Blackwater National Wildlife Refuge
Water Quality Monitoring
Survey Protocol
December 20, 2022

Background and Objectives

The Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan (CCP, USFWS 2006) identifies monitoring water quality on and around Blackwater NWR as a key part of protecting and enhancing trust resources. Objective 1.7.3 in the CCP calls for the long-term monitoring of salinity and other water quality parameters for the purpose of providing baseline data to aid in planning purposes, assessing the effects of implementing restoration tasks, and evaluating habitat conditions.

Blackwater NWR lies within the 537 square mile Blackwater-Wicomico (level 8 Hydrological Unit Code or HUC) Watershed (see figure 1), within the larger 8,980 square mile Upper Chesapeake (level 6 HUC) Watershed. The Nanticoke Watershed Alliance's annual river report card consistently rates water quality in the Fishing Bay watershed as the lowest in their reporting area. Therefore, water monitoring is necessary for prioritizing and assessing efforts to improve Chesapeake Bay water quality.

The specific objectives of this monitoring program are to:

1. Determine the status and trends for water quality conditions on and around Blackwater NWR, capturing spatial and temporal variability at a high enough resolution to guide habitat management, enhancement, and restoration activities. Specific water quality parameters include total nitrogen, total phosphorus, chlorophyll-a, temperature, dissolved oxygen, specific conductivity, pH, turbidity, and salinity.

2. Produce data that will contribute to and strengthen tributary level and bay-wide water quality monitoring programs by partner organizations and ensure data collection and management procedures are sufficient to meet quality assurance requirements for data sharing with the Chesapeake Monitoring Cooperative.

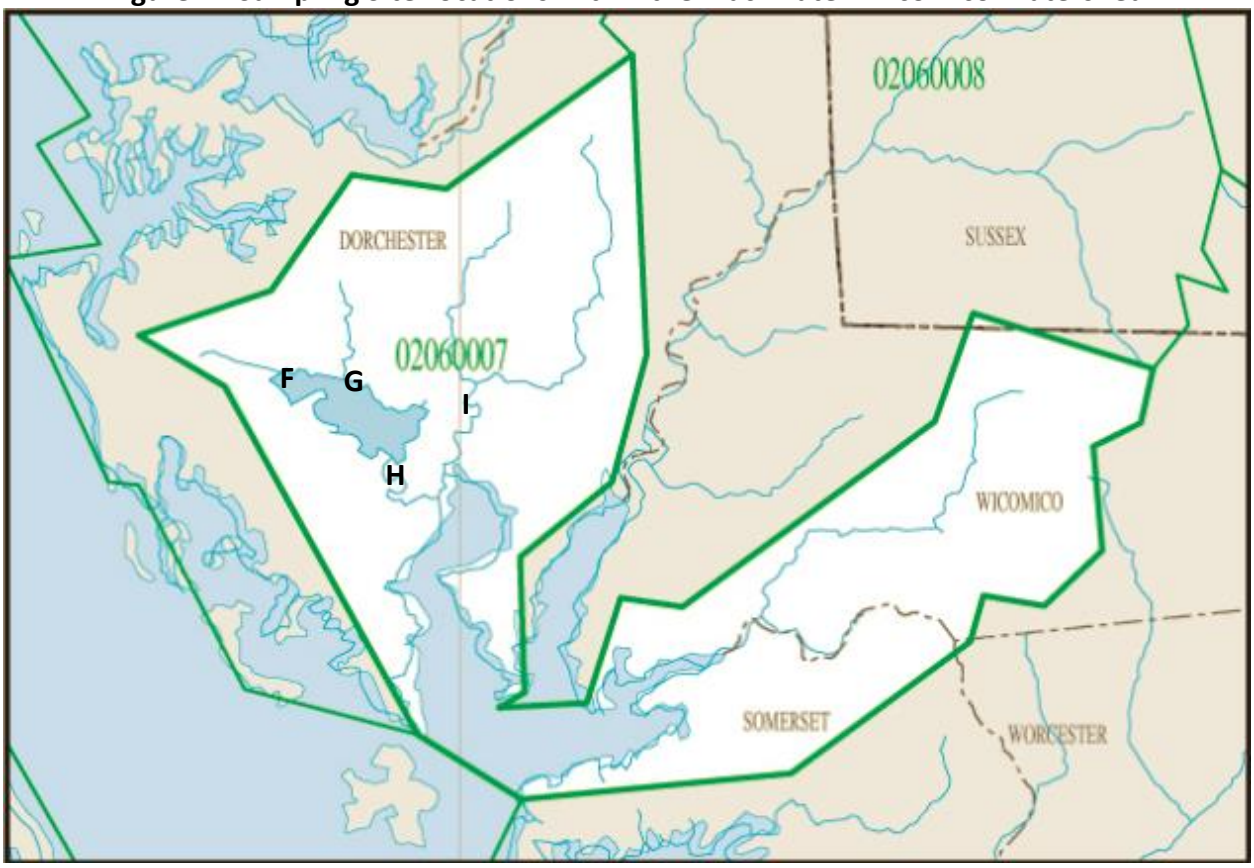
3. Make data available to partners through the Chesapeake Monitoring Cooperative's Chesapeake Data Explorer and communicated to decision makers through water quality report cards and other annual reports.

