COVER SHEET
STANDARD OPERATING PROCEDURE

Operation Title: **GROUNDWATER SAMPLE COLLECTION FOR SITE INVESTIGATION AND ASSESSMENT MONITORING**

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Standard Operating Procedure: **RWM-DR-002**
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1.0 PURPOSE

The purpose of this document is to describe the Maine Department of Environmental Protection, Bureau of Remediation and Waste Management, Division of Remediation (MEDEP/DR) procedure for collecting groundwater samples at or near hazardous substance sites. MEDEP/DR has two standard operating procedures (SOPs) for collection of groundwater samples. This SOP will outline the collection of groundwater samples from temporary wells, or from monitoring wells that are not part of a long term groundwater monitoring program. MEDEP/DR SOP RWM-DR-003 describes the MEDEP/DR's procedure for collection of samples that are part of a long term groundwater monitoring program, also known as "Low Flow" sampling.

2.0 APPLICABILITY

MEDEP/DR is responsible for the investigation and subsequent remediation of hazardous substance, petroleum, and landfill sites throughout Maine. In the course of the investigation and subsequent remediation, samples must be collected and analyzed to determine the geographical extent, chemical characteristics, and relative levels of contaminants at and around each site. For this reason groundwater monitoring wells are often installed on-site and around a site.

3.0 RESPONSIBILITIES

All MEDEP/DR Staff must follow this procedure when performing activities involving the collection of groundwater samples that are not subject to long-term monitoring of concentration trends. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to this procedure.

4.0 DEFINITIONS

- Low Flow Purging – For the purpose of this SOP, Low Flow Purging is defined as pumping a well at a rate equal to the recharge rate of the formation such that a stable drawdown of the water level is achieved at a constant pumping rate.
- Variable Speed Pump – A mechanical device specifically manufactured to remove water from a well at selected rates that are equal to or lower than the recharge rate of the well. For the purposes of this SOP it is limited to bladder or peristaltic type positive displacement pumps, and submersible type rotodynamic pumps.
- Reciprocating type Positive Displacement Pump- This includes all positive placement type pumps that rely on the use of a cylinder or piston arrangement with a foot valve to displace water. This includes all WaTerratm type once cylinder reciprocating pumps.
- Bailer - A long narrow cylinder or bucket-like device with an open top and a check valve at the bottom that is used to remove water from a monitoring well.
- Equipment Blank – De - ionized water run through a piece of sampling equipment to determine if equipment may be a source of contamination.
- Purging - The process of evacuating standing water from the monitoring well prior to sample collection. Trip Blank – De - ionized water put in the appropriate containers under laboratory conditions which is transported with the samples

during a monitoring event for quality assurance/quality control purposes.

- Well Riser Pipe - A length of solid pipe which extends from the screened interval of a monitoring well to the surface of the level from which the well is accessed.

5.0 INTRODUCTION

As stated earlier, the purpose of this SOP (DR#002) is for collecting groundwater samples from existing monitoring wells or recently installed (within 48 hours of sampling) temporary monitoring points (duration of site investigation) where data quality objectives (DQOs) do not require long-term monitoring data analyses. Site specific DQOs should be reviewed to ensure the sampling methods are appropriate.

Low Flow Purging and Sampling (LFS) is the preferred method for obtaining groundwater samples from existing monitoring wells (see SOP RWM-DR-003 - Low Flow Purging and Sampling Protocol) as part of a long term monitoring program. However, LFS is not always a viable sampling method at all monitoring wells. For those wells that are not conducive to LFS, this procedure can be followed.

6.0 PLANNING

A well developed Site conceptual model is imperative for effective groundwater sampling. Prior to conducting any sampling event, a sampling plan should be developed (see SOP RWM-DR-014 - Development of a Sampling and Analysis Plan). Included in the sampling plan should be specifics regarding data quality objectives (DQOs), as DQOs will be part of the determination of which groundwater sampling procedure is required (this SOP or RWM-DR-003), as well as the method of sample removal outlined in this SOP. .

