Date

December 28, 2022

Project No.

1940103307

MULTI-SITE SAMPLING AND ANALYSIS PLAN

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MULTI-SITE SAMPLING AND ANALYSIS PLAN

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DOCUMENT REVISION RECORD

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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		
Duck Creek Power Plant Illinois Power Resources Generating, LLC	201/202	Ash Pond No. 1 Ash Pond No. 2	X	X
	203	GMF Pond	X	X
	204	Landfill		
	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		
	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		
Kincaid Power Plant Kincaid Generation, LLC	141	Ash Pond	X	X
Miami Fort Power Plant Dynegy Miami Fort, LLC	113	Landfill		
	115	Pond System		
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	121	D Basin		
	122	Landfill		
	124	Gypsum Recycle Pond		
	125	Coal Pile Runoff Pond		

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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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
±	plus or minus
%	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
DI	deionized
DMP	Data Management Plan
DQO	Data Quality Objective
EB	equipment blank
EDD	Electronic Data Deliverable
FB	field blank
FD	field duplicate
GMP	Groundwater Monitoring Plan
HASP	Health and Safety Plan
HBL	Health-Based Level
HNO_3	nitric acid
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
NELAP	National Environmental Laboratory Accreditation Program
NTU	nephelometric turbidity units
ORP	oxidation-reduction potential
POC	point-of-contact
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
SAP	Sampling and Analysis Plan
SAR	sampling and analysis request
SOP	Standard Operating Procedure
SU	standard units
TDS	total dissolved solids
µS/cm	microSiemens per centimeter

USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

1.1 Background

This Sampling and Analysis Plan (SAP) 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) for monitored CCR units located in Illinois, 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) at the monitored units listed in **Table A**. The owner or operator of a CCR unit (or multi-unit) must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system at the facility has been designed and constructed to meet the requirements of 40 C.F.R. § 257 and 35 I.A.C. § 845; certification of the monitoring system is included in the site-specific Groundwater Monitoring Plan (GMP).

As directly relevant to this SAP, 40 C.F.R. § 257 and 35 I.A.C. § 845 require that the groundwater monitoring program include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the required background and downgradient wells. 40 C.F.R. § 257 and 35 I.A.C. § 845 require the owner or operator of the CCR unit (or multi-unit) to develop a sampling and analysis program that includes procedures and techniques for: (1) sample collection; (2) sample preservation and shipment; (3) analytical procedures; (4) chain of custody control; and (5) quality assurance and quality control.

1.2 Sampling 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], 2022a) and in the Data Management Plan (DMP; Ramboll, 2022b). The information presented in this SAP will enable field personnel to collect field samples and measurements in a manner that meet the project DQOs. Only one sample will be collected per well per sampling event and submitted for analysis. Data reporting requirements and workflow are provided in the DMP (Ramboll, 2022b).

1.3 Communication Strategy

This SAP provides a communication strategy, which identifies project communication flow between project managers, field personnel, and laboratories. The communication strategy is further described in the DMP (Ramboll, 2022b). The project organization and communication channels are presented in **Figure 1**.

2. FIELD MOBILIZATION AND SITE ACCESS

Prior to initiating field activities, personnel will review the project goals, objectives, and scope. The field sampling team will review the site-specific Health and Safety Plan (HASP), the facility 35 I.A.C. § 845 Safety and Health Plan, and any additional safety requirements specified by a plant, the site-specific GMP, the SAP summary, and Standard Operating Procedures (SOPs). If necessary, field activity area(s) reconnaissance may be performed to familiarize field staff with field conditions, identify access points, and locate monitoring wells.

2.1 Site Access

The facility point-of-contact (POC) identified in the 35 I.A.C. § 845 845 Safety and Health Plan should be notified at least 24 hours before the sampling team arrives at the facility. If not part of the sampling kit, arrangements should be made to obtain the keys for the monitoring devices, and inquiries should be made as to the conditions at the facility (access, weather, operations that may affect sampling, etc.).

Upon arrival at the facility, the sampling team must check in with security. An appropriate government-issued form of identification (*e.g.*, Driver's License) will be needed for security clearance and access to the facility. Personnel must check-in with the site manager or sampling team leader before being allowed into the field activity area. Visitor information (*e.g.*, affiliation, reason for visit, etc.) will be documented in the sign-in/out form maintained at the facility. Unauthorized visitors will not be allowed in field activity areas. Personnel will be required to complete the site orientation and/or health and safety briefings required by the plant. Personnel entering the field activity area will review and act in accordance with the applicable safety plan(s).

2.2 Mobilization Activities

Mobilization activities include:

- Prepare a contact list, including the names of field team personnel and subcontractors, affiliation, and contact numbers for distribution to all field team members.
- Submit site-specific forms (*e.g.,* Business Partner Badge Form) at least 24 hours in advance of arrival at the facility, if applicable.
- Receive permission 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.
- Evaluate accessibility of sampling locations with proposed equipment.
- Coordinate subcontractors that may include drillers, laboratories, surveyors, etc. Review scope of work, schedule, and discuss special equipment needs. Confirm subcontractor lead POC and field personnel names to provide to the plant at least 24 hours prior to arrival at the facility.
- Acquire proper Personal Protective Equipment (PPE).
- Review analytical requirements, prepare the sampling and analysis request (SAR) for submittal to the analytical laboratories, request appropriate sample containers from the analytical laboratories, and discuss delivery/pickup of coolers, including weekend deliveries.

- Secure and verify working conditions of field instruments in accordance with their respective SOPs.
- Load appropriate equipment and supplies to perform the field activities.
- Coordinate the management/disposal of investigative derived waste (IDW).
- Prepare equipment staging areas.
- Locate survey information or identifying the need to survey previous and/or proposed initial sampling locations.

2.3 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 the groundwater sampling have the responsibility to provide the HASP to their staff and are responsible for knowing the HASP requirements.

3. SAMPLE COLLECTION PROCEDURES

3.1 Groundwater Sampling

3.1.1 Overview

This section describes groundwater sampling collection methods and requirements. Groundwater sampling is performed to determine if the CCR unit (or multi-unit) is adversely impacting groundwater. 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 determined by the site-specific GMP, and will be sampled by low-flow methods. Sampling activity details will be recorded on field and data forms (**Appendix A**). General field operations are outlined in the SOPs described herein and presented in **Appendix B**.

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.

All field measurement equipment will be calibrated in accordance with the manufacturer's specifications for initial and routine recalibration to reduce the potential for errant measurements and data.

3.1.2 Water Level Measurements

Groundwater level measurements will be collected prior to the start of each sample collection event as outlined in the site-specific GMP and/or SAR. Water level measurements at a CCR monitored unit will be collected within the same day, or at least within 24 hours of initiating groundwater sampling. If a transducer equipped with a data logger (*e.g.,* HOBO® MX2001 or similar) is present in a well to be sampled, the water level measurement can be collected immediately prior to sampling the well provided the data is downloaded at the time of sampling. Dedicated sampling equipment (pumps and tubing) will be stored within the water column in a manner that allows water levels to be measured without removing this dedicated equipment. 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 SOP No. 6.04, Groundwater and Free Product Level Measurements (**Appendix B**) will be recorded in the field logbook and/or on the appropriate field form. Field logbooks may be in paper or electronic (collected using a tablet) format.

3.1.2.1 Transducer Installation and Monitoring

A single transducer equipped with a data logger (*e.g.,* HOBO® MX2001 or similar) will be installed in wells within the 35 I.A.C. § 845 groundwater monitoring network to measure groundwater elevation in accordance with monitoring requirements of 35 I.A.C. § 845. Prior to initiating groundwater sampling at a well containing a transducer, two depth to groundwater measurements will be collected, a manual measurement and an instantaneous reading from the transducer and stored data downloaded using the HOBOconnect® software. After data has been successfully downloaded from the transducer and a manual water elevation reading collected as described above, groundwater sampling will be initiated. In the event a transducer is not present, groundwater level measurements will be collected manually prior to the start of each sample collection event.

3.1.3 Monitoring Well Groundwater Sampling

Groundwater samples will be collected using low-flow sampling techniques in accordance with USEPA and American Society for Testing and Materials (ASTM) 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 SOP No. 14.01, Sampling Equipment Decontamination (**Appendix B**).

3.1.3.1 Well Integrity

Well integrity will be evaluated and appropriately noted on a field form prior to collection of field data. Well integrity inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional
- Checks to assure that well caps are intact and vented, unless in flood-prone areas in which case caps will not be vented
- Annual measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well
- Checks to assure that wells are clear of internal obstructions, and flow freely

Significantly compromised monitoring wells should not be sampled, photographs of the well will be taken, and the issues will be immediately discussed with the Owner Project Manager for further well evaluation, repair, and/or abandonment. An example monitoring well evaluation form indicating relevant well integrity parameters is included in **Appendix A**. Field data will be recorded as described in Section 3.3.1.

3.1.3.2 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 screened interval. Low-flow sampling conditions have not been reached until the following conditions have been met:

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

The following equipment is required to perform 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.
- 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.
- A calibrated pail to collect purge water.
- Low-flow sampling field forms (**Appendix A**), pens, and field book.

Low-flow groundwater sampling will be conducted in accordance with SOP No. 6.20, Groundwater Sampling - Low Flow (**Appendix B**). 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 SOP No. 6.20, Groundwater Sampling - Low Flow (**Appendix B**). 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) @ 25 degrees Celsius (°C)
pH	± 0.1 Standard Units (SU)
Temperature	± 3 % or ± 0.1 ºC or ± 0.2 degrees Fahrenheit (ºF)
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

When stabilization is achieved and prior to sample collection, the flow-through cell is disconnected, and laboratory containers are filled from the system tubing. The flow rate should not be adjusted following parameter stabilization or during sample collection.

Additional goals for precision, accuracy, and completion of field measurements are provided in **Table 1**.

3.1.3.3 Sample Collection

Once low-flow sampling conditions are met, sample collection may begin. Without turning the pump off, 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 stabilization. Samples will be placed in appropriate laboratory supplied containers and preserved in accordance with the analytical method requirements listed in **Table 2**. 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 (combined radium 226 and 228 and total metals)
- Filtered (samples collected for other monitoring purposes)

During each sampling event, quality control samples will be collected as described in Section 5.4.

In the event that sample turbidity is not below 10 NTUs a sample filtered through a filter (*e.g.,* 0.45-micron) may be collected (at the discretion of the Owner Project Manager or their designee) 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), it will be necessary to let the water in the well recover (up to one or more days) before collecting the sample. If possible, let the well recover with enough volume to collect all analytical parameters. However, low-yield wells may not recover sufficiently within one day to collect all the necessary analytes. Several days may be needed to collect all the necessary samples.

3.2 Source Water Sampling

Supplemental source water sampling may be performed to determine if the CCR unit (or multi-unit) is adversely impacting groundwater (as defined in 40 C.F.R. § 257.53). This sampling protocol may be used for collection of liquid samples from sumps, leachate collection pipes, borings, or other subsurface infrastructure that collects liquid. Source water will be sampled using low-flow methods in accordance with SOP No. 6.20, Groundwater Sampling - Low Flow (Appendix B) unless the well purges dry during sampling. If the well purges dry, source water will be sampled with a peristaltic pump, submersible pump, or single-use bailer in accordance with the methods described in SOP No. 6.02, Groundwater Purging and Sampling (**Appendix B**). Supplemental source water sampling activity details will be recorded on field forms found in SOP No. 6.02, Groundwater Purging and Sampling (**Appendix B**).