Sampling Design

The water quality monitoring program re-establishes past monitoring effort, but in a way where data will both be useful for Blackwater NWR management decisions and shared externally through the Chesapeake Monitoring Cooperative. The long-term monitoring consists of discrete samples and readings taken at four discrete locations on the Blackwater National Wildlife Refuge (Table 1 and Figure 1).

Table 1: Sample Sites			
Site	Site Description	Site Location	Site Justification
F	Route 335, Blackwater River (bridge, mid-channel, northwest side)	Latitude: 38.43803 Longitude: -76.14681	Where Blackwater River flows into "Lake Blackwater"
G	Key Wallace Drive, Little Blackwater River (bridge, mid-channel, north side)	Latitude: 38.44544 Longitude: -76.08389	Where Little Blackwater River flows into "Lake Blackwater"
H	Shorter's Wharf, Maple Dam Road, Blackwater River (bridge, mid-channel, west side)	Latitude: 38.38167 Longitude: -76.06765	At southeast point of "Lake Blackwater" before Blackwater River flows into Fishing Bay
I	Bestpitch Ferry Road, Transquaking River (shoreline, boat launch bulkhead)	Latitude: 38.41712 Longitude: -75.99301	Where Transquaking River flows towards Fishing Bay

Figure 1: Sampling Site Locations within the Blackwater-Wicomico Watershed



Water quality monitoring will consist of taking water samples and readings for temperature, dissolved oxygen, specific conductivity, pH, turbidity, salinity, nitrogen, phosphorus, and chlorophyll a. Nitrogen, phosphorus, and chlorophyll-a samples will be sent to the Horn Point Lab for processing. All other readings will be taken *in situ* using a YSI instrument and Secchi disk.

Sampling locations were selected to adequately capture spatial variability across the project area and characterize key hydrologic units. The exact locations were selected for convenience purposes (bridges for sites F, G, and H, allowing midstream sampling; a boat launch with bulkhead for site I). Site F characterizes the upper Blackwater River and the Buttons Creek tributary as it flows downstream towards Fishing Bay. Site G characterizes the water quality at the mouth of the Little Blackwater River as it flows into the Blackwater River, approximately seven miles downstream from the Nanticoke Watershed Alliance's Little Blackwater 4 sampling point. Site H characterizes water quality as the Blackwater River narrows and eventually flows into Fishing Bay. Site I characterizes the quality of the Transquaking River, approximately 11.2 miles downstream from Nanticoke Watershed Alliance's TRAN2 station on Drawbridge Road, as it approaches Fishing Bay. A final advantage of using these sites is that they were used in the past, allowing a direct comparison with historical data.

By implementing this program with an appropriate quality assurance plan, results will be entered into the Chesapeake Monitoring Program, thus complementing data collected by partners (both current and future) within the HUC 8 and 6 watersheds.

Water quality and nutrient monitoring and sampling will take place year around at each location on a monthly basis. Nutrient and chlorophyll-a sampling will occur as long as sufficient funds are available to pay for the costs of processing the samples. All sampling and quality assurance steps will be done with trained volunteers, under the general supervision of BNWR biology staff and following the quality assurance requirements of the Chesapeake Monitoring Cooperative. BNWR will provide a vehicle, equipment, and supplies for use by the volunteers. However, this program is not expected to require a significant time commitment from BNWR staff.