7.0 PROCEDURE

7.1 OVERVIEW

The collection of groundwater samples can be achieved in several ways. This SOP focuses on collecting samples from temporary or existing wells for the purposes of site investigation or assessing the current water quality at a site with existing monitoring wells where the data is not used to establish trends in concentrations. Additionally, the site specific DQOs allow for a lower quality of data collection than outline in SOP RWM-DR-003 in exchange for a more efficient sampling method that meets the objectives of the sampling event.

7.2 MONITORING WELL TYPES

For the purposes of this SOP well types will be divided into two general categories; existing and newly installed wells (within 48 Hours of sampling). Both types of wells may include micro-wells (less than 2-inches), monitoring wells (2-4 inches) and bedrock wells (6-inch). Newly installed wells can include those installed with a direct push instrument where no drilling fluids are used or with a more traditional method that utilizes drilling fluids. Existing wells and newly installed wells may also be temporary wells that will be properly abandoned (according to MEDEP Guidance) once the assessment is complete

or may remain at the site once the assessment is complete. All of these variations will influence the pump selection and the modifications used to obtain a groundwater sample.

7.2.1 Existing Wells

It may be desirable to sample existing wells during a site investigation or site assessment where DQOs do not meet the requirements for long-term monitoring. The wells may be former bedrock water supply wells, wells from a previous site investigation, or wells installed for monitoring water levels during aggregate mining (sand and gravel pits). Existing wells may have water in the riser or cased portion of the well that is not in direct contact with the formation (including bedrock fractures). Care should be used in pump selection to limit disturbance of the stagnant water in the riser or casing. It may be desirable to monitor select field parameters to determine when to sample an existing well. DQOs will dictate the selection of field parameters and the method of collection (open-cell, closed cell, field kits, meters, etc.).

7.2.1 Newly Installed Wells

Wells are frequently installed as part of a site investigation or assessment and sampled within 48-hours of installation. Wells installed by direct push technology or possibly with small diameter augers are typically referred to as micro-wells. The smaller diameter influences pump selection. Additionally, the depth to water may also play a significant role in pump selection.

Newly installed wells do not have time to develop a stagnation zone in the riser and field parameters are not needed to monitor mixing in the well. However, selected field parameters may be useful for characterizing the groundwater conditions. DQOs will dictate the selection of field parameters and the method of collection (open-cell, closed cell, field kits, meters, etc.).

7.3 SAMPLE COLLECTION PROCEDURE

The groundwater sampling pumps included in this SOP include the use of bladder pumps, submersible pumps, peristaltic pumps which are referred to collectively as variable speed pumps. Additionally, this SOP includes the use of Bailers and reciprocating type positive displacement pumps commonly referred to as WaTerra™ pumps. The type of pump selected and associated method of sampling will impact the quality of the results. The order of preferred pump selection is based on the order of declining quality of results beginning with variable speed pumps, bailers, and then WaTerra™ type pumps as a pump of last resort. Single speed submersible pumps such as a 12-volt purge pump (Whale pump, GeoSub, Cyclone, Water Spout, etc.) may be used under certain situations if the pump discharge is less than the yield of the formation and a constant drawdown can be achieved without dewatering screens or water bearing fractures. In this case, the use of the single speed pump would provide results of similar quality to a variable speed pump. The following sections discuss the sampling pumps in decreasing order of sample quality.

7.3.1 Variable Speed Pumps

Variable speed pumps include bladder, submersible, or peristaltic pumps that are manufactured with a control mechanism that allows the user to mechanically change the speed of the pump discharge without the use of flow restrictors on the pipe or tubing. These pumps allow for the highest quality sample collection included in this SOP.

All pumps should be operated according to the manufacturers instructions to assure proper use of the equipment. If a gasoline powered generator is used as a power supply, care should be taken to eliminate cross-contamination. Any equipment that comes into contact with groundwater and is used at more than one sample location should be properly decontaminated according to the site specific QAPP.

