WATER CHEMISTRY
AND
NUTRIENT ANALYSIS
PROTOCOL

A MANUAL FOR VOLUNTEERS
last revised in 2010

Jug Bay
Wetlands
Sanctuary

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STUDY OVERVIEW

The Chesapeake Bay is the largest estuary in the United States. The ecological health of this estuary is greatly affected by the quality of the water that enters from its tributary rivers, which in turn are affected by their tributary streams. The Jug Bay Wetlands Sanctuary is on the Patuxent River, a mid-sized tributary of the Chesapeake. The Sanctuary is located on the fresh water tidal portion of the river about 50 miles upriver from the mouth at Solomon's. The Patuxent is the largest river located entirely within the state of Maryland and parts of seven counties are within the 915 square-mile watershed.

The top three pollution sources plaguing the Chesapeake also plague the Patuxent—sediment, nitrogen, and phosphorus. The major sources of human-caused pollution loads entering the river are wastewater treatment facilities, agricultural runoff, and acid precipitation. Organizations working to restore the health of our waterways have accomplished much to reduce point source pollution, but we still have much work to do to reduce nonpoint source pollution. In 2009, the Sanctuary began an investigation of the role of three tributary streams draining directly to the river:

- to track the loading to the river of dissolved nutrients from tributary streams
- to gather baseline data on dissolved nutrient concentrations, chemical attributes and physical characteristics of water at Two Run Branch, Pindell Branch, and Galloway Creek
- to educate and train volunteers in the study of water quality and the dynamics of physical characteristics in a stream
- to share our findings with the scientific and resource protection community

The dissolved nutrients under investigation are nitrogen in the form of nitrate/nitrite (NO_2 + NO_3) and ammonium (NH_4), and phosphorus in the form of phosphate(PO_4). Other variables measured are water temperature, air temperature, Secchi depth (clarity)/TSS, dissolved oxygen (DO), salinity, conductivity, and pH (acidity).

There is one sampling period each month.

To accommodate the different volunteers who assist with the study, sampling is conducted weekdays and weekends. This study is land-based and volunteers are permitted to drive to the sites. Some measurements are made directly at the sampling sites while others are made at the Sanctuary lab. Volunteers are expected to sample two designated sites at one of the three streams. Water is collected, filtered, and freezer stored to be analyzed later for dissolved nutrient concentrations at the Chesapeake Biological Laboratory in Solomons, Maryland.

Data are recorded on field data sheets, examined by staff for accuracy, and later transferred by staff and volunteers to computer spreadsheets for analysis. The data are summarized in technical reports as well as distributed to resource agencies, researchers, volunteers, our neighbors in the stream watersheds, and others interested in the study of streams, water chemistry, and the Patuxent River.

The success of our water quality study is due to the commitment of volunteers who convert their interest in water quality and concern for the environment into action. Your regular participation is essential to the success of our study. We greatly appreciate your time and effort. We hope that your volunteer experience is enjoyable, too. Thank you for your help!

100 METER UTM REFERENCE/RESEARCH GRID- JUG BAY WETLAND SANCTUARY

Prepared By The Department Of Public Works- Technical Engineering-Surveys

STUDY PROCEDURES

A. Preliminary Lab Procedures

1. ***stabilize*** the DO meter (found under deep sink)

   a) turn on the meter using the green button on the bottom right

   b) the display should read **Run** at the top, and **Log One Sample** should be highlighted

   c) pull the protective gray sleeve half-way off the probe so that air can circulate

   d) stabilization takes 1-10 minutes

   e) observe the barometric pressure (in mmHg), then calculate DO% saturation

      (1) DO % sat. calculated = barometric pressure / 7.6 (Ex. 760.0 / 7.6 = 100.0%)

      (2) Compare DO % sat. calculated with the % sat on the "Calibration Work Sheet"; if within 2% of the last calibration, proceed to step 3, if not, see laminated "Professional Plus Quick-Start Guide" to calibrate DO