Some parameters are measured *in situ* while others are determined by lab analysis. Table 2 describes the parameters measured *in situ* at each location along with tools used, while Table 3 describes those determined by the Horn Point Laboratory Analytical Service.

Table 2: *in Situ* Parameters Measured

Instrument Used	Measurement	Range	Resolution	Accuracy
YSI Pro DSS	Temperature °C	-5 to 70°C	0.1°C	± 0.2°C
	Conductivity mS/cm	0-100 mS/cm	0.001, 0.01, or 0.1 µS/cm	Greater of ±0.5% or 0.001 mS/cm
		100-200 mS/cm	0.001, 0.01, or 0.1 µS/cm	±1.0%
	Salinity ppt	0-70 ppt	0.01 ppt	Greater of ±1.0% or 0.1 ppt
	Dissolved Oxygen	0-20 mg/L	0.1 mg/L or 0.01 mg/L	Greater of 0.1 mg/L or 1%
		20-50 mg/L	0.1 mg/L or 0.01 mg/L	±8.0%
		0-200%	1% or 0.1%	Greater of 0.1 mg/L or 1%
		200-500%	1% or 0.1%	±8.0%
Secchi Disk	Water clarity	0.1-7.0 m	0.1 m	n/a

Table 3: Laboratory Methods			
Parameter	Detection Unit	Method Reference	Holding Time and Condition
Total Nitrogen (mg/L as N)	0.006 mg/L	Persulfate Digestion: Valderrama (1981), SM 4500-N C modified; NOx Analysis: EPA 353.2	28 days in -20 °C freezer
Total Phosphorus (mg/L as P)	0.002 mg/L	Persulfate Digestion: Valderrama (1981), SM 4500-P B.5; P Analysis: EPA 365.1	28 days in -20 °C freezer
Chlorophyll a	0.05 µg/L	EPA Method 445.0	Frozen < 6 months

Field Methods and Data Collection

Sampling procedures are designed to effectively and efficiently meet the objectives of this program. Trained volunteers collect data once per month, year around. Occasionally, severe ice conditions may prevent sampling at some locations. Testing is intended to be conducted on the second Tuesday of each month. If weather conditions or volunteer availability require rescheduling to a different day, it should be rescheduled to be as close to the original day as possible. Readings and samples should be taken between 8 am and noon.

The water sampling program utilizes a YSI Pro-DSS instrument outfitted with two sensors to measure temperature, pH, salinity, specific conductivity, and dissolved oxygen. The YSI Pro-DSS is also equipped with a cable that reads water depth, allowing for *in situ* readings at various water depths. The YSI Pro-DSS will be calibrated by the water monitoring volunteers trained in calibration techniques within 24 hours prior to conducting the sampling, following the manufacturer's recommended calibration equipment. The battery level should be checked during calibration. If the battery level is below 70%, it should be recharged at that time. The YSI should be validated within 24 hours after the sampling is completed, again following the manufacturer's recommendations. Records of calibration and validation will include: dates, pre- and post-calibration values prior to sampling, post sampling validation readings, and the name of the person doing the calibration and validation. Records will be maintained by the water monitoring volunteers with copies provided BNWR staff on at least an annual basis.

Prior to departing for sampling sites, volunteers will review a checklist of the equipment and supplies needed for conducting the samples. Volunteers will also notify staff of when their departure and expected return time, check out a vehicle, and comply with all other safety requirements.

Aluminum foil packets for filter samples and water bottles for laboratory samples should be prepared and labeled ahead of time. The aluminum foil packet preparation consists of cutting aluminum foil into about a 2.5-3" wide by 5-6" long piece and folding it in half. Using a permanent marker, label it with the site number (F, G, H, I), the date, and a blank line followed by "cc" (used to document the amount of water pressed through the filter to collect the sample). Also label the water collection bottles with the site number (F, G, H, I) and the date. This can be done the morning before leaving HQ for the sampling. It can also be done ahead of time, but if so leave the dates blank.