7.3.1.1 Procedure for Variable Speed Pumps

1) Utilizing a water level indicator that will fit the monitoring well, obtain and record the water level. If water levels will be utilized for determining groundwater flow, it is recommended that water levels be obtained before the insertion of tubing or pumps into the well, as this will displace water, initially raising the water level of the well and giving a false water level. If water level is not needed, it may be possible to conduct sampling without obtaining a water level. However, using a water level indicator will prevent the "setting up" at a dry well.
2) Insert submersible pumps and/or tubing into the well. Place intake at desired monitoring zone, and record depth (if required by SAP).
3) Purge and sample the well. Efforts should be made to purge and sample the well (existing or temporary) at a rate equal to the yield of the formation. This is determined by observing the water level with a meter for draw down. Stabilized drawdown is not a requirement of this SOP, but it is encouraged for obtaining a sample representative of the most permeable portion of the screened zone, and will improve the overall quality of the data if the static and drawdown levels are recorded. If a constant drawdown level is not achievable, then a modified no-purge option (See SOP RWM-DR-003) can be used as long as it meets the DQOs for the site. The modifications of the no-purge procedure will change depending on the type of well being sampled.

7.3.1.1.1 Purge Requirements For New Wells

It is recommended that new wells be purged (if rate of recharge allows) to remove silt that may have been introduced into the well during construction. Once sufficient water has been removed from the well to meet the DQOs for the site, field parameter collection may be desirable to determine aquifer conditions. Field parameters are not required for stabilization prior to sampling because newly installed wells have not developed a stagnant water column. Site specific DQOs will determine the purpose for collecting field parameters.

7.3.1.1.2 Purge Requirements For Existing Wells

Collecting field parameters may be desirable depending on the site specific DQOs. It may be desirable to monitor select field parameters to determine when to sample an

existing well. DQOs will dictate the selection of field parameters and the method of collection (open-cell, closed cell, field kits, meters, etc.). In general, any field parameters that are collected will increase the overall quality of the sampling event.

7.3.2 Bailers

Bailers produce lower quality groundwater samples due to the uncontrolled filling rate of the bailer each time it is lowered below the water level, the physical disturbance of water in the solid riser portion of the well, the impacts of slug removal on the formation and sand pack each time the bailer is filled, and the composite nature of the sample from within and above the screened zone. Prior to purging and collecting a groundwater sample with a bailer, the water in the riser must be evacuated in order to assure that fresh groundwater in the well is being sampled. To ensure that all riser water is replaced with formation water, USEPA protocol recommends that three to five well volumes be evacuated from the well prior to sample collection.

The reason for the use of bailers instead of pumps should be outlined in the sampling and analysis plan (SAP) or Sampling Event Trip Report (SETR) developed for the specific activity. The use of dedicated or disposable bailers is encouraged for each well to avoid cross-contamination.

7.3.2.1 Bailer Sampling Procedure

1) Calculate the water volume in a given well. Begin by using the water level indicator to measure depth to water. Use a clean weighted tape measure to determine the overall depth of the well if it is not known. Whenever possible, measure from the top of the well riser pipe and not from the top of the steel outer casing. Then calculate the height of the water column by subtracting the height of water in the well from the total depth of the well, in feet.

Use the formula and chart below to calculate well volume in gallons. Again, at least three volumes should be purged from the well. When this is not possible, as in the case of purging a slow recharge well dry, it is acceptable to sample the well as soon as enough water (assumed to be fresh groundwater) has entered the well to obtain a sample.

FORMULA FOR CALCULATION OF WELL VOLUME:

WELL DIAMETER x GAL/FT x HGT OF H20 IN FT = VOLUME IN GALS

2	inch	0.1632 =
4	inch	0.6528 =
6	inch	1.469 =

2) Purge the well. Attach clean line to the bailer and lower it into the well until it touches the bottom. Then secure the end of the line or cord to an anchor on the well casing that will hold the bailer in the event that it may be accidentally dropped down the well. Raise the bailer up the well while keeping the line off the ground. Empty the bailer water into a graduated bucket and repeat this procedure until the desired purge volume has been

extracted.
3) Sample the well. Once purged, the well may be sampled by lowering the bailer slowly below the water level and pouring the contents directly into the appropriate laboratory containers.