      (3) Once the DO meter is ready, leave it turned on, replace the protective gray sleeve and proceed to the next step

2. ***gather*** the following field equipment (found under deep sink)

   - ✓ (1) collection cup and/or bucket with attached cord
   - ✓ (1) clipboard
   - ✓ (2) pencils
   - ✓ (1) data sheet – in green folder
   - ✓ (1) Water Quality Procedure manual
   - ✓ (1) YSI ProPlus DO meter
   - ✓ (2) 60 cc syringes (one per stream section)
   - ✓ (2) grab bottles (one per stream section)
   - ✓ (2) thermometers (for air temperature, with back-up)
   - ✓ (1) Black backpack to carry gear

3. ***read*** any notes on clipboard, check for data sheets from the other streams

4. ***know*** the schedule – We only have one DO meter so volunteers cannot overlap sampling times.

5. ***prepare*** the following filter equipment (pull out white carrier from under deep sink)

- ✓ (6) analyzer cups
- ✓ (6) analyzer cup lids
- ✓ (1) Sharpie Extra Fine Point permanent marker
- ✓ (2) Gelman filter units
- ✓ (1) tweezers
- ✓ (2) 2.5 cm GF/F filter pads

6. ***label*** the analyzer cups (see diagram below)

   a) <u>label cups legibly and accurately</u> so the staff at CBL can match nutrient results to the proper site

   b) using the permanent marker, label three (3) cups for each of the stream sections to be sampled, totaling six (6) cups

   c) record site/section code, six number date, and JBWS on the cups

Pindell upstream on October 22nd, 2010 would be labeled as follows:

MM-DD-YY

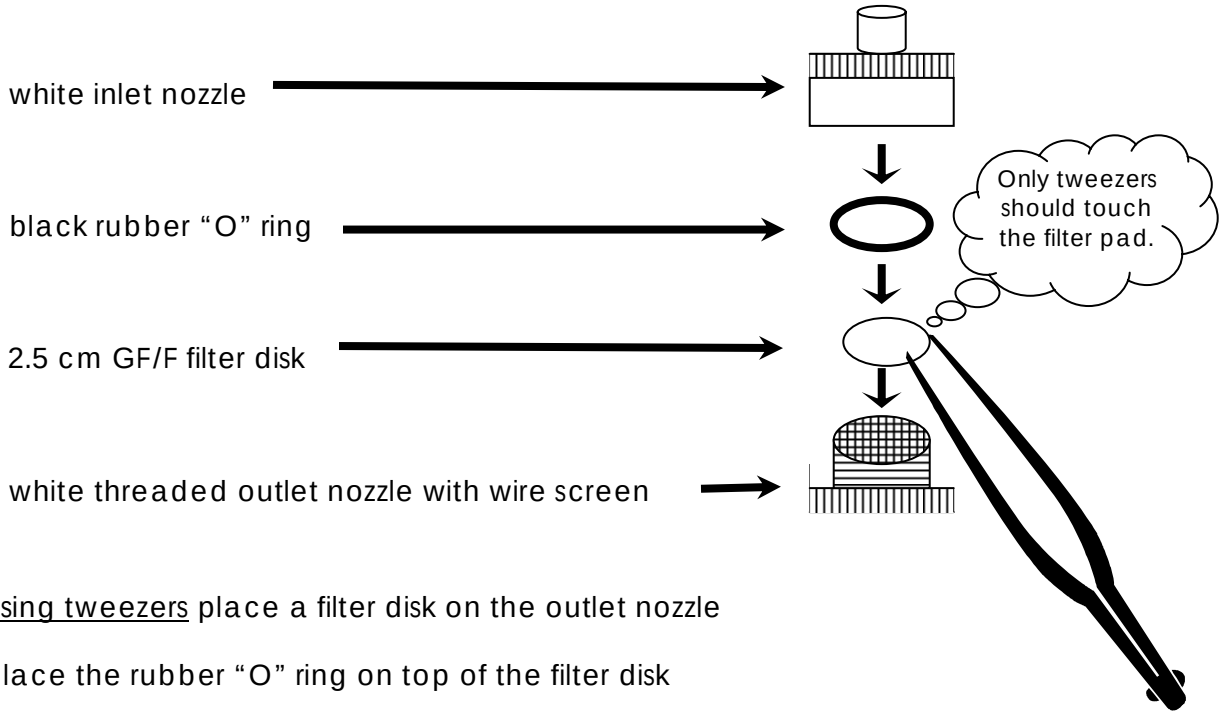
<u>note</u>: this is the only time you do not spell the month

