United States Environmental Protection Agency
Office of Water
Washington, DC
EPA 841-B-11-003

2012 National Lakes Assessment

Field Operations Manual

Version 1.0, May 15, 2012

NOTICE

The intention of the 2012 National Lakes Assessment (NLA 2012) project is to provide a comprehensive "State of the Lakes" assessment for lakes, ponds, and reservoirs across the United States. The complete documentation of overall project management, design, methods, and standards and Quality Assurance/Quality Control measures is contained in this document and companion documents, including:

2012 National Lakes Assessment: Quality Assurance Project Plan (EPA 841-B-11-006)

2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005)

2012 National Lakes Assessment: Laboratory Operations Manual (EPA 841-B-11-004)

These documents together comprise the integrated set of QAPP documents. This document (*Field Operations Manual*) contains a brief introduction and procedures to follow at the base location and on-site, including methods for sampling water chemistry (grabs and *in situ*), phytoplankton, zooplankton, sediment (diatoms and mercury), algal toxins, benthic macroinvertebrates, and physical habitat. These methods are based on both the guidelines developed and followed in the Western Environmental Monitoring and Assessment Program (Baker, et. al., 1997) and methods employed by several key states that were involved in the planning phase of this project. Methods described in this document are to be used specifically in work relating to the NLA 2012. All Project Cooperators should follow these guidelines. Mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use. Details on specific methods for site evaluation and sample processing can be found in the appropriate companion document.

The suggested citation for this document is:

> USEPA. 2011. 2012 National Lakes Assessment. Field Operations Manual. EPA 841-B-11-003. U.S. Environmental Protection Agency, Washington, DC.

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ACRONYMS/ABBREVIATIONS

ANC	acid neutralizing capacity
CO_2	carbon dioxide
CPR	cardiopulmonary resuscitation
DBH	diameter at breast height
DI	deionized
DO	dissolved oxygen
DOC	dissolved organic carbon
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
ETOH	ethyl alcohol
FOM	Field Operations Manual
GIS	geographic information system
GPS	global positioning device
HDPE	high density polyethylene
H_2S	hydrogen sulfide
IM	Information Management
LOM	Lab Operations Manual
MPCA	Minnesota Pollution Control Agency
NALMS	North American Lakes Management Society
NARS	National Aquatic Resource Surveys
NH_4	ammonium
NIST	National Institute of Standards
NLA	National Lakes Assessment
NO_3	nitrate
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PHab	physical habitat
QA	quality assurance
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QCCS	quality control check solution
QRG	Quick Reference Guide
SEG	Site Evaluation Guidelines
SOPs	Standard Operating Procedures
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TSS	total suspended solids
TVS	total volatile solids
USGS	United States Geological Survey

1.0 BACKGROUND

This manual describes field protocols and daily operations for crews to use in the 2012 National Lakes Assessment. The NLA 2012 is a statistical assessment of the condition of our nation's lakes, ponds, and reservoirs (subsequently referred to in this manual as "lakes") and is designed to:

- Assess the condition of the nation's lakes.
- Establish a baseline to compare future surveys for trends assessment and evaluate change in condition since the 2007 National Lakes Assessment (US EPA 2009).
- Help build State and Tribal capacity for monitoring and assessment and promote collaboration across jurisdictional boundaries.

This is one of a series of water surveys being conducted by states, tribes, the U.S. Environmental Protection Agency (EPA), and other partners. In addition to lakes, partners will also study coastal waters, wadeable streams, rivers, and wetlands in a revolving sequence. The purpose of these surveys is to generate statistically-valid reports on the condition of our nation's water resources and identify key stressors to these systems.

The goal of the NLA 2012 is to address two key questions about the quality of the nation's lakes, ponds, and reservoirs:

- What percent of the nation's lakes are in good, fair, and poor condition for key indicators of trophic state, ecological health, and human use (recreation)?
- What is the relative importance of key stressors such as nutrients and pathogens?

The NLA 2012 is designed to be completed during the summer growing season before lake turnover (June through September). Field crews will collect a variety of measurements and indicators from an "index site" located at the deepest point of the lake (or in the middle of the lake if the lake is deeper than 50 meters) and document conditions of the littoral zone and shoreline from stations around the lake.

1.1 Selection of Sampling Locations

EPA selected sampling locations using a probability based survey design (e.g., Stevens and Olsen 2004). Sample surveys have been used in a variety of fields (e.g. election polls, monthly labor estimates, forest inventory analysis) to determine the status of population or resources of interest using a representative sample of relatively few members or sites. Using this survey design allows data from the subset of sampled lakes to be applied to the larger target population and assessments with known confidence bounds to be made.

With input from the states and other partners, EPA used the following framework to guide the site selection process:

- The National Hydrography Dataset (NHD) was used to derive a list of lakes for potential inclusion in the NLA 2012.
- For purposes of this survey "lakes" refers to natural and man-made freshwater lakes, ponds, and reservoirs greater than 1 hectare (approximately 2.5 acres) in the conterminous U.S., excluding the Great Lakes.

Mine ponds, retention basins, cooling ponds, and saline lakes due to salt water intrusion were excluded from this study. For more information on the site exclusion criteria refer to the 2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005).

- The sample size was set to include 1,000 lake sampling events.

The result was the inclusion of 904 discrete lakes, with 96 of the lakes to be scheduled for revisits. Of these, 398 lakes are resample lakes from NLA 2007. An "oversample" list of additional lakes was also generated to allow for replacement of non-target or otherwise unsampleable sites. The oversample list will also accommodate any state wishing to conduct a state scale survey.

Lakes selected for the NLA 2012 are distributed among six size class categories and are spatially distributed across the lower 48 states and nine aggregated Omernik Level 3 ecoregions.

Related NLA 2012 documents include the following:

2012 National Lakes Assessment: Quality Assurance Project Plan (EPA 841-B-11-006)

2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005)

2012 National Lakes Assessment: Laboratory Operations Manual (EPA 841-B-11-004)

These documents are available at: http://www.epa.gov/owow/lakes/lakessurvey.

1.2 Selection and Description of Survey Indicators

As part of the indicator selection process, EPA and the NLA 2012 Steering Committee evaluated indicators used in NLA 2007, refined methodologies, and identified new indicators for NLA 2012. The Steering Committee, comprised of state representatives from each of the EPA regions, provided advice and recommendations to the Agency on matters related to the NLA 2012. Key screening and evaluation criteria included indicator applicability on a national scale, the ability of an indicator to reflect various aspects of ecological condition, and cost-effectiveness (e.g., Kurtz et al, 2001). EPA used the Committee's recommendations to refine methods and develop final documents.

The remainder of this section briefly describes the indicators that the NLA 2012 will use to assess trophic status, ecological integrity, human use value, and lake characteristics (also see Table 1.1). Some indicators provide a basis for evaluating more than one category. For example, an assessment of phytoplankton allows for an examination of ecological integrity and trophic status, and to a certain extent, human use.

1.2.1 Trophic Status and Water Quality Indicators

Lakes are classified according to their trophic state. "Trophic" means nutrition or growth. A eutrophic ("well-nourished") lake has high nutrients and high plant growth. An oligotrophic lake has low nutrient concentrations and low plant growth. Mesotrophic lakes fall somewhere in between eutrophic and oligotrophic lakes.

Three variables, chlorophyll, total phosphorus, and Secchi transparency, are most often used to estimate biomass and define the trophic state of a particular lake. Other variables are measured in conjunction with the trophic state variables to supplement and enhance understanding of lake processes that affect primary productivity.

1.2.1.1 Chlorophyll-a

Chlorophyll is the pigment that allows plants (including algae) to use sunlight to convert simple molecules into organic compounds via the process of photosynthesis. Of the several kinds of chlorophyll, chlorophyll-*a* is the predominant type found in green plants and algae. Measuring chlorophyll-*a* concentrations in water is a surrogate for actually measuring algae biomass and it is used to estimate trophic status.

1.2.1.2 Secchi Disk Transparency

A Secchi disk is a black and white patterned disk commonly used to measure the clarity of water based on the distance the disk can be seen when it is lowered into the water column. The Secchi disk measurement is used to estimate the euphotic zone depth in the field which is generally defined as two-times the Secchi disk depth.

1.2.1.3 Vertical Profile Measurements

Depth profiles for temperature, pH and dissolved oxygen (DO) are taken with a calibrated water quality probe meter or multi-probe sonde from the index site in each lake. This information is used to determine the extent of stratification and the availability of the appropriate temperature range and level of DO necessary to support aquatic life.

1.2.1.4 Water Chemistry and Associated Measurements

Water chemistry measurements are used to determine the acidic conditions, trophic state and nutrient enrichment, and water chemistry type.

1.2.2 Ecological Integrity Indicators

Ecological integrity describes the ecological condition of a lake based on different assemblages of the aquatic community and their physical habitat. The indicators include plankton (phytoplankton and zooplankton), benthic macroinvertebrates, diatoms, and the physical habitat of the shoreline and littoral zones.

1.2.2.1 Benthic Macroinvertebrate Assemblage

Benthic macroinvertebrates are bottom-dwelling animals without backbones (“invertebrates”) that are large enough to be seen with the naked eye (“macro”). Examples of macroinvertebrates include: crayfish, snails, clams, aquatic worms, leeches, and the larval and nymph stages of many insects, including dragonflies, mosquitoes, and mayflies. Populations in the benthic assemblage respond to a wide array of stressors in different ways so that it is often possible to determine the type of stress that has affected a macroinvertebrate assemblage (e.g., Klemm et al., 1990). Because many macroinvertebrates have relatively long life cycles of a year or more and are relatively immobile, the structure and function of the macroinvertebrate assemblage is a response to exposure of present or past conditions. For the NLA, the benthic macroinvertebrate assemblage occupying the littoral zone will be assessed, rather than the profundal assemblage occupying the deeper regions of lakes.

1.2.2.2 Macrophyte Assemblage Characterization

The abundance and type of aquatic macrophyte growth are commonly cited as major concerns of state and individual lake managers. Where submerged aquatic macrophytes are abundant, they can dominate habitat structure, fishability, recreational use and nutrient dynamics in lakes. Consequently, whole Lake evaluations of submerged aquatic macrophytes provide critical information about a lake's ecological integrity, as well as impacts of stressors such as habitat impairment, eutrophication, and invasive species.

1.2.2.3 Physical Habitat Characterization

The characterization of shoreline and littoral zone (the nearshore areas of a lake) physical habitat (PHab) conditions serves three purposes. First, habitat information is essential to the interpretation of expected lake ecological condition in the absence of human disturbance (anthropogenic impacts). Second, the habitat evaluation is a reproducible, quantified estimate of habitat condition, serving as a benchmark against which to compare future habitat changes that might result from anthropogenic activities. Third, the specific selections of habitat information collected aid in the diagnosis of probable causes of ecological degradation in lakes.

In addition to information collected in the field by the shoreline and littoral surveys, the physical habitat description of each lake includes many map-derived variables such as lake surface area, shoreline length, and shoreline complexity. Furthermore, an array of information, including watershed topography and land use, supplements the physical habitat information. The shoreline and littoral characterization concentrates on information best derived “on the ground”. As such, these results provide the linkage between large watershed-scale influences and those influences that directly affect aquatic organisms day to day. Together with water chemistry, the habitat measurements and observations describe the variety of physical and chemical conditions that are necessary to support biological diversity and foster long-term ecosystem stability. These characteristics of lakes and their shorelines are the very aspects that are often changed as a result of anthropogenic activities.

1.2.2.4 Phytoplankton Assemblage

Phytoplankton are plant microorganisms that float in the water, such as certain algae, and are the primary source of energy in most lake systems(e.g., Schriver et al. 1995).Phytoplankton are highly sensitive to changes in ecosystems (e.g., turbidity and nutrient enrichment).

1.2.2.5 Sediment Diatom Assemblage

Diatoms are a group of microscopic algae that have silicon dioxide cell walls and are commonly preserved in lake sediments. This indicator is unique in its ability to indicate past conditions in the lake and its basin based on species specific environmental requirements (e.g., Dixit et al. 1992, Smol 2012). In addition, environmental variables (e.g. alkalinity, total P, conductivity, etc.) have been inferred using diatom-based predictive models. When possible we will date the sediment so that we are able to identify the time of deposition.

1.2.2.6 Sediment Mercury

Mercury is found in many rocks, including coal. When coal is burned, mercury is released into the environment. Mercury in the air eventually settles into water or is washed into water. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish, and animals that eat fish. Fish and shellfish are the main sources of methylmercury exposure to humans.

Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Birds and mammals that eat fish are more exposed to mercury than other animals in aquatic ecosystems. Similarly, predators that eat fish-eating animals may be highly exposed. At high levels of exposure, methylmercury's harmful effects on these animals include death, reduced reproduction, slower growth and development, and abnormal behavior. Mercury information collected from the NLA 2012 will allow scientists to better predict the impacts of mercury deposition on a watershed.

1.2.2.7 Zooplankton Assemblage

Zooplankton are animal microorganisms that consist of crustaceans (e.g., copepods and cladocerans), rotifers (“wheel-animals”), pelagic insect larvae (e.g., phantom midges), and aquatic mites. The zooplankton assemblage constitutes an important element of the food web, where zooplankton transfer energy from algae (primary producers) to larger invertebrate predators and fish. The zooplankton assemblage responds to environmental stressors such as nutrient enrichment and acidification (e.g., Stemberger and Lazorchak 1994, Dodson et al. 2005). The effects of these environmental stressors on zooplankton can be detected through changes in species composition, abundance, and body size distribution.

1.2.3 Human Use Indicators

Human use indicators address the ability of the lake population to support recreational uses such as swimming, fishing and boating. The protection of these uses is one of the requirements of the Clean Water Act under 305(b). The extent of algal toxins (microcystins) and triazine pesticides will serve as the primary indicators of human use.

1.2.3.1 Algal toxins (microcystins)

Microcystis and other cyanobacteria are microscopic organisms found naturally at low concentrations in freshwater systems. Under optimal conditions (such as high light and calm weather, usually in summer), these algae occasionally form blooms, or dense aggregation of cells, that float on the surface of the water forming a thick layer or “mat.” At higher concentrations, blooms may be so dense that they resemble bright green paint that has been spilled in the water. These blooms potentially affect water quality as well as human health (*Microcystis* produces microcystin, a potent liver toxin) and natural resources. Decomposition of large blooms can lower the concentration of DO in the water, resulting in hypoxia (low oxygen) or anoxia (no oxygen). Sometimes, this results in fish kills. The blooms can also be unsightly, often floating at the surface in a layer of decaying, odiferous, gelatinous scum.

Although the likelihood of people being affected by a cyanobacteria bloom is low, minor skin irritation can occur with contact, and gastrointestinal discomfort can also occur if water from a bloom is ingested. People recreationally exposed (e.g., personal watercraft operators) to cyanobacteria blooms have also reported minor skin irritation. Health problems may occur in animals if they are chronically exposed to fresh water with *Microcystis* or other cyanobacteria present. Just as livestock and domestic animals can be poisoned by drinking contaminated water, fish and bird mortalities have been reported in water bodies with persistent cyanobacteria blooms.

1.2.3.2 Triazine Pesticide Screen

Triazine pesticides are herbicides used to control the growth of weeds. Although applied to the land, these chemicals can enter lakes via transport in water (e.g., runoff, groundwater) or atmospheric transport. This screen will provide information about the occurrence and concentration of triazine pesticides in water samples from lakes across the nation.

1.2.4 Other Indicators

1.2.4.1 Lake Characterizations

Observations and impressions about the lake and its surrounding catchment by field crews will be useful for ecological value assessment, development of associations and stressor indicators, and data verification and validation.

1.2.4.2 Dissolved Carbon

EPA is collaborating on a research program to look at dissolved carbon levels in select lakes for purposes of the USGS Land Carbon study on dissolved carbon concentrations.

Table 1.1 Summary table of indicators

Indicator Type	Indicator	Specifications/Location in Lake		
		Desktop Evaluation	**Index Site**	**Littoral Site**
Trophic Indicators	Vertical profile measurements (DO, Temperature, pH)		X	
	Secchi Disk transparency		X	
	Water chemistry (NH_4, NO_3), major anions and cations, alkalinity (ANC), DOC, TSS, silica, conductivity		Integrated water sample	
	Nutrients		Integrated water sample	
	Chlorophyll-*a* (and see human use)		Integrated water sample	
Ecological Integrity	Phytoplankton assemblage		Integrated water sample	J station
	Zooplankton assemblage (composition, structure, and size distribution)		Vertical tow (2 mesh sizes) through water column	
	Benthic macroinvertebrate assemblage			10 physical habitat stations
	Sediment diatom assemblage		Sediment core	
	Sediment dating (natural lakes only)		Sediment core	
	Physical habitat characterization			10 stations
	Macrophyte assemblage characterization			5 stations (A,C,E,G,I)
Human use	Sediment Mercury		Sediment core	
	Chlorophyll-*a* density			J station
	Phytoplankton (cyanobacteria)			J station
	Triazine pesticide screen		Integrated water sample	
	Algal toxins (microcystins)		Integrated water sample	J station
Other Indicators (desktop, some field	Lake area	Using GIS and used in target lake population		

observations)		selection		
	Basin morphometry	Using GIS		
	Characteristics of watershed	Using GIS and verified by state agencies		

2.0 LOGISTICS

2.1 Roles and Contact Information

Effective communication between Field Crews, U.S. Environmental Protection Agency (USEPA) coordinators, and NLA 2012 contractor support staff is essential for the survey to proceed with maximum efficiency and to ensure collection of high quality data. This section provides:

1) A general description of the roles of key NLA 2012 personnel in providing logistical and technical support to the Field Crews
2) Flow of communication between Field Crews and these individuals (i.e., *who to call for specific types of questions or support needs*)
3) Contact information

The **EPA Headquarters Project Management Team** consists of the Project Leader, Alternate Project Leaders, and Project QA Lead. The Team is responsible for overseeing all aspects of the project and ensuring technical and quality assurance requirements are properly carried out. The Team is the final authority on all decisions regarding field sampling, site evaluation, site replacement, and laboratory analysis.

The **EPA Regional Coordinators** are the primary USEPA point of contact for Field Crews operating in their Region. Field Crews should direct all technical and logistical questions to their EPA Coordinator, who will work with the EPA HQ Team to resolve the issue. Field Crews should also work with their EPA Coordinator to schedule an **Assistance Visit** to occur within the first two weeks of field sampling. An Assistance Visit is part of the Quality Assurance component of the NLA 2012 QAPP. To meet the requirements of the QAPP, each Field Crew will allow an EPA employee or contractor to observe that crew sampling for one day. The Assistance Visit is used to confirm the protocols are implemented as intended and to suggest corrective actions, if needed, to the Field Crew's sampling approach.

The **Information Management Coordinator** tracks the Field Crew's sampling schedules to provide packets of forms for each site scheduled to be sampled, and to track the location of each NLA 2012 sample that involves post-processing. Field crews are responsible for providing the Information Management Coordinator with their sampling schedule before sampling occurs and filing a status report after each site visit.

The Contract **Field Logistics Coordinator** is responsible for tracking the Field Crew's sampling activities and overall progress throughout the field season, ensuring that requests for supplies and equipment are filled, and assisting Field Crews with questions concerning field logistics, equipment, and supplies as they arise during the field season. The Field Logistics Coordinator will also review submitted status and tracking forms to ensure that the correct samples have been taken and that those samples are being sent to the labs in an appropriate timeframe.

