CWMN

Citizen Water Monitoring Network:
Restoring a Swimmable Neponset River

Water Monitoring and Sampling Manual

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Table of Contents

INTRODUCTION ***4***
Purpose and Scope 4
NepRWA Background 4
CWMN Background 4
The Importance of Standardized Procedures 5

CHAPTER 1 ..... ***6***

Water Quality Parameters ***6***

Biological Parameters **6**
E. coli, Total and Fecal Coliform, and Enterococcus Bacteria 6
Chlorophyll a 6

Chemical Parameters **7**
Specific Conductance and Salinity 7
Dissolved Oxygen 7
Nitrogen 8
pH 8
Phosphorus 8
Optical Brighteners 9
Surfactants 9

Physical Properties **10**
Stream Depth and Stream Velocity 10
Temperature 10
Total Suspended Solids 10
Turbidity, Color and Odor 11

CHAPTER 2 ..... ***12***

EQUIPMENT ***12***
Basic Sampling Kit 12
Sample Bottles and Replenishing of Supplies 13

CHAPTER 3 ..... ***14***

SAFETY PROCEDURES ***14***
Reporting an Emergency 14
Non-Emergency Problems 14
Automobiles and Roadways 14
Bridges 14
Wading 14
Weather Conditions 15
Pollution Hazards 15

CHAPTER 4 ..... ***16***

Record Keeping ***16***
CWMN Data Sheet 16
Sample Labels 16

CHAPTER 5 ..... ***18***

Before Sampling Day ***18***
One Week Before 18
The Night Before 18

CHAPTER 6 ..... ***19***

General Procedures ***19***

for Sampling Day ***19***
Before Leaving the House on Sampling Morning 19

CHAPTER 7 ..... ***21***

Procedures for Drawing Water ***21***
A Visual Field Guide to Sample Bottles 22
Drawing Water from a Bridge Using the Bridge Buddy 24
Drawing Water from a Boat 26
Drawing Water While Wading 27
Drawing Water with a Sampling Pole 28
Drawing Water at a Pipe 29

CHAPTER 8 ..... ***30***

Other Detailed Procedures ***30***
Measuring Air Temperature 30
Measuring pH 30
Measuring Water Temperature 30
Measuring Stream Depth from a Bridge or Boat 31
Estimating Stream Velocity 31

Chapter 9 ..... ***34***

At the Drop-off Center ***34***
Drop-off Center Procedure 34

CHAPTER 10 ..... ***36***

REFERENCES ***36***

INTRODUCTION

Purpose and Scope

This document describes the procedures and methods that will be used to obtain and analyze water quality samples during regularly scheduled or "routine" operation of the Neponset River Watershed Association's (NepRWA's) Citizen's Water Monitoring Network (CWMN) program. Additional procedures may apply to selected follow-up and special study sampling activities.

NepRWA Background

The Neponset River Watershed Association or "NepRWA" is a private nonprofit conservation group founded in 1967 and made up of citizens, local officials and local business people. NepRWA works to protect and restore the natural resources of the Neponset River and its watershed for the use and enjoyment of present and future generations.

NepRWA conducts water quality testing and other kinds of environmental monitoring as important tools in the effort to clean up pollution sources, restore fisheries and aquatic life, protect the public health and encourage public enjoyment of the river. Much of this work is carried out by a dedicated corps of volunteers.

CWMN Background

The Citizen Water Monitoring Network or "CWMN" is NepRWA's volunteer based water quality monitoring program. The CWMN program collects water quality data on the river and its tributaries. This data is used to determine the overall quality of the river system, to locate and prioritize water quality "hot spots," to design water quality improvement projects, and to evaluate the effectiveness of past water quality restoration efforts. The program brings together a wide array of resources from volunteers, the private sector, local state and federal agencies and donors in pursuit of these goals.

At each CWMN site, volunteers record observational data and field measurements. In addition, volunteers collect water samples and deliver them to one of several drop-off sites. From there, samples are transmitted to the NepRWA headquarters for processing and then on to various laboratories for analysis.

In addition to regularly scheduled or "routine" monitoring, the CWMN program from time to time conducts a variety of "follow-up" or "special study" monitoring activities. Such projects provide additional information on particular areas on interest and are initiated as need and resources arise.

The data generated by the CWMN program are reported back to the volunteers and to the Federal Environmental Protection Agency (EPA), the Massachusetts Department of Environmental Protection (Mass DEP), local municipalities and other interested parties. CWMN data is also made available to the general public via the Association's web site.

The Importance of Standardized Procedures

NepRWA has worked with the EPA, Mass DEP, the Massachusetts Water Resources Authority (MWRA) and others to develop this manual in order to describe protocols and procedures that will provide meaningful and repeatable data. By having all participants in the CWMN program follow standardized procedures, stakeholders of all kinds are assured of the consistent quality of data gathered by the CWMN program.

The procedures and protocols described in this manual represent standard operating procedures or "SOPs" currently accepted in the field of environmental science.

Government and private sector decision makers rely on the data gathered by the Citizens Water Monitoring Network. The procedures spelled out in this manual are based on accepted standard procedures and have been carefully designed to ensure the quality, consistency and reliability of all CWMN data irrespective of who happens to be gathering the data.

Sampling according to the procedures described below is critical to the success of the CWMN program.

CHAPTER 1

Water Quality Parameters

This chapter provides a general overview of the water quality characteristics or "parameters" that are monitored by the CWMN program, including a description of each parameter, its importance to watershed health, and where and how samples are analyzed for these parameters.

The following parameters have been chosen for measurement within the CWMN program because individually they may provide an indication of a specific problem at a sampling site, and taken in combination with other characteristics, as well as considering data from other sites, the information provides an estimation of water quality within the watershed as a whole. Note that not all parameters are necessarily monitored at all sites.

Biological Parameters

E. coli, Total and Fecal Coliform, and Enterococcus Bacteria

Fecal coliform, E. coli and Enterococcus bacteria are bacteria that live in the intestinal tracts of animals and humans. High levels of these types of bacteria may indicate contamination from human or animal wastes, and the potential presence of other disease-causing bacteria and viruses. High bacteria levels render rivers and streams unsafe for swimming, boating, drinking or shell fishing.

The freshwater Neponset and its freshwater tributaries are designated as "Class B waters" under the Massachusetts Surface Water Quality Standards, and as such should have no more than 126 colony forming units or "CFU" of *E.coli* bacteria per 100 ml of water sample when taking the geometric mean of samples taken within the last six months. Alternatively no single sample should exceed 235 colonies per100mL.

In salt water environments such as the Neponset Estuary, the preferred bacterial indicator is Enterococcus. For Enterococcus, the geometric mean of samples taken within the last six months should not exceed 33 colonies per 100mL and no single sample should exceed 61 colonies per 100mL.

Analysis for these parameters is completed in the lab.

Chlorophyll a

Chlorophyll is the pigment that allows plants—including algae—to convert sunlight into organic compounds in the process of photosynthesis. Chlorophyll *a* is the predominant type found in algae and cyanobacteria (blue-green algae), and its abundance is a good indicator of the amount of algae present in natural waters.

