Weighted line or other measuring device for determining water depth at each proposed sampling location.
- Local tide chart (if tidal) or representative staff gauge of known elevation for establishing water depth to standardized datum (e.g., Mean Lower Low Water [MLLW]).
- Tape measure
- Laboratory supplied certified-clean sample containers (appropriate for various analyses to be performed), as may be required in the project-specific Work Plan, FSP or QAPP.
- If dissolved metals analyses will be conducted, appropriate filtration equipment (e.g., peristaltic pump) and filters.
- Transfer containers (for direct dip sample collection) made of similar material (e.g., glass) as the sample containers.
- Field screening equipment (e.g., multi-parameter water meter) as required by the project-specific Work Plan, FSP, QAPP and/or the HASP.
- Sample labels and chain of custody forms - "Sharpies" or markers should be avoided for labelling purposes as the ink may off-gas (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody).
- Sample shipment container labels, chain of custody forms and packing materials for sampling containers as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

- Heavy duty trash bags for disposal of sampling gloves, towels/rags and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Decontamination supplies (refer to **FP 14.01**, Sampling Equipment Decontamination).
- Appropriate waste container and labelling materials used to dispose of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).

3. PROCEDURES REFERENCED

In addition to the reference and guidance documents cited above, the following SWPs and FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **SWP** Subsurface Utility Clearance
- **SWP** Water Work – Inland, Near Shore & Facility
- **SWP** Water Work – Offshore
- **SWP** Water Work – Over Ice
- **FP 1.01**, Field Notes and Records
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody
- **FP 1.04**, Documenting Sampling Locations
- **FP 1.05**, Field Quality Control Samples
- **FP 2.02**, Site Preparation, Inspection and Housekeeping
- **FP 14.01**, Sampling Equipment Decontamination
- **FP 15.01**, Waste Handling

The list above is not intended to be all inclusive. Other SWPs and FPs may need to be referenced based on the specific requirements of the project-specific Work Plan, FSP and/or QAPP (e.g., field screening FPs, FPs for sampling of other media, such as sediment or sediment pore water, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

Strategic decisions including, but not limited to, the selection of the sampling approach and the need to collect additional media samples will be approved by the PIC/PO and/or PM before the

initiation of associated field activities and will be documented in the project-specific Work Plan, FSP and/or QAPP. The Work Plan, FSP and/or QAPP will be designed for the collection of quality data to meet the objectives of the sampling program and will include information such as the number of samples, sampling depth and the laboratory analyses to be performed on each sample as well as quality assurance/quality control (QA/QC) requirements. The Work Plan, FSP and/or QAPP will generally provide for some discretion in the field, depending on encountered conditions; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PIC/PO and/or PM.

When planning a surface water sampling event, the following should be considered:

- *Water Depth*. Determination of the water depth to the sediment surface is an important initial consideration which will influence several variables, such as the selection of sampling equipment, whether a boat is necessary or collection sequencing.
- *Sampler Type*. Surface water samples can be collected using various equipment, including dip samplers, bailers, Kemmerer or van Dorn samplers, peristaltic or submersible pumps and autosamplers, depending on the aquatic system to be sampled and the site-specific requirements. For example, peristaltic pumps and Kemmerer or van Dorn samplers allow for discrete sample collection, and peristaltic and submersible pumps facilitate filtering of surface water samples.
- *Sample Ware*. Sample containers that will come into contact with collected surface water samples should be constructed of inert materials that will not affect the concentration of constituents in the sample. Generally, glass, stainless steel, polypropylene tubing, and Teflon® materials are used for surface water sampling. However, stainless steel containers can be a source of chromium, nickel and other metals if prolonged sample contact is allowed. The use of glass or Teflon® containers is preferable for collection of samples for analysis of organic compounds, while polypropylene is appropriate for collection of samples for heavy metals analyses when samples are immediately acidified upon collection.
- *Sample Filtration*. Filtration is used to determine the dissolved concentrations of constituents (e.g., metals) in surface water, which are generally considered the most bioavailable fraction and therefore most relevant exposure basis for risk assessments. If samples are being collected solely to compare surface water concentrations to a benchmark, sample processing should be consistent with the basis for that benchmark (e.g., U.S. Environmental Protection Agency's [USEPA's] National Recommended Aquatic Life Criteria for metals are generally presented on a dissolved basis). For samples that require filtration prior to analysis, the pore size of the filter is critical in determining what is actually analyzed in filtered samples. A pore size of 0.45 microns is commonly used for many constituents, although other pore sizes may be appropriate depending on the analysis and site characteristics (e.g., the presence of colloidal material). Filtration can be completed in the field (e.g., while on the vessel or shore-side) to prevent degradation of the sample following collection of the sample or in the laboratory to minimize the possibilities for cross-contamination of samples. However, careful consideration should be given to the potential chemistry-related artifacts of delaying sample filtering; consultation with the analytical laboratory is recommended.

- *Potential Sources of Sample Contamination*. Plated or painted sampling equipment can contaminate surface water samples; therefore, such equipment should be avoided if possible. Similarly, support equipment (e.g., boats) could also be a potential source of surface water sample contamination. For example, oils and other hydrocarbons may compromise samples, if samples are collected from a gas-powered vessel (allow sufficient time for fumes or oils associated with boat operation to clear from the area before sampling). If sheens, oil or product are expected on the water surface consider whether the sheens, oil or product and/or underlying surface water should be sampled. In addition, if sampling for per- and polyfluoroalkyl substances (PFAS) refer to **FP 1.07** (PFAS Sampling).
- *Sampling Intervals and Potential Stratification*. Unless otherwise specified in the project-specific Work Plan, FSP or QAPP, surface water samples should be representative of the water body. If water is shallow, sample collection can be targeted in areas that are well mixed to provide the most representative data. To determine whether stratification has taken place in a deeper water body (impoundment, lake, complex river system) and defined sampling intervals, water quality data should be collected. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist that would affect analytical results. Conductivity and oxidation-reduction potential can also assist in the interpretation of analytical data and the selection of surface water sampling locations and depths. Measurements should be collected at up to 1-meter (3-feet) intervals from the water surface to the sediment surface or within the targeted sampling depth.
- *Analyses*. In addition to the chemicals of interest, evaluation of potential human health and ecological risks posed by contaminants of potential concern (COPCs) in surface water must also consider fate and transport pathways that may mitigate or exacerbate COPC exposure. Thus, in addition to COPCs, the sampling program should consider analyses for parameters that could affect the interpretation of results. For example, changes in surface water hardness (for freshwater), salinity, and pH can increase or decrease the bioavailability of many heavy metals. In addition, sorption of chemicals to solids suspended in surface water can be an important fate process that either decreases chemical bioavailability or enhances deposition of chemicals to sediment, thereby affecting which media drive exposure. The valence state (e.g., hexavalent vs. trivalent chromium), proportion of a chemical in dissolved forms (especially metals), and photoactivation of chemicals such as polycyclic aromatic hydrocarbons (PAHs) can be important considerations in evaluating the risk associated with exposure to chemicals in surface water.
- *Sampling Sequence*. To limit potential cross-contamination between sampling locations, sampling activities should be conducted from areas of least suspected to most suspected impacted locations. In flowing systems, sample from background (or upstream) locations first and then sample downstream locations moving towards the most impacted locations.
- *Water Body Use and Local Notice to Mariners.* Uses of the waterbody could affect the sampling activities. For example, boat or barge traffic could potentially limit use of small-sized watercraft or affect travel to/from the sampling area. Similarly, the sampling activities could obstruct or affect safe use of the waterbody by others. Further, wakes created by boat or barge transit can affect the progress and safety of sampling activities. Submit the information required by the USCG to request that a Temporary Local Notice

to Mariners be published in applicable USCG Districts to alert other mariners of the potential hazards to navigation posed by the proposed surface water sampling activities.

- *Tidal Current*. Tides may affect accessibility to shallow sampling locations at certain times during the day or even strand a watercraft. Where tidal swings may affect the ability to implement a sampling program, review tidal charts, and schedule the work around the highest predicted tide. Consider sampling from the shoreline.
- *Health and Safety.* Whenever working adjacent to and/or over water, certain additional health and safety requirements which should be defined in the site-specific HASP (e.g., the buddy system) must be used, and PFDs are required. Consult with **SWP** Water Work (Inland, Nearshore & Facility, Offshore, and/or Over Ice) and the precautions listed in **Section 5** of this FP.
- If entry into the waterbody is required to collect the sample, personnel should be aware of and consider currents prior to entering the water. Further, if the survey is being performed at an ice-filled water body or under frozen ground conditions, sampling should not be performed unless specific safety provisions are defined in the site-specific Work Plan, FSP and/or QAPP and HASP to address risks associated with work on iced or frozen surfaces or the potential for personnel to fall through the ice. For surface water sampling involving a watercraft, these are additional considerations:
    - *Watercraft Type*. Selection of the most appropriate watercraft will depend on the sampling equipment, the water depth in the sampling area, the draft requirements of the watercraft, the waterbody (e.g., river, lake, or ocean shoreline), the sampling team size, and the analyses to be performed (refer to "*Potential Sources of Sample Contamination*" above on potential watercraft effects on sample quality). The watercraft should be registered and/or permitted (as required according to local and/or state regulations), appropriately sized based on the above considerations and should provide the necessary space to work safely under site-specific conditions.
    - *Launch Site Location and Mooring Facilities*. If a boat launch or other means to access the surface water sampling area is not available at the site, access to the waterway from a nearby public or private boat launch will need to be procured to launch the watercraft. In some cases, a crane may be necessary to launch the vessel. In addition, an appropriate and safe mooring location with easy and secure access will need to be identified if the watercraft will remain in the water for an extended period of time. These logistical matters could significantly affect the duration of the surface water sampling event.
    - *Propeller Action.* Propeller action could potentially affect surface water sampling areas and could unintentionally remobilize and redeposit contaminated materials. Further, as indicated in "*Potential Sources of Sample Contamination*" above, fumes or oils associated with boat operation can affect sample quality and representativeness. This is particularly a concern in shallow waters or when using large watercraft. If warranted, smaller sampling vessels equipped with a trolling motor or oars in shallow water should be used.
    - *Water Current*. Water currents or high-water velocities may affect the boat's ability to remain in position; in such cases, spudded vessels may be necessary. Consider sampling from the shoreline. Also, to the extent practicable, avoid passing the watercraft beneath bridges or other obstructions overhanging the waterbody.

- *Anchoring Requirements*. If spudding or anchoring the vessel is required to allow sample collection, ensure that subsurface utilities or other restrictions (e.g., existing subaqueous sediment caps) in the sampling area are mapped (refer to **SWP** Subsurface Utility Clearance). Consider the potential for disturbance of sediments and the potential impact on the surface water being sampled.
- *Watercraft Training (if self-operating the watercraft)*. Only staff that have been licensed and trained to operate watercraft should operate watercraft (refer to water work related **SWPs**). Field staff should familiarize themselves with the watercraft and motor type (e.g., tiller steer or wheel outboard motors) and basic operations prior to use. There are often unexpected mechanical issues with watercraft during field sampling, and prior experience and knowledge of watercraft is especially helpful when having to make quick decisions in the field. Further, online boater safety courses are available through various state resources. Some states require passing a boater safety course prior to operating a watercraft. Therefore, state regulations and guidance governing watercraft operation should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements. Additionally, trailering a watercraft to the site provides its own set of dangers and hazards. Staff should be properly trained on operating a trailer and, if required, have any up-to-date relevant certifications (e.g., Department of Transportation certification) prior to initiating work.
- *Working Over Ice*. The project team should consider whether working over ice is a viable alternative to other type of water work (e.g., offshore, inland, or near shore and facility). Working over ice may present fewer hazards (e.g., watercraft- or wave-related hazards) and/or avoid potential cross contamination from propeller action. If work is being performed on a frozen water body or under frozen ground conditions, Ramboll ice safety requirements must be followed (**SWP** Water Work – Over Ice) and defined in the site-specific Work Plan, FSP, and/or QAPP and HASP.
- *Watercraft Cleaning.* Aquatic invasive species (e.g., zebra mussels) can be difficult to remove from the hull and need to be removed by brush or power washer prior to leaving the site. Failure to properly clean the vessel can lead to the potential spread of invasive species, especially if travelling outside the site's watershed. Therefore, define watercraft cleaning procedures for invasive species, which may include using a high-pressured power washer and soap to remove all algae and organisms from the watercraft prior to leaving the site. If available, refer to state- or region-specific guidance and/or requirements for cleaning watercraft.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). In addition, to the extent that non-dedicated sampling equipment is to be used (e.g., Kemmerer sampler), such sampling equipment should be decontaminated before collection of each sample to minimize potential cross-contamination between samples, as described in **FP 14.01** (Sampling Equipment Decontamination), the site-specific Work Plan, FSP and/or QAPP. Used disposable sampling equipment should be considered IDW and should be managed in accordance with **FP 15.01** (Waste Handling), following the sampling event.

In addition, at a minimum, the following tasks should be completed (as applicable) as field staff prepare for implementation of the work:

- Coordinate and obtain permission for site access.
- Review and sign the site-specific HASP.
- Review applicable permits and permit conditions that may affect site work including agency notifications and restricted operating hours.
- If work is being conducted under agency supervision, make appropriate advance notifications to advise of the start of work.
- Confirm surface water sampling locations.
- Complete the Water Work Hazard Evaluation form (refer to pertinent **SWP** Water Work).
- Review the site-specific Work Plan, FSP and/or QAPP, where applicable.
- Review and discuss with the PIC/PO and/or PM the proposed site-specific Work Plan, FSP or sampling strategy.
- Identify the type of sampling equipment required for site-specific tasks and review the standard instruction manual provided by the manufacturer of the specific sampling equipment being used for surface water sampling.
- Contact the vessel contractor (if applicable) to verify scope and confirm sampling equipment is available and appropriately decontaminated prior to mobilization.
- Contact the laboratory to provide advance notice when sample delivery is anticipated.
- Verify that all equipment/materials and sample ware required to complete the work have been packed prior to mobilization.

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test and/or calibrate equipment that will be used to take field measurements. To increase productivity in the field, it is recommended that prior to mobilization the laboratory-provided sample ware quantities are checked, sample containers are pre-labeled (refer to **FP 1.02**, Sample Handling, Shipping and Chain of Custody) and non-dedicated sampling equipment is decontaminated and packaged (refer to **FP 14.01,** Sampling Equipment Decontamination).

4.3 Surface Water Sampling Guidelines

The following describes guidelines for common techniques and practices used to collect surface water samples.

- Where applicable, contact the identified key site personnel upon arrival to the Site, visually assess proposed work areas and decide where containerized IDW should be staged and stored.
- Don a PFD per HASP and SWP Water Work requirements.
- Review the physical location of each sampling location and sequence of sampling with the boat captain (if applicable) before initiating work.

- If not using a vessel to collect samples, water depths are less than 0.5 meters (1.5 feet) and sediments can be walked on, don the hip waders.
- If possible, monitor local USCG channels, or other appropriate local boating channels, to stay up to date on potential waterway alerts.
- Don a new dedicated pair of gloves before collecting each sample as required by the HASP or site-specific Work Plan or FSP.
- Although equipment will be decontaminated between uses to further limit potential cross-contamination between sampling locations, sampling activities should be conducted from areas of least suspected to most suspected impacted locations. In flowing systems, sample from background or upstream locations first and then sample downstream locations moving towards the most impacted locations.
- Samples should be taken from an area of undisturbed water. To help prevent disturbing and suspending sediment into the water column of the sampling area:
    - Collect surface water and/or porewater samples before collecting sediment samples and before collecting samples for in-situ parameters measurements (e.g., pH, temperature, dissolved oxygen, turbidity, total suspended solids).
    - Avoid disturbing sediments in the vicinity of the sampling area prior to sampling (e.g., propeller action, equipment uses or transiting over sediment surfaces). If possible, approach sampling locations from down current.
    - If sampling from a bridge, collect samples from the upstream side of the bridge to minimize the influence of any trace constituents (e.g., metals) associated with road runoff from the bridge.
    - Collect samples for field parameter measurements after samples for laboratory analyses have been collected.
    - Measure and record the water depth, to the nearest 0.1 foot **after** sampling, to avoid suspension of sediment.
- In the event a sheen or oil is observed at or around the designated sample location, contact the PM and determine if a sample of the sheen and a sample from the water beneath the sheen should be collected.
    - If a sample is to be collected from the sheen, the sampling device should be placed at the downstream extent of the sheen with a small fraction of the collection device both beneath and above the water surface. Draw the sample device slowly through the sheen to collect the correct volume of water for the analysis.
    - If a sample is to be collected from the water column beneath the sheen, use a paddle dipped barely into the water surface to gently clear the area of the sheen. Once the sheen has been dissipated, the surface water sample can be collected with decontaminated sampling equipment following the procedures described above.
- Collect the GPS coordinates of the sampling location using a GPS receiver or other locating device as outlined in **FP 1.04** (Documenting Sampling Locations).
- If required by the site-specific Work Plan or FSP, measure the water elevation using a GPS receiver or install a local surveyed staff gauge where the water surface elevation can be measured at least

once per day manually or with a pressure transducer. Alternatively, estimate the water elevation from the water depth, position and time of measurement, and nearby tidal station or bathymetric data.

- Record the date, time, ambient temperature, cloud cover, precipitation, approximate wind speed and direction, stage of lake/river, tidal conditions, and direction at the sampling location, any unusual observations, and other meteorological conditions.
- If required in the site-specific Work Plan, FSP and/or QAPP, determine the hydrology and morphometrics (e.g., measurements of volume, depth, etc.) of the stream or impoundment being sampled. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths.
- Unless otherwise specified in the site-specific Work Plan, FSP and/or QAPP, sample ware should be filled to capacity, allowing no headspace (unless samples are to be stored frozen in which case some head space is required to allow for sample expansion).
- When approaching a sampling location, position yourself so you are facing upstream if there is a current and collect the sample without disturbing the bottom sediment.

4.3.1 Sample Collection Using Direct Dip Method

Sample collection using the direct dip method is not suitable when there is insufficient water depth to allow for the submersion of the container without disturbance to the bottom sediment layer (and minimize potential suspended sediment contamination of the samples) or when using pre-preserved sample containers (as it could dilute the concentration of preservative necessary for proper sample preservation). The method of collecting surface water samples using direct dip is described below.

- Collect the sample under the water surface (unless specifically required as part of site-specific goals), avoiding surface debris and the boat wake.
    - If using a laboratory supplied sample container, submerge the closed non-preserved sample container to the target sampling depth, open the container to collect the sample and then cap the container while submerged.
    - If using a dip sampler to collect a near surface sample, dip a decontaminated or dedicated dipper into the surface water into the surface water, allowing water to flow into the sampler close to the air water interface to prevent floating materials from collecting in the sampler.
- Carefully and immediately transfer the surface water to the appropriate sample container(s), and then cap[5]. For unpreserved samples collected by directly submerging the sample container, sample transfer is not necessary.

[5] For projects where samples are to be field preserved, add appropriate preservatives following sample collection in accordance with laboratory instructions.

- Once each sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with FP 1.02 (Sample Handling, Shipping and Chain of Custody).

4.3.2 Sample Collection Using Bailers

Bailers can be used to collect composite surface water samples if sufficient water depth is present. The method of collecting surface water samples using bailers is described below:

- Lower the new or decontaminated bailer through the water column until the desired depth is reached, thereby allowing water to be continually displaced through the top bailer.
- Retrieve the bailer.
- Transfer the water sample from the bailer to the laboratory-supplied sample container(s), and then cap.
- Once each sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

4.3.3 Sample Collection Using Kemmerer or Van Dorn Samplers

Discrete surface water samples can be collected from a specific depth using a Kemmerer or Van Dorn sampler. The method of collecting surface water samples using these samplers is described below.

- Follow manufacturer instructions to set the Kemmerer or Van Dorn sampler stoppers into the open position.
- Lower the sampler through the water column until the desired depth is reached.
- Gently move the sampler back and forth to displace water that may have entered as the sampler was lowered to the desired depth and ensure surface water from the desired depth interval has filled the sampler.
- Release the weighted messenger to close the stoppers.
- Retrieve the sampler.
- Transfer the water sample via the sampling port to the laboratory-supplied sample container(s), and then cap.
- Once each sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

4.3.4 Sample Collection Using a Peristaltic Pump

Peristaltic pumps can be used to collect surface water samples from specific depth intervals (in deeper water) or avoid sediment suspension in systems with very shallow water depths (e.g., wetlands) and/or in highly fluid sediment environments. The method of collecting surface water samples using peristaltic pumps is described below.

- Place peristaltic pump on a dry surface as these are not submersible (see **Section 4.3.5**).
- Measure and cut the intake tubing to a length equivalent to the sampling depth (typically less than 25 feet) plus the distance from the water surface at the sampling location to the pump intake. Calculate the corresponding tubing volume.
- Attach the tubing to a metal rod that can be extended to reach the target sampling location without disturbing nearby sediment (shallow water) or can be lowered into the water column (deeper water) to the target depth. Alternatively, add weights to the tubing and position the water intake at the target depth.
    - If collecting discrete samples from a specific depth, do not move the pump intake during sampling. If collecting a vertical composite sample, move the tubing intake at a constant rate vertically up and down the water column over the interval to be composited.
    - In shallow water, position the tubing approximately half-way between the water surface and the sediment layer, if possible.
- If filtered surface water samples are required per the site-specific Work Plan, FSP or QAPP, attach a 0.45-micron filter in-line with the exit tubing from the peristaltic pump. If both unfiltered and filtered samples are required, collect the unfiltered surface water samples first, and then attach the 0.45-micron filter to collect the filtered surface water samples.
- Evacuate at least three (3) tubing volumes of water, discharging into a 5-gallon bucket to avoid discharges to surface water and disturbance of the water surface.
- After evacuating, fill the laboratory-supplied sample container(s) with the required volume(s), and then cap. For small volume sample ware (e.g., vials), fill a non-preserved and unused laboratory-supplied sample container (e.g., collector jar) and then transfer the water sample from the collector jar to the laboratory-supplied sample container(s), and then cap.
- Once each sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

4.3.5 Sample Collection Using a Submersible Pump

- Submersible pumps are designed to collect surface water samples in-situ and in deeper (e.g., submersible) water. The method of collecting surface water samples using submersible pumps is described below.
- Measure and cut the discharge tubing to a length equivalent to the sampling depth plus the distance from the water surface at the sampling location in the vessel. Calculate the corresponding tubing volume.
- Position the pump intake at the target depth, adding weight as needed to maintain position during high-flow conditions. If collecting discrete samples from a specific depth, do not move the pump intake during sampling. If collecting a vertical composite sample, move the pump intake at a constant rate vertically up and down the water column over the interval to be composited.

- If filtered surface water samples are required per the site-specific Work Plan, FSP or QAPP, attach a 0.45-micron filter in-line with the exit tubing from the submersible pump. If both unfiltered and filtered samples are required, collect the unfiltered surface water samples first, and then attach the 0.45-micron filter to collect the filtered surface water samples.
- Evacuate at least three (3) tubing volumes of water, discharging into a 5-gallon bucket to avoid discharges to surface water and disturbance of the water surface.
- After evacuating, fill the laboratory-supplied sample container(s) with the required volume(s), and then cap. For small volume sample ware (e.g., vials), fill a non-preserved and unused laboratory-supplied sample container (e.g., collector jar) and then transfer the water sample from the collector jar to the laboratory-supplied sample container(s) and then cap.
- Once each sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

4.3.6 Sample Collection Using an AutoSampler

- Autosamplers (e.g., "ISCO" samplers) can be used to facilitate sampling in remote areas, at periodic time intervals or upon "triggering" during or after a specific event (such as a severe rain event). The method of collecting surface water samples using autosamplers is described below.
- Calibrate the automatic sampler in accordance with the manufacturer instruction manual and ensure that the unit is fully charged prior to deployment to ensure the proper volume(s) are collected and full operation of the unit during the sampling period. Alternatively, external power sources, such as solar-powered generators, may be used if deployed long-term and available.
- Program the sampler to collect the type of sample (e.g., grab or composite) needed and the frequency or collection criteria (e.g., time, in-stream flow or water level).
- Place collection containers in appropriate positions in the compositor and add ice (if option is available).
- Connect sample tubing and strainer, and position to the correct sampling depth.
- After first sample is collected, confirm that an adequate volume was collected.
- Place lid on the autosampler and place custody seals over the closures so that no tampering occurs. If the sampler is not in a secure area, secure with lock and chain or other means (security cameras, signs), as necessary.
- When recovering the sampler, keep it level to avoid spilling the collected samples. Cap the sample container(s) before transporting them.
- Transfer the water sample(s) from the autosampler sample container(s) to the laboratory-supplied sample container(s), and then cap.
- Once the sample container has been sealed, dry the sample container with a paper towel. Label and store the sample container(s) in accordance with **FP 1.02** (Sample Handling, Shipping and Chain of Custody).

4.4 Decontamination and Investigation Derived Waste

After each sample is collected (for both laboratory analyses and field testing), reusable sampling equipment (e.g., pumps) and devices should be decontaminated clean, as described in **FP 14.01** (Sampling Equipment Decontamination), and dedicated equipment (e.g., tubing) should be discarded and managed as IDW (refer to **FP 15.01**, Waste Handling).

4.5 Sample Containers

As outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with collected surface water samples should be constructed of inert materials that will not affect the concentration of constituents in the sample (e.g., glass, stainless steel, polypropylene tubing). The level of care that needs to be taken with the materials used will depend on the level and types of constituents associated with the sample and the quality assurance needs and study goals. This should be outlined in the site-specific Work Plan, FSP and/or QAPP.

4.6 Sample Transport and Storage

Samples shall be handled, transported and stored to maintain their structural and chemical qualities. Sampling containers shall be handled as outlined in **FP 1.02** (Sample Handling, Shipping and Chain of Custody). Samples should be kept in an ice-filled transport container during fieldwork and covered to limit exposure to light. If the cooler size allows for space between sample containers, bubble wrap should be used to fill annular space and prevent breakage during transport. Glass bottles should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample jars in laboratory-issued foam packing cartons. If shipping samples with preservatives, confirm the sample shipments, packaging, and labeling are performed in accordance with applicable US Department of Transportation (DOT) and/or International Air Transportation Association (IATA) requirements. Retain shipping documents (e.g., air bills, bills of lading) in the project file.

4.7 QA/QC

Follow QA/QC procedures described in the site-specific Work Plan, FSP and/or QAPP throughout the sample collection, processing, handling and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS

Field activities require recording sufficiently detailed information throughout the implementation of field work. Certain precautions should be taken to work safely while collecting surface water samples. Additionally, implementation of the work may face some difficulties, including the following:

- Follow USCG and local safety procedures and equipment, including, but not limited to the use of PFDs; proper vessel identification and registration on the watercraft; proper lighting available on the watercraft; and emergency equipment (e.g., signal flares, first aid kit).

- When working on or near water, all field staff should utilize the "buddy system" and ensure that the site-specific HASP includes safety measures and procedures for water work. Ramboll policy requires PFDs to be worn when working on or within 6 feet/1.8 meters of the water body.
- Check weather reports and weather advisories issued by the National Weather Service prior to conducting field work and during activity, as needed. Beyond typical inclement weather such as rain or thunderstorms, heavy winds can cause excessive turbulence and waves which can create dangerous hazards during on water work. If working during excessively windy conditions, be sure to adequately secure loose and heavy equipment when not in use and avoid surface water sampling if conditions are considered dangerous (e.g., "Small craft advisory" warning by the National Weather Service).
- Always ensure to have a VHF marine radio on board the boat to communicate with marine traffic and to contact USCG in case of emergency. Channel 16 VHF (156.8 MHz) is a marine VHF radio frequency designated as an international distress frequency. Marine radios are also a very helpful tool when communicating with upland support staff. If you will be working on a sampling vessel without an upland support staff, develop a regular check in schedule with the PIC/PO and/or PM to communicate your status and ensure safety throughout the workday.
- It is important to always remain alert and aware of your surroundings when sampling. Each sampling method comes with its own set of individual risks and hazards (e.g., tripping hazards over sampling or mooring lines). Be cautious of shore or bank failure when collecting samples near the edge of water bodies. Working near or underneath bridges can also present unexpected overhead hazards from materials falling from above. All employees and subcontractors are instructed to stop work and report to their supervisor if hazards are not adequately controlled, or if more information is needed to proceed safely.
- If working in an area of high recreational traffic area, assign a dedicated person as a lookout with a pre-approved statement on the ongoing activities and necessary safety warning, including contact(s) for additional information.
- Communication is paramount when working on a watercraft to ensure field staff safety during sampling.
- If working in a high-traffic or turbulent area, be sure to secure loose and heavy equipment (e.g., poles, samplers, etc.) on the deck of the watercraft when not in use. Wakes created by waves or adjacent boats and barges can cause extreme turbulence on the sampling watercraft, so it is important to not create additional hazards from loose or falling objects.
- If sediment or pore water sampling is to be performed, surface water samples must be collected before all sediment or pore water samples are collected.
- Surface water sampling may not be successful where strong currents are present.
- If the site-specific Work Plan, FSP and/or QAPP requires volatile organic or metals analysis (or other analysis requiring field preservation), be sure to avoid direct contact with laboratory-provided preservative chemicals and don appropriate PPE as identified in the site-specific Work Plan and HASP. Additionally, care should be taken to not overfill

preserved sample containers so as to maintain the appropriate ratio of preservative to sample and to avoid spilling the chemical preservative.

