**Standard Operating Procedure**

# SOP-1 Measuring Static Liquid Level

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for measuring Static Liquid Levels in groundwater monitoring wells, leachate levels at leachate level monitoring locations, and collection of total depth measurements.

These step-by-step instructions describe the equipment and methods needed to measure the water level in a well using flat-tape electric water level sensors. Measuring a water level in a well can sometimes be difficult. These instructions do not guarantee that you will be able to measure the water level in a well due to unique site conditions. Proceed cautiously if you choose to take a water level measurement in your well. There is always a potential that you could damage the well equipment or the water level sensor.

## Definitions of Terms

**Water Level Sensor:** A water level sensor used to measure the water level in a well through a flat tape (marked in engineering, standard, or metric scale) that emits a sound when water is detected.

**Recovering Water Level:** A water level in a well that is recovering (rising) after the pump in the well has been turned off, but before the water level has stabilized.

**Static Water Level:** A stable water level in a well not affected by withdrawal (pumping) of ground water. This water level is most representative of surrounding aquifer conditions.

**Water Table:** The top of the water surface in the saturated part of an aquifer.

**Well Cap or Sanitary Seal:** A tight fitting, vermin-proof seal designed to prevent contaminants from flowing down inside the well casing.

**Well Casing:** A tubular structure made of metal or plastic and placed in a well borehole to maintain the well opening. The casing also helps to confine groundwater to a specific groundwater zone and helps to prevent contaminants from mixing with the water.

**Well Liner:** Often used in conjunction with a well casing, this metal or plastic insert is placed inside the well borehole to prevent a collapse.

## References

Wisconsin Department of Natural Resources Groundwater Sampling Field Manual;
PUBL-DG-038 96, September 1996.

Wisconsin Department of Natural Resources Groundwater Sampling Desk Reference;
PUBL-DG-037 96, September 1996.

## Personnel Qualifications

A minimum of one person who is trained in this monitoring technique is required to complete sampling. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

Equipment and procedures used for taking water level measurements vary substantially. Choose water level measuring devices based on their accuracy, precision, ease of use, reliability, durability, ease of decontamination, and cost. Under most circumstances, requires that water level measurements be read to the nearest 0.01 foot (0.25 centimeter [cm]).

Water level measuring devices typically are either manual, non-recording devices or continuous measuring devices that provide an electronic record of changing water levels over time. A separate liquid measuring device should be used for groundwater wells and leachate monitoring devices.

A water level sensor uses a metered tape and electronic current to transmit a signal to a buzzer when water is encountered. These tapes are usually 3/4-inch wide. The flat-tape water level sensors can be easier to read than a coaxial water level meter because the depth-to-water measurements are read directly off of the measuring tape.

In addition to a water level indicator use the following supplies for decon:

- Lab Grade/Deionized/Distilled water.
- Non-phosphate soap such as Liqui-Nox®.
- Spray bottles.
- Paper towels.

Also for data collection:

- Field data sheets.
- Appropriate electronic field data collection device.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

Important technical considerations for collecting accurate water level measurements include:

1. Measure the static water level for a well before purging, sampling, or inserting any instrument or device into a well. If a well is purged, sampled, or a device is inserted into a well before measuring the static water level in the well, the measurement will not represent the static "undisturbed" water level or hydraulic head existing in the well.

2. Collect measurements from all wells on the site as quickly as possible. The best method is to collect measurements from all of the site's wells before doing any other tasks on the wells. This may be impractical and too time consuming for some sites. HOWEVER, AT A MINIMUM, ALL HYDROSTRATIGRAPHIC UNIT C WELL WATER LEVELS MUST BE COLLECTED WITHIN 24 HOURS OF THE ONSET OF WATER LEVEL MEASUREMENTS. It is acceptable to take liquid measurements and sample in one day. This method is acceptable if you collect all water level measurements at a site on the same day and the barometric pressure for that day does not change significantly (e.g., changing high or low pressure, advancing storm, etc.). If the barometric pressure does change significantly during collection, a second round of measurements may be appropriate. It may also be appropriate to recheck measurements if a significant change in pressure is noted when the cap is removed. It is also recommended that the data be compared in the field to a set of historic measurements. If there are significant differences new measurements should be collected.

3. Collect measurements in the order of least-to-most contaminated wells. Furthermore, decontaminate the measuring device between each well to prevent cross-contamination. Do not let any part of the instrument or tape touch the ground or any contaminated surface. Decontaminate before use if necessary.

4. Read measurements from the top of the casing or a reference elevation on the well. This is usually a permanently and clearly-marked or notched spot located at the highest point on the top of the well casing. All top-of-casing or reference elevations must be surveyed to a common point of known elevation so that the water level measurements can be converted to groundwater level elevations, usually expressed as feet above mean sea level (MSL) or as U.S. Geological Survey (USGS) datum. Water level measurements must be accurate and precise to ± 0.01 foot (± 0.25 cm.).

5. Whenever possible, use one measuring device and one person operating it for all wells at a site during each sampling event. Better yet, if possible, use the same measuring device and same person for all wells at a site over the life of a project. This will help ensure that water level data are accurate and comparable. If more than one measuring device is used, check both instruments against a calibrated standard, the same well, and against each other to ensure that they provide the same water level measurements. If necessary, use a correction factor to equalize the readings. Do this after checking each device to determine which tape length is correct.

6. Review historic information on the well including water level data, total depth from top of PVC, and the presence of immiscible layers (light non-aqueous phase liquid [LNAPL]) or dense non-aqueous phase liquid [DNAPL]).

7. Turn off any well pump and record the time as necessary per situation specific SOP.

8. Ensure the Well name and ID number match the field form or electronic data device.

9. Remove well access cover – Well caps, Slip cap, Friction cap, Sanitary Seal, or Turtle Back Plug. Document if well cap popped or well is under vacuum or positive pressure conditions in the well casing. Document these conditions and condition of well cap.

10. The measuring point is a reference point on the well casing or cap from which all measurements are made. Due to equipment limitations, surveyors always survey top of casing from the highest point on the casing if the well casing top is not level. Assign the highest point on the top of the well as the standard measuring point or if flat, place an indelible mark on the north side of the top of the casing. It may be helpful to draw a sketch or description of this measuring point on your water level data sheet and mark the measuring point with permanent marker. Future water level measurements should always be taken from the same spot.

11. Before you lower the water level sensor into the well to complete the measurement process, there are four problems that could occur during the measurement.

    - Well Liners - If a liner is present in your well the water level sensor must be inserted inside the liner to get a reliable water level measurement. CAUTION: False readings are common if the probe is inserted outside of the liner. If the water level sensor is inserted outside of the liner, you may get a false reading with a shallower than expected water level depth. If you are outside the liner, the line and probe may be covered in grit or grime when you reel it up. IMPORTANT: Liners are not always centered in the well or near the top of the casing. Check the well report or look inside the well to see if a liner is present.

    - Hang-Ups - These may happen while lowering or raising the water level sensor. Liners, pumps and wires, joints in the discharge pipe, ice blocks, well damage and rough edges on the inside of the well may cause hang-ups. These conditions need to be documented.

- Cascading - Water or condensate on the side of well casing. Water may enter the well above the static water sensor and drip or cascade down the borehole. This may be due to poor well casing seal, damaged well casing or temperature difference in a saturated atmosphere of the well casing. The water falling down the borehole may cause the water level sensor to give a false reading. Sometimes you may be able to hear if cascading water is present.

- DNAPL and LNAPL layers present - Although measuring LNAPL and DNAPL is not the purpose of this SOP, their presence may interfere with water level measurement accuracy.

Now you may begin to measure the water level. Follow owner's manual for specific water level sensor operation. General description is provided below:

1. Turn the sensor on and into the test position to make sure the battery is good. (The buzzer will sound and the light will turn on.)

2. Following the operation manual to set the sensor and in a position to make a sound and or trigger light indicator when liquid is contacted. The sound position is recommended because you can hear the sound easier than you can see the light from the indicator.

3. If present, turn the sensitivity switch all the way to the right.

4. Slowly release some line down the well casing, allowing the line to slide over your outstretched hand and down the well. CAUTION: Do not let the line free fall because the line can give you a "burn" similar to a rope burn if it slides through your hand too fast or the line may get stuck in the well. Commercial tape slides are made to protect the tape from the side of the well casing and protective pipe.

5. Check the "feel" of the line and probe. The "feel" of the weight on the line is similar to when you are fishing. You "feel" the line for the tug of a fish nibbling the bait. As the probe goes deeper, the weight should increase. If it does not, STOP lowering the line — go to Step 7.

6. Repeat Steps 4 and 5 until the water level sensor indicates the probe is in water or if the probe becomes stuck or hung-up. Remember to check the "feel" of the line and probe about every 20 feet.

7. If you can no longer feel the weight, raise the probe slowly. Continue checking the line to determine whether or not you have regained the weight of the probe. Once you can feel the weight again, begin lowering the probe very slowly. At the point when you cannot feel the weight, stop lowering the probe. Gently bounce the probe by raising and lowering the line about two feet. This method may allow the probe to slide past the hang up. *Ice at ground surface* should be reported as ice but does not represent top of water at the time of measurement.

8. When the water level sensor indicates water, check and make sure that you do not have cascading water. Determining if you have cascading water is indicated if the water sensor buzzer will chatter rather than sound a steady buzzing noise. The light indicator, will flicker off and on. Turn the sensitivity switch down to minimize the background noise.

9. Once you have determined that the probe is in the water, use the reference point mark that has been identified and previously surveyed to measure from.

10. Raise the line until the light or buzzer goes off. Lower the line until the light or buzzer comes back on. Raise the line until the light or buzzer goes off, and hold the tape scale in this position at reference point to determine if the water is rising. At this time, you will know if your water level is rising, falling, or static. IMPORTANT: It is best to record a static water level. If the water

level is still recovering (rising) from recent pumping or pressure from inside of well water, you have three options:

- Wait another 5 to 10 minutes to take another measurement or continue measuring periodically until the water level is stable.
- Come back another time to take a water level measurement.
- Record the existing water level measurement on your datasheet and clearly indicate that the water level is rising falling, or stable.

11. After determining that you have a static water level measurement, use your other hand to pinch the line at the measuring point near the top of the well (which varies depending on the well cap).

12. Now you will need to determine the water level measurement at the measuring point by reading the tape at the pinch point or if able directly read measurement on the tape. Record measurement, date, and time of measurement.

13. Final step is to interpret your water level measurements for accuracy of measurement by:

- Comparing to historical data
- Check for data entry errors such as placement of decimal

Once water level measurement procedures are complete, you may begin to measure the total location depth.

1. Turn the sensor or the sensitivity switch into the off position. Turn the lower switch to either the BUZZ position or the LED position. The BUZZ position is recommended because you can hear the buzzer easier than you can see the light from the LED position.

2. If needed, turn the sensitivity switch to the off position.

3. Follow water level measurement steps 4 to 7 until probe contacts the bottom of the well. Raise and lower the probe slowly so the probe is vertical and not leaning across the diameter of the well. You will notice a weight difference and slack or lack thereof in the tape as you raise and lower.

4. Hold the tape (indicating depth) against the north top edge of the well casing and read depth to the nearest 0.01 foot. Record depth on field sheet. Also record applicable observations such as “soft material felt – no hard bottom” or similar. NOTE: To prevent suspended sediment from negatively impacting groundwater samples, total depth measurements can either be collected 24 hours prior to sampling a well, or after sampling at the well is complete.

5. Decontaminate the water level indicator using Liqui-Nox® and deionized water.

6. Verify that well cap and protective covers are on before leaving the site.

**Standard Operating Procedure**

# SOP-2 Water Quality Sensor Use

## Introduction

This Standard Operating Procedure (SOP) is intended to provide general guidance and methods for using a field sensor to measure water quality parameters from groundwater or surface water that is being purged, sampled, or monitored.

This procedure is applicable to all water quality monitoring requiring use of a water quality sensor. The water quality sensor may be a stand-alone sensor or it may be a combined multi-probe unit used to measure temperature, pH, specific conductance, and/or other water quality parameters. The most common methods used for measuring water quality are instruments that measure in-situ parameters in one of the following two ways:

Water is extracted from its source using a pump and measured in a flow-through cell or in some instances captured and then measured in individual aliquots. This method is preferred when monitoring wells are sampled for laboratory analysis of chemical parameters, and groundwater purging is required.

The sensor is submerged directly into the sample source, such as a monitoring well or surface water body, to collect in-situ monitoring parameters.

## References


U.S. Army Corps of Engineers, 2001. *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, EM-200-1-3, Washington, D.C.

American Society of Testing and Materials, *Standard Guide for Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells*, D6634-01, West Conshohocken, PA.

American Society of Testing and Materials, *Standard Guide for Sampling Ground-Water Monitoring Wells*, D4448-01, West Conshohocken, PA.


## Definitions

- Water Quality Sensor – A device used to measure specific field parameters indicative of water quality, such as temperature, pH, specific conductance, and/or other parameters. The sensor may be stand-alone or it may be a combined multi-probe unit.

- Pump – An electric, compressed air, or inert gas-driven device that raises liquids by means of pressure or suction. The types of pumps that should be used for water quality monitoring should be chosen based on the well size and depth, the type of contaminants, and the specific factors affecting the overall performance of the sampling or monitoring effort. The types of pumps that may be used include centrifugal, peristaltic, centrifugal submersible, gas displacement, and bladder pumps.

- pH – The negative log of the hydrogen ion concentration (-log10 [H+]); a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0 to 14.

- Temperature - The unit of temperature is expressed in degrees centigrade ($^0$C).

- Turbidity – A measure of overall water clarity determined by measurement of the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU) but may also be measured in Jackson Turbidity Units (JTU). This test may be used for monitoring well development activities, but is not required during groundwater monitoring activities. Visual observations can also be used to confirm turbidity in samples.

- Specific Conductance (SC) – A measure of how well water can conduct an electrical current. Conductivity increases with increasing amount and mobility of ions such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution. The unit of conductance is expressed as microsiemens (1/1,000,000 siemen) per centimeter, or µS/cm.

- Oxidation-Reduction (Redox) Potential (ORP) – A measure in volts of the affinity of a substance for electrons compared with hydrogen. Liquids that are more strongly electronegative than hydrogen (i.e., capable of oxidizing) have positive redox potentials. Liquids less electronegative than hydrogen (i.e., capable of reducing) have negative redox potentials. Although the standard hydrogen electrode (SHE) is the ultimate reference for all ORP measurements, in practice an ORP field measurement may be made with other electrodes, such as silver chloride. These values may be converted to SHE values.

## Responsibilities

Employees (or designated consultants) performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Employees (or designated consultants) conducting technical review of task performance are also responsible for following appropriate portions of this SOP. The individual equipment manuals should be consulted for detailed operating and calibration procedures and reagents.

Employees (or designated consultants) are responsible for documenting information in sufficient detail to provide objective documentation (i.e., checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

## Personnel Qualifications

A minimum of one person who is trained in this sampling technique is required to complete sampling. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment

The following equipment is recommended for use in performing water quality measurements:

- Water quality sensor(s) - the field team should have a spare unit readily available in case of an equipment malfunction.

- Spare parts such as alkaline batteries (if used) and sensor probes.

- Pump and discharge hose/line for use with a flow-through cell.

- Paper towels or lint-free wipes.

- Decon water.

- Sample gloves.

- Calibration solutions for all parameters being measured; within expiration dates.
- Plastic sheeting.
- Field data sheets or appropriate electronic data collection device.
- Equipment manual(s).
- Nonphosphate detergent and water solution (e.g., Liqui-Nox®) in spray bottle.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

# Procedures

## General Instructions

- Prior to each day's use, clean the probes per manufacturer recommendations and flow-through cell using decon water.
- Calibrate all field equipment in accordance with manufacturer's guidelines.
- Ensure that the measuring range of the instrument encompasses the expected sample concentration or units.
- Document calibration results of each probe/parameter in the field logbook or calibration certification form along with the date and time.
- Before going to the field, locate all necessary field supplies such as deionized water, calibration solutions, decontamination supplies, and spare parts.
- Consult the instrument's operation manual as well as the project-specific sampling plan to verify that you have prepared the proper equipment and supplies to successfully complete the work.

## Operation of the Instrument

- If using a flow-through cell system, attach the extraction pump and lines in accordance with the pump and sensor manufacturer's instructions. Allow the lines to fill and the probes to become immersed before switching the instrument to its measurement mode.
- If using a down-hole system, allow a few minutes for the probe to stabilize before taking a reading.
- Operate the sensor in accordance with the instrument's operating manual.
- Collect the field parameter reading(s) per the project requirements, and record them in the field form or electronic data collection device.
    - Water quality parameter measurements should be measured in the field immediately before or after sample collection.
    - It is preferred that water quality parameters are measured using a closed, flow-through cell or using a down-well measuring probe to prevent water from contacting the atmosphere

prior to noting the various readings. A groundwater sample should never be collected from water that has already passed through the flow-through cell. All sampling should be completed directly from tubing (or bailer).

- In the event that a sampling location goes dry, water quality parameters may be collected from a sample bottle, but this condition is not considered to be ideal, and should be noted on the field sampling sheet. If water quality parameters are collected in an unpreserved sample bottle or other clean vessel of appropriate size, the sample vessel should be allowed to overflow during purging, so that purge water is allowed to continuously flow past the probe(s).
- Position the flow through cell or water bottle out of direct sunlight to reduce solar heating that will influence measurements.
- As water passes through the flow through cell, or by a probe, record the water quality parameters on the field forms or electronic data collection device.
- Rinse the flow-through cell between each sampled location with deionized water to remove any sediment buildup within the cell that may cause false readings. Also rinse off the probes between each sampled location.

- Decontaminate the sensor with decon water between sampled locations and at the end of the day. For a flow-through system, flush the lines with three line volumes of deionized water or replace with new ones between samples.
- Check the probes for battery charge and physical damage each day, both prior to and after use.
- Store the probes in a cool environment.

**Standard Operating Procedure**

# SOP-3 Groundwater Sampling

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard process to prepare and conduct groundwater sampling from monitoring wells. This is not intended for any future emergent contaminates such as per- and polyfluoroalkyl substances. This process is intended to be used for both paper and electronic collection of data.

## References

Karklins, Steve. *Groundwater Sampling Field Manual*. Wisconsin Department of Natural Resources, 1996.