The following is a list of equipment and supplies:

- YSI Pro-DSS (with cable, cover, probe protection cover, and weight)
- Secchi disk attached to a ≥ 25' meter measure
- ≥ 25' meter measure attached to a weight for measuring water depth
- 3-gallon bucket
- 30' rope with clip (used to attach to buckets to collect water)
- 60 cc syringe
- Syringe filter holder (cartridge for holding filter)
- Forceps (to remove filter samples from cartridge)
- Prepared and pre-labeled aluminum foil packets (for filters)
- Permanent marker
- Cooler with ice (get ice from BNWR headquarters breakroom)
- Ziplock bag for sample foil packets
- 25 mm GF/F filters
- Bottles for collecting water samples
- Clean bottle of distilled water (for blank on even months)
- Dispenser bottle for distilled water
- Disposable rubber gloves
- Clipboard
- Data collection sheet
- Pencil
- Eraser
- Marking tape to mark filters

Fill out the data sheet for the day of sampling:

1. Date collected
2. Date
3. Weather information – record at first sample location:
    a. Average cloud cover
    b. Wind speed
    c. Temperature

The following is the sequence used to collect measurements and samples at each site.

1. Record the time you began collecting data at the site, using the 24-hour clock (e.g., 1 pm = 1300).
2. Record tide: 1 = high tide, 2 = mid-outgoing, 3 = low tide, 4 = mid-incoming
3. Measure water depth:
    a. Use ≥ 25' meter tape with weight attached
    b. Lower tape to bottom of water channel.
    c. Record depth to the nearest centimeter.
    d. In most cases, it is unlikely that the depth can be read directly. Instead, use this 3-step method
        i. With the measure at the bottom of the channel, note the distance to the top of a piling, bridge railing, or other fixed object
        ii. Reel in measure until the weight is at the top of the water, and note the distance to the same object used in prior step
        iii. Find the difference between the two numbers and record that as the depth.

4. Measure water turbidity (clarity) using the Secchi disk, as follows:
    a. If you are wearing sunglasses, remove them and stand with sun to your back. Try to lower Secchi disk in a shaded area.
    b. Lower the disk into the water until the disk barely disappears from sight. Note the depth reading, in meters, based on the length of line submerged. Each mark is one-tenth (or 0.1) meter.
    c. Lower the disk into the water until the disk barely disappears from sight. Note the depth reading, in meters to the nearest centimeter, based on the length of line submerged.
    d. Slowly raise the disk and record the depth at which it reappears (i.e. is barely perceptible).
    e. Average the two depth readings obtained above. The average of the two readings is considered to be the limit of visibility, or index of transparency. Record this average to the nearest centimeter on your data form.
    f. If you are not able to see the depth directly, use the 3-step method described under 3.d.
5. Gather water for the water and filter samples
    a. Water for samples will be collected by bucket, with a separate bucket for each site.
    b. Rinse the bucket 3 times at each site. Attached 30' rope to bucket marked for that site. While firmly holding end of rope, lower or toss bucket into water. Fill with water, raise it and dump water away. Avoid pouring the water directly back into the stream – pour on roadway or parking lot. Repeat 2 more times.
    c. Collect water for samples by lowering bucket, letting it sink about a 1 meter below surface, agitate bucket (pulling up and relaxing rope several times) to collect water at that level.
    d. Raise bucket – this is the water that you will use to fill water sample bottles and syringe for filter. Poor off some of the water, keeping about 2/3s, to make it easier to carry back to truck.
    e. Set the bucket on the truck's open tailgate, using it as a platform to complete tasks 6 and 7.
6. Collect the Chlorophyll-a sample in the filter
    a. Prepare the syringe by adding a clean filter to the syringe cartridge. Unscrew the cartridge into two sections.
    b. Use the forceps and pick up the filter by the edge, being careful not to touch the filter with your fingers.
    c. Center filter on cartridge, and screw on the other section.
    d. Using the large syringe (50 or 60cc) marked for that location, place in bucket and agitate water. Do not stir in a circular motion; instead, swish water back and forth, then side to side.
    e. Rinse syringe by filling it, then empty it outside of bucket, repeating two more times.
    f. On the forth filling, adjust the amount of water so it has 50 ccs. Do this by filling beyond the 50cc mark, point syringe straight up, tapping on side to get out all air bubble, and squeeze plunger until it lines up with the 50cc marking.
    g. Attach the cartridge with the filter to the end of the syringe. Keeping a grip on the cartridge (even if it screws on it might pop off due to pressure), slowly press the plunger. A minimum of 10ccs must be filtered to collect an adequate sample, and ideally all 50ccs will be filtered. If the filter becomes clogged and the plunger becomes difficult to push, stop rather than trying to force the water. Subtract the water remaining from 50ccs, and record that amount on both the data sheet and the foil packet.
    h. Remove the filter cartridge from the syringe, fill the syringe full of air, reattach the syringe, and press the plunger to extract excess water from the filter.