- Peristaltic pumps are not recommended for sampling volatile organic compounds and certain semi-volatile organic compounds since the pump draws water by vacuum (negative pressure) which will result in degassing and subsequent VOC loss.
- Each sample attempt should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, motor exhaust).

6. RECORDKEEPING

Document all sampling locations in accordance with **FP 1.04** (Documenting Sampling Locations) and record information related to the surface water sampling in accordance with **FP 1.01** (Field Notes and Records)**.**

Field observations and measurements to be recorded throughout the sampling program include: date, sampling time, samplers' names, ambient temperature, cloud cover, precipitation, approximate wind speed and direction, stage of lake/river, tidal conditions, estimated water flow velocity and direction at the sampling location, GPS coordinates, water depth, any unusual observations, and other meteorological conditions.

FIELD PROCEDURE NO. 14.01

SAMPLING EQUIPMENT DECONTAMINATION

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD GUIDANCE DOCUMENT NO. 14.01

SAMPLING EQUIPMENT DECONTAMINATION

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 14.01 "Sampling Equipment Decontamination" last revised February 17, 2024.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for decontamination of non-dedicated sampling equipment used for environmental sampling. Decontamination procedures for heavy equipment (e.g., drill rigs, excavators, or other machinery that may be used as part of site investigations or remedial action implementation) are discussed in **FP 14.02** (Heavy Equipment Decontamination) and decontamination procedures for biological sampling equipment are detailed in **FP 14.03** (Biological Sampling Equipment Decontamination). The main purposes of non-dedicated sampling equipment decontamination are to: (a) prevent cross-contamination of samples resulting from the reuse of the sampling equipment, thereby improving data quality and usability; (b) minimize the transfer of contaminants between sites where the sampling equipment are used; (c) ensure that sampling equipment can be effectively reused multiple times; and (d) reduce the potential for workers to be exposed to contamination. Thus, decontamination activities should be viewed as an integral component of the field program.

Sampling equipment decontamination generally is required prior to use, between successive uses, and upon completion of sampling activities (e.g., prior to storing owned equipment or returning rented equipment). Decontamination is performed to ensure that sampling equipment that contacts environmental media (e.g., soil, groundwater, sediment, and surface water) is free from chemical contaminants after each use; and is verified through collection and laboratory analysis of equipment blank samples.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FP. The Ramboll Principal-in-Charge (PIC) and/or Project Manager (PM) shall verify that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC/PO and/or PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

The list below provides an overall summary of equipment that may be necessary for typical non-dedicated field equipment decontamination, but the list should not be considered exhaustive. Additional equipment may be specified in the project-specific Work Plan, Field Sampling Plan, QAPP, and/or HASP. More specialized materials rinses, or reagents may be required depending on depending on the on the field sampling equipment and project specific needs.

- Site information (e.g., figures/maps, contact numbers, previous field logs).
- Digital data collector or field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records).
- Heavy duty trash bags for disposal of gloves, towels/rags and any other non-hazardous waste generated during sampling (refer to **FP 15.01**, Waste Handling).
- Appropriate waste container and labelling materials used to dispose of Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **FP 15.01**, Waste Handling).
- ASTM Type II Distilled and distilled- deionized water (DI water).
- Low-sudsing, non-phosphate containing, laboratory grade detergent (e.g., Alconox or Liquinox, detergent 8).
- Potable water (e.g., tap water).
- Solvent rinse (i.e., high purity acetone or methanol).
- Brushes and other scrubbing devices with non-metallic bristles, such as polypropylene, polyethylene or other plastic.
- Brush with metal bristles or scraper for dry decontamination prior to wet decontamination.
- Test tube brush for wet pump decontamination.
- Spray bottles (at least one filled with potable or distilled water and one filled with DI water).
- 10% nitric acid solution if using carbon steel sampling equipment (e.g., split spoon samplers).
- Organic surfactants (e.g., Simple Green).
- Steam cleaner or pressure washer.
- Racks, stands, standpipes, or other equipment that may be needed for ultra-clean decontamination (e.g., submersible pumps).
- Aluminum foil, Parafilm, or other inert wrapping material.
- At least three 5-gallon buckets and/or larger tubs (for containing larger equipment or when using pressure washers).
- Plastic sheeting or other materials to protect the ground surface.

3. PROCEDURES REFERENCED

In addition to the reference and guidance documents cited above, the following FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **FP 1.01**, Field Notes and Records
- **FP 1.02**, Sample Handling, Shipping and Chain of Custody
- **FP 1.05**, Field Quality Control Samples
- **FP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations
- **FP 5.04**, Surface and Near Surface Soil Sampling
- **FP 5.07**, Subsurface Soil Sampling - Direct Push
- **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube
- **FP 5.15**, Stockpile Sampling
- **FP 5.16**, Soil Sampling for PCB Analysis
- **FP 6.02**, Groundwater Purging and Sampling
- **FP 6.03**, Determination of Hydraulic Properties - Slug Test
- **FP 6.04**, Groundwater and Free Product Level Measurements
- **FP 6.07**, Well Development
- **FP 6.08**, Determination of Hydraulic Properties - Pump Test
- **FP 6.13**, Groundwater Sampling - Vertical Profiling
- **FP 6.14**, Determination of Hydraulic Properties - Packer Pressure Test
- **FP 6.20**, Groundwater Sampling - Low Flow
- **FP 7.01**, Surface Water Sampling
- **FP 8.01**, Sediment Sampling
- **FP 15.01**, Waste Handling
- **FP 15.02**, Waste Sampling

The list above is not intended to be all inclusive. Other FPs and Safe Work Practices (SWPs) may need to be referenced based on the specific requirements of the site-specific Work Plan,

Field Sampling Plan, and/or QAPP (e.g., field screening FPs, FPs for sampling of other media).

4. PROCEDURES

4.1 Planning and Design Considerations

Strategic equipment decontamination decisions will be approved by the PIC/PO and/or PM before the initiation of associated field activities. and will be documented in the project-specific Work Plan, Field Sampling Plan, and/or QAPP. The project-specific Work Plan, Field Sampling Plan, and/or QAPP will be designed to facilitate the collection of quality data that meet the objectives of the sampling program and will include specific requirements for non-dedicated field equipment decontamination. The project-specific Work Plan, Field Sampling Plan, and/or QAPP will generally provide for some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed decontamination procedures should be discussed with and approved by the PIC/PO and/or PM.

Prior to conducting the field investigation, consideration should be given to the equipment decontamination requirements, including:

- Contaminants of concern and type of sampling equipment, including material (e.g., stainless steel, HDPE, Teflon);
- Weather – cold temperatures reduce the potential for solvents to volatilize and increase chances that decontamination fluids could freeze rendering the decontamination ineffective or difficult to perform;
- Identification of where decontamination activities will take place, considering such factors as the configuration of the active investigation/remediation area (the decontamination area should be located away from areas likely to cause recontamination of cleaned equipment), traffic patterns, the location of storm water inlets, surface water bodies, wetlands and other potentially sensitive areas;
- Design of the decontamination pad in consideration of the size of equipment being cleaned, measures to capture overspray or spills, the placement of liners, and other site-specific factors;
- Appropriate procedures and schedules for the collection and disposal of decontamination fluids;
- Appropriate procedures and schedules for the replacement of decontamination fluids; and
- Contingency measures and procedures in the event of a spill resulting from the decontamination activities.

For most decontamination activities, decontamination solutions should be prepared with concentrations of approximately 0.5% to 2% detergent by volume using distilled or potable water, depending on State-specific or regulatory program-specific requirements. In cases where detergent cleansing is not sufficient, cleaning solutions should be selected, or the decontamination train modified such that: (a) cleaning solutions are compatible with the

equipment being decontaminated, and (b) the cleaning solutions are neither contaminants of concern at the site nor used in the specified analytical methods, as described below and in Table 1[1]:

- Solvent rinses (e.g., acetone, methanol) or an organic surfactant solution (e.g., Simple Green) may need to be incorporated as the first step of the decontamination train to remove organic compounds with poor water solubility, such as oil, grease, or tar.
- To neutralize acidic or basic contaminants on equipment, a sodium bicarbonate solution (5% to 15% by volume) or sodium carbonate (10% to 20% aqueous solution).
- A rinsing solution consisting of trisodium phosphate (10% aqueous solution) to remove organic compounds (such as toluene, chloroform, trichloroethene, or polychlorinated biphenyls). Acid rinses (e.g., nitric, hydrochloric) may need to be incorporated into the decontamination train if metals analyses are to be performed. In such cases, additional health and safety as well as waste management measures will be required.

Table 1: Applications of Various Solutions for Decontamination of Field Equipment and Materials [A B C]

Solution	Concentrations	Remarks
Potable Water	Tap water	Used under high pressure or steam to remove heavy mud and dirt, or to rinse off other solutions. When sampling for PFAS refer to **FP 1.07** (PFAS Sampling) for requirements on the potable water.
Laboratory-grade water	Distilled Deionized Reagent grade distilled and deionized water	
Low sudsing non-phosphate detergents (Alconox, Liquinox, Detergent 8)	Typical concentrations are 0.5 to 2% solution by volume	General all-purpose cleaner. Detergent 8 is recommended for spray cleaning.
Sodium bicarbonate (baking soda)	5 to 15% aqueous solution	Used to neutralize either acidic or strongly basic contaminants.
Sodium carbonate (washing soda)	10 to 20% aqueous solution	Effective for neutralizing inorganic acids, organic acids, heavy metals, metal processing wastes.
Trisodium phosphate (TSP Oakite)	10% aqueous solution	Similar to sodium carbonate. Good rinsing solution for organic compounds (such as toluene, chloroform, TCE, PBBs, and PCBs).

[1] Adapted from ASTM-D5088: Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

Table 1: Applications of Various Solutions for Decontamination of Field Equipment and Materials [A B C]

Solution	Concentrations	Remarks
Calcium hypochlorite (HTH)	10% aqueous solution	Disinfectant, bleaching, and oxidizing agent for pesticides, fungicides, chlorinated phenols, dioxins, cyanides, ammonia and other non-acidic inorganic wastes.
Hydrochloric acid, nitric acid	10% nitric 10% to 20% hydrochloric	Used for inorganic bases, alkali and caustic wastes. This material is hazardous and its use should be limited. Care should be taken in both use and disposal of these materials.
Citric, tartaric, oxalic acids or their respective salts	5% solution	Used to clean heavy-metal contaminants.
Organic solvents	Neat, undiluted	Used to remove organic compounds that have poor solubility in water, such as oil, grease, and tars. Do not use a solvent that is one of the analytes of interest or interferes with analyses. Porous materials such as polymers can absorb these solvents. These materials are hazardous and their use should be limited. Care should be taken in both use and disposal of these materials.

Notes:

[A] Examples of commonly recommended cleaning solvents include pesticide-grade" isopropanol, acetone, methanol, hexane, heptane, and ethanol. Note that these materials are hazardous themselves and their will generate hazardous wastes that must be properly contained, handled, shipped and disposed of.

[B] Adapted for Mickam et al. (1989), Moberly (1985), and Richter and Collentine (1983).

[C] Many of the solvents listed are themselves hazardous materials. Care should be taken in both use and disposal of these materials. The Safety Data Sheets should be consulted for the selection of the appropriate PPE, handling, and disposal.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). Since samples will be collected from various media, staff should review and complete pertinent tasks identified in relevant FPs (e.g., **FP 6.02**, Groundwater Purging and Sampling; **FP 5.04**, Surface Soil Sampling; **FP 6.04**, Groundwater and Free Product Level Measurements).

In addition, at a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP. Clean, chemical protective, dedicated gloves must always be worn when handling soil and using sample equipment.

- Coordinate and obtain permission for site access.
- Review project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable.
- Review and discuss with PIC/PO and/or PM the proposed project-specific Work Plan, Field Sampling Plan or sampling strategy outlining decontamination procedures.
- Ensure that all equipment/materials required to complete the work have been secured and packed prior to travel. If equipment is being shipped to an alternate location, arrange for delivery at least one day prior to the start of field work and confirm receipt at the delivery location (e.g., hotel or site).
- Review **FP 15.01** (Waste Handling) for management of decontamination fluids and other IDW.

4.3 Equipment Decontamination Procedures

Decontamination requirements and procedures for sampling/monitoring equipment will vary depending on (a) whether equipment is used for aqueous or non-aqueous media; (b) the analytical method detection levels; and (c) the contaminants of concern (COCs). Commonly used decontamination processes for various equipment and materials are summarized in Table 2 below.[2]

Table 2: Commonly Recommended Decontamination Procedures for Different Equipment and Different Materials of Construction [A B]

	Soapy Water Wash	Tap Water Rinse	10% Nitric Acid Rinse [C]	Organic-Free Water Rinse	Rinse with Solvent	Air Dry	Store in Aluminum Foil or Polyethylene	Discard After Use
Glass	•	•	•	•	• [D]	•	•	
Teflon	•	•	•	•	• [E]	•	•	
Metals and Stainless Steel	•	•	Do not use	•	• [D]	•	•	
PVC	Use Only New PVC							•
HDPE/LDPE	•	•						
Stainless Tubing	•	•	Do not use	•	• [D]	•	•	
Glass Tubing	•	•	•	•	• [D]	•	•	
Well Sounders	•	•		•				

[2] Adapted from ASTM-D5088: Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

Table 2: Commonly Recommended Decontamination Procedures for Different Equipment and Different Materials of Construction [A] [B]

	Soapy Water Wash	Tap Water Rinse	10% Nitric Acid Rinse [C]	Organic-Free Water Rinse	Rinse with Solvent	Air Dry	Store in Aluminum Foil or Polyethylene	Discard After Use
Submersible Pumps	•	•		•				

Notes:

[A] These procedures are based on commonly recommended practices. It should be noted that there is not a lot of experimental data to support some of these practices. Additional Information can be found in studies by Mickam et al., 1989, Parker 1995, Parker and Ranney 1997a, 1997b.

[B] Sampling equipment that employs a process whereby potentially contaminated material passes through internal mechanical workings (pump, housing, impellers, etc.) can be very difficult to decontaminate. This should be considered when identifying an appropriate decontamination process for equipment with internal sample contacting parts.

[C] This step is used in removing inorganic contaminants and can be eliminated if they are not of concern. It is typically not necessary for non-porous surfaces such as glass or stainless steel.

[D] Data by Parker and Ranney 1997a, 1997b should show that solvent rinsing may not be needed.

[E] Data by Parker and Ranney 1997a, 1997b, show that oven drying may be more effective than an organic solvent rinse for removing sorbed organic contaminants.

The following provides a recommended list of practices for non-dedicated field sampling equipment decontamination:

- Construct the decontamination area in the predetermined location as follows:
  - Cover the surface of the decontamination area with plastic sheeting in a flat or lightly sloped or depressed area to ensure that the decontamination fluids and any spills from the decontamination activities are captured and can be easily removed. If needed, use 2” x 4” timber or hay bales to create a frame and overlay the plastic sheeting over it.
  - Place appropriate waste containers within the decontamination area to contain any investigation decontamination wastes and IDW and label the containers as outlined in **FP 15.01** (Waste Handling) pending disposal.
- Don appropriate PPE prior to conducting decontamination (gloves, safety goggles, face shields, Tyvek suits, etc., as appropriate) and change PPE (particularly gloves) as needed during the process to avoid re-contaminating equipment.
- If sampling equipment is laden with soil or sediment or other residuals, dry decontaminate it by scrubbing with a brush or scraper over the appropriate IDW container before proceeding with the wet decontamination. In some cases, residuals will need to be removed using a steam cleaner or pressure washer. Special

considerations/precautions should be employed to ensure decontamination fluids applied under high-pressure and the associated residuals are adequately contained.

- Information regarding the decontamination methodology, date, time and personnel should be recorded in the field notebook (refer to Section 6).

4.3.1 Wet Decontamination, Non-Aqueous Sampling Equipment (Three-Step Decontamination)

Unless otherwise indicated in site-specific work plans or FPs, at a minimum, non-aqueous sampling equipment should follow the following three step wet-decontamination process (see Section 4.3.2 for the Seven-Step Decontamination Process description):

- Set up three five-gallon buckets as follows:
  - Detergent wash bucket – fill two thirds of the bucket with a solution of detergent and potable or distilled water.
  - Potable water rinse bucket – fill one third of the bucket with potable water.
  - Distilled-deionized (DI) water rinse bucket – fill one third of the bucket with DI water. Fill a spray bottle with DI water.
- Place sampling equipment in the detergent wash bucket and remove all visible particulate matter and residual oil and grease using a brush with plastic bristles.
- Once all visible particulate matter has been removed, rinse the equipment in the potable water rinse bucket using copious amounts of potable water and the spray bottle filled with potable water.
- Once all detergent been removed from the sampling equipment, rinse the equipment in the DI water rinse bucket using the spray bottle filled with DI water.
- Inspect the decontaminated equipment before use and at the completion of the sampling event. If contamination persists or is suspected, perform the decontamination procedures for aqueous sampling equipment described below. Otherwise, the sampling equipment is ready for use or storage (refer to **Section 4.3.5**) after it has been allowed to air dry.
- If equipment blanks are required, repeat the final rinse procedure using laboratory-provided blank water in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **FP 1.05** (Field Quality Control Samples).

4.3.2 Wet Decontamination, Aqueous Sampling Equipment (Seven-Step Decontamination)

Unless otherwise indicated in site-specific work plans or FPs, at a minimum, aqueous non-dedicated field sampling equipment (or non-aqueous non-dedicated field sampling equipment requiring additional decontamination) should follow the following seven step wet-decontamination process:

- Set up seven five-gallon buckets as follows (note that some may not be needed depending on the COCs and analyses to be performed):

  - Detergent wash bucket – fill two thirds of the bucket with a solution of detergent and potable or distilled water.
  - Potable water rinse bucket – fill one third of the bucket with potable water.
  - DI water rinse bucket – fill one third of the bucket DI water. Fill a spray bottle with DI water.
  - Nitric acid rinse (only if metals analysis is to be performed) – this bucket will initially be empty. Fill a spray bottle with a solution consisting of 10% nitric acid diluted with DI water.
  - DI water rinse bucket (only if metals analysis is to be performed) – fill one third of the bucket DI water. Fill a spray bottle with DI water.
  - Solvent rinse (only if organics analysis is to be performed) – this bucket will initially be empty. Fill a spray bottle with high purity acetone or methanol. Note that if acetone is known or suspected to be a COC or a Target Compound List analysis is to be performed, methanol should be used. However, methanol cannot be used when sampling media are impacted by gasoline or its by-products.
  - DI water rinse bucket (only if organics analyses is to be performed) – fill one third of the bucket DI water. Fill a spray bottle with DI water.

- Place sampling equipment in the detergent wash bucket and remove all visible particulate matter and residual oil and grease using a brush with plastic bristles. Sampling equipment may need to be opened or taken apart to ensure all components that contact samples are adequately decontaminated.
- Once all visible particulate matter has been removed, rinse the equipment in the potable water rinse bucket using copious amounts of potable water and the spray bottle filled with potable water.
- Once all detergent has been removed from the sampling equipment, rinse the equipment in the first DI water rinse bucket using the spray bottle filled with DI water.
- If metals analysis is to be performed, rinse the equipment in the nitric acid rinse bucket using the spray bottle filled with the nitric acid solution. Follow-up with a rinse in the second DI water rinse bucket using the spray bottle filled with DI water.
- If organics analysis is to be performed, rinse the equipment in the solvent rinse bucket using the spray bottle filled with solvent. After the solvent has been allowed to evaporate, follow-up with a rinse in the third DI water rinse bucket using the spray bottle filled with DI water.
- Inspect the decontaminated equipment before use and at the completion of the sampling event. If contamination persists or is suspected, repeat the decontamination procedures. Otherwise, the sampling equipment is ready for use or storage (refer to **Section 4.3.5**) after it has been allowed to air dry.
- If equipment blanks are required, repeat the final rinse procedure using laboratory-provided blank water in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **FP 1.05** (Field Quality Control Samples).

4.3.3 Wet Decontamination, Aqueous Sampling Equipment - Pumps

Non-disposable sampling equipment, including the pump, support cable, and electrical wires that contact the sample, will be decontaminated thoroughly each day before use ("daily decontamination") and after each well is sampled ("between well decontamination"). Pumps that do not physically come in contact with the groundwater, such as Waterra-positive displacement pumps, only require a decontamination procedure consisting of a detergent wash and a distilled water rinse as described in **Section 4.3.2**.

- Set up six (6) five-gallon buckets or other appropriately sized containers as follows:
  - Potable water bucket – fill one third of the bucket with potable water.
  - Detergent wash bucket – fill two thirds of the bucket with a solution of non-phosphate detergent and potable or distilled water.
  - Potable water rinse bucket – fill one third of the bucket with potable water.
  - Distilled-deionized (DI) water rinse bucket – fill one third of the bucket with DI water. Fill a spray bottle with DI water.
- Make sure that the pump/equipment and nearby electrically powered equipment is grounded, and potential sources of sparks are eliminated before operating pumps during decontamination.
- For rinsing and washing procedures that follow, ensure that the pump intake is below the liquid level in the container and operate to achieve at least 3 recirculation cycles of the pump/tubing volume. If possible, adjust the flow rates (alternate high and low speeds) and/or introduce air periodically to increase cleaning efficiency.
- For the daily decontamination:
  - Place the pump in the detergent wash bucket and remove all visible particulate matter and residual oil and grease using a brush with plastic bristles.
  - Once all visible particulate matter has been removed, rinse the equipment in the pre-rinse potable water rinse bucket using copious amounts of potable water and the spray bottle filled with potable water. Pre-rinse the pump by operating it in the potable water container for 5 minutes and flush or rinse other non-disposable sampling equipment with potable water for 5 minutes.
  - Wash the pump by operating it in the detergent wash container for 5 minutes and flush or rinse other non-disposable sampling equipment with fresh detergent solution for 5 minutes.
  - Rinse the pump by operating it in the potable water rinse container for 5 minutes and flush or rinse other non-disposable sampling equipment with potable water for 5 minutes. To confirm adequate rinsing of pumps, collect a small aliquot of discharged water in a container, and shake to observe sudsing. Repeat until no suds are observed.
  - Disassemble the pump and wash the disassembled pump parts in the detergent wash container, scrubbing all pump parts with a test tube brush.

  - Rinse the disassembled pump parts with potable water in the potable water rinse container.
  - Rinse the following pump parts with DI water in the DI water rinse container: inlet screen, the shaft, the section interconnector, the motor lead assembly and the stator housing.

- For the between well decontamination:
  - Place the pump in the detergent wash bucket and remove all visible particulate matter and residual oil and grease using a brush with plastic bristles.
  - Once all visible particulate matter has been removed, rinse the equipment in the pre-rinse potable water rinse bucket using copious amounts of potable water and the spray bottle filled with potable water. Pre-rinse the pump by operating it in the potable water container for 5 minutes and flush or rinse other non-disposable sampling equipment with potable water for 5 minutes.
  - Wash the pump by operating it in the detergent wash container for 5 minutes and flush or rinse other non-disposable sampling equipment with fresh detergent solution for 5 minutes.
  - Pre-rinse the pump by operating it in the potable water rinse container for 5 minutes and flush or rinse other non-disposable sampling equipment with potable water for 5 minutes. To confirm adequate rinsing of pumps, collect a small aliquot of discharged water in a container, and shake to observe sudsing. Repeat until no suds are observed.
  - Rinse the pump by operating it in the DI water rinse container to pump out 1 to 2 gallons of DI water into a waste container (do not recirculate water and add DI water to container, as needed for pump to operate and maintain flow). If the pump is being used for inorganic constituent sampling only, change gloves, pump/recirculate for 5 or more equipment volumes (adding DI water as needed to maintain flow). Confirm adequate rinsing of pumps, by collecting a small aliquot of discharged water in a container, and shake to observe sudsing. Repeat until no suds are observed.

- If the pump is being used for organic constituent sampling,
  - Don appropriate personal protective equipment (e.g., safety glasses, face shield, apron, nitrile/latex gloves, Tyvek suit, etc.) and work in a well-ventilated area downwind of the sampling locations, in accordance with the Site-Specific HASP.
  - Immerse the pump or the disassembled pump in the methanol rinse container. If immersing the pump ensure the methanol level is above the pump intake level.
  - Operate to discharge approximately 2 liters of solvent into a waste container (adding solvent to container as needed, to maintain flow). Stand back from pumps during operation as a safety precaution.
  - Place any unused methanol into an appropriate waste container and let residual methanol in methanol rinse container evaporate to dryness.
  - Change gloves, and then rinse pump exterior with organic-grade blank water and place into an air-dried container. Add organic-grade blank water to immerse pump to

force residual methanol out of components, and capture in waste methanol container. If pump includes reusable tubing, rinse with an additional approximately 0.5 liter of organic-grade blank water per 10-feet of attached tubing.

- Inspect the decontaminated pump before use, between each use and at the completion of the sampling event. If contamination persists or is suspected, repeat the decontamination procedures. Otherwise, the pump is ready for use or storage (refer to **Section 4.3.5**) after it has been allowed to air dry.
- If equipment blanks are required, repeat the final rinse procedure using laboratory-provided blank water in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **FP 1.05** (Field Quality Control Samples).

4.3.4 Wet Decontamination, Aqueous Sampling Equipment (Field Ultra-Clean Decontamination)

In certain situations (e.g., contaminant or general chemistry parameters are being measured at very low detection limits), equipment such as sampling tubing, and/or stainless steel bailers that come into direct contact with groundwater (or surface water) may require additional cleaning to ensure removal of trace amounts of contaminants.[3,4] These procedures should be detailed in the project-specific Work Plan.

To effectively achieve decontamination of such equipment or where inorganic indicators or ambient sensitive constituents are being analyzed, the following ultra-clean decontamination procedures should be followed as specified in the project-specific Work Plan:

- Set up five sufficiently sized containers containing the following:
  - Detergent wash container – fill two thirds of the container with a solution of detergent and potable water.
  - Potable water rinse container – fill one third of the container with potable water.
  - DI water rinse container – fill one third of the container DI water. Fill a spray bottle with DI water.
  - Methanol rinse container – solvent-resistant container to be filled with approximately 2 liters of solvent (methanol), if organic constituents are being tested and project needs require additional decontamination. Fill a spray bottle with methanol.
  - Blank water – laboratory-provided DI water that is free of known constituents (target analytes). Fill a spray bottle with DI water.
  - Blank water rinse container - this bucket will initially be empty. Fill a spray bottle with organic-grade blank water (i.e., pesticide-grade or volatile-grade), prepared and/or quality assured by the analyzing laboratory.

[3] New Jersey Department of Environmental Protection Field Sampling Procedures Manual, August 2005.

[4] U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A3, April 2004, accessed June 5, 2017, at http://pubs.water.usgs.gov/twri9A3/.

- For pumps, follow the procedures outlined in **Section 4.3.3**.
- Place the sampling equipment in the detergent wash bucket and remove all visible particulate matter and residual oil and grease using a brush with plastic bristles. State specific guidelines may require additional steps, such as soaking prior to removal of particulate matter.
- Once all visible particulate matter has been removed, rinse the equipment in the potable water rinse bucket using copious amounts of potable water and the spray bottle filled with potable water.
- Discard the initial detergent solution (containing particulate matter and residue from initial scrubbing) and replace with new detergent solution. Place the sampling equipment into the container such that the equipment is immersed and agitate it to effectively rinse.
- Remove equipment from container, and then rinse the inside of the container using potable water (until all sudsing stops).
- Rinse exterior of equipment with potable water, and place into DI water rinse container. Agitate equipment to rinse adding potable water/DI water as needed to maintain flow.
- If the equipment is being used for inorganic constituent sampling only, change gloves, and rinse equipment in the DI water container.
- If required, collect a field blank for Quality Assurance purposes in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **FP 1.05** (Field Quality Control Samples).
- If the equipment is being used for organic constituent sampling, don appropriate personal protective equipment (e.g., safety glasses, face shield, apron, nitrile/latex gloves, Tyvek suit, etc.) and work in a well-ventilated area downwind of the sampling locations, in accordance with the Site-Specific HASP.
- Immerse equipment in the methanol rinse container. Agitate equipment. Place any unused methanol into an appropriate waste container and let residual methanol in methanol rinse container evaporate to dryness.
- Change gloves, and then rinse equipment exterior with organic-grade blank water and place into an air-dried container. Add organic-grade blank water to immerse equipment to force residual methanol out of components, and capture in waste methanol container. If equipment includes reusable tubing, rinse with an additional approximately 0.5 liter of organic-grade blank water per 10-feet of attached tubing.
- Inspect the decontaminated equipment before use and at the completion of the sampling event. If contamination persists or is suspected, repeat the decontamination procedures. Otherwise, the sampling equipment is ready for use or storage (refer to **Section 4.3.5**) after it has been allowed to air dry.
- If equipment blanks are required, repeat the final rinse procedure using laboratory-provided blank water in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **FP 1.05** (Field Quality Control Samples).