Excessive quantities of chlorophyll *a* can indicate the presence of algae blooms. These usually consist of a single species of algae, typically a species undesirable for fish and other predators to consume. Unconsumed algae sink to the bottom and decay, using up the oxygen required by other plants and benthic organisms to survive. The presence of too many nutrients, such as nitrogen and phosphorus, can stimulate algal blooms and can result in reduced dissolved oxygen and water clarity.

Chlorophyll *a* also plays a direct role in reducing the amount of light available to plants in shallow-water habitats. This directly impacts the ability of underwater bay grasses to thrive. Like their terrestrial cousins, grasses need sunlight to grow. As chlorophyll *a* levels increase, the amount of sunlight reaching underwater grasses declines.

Chemical Parameters

Specific Conductance and Salinity

Specific Conductance is a measure of the ability of water to pass an electrical current at a standardized temperature (usually 25°C). Specific Conductance in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate and the like which can increase due to excessive road salt among other causes. The basic unit of measurement for specific conductance is the mho or siemen, and is measured in micromhos per centimeter (μmhos/cm). Salinity can be derived through the measurement of specific conductance.

The Massachusetts Surface Water Quality standards currently provide no numeric regulatory standards for specific conductance; however the specific conductance of rivers in the United States generally ranges from 50 to 1500 μmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 μmhos/cm. Specific Conductance outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.

Samples for specific conductance are analyzed in the lab with a conductivity meter.

Dissolved Oxygen

Dissolved Oxygen or "DO" is a measure of the amount of oxygen dissolved in the water. DO is measured both as a concentration (mg/l) and as a function of water temperature in terms of percent saturation.

While the concentration of atmospheric oxygen that humans depend on is relatively constant, levels of oxygen that fish and other aquatic organisms depend on in the water can vary widely. Any pollution that directly or indirectly encourages decomposition such as sewage or nutrients will tend to lower DO levels.

The Massachusetts Surface Water Quality Standards require minimum DO levels of 5.0 mg/l and between 60% and 100% saturation in streams designated as warm water fisheries. In streams designated as cold water fisheries, higher limits of 6 mg/l and 75% saturation apply. While no streams in the Neponset are currently designated as cold water fisheries under the Mass Surface Water Quality Standards, several Neponset streams do support populations of cold water fish and as such the stricter standards should apply.

A separate team of volunteers will measure this parameter in the field during regular sampling events using a dissolved oxygen meter.

Nitrogen

Nitrogen is a critical plant nutrient and is the primary ingredient in landscape fertilizers. Most of the nitrogen in the environment is in gaseous form and makes up 80% of our air. Nitrogen is found in aquatic systems in several different chemical forms, including: nitrates (NO_3), nitrites (NO_2) and ammonia (NH_3). Nitrogen in aquatic systems is constantly being converted among the various chemical forms and even exchanged with the atmosphere through a complex process known as "nitrification."

Excessive levels of nitrogen in the water encourage algae blooms and eutrophication, especially in salt water environments such as the Estuary. Certain critical coastal aquatic plants such as eelgrass are very sensitive to nitrogen levels. Nitrogen is usually not a problem in freshwater streams and ponds where phosphorus is the "limiting nutrient."

Nitrogen enters rivers and streams from the air, from soil, animal wastes, and decomposing plants. The major human sources are sewage, fertilizers, and animal waste. The Massachusetts Surface Water Quality standards currently provide no numeric regulatory standards for nitrogen levels, however research generally indicates that 1 mg/L total nitrogen is a cautionary level.

The CWMN program has monitored three different indicators of nitrogen: total nitrogen, ammonia and nitrate plus nitrite. Total Nitrogen is the total of all forms of nitrogen found in the water. Nitrate is a subset of total nitrogen and is the form take up directly by plants. Nitrite is also a subset of total nitrogen and is a form rapidly converted to nitrate. Ammonia is yet another form of nitrogen, which is also readily converted for plant use and which, as a breakdown product of urine, is always present in sewage. Due to budget cuts, and research that indicates a low relative importance of nitrogen on water quality in the Neponset, testing will be limited to testing Total Nitrogen at a few sites near the Estuary. A select group of sites will also be tested for ammonia.

Analysis for this parameter is completed in the lab.

pH

pH is a measure of the acidity of water. pH is important since water that is too acidic or too basic can be toxic to fish and other aquatic life. pH also plays an important role in how other pollutants such as heavy metals behave in the environment. High or low pH levels can be the result of acid rain/snow, chemicals getting into the waterways, or certain natural conditions. pH is measured on a scale from 1 to 14, with 1 being very acidic, 7 being neutral and 14 being very basic. Under the Massachusetts Surface Water Quality Standards, the Neponset and its tributaries should have pH levels between 6.0 and 8.3.

in some cases, this parameter will be measured in the field using a hand-held pH meter, in other cases, volunteers will collect water samples for analysis at the lab.

Phosphorus

Phosphorous is another critical plant nutrient and is included in landscape fertilizers to promote root growth. Phosphorus also takes several chemical forms, and is usually measured as ortho-phosphate and total phosphate. Given sufficient levels of nitrogen, excessive levels of phosphorous in aquatic systems can lead to algal blooms, excessive weed growth, eutrophication, reduced oxygen levels and unwholesome odors. The reduced oxygen levels caused by eutrophication can cause fish kills. Phosphorous is primarily a concern in freshwater systems where it is the limiting nutrient and is generally not a problem in salt water systems.

Phosphorus enters rivers and streams through many sources: animal wastes, human wastes, fertilizer, detergents, erosion and storm runoff. Because of pollution impacts, phosphates have been banned from clothes washing detergents in Massachusetts, however dishwashing detergents remain one of the largest and most easily preventable sources of phosphorus finding its way into rivers.

The Massachusetts Surface Water Quality standards currently provide no numeric regulatory standards for phosphorous levels, however research generally indicates that orthophosphate levels as low as 0.01 mg/L (part per million) can be problematic

The CWMN program generally monitors for two different indicators of phosphorous: total Phosphorous and Orthophosphate. As the name implies, total phosphorous is a measure of the total amount of phosphorous in all its various chemical forms. Orthophosphate is the soluble inorganic form of phosphorous and is the form which is directly available for uptake by plants. Because orthophosphate in aquatic systems is taken up by plants almost instantly, orthophosphate levels are generally quite low.

Analysis for this parameter is completed in the lab.

Optical Brighteners

Optical brighteners are a class of chemicals that are commonly added to laundry detergents and a variety of other products to make white colors appear brighter. Like surfactants, optical brighteners can be used to help distinguish between sewage related bacterial pollution (which generally also includes detergent waste) and animal or stormwater related sources of bacterial pollution.

There are no standards for acceptable levels of optical brighteners under the Massachusetts Surface Water Quality Standards. Tests for optical brighteners do not indicate a specific quantity of the chemicals, just the presence or absence of the chemicals.