PINU
10-22-10
JBWS

<u>Site Codes:</u>
PIN for Pindell Branch
GAL for Galloway Creek
2R for Two Run Branch

<u>Section Codes:</u>
D for downstream
U for upstream

7. ***assemble*** the Gelman filter units (see diagram below)



   a) <u>using tweezers</u> place a filter disk on the outlet nozzle

   b) place the rubber "O" ring on top of the filter disk

   c) thread the inlet nozzle to the outlet nozzle and tighten

   d) pre-load at least two Gelman filters (very green or very dirty water will quickly clog the disks)

8. ***gather*** the field equipment and head out

9. ***drive*** to the downstream site of the stream you will be sampling (see overview map on page 2)

<u>Be safe!</u> Sampling is done even in inclement weather, but do not risk your safety in treacherous conditions!!!

B. Field Procedures

1. ***sample*** the stream sections properly

   a) always start at the downstream section of the stream so that any disturbances caused will not be reflected on the data collected

2. ***hang*** thermometer in the shade as you approach the sampling section

3. ***record*** start time using 24-hour clock, and site conditions

4. ***determine*** the exact sampling location (sediments shift regularly in the streams), find a nearby spot in the channel with sufficient depth and proceed to step 6; if too shallow proceed to step 5

5. ***rinse*** the bucket without disturbing the sediment, then fill half full with water

6. ***display*** should read Run at the top, and **Log One Sample** should be highlighted.

   a) Press 

and **Log Now!** should be highlighted

   b) Press the ▼ button to highlight **Site:** press 

to see the list of sites

   c) Press ▲ or ▼ button to highlight the correct site, press 

to select

   d) Press the ▼ button to highlight **Folder:**, press 

   e) Press the ▲ or ▼ button to highlight the correct stream folder, press 

to select

7. ***scroll*** back to **Log Now!** using the ▲ button.

8. ***remove*** the probe from the protective cover and submerge it into the stream or bucket.

9. ***stir*** the DO probe steadily (6-inches/second) at mid-height, and perpendicular in the water column

   a) When the reading is stable for at least 10 seconds (drift of up to 0.2 mg/L is acceptable), press and quickly release 

to save (**Saving Config…** will appear in the message line near the bottom of the screen, and after a few seconds it will beep).

10. ***place*** the gray sleeve back over the probe and store the meter in the backpack.

11. ***select*** proper grab bottle and 60 cc syringe for the site being tested

12. ***rinse*** the grab bottle and syringe with stream water

    a) rinse 60 cc syringe by drawing in water from below the surface, and expelling it downstream of the sampling area

       (1) rinse three times

       (2) when cleaned - refill syringe with water from below the surface, and replace blue cap

    b) submerge grab bottle and lid below the surface of the water, fill to 1/3 full, cap, shake, and expel water downstream of the sampling area

       (1) rinse three times

       (2) when cleaned - fill and tighten lid

13. ***observe*** surroundings and use "comments" space provided to record any notes

14. ***gather*** all equipment

15. ***retrieve*** air thermometer as you leave site and record temperature in degrees Celcius

