



### Standard Operating Procedure for Secchi Disk Measurements

#### SOP-WR-W-7

#### APPROVALS:

Deputy Chief of Water Resources:

Sue Kiernan  
Printed Name

*Sue Kiernan*  
Signature

5/11/11  
Date

Quality Assurance Manager:

Connie Carey  
Printed Name

*Connie Carey*  
Signature

5/11/11  
Date

#### DISTRIBUTION

- (x) Surface Water Monitoring & Assessment (Connie Carey) ..... By: cgc Date : 5/11/11
- (x) TMDL Program (Elizabeth Scott) ..... By: ... Date : ...
- (x) Quality Assurance Manager (Tom Getz) ..... By: ... Date : ...

Title: Standard Operating Procedure for Secchi Disk Measurements  
Originator Name: Jane Sawyers

## TABLE OF CONTENTS

<b>1. APPLICABILITY .....</b>	<b>3</b>
<b>2. PURPOSE .....</b>	<b>3</b>
<b>3. DEFINITIONS .....</b>	<b>3</b>
<b>4. RESPONSIBILITIES.....</b>	<b>3</b>
4.1 TRAINING.....	3
4.2 RESPONSIBILITIES OF FIELD ANALYST.....	4
4.3 RESPONSIBILITIES OF PROJECT OR PROGRAM MANAGER.....	4
<b>5. GUIDELINES AND PROCEDURES .....</b>	<b>5</b>
5.1 PROPER USE OF SECCHI DISK .....	5
5.1.1 REQUIRED MATERIALS.....	5
5.1.2 USING THE SECCHI DISK IN THE FIELD .....	5
5.1.3 RECORDING PARAMETER UNITS.....	5
5.2 FIELD MEASUREMENT PROCEDURES.....	6
5.2.1 DETERMINE FIELD PROCEDURE SCHEDULE .....	6
5.2.2 POSITION THE BOAT AT THE DEEPEST POINT OR DESIRED DEPTH.....	6
5.2.3 TAKING THE SECCHI DEPTH MEASUREMENT .....	6
<b>6. QUALITY CONTROL .....</b>	<b>8</b>
6.1 QUALITY CONTROL .....	8
6.2 QUALITY ASSURANCE PLANNING CONSIDERATIONS .....	8
<b>7. REFERENCES .....</b>	<b>8</b>

## Standard Operating Procedure for Secchi Disk Measurements

### 1. APPLICABILITY

This SOP applies to all Office of Water Resources (OWR) staff involved in collecting water clarity measurements in lakes, ponds, reservoirs, and slow moving, deep rivers using a Secchi disk. Exemption from the use of this SOP for project work shall be allowed for reasons of inapplicability determined by management discretion.

### 2. PURPOSE

This SOP establishes a standardized method for performing semi-quantitative field measurements of water clarity in lakes, ponds, reservoirs, and slow-moving, deep rivers using a Secchi disk. It sets a consistent protocol to ensure the quality of OWR's data collection—resulting in improved uniformity, reproducibility, verifiability, and defensibility of the data, as well as increased program credibility.

### 3. DEFINITIONS

3.1 RIDEM – Rhode Island Department of Environmental Management

3.2 OWR – RIDEM Office of Water Resources

3.3 SOP – Standard Operating Procedures

3.4 Secchi disk – A black and white disk lowered by hand into the water to determine water clarity.

3.5 QA – Quality Assurance refers to a systematic process to ensure production of valuable, accurate, reliable, reproducible and defensible environmental data.

3.6 QC – Quality Control refers to the activities performed to affirm production of valuable, accurate, reliable, reproducible and defensible environmental data.

3.7 QI – Quality Improvement refers to any act or process performed to enhance the value, accuracy, reliability, reproducibility or defensibility of environmental data collected by RIDEM OWR.

### 4. RESPONSIBILITIES

#### 4.1 TRAINING

Any RIDEM/OWR personnel collecting Secchi disk measurements for a RIDEM project or program should have completed RIDEM's Quality System Awareness Training Program with appropriate documentation from the Quality Assurance Manager. This training ensures the field analyst recognizes the importance of proper data collection and management and he/she comprehends the

RIDEM Office of Water Resources – Standard Operating Procedures for Secchi Disk Measurements

significance of the environmental decisions that may be made with the data. It is suggested that field analysts have also completed the USEPA Water Quality Standards Academy Basic Course and Supplemental Topic Modules online, but does not require any additional special training or certification.