4.3.5 Storage of Decontaminated Sampling Equipment

To store the decontaminated sampling equipment, wrap the equipment in an inert wrapping material (e.g., aluminum foil, plastic wrap, Parafilm) and place in a sealed container that has been similarly decontaminated. Note than household aluminum foil often has a coating of oil and should not be used. Prior to storage equipment should be air dried to avoid bacterial growth. In some cases, inert gas or filtered air may need to be blown through equipment. Alternatively, the equipment can be chilled to avoid bacterial growth. If bacterial growth is observed, decontaminate again prior to use.

4.3.6 Sample Coolers and Shipping Containers

All company-owned ice chests and reusable containers for sample shipping should be labelled accordingly and not used to store food or drink. These coolers are to be washed with detergent (inside and outside), rinsed with tap water and deionized water and air dried prior to storage and between uses. In the event that an ice chest or reusable container becomes severely contaminated, it should be cleaned per the above, and disposed of in accordance with applicable state and federal regulations.

4.4 QA/QC

Follow QA/QC procedures described in the project-specific Work Plan, Field Sampling Plan, and/or QAPP throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FP 1.05** (Field Quality Control Samples) should be reviewed.

5. PRECAUTIONS

All field activities require recording sufficiently detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety while performing equipment decontamination activities.

- It is important to always remain alert and aware of your surroundings. Decontamination activities may be conducted in proximity to drill rigs or other heavy equipment and can be subject to hazards posed by nearby equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, biological, mechanical, and chemical hazards.
- Prior to mobilization, determine the proposed location of the decontamination areas and evaluate the need for security, barricading, and/or traffic control.
- When working out of sight of the general public or site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the “buddy system” and should ensure that the site-specific HASP includes safety measures and procedures
- Decontamination procedures may involve the use of hazardous materials including acids, and organic solvents, which can pose chemical hazards during transportation, storage, and handling. Prior to use of any such reagents, discuss the health and safety procedures with the PIC/PO and/or PM, and consult the project-specific HASP, as appropriate.

- Decontamination procedures may involve the use of high-pressure applications such as pressure washers and special considerations should be given to containing those fluids and the associated residuals.
- Decontamination wastes are considered IDW and shall be containerized, labelled and managed as outlined in **FP 15.01** (Waste Handling).
- A nitric acid rinse is generally only required if metals analyses is to be performed and/or if visual contamination persists or gross contamination is suspected following the three-step decontamination procedure. When an acid rinse is required additional health and safety as well as waste management measures will be required.
- A solvent rinse is generally only required if organics analyses is to be performed and/or if visual contamination persists or gross contamination is suspected following the three-step decontamination procedure. Note that if acetone is known or suspected to be a COC or a Target Compound List analysis is to be performed, methanol should be used. However, methanol cannot be used when sampling media impacted by gasoline or its by-products.

6. RECORDKEEPING

Document all decontamination activities in accordance with **FP 1.01** (Field Notes and Records). At a minimum, the following information should be recorded for each decontamination activity:

- Date and time.
- The decontamination methodology, including details on the source water and rinsates.
- Location (i.e., boring, well, sample number) where the equipment was used before and after decontamination.
- Location and description of the decontamination area.
- Details on the IDW generated and managed (i.e., stored, characterized, disposed).
- Identification of any field blank samples collected.

FIELD PROCEDURE NO. 14.02

HEAVY EQUIPMENT DECONTAMINATION

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 14.02

HEAVY EQUIPMENT DECONTAMINATION

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 14.02 "Heavy Equipment Decontamination" last revised March 19, 2019.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the decontamination of heavy equipment (e.g., drill rigs, excavators, or other machinery) that may be used as part of site investigations or remedial actions, when permanent decontamination facilities do not exist. Decontamination procedures for non-dedicated sampling equipment (e.g., augers, trowels, split spoons, pumps) that may be used for environmental sampling are discussed in **FP 14.01** (Sampling Equipment Decontamination) and decontamination procedures for biological sampling equipment are detailed in **FP 14.03** (Biological Sampling Equipment Decontamination). The purpose of heavy equipment decontamination is to (a) minimize the tracking or transport of contaminants between contaminated and non-contaminated areas, including off-site areas; (b) prevent potential cross-contamination of samples resulting from the reuse of heavy equipment for sampling, thereby improving data quality and usability; and (c) allow for the safe demobilization of equipment so it can be used elsewhere. Thus, decontamination activities should be viewed as an integral component of the field program. Heavy equipment decontamination should be required (a) prior to the use; (b) during field activities to prevent on-site cross-contamination; and (c) upon completion of environmental field activities prior to demobilization.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

This FP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those recommended in this FP. The Ramboll Principal-in-Charge (PIC) and Project Manager (PM) shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project or as established by applicable Ramboll document handling and retention policies. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

A general checklist of equipment and materials that may be required for typical heavy equipment decontamination procedures is provided below. This checklist includes an overall summary of general equipment and materials typically required for heavy equipment decontamination and should not be considered exhaustive. More specialized materials, rinses, or reagents may be required depending on the sampling equipment, chemicals present, and project-specific needs.

2.1 General Equipment Checklist

- Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points);
- Field notebook and all-weather or permanent pens as outlined in **FP 1.01** (Field Notes and Records);
- Trash Bags – for disposal of gloves and any other non-hazardous waste generated during decontamination activities (refer to **FP 15.01**, Waste Handling);
- Appropriate waste container for disposal of any decontamination wastes, such as 55-gallon drums or frac tanks (refer to **FP 15.01**, Waste Handling); and
- Labels for waste containers as outlined in **FP 15.01** (Waste Handling).

2.2 Heavy Equipment Decontamination Checklist

- If pressure washing and/or steam cleaning is required, additional personal protective equipment (PPE) may be required as described in the site-specific HASP (e.g., Tyvek suit, face shield, rubber boots, rubber gloves);
- Low-sudsing, non-phosphate containing, laboratory grade detergent (e.g., Liquinox, Alconox, or Detergent 8);
- Potable water (e.g., tap water);
- Brushes, brooms, scrapers and/or other scrubbing devices with either metallic or non-metallic bristles (polypropylene, polyethylene, or other plastic material);
- Steam cleaner or pressure washer;
- Racks, stands, standpipes, or other equipment that may be needed for auger and/or drill rod decontamination;
- Plastic sheeting or other water-impermeable material to protect the ground surface; and
- Soil, hay bales, sand bags, or other material suitable for constructing a berm around the decontamination pad, access/egress ramps, or a prefabricated self-contained temporary truck wash system.

3. PROCEDURES REFERENCED

The following FPs are related to this FP and should be reviewed prior to mobilization, as needed:

- **FP 1.01**, Field Notes and Records.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations.
- **FP 5.07**, Subsurface Soil Sampling - Direct Push.
- **FP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
- **FP 5.15**, Stockpile Sampling.
- **FP 14.01**, Sampling Equipment Decontamination.
- **FP 15.01**, Waste Handling.
- **FP 15.02**, Waste Sampling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPI) may need to be reviewed based on the specific requirements of the site-specific Work Plan/Sampling Plan (e.g., field screening FPs, FPs for sampling, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant equipment decontamination procedure decisions shall be approved by the PIC and/or PM before the initiation of planned field activities. The Work Plan/Sampling Plan should be designed for the appropriate remedial actions and/or the collection of representative data that will meet the goals or data quality objectives of the study/monitoring program and should include specific requirements for heavy equipment decontamination, as necessary. The Work Plan/Sampling Plan will generally provide some discretion for modifications in the field depending on conditions encountered; however, any significant departure from prescribed decontamination procedures should be discussed with and approved by the PIC and/or PM prior to implementation.

Prior to conducting field work, a decontamination plan should be developed. During the planning phase of projects requiring heavy equipment decontamination, consideration should be given to the heavy equipment decontamination requirements, including:

- Identification of where decontamination activities will take place, considering such factors as traffic patterns, the location of storm water inlets, surface water bodies, wetlands and other potentially sensitive areas, and planned work areas. The decontamination pad should be located away from work areas, and where applicable, before the transition to paved surfaces and near the access point to the site to prevent

recontamination. It should also be located away from public areas, buildings, or personal vehicles.

- Design of the decontamination pad after evaluating the size of equipment being cleaned, including measures to capture overspray or spills, means and methods for collecting, transferring and storing decontamination fluids and solid materials resulting from the decontamination process, and other site-specific factors. The pad should be large enough to contain not only the equipment to be decontaminated but also any over-spray.
- Appropriate procedures and schedules for the replenishment of wash-water and disposal of decontamination fluids and solid materials resulting from the decontamination process.
- Contingency measures and procedures in the event of a spill resulting from the decontamination activities.

For most heavy equipment decontamination activities, decontamination may be conducted using potable water. If a decontamination solution is required, a solution of approximately 0.5% to 2% laboratory-grade detergent by volume using tap water may be used, depending on State-specific or regulatory program-specific requirements.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02** (Site Preparation, Inspection and Housekeeping). In addition, at a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Coordinate and obtain permission for site access;
- Review project-specific Work Plan/Sampling Plan, where applicable;
- Review project-specific Quality Assurance Project Plan (QAPP), where applicable;
- Review and discuss with the PIC and/or PM the proposed Work Plan/sampling plan outlining decontamination procedures; and
- Review **FP 15.01** (Waste Handling) for management of decontamination fluids and other investigation derived waste (IDW).

4.3 General Heavy Equipment Decontamination Procedures

Heavy equipment decontamination requirements and procedures will vary depending on (a) the equipment or equipment parts (e.g., excavator bucket versus excavator tracks) that need to be decontaminated; (b) the duration of the remedial activity warranting decontamination and the frequency of equipment decontamination; and (c) the chemicals of concern (COCs).

Where decontamination is only required to prevent tracking of non-contaminated soil into public roadways as a soil and sediment control measures, dry decontamination methods including the use of a gravel track-out pad may be appropriate. The following

provides a recommended list of practices for heavy equipment decontamination to remove non-contaminated soils:

- Construct a track-out pad where unpaved areas transition to paved areas. The general configuration of the track-out pad is typically defined by local Soil Conservation Districts and generally consists of a 10- to 12-foot wide by 50-foot long area with 6 to 12 inches of 3-inch to 6-inch diameter washed gravel or stone (e.g., the tracking pad should be relatively free of sand or fine-graded materials). In some cases, a geotextile may be placed below the gravel for filtration or reinforcement if the ground is soft and/or as a visual demarcation layer.
- Perform dry decontamination prior to entering the gravel track-out pad, adjacent to the work areas, as follows:
  - Don appropriate PPE as specified in the HASP. PPE may include hard hats, safety glasses, gloves, and/or protective coveralls (e.g., Tyvek).
  - Scrub equipment (wheels, sides, undercarriage, bucket) with a brush, broom, or scraper to remove soils adhered to equipment. A long-handled brush may be needed to reach the top and undercarriage.
  - Inspect equipment to ensure it is free of adhered soil residue.
  - Spread materials removed from the equipment within the designated area defined in the Work Plan.
- Have the equipment operator run equipment through the track-out pad to further loosen and remove soils from equipment tracks and/or tires.
  - If the track-out pad voids become clogged with soils, the gravel may need to be turned or replaced.
  - When the track-out pad is no longer needed it should be dismantled and the materials managed as waste in accordance with the project-specific Work Plan or Sampling Plan and **FP 15.01** (Waste Handling). Since these materials are non-contaminated, the materials could potentially be reused on-site or off-site. Such options should be discussed with and approved by the PIC and/or PM prior to implementation.

The following provides a recommended list of practices for heavy equipment decontamination where decontamination is required to prevent tracking of contaminated soil into uncontaminated areas of the site or into public roadways where permanent decontamination facilities do not exist or are required:

- Install the prefabricated self-contained temporary truck wash system in accordance with manufacturer instructions; or
- Construct the temporary decontamination pad in the predetermined location as follows:
  - Excavate an area, sized for the anticipated equipment (typically about 12 feet wide and 30 feet long), to create a depression at least two feet deep. Alternatively, the decontamination pad can be constructed by constructing a berm using soils, hay bales or timber. The bottom of the excavation or decontamination pad should be

graded to drain to one of the corners, which should be excavated to accommodate a sump to allow for the pumping of wash-water and entrained solids.

- Line the surface of the decontamination pad with plastic sheeting and/or geomembrane of sufficient thickness and strength to support the anticipated loads without tearing or ripping. If the decontamination pad is constructed by constructing berms using soils, or hay bales or timber, extend the plastic sheeting and/or geomembrane over the berm/hay bales/timber and secure the sheeting outside the decontamination pad with sand bags or other weighted material.
- Ramps may need to be constructed at the entrance and/or exit of the decontamination pad. These should be constructed with washed stone.
- In some cases, the sump should also include means to support the sump walls (e.g., open pipe within which a pump will be installed).
- If required in the decontamination pad design, place the specified thickness of the specified stone, wooden crane mats, or other specified protective materials over the geomembrane. Typically, the stone layer is at least 6 inches thick and consists of 1- to 3-inch diameter washed stone.
- Install a transfer pump within the sump and connect discharge piping to the appropriate waste containers.
- Provide water supply line and connect to pressure washer or steamer, as needed.
- Place appropriate waste containers within the decontamination pad to contain any decontamination wastes and IDW, and label the containers as outlined in **FP 15.01** (Waste Handling) pending disposal.

Following construction or installation of the heavy equipment decontamination pad (or if one already exists):

- Have the equipment operator stage equipment within the decontamination pad. If augers, drill rods, and other drilling equipment parts will be decontaminated, have the driller place it on racks or pallets.
- Don appropriate PPE as specified in the site-specific HASP.
- If large equipment is laden with soil, sediment, or other residue, perform dry decontamination within the decontamination pad, as follows:
  - Scrub equipment (wheels, sides, undercarriage, bucket, etc.) with a brush, broom, or scraper to remove soils adhered to equipment. A long-handled brush may be needed to reach the top and undercarriage.
  - Inspect equipment to ensure it is free of adhered soil residue.
- If dry decontamination does not remove residual materials or if required by the project-specific Work Plan or Sampling Plan, perform wet decontamination within the decontamination pad, as follows:
  - Use a water hose, pressure washer, or steam cleaner connected to a potable water supply source to dislodge residual materials adhered to equipment (wheels, sides,

undercarriage, bucket, etc.) taking care when moving around to avoid slipping on wet surfaces.

  - Monitor the water levels in the sump and activate the sump pump as needed to ensure the decontamination pad will not overfill.
  - While pumping, monitor the water levels in the liquid waste container to ensure it will not overfill. Do not fill containers to more than 85% of their capacity, especially when freezing temperatures are expected.
  - Inspect equipment to ensure it is free of adhered soil residue.
  - If soils or residue remain on the equipment, mix low sudsing, non-phosphate containing, laboratory grade detergent with potable water in a bucket and scrub the equipment. Follow the soap wash with a potable water rinse using a water hose, pressure washer or steamer connected to a potable water supply source.
  - Inspect equipment to ensure it is free of adhered soil residue.
- Have the equipment operator run equipment through the track-out pad at the transition from unpaved to paved areas before accessing paved roads.
- If maintenance of the decontamination pad is required:
  - If not lined with a protective layer (e.g., stone, crane mats), sweep up the materials removed from the equipment and place in the designated waste containers as specified in the Work Plan or by the PM and/or site contact (see section 4.6 below).
  - If provided with a protective layer, wash, turn or place additional materials as appropriate to maintain functionality of the decontamination pad.
- When the decontamination pad and/or the track-out pad are no longer needed they should be dismantled and the materials managed as waste in accordance with the project-specific Work Plan or Sampling Plan, and **FP 15.01** (Waste Handling). Solid and liquid wastes should be characterized for disposal purposes as required by the project-specific Work Plan or Sampling Plan, and **FP 15.02** (Waste Sampling).

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Certain precautions should be taken to ensure safety while performing equipment decontamination activities.

- It is important to always remain alert and aware of your surroundings. Decontamination activities may be conducted in proximity to drill rigs or other heavy equipment and can be subject to hazards posed by nearby equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, determine the proposed location of the decontamination pad and evaluate the need for security, barricades, and/or pedestrian and traffic control.
- When working out of sight of the general public or site employees in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the "buddy system"

and should ensure that the project-specific HASP includes safety measures and procedures.

- Decontamination procedures may involve the use of high-pressure or high-heat applications such as pressure washers or steam cleaning equipment and special considerations should be given to containing those fluids and the associated residuals, as well as the physical hazards posed by such applications.
- Personnel performing the decontamination should stay up wind of spray from the washer or steam cleaner and should take care when moving around the decontamination pad to avoid slipping on wet surfaces.
- There shall be no eating or drinking in the decontamination area and all non-essential personnel shall be kept out of the area and areas of possible overspray.

6. RECORDKEEPING

Document all decontamination activities in accordance with **FP 1.01** (Field Notes and Records). At a minimum, the following information should be recorded for each decontamination activity:

- Date and time.
- The decontamination methodology, including details on the source water.
- Location, description and photos of the decontamination area.
- Document decontamination activities, including photographs, if required by the Work Plan.
- Details on the IDW generated and how it was managed (e.g., stored, disposed).

FIELD PROCEDURE NO. 15.01

WASTE HANDLING AND MANAGEMENT PROCEDURES

VISTRA PROJECT

PROJECT NO. 1940112376

RAMBOLL

FIELD PROCEDURE NO. 15.01

WASTE HANDLING AND MANAGEMENT PROCEDURES

Documents Used as Reference During Preparation:	Ramboll Field Procedure NO 15.01 "Waste Handling and Management Procedures" last revised August 8, 2019.
Applications	This Field Procedure (FP) issued on September 4, 2025 is specific to work for Dynegy Miami Fort, LLC; Dynegy Midwest Generation, LLC; Zimmer Power Company, LLC; Electric Energy, Inc; Illinois Power Generating Company; Illinois Power Resources Generating, LLC; and Kincaid Generation, LLC.

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1. INTRODUCTION

This Field Procedure Document (FP) presents general procedures for use by Ramboll employees working on Vistra projects for the handling and management of waste materials generated during implementation of site investigation or remedial action activities. Waste materials may include:

- Solids (e.g., soil cuttings, excavated soils or sediments, demolition[1] materials, remediation waste[2]);
- Liquids (e.g., well development water, decontamination fluids, waste water, recovered groundwater, recovered dense non-aqueous phase liquids, remediation waste[2]);
- Personal protective equipment (PPE; such as used gloves, Tyvek/chemical-resistant coveralls, spent respirator cartridges);and
- Miscellaneous municipal solid waste (office waste, food waste, plastic bags, discarded paper products).

Generally, waste generated during implementation of site investigations or remedial activities is classified as either (1) hazardous, or (2) non-hazardous waste. Hazardous wastes are regulated by the Resource Conservation and Recovery Act (RCRA) or individual states (as non-RCRA hazardous waste [e.g., used oil in California]). Non-hazardous waste can be non-regulated, or it can be regulated by other regulatory programs such as the Toxic Substances Control Act (TSCA).

1. RCRA regulates the control of the generation, transportation, treatment, storage, and disposal of solid[3] waste. A solid waste is considered hazardous, if not excluded from regulation as hazardous waste (40 CFR 261.4) and if it (a) exhibits hazardous waste characteristics as defined in 40 CFR 261 Subpart C (i.e., ignitability, corrosivity, reactivity or toxicity), (b) is listed in 40 CFR Subpart D, or (c) is a mixture of solid waste and one or more hazardous wastes not specifically excluded under 40 CFR 260.20 and 260.22. These materials will require management as hazardous waste at permitted facilities conforming to RCRA Subtitle C and may be subject to the land disposal restrictions of 40 CFR 268.

   Note that in some states, some wastes are classified as non-RCRA hazardous waste because they are considered hazardous on a state level but are not listed as hazardous under RCRA. State requirements and definitions regarding classification of hazardous wastes should be reviewed.

2. TSCA regulated wastes that may be encountered during site investigations or remedial activities include polychlorinated biphenyls (PCBs), lead, and asbestos[4]. Generally, these pollutants are not defined as hazardous waste. PCB wastes are subject to the disposal

[1] In this document, demolition materials refer to separated concrete, concrete rubble, concrete slabs, block, brick and concrete fines.

[2] In this document, remediation waste refers to unsuitable or contaminated excess solid reagents (e.g., ZVI) or liquid (e.g., oxidants) that cannot be used as originally intended.

[3] It is important to note that the RCRA definition of solid waste refers to any discarded materials, including those that are physically solid, liquid, semi-solid, or contained gaseous material.

[4] In the context of this FP, TSCA waste refers to PCB waste, managed under the TSCA program.

requirements of 40 CFR 761 Subpart D. PCB remediation waste refers to PCB-containing waste generated as a result of a spill, release, or other unauthorized disposal, at the following concentrations: (a) materials disposed of prior to April 18, 1978, that are currently at concentrations ≥50 parts per million (ppm) PCBs, regardless of the concentration of the original spill; (b) materials that are currently at any volume or concentration where the original source was ≥500 ppm PCBs beginning on April 18, 1978; (c) materials that are currently at any volume or concentration where the original source was ≥50 ppm PCBs beginning on July 2, 1979; and d) materials that are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR 761. PCB remediation waste includes soil, debris generated as a result of a PCB spill cleanup, sewage sludge, aqueous decantate, buildings and other man-made structures (such as concrete floors, wood floors, or walls), porous surfaces, and non-porous surfaces. These materials will require management as TSCA-regulated waste at permitted facilities.

3. Non-hazardous waste refers to solid waste that does not meet the RCRA definition of hazardous waste. These materials will require management as non-hazardous waste at permitted facilities conforming to RCRA Subtitle D.

In some cases, comingled waste, which is a waste that meets the definition of both hazardous waste and TSCA regulated waste, may be generated from investigation or remedial activities. Such waste will require management in conformance to both RCRA Subtitle C and 40 CFR 761 Subpart D and may be subject to the land disposal restrictions of 40 CFR 268.

This FP was prepared to document the procedures and techniques that will be used to fulfill the program requirements of the United states Environmental Protection Agency (USEPA) Final Rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [40 C.F.R.] § 257) and the State of Illinois Standards for the Disposal of CCRs in Surface Impoundments (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 845), herein referred to as Part 845.

It should be noted that Ramboll Principal-in-charge (PIC) and Project Manager (PM) should make sure that the project Client has signed Ramboll's specific terms and conditions in reference to RCRA compliance. Similarly, Ramboll waste management subcontractors should adhere to Ramboll standard terms. It should be understood, that Ramboll's role is only to oversee/coordinate the waste handling activities; Ramboll personnel shall not transport or dispose of any waste.

This FP does not supersede Ramboll Health and Safety procedures or HASP requirements; in the event of conflict between this FP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this FP. The Ramboll PIC and PM shall ensure that all project personnel review and sign the

applicable HASP, and that the signed HASP and relevant project information are maintained in the project file and are available to all site personnel for the duration of the project.

2. EQUIPMENT/MATERIALS

A general checklist of equipment that may be required for typical waste handling and management is provided below. This checklist includes equipment and supplies typically required; however, it should not be considered exhaustive. Additional equipment may be specified in the project-specific Work Plan and/or HASP.

2.1 General Waste Handling Equipment

- Site information (maps, contact numbers, previous field logs, etc.).
- Garbage bags, plastic bags, rolls of plastic sheeting
- Tool kit with appropriate tools for opening/closing containers and securing covers (socket wrench set, pry bar, drum wrench, duct tape, bungee cords, rope).
- Containers for waste (e.g. Department of Transportation (DOT)-rated 55-gallon open and closed top drums, covered roll-off bins, baker tanks, poly tanks, 5-gallon buckets with lids)
- Equipment for moving containers (e.g. drum dolly, truck with a lift gate, forklift[5])
- Hazardous/Non-hazardous/Analysis pending drum labels (weatherproof)
- Field screening equipment as required by the site-specific Work Plan or Sampling Plan and the site-specific HASP.
- PPE in accordance with the site-specific HASP, including sterile gloves, which must always be worn when handling waste. Note that Level B or C PPE may be required.
- Fire extinguisher and spill containment equipment
- Field book or pertinent field logs/forms, chain of custody forms, and all-weather or permanent pens as outlined in **FP 1.01** - Field Notes and Records.

2.2 Miscellaneous Additional Suggested Equipment

- Extra vehicle keys.
- First aid kit.
- Mobile phone and camera.
- Credit card for gas and emergencies.
- Road and site maps.

[5] Note that forklifts should not be operated by Ramboll employees.

3. PROCEDURES REFERENCED

The following Standard Practice Instruction (SPIs) and FPs are related to this FP and should be reviewed prior to fieldwork, as needed:

- **FP 1.01**, Field Notes and Records.
- **FP 2.02**, Site Preparation, Inspection and Housekeeping.
- **FP 14.02**, Heavy Equipment Decontamination.
- **FP 15.02**, Waste Sampling.

The list above is not intended to be all inclusive. Other FPs and Standard Practice Instruction (SPIs) may need to be referenced based on the specific requirements of the site-specific Work Plan/Sampling Plan/HASP (e.g., field screening FPs).

4. PROCEDURES

4.1 Planning and Design Considerations

Waste generated during site investigations and remedial activities typically includes solid waste (including contaminated soil or sediment, waste or non-spec remediation materials, and demolition materials), liquid waste (including contaminated groundwater, waste water, Non-aqueous phase liquids (NAPLs), and decontamination water), used PPE, and/or municipal solid waste. Management and handling of waste materials will depend, among other considerations, on:

- The waste characterization results (refer to **FP 15.02**, Waste Sampling). Waste materials are typically segregated and stored separately based on characterization results or suspected levels of contamination, such that RCRA hazardous waste, non-RCRA state-specific hazardous waste, TSCA regulated waste, comingled RCRA hazardous and TSCA regulated waste, non-hazardous waste, and municipal solid waste are managed independently;
- How waste is stored. Solid waste materials are typically stored in stockpiles, drums, or roll-off bins or could be directly loaded onto trucks. Similarly, liquid wastes are typically containerized in drums or tanks, and could be extracted by vacuum trucks. Municipal solid waste is typically stored in plastic bags. PPE is typically stored in drums and managed as solid waste, and in some cases, in plastic bags and managed as municipal solid waste;
- The condition of the storage device. In cases where waste materials are stored in drums or other containers that are damaged, corroded, dented or bulging, such containers may need to be overpacked to allow safe handling and transport; contact and discuss with PIC and/or PM and waste disposal subcontractor on how to proceed;
- The quantity of waste and the location of the disposal or treatment facility. These could define the most cost-effective waste management (e.g., transport via truck, rail or barge); and

- The location of the waste materials. This could define what equipment may be required to load and transport the wastes and whether any site improvements (e.g., temporary access roads or ramps) will be necessary.

All significant waste management and handling strategy decisions shall be approved by the PIC and/or PM before the initiation of field activities, including, but not limited to, the selection of the waste disposal or treatment facility and the mode of transport. As part of this process, the licensing (e.g., State permit or license) and regulatory status (e.g., if subjected to significant fines or violations) of the treatment or disposal facility(ies) should be evaluated. The Work Plan/Sampling Plan/HASP should clearly establish procedures for waste material storage, loading, and transport and meet applicable waste transport disposal requirements. The Work Plan/Sampling Plan/HASP should generally provide for some discretion for modifications in the field depending on encountered conditions; however, any significant departure from prescribed sampling activities should be approved by the PIC and/or PM.

4.2 Pre-Field Work Preparation Procedures

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FP 2.02**, Site Preparation, Inspection and Housekeeping. In addition, to the extent that non-dedicated equipment is to be used (e.g., excavator bucket for loading of waste material), to minimize potential cross-contamination of materials, such equipment should be decontaminated as described in **FP 14.02** (Heavy Equipment Decontamination), the project-specific Work Plan/sampling plan and/or the Quality Assurance Project Plan (QAPP).

At a minimum, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Review any permits and permit conditions that may be required for the planned site work including air, dust, sound monitoring, and restricted operating hours;
- If work is being conducted under agency supervision, make appropriate advance notifications to advise commencement of the field effort;
- Coordinate and obtain permission for site access and define, with the Site Owner, where waste containers should be staged. The location should be secured and, ideally, should be easily accessible to waste haulers;
- Complete a subsurface clearance (refer to **SPI 27**), if excavating and direct loading solid waste materials;
- Review project-specific Work Plan/Sampling Plan, where applicable;
- Review project-specific QAPP, where/if applicable;
- Review and discuss with PIC and/or PM the proposed waste management and handling strategy, including which wastes should be segregated (if any) based on characterization results;

- Review the standard instruction manual provided by the manufacturer of the specific field monitoring and/or sampling equipment being used for the waste management activity; and
- Ensure that all equipment/materials required to complete the work have been packed prior to mobilization.

4.3 General Waste Management Guidelines

The waste management procedures outlined in this FP are for solid waste[6] (e.g., soil cuttings, excavated materials or sediment), demolition materials, liquid waste (e.g., well development water, decontamination fluids, contaminated groundwater, waste water), NAPL, and used PPE. The following provides a recommended list of practices for waste management and handling activities.

Prior to the commencement of the field effort, Ramboll oversight personnel should inspect, test, and/or calibrate equipment that will be used to take field measurements. In addition, prior to their use all waste containers should be inspected for the following:

- Bulging/dimples;
- Crystals around the drum opening;
- Leaks, holes, stains;
- Existing Labels, markings, hazard warnings;
- Rust; and
- Damaged wall, bottom, lid/hatch or cover.