i. Remove the filter cartridge from the syringe. Unfold the aluminum packet labeled for that site, carefully unscrew the cartridge, and using the forceps gently grasp the edge of the filter to lift from the cartridge and lay with the filter sample side up in the center of the aluminum.
j. Continuing to use the forceps, fold the filter in half with the sample inside of the fold, continuing to center in line with the fold line on the aluminum packet. Fold up the sides of the foil packet and double check to make sure it has the current date, sample site, and volume filtered.
k. Immediately place foil packet in zip lock bag in the cooler with the ice pack.

7. Collect water for N/P lab sample.
    a. Using the syringe with no filter in place, agitate water in bucket by moving back and forth and side-to-side.
    b. Draw about 30ccs of water.
    c. Carefully open sample bottle, ensuring that nothing contaminates inside of bottle or its lid.
    d. Use water in syringe, fill sample bottle about 3/4s full.
    e. Double check to make sure bottle is correctly labeled with site and date.
    f. Place water bottles in zip lock bag and place in cooler with ice.
8. For quality assurance purposes, a duplicate filter and water sample should be taken at the first site visited on even numbered months. Repeat steps 6 and 7 for the first site visited. Label these samples as you would for the first ones (e.g., site name, date, amount of water for filter), adding "duplicate" to the label.
9. Other readings should be taken using the YSI Pro-DSS instrument.
    a. Remove protective cover and install sampling cover (the one with large holes). Attach weight to bottom of this cover.
    b. Turn on YSI instrument
    c. Lower the cable into the water. Using the depth indicator, lower probe to 0.5 meters. Allow unit to stabilize for about 10 seconds.
    d. Record pH, water temperature, DO, specific conductivity, and salinity.
    e. Take a second reading at 1.0 meters from the bottom. Using the total depth measurement from step 3, lower the probe to 1 meter above the bottom. Allow unit to stabilize for about 10 seconds.
    f. Record pH, water temperature, DO, specific conductivity, and salinity for the lower reading.
    g. Raise probe, rinse with clean water (distilled or tap), and replace with protective cover. Make sure you leave a small amount of water inside the protective cover – the probes need to be kept moist.
    h. Turn off and store YSI.

If two volunteers are conducting the sample, one can carry out steps 3, 4, and 9 (water depth, Secchi disk, and YSI) while the other carries out 5, 6, 7, and 8 (filters and water samples).

Once sampling is completed for the day, gear should be cleaned up and stored properly. Syringes and cartridges should be rinsed using tap water. YSI meter should be rinsed prior to validation. All equipment should be stored in area designated by BNWR staff. YSI meter and other supplies may be stored with a volunteer designated to carry out calibration and validation upon approval by BNWR staff.

Volunteers will transport the filter and water samples to the Horn Point Lab as soon as possible for appropriate storage and processing. If the filter and samples cannot be transported the same day, they should be frozen (below 0°C) as soon as possible and kept frozen until they are delivered to the Lab.

The data sheets should be thoroughly reviewed for completeness and accuracy at the end of each field session.

Data Management and Analysis

Data management begins with proper recording of measurements in the field. All data collected will be recorded on pre-formatted, project specific data sheets. Containers used for collecting samples will be pre-labeled in the office whenever possible. Upon returning to the office after collecting data, the field technician responsible for collecting and recording data will thoroughly review the data sheet for completeness, legibility, and accuracy.