3.3 Field Documentation

3.3.1 Field Data Recording

Field activities will be documented in accordance with this SAP and SOP No. 1.01, Field Records and Notes (**Appendix B**). Documentation will be completed through the use of the following field forms provided in **Appendix A** and/or a field notebook or dedicated digital field tablet.

- Monitoring Well Evaluation Checklist
- Well Development and Groundwater Sampling Field Form
- Chain of custody (COC)
- Field Calibration Form

Data generated in the field will be reduced and validated, as appropriate, before reporting. Field entries into the relevant field forms will be verified against the collected field data. Data collected in the field will be scanned following completion of the sampling event and transmitted to the Lab

Liaison within 2 days. Digital collection of data using the QNOPY digital mobile application (or equivalent, as approved by Ramboll Program Manager and the Owner PM).

3.3.2 Data Tracking, Storage, and Retrieval

Field data forms, notes, and COCs will be scanned and stored electronically in the project file and retrieved as described in the QAPP (Ramboll, 2022a) and the DMP (Ramboll, 2022b).

3.3.3 Final Documentation Files

All final data, field notes, and other pertinent documents produced or delivered will be tracked and stored as described in the QAPP (Ramboll, 2022a) and the DMP (Ramboll, 2022b).

4. DECONTAMINATION

4.1 Overview

Decontamination procedures will be performed to remove chemical constituents from non-dedicated sampling equipment used during groundwater monitoring 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.

4.2 Decontamination of Equipment

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 and documented in accordance with SOP No. 14.01, Sampling Equipment Decontamination (**Appendix B**).

4.2.1 Sampling Equipment

Non-dedicated sampling equipment will be washed with a solution of Alconox™ and potable water, and then triple 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 at a minimum:

- Water level meter
- Flow through cell

Equipment decontamination procedures are described in SOP No. 14.01, Sampling Equipment Decontamination (**Appendix B**).

4.2.2 Sample Container Decontamination

Sample container decontamination is not required; the analytical laboratory will provide pre-cleaned and preserved (as applicable) containers for samples to be submitted for laboratory analysis. Sample containers will not be used if the container integrity is compromised in any manner, and arrangements will be made with the laboratory to get replacement container(s).

5. SAMPLE PRESERVATION, SHIPMENT, CHAIN OF CUSTODY AND FIELD QUALITY ASSURANCE/QUALITY CONTROL

Sample labeling, handling, and COC requirements are described in SOP No. 1.02, Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix B**). Alternate sample labeling methods are acceptable upon approval by Ramboll and the owner/operator.

5.1 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 site-specific GMP.

5.2 Sample Identification

CCR unit (or multi-unit) identification (Unit ID or Multi-Unit ID) and monitoring well identification (Well ID) will be according to owner/operator guidelines. Samples collected in the field will be identified on the COC 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 and as described in the DMP (Ramboll, 2022b).

5.3 Sample Container, Volume, Preservation and Holding Times

Groundwater will be containerized, preserved, and stored in accordance with this SAP and SOP No. 1.02, Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix B**) and the DMP (Ramboll, 2022b). Sample containers, volumes, preservatives, and holding times for groundwater samples are summarized on **Table 2**. 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.

5.4 Field Sampling Quality Control

Field Quality Control (QC) samples to be collected as described below and described in the QAPP (Ramboll, 2022a). Field QC collected samples are:

- Field duplicates (FDs)
- Field blanks (FBs) (if required by project manager)
- Equipment blanks (EBs) (if non-dedicated sampling equipment used)
- Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

5.4.1 Field Duplicates

FD samples are collected to evaluate the precision of the whole method, from field sampling to laboratory analysis. FD samples shall 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.

During each sampling event, FDs will be collected at randomly selected wells at a frequency of one in every 10 primary samples and will be analyzed for the same suite of parameters as the primary sample. Duplicate samples will be labeled and packaged in the same manner as primary samples but with "-Dup" appended to the sample ID. Field duplicate quality control samples will be collected by sequentially alternating filling between containers. See Section 5.4 below for more detailed discussion of field quality control samples. Procedures for collecting groundwater samples are described in SOP No. 6.02, Groundwater Purging and Sampling (**Appendix B**) and SOP No. 6.20, Groundwater Sampling - Low Flow (**Appendix B**).

5.4.2 Field Blanks

FBs are used to identify potential contamination of a sample by contaminants from a source not associated with the sample collected (*e.g.*, air-borne dust from a source not related to the samples). FB shall be collected by pouring distilled or DI water directly into the appropriate sample containers at pre-designated locations. They shall also be preserved in the same manner and submitted for the same analyses as investigative samples. After collection, FB are handled and treated in the same manner as primary samples. If required, one FB will be collected per sampling event. The SAR will specify if a FB is required.

5.4.3 Equipment Blanks

EBs are also referred to as rinsate blanks or equipment rinsates. EBs are used to determine if non-dedicated equipment decontamination procedures are sufficient and there is no cross-contamination from one sample to another, and may be used to determine if dedicated equipment is free of measurable concentrations of constituents of potential concern. EBs shall be collected by pouring distilled or DI water onto or into the sampling equipment and directly filling the appropriate sample containers with the water that has contacted the sampling equipment. EB are always collected after sampling equipment has been decontaminated and may be performed prior to collecting the first sample, after collecting highly impacted samples, and/or at the conclusion of sampling. After collection, EBs are handled and treated in the same manner as primary samples, unless noted otherwise in site-specific documents. If required, one equipment blank may be collected per sampling event.

5.4.4 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. MS/MSD samples will be collected at a ratio of one MS/MSD sample per twenty parent samples collected.

5.5 Sample Custody

COC procedures are required by USEPA guidance and will be conducted in accordance with the SOP No. 1.02, Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix B**) and the DMP (Ramboll, 2022x). 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 the SOP No. 1.02, Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix B**). All samples must be accompanied by a COC form at all times . 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 A**.

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.

5.6 Sample Shipping

Transportation and shipping requirements are detailed in SOP No. 1.02, Sample Naming, Labeling, Handling, Shipping and Chain of Custody (**Appendix B**). Deviations from the packing and shipment SOP are allowable if the samplers deliver the samples to the laboratory themselves; 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.

6. 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, 2022a). 40 C.F.R. § 257 and 35 I.A.C. § 845 define the parameters to be analyzed and include the following:

Table C. Groundwater Monitoring Program Parameters

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

The Sampling and Analysis Summary is provided on **Table 2**. 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, 2022a) 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.

The analytical laboratory will qualify data based on the analytical method and will provide the Owner, Owner Program Manager and Ramboll a Level 4 Electronic Data Deliverable (EDD) in an agreed upon format which is compatible with the Ramboll and the owner/operator’s databases in accordance with the QAPP (Ramboll, 2022a). Additional reporting and documentation procedures are described in the DMP (Ramboll, 2022b).

7. DATA MANAGEMENT

Field and groundwater analytical data will be managed and stored by Ramboll as described in the QAPP (Ramboll, 2022a) and the DMP (Ramboll, 2022b).

8. MANAGEMENT OF INVESTIGATIVE DERIVED WASTES

IDW (purge water and decontamination solutions) will be produced during sampling activities. The methodology for the management, storage, and disposal of the wastes is described below. Groundwater (purge water) 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.

8.1 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.

8.2 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.

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), 2022a. Quality Assurance Project Plan. December 28, 2022.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022b. Data Management Plan. December 28, 2022.

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

TABLES

TABLE 1. 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 2. SAMPLING AND ANALYSIS SUMMARY
SAMPLING AND ANALYSIS PLAN
VISTRA CORP

Parameter	Analytical Method[1]	Number of Parent Samples[2]	Field Duplicates[3]	Field Blanks[4]	Equipment Blanks[4]	MS/MSD[5]	Total[6]	Container Type	Minimum Volume[7]	Preservation (Cool to 4 °C for all samples)	Sample Hold Time from Collection Date
Metals - Appendix III (1)											
Boron and Calcium	6020	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	600 mL	HNO_3 to pH<2	6 months
Metals - Appendix IV (2)											
Other Metals (3)	6020, Li - EPA 200.7	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	600 mL	HNO3 to pH<2	6 months
Mercury	7470A or 6020	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	400 mL	HNO_3 to pH<2	28 days
Inorganic Parameters - Appendix III (1)											
Fluoride	9056A, 9251 or EPA 300	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	300 mL	Cool to 4 °C	28 days
Chloride	9056A, 9251 or EPA 300	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	100 mL	Cool to 4 °C	28 days
Sulfate	9056A, 9251 or EPA 300	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	50 mL	Cool to 4 °C	28 days
Total Dissolved Solids	SM 2540 C	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	200 mL	Cool to 4 °C	7 days
Radium - Appendix IV (2)											
Radium 226	9315 or EPA 903	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	1000 mL	HNO3 to pH<2	6 months
Radium 228	9320 or EPA 904	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	plastic	1000 mL	HNO_3 to pH<2	6 months
Field Parameters											
pH (1)	SM 4500-H+ B	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell	NA	none	immediately
Dissolved Oxygen	SM 4500-O/405.1	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell	NA	none	immediately
Temperature	SM 2550	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential	SM 258O B	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell	NA	none	immediately
Specific Conductivity	SM 2510 B	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell	NA	none	immediately
Turbidity (4)	SM 2130 B	TBD	10% of parent samples	TBD	TBD	5% of parent samples	TBD	flow-through cell or hand-held turbidity meter	NA	none	immediately

Notes:
(1) USEPA Appendix III Parameters: collected during Background, Detection and Assessment Monitoring phases (boron, calcium, chloride, fluoride, pH, sulfate, total dissolved solids (TDS)
(2) USEPA Appendix IV Parameters: collected during Background and Assessment Monitoring phases
(antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 combined
(3) Other Metals = antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, lithium, molybdenum, selenium, thallium
(4) If turbidity exceeds 10 NTUs, a duplicate sample filtered through a .45 micron filter may be collected for metals analysis in addition to the unfiltered sample. Both samples would be submitted for analysis
°C = degrees Celsius
EPA = United States Environmental Protection Agency
HNO_3 = nitric acid
mL = milliliter
NA = not applicable
TBD = to be determined
USEPA = United States Environmental Protection Agency

1. Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate
2. Parent sample frequency is provided in the site-specific Groundwater Monitoring Plan.
3. Field duplicates will be collected at a frequency of one per group of 10 or fewer investigative water sample. Field duplicates will not be collected for radium analysis
4. Field blanks will be collected at the discretion of the project manager; Equipment blanks will be collected at a rate of 1 per sampling event if non-dedicated equipment is used
5. Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of one per group of 20 or fewer investigative water samples per CCR unit/multi-unit. Additional volume to be determined by laboratory
6. Total Sample number will be rounded up to nearest whole number based on number of expected percentage of field duplicates, blanks, and MS/MSD samples.
7. Sample volume is estimated and will be determined by the laboratory