Optical brighteners are not routinely collected as part of the CWMN program and are only used as needed to follow up on suspected problem areas. As such, detailed procedures for their collection are not presented in this manual. Optical Brighteners are tested by placing an absorbent wad of untreated cotton in a stream or storm drain for a period of 3 to 10 days. If optical brighteners are present in the water, they will attach to the cotton and can be detected by examining the cotton under a UV light. The particular advantage of testing for optical brighteners is that the long duration of the test has an increased probability of detecting intermittent sewer problems which are less likely to be detected by an instantaneous grab sample.

Surfactants

Surfactants are ingredients in detergents. Surfactants can be used to help distinguish between sewage related bacterial pollution (which generally also includes detergent waste) and animal or stormwater related sources of bacterial pollution.

There are no standards for acceptable levels of surfactants under the Massachusetts Surface Water Quality Standards. However, as there are no natural sources of these compounds, the presence of them in rivers and streams may indicate the presence of illicit discharges or the need for Best Management Practices to control runoff.

Surfactants are not routinely collected as part of the CWMN program and are only used as needed to follow up on suspected problem areas. As such, detailed procedures for their collection are not presented in this manual. Surfactants can be estimated using field test kits or can be precisely quantified using laboratory methods.

Physical Properties

Stream Depth and Stream Velocity

Stream depth and stream velocity indicate the amount of water in a stream. Taken together they help provide a picture of the overall condition of the stream during each CWMN event. Depth is measured in inches and feet. Stream velocity is measured in feet per second. Using detailed measurements of stream depth, stream width and stream velocity, one can compute stream discharge or the total volume of water passing through a stream at a given moment. Stream discharge is generally expressed in "millions of gallons per day" or "cubic feet per second."

Stream depth and stream velocity are critical characteristics of aquatic habitats. Many fish and other aquatic life forms are adapted to survive in a particular depth/velocity combination. For example pond fish like largemouth bass are adapted to deep slow moving water while river fish like brook trout are adapted to shallower faster moving water. Stream discharge is also an important factor influencing water quality. Adequate volumes of water help dilute pollutants and reduced stream discharge often results in warmer water with lower dissolved oxygen levels.

Because depth and velocity are so varied there are no simple rules of thumb for the "right" depth and velocity for a stream. CWMN volunteers take rough estimates of stream depth and stream velocity in the field using a depth line or staff gage, along with a float and timer.

Temperature

Water temperature may not seem like "pollution," but it is critical for rivers and streams to remain relatively cool, in order for fish and other aquatic life to survive. As water temperature increases, dissolved oxygen decreases, and a variety of chemical and biological processes in streams begin to change.

Water temperatures can be artificially elevated for a variety of reasons. These include shallow ponding from the construction of dams, the elimination of shade trees along river banks, discharges of industrial cooling water, storm water running off hot pavement, or when cool water from underground aquifers is diverted from the stream by nearby wells. Under the Clean Water Act, streams designated as warm water fisheries should have temperatures of less than 28.3 degrees Celsius. Cold water fisheries should have temperatures of 20 degrees Celsius or less. While no streams in the Neponset are currently designated as cold water fisheries under the Mass Surface Water Quality Standards, several Neponset streams do support populations of cold water fish and as such the stricter standards should apply.

This parameter is measured with a thermometer by volunteers in the field

Total Suspended Solids

Total Suspended Solids or "TSS" is a measure of the amount of dust dirt, sand and other particles stirred up in the water. TSS is measured in mg/l.

Excessive amounts of suspended solids can cause increased turbidity (cloudiness) and reduced light penetration is streams and ponds. Many fish and other forms of aquatic life require rocky or gravelly stream bottoms for spawning and survival. Excess suspended solids can settle out of the water (a process called "sedimentation"), burying fish spawning areas and aquatic plants. Sedimentation can make rivers and streams unpleasant for recreation and can, over time, cause the build up of sediment to such a degree that the carrying capacity of the stream is reduced, thereby contributing to flooding problems. In addition, other pollutants such as oil, heavy metals and nutrients are frequently attached to suspended solids. Thus, TSS can sometimes give a very rough indication of where there might be problems with these other pollutants.

Suspended solids enter streams primarily through erosion. This can include erosion of the stream banks themselves, especially where development activities have increased peak stream discharge and velocities. Other sources of suspended solids include erosion from poorly controlled construction site activities, dumping of leaves and debris into streams and runoff of sand from roadways.

TSS problems tend to be short lived but drastic, occurring only when rainfall is sufficiently intense to generate erosion. As a result it is fairly unusual to capture water samples that reflect worst case TSS levels. The Massachusetts Surface Water Quality Standards currently provide no numeric regulatory standards for TSS levels. However, research indicates that TSS should generally be less than 25 mg/L during wet weather and should be minimal during dry weather.

Analysis for this parameter is performed in the lab, but due to budget cuts, regular analysis for total suspended solids will not be performed.

Turbidity, Color and Odor

Turbidity is a measure of how cloudy the water is or more specifically, the ability of the water to pass light. Color is a measure of the wavelengths of light reflected by the water as separate and distinct from the cloudiness of the water. Odor is self explanatory.

Color, odor and turbidity can provide important data about the health of a stream. Unusual colors, odors or turbidity or any marked changes in any of these parameters over time may be indicative of a wide variety of potential problems with a stream.

Observations for these parameters are taken directly by volunteers in the field using their own senses, with information recorded on the data sheet according to three different descriptive scales.

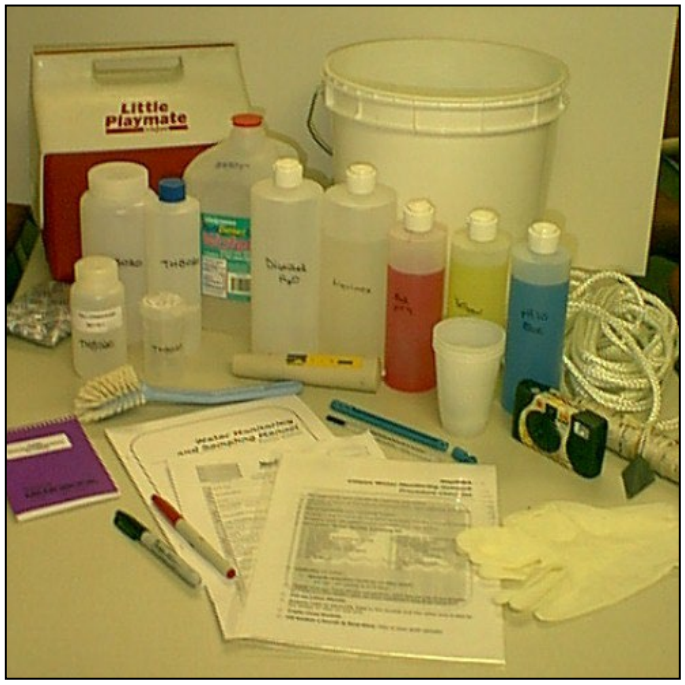
CHAPTER 2

EQUIPMENT

Basic Sampling Kit

Each regular (non-DO) CWMN volunteer or volunteer team is issued the following kit of equipment at their initial training (note that not every volunteer will necessarily be issued this entire kit):

1 thermometer
1 liter distilled water
1 bottle Liquinox detergent (if applicable)
1 bridge buddy, waders and PFD (if applicable)
1 rope (if applicable)
1 sampling pole (if applicable)
1 scrub brush
1 depth line w/ attached weight
1 yard stick or half yard stick
2+ latex gloves
1 black "Sharpie" marker
1 pencil
1 procedure checklist
1+ data sheet(s)
1 cooler (provided by volunteer)
1 set clean sample bottles



Sample Bottles and Replenishing of Supplies

Clean sample bottles are "used up" during each round of sampling and other supplies such no-phosphate detergent, distilled water and the like may be consumed over time. On sampling day when volunteers drop off their filled sample bottles at the drop-off center, a new set of clean bottles will be waiting for the volunteer to take home for use during the next sampling event. Periodically, all volunteers will be asked to collect "duplicate" samples as a quality control measure. When a volunteer is scheduled for duplicates at the next sampling event, two sets of clean sample bottles will be waiting at the drop off center.