Containers showing any of the signs listed above or containing liquid or solid residue of unknown origin should not be used for waste containerization and should be removed from the site by an appropriate contractor under Ramboll supervision and discarded.

4.3.1 Solid Waste

Excess soil or sediment generated during field investigations may include soil cuttings and/or drilling muds from boreholes. In addition, soil waste is generated from remedial implementation (such as installation of injection wells or excavation of contaminated soils or sediment). The following provides a recommended list of practices for the handling and management of solid waste generated from soil borings:

- If allowed by State regulations, soil cuttings can be returned to the borehole in the reverse order that they were collected, such that cuttings from the last interval sampled are inserted into the borehole first. This will result in the placement of excess soil cuttings from the approximate intervals that they were collected from.

[6] Common trash (office waste, food waste, etc.) may be disposed of as municipal solid waste provided it has not been in contact with solid or liquid waste.

- If the cuttings from soil borings need to be disposed off-site, excess soil cuttings should be containerized. Generally, 55-gallon, DOT-rated steel drums are utilized for this purpose.
- In instances where small quantities of soil cuttings are generated, a 5-gallon plastic or steel bucket with a lid can be utilized to containerize the soil cuttings. In instances where large quantities of soil cuttings are generated or where soil cuttings are generated concurrent with a remedial action that includes excavation of soil, the soil cuttings can be containerized in roll-off bins or stockpiles in the same manner as the excavated soils.
- Drum lids, bucket lids and roll-off bin covers should be open only when solid waste materials are being added to the containers and the lids/covers should be secured at the end of each workday and/or once the container(s) is full. The containers should be labeled in accordance with **Section 4.4** and disposed off-site in accordance with **Section 4.5**.

Remedial activity-related solid waste such as excavated soil can either be containerized in roll-off bins fitted with covers, stockpiled or directly loaded onto trucks for off-site disposal. Stockpiling and placement in roll-off bins is typically used when waste characterization results are not available or when site conditions or the rate of solid waste generation does not allow direct loading. Direct loading is allowable when waste characterization has been completed and the required approvals of the waste disposal facility(ies) have been procured. The following provides a recommended list of practices for the handling and management of solid waste generated from removal activities:

- <u>If solid waste is to be stockpiled prior to loading for off-site disposal</u>:
  - Construct a berm around each proposed stockpile (a separate stockpile should be created for each solid waste classification) with site soils, imported fill or hay bales and place a layer of plastic sheeting or a geomembrane under/at the base of the proposed stockpile area and over the berm. This system will prevent direct contact between the stockpiled material and the underlying soils and prevent water (e.g. rainwater) from emanating to/from the stockpile area.
  - Place hay bales or silt fence around the proposed stockpile area as a soil erosion and sediment control measure.
  - Once solid waste placement in the stockpile area commences, the stockpile should be covered with plastic sheeting at the end of each work day and when precipitation is forecasted. The plastic sheeting layer should be secured with sand bags and ropes to ensure no portion of the solid waste stockpile is exposed to the elements.
- <u>If solid waste is to be placed in roll-off bins</u>:
  - Place a layer of plastic sheeting along the side of the roll-off bin where material loading will take place. This will allow collection of any spilled materials and prevent direct contact between materials requiring off-site disposal and the underlying soils. Note, a layer of plastic sheeting may also be placed inside the roll-off bin by the waste transport subcontractor.

- Once solid waste placement in the roll-off bin commences, the roll-off bin should be covered and secured with the lid or a tarp at the end of each work day and when precipitation is forecasted.

- If solid waste is to be directly loaded onto trucks:
  - Prepare the loading area in accordance with the Remedial Action Work Plan.
  - Prior to loading trucks, ensure that waste materials cannot be spilled out of the vehicle during transport. If need be, the truck bed may need to be lined with plastic sheeting to prevent loss of waste during transport.
  - When loading trucks, ensure the load is evenly distributed on the truck bed and that the load does not exceed the truck capacity. If weights are exceeded, the truck may not be allowed on the road, subject to fines, and/or may be denied access to the disposal facility.
  - Upon completion of the truck loading, the load should be covered with a secured tarp to prevent material loss during transport.

4.3.2 Demolition Materials

Demolition materials are sometimes generated during a site investigation/remediation. Remedial activity-related demolition waste such as separated concrete, concrete rubble, concrete slabs, block, brick and concrete fines can either be containerized in roll-off bins fitted with covers, stockpiled, or directly loaded onto trucks for off-site disposal. Like solid wastes, stockpiling and placement in roll-off bins is typically used when waste characterization results are not available or when site conditions or the rate of demolition waste generation does not allow direct loading. As with solid wastes, direct loading is only allowable when waste characterization has been completed and the required approvals of the waste disposal facility(ies) have been procured. The following provides a recommended list of practices for the handling and management of demolition waste generated from removal activities:

- If demolition waste is to be stockpiled and has not been impacted by site contaminants:
  - Place hay bales or silt fence around the proposed stockpile area as a soil erosion and sediment control measure.
- If demolition waste is to be stockpiled and has been impacted by site contaminants:
  - Construct a berm around each proposed stockpile (a separate stockpile should be created for each demolition waste classification) with site soils, imported fill or hay bales and place a layer of plastic sheeting or a geomembrane under/at the base of the proposed stockpile area and over the berm. This system will prevent direct contact between the stockpiled material and the underlying soils and prevent water (e.g. rainwater) from emanating to/from the stockpile area.
  - Place hay bales or silt fence around the proposed stockpile area as a soil erosion and sediment control measure.
  - Once demolition waste placement in the stockpile area commences, the stockpile should be covered with plastic sheeting at the end of each work day and when precipitation is forecasted. The plastic sheeting layer should be secured with sand

bags and ropes to ensure no portion of the solid waste stockpile is exposed to the elements.

- If demolition waste is to be placed in roll-off bins and has not been impacted by site contaminants:
  - Once demolition waste placement in the roll-off bin commences, the roll-off bin should be covered and secured with the lid or a tarp at the end of each work day and when precipitation is forecasted.
- If demolition waste is to be placed in roll-off bins and has been impacted by site contaminants:
  - Place a layer of plastic sheeting along the side of the roll-off box where material loading will take place. This will allow collection of any spilled materials and prevent direct contact between materials requiring off-site disposal and the underlying soils.
  - Once solid waste placement in the roll-off bin commences, the roll-off bin should be covered and secured with a tarp at the end of each work day and when precipitation is forecasted.
- If demolition waste is to be directly loaded onto trucks:
  - Prepare the loading area in accordance with the Remedial Action Work Plan.
  - Prior to loading trucks, ensure that waste materials cannot be spilled out of the vehicle during transport. If need be, the truck bed may need to be lined with plastic sheeting to prevent loss of waste during transport.
  - When loading trucks, ensure the load is evenly distributed on the truck bed and that the load does not exceed the truck capacity. If weights are exceeded, the truck may not be allowed on the road, subject to fines, and/or may be denied access to the disposal facility.
  - Upon completion of the truck loading, the load should be covered with a secured tarp to prevent material loss during transport.

4.3.3 Liquid Waste

Liquid wastes produced during field investigations may include groundwater generated during well development, purging, sampling and decontamination fluids. In addition, liquid waste can generated from remedy implementation (such as extracted groundwater from recovery wells or from dewatering activities, decontamination fluids, and remediation liquid wastes). Until waste characterization results are available, all liquid wastes shall be containerized. The following provides a recommended list of practices for the handling and management of liquid waste generated during field investigations and remedy implementation.

- All liquid wastes should be containerized pending the results of analytical testing. Generally, 55-gallon, DOT-rated steel, closed top drums are utilized for this purpose. In instances where there little liquid waste is generated, a 5-gallon plastic or steel bucket with a lid can be utilized to containerize generated liquids. In instances where large quantities of liquid waste are generated, liquids can be containerized in bulk containers such as frac tanks or poly tanks.

- Container lids (i.e., drum lids, bucket lids or frac tank hatches) should be open only during filling activities and the lids should be secured at the end of each workday, during rainfall events and once the container(s) is full. The containers should be labeled in accordance with **Section 4.4** and disposed off-site in accordance with **Section 4.5**.

If explicitly allowed by Federal and/or State regulations, containerized liquid waste (specifically, well development water and purge water) may be discharged to the ground in the immediate vicinity of the well the waste originated from provided that: (a) pertinent authorities have been notified or the activity is otherwise permitted; (b) liquid wastes only consist of well development and purge water (e.g., no decontamination water); and (c) chemical analysis of the contents of the container indicate that analytes are not above regulatory levels. If allowed by applicable Federal, State and/or local permits, remedial activity-related liquid wastes may be discharged to groundwater, surface water or a publicly owned treatment works (POTW) provided that: (a) pertinent permits have been procured; (b) the liquid waste is pretreated, as needed, to meet discharge requirements; and (c) a discharge monitoring program is implemented in accordance with permit requirements.

4.3.4 NAPL

NAPL may be generated during field investigations or as part of the remedy implementation (e.g., NAPL recovery, decanted oil from an oil/water separator). The following provides a recommended list of practices for the handling and management of NAPL waste.

- All NAPL should be containerized for off-site disposal. Generally, 55-gallon, DOT-rated steel, closed top drums are utilized for this purpose. In the event small or larger quantities of NAPL are generated, adequately sized containers with lids made of compatible material can be utilized.
- Drum and container lids should be open only during filling activities and the lids should be secured at the end of each workday, during rainfall events, and once the container(s) is full. The containers should be labeled in accordance with **Section 4.4** and disposed off-site in accordance with **Section 4.5**.

4.3.5 PPE and Expendable Sampling Equipment

PPE and expendable sampling equipment (e.g. disposable bailers, plastic dipper cups) generated during most investigation and remedial activities should be containerized in plastic garbage bags. In some instances where there are known hazardous materials being handled, the PPE should be containerized in drums until waste characterization sampling can be completed (refer to **FP 15.02**). If there is uncertainty regarding the hazard classification of the site media, the materials should be containerized in drums and sampled for waste characterization and disposal purposes.

4.3.6 Containers with Unknown Contents

During field investigations or remedial actions, containers (e.g., 55-gallon drums, 5-gallon buckets) with unknown contents are sometimes encountered. Under no circumstance, should containers with unknown contents be handled or managed; contact and discuss with PIC and/or PM how to proceed.

4.4 Labeling

All waste containers must be properly labeled. All wastes must be characterized as either hazardous (RCRA or State), TSCA-regulated (PCBs), or non-hazardous/non-regulated. Waste labels should be weatherproof and completed legibly with a permanent marker to prevent being washed out, smeared, or faded. Another alternative to printed labels is to mark the container directly with paint pens. Label or markings on the container should be on the side of the container to minimize weathering effects.

In general, waste characteristics are not known during site investigations and generated wastes must be sampled to determine appropriate disposal options. Waste containers for these types of wastes will include a notification label stating that "*Waste Characterization Pending Analysis*" and the following information should be included on the label:

- Description of the waste (e.g. purge water, soil cuttings);
- Waste generation location (e.g. MW4 thru MW5, SBs-5, 6, 7 & 8) and depth, if applicable;
- Waste generation address;
- Date(s) waste was generated; and
- Client Contact Information (e.g. Name and phone number of someone familiar with the waste – can be the Site contact).

Once the waste has been characterized, the label should be changed as appropriate to non-hazardous, hazardous, or TSCA-regulated waste.

Waste characterization for materials to be generated during remedial activities has typically been completed prior to implementation of these activities. For these wastes the following information should be included on the appropriate label.

For non-hazardous wastes, a pre-printed label with the words "Non-Hazardous Waste" can be used and the following information shall be included on the label:

- Description of the waste (e.g. purge water, soil cuttings);
- Waste generation location (e.g. MW4 thru MW5, SBs-5, 6, 7 & 8) and depth, if applicable;
- Waste generation address;
- Date(s) waste was generated; and
- Client Contact Information (e.g. Name and phone number of someone familiar with the waste – can be the Site contact).

For hazardous wastes, a pre-printed label with the words "Hazardous Waste" can be used and the following information shall be included on the label:

- Description of the waste (e.g. purge water, soil cuttings);

- Waste generation location (e.g. MW4 thru MW5, SBs-5, 6, 7 & 8) and depth, if applicable;
- Date(s) waste was generated;
- Generator Information (e.g. Name, address, and telephone number of the Site Owner/Site Environmental Manager);
- EPA identification number – supplied by the Site Owner/Site Environmental Manger; and
- Client Contact Information (e.g. Name and phone number of someone familiar with the waste – can be the Site contact).

4.5 Waste Management

4.5.1 Waste Characterization

All waste generated during the course of site investigations or remedial actions shall be characterized for disposal in accordance with **FP 15.02**, Waste Sampling.

4.5.2 Waste Storage

All waste should be transported off-site to an approved disposal or treatment facility as soon as possible. For waste that is temporarily stored on-site, inspections must be performed and documented regularly to ensure that waste containers have not been damaged, vandalized or otherwise compromised and that the waste is secure and contained. For all RCRA hazardous waste storage areas, these inspections shall be performed weekly (typically by the Client representative or other site personnel). Special attention should be given to RCRA hazardous wastes, TSCA regulated wastes, and mixed RCRA and TSCA wastes. The following summarizes waste storage requirements for these special wastes.

1. RCRA Hazardous Waste cannot accumulate on-site for longer than 90 days for large quantity generators and 180 days for small quantity generators (per 40 CFR 262). A hazardous waste storage area inspection checklist is provided in **Attachment A**. The following requirements for hazardous waste storage must be implemented:
   - Hazardous waste signs shall be posted as required by federal or state statutes;
   - The storage area must be separate and secured;
   - Secondary containment must be in place to contain any spills;
   - A spill kit must be available;
   - A fire extinguisher must be available; and
   - Adequate aisle space must be maintained between containers.
2. TSCA regulated remediation wastes (specifically PCB) cannot accumulate on-site for longer than 180 days.

4.5.3 Waste Loading and Transport

Following waste characterization, required approvals shall be procured from the disposal facility(ies) and, where applicable, state or federal agencies. Solid and liquid wastes can be transported for off-site disposal via truck, rail or barge.

Prior to waste loading, measures shall be taken to prevent the accidental release of contaminated materials to unimpacted areas. These may include placement of tarps in loading areas to prevent accidental spills during loading, and construction of a tracking pad/stabilized construction entrance or a wash station to prevent the off-site tracking of waste materials. Before the vehicle transporting waste materials leaves the loading area, it should be inspected to ensure it is free of soils that may have spilled during loading or have adhered to the vehicle.

All waste shall be transported and disposed of in accordance with applicable State, Federal, and local regulations. Wastes that are classified as hazardous shall be shipped/transported by state-certified waste haulers and shall be accompanied by a hazardous waste manifest (EPA Form 8700-22). PCB wastes shall be shipped/transported by state-certified waste haulers and shall be accompanied by a manifest (EPA Form 8700-22). Although PCB wastes are not regulated under RCRA, some States track PCB wastes as State-Regulated hazardous wastes – consult State regulations and guidance or contact your local Ramboll staff for any regional or local requirements before conducting the work. Non-hazardous wastes may be shipped using other types of shipping documents such as non-hazardous waste manifests or bills of lading. All shipping documents shall be signed by the generator (i.e., the site owner or their authorized representative), the hauler and the disposal facility (upon receipt of the waste).

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Certain precautions should be taken to ensure safety while conducting waste handling.

- It is important to always remain alert and aware of your surroundings. Waste handling and management can involve the use of field trucks and associated equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.
- Prior to mobilization, determine the waste storage means and locations and the need for security, barricading, and/or traffic control (e.g., when waste haulers enter or leave the site).
- To the extent practicable and as allowed by the Work Plan, wastes should be segregated such that different waste types (solid waste, demolition waste, NAPL and liquid waste) and waste classifications (hazardous, TSCA regulated, comingled hazardous-TSCA waste, and non-regulated waste) are handled, stored and managed separately. While additional storage will be required, it will typically result in more cost-efficient waste management and disposal.
- Prior to loading waste materials onto trucks, ensure that trucks are in good condition such that waste materials cannot be spilled out of the vehicle during transport.
- Prior to placement of waste into containers, ensure that the containers are empty, intact and in good condition, and compatible with the waste to be stored. Containers that are deteriorating (e.g., cracked, rusted) or leaking must not be used. Waste stored in defective containers must be transferred to containers in good condition.

- When trucks are being loaded, ensure the load is evenly distributed on the truck bed and that the load does not exceed the truck capacity. If weights are exceeded, the truck may not be allowed on the road, subject to fines, and/or may be denied access to the disposal facility.
- Before leaving the loading area, vehicles transporting waste materials should be inspected to ensure they are free of soils that may have spilled during loading or have adhered to the vehicle.
- Although PCB wastes are not regulated under RCRA, some States track PCB wastes as State-Regulated hazardous wastes. Therefore, State regulations and guidance governing PCB wastes should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements.

6. RECORDKEEPING

All waste generated during site activities should be inventoried in either the field log book or on waste inventory/disposal log forms and photographs. A sample waste inventory/disposal log form is provided in **Attachment B**. Each container should be tracked by the following:

- Waste generation date(s);
- Waste generation location;
- Waste characterization type (e.g. pending analysis, non-hazardous, hazardous);
- Container size/approximate waste quantity; and
- Media type (e.g. liquid, solid).

For waste that is temporarily stored on-site, inspections must be documented. Once the waste has been shipped off-site, the field log book or waste inventory/disposal log form should be updated with the following:

- Disposal shipment date;
- Transporter information;
- Disposal facility information; and
- Certificate of disposal information (e.g., manifest or record from the receiving waste disposal or treatment facility indicating the quantity and type of waste and the date of receipts at the facility).

Document all information collected in accordance with **FP 1.01** (Field Notes and Records). Note that Federal and State regulation may require separate reporting requirements, specifically for hazardous wastes (e.g., State Hazardous Waste Annual Reports, USEPA Biennial Certification Forms - EPA Form 8700-13 A/B).

APPENDIX B
FIELD AND DATA FORMS

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

EXAMPLE

Section A **Required** Client Information:		**Section B** **Required** Project Information:		**Section C** Invoice Information:	
Company:	Dynegy Midwest Generation, LLC	Report To:	Brian Voelker	Attention:	
Address:	13498 E. 900th St	Copy To:		Company Name:	Dynegy Midwest Generation, LLC
				Address:	see Section A
Email To:	Brian.Voelker@VistraCorp.com	Purchase Order No.:		Quote Reference:	
Phone:	(217) 753-8911 Fax:	Project Name:		Project Manager:	
Requested Due Date/TAT:	**10 day**	Project Number:	2285	Profile #:	

REGULATORY AGENCY

NPDES **GROUND WATER** DRINKING WATER

UST RCRA OTHER

Site Location ***STATE:*** IL

Requested Analysis Filtered (Y/N)

ITEM #	**Section D** **Required** Client Information **SAMPLE ID** (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	**Valid Matrix Codes** MATRIX / CODE DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Y/N	Analysis Test	HEN_257_801	HEN_257_802	HEN_257_803	HEN_257_804	HEN_811_801	HEN_CLOSURE_802-804	HEN_CLOSURE_804	HEN_WPCP_East	HEN_WPCP_West				Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	02_23Q1																												
2	07_23Q1																												
3	08_23Q1																												
4	10_23Q1																												
5	12_23Q1																												
6	13_23Q1																												
7	16_23Q1																												
8	17_23Q1																												
9	22_23Q1																												
10	23_23Q1																												
11	25_23Q1																												
12	26_23Q1																												
13	27_23Q1																												
14	30_23Q1																												
15	31_23Q1																												
16	32_23Q1																												

ADDITIONAL COMMENTS	**RELINQUISHED BY / AFFILIATION**	**DATE**	**TIME**	**ACCEPTED BY / AFFILIATION**	**DATE**	**TIME**	**SAMPLE CONDITIONS**
HEN-23Q1 Rev 0							

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: **DATE Signed (MM/DD/YY):**

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Field Calibration Form

PROJECT INFORMATION

Site:		Client:		Date:	
Project Number		Task #:			
Calibrated By (Full Name)					

METER SUMMARY

Meter	Make/Model	Serial #
Multi-Parameter Probe (pH, DO, ORP, SC, Turbidity)		
Turbidity Meter		
Other:		

SPECIFIC CONDUCTANCE [1]

Time HH:MM	Calibration Standard Temp deg C	Specific Conductance (Before Adj.) µS/cm	Specific Conductance (After Adj.) µS/cm		Standard Lot No.	
					Calibration Standard Value	
					Standard Exp. Date	

1) Perform SC calibration prior to pH, as pH standard is extremely conductive and can skew calibration.

pH [2]

Time HH:MM	pH Buffer	Calibration Standard Temp deg C	pH (Before Adj.)	pH (After Adj.)	Slope	MV		Buffer Lot #'s	
								pH ___	
								pH ___	
								pH ___	
								Buffer Exp. Dates	
								pH ___	
								pH ___	
								pH ___	

2) A 3-point pH calibration should be used if a 2-point does not bracket the range of pH expected or if the range is unknown or expected to vary greatly.

ORP

Time HH:MM	Calibration Standard Value mV	Calibration Standard Temp deg C	ORP (Before Adj.) µS/cm	ORP (After Adj.) µS/cm		Standard Lot No.	Standard Exp. Date

DISSOLVED OXYGEN

% Saturation Method	Time HH:MM	Barometric Pressure	Initial Reading mg/L	% Saturation	Calibrated To mg/L	Final Reading mg/L
100%						
0 %						

TURBIDITY

0 NTU			___ NTU		
Time HH:MM	Initial Reading NTU	Calibrated To NTU	Time HH:MM	Initial Reading NTU	Calibrated To NTU
				Standard Lot No:	
				Standard Exp. Date	

Additional Notes:

Monitoring Well Evaluation Checklist

Site		Major wells repairs* required to maintain well integrity?	Yes	No	NA
Inspection Date					
Well Number					

Stick-up Monitoring Wells	Yes	No	NA	**Comments**
1. Outer protective Casing				
Corroded				
Dented				
Cracked				
Loose				
2. Inner casing				
Corroded				
Dented				
Cracked				
Loose				
	Yes	No	NA	
3. Are there weep holes in outer casing?				
4. Weep holes able to drain?				
5. Is there a lockable cap present?				
6. Is there a lock present?				
7. Bumper posts in good condition?				

Flushmount Monitoring Wells	Yes	No	NA
8. Can the lid be secured tightly?			
9. Does the lid have a gasket that seals?			
10. Water in the flushmount?			
11. Well cap lockable?			
12. Lock is present?			

All Monitoring Wells	Yes	No	NA
Downhole Condition			
12. Water level measuring point clearly marked?			
13. Are there obstructions in well?			
14. Are there plant roots or vegetation in well?			
15. Is there sediment in bottom of well?			
If present, how much sediment?	ft		
16. Installed as total depth.	ft		
17. Measured total depth of well.	ft		

General Condition	Yes	No	NA
18. Concrete pad installed?			
19 . Concrete pad			
Slope away form casing?			
Deteriorated?			
Heaved or below surrounding grade?			
20. Surface seal settling?			
21. Well clearly visible and labeled?			

Comments:

* Major well repair are those that require a subcontractor or separate mobilization to complete

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: _____ Client: _____

Project Number: _____ Task #: _____ Start Date: _____ Time: _____

Field Personnel: _____ Finish Date: _____ Time: _____

WELL INFORMATION

Well ID: _____

Casing ID: _____ Inches

Screen Interval: _____

Borehole Diameter: _____ Inches

Filter Pack Interval: _____

EVENT TYPE

☐ Well Development

☐ Low-Flow / Low-Stress Sampling

☐ Well Volume Approach Sampling

☐ Other (Specify below)

_____

PURGE INFORMATION

Purge Method: ☐ Bailer ☐ Pump

Bailer Type: n/a

Pump Type and Serial #: _____

Tube/Pump Intake Depth: _____

Stabilized Pumping Rate: _____

DEPTH MEASUREMENTS

	INITIAL		FINAL	
	Depth FT BTOC	Time (24-Hour)	Depth FT BTOC	Time (24-Hour)
LNAPL				
Groundwater				
DNAPL				
Casing Base				

VOLUME CALCULATION AND PRODUCTION INFORMATION

Volume Calculation Type: ☐ Well Casing ☐ Borehole

Volume Per Foot: _____

Standing Water Column: _____ feet

1 Well Volume: _____ Gallons 3 Well Volumes: _____ Gallons

5 Well Volumes: _____ Gallons 10 Well Volumes: _____ Gallons

Total Volumes Produced: _____ Gallons

Well Purged Dry? ☐ Yes ☐ No

Water Level Serial #: _____ Water Quality Probe Type and Serial # _____

WATER QUALITY INDICATOR PARAMETERS

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial											
purge											

NOTES

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na - Not Applicable
nm - Not Measured
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units
Temp - Temperature
°C - Degrees Celcius

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: _____ Client: _____

Project Number: _____ Task #: _____ Start Date: _____ Time: _____

Field Personnel: _____ Finish Date: _____ Time: _____

WELL INFORMATION

Well ID: _____

Casing ID: _____ inches

EVENT TYPE

☐ Well Development ☐ Low-Flow / Low Stress Sampling

☐ Well Volume Approach Sampling ☐ Other (Specify): _____

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity

NOTES (continued)

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na - Not Applicable
nm - Not Measured
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units
Temp - Temperature
°C - Degrees Celcius

APPENDIX D
MULTI-SITE QUALITY ASSURANCE PROJECT PLAN

Date
September 4, 2025

Project No.
1940112376

MULTI-SITE QUALITY ASSURANCE PROJECT PLAN REVISION 1

RAMBOLL Bright ideas. Sustainable change.

MULTI-SITE QUALITY ASSURANCE PROJECT PLAN REVISION 1

Project no.	**1940112376**
Recipient	**Vistra Corp**
Document type	**Quality Assurance Project Plan Revision 1**
Revision	**1**
Date	**September 4, 2025**
Prepared by	**Kristin A. Drucquer**
Checked by	**Lauren D. Cook**
Approved by	**Brian G. Hennings, PG and Nicole M. Pagano, PE, PG**

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DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	December 28, 2022	• Original Document
Revision 1	September 4, 2025	• Table A – Zimmer Power Plant Units 121, 124, and 125 are no longer monitored under 40 C.F.R. § 257 • Content of the Data Management Plan, dated December 28, 2022, has been incorporated into this document • Table 1 and Appendix A were revised to remove redundancy • Added solid phase sampling to Section 2.1, "Data Quality Objectives"; Table 7, "Solid Extraction and Analysis Methods"; and minor related edits throughout the document

DOCUMENT APPLICABILITY BY FACILITY OWNER

Table A. Document Applicability by Facility Owner

Facility & Owner	Unit ID	Unit Name	40 C.F.R. § 257	35 I.A.C. § 845
Baldwin Power Plant Dynegy Midwest Generation, LLC	601	Bottom Ash Pond	X	X
	605	Fly Ash Pond System	X	X
Coffeen Power Plant Illinois Power Generating Company	101	Ash Pond No. 1	X	X
	102	Ash Pond No. 2	X	X
	103	GMF Gypsum Stack Pond	X	X
	104	GMF Recycle Pond	X	X
	105	Landfill	X	
Duck Creek Power Plant Illinois Power Resources Generating, LLC	201/202	Ash Pond No. 1 Ash Pond No. 2		X
	203	GMF Pond	X	X
	204	Landfill	X	
	205	Bottom Ash Basin	X	X
Edwards Power Plant Illinois Power Resources Generating, LLC	301	Ash Pond	X	X
Hennepin Power Plant Dynegy Midwest Generation, LLC	801	Landfill	X	
	802	Ash Pond No. 2	X	
	803	East Ash Pond	X	X
	804	Old West Ash Pond	X	X
	802/805	Ash Pond No. 2 Ash Pond No. 4		X
Joppa Power Plant Electric Energy, Inc.	401	East Ash Pond	X	X
	402	Landfill	X	
Kincaid Power Plant Kincaid Generation, LLC	141	Ash Pond	X	X
Miami Fort Power Plant Dynegy Miami Fort, LLC	113	Landfill	X	
	115	Pond System	X	
Newton Power Plant Illinois Power Generating Company	501	Primary Ash Pond	X	X
	502	Landfill 2	X	
Vermilion Power Plant Dynegy Midwest Generation, LLC	910	North Ash Pond		X
	911	Old East Ash Pond		X
	912	New East Ash Pond		X
Zimmer Power Plant Zimmer Power Company, LLC	122	Landfill	X	

Notes:
35 I.A.C. = Title 35 of the Illinois Administrative Code
40 C.F.R. = Title 40 of the Code of Federal Regulations

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Table A Document Applicability by Facility Owner

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Table 2 Summary of QA/QC Samples
Table 3 Sample Preservation, Containers, and Holding Times
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Table 7 Solid Extraction and Analysis Methods

FIGURES

Figure 1 Organization and Communication Flow Chart

APPENDICES

Appendix A Groundwater Analytical Methods and Analytical Performance Criteria for Compliance Sampling

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%R	percent recovery
%RSD	percent relative standard deviation
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
CAS	Chemical Abstracts Service
CCR	coal combustion residuals
Consultant PM	Consultant Project Manager
DI	deionized
DQI	Data Quality Indicator
DQO	Data Quality Objective
DO	dissolved oxygen
EB	equipment blank
EDD	Electronic Data Deliverable
FB	field blank
FD	field duplicate
GMP	Groundwater Monitoring Plan
ICP	inductively coupled plasma
Lab Field Team Lead	Laboratory Field Team Lead
Lab Liaison	Laboratory Liaison
Lab Manager	Laboratory Manager
Lab PM	Laboratory Project Manager
Lab QA/QC Manager	Laboratory Quality Assurance/Quality Control Manager
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSD	Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
ORP	oxidation-reduction potential
PC	Plant Coordinator
PDF	Portable Data Format
POC	point-of-contact
QA	Quality Assurance
QAM	QA Manual
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance and Quality Control
QC	Quality Control
Ramboll	Ramboll Americas Engineering Solutions, Inc.
Ramboll PgM	Ramboll Program Manager

Ramboll PM	Ramboll Project Manager
RL	Reporting Limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SAR	sampling and analysis request
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
TB	trip blank
TIC	Tentatively Identified Compounds
USEPA	United States Environmental Protection Agency
Vistra	Vistra Corp.
Vistra PgM	Vistra Program Manager
VOC	volatile organic compound

1. QUALITY ASSURANCE PROJECT PLAN OBJECTIVES

This Quality Assurance Project Plan (QAPP) has been prepared to document the quality assurance and quality control (QA/QC) procedures and performance criteria applicable to data collection tasks associated with groundwater, surface water, porewater, leachate, ash and soil sampling and analysis at the monitored units listed in **Table A**.

