WATER QUALITY PROGRAMS DIVISION

Standard Operating Procedure for the Measurement of Turbidity in Streams

Revised and Adopted November 2005

Draft Copy

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STANDARD OPERATING PROCEDURE FOR THE MEASUREMENT OF TURBIDITY IN STREAMS
REVISED AND ADOPTED NOVEMBER 2005

1.0 General Information

Water for use in turbidity analysis is collected using one of the vials in the turbidometer kit (for immediate analysis) or a clean one pint plastic bottle (for later analysis). Prime the vial or bottle with native water from the churn splitter and, while churning, fill the vial above the white line or fill the pint bottle to the top ensuring that the bottle 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 in 24 hours, but immediate analysis is preferable. Turbidity is measured using the Hach© 2100P portable Turbidometer. 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 Turbidometer 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 wadable and bridge sites. Please refer to the OWRB safety manual for instructions on how to sample both 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 are 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. Spike or known samples may be submitted to test the efficacy of the analytical laboratory. The QA/QC protocols for turbidity can be found in the document “Standard Operating Procedure for the Collection of Water Quality Samples”.

5.0 Personnel and Equipment

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.

In most instances, the collection of water qulaity samples requires only one field person. However, depending on the safety requirements of a particular station, additional crew members may be necessary to ensure a safe work zone. Equipment used to collect the turbidity sample are described in the document "Standard Operating Procedure for the Collection of Water Quality Samples".

5.1 Hach© 2100P PORTABLE Turbidometer.

5.11 Maintenance

When not in use, the turbidometer and vials should be in kept their blue 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 twice with deinonized water and stored filled with deionized water. Vials should never be stored inside the instrument. Instruments should never be stored in temperatures below freezing in extremely hot temperatures.

5.12 Calibration

There are 2 types of calibration for the Hach© 2100P - primary and secondary calibration. Primary calibration must be completed at least every three months. Primary calibration should also be completed every time batteries are changed, every 3 months, or if secondary calibration values are significantly different from the last primary calibration values. A secondary calibration must be completed at the beginning of each sampling day. Secondary calibration uses the gelex secondary standards stored in each Turbidometer case. Once secondary calibration is complete and the results are satisfactory, you are ready to read the turbidity of actual samples.

To perform a primary calibration:

1) Place a drop of silicone on the Stabl Cal <0.1 NTU ampule (blank) and spread evenly with a chemwipe. 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 Stabl Cal 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 Stabl Cal 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 Stabl Cal 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 log book, Record the date, your initials, and primary calibration completed.
9) Next, perform a secondary calibration as described below.

To perform a secondary calibration:

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 **chemwipe (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.

6.0 Measurement of Turbidity

6.1 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 well mixed 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.
6) **Make three turbidity readings per sample.** Record the cumulative total and the average (rounded to the nearest whole number) on the field data sheet (e.g., 2 readings of 30 and 1 reading of 31 would be recorded as “3/91 = 30”).

6.2 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) While churning, fill vial to the white line (miniscus should sit on the white line),
4) Clean vial with silicone oil by adding a single dropping and spreading with a chemwipe (do not use an abrasive cloth),

5) Invert vial several times and visually ensure that all sample particles have been dislodged,
6) Place vial in cell compartment, align orientation marks, and press **READ** (samples should be read with no decimal),
7) Record reading and visually ensure that the sample did not fog,
8) Repeat steps 4-7 two times (for a total of 3 readings). It will not be necessary to add a drop of silicone oil after each reading. The vial can be cleaned with only the previously used chemwipe.
9) Turn unit off after each use.

7.0 Forms

Turbidity data are maintained on the station field form. They are data and should be treated as such. Therefore, they should be written, legible, and complete. To avoid confusion and loss of data, a new sheet should be used at each new project site. Field notes should be initialed and dated by the collecting personnel and data entry personnel. For guidance on proper procedure to complete the field notes, refer to your supervisor and or FTE. Field notes can be found at S:\Monitoring\STREAMS\forms\Field Notes.doc.

8.0 Data Storage

All completed paper copies of forms and data sheets should be maintained with the appropriate station notebook. The data from the field notes and laboratory data sheets should be either entered into or uploaded to the Water Quality Database. Each sample should be maintained electronically in the database under a unique sample number.

9.0 References

Hach Company. 2100P Turbidometer Manual. Loveland, CO.