

Monitoring Guidance for Cape Cod Ponds

Building on the history of pond monitoring that town staff and citizens alike have contributed to since the publication of the 2003 Ponds Atlas, a guiding framework for regional pond monitoring on Cape Cod is currently under development. As part of this framework, a Quality Assurance Project Plan (QAPP) for regional pond monitoring has been developed, which contains information about monitoring program structure, volunteer organization and training, data management, and protocols for sample collection, transport, and analysis. While certain elements of the monitoring framework are not yet in place, the information specific to sampling activities may be helpful as a reference for pond groups and organizations that are already established or are contemplating their own monitoring program. As groups continue to monitor or start monitoring, coordination of monitoring protocols with the upcoming Cape Cod Ponds Monitoring Program will streamline the launch of that regional effort.

The following information has been adapted from the QAPP established for the upcoming regional monitoring program and reformatted to best guide pond groups and organizations.

Designing a sampling program

The structure of a sampling program should be informed by and be a direct reflection of the goals that monitoring is intended to achieve. While there will be some areas of overlap, the structure and objectives of a regional monitoring program may be quite different from a monitoring program for a single pond.

The goal of the regional monitoring program is to establish a representative sample of ponds across the Cape, that provide insight into regional freshwater pond water quality and how it is impacted by factors including pond size, surrounding land use, land cover, and watershed characteristics. Initially, the Cape Cod Ponds Monitoring Program will consist of a snapshot reconnaissance-level approach to monitoring pond water quality, similar to the Pond and Lake Stewards program, to identify potential issues that may require remediation or further in-depth monitoring or studies. It is expected that the monitoring program will expand over time, with ponds that fill gaps and allow for more representative sampling of different watershed characteristics being prioritized. Details for that prioritization will be included in subsequent revisions to the Program's QAPP.

The Regional Monitoring Program will use the following criteria to guide initial selection of ponds for monitoring:

- Ponds must have a public access point
- Ponds with an active monitoring presence, or a history of monitoring (but not necessarily an active group) will be prioritized
- Ponds with demand for sampling will also be prioritized. Demand could be based on interest from residents, recreational or restoration/conservation significance to the town, or other factors

- In the future, other data sets may be used to aid in the selection of additional ponds for monitoring. As specific data sets and criteria are identified, the QAPP will be updated appropriately to include those details.

For monitoring programs at a smaller scale, the objectives and sample design will be different and should reflect local concerns or priorities. Modifications to a monitoring program may be used to target local threats to ponds such as the presence of invasive species or algal blooms, or to focus on local resources such as swimming beaches or fish habitat. Collecting one sample per year in a snapshot approach provides some basic understanding of year-to-year changes in ponds, but the number of sampling locations and sample frequency should be adjusted to fit the characteristics of the pond, program budget, and goals of monitoring. For example, adding a sampling event in late spring to the established late summer sampling date can provide insight into how a pond changes throughout the growing season. Additional sampling locations may also be appropriate for ponds with multiple basins that do not completely mix, or where specific concerns might dictate targeted sampling. Regardless of sampling frequency and location, the types of data collected should be similar to those proposed for the Cape Cod Ponds Monitoring Program, which were selected to provide a solid foundation for developing a pond management strategy. Following this approach can fit local priorities while collecting data that is directly comparable to historical and future measurements throughout the region and enhances our understanding of pond health throughout Cape Cod.

Equipment Needs

It is worth noting that a monitoring program can be started with as little equipment as a Secchi disk. This section outlines the equipment needed to conduct monitoring in accordance with the Cape Cod Ponds Monitoring Program QAPP. Equipment usage and methods are detailed in the Sampling Methods section.

For Field Measurements:

- Secchi disk
- Multiparameter meter (temperature, dissolved oxygen, pH, conductivity)

For Lab Samples:

- Niskin sampler

Most equipment can be purchased from environmental sampling or instrument vendors, including:

Cole-Parmer (coleparmer.com)

EnviroSupply (envirosupply.net)

Forestry Suppliers (forestry-suppliers.com)

Grainger (grainger.com)

Pine Environmental (pine-environmental.com)

Sampling Methods

The Cape Cod Ponds Monitoring Program follows a sampling protocol that has been used for citizen-based, volunteer pond water quality monitoring snapshots for 13 years on Cape Cod. Using the

same approach allows for direct comparison with previous monitoring data while also providing a valuable comparison between the ponds in the present study and other southeastern Massachusetts ponds that are in the same ecoregion.

As a snapshot sampling program, each pond should be visited once during the August 1 to September 30 sampling period, with monitoring activities including field monitoring of water quality conditions and collection of water samples for lab analyses. Samples should be collected between 7 a.m. and 3 p.m. to maximize phytoplankton activity. The sampling period was selected to sample what is likely to be the worst nutrient related water quality conditions in the ponds. Individual sampling dates within the sampling period should be arranged based on sampler availability, lab schedule, and weather forecasts to maintain representative sampling conditions and individual safety.

