

# Turbidity

## INTRODUCTION

Turbidity is a measure of water's lack of clarity. Water with high turbidity is cloudy, while water with low turbidity is clear. The cloudiness is produced by light reflecting off of particles in the water; therefore, the more particles in the water, the higher the turbidity.

Many factors can contribute to the turbidity of water. An increase in stream flow due to heavy rains or a decrease in stream-bank vegetation can speed up the process of soil erosion. This will add suspended particles, such as clay and silt, to the water.

Runoff of various types contains suspended solids that may add to the turbidity of a stream.

Agricultural runoff often contains suspended soil particles. Other types of runoff include industrial wastes, water treatment plant effluent, and urban runoff from parking lots, roads, and rooftops.

Bottom-dwelling aquatic organisms, such as catfish, can contribute to the turbidity of the water by stirring up the sediment that has built up on the bottom of the stream. Organic matter such as plankton or decaying plant and animal matter that is suspended in the water can also increase the turbidity in a stream.

### Sources of Turbidity

- Soil erosion
  - silt
  - clay
- Urban runoff
  - road grime
  - rooftops
  - parking lots
- Industrial waste
  - sewage treatment effluent
  - particulates
- Abundant bottom-dwellers
  - stirring up sediments
- Organics
  - microorganisms
  - decaying plants and animals
  - gasoline or oil from roads

### Effects of Turbidity

- Reduces water clarity
- Aesthetically displeasing
- Decreases photosynthetic rate
- Increases water temperature

High turbidity will decrease the amount of sunlight able to penetrate the water, thereby decreasing the photosynthetic rate. Reduced clarity also makes the water less aesthetically pleasing. While this may not be harmful directly, it is certainly undesirable for many water uses.

When the water is cloudy, sunlight will warm it more efficiently. This occurs because the suspended

particles in the water absorb the sunlight, warming the surrounding water. This can lead to other problems associated with increased temperature levels.

While highly turbid water can be detrimental to an aquatic ecosystem, it is not correct to assume that clear water is always healthy. Slightly turbid water can be perfectly healthy, while clear water could contain unseen toxins or unhealthy levels of nutrients.

## Expected Levels

Turbidity is measured in *Nephelometric Turbidity Units*, NTU. According to the USGS, the turbidity of surface water is usually between 1 NTU and 50 NTU. Turbidity is often higher than this, however, especially after heavy rain when water levels are high. Turbidity can be lower than expected in still water because of the settling of suspended particles that might occur. The turbidity of some selected rivers are shown in Table 1. Water is visibly turbid at levels above 5 NTU. The standard for drinking water is 0.5 NTU to 1.0 NTU.

Table 1: Turbidity Levels in Selected Rivers	
Site	Turbidity (NTU)
Sacramento River, Keswick, CA	4
Hudson River, Poughkeepsie, NY	15
Mississippi River, Memphis, TN	39
Rio Grande, El Paso, TX	80
Colorado River, CO-UT state line	180

## Summary of Method

Turbidity is measured using a Vernier Turbidity Sensor. A cuvette of sample water is placed in the Turbidity Sensor and the value in NTU is read directly from the computer. Measurements can be made on site or in the lab at a later time.

## TURBIDITY

### Materials Checklist

- |                                       |   |
|---------------------------------------|---|
| ___ computer                          | ___ Turbidity Standard (StableCal <sup>®</sup> Formazin Standard 100 NTU) |
| ___ Vernier computer interface        | ___ Turbidity Cuvette   |
| ___ Logger <i>Pro</i>                 | ___ soft, lint-free cloth or tissue                                       |
| ___ Vernier Turbidity Sensor          | ___ sampling bottle with lid  |
| ___ water bottle with distilled water |   |


### Collection and Storage of Samples


1. This test can be conducted on site or in the lab. Obtain the sample in a bottle that has a lid to allow for gentle mixing just prior to testing. Approximately 100 mL of water is required.
2. It is important to obtain the water sample from below the surface of the water and as far away from the shore as is safe. If suitable areas of the stream appear to be unreachable, samplers consisting of a rod and container can be constructed for collection. Refer to page Intro-4 of the Introduction for more details.
3. Stand upstream from any activity that could stir up sediment and affect your readings. Hold the sample bottle upstream from your body.
4. If the testing cannot be conducted within a few hours, place the sample in an ice chest or a refrigerator.