16. ***repeat*** steps 2 through 15 at upstream section, then return to lab

C.Followup Lab Procedures

1. ***filter*** sample water into analyzer cups

   a) if present, remove the blue cap from the 60 cc downstream syringe

   b) press the syringe tip firmly into the inlet nozzle on an assembled, preloaded Gelman filter unit, twist to tighten

   c) select the 3 analyzer cups that match the stream section on the syringe and get out 3 caps

   d) using thumb pressure on the plunger, rinse the cups and caps three times each using filtered water through the Gelman unit

<u>Important!</u> Use gentle pressure when filtering. <u>Never</u> force samples!
Diatom and algae cells can fracture resulting in a false high nitrogen reading.
If the plunger becomes difficult to push, replace the filter pad.

   e) fill analyzer cups 1/2 to 2/3 full (overfilling causes cracking when sample is frozen)

   f) cap analyzer cups and set aside

   g) repeat steps b through f for the upstream site

2. ***store*** analytical samples

   a) take the white rack from the lab freezer

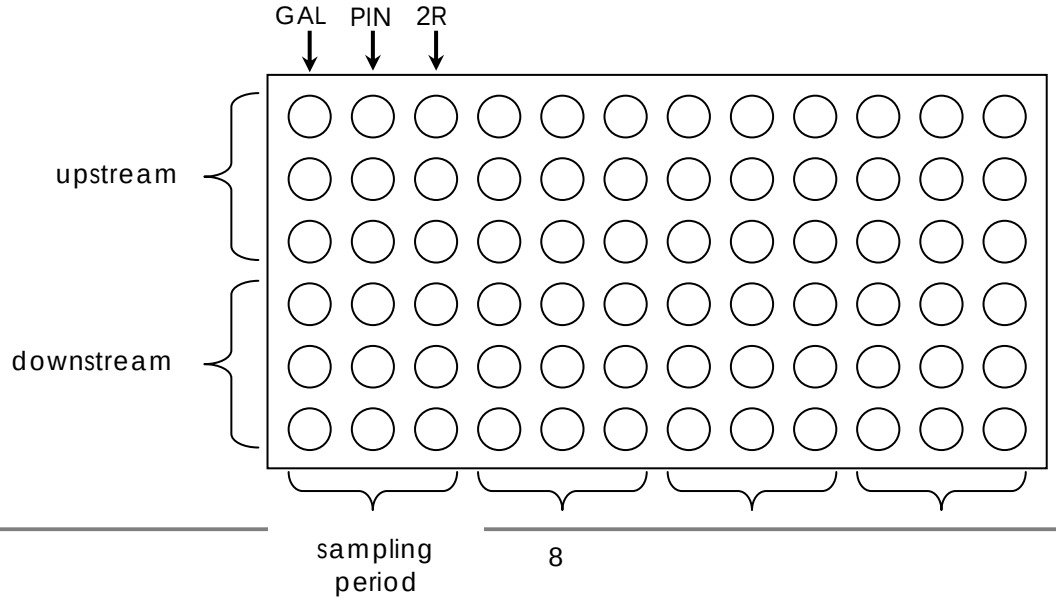
   b) all writing must face forward

      (1) start in the back left corner

      (2) arrange cups by sampling order

      (3) group cups by sampling period

   c) return white rack to freezer immediately



3. ***filter*** for total suspended solids (TSS)

a) gather hand pump filter unit, roll of aluminum foil, fine point Sharpie pen, and graduated cylinder from under the deep sink and place on lab bench

b) cut two small sheets of aluminum foil from the roll (about 4in x 4in), set aside

c) rinse filter cup with distilled water and pump through filter unit

d) disassemble filter unit, and empty contents from glass beaker

e) using tweezers, place a pre-weighed filter pad on filter center, being careful not to touch the filter pad