Table 2.1 Personnel to call for specific types of questions and support needs.

Personnel	Call
EPA Regional Coordinators	First, to ask any questions about NLA, including questions on field protocols Grant questions Schedule Field Assistance Visit
EPA HQ Project Management Team	Ask questions about site access, site evaluation, and site

	replacement Ask questions about shipping locations and sample handling procedures Ask questions about Field Methods Ask questions about Survey Design Ask questions about QA procedures Ask questions about Lab Methods If you can't reach Regional Coordinator, IM Coordinator, or Field Logistics Coordinator If you are unsure who to call
Personnel	**ONLY Call**
Information Management Coordinator	Order field forms or site kits Submit a status report Notify EPA about change in sampling schedule Ask questions about submitting data packet If EPA Regional Coordinator directs you to them
Contract Logistics Coordinator	Order replacement items for site kits, base kits, or miscellaneous supplies Ask questions about shipping contract, or to order more shipping forms If EPA Coordinator directs you to them If you can't reach an EPA HQ or Regional Coordinator and it is an urgent question

Table 2.2 Contact information

Title	Name	Contact Information
EPA HQ Project Lead	Amina Pollard, OW	pollard.amina@epa.gov 202-566-2360
EPA HQ Project QA Lead	Sarah Lehmann, OW	lehmann.sarah@epa.gov 202-566-1379
EPA HQ Logistics Lead	Marsha Landis, OW	landis.marsha@epa.gov 202-564-2858
Contract Field Logistics Coordinator	Chris Turner, GLEC Inc.	cturner@glec.com 715-829-3737
Information Management Coordinator	Marlys Cappaert, SRA International Inc.	cappaert.marlys@epa.gov 541-754-4467 541-754-4799 (fax)
Regional EPA Coordinators	Hilary Snook, Region 1	snook.hilary@epa.gov 617-918-8670
	Jim Kurtenbach, Region 2	kurtenbach.james@epa.gov 732-321-6695
	Frank Borsuk, Region 3	borsuk.frank@epa.gov 304-234-0241
	Marion Hopkins, Region 4	hopkins.marion@epa.gov 404-562-9481
	Mari Nord, Region 5	nord.mari@epa.gov 312-886-3017

	Mike Schaub, Region 6	schaub.mike@epa.gov 214-665-7314
	Gary Welker, Region 7	welker.gary@epa.gov 913-551-7177
	Kris Jensen, Region 8 Jeff McPherson, Region 8	jensen.kris@epa.gov 303-312-6237 mcpherson.jeffrey@epa.gov 303-312-7752
	Sue Keydel, Region 9	keydel.susan@epa.gov 415-972-3106
	Lil Herger, Region 10	herger.lillian@epa.gov 206-553-1074

2.2 Key Information and Materials

2.2.1 Site Maps

Site maps have been provided to assist in the site evaluation process. Three maps are available: an aerial image, topographic map, and road map, see Figure 2.1. These maps provide an overlay of the NHD waterbody layer with the coordinate and label for the lake, if available. Each site is symbolized by the panel the lake is considered within: NLA 2007 site, NLA 2007 revisit site, NLA 2012 site, and NLA 2012 revisit site. Other important information that may assist in site evaluation is included on the map including: county, state, EPA region, latitude, longitude, class, ownership, and lake area. These maps will be helpful in the planning and preparation for visiting and sampling a particular NLA 2012 site. These maps will become part of your site packet. See more information on the site packet in Section 4.1.

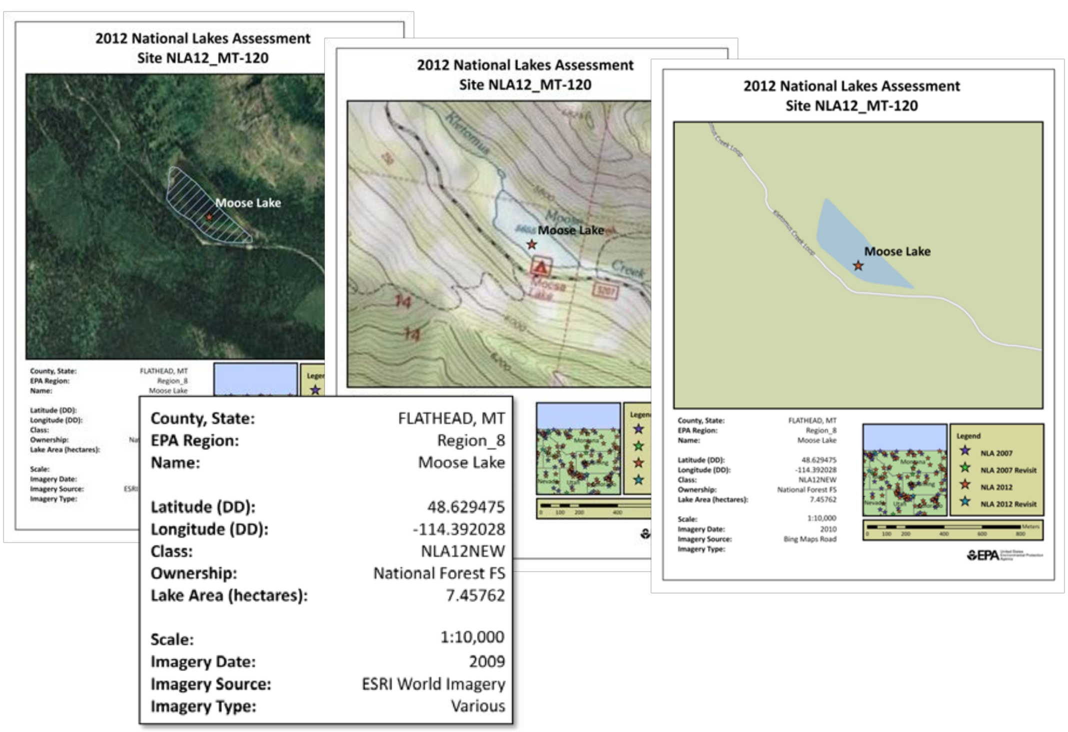


Figure 2.1 Sample site maps.

2.2.2 Forms (Paper or Electronic)

Forms are the key to data collection and tracking for the NLA 2012. This year, we have developed electronic forms as well as paper forms. These electronic forms should streamline data collection. Field crews will have the option of using paper or electronic forms.

2.2.2.1 Field Forms

Field forms are the primary documents where we record measures, observations, and collection information during the course of the field day. Additional information regarding specifics of data entry is contained in Section 3.2.

- **Paper Field Forms:** A paper field form packet for each site will be provided by the NARS IM Coordinator if you have elected to use paper field data collection. You will need to add these forms to the site packet (see Section 4.1) prior to going in the field. After a site is sampled, the completed NLA 2012 paper field forms are checked for completeness and organized sequentially into a Data Packet. The Data Packets from several sites are batched together and sent every 1-2 weeks to the NARS IM Center and accompanied by a Tracking – Packets form (see Section 2.2.2.2) to track which data packets have been shipped. Extra paper field forms will be provided to field crews to serve as backup copies in case of lost forms or problems with electronic field forms.

- **Electronic Field Forms:** This form of data collection can be collected through 3 platforms: an iOS, Android or a Windows portable electronic device (tablets, phones). This will require a field crew to download or install the developed Application (or "App") onto the device. The field forms will be optimized for tablet devices. Once downloaded and the App launched, the field forms will be split into sections or "form-lets" for easier data entry. It is important for a field crew to familiarize themselves with the App prior to field sampling. In addition, all data must be submitted through one device (even if multiple devices are used in the field).

2.2.2.2 Tracking Forms

Tracking forms describe the status and location of all samples collected during NLA 2012. Field crew leaders will typically transmit these forms electronically to the NARS IM Center at specified times and you will pack hard copies in shipping containers with the samples. See APPENDIX D: SHIPPING GUIDELINES for more information.

- **Site and Sample Status/Water Chemistry Lab Tracking**: Transmitted within 24 hours of sampling or visiting a site to report on the status of the site (e.g. sampleable or not), to record the Sample ID numbers, and to indicate the status of all samples collected at the site (immediate shipment and batch shipments). This also serves as the tracking form for sample shipped to the WRS lab.

- **Tracking – Packets**: Accompany packets that are batched together from multiple sites and shipped every 1 or 2 weeks. These are sent to the NARS IM Center.

- **Tracking – Batched Samples:** Accompany samples that are batched together from multiple sites and shipped every 1 or 2 weeks. Whenever batched samples are shipped to their designated lab for analysis, the appropriate tracking form, which lists the Sample ID numbers for all samples packed in a shipping container, is included in the shipping package and is also transmitted electronically to the NARS IM Center.

2.2.3 Equipment and Supplies

2.2.3.1 Request Form

Field Crews will submit requests for field forms, labels and site kits via an electronic **Request Form**. This form will be submitted to the NARS Information Management (IM) Coordinator who will ensure that the request reaches the appropriate entity. Crews must submit sampling schedules at or before the time of submitting request forms. Crews should submit the **Request Form** at least 2 weeks prior to their desired sampling date.

2.2.3.2 Base Kit

The Base Kit is comprised of the subset of durable equipment and supplies needed for NLA 2012 sampling that is provided by USEPA through the Field Logistics Coordinator. Typically one Base Kit is provided to each Field Crew and contains some of the equipment that is used throughout the field season. See APPENDIX B: EQUIPMENT & SUPPLIESfor a list of the items provided by USEPA in the Base Kit. We anticipate that this equipment will be available for use in future NLA efforts.

2.2.3.3 Site Kit

A Site Kit contains the subset of consumable supplies (i.e., items used up during sampling or requiring replacement after use) provided by USEPA through the Field Logistics Coordinator. The site kit will contain all the sample bottles and labels necessary for sampling a single lake. A new Site Kit is provided for each site sampled. See APPENDIX B: EQUIPMENT & SUPPLIESfor the consumable items that will be provided by USEPA.

2.2.3.4 Field Crew Supplied Items

The field crew will also supply particular items for the field sampling day. These might include supplies from the previous 2007 NLA, typical field equipment (like a GPS), or boat equipment. See APPENDIX B: EQUIPMENT & SUPPLIES for the items that the field crew will need to provide.

2.2.4 Other Resources

The complete documentation of overall project management, design, methods and standards, and quality assurance/quality control measures is contained in this document and companion documents (listed in NOTICE and described below). The 2012 NLA participants have agreed to follow this QAPP, including the protocols and design, and the associated documents – the NLA 2012 FOM, LOM and SEG.

2.2.4.1 Quick Reference Guide

Field crews will receive a NLA 2012 Quick Reference Guide (QRG) containing tables and figures summarizing field activities and protocols from the NLA 2012 Field Operations Manual (FOM). The QRG is meant to be used in the field to give NLA 2012 Field Crews a list of the required sampling protocols at each lake. While comprehensive, the steps contained in this QRG are not as detailed as the descriptions found within the NLA 2012 FOM. The user is assumed to have attending Field Training and completely read and understood the FOM before using this QRG at a field site. This waterproof handbook will be a field reference used by field crews after completing a required field training session. The field crews are also required to keep the FOM available in the field for reference and for possible protocol clarification.

2.2.4.2 Site Evaluation Guidelines

The NLA 2012 Site Evaluation Guidelines (SEG) outlines the process to compile the final list of candidate lakes for sampling. The process includes locating a candidate lake, evaluating the lake to determine if it meets the criteria for inclusion in the target population and is accessible for sampling, and if not, replacing it with an alternate candidate lake.

2.2.4.3 Quality Assurance Project Plan

Large-scale and/or long-term monitoring programs such as those envisioned for national surveys and assessments require a rigorous Quality Assurance program that can be implemented consistently by all participants throughout the duration of the monitoring period. QA is a required element of all EPA-sponsored studies that involve the collection of environmental data (USEPA 2000a, 2000b). Field crews will be provided a copy of the NLA 2012 Quality Assurance and Project Plan (QAPP). The QAPP contains more detailed information regarding QA/QC activities and procedures associated with general field operations, sample collection, measurement data collection for specific indicators, and data reporting activities. For more information on the project level Quality Assurance procedures, refer to the NLA 2012 QAPP.

2.2.4.4 Lab Operations Manual

The methods used for the laboratory sample analysis is available in the NLA 2012 Lab Operations Manual (LOM).

3.0 DAILY FIELD ACTIVITIES SUMMARY

This section presents a general overview of the activities that a field crew conducts during a typical 1-day sampling visit to a lake. The following sections include general guidelines for safety and health, recording data and using standardized field data forms and sample labels.

3.1 Safety and Health

Collection and analysis of samples can involve significant risks to personal safety and health. This section describes recommended training, communications, safety considerations, safety equipment and facilities, and safety guidelines for field operations. All field crews should develop a safety plan according to the requirements of their organization.

3.1.1 General Considerations

Important considerations related to field safety are listed below. It is the responsibility of the group safety officer or project leader to ensure that the necessary safety courses are taken by all field personnel and that all safety policies and procedures are followed. Sources of information regarding safety-related training include the American Red Cross (1979), the National Institute for Occupational Safety and Health (1981), U.S. Coast Guard (1987) and Ohio EPA (1990).

3.1.1.1 Recommended Training

- First aid
- Cardiopulmonary resuscitation (CPR)
- Vehicle safety (e.g., operation of 4-wheel drive vehicles, trailer towing and maneuvering)
- Boating and water safety (if boats are required to access sites)
- Field safety (weather, personal safety, orienteering, site reconnaissance prior to sampling)
- Equipment design, operation, and maintenance
- Handling of chemicals and other hazardous materials

3.1.1.2 Communications

A communications plan to address safety and emergency situations is essential. All field personnel need to be fully aware of all lines of communication. Field personnel should have a daily check-in procedure with their supervisor for safety. An emergency communications plan should include contacts for police, ambulance, fire departments, hospitals, and search and rescue personnel. Here are some items to address:

- Check-in schedule
- Sampling itinerary (vehicle used & description, time of departure & return, travel route)
- Contacts for police, ambulance, hospitals, fire departments, search and rescue personnel
- Emergency services available near each sampling site and base location
- Cell (or satellite) phone number, if possible

3.1.1.3 Personal Safety

Proper field clothing should be worn to prevent hypothermia, heat exhaustion, sunstroke, drowning, or other dangers. Field personnel should be able to swim, and a personal flotation device (PFD) must be used. Chest waders made of rubberized or neoprene material and suitable footwear must always be worn with a belt to prevent them from filling with water in case of a fall. Here are some personal safety items to address:

- Field clothing and other protective gear including lifejackets for all crew members
- Medical and personal information (allergies, personal health conditions)
- Personal contacts (family, telephone numbers, etc.)
- Physical exams and immunizations

3.1.1.4 Sampling Equipment

Persons using sampling equipment should become familiar with the hazards involved and establish appropriate safety practices prior to using them. Make sure all equipment is in safe working condition. If boats are used to access sampling sites, personnel must consider and prepare for hazards associated with the operation of motor vehicles, boats, winches, tools, and other incidental equipment. Boat operators should be familiar with U.S. Coast Guard rules and regulations for safe boating contained in the pamphlet, "*Federal Requirements for Recreational Boats*, " available from a local U.S. Coast Guard Director or Auxiliary or State Boating Official (U.S. Coast Guard, 1987). As dictated by specific state regulations, all boats with motors should have fire extinguishers, boat horns, life jackets, flotation cushions, and flares or communication devices.

Many hazards lie out of sight in the bottoms of lakes, rivers and streams. Broken glass or sharp pieces of metal embedded in the substrate can cause serious injury if care is not exercised when walking or working with the hands in such environments. Infectious agents and toxic substances that can be absorbed through the skin or inhaled may also be present in the water or sediment. Personnel who may be exposed to water known or suspected to contain human or animal wastes that carry causative agents or pathogens must be immunized against tetanus, hepatitis, typhoid fever, and polio. Biological wastes can also be a threat in the form of viruses, bacteria, rickettsia, fungi, or parasites.

3.1.2 Safety Equipment

Appropriate safety apparel such as waders, gloves, safety glasses, etc. must be available and used when necessary. First aid kits, fire extinguishers, and blankets must be readily available in the field. Cellular or satellite telephones and/or portable radios should be provided to field crews working in remote areas for use in case of an emergency. Supplies such as anti-bacterial soap and an adequate supply of clean water or ethyl alcohol must be available for cleaning exposed body parts that may have been contaminated by pollutants in the water.

3.1.2.1 Safety Guidelines for Field Operations

General safety guidelines for field operations are presented below. Personnel participating in field activities on a regular or infrequent basis should be in sound physical condition and have a physical examination annually or in accordance with Regional, State, or organizational requirements. All surface waters and sediments should be considered potential health hazards due to potential toxic substances or pathogens. Persons must become familiar with the health hazards associated with using chemical fixing and/or preserving agents. Chemical wastes can be hazardous due to flammability, explosiveness, toxicity, causticity, or chemical reactivity. All chemical wastes must be discarded according to standardized health and hazards procedures (e.g., National Institute for Occupational Safety and Health [1981]; U.S. EPA [1986]).

During the course of field research activities, field crews may observe violations of environmental regulations, may discover improperly disposed hazardous materials, or may observe or be involved with an accidental spill or release of hazardous materials. In such cases it is important that the proper actions be taken and that field personnel do not expose themselves to something harmful. The following guidelines should be applied:

1. First and foremost, protect the health and safety of all personnel. Take any necessary steps to avoid injury or exposure to hazardous materials. If you have been trained to take action such as cleaning up a minor fuel spill during fueling of a boat, do it. However, you should always err on the side of personal safety.
2. Field personnel should never disturb or retrieve improperly disposed hazardous materials from the field to bring back to a facility for "disposal." To do so may worsen the impact, may incur personal liability or liability for the crew members and their respective organizations, may cause personal injury, or may cause unbudgeted expenditure of time and money for proper treatment and disposal of the material. However, it is important not to ignore environmental incidents. Notify the proper authorities of any incident of this type so that they may take the necessary actions to properly respond to the incident.
3. For most environmental incidents, the following emergency telephone numbers should be provided to all field crews: State or Tribal department of environmental quality or protection, U.S. Coast Guard, and the U.S. EPA regional office. In the event of a major environmental incident, the National Response Center may need to be notified at 1-800-424-8802.

Specific Safety Guidelines are below:

- Two persons must be present during all sample collection activities, and no one should be left alone while in the field.
- Minimize exposure to lake water and sediments as much as possible. Use gloves if necessary, and clean exposed body parts as soon as possible after contact.
- All electrical equipment must bear the approval seal of Underwriters Laboratories (UL) and must be properly grounded to protect against electric shock.
- Use heavy gloves when hands are used to agitate the substrate during collection of benthic macroinvertebrate samples.
- Use appropriate protective equipment (e.g., gloves, safety glasses) when handling and using hazardous chemicals
- Persons working in areas where poisonous snakes may be encountered must check with the local Drug and Poison Control Center for recommendations on what should be done in case of a bite from a poisonous snake.
- Any person allergic to bee stings, other insect bites, or plants (i.e., poison ivy, oak, sumac, etc.) must take proper precautions and have any needed medications handy (e.g., an “Epi-Pen”).
- Protect yourself against the bite of deer or wood ticks because of the potential risk of acquiring pathogens that cause Rocky Mountain spotted fever, Lyme disease, and other diseases.
- Be familiar with the symptoms of hypothermia and know what to do in case symptoms occur. Hypothermia can kill a person at temperatures much above freezing (up to 10°C or 50°F) if he or she is exposed to wind or becomes wet.
- Be familiar with the symptoms of heat/sun stroke and be prepared to move a suffering individual into cooler surroundings and hydrate immediately.
- Handle and dispose of chemical wastes properly. Do not dispose of any chemicals in the field.