In addition a crate of other consumable supplies will also be waiting at the drop-off center, and volunteers should check their inventory of supplies and replenish their stocks as needed before leaving. Finally, volunteers will find backup equipment such as thermometers and pH meters available at the drop off center which can be exchanged for any malfunctioning units.

In the event that a volunteer finds themselves without needed supplies, they can always contact the NepRWA office and arrange to pick up whatever they might need before the next sampling event.

CHAPTER 3

SAFETY PROCEDURES

NepRWA volunteer and staff safety is the CWMN program's top priority. The following safety procedures have been developed to ensure the safety of everyone who participates in the CWMN program. However, common sense is the most important safety tool: under no circumstances should anyone put themselves in harm's way, to complete the sampling.

Reporting an Emergency

In case of an *emergency* while monitoring, volunteers should call 911 from any location. All towns in the watershed have "enhanced 911" service. Only after calling 911 should they call the NepRWA office at 781-575-0354.

Non-Emergency Problems

Non-emergency problems should be reported to NepRWA at 781-575-0354. A volunteer staffs the NepRWA office from 6 AM on sampling days. That person will contact others to answer questions or possibly cover a site at the last minute.

Automobiles and Roadways

Many sites are located on busy roadways, which are not commonly used by pedestrians. Your presence may be a surprise to motorists. Please observe the following precautions:

- Wear high-visibility clothing.
- Warn approaching traffic of your presence by parking your car nearby on the same side of the street.
- Use extreme caution when crossing the street.

Bridges

Most CWMN sites are located at bridges. Always use extreme caution at the edge of a bridge.

- Test railings before leaning against them.
- Never climb or sit on railings.

Wading

Wading is necessary at a few CWMN sites.

- If a site calls for wading consult with a NepRWA staff member to see if it might be possible to sample using a pole instead.
- Do not wade alone!
- Only wade when the water is less than knee-deep and not fast moving.
- Waders and life jackets are required for wading.

Weather Conditions

The CWMN program requires that volunteers be outside during cold and/or rainy conditions. Monitors should expect to be at their site for up to 45 minutes and should dress appropriately. If there is lightning in the area, stay out of contact with the water, avoid contact with metal on bridges and stay away from all tall trees.

Pollution Hazards

While most of the Neponset River and its tributaries are now swimmable during dry weather, some CWMN sampling locations are known to be seriously polluted. Volunteers should presume that most CWMN sampling locations are significantly polluted during heavy rain.

- Be aware of the degree of probable pollution associated with your site.
- Wear the disposable latex gloves in your sampling kit (they help protect you and the sample!)
- Avoid putting hands or wet clothing in your mouth.
- Never hold pens, pencils or other sampling equipment in your mouth (even though it would be helpful to have a third hand!)
- Carry disinfectant self-drying hand-washing soap available at pharmacies.
- Avoid eating until after you have washed your hands.

CHAPTER 4

Record Keeping

It is critical to keep meticulous records of observations and sample information. All information is recorded in either ballpoint pen or pencil (which works better on wet paper). Never erase what you think may be a mistake. Instead cross it out neatly with a single line, and write the correct entry next to or above it.

It is especially important to keep notes if for any reason a volunteer needs to deviate from the procedures laid out in this manual.

CWMN Data Sheet

This data sheet is filled out at the time of sampling and is handed off with samples at the drop-off center. The information on the data sheet should match the information found in the field notebook.

There are five sections that should be filled out on this sheet which correspond to the five steps in the sampling process: General Info, Weather, Laboratory, Physical, and Flow. See the figure below for a sample of this form.

Sample Labels

Your sampling bottles will come pre marked with your station number in indelible marker. Before you fill your bottles please double check each of the bottles to ensure that they are marked with the correct station number.

WATER QUALITY FIELD DATA SHEET - 2017 VERSION
Citizen Water Monitoring Network (CWMN)

neponset river WATERSHED ASSOCIATION

MONITOR NAME: _____

DATE: _____

ARRIVAL TIME: _____

END TIME: _____

For Office Use Only
Sediment: ☐ None | ☐ Light | ☐ Heavy

Site Information & Current Weather Conditions

SITE ID AND DESCRIPTION: _____

WEATHER: ☐ Clear | ☐ Partly Cloudy | ☐ Overcast | ☐ Drizzle | ☐ Rain | ☐ Snow | ☐ Other: _____

IS NEARBY PAVEMENT WET? ☐ Yes | ☐ No

Sampling Information

SAMPLING METHOD: ☐ Bridge Buddy | ☐ Direct Fill | ☐ Pole

SAMPLING FROM: ☐ Bridge (Upstream Side) | ☐ Bridge (Downstream Side) | ☐ Stream Side | ☐ Pond

ARE DUPLICATES BEING TAKEN? ☐ Yes | ☐ No

Sampling Order	Bottle Description	Time Taken
1 - Bacteria	Smallest, sterile bottle (250 mL)	
2 – Nutrients	Largest bottle (1 L)	
3 – pH	Medium "fill me" bottle (500 mL)	

WERE SAMPLES ICED IMMEDIATELY? ☐ Yes | ☐ No

Physical Properties of Water

THERMOMETER NUMBER: _____

AIR TEMPERATURE (CELSIUS): _____ | **WATER TEMPERATURE (CELSIUS):** _____

WATER CLARITY: ☐ Clear | ☐ Clear with Suspended Particles | ☐ Slightly Cloudy | ☐ Cloudy | ☐ Other: _____

WATER COLOR: ☐ Clear | ☐ "Weak Tea" | ☐ "Strong Tea" | ☐ Greenish | ☐ Blackish | ☐ Other: _____

WATER ODOR: ☐ None | ☐ Earthy | ☐ Rotten Eggs | ☐ Petroleum/Asphalt | ☐ Other: _____

Depth and Velocity Data

DEPTH (INCHES): _____

STAFF GAGE HEIGHT (IF APPLICABLE, IN FEET): _____

DISTANCE USED FOR FLOAT TEST (FEET): _____

I CANNOT MEASURE: ☐ Depth | ☐ Flow

TRIAL NUMBER	TIME RECORDED (SECONDS)
1	
2	
3	

Comments and Observations

Does the stream look better, worse, or the same as usual today? Why? _____

_____

_____

Additional Comments on Back? ☐ Yes | ☐ No

CHAPTER 5
Before Sampling Day

One Week Before

Before the sampling event is upon you, review the following:

1. **Know your site location**. Make sure that you have a map or good directions. Know approximately how long it takes to get to the sampling site and the drop off site.
2. **Contact your sampling partner**. Make arrangements to meet and determine who will pick up supplies, who will bring the equipment, who will drop off the samples.
3. **Pick up any needed supplies** such as buffer solutions, gloves, distilled water, Liquinox, etc. These supplies will be available at the drop-off site along with your sample bottles for the next event.
4. **If you are unable to sample**, contact NepRWA (781-575-0354) as soon as you know to allow time to find a replacement. If you do not find out until the morning of sampling that you cannot sample, please call the NepRWA office (781) 575-0354 immediately and leave a message in the CWMN mail box. NepRWA staff will attempt to sample your site at the last minute.