To properly employ the Secchi disk, the field analyst must be familiar with and comply with the data collection techniques stated in this SOP. The field analyst is required to read and understand this SOP. The field analyst should complete and submit any required training forms and/or field assessments for project and/or program QAPPs to document proficiency with this procedure. Any field analyst not familiar with the use of the Secchi disk should be assisted by OWR staff who are accustomed to using the equipment.

#### **4.2 RESPONSIBILITIES OF FIELD ANALYST**

The field analyst is responsible for checking the required equipment in the Sampling Center at the beginning of the sampling event before taking measurements in the field. The field analyst is responsible for verifying that the Secchi disk is in proper operating condition prior to use (i.e. no cracks in the disk; black and white pattern apparent; securely attached to measuring tape) and communicating to the project manager when equipment is in need of repair or replacement. The field analyst is also responsible for ensuring that all supplementary equipment (weight, measuring tape, canoe or kayak, etc.) is present and in working condition. The field analyst is also responsible for using best professional judgment to determine if site conditions are safe for performing the procedure. The field analyst is accountable for employing proper measurement procedures and data recording in accordance with this SOP.

#### **4.3 RESPONSIBILITIES OF PROJECT OR PROGRAM MANAGER**

The project or program manager is responsible for providing the materials, resources, and/or guidance necessary to perform the measurements in accordance with this SOP. The project manager is responsible for ensuring that the field analyst operates the Secchi disk correctly in accordance with this SOP and that any additional, project-specific requirements are communicated to the project team. The project manager is responsible for ensuring the Secchi disk is maintained in proper operating condition annually. This includes ensuring the Secchi disk is not cracked, the weight is attached, the measuring tape or rope is attached, and repairing it or reordering equipment when necessary. The project manager will determine and communicate with field analysts what procedures and order of procedures are to be accomplished during each sampling event to a sampling location. If the measurement is being done on a river that is not accessible by boat, the project manager will determine if the measurement can be done from another structure. Further, the project manager shall ensure annual renewal and periodic revisions to this SOP as necessary to reflect current needs and standards as well as renew this SOP every five years.

## 5. GUIDELINES AND PROCEDURES

### 5.1 PROPER USE OF SECCHI DISK

#### 5.1.1 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Secchi disk with attachment clip/structure (Figure 1, similar to Forestry Suppliers Item Number 77912)
  - Extra weight (optional)
- AquaVue™ tube (Figure 1, similar to Wildco Item Number 79-015)
- Fiberglass Measuring tape (0.1 m increments) (Figure 1, similar to Grainger Item Number 3VZJ6)
- Datasheet or field notebook printed on waterproof paper (paper similar to Grainger Item Number 3XFR7)
- Clipboard
- Pencil or Rite in the Rain Pen (similar to Forestry Suppliers Item Number 49237)
- Boat, canoe or kayak
- Paddles and motor
- Anchors
- Lifejackets
- Depth finder

#### 5.1.2 USING THE SECCHI DISK IN THE FIELD

For most purposes, the Secchi disk is used specifically for in situ water clarity measurements taken directly in the field, in lake, ponds, reservoirs, and slow-moving, deep rivers. This method does not require sample containers or preservation.

#### 5.1.3 RECORDING PARAMETER UNITS

The following units should be used when recording measurements taken with the Secchi disk:

Secchi depth.....meter

## 5.2 FIELD MEASUREMENT PROCEDURES

### 5.2.1 DETERMINE FIELD PROCEDURE SCHEDULE

Prior to departure, the project manager will communicate with the field analysts what procedures should be accomplished for each sampling trip to the sampling location and the order the field procedures should be completed. Prior to performing this analysis, the field analyst should ensure the Secchi disk measurement is taken at an appropriate time of day and in the correct order. This procedure may disrupt fish and microscopic organisms, such as phytoplankton and zooplankton, which can interfere with other field procedures and sample collections in lakes, ponds, reservoirs, and slow-moving, deep rivers. Secchi disk measurements should be measured after these samples have been collected. However, Secchi disk measurements should be taken before any sampling procedure or activity that may disturb bottom sediments to avoid increasing turbidity at the location. The field analyst should note any disturbance to the bottom sediment in the Comment/Notes section of the field datasheet (Figure 2) or appropriate field notebook. Secchi disk measurements should be made between approximately 10 AM and 2 PM to capture phytoplankton and other biological organisms' diurnal movements.