3.2 Recording Data and Other Information

All samples need to be identified and tracked, and associated information for each sample must be recorded. It is imperative that field and sample information be recorded accurately, consistently, and legibly. The cost of a sampling visit coupled with the short index period severely limits the ability to resample a lake if the initial information recorded was inaccurate or illegible. There are two forums for collecting sample data, as mentioned in Section 2.2.2, paper field forms and electronic field forms. Whichever format your field crew chooses to utilize, see below for important information pertaining to data entry for each of these forms.

3.2.1 Paper Field Forms

The NLA 2012 data and tracking forms are formatted so that the data you record can be scanned into a data entry system. It is important that field data and sample information are recorded accurately, consistently, and legibly. General guidelines for recording field measurements are presented in

Table 3.1. More detailed instructions for filling out specific forms are provided in each protocol chapter of this manual.

- **Official Data Forms** – The NARS IM Center will provide all forms for use in the NLA 2012. These forms will be provided in the **Field Form Packet** for each site. It is important to use only the forms provided by the NARS IM Team and not photocopies or other printouts, because they are formatted for to be read by the digital data scanners. Data not recorded on the official NLA 2012 Field Forms are unusable.
- **Site Number, Date, and Page Numbers:** Field forms will arrive without any site information completed, and each field crew must complete the header area of each page with the appropriate information (e.g., site ID, Date, Crew ID, etc). If any of this information is incorrect or omitted, it may be impossible to connect data or samples to a particular site, resulting in lost data.
    - The Site ID is NOT preprinted on the forms or on the labels and tags.
    - The Sample ID numbers ARE preprinted on sample labels and tags. Thus, it is vital to ensure that you correctly enter the Sample ID numbers in the correct areas on the field forms. It is also essential that you correctly enter the Site ID and Date on the labels and tags, along with any other required information for the specific sample.
    - Record the date sampling is initiated wherever it is requested.
- **Form Instructions** – Carefully follow all instructions on each data form. Consult the appropriate protocol chapter, if you have questions not answered by the form instructions, about how to record data for a particular form.
- **Confirmation Bubbles** – Most NLA forms have confirmation bubbles to indicate the meaning of blank data fields or unfilled data bubbles. Read these statements carefully and fill in the bubbles as requested to confirm exactly what empty data fields or unfilled data bubbles on a particular form mean. Completing the confirmation bubbles is critical to note that a data element was not observed at the site, rather than overlooked by the Field Crew.
- **Data Flags and Comments** – There is space on all forms to flag data for which additional information or explanation may be needed.

Table 3.1 Guidelines for recording field measurements and tracking information.

ACTIVITY	GUIDELINES

Field Measurements	
Data Recording	• Record observations and measurement values only on official NLA paper field forms (water-resistant) or electronic field forms. • Use a writing instrument that leaves clear, dark text (e.g. a No. 2 pencil for field forms or a water and smear proof fine-point indelible marker for labels as appropriate) to record information. • If you make an error when recording data and changes are required, it is best to cross out the error with a single horizontal line and rewrite the correct information. Use a flag if there isn't enough room in the data field and write the correct information in the comments section. • Complete all header information and record all data and sample id information requested on each form. • Use the correct Crew ID that was assigned during field training. • Use the formats specified. • Print legibly (and as large as possible). Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.), but do not use slashes (i.e. lines drawn through the character). Printing in capital letters enhances legibility. • For data that is recorded by filling in a data bubble, be certain to keep markings inside the circle while completely filling the bubble. • In cases where information is to be recorded repeatedly on a series of lines (e.g., physical habitat characteristics), do not use "ditto marks" (") or a straight vertical line. Record the information that is repeated on the first and last lines, and then connect these using a wavy vertical line. • When recording comments, print **legibly**. Make notations in comments field only; avoid marginal notes. Be concise, but avoid using abbreviations or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form. • Do not doodle on the forms, including the margins.
Data Qualifiers (Flags)	• Use only defined flag codes and record on data form in appropriate field. K = No measurement or observation made. U = Suspect measurement; re-measurement not possible. F_n = Miscellaneous flags (n=1, 2, etc.) assigned by a field crew during a particular sampling visit. • Explain reason for using K or U flags and define F_n flag in the comments section of the data form. Ensure the F_n numbers are unique on the data form and matched to the flag definition. F_n flags and definitions are not linked from one form to the next, so definitions need to be rewritten on each sheet whenever necessary.
Sample Collection	
Sample Labels and Tags	• Use a writing instrument that leaves clear, dark text (e.g., a No. 2 pencil or a water or smear proof fine-point indelible marker as appropriate) to record information on all labels and tags. • Use the sample-type appropriate adhesive labels or tags with preprinted Site ID and Sample ID numbers for each sample. Be sure to fill in any requested information about the sample on the sample label or tag, and affix it to the outside of the sample container. Cover completed labels and tags with clear tape. • Place a waterproof label inside each benthic macroinvertebrate collection jar with the required information written with a No. 2 lead pencil
Sample Collection Information	• Record that each sample has been collected on the appropriate data form. Be sure to record the Sample ID number from labels and tags in the appropriate fields on the data forms using the format requested on each data form.

ACTIVITY	GUIDELINES
Field Measurements	
Data Recording	• Record observations and measurement values only on official NLA paper field forms (water-resistant) or electronic field forms. • Use a writing instrument that leaves clear, dark text (e.g. a No. 2 pencil for field forms or a water and smear proof fine-point indelible marker for labels as appropriate) to record information. • If you make an error when recording data and changes are required, it is best to cross out the error with a single horizontal line and rewrite the correct information. Use a flag if there isn't enough room in the data field and write the correct information in the comments section. • Complete all header information and record all data and sample id information requested on each form. • Use the correct Crew ID that was assigned during field training. • Use the formats specified. • Print legibly (and as large as possible). Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.), but do not use slashes (i.e. lines drawn through the character). Printing in capital letters enhances legibility. • For data that is recorded by filling in a data bubble, be certain to keep markings inside the circle while completely filling the bubble. • In cases where information is to be recorded repeatedly on a series of lines (e.g., physical habitat characteristics), do not use "ditto marks" (") or a straight vertical line. Record the information that is repeated on the first and last lines, and then connect these using a wavy vertical line. • When recording comments, print **legibly**. Make notations in comments field only; avoid marginal notes. Be concise, but avoid using abbreviations or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form. • Do not doodle on the forms, including the margins.
Data Qualifiers (Flags)	• Use only defined flag codes and record on data form in appropriate field. K = No measurement or observation made. U = Suspect measurement; re-measurement not possible. F_n = Miscellaneous flags (*n*=1, 2, etc.) assigned by a field crew during a particular sampling visit. • Explain reason for using K or U flags and define F_n flag in the comments section of the data form. Ensure the F_n numbers are unique on the data form and matched to the flag definition. F_n flags and definitions are not linked from one form to the next, so definitions need to be rewritten on each sheet whenever necessary.
QA and Tracking	
Before Leaving Site: Review of Data Forms and Comparison of Sample Labels and Data Forms	• Review all data forms for accuracy, completeness, and legibility. • Review all sample labels for accuracy, completeness, and legibility. • Verify that the information recorded on the sample labels and tags is consistent with all Sample IDs listed on all data forms and on tracking form. • Confirm that the forms have been reviewed by recording your initials in the "Reviewed by" field in the upper right corner of each form.
Before Shipping Data Packets and Samples: Review of Data	• The Field Crew Leader must review the completed Data Packet before its transfer to the NARS IM Center to ensure it is complete and all data forms are consistent, correct, and legible. • Complete all tracking forms required for all samples being shipped. Review tracking

ACTIVITY	GUIDELINES
Field Measurements	
Data Recording	• Record observations and measurement values only on official NLA paper field forms (water-resistant) or electronic field forms. • Use a writing instrument that leaves clear, dark text (e.g. a No. 2 pencil for field forms or a water and smear proof fine-point indelible marker for labels as appropriate) to record information. • If you make an error when recording data and changes are required, it is best to cross out the error with a single horizontal line and rewrite the correct information. Use a flag if there isn't enough room in the data field and write the correct information in the comments section. • Complete all header information and record all data and sample id information requested on each form. • Use the correct Crew ID that was assigned during field training. • Use the formats specified. • Print legibly (and as large as possible). Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.), but do not use slashes (i.e. lines drawn through the character). Printing in capital letters enhances legibility. • For data that is recorded by filling in a data bubble, be certain to keep markings inside the circle while completely filling the bubble. • In cases where information is to be recorded repeatedly on a series of lines (e.g., physical habitat characteristics), do not use "ditto marks" (") or a straight vertical line. Record the information that is repeated on the first and last lines, and then connect these using a wavy vertical line. • When recording comments, print **legibly**. Make notations in comments field only; avoid marginal notes. Be concise, but avoid using abbreviations or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form. • Do not doodle on the forms, including the margins.
Data Qualifiers (Flags)	• Use only defined flag codes and record on data form in appropriate field. K = No measurement or observation made. U = Suspect measurement; re-measurement not possible. F_n = Miscellaneous flags (*n*=1, 2, etc.) assigned by a field crew during a particular sampling visit. • Explain reason for using K or U flags and define F_n flag in the comments section of the data form. Ensure the F_n numbers are unique on the data form and matched to the flag definition. F_n flags and definitions are not linked from one form to the next, so definitions need to be rewritten on each sheet whenever necessary.
Packets, Sample Labels and Tracking Forms	forms for consistency, correctness, and legibility. • Compare labels and tags on samples with the Sample IDs recorded on the tracking form for accuracy, completeness, and legibility before shipping samples and transmitting the tracking forms to the NARS IM Center.

3.2.2 Electronic Field Forms

Many of the above guidelines will be followed for Electronic field forms. Additional data checks are built into the application which will not allow particular data to be entered if certain conditions are not met. But despite those checks, it is important to note that the field crew is responsible for the data entered and must be careful to make sure the data entered is accurate for the site.

3.3 Sampling Scenario

Field methods for the NLA 2012 are designed to be completed in one field day for most lakes. Depending on the time needed for both the sampling and traveling for that day, an additional day may be needed for pre-departure and post-sampling activities (e.g., cleaning equipment, repairing gear, shipping samples, and traveling to the next lake). Remote lakes with lengthy or difficult approaches may require more time to gain access to the lake, and field crews will need to plan accordingly.

A field crew typically will consist of at least two people. Two people are always required in the boat together to execute the sampling activities and to ensure safety. Any additional crew members may either remain on shore to provide logistical support or be deployed in a second boat to assist in data collection. Figure 3.1 and Figure 3.2 present a daily field sampling scenario showing how the work load may be split between crew members. Each field crew should define roles and responsibilities for each crew member to organize field activities efficiently. Minor modifications to the sampling scenario may be made by crews; however the sequence of sampling events presented in Figure 3.1 cannot be changed and is based on the need to protect some types of samples from potential contamination and to minimize holding times once samples are collected. The following sections further define the sampling sequence and the protocols for sampling activities.

NOTE*: When sampling large lakes (lakes > 10,000 hectares), field crews may omit the physical habitat and benthic macroinvertebrate sampling efforts altogether, and phytoplankton (cyanobacteria), chlorophyll-a, and algal toxin samples will be collected near the launch site.*

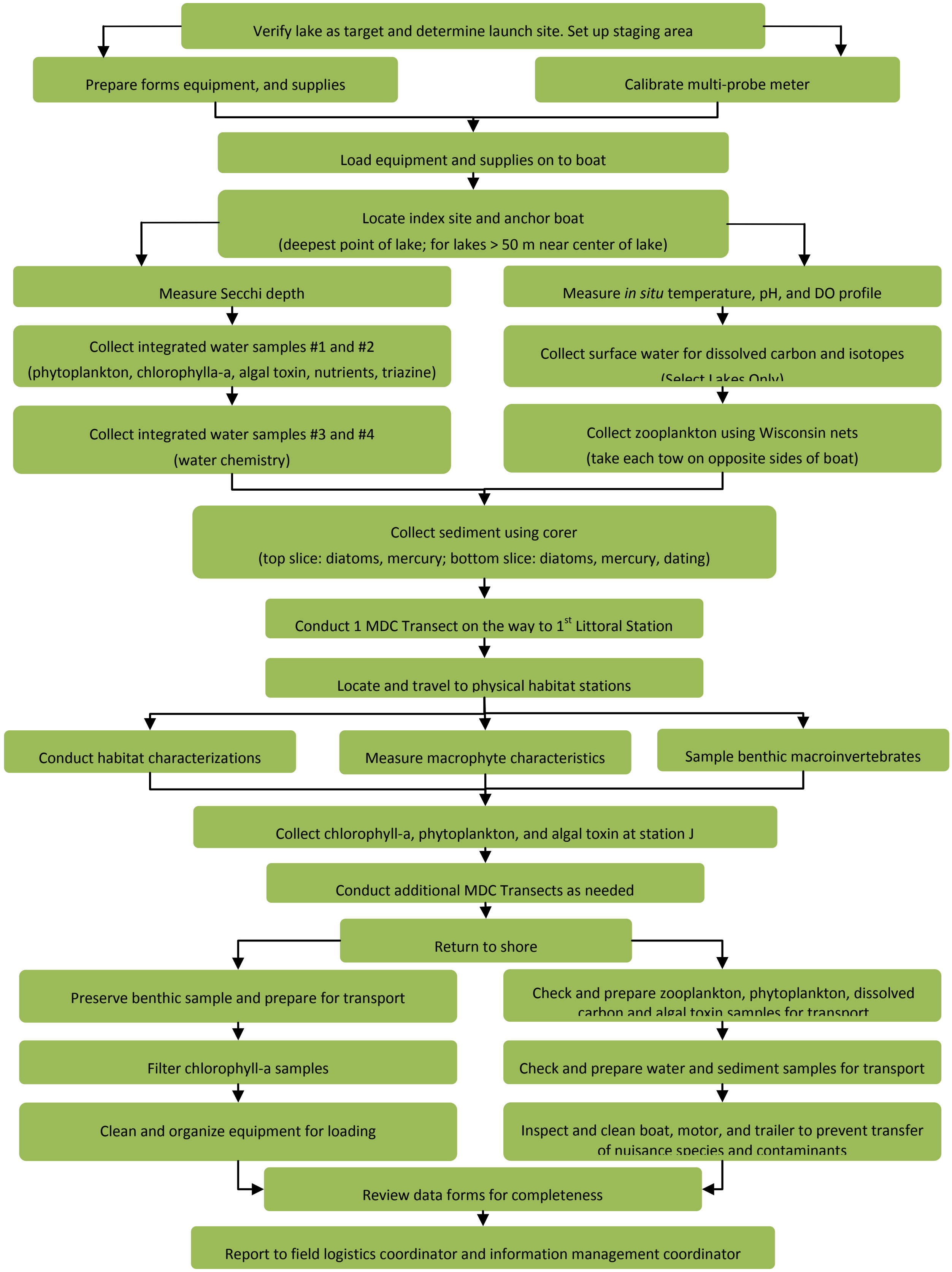


Figure 3.1 Daily operations summary

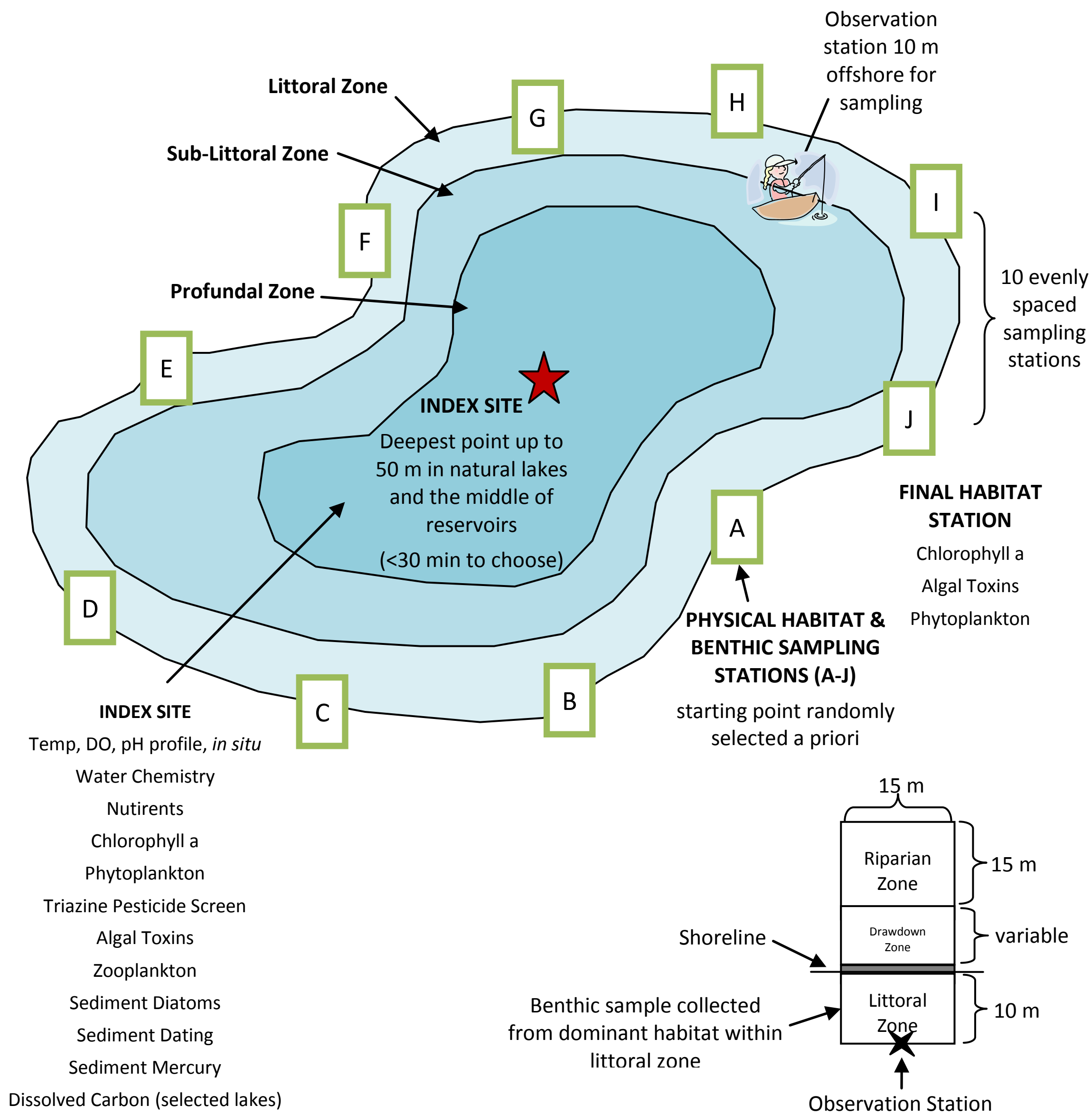


Figure 3.2 Location of sample collection points and physical habitat (PHab) stations.

