

STANDARD OPERATING PROCEDURE FOR COLLECTION OF LAKE WATER SAMPLES

State of Utah
Department of Environmental Quality
Division of Water Quality



Revision 0
Effective May 1, 2014

Utah Division of Water Quality (DWQ) Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical experts. This document is intended primarily for internal DWQ use. This SOP should not replace any official published methods.

Any reference within this document to specific equipment, manufacturers, or supplies is only for descriptive purposes and does not constitute an endorsement of a particular product or service by the author or by DWQ. Additionally, any distribution of this SOP does not constitute an endorsement of a particular procedure or method.

Although DWQ will follow this SOP in most instances, there may be instances in which DWQ will use an alternative methodology, procedure, or process.¹

¹ *Disclaimer language above adapted from Washington State Department of Ecology SOPs.*

REVISION PAGE

Date	Revision #	Summary of Changes	Sections	Other Comments
11/1/13	1	not applicable	not applicable	Previous version was put into new standardized format, began document control/revision tracking.
5/1/14	0	Changed revision number, minor formatting	Not applicable	First version should have been revision 0

TABLE OF CONTENTS

1.0	Scope and Applicability	5
2.0	Summary of Method	5
3.0	Definitions.....	5
4.0	Health and Safety Warnings.....	6
5.0	Cautions & inTeRferences.....	6
6.0	Personnel Qualifications/Responsibilities	7
7.0	Equipment and Supplies.....	7
8.0	Procedure	7
9.0	Data and Records Management.....	12
10.0	Quality Assurance and Quality Control.....	12
11.0	References	13
12.0	Appendix	14

1.0 SCOPE AND APPLICABILITY

This document presents the Utah Division of Water Quality's (DWQ) Standard Operating Procedure (SOP) for performing routine water sample collection on lakes, reservoirs, and ponds. This SOP applies to all DWQ field staff, non-DWQ cooperators, and volunteer monitors trained on this SOP.

This SOP describes water samples taken at any depth within the water column from the water surface to the bottom. Application is limited to water samples collected for chemical and biological analysis. Secchi and Hydrolab readings, as well as equipment decontamination to prevent the spread of invasive species are covered in separate DWQ SOPs.

2.0 SUMMARY OF METHOD

Water samples are collected from the surface, above and below the thermocline, and at water bottom using a variety of equipment. Depending on the water samples being collected, filtering of the collected sample may be performed. The following are the primary types of lake water samples:

- Grab sample: bottle in hand filled below water surface; for shallow lakes
- Surface sample: this surface sample is a depth-integrated (vertically-integrated) sample of up to the first two meters of the water column
- Depth sample: this sample is collected at a specific depth below two meters

3.0 DEFINITIONS

Vertegrator - This is the State of Utah's abbreviated term for an integrated vertical sampler. This sampler allows a composite water sample to be collected from the first two meters of the water column (surface sample). It is constructed of a two meter long PVC tube with a valve on the bottom and a rubber cork on top.

Kemmerer - This sampler can be lowered to any depth and then tripped by a messenger to collect water from a specific depth. It is constructed of an open tube container with gaskets/stoppers attached at each end, a line for lowering and measuring depth, and a messenger (a metal cylinder) which, when sent down the line, closes the ends of the tube to collect the discrete sample.

Thermocline - As defined by the Environmental Protection Agency (EPA), a thermocline is the middle layer of a thermally stratified lake or reservoir. In this layer, there is a rapid decrease in temperatures.

DWQ uses a sonde with a temperature probe to find the thermocline (a change in $> 1^{\circ}\text{C}$ over a depth of 1 meter).

$^{\circ}\text{C}$ - degrees Celsius

m - meter(s)

4.0 HEALTH AND SAFETY WARNINGS

Many containers used for water samples contain acid preservative (sulfuric acid, nitric acid). Proper handling of these containers should be followed to prevent skin irritation, and eye injury.

Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, the sample visit is recommended to be rescheduled. If hazardous weather conditions arise during sampling, such as lightning or high winds, personnel should cease sampling and move to a safe location.

All boats should be equipped with safety equipment such as personal flotation devices (PFD's), oars, air horn, fire extinguisher, etc. Utah's Boating Laws and Rules shall be followed by all field personnel.

5.0 CAUTIONS & INTERFERENCES

Sample contamination can occur if sampling devices are not properly rinsed. Equipment (Vertegrotor and Kemmerer) must be triple-rinsed on the opposite side of boat from where water samples will be collected. All equipment that comes in contact with sample water should be washed with Liquinox, rinsed with DI water, and allowed to dry between sampling locations.

Contamination may also occur at the lake bottom due to agitation of bottom sediments. To prevent this, do not take bottom samples near the boat anchor. Use the depth finder at the water sample collection point to avoid hitting the bottom with the Kemmerer.

Samples should not be collected near the boat motor for risk of contamination by gas/oil.

Samples collected for chlorophyll-a and phytoplankton analyses should be placed on ice in the dark immediately while on the lake between sites and the shore before processing.

6.0 PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

Samplers are required to read this SOP annually and acknowledge they have done so via a signature page (see **Appendix**) that will be kept on-file at DWQ along with the official hard copy of this SOP.

Personnel performing lake water sampling must be familiar with sampling techniques, safety procedures, proper handling, and record keeping. Samplers are responsible for attending refresher meetings held prior to each field season to review procedures and techniques. New staff will be trained in the field by experienced personnel.

7.0 EQUIPMENT AND SUPPLIES

Many different kinds of equipment are needed for lake water sampling. Below is a list of general equipment needs. Also consult DWQ's SOP for Water Chemistry Sample Collection and DWQ's SOP for Hydrolabs for a more exhaustive equipment list.

<input type="checkbox"/> Copy of this SOP	<input type="checkbox"/> Geo-pump
<input type="checkbox"/> Boat	<input type="checkbox"/> Filters
<input type="checkbox"/> Boat anchor	<input type="checkbox"/> Cooler
<input type="checkbox"/> Depth finder	<input type="checkbox"/> Ice
<input type="checkbox"/> Maps	<input type="checkbox"/> Safety gear
<input type="checkbox"/> Secchi disk	<input type="checkbox"/> GPS unit
<input type="checkbox"/> Vertegrator	<input type="checkbox"/> Lab sheets/field notebook
<input type="checkbox"/> Kemmerer sampler	<input type="checkbox"/> Pens/markers
<input type="checkbox"/> Labeled sample bottles	<input type="checkbox"/> Camera
<input type="checkbox"/> Run portfolio/Sampling and Analysis Plan	<input type="checkbox"/> Deionized (DI) water
<input type="checkbox"/> Clean, unused plastic jug ("transfer" bottle) for collecting raw sample to be filtered for dissolved constituents in the field including chlorophyll-a samples	

8.0 PROCEDURE

Refer to **Figure 2** at the end of this section for an overview of a lake sampling workflow. Pack sampling equipment and supplies into the boat to be used for sampling. Launch the boat into the waterbody and drive (using a GPS unit) to the sampling point. Once you arrive at the sampling site and anchor the boat, proceed with the following steps:

8.1 Surface Sample Collection

- 1) Take a Secchi disk reading to establish the depth at which the surface water samples will be collected. Please refer to the document "Standard Operating Procedure for Secchi Readings" for detailed instructions for taking Secchi readings. The sample depth is calculated as 2 x the Secchi reading (e.g., if Secchi reading is 0.8 meters, the surface sample will be taken at 1.6 meters). NOTE: If the Secchi reading is greater than 1 meter, the surface sample should be taken at a maximum depth of 2 meters (e.g., if Secchi reading = 3.8 meters, the surface

sample will be taken at 2 meters). If the Secchi reading calculation results in a surface sample depth of ≤ 0.5 meter, a grab sample* will be taken.