## Personnel Qualifications

Personnel executing this protocol should have existing knowledge of groundwater sampling methods and the requirements of NR 140 and NR 507. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

The following equipment is recommended but is generally recognized that it is sizeable based on site-specific sampling projects and samplers may have variations to this list.

- General Sampling Equipment
  - 5 gal buckets
  - Bolt cutters
  - Calibration solutions
  - Chain of custody forms and custody seals
  - Cooler with Ice
  - Cube containers
  - Decon Water and non-phosphate soap such as Liqui-Nox®
  - Brushes
  - Field forms/site documents or appropriate electronic data collection device
  - Gloves
  - Tool for clearing around wells
  - Paper towels
  - Water quality sensor (s) - the field team should have a spare unit readily available in case of an equipment malfunction
  - Calibration solutions (check expiration dates)
  - Sample bottles
  - Site keys
  - Water level indicator
  - Portable table
  - Canopy to shade cell and tubing
- Purge and Sampling Equipment
  - Adjustable rate, submersible chemical inert pumps
  - Peristaltic pump (as needed)
  - Submersible pumps (as needed)
  - Tubing compatible with sampling parameters (as needed)
  - 0.45-micron In-line filters (as needed)
  - Bailers and nylon rope (as needed)
  - Battery
  - DI water wash buckets
    - 3 gals DI water
    - 3 gals DI water + Liquinox®
  - Purge water collection buckets with lids/tank
  - Spare well caps
  - Spare locks

- Socket wrench and socket set for flush mount covers as needed

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

Groundwater samples will be collected no earlier than 24 hours after completion of well construction and development.

Wells will typically be sampled by the purge method using equipment that is chemically inert based on the site-specific field sampling parameters (bailer or pump) or by the low-flow method using a peristaltic pump and chemically inert tubing. In some situations, and with WDNR permission, wells may be sampled using passive sampling devices such as a Hydrasleeve. The method used should be determined by both the depth to water in the well (limitation of lift capability of the pump) and well recharge rate (low recharge wells cannot be low-flow sampled) or other conditions identified in the field.

1. Pre-Monitoring.
    a. Calibrate water quality sensor.
    b. Equipment decontamination.
    c. Check bottle order.
    d. Prepare chain of custody for and electronic data deliverable (EDD)
    e. Print labels or pre-fill out labels. Use waterproof ink and securely attach labels to bottles, as ice used to cool samples can smear ink and cause labels to detach. Storing samples in plastic bags will help prevent these problems. Labels should include (1) a unique sample number and Wisconsin Unique Well Number (WUWN) if available; (2) site or facility name; (3) date and time sample was collected; (4) sample collector's initials; (5) preservative added to the sample; and (6) the analysis required.
    f. Verify sample parameters, volumes, and preservative types (if any).
    g. Verify whether sample filtering is needed depending on sample type(s).
    h. If using an electronic field data collection device, prepare electronic data files.
    i. Clean nitrile gloves need to be used during sampling.
2. Well Inspection.
    a. Check exterior well conditions for damage.
    b. Check lock and well cap.
        i. Lock should be locked.
        ii. Well cap needs to be present.
        iii. Well labeling needs to be present and easily readable.
        iv. Note well damage.
3. Pre-Sampling Field Reading.

a. Measure/record depth to water and total depth using the procedures outlined in Standard Operating Procedure SOP-1 (Measuring Static Liquid Level).

   i. Start with least contaminated well if known.
   ii. Measure well depth and water level to the nearest 0.01 ft.
   iii. Decontaminate water level sensor between wells.

   Note: To prevent suspended sediment from negatively impacting groundwater samples, total depth measurements can either be collected 24 hours prior to sampling a well, or after sampling at the well is complete.

4. Purging (if Low Flow Purging is being used go to #5).

   a. Bail with disposable chemical inert bailer, or dedicated bailer, and rope or

   b. Lower pump into well and hang 0.5 ft off bottom of well (the pump should not be placed at the bottom of the well screen).

      i. Purge water into a 5 gal bucket.

         1. Until dry or see Item 2.
         2. 4 well volumes need to be removed.

            a. For 1.5-inch well, multiply 0.1 gal/ft times the water column thickness in feet for total gallons to be removed.

            b. For 2-inch well, multiply 0.163 gal/ft times the water column thickness in feet for total gallons to be removed.

            c. For 3-inch well, multiply 0.37 gal/ft times the water column thickness in feet for total gallons to be removed.

         3. Record purge volume and flow rate (gal/min), if applicable.

      ii. Well recovery.

         1. Purged dry.

            a. Allow well to recover. Return to sample within 24 hours.

      iii. If 4 well volumes were purged, then sample can be collected.

5. Low-Flow Sampling.

   Use the total well depth measured and the screen length to determine the location of the center of the screened interval.

   a. Lower chemical inert equipment (pump or tubing) into well at approximately 0.5 ft from bottom of well (the equipment opening should be located in the approximate center of the screened interval without placing it on the bottom of the well).

   b. Collect turbidity samples when required.

   c. Connect flow-through cell and calibrated water quality meter.

   d. Hang water level sensor in well.

   e. Follow pump operating procedures per the manufacturer's specification.

   f. Begin purging into a 5-gal bucket.

   g. Collect initial field reading and record reading every 5 minutes thereafter.

h. Water level should stabilize.

i. If water level continues to lower, slow purge rate.

i. Monitor field parameters using the water quality meter until stabilization occurs as required by the site Sampling and Analysis Plan. Record readings in field forms or electronic data collection device after:

i. Three consecutive readings spaced about 2 minutes apart or about 0.5 well volumes or more apart are within the following ranges indicated on Table 1:

**Table 1**

**Water Quality Parameter Stabilization Criteria**

| Parameter | Range (unit) |
|---|---|
| Dissolved Oxygen | +/- 0.2 mg/L |
| Specific Conductivity | +/- 5.0 µmhos/cm for concentrations < 1,000 µmhos/cm<br>+/- 10.0 µmhos/cm for concentrations > 1,000 µmhos/cm |
| pH | +/- 0.1 pH unit |
| ORP | +/- 30 mV |
| Temperature | +/- 0.1 °C |
| Turbidity | < 5 NTUs if metal sample will not be filtered |

Unfiltered samples are collected directly from outlet, while filtered samples are collect through an added 0.45-micron filter prior to filling sample bottles.

6. No Purge Passive Sampling

a. If using a Hydrasleeve:

i. The Hydrasleeve is placed in well a minimum of two weeks before sampling is to occur but may be placed in the well at the end of a sampling event for recovery at the next sampling event. The Hydrasleeve shall be placed within the well screen interval and not disturb bottom sediments. Pull the Hydrasleeve from the well causing the unit to close and contain the water within it. Hang the unit such that the provided emptying device can be inserted to allow removal of water. The emptying device should be used in intervals, starting near the top, to reduce the potential of losing all of the water.

7. Sample Collection.

a. If using a bailer:

i. For unfiltered parameters: collect water in an inert container from which sample bottles can be filled, or directly fill sample bottles by slowly releasing water from the bailer into the bottles.

ii. For filtered samples: use tubing with a 0.45-micron filter to filter water from the container or directly connect the filter to the bailer or low flow sampling device.

iii. If filling sample bottles directly from the bailer, slowly release water from the bottom of the bailer to allow water from the bottom of the bailer into the sample container. Take care to minimize agitation to the water when filling sample containers.

iv. If using a transferred container, it needs to be thoroughly rinsed between samples.

b. If pumping direct from well, including, but not limited to, low-flow sampling devices and peristaltic pumps:

i. Collect unfiltered samples once stabilization standards are met.

ii. Filtered samples should be collected using a 0.45-micron in-line filter, once unfiltered samples are collected. If at all possible, an oil free pump should be used to create the pressure needed to push the water through the filter. Be careful not to agitate the sample as it may alter the sample results.

c. Volatile Organic Analysis (VOA) sample bottle filling:

i. Fill volatile organic analysis (VOA) bottles first, before collecting filtered samples. See Attached Section 2.5 from the WDNR Groundwater Sampling Field Manual.

ii. Make sure to add water slowly to limit sample aeration.

iii. Create a positive meniscus before placing cap on bottle.

iv. Check each bottle to make sure no air bubbles are present.

v. VOA samples are not to be filtered.

d. Filtered inorganic sample (acid preserved) bottle filling:

i. Fill filtered samples after VOA bottles. See Attached Section 2.5 from the WDNR Groundwater Sampling Field Manual.

ii. Make sure to add water slowly to limit loss of acid preservation.

iii. Do not overfill sample bottles.

iv. Collect unfiltered, unpreserved samples last.

e. Preserve samples, as appropriate, if not collecting directly into laboratory pre-preserved bottles.

i. Samples need to be place directly on ice in laboratory preserved bottles as required by the parameter method.

ii. Note the physical appearance of the sample (i.e., presence or absence of color, odor, and turbidity) at the time of sampling on the field sampling forms

iii. Record the sample date and time on the field forms or electronic data collection device.

iv. Place all sample bottles in an iced cooler and deliver under proper chain of custody to the Laboratory.

f. Measure water quality parameters in situ (down well) or “out of the well” in accordance with Section 2.6 of Wisconsin Department of Natural Resources’ (WDNR) Groundwater Sampling Field Manual.

g. Record all necessary field parameters onto field forms or electronic data collection device.

h. Decontaminate any non-dedicated equipment between sample locations following the decontamination SOP.

8. Post-Sampling.

   a. Complete chain of custody form and double check against information on bottles and complete any required field forms electronic data collection device.

   b. Place custody seal and security tape on each cooler that is not hand delivered to the receiving agent. If custody seals are used, affix each seal to the sample container such that it has to be broken to open the container. The seal should include the initials of the person sealing the container and the date and time the container is sealed. If security tape is used, make sure that the tape needs to be cut or ripped to open the cooler. Use nylon-reinforced or equivalent tape that cannot be tampered with in an unnoticed manner. The tape should include the initials of the person, sealing the container and the date and time of sealing.

   c. Deliver or call for pick-up of samples.

   d. Complete a chain of custody seal for shipped samples.

   e. Enter field readings into database or submit sampling forms to the County's consultant and the WDNR as directed.

   f. Replace well cap. Secure and lock well casing.

# Attachment A

# Section 2.5 - WDNR Groundwater Sampling Field Manual

## 2.5 SAMPLE COLLECTION

### Sample Collection and Filling Procedures

☞ Take in-field water quality measurements before or ***immediately*** after sample collection. (See Section 2.6.)

☞ Open only one sample container or one set of sample containers immediately before filling. Preserve samples within 15 minutes of collection and immediately place on ice.

☞ Minimize the contact of extraneous contamination with sample containers and equipment. Common extraneous contaminants include perfumes, cosmetics, bug spray, sun tan lotion, Sharpie®, spray lubricants (e.g., WD-40®) and engine fumes. Sample up wind or remove extraneous contaminants before opening containers and collecting samples.

☞ Use waterproof labels. Write on them with a permanent, waterproof marking device (e.g., grease pencil). Labels should include:

- ✓ A unique sample number and WUWN (if applicable).
- ✓ Site/project name or other identifier.
- ✓ Date and time sample collected.
- ✓ Sample collectors initials.
- ✓ Type of preservation added and analysis required.

☞ Appendix C includes a table that indicates a substance's potential to volatilize from a water sample during sample collection. Use extra caution when collecting samples that have a "medium" or "high" potential to volatalize from water.

☞ Remember to keep complete and accurate records. Record all field information before proceeding to the next well.

<u>Order of Filling Sample Containers</u>

Collect sample parameters in the following order:

1. Unfiltered samples for in-field water quality measurements. (This is not necessary if you take down-well or closed flow-through cell measurements.)
2. Volatile organic compounds (VOCs).
3. Non-filtered, non-preserved (e.g., sulfate, total chromium VI, mercury, semi- and non-volatiles, pesticides, PCBs).
4. Non-filtered, preserved (e.g., nitrogen series [ammonia, nitrates, nitrites, etc.], phenolics, total phosphorous, total metals, cyanide, total organic carbon).
5. Filtered, non-preserved (e.g., dissolved chromium VI).
6. Filtered, preserved immediately (e.g., dissolved metals)
7. Miscellaneous parameters.

***Note:*** Collect sulfate samples before sulfuric acid preserved samples (e.g., nitrogen series). Collect nitrogen series samples before nitric acid preserved samples (e.g., boron, dissolved metals).

Procedures for Filling Sample Containers

***Note:*** If a sample container already has preservative in it before you fill it (common for VOC vials), do not rinse the container before filling and take care to minimize sample overflow that may dilute the preservative.

1. Tip the sample container at a slight angle and allow a slow steady stream of water to run down its inner wall. Hold the sampling discharge tube close to the sample container but do not touch it.

2. Immediately after filling a sample container, if not already done, add any required preservative (filter first, if required), replace the cap, add the label, and place the sample in a plastic bag (optional) on ice in a cooler.

3. Record the "time sample collected." To avoid confusion, you may wish to record sample collection time in military time (e.g., 1300 instead of 1:00 pm, 1845 instead of 6:45 pm, etc.,)

## Volatile Organic Compounds (VOCs)

***Note:*** Do ***not*** filter VOC or other organic samples. Turn off any nearby gasoline engines or sample up wind of any engine exhaust. Remember to store one trip blank per cooler when collecting volatile (VOCs, GRO, and PVOCs) samples. Store empty VOC containers on ice to help you reduce VOC volatilization when you fill them.

1. If a laboratory hasn't already done so, add sufficient preservation to the container.

2. Tip the container at a slight angle and allow a slow, steady stream of water to run down its inner wall.

3. Fill the sample container until the water forms a positive meniscus at the brim, then immediately replace the cap.

4. Invert the sample container and tap it lightly to check for bubbles. If bubbles are present, fill a new sample container (containing preservative) and check for bubbles the same way. If bubbles are unavoidable, collect numerous samples and save those with the least amount of bubbles. Do not try to reopen and add more water to samples that have bubbles.

   Refill a ***used*** container only if you again add sufficient preservative ***and*** refill it with water from the same well, to avoid cross-contamination between samples.

5. Label the sample, place it in a plastic bag (optional), then immediately place it on ice in a cooler. Record the "time sample collected."

## Semi-volatiles and Pesticides

When collecting semi-volatiles and pesticides, unless project objectives or regulations require otherwise, use similar, but less rigourous, procedures as those described for collecting VOC samples. Use the same equipment decontamination and storage procedures you use for collecting VOC samples.

When collecting semi-volatiles and pesticides, the type of sample container, volume and preservative may be quite different than that required for VOC samples. In addition, leave approximately ½ inch of air space when filling sample bottles to allow for expansion. Otherwise, the bottles may break.

> ***Note:*** The number of sample bottles required depends on the number of different extraction, clean-up, analytical methods and quality control (QC) needed for the project. Remember that laboratories are required to duplicate and spike samples at a set frequency. Collecting insufficient sample volumes may result in higher detection limits, because sample volume must be reduced to accommodate QC requirements.

## Inorganics

Inorganic samples (e.g., dissolved metals) are quite susceptible to aeration, oxidation, precipitation, coprecipitation, extraneous contamination and cross-contamination during sampling, filtering and handling. Therefore, take extra care to avoid sample aeration before filtering (if required) and preserving. Unless WDNR requires or approves otherwise***field filter*** inorganic samples and***preserve immediately*** after collection. Refer to Section 2.7 regarding filtering procedures.

## Other Sample Parameters

Other sample parameters subject to rapid change (by aeration and subsequent changes in redox state, or addition or loss of dissolved gasses) once groundwater is removed from a well include: chromium VI, pH, Eh, oxygen, inorganic carbon, alkalinity, TOC, ammonium, nitrate/nitrite, sulfide, cyanide, molybdenum, mercury, selenium, dissolved iron (ferrous iron - $Fe^{2}$), manganese, zinc, cadmium, lead, vanadium, arsenic and phosphate. Take precautions to avoid altering these parameters during sampling. Add preservative, if required,***immediately*** and place on ice in a cooler.

For those interested in monitoring indicators of biodegredation that may be occurring in groundwater at a site, use a field test kit (e.g., colorimetric), sensor probe or other field test (e.g., portable gas chromatogram) to quantify pH, dissolved oxygen, nitrate, sulfate, ferrous iron, redox potential and manganese ***in the field*** immediately after sample collection. In addition, alkalinity, methane and carbon dioxide should be measured in the field immediately after collection, or less preferably, in the laboratory.

Contact a qualified laboratory for specific directions on collecting, preserving and handling samples not discussed in this manual.

**Standard Operating Procedure**

# SOP-4 Potable (Drinking) Water Sampling

## Introduction

The purpose of collecting a potable (drinking) water quality sample is to obtain a sample that is representative of in-situ, groundwater conditions in the formation being monitored. Potable groundwater collected from different formations and different groundwater sampling points can be substantially altered if not collected properly. These water sampling procedures provide a consistent method for collecting representative samples and documenting and tracking sample collection. This process is intended to be used for both paper and electronic collection of data.

## References

All procedures followed should be approved methods of the state regulatory agency in which the monitoring site resides.

- The Groundwater Sampling Desk Reference (PUBL-DG-037 96, September 1996) (WDNR, 1996a) and the Groundwater Sampling Field Manual (PUBL-DG-038 96, September 1996) (WDNR, 1996b) should be reviewed for sample collection programs in Wisconsin. Wisconsin Administrative Code Chapter NR 809 should be consulted for compliance with Safe Drinking Water Act (SDWA) sampling.

- There are also several ASTM International (ASTM) standards on analyzing specific parameters for different potable well monitoring procedures and are available as a reference.

- Wisconsin Department of Natural Resources, NR 809.

## Personnel Qualifications

A minimum of one person who is trained in this sampling technique is required to complete sampling. A minimum of two people are required to conduct some sampling activities. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

- Personal protective equipment that you would normally use when collecting samples at the sample collection site (i.e., gloves, etc.).

- Shipping container(s) for the sampling event to identify and protect bottles from possible sources of cross-contamination and breakage during storage and transportation.

- The correct quantity of properly cleaned, prepared and preserved bottles for the parameters being analyzed.

- Data log book/sheets or appropriate electronic data collection device, lab sheets, and chain of custody forms.

- Field equipment for field readings (i.e., pH meter, conductivity meter, etc.).