The field crew arrives at the lake in the early morning to complete the sampling in a single day. The sampling sequence is to:

1. verify lake, calibrate equipment, locate and travel to the index site
2. conduct depth profile measurements of DO, temperature, and pH
3. take Secchi disk transparency depth measurement
4. use the integrated sampler to collect water chemistry, chlorophyll-*a*, triazine pesticide screen, algal toxin, nutrient, and phytoplankton samples
5. collect dissolved carbon and water isotope samples (at selected lakes)
6. collect zooplankton samples
7. collect sediment core sample for sediment mercury, diatoms, and dating

8. conduct physical habitat characterization around the margin of the lake at ten littoral zone stations (A,B,C,D,E,F,G,H,I,J)
9. conduct macrophyte assemblage characterization at every other littoral zone station (A,C,E,G,I)
10. collect benthic samples at ten littoral zone stations (A,B,C,D,E,F,G,H,I,J)
11. collect samples at the J physical habitat station for chlorophyll-*a*, algal toxins, and phytoplankton
12. filter 2 chlorophyll-*a* samples (one each from index and J physical habitat station)
13. preserve and prepare all samples for shipment
14. review field forms (electronic or paper)
15. report sampling event
16. ship time-sensitive samples (water chemistry, nutrients, chlorophyll-*a*, and sediment mercury)

4.0 BASE SITE ACTIVITIES

Field crews are to conduct a number of activities at their base site (i.e., office or laboratory, camping site, or motel). These include tasks that must be completed both before departure to the lake site and after return from the field (Figure 4.1). Close attention to these activities is required to ensure that the field crews know:

(1) where they are going
(2) that access is permissible and possible
(3) that equipment and supplies are available and in good working order to complete the sampling effort
(4) that samples are packed and shipped appropriately

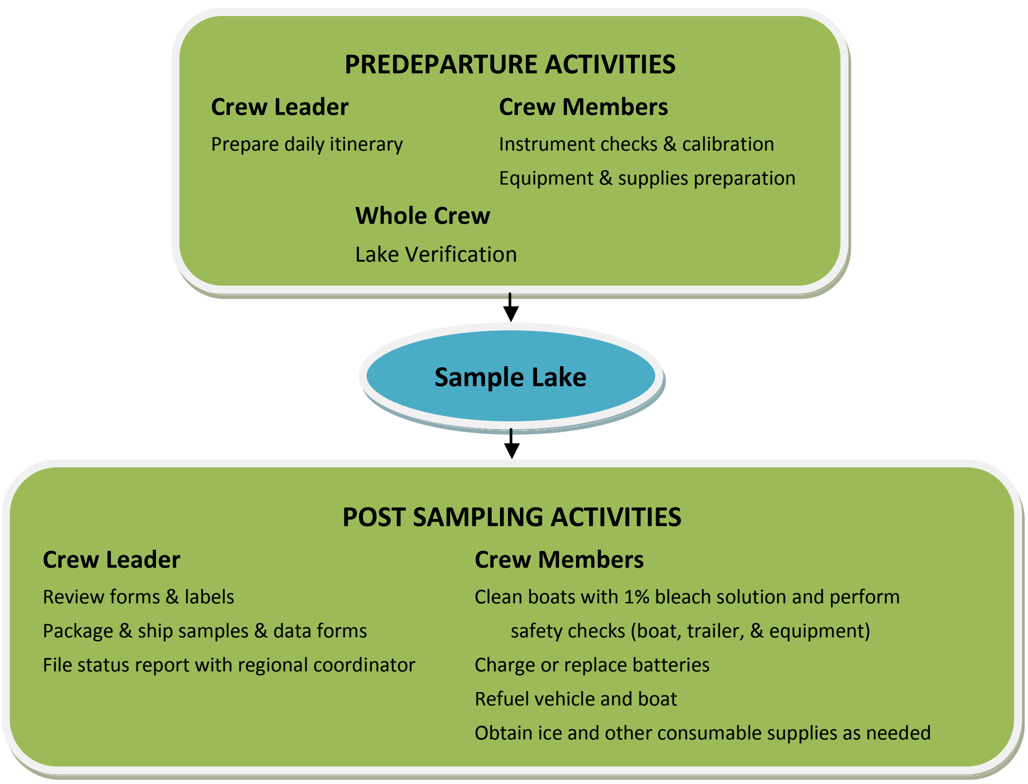


Figure 4.1 Overview of base site activities

4.1 Predeparture Activities

Predeparture activities include developing daily itineraries, checking and calibrating instruments, preparing equipment and supplies, and lake verification. Procedures for these activities, which will take place at your office or laboratory, camping site, or motel, are described in the following sections.

4.1.1 Daily Itineraries and Site Packets

The Field Crew Leader is responsible for developing daily itineraries and a site packet. A site packet contains information key to the planning and preparation for visiting and sampling a particular NLA site. Development of site packets should have been initiated during site evaluation and reconnaissance (See

NLA 2012 Site Evaluation Guidelines). However, the field crew may need to gather additional information for the site packet during preparation for the sampling visit. Also, it is the responsibility of the field crew to obtain access permissions and any needed permits as part of developing the site packet. Prior to a field crew traveling to a NLA site for sampling, the information for the site packet must be gathered and reviewed.

This entails compiling maps, contact information, copies of permission letters, and access instructions. The Field Crew Leader must be sure to lay out the physical habitat (PHab) stations on a site map before the sampling day (see Section 6.1.3). Additional activities include confirming the best access routes, calling the landowners or local contacts, and confirming lodging plans. Changes in the itinerary during the week, such as cancelling a sampling day, must be relayed by the Field Crew Leader to the NLA 2012 Field Logistics Coordinator as soon as possible. The site packet may include the following documents:

- **Field forms** (paper or electronic)
- **Site maps**: Provided by EPA HQ Team, see section on Site Maps.
- **Other Maps, Imagery, or GIS Data:** Any other maps, aerial photos, GIS data, or sources of information compiled by Field Crews and/or their partners that could be helpful to sampling the NLA sites.
- **Land Ownership Status, Requirements and Permissions for Access:**
    - Landowner identity and contact information.
    - Results of communication with landowners.
    - Documentation of permission to access private land.
    - Permissions for crossing private lands to reach sites located on public lands.
    - For public land, response of relevant agency to notification that you will be accessing a site, and, if needed, permissions to do so.
- **Permits:** Any permits or documentation required for site access, or for data collection activities or sample/specimen collection.
- **Information for Accessing the Site:**
    - Contact information for landowners.
    - Notes about whether landowner(s) want to be informed when Field Crew is on site.
    - Contact information for individuals who must be available to open gates or allow entry to a site, and the time and location for meeting them.
    - Notes on locked gates, pets, livestock, or other things that could impede access.
    - Notes about active hunting, farming, mining, or other activities on or near the site.
    - Current conditions that could prevent access (e.g., high water, forest fires).
- **Site Evaluation Notes:**
    - Site Evaluation notes, annotated aerial photos, sketch map, and completed site evaluation form that can aid with planning for accessing or sampling a site.
- **Driving and Hiking Routes to the Site:**
    - Detailed driving directions may be obtained from the NLA Google Earth files.
    - Results from the Site Evaluation may include driving directions and notations about site access or logistically challenging conditions on the site, which can be useful in relocating the site or helpful in anticipating special circumstances.

- **Preliminary Plan for Establishing Physical Habitat Stations:** As part of the base location activities to prepare for field work, review aerial photos and maps of the site and make a plan for laying out the PHab stations. This plan should be included in the Site Packet.
- **Any other site specific information useful to the Field Crew.**

4.1.2 Instrument Checks and Calibration

Test and calibrate instruments prior to sampling. You can calibrate instruments and probes prior to departure for the lake site or at the lake, with the exception of the DO probe (NOTE: some newer instruments may allow for calibration independent of altitude). Because of the potential influence of altitude, calibrate the DO probe at the lake site. Field instruments include a multi-probe unit for measuring temperature, DO, and pH and a Global Positioning System (GPS) receiver. Field crews should have access to backup instruments if any instruments fail the manufacturer performance tests or calibrations.

4.1.2.1 Multi-probe Meter Performance Test

Test and pre-calibrate the multi-probe meter prior to departure from the base site, following either the SOP developed for the instrument of the manufacturer's calibration and maintenance procedures. Field crews should perform a QC check of the pH meter calibration (and conductivity meter calibration, if this optional measurement is taken). Field crews will have to prepare or purchase their own QC solution.

4.1.2.2 Global Positioning System Use and Battery Check

A GPS unit is used to locate the launch, index site and each station for the physical habitat stations and macrophyte transects. Therefore, it is imperative that the Field Crew understands how to operate their GPS unit.

The Global Positioning System (GPS) uses signals sent from multiple orbiting satellites to a ground-based sensor in order to fix a position on the earth. Position accuracy depends on the Position Dilution of Precision (PDOP) which is a measure of the geometry of the satellite spread over the location of the observer. Low PDOP values represent more advantageous satellite geometry and give better positional accuracy (wider spread of satellites for more definitive triangulation). For NARS a target PDOP < 10 is preferred.

GPS uses many alternative mathematical models to describe the spherical shape of the earth and each is a separate Datum. Commonly used datums include NAD27 CONUS, NAD83, and WGS84. Each represents a different interpretation of the shape of the earth. The NARS standard is **NAD83**. Thus, all GPS units should be switched to this standard as part of their pre field-use set up. Crews should confirm that the NAD83 datum is being used when the GPS is turned on prior to data collection. If the GPS is not set for NAD83 and the unit cannot be changed readily, note the datum used on the data forms for later conversion.

GPS devices use a variety of units for position designation based on an imaginary latitude and longitude coordinate grid system laid across the earth (degrees, minutes, seconds, or degrees and decimal minutes, and UTMs (a metric system). The NARS standard is **decimal degrees** for reporting all GPS positions.

Refer to the GPS user's manual to provide specific instructions on setting the Datum, coordinate system, and units to NLA standards.

Turn on the GPS receiver and check the batteries prior to departure. Replace batteries immediately if a battery warning is displayed.

4.1.2.3 *Electronic Data Capture Device Battery Check (if applicable)*

Turn on the electronic device and check the batteries prior to departure. Charge immediately if a battery warning is displayed and charge fully to ensure enough battery for a full field day. Battery packs are often available for these devices if that is a concern.

Table 4.1 Instrument checks and calibration

Equipment	Preparation
GPS Unit	Check the batteries prior to departure Ensure map datum is set to NAD83 Perform manufacturer checks as necessary to ensure accuracy
Multi-parameter Probe	Calibrate per manufacturer guidelines (Dissolved Oxygen to be calibrated at lake) Check the batteries prior to departure Perform QC Check as directed by manufacturer and/or lab protocols (field crews will supply QC check solution)
Electronic Data Capture Device (Optional)	Check the batteries prior to departure Ensure NLA Data collection Application is installed and functioning

4.1.3 Equipment and Supply Preparation

Check your inventory of supplies and equipment prior to departure using the equipment and supplies checklists provided in the Appendix; use of the lists is strongly recommended. Pack meters, probes, and sampling gear in such a way as to minimize physical shock and vibration during transport. If necessary, prepare stock preservation solutions as described in Table 4.2. Follow the regulations of the Occupational Safety and Health Administration (OSHA).

Table 4.2 Stock solutions, uses, and methods for preparation.

Solution	Use	Preparation
Bleach (1%)	Clean nets, other gear, and inside of boat.	Add 40 mL bleach to 3,600 mL distilled water.
Lugol's	Preservative for phytoplankton samples.	Lugol's will be supplied with base kit. If preparation is needed: Dissolve 100 g KI in 1 L of distilled water. Dissolve 50 g iodine (crystalline) in 100 mL glacial acetic acid. Mix these two solutions. Remove any precipitates. Store in the dark.
95% Ethanol	Preservative for benthic invertebrate samples and zooplankton samples.	No preparation needed (use stock solution as is).

Refuel vehicle(s) and conduct maintenance activities the night before a sampling trip. Check trailer lights, turn signals, and brake lights before departure. In addition, inspect your vehicles, boats, and trailers every morning before departure. Pay particular attention to the trailer hitch, electrical connections, tie downs, tire pressure, and the overall condition of the boats.

Label and package the sample containers into site kits prior to departure (except for sediment mercury and chlorophyll A labels). Container labels should not be covered with clear tape until all information is completed during sampling at the lake. Store an extra kit of sampling supplies (Cubitainers®, bottles, glass fiber filters, foil, gloves, forms, pencils, permanent markers, and labels) in the vehicles. Inventory these extra supply kits prior to each lake visit. Be sure to order field sampling site kits well in advance (2 week minimum) by submitting the electronic **Request Form**.

4.1.4 General Equipment and Supplies for all Activities

Table 4.3 indicates equipment and supplies that will be used for all activities.

Table 4.3 Equipment and supplies – all activities.

Type	Item	Quantity
Forms	NLA 2012 Verification	1
	NLA 2012 Index Profile (front & back)	1
	NLA 2012 Index Sample Collection (pages 1-3)	1
	NLA 2012 Physical Habitat (front & back)	10+
	NLA 2012 Macrophyte Assemblage Characterization (front & back)	1
	NLA 2012 Littoral Sample Collection (front & back)	1
	NLA 2012 Invasive Plants and Invertebrate	1
	NLA 2012 Assessment (front & back)	1
	NLA 2012 Site and Sample Status/Water Chemistry Lab Tracking	1
	NLA 2012 Tracking – Batched Samples	1
	NLA 2012 Tracking – Packets	1
Reference	NLA 2012 Field Operations Manual (FOM)	1
	NLA 2012 Quick Reference Guide (QRG)	1
	NLA 2012 Quality Assurance Project Plan (QAPP)	1
	NLA 2012 Site Evaluation Guidelines (SEG)	1
	NLA 2012 Fact Sheets	10
Documentation	Clipboard	1
	Pencils (#2, for data forms)	1
	Permanent markers (fine tip, for most labels)	1
	Labels	
	Field Notebook (optional)	1
	Tape strips (3M, pack) (to cover sample labels)	As needed
Collection	Access permission documents/permit (if required)	1

4.2 Lake Verification

4.2.1 Lake Verification at the Launch Site

You must verify that you are at the correct lake and whether it meets the criteria for sampling. Confirming that you are at the correct lake is based on map coordinates, locational data from the GPS when possible, and any other evidence such as signs or conversations with local residents. Record locational coordinates for the lake on the **Verification** form. If GPS coordinates are obtained, check the GPS box and record the latitude, longitude, and the type of satellite fix (2D or 3D) for the launch site. All coordinates will be recorded in the NAD 83 datum. Compare the map coordinates given on the lake spreadsheet for the lake with the GPS coordinates displayed for the launch site, and verify that you are at the correct lake. [Note: The map coordinates in the spreadsheet represent the “labeling point” in NHD and may not be near either the index site or the launch site.] This can be confirmed via other methods (e.g., map, landowner confirmation) that the correct sample lake has been located. If GPS coordinates are not available, do not record any information, but try to obtain the information at a later time during the visit. A fix may be taken at any time during a lake visit and recorded by flagging the launch site coordinates and providing a comment.

Record directions to the lake and a description of the launch site on the **Verification** form regardless of whether the site is sampled or not. This information is very important and will be used in the future if the lake is revisited by another sampling crew. Provide information about signs, road numbers, gates, landmarks, and any additional information you feel will be useful to another sampling crew in relocating this lake. It is also helpful to describe the distance traveled (miles) between turns. Also describe the launch site. For example: Can the boat be launched with a trailer? Are there fees? Is the launch paved or does it consist of soft sand? What landmarks are at the launch? Owing to privacy concerns, do not record landowner contact information (e.g., name, address, phone, email address) on the field form.

In addition to or in the absence of an accurate GPS reading, use as many of the following methods as possible to verify the site:

- Obtain confirmation from a local person familiar with the area.
- Identify confirming roads and signs.
- Compare lake shape to that shown on a topographic map (USGS 7.5 minute map or equivalent).
- Determine lake position relative to identifiable topographic features shown on the map.

If the lake shape on the USGS topographic map does not correspond with the actual lake shape from your site map, and you cannot verify the lake by any other means, check "Not Verified" and provide comments on the **Verification** form. At each lake, evaluate whether or not the lake meets the NLA operational definition of a “lake”:

- ≥ 1 ha in total surface area
- ≥ 1000 square meters of open water
- ≥ 1 meter in depth
- Not saline (due to salt water intrusion or tidal influence)
- Not used for aquaculture, disposal-tailings, mine-tailings, sewage treatment, evaporation, or other unspecified disposal use

If the lake does not meet this definition, check "non-target" in the lake sampled section on the middle of the **Verification** form and provide an explanation for not sampling the lake. Add any additional explanation as required. (For complete details on the Site Evaluation process, refer to the companion document *Site Evaluation Guidelines* [EPA 841-B-06-003]).

Record the names of each crew member on the **Verification** form.

Regardless of whether the lake is sampled or not, the field crew must fill out and submit a **Verification** form for every lake that is visited.

4.2.2 Locating Index Site

Go to the deepest point in the lake to locate the index site (or middle of the lake for reservoirs). If the deepest point exceeds 50 m in depth, do not establish the index site at this location; instead just go as close to the middle of the lake as you can without exceeding 50 m in depth. The procedure below outlines sonar operation and procedures for finding the index site. For reservoirs, the index site is located near the mid-point of the reservoir rather than at the deepest point, which may be near the dam. Once in the general area, use the sonar unit to locate the deepest point (≤ 50 m). When an acceptable site is located, anchor the boat. Lower the anchor slowly to minimize disturbance to the water column and sediment. Determine the coordinates of the index site by GPS (if satellite coverage is available) and record on the **Index Profile** form. In addition, check the GPS fix box to indicate the type of satellite fix (2D or 3D) for the index site coordinates. If satellite coverage is not available at that time, try again before leaving the index site. The following is the procedure to be used:

1. Operate sonar unit according to manufacturer's specific operating procedures. If possible, depth readings should be made and recorded in metric units (be sure to specify units on the **Index Profile** form).
2. Use the sonar in the area expected to be the deepest. Spend no more than 30 minutes searching for the deepest point; the maximum depth for the index site is 50 meters.
3. Anchor the boat.
4. Determine the coordinates using GPS. Record GPS coordinates on the **Index Profile** form.

4.2.3 Equipment and Supply List

Table 4.4 is the checklist for equipment and supplies required to conduct protocols described in this section. It is similar to but may be somewhat different from the checklist that is used at a base site to assure that all equipment and supplies are taken to and available at the lake. Field crews should use the checklist presented in this section to assure that the equipment and supplies are organized and available on the boat in order to conduct protocols correctly and efficiently.

Table 4.4 Equipment and Supplies – lake verification.

Type	Item	Quantity
Form	NLA 2012 Verification	1
Collection	Depth Finder (hand-held or boat mounted sonar)	1
	GPS unit (with manual, reference card, extra battery)	1
	Anchor (with 75 m line or sufficient to anchor in 50 m depth)	1-2

4.3 Post Sampling Activities

Upon return to the launch site after sampling, review all labels and completed data forms for accuracy, completeness, and legibility and make a final inspection of samples. If information is missing from the forms or labels, the Field Crew Leader provides the missing information. The Field Crew Leader initials all paper field forms after review. If using electronic forms, the Field Crew Leader will need to confirm that they have reviewed forms prior to submission. Other post sampling activities include: sample filtering, inspection and cleaning of sampling equipment, inventory and sample preparation, sample shipment, and communications.