The Night Before

The night before sampling is to take place, take a few moments to prepare.

1. Familiarize yourself with the **directions and procedures**. Know where you will be tomorrow. Review the sampling procedures in the water monitoring and sampling manual.
2. **Assemble all equipment** that will be needed the next morning (sample bottles, thermometer, sampling pole or Bridge Buddy, latex gloves, cooler, sampling forms, field notebook, etc.) and place it in your equipment bag. Always bring extra sampling bottles along in case you drop or contaminate a sample bottle.
3. **Pre-fill information on the data sheet** as much as possible in order to save time in the morning. Place them with your other equipment.
4. **Freeze a bag of ice** or a clean "ice pack." Store it in the freezer overnight.
5. Finally, **notify someone that you plan to go sampling** the next morning.

CHAPTER 6
General Procedures
for Sampling Day

Before Leaving the House on Sampling Morning

1. Pick up your sample bottles, ice packs, and cooler.
2. Pick up your sampling equipment
3. Go to the site.

Overview of What Happens at the Sampling Site

The following provides an overview of what happens at the sampling site. Refer to more detailed descriptions of specific tasks in the sections referenced.

Timing is a very important part of the overall sampling procedures. Water samples must come out of the stream between 6:00 AM and 7:45 AM. Deliver your samples to the drop off center so that you can complete the labeling by 8:00 AM at the latest. The drop off coordinator must leave the center at 8:00 AM. MWRA in Deer Island may refuse to accept samples that arrive in Winthrop after 10:00.

1. **Fill out the general information** section of the data sheet. Remember to enter your SITE ID#, site description and your name.
2. **Complete the weather section** of the data sheet. Be sure to note if there has been any precipitation in the last 48 hours. Measure air temperature with the supplied thermometer.
3. **Draw water from the stream** using the appropriate method and fill the sample bottles. Refer to detailed procedures in Chapter 6 for drawing water from a bridge, boat, wade, pole or pipe.
4. **Fill out the Laboratory section** of the data sheet.
5. **Measure the temperature** of the sample. Record in the Physical section of the data sheet (see chapter 8 for details).
6. **Note the color, turbidity and odor** of the water in the Physical section of the data sheet (see chapter 8 for details).
7. **Measure the stream depth** using the provided depth line or reading the staff gage where available. Record in the Quantity section of the data sheet (see chapter 8 for details).

8. **Estimate the stream velocity** using the "orange peel (or other floating object) test." Record in the Quantity section of the data sheet (see chapter 8 for details).
9. Make sure that the data sheet has been completed.
10. Pack up equipment and take samples to the drop-off center to complete labeling procedures by 8:00 AM (see chapter 9 for the details of what happens at the drop off site).

CHAPTER 7

Procedures for Drawing Water

One of the basic skills which all CWMN volunteers must develop is the ability to fill sample bottles with water in a standardized way that minimizes the possibility that samples will be contaminated.

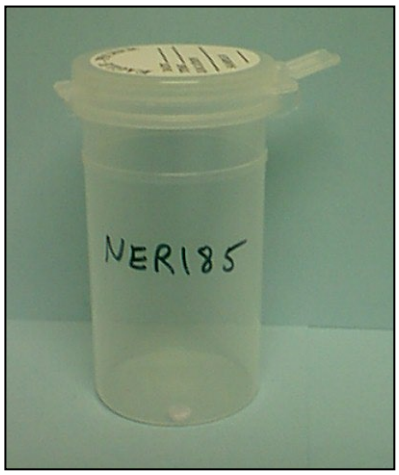
There are five different types of situations where volunteers may have to gather water for a sample: from a bridge, from a boat, wading in the stream, with an extension pole and at an outfall pipe. The procedures for each situation are summarized below.

Irrespective of the situation, there are a few guidelines that always apply:

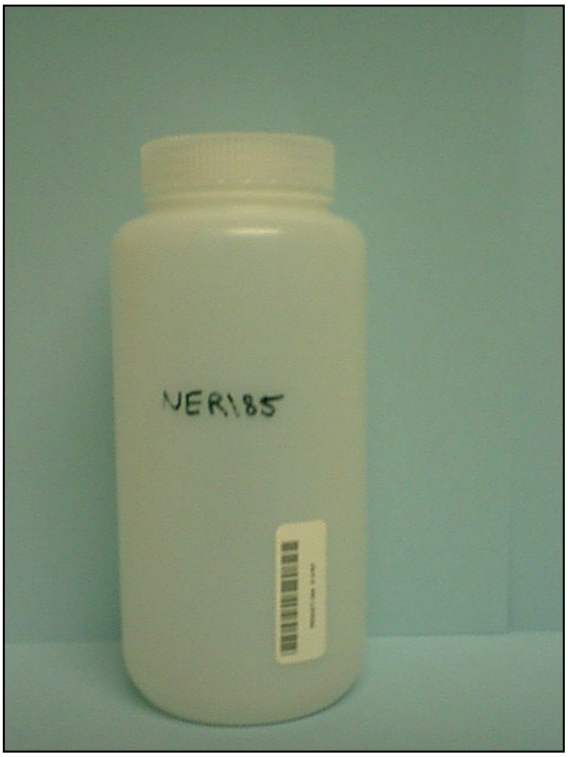
- Always face upstream to fill bottles and ensure that your body is downstream of the container.
- Never put your hands or fingers inside the sample bottle or bottle cap.
- Prevent contamination from getting inside the cap while it is off the bottle by having an assistant hold the caps (no more than two at a time!) or temporarily placing them inside an unused plastic bag.
- Always wear a fresh pair of the disposable gloves provided with your sampling kit. The gloves protect both you and your sample. If sampling more than one site, change gloves between sites.
- Always fill bottles, in order, according to ease of contamination (easiest to contaminate first). Thus fill bacteria, TSS, nutrient and conductivity bottles in that order. See photos of various bottle types at the end of this chapter.
- Except for pH/specific conductance samples, always leave about a ½ inch of empty "headspace" at the top of the bottle before capping it off. If necessary, pour a little off before capping.
- Be careful to avoid touching or bumping the open bottle against any surfaces such as the side of a bridge or pipe.
- When the water in the stream is shallow, be careful not to stir up river-bottom sediment such that it gets into your sample bottle.
- Debris floating on the surface of a sample draw is normal and will not contaminate your sample. If there is excessive debris, try to pour some of it off.
- When taking duplicates, be sure that both bottles for a given parameter (i.e. both bacteria bottles) are filled simultaneously using the "two handed direct fill method," or by placing both bottles in the Bridge Buddy at the same time.