FIGURES

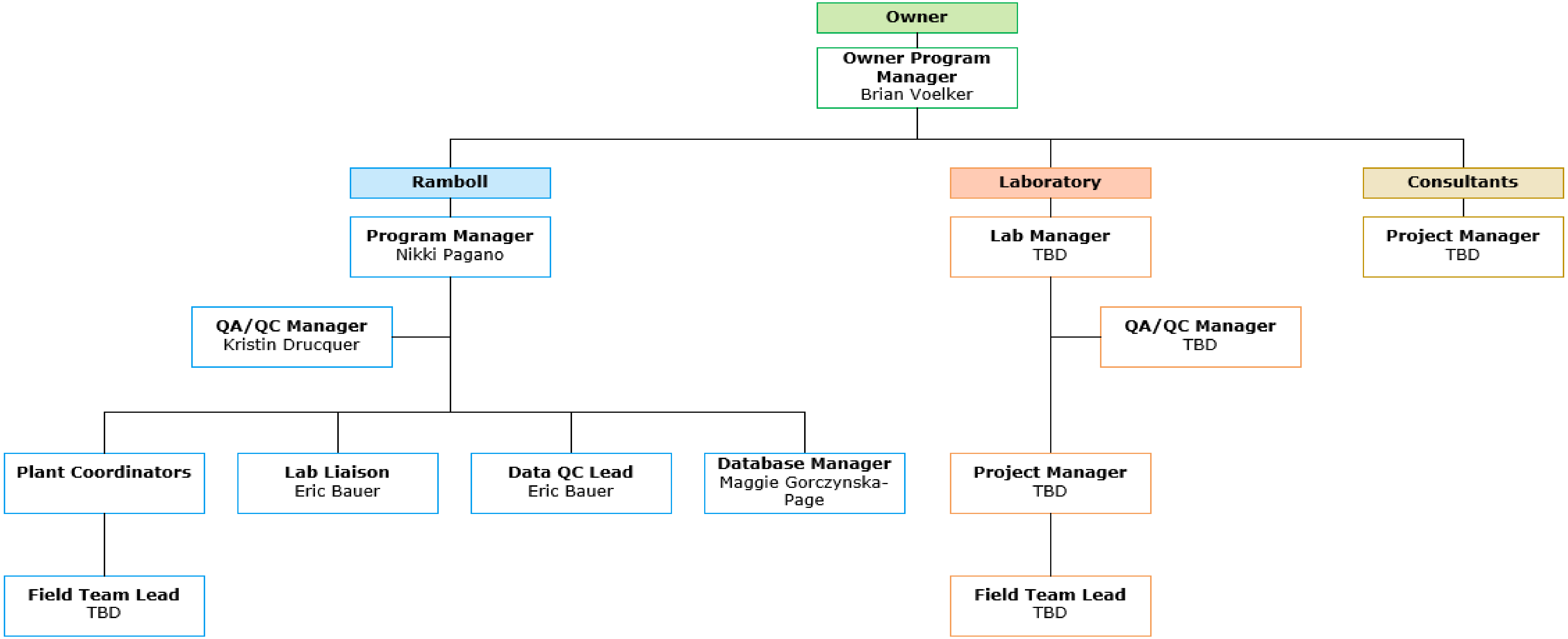

FIGURE 1. ORGANIZATION FLOW CHART

APPENDICES

APPENDIX A
FIELD AND DATA FORMS

APPENDIX A
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

Page: **1** of **3**

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	**REGULATORY AGENCY**
		Address: see Section A	NPDES **GROUND WATER** DRINKING WATER
Email To: Brian.Voelker@VistraCorp.com	Purchase Order No.:	Quote Reference:	UST RCRA OTHER
Phone: (217) 753-8911 Fax:	Project Name:	Project Manager:	Site Location
Requested Due Date/TAT: **10 day**	Project Number: 2285	Profile #:	***STATE:*** IL

Section D
Required Client Information

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

				COLLECTED				Preservatives								Y / N ⬇	Requested Analysis Filtered (Y/N)													
ITEM #	**SAMPLE ID** (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	DATE	TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	**⬇Analysis Test⬇**	HEN_257_801	HEN_257_802	HEN_257_803	HEN_257_804	HEN_811_801	HEN_CLOSURE_802-805	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										
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY):

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Field Calibration Form
Groundwater Quality Meter

Groundwater Quality Meter Manufacturer/Model ______________
Serial Number ____________________
oxidation/reduction potential, dissolved oxygen, pH, tubidity ____

Date of Calibration Check	Calibration Standard Concentration	Calibration Reading	Within +/_ 10% (yes or no)	Comments

Monitoring Well Evaluation Checklist

Site ______________________

Inspection Date ________

Well Number ________

Major wells repairs* required to maintain well integrity?	Yes	No	NA

Stick-up Monitoring Wells	Yes	No	NA	Comments
1. Outer protective Casing				
Not corroded				
Not dented				
Not cracked				
Not loose				

2. Inner casing	Yes	No	NA	
Not corroded				
Not dented				
Not cracked				
Not 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. No water in the flushmount?				
11. Is the well cap lockable?				
12. Is there a lock present?				

All Monitoring Wells	Yes	No	NA	
Downhole Condition				
12. Water level measuring point clearly marked?				
13. No obstructions in well?				
14. No plant roots or vegetation in well?				
15. No 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?				
Not deteriorated?				
Not heaved or below surrounding grade?				
20. No 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 B
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE NO. 1.01

FIELD RECORDS AND NOTES

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 1.01

FIELD RECORDS AND NOTES

Prepared By:	Clem Ockay Sharon Burkett Jason Swankert Jinjun Wang
Peer Reviewed By:	Michael Potts Jose Sananes Stan Popelar Jessica Donovan Nestor Soler
Approved By:	J. Mark Nielsen
Applicable To:	All North American offices
Effective Date:	February 21, 2014
Revision Date:	July 12, 2016
Revision Notes:	1. Revised company name and format. 2. Issued as SOP 12/16/2022
Documents Used as Reference During Preparation:	
Application	This standard operating procedure (SOP) 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.

CONTENTS

ATTACHMENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general procedures established by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for recording and maintaining field notes associated with field activities, site visits, and sampling efforts detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022).

This SOP 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.

It should be noted that this SOP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this SOP 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 SOP. The Ramboll Project Manager (PM) shall ensure that 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 PM indicate approval of the methods and precautions outlined in the HASP.

2. EQUIPMENT/MATERIALS

Equipment and materials necessary to conform to this SOP include:

- 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.
- Watch (or other time keeping device).

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

- Field Log Forms (preferably produced on “Rite-in-the-Rain” water-resistant paper).
- Ruler/Straight Edge.
- Stop-Watch.
- Calculator.
- Laptop Computer.
- 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 activity summary reports, may be produced from the field notes and maintained electronically in portable document format (pdf). An example of Ramboll's activity summary report is provided in **Attachment A**.

3. PROCEDURES REFERENCED

The following SOPs and Standard Practice Instruction (SPI) are related to this SOP and should be referenced, as needed:

- **SPI 27**, Utility Clearance.
- All field sampling and installation SOP categories.

The list above is not intended to be all inclusive. Other SPIs and SOPs may need to be referenced based on the specific requirements of the site-specific sampling plan (e.g., field screening SOPs, SOPs for sampling, etc.).

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 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.
- Scan and/or photocopy the field notes regularly (at least weekly if long-term field work is ongoing).
- Descriptions of activities should be objective, <u>not</u> subjective.
- Descriptions should be consistent with the level of certainty of the observation, for example record "odor <u>like</u> 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.

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. 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 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:

- 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.
- 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).
- 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 SOP 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 Utility Clearance

In accordance with Standard Practice Instruction (SPI) 27, 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 SPI 27. In addition, the subsurface clearance form included in the health & safety plan should be completed.

4.4.1 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.

4.4.2 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.

4.4.3 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.

4.4.4 Documenting a Health and Safety or Utility Incident

- After attending to emergency needs, document all pertinent information in the field book including notifications made and details of the incident such as personnel and equipment involved, and measurements as appropriate.
- Include a description of each photograph in your field book including the information outlined in **Section 4.6** (Photographs).

4.5 Oversight of Remedial Activities

While record keeping requirements for remedial or construction projects must remain consistent with the procedures of this SOP, additional information may need to be tracked and recorded. Discuss the specific requirements with the PM 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, such as that included in Attachment A, should be completed and maintained electronically in portable document format (pdf).

4.6 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 and roll number if using film. Image number if using a digital camera.
- When appropriate, include a person or object for scale (a coin, tape measure, vehicle, etc.).

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. For film photographs, label the outside envelope from the photos and negatives clearly with case/project number, names, dates, etc.

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 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). 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.

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.

ATTACHMENT A
SAMPLE PROJECT-SPECIFIC ACTIVITY SUMMARY REPORT

Activity Summary Report

Date(s): ______________________________ Page 1 of 3

Project:		Location:	
Project #:			
Task #:			

Date	Arrival Time	Departure Time	Temperature AM/PM	Cloud Cover AM/PM	Wind Conditions AM/PM

Summary of Field Notes/Sheets Recorded:

☐ Sample Control Log(s) ______________________________

☐ Well Condition Form(s) ______________________________

☐ Water Level and Field Parameters Field Form(s) ______________________________

☐ Well Development And Groundwater Sampling Field Form(s) ______________________________

☐ Chain-of-Custody(s) ______________________________

☐ Equipment Rental Information ______________________________

☐ Other: ______________________________

Contractor Summary:

Summary of Equipment On-Site:

Site Visitor Summary:

Activity Summary Report

Date(s): ____________________ Page 2 of 3

Project Number: ____________________

Summary of Work (include sample locations, types, media, etc…)

Activity Summary Report

Date(s): ________________________ Page 3 of 3

Project Number: ________________________

Issues/ Resolution:

Additional Comments:

Field Representative: ____________________ Signature: ____________________

Date: ______________________________

STANDARD OPERATING PROCEDURE NO. 1.02

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

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 1.02

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

Prepared By:	Chris Buzgo Taryn Correll Melanie Charles
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Approved By:	J. Mark Nielsen
Applicable To:	All North American offices
Effective Date:	September 16, 2014
Revision Date:	June 1, 2016
Revision Notes:	1. Revised company name and format. 2. Issued as SOP 12/16/2022
Documents Used as Reference During Preparation:	US EPA Region 4, 2007. *Sample and Evidence Management*.
Application	This standard operating procedure (SOP) 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.

CONTENTS

ATTACHMENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general guidelines and procedures established by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for sample management including identification, labeling, handling/packaging, chain-of-custody, and transport detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022). 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 SOP 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 SOP, which may be important to adhere to for the sake of continuity and consistency. See the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022) for additional information. Additional specific requirements for these types of projects and activities will be reviewed by the Ramboll Project Manager (PM) and any additional requirements will be defined in a site-specific Work Plan, sampling plan and/or project-specific SOPs.

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 SOP. For media that are not as commonly sampled, this SOP should be reviewed in the context of project-specific sampling requirements, and modified as applicable.