4.3.1 Equipment Cleanup and Check

You must inspect all equipment, including nets, boat, and trailer, and clean off any plant and animal material. This effort ensures that introductions of nuisance species such as Eurasian watermilfoil (*Myriophyllum spicatum*) and zebra mussels (*Dreissena polymorpha*) do not occur between lakes. Prior to leaving a lake, drain all bilge water or live wells in the boat. Inspect, clean, and handpick plant and animal remains from vehicle, boat, motor, and trailer that contact lake water. Inspect and remove any remnants of vegetation or animal life. Before moving to the next lake, if a commercial car wash facility is available, thoroughly clean vehicle, boat, and trailer (hot water pressurized rinse – no soap). Rinse equipment and boat with 1% bleach solution to prevent spread of exotics. Procedures are below.

1. Clean for biological contaminants (e.g., Eurasian water milfoil, zebra mussels, and alewife):
    a. Prior to departing from a lake, drain all bilge water from the boat.
    b. At the lake, inspect motors, boat, and the trailer for evidence of plant fragments especially in or near the propeller and water intakes. Remove all plant fragments.
    c. At the lake or base site, dry out and inspect nets and buckets and remove any remnant vegetation or animal life. Disinfect gear with 1% bleach solution.

   d. If a commercial car wash facility is available, thoroughly clean vehicle and boat (hot water pressurized rinse--no soap).
2. Clean and dry other equipment prior to storage:
   a. Rinse chlorophyll-*a* collection bottles three times with distilled water after each use.
   b. Rinse graduated cylinders, bulk water sampling containers and other sampling devices three times with distilled water after each use.
   c. Briefly soak zooplankton nets in a 1% bleach solution and dry after each use. Do not dry in sunlight because the mesh is photosensitive.
   d. Clean core sampler, sectioning apparatus, and siphon thoroughly with tap water and bottle brush at the base site.
   e. Rinse coolers with water to clean off any dirt or debris on the outside and inside.
3. Inventory equipment and supply needs and request supplies via the electronic **Request Form** (forms or site kits) or from the Field Logistics Coordinator (other items).
4. Remove multi-probe meter and GPS from carrying cases and set up for predeparture checks and calibration. Examine the oxygen membranes for cracks, wrinkles, or bubbles. Replace if necessary.
5. Recharge/replace batteries as necessary.
6. Recheck field forms from the day's sampling activities. Make corrections and completions where possible, and initial each form after review.

4.3.2 Shipment of Samples and Forms

You must ship or deliver time-sensitive samples (i.e., water chemistry, nutrients, chlorophyll-*a*, and sediment mercury) to the appropriate analytical laboratories as soon as possible after collection. This means the samples will be overnighted. Other samples may be shipped or delivered in batches provided they can be adequately stabilized (i.e., preserve or freeze, according to specifications). Report all sample shipments to the NARS IM Coordinator (by transmitting/faxing the appropriate tracking forms) as soon as possible so that the analytical laboratories can be notified to receive samples and they can be tracked if they do not arrive when expected.

Field crews are to fill out one sample tracking form (either **Site and Sample Status/Water Chemistry Lab Tracking** or **Tracking – Batched Samples** form) for each sample shipment. As previously mentioned, some samples will be sent individually to analytical labs, while others will be sent in batches. On each sample tracking form, the following information must be recorded:

- Airbill or package tracking number
- Date sample(s) were sent
- Site ID where each sample was collected
- Sample type code:
  - BENT – Benthic macroinvertebrates
  - CHEM – Chemistry
  - CARU – Dissolved carbon (unacidified)
  - CARP – Dissolved carbon (pre-acidified)
  - CHLX – Chlorophyll-*a* (index)
  - CHLL – Chlorophyll-*a* (littoral)
  - ISOT – Dissolved Carbon isotope
  - MICX – Algal toxin (microcystins, index)
  - MICL – Algal toxin (microcystins, littoral)

- NUTS – Nutrient
- PHYX – Phytoplankton (index)
- PHYL – Phytoplankton (littoral)
- SEDD – Sediment dating
- SEDT – Sediment diatoms (top)
- SEDB – Sediment diatoms (bottom)
- SEDH – Sediment mercury (top)
- SEDG – Sediment mercury (bottom)
- TRIA – Triazine Pesticide Screen
- ZOCN – Zooplankton coarse (150 micron mesh)
- ZOFN – Zooplankton fine (50 micron mesh)
- ZOCR – Zooplankton coarse (243 micron mesh, 2007 resample lakes)
- ZOFR – Zooplankton fine (80 micron mesh, 2007 resample lakes)

- Date when the sample(s) was collected
- Site visit number (e.g., 1 for first visit, 2 for revisit)
- Sample ID number preprinted on label
- Number of containers for each sample
- Any additional comments

See APPENDIX D: SHIPPING GUIDELINES for further information.

4.3.3 Communications

The Field Crew Leader must review all data forms for consistency, correctness, and legibility before transferring them to the NARS IM Center. Each field crew leader must submit a Site and Sample Status/WRS Tracking to the NARS IM Center (typically via email or fax) after each site visit (whether the site is sampled or not). General communications information, including contact information for the NARS IM Center is outlined in Section 2.1.

5.0 INDEX SITE ACTIVITIES

You will collect several different measurements and indicators at the index site (as described in Table 1.1): a temperature, DO, and pH depth profile, Secchi transparency, chlorophyll-*a*, phytoplankton, algal toxins, water chemistry, nutrients, triazine, and zooplankton samples, and a sediment core. A detailed description of the individual elements is provided below.

5.1 Temperature, DO, and pH profile

5.1.1 Summary of Method

Use a multi-parameter water quality meter (or sonde) to measure temperature, DO, and pH at predefined depth intervals. Calibrate the sonde probes as necessary and check the calibration against an independent quality control check sample if possible. Record weather and water conditions. Measurement intervals are based on the site depth. Lower the sonde into the water and record the vertical profile of temperature, DO, and pH at the predetermined depth intervals. Once the profile is completed, make another DO measurement at the surface and compare it to the initial reading to see if the probe is functioning correctly and holding calibration. If the lake is thermally stratified, note the top and bottom of the metalimnion based on the temperature readings (usually a change of ≥1 °C per meter of depth).

The meters and probes are delicate; take care to avoid putting the probe into contact with the bottom sediments. An accurate measure of the site depth will help prevent this from occurring.

5.1.2 Equipment and Supplies

Table 5.1 Equipment and supplies – temperature, pH, and DO profiles.

Type	Item	Quantity
Form	NLA 2012 Index Profile	1
Collection: Water column depth	Depth Finder (hand-held or boat mounted sonar) Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip OR Rod (calibrated) for very shallow lakes	1 1
Collection: Profile measurements & calibration	Multi-parameter water quality meter (with temperature, pH, and DO probes) Sounding line (50 m, calibrated, marked in 0.4 m intervals) with clip Squirt bottle (1 L Nalgene) – De-ionized (DI) Squirt bottle (1 L Nalgene) – lake water Calibration cups Calibration and quality control check standards Barometer or elevation chart to use for calibration	1 1 1 1

5.1.2.1 Multi-Probe Sonde

The multi-probe sonde must be heavy enough to minimize wobbling as it is lowered and raised in the water column. Also, the instrument must be stabilized prior to taking a reading. Experiment with the sonde prior to sampling and add weight to the cable if needed. Some State or Tribal agencies may want to attach additional probes to the sonde and collect profile data on other parameters. While not required for the NLA 2012, including this data is not discouraged, and the **Index Profile** form is designed to capture these additional data.

5.1.2.2 Temperature Meter

Check the accuracy of the sensor against a thermometer (a non-mercury type is recommended) that is traceable to the National Institute of Standards (NIST) at least once per sampling season. The entire temperature range encountered in the NLA 2012 should be incorporated in the testing procedure and a record of test results kept on file.

5.1.2.3 DO Probe

Calibrate the DO probe prior to each sampling event (Note: some newer instruments and probes may not require this). It is recommended you calibrate the probe in the field against an atmospheric standard (ambient air saturated with water, or water saturated with air for optical probes) prior to launching the boat. In addition, manufacturers typically recommend periodic comparisons with a DO chemical analysis procedure (e.g., Winkler titration) to check accuracy and linearity. Small "mini-Winkler" titration kits are suitable for this check and can be taken into the field.

5.1.2.4 pH Meter

Calibrate the pH electrode prior to each sampling event in accordance with the manufacturer's instructions and your organization's existing standard operating procedure (SOP). Conduct a quality control check with a different standard to verify the calibration and periodically evaluate instrument precision (see Section 4.1.2.1). Ideally, the check standard should be similar in ionic strength to the lake water samples you will be measuring. Standard buffer solutions used to calibrate electrodes may not be representative of typical lake waters.

5.1.2.5 Conductivity

A field conductivity measurement is optional for the NLA 2012. If the Field Crew opts to take conductivity measurements, the conductivity meter must be calibrated prior to each sampling event. Calibrate the meter in accordance with the manufacturer's instructions. Note whether the values recorded have been temperature corrected to 25 °C by the meter.

5.1.2.6 Index Profile Form

Use the **Index Profile** form to record the following:

- Use the top portion of Page 1 to record environmental conditions observed at the site and the depth of the lake at the index site.
- Use the remaining portion of page 1 to record your calibration information. Documentation includes the instrument's manufacturer and model number (e.g., YSI 600XL with 650 display), identification number, QCS values (for pH and conductivity, if available), and the instrument readings. The purpose of the ID number is to track which instrument provided the data, in the event that it is later discovered that the unit was operating in error; it will likely be an internal reference number or code supplied by the entity conducting the field sampling.
- The profile table is on the back of the form. It includes columns to record depth, DO, pH and temperature (as well as optional conductivity) and a column to indicate the location of the metalimnion based on temperature changes. It also contains a "Flag" column to note a problem or other conditions of interest.
- The comment section is used to report on "Flagged" measurements or other conditions of note.

5.1.3 Depth Profile Procedure

These are the step-by-step procedures for measuring temperature, pH, and DO profiles at the index site.

1. Calibrate Instrument
    a. Check meter and probes and calibrate according to manufacturers specifications.
    b. Enter calibration information on the front of the **Index Profile** form.
2. Record Site Conditions:
    a. Observe site conditions and fill out the "Site Conditions" portion of the **Index Profile** form. Conditions to be reported include:
        i. Precipitation ("None, "Light," or "Heavy")
        ii. Surface conditions ("Flat," "Ripples," "Choppy," or "Whitecaps")
    b. Presence or absence of odor or scum. (Choice of "Yes" or "No" plus space to describe the odor or scum if present)
3. Determine Site Depth:
    a. Accurately measure the depth using a sounding line or other means and record on the **Index Profile** form.
    b. Indicate method used.
4. Determine Measurement Intervals:
    a. The number of readings and the depth intervals taken depends on the site depth. Below is a list of rules for determining the intervals:
        i. The profile will always begin with a measurement just below the surface.
        ii. The last (deepest) measurements will always be at 0.5 m above the bottom.
        iii. If the site is < 3.0 m deep, record measurements beginning just below the surface and at 0.5 m intervals, until 0.5 m above the bottom.
        iv. If the depth is between 3.0-20 m, record beginning just below the surface and then at 1.0 m intervals through 20 m (or until reaching 0.5 m above the bottom).
        v. If the depth exceeds 20 m, record beginning just below the surface, then at 1.0 m intervals until you reach 20 m, then at 2 m intervals until 0.5 m above the bottom or the maximum depth of 50 m is reached. You will need to take measurements at least every meter within the metalimnion.
    b. Using the above rules, record the intervals for the profile in the Depth column of the **Index Profile** form.
5. Measure Temperature, DO, and pH:
    a. Lower the sonde in the water and measure the vertical profile of temperature, DO and pH at the predetermined depth intervals. Be careful not to let the probe touch the bottom.
    b. Record the measurements on the **Index Profile** form.
    c. Flag any measurements that the crew feels needs further comment or when a measurement cannot be made.
    d. Use the flag codes on the form and the comment box found on the second page.
6. Duplicate Surface DO Measurement
    a. When the profile is completed, take another measurement at the surface, record it, and compare it to the initial surface reading.
    b. Mark 'Yes' or 'No' on the form if the second DO reading is within 0.5 mg/L of the initial surface reading. This provides information regarding measurement precision and possible calibration drift during the profile.
        i. If measurement is not within 0.5 mg/L, verify your calibration.

ii. If DO is found to be out of calibration, re-calibrate and re-record DO measures on a backup form.

7. Determine the Metalimnion:
   a. If the lake is thermally stratified, note the top and bottom of the metalimnion in the Metalimnion column.
   b. For standardization purposes, the metalimnion has been defined in the protocol as an area where water temperature changes at least 1 degree per meter.
   c. If you suspect that the metalimnion exists but does not change at the specified rate, estimate the top and bottom of the metalimnion as best you can, flag the data and explain.

5.2 Secchi Disk Transparency

5.2.1 Summary of Method

A Secchi disk is a black and white patterned disk used to measure a lake's clarity (see Figure 5.1). Take the reading on the shady side of the boat, without sunglasses, hat, or other viewing aids. Record the depths where the disk disappears when descending and reappears when retrieving.

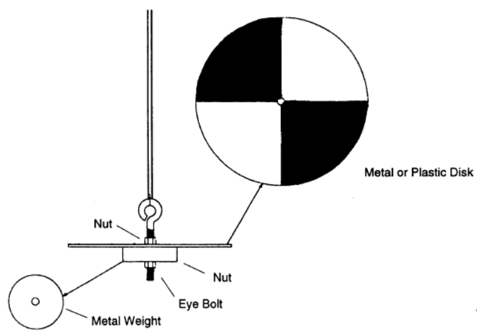


Figure 5.1 Secchi disk diagram (EPA, 1991).

5.2.2 Equipment and Supplies

Table 5.2 Equipment and supplies – Secchi disk transparency.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
Collection	Meter stick (cm) Secchi Disk (20 cm diameter) Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1 1 1

5.2.3 Procedure for Determining Secchi Transparency

Because different people measuring Secchi transparency at the same site may obtain different results (due to differences in vision and interpreting disk disappearance and reappearance), it is recommended that one crew member conduct Secchi disk measurements at all lakes.

If the lake is shallow and the water clear, the Secchi disk might reach the bottom and still be visible. If this is the case, it is important to not stir up the bottom sediments while anchoring the boat. Move the boat away from the anchor before taking the reading. If the disk is visible at the bottom of the lake, indicate this on the **Index** Sample Collection form.

States that wish to take additional measurements for comparisons using a view scope are encouraged to do so after completing the Secchi disk measurements following the NLA protocols.

The following procedure is to be followed:

1. Confirm that the lowering line is firmly attached to the Secchi disk.
2. Remove sunglasses and hat. Also, do not use view scopes or other visual aids. If wearing prescription sunglasses, temporarily replace them with regular clear lens prescription glasses.
3. Lower the Secchi disk over the shaded side of the boat until it disappears.
4. Read the depth indicated on the lowering line. If the disappearance depth is <1.0 meter, determine the depth to the nearest 0.05 meter by marking the line at the nearest depth marker and measuring the remaining length with a tape measure. Otherwise, estimate the disappearance depth to the nearest 0.1 meter. Record the disappearance depth.
5. Lower the disk a bit farther and then slowly raise the disk until it reappears and record the reappearance depth, using the same level of precision as before.
6. Calculate the euphotic zone depth by multiplying the depth where the disk reappears by 2. Use this calculation to determine the depth at which water samples will be taken with the integrated sampler:
    - 6.1 If euphotic zone is less than 2 meters, water samples will be collected only within the euphotic zone.
    - 6.2 If euphotic zone is greater than 2 meters, water samples will be taken from the top 2 meters of the water column.
7. Record the depth of integrated water samples.
8. Note any conditions that might affect the accuracy of the measurement in the comments field.

5.3 Water Sample Collection and Preservation

5.3.1 Summary of Method

Collect water samples using an “integrated sampler”- based on a design by the Minnesota Pollution Control Agency (MPCA), see Figure 5.2. The device is a PVC tube 6.6 feet (2 meters) long with an inside diameter of 1.24 inches (3.2 centimeters) fitted with a stopper plug on one end and a valve on the other. The device allows collection of water from the upper two meters of the water column (within the euphotic zone). If the euphotic zone is < 2.0m deep (as calculated in the Secchi Disk Transparency section of the form), lower the integrated sampler only to the depth of the euphotic zone, and take additional grab samples as necessary to collect the total volume needed for the samples.

Remove the rubber stopper and rinse the sampler by submerging it in the lake three times. With the valve open and the stopper off, slowly lower the sampler into the water as vertically as possible until the upper end is just below the surface (or you have reached the depth of the euphotic zone if it is <2 m). Cap and slowly raise the sampler. Close the valve when the bottom of the sampler is near the surface. Dispense the contents of the sampler into a 4 L Cubitainer®.

5.3.2 Equipment and Supplies

Table 5.3 provides the equipment and supplies needed to collect water samples at the index site.

Table 5.3 Equipment and supplies – water samples.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
Collection: Water Sample	Integrated sampler device (MPCA design)	1
	Funnel	1
	Gloves (latex/nitrile, non-powdered)	1
Storing & Preservation	Cubitainer® (4L) – water chemistry	1
	HDPE bottle (60 mL, white, wide-mouth) – triazine	1
	HDPE bottle (250 mL, brown, wide-mouth) – nutrients	1
	HDPE bottle (500 mL, white, wide-mouth) – algal toxins	1
	HDPE bottle (1 L, white, narrow-mouth) – phytoplankton	1
	Poly bottle (2 L, brown, labeled INDEX) – chlorophyll A	1
	H_2SO_4 ampoules – nutrients	1-2
	pH paper – nutrients	1
	Wet ice	As needed
	Lugol's solution (250 mL bottle)	5-10 mL
	Cooler	1

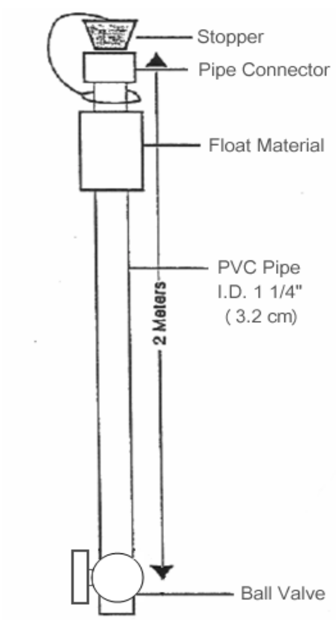


Figure 5.2 Integrated water sampler device (MPCA).

5.3.3 Sampling Procedure

Assuming the euphotic zone is ≥ 2 meters; collect four integrated water samples (Figure 5.3). Samples #1 and #2 are to be transferred from the sampler to the 4 L Cubitainer®, mixed thoroughly, and poured off into one 2 L sample bottle for ***chlorophyll-a*** filtering, one 1 L sample bottle for ***phytoplankton*** processing, one 500 mL bottle for the ***algal toxins*** sample, one 250 L sample bottle for ***nutrients***, and one 60 mL bottle for the ***triazine*** pesticide sample. Samples #3 and #4 are to be transferred from the sampler to the 4 L Cubitainer® for the water chemistry sample. If the euphotic zone is less than 2 meters, only collect water from the euphotic zone and increase the number of grab samples accordingly.