### 5.2.2 POSITION THE BOAT AT THE DEEPEST POINT OR DESIRED DEPTH

If a bathymetric map is available, the field analyst should use the map and distinguishing land characteristics (i.e. outfall structures, points, inlets, boat launch) to find the general location of the deepest spot or desired depth in the lake or river. The field analyst should verify the location by confirming several depth locations with the depth finder around the general location of the deepest spot or desired depth. Once the deepest location or desired depth is established, the field analyst should carefully lower the anchor so that bottom sediment is not disturbed into the water column. The field analyst should record the depth of the deepest location or desired depth to the nearest tenth of a meter on the field datasheet (Figure 2) or appropriate field notebook. For monitoring section sampling events, the field analyst should fill out the information at the top of the field datasheet (Figure 2) prior to collection of a water sample with the integrated sampler.

### 5.2.3 TAKING THE SECCHI DEPTH MEASUREMENT

The field analyst should remove sunglasses (prescription or non-prescription) but continue to wear any clear prescription glasses. Determine which side of the boat is exposed to the sun. The measurement should be taken on the **shaded** side of the boat to reduce glare. Where there is no shade, keep your back toward the sun to block glare/reflection. When taking a measurement the Secchi disk should remain in the water directly below your hand holding the measuring tape/line attached to the Secchi disk. If the current or wind causes the disk to drift, extra weight should be added to the disk to avoid skewed measurements when read at an angle.

- Unwind the measuring tape attached to the Secchi disk to equal the deepest spot or desired depth. Place your foot gently on the measuring tape wheel in the bottom of the boat in case you drop the equipment.
- In one hand, hold the AquaVue™ tube by the handle and lower the end with the lens approximately 4 inches into the water. In your other hand, hold the measuring tape with the Secchi disk (securely attached) over the water.
- Look through the viewing end of the AquaVue™ tube
- Using the measuring tape, slowly lower the Secchi disk over the side of the boat into the water and watch through the AquaVue™ tube until it disappears from view or hits the bottom (if completely clear).
  - Note: If the Secchi disk hits the bottom and is still visible, record the depth at the water surface and write “VOB” indicating the Secchi disk is visible on bottom on the datasheet or appropriate field notebook. Do not continue with steps listed below.
- Read aloud the depth at the water surface to the nearest tenth of a meter to the second field analyst, and then lower the Secchi disk deeper (another 0.3 meters).
  - Note: The second field analyst should record this number on the datasheet or appropriate field notebook.
- Slowly begin to raise the Secchi disk. When you can make out the Secchi disk pattern, stop raising the Secchi disk.
- Place the AquaVue™ tube back in the boat and read aloud the depth at the water surface to the second field analyst.
  - Note: The second field analyst should record this number on the datasheet or appropriate field notebook.
- The second field analyst should determine the average of the two recorded depths and round to the nearest tenth of a meter. The average value should be recorded on the datasheet.
- Remove all equipment from the water and repeat the entire measurement process as detailed above and record the second set of Secchi depth measurements on the datasheet. If the two average Secchi measurements are not within 5%, repeat the measurement a third time.
  - Calculate the 5% error by multiplying Secchi measurement 1 by 0.05 and rounding to the nearest tenth. Adding and subtracting the resulting value to the first reading will give the range of acceptable second readings. If the second reading falls in this range, then the reading is accepted. If the second reading does not fall in this range, then a third Secchi measurement should be taken.

- Example: Secchi 1 = 6.5; Secchi 2 = 6.7

$$6.5 * 0.05 = 0.325 \text{ (rounded 0.3)}$$

Acceptable range = 6.2 to 6.8

Secchi values are accepted

- If the third reading is also out of the acceptable range, then the field analyst should check the depth meter to make sure the boat is still located at the deepest spot. If the boat has drifted, the field analyst should pull up the anchor and move back to the deepest spot or desired depth. The procedure should then be repeated. The QC issue will be noted on the field datasheet or appropriate field notebook and reported to the project manager.