- Garden hose

- 5-gallon buckets

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

Potable (drinking water) sampling presents some difficulties due to the inability to control how a sample is being collected or what disturbances are occurring as a result of that collection.

To obtain a representative sample of groundwater, it must be understood that the composition of the water within the well casing, pump, and distribution system and in close proximity to the well may not be representative of the overall aquifer quality at that location. Therefore, it is necessary to purge the well until the well is thoroughly flushed of standing water and contains fresh water from the aquifer.

A general discussion of procedures applicable to all groundwater sample collection efforts and those procedures specific to groundwater and private wells are as follows:

1. Pre-sampling Activities:
    a. Ask permission to access the owner's property and water supply system prior to sampling event.
    b. Schedule a date and time with the owner for the sampling event.
    c. Prior to accessing the potable well property location, verify parameters to be collected and all equipment is working and decontaminated.
    d. Locate, well head faucet, a faucet after the pump, faucet prior to the pressure tank, outside faucet or basement cold water faucet as close to the source or well pump as possible and that (if possible) precedes any filtration or treatment, softener, heater, storage or pressure system, or tank.
        i. Confirm that the chosen location is deemed acceptable for sampling with well owner.
        ii. If present, and after confirming the owner's permission, remove any aerators, filters or other water system devices from the chosen sampling location.
        iii. Samples can be collected while the well pump is running.
        iv. Confirm from records or owners direction, and specific sampling requirements for each potable well location.
    e. Water sample collection system must be purged. Purging a water supply well before sampling will remove the stagnant water that has been in contact with well material, pump, plumbing, and distribution system. Sample collection discharge flow volume will be reduced from purging flow volume.
        i. Purge from multiple locations throughout the water system (to increase purging volume and increase efficiency of time).
        ii. If purging water through a hose, move hose discharge away from building foundation.
        iii. Purging process will take approximately ten (10) minutes.
            1. If the sampling tap is located after the pressure tank, allow the water to run for at least 25 minutes and to become cold before collecting any

samples. This should allow the stagnant water to be flushed out of the pressure tank and be replaced by freshly pumped water. For large pressure tanks, wells located far from buildings, and deep water wells, a longer waiting period may be necessary. Either calculate the necessary flushing time based on the water system and pressure tank volume and purging flow rate or allow the pump to cycle at least four times and wait until the water is cold before collecting your samples.

iv. A minimum amount to be purged is four (4) pump cycles.

v. No purging is required for fecal coliform. Sample point must be flamed before water sample is collected for fecal coli form.

vi. Samples cannot be collected through garden hose. If you must use a hose during the purging process, remove the hose before collecting the sample.

2. Sampling Activities:

Groundwater samples should be collected in the shortest possible time while maintaining sample integrity.

a. Obtain field measurements (pH, specific conductivity, temperature, dissolved oxygen, and redox) immediately after the purging phase and sampling phase in accordance with Section 2.6 of the Groundwater Sampling Field Manual (WDNR, 1996b). It is also best to obtain these readings in-situ whenever possible or through flow-through conditions.

b. Record the measurements on a field sampling form or electronic data collection device. The physical appearance of the sample (i.e., presence or absence of color, odor, and turbidity) will also be recorded.

c. Collect one duplicate sample for every twenty samples or at least once per day or per sampling plan.

d. Use the purging method for sampling unless otherwise specified.

e. When faucet sampling, reduce the flow rate to the lowest rate where sample collection can be completed efficiently.

f. Fill sample bottles directly from faucet with minimal air contact. Volatile organic compound vials shall be headspace free.

i. When filling sample bottles:

i. Carefully remove bottle caps so the inside of cap is not touched.

ii. Bottle caps shall be handled in a manner that prevents/minimizes contamination.

iii. Fill sample bottles with a minimal amount of air contact and without allowing the sampling equipment or personnel to contact the inside of the bottle.

g. Place all samples on ice after collection.

h. Field and trip blanks are used as a control or to detect contamination that may be introduced in the field, in transit, in bottle preparation, sample handling, or analysis. Trip blanks remain with sample containers while in transit and throughout the entire sampling and analysis event. These vials are not to be opened. Field blanks are prepared in the field and represent the background air conditions that may interfere with the representative sample.

i. If a split sample needs to be obtained, aliquots of water obtained from the sample point must not be altered between sampling bottles to provide the best representative sample as possible for each split sample.

j. State guideline and project specific requirements may vary regarding filtration of samples in the field. In general, drinking water samples should not be field filtered.

k. If sample bottles from the lab are not pre-preserved, the specified preservative shall be added immediately after sample collection. Samples shall also be iced immediately after collection.

l. Record sampling time, tap location, and time of collection.

m. Draw a diagram of where samples were collected in relation to the wellhead and the spigot or faucet location on the outside or inside of the house or other building. Take photo of sample location with owner's permission.

n. Place all samples in designated sample cooler(s).

o. Make sure sampling point is shut off and replace any aerators or filters that were removed before leaving private property.

**Standard Operating Procedure**

# SOP-5 Sedimentation Pond Sampling

## Introduction

The general procedures to be utilized in obtaining sedimentation pond waters samples are outlined below. Grab samples will be obtained by submerging the sample bottle under the water surface interface prior to opening the sample bottle. Samples will be collected in a well-mixed area of flow, representative of the surface water being discharged from the pond. No samples are collected if there is no discharge.

Contamination of samples or sample containers may originate from air, sampling personnel or contacted surfaces. To avoid contamination and to properly collect representative samples the sampler should have a good understanding of potential sources of contamination.

Other sample collection methods may need to be considered depending on site access, site location flow changes, seasonal changes, and safety needs. These equipment choices include but are not limited to using a boat, pond sampler, disposable bailers, and peristaltic pumps as options.

## Reference

Wisconsin Department of Natural Resources, 1996. "Groundwater Sampling Field Manual" (PUBL-DG-038 96) Bureau of Drinking Water and Groundwater. September 1996.

## Personnel Qualifications

A minimum of one person who is trained in this sampling technique is required to complete sampling. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

- Shipping container(s) for the sampling event to identify and protect bottles from possible sources of cross-contamination and breakage during storage and transportation.
- The correct quantity of properly cleaned and prepared sample bottles for parameters being collected. Note: Sample bottles may be pre-preserved in the laboratory.
- Gloves per safety plan – Keep in mind water temperature where liner gloves and shoulder length gloves may be necessary.
- Depending on site, water depth and accessibility waders, hip boots, knee boots or some other sort of water proof leg wear may be needed. Keep in mind water temperature and ambient air temperature when selecting material.
- Required laboratory sample bottles, coolers, ice.
- Provision for labeling samples (pre-labeled outer bags or other method).

- A sampling table and clean plastic sheeting to cover the table top and plastic clamps or other provision for retaining the plastic sheet on the table (the table may not be necessary if you don't have to set down bottles or you may set them down on another plastic-covered surface such as a cooler).

- Data log book or adequate electronic data collection device, lab sheets, and chain of custody forms.

- Personal protective equipment that is normally used when collecting samples at the sample collection site.

- HASP or Short Form Safety Plan – Identify accessibility issues, temperature and water flow safety, and required number of people to complete sampling event.

- A calibrated water quality meter.

- Decon water and Liqui-Nox® in spray bottles.

## Procedures

This is the basic procedure for collecting one sample. To collect multiple samples the procedures are replicated. These procedures may be modified per site specific sampling plan or analytical collection requirements.

Sedimentation pond sampling shall occur quarterly during periods of active discharge.

The basic procedures for collecting a surface water sample are:

1. All team members carry the equipment near the sampling location. If using a water craft, place equipment in watercraft. Location should be documented for repeatability of collecting future samples such as GPS coordinates or landmarks.

2. Prepare the sampling staging area to minimize contamination. Lay plastic sheeting down if needed for clean work area. Check wind and weather conditions. In field book or electronic data collection device, note sedimentation pond condition, operations of heavy equipment or other gas power equipment operating in area, exhaust from buildings, and any other potential sources of contamination. If any of the above conditions affect sample collection, the sampling event shall cease until conditions permit accurate sample collection.

3. If necessary to enter the sedimentation pond discharge stream or channel, plan to enter the water body downstream or downwind from sample location. Sample location should be upstream of any culvert, bridge, or gauging station. Ideally the sample location should be deep enough to be able to submerge sample bottles. Water sample collection should be completed before stream gauging activities unless sample collection is dependent on flow.

4. If multiple team members, designate one member of the team as the sample collector to enter the discharge stream or channel. The other team members to handle and manage sample bottles from shore.

5. Enter the water and proceed upstream to sample location.

6. Measure water quality parameters at the time of sampling in accordance with Section 2.6 of the Groundwater Sampling Field Manual (WDNR, 1996) and record the measurements on a field sampling form or electronic data collection device. Record the physical appearance of the water sample (i.e., presence or absence of color, odor, and turbidity) on the field form or electronic data collection device.

7. If pre-preserved sample bottles are used, a pond sampler or similar device should be use to collect samples. If unpreserved sample bottles are used, the following is an acceptable sample collection method:

    i. Submerge analytical samples bottles below the water. It is important to collect a representative sample by breaking the surface tension and not collecting floaters on the surface. Sampler should reach slightly forward and the sample bottle should be upright and pointed upstream into the flow. Depending on depth of stream, it may be necessary to collect samples at a predetermine depth.

    ii. Remove the bottle cap slightly from the bottle under water and bleed the flowing surface water into the sample bottle at a slow rate. Air bubbles at the water surface will indicate the bottle is filling. When bubbles cease, the bottle is full leaving a slight headspace.

    iii. Ensure the sample bottle is partially filled and the bottle cap tightened before bottle is removed from the water. If triple rinse is to be performed, sampler must shake the water in the analytical bottle and dump the water back into the surface water away from sample location, if the bottle is not pre-preserved.

    iv. Tightly screw the cap back onto the bottle under water.

    v. Remove the bottle from the water and exchange sample bottle with the person on shore. The sample bottle is returned to a position which protects and maintains contaminant-free sampling while continuing with additional sample bottle collection. The sampler must continue with sample collection until all sample point bottles are filled.

8. Samples shall be placed on ice.

9. Prepare and sign a chain of custody (COC) for the samples.

At the end of the sampling event, document the above sampling procedure in the project field notebook, field forms, or electronic data collection device. Note: Any possible sources of cross contamination that could affect the results during the sampling procedure.

**Standard Operating Procedure**

# SOP-6 Landfill Gas Field Monitoring

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedure for collecting landfill gas (LFG) measurements from LFG monitoring devices such as gas extraction wells, gas vents, and other similar devices.

An industry standard multi-gas meter specifically designed for use on landfills is required to monitor LFG extraction systems, flares, and migration control systems. The instrument will be capable of monitoring and analyzing pressure, percent $CH_4$, and percent $O_2$ of LFG with displayable readings that can be stored in the instrument or downloaded to a personal computer for reporting, analyzing, and archiving.

## References

NR 507.22 - Gas Monitoring

## Personnel Qualifications

Personnel operating the multi-gas meter should be familiar with the health and safety requirements for landfill gas system operations and maintenance. Specific training may be required for particular systems. Landfill gas can be highly explosive, corrosive, and flammable.

## Equipment and Supplies

Multi-gas meter

- Current manufacturer's meter certification (annually or per manufacturers' specifications, whichever is more frequent).

Calibration Standards (gases) – gas content percentages shall be determined by the manufacturer specifications:

- Methane.
- Oxygen.

Other

- Field form or appropriate electronic data collection device that includes well IDs.
- Required monitoring parameters.
- Calibration information.
- Extra sample tubing.
- Keys for protective cover/casing.
- Tools for cleaning sample ports.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

1. Review the site layout, potential challenges, emergency procedures, and site conditions that are seasonally appropriate.

2. Calibrate and set up the multi-gas meter per the manufacturer's specifications at least daily before monitoring.

3. Calibrate pressure sensors.

4. Collect and record required information for each event, either by using software for the multi-gas meter, handwritten in field form, or other electronic form. Typically, information to collected includes the following:

   - Well pressure.
   - Percent methane (CH4).
   - Percent oxygen (O2).
   - Gas temperature.
   - Gas flow (if necessary).
   - Vacuum.
   - On-site meteorological data (if available). As an alternative, the meteorological data may be gathered at a later time from observations taken at the nearest National Oceanic and Atmospheric Administration recognized meteorological station, using observations from the time closest to the start of the monitoring event. Record the following meteorological data:
     - Air temperature (°F).
     - Barometric pressure (mm Hg).
     - Trend in barometric pressure (rising, falling, stable).

5. Sample Collection Gas Well

   Proceed to gas well

   a. Record the gas well ID number.

   b. Remove gas well sample port cap and clean port, if necessary.

   c. Attach multi-gas meter to sample port, open valve:

      i. With the multi-gas meter turned on, but the pump turned off, connect the sampling tube from the instrument to the sample port, ensuring that the sampling port valve remains shut.
      ii. With the pump turned off, open the sampling port and immediately record the header pressure (inches of water).
      iii. Continue to purge the sampling port until methane and oxygen are stabilized. Record stabilized oxygen and methane reading.

   d. Read and record gas flow rate, if necessary.

   e. Make any well valve adjustments.

   f. Shut sample port valves to prevent potential gas from escaping from the atmosphere.

   g. Close the protective casing and lock the case.

h. Purge multi-gas meter, if necessary.

i. Record the ground condition around the gas probe/extraction well (i.e., is the ground surface immediate to the gas probe sloped or flat, wet or dry, vegetated or bare, etc.?).

j. Document any damage or necessary repairs to the monitoring probes/extraction wells.
*(NOTE: The system should be operating with a constant vacuum to make well field adjustments.)*

6. Perform any corrective actions and re-monitoring work as necessary under site permit requirements.

7. Record data and any additional comments on field forms or data recorder.

8. Verify data is collected for the gas well in accordance with site sampling requirements and then proceed to the next gas well.

**Standard Operating Procedure**

# SOP-7 Perimeter Gas Probe Monitoring

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for collecting landfill gas (LFG) measurements from perimeter gas probes and other similar devices outside the waste limits.

An industry standard multi-gas meter specifically designed for use on landfills is required for regulatory monitoring compliance of perimeter gas probes. The readings shall be displayable and able to be stored in the instrument or downloaded to a personal computer for reporting, analyzing, and archiving. The instrument will be capable of monitoring and analyzing pressure, percent $CH_4$, percent $CO_2$, and percent oxygen of LFG.

## References

NR 507.22 (1) - Gas Monitoring.

## Personnel Qualifications

Personnel monitoring perimeter LFG probes need to be familiar with the site and the hazards of LFG. LFG is explosive, corrosive, and flammable. Only properly trained field personnel should conduct perimeter gas probe monitoring.

## Equipment and Supplies

Multi-gas meter

- Current manufacturer's meter certification (annually or per manufacturer's specifications, whichever is more frequent).

Calibration Standards (gases) – gas content percentages shall be determined by the manufacturer specifications:

- Methane.
- Oxygen.

Other

- Field form or appropriate electronic data collection device that includes well IDs.
- Required monitoring parameters.
- Calibration information.
- Extra sampling tubing.
- Keys for protective cover/casing.
- Tools for cleaning sample ports.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

1. Review the site layout, potential challenges, emergency procedures, and site conditions that are seasonally appropriate.

2. Calibrate and set up the multi-gas meter per the manufacturer's specifications at least daily before monitoring.

3. Calibrate pressure sensors.

4. Collect and record required information for each event, either by using the multi-gas meter software or field form or electronic data collection device.

    - Barometric pressure and trend.
    - Percent methane ($CH_4$).
    - Percent oxygen ($O_2$).
    - Field comments.

5. Sample Collection Perimeter Gas Probe

    Proceed to probe

    A. Record the probe ID.
    B. Unlock and remove cap, if necessary.
    C. Record any probe condition observations (if necessary) such as:

        - Sealed from atmosphere.
        - Odor.
        - Damage.
        - Ground surface.

    D. Clean sample port, as needed.
    E. Attach multi-gas meter to probe sample port, open valve.
    F. Read and record initial stabilized percent $CH_4$ and $O_2$.
    G. Read and record stabilized readings, $CH_4$ and $O_2$.
    H. Shut probe sample port valve.
    I. Detach multi-gas meter from the sample port.
    J. Replace probe cap and lock as appropriate.
    K. Purge multi-gas meter if necessary.

6. Record data and any additional comments on field forms or electronic data collection device.

7. Verify data is collected for the probe in accordance with site sampling requirements and then proceed to the next probe.

**Standard Operating Procedure**

# SOP-8 Leachate Sampling

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedure for collecting leachate from leachate pump stations.

## References

Wisconsin Department of Natural Resources, NR 507.

## Personnel Qualifications

Personnel executing this protocol should have existing knowledge of sampling technique. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

- Laboratory supplied sample bottles.
- Field data sheets or electronic data collection device, chain-of-custody forms, and custody seals.
- Nitrile gloves.
- 5-gallon buckets with lid.
- Paper towels.
- Ice for sample coolers.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

The following sampling procedures will be used to collect leachate samples from the leachate pump stations:

1. Verify sample parameters and volumes prior to sample collection.

2. Begin to fill the laboratory-supplied sample bottles from the spigot slowly as to prevent foaming. Take care not to overfill sample containers containing chemical preservative.

3. If the pump station spigots are not operable, then open the leachate pump station valve vaults and collect the leachate manually using a bailer as follows:

    - Tie new nylon rope onto a new, disposable bottom emptying bailer; lower the bailer to the bottom of the vault.

    - Remove the bailer and fill sample bottles by slowly releasing leachate from the bottom of the bailer to allow leachate from the bottom of the bailer into the sample container. Take care to minimize agitation to the liquid when retrieving bailer and filling sample containers.

    - Very slowly fill sample bottles as the leachate will react with preservatives.

4. If quality assurance samples are required, fill the additional set of laboratory-supplied sample bottles from the spigot.

5. Measure the required field parameters at the time of sampling and record them onto the field forms or electronic data collection device. The physical appearance of the sample (i.e., presence or absence of color, odor, and turbidity) shall also be noted on the field forms or electronic data tablet.

6. Record the sample date and time on the field forms or electronic data collection device. Label all sample bottles using the sample naming convention established in the environmental monitoring plan.

7. Place all leachate samples in designated separate sample cooler(s). Make sure the sampling point is shut off before leaving pump station.