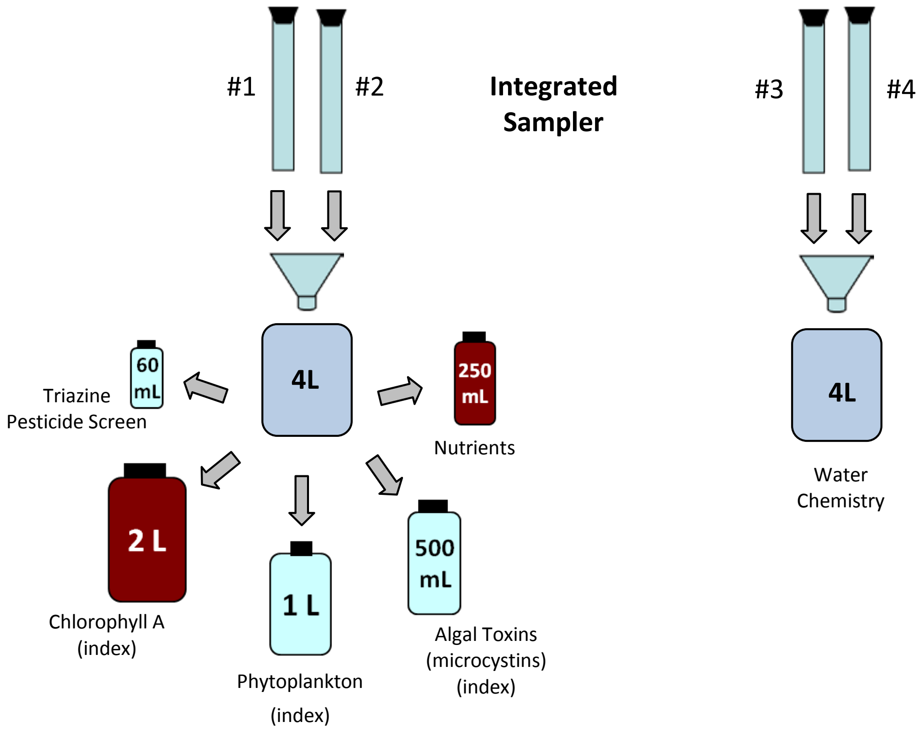


Figure 5.3 Procedure for using the integrated sampler device to collect depth integrated samples.

5.3.3.1.1 Sample Collection

1. Make sure all necessary data had been written on the sample labels and labels are completely covered with clear tape.
2. Put on surgical gloves (non-powdered). Do not handle any food, drink, sunscreen, or insect repellant until after samples have been collected.
3. Rinse each water sample collection container with surface water 3 times.
4. Remove the rubber stopper cap and open the valve on the bottom end of the sampler. Rinse by submerging it three times in the lake and draining. Do this on the opposite side of the boat you plan to sample from. Do not take samples near the motor.
5. Slowly lower the sampler into the lake as vertically as possible. Stop when the upper end is just below the surface. If the euphotic zone is < 2.0 m deep (as calculated in the Secchi Disk Transparency section of the form), the integrated sampler will be lowered only to the depth of the euphotic zone; additional samples will be taken to collect the volume needed for the samples (8 L total).
6. Cap the upper end with the rubber stopper firmly and slowly raise the sampler.
7. When the bottom of the sampler is near the surface, reach underneath and close the valve on the bottom end.

8. Lift the sampler into the boat, keeping it as vertical as possible. When possible, move the containers to a shaded area of the boat to avoid exposing the sample to direct sunlight when dispensed.
9. Pour the contents of sample #1 and sample #2 into the 4 L Cubitainer® and mix well.
10. Fill the 2 L brown bottle (labeled Index Chlorophyll) from the 4 L Cubitainer®. This is the chlorophyll sample, which will be filtered on shore (see Section 7.2.2). Place on ice until filtration can be initiated.
11. Fill the 1 L phytoplankton bottle from the 4 L Cubitainer®, allowing enough headspace to add at least 5 mL of preservative.
12. Fill the 500 mL bottle from the 4 L Cubitainer®. This is the algal toxin sample. Place the bottle in the cooler with sealed 1-gal plastic bags of ice.
13. Fill the 250 mL bottle from the 4 L Cubitainer®. This is the nutrient sample.
14. Fill the 60 mL bottle from the 4 L Cubitainer®. This is the triazine sample.
15. Pour the contents of sample #3 and sample #4 from the integrated sampler into the 4 L Cubitainer®.

5.3.3.1.2 Sample Preservation

1. For the phytoplankton sample, add 5 mL of Lugol's solution to the 1 L phytoplankton bottle. Cap the bottle and invert until well mixed. The sample should resemble the color of weak tea. If needed, add additional Lugol's 2-3 mL at a time.
2. For the nutrients sample, add acid from an ampoule to the water to stabilize the sample. Test the acidity level of the water with pH paper. You need to ensure that the water has a pH <2. If not, add another ampoule of acid until the test of the water indicates that the sample has the appropriate acidity. In most cases one ampoule will be sufficient. Place the bottle in the cooler with sealed 1-gal plastic bags of ice. Dispose of ampoule properly.
3. Place all samples in the cooler with ice.

5.4 Dissolved Carbon

5.4.1 Summary of Method

At selected lakes[a], field crews will collect separate water samples from near the surface of the lake for the analysis of dissolved carbon dioxide (CO_2), methane (CH_4), dissolved inorganic carbon (DIC), and water stable isotopes. The results will be used to assess dissolved carbon concentrations and hydrologic conditions in lakes across the nation and will contribute to the USGS Land Carbon project.

5.4.2 Equipment and Supplies

Table 5.4 Equipment and supplies – dissolved carbon.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1

[a] A list of the specific site identifiers for the selected lakes for dissolved carbon and water isotope sample collection is available on the NARS Sharefile (https://nars.sharefile.com/).

Collection	Serum bottles: un-acidified (blue tape for CO_2 and CH_4) pre-acidified (pink tape for DIC) Water isotope bottle (10mL) Poly syringe (60mL) with attached 3-way stopcock Syringe filter (0.45 µM) Needles	 1 1 1 1 1 3 (1 is spare)

5.4.3 Sampling Procedure

Use a syringe to collect two bubble-free water samples from a few centimeters below the lake surface. Use a fresh needle for each sample (one needle is a spare). Collect the unacidified samples first, and then the acidified samples. Also collect one 10 mL bubble-free sample for water isotopes (no needle needed). Store the samples on ice, but avoid freezing them.

If lake water conditions are bad (e.g., very turbulent) and you are concerned about injecting the sample while at the index site, you will follow steps 1 through 6 as described in the procedure below. You will ensure that there are no bubbles in the filled syringe, seal the water sample in the syringe by turning the stopcock, and place the filled syringe in the ice-filled cooler. Once you arrive in less turbulent waters (littoral/ shoreline stations) or to shore, you will follow the remaining steps (7 through 15) in this procedure to transfer the water into the appropriate sample bottles. It is important that you transfer the water from the syringe to the sample bottles as soon as possible to reduce the likelihood of contamination.

The following procedure is to be followed:

1. Make sure that the EPA NLA 2012 tracking labels are affixed properly and that they are completely covered with clear tape.
2. Put on gloves.
3. There are 2 serum bottles per site. One bottle has blue tape on it – this bottle is not acidified and is for CO_2 and CH_4 analysis. The other bottle has pink tape on it – this bottle is pre-acidified, and is for DIC and/or ^{13}C-DIC analysis.
4. Fill the un-acidified bottle first and use a fresh needle on each bottle, as described below.
5. With a 3-way stopcock attached to the 60 mL syringe, draw in about 10 mL of water from a few cm below the water surface. Expel water from the syringe underwater to rinse it. Repeat rinse, eliminating bubbles from the syringe and expelling the water in the syringe under water, so that you can draw in bubble-free water for the sample (next step).
6. Carefully (i.e., pull the plunger slowly) fill the syringe with lake water. If bubbles get in the syringe, hold the syringe upright (plunger down), and tap the side of the syringe to dislodge the bubbles so they rise to the tip of the syringe. Then expel the resulting air pocket using the syringe plunger. Once bubbles are removed, close the stopcock to prevent air exchange with the sample.
7. Attach the 0.45 µm syringe filter to the luer tip on the 3-way stopcock on the syringe. Make sure the connection is tight by using the locking ring on the 3-way stopcock to secure the filter.
8. Attach the needle to the tip of the 0.45 µm filter. Make sure connection is tight. Push it on as hard as it can possibly go.

9. While pointing the syringe up, open the stopcock and push the plunger to expel air from the filter and needle. Once 5 mL of water has passed through the filter and needle, insert the needle into the first serum bottle through the stopper, and inject 15 mL of water into the bottle. The amount does not have to be exact, but please try to aim for 14-16 mL.
   NOTE: While injecting sample water into the bottles, it is best to have the syringe pointed up. When removing the needle from the serum stopper, having the serum bottle upside down on top of the syringe needle would mean that gas cannot follow the needle as it is removed and escape to the atmosphere.
10. After injecting 15 mL of water into the bottle, keep pressure on the syringe plunger and hold the base of the needle firmly while you remove the syringe/needle from the bottle. If the needle comes out of the syringe and the sample is exposed to air, the sample has been compromised. Write "BAD" on this bottle. Move on to the next step (or if this is the second bottle, then sampling is over).
11. Replace the plastic cover for the needle. Change needle and repeat the procedure (steps 8-10) with the acidified bottle (with the pink tape on it).
12. After filling both serum bottles, remove the needle and use the syringe and filter to fill the 10 mL bottle for water stable isotopes by filtering water directly from the syringe into the bottle. The bottle needs to be filled completely with no bubbles. If necessary, more lake water can be collected from several centimeters below the surface using the syringe. Fill the bottle completely (creating a convex meniscus) and carefully screw on the cap. Turn the bottle upside down to make sure there are no bubbles. If necessary, the bottle can be opened and re-filled with filtered lake water to ensure that there are no bubbles.
13. The syringes can be reused indefinitely, and do not have to be rinsed again for the second dissolved carbon sample or for the isotope sample.
14. Please don't let the serum bottles or water isotope vials freeze. Ideally they should then be kept in a refrigerator until they are shipped. Please pack them carefully, as they can break in transit.
15. Pack the serum bottles, isotopes bottle, used needles, and filter back into the package. Place the entire package on ice for shipment.

5.5 Zooplankton Collection

5.5.1 All Lakes

5.5.1.1 Summary of Method

Collect two vertical samples using a fine mesh (50 μm) and coarse mesh (150 μm) Wisconsin nets with collection bucket attached at the cod end. Each net is slowly lowered over the side of the boat into the water. The net is retrieved back to the surface at a slow, steady rate. Lift the net out of the water; rinse it from the outside to free organisms from the side of the net, and to concentrate them in the collection bucket. Transfer the sample from the bucket to a 125 mL sample container. Narcotize the organisms with carbon dioxide and preserve each sample with 95% ethanol. You will repeat the procedure with the other net on the opposite side (or end) of the boat. The cumulative tow length for each net is 5m. In shallow lakes, multiple tows with each net are required to achieve the cumulative tow length. The objective is to sample a sufficient volume of water to obtain at least 300 organisms per sample from all but the most oligotrophic lakes.

5.5.1.2 Equipment and Supplies

Table 5.5 provides the equipment and supplies needed to collect a zooplankton sample. Figure 5.4 is an illustration of the zooplankton nets and collection buckets.

Table 5.5 Equipment and supplies – zooplankton collection.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
Collection	Plankton net (50 µm) and collection bucket	1
	Plankton net (150 µm) and collection bucket	1
	Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1
	Funnel	1
	Squirt bottle (1 L Nalgene) – de-ionized (DI)	1
	Squirt bottle (1 L Nalgene) – lake water	1
	CO_2 (Alka seltzer) tablets	1
	Pail (narcotization chamber)	1
Storing & Preservation	HDPE bottle (125 mL, white, wide-mouth)	1
	Ethanol (95%)	1

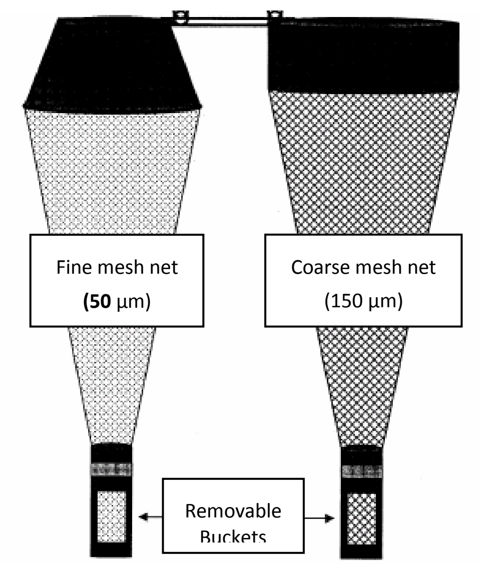


Figure 5.4 Wisconsin net and collection bucket diagram.

5.5.1.3 Sampling Procedure

The procedures for collecting and processing zooplankton samples are presented below.

5.5.1.3.1 Sample Collection

1. Determine and record the number of tows required to achieve the standard cumulative 5 m tow on the **Index** Sample Collection form.
    a. For lakes deeper than 7 m, you will take a 5 m tow.
    b. For lakes with a depth less than 7 m, you will determine and record the number of tows

that will be required to achieve a standard cumulative 5 m tow. For example, if the lake is 6 meters deep, you will take two 2.5 m tows.

Depth of lake (m)	Depth of Tow	Number of Tows
7	5 m	1
6	2.5 m	2
5	2.5 m	2
4	2.5 m	2
3	1 m	5
2	1 m	5
1 - 2	0.5 m	10

c. The zooplankton collection methods vary slightly depending on the number of tows required to achieve a standard cumulative 5 m tow.
   i. If the number of tows = 1: follow steps 2 through 14 described below.
   ii. If the number of tows ≥ 2: follow steps 2 through 13 described below. After step 13, you will pour the contents of the collection bucket into a clean (i.e., DI rinsed) 1-gallon pail. While taking care not to tip the zooplankton sample in the pail, you will repeat steps 2 through 13 for the second tow. Add the contents of the collection bucket from the second tow to the pail. You will continue to take zooplankton tows and add samples from the collection bucket into the pail until you reach your target number of tows (2, 5, or 10). Pour the contents of the pail into the collection bucket to filter out some of the excess water. Rinse the bucket with DI water and pour the contents of this rinse into the collection bucket with the zooplankton sample. Once the zooplankton sample has been filtered down to an appropriate volume in the collection bucket, you will continue on to step 14.

2. Prior to each use, carefully clean and thoroughly rinse the interior of the plankton nets and buckets with DI water.
3. Carefully inspect the nets and buckets for holes or tears.
4. Attach the collection buckets to the “cod” end of the nets and secure. Make sure you attached the correct bucket to the correct net (i.e., the mesh sizes match).
5. Attach the bridled end of the plankton net to a 0.25” calibrated line with markings every 0.5 m (you can use the line for the Secchi disk).
6. Carefully and slowly lower the first net in a constant upright position over the side of the boat.
7. Continue lowering the net to the correct depth (remember to account for the length of the bridle). If more than one tow is needed, be sure to take additional tows from different locations around the boat.
8. Retrieve the net by pulling back to the surface at a steady rate (0.3 m or 1 ft/s) without stopping.
9. Once at the surface, slowly dip the net up and down in the water without submersing the net mouth to rinse contents into the collection bucket.

10. Complete the rinsing of the net contents by spraying lake water against the outside of the net with a squirt bottle or similar tool. Be careful not to splash or squirt lake water into the net mouth, or additional organisms may be collected.
11. If additional rinsing is needed on the interior of the net, use a squirt bottle with DI water only to avoid introducing additional organisms.
12. Once all organisms have been rinsed into the collection bucket, hold the collection bucket in a vertical position, and carefully remove the bucket from the net.
13. Concentrate the contents of the collection bucket by swirling the collection bucket without spilling the contents. Excess lake water will filter out of the bucket from the screened sides.
14. Repeat steps 5-13 with the second net on the opposite side (or end) of the boat.

5.5.1.3.2 Sample Processing

1. Set the collection bucket in a pail filled half full with lake water to which 2 CO_2 (alka-seltzer) tablets have been added. Ensure that the organisms in the collection bucket are submerged in the water, but be careful not to submerge the top of the collection bucket, or sample loss will occur. The CO_2 narcotizes the zooplankton to relax their external structure prior to preservation in 95% ethanol. This facilitates taxonomic identification. Wait until zooplankton movement has stopped (usually about 1 min).
2. Check the sample label on the bottle to verify which sample has been collected (coarse or fine mesh). Record the sample ID number and check that it is preserved on the form.
3. Use small volumes of DI water from a squirt bottle to rinse the contents of the mesh net collection bucket into the 125 mL polyethylene bottle. Rinse the collection bucket with DI water three to four times or until the majority of zooplankton have been removed without allowing the bottle to fill more than half full (~60-70 mL of sample and rinse water combined). After the zooplankton has been transferred and the sample bottle is half full with sample and rinsate, fill the bottle to the shoulder with 95% ethanol. Use a funnel if necessary.
4. In some cases, the volume of zooplankton collected in the collection bucket may exceed 125 mL. Do not try to force the entire sample into a single bottle, or the preservative will not function properly and the sample may be lost. In such cases, fill the first bottle half full, and then use a second bottle to preserve the additional amount of sample. Use an “extra jar” label (i.e., one with no sample number printed on it). Complete the label, and print in the sample number assigned to the first container on the label of the second container. On the form, record a “2” in the “No. Jars” field.
5. Record the sample ID number and check on the form that it is preserved.
6. Verify that all information on the labels and the form is complete and correctly recorded.
7. Repeat steps 1-6 for the second sample collected.

5.5.2 Resample Lakes (NLA 2007 Protocol)

At resample site lakes, collect additional zooplankton samples following the protocol used in NLA 2007 (different net design, mesh sized, and cumulative tow length). Results from this set of samples will be compared to the NLA 2007 zooplankton samples and potentially serves as a means to calibrate the 2012 and 2007 results.

5.5.2.1 Summary of Method

Collect two vertical samples using the fine mesh (80 μm) and coarse mesh (243 μm) Wisconsin nets from NLA 2007. The sampling procedure differs for these samples compared to those described in section

5.5.1.3, in that a single tow is taken of the entire index site water column, for both the 80 µm and 243 µm nets. Nets are lowered to within 0.5 m of the bottom and then pulled vertically. Additionally, when the depth of the index site is less than 2 m and the Secchi disk can be seen at the bottom, a second tow is made and the samples combined (cumulative tow length equals 3 m or less).

5.5.2.2 Equipment and Supplies

Table 5.6 provides the equipment and supplies needed to collect a zooplankton sample using the NLA 2007 protocol.

Table 5.6 Equipment and supplies – zooplankton collection (NLA 2007 method).