The field data sheet is given to the data entry technician. The data entry phases is where the data is transferred from the paper field data sheet to an electronic format. In the case of the nitrogen, phosphorous, and chlorophyll-a data, these data are received in an electronic format from the Horn Point Lab. Both types of data are transcribed into a blank copy of the master Excel spreadsheet template. The file is saved on the station's public drive and is labeled with the date of data collection. Any issues found with the data at this point are resolved with the field technicians or Horn Point Lab. Throughout the entire data entry, verification, and validation process, any modifications to the original data will be clear and concise, while preserving the original data or comment (i.e., original data will not be erased). After initial data entry, the data entry technician begins with the verification process by visually proofing 100% of the data against the original data sheets for accuracy.

Once the initial data entry phase is completed, data verification continues with the quality assurance (QA) technician. The QA technician will be a different individual than those responsible for data collecting and/or data entry. The QA technician opens the Excel file completed by the data entry technician and copy/pastes into the Excel file containing data for that calendar year and is named using the following convention:

BLK_waterquality_data_YYYY_*YYYY*.xls

where *year* is the calendar year for the data being collected. So for data collected during calendar year 2020, the file should be named BLK_waterquality_data_2020_2020.xls, for the calendar year 2021 it should be named BLK_waterquality_data_2020_2021.xls, etc.

These files serve as a working copy of the data for the data entry person for the calendar year. The QA technician visually inspects 100% of the data against the original data sheets for errors. Any errors found are checked with the data entry technician, field technicians, or Horn Point Lab, as needed, before any corrections are made to the electronic file. The QA technician is also responsible for checking the duplicate Horn Point lab samples, as well as maintaining records of instrument calibration and validation.

The project biologist or designee is responsible for data validation. Data validation will occur prior to entering the data into data explorer. Data validation will be done by a different individual than the QA technician if staffing allows. Data validation consists of visual inspection of data as well as graphical display of data and descriptive statistics to detect errors. A randomly selected subset of records (≥10%) for the year is reviewed against original data sheets for errors. Data will be graphically displayed using box plots, histograms, line plots, etc. as well as summarized with basic descriptive statistics to detect outliers and check data for logic and range errors. Any suspect data will be evaluated. If any errors are detected during the validation process, the data set is returned to the validation process to ensure the integrity of the data set. Once the data set successfully passes, the file is locked and password protected to prevent any future corruption of data. Data will be sent to interested partners to contribute to larger, land-scape level analysis. Once the Blackwater NWR water monitoring protocols are approved by the Chesapeake Monitoring Cooperative and the CMC allows access to their system, data will be shared or entered into their reporting system.

BNWR staff or designated volunteers will be trained on uploading data to the Data Explorer. Data will be uploaded to the Data Explorer on a regular basis. Once all quality assurance and validation protocols are completed, the data will be converted into the template provided by the CMC to be uploaded into the Chesapeake Data Explorer via bulk upload. The data will then be published so that it is accessible on the homepage map and query page. This data will be uploaded periodically to meet the reporting deadlines for CMC reports such as water quality report cards, with prior calendar year data uploaded by March 1 of the following year (e.g., data for January – December 2021 will be uploaded by March 1, 2022). All data published on the Chesapeake Data Explorer are uploaded to the Chesapeake Bay Program's DUET system and EPA's Water Quality Exchange (WQX) by the CMC team, and is publicly available for federal, state, and other entities to use.

A simple summary analysis of data will be completed at the close of each calendar year. Descriptive statistics will be generated for each parameter using appropriate software. An example of the format used to present this analysis is found in Table 4. The annual analysis will also include any notes on important findings or problems encountered during the year. The analysis will also list the personal who served as field technicians, data entry technicians, QA technicians, and/or project biologists for the year. A print out of the raw data for the year will also be included as backup. The project biologist is responsible for the completion and accuracy of the annual analysis. This analysis will ensure that a dataset of sufficient quality is available to guide habitat management, enhancement and restoration activities.

Table 4: Descriptive Statistics for Calendar Year YYYY

Location	N	Min	Max	Mean	Std. Dev.	Median
F - Route 335, Blackwater River						
G - Key Wallace Drive, Little Blackwater River						
H - Shorter's Wharf, Blackwater River						
I - Bestpitch Ferry, Transquaking River						

Reporting

While an analysis of the data and a brief summary will be completed annually, a more thorough project report will be completed every 3-5 years, depending on staff resources and need. The project report will evaluate trends in water quality conditions both temporarily and spatially. The report will establish a baseline dataset characterizing total nitrogen, total phosphorus, and chlorophyll-a levels on and around Blackwater NWR. The outline of the report will follow the most recent USFWS protocol and include pertinent recommended components.