This QAPP has been prepared in general accordance with the applicable elements of several United States Environmental Protection Agency (USEPA) guidance documents, including Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4 (USEPA, 2006); EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (USEPA, 2001); and Guidance for Quality Assurance Project Plans, EPA QA/G-5 (USEPA, 2002).

The purpose of the QAPP is to outline the procedures, methods, performance criteria, and other specifications used to ensure that sample collection, analysis, and data management produce data that are representative of field conditions, meet the data quality objectives (DQOs) established in this document, and are of acceptable quality to meet industry standards.

Quality Control (QC) is the basic building block of data quality. It starts with establishing limits of acceptable performance and defining activities whose purpose is to control quality at the source by finding problems and defects. At its simplest, QC is inspecting, testing, or checking data to make sure it is correct, valid, or otherwise in accordance with established specifications. The intent is to identify data that is not correct, and either correct or eliminate it, to make sure all data conforms to the specifications, and/or functions as required. QC does not ensure quality; it only finds instances where quality is absent or below established criteria.

Quality Assurance (QA) can be defined as the integrated system of activities that ensures that a project meets defined standards. QA asserts that data quality can be improved by looking 'further up the line'. It is aimed at preventing nonconforming or invalid data. QA can be defined as the integrated system of activities that ensures that a project meets defined standards. QA still has QC at its core to control data quality, but it goes beyond testing or inspection to also consider related activities or processes (such as training, document control, and audits) that may be resulting in systemic and recurring data quality issues. The overall goal of the QA/QC procedures and specifications established in this QAPP is to ensure that comparable and representative data are produced during data collection tasks and that data quality is consistently assessed and documented with respect to its precision, accuracy, sensitivity, and completeness. The specific QAPP objectives are to:

- Provide standardized methods and quality specifications for all anticipated field sampling, analysis, and data review procedures
- Provide guidance and criteria for selected field and analytical procedures
- Establish procedures for reviewing and documenting compliance with field and analytical procedures

This QAPP identifies the planning, implementation, and assessment procedures for the QA/QC program to be followed for aqueous (*i.e.*, groundwater, surface water, porewater, and leachate) and solid (*i.e.*, soil, sediment, and coal combustion residuals [CCR]) data collection tasks including the following:

- Collecting aqueous and solid samples
- Conducting field analysis of water quality parameters
- Labeling and shipping samples to laboratories
- Documenting field activities
- Coordinating laboratory services
- Reviewing and validating laboratory data
- Submitting finalized, validated data

The QAPP will be expanded or revised if further sampling work activities or analyses are identified.

2. DATA QUALITY OBJECTIVES

The overall goal of the QA/QC procedures and specifications established in this QAPP is to ensure that comparable and representative data are produced, and that data quality is consistently assessed and documented to accomplish the sampling objectives. To achieve this goal, a systematic approach is followed in the planning of this project equivalent to the USEPA DQO Process, as described in Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4 (USEPA, 2006).

2.1 DQO Process

The DQO Process is a series of logical steps that guides users to a plan for collecting environmental data. It is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for generating data of sufficient quality and quantity to support the goals of the study. The DQO Process consists of seven iterative steps; the iterative nature of the DQO Process allows one or more of these steps to be revisited as more information on the problem is obtained.

2.1.1 Aqueous Samples

Step 1: State the Problem

The monitored units located at the project facilities could pose unacceptable risk to human health or the environment. The units are subject to compliance with one or more state or federal regulatory programs.

Step 2: Identify the Goal of the Study

Collect and analyze aqueous samples for site characterization and to evaluate potential impacts to receptors from the subject units. If exceedances of regulatory standards are detected, one or more of the following may be necessary: develop an Alternative Source Demonstration (ASD); identify the nature and extent of impact; and/or develop a Corrective Action Plan (CAP).

Step 3: Identify the Information Inputs

The primary required data type will be the analytical results from the aqueous samples collected from the well networks. Additional aqueous matrices such as surface water, porewater, and leachate may also be collected at the monitored units. The analytical methods for aqueous samples analyzed in accordance with 40 C.F.R. § 257 and 35 I.A.C. § 845 are listed in **Table 1**.

Appendix A lists methods and parameters that may be collected for other purposes.

Step 4: Define the Boundaries of the Study

Sampling will be conducted from established groundwater systems located at each monitored unit.

Step 5: Develop the Analytical Approach

The unit- and regulatory-specific Groundwater Monitoring Plan (GMP) outlines the groundwater monitoring network, including a detailed map, the parameters to be analyzed, and the monitoring frequency, all in accordance with the applicable regulatory program. The Sampling and Analysis Plan (SAP) (Ramboll, 2025) stipulates that only one sample will be collected per well per

sampling event and analyzed for all parameters specified in the sampling and analysis request (SAR), or in lieu of a SAR, the corresponding regulatory program or permit.

Step 6: Specify Performance of Acceptance Criteria

Performance and acceptance criteria have been designed to ensure that potential impacts from the monitored units can be accurately and precisely identified, delineated and characterized. Criteria have been developed for the QA/QC sample types that will be utilized and are listed on **Table 2**. **Table 3** summarizes the sample preservation, containers, and hold time requirements. **Tables 4 through 6** list the QC requirements and corrective actions required for the sampling analyses typically performed at the monitored units listed in **Table A**.

Step 7: Develop the Detailed Plan for Obtaining Data

The QA/QC procedures for this project require that the data meet minimum requirements for precision, accuracy, completeness, representativeness, comparability, and sensitivity. The procedures and minimum requirements are presented in the subsequent sections of this QAPP.

The primary and subcontracted laboratories will perform analytical work in accordance with this QAPP, their internal Standard Operating Procedures (SOPs) and QA Manuals (QAMs), which comply with National Environmental Laboratory Accreditation Conference (NELAC) standards and USEPA protocols established in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), VI (2019) and subsequent revisions.

The primary laboratory is responsible for providing a copy of this QAPP to any subcontracted laboratories and ensuring that they follow the requirements of the QAPP. The QAMs include names of the responsible oversight individuals, QA/QC manual review and update procedures, organization and responsibilities of various individuals, QA/QC objectives and reports, QA/QC policies and procedures including sampling and receiving policies, equipment calibrations and maintenance information, necessary reagents and standards, extraction and analysis methods, data review and reporting processes, QA/QC procedures, system audits and corrective actions, certifications, recordkeeping and sample retention, sample disposal procedures, recent method detection limit (MDL) studies, and other QA/QC criteria relevant to the specific analytical methods.

The QA/QC Manager will evaluate the field and laboratory data against the requirements of the QAPP. Each analytical laboratory will annually provide the most current QA/QC information, SOPs, and QAMs that specify laboratory QA/QC samples and acceptance levels for each method. The project specific MDLs and reporting limits (RLs) and QC limits for the parameters to be tested will be provided by the laboratories.

Project laboratories will either use the limits specified in this QAPP or propose equally or more stringent statistically calculated QC limits. Specific QA/QC (Field Duplicates, Equipment Blanks, *etc.*) samples will be analyzed to satisfy the DQOs. The QA/QC samples to be used and the minimum frequency of their analysis are summarized in **Table 2.** The data obtained will conform to the QC requirements specified in this QAPP.

2.1.2 Solid Samples

Step 1: State the Problem

Solid samples may be collected during site characterization. Site characterization for the monitored units may include characterization of the materials contained within the unit or the soils surrounding the unit. Sampling and analysis of solid samples may be required to fulfill regulatory program requirements.

Step 2: Identify the Goal of the Study

Analytical results will be used to characterize the chemical and mineralogical content of solid phase materials.

Step 3: Identify the Information Inputs

Analyses of solid phases (*i.e.,* soil, sediment, or CCR) may be conducted to support additional site characterization or to meet regulatory requirements.

Step 4: Define the Boundaries of the Study

Solid phase samples may be collected from within the subject unit or from the materials surrounding the subject unit to identify potential solid phase sources for impacts observed in groundwater.

Step 5: Develop the Analytical Approach

Solids samples will be collected according to professional judgement to meet site characterization or regulatory requirements.

Step 6: Specify Performance of Acceptance Criteria

Table 7 notes the QA/QC sample types that may be applicable to solid phase data collection. Performance criteria are based on the laboratories' internal limits. Optional QA/QC types may be applied according to the professional judgement of the client, Ramboll, or the Laboratory Project Manager.

Step 7: Develop the Detailed Plan for Obtaining Data

The primary and all other subcontracted laboratories will perform analytical work in accordance with this QAPP, their internal SOPs and QAMs, which comply where possible with NELAC standards and USEPA protocols established in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), VI (2019) and subsequent revisions. The primary laboratory is responsible for providing a copy of this QAPP to any subcontracted laboratories and ensuring that they follow the requirements of the QAPP.

2.2 Characteristics of Data Quality

The term "data quality" refers to the level of uncertainty associated with a particular data set. Data quality associated with environmental measurement is a function of the sampling plan rationale and procedures used to collect the samples, as well as of the analytical methods and instrumentation used in making the measurements. Uncertainty cannot be eliminated entirely

from environmental data. However, QA programs effective in measuring uncertainty in data are employed to monitor and control deviations from the desired DQOs. Sources of uncertainty that can be traced to the sampling component include poor sampling plan design, incorrect sample handling, faulty sample transportation, and inconsistent use of SOPs. The most common sources of uncertainty that can be traced to the analytical component of the total measurement system are problems associated with calibration and contamination.

The purpose of this QAPP is to ensure that the data collected are of known and documented quality and useful for the purposes for which they are intended. The procedures described are designed to obtain data quality indicators for each field procedure and analytical method. To ensure that quality data continues to be produced, systematic checks must show that test results and field procedures remain reproducible and that the analytical methodology is actually measuring the quantity of parameters in each sample.

All laboratory analytical data will be generated by a NELAC-certified laboratory and validated. This applies to the primary laboratory and any laboratory subcontracted by the primary laboratory. The primary laboratory is responsible for ensuring any subcontracted laboratories are NELAC-certified and/or certified for the applicable subcontracted methods. Laboratories must have an in-place program for data reduction, validation, and reporting as discussed in this QAPP. The reliability and credibility of analytical laboratory results can be corroborated by the inclusion of a program of scheduled replicate analyses, analyses of standard or spiked samples, and analysis of split samples with QA laboratories for some projects. Regularly scheduled analyses of known duplicates, standards, and spiked samples are a routine aspect of data reduction, validation, and reporting procedures.

2.3 Measurement Performance Criteria

Performance and acceptance criteria are often expressed in terms of data quality indicators (DQIs). The principal data quality indicators are sensitivity, accuracy, precision, completeness, representativeness, and comparability. These DQIs are discussed below.

2.3.1 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (*i.e.,* the MDL) or quantified (*i.e.,* the RL). Where practicable, to reduce the possibility of false negatives, the RL of each contaminant of concern should be lower than its corresponding screening value. In cases where a screening value is below the RL, the sample-adjusted MDL can be used to evaluate the presence or absence of the analyte from environmental samples. Furthermore, to be considered valid for project use under normal conditions, the concentrations of contaminants of concern in any blank (*e.g.,* equipment blank, field blank, and/or method blank) should not exceed the laboratory RLs, unless a higher number is considered valid to reflect actual field and laboratory conditions. Target parameters reported for all blanks should be below the RL to reduce the possibility of false positives. The specific MDLs, RLs, and screening values for 40 C.F.R. § 257 and 35 I.A.C. § 845 parameters are listed in **Table 1**. **Appendix A** lists the MDLs, RLs, and screening values for parameters that may be collected for other purposes.

In the case of radionuclides, the actual result of the analysis is reported regardless of the minimum detectable concentration (MDC) metric. The MDC is a sample-specific value defined as the lowest level of activity in a sample that is statistically distinguishable from a sample with no

activity. For radiochemical analysis, the MDC is functionally equivalent to the MDL and no RL is reported.

2.3.2 Accuracy

Accuracy of the data is the measure of the overall agreement of a measured value to the true value. It includes a combination of systematic error (*i.e.,* bias) and random error (*i.e.,* precision) components of sampling and analytical operations. It reflects the total error associated with a measurement. A measurement is considered accurate when the value reported does not differ from the true value or known concentration of a spike sample or standard beyond an acceptable margin. Field and laboratory activities are subject to accuracy checks.

To estimate the accuracy of the data, a selected sample is spiked with a known amount of a standard and is analyzed; the results of which are used to calculate percent recovery (%R). Accuracy of laboratory analyses will be assessed by comparing results for a surrogate standard, matrix spike (MS) or laboratory control sample (LCS), and initial and continuing calibration of instruments to control limits. Laboratory accuracy is expressed as %R. If the %R is determined to be outside of acceptance criteria, the data will be flagged for reporting purposes. Accuracy goals vary for analytical data by the type of analysis employed. Laboratory goals are established as part of the laboratory QA/QC program as described in the QA Manual and SOPs.

Accuracy of field measured data will be maintained by keeping the field instruments in proper working condition and calibrating as specified by operation manuals. The specific maintenance and calibration procedures in the operation manuals will be followed. The results of calibrations will be evaluated against the limits established in operation manuals specific to each instrument and recorded in field logbooks. Field accuracy will also be assessed in part through adherence to all sample handling, preservation, and holding time requirements as described in this QAPP.

2.3.3 Precision

Precision of the data is the measure of reproducibility or agreement among repeated measurements of the same sample under identical or substantially similar conditions. It is represented as either a range of values or as a standard deviation about the mean value. Precision goals vary for analytical data by the type of QC samples measured. Both laboratory and field QC samples are utilized to measure precision. Precision may be expressed as a percentage of the mean of measurements, such as relative range or relative standard deviation.

Analytical precision is a measurement of the variability associated with duplicate or replicate analyses of the same sample in the laboratory. Analytical precision is determined by analysis of laboratory QC samples, such as matrix spike duplicates (MSD) or laboratory control sample duplicates (LCSD), or laboratory sample duplicates. These samples should contain concentrations of an analyte above the RL. The most commonly used estimates of precision are percent relative standard deviation (%RSD) and the relative percent difference (RPD) when only two samples are used. RPDs for laboratory control samples are listed in **Table 1** under LCS/LCSD Control RPD and MS/MSD or Laboratory Duplicate RPD Control Limits. The precision goal for aqueous field sample RPD is ≤30%. Field sample RPDs are listed in **Table 2** under Field Duplicate Samples. Samples outside the limits will be noted and reported with qualifiers.

Total precision is a measurement of the variability associated with the entire sampling and analytical process. It is determined by analysis of field duplicate samples, which measure

variability introduced by the laboratory and field operations. Field duplicate samples are analyzed to assess field and analytical precision.

Table 2 sets forth the frequency with which laboratory duplicate samples (*i.e.,* LCSD and MSD) will be analyzed as well as the allowable difference in results for laboratory QA/QC samples. If the precision goals indicated in this QAPP are not met, the data will be qualified for reporting purposes.

2.3.4 Completeness

Completeness is defined as the percentage of measurements judged to be valid based on the number of planned analyses. The completeness goal is to generate a sufficient amount of valid data to meet project needs. Completeness describes the content of the data set once errors, if any, have been identified and qualified and rejected data have been removed from the data set. Completeness may also be impacted when planned samples are not collected (*e.g.,* well damage makes sample collection impossible) or collected samples are not analyzed (*e.g.,* sample bottle broken in transit). The number of valid results divided by the number of planned results, expressed as a percentage, determines the completeness of the data set. The target completeness objective for this project is 95%. The data set will be considered complete if at least 95% of the data planned for collection is usable without meaningful qualifiers or errors. The data completeness will be evaluated during the data validation review process.

2.3.5 Representativeness

Representativeness is a qualitative term used to express the degree to which data accurately and precisely represent a characteristic of a population. It is mostly concerned with the proper design of the sampling program. Sample collection and handling methods, sample preparation, analytical procedures, holding times, and QA protocols developed for this project, and discussed in the subsequent sections of this document, have been established to ensure that the collected data are representative.

2.3.6 Comparability

Comparability is a qualitative term used to express the confidence with which one data set can be compared to another data set. The objective for the QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions as encountered are considered in determining comparability. Data comparability will be sustained in this project through the use of defined procedures for sampling and analysis (sample collection and handling, sample preparation, and analytical procedures), reporting in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.

The data set will be considered comparable when USEPA or other standard methods have been used for analyses, the data set is representative, and the field investigation is conducted in accordance with accepted industry standards. Laboratory analyses for aqueous samples will be performed in accordance with prescribed USEPA protocols established in the document Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Final Update VI (USEPA, 2019) and subsequent updates, or other appropriate methods as required.

3. PROJECT ORGANIZATION, ROLES, AND RESPONSIBILITIES

Implementation of this QAPP requires the involvement of a wide range of individuals and organizations working together as a team. The project organization, and roles and responsibilities of the individuals involved, are defined in the QAPP to promote a clear understanding of the role that each party plays and to provide the lines of authority and reporting for the project. Personnel assigned to the project will be required to familiarize themselves with pertinent protocols and procedures presented in this QAPP. Key project positions relate to project oversight, project management, sampling and analytical data acquisition management, data validation management, and database management. Delegation of responsibilities is permitted, but accountability remains with the designated role holder.

The project organization and roles and responsibilities are summarized in the sections below. **Figure 1** presents the Organization and Communication Flow Chart.

3.1 Vistra

Each facility is owned by a subsidiary of Vistra. Facility owners are listed in **Table A**.

3.1.1 Vistra Program Manager

The Vistra Program Manager (Vistra PgM) contracts the analytical laboratory work performed under this QAPP. Primary external points-of-contact (POCs) are the Ramboll Program Manager (Ramboll PgM), the Laboratory Manager (Lab Manager), and the Laboratory Project Manager (Lab PM).

3.2 Ramboll

3.2.1 Ramboll Program Manager

The Ramboll PgM is responsible for technical and policy decisions involving the project, including interaction with stakeholders. The Ramboll PgM will make recommendations to the Vistra PgM if significant policy changes are warranted. The Ramboll PgM will have primary responsibility for project QA/QC and will evaluate and, if necessary, implement any corrective actions regarding data quality issues. Primary external POCs are the Vistra PgM, the Consultant Project Manager (Consultant PM) for other consulting partners collecting data, Lab Manager and the Lab PM.

3.2.2 Ramboll Quality Assurance/Quality Control Manager

The Ramboll QA/QC Manager will oversee implementation of QA/QC procedures during the field sampling program and is responsible for reviewing the project QA/QC program as it relates to the collection and completeness of data from field and laboratory operations. During the contracting process the QA/QC Manager will ensure that method control limits are sufficient to meet this QAPP and are adequate for the use of the data. After receiving analytical results, the Ramboll QA/QC Manager will evaluate the field and laboratory data against the requirements of the QAPP.

3.2.3 Ramboll Laboratory Liaison

The Ramboll Laboratory Liaison (Lab Liaison) is responsible for communication and coordination with the analytical laboratories. The primary external POC is the Lab PM.

3.2.4 Ramboll Data QC Lead

The Ramboll Data QC Lead is responsible for reviewing analytical data and tracking data through the data verification/validation and reporting processes. The Ramboll Data QC Lead will work with the Ramboll QA/QC Manager to evaluate the field and laboratory data against the requirements of this QAPP. The Ramboll Data QC Lead, performs data validation for all analytical data generated.

3.2.5 Ramboll Plant Coordinators

The Plant Coordinators (PCs) are responsible for implementation and review of overall project quality of the collection, completeness, and presentation of the data. If field conditions require modifications to protocol outlined in the QAPP, or if questions arise, the PCs will be the primary contact for direction of Ramboll field personnel. If the sampling is being performed by the laboratory, the Lab PM will contact the Ramboll Lab Liaison who will work with the Ramboll PCs and communicate with the Lab PM. PCs are responsible for overseeing review of the QA/QC programs related to the compilation of data. The PC is responsible for compliance monitoring activities, including preparing sampling and analysis request packages, reviewing analytical results, and determining resample needs.

3.2.6 Ramboll Field Team Lead

The Ramboll Field Team Lead is responsible for implementation of the workplan or GMP and SAP (Ramboll, 2025) and is responsible for general oversight of field activities being performed by Ramboll.

3.2.7 Ramboll Project Managers

The Ramboll PMs are responsible for executing projects outside of the routine groundwater compliance program that include fieldwork and/or laboratory analysis. Ramboll PMs work closely with the Ramboll PC assigned to the plant where work will be performed. In some instances, the Ramboll PM is also the Ramboll PC.

3.2.8 Ramboll Database Manager

The Ramboll Database Manager is responsible for working with the Ramboll Data QC Lead to assist with analytical data review and tracking data through the data validation and reporting processes. The Ramboll Database Manager is responsible for processing and uploading data to Vistra's comprehensive database, controlling access to the data, performing maintenance and database QC, and preparing the data for electronic submissions.

3.3 Consultants

3.3.1 Consultant Project Manager

Consultant PMs will communicate with the Ramboll PgM, Ramboll PC, and the Ramboll Lab Liaison prior to sample collection to ensure the proper procedures have been followed so that the data can be processed without delay. This applies to sampling they are performing or have requested of the laboratory. The Consultant PM is responsible for providing data downloads from transducers, sampling and calibration records, and all analytical data to Ramboll for storage in the database. For routine compliance monitoring, the PC will provide the Consultant PM an opportunity to review the SAR prior to submittal to the laboratory. Primary external POCs are the Ramboll PgM and the Lab PM, if the laboratory is contracted by the Consultant.

3.4 Analytical Laboratories

3.4.1 Laboratory Manager

The Lab Manager is responsible for the overall execution of the work including laboratory analyses, maintaining appropriate certifications, and ensuring equipment is appropriately maintained and operated. The Lab Manager will have primary responsibility for project QA/QC and will evaluate and, if necessary, implement any corrective actions regarding data quality issues. Primary external POCs are the Vistra PgM and the Ramboll PgM.

3.4.2 Laboratory Project Manager

Each laboratory will assign a Lab PM as the primary point-of-contact for the project. The Lab PM is responsible for ensuring project data meet the QA/QC objectives established herein. The Lab PM is also responsible for the field sampling program, tracking the progress of testing in the laboratory and ensuring the timely delivery of data or other laboratory deliverables to the project team. The Lab PM will work with the Ramboll Data QC Lead to resolve any QA/QC deficiencies and implement any necessary corrective actions. Analytical laboratories may also subcontract analyses to other certified laboratories that can meet the requirements of this QAPP upon written approval of the Ramboll PgM or the Ramboll Data QC Lead. Primary external POCs include the Vistra PgM, Ramboll PgM, Ramboll Lab Liaison, and Ramboll Data QC Lead.

3.4.3 Laboratory Quality Assurance/Quality Control Manager

The Laboratory Quality Assurance/Quality Control Manager (Lab QA/QC Manager) serves as the focal point for QA/QC at the laboratory and is responsible for oversight of quality control data. The Lab QA/QC Manager is responsible for ensuring internal laboratory QA/QC procedures are being followed and implementing corrective action after nonconformances are identified.

3.4.4 Laboratory Field Team Lead

The Laboratory Field Team Lead (Lab Field Team Lead) is responsible for overall implementation of the workplan or GMP and the SAP (Ramboll, 2025) and is responsible for general oversight of field activities. The Lab Field Team Lead will communicate with the Lab PM with questions that arise in the field.

3.5 Certifications

The primary laboratory and all subcontracted laboratories will maintain current NELAC-certification for aqueous sample analyses. The Lab Manager will be responsible for ensuring certification is maintained for the analytical laboratory.

4. DATA GENERATION AND ACQUISITION

This section discusses: sampling process design, sampling methods, sample handling and custody, and analytical methods.

4.1 Sampling Process Design

This QAPP is intended to cover collection of aqueous (*i.e.,* groundwater, surface water, porewater, leachate) and solid (*i.e.,* soil, sediment, CCR) samples. Samples will be collected according to applicable USEPA guidelines and following the procedures described in the SAP (Ramboll, 2025).

4.2 Sampling Methods

Sampling will be conducted in accordance with the procedures described in the workplan or GMP and the SAP (Ramboll, 2025). In case of discrepancies, between the workplan and SAP, the workplan takes precedence.

4.3 Sample Handling and Custody Requirements

The subcontracted analytical laboratories will handle samples in a manner to maximize data quality. Samples will be collected, handled, and stored in such a manner that they are representative of their original condition and chemical composition. Identification of samples and maintenance of custody are important elements that must also be utilized to ensure samples characterize site conditions. All samples will be properly identified and maintained under chain-of-custody (COC) protocol to protect sample integrity. The following sections discuss the sample handling and custody requirements in detail.

4.3.1 Sample Identification

To maintain consistency, the Sample Unique identifier, which includes the Unique Location identifier, will be entered onto the sample labels, and chain-of-custody forms. Field forms and logbooks may use either the location name or the Unique Loc ID. Field and data form example are included in the SAP (Ramboll, 2025).

Aqueous samples collected in the field will be identified on the chain-of-custody by a unique Program ID that includes: 1) the plant acronym, 2) abbreviation of the regulation or permit, and 3) the Unit ID or Multi-Unit ID defined in the site-specific GMP. An example of a Unique Location ID is COF_G280.

4.3.2 Sample Labels

All samples will be labeled in a clear and precise way for proper identification in the field, laboratory, and progress reports.

A sample label will be affixed to all sample containers sent to the analytical laboratory. Field personnel will complete an identification label for each sample with the following information written in waterproof, permanent ink:

- Unique Loc ID
- Unique Sample ID

- Date and time (in 24-hour clock format) sample collected
- Filtering performed, if any
- Preservative used, if any
- Name or initials of sampler
- Analyses or analysis code requested

The use of pre-printed sample labels is preferred to reduce sample misidentification problems due to transcription errors. Sample labels must be completed and affixed to the sample container in the field at the time of sample collection.

If errors are made on a sample label, corrections will be made by drawing a single line through the error and recording the correct information. All corrections will be dated and initialed.

4.3.3 Chain-of-Custody Forms and Custody Seals

Completed original chain-of-custody forms will be sent with each sample shipment to document collection and shipment of samples for off-site laboratory analysis with electronic copies to be maintained with project files. The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. A custody seal signed by the sampler will be used to maintain custodial integrity of the samples during shipment to the laboratory.

4.3.4 Containers, Preservation, and Holding Times

Each lot of preservative and sampling containers will be certified as contaminant-free by the provider and/or the laboratory. The laboratories will maintain certification documentation in their files. All preserved samples will be clearly identified on the sample label and chain-of-custody form. If samples requiring preservation are not preserved, field records will clearly specify the reason for the discrepancy.

Aqueous sample containers will be placed in airtight plastic bags, if possible, and refrigerated or placed in a cooler with ice to chill and maintain a sample temperature of ≤ 6 degrees Celsius (°C). Aqueous samples should not be frozen.

Chemical activity continues in the sample until it is either analyzed or preserved. Once the sample has been preserved, the sample may be held for a period of time before analysis. The time from the collection of the sample to the analysis is defined as the holding time.

The analytical methods, type of sample containers to be used for each sample type and analysis, preservation requirements for all samples, and holding times are provided for aqueous samples in **Table 3**. Solid samples for inorganic analyses (**Table 7**) will be collected in glass containers with no headspace, cooled to ≤ 6 °C, and analyzed within 180 days or frozen in airtight containers and analyzed within a year.

4.4 Analytical Methods

Both field measurement methods and analytical laboratory methods will be utilized to analyze samples during implementation of this QAPP. Analytical methods for 40 C.F.R. § 257 and 35 I.A.C. § 845 parameters are listed in **Table 1** (aqueous samples). Solid sample analytical methods are listed in **Table 7**. **Appendix A** includes methods for parameters that may be

collected for other purposes. Laboratory SOPs developed and approved by the laboratories performing the analyses are required to be provided for the listed methods.