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
Collection	Plankton net (80 µm) and collection bucket	1
	Plankton net (243 µm) and collection bucket	1
	Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1
	Funnel	1
	Squirt bottle (1 L Nalgene) – de-ionized (DI)	1
	Squirt bottle (1 L Nalgene) – lake water	1
	CO_2 (Alka seltzer) tablets	1
	Pail (narcotization chamber)	1
Storing & Preservation	HDPE bottle (125 mL, white, wide-mouth)	1
	Ethanol (95%)	1

5.5.2.3 Sample Collection and Processing Procedure

5.5.2.3.1 Sample Collection

1. Record the Site ID and date on the sample label. Record the length of tow (normally calculated by subtracting 0.5 m from the water depth) on the form.
2. Prior to each use, carefully clean and thoroughly rinse the interior of the plankton nets and buckets with DI water.
3. Carefully inspect the nets and buckets for holes or tears.
4. Attach the collection buckets to the “cod” end of the nets and secure. Make sure that the mesh sizes of the net and bucket match.
5. Attach the bridled end of the plankton net to a 0.25 inch calibrated line with markings every 0.5 m (you can use the line for the Secchi disk, if necessary).
6. Carefully and slowly lower the first net in a constant upright position over the side of the boat.
7. Continue lowering the net until the mouth of the net is 0.5 meters above the lake bottom (remember to account for the length of the bridle). If the depth is < 2 m and the Secchi disk could be seen at the bottom, a second tow is made and the samples combined (cumulative tow length = 3 m or less).
8. Retrieve the net by pulling back to the surface at a steady constant rate without stopping (0.3 m or 1 ft per second).
9. Once at the surface, slowly dip the net up and down in the water without submersing the net mouth and help rinse contents into the collection bucket.

10. Complete the rinsing of the net contents by spraying water against the outside of the net with a squirt bottle or similar tool. Be careful not to splash or squirt lake water into the net mouth, or additional organisms may be collected.
11. If additional rinsing is needed on the interior of the net, use a squirt bottle with DI water only to avoid introducing additional organisms.
12. Once all organisms have been rinsed into the collection bucket, hold the collection bucket in a vertical position.
13. Concentrate the contents of the collection bucket by swirling the bucket without spilling the contents. Excess lake water will filter out of the bucket from the screened sides.
14. Repeat steps 5-13 with the second net on the opposite side (or end) of the boat.
15. Follow the sample processing procedure outlined in section 5.5.1.3.2.

5.6 Sediment Mercury, Diatoms, and Dating Sample Collection

5.6.1 Summary of Method

Use a gravity-type sediment corer to collect an intact sediment core at the index site and then slice off the top and bottom of the core for analysis in the laboratory. The lab will use trace-metal clean techniques to analyze sediment from the top and bottom slices. The results will be used to assess current and past conditions of mercury loading and diatom frustule abundance and composition across the nation. The bottom core sample (collected from natural lakes only) will be dated (using lead-210) to allow for estimates of the approximate age of the bottom of the core. By including sediment aging, this investigation will provide a general indication of the rate of change of two key indicators for our nation's lakes.

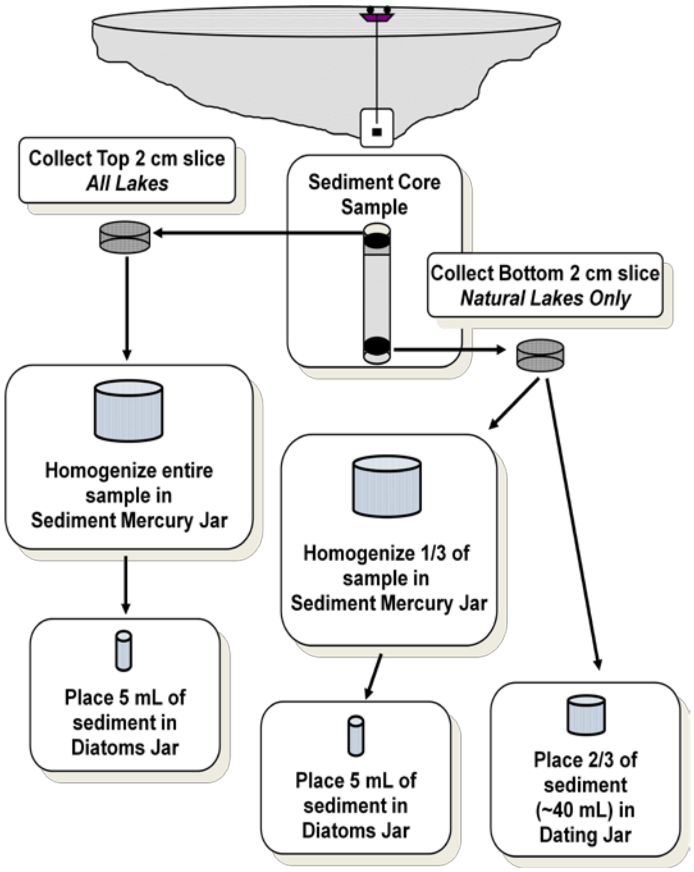


Figure 5.5 Sediment core sample summary.

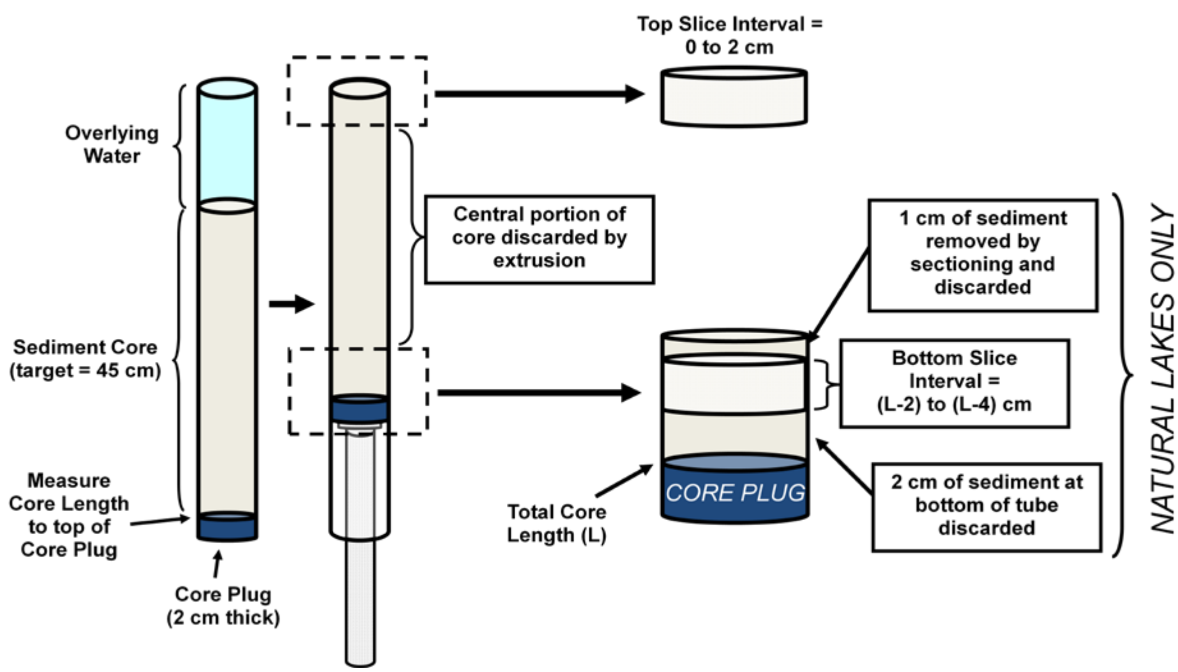


Figure 5.6 Sediment core sample summary - detail.

5.6.2 Equipment and Supplies

Table 5.7 provides the equipment and supplies needed to collect a sediment core sample. Figure 5.7 is an illustration of the gravity corer (68 mm diameter and 60 cm long core tube) and sectioning apparatus. Core tubes will be marked at 45 cm.

Table 5.7 Equipment and supplies – sediment core sample.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
Collection: **Sediment Core**	Corer head (gravity, with cable and messenger) Core tube Sectioning tube (6 cm, 2.5 in ID, line marked 2 cm from bottom of tube) Sectioning stage Extruder rod Spatula (1.5 inch plastic putty knife) Syringe (60 mL) with tubing siphon overlying water Core plug Screwdriver	1 1 1 1 1 1 1 1 1 1
Collection: **Sediment Mercury**	Kit: Sediment Mercury pre-cleaned supplies in ziploc bag: - Transfer Pipette (plastic) - Screw top jar (125 mL, plastic) Gloves (latex/nitrile, non-powdered) Scoopula	 2 2 1-2 pairs 1
Storage & Preservation: **Sediment Diatoms**	Screw top jar (15 mL, plastic)	1 in reservoirs 2 in natural lakes
Storage: **Sediment Dating**	Screw top jar (60 mL, plastic)	1 (natural lakes only)

5.6.3 Sampling Procedure

Collect a 45 cm long sediment core from undisturbed sediments at or near the index site and section off 2 cm of sediment from the top (at all lakes) and bottom (at natural lakes only) of the core sample for analysis. Sediment from the top will be used for the following samples: mercury and diatoms. Samples from the bottom of the core (natural lakes only) will be used for the following samples: mercury, diatoms and dating analysis.

In natural lakes, the composition and texture of the bottom will vary from lake to lake and, in some lakes, it will be impossible to get a 45 cm core because the bottom is too rocky, the sediments are too dense, or, if it is a shallow lake, there are macrophytes covering the bottom. It is essential that the GPS coordinates be recorded and the collection location be marked on the **Index** Sample Collection form.

If you collect a core less than 45 cm long on your first try, move to another location near the index site to find an area with a softer bottom. In addition, you can experiment with getting improved penetration by adding additional weight (if available) to the corer, and/ or by releasing the corer further above the sediments. If a 45 cm core sample cannot be collected from natural lakes after attempting at least three locations, process the last core that you obtained. The procedures for collecting and processing sediment cores are presented below.

If you collect a core longer than 45 cm long, as long as there is water on top of the sediment core, this will be acceptable for use.

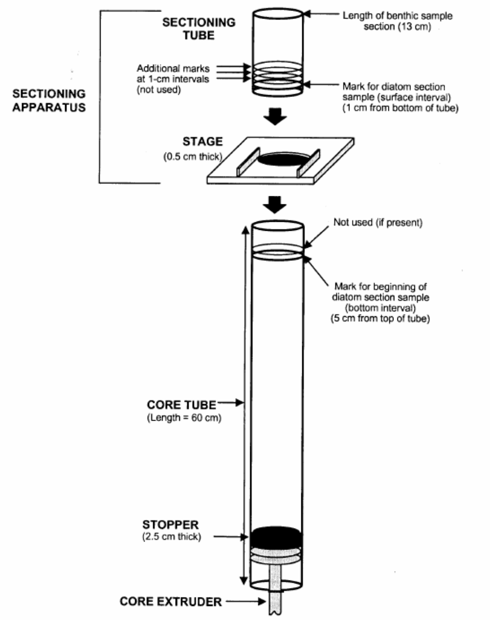


Figure 5.7 Illustration of the core tube and sectioning apparatus.

5.6.3.1 Sediment Core Sample Collection

1. Wear surgical gloves at all times during sample collection to protect yourself from any potential contaminants in the sediments, and to prevent contamination of the sample from trace mercury on the skin of the sampling crew.
2. If the bottom has been disturbed during the initial depth determination or for any other reason, move at least 5 m to take the core. It is critical that the corer strikes undisturbed surface sediments.
3. Insert the core tube into the sampling housing apparatus and tighten the hose clamp screws to secure the tube. Ensure the messenger is attached to the sampler line. Set the release mechanism.
4. Slowly lower the corer through the water column until the bottom of the core tube is just touching the sediment surface. Raise the corer 1 m and while maintaining a slight tension on the line, lower the corer allowing it to settle into the bottom substrate. Immediately after the corer drops into the sediments, maintain line tension to prevent the corer from tilting and disturbing the core sample. [Keep in mind that the goal is to obtain a core 45 cm in length. If this core length is not obtained the first time, the operation might need to be repeated at a new location using additional weights on the corer (if available) and/or a greater release height in order to improve penetration and obtain a longer core. If the core length exceeds the length of the core tube, the operation might need to be repeated at a new location using less weight on the corer and/or a shorter release height.]
5. Trip the corer by releasing the messenger weight so that it slides down the line. Keeping the line vertical and keeping tension on the line will help ensure that the messenger reaches the sampler and trips the mechanism.
6. Slowly raise the corer back to the surface, keeping the bottom of the core tube under the water.

7. While keeping the bottom of the core tube under water, reach under the surface and plug the bottom of the corer with a corer tube plug. To do this without disturbing the water-sediment interface, you cannot tilt the corer more than 45 degrees. (Note: core tube plugs are easily lost. Be sure to have spares available at all times.)
8. Keeping your hand under the corer tube plug, raise the corer into the boat in a vertical position. Stand the corer in a large tub or bucket to prevent contaminating the boat with sediment material.

5.6.3.2 Sediment Core Processing

1. Measure the length of the core to the nearest 0.1 cm and record the interval on the **Index** Sample Collection form and on the two sample labels. Determine the intervals by:
   a. Top Slice Interval: 0 to 2 cm
   b. Bottom Slice Interval: Calculate using the formula where L equals total length: (L-2) to (L-4) cm
1. Put gloves on. Record the Site ID, date, and collection intervals on sediment core sample labels. Prepare containers and attach the labels to two plastic containers (for diatoms), one 60 mL screw top plastic jar (for sediment dating), and plastic jars (for sediment mercury). Cover labels with tape. IMPORTANT: only handle sediment mercury containers with clean gloved hands, and keep the containers in the provided plastic bags whenever possible.
   - The pre-washed “sampling kit” for the sediment sample will be provided in a resealable plastic bag. Do not open the bag until you are ready to collect the sediment sample, and make sure the contents of the kit do not come into contact with anything other than the sediment sample.
2. Detach the core tube from the corer. One crew member should hold the sampler in a vertical position while the second person dismantles the unit.
3. Position the extruder under the corer tube plug at the base of the coring tube. Supporting both the core tube and the extruder in a vertical position, **slowly** lower the coring tube onto the extruder until the sediment is approximately 1 cm below the top of the tube.
4. Remove the water above the sediment core by using a syringe with tube so that the surface sediments are not disturbed.
5. Secure the sectioning stage onto the top of the coring tube. Place the Plexiglas sectioning tube (marked with a line 2 cm from the bottom) on the stage directly over the coring tube. Slowly extrude the sediment core into the sectioning tube until the top of the sediment reaches the 2 cm line on the sectioning tube. Slide the sectioning tube onto the flat part of the stage and scrape the top 2 cm section of sediment into a clean 125 mL container labeled for the top interval sediment mercury sample (a clean reusable plastic spatula may be used to aid in transferring the sample to the container).
6. Recap sediment mercury sample cup and return to bags.

5.6.3.3 Bottom Sample Collection (Natural Lakes Only)

7. Before collecting the bottom section, remove the stage and sectioning tube and rinse in lake water. Also rinse the spatula, gloved hands and any other implements that have come in contact with the sediment. This procedure prevents contamination of the bottom sediment layer with

diatoms from the top portion of the core. This step is critical because a small amount of sediment contains millions of diatoms that would contaminate the population structure needed to compare environmental conditions depicted by top and bottom core samples.

8. Continue extruding the sample, discarding the central portion of the sediment in the tube, until the bottom of the corer tube plug is approximately 7 cm (3 inches) from the top of the coring tube.
9. Rinse any sediment from your gloved hands. Re-affix the sectioning stage and sectioning tube to the top of the coring tube. Extrude the sample into the sectioning tube until the bottom of the stopper reaches a point 6 cm from the top of the tube. Section the extruded sediment (approximately 1 cm) and discard. This operation results in exactly 4 cm of sediment remaining in the core tube.
10. Rinse the sectioning tube with lake water. Without removing the sectioning stage from the coring tube, slightly tilt the tube and wash the stage with a small amount of water from a squirt bottle. Make sure the rinse water runs off the stage and not into the coring tube with sediment. Extrude the sample until the top of the sediment is at the 2 cm mark on the sectioning tube. Slide the sectioning tube onto the flat part of the stage.
11. Cut off 1/3 of the sample and transfer to the sediment mercury container, 125 mL plastic container. Transfer the remaining sediment into the 60 mL screw top container for sediment dating. Discard the remaining 2 cm.

5.6.3.4 Diatom Sample Collection

1. Retrieve the mercury sample container from the bag with clean, gloved hands. Remove the lid. Using the transfer pipette, homogenize the sediment in the 125 mL container, transfer 5 mL sample from the mercury container to the diatom container.
2. The sediment remaining in the 125 mL container is the sediment mercury sample. Recap and replace the sediment mercury container in the bag. Seal. Place the mercury sediment sample on ice immediately and keep cold until shipment.
3. If you collected sediment from the bottom of the core, repeat this sub-sampling process for the bottom sediment sample. Note: If the sediment is too firm to homogenize with the pipette, use a clean scoopula included in the base kit.
4. Place containers in a cooler with bags of ice.
5. Rinse the corer, spatula, coring device, and sectioning apparatus thoroughly with lake water. Rinse with tap water at the next base site. After cleaning the core tube, cover the ends with the orange caps and place all other sectioning equipment into a clean plastic bag.

5.7 Macrophyte Observation - Maximum Depth of Colonization

After sampling the index site, you will check the lake for the presence of macrophytes by estimating the maximum depth of colonization (MDC) along one transect as you head in toward shore (e.g., your first littoral/ shoreline station). You will follow the protocol described in 6.2.4.2, where you move the boat from the index site to an appropriate depth and use the rake to sample for macrophyte presence at one meter increments along a transect. You will record your observations on the **Macrophyte Assemblage Characterization** form.

6.0 LITTORAL AND SHORELINE ACTIVITIES

To better understand the character of near-shore habitats and conditions, travel to 10 evenly spaced physical habitat (PHab) stations around the lake and document conditions and characteristics observed within a defined plot area. The full array of measurements and sampling described in this chapter include:

- measures or observations of littoral, shoreline, draw-down zone, and riparian physical habitat cover and structure at the 10 PHab stations;
- observations of invasive plants and macroinvertebrates;
- sampling of benthic macroinvertebrates at each of the 10 stations and composited as a single sample; and
- collection of water samples at the J station for chlorophyll-*a* cell density, phytoplankton, and algal toxins (microcystins).

It should be noted that for lakes with a surface area of greater than 10,000 ha (defined as large lakes), the crews do not have to travel to the PHab stations and perform physical habitat assessments, benthic macroinvertebrate, or macrophyte sampling due to the increased level of effort required to travel around these large lakes. However, we encourage crews to complete the physical habitat characterizations on large lakes. Additionally, water samples for the above three indicators can be collected near the boat launch at these large lakes.

Note: when large islands are present, or when certain other circumstances arise, sites may contain more than 10 PHab stations.

6.1 Physical Habitat Characterization

6.1.1 Summary of Method

The approximate locations of the 10 lake shore stations are determined prior to the sampling visit and marked on the Site Map. Figure 3.2 displays the placement and distribution of PHab stations around the lake. Within each PHab station, you will set up a plot as shown in Figure 6.1. The plot measures 15m wide, and includes a littoral plot extending 10m out from the shoreline, a drawdown zone plot (newly added to the NLA 2012 methods) extending inland from the shoreline to the normal high-water level, a 1m shoreline zone plot at the shore just above the present water line, and a 15m wide riparian plot that begins at the normal high water mark and extends 15m landward. The drawdown zone plot extends a variable distance inland depending on the degree of drawdown and, if it is negligible, can be ignored if the lake is at its normal high water mark.