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

2. EQUIPMENT/MATERIALS

Equipment and materials necessary to conform to this SOP 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

- All field sampling SOP categories.
- **SOP 1.01**, Field Notes and Records.
- **SOP 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 the sample name format to be used since there may be occasions when the standard sample identification (ID) format detailed in this SOP 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 SOP, 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 **SOP 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).
- 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 SOPs.
- 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. An example completed COC is included in **Attachment A**.

- 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 SOPs.
- 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 <u>second most preferred method</u> 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 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 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 **SOP 1.01**, Field Notes and Records. After the COC is signed, by both the releaser and receiver of samples and the 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.

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.

ATTACHMENT A
SAMPLE COMPLETED COC FORM

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

EXAMPLE

Page: 1 of 3

Section A
Required Client Information:

Company: Dynegy Midwest Generation, LLC
Address: 13498 E. 900th St
Email To: Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911 Fax:
Requested Due Date/TAT: **10 day**

Section B
Required Project Information:

Report To: Brian Voelker
Copy To:
Purchase Order No.:
Project Name:
Project Number: 2285

Section C
Invoice Information:

Attention:
Company Name: Dynegy Midwest Generation, LLC
Address: see Section A
Quote Reference:
Project Manager:
Profile #:

REGULATORY AGENCY

NPDES **GROUND WATER** DRINKING WATER
UST RCRA OTHER

Site Location IL
STATE:

Section D
Required Client Information

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

ITEM #	**SAMPLE ID** (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED		SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	*Preservatives*								Y/N	**Requested Analysis Filtered (Y/N)**												Residual Chlorine (Y/N)	**Project No./ Lab I.D.**
				DATE	TIME			Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	**Analysis Test**	HEN_257_801	HEN_257_802	HEN_257_803	HEN_257_804	HEN_811_801	HEN_CLOSURE_802-805	HEN_CLOSURE_804	HEN_WPCP_East	HEN_WPCP_West					
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
HEN-23Q1 Rev 0						

SAMPLE CONDITIONS

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:
SIGNATURE of SAMPLER: **DATE Signed (MM/DD/YY):**

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

STANDARD OPERATING PROCEDURE NO. 6.02

GROUNDWATER PURGING AND SAMPLING

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 6.02

GROUNDWATER PURGING AND SAMPLING

Prepared By:	Will Larrison
Peer Reviewed By:	Jose Sananes David Lis David Heidlauf Ryan Keeler Seema Turner Valerie Turner David Heinze Carol Serlin Clem Ockay Nestor Soler
Approved By:	J. Mark Nielsen
Applicable To:	All North American offices
Effective Date:	May 23, 2016
Revision Notes:	
Documents Used as Reference During Preparation:	US EPA Region 4, Science and Ecosystem Support Division, March 6, 2013. *Groundwater Sampling*, SESDPROC-301-R3. US EPA Region 9 Laboratory, September 2004. *Field Sampling Guidance Document #1220 – Groundwater Well Sampling*. US EPA OSWER, *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, EPA 542-S-02-001, May 2002. NJDEP, August 2005. *Field Sampling Procedures Manual*. USGS, 2006. *National Field Manual for the Collection of Water-Quality Data*, Chapter 4.
Application	This standard operating procedure (SOP) 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.

CONTENTS

ATTACHMENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general guidelines established by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for the collection of groundwater samples for laboratory analysis following well purging (other than low-flow sampling techniques which are described in **SOP 6.20**, Groundwater Sampling – Low Flow) and detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022).

This SOP 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.

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 (refer to **Attachment A**), 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.

It should be noted that this SOP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this SOP 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 SOP. The Ramboll Project Manager (PM) shall ensure 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. The signatures of the 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 **SOP 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 **SOP 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 **SOP 15.01**, Waste Handling);
   - Labeling materials for IDW containers as outlined in **SOP 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 **SOP 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 **SOP 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 **SOP 1.02**, Sample Handling, Shipping and Chain of Custody);
    - Sample labels and clear tape;
    - Chain of custody forms (refer to **SOP 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 SOPs are related to this SOP and should be reviewed prior to mobilization, as needed:

- **SOP 1.01**, Field Notes and Records.
- **SOP 1.02**, Sample Handling, Shipping and Chain of Custody.
- **SOP 1.03**, Analytical Data Management.
- **SOP 1.05**, Field Quality Control Samples.
- **SOP 2.02**, Site Preparation, Inspection and Housekeeping.
- **SOP 4.04**, Field Screening - Water Quality.
- **SOP 4.06**, Equipment Calibration.
- **SOP 6.04**, Groundwater and Free Product Level Measurements.

- **SOP 6.20**, Groundwater Sampling - Low Flow Purge.
- **SOP 14.01**, Sampling Equipment Decontamination.
- **SOP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other SOPs 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 SOPs, SOPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant sampling strategy decisions will be approved by the 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 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. A detailed list of bailer/pump options and their advantages/limitations is provided on **Table 1** in **Attachment A**.
- *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 SOPs 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 **SOP 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 **SOP 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 **SOP 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 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 **SOP 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 **SOP 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 (refer to **SOP 4.06**, Equipment Calibration). 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 **SOP 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. A description of groundwater sampling equipment is provided in **Attachment A**. 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 **SOP 6.04**, Groundwater and Free Product Measurements) and measure gas concentrations in accordance with the applicable manufacturer instructions and field screening SOPs (e.g., **SOP 4.01** - Field Screening - Combustible Gas, **SOP 4.02** - Field Screening - Volatile Gas, **SOP 4.03** - Field Screening - Landfill 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 **SOP 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 **SOP 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:

    $$V_w = 7.48(\pi \frac{d_w^2}{4} \mathrm{h}_w)$$

    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 **SOP 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:

$$V_w = 7.48\left(\pi \frac{d_w^2}{4} \mathrm{h}_w\right)$$

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 SOPs 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 **SOP 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 **SOP 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 the 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 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 **SOP 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 PM so necessary maintenance, redevelopment or repairs are conducted before the next planned water sampling event.

4.4 Sample Containers

As outlined in **SOP 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 **SOP 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 **SOP 1.05** (Field Quality Control Samples) should be reviewed.

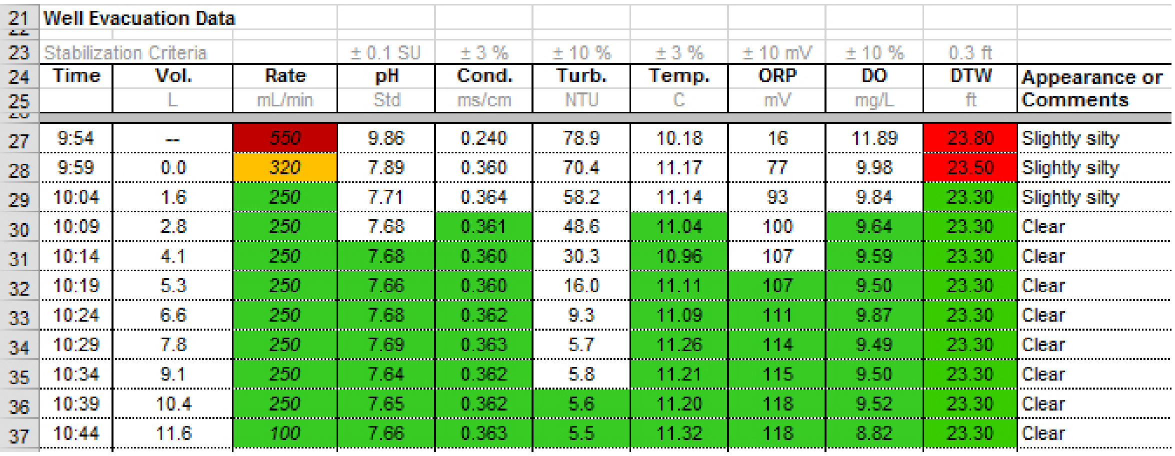
5. PRECAUTIONS AND OTHER CONSIDERATIONS

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 **SOP 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 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 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. To see a report-ready completed sheet, see **Attachment B.**

- 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 **SOP 1.04** (Documenting Sampling Locations) and record all information related to groundwater sampling in accordance with **SOP 1.01** (Field Notes and Records) and **SOP 1.03** (Data Management).

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.

ATTACHMENT A
GROUNDWATER PURGING AND SAMPLING EQUIPMENT

Several styles of well evacuation equipment exist for the collection of groundwater samples. Equipment choice will depend on a variety of factors including but not limited to cost, well specifications, and sampling parameters. The following are brief descriptions of the more commonly used groundwater purging and/or sampling equipment.

Bailer

The bailer is one of the oldest and simplest methods of sampling and consists of a rigid cylindrical length of polyethylene, PTFE or stainless steel with a check valve or other sealing mechanism at one or both ends. It is available in numerous dimensions to accommodate a wide variety of well diameters. Double check valve bottom-draining bailers are recommended as they allow for lessened sample disturbance during transfer to the container.

Figure 1 Disposable Bailers

Source: http://www.geotechenv.com/

Figure 2 Peristaltic Pump

Source: http://www.geotechenv.com/

Peristaltic Pump

A suction lift pump (negative air pressure) consisting of a rotor and ball bearing rollers. Liquid moves totally within the tubing dedicated for sampling so no part of the pump contacts the liquid. Medical-grade silastic tubing is recommended for the section in contact with the rollers. Geopump and Solinst are popular manufacturers of this pump type.

Submersible Pump

Consists of an electric motor in a stainless steel and Teflon housing that drives two or more impellers at high rates of rotation, bringing water to the surface at a continuous rate. It can be operated with a generator or a 12V battery. Grundfos is a popular manufacturer of this pump type.

Figure 3 Submersible Pump

Source: http://www.geotechenv.com/

Gear Pump

A small and lightweight pump that is similar to the submersible pump. It functions through the use of two or more internal gears that create positive displacement. As the gears rotate they separate on the intake side of the pump, creating a void and suction which is filled by fluid. The fluid is carried by the gears to the discharge side of the pump, where the meshing of the gears displaces the fluid. Fultz is a popular manufacturer of these pumps.

Figure 4 Gear Pump

Source: http://www.nj.gov

Inertial Pump

Working on the principal of inertia, this pump consists of tubing with a check valve at one end of it. The pump operates simply by lifting the pump up and dropping it back down. The check valve allows water to enter when the pump is dropped, but not escape when lifting the pump back up. Continued up and down movement advances water upward due to inertia. Waterra is a common manufacturer of this type of pump

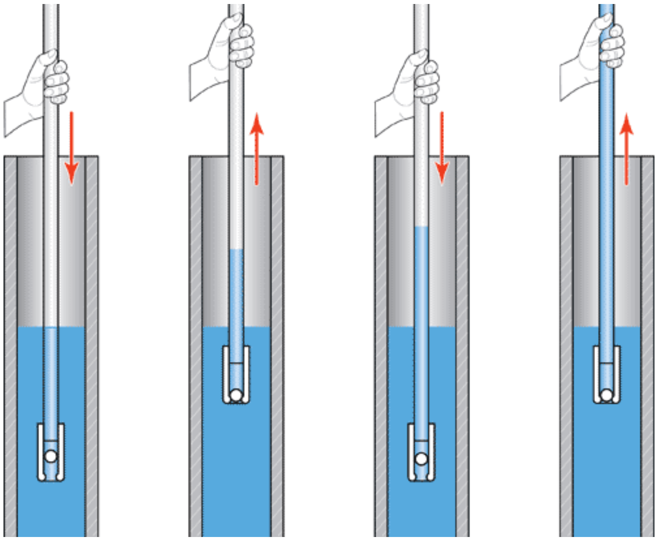


Figure 7 Ineartial Pump

Source: http://www.fao.org

A comparison of the various pump options and their advantages/limitations is provided on **Table 1**.