The field monitoring protocol described in the QAPP recommends that primary samples are collected from the deepest area of the pond, which should be located using a depth sounder. Sampling typically requires a small boat or kayak for access, unless a bridge or boardwalk facilitates safe collection of samples from the designated location. For new sampling locations, GPS coordinates should be established and recorded prior to, or during the first sampling. Existing sampling locations should be maintained where possible by using previous coordinates.

Field Measurements

At each location, a pre-calibrated multi-parameter water quality meter (e.g. YSI, Oakton, or similar) is used to measure temperature, pH, dissolved oxygen, and conductivity profiles at regular depth intervals as indicated below, and a Secchi disk to measure water transparency. Measurements should be recorded on a field sheet like the one attached.

Table 1. Recommended sampling depths based on total pond depth

Pond Depth	<1 m	1-9 m	9-11 m	>11 m
0.5 m	2 samples	1 sample	1 sample	1 sample
3 m			1 sample	1 sample
9 m				1 sample
1 m above bottom		1 sample	1 sample	1 sample

Laboratory Analyses

Water samples for laboratory analysis should be collected at standardized depths through the water column using Niskin samplers or similar sample collection devices according to the depth intervals shown in Table 1. Lab analysis of samples should include alkalinity, total phosphorus, total nitrogen, dissolved inorganic nutrients (nitrate+nitrite, ortho-phosphate, ammonium), chlorophyll *a* and phaeophytin. The sample collection details for each analysis will be determined by the analytical method specified by the laboratory.

The regional monitoring QAPP currently contains protocols and standard operating procedures from the Provincetown Center for Coastal Studies lab, which are included in Table 2. Incorporating additional laboratories into the QAPP is anticipated as part of the QAPP revision process. Groups are encouraged to arrange sampling events with an environmental laboratory certified to run the appropriate freshwater analyses. Laboratories typically provide sample collection bottles and sample coolers and will also determine sampling and labeling methods and protocols.

For example, under the regional pond monitoring QAPP and as detailed in Table 2, a one-liter water sample is collected and divided into three subsamples: one for Total Nitrogen and Total Phosphorus; one for Nitrate/Nitrite, Ammonia, and Ortho-phosphate; and one for Chlorophyll a and Phaeophytin. A separate 250 ml sample is collected for Alkalinity. A minimum of two sets of samples for lab analyses should be collected at each pond. Field measurements should be recorded on a field sampling sheet, like the one attached, and/or stored in the memory of the multiparameter meter and downloaded at the conclusion of sampling.

Table 2. Sample collection and storage requirements for lab analysis samples specific to the Center for Coastal Studies lab.

Parameter	Sample Container	Analytical Sample Volume per analyte	Sample Processing	Maximum Holding Time to Analysis
Total Nitrogen Total Phosphorus	1-L wide-mouth Amber HDPE bottle	125 ml	Decant into 125 ml polypropylene bottle and freeze until analysis.	28 days
Nitrate/Nitrite Ammonia Ortho-phosphate		80 ml	Pass through Nucleopore filter, freeze filtrate in 100 ml whirl pak until analysis	28 days
Chlorophyll <i>a</i> Phaeophytin		100 - 500 ml	Pass sample through Whatman GF/F. Wrap filter in foil and freeze until analysis.	28 days
Alkalinity	250 ml wide-mouth HDPE bottle	250 ml	N/A	24 hours

Sample Handling and Custody

As noted above, the specific details regarding sampling protocol should be defined by the monitoring program and laboratory. Sample handling and custody will also be determined by the lab and program. Chain-of-Custody and handling is important to track where and when the samples were taken, by whom, and that sample integrity has been maintained prior to analysis. An example Chain-of-Custody Form is attached. Important elements these sheets should include are sample ID, which can be created to distinguish sampling sites and sample replicates, Pond ID (found using the [Cape Cod Ponds Atlas](#)), pond name, sampler name, and sample date and time. Example protocols that a lab and monitoring program may design are provided below:

Samples will be divided, filtered as applicable, and frozen; or transferred to dark HDPE acid-washed 1-liter bottles and transported by the volunteers, courier, or Monitoring Coordinator in coolers with ice packs (4°C) from the sampling site to the lab. Duplicate quality assurance (QA) samples will be collected and analyzed for 10% of samples collected during the sampling period. All samples will be processed and frozen or delivered to the lab within six (6) hours of collection.

Sample Bottles: The laboratory provides pre-cleaned polyethylene bottles to the program Monitoring Coordinator prior to sampling. The top and side of all bottles should be labeled, including the organization's name, date sample was collected, and sample ID.