4.4.1 Field Measurement Methods

Samplers should conduct in-field measurements for depth to water, pH, conductivity, dissolved oxygen (DO), oxygen-reduction potential (ORP), turbidity, and temperature of aqueous samples. An appropriate water quality meter and calibration standards as recommended by the instrument manufacturer will be used. All meter standardizations, QC, and sample results will be recorded on the appropriate field forms. Precision and accuracy goals for field measurements are included in the SAP (Ramboll, 2025).

4.4.2 Laboratory Analytical Methods

Each analytical laboratory used during implementation of this QAPP will be expected to provide laboratory QA/QC documents (including QAM and SOPs) for review by the QA/QC Manager. In addition, analytical laboratories may be requested to provide current MDL studies, proposed RLs and other sources that contain QC procedures, QC acceptance criteria, and corresponding corrective actions for the analytical methods to be used during implementation of the QAPP.

The laboratory will use analytical methods and QA/QC procedures in conformance with approved methods for all samples. Copies of the laboratory QAMs and SOPs for all laboratories will be retained on file with Ramboll. In the event that the listed procedures cannot be performed, the laboratory will notify the facility owner of the conflict. Unless specifically directed otherwise by the Ramboll PgM or Vistra PgM, the standard or superseding test methods will govern. No changes in prescribed analytical methods will be made unless approved by the Vistra PgM.

RLs compiled in **Table 1** are from a review of RLs generally achieved by the laboratories used for implementation of this QAPP. It should be noted that the limits listed in **Table 1** are laboratory dependent using clean matrices and may not always be achievable due to sample matrix effects, necessary dilution of the sample, and/or interferences. RLs should be lower than the regulatory limits specified in 40 C.F.R. § 257 and 35 I.A.C. § 845 in **Table 1**, and the Screening Levels in **Appendix A**.

5. DOCUMENTATION, REPORTING, AND DATA MANAGEMENT

This section includes information about the requirements for laboratory data packages including field sampling records, if the laboratory performs the sampling. Requirements for field documentation are described in the SAP (Ramboll, 2025).

Records that may be generated during field work include field logs and data sheets, photographic logs, sample COC records, sample labels, equipment inspection and calibration records, and others as necessary. Units of measure for any field measurements and/or analyses will be clearly identified on the field forms and in notes and logs as necessary. Field and data forms are included in the SAP (Ramboll, 2025).

Analytical data will contain the necessary sample results and QC data to assure compliance with the DQOs defined for the project. Laboratory data will be provided in Portable Data Format (PDF), and in electronic data deliverable (EDD) format in accordance with this QAPP.

5.1 Field Data

Data that may be collected in the field primarily consist of field-measured water quality parameters including pH, temperature, conductivity, DO, ORP, turbidity, depth to groundwater measurements, soil and rock descriptions and sample depth measurements.

Upon generation all field data, including calibration checks and results, will be documented using forms or logbooks in either written or digital format. The QA/QC Manager and the PC will review field data to evaluate the completeness and accuracy of the field records.

5.2 Verification of Electronic Data

Electronic data are generally derived from automated data acquisition systems in an analytical laboratory setting. Analytical instruments are equipped with software that performs various manipulations, identifications, and calculations of data. Software calculations are verified manually during the data validation process. Other data generated by the analytical laboratories may consist of manually recorded results. This data may be documented in a logbook and may subsequently be entered in the form of electronic files. As a part of their periodic reviews of logbooks and deliverables, the analytical laboratories will review transcriptions to ensure accuracy. Any errors encountered will trigger further auditing until no transcription errors are encountered in the audit set, up to and including 100 percent review.

Data will be reported in hard copy form and digital format. Screening level data are generally reported in summary form including sample identification information, results for the sample analyses, and a summary of the QC data including calibrations and verifications of precision, accuracy, and representativeness, where appropriate.

If data manipulation or reduction of raw data is performed digitally, the formulae or macros employed for these purposes will be validated by comparing the results of a sample manual calculation to the digitally calculated result. This validation will be documented and maintained in central files.

5.3 Electronic Data Deliverables

In addition to PDF data reports provided by the contract laboratory, analytical data will be submitted to the consultant as EDDs. It is the responsibility of the analytical laboratory to ensure that the data provided by PDF identical to the EDDs including significant digits and units. The EDD may contain additional information than that provided in the PDF.

The EDD must contain the following information at a minimum:

- Unique Location ID
- Unique Sample ID
- Sample Date
- Sample Time
- Laboratory Sample ID
- Analytical Method
- Analyte Name
- Chemical Abstracts Service (CAS) Number
- STORET
- Dissolved or Total Analysis
- Result
- Detect Flag (Yes/No)
- Laboratory Qualifier
- Units
- Reporting Limit
- MDL
- Sample Adjusted MDL
- Spike Levels
- %R
- RPD
- Control limits for %R and RPD
- Extraction Method
- Cleanup Method
- Sample Receipt Date
- Extraction Date
- Analysis Date
- Analysis Time

- Dilution Factor
- Result Reportable (Yes/No)
- Batch Number
- Sample Delivery Group (SDG)

Where feasible, the laboratory will provide an EDD for solids sample analysis including the applicable information listed above.

5.4 Analytical Data Packages

The following section discusses general laboratory requirements for preparing data packages. Data packages provided by contract analytical laboratories for aqueous sample results will be at USEPA Level II or Level IV, depending on the level of data validation required. A 10-business day turnaround time from the time of laboratory receipt will be requested for the laboratory to report the Level II data package.

The Level II data package includes the following information:

- Sample and client information
- Sampling time and date
- Sample number
- Analytical method
- Environmental sample results or measurements
- Reporting limits and method detection limits
- Chain-of-custody
- Sample receipt checklist
- Summary of QA/QC results
- Method blank results
- Surrogate recoveries, if applicable
- LCS/LCSD results, recoveries, RPDs and control limits
- MS/MSD results, recoveries, RPDs, and control limits
- Duplicate results RPD
- Spike amount
- Dilution factors
- Initial sample aliquots (weights or volumes) and final sample volumes
- Sample preparation and analytical batch association
- Case narrative

The Level IV data package includes the same information as the Level II data package with the following additional information:

- Instrument summary forms for initial calibration, tunes (mass spectrometry methods only), calibration verification, internal standards, interference check standards (metals only), serial dilutions (metals only), and post digestion spikes (metals only).
- Raw data for all samples including chromatograms and instrument outputs for internal standards (when applicable), tunes, calibrations, QA/QC samples, etc.
- Sample preparation logs, sample run logs or injection logs

The data package for solid sample results includes the Level II information above as applicable to the analysis listed in **Table 7**. Turn-around times will vary depending upon the test method requirements.

The case narrative will be written, and the release of data will be authorized by the laboratory director. Items to be included in the case narrative are the Unique Location ID with the corresponding laboratory ID, parameters analyzed in each sample and the methodology used (USEPA method numbers or other citation), detailed description of all problems encountered and corrective actions taken, discussion of possible reasons for results exceeding the acceptable laboratory QA/QC results, and observations regarding any occurrences which may affect sample integrity or data quality.

Legible copies of the chain-of-custody forms for each sample will be maintained in the data package. Cooler log-in sheets will be associated with the corresponding chain-of-custody form(s). Any integral laboratory tracking document will also be included. Field sampling records will be provided when the laboratory performs or subcontracts the sampling.

For each environmental sample analysis, this summary shall include Unique Location ID, Unique Sample ID, and corresponding laboratory ID, sample matrix, collection date and time, laboratory receipt date and time, date and time of sample extraction (if applicable), date and time of analysis, identification of the instrument used for analysis, instrument specifications, weight or volume of sample used for analysis and/or extraction, dilution or concentration factor used for the sample extract, method detection limit or sample quantitation limit, definitions of any data qualifiers used, and analytical results.

The following QA/QC results will be presented in summary form. Acceptance limits for all categories of QC criteria will be provided with the data. The summary of QA/QC results for aqueous analyses will include, but will not be limited to the following:

- Method Blank Analyses – The concentrations of any parameters found in blanks will be reported, even if the detected amounts are less than the RL. The samples and QA/QC analyses associated with each method blank will be stated.
- Surrogate Standard Recovery (organic analyses only) – The name and concentration of each surrogate compound added will be detailed. The percent recovery of each surrogate compound in the samples, method blanks, MS/MSD, and other QA/QC analyses will be summarized with Unique Location ID such that the information can be linked to sample and QA/QC analyses.
- Matrix Spike and Matrix Spike Duplicate – For MS/MSD analyses the sample results, spiked sample results, percent recovery, and associated recovery and RPD control limits will be detailed. Parent sample results will also be included on the summary form.

- Laboratory Control Sample and Laboratory Control Sample Duplicate – For LCS/LCSD analyses, the spiked sample results, %R, and associated recovery and RPD control limits will be detailed. LCS/LCSD analyses will also include source of the sample(s), true value concentrations, found concentrations, percent recovery for each element analyzed, and the date and time of analysis.
- Laboratory Duplicates – For laboratory duplicate analyses the sample results, RPD between duplicate analyses, and control limits will be reported, as applicable. For laboratory QC check and/or LCS analyses, the %R and acceptable control limits for each analyte will be reported. All batch QC information will be linked to the corresponding sample groups.

Solid phase sample QA/QC samples vary by analysis as summarized on Table 7.

All data packages will be reviewed by the individual laboratory QA Manager or designated data review specialists to ensure accurate documentation of any deviations from sample preparation, analysis, and/or QA/QC procedures and descriptions. Any problems identified by the laboratory QA Manager or designated data review specialists will be documented in the narrative of the report.

5.5 Laboratory Record Retention

Raw data will be available for further inspection, if required, and maintained in each laboratory's central job file. Records related to the analytical effort (*i.e.,* cost information, scheduling, custody) are maintained at the laboratories in a secured location. Moreover, analytical laboratories will have the ability to archive data and quality records in a secured area protected from fire and environmental deterioration.

All records necessary to reproduce the analytical calculations and support the reported results must be maintained for a minimum of five years. Types of records to be maintained for the project include, but are not limited to the following:

- Chain-of-custody forms, including information regarding the sampler's name, date of sampling, type of sampling, sampling location and depth, number and type of sampling containers, signatures of sample custodians with transfer date and times noted, and sample receipt information including temperature and conditions upon arrival at the laboratory
- Cooler receipt form documenting sample conditions upon arrival at the laboratory
- Any discrepancy and/or deficiency report forms due to problems encountered during sampling, transportation, or analysis
- Sample destruction authorization forms containing information on the manner of final disposal of samples upon completion of analysis
- All laboratory notebooks including raw data readings, calibration details, QC checks, etc.
- Hard copies of data system printouts (chromatograms, mass spectra, inductively coupled plasma [ICP] instrument data files, etc.). Tabulation of analytical results with supporting QC information sample preparation documents and records.
- Sampling field records

5.6 Data Management

Data will be generated during sampling and measurement activities, and at the laboratory via analytical testing of samples. The data will be entered into a database system managed by Ramboll. The database will be maintained on a secure, enterprise-level database server that is backed-up regularly. Access to the database will be restricted to authorized users.

EDDs provided by the laboratories should be in the EDD format as defined by the Ramboll. Prior to loading data into the database, EDDs will be reviewed for consistency with the file format and valid values. Data collected in the field will also be entered into the database and integrated with laboratory data.

A detailed description of laboratory data management procedures will be provided in the laboratory QAM.

6. QUALITY CONTROL REQUIREMENTS

There is potential variability in any sample collection, analysis, or measurement activity. QC activities are those technical activities routinely performed, not to eliminate or minimize errors, but to assess and demonstrate reliability and confidence in the measurement data generated. This section identifies QC checks for sample collection, field measurements, and laboratory analyses for sample data collected.

6.1 Field QC Procedures

Field QA/QC samples that will be collected during the proposed investigation include field duplicate samples, field blanks, trip blanks, equipment blanks, and matrix spike/matrix spike duplicates. The description and purpose of these samples is discussed in this section. The frequency of analysis of field QA/QC samples is summarized in **Table 2** for aqueous sampling and **Table 7** for solid sampling.

6.1.1 Field Duplicates

The field duplicate (FD) is a replicate sample collected by sequentially alternating filling between the primary sample container and the FD sample container and is used to document representativeness and precision. FD samples will be labeled and packaged in the same manner as primary samples but with "-Dup" appended to the Unique Sample ID. Aqueous FDs will be collected at a frequency of one in every 10 primary samples and will be analyzed for the same suite of parameters as the primary sample. Solid phase FDs will be collected at the discretion of the Vistra PgM and Ramboll PgM. The RPD between the field duplicate sample and the primary sample is evaluated to assess the homogeneity of the sample matrix and to assess the reproducibility of laboratory and field sample collection techniques.

6.1.2 Field Blanks

Field blank (FB) samples are used to assess the presence of contaminants arising from field sampling procedures. FB samples are obtained by filling a clean sampling container with analyte-free deionized (DI) water, in the field at a sample location. The sample then is analyzed in the same manner as the primary sample. FB samples will be analyzed for the same suite of parameters as the primary sample to assess potential background contamination, contamination due to bottles and preservatives, or errors in the sampling process. If specified by the PC or Consultant PM, one FB will be collected per sampling event.

6.1.3 Equipment Blanks

Equipment blank (EB) samples are used to assess the effectiveness of decontamination procedures. EB samples are obtained by filling decontaminated sampling equipment with analyte-free DI water and sampling this water. Alternatively, DI water can be poured over or through the decontaminated sampling equipment and then collected. EBs will only be collected from equipment that comes in contact with non-dedicated, multiple use sampling materials. If required, EBs will be collected at a frequency of one per day that non-dedicated equipment is used and will be analyzed for the same suite of parameters as the primary sample to assess the effectiveness of decontamination procedures.

6.1.4 Trip Blanks

Trip blanks (TB) samples are used to assess the potential for cross-contamination of volatile organic compounds (VOCs) between samples during storage and shipment. TB samples are only necessary when VOCs are being analyzed. A TB sample consists of one or more sample containers that are prepared at the analytical laboratory by filling with reagent-grade DI water. The TB sample is added to the sample cooler or other shipping container as soon as the first primary sample is collected. The TB sample accompanies the primary samples to the laboratory and is analyzed using the same analytical method as the primary samples. TB samples will be prepared and accompany any cooler or shipment that holds VOC samples.

6.1.5 Matrix Spike/Matrix Spike Duplicates

Matrix Spike/Matrix Spike Duplicates (MS/MSD) samples are collected to evaluate the effect of sample matrix on analytical results and the precision and accuracy of laboratory procedures. As with field duplicate samples, MS/MSD samples should be collected at the same time, using the same procedures and equipment, and in the same types of containers as the parent samples. They shall also be preserved in the same manner and submitted for the same analyses as the parent samples. Aqueous MS/MSD samples will be collected at a ratio of one MS/MSD sample per twenty parent samples collected. Solid phase MS/MSD samples will be collected at the discretion of the Ramboll PgM or Consultant PM.

6.2 Laboratory QC Procedures

The laboratory QA/QC program includes performing analytical methods according to prescribed protocols and analyzing laboratory QA/QC samples to measure precision and accuracy of laboratory methods and equipment, instrument calibration, and preventive maintenance. Laboratory QA/QC samples and parameters that will be analyzed include method blanks, laboratory control samples, matrix spikes, laboratory duplicates, and surrogates. The acceptable limits of the laboratory QA/QC samples are provided in **Table 1**. The frequency of analysis of laboratory QA/QC samples is summarized in **Table 2**.

6.2.1 Method Blanks

A method blank is a sample of a matrix similar to the batch of associated samples. It is used to assess potential contamination in the laboratory process (*e.g.,* contaminated reagents, improperly cleaned or calibrated equipment). For each analytical method, the laboratory will analyze one method blank sample per 20 primary field samples, or one per preparation batch, whichever is more frequent.

6.2.2 Laboratory Control Samples

A laboratory control sample is a known matrix (*e.g.,* reagent water) that has been spiked with a known concentration of specific target parameters. It is used to demonstrate the accuracy of the analytical process. For each analytical method, a laboratory control sample will be analyzed once per 20 primary field samples, or one per laboratory preparation or analytical batch, depending on the analytical method.

6.2.3 Matrix Spikes

Matrix spikes are performed by the analytical laboratory on MS/MSD samples in order to evaluate the efficiency of the sample extraction and analysis procedures. Matrix spike samples are

necessary because matrix interference may have a widely varying impact on the accuracy and precision of the extraction or analysis. The matrix spike is prepared by the addition of known quantities of specific target compounds to a sample. The sample then is extracted and analyzed. The results of the analysis are compared with the known additions and a matrix spike recovery is calculated giving an evaluation of the accuracy of the extraction and analysis procedures. Typically, matrix spikes are performed in duplicate in order to evaluate the precision of the procedures as well as the accuracy. Matrix spike %Rs are reviewed to check that they are within acceptable range. For applicable analytical methods matrix spikes and matrix spike duplicates will be analyzed by the laboratory at a frequency of at least 1 per 20 primary field samples, or one per preparation batch, whichever is more frequent.

6.2.4 Laboratory Duplicates

Duplicate samples are used to assess precision in the analytical method. An additional aliquot is extracted from the primary sample and analyzed using the identical procedures as the primary sample. Then the results are compared to assess the precision. There are three types of duplicates: sample duplicates, laboratory control sample duplicates, and matrix spike duplicates. For applicable analytical methods duplicates will be collected and analyzed at a frequency of at least 1 per 20 primary field samples, or one per preparation batch, whichever is more frequent.

6.2.5 Surrogates

A surrogate is a chemically similar compound spiked into each sample analyzed. Surrogates assess the accuracy of each individual analysis based on the surrogate recoveries. A surrogate (typically more than one) will be analyzed for each primary sample when applicable to the specified method. Surrogate recovery should fall within the limits set by the laboratory in accordance with procedures specified by the method.

6.3 Corrective Actions

Corrective actions may be initiated if precision or accuracy goals are not achieved. The initial step in corrective action will be to instruct the laboratory to examine its procedures to assess whether analytical or computational errors caused the anomalous results. At the same time, sample collection and handling procedures will be reviewed to assess whether they could have contributed to the anomalous results. Based on this evaluation, the Ramboll QC Lead with the Ramboll PgM and Ramboll QA/QC Manager, will assess whether re-analysis or re-sampling is required or whether any protocol should be modified for future sampling events. Any changes in laboratory methods, or quality assurance parameters or limits, require written approval prior to implementation by the laboratory.

7. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, MAINTENANCE, AND CALIBRATION

7.1 Field Instrumentation

Equipment used in the collection of field measurements will be maintained according to the manufacturer's specifications and will be inspected and calibrated prior to use. Field equipment requiring testing, inspection, and maintenance are:

- Water quality meter(s) utilized to measure pH, temperature, conductivity, DO, ORP, and turbidity
- A flow through cell
- Electric water level meter utilized to measure depth to groundwater
- Low flow adjustable sampling pump utilized for collection of groundwater, and
- Dedicated pressure transducers, equipped with data loggers, for measuring and recording atmospheric pressure, water level and temperature.

The operating manuals for each piece of field equipment used describe the procedures required for testing, inspecting, and maintaining this equipment. Field procedures for using the field instrumentation and decontamination methods are included in the SAP (Ramboll, 2025). Testing, inspection, and maintenance of field equipment and documentation of completion of these activities will be the responsibility of field personnel under the direction of the Ramboll or Lab/Consultant Field Team Lead.

7.2 Laboratory Equipment

An instrument maintenance record is maintained for each instrument in the laboratory. In general, the records contain a schedule of maintenance, as well as a complete history of past maintenance, both routine and non-routine, for that instrument.

Preventive maintenance is performed according to the procedures specified in the manufacturer's instrument manuals, including lubrication, source cleaning, and detector cleaning, and the frequency of such maintenance. Chromatographic carrier gas purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Precision and accuracy data are examined for trends and excursion beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or another of the pre-determined QC criteria.

7.3 Laboratory Calibration Procedures

The laboratory SOPs and QAMs address the calibration and frequency of calibration required for laboratory instruments as well as a description of documentation that will be completed. **Tables 4 through 6** summarize the minimum frequency and scope of laboratory checks and calibrations to be performed for the analyses included in this QAPP. Laboratories may have more stringent requirements as part of their SOPs but must meet these minimum requirements as well as satisfying specific requirements of the standard methods specified for this project.

The Lab Manager will be responsible for ensuring proper calibration and recordkeeping are conducted and will inform the Ramboll Data QC Lead of any issues that may impact analytical results.

7.4 Inspection and Acceptance of Supplies and Consumables

Field and laboratory supplies and consumables that may directly or indirectly affect the quality of results will be inspected. Only supplies and consumables that have been determined to be acceptable will be utilized for the project.

Containers will be provided by the laboratory or their approved supplier for samples to be analyzed by the laboratory. If any container is found to have a defect or damage it will be properly discarded, and replacements will be requested as necessary. Other field supplies and consumables to be used include items such as bailers, bailer cord, calibration standards, disposable bladders for pumping, sample tubing, and distilled water. These supplies will be inspected upon receipt in part to verify they are new and in their original packaging. If any defects are noted or suspected, they will be properly discarded and replaced prior to use.

The supplies and consumables for this project will be handled and stored in a manner that will not compromise sampling results. This will involve keeping items in their original containers until use, sealing containers properly between uses, or storing items in new or dedicated plastic bags.

The Ramboll or Lab/Consultant Field Team Lead with assistance from field personnel will be responsible for inspecting and accepting field supplies and consumables and providing replacements as necessary. Field personnel will inventory critical supplies on a regular basis and report to the Ramboll or Lab Field Team Lead to ensure that work will not be delayed unnecessarily.

7.5 Laboratory Supplies and Consumables

A detailed description of the laboratory inspection and acceptance policy for supplies and consumables will be provided in the laboratory QA Manual. A list of primary supplies and consumables necessary for each laboratory analysis will be provided in the individual laboratory SOPs.

The laboratory is responsible for ensuring that supplies and consumables are appropriate and adhere to laboratory policy as described in their QAM. Any issues regarding supplies that could have a negative effect on data quality will be communicated to the Lab PM who will inform the Ramboll Data QC Lead in a timely manner.

8. ASSESSMENT AND OVERSIGHT

Assessment and oversight are designed to determine whether the QAPP and SAP (Ramboll, 2025) are being implemented as approved, to increase confidence in the information obtained, and ultimately, to determine whether the information may be used for its intended purpose(s).

8.1 Assessment and Response Actions

8.1.1 Field Assessments and Response Actions

The Ramboll QA/QC Manager, or other person designated by the Ramboll PgM will perform periodic assessments of compliance with the QAPP and the SAP (Ramboll, 2025). When problems or issues are identified, the Lab Manager and Lab PM, and in instances where Ramboll is collecting the samples, the Ramboll PgM will be notified of the issue and instructed as to how to proceed going forward. If a subsequent assessment reveals that the problem has not been corrected, a field audit may be conducted.

Periodic unannounced audits may be conducted of field operations. Such audits may include evaluation of the following actions: field procedures, sampling activities, field forms and logbooks, chain-of-custody procedures, field measurements, field equipment calibration procedures, and sample packaging and shipment. Additional routine audits may be conducted during the course of collecting data as deemed necessary by the Ramboll QA/QC Manager to verify conformance with corrective actions identified in a previous audit and/or to provide additional qualitative assessment of field procedures. The Lab Manager will be responsible for ensuring corrective actions identified by the audit are completed. Consultants are responsible for conducting field assessments for the task-specific work they are implementing.

8.1.2 Laboratory Assessments and Response Actions

The laboratory will be responsible for its own compliance with the QAPP. If an internal audit identifies a nonconformance that affects analytical results for this project then the Lab PM will notify the Ramboll Data QC Lead, Ramboll PgM, and Ramboll QA/QC Manager in writing describing the nonconformance, the impact to analytical results, and corrective actions implemented to respond to the nonconformance.

During the data validation process, the Ramboll Data QC Manager will review selected elements of the laboratory performance as it relates to the QAPP. If non-compliance issues are identified, the laboratory will be notified as to what issue(s) has been identified and will be required to prepare a written response to the consultant regarding what corrective action will be taken to address the issue. If non-compliance problems persist, audits and/or further performance evaluation may be implemented.

8.2 Descriptions of Audits

Audits may be performed to review and evaluate the adequacy of the QAPP and to ascertain that it is being implemented.

A systems audit includes an evaluation of field and laboratory QA/QC procedures. If the systems audit shows a significant discrepancy from the QAPP or SAP (Ramboll, 2025), the responsible party will remedy the situation before work continues. Each major system change will require a written summary to document the change made.

A performance audit includes careful evaluation of field, laboratory, and data documentation and management procedures to determine accuracy. Upon discovery of significant deviation from the QAPP, the nature and extent of the deviation will be recorded. Corrective action will be taken to remedy the deviation as necessary.

The Ramboll QA/QC Manager has the responsibility of performing, or delegating, audits as deemed necessary and upon learning of any nonconformance. The Ramboll PgM has the ultimate responsibility for implementing corrective actions.

8.3 Reports to Management

Upon completion of any audit, the Ramboll QA/QC Manager will document and report on the QA/QC results and the identified issues (*i.e.,* laboratory and/or field) to the Ramboll PgM. The Ramboll Data QC Lead and Ramboll PCs will evaluate the impact of the QA/QC issues and determine if the deviations will result in an adverse effect on the project conclusions.

9. DATA VALIDATION AND USABILITY

9.1 Data Review, Validation, and Verification Requirements

All monitoring data will undergo two levels of review, verification, and validation. The laboratories and Ramboll will provide data verification. Data validation will be performed by Ramboll, and/or independent data validation contractors.

9.2 Validation and Verification Methods

9.2.1 Verification of Field Data Procedures

Procedures to verify field data include checking for transcription errors and review of field logbooks at the time of data collection. Field sampling efforts as described in the field logbooks will be reviewed at the conclusion of each sampling event to confirm sampling procedures followed established procedures. This task will be the responsibility of the Ramboll Data QC Lead, Ramboll or Lab Field Team Lead.

9.2.2 Laboratory Data Verification Procedures

Initial data reduction, verification, and reporting will be performed by the laboratory as described in the laboratory QAMs and SOPs.

The laboratory will perform in-house analytical data verification under the direction of their QA/QC Manager and the Lab PM. The laboratory will be responsible for assessing data quality and advising of any data rated "preliminary", "unacceptable", or other notations that would caution the data user of possible nonconformance.

The Lab QA/QC Manager will routinely audit or provide a secondary review of reports to assess data quality. This data assessment will assume that the sample was properly collected and handled.

The Lab QA/QC Manager will conduct a systematic review of the data for compliance with the established QC criteria based on spike, duplicate and blank results, and an evaluation of data precision, accuracy, and completeness will be performed.

After the laboratory has completed its review of the data and released a report to Ramboll and the project team, a second stage of review will be done. This process will be called data verification. Data verification involves the review of contractual obligations between the Vistra PgM and the laboratory. This review will be equivalent to the Stage 1 validation as defined by USEPA (USEPA, 2009). The review will include, at a minimum:

- Review of sample handling (chains-of-custody)
- Review of methods performed
- Review of samples analyzed
- Review of reported analyte lists
- Review of reporting limits

9.3 Laboratory Data Validation Procedures

Data validation evaluates the analytical quality of a data set and occurs after data verification. Ramboll is responsible for ensuring that the data are validated. Data validation will be performed by staff that have been trained in data validation procedures and are knowledgeable about the analytical methods and data validation guidelines. Data validation will be consistent with the USEPA National Functional Guidelines for Organic and Inorganic Superfund Methods Data Review (USEPA, 2020a; USEPA, 2020b).

QA/QC criteria checked during the validation process will include items identified in "Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use" (USEPA, 2009). At a minimum, all data generated will be validated as 100% Stage 2A. If the Stage 2A validation indicates significant deficiencies with respect to the data or the raw data needs to be evaluated, a higher level of data validation may be necessary. A sample list of validation checks at each stage are outlined below:

Stage 1 data validation checks include:

- Completeness check
- Chain-of-custody review
- Evaluate sample results by comparing sample conditions upon receipt at the laboratory (*e.g.,* preservation checks) and sample characteristics (*e.g.,* percent moisture to the requirements and guidelines present in national or regional data validation documents, analytical methods(s) or contract.

Stage 2A data validation checks include:

- All parameters reviewed for Stage 1
- Review of holding times
- Review of QC summaries, including negative controls (*i.e.,* blanks), positive controls (*i.e.,* LCS), and sample specific controls (*i.e.,* replicates, matrix spikes, surrogates, tracers/yields)
- Frequency of QC samples checked for appropriateness (*e.g.,* one LCS per twenty samples in a preparation batch)

Stage 2B data validation checks include:

- All parameters reviewed for Stage 1 and Stage 2A
- Initial and continuing calibration
- Review of internal standards
- Interference check sample, ICP serial dilution, gas chromatography/mass spectrometry instrument performance check, and RLs
- Project or sampling specific items that have been identified for review
- Overall assessment

Stage 4 data validation checks include:

- All parameters reviewed for Stage 1, Stage 2A, and Stage 2B

- Random recalculation (10-20%) of reported results versus raw data
- Review of Compound Identification, and Tentatively Identified Compounds (TICs), where appropriate
- Random check (10-20%) of integration and mass spectrum matches, where appropriate

9.3.1 Data Validation Qualifiers

During the validation process, final data qualifiers will be applied to the final results using the latest version of the USEPA National Functional Guidelines for Organic and Inorganic Superfund Methods Data Review (USEPA, 2020a; USEPA, 2020b) and professional judgement. The data validation qualifiers indicate known issues, biases, and uncertainties associated with the final results. The USEPA National Functional Guidelines for Organic and Inorganic Superfund Methods Data Review (USEPA, 2020a; USEPA, 2020b) define the following data validation flags which will be assigned, as appropriate, during the data validation process:

U: The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.