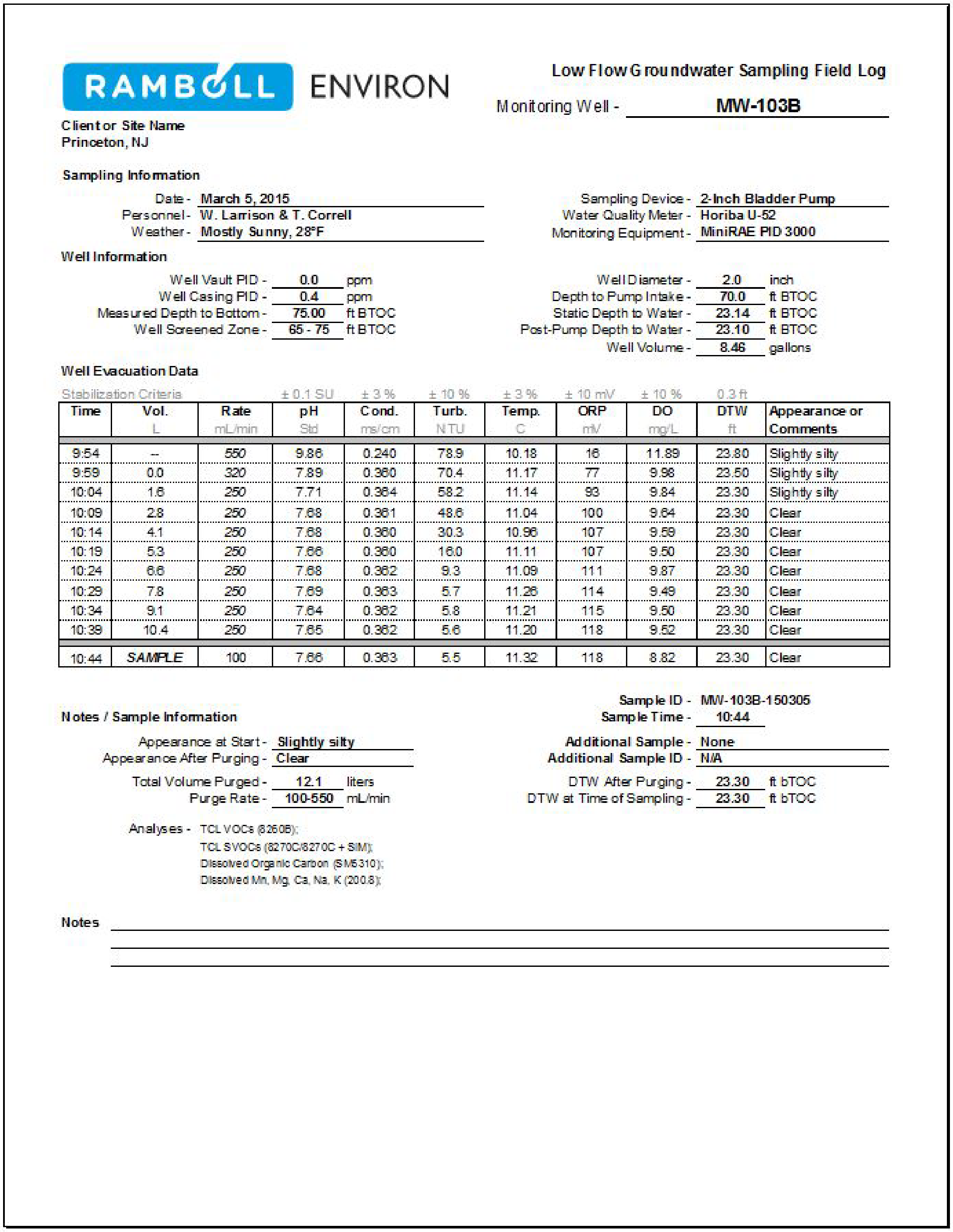
Table 1 - Groundwater Sampling Pumps

Pump Type	Advantages	Disadvantages	Sampling Capability	Approximate Lift Capacity
Bailers	• Simple • Low cost • No power source needed • Portable and readily available	• Disturbance of sample generally unavoidable • Cannot be relied upon for air sensitive parameters including DO, pH, CO and Fe • VOC may be biased low (due to aeration)	VOC results may be biased low due to aeration of the sample and thus this is not the preferred method for VOC sampling.	Not Applicable
Peristaltic Pump	• Speed of operation is variably controlled • No decontamination of the pump necessary • Easy to operate	• Limited to a depth of about 25 ft • Not reliable for air sensitive parameters including DO, pH, CO2 or Fe • Not reliable for VOCs and SVOCs • Needs external power source • Some devices require priming • Some devices difficult to sample through due to surges in flow	Restricted from sampling for VOCs and SVOCs due to the negative pressure imparted upon the sample.	Up to 25 feet
Bladder Pump	• Acceptable for sampling for all parameters • Simple design and operation • Minimal disturbance of sample	• Large gas volumes may be needed • Only pumps with disposable bladders may be field cleaned for portable use when approved decontamination methods are employed • Depth	Acceptable for sampling for all parameters.	Up to 500 feet

Table 1 - Groundwater Sampling Pumps

Pump Type	Advantages	Disadvantages	Sampling Capability	Approximate Lift Capacity
Submersible Centrifugal Pump	• Versatile and light weight • Variable speed control for fine tuning of flow rate • Acceptable for low-flow purging and sampling • Able to be thoroughly decontaminated due to ability of complete disassembly	• Sample temperature may be biased high during low-flow sampling due to high rotation rate of impellers • Motor stall possible at low pumping rates • Requires external power source • Impellers easily damaged by silty/sandy water • Difficult to clean and maintain in the field	May not be acceptable for sampling for trace contaminants, but useful for all other parameters.	Up to 525 feet
Gear Pump	• Good variable speed control especially at low rates • Acceptable for low flow purging and sampling • Light weight	• Difficult to decontaminate when in the field • Turbid purge water wears on the gears • Cannot properly handle suspended solids • Gears may be damaged in silty/sandy water • Gears may bind in water exceeding 85 degrees F	Acceptable for sampling for all parameters.	Up to 150 feet
Inertial Pump	• Inexpensive and easy to operate • Rapid method for sampling shallow wells Simple decontamination of valves	• Labor intensive and time consuming • Unavoidable agitation caused by pumping resulting in agitation and aeration • Uneven sample delivery. Some models are only useful in 2-inch diameter wells	May not be acceptable for sampling VOCs due to potential loss through agitation.	Between 75 to 300 feet, depending on type of pump and well

ATTACHMENT B
GROUNDWATER PURGING SHEET



RAMBOLL ENVIRON

Low Flow Groundwater Sampling Field Log

Monitoring Well - **MW-103B**

Client or Site Name
Princeton, NJ

Sampling Information

Date - **March 5, 2015**
Personnel - **W. Larrison & T. Correll**
Weather - **Mostly Sunny, 28°F**

Sampling Device - **2-Inch Bladder Pump**
Water Quality Meter - **Horiba U-52**
Monitoring Equipment - **MiniRAE PID 3000**

Well Information

Well Vault PID - 0.0 ppm
Well Casing PID - 0.4 ppm
Measured Depth to Bottom - 75.00 ft BTOC
Well Screened Zone - 65 - 75 ft BTOC

Well Diameter - 2.0 inch
Depth to Pump Intake - 70.0 ft BTOC
Static Depth to Water - 23.14 ft BTOC
Post-Pump Depth to Water - 23.10 ft BTOC
Well Volume - 8.46 gallons

Well Evacuation Data

Stabilization Criteria			± 0.1 SU	± 3 %	± 10 %	± 3 %	± 10 mV	± 10 %	0.3 ft	
Time	**Vol.** L	**Rate** mL/min	**pH** Std	**Cond.** ms/cm	**Turb.** NTU	**Temp.** C	**ORP** mV	**DO** mg/L	**DTW** ft	**Appearance or Comments**
9:54	--	*550*	9.86	0.240	78.9	10.18	16	11.89	23.80	Slightly silty
9:59	0.0	*320*	7.89	0.360	70.4	11.17	77	9.98	23.50	Slightly silty
10:04	1.6	*250*	7.71	0.364	58.2	11.14	93	9.84	23.30	Slightly silty
10:09	2.8	*250*	7.68	0.361	48.6	11.04	100	9.64	23.30	Clear
10:14	4.1	*250*	7.68	0.360	30.3	10.96	107	9.59	23.30	Clear
10:19	5.3	*250*	7.66	0.360	16.0	11.11	107	9.50	23.30	Clear
10:24	6.6	*250*	7.68	0.362	9.3	11.09	111	9.87	23.30	Clear
10:29	7.8	*250*	7.69	0.363	5.7	11.26	114	9.49	23.30	Clear
10:34	9.1	*250*	7.64	0.362	5.8	11.21	115	9.50	23.30	Clear
10:39	10.4	*250*	7.65	0.362	5.6	11.20	118	9.52	23.30	Clear
10:44	***SAMPLE***	100	7.66	0.363	5.5	11.32	118	8.82	23.30	Clear

Notes / Sample Information

Sample ID - MW-103B-150305
Sample Time - 10:44

Appearance at Start - **Slightly silty**
Appearance After Purging - **Clear**

Additional Sample - None
Additional Sample ID - N/A

Total Volume Purged - 12.1 liters
Purge Rate - 100-550 mL/min

DTW After Purging - 23.30 ft bTOC
DTW at Time of Sampling - 23.30 ft bTOC

Analyses - TCL VOCs (8260B);
TCL SVOCs (8270C/8270C + SIM);
Dissolved Organic Carbon (SM5310);
Dissolved Mn, Mg, Ca, Na, K (200.8);

Notes

Figure 2:

Completed Groundwater Purge Sheet, finalized for printing.

STANDARD OPERATING PROCEDURE NO. 6.04

GROUNDWATER AND FREE PRODUCT LEVEL MEASUREMENTS

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 6.04

GROUNDWATER AND FREE PRODUCT LEVEL MEASUREMENTS

Prepared By:	Doug Burge Josh Myers
Peer Reviewed By:	Nick Zurweller Jason Schwankert Justine Petras Christopher Ritchie John Noble Luke Chmielecki Carol Serlin Jose Sananes Nestor Soler
Approved By:	J. Mark Nielsen
Applicable To:	All North American offices
Effective Date:	February 21, 2014
Revision Date:	July 12, 2016
Revision Notes:	1. Revised company name and format. 2. Issued as SOP 12/16/2022
Documents Used as Reference During Preparation:	
Application	This standard operating procedure (SOP) 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.

CONTENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general guidelines established by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for groundwater level measurements (depth to water) in groundwater monitoring wells or piezometers detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022). These guidelines may also be applicable for measuring the depth to water in other types of wells (potable and non-potable) or boreholes as applicable.