### Testing Procedure





1. Position the computer safely away from the water. Keep water away from the computer at all times.
2. Plug the Turbidity Sensor into Channel 1 of the Vernier interface. **Important:** Let the Turbidity Sensor warm up for two minutes before proceeding to the next step.
3. Prepare the computer for data collection by opening the file “03 Turbidity” from the *Water Quality with Vernier* folder of Logger*Pro*.
4. You are now ready to calibrate the Turbidity Sensor.

#### First Calibration Point

- a. Choose Calibrate ► CH1: Turbidity (NTU) from the Experiment menu and then click .
- b. Prepare a *blank* by rinsing the glass turbidity cuvette with distilled water, then filling it with distilled water so that the bottom of the meniscus is even with the top of the white line. Place the lid on the cuvette. Gently wipe the outside with a soft, lint-free cloth or tissue.
- c. Check the cuvette for air bubbles. If air bubbles are present, gently tap the bottom of the cuvette on a hard surface to dislodge them.

- d. Holding the cuvette by the lid, place it in the Turbidity Sensor. Make sure that the mark on the cuvette is aligned with the mark on the Turbidity Sensor. Close the lid.
- e. Type **0** (the value in NTU) in the edit box.
- f. When the displayed voltage reading for Reading 1 stabilizes, click .
- g. Remove the cuvette and set aside for use in Step 5.

#### Second Calibration Point

- h. Obtain the cuvette containing the Turbidity Standard (100 NTU) and gently invert it four times to mix in any particles that may have settled to the bottom. **Important:** Do not shake the standard. Shaking will introduce tiny air bubbles that will affect turbidity.
  - i. Wipe the outside with a soft, lint-free cloth or tissue.
  - j. Holding the standard by the lid, place it in the Turbidity Sensor. Make sure that the mark on the cuvette is aligned with the mark on the Turbidity Sensor. Close the lid.
  - k. Type the **100** (the value in NTU) in the edit box.
  - l. When the displayed voltage reading for Reading 2 stabilizes, click , then click .
5. You are now ready to collect turbidity data.
    - a. Gently invert the sample water to mix in any particles that may have settled to the bottom. **Important:** Do not shake the sample. Shaking will introduce tiny air bubbles that will affect turbidity.
    - b. Empty the water from the cuvette used in Step 4.
    - c. Rinse the cuvette with sample water, then fill it with sample water so that the bottom of the meniscus is even with the top of the white line. Place the lid on the cuvette. Gently wipe the outside with a soft, lint-free cloth or tissue.
    - d. Check the cuvette for air bubbles. If air bubbles are present, gently tap the bottom of the cuvette on a hard surface to dislodge them.
    - e. Holding the cuvette by the lid, place it into the Turbidity Sensor. Make sure it is in the same orientation in the cuvette slot that it was before. Close the lid of the Turbidity Sensor.
    - f. Click  to begin data collection.
    - g. Click  to begin a 10 s sampling run. Keep the lid closed for the next 10 seconds. **Note:** Particles in the water will settle over time and show a slow downward drift in turbidity readings. Therefore, start data collection soon after placing the cuvette in the sensor.
    - h. When the sampling run is complete, stop data collection and record the average temperature on the Data & Calculations sheet.
  6. Return to Step 5 to obtain a second reading. When both readings have been taken, rinse the cuvette with distilled water.

## DATA & CALCULATIONS

### Turbidity

Stream or lake: \_\_\_\_\_

Time of day: \_\_\_\_\_

Site name: \_\_\_\_\_

Student name: \_\_\_\_\_

Site number: \_\_\_\_\_

Student name: \_\_\_\_\_

Date: \_\_\_\_\_

Student name: \_\_\_\_\_

Column	A
Reading	Turbidity (NTU)
1	
2	
Average Turbidity (NTU)	

Column Procedure:

A. Record turbidity as read from the computer.

Field Observations (e.g., weather, geography, vegetation along stream) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Test Completed: \_\_\_\_\_ Date: \_\_\_\_\_

# Vernier Lab Safety Instructions Disclaimer

**THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.**

**This copy does not include:**

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Water Quality with Vernier* lab manual includes 16 water quality tests and essential teacher information. The full lab book is available for purchase at:

<http://www.vernier.com/cmat/wqv.html>



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