8. Collect quality control samples as described in the Sampling and Analysis Plan.

**Standard Operating Procedure**

# SOP-9 Equipment Decontamination

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for non-dedicated, and in some cases, dedicated, equipment decontamination. Non-dedicated equipment is used at more than one sampling location. This includes but is not limited to:

- Water level meters
- pH, conductivity, and temperature probes
- re-useable bailers
- Bailer rope when reused (not recommended)
- Filtering equipment
- Storage equipment including totes and pails

All non-dedicated equipment must be decontaminated between sampling points. In some situations, it may be necessary to decontaminate dedicated equipment such as bailers and rope. An example situation would be if the dedicated bailer fell on the ground or the rope touched the ground (may be better to replace the rope in some cases).

Check with your laboratory for recommended equipment cleaning solutions and procedures for each analyte you are sampling.

Specific decontamination procedures for equipment used for emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) sampling are not included in this SOP. Please follow current Environmental Protection Agency guidelines.

## Personnel Qualifications

Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

- Decon water (de-ionized water or municipal water tested free of contaminants monitored for at site).
- Approximately 2.5 percent by weight non-phosphate soap (e.g., Liqui-Nox®) and water solution.
- Large plastic pails or tubs/bottles for detergent and water.
- Scrub brushes.
- Plastic bags.
- Paper towels.
- Field book or appropriate data collection device.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Minimum Decontamination Procedures

1. When possible, decon equipment upwind of airborne sources of contamination such as vehicle exhaust, facility equipment and landfill operations. When this is not possible, take precautions to immediately store equipment upon completion of deconning process.

2. Disassemble the equipment, if possible. Use a weak non-phosphate soap and water solution and scrub the equipment inside and out. Visually inspect the equipment to ensure no visible contamination is present.

3. Thoroughly rinse the equipment with decon water and air dry. Reassemble the equipment, if applicable.

4. Containerize all wash and rinse water generated during decontamination activities, if required for project specific sampling activities.

5. Store and transport the equipment in clean plastic, aluminum foil, or a container that will protect the equipment from extraneous contamination, including, but limited to airborne dust and fumes, mud and rainfall.

***Note***: If in some cases it may not be necessary to complete step 1. Consult with WDNR staff if you are uncertain.

## More Rigorous Decontamination Procedures

1. Disassemble the equipment as much as possible. Because disassembling equipment can take time and be hard on the equipment, use professional judgment to determine when this is necessary.

2. Wash equipment with a non-phosphate detergent solution and scrub with an inert brush.

3. For internal mechanisms and tubing, circulate the detergent solution through the equipment.

4. Thoroughly rinse the dedicated and disposal (if reusing) equipment with Decon water.

    a. For ***organic*** (e.g., VOCs) sample collection, rinse equipment with an organic desorbing agent (e.g., pesticide grade isopropanol, acetone, methanol or hexane).

    b. For inorganic sample collection, rinse equipment with inorganic desorbing agent (e.g., dilute [0.1 Normal] reagent grade hydrochloric acid or nitric acid solution). For stainless steel and low-carbon steel, a more dilute hydrochloric acid solution (1 percent) is recommended.

    ***Note:*** If you use organic or inorganic desorbing agents, check with your laboratory regarding potential analytical interferences caused by desorbing agents and their proper use and disposal.

5. Rinse the equipment with decon water only if you are using an ***inorganic*** desorbing agent.

6. Rinse with decon water. If practical, allow the equipment to air dry before its next use or storage.

7. Containerize all wash and rinse water generated during decontamination activities unless specific conditions allow for discharge to the land surface. If discharge to the land surface it should be away from any monitoring points. No chemicals such as acetone, for instance, should be discharged to the environment.

8. Store and transport the equipment in clean plastic, aluminum foil or a container that will protect it from extraneous contamination.

Other decontamination methods such as high-pressure steam cleaning, hot-water power wash, ultrasonic cleaning and other methods decontaminate most equipment satisfactorily. Refer to the manufacturer's instructions for use.

***Note:*** Dedicated sampling equipment ("permanently" left in the well) significantly reduces the need for equipment decontamination. Sampling equipment used in wells containing free product should be dedicated (suspended above the water column) or disposable.

## Decontamination Documentation

At a minimum, decontamination documentation should be written in the field book or electronic data collection device to include the following:

1. The location where decontamination occurred, ie are they deconning downwind of fill area or other sources of airborne contaminates.

2. The individuals performing the decontamination.

3. The decontamination procedures, including the wash solution and rinse water used (e.g., potable water and Decon water).

4. Equipment storage and transport procedures.

5. The handling and disposal of decontamination wastewater.

**Standard Operating Procedure**

# SOP-10 Sample Chain of Custody

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to identify sample custody, proper documentation, and security as the sample is transported. All samples collected must be accompanied by a chain of custody when submitted for analysis to ensure proper security and legal handling of samples.

Proper documentation of sample custody is necessary to trace a sample from point of origin through the final report or completion of the project. Requiring samples to have a chain of custody ensures proper security and legal handling of samples as they move between the different parties that are responsible for their collection and analysis. A chain of custody is prepared by completing a chain of custody record form. Typically, these forms are provided by the laboratory that is providing the sample bottles and analysis. If the laboratory does not supply a form, there is a generic chain of custody form which can be used (see Attachment 1). Chain of custody (COC) record forms will be filled out by the sampler(s) at the time of sampling and shipping.

This process is intended to be used for both paper and electronic chain of custody forms.

## References

WDNR, NR 149.

## Personnel Qualifications/Requirements

The sampler(s) must be trained in properly filling out chain of custody forms.

## Equipment and Supplies

- Electronic or paper copy of COC form (one per cooler or set of coolers to be sent to the laboratory at one time).
- Pen.
- Appropriate electronic data collection device for electronic chain of custody.
- Collected Samples.
- Bottle Labels.
- Custody Seals.
- Shipping Tape (if shipped).

## Procedures

Sample chain of custody documentation will be prepared by the sampler(s) immediately following the collection of samples. A chain of custody is a legal document. Therefore, it must be completed in pen. COCs can also be completed electronically, an electronic chain of custody form can be completed on an appropriate electronic data collection device and printed. However, signatures on both electronic and paper chain of custody forms must be in ink. Samples shall be segregated to separate COCs by landfill license.

COC forms will generally include the following information:

1. A unique chain of custody number
2. Laboratory shipping address

3. Project contact (in most cases, that will be the lab coordinator)
4. Contact phone number
5. Project number ID
6. Project name
7. Landfill WDNR license number
8. Project state
9. Name of sampler(s)
10. Field ID and unique number
11. Sample description
12. Date sample collected
13. Time sample collected (use military time)
14. Analyses requested
15. Sample matrix
16. Preservation of samples
17. Indicate whether or not sample was field filtered
18. Page numbers if more than one chain of custody
19. Address for where reports should be mailed
20. Address of where invoice should be sent
21. Regulatory program
22. Special quality assurance needs (turnaround time)
23. Any request for data submitted by e-mail or any other format other than printed copy
24. Laboratory receiving information section completed by the laboratory
25. Shipping method and tracking numbers
    i. Airbill number: Used for shipping (if samples are hand-delivered to their destination, "Hand Delivered" should appear in this field).
    ii. Shipping Label: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use "Sample Custodian."
26. Signature section for transfer of custody with date and time section
27. Quality Control (QC) Type: This is for field quality control only, and includes field duplicates, field blanks, equipment blanks, and trip blanks.
28. COC Record Fields: The sampler's signature must appear in the "Relinquished By" field. The date and time (military time) must also be included. Although the samples are "relinquished" to the shipping carrier, the shipping carrier does not have access to the

samples as long as the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the COC form.

29. Sample(s) to be used for Laboratory QC: This identifies which samples are to be used for matrix spike/matrix spike duplicate analyses.

After collection, samples are securely stored and packaged as required by analytical protocol until delivered to the laboratory. The COC document remains with the samples during transport and serves as a written record of sample possession and transference. A sample is considered to be in custody if it is in one's possession, is locked and sealed during shipment, or is placed in a secure area limited to authorized personnel. The COC must be signed and dated by everyone who takes possession of the sample. If the electronic chain of custody form is used, a minimum of two printed copies must accompany the samples to the laboratory. All copies are signed and dated during sample transfer. Laboratory personnel will note any damaged sample containers, or discrepancies between the sample label and information on the COC form.

**Standard Operating Procedure**

# SOP-11 Shipping and Packaging of Non-Hazardous Samples

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide general instructions in the packaging and shipping of non-hazardous samples. The primary use of this SOP is for the transportation of samples collected on site to be sent off site for physical, chemical, and/or radiological analysis.

Non-hazardous samples are those that do not meet any hazard class definitions found in 49 Code of Federal Regulations (CFR) 107-178, including materials designated as Class 9 materials and materials that represent Reportable Quantities (hazardous substances).

## References

- 49 CFR Parts 107-178.
- State Department of Transportation (DOT).
- International Air Transport Association (IATA).
- Shipping carrier instructions.

## Definitions

- Cooler/Shipping Container – Any hard-sided insulated container meeting any state DOT or IATA's general packaging requirements.
- Bubble Wrap – Plastic sheeting with entrained air bubbles for protective packaging purposes.

## Equipment and Supplies

- Shipping container.
- Samples.
- Ice.
- Various types of packing supplies.
- Plastic bags.
- Ziploc® plastic bags.
- Custody seals.

### Packaging

1. Follow shipping instructions from contracting lab.
2. Use tape to seal off the cooler drain on the inside and outside to prevent leakage.
3. Place packing material on the bottom of the shipping container (cooler) to provide a soft impact surface.
4. Place a 55-gallon or equivalent plastic bag into the cooler (to minimize possibility of leakage during transit).

5. Starting with the largest glass container, wrap each container with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.

6. Pack the largest glass containers in bottom of the cooler, placing packing material between each of the containers to avoid breakage from bumping.

7. Double-bag the ice (chips or cubes) in gallon or quart freezer Ziploc® plastic bags and wedge the ice bags between the sample bottles. (Use "quality" ice, not ice from motel ice machine.)

8. Add bags of ice across the top of samples.

9. When sufficiently full, seal the inner protective plastic bag and place additional packing material on top of the bag to minimize shifting of containers during shipment.

10. Tape a gallon Ziploc® bag to the inside of the cooler lid, place the completed chain of custody document inside, and seal the cooler shut.

11. Tape the shipping container (cooler) shut using packing tape, duct tape, or nylon-reinforced or equivalent tape that cannot be tampered with in an unnoticed manner. Taping should be performed to ensure the lid cannot open during transport. If security tape is used, make sure that the tape needs to be cut or ripped to open the cooler. The tape should include the initials of the person sealing the container and the date and time of sealing.

12. Place a custody seal on two separate portions of the cooler to provide evidence that the lid has not been opened prior to receipt by the intended recipient. Affix the seal to the sample container so that it has to be broken to open the container. The seal should include the initials of the person sealing the container and the date and time the container is sealed.

## Labeling

1. "This Side Up" arrow must be adhered to all sides of the cooler.

2. The name and address of the receiver and the shipper must be on the top of the cooler.

3. The air bill must be attached to the top of the cooler or to the handle by zip tie.

## Shipping Documentation

1. If project has specific cooler shipment checklist requirements it shall be completed and kept in the project file. Custody seal numbers may need to be recorded and tracked.

2. Shipping tracking numbers should be kept in project file.

3. Shipping costs should be recorded and kept in project file.

**Standard Operating Procedure**

# SOP-12 Gas Canister Sampling

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedure for collecting gas canister samples.

## References

WDNR, NR 507 – Gas Monitoring.

## Personnel Qualifications

Personnel monitoring perimeter LFG probes need to be familiar with the site and the hazards of LFG. LFG is explosive, corrosive, and flammable. Only properly trained field personnel should conduct perimeter gas probe monitoring. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment/Materials

- Sample canisters.
- Flow Controller set to 200 milliliters per minute (mL/min).
- Digital vacuum gauge.
- Field duplicate stainless-steel sampling "T".
- Swagelock fittings.
- ½-inch, 9/16-inch, and adjustable wrenches.
- Teflon tubing.
- Field data sheets or appropriate electronic data collection device.
- Chain-of-custody forms, and custody seals.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures/Guidelines

Air pressure decreases with increasing elevation. Therefore, a gas collection canister evacuated at a laboratory located at sea level will show a lower vacuum measurement at a higher altitude. Generally, a 1,000-foot rise in elevation corresponds to a 1-inch Hg drop in canister pressure. If there is a significant difference in elevation between the selected laboratory supplying the canister and the site, the laboratory should be notified in advance of the field event so the initial evacuated canister vacuum can be adjusted accordingly. This will ensure there is enough vacuum pressure within the canisters to collect the sample given the site elevation.

At the start of the sampling event, record the onsite meteorological data (if available). As an alternative, the meteorological data may be gathered at a later time from observations taken at the nearest National Oceanic and Atmospheric Administration recognized meteorological station, using observations from the time closest to the start of the monitoring event.

- Record the following meteorological data:
  - Air temperature (°F).
  - Barometric pressure (mm Hg).
  - Trend in barometric pressure (rising, falling, stable).

The following monitoring procedures shall be used to collect gas canister samples:

1. Verify that the canister has been certified clean by the laboratory. Retain certification documentation for the project records.

2. Verify that the canister has sufficient initial vacuum for sampling. Measure the initial canister vacuum using an external digital gauge as follows:

    a. Verify that the canister knob is closed then remove the protective cap from the valve on the canister.

    b. Attach the digital vacuum gauge to the canister. The digital vacuum gauge with 0.25 percent accuracy at the -30 to 0 inches of mercury (Hg) range, and National Institute of Standards and Technology (NIST)-traceable calibration for vacuum measurements.

    c. Open the canister knob and record the initial canister pressure.

    d. Close the canister knob and remove the digital vacuum gauge.

    e. Do not collect a sample using a canister without sufficient initial vacuum (only canisters between -28 and -30 inches of Hg should be used). Low initial vacuum could create a low bias in analytical results due to air leakage.

3. Record the canister ID on the field sampling form or electronic data collection device.

4. Connect the flow controller (calibrated to 200 mL/min) to the sample canister. Record the flow controller ID on the field sampling form or electronic data collection device.

5. Connect the flow controller to the sample port using Teflon tubing.

6. If the canister has a built-in or assigned vacuum gauge, allow the canister to fill until the vacuum reaches 2 to 10 inches of Hg for 6-liter canisters and 2 to 5 inches of Hg for 1-liter canister. A small amount of vacuum should be left in the canister, so the laboratory can confirm that the canister was not opened during shipment.

7. Ensure that the sampling port valve and the canister knob are closed, then remove the flow controller from the sampling port and canister.

8. Attach the digital vacuum gauge to the canister.

9. Open the canister knob and record the final canister pressure.

10. Close the canister knob and remove the digital vacuum gauge.

11. Canisters with no vacuum left (0 inches Hg) should not be analyzed. Re-sampling will be necessary if a canister arrives at the laboratory with no vacuum.

12. Record the sampling date and times on the sampling form or electronic data collection device.

13. Quality control samples should be collected in accordance with the Sampling and Analysis Plan. When field duplicate samples are collected a stainless-steel sampling “T” should be used so that the normal and field duplicate sample are collected over the same time interval. In this scenario, two flow controllers will be utilized, with one flow controller connected to each canister.

14. Complete chain of custody form and double check against information on canister and complete any other required field forms.

15. Complete a chain of custody seal for each cooler that is not hand delivered to the receiving agent. Affix each seal to the sample container such that it has to be broken to open the container. The seal should include the initials of the person sealing the container and the date and time the container is sealed. If security tape is used, make sure that the tape needs to be cut or ripped to open the cooler. Use nylon-reinforced or equivalent tape that cannot be tampered with in an unnoticed manner. The tape should include the initials of the person sealing the container and the date and time of sealing.

16. Deliver or call for pick-up of samples.

17. Enter field reading into database or submit sampling forms to the County's consultant and the WDNR as directed.

**Standard Operating Procedure**

# SOP-13 Groundwater Monitoring Well Construction and Repair

## Introduction

This Standard Operating Procedure (SOP) is applicable to projects where it is necessary to provide oversight of subcontractors during borehole, monitoring well and piezometer installation activities, and repairs or modifications to these wells, to ensure activities meet state and federal regulations where applicable. It is important that proper borehole/well construction procedures are followed in order to eliminate the risk of surface contaminants entering the groundwater at wellheads and to eliminate the potential safety risks associated with inappropriately constructed wells.

As monitoring well construction regulations vary by state, it is important to review Wisconsin Administrative Code NR 141 prior to beginning work. This SOP should be used in conjunction with NR 141.

This SOP is applicable to all projects on site where monitoring wells are constructed, repaired or modified.

## References

Wisconsin Administrative Code, Department of Natural Resources, *Groundwater Monitoring Well Requirements*. Chapter NR 141, March 2000, No. 531.
http://www.legis.state.wi.us/rsb/code/nr/nr141.pdf

## Personnel Qualifications

Personnel executing this protocol should have existing knowledge of drilling and well installation methods. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan for environmental activities conducted at the facility.

## Equipment and Supplies

- Field forms (Well Construction Documentation Form, Soil Boring Log Field Form) Record on WDNR Monitoring Well Construction/Well Development Form 4400-113A Rev 7-98 (Attachment A).
- Drilling oversight checklist SOP.
- Soil borehole logging SOP.
- Camera.
- Field book or appropriate electronic data collection device.
- Distilled water.
- 5-gallon pail.
- Alconox or equivalent detergent.

- Trowel.
- Ziploc® bags.
- Tape measure.
- Water interface probe.
- Munsell soil color chart.
- Pocket penetrometer.
- Nitrile gloves.
- Personal protective equipment.
- Drill rig.
- Contaminant free pens/permanent markers.
- Well construction material (i.e., riser pipe, bentonite chips, filter pack, screen, etc.).
- Appropriate state administrative code and rules.
- Appropriate tools to remove damaged well casing or Protop (i.e., shovels, pry bars, saws, inside pipe cutters, etc.).