Personnel Requirements and Training

This survey requires at least one field technician (2 or more preferable), a data entry technician, a quality control technician, and a project biologist. If any future sites are included that may only be accessed by boat, two technicians must be present for sampling those points for safety reasons, with at least one having completed MOCC training and holding a current MOCC certification. Field technicians for the most part will consist of volunteers. Under staff or volunteer shortages, one individual may fill multiple roles, but different people must serve as data entry and quality control technicians to meet minimum quality assurance/quality control specifications of the project.

Most of the training requirements for water monitoring fall on the field technicians. At least one field technician is required to have completed defensive driving and hold a current certification to operate a government-owned vehicle. Field technicians should be properly trained on the use of equipment for data collection and collection of water and nutrient samples. Field technicians will receive training refreshers on protocols and equipment operation on an annual basis. At least one field technician will be trained on procedures for calibrating and validating the YSI equipment, including any required training and certifications needed to comply with Chesapeake Monitoring Cooperative requirements.

The data entry technician is responsible for transferring data from paper field data sheets to digital files, as well as the first level data verification. The data entry technician should have a basic level of understanding of water quality parameters, field procedures, and Excel software.

The quality assurance technician is responsible for finishing data verification and should have a sound knowledge of water quality parameters, field methods, survey design, and data management process and software. This person is also responsible for ensuring that vehicles are available for the field technicians, and if available try to accompany the field technicians at least once a year when collecting samples.

The project biologist is ultimately responsible for the successful implementation of protocols and data quality. The project biologist conducts or delegates data validation and provides the final review of data and summary reports. This person must have a sound knowledge of water quality parameters, field methods, survey design, and data management, as well as budget preparation, project planning, and dissemination of data.

Water Quality Monitoring – Blackwater National Wildlife Refuge

Date: _____ Collected by: _____

Wind Speed mph/Direction _____ Cloud Cover % _____

Location	Start Time 24 hr	Air Temp °F	Tide*	Depth (meters)	Secchi (meters)	Reading Level	H2O Temp °C	DO%	DO ppm	Spec Cond ms/cm	Salinity ppt	pH	Volume filtered
F - Route 335, Blackwater River						Top (0.5 m from surface)							
						Bottom (1.0 m from bottom)							
G - Key Wallace Drive, Little Blackwater River						Top (0.5 m from surface)							
						Bottom (1.0 m from bottom)							
H - Shorter's Wharf, Blackwater River						Top (0.5 m from surface)							
						Bottom (1.0 m from bottom)							
I - Bestpitch Ferry, Transquaking River						Top (0.5 m from surface)							
						Bottom (1.0 m from bottom)							

Tide: 1=High, 2=mid-outgoing, 3=Low, 4=mid-incoming

YSI Calibration Protocol

Checklist

- ☐ YSI Calibration Datasheet
- ☐ YSI
- ☐ Standard Conductivity Solution - 1000 SPC
- ☐ pH 7.00 Buffer Solution (yellow)
- ☐ pH 10.00 Buffer Solution (blue)
- ☐ Two bottles to store used buffer solution labeled “Used pH 7” and “Used pH 10”
- ☐ Distilled Water

Recommended Set up

1. Folder of past calibration sheets
2. Display Barometric Pressure and Specific Conductance
    a. Probe→Display→Barometer→mmHg
    b. Probe→Display→Conductivity→Sp. Conductance→SPC uS/cm

Calibrating

1. Unscrew YSI probe cap
2. Calibrate dissolved oxygen if needed (Acceptable range: 95 %/L – 105 %/L)
    a. Record pre-calibrated DO on Calibration Sheet
    b. Calibrate→ DO (%/L)→ Accept Calibration
    c. Wait 1 minute for DO to stabilize, make sure calibrated DO is within range
    d. Record post-calibrated DO% and mg/l on Calibration Sheet
3. Record barometric pressure (mmHg) and temperature (these values are not calibrated, if they look off make a note as we may need to send it in for repair)
4. Once finished calibrating DO, rinse the cap with DI water and fill them with the pH solutions and the conductivity solution
5. *Calibrating Specific Conductivity*
    a. Rinse probe with DI water and place into cap with conductivity standard solution

i. Display conductivity calibration page: Cal→ Conductivity→Sp. Conductance→SPC uS/cm

b. Wait for pre-calibration reading to settle. Record in pre-calibration under SC (us/cm)
c. Change calibration value to read [1000]
d. Accept calibration
e. Wait for SC to settle, record in post calibration
f. Acceptable range: 900-1,100. Check box if calibrates
g. Remove probe and rinse with DI water