This SOP 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.

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 SOP does not supersede Ramboll Health and Safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this SOP 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 SOP. The Ramboll Project Manager (PM) shall ensure 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. The signature of the 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 SOPs are related to this SOP and should be referenced, as needed:

- **SOP 1.01**, Field Notes and Records;
- **SOP 1.03**, Data Management;
- **SOP 1.06**, Field Surveying and Monitoring Well Elevation Surveying;
- **SOP 2.02**, Site Preparation, Inspection and Housekeeping;
- **SOP 4.06**, Equipment Calibration;
- **SOP 6.15**, Well Construction Record; and
- **SOP 14.01**, Sampling Equipment Decontamination.

The list above is not intended to be all inclusive. Other SOPs 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 SOPs, SOPs 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 **SOP 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 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 **SOP 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 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 PM.

Prior to the commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements (refer to **SOP 4.06**, Equipment Calibration).

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 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 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 SOP. 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 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 **SOP 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 **SOP 1.04** (Documenting Sampling Locations) and record all information in accordance with **SOP 1.01** (Field Notes and Records) and **SOP 1.03** (Data Management).

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.

STANDARD OPERATING PROCEDURE NO. 6.20

GROUNDWATER SAMPLING - LOW FLOW

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 6.20

GROUNDWATER SAMPLING - LOW FLOW

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Application	This standard operating procedure (SOP) 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.

CONTENTS

ATTACHMENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general guidelines developed by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for the collection of groundwater samples for laboratory analysis using low-flow purging and sampling techniques detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022).

This SOP 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.

The purpose of Low-Flow Purging and Sampling (LFPS) is to collect groundwater samples that are representative of ambient groundwater conditions in the aquifer. 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.

It should be noted that this SOP does not supersede Ramboll health and safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this SOP 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 SOP. The Ramboll 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 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 LFPS is provided below. Additional equipment may be specified in the project-specific HASP and/or Field Sampling Plan (FSP). This checklist includes an overall summary of general equipment typically required for LFPS and 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 of the equipment and materials that are required for low-flow groundwater sampling.

1. General Groundwater Sampling Equipment Checklist:
   - Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points);
   - Well construction specifications and diagrams;
   - Groundwater sampling logs and field forms from the previous sampling event;
   - Field notebook and all-weather or permanent pens as outlined in **SOP 1.01** (Field Notes and Records).
   - Plastic sheeting;
   - Cable ties;
   - Keys for wells;
   - Measuring tape;
   - Electronic water level indicator (refer to **SOP 6.04**, Groundwater and Free-Product Level Measurements);
   - Sample containers (appropriate for various analysis to be performed);
   - Sample shipment containers and ancillary materials (refer to **SOP 1.02**, Sample Handling, Shipping and Chain of Custody);
   - Sample labels, indelible pen or sharpie, and clear tape;
   - Chain of custody forms (refer to **SOP 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 **SOP 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 **SOP 15.01**, Waste Handling);
   - Labeling materials for Investigation Derived Waste (IDW) containers as outlined in **SOP 15.01** (Waste Handling);
   - Bucket, spray bottle, distilled/deionized water, and Liquinox (or Alconox) – used for the decontamination of sampling and monitoring equipment (refer to **SOP 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. Project- or Task-Specific LFPS Equipment Checklist:
   - 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 must be either Teflon® or Teflon®-lined polyethylene. However, when sampling for metals analysis only, the tubing may be constructed of flexible polypropylene or polyethylene;
   - 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);
   - Plumbing fittings – check valves, barbed “T” or “Y” fittings, stainless-steel needle valves or stainless-steel/Teflon ball valves; and
   - 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).
3. Miscellaneous 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 plugs/well caps, well lid bolts;
   - Road and site maps;
   - Folding work table;
   - Mobile phone; and
   - Camera and extra batteries.

A description of the types of LFPS pumps is provided in **Attachment A**.

3. REFERENCED GUIDANCE DOCUMENTS

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

- **SOP 1.01**, Field Notes and Records;
- **SOP 1.02**, Sample Handling, Shipping and Chain of Custody;
- **SOP 1.03**, Data Management;
- **SOP 1.05**, Field Quality Control Samples;
- **SOP 2.02**, Site Preparation, Inspection and Housekeeping;
- **SOP 4.04**, Field Screening - Water Quality;
- **SOP 4.06**, Equipment Calibration;
- **SOP 6.02**, Groundwater Sampling;
- **SOP 6.04**, Groundwater and Free Product Measurements;
- **SOP 14.01**, Sampling Equipment Decontamination; and
- **SOP 15.01**, Waste Handling.

The list above is not intended to be all inclusive. Other SOPs 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 SOPs, SOPs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant sampling strategy decisions will be approved by the 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 number of samples, locations, depths, number of sampling sites, analytical parameters, methods, and analytical detection/reporting limits, as well as quality assurance/quality control sample requirements. The Work Plan/Field Sampling Plan will generally provide some discretion in the field depending on the conditions encountered; however, any significant departure from prescribed sampling activities should be discussed with and approved by the PM.

When planning a low-flow sampling event, the following should be considered:

- *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 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. A description of common LFPS equipment is provided in **Attachment A** and a list of their advantages/limitations is provided on **Table 1** in **Attachment A**.

- *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 discharge of the flow cell may be fitted with a check valve.
- *Pump Intake Location* - When LFPS is performed correctly, the data being collected should be reflective of water quality within a narrow zone along a length of well screen or fracture in an open borehole. For these reasons, it is important to place the pump intake in the zone of highest contaminant concentration or contaminant flux along the screened/open-hole interval. This is particularly important in wells constructed with more than five 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 by borehole geophysical methods (refer to **SOP 3.08**, Downhole Gamma Ray Logging, **SOP 3.09**, Downhole Caliper Logging, and/or **SOP 3.10**, Downhole Geophysical, Acoustic, and Video Logging), hydrogeological field tests (refer to **SOP 6.03**, Determination of Hydraulic Properties - Slug Test and/or **SOP 6.08**, Determination of Hydraulic Properties - Pump Test) 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 SOPs 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 **SOP 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 **SOP 6.02**, Groundwater 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 **SOP 14.01** (Sampling Equipment Decontamination), project-specific Work Plan/Field Sampling Plan, and/or Quality Assurance Project Plan (QAPP). Used dedicated sampling equipment that is considered IDW should be managed in accordance with **SOP 15.01**, Waste Handling, following the sampling 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.
- Review project-specific Work Plan/Field Sampling Plan/QAPP, where applicable.
- Review and discuss with the 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(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 mobilizing.
- Ensure that all equipment/materials required to complete the work have been secured and packed prior to travel.

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 **SOP 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 **SOP 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 (refer to **SOP 4.06**, Equipment Calibration). Pre-measuring the pump suspension line and/or discharge tubing to the individualized targeted well depths, and pre-labeling sample containers in advance of field efforts will increase productivity (refer to **SOP 1.02**, Sample Handling, Shipping and Chain of Custody). However, special care should be taken to ensure that the correct pre-labelled 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 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 **SOP 6.04**, Groundwater and Free Product Measurements) and measure head space concentrations in accordance with the applicable manufacturer instructions and field screening SOPs (e.g., **SOP 4.01**, Field Screening - Combustible Gas; **SOP 4.02**, Field Screening - Volatile Gas; **SOP 4.03**, Field Screening - Landfill 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 plan.
- As detailed in **SOP 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 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 **SOP 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 **SOP 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.
- Prior to groundwater sampling, the well should be purged. 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 SOPs 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)
ORP/Eh	± 10 millivolts
Water Level Drawdown	< 0.3 ft from static [See Note 4]

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: 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 **SOP 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 and disconnect the water quality meter from the discharge tubing;
- Wells should be sampled as soon as possible after purging. Refer to **SOP 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 **SOP 6.02**, Groundwater Sampling.
- 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, remove the equipment from the monitoring well and decontaminate in accordance with **SOP 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 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 PM so necessary maintenance, redevelopment or repairs are conducted before the next planned water sampling event.

4.4 Sample Containers

As outlined in **SOP 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 sample container requirements and the quality assurance needs 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.

4.5 Sample Transport and Storage

Samples shall be handled, transported and stored in an attempt to maintain structural and chemical qualities of the groundwater samples. Sampling bottles shall be handled as outlined in **SOP 1.02** (Sample Handling, Shipping and Chain of Custody). All samples should be kept in an ice-filled transport container during field work 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 bottle ware 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 labelling are performed in accordance with applicable DOT-requirements.

4.6 QA/QC

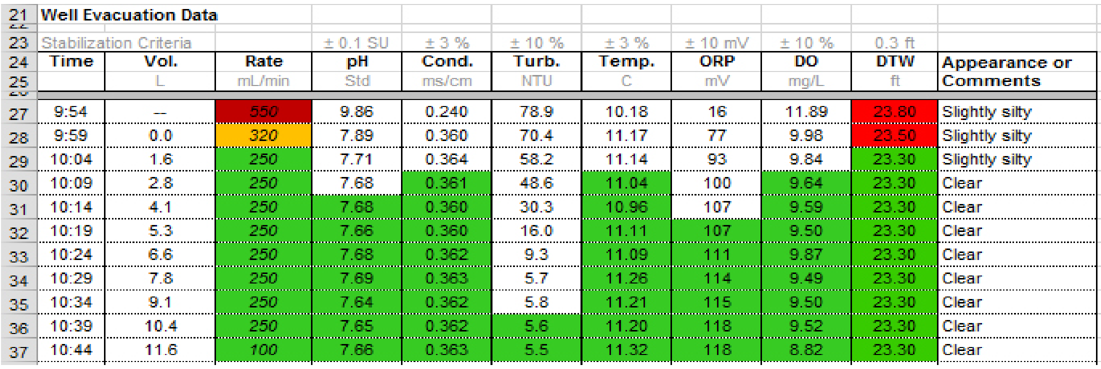
Quality Assurance/Quality Control (QA/QC) procedures described in the project-specific Work Plan/Field Sampling Plan and/or QAPP must be followed throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **SOP 1.05** (Field Quality Control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

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, including the following:

- 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 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 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 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 **SOP 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**
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 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 **Attachment B**.

- 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.
- 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.
- Each sampling effort should attempt to minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).
- 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 **SOP 1.04** (Documenting Sampling Locations) and record all information related to groundwater sampling in accordance with **SOP 1.01** (Field Notes and Records) and **SOP 1.03** (Data Management).

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.

ATTACHMENT A
GROUNDWATER SAMPLING EQUIPMENT

ATTACHMENT A - GROUNDWATER SAMPLING EQUIPMENT

Several types of well water evacuation equipment exist for the collection of groundwater samples using LFPS techniques. Equipment choice will depend on a variety of factors including but not limited to cost, well specifications, and sampling parameters. Two basic collection scenarios have a bearing on pump selection:

- Dedicated System (a permanently installed pump system in a well) – A dedicated pump system consists of a single pump and tubing set up in each permanent monitoring well. This allows consistent sampling from a targeted monitor zone without the need to install/remove the pump during each monitoring event. Typically used for long-term monitoring at sites, a dedicated system usually consists of the pump and the associated tubing, with the controller mobilized for each sampling event.
- Portable System (transferable from well to well) – A portable LFPS system allows low-flow sampling from many monitoring wells using the same pump. Commonly available portable systems are easy to disassemble, without any tools, and simple to clean to eliminate any potential cross contamination.