- 2) Label the appropriate sample bottles with current date/time, site description, Monitoring Location ID (MLID or STORET), and samplers' initials. Fill out lab sheets to match all information on the associated sample bottles. An example of a filled out sample bottle label is included in **Figure 1** below.

Figure 1. Sample bottle label.

Total Chemistry	
<u>STORET</u>	<u>4937130 (2)</u>
<u>Site Description</u>	<u>Pelican Lake 01</u>
<u>Date:</u>	<u>09/17/2011</u>
<u>Time:</u>	<u>1315</u>
<u>Samplers</u>	<u>AA, BB</u>

Note: Special label coding is used for lake water samples. For surface samples, type (2) shall be recorded on bottle labels. Bottom samples are recorded as type (29). Thermocline samples are recorded as (23) - above thermocline and (27) - below thermocline.

- 3) Triple rinse the Vertegrator sampler on opposite side of boat from where samples will be collected. For each rinse, dunk the sampler into water until fully submerged and then raise it up out of the water.
- 4) Move to the side of the boat where sampling will occur. With the cork off the top of the Vertegrator twist the valve on the bottom end until it is in the "un-lock" position.
- 5) Hold the Vertegrator upright and lower it to determined depth by lining up the graduated marks on the PVC pipe with the water surface. Cork the Vertegrator securely and then slowly raise it to water surface. Before lifting the Vertegrator above the water surface, twist the valve to the "lock" position.
- 6) Tilt the sampler back and forth to thoroughly mix the water sample. Twist the valve back to the "un-lock" position to fill the appropriate sample bottles. Refer to the DWQ SOP for water sample collection regarding bottle rinsing, preservatives, and bottle types according to analyte, and to the DWQ SOPs for filtering chlorophyll-a and nutrients/metals samples if those parameters are to be collected according to the Sampling and Analysis Plan (SAP). Collect chlorophyll-a samples into a clean transfer jug until they can be field filtered.
- 7) Repeat Steps 4-5 if more water volume is needed to fill all of the sample bottles.

- 8) Be sure to label bottles as type 2. Securely tighten bottle caps and place the samples into the cooler with wet ice.
- 9) It is important to place samples collected for chlorophyll-a and phytoplankton analyses on ice in the dark immediately.

8.2 Lake Depth Measurement

Total lake depth is measured once surface samples have been collected. Lower the depth finder to just below the water's surface and allow time for the depth reading to stabilize. Repeat if an accurate reading is not obtained (e.g., boat was rocking). Proceed to lake-bottom sample collection (**Section 8.3**) if the waterbody depth is **3 meters or greater**. If the waterbody depth is less than 3 meters, no further water sample collection is required unless otherwise specified in the SAP. Record the total lake depth on appropriate lab sheet.