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures for Installation

The following procedure should be used as a guideline in conjunction with applicable state regulations to ensure proper documentation and oversight of well installation:

1. Confirm public and private utilities have been located.
2. Mobilization to proposed monitoring well location as specified in the project work plan.
3. Log all drill core obtained in accordance with ASTM D-2487-17 Standard Practice for Description and Identification of Soils. Record soil and bedrock details on a WDNR Form 4400-122 Soil Boring Log Information form.
4. Verify well construction plans based on field observations with the project manager as appropriate.
5. Once the target depth is met and the borehole is reamed, verify the depth by tagging the bottom of the borehole. Record this in the field log book or electronic data collection device and on a WDNR Monitoring Well Construction form, 3300-113A.
6. Watch as the monitoring well is constructed in the borehole. Record all observations in the Field Log Book or electronic data collection device and well construction field form.

a. Count each segment of the well screen, and determine the well screen footage. Verify the screen slot size and length is correct.

b. Count each segment of the well casing and determine the well casing footage. Verify the well casing diameter, schedule, thickness, and length is correct.

c. Sum the length of the installed well screen and well casing. Verify the total well length is correct.

d. At no time should joints be glued. NR 141.07(3) (3) Assembly and installation states: All casing couplings shall be constructed of flush threaded joints. Solvent welded joints may not be used without prior written approval by the department. The casing shall be centered in the borehole.

7. Watch as the annular space is filled. Record all observations in the Field Log Book or electronic data collection device and well construction field form.

   a. Record the type of filter pack material being used. Verify that the filter pack being used is in compliance with the work plan and any applicable regulations. Filter Pack Seal.

   b. *Specifications.* All permanent groundwater monitoring wells installed with filter packs shall be constructed with a filter pack seal. For all water table observation wells and piezometers, the filter pack seal shall extend 2 feet upward from the top of the filter pack and shall consist of 2 feet of clean fine sand. When high-solids grout, granular bentonite slurry, bentonite-cement grout or neat cement grout is used as the annular space sealant, 5 feet of bentonite shall be placed on top of the clean fine sand seal. Bentonite chips no greater than 3/8 inch in diameter or bentonite pellets shall be used for seals placed below the water table. Bentonite granules may be used for seals when there is no standing water above the filter pack and the borehole is less than 25 feet or in areas where the depth to water table is less than 7 feet. For water table observation wells constructed in areas where the depth to water table is less than 16 feet, the filter pack seal shall be reduced to 2 feet of bentonite to allow for the required amount of annular space sealant to be placed. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the required filter pack seal may be reduced to allow for the required amount of annular space sealant to be placed.

   c. ***In****stallation.* A tape measure, measuring rod or similar device shall be used to ensure that the filter pack seal is installed over the proper depth interval. The tape measure, measuring rod or similar device shall be carefully raised and lowered while the filter pack seal material is being placed to identify bridging. If bridging occurs the filter pack seal material shall be tamped into place, surrounding the well casing, using a measuring rod or similar device. When a tremie pipe is used to place the filter pack seal the procedures of s. NR 141.10 shall be followed. Bentonite pellets, bentonite chips or bentonite granules shall be hydrated in 2-foot lifts as placed in the borehole when placed above the water table.

   d. Verify that the filter pack is being placed using a tremie method.

   e. Have the driller tag the top of the filter pack, verify that the top of the filter pack is placed as required by the work plan or applicable regulations at the appropriate height above the well screen. Verify that the driller has surged the well screen, and that the filter pack is at the appropriate height.

   f. If transition sand is being used, complete the last three steps with the transition sand layer.

   g. Record the type of bentonite chip/pellet seal being placed between the filter pack (or transition sand) and the annular seal.

h. Verify that the seal is being placed using a tremie method.

i. Have the driller tag the top of the bentonite chip/pellet seal, and verify that the top of the seal is placed as required by the work plan or applicable regulations at the appropriate height above the well screen. Verify that the driller hydrates this layer prior to placing the bentonite seal.

j. Record the type of annual seal material being used. Annual Space *Specifications.* All permanent groundwater monitoring wells shall be installed with an annular space seal designed to achieve a permeability of 1 x 10-7 centimeters per second or less. For permanent groundwater monitoring wells constructed with filter packs, the annular space seal shall extend from the filter pack seal to the ground surface seal and shall be at least 2 feet in length. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the annular space seal shall be bentonite granules. For monitoring wells constructed into bedrock formations and without well screens, the annular space seal shall extend from the bottom of the outer borehole to the ground surface seal and shall be at least 2 feet in length. Sealant materials may not contain additives. These requirements may be met by:

    i. Bentonite granules slurry may be used as an annular space sealant in any type of monitoring well except where the depth to the water table is less than 7 feet.

    ii. Bentonite pellets, bentonite chips or bentonite granules may be used to seal the annular space under the following conditions.

    iii. Bentonite granules may be used when there is no standing water in the well above the filter pack and the total well depth is less than 25 feet or the depth to water table is less than 7 feet.

    iv. Bentonite chips with diameter no larger than 3/8 inch or bentonite pellets may be used when the depth of standing water in the well is less than 30 feet and the total depth of the annular space seal is less than 50 feet except where the depth to the water table is less than 7 feet.

    v. Bentonite chips with diameter no larger than 3/8 inch or bentonite pellets may be used when the depth of standing water in the well is less than 30 feet and the total depth of the annular space seal is less than 50 feet except where the depth to the water table is less than 7 feet.

    vi. High-solids grout approved by the department, bentonite-cement grout or neat-cement grout may be used to seal the annular space in which a bentonite filter pack seal has been placed except where the depth to the water table is less than 7 feet.

    vii. When bentonite chips with diameter no larger than 3/8 inch, bentonite pellets or granules are used to seal the annular space, they may either be poured freely down the borehole or added through a tremie pipe, provided the specifications of par. (a) are met. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) (a) and (b) shall be followed.

    viii. When grouts or slurries are used to seal the annular space, the material may be poured freely down a tremie pipe or pumped down a borehole with the use of a tremie pipe, provided the specifications of par. (a) are met. For wells 100 feet in depth or greater the sealant material shall be pumped down the borehole with the use of a tremie pipe. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) shall be followed.

    ix. When any slurry or grout is used, there shall be a 12-hour period between the time the annular space seal is installed and the time the protective cover pipe is installed. Any

settling in the annular space seal shall be topped off before the protective cover pipe is installed.

x. The top of the well casing shall be covered with a protective cap.

1. Record the ratio of bentonite/cement/water mixture being used.

2. Count the number of bags of mix and gallons of seal placed down the hole. Compare the volume to the table below to ensure enough material was placed in the borehole.

| Volume of Open Boreholes and Annulus Between Casing and Hole | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hole Diameter | Volume/ Lineal Ft. of Hole | | Nominal Casing Diameter | Volume Gal/Linear Ft. of Annulus | | Lbs Sand/ Lineal Ft. of Annulus | Lbs 1/2 " Pellets Per Lineal Ft. of Annulus |
| | Gal. | Cu Ft. | | Gal. | Cu Ft. | | |
| 7 1/4" | 2.14 | .29 | 1 1/4" | 2.03 | 0.27 | 27 | 21 |
| 7 1/4" | 2.14 | .29 | 2" | 1.91 | 0.26 | 26 | 20 |
| 7 3/4" | 2.45 | .33 | 2" | 2.22 | 0.30 | 30 | 23 |
| 8 1/4" | 2.78 | .37 | 2" | 2.55 | 0.34 | 34 | 26 |
| 10 1/4" 1/4" | 4.29 | .57 | 2" | 4.06 | 0.54 | 54 | 41 |
| 8 1/4" | 2.78 | .37 | 3" | 2.28 | 0.30 | 30 | 23 |
| 10 1/4" 1/4" | 4.29 | .57 | 3" | 3.79 | 0.51 | 51 | 38 |
| 12 1/4" 1/4" | 6.13 | .82 | 3" | 5.62 | 0.75 | 75 | 57 |
| 8 1/4" | 2.78 | .37 | 4" | 1.95 | 0.26 | 26 | 20 |
| 10 1/4" 1/4" | 4.29 | .57 | 4" | 3.46 | 0.46 | 46 | 35 |
| 12 1/4" 1/4" | 6.13 | .82 | 4" | 5.30 | 0.71 | 71 | 54 |
| 12 1/4" | 6.13 | .82 | 6" | 4.33 | 0.58 | 58 | 44 |

8. Watch as the monitoring well is completed. Record all observations in the Field Log Book or electronic data collection device and well construction field form.

9. Verify that the monitoring well casing is cut level at the appropriate height above ground surface.

10. Using the water probe, record the water level and total well length in the well construction field log.

11. Verify that the well has been installed straight by physically looking straight down the hole with a light.

12. Verify that an approved protective well completion and well cap was installed in accordance with the work plan and applicable regulations. For riser pipe ground surface seal all permanent groundwater monitoring wells surface seals shall be:

a. Constructed with a bentonite or concrete ground surface seal.

b. Shall extend to a minimum of 60 inches below the land surface, and the top shall be sloped away from the well casing. If bentonite is used, the top of the surface seal shall terminate 6 inches below the land surface and shall be covered with top soil or native soil to prevent drying out or animal consuming the bentonite.

c. Installed around the protective cover and may not be placed between the protective cover pipe and the well casing. If the monitoring well depth is such that both a minimum 2-foot annular space seal and a minimum 5-foot ground surface seal cannot both be placed, the ground surface seal may be shortened.

For protective cover pipe (Protop) the protective cover pipe shall:

a. Consist of a metal casing at least 2 inches larger in diameter than the well casing with a locking cap.

b. Extend from the bottom of the ground surface seal to a minimum of 24 inches above the ground surface except as provided in sub.

c. There may be no more than 4 inches between the top of the well casing and the top of the protective cover pipe.

d. Extend above the top of the well casing. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the required length of protective cover shall be reduced and may not extend through the annular space seal or into the filter pack.

e. If the monitoring well is located in a floodplain, the protective cover pipe shall be watertight. The department may require additional protective devices, such as rings of brightly colored posts around the well, as necessary. Weep holes or vents may be used in protective cover pipes.

13. For all ground surface seal and flush mounted protective cover pipe all permanent groundwater monitoring wells with a flush mounted protective cover pipe shall be:

a. Constructed with a concrete ground surface seal.

b. The ground surface seal shall extend to, but not beyond, the total depth of the flush mounted protective cover pipe.

c. The ground surface seal shall be installed around the flush mounted protective cover pipe and may not be placed between the flush mounted protective cover pipe and the well casing.

d. May be installed only in high vehicular traffic areas.

e. May not be installed in areas subject to ponding or flooding.

f. Flush mounted protective cover's lid shall have the wording “monitoring well" on its outer surface.

g. Shall be installed through an impervious surface such as asphalt or concrete. If an impervious surface does not exist one shall be created which will support the weight of the traffic in the area. The flush mounted protective cover pipe shall consist of a watertight metal casing with an inside diameter at least 4 inches greater than the inside diameter of the monitoring well casing.

h. Flush mounted protective cover pipe shall be one continuous metal piece or 2 metal pieces which are joined with a continuous weld.

i. Flush mounted protective cover pipe shall be a minimum of 12 inches in length and there may be no more than 8 inches between the top of the monitoring well casing and the top of the flush mounted protective cover pipe after installation.

j. The flush mounted protective cover pipe shall have an exterior flange or lugs.

k. Pipe may not extend beyond the annular space seal.

l. Protective cover pipe or the monitoring well shall have a locking mechanism.

m. The monitoring well installed within any flush mounted protective cover pipe shall have a watertight cap.

14. Upon completion of the monitoring well and protective casing completion:

    a. Mark north on the top of the well casing and label the casing and well cap with the well identification number using a permanent, contaminant free marker.

    b. Top of casing shall be covered with a cap.

    c. Install an approved lock on the protective well casing.

    d. Make sure driller attached a Wisconsin Unique Well Number sticker on the well and record the number on the well construction form.

    e. Make sure the well name is clearly visible on the side of the protective casing if it is stick or adhered to the cover of a flush mounted protective unit.

    f. Vertically survey and record the casing and protective cover elevations.

## Procedures for Repair

The following procedure should be used as a guideline in conjunction with all applicable state regulations to ensure proper documentation and oversight of well repair, well casing (riser) extensions and reductions. The work activity shall introduce the least possible amount of foreign material into the well casing, produce the least possible disturbance to the formation. The Solid Waste Superintendent or a designee experienced in well construction and repairs shall witness the well repair work.

1. Verify well construction from original installation forms and field observations needed for repair with the Solid Waste Superintendent or his designee.

2. If Protop is damaged verify length and type to be repaired or replaced.

3. If casing (typically Schedule 40 of 80 flush-threaded PVC) is damaged and must be replaced, or the pipe must be extended due to changes in site conditions, verify length and order if not already available on site. Note that Schedule 40 and Schedule 80 PVC pipe are different thicknesses and not compatible.

4. The casing shall be centered in the borehole. Assembly and installation states all casing couplings shall be constructed of flush threaded joints. **Solvent welded joints may not be used without prior written approval by the department, and it is the policy of this facility that they will not be used at all**. The casing shall be centered in the borehole. It is preferred that an extension be added at a flush threaded joint. When it is not possible to add a casing extension at a flush threaded joint, a Fernco coupling shall be used to join the casing pieces.

5. Prior to use, the casings and couplings shall be inspected for cuts, deformations, gouges, deep scratches, damaged ends and other imperfections.

6. Mobilize to the identified well location with appropriate material and tools to complete the work.

7. If in question which well to work on, make sure the well number on the well matches the documentation supplied by the Solid Waste Supervisor or his designee.

8. Precautions shall be taken to prevent cross contamination of aquifers or uncontaminated zones from work being performed at the ground surface.

9. Verify segment of the well casing, and determine the well casing footage that needs to be repaired, extended or reduced.

10. Verify the well casing diameter, thickness, and length is correct.

11. Verify the total well length is correct.

12. Top of casing shall be covered with a cap.

13. Fill annular space as noted above in the Well Construction section. Verify that the monitoring well casing is cut to level as appropriate for the repair, extension or reduction. The cut should be as horizontal as possible.

14. Verify after repair that the well casing is straight.

15. Install new protective steel stick up pipe or flush box, with the well casing centered in the middle.

16. Bentonite should be placed around the outside of steel protective steel stick up pipes, with top six inches replaced with topsoil. When concrete is needed to anchor protective steel pipes or flush boxes, the protective unit shall be placed first with concreted placed around the outside of the unit. At no time shall concrete come in contact with well casing.

17. Upon completion of repair of the monitoring well and protective casing completion:

    a. Mark north on the top of the well casing and label the casing and well cap with the well identification number using a permanent, contaminant free marker.

    b. Vertically survey and record the casing and protective cover elevations.

    c. If the total well depth has changed, record the new depth.

    d. Top of casing shall be covered with a cap

    e. Install an approved lock on the protective well casing.

    f. Make sure all observations are recorded in field log book, field form, or electronic data collection device.

    g. Make sure driller attached a Wisconsin Unique Well Number sticker on the well and record the number on the well construction form.

    h. Make sure the well name is clearly visible on the side of the protective casing if it is stick or adhered to the cover of a flush mounted protective unit.

18. Develop or redevelop well following procedures described in SOP-14.

# Attachment A

# Field Forms and WDNR Monitoring Well Construction/Well Development Form 4400-113A – Rev 7-98

7-98

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐ _____

# MONITORING WELL CONSTRUCTION

Form 4400-113A Rev. 7-98

| | | |
|---|---|---|
| Facility/Project Name | Local Grid Location of Well _____ ft. ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. | Well Name |
| Facility License, Permit or Monitoring No. | Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. ° ' " Long. ° ' " or | Wis. Unique Well No. / DNR Well ID No. |
| Facility ID | St. Plane _____ ft. N, _____ ft. E. S/C/N | Date Well Installed m m / d d / y y y y |
| Type of Well Well Code ____/____ | Section Location of Waste/Source ____1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W | Well Installed By: Name (first, last) and Firm |
| Distance from Waste/Source _____ ft. / Enf. Stds. Apply ☐ | Location of Well Relative to Waste/Source u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known | Gov. Lot Number |

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation _____ ft. MSL

C. Land surface elevation _____ ft. MSL

D. Surface seal, bottom _____ ft. MSL or _____ ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐ 50
Hollow Stem Auger ☐ 41
Other ☐ ▒▒
_____

15. Drilling fluid used: Water ☐ 02 Air ☐ 01
Drilling Mud ☐ 03 None ☐ 99

16. Drilling additives used? ☐ Yes ☐ No
Describe _____

17. Source of water (attach analysis, if required):
_____

E. Bentonite seal, top _____ ft. MSL or _____ ft.

F. Fine sand, top _____ ft. MSL or _____ ft.

G. Filter pack, top _____ ft. MSL or _____ ft.

H. Screen joint, top _____ ft. MSL or _____ ft.

I. Well bottom _____ ft. MSL or _____ ft.

J. Filter pack, bottom _____ ft MSL or _____ ft.

K. Borehole, bottom _____ ft MSL or _____ ft.

L. Borehole, diameter _____ in.

M. O.D. well casing _____ in.

N. I.D. well casing _____ in.

1. Cap and lock? ☐ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: _____ in.
b. Length: _____ ft.
c. Material: Steel ☐ 04
Other ☐ ▒▒
_____
d. Additional protection? ☐ Yes ☐ No
If yes, describe: _____

3. Surface seal: Bentonite ☐ 30
Concrete ☐ 01
Other ☐ ▒▒
_____

4. Material between well casing and protective pipe:
Bentonite ☐ 30
Other ☐ ▒▒
_____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. _____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. _____ $Ft^3$ volume added for any of the above
f. How installed: Tremie ☐ 01
Tremie pumped ☐ 02
Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 32
c. _____ Other ☐ ▒▒

7. Fine sand material: Manufacturer, product name & mesh size
a. _____ ▒▒
b. Volume added _____ $ft^3$

8. Filter pack material: Manufacturer, product name & mesh size
a. _____ ▒▒
b. Volume added _____ $ft^3$

9. Well casing: Flush threaded PVC schedule 40 ☐ 23
Flush threaded PVC schedule 80 ☐ 24
_____ Other ☐ ▒▒

10. Screen material: _____ ▒▒
a. Screen type: Factory cut ☐ 11
Continuous slot ☐ 01
_____ Other ☐ ▒▒
b. Manufacturer _____
c. Slot size: 0.____ in.
d. Slotted length: _____ ft.