Bladder pumps can be used for either system, however, only those with disposable bladders and easily cleaned parts are suitable when sampling on a well-to-well basis. Variable-speed submersible-centrifugal pumps, gear or progressive-cavity pumps can be used for either operating system as long as they are constructed of easy to clean stainless steel/Teflon® parts. Pumps constructed with impellers, helicoils, or gears, which are difficult to clean or are constructed of unacceptable plastic parts, are not suitable for sampling.

Following are brief descriptions of more commonly used pumps for low-flow groundwater purging and/or sampling. A comparison of these pumps is provided in **Table 1**.

Bladder Pumps

Bladder pumps use pneumatic pressure, a liner or bladder and a series of check valves that allow the bladder to fill with liquid then pneumatic pressure pushes on the bladder forcing fluid from the pump. The assembly typically includes a pump, a controller, an air compressor or compressed air, and tubing. Pneumatic bladder pumps operate with a unique, gentle action ideal for low-flow sampling. Timed on/off cycles of compressed air alternately squeeze the flexible bladder to displace water out of the pump, and release it to allow the pump to refill by submergence. Following the fill cycle, compressed air or nitrogen from a cylinder or compressor at the wellhead is driven down to the pump through tubing to compress the bladder, thus driving the water sample up to the surface through a second tubing line. The pumping sequence consists of repeated fill–compress cycles, using a pneumatic controller positioned at the wellhead. The controller is used to vary the duration and frequency of the fill–compress cycles in order to deliver the desired sample flow rate at the wellhead.

Figure 1: Bladder Pump Setup (left) and Pump (right)

Source: www.soilinst.com

The bladder design offers the advantage of minimizing sample turbulence, which can result in loss of VOCs in the sample, as well as eliminating contact of the water sample with the compressed air or nitrogen used to lift the sample to the surface. Bladder pumps run easily at low rates for extended times without overheating (like high-speed electric pump motors) which can alter samples and ruin the pumps, and without creating any disturbance that could affect sample chemistry. Some manufacturers of bladder pumps include QED, Geotech and Solinst.

Submersible Pumps

Submersible pumps consist of an electric motor in a stainless steel and Teflon housing that drives two or more impellers at high rates of rotation, bringing water to the surface at an uninterrupted flow during sampling. The assembly typically includes a pump, a controller, a power source, and tubing.

Figure 2: Submersible Pump

Source: http://www.geotechenv.com/

These pumps are light weight and versatile. To overcome potential overheating that could affect sample quality, the pumps can be provided with a cooling shroud. To avoid potential issues backflow, the pump should be provided with a check valve. In addition, to provide greater pump speed control (e.g., to account for changes in pressure and torque at the impellers) and minimize potential pump flow loss, the pump controller should be equipped with a "ten turn pot" frequency adjustment knob. Some manufacturers of submersible pumps include Geotech, and Waterra.

Figure 3: Gear Pump

(Source: http://www.fultzpumps.com)

Gear Pump

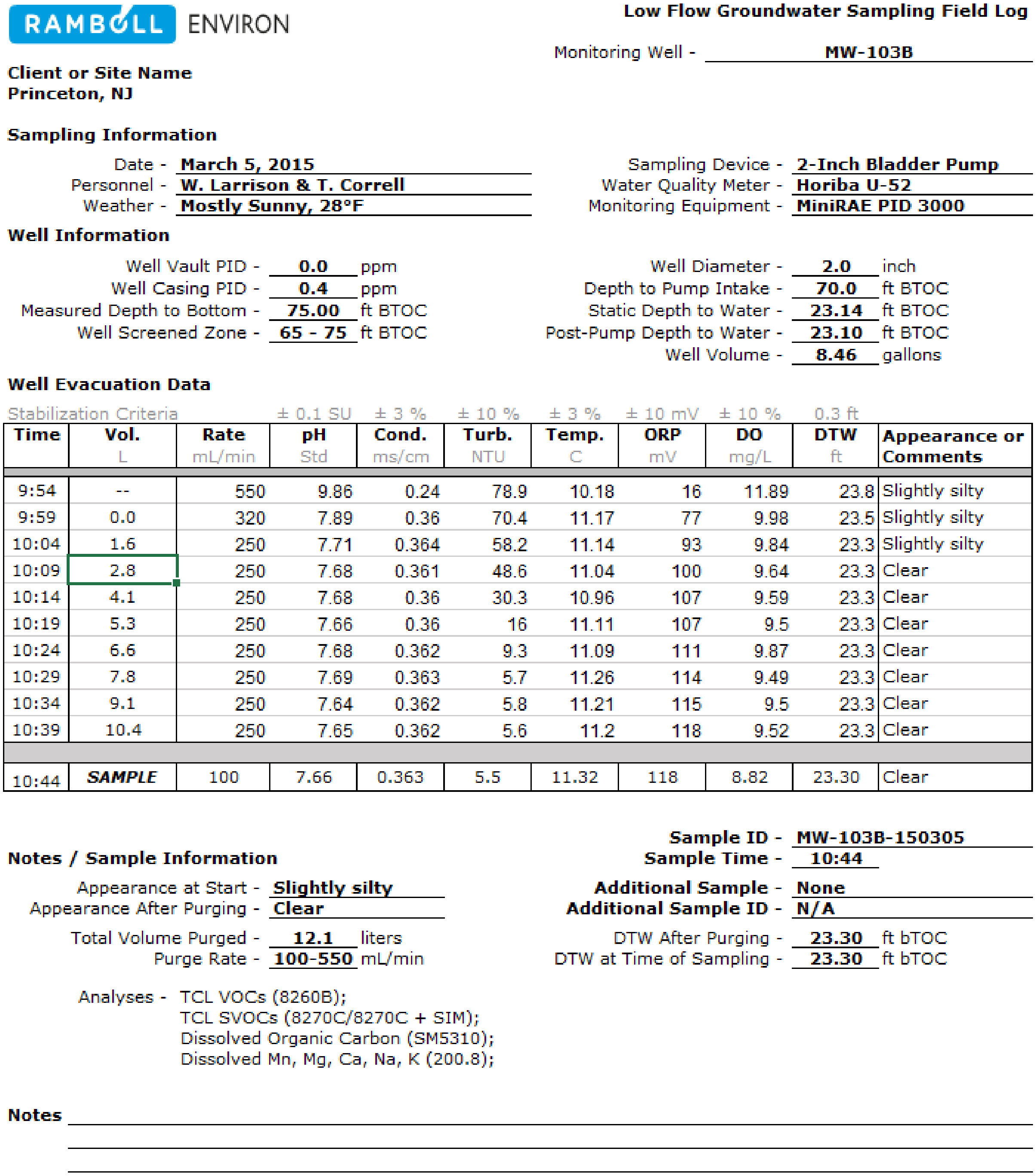
The gear pump is a small and lightweight pump that is constructed of stainless steel and Teflon® and operates on positive displacement. The assembly typically includes a pump, a controller, a battery, and tubing. It functions through the use of two or more internal Teflon® gears within a stainless steel cavity that displaces water up the hose in a steady stream. As the gears rotate they separate on the intake side of the pump, creating a void and suction which is filled by fluid. The fluid is carried by the gears to the discharge side of the pump, where the meshing of the gears displaces the fluid.

The pump's low rpm electric motor will not disturb the sample as it generates little heat. Compared to the submersible pumps, which have impellers, the gear pumps require less flow rate adjustments and provide more consistent flow. Fultz is a manufacturer of gear pumps.

Table 1: Groundwater Sampling Pumps

Pump Type	Advantages	Disadvantages	Sampling Capability	Approximate Lift Capacity
Bladder Pump	• Acceptable for sampling for all parameters. • Simple design and operation • Minimal disturbance of sample.	• Large gas volumes may be needed. • Only pumps with disposable bladders may be field cleaned for portable use when approved decontamination methods are employed.	Acceptable for sampling for all parameters.	Up to 1000 feet
Submersible Centrifugal Pump	• Versatile and light weight. • Variable speed control for fine tuning of flow rate. • Able to be thoroughly decontaminated due to ability of complete disassembly.	• Sample temperature may be biased high during low-flow sampling due to high rotation rate of impellers. • Motor stall possible at low pumping rates. • Requires external power source. • Impellers easily damaged by silty/sandy water. • Difficult to clean and maintain in the field.	May not be acceptable for sampling for trace contaminants, but useful for all other parameters.	Up to 280 feet
Gear Pump	• Good variable speed control especially at low rates. • Light weight. • Does not have temperature issue as gears do not create excess heat like electric impeller pumps.	• Difficult to decontaminate when in the field. • Turbid purge water wears on the gears. • Cannot properly handle suspended solids. • Gears may be damaged in silty/sandy water. • Gears may bind in water exceeding 85 degrees F.	Acceptable for sampling for all parameters.	Up to 150 feet

ATTACHMENT B
GROUNDWATER PURGING SHEET



RAMBOLL ENVIRON

Low Flow Groundwater Sampling Field Log

Monitoring Well - **MW-103B**

Client or Site Name
Princeton, NJ

Sampling Information

Date - **March 5, 2015**
Personnel - **W. Larrison & T. Correll**
Weather - **Mostly Sunny, 28°F**

Sampling Device - **2-Inch Bladder Pump**
Water Quality Meter - **Horiba U-52**
Monitoring Equipment - **MiniRAE PID 3000**

Well Information

Well Vault PID - **0.0** ppm
Well Casing PID - **0.4** ppm
Measured Depth to Bottom - **75.00** ft BTOC
Well Screened Zone - **65 - 75** ft BTOC

Well Diameter - **2.0** inch
Depth to Pump Intake - **70.0** ft BTOC
Static Depth to Water - **23.14** ft BTOC
Post-Pump Depth to Water - **23.10** ft BTOC
Well Volume - **8.46** gallons

Well Evacuation Data

Time	Vol. L	Rate mL/min	pH Std	Cond. ms/cm	Turb. NTU	Temp. C	ORP mV	DO mg/L	DTW ft	Appearance or Comments
Stabilization Criteria			± 0.1 SU	± 3 %	± 10 %	± 3 %	± 10 mV	± 10 %	0.3 ft	
9:54	--	550	9.86	0.24	78.9	10.18	16	11.89	23.8	Slightly silty
9:59	0.0	320	7.89	0.36	70.4	11.17	77	9.98	23.5	Slightly silty
10:04	1.6	250	7.71	0.364	58.2	11.14	93	9.84	23.3	Slightly silty
10:09	2.8	250	7.68	0.361	48.6	11.04	100	9.64	23.3	Clear
10:14	4.1	250	7.68	0.36	30.3	10.96	107	9.59	23.3	Clear
10:19	5.3	250	7.66	0.36	16	11.11	107	9.5	23.3	Clear
10:24	6.6	250	7.68	0.362	9.3	11.09	111	9.87	23.3	Clear
10:29	7.8	250	7.69	0.363	5.7	11.26	114	9.49	23.3	Clear
10:34	9.1	250	7.64	0.362	5.8	11.21	115	9.5	23.3	Clear
10:39	10.4	250	7.65	0.362	5.6	11.2	118	9.52	23.3	Clear
10:44	***SAMPLE***	100	7.66	0.363	5.5	11.32	118	8.82	23.30	Clear

Sample ID - MW-103B-150305
Sample Time - 10:44

Notes / Sample Information

Appearance at Start - **Slightly silty**
Appearance After Purging - **Clear**

Total Volume Purged - **12.1** liters
Purge Rate - **100-550** mL/min

Additional Sample - None
Additional Sample ID - N/A

DTW After Purging - **23.30** ft bTOC
DTW at Time of Sampling - **23.30** ft bTOC

Analyses - TCL VOCs (8260B);
TCL SVOCs (8270C/8270C + SIM);
Dissolved Organic Carbon (SM5310);
Dissolved Mn, Mg, Ca, Na, K (200.8);

Notes

Figure 2: Complete Groundwater Purge Sheet

Completed groundwater purge sheet, finalized for printing.