A Visual Field Guide to Sample Bottles

This MWRA bacteria bottle is a sterile, 250 mL wide mouth bottle wrapped in plastic. It should be filled first

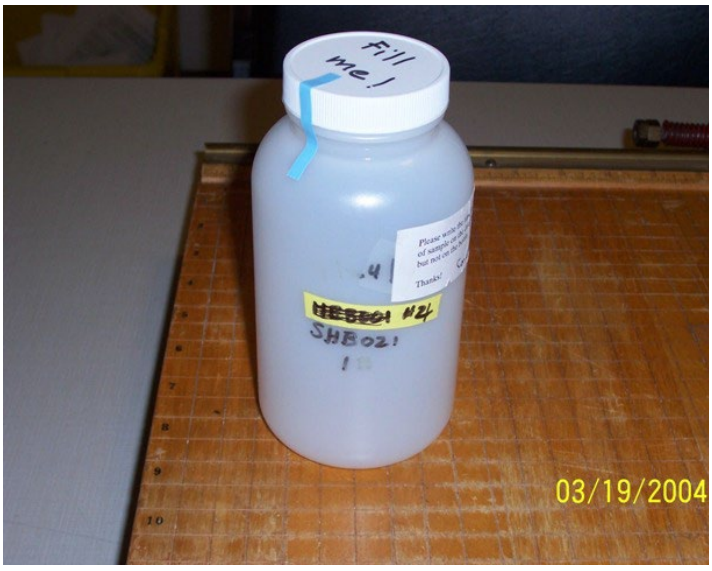


This NepRWA bacteria bottle is a 125 ml bottle with a built in lid. Bacteria bottle should be filled first



The nutrient bottle is a one liter wide mouth bottle. Fill this one third.

The pH bottle is a half-liter wide mouth bottle. Fill this one last.



The chlorophyll bottle is a brown 1 L wide-mouth bottle. It should be filled after the bacteria sample is taken.

Drawing Water from a Bridge Using the Bridge Buddy

When sampling from a bridge, volunteers will use the "Bridge Buddy" to lower sterile (and other) sample bottles to the water. NEVER USE a bucket to collect water for a CWMN sample. The Bridge Buddy is considered a "regulatory" quality sample collection method for all parameters except metals.

1. **Choose your spot.** Position yourself on the downstream side of the bridge and chose a sampling spot in the deepest part of the main flow of the stream.
2. **Don** latex gloves.
3. **Ensure that the rope is securely attached** and stand on the loose end of rope before the casting your Buddy.
4. **Triple rinse the Bridge Buddy.** Click the straps loosely into the buckles and lower the empty (no bottles) Bridge Buddy to the water. Dip it in three times to rinse thoroughly. Pull it back up and stand it upright in a convenient spot.
5. **Load the first set of bottles.** Select the first two samples bottles to be filled. Confirm that the bottles are labeled with the correct sample location. WITHOUT removing the caps, slide the bottles into the Buddy. Position the bottles so that the tops are at the same height and above the wire-rope attachment point (see photo). The bottom of 1L bottles will sit on the crossleg, other bottles will be "suspended in the air." Tighten the ratchet buckles until the bottles are secure but not crushed.
6. **Uncap the bottles.** Unscrew the caps on the loaded bottles and place them in a new, clean plastic bag, or have an assistant hold them facing down. DO NOT touch the inside of the caps!
7. **Lower the buddy and collect sample.** Lift the Bridge Buddy by the rope, being careful NOT to let the rope touch the rims of the bottles. Lower the Buddy to **just above** the water, being careful not to bump into the bridge which might cause debris to fall into the bottle.
8. **Assuming the stream is at least 16" deep,** lower the buddy smoothly into the water so that the mouths of the bottles are 6" to 12" below the surface, being careful NOT to disturb any bottom

sediment. Wait approximately 10 seconds for the bottles to fill (longer for narrow mouth bottles) and bring them back up.

9. **Sampling in shallow water.** In water less than 9" deep, you will need to use the "lay down" sampling technique. Lower the bridge buddy to just above the water surface and position it perpendicular to the stream with the buckles facing downstream. Lower it gently into the stream so that it is standing upright on the bottom with the bottle mouths above the water surface and maintain a slight tension on the rope. Wait at least 5 long seconds for the stream to settle and any bottom sediment to wash downstream. Gently tip the bridge buddy onto its side with the mouths facing in an UPSTREAM direction. The weight of the Bridge Buddy will then pull the bottles below the surface. Maintain slight tension on the rope so that water is drawn in from the surface, without the Bridge buddy "plunking" onto the stream bottom and stirring up sediment. Using this method, the Bridge Buddy can fill most bottles 75% full in as little as 2" to 3" of water. If the water is shallower, or if a larger sample volume is needed, you will need to take two grabs (using the same type of bottle i.e. a sterile second bottle for a sterile bacteria sample) and then combine the two grabs to produce an adequate sample volume.

10. **Bring the Bridge Buddy back up,** being careful not to hit the bridge or let the rope contact the bottle rims. Visually check the water in the sample bottles for contamination with bottom sediment. If bottom sediment is found, dump out the samples, refill the bottles from the river and dump out three times (i.e. triple rinse the sample bottles with river water) then on the fourth time, take a clean sample and proceed to step 11.
11. **Cap and Ice.** Recap the bottles firmly. Release the ratchet straps. Note the sampling time on the data sheet, and place the samples on ice.
12. **Collect more samples.** Collect additional samples as needed, including a final bottle of water to use for the on-site temperature test.
13. **Complete remaining procedures** and field measurements as described in the previous chapter under the heading "Overview of What Happens at the Sampling Site."

14. **Rinse the Bridge Buddy.** Before storing the bridge buddy, give it a rinse with clean tap water. It is especially critical to rinse the buckles off after sampling in salt water.

Drawing Water from a Boat

When sampling from a boat, volunteers will use the direct fill method, reaching out in the upstream direction.

1. **Don** latex gloves.
2. Always **wear a lifejacket** while sampling from a boat and **never sample from a boat alone**!
3. Record the **exact** time the bucket or bottle was pulled on the laboratory section on your data sheet.
4. **Wait until the boat comes to a stop** and begins to drift with the current before collecting.
5. **Determine which side is "upstream."** The upstream side of the boat is the side WITHOUT any eddy currents. Sampling always occurs on the "upstream side."
6. **Use the "direct fill" method** to fill sample bottles **starting with bacteria**. Unscrew the cap of the first bottle, giving the cap to an assistant or placing it inside a clean plastic bag. Grasp the bottle by the bottom and gently plunge it into the water to wrist depth, open mouth down on the "upstream side of the boat. Gently pivot the open mouth of the bottle upward in the upstream direction, holding the open end 3" to 6" below the water surface until the bottle fills.
7. **If collecting duplicates** use the simultaneous "two-handed direct fill method" to collect each pair of duplicates samples at the same time.
8. **Withdraw the bottle** from the water and **pour off a small amount** of water from the bottle to allow for "headspace."
9. **Seal** the bottle tightly and **place it on ice**.
10. **Repeat** steps 6 through 9 for the **nutrient and pH bottles**, in that order.
11. **Complete remaining procedures** and field measurements as described in the previous chapter under the heading "Overview of What Happens at the Sampling Site."