7.3.3 Reciprocating-Positive Displacement Pumps

Reciprocating-Positive Displacement Pumps, of which WaTerra™ is a specific example, produce the lowest quality sample due to the physical movement of the pump in the well. The reciprocating action disturbs the sediment in the bottom of the well, generates friction between the well materials and the pump, and partially mixes water in the screen zone with water in the riser. Additionally, the hydraulic forces exhibited by the pump disturb the equilibrium the aquifer has with the filter sand and acts to re-develop the equilibrium (re-develop the well) during the sampling event.

As with the case of bailers, the reason for using bailers instead of pumps should be outlined in the sampling and analysis plan (SAP) or Sampling Event Trip Report (SETR) developed for the specific activity.

7.3.3.1 Reciprocating-Positive Displacement Pump Procedure

If this type of pump is used at a site, it should be used according to the manufacturer's instructions.

7.4 SAMPLE CONTAINERIZATION

Container requirements should be stated in the project SAP, as required by the laboratory conducting the sample analysis. Samples should be containerized and preserved utilizing containers and preservation protocol provided by the laboratory conducting the analysis.

8.0 DECONTAMINATION

Decontamination of sampling equipment should be conducted following procedure outlined in MEDEP/DR SOP RWM-DR-017 – Decontamination procedures, and as outlined in the project specific SAP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Data quality objectives should be stated in the SAP. . Quality Assurance/Quality Control (QA/QC) samples may be collected if needed to meet your data quality objectives. The following are typical types of QA/QC samples that may be collected as part of the QA/QC program for groundwater sample collection utilizing this SOP, other QA/QC samples may be collected as stated in the SAP. For an additional discussion of QA/QC, please refer to the MEDEP/DR Quality Assurance Plan, Section 5 and Section 10. All analytical data should be reviewed and assessed to determine if DQOs have been met. If review indicates DQOs have not been met, corrective action will be recommended by the reviewer.

9.1 TYPICAL QA/QC SAMPLES

9.1.1 Equipment Blanks

If using non dedicated or disposable equipment, equipment blanks should be collected at a rate of 5%, one equipment blank every twenty samples collected. The equipment blank will consist of purging de-ionized water through submersible pumps and piping, and/ or rinsing equipment with de-ionized water, and collection for appropriate sample analysis.

9.1.2 Duplicate Samples

It is recommended that duplicate samples be collected at a rate of 5% to assess sample location variability.

9.1.3 Trip Blank

A trip blank may be necessary when sampling for volatile organic compounds. The need for a trip blank will be outlined in the SAP.

9.1.4 Background Samples

The need for background groundwater samples will be outlined in the SAP.

9.2 SPECIAL CONSIDERATIONS FOR METALS ANALYSIS

Temporarily installed wells or wells that have been installed and constructed improperly may not allow for the collection of a silt free sample. This silt does not represent the natural mobile load in the aquifer, and samples that include the silt may introduce non-mobile elements into the water sample. Therefore, it is recommended that samples collected for metals analysis utilizing this SOP be filtered with an in-line 0.2-0.45 um particulate filter. The filter should be purged (approximately 25 - 50 mL) with the groundwater being sampled prior to sample collection, or as per filter manufacturer's instructions. Site specific DQOs will determine if unfiltered samples are necessary under this SOP.

10.0 DOCUMENTATION/ CHAIN OF CUSTODY

All site visits, including groundwater sampling events shall be documented as described in the SOP RWM-DR-013 - Documentation of Field Notebooks and development of an SETR. Use of specialized sampling forms is allowed, following the procedure outlined in DR-013. Sample custody must be followed as outlined in MEDEP/DR SOP#012 – Chain of Custody Protocol.