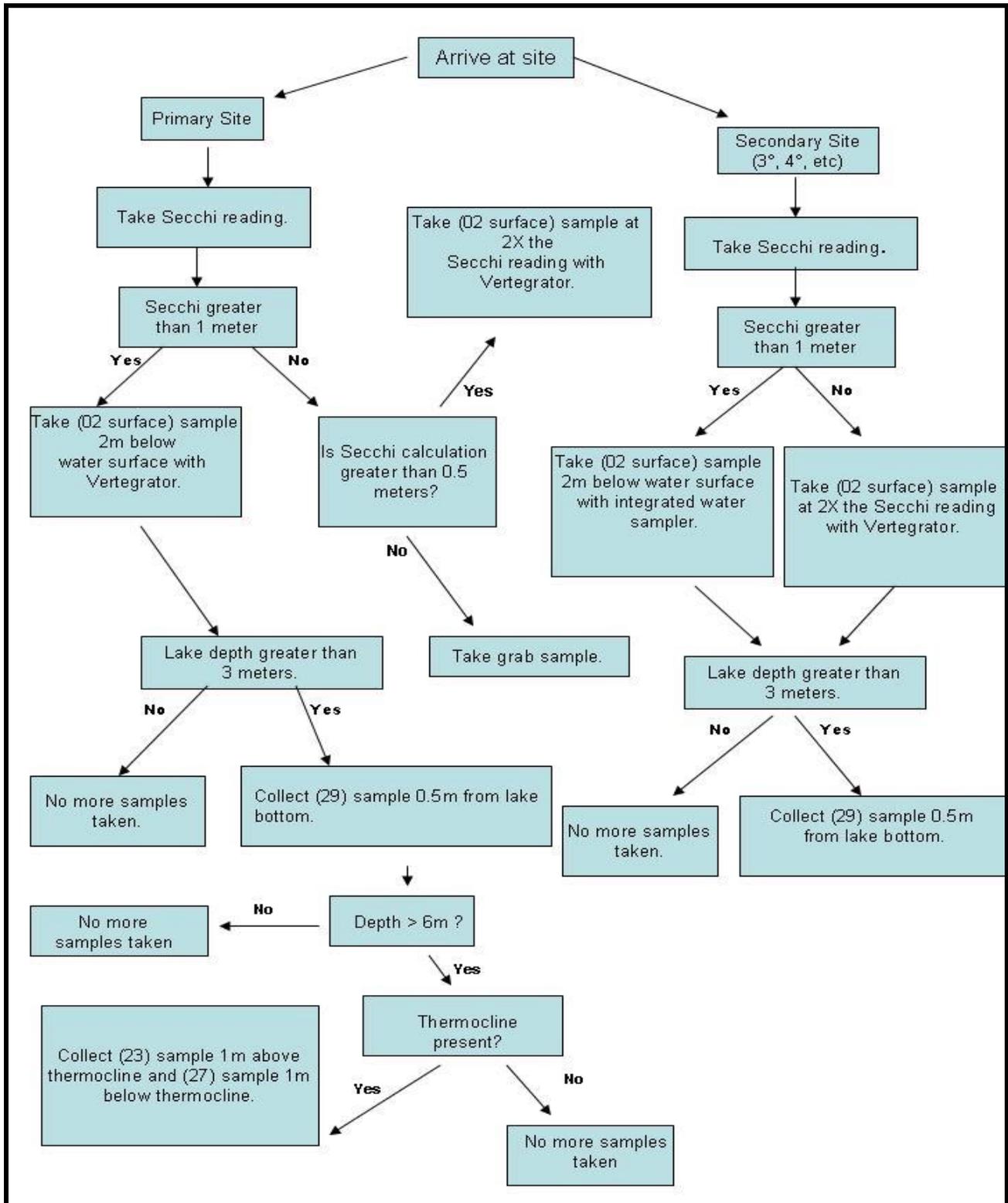
8.3 Depth Sample Collection (lake bottom and thermocline samples)

- 1) If lake depth is measured to be 3 meters or greater, proceed with the following steps to collect samples every 1 meter until 0.5 meters above the lake bottom. Be sure to label bottles with the proper coding – type 29 for bottom samples. Record the exact sample depth on the lab sheet labeled type 29.
- 2) Triple rinse the Kemmerer sampler on the opposite side of boat from where sample collection will occur. To rinse, lock the apparatus (two end stoppers locked in the “open” position) and dunk the sampler into the water three times.
- 3) Next, close the discharge valve to prevent loss of sample.
- 4) Move to the side of the boat where sample collection will occur. Place the Kemmerer into the water in the upright position, and hold onto the messenger while slowly lowering the Kemmerer to the correct sample depth (0.5 meters from the bottom).
- 5) Once the Kemmerer is at the correct sample depth, drop the metal messenger. The messenger trips the Kemmerer's mechanism and seals water within its container.
- 6) Hoist the Kemmerer back up to the boat, taking care to keep the Kemmerer in an upright position to avoid any loss of sample. Open the discharge valve and fill the appropriate sample bottles. Securely tighten bottle caps and place the samples into the cooler with wet ice. Dump any sample remaining within the Kemmerer back into the waterbody.
- 7) The presence of a thermocline (defined in **Section 3.0**) is assessed at the primary site using a multiparameter sonde and the temperature depth profiles are recorded