Drawing Water While Wading

When sampling from a wading position, volunteers will use the direct fill method, reaching out in the upstream direction.

1. **Don** latex gloves.
2. **Always wear a lifejacket while wading and never wade alone!**
3. Confirm that the correct site numbers are written on all the bottles. Record the **exact** time the bucket or bottle was pulled on the laboratory section on your data sheet.
4. Move carefully towards the current and **establish solid footing** before filling sample bottles.
5. **Stand still for a few seconds** to allow any stirred up sediment to be carried away by the current.
6. **Use the "direct fill" method** to fill sample bottles, beginning with the **bacteria bottle.** Unscrew the cap of the first bottle, giving the cap to an assistant or placing it inside a clean plastic bag. Grasp the bottle by the bottom and gently plunge it into the water to wrist depth, open mouth down and facing in the upstream direction. Gently pivot the open mouth of the bottle upward in the upstream direction, holding the open end 3" to 6" below the water surface until the bottle fills.
7. **If collecting duplicates** use the simultaneous "two-handed direct fill method" to collect each pair of duplicates samples at the same time.
8. **Withdraw the bottle from the water and pour off a small amount** of water from the bottle to allow for "headspace."
9. **Seal the bottle tightly and place it on ice.**
10. **Repeat** steps 6 through 9 for the **nutrient and pH bottles**, in that order.
11. **Complete remaining procedures** and field measurements as described in the previous chapter under the heading "Overview of What Happens at the Sampling Site."

Drawing Water with a Sampling Pole

When sampling using an extension pole, volunteers will use the direct fill method, reaching out in the upstream direction.

1. **Don** latex gloves.
2. Chose a good position with firm footing, reasonably close to the stream. Extend your pole to the appropriate length and twist the locking collar. Reach out to the water with the pole to confirm that the pole is the right length and readjust if needed.
3. Confirm that the correct site numbers are written on all the bottles. Record the **exact** time the bucket or bottle was pulled on the laboratory section on your data sheet.
4. Beginning with the **bacteria bottle, with the lid still on the bottle** strap it to the fixture on the end of the pole using the provided strap. Once the bottle is securely mounted, unscrew the cap of the first bottle, giving the cap to an assistant or placing it inside a clean plastic bag. Reach out toward the middle of the stream with the pole and dip the bottle in.
5. Pull the pole back, pour off some water is needed to create head space, screw the cap on the bottle tightly and **then** un-strap the bottle from the pole and place the bottle on ice.
6. **If collecting duplicates** attach the duplicate bottle for the same parameter to the pole (i.e. bacteria due right after bacteria sample) and repeat steps 4 and 5, trying to take the duplicate in the same spot in the stream as the original and as quickly as possible after the original.
7. **Repeat** steps 4 through 6 for the **nutrient and pH bottles**, in that order.
8. **Use a spare bottle to take a final grab of water in which to take the water temperature.**
9. **Complete remaining procedures** and field measurements as described in the previous chapter under the heading "Overview of What Happens at the Sampling Site."

Drawing Water at a Pipe

When sampling at a pipe outfall, volunteers will use the direct fill method, facing the bottle mouth into the oncoming pipe flow. Volunteers may approach a pipe by boat, by wading, on foot without wading or on foot using an extension pole. Procedures are similar to those listed above under Sampling from a Boat and Sampling While Wading. However, please bear the following special considerations in mind when sampling from a pipe.

- Bring a partner and wear a lifejacket when sampling at a pipe location.
- Do not climb, crawl or undertake other acrobatic maneuvers to sample at a pipe.
- The water at a pipe may be very dirty. Always wear gloves, and keep your face and body well away from the water. Wash your hands immediately after sampling. Where necessary wear wading gear to protect your legs from splashing.

1. **Don** latex gloves.
2. Confirm that the correct site numbers are written on all the bottles. Record the **exact** time the bucket or bottle was pulled on the laboratory section on your data sheet.
3. **Approach the pipe and establish firm footing.**
4. **Use the "direct fill" method to fill sample bottles**, beginning with the **bacteria bottle.** Unscrew the cap of the first bottle, giving the cap to an assistant or placing it inside a clean plastic bag. Grasp the bottle by the bottom or from the side and gently lower the open mouth of the bottle into the flow of water facing in an upstream direction until the bottle fills. Exercise caution not to contact the pipe surface and not to disturb any sediment in the pipe.
5. **If collecting duplicates** use the simultaneous "two-handed direct fill method" to collect each pair of duplicates samples at the same time.
6. **Withdraw the bottle from the water and pour off a small amount** of water from the bottle to allow for "headspace."
7. **Seal the bottle tightly and place it on ice.**
8. **Repeat** steps 4 through 7 for the **nutrient and pH bottles**, in that order.
9. **Complete remaining procedures** and field measurements as described in the previous chapter under the heading "Overview of What Happens at the Sampling Site."

CHAPTER 8

Other Detailed Procedures

This chapter expands upon the basic sampling instructions provided in chapter 5, providing details of how to complete individual sampling operations and field measurements

Measuring Air Temperature

The most efficient way to measure air temperature is to get out your thermometer as soon as you arrive at the site and find a place where it can be propped up out of the way. Complete the rest of the sampling activity then read and record the air temp just before using the thermometer to take the water temp.

1. **Hold thermometer vertically** in the air, or find a spot where you can lay the thermometer down with the probe end sticking out into the air, not touching any surfaces.
2. **Wait three minutes**.
3. **Read** the temperature **to the nearest 0.5° Celsius.**

Measuring pH

1. pH is no longer measured on-site on a routine basis. Perform this procedure only if you have been specially instructed to do so.
2. **Remove the cap and turn pH meter on.**
3. **Check the meter calibration.** Place the meter in pH buffer #7 (yellow) and record the calibration confirmation reading on the data sheet. Do not hit the CAL button! The display should not be flashing.
4. **Rinse the electrode** with distilled water and gently shake dry.
5. After all sample bottles have been filled, **place pH meter in the water to a depth of 1 to 2 inches**. The water level cannot be higher than the line just above the bulb.
6. **Stir gently and wait until the pH level stabilizes.**
7. **Read pH value and record on data sheet.**

Measuring Water Temperature

1. **Hold thermometer vertically** in the water with the probe end submerged at least 2 inches.
2. **Wait three minutes**.
3. **Read** the temperature **to the nearest 0.5° Celsius.**

Measuring Stream Depth from a Bridge or Boat

Note when measuring stream depth from a wade or a pipe, simply insert the yardstick into the water and read off the depth. If your station is equipped with a staff gauge, skip this procedure and simply read the water level off the staff gauge in feet and 100ths of feet.