6. *Calibrating pH*
    a. Rinse probe by filling cap to calibration line with DI water or used 7.00 buffer solution (yellow), insert probe and screw on cap, shake 10 times, unscrew and dump out water/solution
    b. Fill to calibration line with new 7.00 buffer solution
    c. Display conductivity calibration page
        i. Cal→ pH
    d. Wait for pre-calibration reading to settle, record in pre-calibration under 7.00
    e. If needed, change calibration value to read [7.00]
    f. Accept calibration
        i. Notice box on very bottom: “Ready for point.” this will change to “Ready for point 2.” This indicates moving to 10.00 buffer
    g. Remove and save 7.00 solution in bottle labeled “used 7.00 solution”
    h. Remove and repeat steps for 10.00 buffer solution (blue)
    i. After 10.00 buffer, accept calibration and press Cal to finish calibrating
    j. Remove and rinse probe with DI water and place probe in new 7.00 buffer
    k. Wait for pH to settle, record in post calibration
    l. Acceptable range: 6.80-7.20. Check box if calibrates
    m. Remove probe and rinse with DI water

7. Once finished, return all caps to YSIs make sure display screen is set the original appearance by removing Sp. Conductance and Barometer
8. If you observe any issues when calibrating (i.e. if a YSI is slow to settle on a reading), record these on the data sheet—if it's a recurring problem, send the YSI in for repair.
9. If the YSI calibrate for a particular parameter, do not take the field reading for that parameter until the meter has been fixed and the YSI can be successfully calibrated.

Post-Calibration Verification

1. Verify that the YSI probe remains within the calibration standards. Do not calibrate – simply verify that the parameters remain within the acceptable range.
2. *pH Verification*
    a. Place YSI Probe in new 7.00 buffer solution
    b. Wait for pH value to stabilize
    c. Acceptable range: +/- .20 Units (6.80-7.20)
3. *DO Verification*
    a. Acceptable range: +/-0.3 mg/L
4. *SPC Verification*
    a. Place YSI Probe in 1000 conductivity standard solution
    b. Wait for SPC value to stabilize
    c. Acceptable range: +/- 5% (900-1,100)
5. If probe reads outside of these standards, recalibrate the YSI and flag data
    a. YSI may need to be fixed/go in for maintenance

CALIBRATION SHEET

Solution Expiration Date:		pH7 / / pH10 / / sx1000 / /	Name of Calibrator:			
Calibration Date:		/ /	YSI Name: Pro DSS			
Verification Date:		/ /	Probe Number: 19H100436			
Parameter		Pre-Calibration	Post-Calibration	Calibrates? Y/N	Verification Value	Standard
Temp						pH: 7/10
mmHg						SC: 1000
pH	7.00					Notes:
	10.00					
DO %						
DO mg/L						
SC (µs/cm)						

Solution Expiration Date:		pH7 / / pH10 / / sx1000 / /	Name of Calibrator:			
Calibration Date:		/ /	YSI Name: Pro DSS			
Verification Date:		/ /	Probe Number: 19H100436			
Parameter		Pre-Calibration	Post-Calibration	Calibrates? Y/N	Verification Value	Standard
Temp						pH: 7/10
mmHg						SC: 1000
pH	7.00					Notes:
	10.00					
DO %						
DO mg/L						
SC (µs/cm)						

Solution Expiration Date:		pH7 / / pH10 / / sx1000 / /	Name of Calibrator:			
Calibration Date:		/ /	YSI Name: Pro DSS			
Verification Date:		/ /	Probe Number: 19H100436			
Parameter		Pre-Calibration	Post-Calibration	Calibrates? Y/N	Verification Value	Standard
Temp						pH: 7/10
mmHg						SC: 1000
pH	7.00					Notes:
	10.00					
DO %						
DO mg/L						
SC (µs/cm)						