J: The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+: The result is an estimated quantity, but the result may be biased high.

J-: The result is an estimated quantity, but the result may be biased low.

UJ: The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R: The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

If multiple flags are required for a result, the most severe flag will be applied to the electronic result. The hierarchy of flags from the most severe to the least severe will be as follows: R, UJ, U, and J.

9.4 Reconciliation with Data Quality Objectives

Analytical results obtained from the project will be reconciled with the requirements specified in this QAPP. Data validation and usability include the final project checks to evaluate if the data obtained conforms to the project's objectives, and to estimate the effect of any deviations. Assessment of data for precision, accuracy, and completeness will be performed according to the following quantitative definitions.

9.4.1 Precision

If calculated from duplicate measurements:

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2)/2}$$

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use %RSD rather than RPD:

$$\%RSD = \left(s\sqrt{y}\right) \times 100$$

$\%RSD$ = percent relative standard deviation
s = standard deviation of replicates
$\bar{y}$ = mean of replicate analyses

Standard deviation is defined as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(y_i/\bar{y})^{-2}}{n-1}}$$

s = standard deviation
y_i = measured value of the ith replicate
$\bar{y}$ = mean of replicate analyses
n = number of replicates

9.4.2 Accuracy

For measurements where matrix spikes are used:

$$\%R = \left(\frac{S-U}{C_{sa}}\right) \times 100$$

$\%R$ = percent recovery
S = measured concentration in spike aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

9.4.3 Completeness (Statistical)

Defined as follows for all measurements:

$$\%C = \left(\frac{V}{T}\right) \times 100$$

$\%C$ = percent completeness
V = number of measurements judged valid
T = total number of planned measurements

9.5 Reconciliation With Data User Requirements

All laboratory data and validation results will be reviewed to determine if the data meet the DQOs. Project results that do not meet DQOs will be reviewed by the Ramboll Data QC Lead. Raw analytical data, laboratory notebooks, or other laboratory data may be obtained and examined as necessary. Corrective actions will begin with identifying the source of the problem. Potential problem sources may include failure to adhere to method procedures, improper data reduction, equipment malfunctions, or systemic contamination.

The first level of responsibility for identifying problems and initiating corrective action will be with the sampler or field personnel under the supervision of the Ramboll or Lab Field Team Lead, depending on who is performing the work. The second level of responsibility will be with any person reviewing the data including the Ramboll Data QC Lead and the Ramboll PCs.

If critical data are found to not meet QC objectives, the Lab Manager, will take appropriate action to obtain acceptable data as determined necessary. This may include reanalyzing existing samples, collecting new investigative samples, or other actions that will result in obtaining acceptable data. The specific course of action will be determined on a case by case basis based in part on the effect the nonconformance may have on the sampling objectives.

Data that provide useful information but are not critical for achieving sampling objectives will be appropriately documented if they do not meet QC objectives. However, resampling or re-analysis to address such data will typically not be necessary.

Other corrective actions may include more intensive training, equipment repair followed by a more intensive preventive maintenance program, or removal of the source of systemic problems. All corrective actions will be reviewed by the Ramboll QA/QC Manager and the Ramboll Project Manager (Ramboll PM) for certainty that resolution was achieved. Once resolved, the corrective action procedure will be fully documented.

10. REFERENCES

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TABLES

TABLE 1. GROUNDWATER ANALYTICAL METHODS AND ANALYTICAL PERFORMANCE CRITERIA FOR 40 C.F.R. § 257 AND 35 I.A.C. § 845
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

Constituent	CAS	Unit	Analytical Methods [1]	40 C.F.R. § 257 MCL [2] or HBL	35 I.A.C. § 845 Groundwater Protection Standard	35 I.A.C. § 620 Groudwater Protection Standard	Target RL [4]	Target MDL [4]	LCS/LCSD Recovery Control Limits	LCS/LCSD Control RPD	MS/MSD Recovery Control Limits	MS/MSD or Lab Duplicate RPD Control Limits
Metals												
Antimony	7440-36-0	µg/L	6020A	6	6	6	1	0.25	80-120	20	75-125	20
Arsenic	7440-38-2	µg/L	6020A	10	10	10	1	0.25	80-120	20	75-125	20
Barium	7440-39-3	µg/L	6010B or 6020A	2,000	2,000	2,000	1	0.4	80-120	20	75-125	20
Beryllium	7440-41-7	µg/L	6010B or 6020A	4	4	4	1	0.5	80-120	20	75-125	20
Boron	7440-42-8	µg/L	6010B or 6020A	NS	2,000	2,000	25	10	80-120	20	75-125	20
Cadmium	7440-43-9	µg/L	6010B or 6020A	5	5	5	1	0.25	80-120	20	75-125	20
Calcium	7440-70-2	µg/L	6010B or 6020A	NS	NS	NS	125	100	80-120	20	75-125	20
Chromium	7440-47-3	µg/L	6010B or 6020A	100	100	100	1	0.3	80-120	20	75-125	20
Cobalt	7440-48-4	µg/L	6020A	6	6	1000	1	0.25	80-120	20	75-125	20
Copper		µg/L	6010B or 6020A	NS	NS	650	5	1	80-120	20	75-125	20
Iron		µg/L	6010B or 6020A	NS	NS	5000	100	10	80-120	20	75-125	20
Lead	7439-92-1	µg/L	6020A	15	7.5	7.5	1	0.25	80-120	20	75-125	20
Lithium	7439-93-2	µg/L	6020A	40	40	NS	1	0.5	80-120	20	75-125	20
Magnesium	7439-95-4	µg/L	6010B or 6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Manganese		µg/L	6010B or 6020A	NS	NS	150	5	1	80-120	20	75-125	20
Mercury	7439-97-6	µg/L	7470A or 6020A	2	2	2	0.2	0.051	80-120	20	75-125	20
Molybdenum	7439-98-7	µg/L	7470A or 6020A	100	100	NS	1	0.25	80-120	20	75-125	20
Nickel		µg/L	6010B or 6020A	NS	NS	100	5	0.5	80-120	20	75-125	20
Potassium	7440-09-7	µg/L	6010B or 6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Selenium	7782-49-2	µg/L	6020A	50	50	50	1	0.9	80-120	20	75-125	20
Sodium	7440-23-5	µg/L	6020A	NS	NS	NS	NS	NS	80-120	20	75-125	20
Thallium	7440-28-0	µg/L	6020A	2	2	2	1	0.25	80-120	20	75-125	20
Vanadium		µg/L	6010B or 6020A	NS	NS	49	5	3	80-120	20	75-125	20
Zinc		µg/L	6010B or 6020A	NS	NS	5000	10	6	80-120	20	75-125	20
Inorganics												
Alkalinity, bicarbonate	--	mg/L	SM 2320 B	NS	NS	NS	NS	NS	80-120	20	--	20
Alkalinity, carbonate	--	mg/L	SM 2320 B	NS	NS	NS	NS	NS	80-120	20	--	20
Chloride	16887-00-6	mg/L	9056A, 9251 or EPA 300	250 [3]	200	200	5	1	80-120	20	80-120	20
Fluoride	7681	mg/L	9056A, 9251 or EPA 300	4	4	4	0.1	0.05	80-120	20	80-120	20
Nitrate		mg/L	SM 4500-NO3, EPA 300, or EPA 353.2	NS	NS	10	0.05	0.01	80-120	20	80-120	20
Sulfate	18785-72-3	mg/L	9056A, 9251 or EPA 300	250 [3]	400	400	10	5	80-120	20	80-120	20
Total Dissolved Solids	-	mg/L	SM 2540 C	500 [3]	1,200	1,200	20	10	90-110	10	90-110	10
Other												
Combined Radium 226/228	7440-14-4	pCi/L	9315 and 9320; or EPA 903 and 904	5	5	20 [5]	-- [6]	-- [7]	70-130	30	60-140	40

Notes:
EPA = United States Environmental Protection Agency
HBL = Health-based level
MDL = Method detection limit as established by the laboratory
LCS/LCSD = Laboratory Control Sample/Laboratory Control Sample Duplicate
MS/MSD = Matrix Spike/Matrix Spike Duplicate
µg/L = micrograms per liter
mg/L = milligrams per liter
NS = No standard
pCi/L = picoCuries per liter
RL = Reporting limit as established by the laboratory
RPD = Relative Percent Difference
SM = Standard Method

1. Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.
2. USEPA MCL = United States Environmental Protection Agency Maximum Contaminant Level.
3. USEPA SMCL = United States Environmental Protection Agency Secondary Maximum Contaminant Level.
4. Reporting limits and method detection limits will vary depending on the laboratory performing the work.
5. The Groundwater Protection Standards for radium 226 and radium 228 individually are 20 pCi/L.
6. All radium results will be reported (values may be positive or negative) and will include uncertainty and the calculated minimum detectable concentration (MDC).
7. Laboratories calculate a minimum detectable concentration (MDC) based on the sample.

TABLE 2. SUMMARY OF QA/QC SAMPLES
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

Quality Control Sample Type	Frequency of Analysis		Measurement Performance Criteria
	Aqueous Samples	Solid Samples[1]	
Contamination Control Samples			
Laboratory Method Blank	One per each analytical method. One in every batch of samples (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	No target analyte concentrations ≥ RL
Trip Blank	One per cooler/shipment if VOCs are tested; analyze for VOCs only.	NA	No target analyte concentrations ≥ RL
Equipment Blank	One per each analytical method. One per day, if required. Equipment blanks will not be collected when dedicated or single-use equipment is used for sample collection.	NA	No target analyte concentrations ≥ RL
Field Blank	As requested.	As requested.	No target analyte concentrations ≥ RL
Accuracy Control Samples			
Laboratory Control Samples	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Surrogate Spiked Samples	For methods that use surrogate(s), the surrogate(s) will be spiked and analyzed in all samples and in all batch quality control samples.	NA	Laboratory's statistically derived control limits
Matrix Spike Samples	Analyzed in each batch, where applicable to the method (not to exceed 20 samples).	NA	Laboratory's statistically derived control limits
Precision Control Samples			
Field Duplicate Sample	One per each analytical method. One per every 10 field samples collected.	As requested.	RPD ≤ 30% when analyte is detected in both sample and field duplicate above the RL. For sample results that are less than or equal to five times the RL, the criterion of plus or minus two times the RL will be applied to evaluate field duplicates.
Laboratory Control Sample Duplicates	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Laboratory Duplicate Sample	One per each analytical method. One in every preparation batch (not to exceed 20 samples).	One per each extraction or analysis method. One in every preparation batch (not to exceed 20 samples).	Laboratory's statistically derived control limits
Matrix Spike Duplicate Samples	Analyzed in each batch, where applicable to the method (not to exceed 20 samples).	NA	Laboratory's statistically derived control limits

Notes:
1. See Table 7 for relevant soil methods.
QA/QC = quality assurance/quality control
RL = Reporting limit
RPD = Relative percent difference

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TABLE 3. SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

MATRIX	ANALYTES	ANALYTICAL METHOD	PRESERVATION	CONTAINER [1, 2]	TAT	HOLD TIME [3]	
						Prior to Extraction	After Extraction
Water	VOCs	8260B, 8011	HCl to pH <2; no headspace; cool to ≤6 °C	3 x 40 mL glass VOA vials	10d	14d	
Water	SVCOs	8270C	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Phenols	9066 or 420.4 Rev1	H_2SO_4; Cool to ≤6 °C	2 x 500 mL amber glass		28d	
Water	Ammonia as Nitrogen, dissolved	350.1 REV2 or M4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrate nitrogen, dissolved	300.0 or E353.2	Cool to ≤6 °C	500 mL HDPE	10d	48h	
Water	Nitrate nitrogen, total	300.0, 353.2, or SM 4500-NO3 F	Cool to ≤6 °C	500 mL HDPE	10d	48h	
Water	Nitrite + Nitrate	E353.2	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrite nitrogen, dissolved	M4500-NO2 B	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrite nitrogen, total	M4500-NO2 B	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, Ammonia	350.1 or SM 4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, kjeldahl, total	350.1 or SM 4500-NH3 G	H_2SO_4 to pH <2; ≤6 °C	500 mL HDPE	10d	28d	
Water	Nitrogen, total	351.2/353.2	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Phosphorus, dissolved	6020A	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Phosphorus, total	6020A or 6010B or SM 4500P F 1999	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Sulfide, dissolved	SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfide, Reactive	SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfide, total	M4500-S D or SM 4500 S2 F 2000	$2NZn(C_2H_3O_2)_2$ and NaOH to pH >9; cool to ≤6°C	500 mL HDPE	10d	7d	
Water	Sulfur, total	6010B	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Herbicides	8151A, 515.3 REV1, or 8321B	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Organochlorine Pesticides	8081A, 8081B	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	PCBs	8082A	Cool to ≤6 °C	2 x 1 L amber glass	10d	7d	40d
Water	Metals	6020, Li - EPA 200.7	HNO_3 to pH <2	500 mL HDPE	10d	180d	
Water	Mercury	7470A or 6020	HNO_3 to pH <2	500 mL HDPE	10d	28d	
Water	Alkalinity and Carbonate	SM 2320 B	Cool to ≤6 °C	500 mL HDPE	10d	14d	
Water	Chloride, Fluoride, Sulfate	9056A, 9251 or EPA 300	Cool to ≤6 °C	500 mL HDPE	10d	28d	
Water	Total Dissolved Solids (TDS)	SM 2540 C	Cool to ≤6 °C	1 L HDPE	10d	7d	
Water	Radium 226	9315 or EPA 903	None	2 x 1 L HDPE	22d	180d	
Water	Radium 228	9320 or EPA 904	None	2 x 1 L HDPE	22d	180d	
Water	Bacteria (Fecal Coliform)	SM 9222B or D	$Na_2S_2O_3$; Cool to ≤6 °C	120 mL HDPE	10d	24hr	
Water	Biochemical Oxygen Demand (5 day - 20 deg C)	SM 5210B 2001	Cool to ≤6 °C	1 L HDPE	10d	48hr	
Water	Carbon, dissolved organic	SM 5310C 2000	HCl to pH <2; cool to ≤6 °C	2 x 1 L amber glass	10d	28d	
Water	Carbon, total organic	9060 or M5310C or SM 5310C 2000	HCl to pH <2; cool to ≤6 °C	2 x 1 L amber glass	10d	28d	
Water	Chemical Oxygen Demand	SM 5220 D 1997	H_2SO_4 to pH <2; ≤6 °C	250 mL glass	10d	28d	
Water	Cyanide, dissolved	9012A (TCN) Aqueou	NaOH to pH >10; ≤6 °C	250 mL HDPE	10d	14d	

TABLE 3. SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

MATRIX	ANALYTES	ANALYTICAL METHOD	PRESERVATION	CONTAINER [1, 2]	TAT	HOLD TIME [3]	
						Prior to Extraction	After Extraction
Water	Cyanide, Reactive	9012A REV1 7.3.3	NaOH to pH >10; ≤6 ˚C	250 mL HDPE	10d	14d	
Water	Cyanide, total	335.4 REV1 or 9012A or ASTM D7511-09e2	NaOH to pH >10; ≤6 ˚C	250 mL HDPE	10d	14d	
Water	Flashpoint, Pensky-Martens Closed Cup	1020B	Cool to ≤6 °C	250 mL HDPE	10d	14d	
Water	Fraction of Oragnic Carbon (FOC)	ASTM-D2974 (FOC & OM)	HCl to pH <2; cool to ≤6 ˚C	2 x 1 L amber glass	10d	28d	
Water	Oil & grease (soxhlet ext)	1664A	H_2SO_4 to pH <2; ≤6 ˚C	2 x 1 L amber glass	10d	28d	
Water	Perchlorate	E314	Cool to ≤6 °C	250 mL HDPE	10d	28d	
Water	Temperature (Celsius)	Field or M2550B					
Water	Temperature (Fahrenheit)	Field or M2550B					
Water	Total Suspended Solids	SM 2540 D 1997	Cool to ≤6 °C	1 L HDPE	10d	7d	

Notes:
ASTM = American Society for Testing and Materials
d = day(s)
h = hours
HCL = Hydrochloric Acid
HDPE = high-density polyethylene
HNO_3 = Nitric Acid
H_2SO_4 = Sulfuric Acid
L = liter
mL = milliliters
NaOH = Sodium Hydroxide
SM = Standard Method
TAT = Turnaround Time
y = year
1. Additional volume will be collected for MS/MSD samples.
2. Laboratory may provide alternate containers as long as the containers meet the requirements of the method and allow the collection of sufficient volume to perform the analysis.
3. Holding time begins from date of sample collection.

TABLE 4. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - METALS 6020/200.7 AND MERCURY 7470A
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Holding Times	Samples must be digested and analyzed within holding time.	Metals: 180 days from collection to analysis for aqueous and solid samples. Mercury: 28 days from collection to analysis.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify QAO since re-sampling may be required. 2. Document corrective action in the case narrative.
ICP/MS tuning, Mass Calibration and Resolution Checks	Analyze tune solution at least 4 times after the instrument has equilibrated prior to sample analysis. Evaluate mass calibration and resolution checks in the mass regions of interest. Solution contains elements representing all of the mass regions of interest (such as Li, Co, In, Tl) to verify resolution and mass calibration within criteria.	1. Verify instrument stability by an analysis of the tuning solution for at least four integrations with relative standard deviations of <5% for the analytes contained in the tuning solution. 2. If mass calibration is >0.1amu from the true value, mass calibration must be adjusted to correct values. 3. Resolution must be less than 0.9 atomic mass units (amu) of full width at 10% of peak height. 4. Provide documentation of mass calibration and resolution evaluations in the data package.	- 1. Identify and correct problem, and retune instrument samples cannot be analyzed until tune criteria is met.
ICP/MS Initial and Continuing Calibration Verification (ICV, CCV)	Calibration includes a calibration blank and a single high standard or multi-point standards (three non-zero standards that effectively bracket the desired sample concentration range). Calibration standard solutions must contain appropriate internal standard for each target element. For ICP/MS, prior to preparing standards, each stock solution must be analyzed separately to determine any interferences. The initial calibration verification (ICV) must be prepared in the same matrix as the calibration standards but as an independent standard (second-source calibration verification [SCV]) near the midpoint and at the low concentration of the linear range at a concentration other than the calibration standards. Verify calibration with ICV, ICB immediately after calibration. Verify with CCV, CCB at frequency of every 10 samples and at the end of the sequence.	ICV, CCV must be 90% to 110% of expected value for ICP/MS. If the ICP/MS is re-sloped or recalibrated after the ICV is analyzed, a new CCV, CCB must be analyzed prior to sample analysis. Provide documentation of calibration standard monitoring and evaluation.	1. Reanalyze. 2. If criteria are still not met, terminate analysis, identify and correct problem, recalibrate, and contact QAO. 3. Document corrective action in case narrative samples cannot be analyzed until calibration control limit criteria have been met.
Lower Limit of Quantitation Check (LLQC)	For ICP, LLQC is a standard at the RL concentration analyzed quarterly for all elements at the RL level.	The percent recovery of the LLQC must meet the laboratory established control limits.	1. The LLQC shall be re-analyzed immediately for those analytes; if the results of the re-analysis for those analytes fall within the control limits, no further corrective action is required. 2. If the results of the re-analysis for those analytes do not fall within the control limits, the analysis shall be terminated, the problem corrected, the instrument recalibrated, the LLQC analyzed, and the samples associated with the LLQC re-analyzed. 3. Document any observation or corrective action in the case narrative.
Internal Standard	Monitored for all samples, blanks, standards, and QC samples analyzed.	Internal standard counts should be within 30% of Internal standard counts of the calibration standard for all samples and standards.	1. If internal standard area is not within 30%, review the internal areas of the closest calibration blanks for compliance. If the calibration blanks meet criteria; dilute the sample five fold and reanalyze. 2. If the internal standard area of the calibration blank is also outside of 30%, stop sample analysis and recalibrate.

TABLE 4. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - METALS 6020/200.7 AND MERCURY 7470A
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Internal Standard for ICP/MS	Appropriate internal standard as listed in Method 6020 is required for each analyte. The internal standard should be no more than 50 amu from the target element. Recommended internal standards include 6Li, 45 Sc, 89Y, 103 Rh, 115In, 159Tb, 169Ho, 209Bi.	Intensity of all internal standards must be monitored for every analysis. The intensity of any internal standard must be >70% or <130% of the intensity of the internal standard in the initial calibration standard or blank. Document internal standard intensity and the evaluation for each analysis performed and include in the data package. The intensity of the internal standard of the CCB and CCV must agree within ±20% of the intensity of the internal standard in the ICV or calibration blank.	1. If sample analysis fails, dilute the sample fivefold (1+4), adjust internal standard and reanalyze. 2. Repeat until internal standard intensify meets criteria. 3. If the CCB or CCV intensity fails, terminate analysis, identify and correct problem, recalibrate, verify calibration and reanalyze samples, document in the case narrative, and contact QAO.
Contract Required Detection Limit (CRDL) Standard for ICP, ICPMS and AA.	1. For ICP, the CRDL is the RL concentration at the beginning and end of each run for all elements at the RL level. 2. The CRDL shall be run for every wavelength used for analysis.	The percent recovery of the CRDL must meet the control limits of 70-130%.	1. The CRDL shall be re-analyzed immediately for those analytes; if the results of the re-analysis for those analytes fall within the control limits, no further corrective action is required. 2. If the results of the re-analysis for those analytes do not fall within the control limits, narrate the failure in the case narrative. 3. Document any corrective action in case narrative.
Initial and Continuing Calibration Blank (ICB/CCB) (Iron, manganese, calcium)	After ICV, CCV, at beginning and end of run and at a rate of 10%.	The absolute value of the ICB and CCB must not exceed the RL.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate and reanalyze affected samples. 3. Document corrective action in the case narrative - samples should not be analyzed until blank control limit criteria have been met.
Preparation Blank (PB) Analysis	1 per batch of samples digested, or 1 in 20, whichever is greater. PB shall be carried through the complete procedure and contain the same acid concentration in the final solution as the sample solution used for analysis.	The absolute value of the method blank must not exceed the RL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and re-preparation and reanalyze affected samples if detected. 3. Document corrective action in the case narrative - samples cannot be analyzed until blank criteria are met.
Field Blank Analysis	Collected one per 10 samples or once per sampling event.	Less than RL.	1. Investigate problem. 2. Document in the case narrative.
Rinse Blank	Rinse blank must be analyzed following every sample and standard to flush the instrument.	Not applicable.	Not applicable.
Laboratory Control Sample (LCS)	Every 20 samples or each digestion batch. Prepared independently from calibration standards. LCS must contain all target analytes.	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, and other QC criteria are met, report both runs. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action in the case narrative.
Serial Dilution Analysis for ICP (Metals)	Required once per analytical batch when analyte concentration is >50 times the instrument IDL or MDL. Samples from the investigation must be used for Serial dilution analysis.	An analysis of a 1:5 dilution of the sample should provide a result with 90% to 110% of the original determination (for concentrations 50x the MDL.	1. Report results 2. Document corrective action in the case narrative.

TABLE 4. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - METALS 6020/200.7 AND MERCURY 7470A
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Serial Dilution Analysis for ICP/MS	Required when analyte concentration is >100 times the reagent blank and is within the linear range of the ICP/MS. Performed for every 20 samples for each matrix or per batch.	An analysis of a 1:4 dilution of the sample should provide a result with 90% to 110% of the original determination.	1. Qualify data. 2. Document corrective action in the case narrative.
Interference Check Sample Analysis for ICP (Metals)	Beginning of each analytical for ICP. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents.	Results for the ICS Solution AB (ICSAB) during the analytical runs shall fall within the control limit of ±2 times the RL of the true value or ±20% of the true value, whichever is greater, for the analytes included in the ICSAB.	1. Reanalyze. 2. If limits are still exceeded, adjust instrument. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document corrective action in the case narrative.
Interference Check Sample Analysis for ICP/MS	Beginning of each analytical run or once during every 12 hours, whichever is more frequent for ICP/MS. For measurement of elemental, molecular ion isobaric interference corrections. ICSA/ICSAB contains known concentration of interfering elements that will demonstrate the magnitude of the molecular ion isobaric interferences to verify that the interferences are corrected by the data system within the control limits.	Percent recovery of all elements must be within current laboratory control limits. Document the ICSA/ICSAB evaluations and include in the data package.	1. Reanalyze. 2. If limits are still exceeded, adjust interference corrections for instrument, contact QAO, samples cannot be analyzed until ICSA/ICSAB control limit criteria have been met. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document corrective action in the case narrative.
Matrix Spike Analysis	Collected one per 20 samples or one per matrix (for less than 20 samples). Samples from the investigation must be used for MS/MSD analysis.	Recovery within laboratory control limits or 75-125%, or in-house laboratory limits. Recovery does not apply if sample concentration > 4 X spike concentration. Spike must contain all analytes. The lowest acceptable laboratory control limits for recovery will be 10%.	1. Analyze post-digestion/post-distillation spike. 2. Document corrective action in the case narrative.
Post Digestion Spike	Spike must contain all target elements. Performed every 20 samples as necessary.	Recovery within 75 125% of true value.	1. Dilute sample and reanalyze. 2. If recovery is outside limits, document in the case narrative. 3. Standard additions may be used to compensate for matrix effects.
Internal standard (Metals)	May be used for each sample instead of post-digestion spike.	Internal Standard counts must be within 30% of Internal Standard counts of ICB for ICP-MS.	Reanalyze.
Laboratory Duplicate or Matrix Spike Duplicate Analysis	Field collected - Samples from the investigation must be used for Laboratory Duplicate and MSD analysis.	Laboratory control limit or 20% for RPD shall be used for original and duplicate sample values greater than or equal to five times the RL. A control limit of the RL value shall be used if either the sample or duplicate value is less than five times the CRQL.	1. Investigate problem and reanalyze. 2. Document corrective action in the case narrative.
Field Duplicate Analysis	Field collected - The field duplicate identification will not be provided to the laboratory.	Validation criteria: 30% RPD for waters. For sample results that are less than or equal to five times the RL, the criterion of plus or minus two times the RL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Laboratory Control Limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable.	Not applicable.

TABLE 4. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - METALS 6020/200.7 AND MERCURY 7470A
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
System Operation for ICP/MS	Use an average of 3 integrations for both the calibration and sample analysis. All masses which could affect data quality will be monitored to determine the potential effect from the matrix. Isotopes listed in the method should be used.	Not applicable.	Not applicable.
Interference Monitoring for ICP/MS	The analyst is required to monitor potential sources of interferences by measuring the elements of interest or a molecular species that may indicate the presence of an interferent and by taking appropriate action to ensure data of known quality. Interferences must be corrected by using correction equations based on observed isotopic signals and by monitoring the intensity of the internal standards. The rinse period between samples must be long enough to eliminate significant memory interferences. 5. Extensive QC for interference corrections must be performed. Samples exhibiting isobaric elemental interferences (isotopes of different elements with similar mass to charge ratio or very high ion currents at adjacent masses) require resolution improvement, matrix separation, or alternate isotopes.	Not applicable.	Not applicable.
Analyte Quantitation	Concentrations for ICP/MS analysis are reported based on dry weight of the sample. Calculations for the ICP/MS should include appropriate interference corrections, internal standard normalization, and summation of signals at 206, 207, and 208 mass to charge for lead. All QC criteria must be met when applying correction equations. If interference is detected, elements impacted are flagged to indicate percentage interference correction applied to the data or an uncorrected interference because of the equation used for quantitation.	Not applicable.	Not applicable.
Dilutions for ICP/MS	Analyze samples at a 1:5 dilution. Dilute and reanalyze samples with concentrations that are still greater than the linear range of the instrument. The laboratory will note in the data package which analytical runs were used to report the sample results.	Not applicable.	Not applicable.
MDL Determination	Before any field samples are analyzed, the MDLs shall be determined for non-prepared analyses, each digestion procedure and instrument used, prior to the start of analyses. MDL studies are conducted or verified at least annually.	Not applicable.	Not Applicable.

TABLE 4. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - METALS 6020/200.7 AND MERCURY 7470A
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Linear Range Analysis for ICP	Every 6 months must be routinely monitored by analysis of high concentration standard.	Results for high point standard must be within 10% of true value.	Not applicable.
Interelement Correction For ICP	Within 6 months of the start of analysis and annually. Correction factors for Al, Ca, Fe, and Mg must be reported and for others if they are applied.	Not applicable.	Not applicable.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable.	Not applicable.
Dilutions	1. When target analyte concentration exceed linear dynamic range of the instrument. 2. When matrix interference demonstrated by lab and documented in the case narrative. 3. Laboratory will note in the data deliverables which analytical runs were reported.	Not applicable.	Not applicable.
Deliverables	1. Full CLP-like deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable.	Provide missing or additional deliverables for validation purposes.
Method and QAPP Requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable.	Not applicable.