(1) record filter number on datasheet

f) reassemble the filter unit and place on stand

g) select the downstream grab bottle and <u>mix well</u> by inverting the bottle several times

h) pour between 100-200mL of sample water into filter cup (depending on how clear or dirty the water appears)

i) pump the water through the filter unit, then remove the glass beaker and pour contents into the graduated cylinder

j) make a note of the volume filtered on the datasheet and assess color change on filter pad using the color change key

(1) repeat step g-j until coloration on filter is significant (between 1 - 2 on the key)

(2) <u>*NOTE*</u>: the filter unit only holds 250mL of water, so make sure you remove the filter top and measure the sample water before it overflows the glass beaker

k) once significant color change is reached, record the total volume filtered in the corresponding space on the datasheet

l) rinse the filter cup with distilled water

m) unscrew the top portion of the filter unit to expose filter pad

n) using two pairs of forceps, fold filter <u>exactly</u> in half, being careful not to touch material on filter with either the forceps or your fingers

o) once folded, use tweezers to place filter on aluminum foil square

p) enclose filter by folding aluminum into a pouch and using the Sharpie, label with JBWS-TSS, site name, date, filter number, and volume filtered

q) repeat steps c through p for the upstream grab bottle

r) place samples in the freezer in the zip-top bag

4. ***retrieve*** saved DO meter data

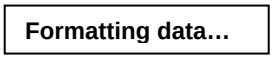
   a) press the File button  , display should read Folders at the top

   b) press the ▼ button to highlight **View Data,** press 

   c) use the ▲ or ▼ button to highlight **Folder:,** press 

   d) use the ▲ or ▼ button to highlight **Site,** press 

   e) scroll back to **Show Data** using the ▲ button**,** press 

(

will appear in the message line near the bottom of the screen, and after a few seconds the data will display)

   f) data is sorted by date and time stamp so you can view both sites on one stream simultaneously

   g) use the ◀ and ▶ buttons to scroll side to side

   h) when finished recalling data, press the green button on the bottom right to turn the meter off

5. ***clean*** equipment

   a) remove gray sleeve from DO meter probe, rinse probe and sleeve with squirt bottle of distilled water, replace the gray sleeve back over the probe and store the meter in the backpack

   b) disassemble Gelman filter units, dispose of filter pads, and place units in distilled water bath

   c) rinse syringes and grab bottles with tap water

6. ***dry*** equipment

   a) place syringes and grab bottles on drying rack

   b) place collection cup and/or bucket near lab sink to dry

   c) remove Gelman filter units from bath and air dry on paper towels

Followup Lab Procedures

7. ***carefully check*** the data sheet for…completeness…clarity…readability

8. ***write*** any notes for the staff on clipboard (e.g., running low on equipment, DO meter malfunction)

9. ***place*** all dry equipment back in storage

10. ***record*** your volunteer hours

D. Site Descriptions

	Galloway Creek	Pindell Branch	Two Run Branch
Downstream	Beaver Pond	Above Waterfall	Beaver Pond
Upstream	Culvert	Culvert	Mickey's Foot Bridge

Galloway Creek Downstream (GALD)

- **Sampling Location:** just below the blown-out beaver dam, along the west stream bank, about halfway between grid poles 542-J and 542-K

Galloway Creek Upstream (GALU)

- **Sampling Location:** at the culvert, near grid pole 537-T

Pindell Branch Downstream (PIND)

- **Sampling Location:** just above the small waterfall, about halfway between grid poles 502-P and 503-Q

Pindell Branch Upstream (PINU)

- **Sampling Location:** just above the culvert on the north side of the farm entrance road, about 25 meters southwest of grid pole 509-U

Two Run Branch Downstream (2RD)

- **Sampling Location:** at the west side of the beaver dam, near grid pole 509-J

Two Run Branch Upstream (2RU)

- **Sampling Location:** at the intersection of Two Run trail and the Upper Railroad Bed trail, from the bridge, about 35 meters southwest of grid pole 513-L

FOR ALL SITES: **Air Temperature Location:** in the shade of the trees and bushes at the edge of the stream channel