STANDARD OPERATING PROCEDURE NO. 14.01

SAMPLING EQUIPMENT DECONTAMINATION

PROJECT NO. 1940103307

STANDARD OPERATING PROCEDURE NO. 14.01

SAMPLING EQUIPMENT DECONTAMINATION

Prepared By:	Devon Rowe
Peer Reviewed By:	Jose Sananes Stan Popelar Beth Richter John Noble Alexis Hillman David Heinze Carol Serlin Nestor Soler
Approved By:	
Applicable To:	All North American offices
Effective Date:	March 19, 2019
Revision Notes:	1. Revised company name and format. 2. Issued as SOP 12/16/2022
Documents Used as Reference During Preparation:	ASTM D5088 – Standard Practice for Decontamination of Field Equipment Used at Waste Sites. 2015. NJDEP, August 2005. Field Sampling Procedures Manual. USEPA Region 9 Field Sampling Guidance Document #1230, Sampling Equipment Decontamination. 1999. USEPA Region 4 Science and Ecosystem Support Division Operating Procedure, Field Equipment Cleaning and Decontamination, #SESDPROC-205-R1. 2007. USGS, 2006. National Field Manual for the Collection of Water-Quality Data.
Application	This standard operating procedure (SOP) 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.

CONTENTS

1. INTRODUCTION

This Standard Operating Procedure (SOP) presents general guidelines established by Ramboll Americas Engineering Solutions, Inc. (Ramboll) for the decontamination of non-dedicated sampling equipment used for environmental sampling detailed in the Vistra Multi-Site Sampling and Analysis Plan (Ramboll, 2022).

This SOP 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.

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; and (c) ensure that sampling equipment can be effectively reused multiple times. 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 SOP does not supersede Ramboll health and safety procedures or Site-Specific Health and Safety Plan (HASP) requirements; in the event of conflict between this SOP 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 SOP. The Ramboll Project Manager (PM) shall ensure 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’s document handling and retention policies. The signatures of the 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 non-dedicated field equipment decontamination procedures is provided below. This checklist includes an overall summary of general equipment typically required for this equipment decontamination and should not be considered exhaustive. More specialized materials, rinses, or reagents may be required depending on the field sampling equipment 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 **SOP 1.01** (Field Notes and Records).
- Trash Bags - used to dispose of gloves and any other non-hazardous waste generated during sampling (refer to **SOP 15.01**, Waste Handling).
- Appropriate waste container – used to dispose of any Investigation Derived Wastes (IDW) and/or decontamination wastes (refer to **SOP 15.01**, Waste Handling).
- Labels for IDW containers as outlined in **SOP 15.01** (Waste Handling).

2.2 Equipment Decontamination Equipment Checklist

- 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.
- 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

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

- **SOP 1.01**, Field Notes and Records.
- **SOP 1.02**, Sample Handling, Shipping and Chain of Custody.
- **SOP 1.03**, Data Management.
- **SOP 1.05**, Field Quality Control Samples.
- **SOP 5.02**, Subsurface Soil Sampling - Test Pits and Excavations.
- **SOP 5.04**, Surface Soil Sampling.
- **SOP 5.05**, Soil Sampling for VOC Analysis.
- **SOP 5.07**, Subsurface Soil Sampling - Direct Push.
- **SOP 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
- **SOP 5.15**, Stockpile Sampling.
- **SOP 5.16**, Soil Sampling for PCB Analysis.
- **SOP 6.02**, Groundwater Sampling.
- **SOP 6.03**, Determination of Hydraulic Properties - Slug Test.
- **SOP 6.04**, Groundwater and Free Product Level Measurements.
- **SOP 6.07**, Well Development.
- **SOP 6.08**, Determination of Hydraulic Properties - Pump Test.
- **SOP 6.09**, Groundwater Sampling - Private and Domestic Wells.
- **SOP 6.10**, Groundwater Sampling for Low Level Mercury.
- **SOP 6.13**, Groundwater Sampling - Vertical Profiling.
- **SOP 6.14**, Determination of Hydraulic Properties - Packer Pressure Test.
- **SOP 6.16**, Groundwater Sampling - Free Product/NAPL.
- **SOP 6.20**, Groundwater Sampling - Low Flow.
- **SOP 7.01**, Surface Water Sampling.
- **SOP 8.01**, Sediment Sampling.
- **SOP 15.01**, Waste Handling.
- **SOP 15.02**, Waste Sampling.

The list above is not intended to be all inclusive. Other SOPs 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 SOPs, and SOPs for sampling).

4. PROCEDURES

4.1 Planning and Design Considerations

All significant equipment decontamination decisions shall be approved by the PM before the initiation of field activities. The Work Plan/Sampling Plan should be designed to facilitate the collection of representative data that will meet the goals and data quality objectives of the study/monitoring program and should include specific requirements for non-dedicated field equipment decontamination. 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 decontamination procedures should be discussed with and approved by the PM prior to implementation.

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);
- 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;
- 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 the cleaning agents 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.

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[1] 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
Portable Water	Tap water	Used under high pressure or steam to remove heavy mud and dirt, or to rinse off other solutions.
Laboratory-grade water	Distilled Deionized Reagent grade distilled and deionized water	
Low sudsing non-phosphate detergents (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).
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.

Table 1: Applications of Various Solutions for Decontamination of Field Equipment and Materials [A, B, C]

Solution	Concentrations	Remarks

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 **SOP 2.02** (Site Preparation, Inspection and Housekeeping). In addition, since samples will be collected from various media, field staff should review and complete pertinent tasks identified in relevant SOPs (e.g., **SOP 6.02**, Groundwater Sampling; **SOP 5.04**, Surface Soil Sampling; **SOP 6.04**, Groundwater and Free Product Level Measurements, etc.).

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 PM the proposed Work Plan/sampling plan outlining decontamination procedures;
- Review and complete pertinent tasks identified in the applicable sampling SOPs (e.g., **SOP 6.02**, Groundwater Sampling; **SOP 5.04**, Surface Soil Sampling; **SOP 6.04**, Groundwater and Free Product Level Measurements); and
- Review **SOP 15.01** (Waste Handling) for management of decontamination fluids and other IDW.

4.3 General 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 for 24h	Oven Dry	Store in Aluminum Foil or Polyethylene	Discard After Use
Glass	●	●	●	●	● [D]	●		●	
Teflon	●	●	●	●	● [E]	●		●	
Metals and Stainless Steel	●	●	Do not use	●	● [D]	●		●	
Teflon Tubing	●	●	●		● [E]		● [F]	●	
PVC Tubing				Use Only New PVC Tubing					●
Stainless Tubing	●	●	Do not use	●	● [D]	●		●	
Glass Tubing	●	●	●	●	● [D]	●		●	
Well Sounders	●	●		●					
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 in press.

[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.

[F] Excessive heat that could damage the polymer should not be used. Check manufacturer's recommendations for heat tolerance.

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[2] ASTM-D5088: Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

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 **SOP 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 note book (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 SOPs, 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. 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 after it has been allowed to air dry.

4.3.2 Wet Decontamination, Aqueous Sampling Equipment (Seven-Step Decontamination)

Unless otherwise indicated in site-specific work plans or SOPs, 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. If contamination persists or is suspected, repeat the decontamination procedures.

4.3.3 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 pumps, 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.
- Place pump and other 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.

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[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/.

- 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 pump and other sampling equipment into the container such that the equipment is immersed.
    - Agitate equipment to effectively rinse.
    - For pumps, ensure that the intake is below the detergent solution level) 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.
    - When completed, pump approximately two pump/tubing volumes into a waste container (adding additional detergent solution to container, as needed for pump to operate).
- Remove equipment from container, and then rinse the inside of the container using potable water (until all sudsing stops).
- Rinse exterior of equipment/pump with potable water, and place into DI water rinse container (for pumps, water should be above the pump intake). Agitate equipment to rinse. For pumps, continue agitating within the DI water rinse container, and begin pumping but do not recirculate water – discharge to a waste container. Recirculate for five or more equipment volumes (adding potable water/DI water as needed to maintain flow). To confirm adequate rinsing of pumps, capture a small aliquot of discharged water in a container, and shake to observe sudsing. Repeat until no suds appear.
- If the equipment is being used for inorganic constituent sampling only, change gloves, and rinse equipment in the DI water container. For pumps, use similar procedure as above (discharging water, not recirculating) and test for suds using a small bottle.
- 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 **SOP 1.05** (Field Quality Control Samples).
- If the pump/equipment is being used for organic constituent sampling, place in the methanol rinse container. Make sure that the pump/equipment and nearby electrically powered equipment is grounded, and potential sources of sparks are eliminated before operating pumps. 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 pump/equipment in the methanol rinse container (for pumps, to above the intake level). Agitate equipment, or for pumps, 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/equipment exterior with organic-grade blank water and place into an air-dried container. Add organic-grade blank water to immerse

equipment/pump to force residual methanol out of components, and capture in waste methanol container. If pump/equipment includes reusable tubing, rinse with an additional approximately 0.5 liter of organic-grade blank water per 10-feet of attached tubing.

- If equipment blanks are required, repeat this procedure using laboratory-provided blank water, and collect a field blank in accordance with the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP) and **SOP 1.05** (Field Quality Control Samples).

4.3.4 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. 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.

4.4 Quality Assurance/Quality Control

The effectiveness of the sampling equipment decontamination procedures is evaluated through collection of field blank samples. Guidance on the collection of field blanks is provided in **SOP 1.05** (Field Quality Control Samples). Details on the number of field blanks and the analyses to be performed on each sample, along with other Quality Assurance/Quality Control (QA/QC) procedures should be outlined in the project-specific Work Plan/Sampling Plan, or Quality Assurance Project Plan (QAPP). In their absence, the QA/QC guidelines of **SOP 1.05** (Field Quality Control Samples) should be reviewed. However, it is generally recommended that field blanks be collected at a rate of 5% (1 per 20) of the total number of samples collected throughout the sampling event or one per sampling day if the total number of samples is less than 20. State-specific or regulatory program-specific guidelines may require that field blanks be collected more frequently.

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 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 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 project-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 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 **SOP 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 **SOP 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.

7. REFERENCES

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. Multi-Site Sampling and Analysis Plan, Prepared for Vistra Corp. December 22, 2022.