1. Depth should be measured as close to the center of the stream as possible, away from abutments and other obstructions to flow. Choose the deepest part of the stream and always measure in the same spot. A small mark on the bridge railing with indelible marker can help ensure a consistent depth measurement.
2. Place a yard stick on the bridge railing or on the ground near the railing.
3. Lower the depth line into the water until it barely hits bottom. Move the line up and down a bit until it is clearly just touching the bottom rather than being perched on a rock or other obstruction.
4. Reach out with your fingers held level with the top of the bridge railing and pinch the depth line with two fingers. DO NOT LET GO!
5. Without letting go with the first hand, raise the depth line up until the bottom of the weight is just skimming the surface of the water. Move the weight up and down a bit and watch for ripples to confirm that the bottom of the weight is right on the water surface.
6. Reach out with your free hand (the one not already pinching the string), holding your fingers level with the same spot on the bridge railing and pinch the string in this second location. DO NOT LET GO!
7. You should now be pinching the string with both hands, with one hand marking the bottom of the river and the other marking the top.
8. Without releasing either pinch, maneuver your hands over to the yardstick and use it measure off the length of string between your fingers. Record this information on your data sheet.

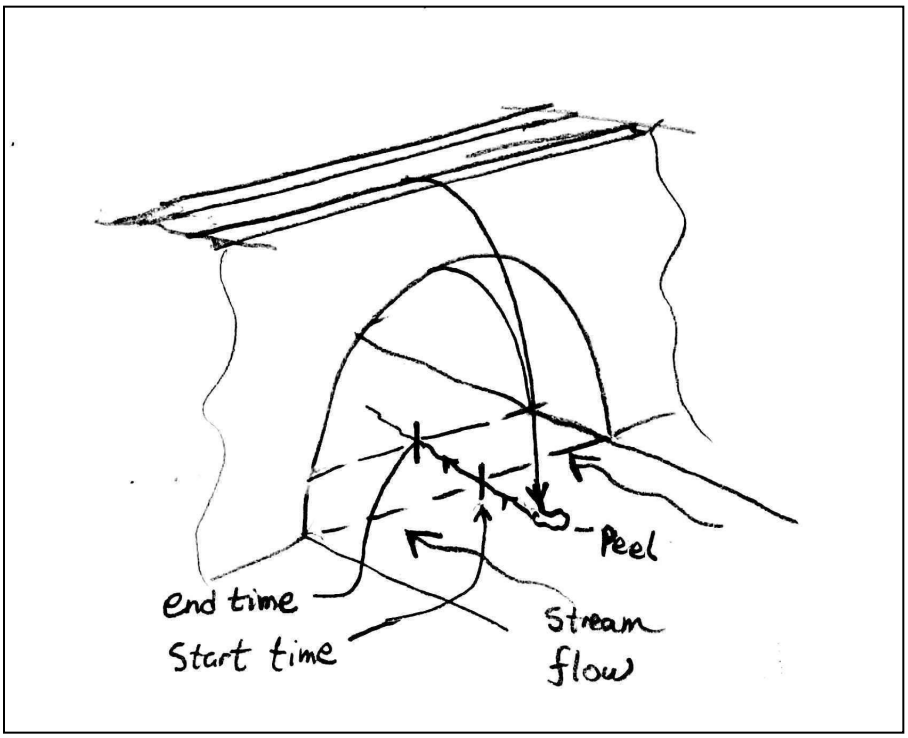
Estimating Stream Velocity

If you do not have an orange peel you can use a piece of floating debris coming from upstream, such as a leaf, provided it is in the center of the channel and continues to move downstream free from obstruction.

Velocity Measurements from a Bridge

1. **Throw orange peel or similar floatable into the water** on the upstream side of the bridge.
2. **Record the time** (in seconds) it takes the peel to travel beneath the bridge (from upstream to downstream).
3. **Repeat steps 1 and 2 two more times,** and record the times. If times are drastically different, repeat three more times.
4. **Record the average** of the three times.
5. Divide the distance across the bridge (in feet) by the average time (in

seconds) to estimate the average velocity.



Velocity Measurements from Water's Edge

1. **Mark off 10 to 20 feet** on the shoreline from upstream to downstream. Measure the distance in feet. Be sure to select upstream and downstream locations that can be easily identified (i.e. where a large rock or tree is present) or mark the locations.
2. **Throw orange peel at the upstream location** in the center of the channel.
3. **Record the time (in seconds)** it takes the peel to travel to the downstream location.
4. **Repeat two more times**. Record the times. If times are drastically different, repeat three more times**.**
5. **Record the average** of the three times**.**
6. **Calculate the velocity** by dividing the distance (in feet) by the average time (in seconds).

Chapter 9

At the Drop-off Center

The last step in the sampling process is delivering the samples to the drop off center, completing some paperwork and replenishing bottles and supplies.

The Drop-off Coordinators leave the Drop-off Centers to deliver all the samples to the NepRWA office at 8:00 AM. Plan the timing of your sampling activities to ensure that your samples arrive at the Drop-off Center before 8:00 AM. Otherwise it may not be possible to analyze your samples.

If you have collected samples but missed the drop-off deadline, call the NepRWA office at 781-575-0354 as soon as possible and we will attempt to make alternate arrangements if possible.

Please be sure to go to the "right" drop off center. During training, all volunteers will select a preferred Drop-off Center. Please use this Drop-off Center every time as the Sampling Coordinator will have arranged to have your bottles for the next round "meet" you at that Drop-off Center. If you wish to change Drop-off Centers for any reason, just let the Sampling Coordinator at the NepRWA office know.

Drop-off Center Procedure

1. **Obtain the labels for your site from the drop-off coordinator.** For each label, under "Date/Time Coll:," fill in the date and time **from your field data sheet** that each sample was collected, and under "Collected by:", fill in your initials.
2. Remove one sample bottle at a time from your cooler, starting with any bacteria bottles.
3. Find the correct label for your bottle and affix it to the bottle. The label tells the lab what type of tests to do on that particular bottle so check the label to make sure you attach the bacteria label to the bacteria bottle, etc. The test type is on the lower left of the MWRA label.
4. Place bottle into the large NepRWA cooler.
5. Continue to transfer samples from your cooler and label one bottle at a time, immediately placing labeled bottle into the large NepRWA cooler, until all bottles have been transferred. There will be no label for the conductivity/pH bottle.
6. Put your ice into the NepRWA cooler.
7. Put completed data sheets in envelope.
8. **Fill out the chain-of-custody forms at the drop-off site**. Your samples may go to several different labs for analysis. Each lab will have its own chain of custody form for the samples that it will process. Therefore, most volunteers will need to fill out more than one chain of custody. Each form should contain your signature, date and time that you collected your sample.

9. **Pick up clean sample bottles and any needed supplies or equipment** for the next sampling event. Leave behind any empty supply bottles or malfunctioning equipment.
10. **Enjoy the rest of your day!**

CHAPTER 10

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