TABLE 5. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - ALKALINITY, ANIONS, TOTAL DISSOLVED SOLIDS
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Holding Times	Samples must be analyzed within holding time.	Alkalinity: Analyze within 14 days from collection. Chloride, Fluoride, and Sulfate: Analyze within 28 days from collection. Total Dissolved Solids: Analyze within 7 days from collection.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the Quality Assurance Officer (QAO) since re-sampling may be required. 2. Document corrective action in the case narrative.
Initial Calibration	Prior to sample analysis.	Anions: 1. Five concentrations for each target analyte bracketing expected concentration range for all target compounds. One standard must be at the RL concentration. 2. Do not force the calibration line through zero. 3. Linear calibration using response factor with RSD less than or equal to 10% or use linear regression. If RSD <10% the average calibration factor (external calibration) is used for quantitation. 4. For compounds with RSD greater than 10% use linear calibration that does not pass through the origin with least squares regression (r for un-weighted least squares regression, Coefficient of Determination or r2 must be greater than 0.990) or non-linear calibration using no more than third order with seven standards, (COD or r2 must be greater than 0.990). Alkalinity: 2.Alkalinity - Slope between 92 and 102. Each reading ± 0.05 S.U. of pH standard; same applies to Standard Reference Materials (SRMs).	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action in the case narrative - samples cannot be analyzed until calibration criteria have been met.
Initial and Continuing Calibration Verification (ICV, CCV)	ICV analyzed following initial calibration and CCV after every 10 samples and at the end of the sequence.	ICV/CCV: Recovery of 90% to 110% of true value.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action in the case narrative - samples cannot be analyzed until calibration criteria have been met.
Initial and Continuing Calibration Blank (ICB/CCB)	After ICV, CCV, at beginning and end of run and at a rate of 10% or every 2 hours during run.	The absolute value of the ICB and CCB must not exceed the RL.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate and reanalyze affected samples. 3. Document corrective action in the case narrative - samples cannot be analyzed until blank control limit criteria have been met.
Retention Time Windows	Retention time windows (absolute retention time) must be established.	Compounds must be within established retention time windows for the associated calibration standards. Retention time windows must be provided for each calibration verification.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. 3. Document corrective action in the case narrative.
Preparation Blank Analysis	1 per batch of samples digested, or 1 in 20, whichever is greater. PB shall be carried through the complete procedure and contain the same reagent concentration in the final solution as the sample solution used for analysis.	1. The absolute value of the method blank must not exceed the RL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and re-preparation and reanalyze affected samples if detected. 3. Document corrective action in the case narrative - samples cannot be analyzed until blank criteria are met.
Laboratory Control Sample Analysis	Every 20 samples or each preparation batch. Prepared independently from calibration standards.	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, and other QC criteria are met, report both runs. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action in the case narrative.

TABLE 5. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - ALKALINITY, ANIONS, TOTAL DISSOLVED SOLIDS
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Matrix Spike Analysis	Collected per project requirements. Spike must contain all analytes. Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory.	Recovery within laboratory control limits or 75-125%. Recovery does not apply if sample concentration > 4 X spike concentration. The lowest acceptable laboratory control limits for recovery will be 10%.	1. Document corrective action in the case narrative.
Laboratory Duplicate or Matrix Spike Duplicate Analysis	Collected per project requirements. Samples from the investigation must be used for Laboratory Duplicate and MSD analysis.	Laboratory control limit or 20% for RPD shall be used for original and duplicate sample values greater than or equal to five times the RL. A control limit of the RL value shall be used if either the sample or duplicate value is less than five times the RL.	1. Investigate problem and reanalyze. 2. Document corrective action in the case narrative.
Field / Equipment Blank Analysis	Collected per project requirements.	Less than RL.	1. Investigate problem. 2. Document in the case narrative.
Field Duplicate Analysis	Collected per project requirements. The field duplicate identification will not be provided to the laboratory.	30% RPD for waters. For sample results that are less than or equal to five times the RL, the criterion of plus or minus two times the RL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Dilutions	1. When target analyte concentration exceed upper limit of calibration curve. 2. When matrix interference demonstrated by lab and documented in the case narrative. 3. Laboratory will note in the data deliverables which analytical runs were reported.	Not applicable.	Not applicable.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable.	Not applicable.
Deliverables	1. Full CLP deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided upon request. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable.	Provide missing or additional deliverables for validation purposes.
Method and QAPP Requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable.	Not applicable.

TABLE 6. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - RADIUM 226 AND 228
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Holding Times	Samples must be prepared and analyzed within holding time.	180 days from collection	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the QAO since re-sampling may be required. 2. Document corrective action in the case narrative.
Calibration	Each detector must be calibrated annually or unacceptable change is detected. Standards must be valid.	The detector resolution must not exceed 10% of the manufacturer's specifications.	1. Repeat calibration until criteria are met. 2. Document corrective actions in the case narrative.
Detector Backgrounds	At a minimum, the Lucas Cells are counted on the day of use and for the same duration as the samples.	Background for each detector will not contain any target analytes above the required detection limit (RDL).	1. Repeat background until criteria are met. 2. Document corrective actions in the case narrative.
Background Check	Background is checked every day of use.	Results must be within ± 3 standard deviations of the decay corrected value for each isotope in the source.	1. Repeat until criteria are met. 2. Document corrective actions in the case narrative.
Preparation Blank Analysis	One blank with each sample batch. Counted for the same count duration as the samples. MDC calculated based on greatest sample volume or weight of the sample batch.	The MDC must meet the RDL. Activity must be less than or equal to the RDL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and re-preparation and reanalyze affected samples if detected. 3. Document corrective action in the case narrative.
Field / Equipment Blank Analysis	Collected one per sampling equipment and after every 20 samples.	Less than RDL.	1. Investigate problem. 2. Document in the case narrative.
Laboratory Control Sample Analysis	Every 20 samples or each digestion batch. The LCS used must be the same matrix and geometry and at an appropriate activity of the samples in the analytical batch. The LCS must be counted for the same duration and the spectra processed in the same manner (instrument calibration parameters, algorithms) as the samples in the analytical batch.	Recovery within laboratory control limits.	1. Reanalyze LCS. 2. Stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 3. Document corrective action in the case narrative.
Laboratory Duplicate	One for each analytical batch of 20 samples or less. The duplicate must be counted for the same duration as the sample.	RPD < laboratory control limit.	1. Reanalyze duplicate. 2. Document corrective action in the case narrative.
Field Duplicate Analysis	Collected 1 per matrix; every 20 samples of similar matrix	30% RPD for waters.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Sample re-analysis	Re-analysis should be performed for the sample batch for the following: 1. Sample detection limit target not met. 2. Inadequate aliquot size 3. Inadequate count duration 4. Low detector efficiencies 5. High detector backgrounds 6. LCS ± the error is outside of the known value ± the error of the measurement 7. Preparation blank activity greater than target analyte RDL	Not applicable	Not applicable

TABLE 6. QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS - RADIUM 226 AND 228
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

DATA QUALITY INDICATOR (WHERE APPLICABLE TO SPECIFIC METHOD)	FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
Laboratory control limits	1. Generated with results from a minimum of 20 analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Minimum Detectable Concentration (MDC)	MDC will be provided for each sample and QC sample analyzed.	Not applicable	Not applicable
Case narrative	The case narrative must address the following (where applicable): 1. Data interpretation used to report results or resolution of interference issues. 2. Sample preparation description. 3. Modifications of methods used.	Not applicable	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Deliverables	1. CLP-like deliverables must be provided to document each audit item for easy reference and inspection. 2. Analytical sequence logs, including geometry used for each analysis, for calibration, sample and QC samples will be provided in the data packages. 3. Preparation logs will be included for each sample and QC sample will be provided in the data package. 4. The certificates of calibrations for each standard used in the analysis will be provided in the data package. 5. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 6. Final spiking concentrations will be presented in summary form. 7. Standard tracing information will be provided. 8. Cooler temperatures will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method and QAPP Requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable.	Not applicable.

TABLE 7. SOLID EXTRACTION AND ANALYSIS METHODS
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

Method Name	Method Reference	Followed By	Description	Applicable QA/QC
Extraction Methods				
Total Environmental Metals	USEPA 3050B	Analysis per Table 1	Strong acid digestion targeting all elements that could become "environmentally available".	Table 2 (LMB, LCS/LCSD, LDS)
Sequential Extraction Procedure	NA[1]	Analysis per Table 1	Sequential extraction is a specialty analytical method that uses progressively stronger reagents to dissolve solid phase fractions and measures the metal content associated with each fraction.	Table 2 (LMB, LCS/LCSD, LDS)
Synthetic Precipitation Leaching Procedure	SW-846 1312	Analysis per Table 1	Extraction method used to simulate leaching of soils and solid wastes exposed to natural rainwater.	Table 2 (LMB, LCS/LCSD, LDS)
Toxicity Characteristic Leaching Procedure	SW-846 1311	Analysis per Table 1	Extraction method used to categorize solid waste according to 40 C.F.R. § 261.24.	Table 2 (LMB, LCS/LCSD, LDS)
Cation Exchange Capacity	USEPA 9081	Analysis per Table 1	All sorbed cations on a sample are replaced with sodium, which is subsequently displaced by ammonium. The amount of sodium displaced is then analyzed to determine the cation exchange capacity.	Table 2 (LMB)
Analysis Methods				
Loss On Ignition	ASTM D7348[2]	NA	Estimates the organic content of a sample based on mass difference before and after combustion of a sample.	Table 2 (LMB)
Total Organic Carbon	SW-846 9060A	NA	An canbonaceous analyzer is used to quantify the amount of organic carbon in a sample.	Table 2 (LMB, LCS/LCSD)
X-Ray Diffraction (XRD)	NA[1]	NA	XRD quantifies the relative proportion of crystalline and mineral phases in a solid sample by comparing the x-ray diffraction patterns observed in a sample to those of known compounds in a reference database.	The lab report for each XRD analysis will include sample preparation details and instrument parameters (which may vary depending on the target minerals). The results will be verified by personnel familiar with the geology and lithology of the samples. If a reported mineral phase is unlikely to occur in the environment, alternative interpretations of the diffraction pattern will be discussed with the laboratory and a revised report may be issued.

Notes:
1. A laboratory-specific SOP will be provided.
2. Combustion temperature may be modified based on sample matrix and noted in the lab report.
LCS/LCSD = laboratory control sample/laboratory control sample duplicate
LDS = laboratory duplicate sample
LMB = laboratory method blank
USEPA = United States Environmental Protection Agency

FIGURES

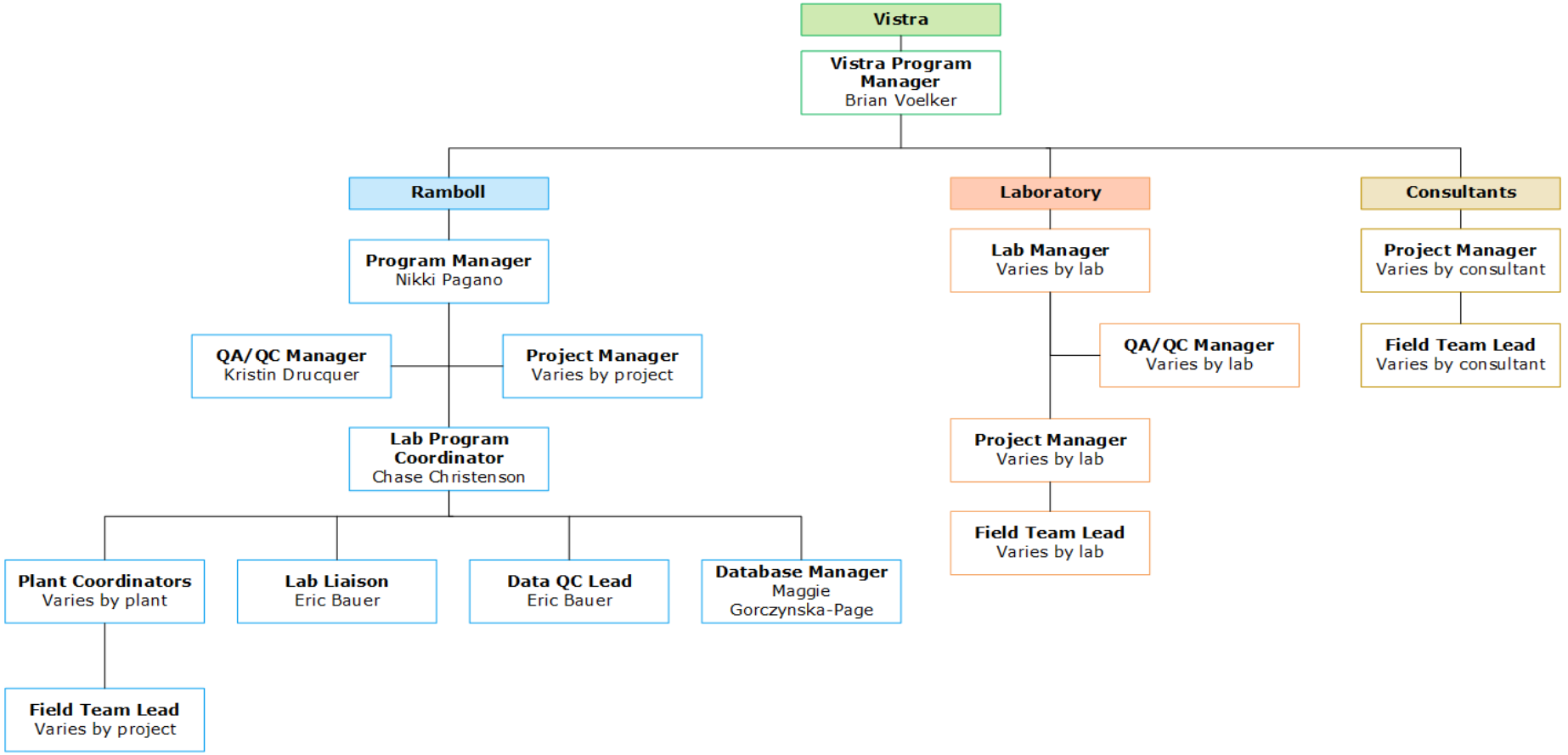


FIGURE 1. ORGANIZATION FLOW CHART

APPENDIX A
GROUNDWATER ANALYTICAL METHODS AND ANALYTICAL PERFORMANCE CRITERIA FOR COMPLIANCE SAMPLING

APPENDIX A. ANALYTICAL METHODS AND ANALYTICAL PERFORMANCE CRITERIA
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

Constituent	Unit	Analytical Methods [1]	Target RL [2]	LCS Recovery Control Limits [3]	LCS/LCSD Control RPD [3]	MS/MSD Recovery Control Limits [3]	MS/MSD or Lab Duplicate RPD Control Limits [3]
VOCs							
1,1,1,2-Tetrachloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1,1-Trichloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1,2,2-Tetrachloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1,2-Trichloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1-Dichloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1-Dichloroethene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,1-Dichloropropene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2,3-Trichlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2,3-Trichloropropane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2,4-Trichlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2,4-Trimethylbenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2-Dibromo-3-chloropropane	µg/L	SW-846 8260B	0.05	80-120	20	70-130	30
1,2-Dibromoethane	µg/L	SW-846 8260B	0.05	80-120	20	70-130	30
1,2-Dichlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2-Dichloroethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2-Dichloroethene	µg/L	SW-846 8260B	2	80-120	20	70-130	30
1,2-Dichloroethene, cis-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2-Dichloroethene, trans-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,2-Dichloropropane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,3,5-Trimethylbenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,3-Dichlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,3-Dichloropropane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,3-Dichloropropene	µg/L	SW-846 8260B	2	80-120	20	70-130	30
1,3-Dichloropropene, cis-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,3-Dichloropropene, trans-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,4-Dichloro-2-butene, trans-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1,4-Dichlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
1-Butanol	µg/L	SW-846 6260B, SW-846 8015M	1000	80-120	20	70-130	30
1-Propanol	µg/L	SW-846 6260B, SW-846 8015M	1000	80-120	20	70-130	30
2,2-Dichloropropane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
2-Chloroethyl vinyl ether	µg/L	SW-846 8260B	10	80-120	20	70-130	30
2-Chlorotoluene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
2-Propanol	µg/L	SW-846 6260B, SW-846 8015M	1000	80-120	20	70-130	30
2-Hexanone	µg/L	SW-846 8260B	5	80-120	20	70-130	30
4-Chlorotoluene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
4-Methyl-2-pentanone	µg/L	SW-846 8260B	5	80-120	20	70-130	30
Acetone	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Acrylonitrile	µg/L	SW-846 8260B	50	80-120	20	70-130	30

APPENDIX A. ANALYTICAL METHODS AND ANALYTICAL PERFORMANCE CRITERIA
QUALITY ASSURANCE PROJECT PLAN
VISTRA CORP

Constituent	Unit	Analytical Methods [1]	Target RL [2]	LCS Recovery Control Limits [3]	LCS/LCSD Control RPD [3]	MS/MSD Recovery Control Limits [3]	MS/MSD or Lab Duplicate RPD Control Limits [3]
Benzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
bis (chloromethyl) ether	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Bromobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Bromodichloromethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Bromoform	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Bromomethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Butylbenzene, n-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Butylbenzene, sec-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Butylbenzene, tert-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Carbon Disulfide	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Carbon Tetrachloride	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Chlorobenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Chlorobromomethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Chlorodibromomethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Chloroethane	µg/L	SW-846 8260B	2	80-120	20	70-130	30
Chloroform	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Chloromethane	µg/L	SW-846 8260B	2	80-120	20	70-130	30
Dichlorodifluoromethane	µg/L	SW-846 8260B	2	80-120	20	70-130	30
Ethyl acetate	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Ethylbenzene, total	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Hexachlorobutadiene [4]	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Iodomethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Isopropylbenzene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Isopropyltoluene, p-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Methyl Ethyl Ketone (2-Butanone)	µg/L	SW-846 8260B	5	80-120	20	70-130	30
Naphthalene, total [4]	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Nitrobenzene [4]	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Dibromomethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Dichloromethane	µg/L	SW-846 8260B	5	80-120	20	70-130	30
Propylbenzene, n-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Styrene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Tetrachloroethene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Tetrahydrofuran	µg/L	SW-846 8260B	10	80-120	20	70-130	30
Toluene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Trichloroethene	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Trichlorofluoromethane	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Vinyl Acetate	µg/L	SW-846 8260B	5	80-120	20	70-130	30
Vinyl Chloride	µg/L	SW-846 8260B	2	80-120	20	70-130	30
Xylene	µg/L	SW-846 8260B	3	80-120	20	70-130	30

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Xylene, m- & p-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
Xylene, o-	µg/L	SW-846 8260B	1	80-120	20	70-130	30
SVOC							
2,4,5-Trichlorophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2,4,6-Trichlorophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2,4-Dichlorophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2,4-Dimethylphenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2,4-Dinitrophenol	µg/L	SW-846 8270C	50	80-120	20	70-130	30
2,4-Dinitrotoluene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2,6-Dinitrotoluene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2-Chloronaphthalene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2-Chlorophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2-Methylphenol, total	µg/L	SW-846 8270C	10	80-120	20	70-130	30
2-Nitrophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
3,3-Dichlorobenzidine	µg/L	SW-846 8270C	25	80-120	20	70-130	30
4,6-Dinitro-ortho-cresol	µg/L	SW-846 8270C	50	80-120	20	70-130	30
4-Bromophenyl phenyl ether	µg/L	SW-846 8270C	10	80-120	20	70-130	30
4-Chlorophenyl phenyl ether	µg/L	SW-846 8270C	10	80-120	20	70-130	30
4-Methylphenol, total	µg/L	SW-846 8270C	10	80-120	20	70-130	30
4-Nitrophenol	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Acenaphthene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Alachlor	µg/L	SW-846 8081B, SW-846 8270C	0.5	80-120	20	70-130	30
Aldicarb	µg/L	SW-846 8270C	0.5	80-120	20	70-130	30
Aldrin	µg/L	SW-846 8081B, SW-846 8270C	0.05	80-120	20	70-130	30
BHC, alpha-	µg/L	SW-846 8081B, SW-846 8270C	0.05	80-120	20	70-130	30
BHC, beta-	µg/L	SW-846 8081B, SW-846 8270C	0.05	80-120	20	70-130	30
BHC, delta-	µg/L	SW-846 8081B, SW-846 8270C	0.05	80-120	20	70-130	30
Anthracene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Atrazine	µg/L	SW-846 8270C	0.5	80-120	20	70-130	30
Benzo(a)anthracene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Benzo(a)pyrene	µg/L	SW-846 8270C	0.2	80-120	20	70-130	30
Benzo(b)fluoranthene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Benzo(g,h,i)perylene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Benzo(k)fluoranthene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
bis (2-chloroethoxy) methane	µg/L	SW-846 8270C	10	80-120	20	70-130	30
bis (2-chloroethyl) ether	µg/L	SW-846 8270C	10	80-120	20	70-130	30
bis (2-ethylhexyl) phthalate	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Bis(2-chloroisopropyl)ether	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Butyl benzyl phthalate, n-	µg/L	SW-846 8270C	10	80-120	20	70-130	30

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Carbofuran	µg/L	SW-846 8270C	1.5	80-120	20	70-130	30
Chrysene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Cresol, m-	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Cresol, m- & p-	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Cresol, Total	µg/L	SW-846 8270C	30	80-120	20	70-130	30
Dibenzo(a,h)anthracene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Dieldrin	µg/L	SW-846 8081B, SW-846 8270C	0.1	80-120	20	70-130	30
Diethyl phthalate	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Dimethyl phthalate	µg/L	SW-846 8270C	10	80-120	20	70-130	30
di-n-butyl phthalate	µg/L	SW-846 8270C	10	80-120	20	70-130	30
di-n-octyl phthalate	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Endosulfan, alpha	µg/L	SW-846 8081B, SW-846 8270C	0.1	80-120	20	70-130	30
Endosulfan, beta	µg/L	SW-846 8081B, SW-846 8270C	0.1	80-120	20	70-130	30
Endrin aldehyde	µg/L	SW-846 8081B, SW-846 8270C	1	80-120	20	70-130	30
Fluoranthene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Fluorene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Hexachlorobenzene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Hexachlorobutadiene [4]	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Hexachlorocyclopentadiene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Hexachloroethane	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Indeno(1,2,3-cd)pyrene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Naphthalene, total [4]	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Nitrobenzene [4]	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Nitrosodimethylamine, n-	µg/L	SW-846 8270C	20	80-120	20	70-130	30
Nitrosodiphenylamine, n-	µg/L	SW-846 8270C	20	80-120	20	70-130	30
Nitrosodipropylamine, n-	µg/L	SW-846 8270C	20	80-120	20	70-130	30
Phenanthrene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Pyrene	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Pyridine	µg/L	SW-846 8270C	10	80-120	20	70-130	30
Simazine	µg/L	SW-846 8270C	0.2	80-120	20	70-130	30
Tetrachlorodibenzo-p-dioxins	µg/L	SW-846 8280B, SW-846 8290A	50	80-120	20	70-130	30
Phenols	µg/L	USEPA 420.1, SW-846 9066	5	80-120	20	70-130	30
Inorganics							
Nitrite + Nitrate	mg/L	USEPA 300 R2.1, USEPA 353.2, Method 4500-NO	0.05	90-110	10	90-110	10
Nitrite nitrogen	mg/L	Method 4500-NO2	0.05	90-110	10	90-110	10
Ammonia nitrogen	mg/L	USEPA 350.1; Method 4500-NH3	1	90-110	10	90-110	10
Nitrogen, kjeldahl	mg/L	USEPA 351.2, Method 4500-Norg	1	90-110	10	90-110	10
Phosphorus	mg/L	46 6010, SW-846 6020, Method 4500-P, USEPA	0.005	80-120	20	75-125	20
Sulfide, Reactive solid	mg/L	USEPA 9034	20	90-110	10	90-110	10

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Sulfide, total aqueous	mg/L	Method 4500 S2	2	90-110	10	90-110	10
Herbicides							
2,4,5-Trichlorophenoxyacetic acid	µg/L	SW-846 8151A	0.05	80-120	20	70-130	30
2,4-Dichlorophenoxyacetic acid	µg/L	SW-846 8151A; SW-846 8321B	0.1	80-120	20	70-130	30
Dalapon	µg/L	SW-846 8151A	1.5	80-120	20	70-130	30
Dicamba	µg/L	SW-846 8151A	0.5	80-120	20	70-130	30
Dinoseb	µg/L	SW-846 8151A; SW-846 8321B	0.2	80-120	20	70-130	30
Endothall	µg/L	USEPA 548.1	10	80-120	20	70-130	30
MCPP	µg/L	SW8151A	10	80-120	20	70-130	30
Picloram	µg/L	SW-846 8151A	0.2	80-120	20	70-130	30
Silvex	µg/L	SW-846 8151A; SW-846 8321B	0.05	80-120	20	70-130	30
Pesticides							
4,4-DDD	µg/L	SW-846 8081B	1	80-120	20	70-130	30
4,4-DDE	µg/L	SW-846 8081B	1	80-120	20	70-130	30
Alachlor	µg/L	SW-846 8081B	0.5	80-120	20	70-130	30
Aldrin	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
BHC, alpha-	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
BHC, beta-	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
BHC, delta-	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
Dieldrin	µg/L	SW-846 8081B	0.1	80-120	20	70-130	30
Endosulfan, alpha	µg/L	SW-846 8081B	0.1	80-120	20	70-130	30
Endosulfan, beta	µg/L	SW-846 8081B	0.1	80-120	20	70-130	30
Endrin aldehyde	µg/L	SW-846 8081B	1	80-120	20	70-130	30
Chlordane (tech mix & metabs)	µg/L	SW-846 8081B	0.5	80-120	20	70-130	30
Endrin	µg/L	SW-846 8081B	0.1	80-120	20	70-130	30
Heptachlor epoxide	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
Heptachlor	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
Lindane	µg/L	SW-846 8081B	0.05	80-120	20	70-130	30
Methoxychlor	µg/L	SW-846 8081B	0.5	80-120	20	70-130	30
Parathion	µg/L	SW-846 8270C	0.2	80-120	20	70-130	30
Pentachlorophenol	µg/L	SW-846 8151A, SW-846 8270C	0.05	80-120	20	70-130	30
Toxaphene	µg/L	SW-846 8081B	1.5	80-120	20	70-130	30
PCBs							
PCBs, total	µg/L	SW-846 8082	0.5	80-120	20	70-130	30
Metals							
Aluminum	mg/L	SW-846 6010B, SW-846 6020A	0.01	80-120	20	75-125	20
Arsenate(+5)	µg/L	USEPA 1632	1	80-120	20	75-125	20
Arsenite(+3)	µg/L	USEPA 1632	1	80-120	20	75-125	20
Arsenic, Inorganic	µg/L	USEPA 1632	1	80-120	20	75-125	20

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Ferric Iron	µg/L	SM 3500-Fe	20	80-120	20	75-125	20
Ferrous Iron	µg/L	SM 3500-Fe	20	80-120	20	75-125	20
Silver	mg/L	SW-846 6010B, SW-846 6020A	0.005	80-120	20	75-125	20
Strontium	mg/L	SW-846 6010B, SW-846 6020A	0.01	80-120	20	75-125	20
Tin	mg/L	SW-846 6010B, SW-846 6020A	0.06	80-120	20	75-125	20
Others							
Bacteria (Fecal Coliform)	col./100 ml	SM 9222	10	80-120	20	--	--
Biochemical Oxygen Demand (5 day - 20 deg C)	mg/L	SM 5210	10	80-120	20	--	--
Carbon, organic	mg/L	9060 or SM 5310	1	80-120	20	80-120	20
Chemical Oxygen Demand	mg/L	SM 5220	10	80-120	--	--	--
Cyanide	mg/L	USEPA 9012A	0.005	80-120	20	80-120	20
Flashpoint, Pensky-Martens Closed Cup	degrees F	SW-846 1010	50	80-120	20	--	--
Oil & grease (soxhlet ext)	mg/L	USEPA 1664A	5	80-120	20	70-130	30
Perchlorate	mg/L	SW-846 6850, E314	0.005	80-120	20	70-130	30
Temperature	degrees	SM 2550	NA	--	--	--	--
Total Suspended Solids	mg/L	SM 2540D	5	80-120	20	--	--

Notes:
col./100 ml = coliform per 100 milliliters
degrees C = degrees Celsius
degrees F = degrees Fahrenheit
µg/L = micrograms per liter
mg/L = milligrams per liter
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
1. Analytical methods may be updated with more recent versions as appropriate.
2. RLs will vary depending on the laboratory performing the work. RLs will be provided by laboratory if/when additional parameters are needed.
3. LCS/LCSD and MS/MSD control limits are laboratory specific; control limits will be updated during laboratory procurement.
4. Analyte may be analyzed as a VOC or an SVOC.