11. Backfill material (below filter pack): None ☐ 14
_____ Other ☐ ▒▒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

| Signature | Firm |
|---|---|
| | |

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

# MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐ _____

| Facility/Project Name | County Name | Well Name |
|---|---|---|
| | | |

| Facility License, Permit or Monitoring Number | County Code | Wis. Unique Well Number | DNR Well ID Number |
|---|---|---|---|
| | _ _ | _ _ _ _ _ _ _ | _ _ _ |

1. Can this well be purged dry? ☐ Yes ☐ No

2. Well development method

| | |
|---|---|
| surged with bailer and bailed | ☐ 41 |
| surged with bailer and pumped | ☐ 61 |
| surged with block and bailed | ☐ 42 |
| surged with block and pumped | ☐ 62 |
| surged with block, bailed and pumped | ☐ 70 |
| compressed air | ☐ 20 |
| bailed only | ☐ 10 |
| pumped only | ☐ 51 |
| pumped slowly | ☐ 50 |
| Other _____ | ☐ |

3. Time spent developing well _ _ _ _ min.

4. Depth of well (from top of well casisng) _ _ _ . _ ft.

5. Inside diameter of well _ _ . _ _ in.

6. Volume of water in filter pack and well casing _ _ _ . _ gal.

7. Volume of water removed from well _ _ _ . _ gal.

8. Volume of water added (if any) _ _ _ . _ gal.

9. Source of water added _____

10. Analysis performed on water added? (If yes, attach results) ☐ Yes ☐ No

| | Before Development | After Development |
|---|---|---|
| 11. Depth to Water (from top of well casing) | a. _ _ _ . _ _ ft. | _ _ _ . _ _ ft. |
| Date | b. _ _/_ _/_ _ _ _ (m m d d y y y y) | _ _/_ _/_ _ _ _ (m m d d y y y y) |
| Time | c. _ _ : _ _ ☐ a.m. ☐ p.m. | _ _ : _ _ ☐ a.m. ☐ p.m. |
| 12. Sediment in well bottom | _ _ . _ inches | _ _ . _ inches |
| 13. Water clarity | Clear ☐ 10 Turbid ☐ 15 (Describe) | Clear ☐ 20 Turbid ☐ 25 (Describe) |

Fill in if drilling fluids were used and well is at solid waste facility:

| | | |
|---|---|---|
| 14. Total suspended solids | _ _ _ _ . _ mg/l | _ _ _ _ . _ mg/l |
| 15. COD | _ _ _ _ . _ mg/l | _ _ _ _ . _ mg/l |

16. Well developed by: Name (first, last) and Firm
First Name: Last Name:
Firm:

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: _____ Last Name: _____
Facility/Firm: _____
Street: _____
City/State/Zip: _____

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: _____
Print Name: _____
Firm: _____

NOTE: See instructions for more information including a list of county codes and well type codes.

**State of Wisconsin**
**Department of Natural Resources**

# INSTRUCTIONS
## Monitoring Well Construction Form 4400-113A

**General Instructions**: Fill out both a monitoring well construction form (4400-113A) and a monitoring well development form (4400-113B) for each well installed. Sign each form. Please note that these forms are subject to change. (Personally identifiable information on these forms is not intended to be used for any other purpose.)

**Routing:** Return these forms to the project manager or plan reviewer for the DNR program who required the well installation. If the project manager/plan reviewer is in the Regional Office, send the original forms to the Regional Office and a copy to the Central Office in Madison. If the project manager/plan reviewer is in the Central Office, send the original forms there and a copy to the Regional Office. If your project does not have a project manager or plan reviewer or you don't know who it is, send the forms to the appropriate program in the Central Office. The addresses of the DNR offices are provided on the attached map.

Check the appropriate routing box at the top of the forms to assure proper routing once the forms reach DNR.

**Time-saving tip:** When filling out many forms at once, you can save time by using a photocopier. Fill out one form (the "original") with any information that is the same for all wells, such as facility name, section location, grid origin location, drilling method and well casing type. Photocopy both sides of the "original", making as many copies as there are wells. On the separate copies, fill in the details that are unique for each well.

### TOP LEFT

**Facility/Project Name:** Fill in the name of landfill, wastewater treatment facility, surface impoundment, spill or project.

**Facility License, Permit, or Monitoring Number:** Fill in number assigned to facility by the Department. If unknown, leave blank.

**Facility ID:** Fill in the nine digit Facility ID (FID) assigned to the site.

**Type of Well:** Record the type of well code (number/initials) from the following list:

| | |
|---|---|
| 11/mw | Water table observation well (monitoring well screen intersecting the water table) (non Subtitle D well) |
| 12/pz | Piezometer (monitoring well with screen sealed below the water table) (non Subtitle D well) |
| 17/gc | Gradient control |
| 18/at | Aquifer test |
| 24/lh | Leachate head well |
| 26/ew | Groundwater extraction well |
| 27/he | Horizontal groundwater extraction well |
| 28/hw | Horizontal monitoring well |
| 29/ha | Horizontal vapor extraction well |
| 51/gp | Gas probe |
| 53/ge | Gas extraction well |
| 57/sv | Soil venting wells (includes both soil vapor extraction and bioventing, includes both extraction and unsaturated zone gas phase injection wells installed in soil or fill, but not refuse |
| 61/ij | Injection well (injection of liquids not gases) |

62/as In situ air sparging well (injection well to inject gases into the aquifer
63/uv Unterdruck Verdampfer Brunnen (UVB) wells (sparging wells where the gases remain in the well and are not injected into the aquifer)
64/le Groundwater and light non-aqueous phase liquid (LNAPL) extraction wells
65/de Groundwater and dense non-aqueous phase liquid (DNAPL) extraction wells
66/ve Vacuum enhanced groundwater extraction wells
67/vi Vacuum enhanced groundwater and LNAPL extraction wells
68/vd Vacuum enhanced groundwater and DNAPL extraction wells
71/dw Subtitle D water table observation well (see 11/mw above)
72/dp Subtitle D piezometer (see 12/pz above)
99/Ot Other

**Distance From Waste/Source:** Enter distance in feet from the monitoring well to the edge of a facility waste storage or discharge structure, e.g., from the edge of a wastewater lagoon or the approved waste fill boundary for a landfill. For a contaminant source which is not a facility, e.g., a spill, enter the distance the well is from the contaminant source.

**Enf. Stds. Apply:** Check this box only if enforcement standards apply at this well. Enforcement standards apply at any well beyond the Design Management Zone or the property boundary of the facility or at a water supply well. For spills, enforcement standards apply at every point at which groundwater is monitored. (For more information, see s. NR 140.22, Wis. Adm. Code.)

**TOP CENTER**

**Local Grid Location:** The location of the well to the nearest foot, in relation to the grid origin established for the site. If the exact location of the well is given in State Plane Coordinates, then leave these fields blank.

**Local Grid Origin or Well Location:** Check the appropriate box behind the Local Grid Origin or the Well Location text. Locate the grid origin at a permanent feature near the waste or source of contamination. Give the location in State Plane Coordinates or Latitude and Longitude in degrees, minutes and seconds (using 1927 North American Datum). If State Plane Coordinates are used, circle the appropriate letter for south, central or north zone. Alternately, an acceptable method for providing this information without surveying is to locate the Grid Origin on a USGS 7.5 minute quadrangle map. The Location of the Grid Origin can then be interpolated (estimated) using standard cartographic techniques. If the Grid Origin location is estimated, check the estimated box.

The Well Location can be determined directly by surveying or by Global Positioning System (GPS) (with processing to be accurate within 1 foot and reported with precision to hundredths of a second). If the exact location of the well is given in State Plane Coordinates, then leave the Local Grid Location fields blank.

**Section Location of Waste/Source:** Fill in the quarter quarter and quarter section, section, township, range and range direction of the waste or source.

**Location of Well Relative to Waste/Source:** Check the box which describes the location of the well in the groundwater flow system relative to the disposal site, spill, etc. If groundwater flow directions are unknown, check "not known."

**Gov. Lot Number:** Provide the government lot number for the property if applicable. (Government lot numbers are the legal description of a tract of land adjacent to a lake or stream where a proper quarter or quarter quarter section corner could not be established.)

## TOP RIGHT

**Well Name:** Fill in common well name, such as B-ll, OW-13A, or MW-5R. (Use the suffix "R" for a replacement well.)

**Wis. Unique Well Number:** Fill in the 2 alphabetic and 3 numeric Wisconsin Unique Well Number (WUWN) on this form. In addition, attach the WUWN tag to the inside of the protective cover pipe and record that number on the Soil Boring Log Information form 4400-122 and Monitoring Well Development form 4400-113B. WUWN tags are available from the DNR Central or Regional Offices.

**DNR Well ID Number:** The 3 digit number assigned to the well by the Department.

**Date Well Installed:** List Month/Day/Year (mm/dd/yyyy) the well was installed.

**Well Installed By:** Fill in name (first and last) and firm of the person who supervised the drilling. The person must be a hydrogeologist, a drilling crew chief or experienced engineering technician.

## LEFT SIDE

**Numerical Specifications:** Fill in data for letters A through N which refer to design elements on the figure on the form. Letters A, B and C must be reported as elevations in feet above mean sea level (MSL), surveyed to the nearest 0.01 foot. Letters D through K may be either elevation above MSL or depth below land surface, accurate to the nearest 0.1 foot.

A. **Protective pipe, top elevation.** With cap off. Referenced to Mean Sea Level (MSL).

B. **Well casing, top elevation.** With cap off. Referenced to MSL.

C. **Land surface elevation.** Referenced to MSL.

D. **Surface seal, bottom.** Fill in elevation, MSL or depth below land surface.

E. **Bentonite seal, top.** MSL or depth below land surface. (See NR 141.13(1) to determine if this seal is required)

F. **Fine sand, top.** MSL or depth below land surface. Cross out if not installed.

G. **Filter pack, top.** MSL or depth below land surface.

H. **Screen joint, top.** MSL or depth below land surface. (Top of the entire screen section, NOT the top slot)

L. **Well bottom.** MSL or depth below land surface.

J. **Filter pack, bottom.** MSL or depth below land surface.

K. **Borehole, bottom.** MSL or depth below land surface.

L. **Borehole, diameter**: Diameter to nearest 0.1 inch.

M. **O.D. well casing**: Outside diameter to nearest 0.01 inch.

N. **I.D. well casing**: Inside diameter to nearest 0.01 inch.

N. **I.D. well casing**: Inside diameter to nearest 0.01 inch.

## LEFT CENTER INSERT (BOX)

12. **USCS classification of soil near screen**: Check boxes for all soil types (or bedrock) found at the depths spanned by the well screen, using the Unified Soil Classification System symbols. Refer to the native soil near the screen, not to the filter pack material.

13. **Sieve analysis performed?**: Check box. A sieve analysis for soil near the screen is required for all wells.

14. **Drilling method used**: Choose from among the choices on the form or check "Other" and write in one of the choices below:

| | | | |
|---|---|---|---|
| Reverse rotary | Solid stem auger | Cable tool | Driven point |
| Vibratory | Casing hammer | Wash boring | |

15. **Drilling fluid used**: Check appropriate box or boxes.

16. **Drilling additives used**: Check box. If yes, describe.

17. **Source of water**: Cite source(s) of any water used to drill the well OR to hydrate dry bentonite OR to mix annular space sealant. Cite exact source so that a sample of the water can be obtained later, if necessary. If the well is at a solid waste facility, attach an analysis of the water according to s. NR 507.06(1), Wis. Adm. Code.

## RIGHT SIDE

1. **Cap and Lock**: Check box.

2. **Protective pipe**: Provide the information below.

   a. **Inside diameter**: Give to nearest 0.1 inch.
   b. **Length**: Give to nearest 0.1 foot
   c. **Material**: Check box. If "Other", describe.
   d. **Additional protection?**: Check box. If 'Yes', describe.

3. **Surface seal**: Check box for the material used to prevent surface water from entering the borehole. If "Other," describe.

4. **Material between well casing and protective pipe**: Check box. If "Other", describe.

5. **Annular space seal**: Check boxes for both materials used and how installed, and fill in volume used.

   Material: If dry bentonite, list source of water used for hydration on line #17. For wells installed at a solid waste site, attach an analysis of water (see s. NR 507.06(1), Wis. Adm. Code.) For other choices, fill in pounds per gallon mud weight or percent bentonite as appropriate.

   e. **Volume**: Fill in volume used in cubic feet.
   f. **How installed**: Check box for how the annular space seal was installed. If dropped from the land surface, check "Gravity."

6. **Bentonite seal**: If bentonite pellets were used, also check the pellet diameter. If material installed was the same as the annular space seal, or if no filter pack seal was installed, write "none."

7. **Fine sand material**: Fine sand is used to prevent migration of annular space seal material into the filter pack.

   a. Indicate manufacturer, product name, and mesh size.
   b. Indicate volume added.

8. **Filter pack material**: General description of filter pack material, e.g., "430 grit sand," and name of filter pack manufacturer, product name or number, and volume added. Attach grain size analysis of filter pack and state quantity used.

9. **Well casing**: Check box for PVC type. If "Other", describe. Examples of "Other" include stainless steel, steel, and Teflon ©.

10. **Screen material**: If same as well casing, write "same."

    a. **Screen type**: Check box. If "Other", describe the design.
    b. **Manufacturer**: List name of manufacturer.
    c. **Slot size**: Give width of slot in thousandths (0.001) of an inch.
    d. **Slotted length**: Give distance from top slot to bottom slot to nearest 0.1 foot.

11. **Backfill material**: Check "None" or, if "Other", describe any backfill installed below the filter pack.

**FAR BOTTOM**

"I hereby certify that the information on this form is true and correct to the best of my knowledge.": Sign the form and indicate name of firm.

## MONITORING WELL DEVELOPMENT FORM 4400-113B

### TOP TWO LINES

**Facility/Project Name**: Fill in the name of landfill, wastewater treatment facility, surface impoundment, spill or project.

**Facility License Permit, or Monitoring Number**: Enter number assigned to facility by the DNR. If unknown, leave blank.

**County Name**: Fill in the name of the county in which the well is installed.

**County Code**: Fill in the two digit county code number.

| | | | | |
|---|---|---|---|---|
| 1 . Adams | 16. Douglas | 31. Kewaunee | 46. Ozaukee | 61. Taylor |
| 2. Ashland | 17. Dunn | 32. La Crosse | 47. Pepin | 62. Trempealeau |
| 3. Barron | 18. Eau Claire | 33. Lafayette | 48. Pierce | 63. Vernon |
| 4. Bayfield | 19. Florence | 34. Langlade | 49. Polk | 64. Vilas |
| 5. Brown | 20. Fond Du Lac | 35. Lincoln | 50. Portage | 65. Walworth |
| 6. Buffalo | 21. Forest | 36. Manitowoc | 51. Price | 66. Washburn |
| 7. Burnett | 22. Grant | 37. Marathon | 52. Racine | 67. Washington |
| 8. Calumet | 23. Green | 38. Marinette | 53. Richland | 68. Waukesha |
| 9. Chippewa | 24. Green Lake | 39. Marquette | 54. Rock | 69. Waupaca |

| | | | | |
|---|---|---|---|---|
| 10. Clark | 25. Iowa | 40. Menominee | 55. Rusk | 70. Waushara |
| 11. Columbia | 26. Iron | 41. Mlwaukee | 56. St. Croix | 71. Winnebago |
| 12. Crawford | 27. Jackson | 42. Monroe | 57. Sauk | 72. Wood |
| 13. Dane | 28 Jefferson | 43. Oconto | 58. Sawyer | |
| 14. Dodge | 29. Juneau | 44. Oneida | 59. Shawano | |
| 15. Door | 30. Kenosha | 45. Outagamie | 60. Sheboygan | |

**Well Name**: Fill in common well name, such as P-11, OW-13A, or MW-5R. (Use the suffix "R" for a replacement well.)

**Wis. Unique Well Number**: Record Wisconsin Unique Well Number assigned to the well.

**DNR Well ID Number**: The 3 digit number assigned to the well by the Department.

**LEFT COLUMN**

1. **Can this well be purged dry?** Check whether well can or cannot be purged dry (all water removed).

2. **Well development method**: Check appropriate box. If "Other", describe. Note that a well shall be surged and purged for a minimum of 30 minutes.

3. **Time spent developing well**: In minutes.

4. **Depth of well**: In tenths (0.1) of feet, from top of well casing.

5. **Inside diameter of well**: In hundredths (0.01) of inches.

6. **Volume of water in filter pack and well casing**: In tenths (0.1) of gallons.

7. **Volume of water removed from well**: In tenths (0.1) of gallons.

8. **Volume of water added, if any**: In tenths (0.1) of gallons.

9. **Source of water added**: Cite exact source so that a sample of the water can be obtained later, if necessary.

10. **Analysis performed on water added?** Check appropriate box. If well is installed at a solid waste facility, attach analysis of water according to s. NR 507.06(1), Wis. Adm. Code.

**RIGHT COLUMN**

11. **Depth to water**:

    a. Enter distance from top of well casing to water level in well, in hundredths (0.01) of a foot, both before and after development.

    b. **Date**: Enter month/day/year (mm/dd/yyyy) development began and ended.

    c. **Time**: Enter according to a twelve hour clock the time development began and ended.

12. **Sediment in well bottom**: Compute to tenths (0.1) of inches, both before and after development.

13. **Water clarity**: Check box and describe.

14. **Total suspended solids**: Total Suspended Solids, as determined by a certified or registered analytical laboratory. Required only for wells near solid waste facilities when drilling fluids were used.

15. **COD**: Chemical oxygen demand, as determined by a certified or registered analytical laboratory. Required only for wells near solid waste facilities when drilling fluids were used.