Chain of Custody: The Chain of Custody form is included with the samples upon delivery to the lab and a copy is filed with monitoring records. It includes relevant information such as the date and time of delivery, the pond name and location, who retrieved the samples at the delivery site, the number of samples, and a list of the sample IDs included in the delivery. Samples must meet the holding time requirements for each lab analysis, and if samples surpass recommended holding times, the respective data are flagged as suspect.

Data management

Monitoring data should be recorded on field sheets, like the one attached. Electronic copies, through scans or photographs of field sheets should also be collected for redundancy. Data should be input to excel or similar data analysis program where it can be graphed to determine outliers and track trends. Data collected through the Cape Cod Ponds Monitoring Program will be shared with the Commission in electronic form (xlsx, csv) or uploaded directly into the water quality database . All field and lab data will be retained in electronic copy on the Commission's Regional Water Quality Database. Ponds groups or organizations should consider sharing data with the Commission to contribute to the Regional Water Quality Database. Procedures can be developed to import data from a variety of formats into the regional database, and staff are available to assist monitoring groups with the data sharing and import processes.

Data Quality

Data collected through the regional monitoring program will be used in making decisions regarding pond protection and management activities, and as such it is critical to have a QAPP detailing the program, sampling, analysis, and data management protocols. While maintaining data quality is

important at the local and regional level, such rigorous protocols may not be needed for non-regulatory or municipal decision-making purposes. The Massachusetts Department of Environmental Protection has guidance regarding data quality and data use that may be helpful for determining whether a QAPP is needed for your particular situation (<https://www.mass.gov/guides/external-data-submittals-to-the-watershed-planning-program>). When the regional program is operational, local monitoring programs should be able to operate under the regional QAPP to ensure data collected can be used for its desired purposes up to and including support for regulatory decisions. In the interim, programs can utilize these monitoring guidelines to develop a plan to ensure the quality of data collected is appropriate for its intended usage. In order for the data to be useable (i.e., for inclusion in a regional water quality monitoring database), data must meet certain data quality objectives. These data quality objectives are listed below:

- Samples collected are representative of the study area;
- Data collected in the field and in the lab are accurate and unbiased;
- Data sensitivity and precision fall within acceptable resolutions specified by regulatory agencies and equipment manufacturers;
- Data collection is complete – missing or erroneous data does not exceed 20% of intended collection; and
- Data are comparable across sites and across water quality programs.

Sample Chain of Custody Information:

For Sender to fill out:

Pond ID:

Pond name, town:

Date and time samples placed in cooler:

Number of samples sent:

Name of person packing cooler with samples:

Notes or instructions for lab:

For Receiving Lab to fill out:

Cooler ID:

Pond ID:

Pond name, town:

Date and time cooler received:

Number of samples received:

Condition of samples received (i.e., temperature):

Initials of person receiving cooler and unpacking samples:

Notes or instructions for analytical lab staff:

Example Chain-of-Custody Form

Lab: _____

Client: _____ Samplers Signature _____

Ship Date: _____

Sample ID	Station	Date	Time	Type	#Bottles	Analyses	Comments
WM01	Swan Pond	7/7/20	14:07	water	1	DIN	Filtered with 0.45 μ m filter

Relinquished by: Signature	Received by: Signature	Date/Time
Relinquished by: Signature	Received by: Signature	Date/Time

Example Sample Label

Sample ID:	_____	Sample #:	_____
Pond Name:	_____	Sample Depth:	_____
Pond ID:	_____	Town:	_____
Sampler Initials:	_____	Organization:	_____
Date:	_____ _____	Time:	_____ _____

Example Field Checklist, Cape Cod Ponds Monitoring Program

Pond Monitoring Program Checklist

Needed prior to sampling date:

- Ensure adequate bottle supply for all anticipated samples, including field duplicates
- Ensure all sampling equipment is working properly.
- Gather all ancillary field materials, including GPS, sampling sheets, coolers, ice packs, labeling pen, etc.

For sampling day:

- Field monitoring/sampling chain-of-custody sheets for each pond
- Map(s) or queued digital map images of access points
- Phone numbers of access contacts for private access points
- Sufficient sample bottles for each pond plus field duplicates
- Cooler and ice packs (each cooler is assigned a unique number)
- Sampling equipment, including DO/Temperature meter, sampling device, and Secchi disk

Return of samples to lab:

- Ensure samples remain cold until returned.
- Samples should be sent to CCS lab within 6 hours of collection to maintain holding times.
- Field monitoring/sampling chain-of-custody sheets should be signed by samplers, transfer personnel, and all Lab staff that control/transport the samples/data sheets, including time and location.
- Photograph field monitoring/sampling chain-of-custody sheet
- Ensure field monitoring/sampling chain-of-custody sheets are collected and stored for later review and input of field data into spreadsheets.