WATER QUALITY PROGRAMS DIVISION

Standard Operating Procedure for the Measurement of Turbidity in Surface Waters

Revised and Adopted May 2022

Final Copy

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Standard Operating Procedure for the Measurement of Turbidity in Surface Waters

Revision Date	Version	Description of Changes	Effective Date
11/2005	1.0		11/2005
02/08/2022	1.1	• Reworked numbering • Updated steps for calibration and measurement • Changed wording to clear up confusing language	02/2022
05/05/2022	1.2	• Updated formatting	05/05/2022

STANDARD OPERATING PROCEDURE FOR THE MEASUREMENT OF TURBIDITY IN SURFACE WATERS

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1.0 General Information

Water for use in turbidity analysis is collected using one of the vials in the turbidimeter kit (for immediate analysis) or a clean one-liter plastic bottle (for later analysis). Prime the vial or bottle with native water from the lake and then fill the vial above the white line or fill the pint bottle to the top ensuring that the sample is not aerated. If collecting for later analysis, place the bottle on ice until analysis is made (water must be brought to ambient temperature for an accurate reading to be determined). Analysis must be made within 24 hours, but immediate analysis is preferable. Turbidity is measured using the Hach© 2100P portable Turbidimeter or equivalent instrument reading in Nephelometric Turbidity Units (NTU). Remember that dirty glassware and the presence of air bubbles may give false results. Be sure to record all calibration information in the log notebook found in each Turbidimeter case.

2.0 Definitions/Terms

3.0 Safety

Upon reaching the sampling location, site safety determinations should be made before proceeding. These will be different for all sites. Please refer to the OWRB safety manual for instructions on how to safely sample various kinds of sites. When regulating the flow of traffic is necessary, please refer to the portion of the safety manual outlining “Traffic Safety Protocols”.

4.0 Quality of the Measurement

When sampling for all programs, Quality Assurance/Quality Control (QA/QC) samples will be routinely collected to assure that environmental samples meet the Data Quality Objectives (DQO’s) that are outlined in the controlling Quality Assurance Project Plan (QAPP). QA/QC sampling is designed to control each step of the sampling process. Blanks are collected to ensure that field personnel are properly cleaning the plastics and glassware used in field sampling. Duplicate samples may be collected to ensure that composite samples are properly processed. Replicate samples may be collected to ensure that the sampling methodology employed is collecting a representative sample. The QA/QC protocols for collecting and processing turbidity samples from surface waters can be found in the documents “Standard Operating Procedure for the Collection of Water Quality Samples in Lakes” and “Standard Operating Procedure for the Collection of Water Quality Samples in Streams.”

5.0 Personnel and Equipment

5.1 Personnel

Principle investigators for the OWRB are required to have degrees and/or experience with biological or other applicable sciences. Principle investigators are defined as crew leaders, and this designation may be made upon the leader of a multi- or a one-person crew. Training is required for all SOPs dealing with water quality and

quantity collections and measurements as well as habitat assessments and biological collections. In-house training will be conducted for the use of all meters and digital titrators used for water quality or quantity measurements. Investigators must be familiar with OWRB SOP document, and all training will follow the methods outlined in that document. Extra training will be provided when new SOPs are developed. Training of field crews will be done through dry run exercises in the laboratory to familiarize field crews with sample collection, sample preservation, instrument operation, calibration, and maintenance. In addition, when new personnel are hired or new methods developed, qualified staff will train on sample collection, measurement, and field analysis methods through side-by-side field trips. These trips will familiarize staff with SOP requirements. When training is considered adequate, a qualified staff member will check field staff for adherence to SOPs.

5.2 Equipment

Equipment used to collect turbidity samples from surface waters is described in the documents "Standard Operating Procedure for the Collection of Water Quality Samples" and "Standard Operating Procedure for the Collection of Water Quality Samples in Streams."

6.0 Hach© 2100P PORTABLE Turbidimeter

6.1 Maintenance

When not in use, the turbidimeter and vials should be in kept their field case. The instrument should be kept dry and clean both inside and out. The vials should be kept clean and free of abrasions. After each measurement, the vial and lid should be rinsed at least twice with deionized water and stored filled with deionized water. Vials should never be stored inside the instrument. Instruments should never be stored in temperatures below freezing or in extremely hot temperatures, nor in high humidity conditions.

6.2 Calibration

Calibrations are performed according to manufacturer specifications which can be found here. Primary calibration must be completed at least every three months. Primary calibration should also be completed every time batteries are changed, every three months, or if instrument verification values are significantly different from the last primary calibration values. A routine instrument verification must be completed at the beginning of each sampling day. Instrument verification uses the Gelex® secondary standards stored in each Turbidimeter case. Once instrument verification is complete and the results are satisfactory, you are ready to measure the turbidity of actual samples.