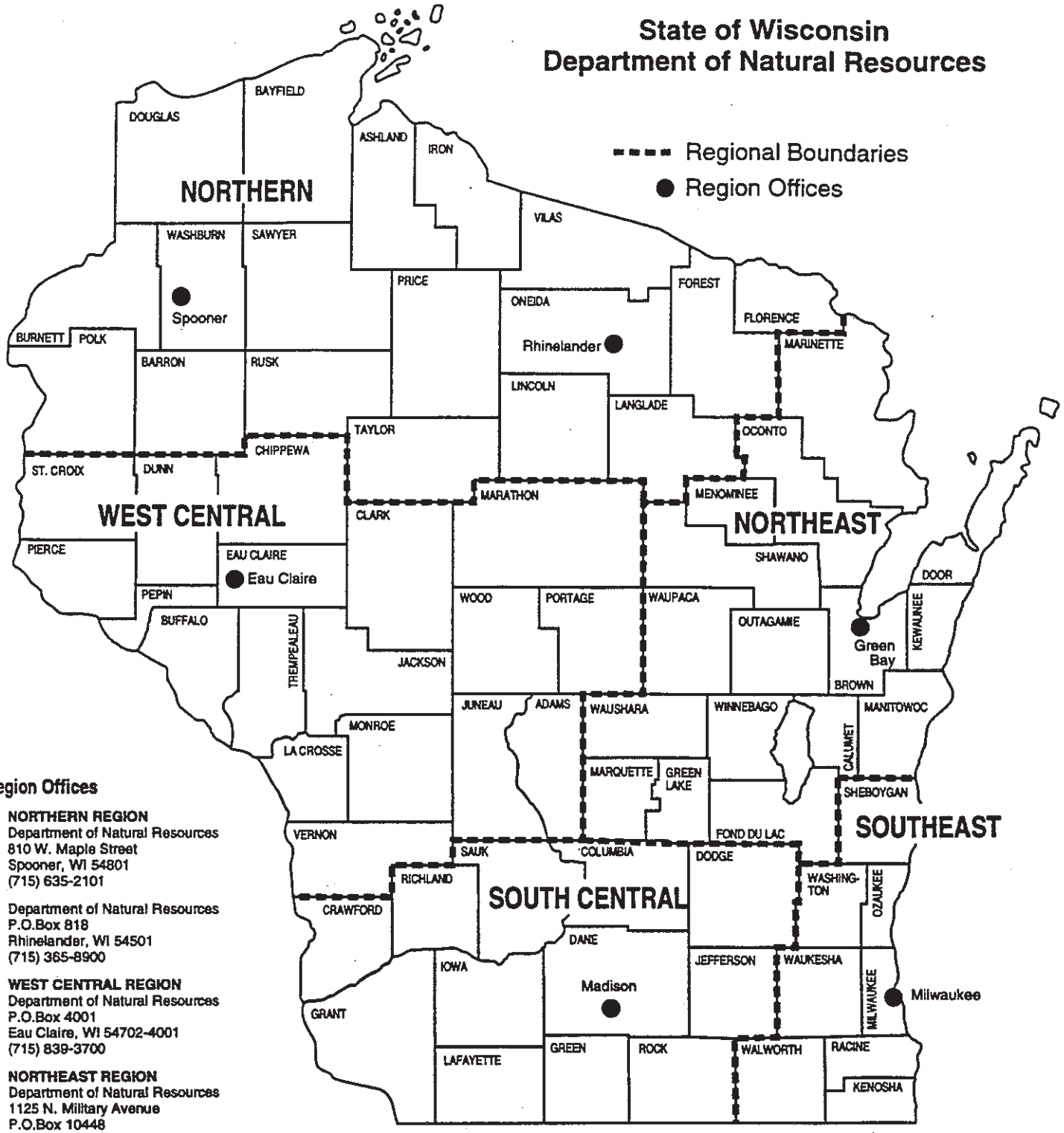
16. **Well developed by**: Enter the name (first and last) and firm of the person who supervised the development This person must be a hydrogeologist, the drilling crew chief, or an experienced engineering technician.

**BOTTOM SECTION**

17. **Additional comments on development**: Describe any of the above in more detail or add information such as the relative recovery rates of wells or the amount of drilling fluid lost to the formation and the amount of water removed to account for lost drilling fluid. For example, if 150 gallons of drilling water were, lost, you should remove the volume of water in the filter pack and well casing plus 150 gallons as part of development.

**Name and Address of Facility/Owner/Responsible Party Contact**: Enter a contact name (first and last), or a firm name or facility name, street address, city, state, and zip code of the facility or site.

**Signature, Print Name, and Firm**: Signature and printed name of the person filling out the form and name of firm for which the person works.




## Region Offices

**NORTHERN REGION**
Department of Natural Resources
810 W. Maple Street
Spooner, WI 54801
(715) 635-2101

Department of Natural Resources
P.O.Box 818
Rhinelander, WI 54501
(715) 365-8900

**WEST CENTRAL REGION**
Department of Natural Resources
P.O.Box 4001
Eau Claire, WI 54702-4001
(715) 839-3700

**NORTHEAST REGION**
Department of Natural Resources
1125 N. Military Avenue
P.O.Box 10448
Green Bay, WI 54307
(920) 492-5800

**SOUTHEAST REGION**
Department of Natural Resources
2300 N. Dr. Martin Luther King Jr. Dr.
P.O.Box 12436
Milwaukee, WI 53212
(414) 263-8500

**SOUTH CENTRAL REGION**
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711
(608) 275-3266

REV 7-97

**Standard Operating Procedure**

# SOP-14 Groundwater Monitoring Well Development

## Introduction

This Standard Operating Procedure (SOP) is applicable to the development or redevelopment of groundwater monitoring wells. The SOP should be used for the installation and development of groundwater monitoring wells which are outlined in the administrative codes and rules given in the reference section of this SOP and described in SOP-13. It shall also be used to redevelop monitoring wells when the need arises. It is important that proper monitoring well/piezometer development procedures are followed in order to ensure representative samples will be collected from the monitoring well or piezometer.

## References

Wisconsin Administrative Code, Department of Natural Resources, Groundwater Monitoring Well Requirements. Chapter NR 141, March 2000, No. 531.
http://www.legis.state.wi.us/rsb/code/nr/nr141.pdf

## Personnel Qualifications

Personnel executing this protocol should have existing knowledge of well development methods or be supervised by an individual with experience. A minimum of one person who is trained in this sampling technique is required to complete sampling. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HSAP) for environmental activities conducted at the facility.

## Equipment and Supplies

- Well Development Documentation Forms (Attachment A or applicable state form).
- Field Book or appropriate electronic data collection device.
- Pens/Permanent Markers.
- Water Level Indicator.
- Bailer or Pump.
- Power source for pump.
- Bailer or Surge Block
  .
- Rope.
- Multi parameter meter, if needed.

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

The following presents a general procedure for personnel to follow to ensure the proper development of monitoring wells:

All monitoring wells should be developed by the driller after the grout has set for at least 24 hours by surging and bailing or by over-pumping. Alternatively, this task may be completed by an environmental contractor or county staff in some situations, including following the repair maintenance of a monitoring well. By alternating pumping and well recovery, over-pumping will agitate the filter pack sufficiently to remove fines. Alternatively, surging with a surge block or bailer will agitate the filter pack to remove fines. The discharge from the well will be monitored continuously.

Before they are developed, water levels will be measured with an electronic water level sensor. The bottom of the well will be tagged with a decontaminated measuring tape to determine the amount of sediment that accumulated in the monitoring well during construction. The well will be developed until a particulate-free discharge is observed and the field parameters (pH, specific conductance, turbidity, and temperature) have stabilized, additional parameters may be required. Field parameters will be recorded on the well development record after removing each well volume.

The field staff will record the following during well development:

- Field parameters.
- Time spent on each operation: surging, bailing, and pumping.
- Well volumes and gallons removed.
- Estimated pumping rate.
- Record on WDNR Monitoring Well Construction/Well Development Form 4400-113A Rev 7-98 (Attachment A).

Development will continue until field parameters have stabilized within 10 percent of the previous reading or ten well volumes have been removed (see NR 141), unless the well purges dry. The field staff will discuss the field parameter data and development with their Field Manager, the Solid Waste Supervisor or a designee. The Field Manager, the Solid Waste Supervisor or his designee will decide when development is complete. All development equipment will be decontaminated after developing each well.

# Attachment A

# WDNR Monitoring Well Construction/Well Development Form 4400-113A Rev 7-98

7-98

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐ _____

# MONITORING WELL CONSTRUCTION

Form 4400-113A Rev. 7-98

| | | |
|---|---|---|
| Facility/Project Name | Local Grid Location of Well _____ ft. ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. | Well Name |
| Facility License, Permit or Monitoring No. | Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. ° ' " Long. ° ' " or | Wis. Unique Well No. / DNR Well ID No. |
| Facility ID | St. Plane _____ ft. N, _____ ft. E. S/C/N | Date Well Installed m m / d d / y y y y |
| Type of Well Well Code ____/____ | Section Location of Waste/Source ____1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W | Well Installed By: Name (first, last) and Firm |
| Distance from Waste/Source _____ ft. / Enf. Stds. Apply ☐ | Location of Well Relative to Waste/Source u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known | Gov. Lot Number |

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation _____ ft. MSL

C. Land surface elevation _____ ft. MSL

D. Surface seal, bottom _____ ft. MSL or _____ ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐ 50
Hollow Stem Auger ☐ 41
Other ☐ ▒▒
_____

15. Drilling fluid used: Water ☐ 02 Air ☐ 01
Drilling Mud ☐ 03 None ☐ 99

16. Drilling additives used? ☐ Yes ☐ No
Describe _____

17. Source of water (attach analysis, if required):
_____

E. Bentonite seal, top _____ ft. MSL or _____ ft.

F. Fine sand, top _____ ft. MSL or _____ ft.

G. Filter pack, top _____ ft. MSL or _____ ft.

H. Screen joint, top _____ ft. MSL or _____ ft.

I. Well bottom _____ ft. MSL or _____ ft.

J. Filter pack, bottom _____ ft MSL or _____ ft.

K. Borehole, bottom _____ ft MSL or _____ ft.

L. Borehole, diameter _____ in.

M. O.D. well casing _____ in.

N. I.D. well casing _____ in.

1. Cap and lock? ☐ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: _____ in.
b. Length: _____ ft.
c. Material: Steel ☐ 04
Other ☐ ▒▒
_____
d. Additional protection? ☐ Yes ☐ No
If yes, describe: _____

3. Surface seal: Bentonite ☐ 30
Concrete ☐ 01
Other ☐ ▒▒
_____

4. Material between well casing and protective pipe:
Bentonite ☐ 30
Other ☐ ▒▒
_____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. _____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. _____ $Ft^3$ volume added for any of the above
f. How installed: Tremie ☐ 01
Tremie pumped ☐ 02
Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 32
c. _____ Other ☐ ▒▒

7. Fine sand material: Manufacturer, product name & mesh size
a. _____ ▒▒
b. Volume added _____ $ft^3$

8. Filter pack material: Manufacturer, product name & mesh size
a. _____ ▒▒
b. Volume added _____ $ft^3$

9. Well casing: Flush threaded PVC schedule 40 ☐ 23
Flush threaded PVC schedule 80 ☐ 24
_____ Other ☐ ▒▒

10. Screen material: _____ ▒▒
a. Screen type: Factory cut ☐ 11
Continuous slot ☐ 01
_____ Other ☐ ▒▒
b. Manufacturer _____
c. Slot size: 0.____ in.
d. Slotted length: _____ ft.

11. Backfill material (below filter pack): None ☐ 14
_____ Other ☐ ▒▒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

| Signature | Firm |
|---|---|
| | |

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

# MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐ _____

| Facility/Project Name | County Name | Well Name |
|---|---|---|
| | | |

| Facility License, Permit or Monitoring Number | County Code | Wis. Unique Well Number | DNR Well ID Number |
|---|---|---|---|
| | _ _ | _ _ _ _ _ _ _ | _ _ _ |

1. Can this well be purged dry? ☐ Yes ☐ No

2. Well development method

| | |
|---|---|
| surged with bailer and bailed | ☐ 41 |
| surged with bailer and pumped | ☐ 61 |
| surged with block and bailed | ☐ 42 |
| surged with block and pumped | ☐ 62 |
| surged with block, bailed and pumped | ☐ 70 |
| compressed air | ☐ 20 |
| bailed only | ☐ 10 |
| pumped only | ☐ 51 |
| pumped slowly | ☐ 50 |
| Other _____ | ☐ |

3. Time spent developing well _ _ _ _ min.

4. Depth of well (from top of well casisng) _ _ _ . _ ft.

5. Inside diameter of well _ _ . _ _ in.

6. Volume of water in filter pack and well casing _ _ _ . _ gal.

7. Volume of water removed from well _ _ _ . _ gal.

8. Volume of water added (if any) _ _ _ . _ gal.

9. Source of water added _____

10. Analysis performed on water added? (If yes, attach results) ☐ Yes ☐ No

| | Before Development | After Development |
|---|---|---|
| 11. Depth to Water (from top of well casing) | a. _ _ _ . _ _ ft. | _ _ _ . _ _ ft. |
| Date | b. _ _/_ _/_ _ _ _ (m m d d y y y y) | _ _/_ _/_ _ _ _ (m m d d y y y y) |
| Time | c. _ _ : _ _ ☐ a.m. ☐ p.m. | _ _ : _ _ ☐ a.m. ☐ p.m. |
| 12. Sediment in well bottom | _ _ . _ inches | _ _ . _ inches |
| 13. Water clarity | Clear ☐ 10 Turbid ☐ 15 (Describe) | Clear ☐ 20 Turbid ☐ 25 (Describe) |

Fill in if drilling fluids were used and well is at solid waste facility:

| | | |
|---|---|---|
| 14. Total suspended solids | _ _ _ _ . _ mg/l | _ _ _ _ . _ mg/l |
| 15. COD | _ _ _ _ . _ mg/l | _ _ _ _ . _ mg/l |

16. Well developed by: Name (first, last) and Firm
First Name: Last Name:
Firm:

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: _____ Last Name: _____
Facility/Firm: _____
Street: _____
City/State/Zip: _____

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: _____
Print Name: _____
Firm: _____

NOTE: See instructions for more information including a list of county codes and well type codes.

**State of Wisconsin**
**Department of Natural Resources**

# INSTRUCTIONS
## Monitoring Well Construction Form 4400-113A

**General Instructions**: Fill out both a monitoring well construction form (4400-113A) and a monitoring well development form (4400-113B) for each well installed. Sign each form. Please note that these forms are subject to change. (Personally identifiable information on these forms is not intended to be used for any other purpose.)

**Routing:** Return these forms to the project manager or plan reviewer for the DNR program who required the well installation. If the project manager/plan reviewer is in the Regional Office, send the original forms to the Regional Office and a copy to the Central Office in Madison. If the project manager/plan reviewer is in the Central Office, send the original forms there and a copy to the Regional Office. If your project does not have a project manager or plan reviewer or you don't know who it is, send the forms to the appropriate program in the Central Office. The addresses of the DNR offices are provided on the attached map.

Check the appropriate routing box at the top of the forms to assure proper routing once the forms reach DNR.

**Time-saving tip:** When filling out many forms at once, you can save time by using a photocopier. Fill out one form (the "original") with any information that is the same for all wells, such as facility name, section location, grid origin location, drilling method and well casing type. Photocopy both sides of the "original", making as many copies as there are wells. On the separate copies, fill in the details that are unique for each well.

### TOP LEFT

**Facility/Project Name:** Fill in the name of landfill, wastewater treatment facility, surface impoundment, spill or project.

**Facility License, Permit, or Monitoring Number:** Fill in number assigned to facility by the Department. If unknown, leave blank.

**Facility ID:** Fill in the nine digit Facility ID (FID) assigned to the site.

**Type of Well:** Record the type of well code (number/initials) from the following list:

| | |
|---|---|
| 11/mw | Water table observation well (monitoring well screen intersecting the water table) (non Subtitle D well) |
| 12/pz | Piezometer (monitoring well with screen sealed below the water table) (non Subtitle D well) |
| 17/gc | Gradient control |
| 18/at | Aquifer test |
| 24/lh | Leachate head well |
| 26/ew | Groundwater extraction well |
| 27/he | Horizontal groundwater extraction well |
| 28/hw | Horizontal monitoring well |
| 29/ha | Horizontal vapor extraction well |
| 51/gp | Gas probe |
| 53/ge | Gas extraction well |
| 57/sv | Soil venting wells (includes both soil vapor extraction and bioventing, includes both extraction and unsaturated zone gas phase injection wells installed in soil or fill, but not refuse |
| 61/ij | Injection well (injection of liquids not gases) |

62/as In situ air sparging well (injection well to inject gases into the aquifer
63/uv Unterdruck Verdampfer Brunnen (UVB) wells (sparging wells where the gases remain in the well and are not injected into the aquifer)
64/le Groundwater and light non-aqueous phase liquid (LNAPL) extraction wells
65/de Groundwater and dense non-aqueous phase liquid (DNAPL) extraction wells
66/ve Vacuum enhanced groundwater extraction wells
67/vi Vacuum enhanced groundwater and LNAPL extraction wells
68/vd Vacuum enhanced groundwater and DNAPL extraction wells
71/dw Subtitle D water table observation well (see 11/mw above)
72/dp Subtitle D piezometer (see 12/pz above)
99/Ot Other

**Distance From Waste/Source:** Enter distance in feet from the monitoring well to the edge of a facility waste storage or discharge structure, e.g., from the edge of a wastewater lagoon or the approved waste fill boundary for a landfill. For a contaminant source which is not a facility, e.g., a spill, enter the distance the well is from the contaminant source.

**Enf. Stds. Apply:** Check this box only if enforcement standards apply at this well. Enforcement standards apply at any well beyond the Design Management Zone or the property boundary of the facility or at a water supply well. For spills, enforcement standards apply at every point at which groundwater is monitored. (For more information, see s. NR 140.22, Wis. Adm. Code.)

**TOP CENTER**

**Local Grid Location:** The location of the well to the nearest foot, in relation to the grid origin established for the site. If the exact location of the well is given in State Plane Coordinates, then leave these fields blank.

**Local Grid Origin or Well Location:** Check the appropriate box behind the Local Grid Origin or the Well Location text. Locate the grid origin at a permanent feature near the waste or source of contamination. Give the location in State Plane Coordinates or Latitude and Longitude in degrees, minutes and seconds (using 1927 North American Datum). If State Plane Coordinates are used, circle the appropriate letter for south, central or north zone. Alternately, an acceptable method for providing this information without surveying is to locate the Grid Origin on a USGS 7.5 minute quadrangle map. The Location of the Grid Origin can then be interpolated (estimated) using standard cartographic techniques. If the Grid Origin location is estimated, check the estimated box.

The Well Location can be determined directly by surveying or by Global Positioning System (GPS) (with processing to be accurate within 1 foot and reported with precision to hundredths of a second). If the exact location of the well is given in State Plane Coordinates, then leave the Local Grid Location fields blank.

**Section Location of Waste/Source:** Fill in the quarter quarter and quarter section, section, township, range and range direction of the waste or source.