electronically. See DWQ's SOP for Lake Hydrolab readings. If there is no thermocline, no further samples need to be collected. If there is a thermocline, the sonde operator will inform the sampler of the appropriate depths to sample. Thermocline samples should be collected at 1 meter above the thermocline (type 23) and 1 meter below the thermocline (type 27). In some cases, there may be a top to a thermocline but no distinct bottom. If this occurs, collect a type 23 sample only. Record the exact sample depth on the lab sheets labeled type 23 and/or type 27. Be sure to label sample bottles as type 23 and/or type 27.

- 8) Return to the boat ramp and unload the boat. Perform any required sample filtering lake-side in case additional water samples need to be collected. Please refer to DWQ SOPs for processing water samples.
- 9) Between sampling locations and at the end of the sampling trip, all equipment (sampling devices, boats, and trailers, etc.) used in the collection of water samples from the waters of the state of Utah that come in direct contact with the waterbody must be cleaned according to DWQ's decontamination procedures.

Figure 2. Lake sampling workflow.



9.0 DATA AND RECORDS MANAGEMENT

Use the following equation for calculating the appropriate depth for the surface sample collection.

Surface sample calculation:

$$\text{Surface sample depth} = \text{Secchi reading} \times 2$$

All lab sheets will be filled out correctly. Date and time recorded on sample bottles must match the date and time recorded on lab sheets. Failure to record the correct depth code (type 2, 29, etc) on a sample bottle may result in rejection of the water sample. Sample depths must be recorded on appropriate lab sheets.

Once personnel reach the laboratory to drop off samples, all lab sheets will be scanned and saved into the DWQ Monitoring Section shared folder for lakes data. These lab sheets hold important information that will be kept with the sampling trip data including sample depths, Secchi readings, sampling time, etc.

10.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control (QC) samples (equipment blanks, field blanks, trip blanks, field duplicates, etc.) should be collected at the frequency given in the project-specific SAP. Minimum collection frequency and performance requirements for QC samples are given in DWQ's Quality Assurance Program Plan.

To collect an equipment blank for lake sampling, triple rinse the Vertegrator and Kemmerer with deionized water. Fill the sampler a 4th time with deionized water and pour this "rinse" (sample) into the appropriately labeled sample bottles to be analyzed as the equipment blank. All sample types taken throughout the lake sampling trip must have an equipment blank except for phytoplankton. If transfer bottles are used for filtered constituents, they should be also be decontaminated/rinsed with DI water and then filled with the blank water from the Vertegrator or Kemmerer prior to filtering. It is important that *every* piece of equipment that normally touches a sample is incorporated into the equipment blank sampling process.

Field duplicates should be rotated between surface, bottom and depth samples (type 2, 29, 23, and 27). With volume restriction of the Vertegrator, it is impossible to simultaneously fill both the regular sample bottles and the duplicate sample bottles. Therefore these duplicates are prepared by pouring the sample water from the Vertegrator into a half-gallon clean "transfer" container provided by the laboratory. Pour the water from the transfer container equally between the regular and duplicate bottles. Continue collecting water with the Vertegrator, using the transfer container, until all the bottles for both regular and duplicate samples are filled. Filtered duplicate samples will be filtered according to the filtering SOP.

11.0 REFERENCES

Related DWQ SOPs:

Standard Operating Procedure for Collection of Water Chemistry Samples

Standard Operating Procedure for Decontamination of Monitoring Equipment

Standard Operating Procedure for Hydrolab Data Collection in Lakes

Standard Operating Procedure for Secchi Disk Depth Measurements