To perform a primary calibration:

1) Place a drop of silicone on the StablCal® <0.1 NTU ampule (blank) and spread evenly with a Kimwipe®. Place the ampule in the cell compartment and align the orientation arrow with the orientation mark on the front of the cell compartment. Close the lid. Turn the Hach 2100P on by pressing **I/O.**
2) Press **CAL** and the "S0" icons will be displayed. The "0" will flash. The 4-digit display will show the value of the SO standard for the previous calibration. If the blank value was forced to 0.0 the display will be blank. Press to get a numerical display.
3) Press **READ**. The instrument will count from 60 to 0 (67 to 0 if the signal average is on), read the blank. The display will automatically increment to the next standard. Remove the sample cell from the compartment.
4) The display will show the "S1" (with the 1 flashing) and the "20 NTU" or the value of the S1 standard for the previous calibration. If the value is incorrect, edit the value by pressing the key until the number that needs editing flashes. Use the key to scroll to the correct number. After editing,

insert the 20 NTU StablCal® ampule (coated with silicone) into cell compartment, align orientation marks, close lid and press READ. The instrument will count from 60 to 0, measure turbidity, and store value. Remove ampule.

5) The display will show the “S2" and the “100 NTU” or the value of the S2 standard for the previous calibration. If the value is incorrect, edit using previously described procedure. Insert the silicone coated 100 NTU StablCal® ampule, align the orientation marks, close the lid, and press **READ**. The instrument will count from 60 to 0 then automatically increment to the next standard. Remove the sample ampule from the cell compartment.
6) The display will show the “S3" and “800 NTU”. If the numeric value is incorrect edit as described above. Insert the silicone coated 800 NTU StablCal® ampule, align the orientation marks, close the lid, and press **READ**. The instrument will count from 60 to 0 then automatically increment back to the S0 display. Remove the sample ampule from the cell compartment.
7) Press: **CAL** to accept the calibration. The instrument will return to measurement mode automatically.
8) In the calibration logbook, Record the date, your initials, and primary calibration completed.
9) Next, perform an instrument verification as described below.

To perform instrument verification:

1) Turn the Hach© 2100P on by pressing **I/O**.
2) Select automatic range mode using the **RANGE** key. This setting should always be set to whole numbers unless changed by the project manager.
3) Thoroughly clean the outside of the Gelex® vials and apply a thin coating of silicone oil using a Kimwipe® **(abrasive material will scratch the vial)**.
4) Place the 0-10 NTU Gelex® standard in the cell compartment and align orientation marks. Close the lid and press **READ**. Record the value on the calibration log.
5) Repeat steps 3 and 4 for the 10-100 NTU and 100-1000 NTU Gelex® standards. If this is the first measurement of Gelex® values following primary calibration, these values will be what future readings are compared to for accuracy. If this is not the first measurement following primary calibration, compare to the values collected immediately following primary calibration. If the two sets of values are significantly different, primary calibration is necessary.

7.0 Measurement of Turbidity

7.1 General Guidelines for Measuring Turbidity

1) **Turbidity should be measured at the site**, but on occasion this may not be possible, so it **must be read within 24 hours of collection**.
2) **Sample should always be well mixed**. Sample vial must be well mixed immediately before reading. If the sample is to be read later, bottles must be homogenized to dislodge any particles that may have settled.
3) **Attempt to use the same sample cell when measuring turbidity**. The glass in each cell is slightly different and therefore reflects light differently. Using separate cells for each sample could introduce additional error to the method and bias results.
4) **It is imperative to clean and prime the glass before each use**. Scratches, fingerprints, and water droplets on the inside of the turbidity tube or inside the light chamber can cause stray light interference, leading to inaccurate results.

5) **Do not let the glass fog while reading the sample**. As stated before, it is important to read samples at the ambient temperature, but this may not be possible if the temperature of the water is too cold. In this case, collect the sample in the vial and allow it to warm before taking the reading. If samples were stored on ice, the sample must be allowed to warm before reading.

7.2 Measurement with Hach© 2100P unit

To measure turbidity, follow these steps:

1) Clean vial with deionized water ensuring that all residue is gone
2) Prime vial with sample water
3) Homogenize the sample by gently inverting the one-liter sample or by slowly operating the churn splitter handle
4) Fill vial to the white line (meniscus should sit on the white line). Cap the vial
5) Clean vial with silicon oil by adding a single dropping and spreading with a Kimwipe® (do not use an abrasive cloth)
6) Invert vial several times and visually ensure that all sample particles have been dislodged
7) Place vial in cell compartment, align orientation marks, and press **READ**
8) Record reading and visually ensure that the sample did not fog
9) Turn unit off after each use.

8.0 Forms

Turbidity data are recorded and maintained on the trips field sheet. They are data and should be treated as such. Therefore, they should be accurate and complete. Field notes should be recorded on the field sheet by the collecting personnel. For guidance on proper procedure to complete the field notes, refer to your supervisor and/or FTE.

9.0 Data Storage

When weather permits, the electronic lakes field sheet should be completed on a laptop or tablet and saved in the format “Trip ID Site Name Season Year.” If the paper copy is used it should be transcribed into an electronic field data sheet as soon as possible and stored in the appropriate binder and on the Water Quality network drive. These data associated notes and comments will be uploaded to the AQWMS Water Quality Database for permanent cloud storage.

10.0 References

Hach Company (2008). 2100P Turbidimeter Manual. Loveland, CO. https://www.hach.com/asset-get.download.jsa?id=7639984911

OWRB. (2017). *Office and Field Safety Manual.* Oklahoma City: OWRB.

OWRB. (July 2018). Standard Operating Procedure for the Collection of Water Quality Samples in Lakes. Oklahoma City: OWRB.

OWRB. (Janurary 2013). Standard Operating Procedure for the Collection of Water Quality Samples in Streams. Oklahoma City: OWRB.