**Location of Well Relative to Waste/Source:** Check the box which describes the location of the well in the groundwater flow system relative to the disposal site, spill, etc. If groundwater flow directions are unknown, check "not known."

**Gov. Lot Number:** Provide the government lot number for the property if applicable. (Government lot numbers are the legal description of a tract of land adjacent to a lake or stream where a proper quarter or quarter quarter section corner could not be established.)

## TOP RIGHT

**Well Name:** Fill in common well name, such as B-ll, OW-13A, or MW-5R. (Use the suffix "R" for a replacement well.)

**Wis. Unique Well Number:** Fill in the 2 alphabetic and 3 numeric Wisconsin Unique Well Number (WUWN) on this form. In addition, attach the WUWN tag to the inside of the protective cover pipe and record that number on the Soil Boring Log Information form 4400-122 and Monitoring Well Development form 4400-113B. WUWN tags are available from the DNR Central or Regional Offices.

**DNR Well ID Number:** The 3 digit number assigned to the well by the Department.

**Date Well Installed:** List Month/Day/Year (mm/dd/yyyy) the well was installed.

**Well Installed By:** Fill in name (first and last) and firm of the person who supervised the drilling. The person must be a hydrogeologist, a drilling crew chief or experienced engineering technician.

## LEFT SIDE

**Numerical Specifications:** Fill in data for letters A through N which refer to design elements on the figure on the form. Letters A, B and C must be reported as elevations in feet above mean sea level (MSL), surveyed to the nearest 0.01 foot. Letters D through K may be either elevation above MSL or depth below land surface, accurate to the nearest 0.1 foot.

A. **Protective pipe, top elevation.** With cap off. Referenced to Mean Sea Level (MSL).

B. **Well casing, top elevation.** With cap off. Referenced to MSL.

C. **Land surface elevation.** Referenced to MSL.

D. **Surface seal, bottom.** Fill in elevation, MSL or depth below land surface.

E. **Bentonite seal, top.** MSL or depth below land surface. (See NR 141.13(1) to determine if this seal is required)

F. **Fine sand, top.** MSL or depth below land surface. Cross out if not installed.

G. **Filter pack, top.** MSL or depth below land surface.

H. **Screen joint, top.** MSL or depth below land surface. (Top of the entire screen section, NOT the top slot)

L. **Well bottom.** MSL or depth below land surface.

J. **Filter pack, bottom.** MSL or depth below land surface.

K. **Borehole, bottom.** MSL or depth below land surface.

L. **Borehole, diameter**: Diameter to nearest 0.1 inch.

M. **O.D. well casing**: Outside diameter to nearest 0.01 inch.

N. **I.D. well casing**: Inside diameter to nearest 0.01 inch.

N. **I.D. well casing**: Inside diameter to nearest 0.01 inch.

## LEFT CENTER INSERT (BOX)

12. **USCS classification of soil near screen**: Check boxes for all soil types (or bedrock) found at the depths spanned by the well screen, using the Unified Soil Classification System symbols. Refer to the native soil near the screen, not to the filter pack material.

13. **Sieve analysis performed?**: Check box. A sieve analysis for soil near the screen is required for all wells.

14. **Drilling method used**: Choose from among the choices on the form or check "Other" and write in one of the choices below:

| | | | |
|---|---|---|---|
| Reverse rotary | Solid stem auger | Cable tool | Driven point |
| Vibratory | Casing hammer | Wash boring | |

15. **Drilling fluid used**: Check appropriate box or boxes.

16. **Drilling additives used**: Check box. If yes, describe.

17. **Source of water**: Cite source(s) of any water used to drill the well OR to hydrate dry bentonite OR to mix annular space sealant. Cite exact source so that a sample of the water can be obtained later, if necessary. If the well is at a solid waste facility, attach an analysis of the water according to s. NR 507.06(1), Wis. Adm. Code.

## RIGHT SIDE

1. **Cap and Lock**: Check box.

2. **Protective pipe**: Provide the information below.

   a. **Inside diameter**: Give to nearest 0.1 inch.
   b. **Length**: Give to nearest 0.1 foot
   c. **Material**: Check box. If "Other", describe.
   d. **Additional protection?**: Check box. If 'Yes', describe.

3. **Surface seal**: Check box for the material used to prevent surface water from entering the borehole. If "Other," describe.

4. **Material between well casing and protective pipe**: Check box. If "Other", describe.

5. **Annular space seal**: Check boxes for both materials used and how installed, and fill in volume used.

   Material: If dry bentonite, list source of water used for hydration on line #17. For wells installed at a solid waste site, attach an analysis of water (see s. NR 507.06(1), Wis. Adm. Code.) For other choices, fill in pounds per gallon mud weight or percent bentonite as appropriate.

   e. **Volume**: Fill in volume used in cubic feet.
   f. **How installed**: Check box for how the annular space seal was installed. If dropped from the land surface, check "Gravity."

6. **Bentonite seal**: If bentonite pellets were used, also check the pellet diameter. If material installed was the same as the annular space seal, or if no filter pack seal was installed, write "none."

7. **Fine sand material**: Fine sand is used to prevent migration of annular space seal material into the filter pack.

   a. Indicate manufacturer, product name, and mesh size.
   b. Indicate volume added.

8. **Filter pack material**: General description of filter pack material, e.g., "430 grit sand," and name of filter pack manufacturer, product name or number, and volume added. Attach grain size analysis of filter pack and state quantity used.

9. **Well casing**: Check box for PVC type. If "Other", describe. Examples of "Other" include stainless steel, steel, and Teflon ©.

10. **Screen material**: If same as well casing, write "same."

    a. **Screen type**: Check box. If "Other", describe the design.
    b. **Manufacturer**: List name of manufacturer.
    c. **Slot size**: Give width of slot in thousandths (0.001) of an inch.
    d. **Slotted length**: Give distance from top slot to bottom slot to nearest 0.1 foot.

11. **Backfill material**: Check "None" or, if "Other", describe any backfill installed below the filter pack.

**FAR BOTTOM**

"I hereby certify that the information on this form is true and correct to the best of my knowledge.": Sign the form and indicate name of firm.

## MONITORING WELL DEVELOPMENT FORM 4400-113B

### TOP TWO LINES

**Facility/Project Name**: Fill in the name of landfill, wastewater treatment facility, surface impoundment, spill or project.

**Facility License Permit, or Monitoring Number**: Enter number assigned to facility by the DNR. If unknown, leave blank.

**County Name**: Fill in the name of the county in which the well is installed.

**County Code**: Fill in the two digit county code number.

| | | | | |
|---|---|---|---|---|
| 1 . Adams | 16. Douglas | 31. Kewaunee | 46. Ozaukee | 61. Taylor |
| 2. Ashland | 17. Dunn | 32. La Crosse | 47. Pepin | 62. Trempealeau |
| 3. Barron | 18. Eau Claire | 33. Lafayette | 48. Pierce | 63. Vernon |
| 4. Bayfield | 19. Florence | 34. Langlade | 49. Polk | 64. Vilas |
| 5. Brown | 20. Fond Du Lac | 35. Lincoln | 50. Portage | 65. Walworth |
| 6. Buffalo | 21. Forest | 36. Manitowoc | 51. Price | 66. Washburn |
| 7. Burnett | 22. Grant | 37. Marathon | 52. Racine | 67. Washington |
| 8. Calumet | 23. Green | 38. Marinette | 53. Richland | 68. Waukesha |
| 9. Chippewa | 24. Green Lake | 39. Marquette | 54. Rock | 69. Waupaca |

| | | | | |
|---|---|---|---|---|
| 10. Clark | 25. Iowa | 40. Menominee | 55. Rusk | 70. Waushara |
| 11. Columbia | 26. Iron | 41. Mlwaukee | 56. St. Croix | 71. Winnebago |
| 12. Crawford | 27. Jackson | 42. Monroe | 57. Sauk | 72. Wood |
| 13. Dane | 28 Jefferson | 43. Oconto | 58. Sawyer | |
| 14. Dodge | 29. Juneau | 44. Oneida | 59. Shawano | |
| 15. Door | 30. Kenosha | 45. Outagamie | 60. Sheboygan | |

**Well Name**: Fill in common well name, such as P-11, OW-13A, or MW-5R. (Use the suffix "R" for a replacement well.)

**Wis. Unique Well Number**: Record Wisconsin Unique Well Number assigned to the well.

**DNR Well ID Number**: The 3 digit number assigned to the well by the Department.

**LEFT COLUMN**

1. **Can this well be purged dry?** Check whether well can or cannot be purged dry (all water removed).

2. **Well development method**: Check appropriate box. If "Other", describe. Note that a well shall be surged and purged for a minimum of 30 minutes.

3. **Time spent developing well**: In minutes.

4. **Depth of well**: In tenths (0.1) of feet, from top of well casing.

5. **Inside diameter of well**: In hundredths (0.01) of inches.

6. **Volume of water in filter pack and well casing**: In tenths (0.1) of gallons.

7. **Volume of water removed from well**: In tenths (0.1) of gallons.

8. **Volume of water added, if any**: In tenths (0.1) of gallons.

9. **Source of water added**: Cite exact source so that a sample of the water can be obtained later, if necessary.

10. **Analysis performed on water added?** Check appropriate box. If well is installed at a solid waste facility, attach analysis of water according to s. NR 507.06(1), Wis. Adm. Code.

**RIGHT COLUMN**

11. **Depth to water**:

    a. Enter distance from top of well casing to water level in well, in hundredths (0.01) of a foot, both before and after development.

    b. **Date**: Enter month/day/year (mm/dd/yyyy) development began and ended.

    c. **Time**: Enter according to a twelve hour clock the time development began and ended.

12. **Sediment in well bottom**: Compute to tenths (0.1) of inches, both before and after development.

13. **Water clarity**: Check box and describe.

14. **Total suspended solids**: Total Suspended Solids, as determined by a certified or registered analytical laboratory. Required only for wells near solid waste facilities when drilling fluids were used.

15. **COD**: Chemical oxygen demand, as determined by a certified or registered analytical laboratory. Required only for wells near solid waste facilities when drilling fluids were used.

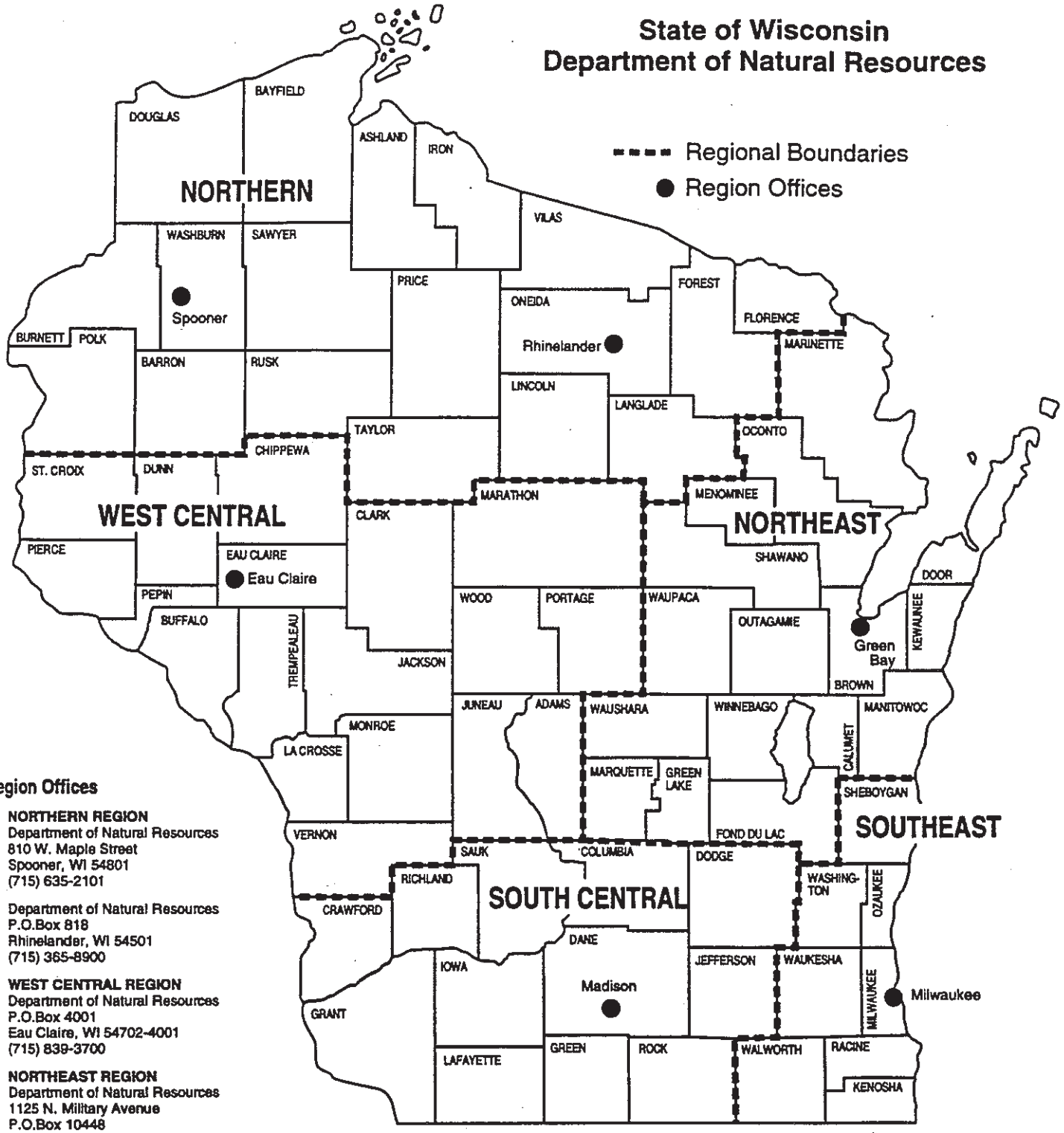
16. **Well developed by**: Enter the name (first and last) and firm of the person who supervised the development This person must be a hydrogeologist, the drilling crew chief, or an experienced engineering technician.

**BOTTOM SECTION**

17. **Additional comments on development**: Describe any of the above in more detail or add information such as the relative recovery rates of wells or the amount of drilling fluid lost to the formation and the amount of water removed to account for lost drilling fluid. For example, if 150 gallons of drilling water were, lost, you should remove the volume of water in the filter pack and well casing plus 150 gallons as part of development.

**Name and Address of Facility/Owner/Responsible Party Contact**: Enter a contact name (first and last), or a firm name or facility name, street address, city, state, and zip code of the facility or site.

**Signature, Print Name, and Firm**: Signature and printed name of the person filling out the form and name of firm for which the person works.




## Region Offices

**NORTHERN REGION**
Department of Natural Resources
810 W. Maple Street
Spooner, WI 54801
(715) 635-2101

Department of Natural Resources
P.O.Box 818
Rhinelander, WI 54501
(715) 365-8900

**WEST CENTRAL REGION**
Department of Natural Resources
P.O.Box 4001
Eau Claire, WI 54702-4001
(715) 839-3700

**NORTHEAST REGION**
Department of Natural Resources
1125 N. Military Avenue
P.O.Box 10448
Green Bay, WI 54307
(920) 492-5800

**SOUTHEAST REGION**
Department of Natural Resources
2300 N. Dr. Martin Luther King Jr. Dr.
P.O.Box 12436
Milwaukee, WI 53212
(414) 263-8500

**SOUTH CENTRAL REGION**
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711
(608) 275-3266

REV 7-97

**Standard Operating Procedure**

# SOP-15 Temporary Groundwater Extraction Sump Sampling

## Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedure for collecting groundwater samples from temporary groundwater extraction sumps.

## References

Wisconsin Department of Natural Resources, NR 507.

## Personnel Qualifications

Personnel executing this protocol should have existing knowledge of sampling technique. Field staff must follow County Department health and safety requirements, or those of its employer, whichever are stricter. Knowledge of and access to a Health and Safety Plan (HASP) for environmental activities conducted at the facility.

## Equipment and Supplies

The following equipment is recommended but is generally recognized that it is sizeable based on site specific sampling projects.

- General Sampling Equipment
  - 5 gal buckets
  - Tool kit
  - Calibration solutions
  - Chain of custody forms and custody seals
  - Cooler with Ice
  - Cube containers
  - Decon Water and non-phosphate soap such as Liqui-Nox®
  - Field forms/site documents or appropriate electronic data collection device
  - Work and Nitrile gloves
  - Paper towels
  - Laboratory supplied sample bottles
  - Site keys
  - Portable table
  - Canopy to shade cell and tubing
- Purge and Sampling Equipment
  - Peristaltic pump (as needed to prepare filtered samples)
  - Tubing compatible with sampling parameters (as needed)
  - 0.45-micron In-line filters (as needed)
  - Battery
  - DI water wash buckets
    - 3 gals DI water
    - 3 gals DI water + Liquinox®
  - Water quality sensor (s) - the field team should have a spare unit readily available in case of an equipment malfunction

Field personnel should always carry their company specific HASP on their person or in their vehicle. The HASP should identify environmental concerns to be mindful of, including but not limited to, weather conditions, insects, plants, water safety and directions to follow during an emergency. The plan should also identify the minimum number of people required for the various sampling tasks.

## Procedures

The following sampling procedures will be used to collect groundwater samples from the temporary groundwater extraction sump discharge points:

1. Verify sample parameters and volumes prior to sample collection.

2. If pump station is discharging, begin to fill the cube containers from the discharge point slowly as to prevent foaming.

3. If the pump is not actively discharging, use manual control switch to turn on pump when ready to sample the fill cube containers.

4. If quality assurance samples are required, fill additional cube containers.

5. Fill set of laboratory-supplied sample bottles from the cube containers, using a peristaltic pump or other device, pump water from the cube containers and an inline filter to prepare filtered samples. Be careful not to overfill acid preserved sample bottles.

6. Measure the required field parameters at the time of sampling and record them onto the field forms or electronic data collection device. The physical appearance of the sample (i.e., presence or absence of color, odor, and turbidity) shall also be noted.

7. Record the sample date and time on the field forms or into electronic data collection device. Label all sample bottles using the sample naming convention established in the Sampling and Analysis Plan.

8. Collect quality control samples as described in the Sampling and Analysis Plan.

9. Place all groundwater samples in a cooler. Prepare laboratory chain of custody form following the instructions on SOP-10 (Sample Chain of Custody).

10. Make sure the sampling point is shut off before leaving pump station if it was manually turned on.