## 6. QUALITY CONTROL

### 6.1 QUALITY CONTROL

Quality control will be assessed by calculating the 5% error as described in Section 5.2.3. This will give a measure of precision for the procedure.

### 6.2 QUALITY ASSURANCE PLANNING CONSIDERATIONS

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. Unless specified otherwise in a site or project-specific work plan, Quality Assurance Project Plan (QAPP), Quality Assurance Program Plan (QAPP) or laboratory Quality Assurance Manual (QAM), all data collected following the protocols set forth in this document will be collected in accordance with the minimum QAQC requirements of Section 6.1. Further quality assurance requirements will be defined in project specific work plans and may include duplicate or replicate measurements or confirmatory analyses.

## 7. REFERENCES

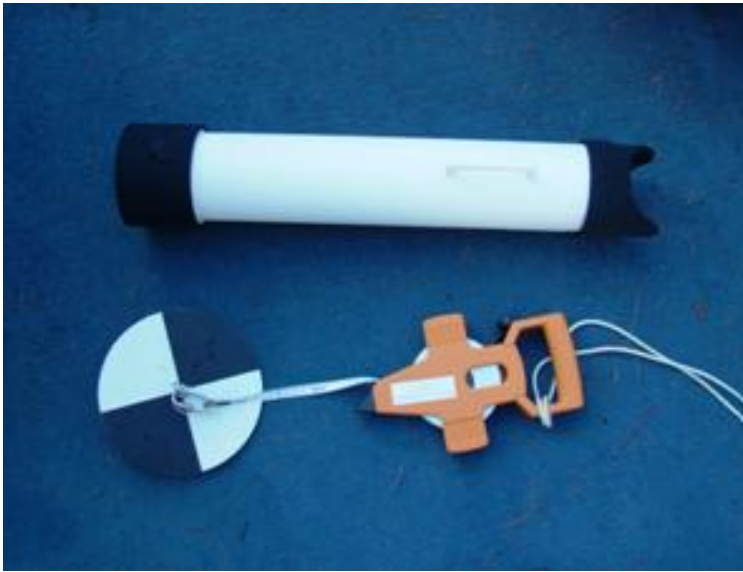
Green, L.T., E.M. Herron, and A.J. Gold. 2010. *URI Watershed Watch Revised Lake and Pond Monitoring Manual*. College of the Environmental and Life Sciences, University of Rhode Island. Contribution #5047.

USEPA. 1997. *Volunteer Stream Monitoring: A Methods Manual*. Office of Water Resources, U.S. Environmental Protection Agency. EPA 841-B-97-003.  
[www.epa.gov/volunteer/stream/155.html](http://www.epa.gov/volunteer/stream/155.html)

Wetzel, R.G. and Likens, G.E. 2001. *Limnological Analyses*, 3<sup>rd</sup> ed. New York: Spring Science and Business Media, Inc., 429 pp.



Figure 1. Secchi Disk and Associated Equipment



<http://baunegbeg.net/>

Figure 2. Lake Datasheet for Monitoring Section Sampling Events

<b>Lake Sampling Datasheet</b>			
<b>Lake Name:</b>	_____		<b>Town:</b> _____
<b>Date:</b>	_____	<b>Military Time:</b> _____	<b>Collectors:</b> _____
<b>Meter #</b>	_____		
<b>Max Depth:</b>	_____	m	
<b>Weather:</b> (Circle one)	<b>Clear</b>  <b>Raining</b>	<b>Partly Cloudy</b>  <b>Windy</b>	<b>Overcast</b>  <b>Sunny</b>
<b>Air Temperature:</b>	_____	°C	
<b>Comments/Notes:</b>			
<b>Secchi Depth #1</b>	_____	m	
<b>Secchi Depth #2</b>	_____	m	
<b>QC Range (5%)</b>	_____	m	<b>Accepted?</b> _____
<b>Secchi Depth #3</b>	_____	m	<b>Action?</b> _____
<b>Secchi Depth #1 redo</b>	_____	m	
<b>Secchi Depth #2 redo</b>	_____	m	
			<b>QC Measurement</b> (20% of sites)
<b>Water Column Readings</b> (reading taken at 1m)	<b>Temperature</b>	_____	°C
	<b>pH</b>	_____	
	<b>Specific Conductivity</b>	_____	µS/cm
	<b>Dissolved Oxygen</b>	_____	mg/L
		_____	%