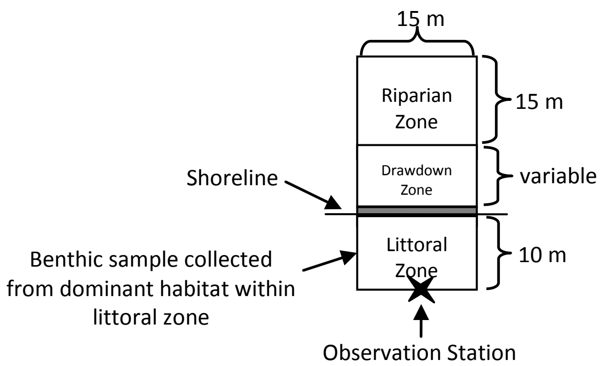


Figure 6.1 Dimensions and layout of a physical habitat station.

As described below, you will record observations from each of the zones on the **Physical Habitat** form.

6.1.2 Equipment and Supplies

Table 6.1 provides the equipment and supplies needed to locate the PHab stations and conduct the physical habitat characterization.

Table 6.1 Equipment and supplies – physical habitat assessment.

Type	Item	Quantity
Form	NLA 2012 Verification	1
	NLA 2012 Physical Habitat	10
Collection	Depth Sounder (hand-held or boat mounted sonar)	1
	Sounding rod (3 m , marked in 0.1 m increments, calibrated, PVC)	1
	GPS unit (with manual, reference card, extra battery)	1
	Rangefinder (for estimating horizontal drawdown)	1 (optional)
	Clinometer (for use as a level to measure vertical drawdown)	1
	Surveyors rod (for measuring vertical drawdown)	1
	Binoculars (for making observations of distant riparian)	1
	Map wheel or string (for measuring shoreline distances on site map)	1
	Anchor (with 75 m line or sufficient to anchor in 50 m depth)	1
	Buoy (for marking observation point)	1

6.1.3 Locating the Physical Habitat Stations and Defining the Shoreline Boundary

6.1.3.1 Base Site Activities

It is important that you set up PHab stations beforehand in the office to minimize bias in site selection and to ensure efficient location of stations once at the lake.

1. Using a lake map, select a random starting point on the lake outline. Any reasonable method may be used select the starting point (e.g. tossing a coin on the map, place a compass on the map in the center of the lake and find due north), this is your "A" station.
2. It is important that the remaining nine stations be located at equal distances around the lake (see Figure 3.2). These will be your "B" through "J" stations. Field crews can do this manually (by either using a string to trace the perimeter of the lake, which can then be straightened and marked in equal intervals, or by using a map wheel) or electronically (with GIS or other digital mapping tools) to measure the perimeter of the lake and dividing by 10.

3. Using a GIS or other digital mapping tool application to locate the coordinates of the ten stations that can then be entered as GPS waypoints greatly facilitates correctly locating PHab stations by boat in the field, especially on large lakes.
4. Mark the physical habitat stations on a site map.

Note: In revisit lakes (see 8.1 for more information), you will re-randomize and relocate the physical habitat sites. We re-randomize the sites because we use the revisit data to examine variability of the entire lake assessment.

6.1.3.2 Littoral and Shoreline Activities

Using the site maps and GPS, proceed by boat around the lake, locate, and stop at each of the 10 PHab stations. Position the boat at a distance of 10 m, anchor if necessary, and make the semi-quantitative measurements on the **Physical Habitat** form. Complete a separate **Physical Habitat** form for each station.

Make every reasonable attempt to record physical habitat observations and measurements for all 10 PHab stations. Where this is impossible, record flags as specified in Table 3.1.

Remember, numbered “F” flags pertain to the front and back side of each individual form (e.g., you can assign an F1 flag to mean something different at different habitat stations). Similarly, “F” flags do not carry over from one form to the next, so all “F” flags entered on a form must be defined on that same form.

6.1.3.3 Shoreline and Station Location Adjustments

Once in the field, you may encounter situations that require you to modify the shoreline and/or station location(s) from the intended locations marked on the site map. If this occurs, make the corrections and adjustments on the **Physical Habitat** form and note the reasons on the comments section of the form. The general guidelines for locating or modifying the location of the littoral and shoreline stations are summarized below.

1. Locate station using maps, aerial photos, or GPS units.
2. Define shore as either the current waterline OR the boundary between open water and the edge of dense vegetation (terrestrial, wetland, or emergent vegetation) or extensive very shallow water (shoreline defined by limit for navigating your boat).
3. If the shoreline observed in the field differs from the mapped shoreline: mark “Station Relocated” and enter a comment on the **Physical Habitat** form stating the apparent reason (e.g., drought, flooding, dredging).
4. If a PHab station is lost because of shoreline changes: mark “Station Relocated” at the top of the **Physical Habitat** form, and position one or more new stations at approximately equal intervals.
5. If a station is eliminated, mark the “Station Dropped” box.
6. If the shoreline observed in the field differs radically from the site map and you are sure you are at the correct lake, sketch a map of the lake or use one of the maps from your site packet. Use a string to measure the new outline, divide it into 10 equal parts, and lay out the 10 station locations.

6.1.3.3.1 Islands

Islands may be an additional source of shoreline habitat on a lake and we will account for them by adding island physical habitat stations. Island stations are in addition to the A-J stations. The guidelines for adding island stations follow:

- If the shoreline of an island makes up 10-20% of the lake's shoreline, add one PHab station (A-K)
- If the shoreline of an island makes up more than 20% of the lake's shoreline, add one more PHab station (A-L)
- Island stations are designated by marking the "Is it an island?" bubble on the form, by a new station letter (K, L, etc), and by marking the island location and station on a site map.

6.1.3.3.2 Ambiguous Shorelines

The shoreline is defined as the interface between "lake-like" conditions and riparian or wetland conditions. In most cases, the shoreline will be easily identified as the current waterline. In some instances, however, the shoreline might not be obvious. Listed below are some general situations and rules that should be applied to them.

- If there has been a significant drop in lake level due to drought, dam repair, or other reasons, shallow areas may be exposed that are usually covered with water. In this case, consider the current waterline as shoreline for the purposes of this survey, not the normal waterline.
- If there are extensive very shallow areas or shoals, consider the shoreline to be the boundary between the shallow area and deeper open water, as defined by ease of access by a small sampling boat.
- If access to the true shoreline is prevented by an area of dense aquatic or terrestrial vegetation, consider the shoreline to be the boundary between the vegetation and deeper open water. Again define the operational shoreline by ease of access by small sampling boat.
- If a river or stream enters a lake, the shoreline begins where no flow is visible.

6.1.3.3.3 Actual shoreline is different than appears on the map

The goal of the physical habitat survey is to characterize the lakeshore based on observations of conditions at 10 evenly spaced PHab sites around the lake. Adjustments to station locations might be needed if the field crew runs into unusual conditions or problems. Below are some rules concerning modifications to the station location(s).

- If only a small portion of the shoreline differs and it does not affect, or only slightly affects, a PHab site location, sketch the lake shoreline on the site map and reposition the station (if needed).
- If the difference causes a contraction of the shoreline and a PHab station location is lost, sketch the lake shoreline on the site map and make a decision to (a) keep the station, relocate it on the revised shoreline map and adjust some or all other stations in order to keep stations evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations).
- If the difference causes an expansion of the shoreline, the crew should sketch the lake shoreline on the site map and make a decision to (a) add one or more stations, mark them on the revised shoreline map and adjust some or all other stations if needed so they are evenly spaced around the lake (i.e., designate more than 10 stations), or (b) adjust the stations so that they are evenly spaced around the lake (i.e., keep 10 stations).
- If the Site Map does not in any way match the lake shoreline, draw a new sketch map approximating the shoreline, and re-establish the 10 PHab stations. A quick way to locate 10

evenly-spaced PHab stations is to: (a) lay a piece of string on the lake perimeter, (b) pick up the string, measure it, and mark out 10 equal parts, and (c) lay the string back on the perimeter and use the marks to locate the 10 sites on the map.

6.1.3.3.4 PHab Station is inaccessible

- If a PHab station is inaccessible, you must make a decision to (a) relocate the station and adjust some or all other stations so that they are evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations). The size of the lake will help drive this decision.
- Draw all adjustments to the shoreline based on field observations directly on the Site Map and explain the adjustments in the comments section of the **Physical Habitat** form.

6.1.3.4 Identifying Relocated and New Stations on the Form

Use the following notations when recording station location modifications.

- If you relocate a station, note the new location on the Site Map and check the appropriate original station letter (e.g., “C”) on that form. In addition, check the box for the station letter on the **Physical Habitat** form and check the box for “Station Relocated.”
- If a station is lost and cannot be replaced, cross out the original station location on the pre-printed Site Map and check the box for “Station Dropped” on the **Physical Habitat** form.
- If you add one or more stations, indicate the nearest station locations on the Site Map, and fill in the box for “New Station” on a blank **Physical Habitat** form.

6.1.4 Establishing the Physical Habitat Plot

You will establish a plot for physical habitat characterization at each PHab station. You will make most observations and measurements of the shoreline from the boat at the observation point 10 m from shore (estimated by eye). Limit observations at each station to the area that is within the defined plot dimensions. After setting plot dimensions, you may need to move around within the littoral plot to see or probe the bottom or even go onto shore to make observations.

6.1.4.1 Physical Habitat Plot Dimensions

You will identify up to four distinct zones within each physical habitat plot (Figure 6.1), where you estimate the zone dimensions by eye.

6.1.4.1.1 Littoral

This within lake zone is a fixed size that is 15m wide along the shoreline and 10m out into the lake.

6.1.4.1.2 Shoreline

The shoreline zone is a fixed 15m wide strip along the shore just above the present water line and 1 m inland. The shoreline boundary is defined as the approximate interface between "lake-like" conditions and riparian or wetland conditions. In cases where the lake shoreline is not obvious (e.g., where there is evidence of large seasonal change in lake level) define the shoreline as the current waterline. In cases where the lake shoreline is not visible, define the lake shoreline as the approximate boundary between open water and swamp or marsh conditions into which your boat could not easily move.

6.1.4.1.3 Drawdown

When present, the drawdown zone plot has a fixed width (15 m) but a variable extent inland determined by your judgment and measurement of the horizontal drawdown distance from the shore to the normal high water mark at the station.

6.1.4.1.4 Riparian

The riparian zone is a fixed size that runs 15m parallel to the shoreline and extends 15m from the normal high-water mark inland.

6.1.5 General Observations

Note: At the PHab station J, collect samples from the water column (Sections 6.3 and 6.4) before conducting the habitat characterization at that station.

Begin the physical habitat characterization with general observations.

1. Set up your plot within your physical habitat station
2. Measure and record the lake depth 10 m from the shore at each PHab station (observation point). Note the new location on the **Physical Habitat** form if the point has to be relocated for some reason.
3. Note on the **Physical Habitat** form whether there is shoreline flooding. If so, estimate the depth and the horizontal distance of flooding. A lake at normal high-water level at the time of sampling will have these sections left blank for height and distance.
4. Note on the **Physical Habitat** form whether there is drawdown. If so, estimate and record the vertical (height) and the horizontal (distance) distances between the present lake level and the normal high water line. Your measurement or estimate of horizontal drawdown distance will set the inland extent of the drawdown portion of the PHab field plot. The vertical height can be measured using the clinometer as a level in combination with the survey pole, or by visual estimation. Similarly, the horizontal distance up the bank between current lake level and the evidence of the normal high water level is usually done using a laser range finder. A lake at normal high-water level at the time of sampling will be left blank for both drawdown height and horizontal distance.
5. Also record the bank angle description that best reflects the current shoreline that is dominant within your field of vision in the 1 meter shoreline zone:
    a. Near vertical/undercut (>75 degrees),
    b. steep (>30 to 75 degrees; need hands to climb up)
    c. gradual, (5 to 30 degrees; can walk up)
    d. flat (< 5 degrees)

    NOTE: This will be completed even if there is no drawdown.
6. Record the presence or absence of water surface scums, algal mats, or oil slicks within the littoral zone.

6.1.6 Estimate Substrate Characteristics

You will use semi-quantitaitve categories to estimate cover for substrate types (e.g. bedrock, boulders, cobble, gravel, sand, silt/clay/muck, woody debris, organic matter, and vegetation) and also for fish habitat cover, aquatic macrophytes, and terrestrial vegetation. The categories are as follows:

- 0 = absent (0% cover)
- 1 = sparse (<10% cover)
- 2 = moderate (10 – 40% cover)

- 3 = heavy (40 – 75% cover)
- 4 = very heavy (>75% cover)

When estimating cover mixtures of more than one class might all be given sparse (1), moderate (2), or heavy (3) ratings. One dominant class with no clear subdominant class might be ranked very heavy (4) with all the remaining classes either sparse (1) or absent (0). Two dominant classes with more than 40 percent cover can both be given a 3.

7. Estimate the areal cover of bottom substrate types and particle size classes observed within the littoral and the shoreline zones. Cover categories range from absent to very heavy. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form. In most cases these estimates can be made from the boat or can be made while wading if preferred.
   - If the bottom substrate is not visible, you should probe the bottom beneath the boat with the sounding rod (you may have to move closer to shore if you are too deep to use the rod). Soft sediment can be brought to the surface for examination. Hard sediments can be "felt" with the sounding rod. Sandy substrate can be "felt" or "heard" by twisting the sounding rod and detecting grittiness. Estimating cover of various substrate types will typically require multiple probes within the littoral plot. If you have to move into shallow water to use the sounding rod to observe sediment characteristics, flag the observation and record the depth where you observed the sediment.
   - If the bottom is covered with materials other than mineral substrates, choose “Woody Debris”, “Organic (leaf pack, detritus)”, or “Vegetation/Other”.
   - If the substrate is concealed and remote sampling is not possible, use "Not observed" flag (K).
8. Record sediment color within the littoral zone. Select "None” or “Other" if the sediment does not match one of the color categories options on the **Physical Habitat** form.
9. Record sediment odor within the littoral zone. For sediment odor, the choices are "H_2S" (sulfurous, rotten egg), "Anoxic" (sewage odor), "Chemical" (strong odor like turpentine, paint, etc.), "Oil", or “Other" (including musty, organic, and fishy odors). If "Other" is indicated, explain the observation in the comment section of the form.

6.1.7 Estimate Aquatic Macrophyte Cover

10. Note and record whether macrophytes extend lake-ward from the observation point.
11. Estimate the areal cover of submerged, emergent (has erect portions above the water surface), floating (either rooted or non-rooted vegetation), and total macrophytes within the littoral zone. Cover categories range from absent to very heavy, as described in 6.1.6. As for substrate, estimating aquatic macrophyte cover may require multiple probes within the littoral plot. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form. These estimates can be made from the boat or while wading.
    - If you cannot see or probe the bottom, move closer to shore and note your new location with a flag.

6.1.8 Estimate Fish Habitat Cover

Estimate the areal cover of potential fish habitat observed within the littoral and, when present, drawdown zone(s). These features are within or partially within the water and conceal fish from aquatic and terrestrial predators such as large fish, otters, kingfishers, and osprey. Cover categories range from absent to very heavy, as described in 6.1.6. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form. In most cases these estimates can be made from the boat. Estimating fish habitat cover may require multiple probes within the littoral plot.

12. Estimate and record cover for the following fish habitat types:
    - Aquatic and Inundated Herbaceous Vegetation: Submerged, floating, or emergent live aquatic or non-woody herbaceous plants
    - Woody Debris/Snags: Inundated or partially inundated dead trees, branches, or rootwads with diameter >0.3 m (1 ft)
    - Woody brush/woody debris: Inundated dead or living woody vegetation <0.3 m diameter.
    - Inundated Live Trees: Inundated portions of trees >0.3 m in diameter
    - Overhanging Vegetation: <1 m from the water surface (do not include higher overhanging vegetation, which might provide perches for birds such as kingfishers)
    - Ledges or Sharp Dropoffs: Overhanging banks, submerged rock shelves, and steep sloping rock walls
    - Boulders: Larger than basketball size
    - Human Structures: Docks, barges, houseboats, swimming platforms, tires, car bodies, and habitat enhancement structures (e.g., log rafts)

Note: In the drawdown zone you will estimate the potential fish cover (e.g., what cover would there be if the drawdown zone were inundated – i.e., part of the littoral zone). The potential fish cover estimates are made only if there is a visible drawdown zone. For the observations, the question is "What cover would there be if the drawdown zone were inundated – i.e., part of the littoral zone. " Then, for example, a bunch of dried aquatic macrophtes would be "Aquatic and Inundated Herbaceous Veg." – So would newly-grown terrestrial grasses. Cyprus trees left "high and dry" would qualify as "Inundated Live Trees >0.3m dia." Overhanging vegetation rooted above the drawdown zone could be "Overhanging Veg. within 1m of the Surface".

6.1.9 Estimate the Cover and Type of Riparian and Drawdown Zone Vegetation

You will estimate the areal cover of different types of vegetation in the riparian and, when present, drawdown zone(s). Vegetation cover is divided into three layers, which are described below. Note that individual plants can contribute cover to more than one layer. Similarly note that some things other than vegetation are possible entries for the "Ground Cover" layer (e.g., water or barren ground).

6.1.9.1 Canopy Vegetation (greater than 5 m high)

13. Record the type of vegetation in the canopy as deciduous, coniferous, broadleaf evergreen, or mixed, where mixed is defined as a segment where at least 10% of the areal coverage is made up of the alternate vegetation type.
14. Estimate the areal cover of big (trunk >0.3 m diameter at breast height) and small (trunk <0.3 m diameter at breast height) trees. Cover categories range from absent to very heavy, as described in 6.1.6. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form.

6.1.9.2 Understory Vegetation (5m to 0.5m high)

15. Record the type of vegetation in the understory as deciduous, coniferous, broadleaf evergreen, or mixed, where mixed is defined as above.
16. Estimate the areal cover of woody vegetation and tall herb grasses, and forbs. Cover categories range from absent to very heavy, as described in 6.1.6. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form.

6.1.9.3 Ground Cover (lower than 0.5m high)

17. Estimate the areal cover of woody vegetation; tall herbs, grasses, and forbs; standing water or inundated vegetation; and barren, bare dirt, or buildings. Cover categories range from absent to very heavy, as described in 6.1.6. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form.

6.1.9.4 Considerations for Drawdown conditions

Drawdown Zone vegetation entries are located to the right of Riparian Zone Vegetation on the **Physical Habitat** form. They are filled out only if there is a drawdown zone. Unlike the case with potential fish cover, record these vegetation estimates just as you see them --- i.e., Do not in this case imagine that the drawdown zone is under water. For Example: There must be water on the ground (e.g., puddles) to have an entry for "standing water or Inundated vegetation" in the drawdown zone. Trees and other vegetation are simply that --- they are not entered as "standing water or inundated vegetation. Newly-grown grasses <0.5m high are entered under "Herbs, Grasses, & Forbes" Newly-grown brush is entered according to its size class and whether it is woody or not. Large trees rooted above the drawdown zone can contribute cover over the drawdown zone. Dried aquatic macrophyte vegetation cover is entered under "Herbs, Grasses, & Forbes" with comment that it is dried aquatic macrophytes. There may be a lot of zeros for vegetation in the drawdown zone.

6.1.10 Record Evidence of Human influence

18 You will record any observations of human influences within the riparian and drawdown zones within the physical habitat plot. When a drawdown zone is present, human influences within the littoral plot are recorded in the drawdown portion of the **Physical Habitat** form. When there is no drawdown zone, littoral entries are included in the riparian zone portion of the form. Within each zone, observations are recorded as not present (0), present outside and/ or adjacent to (P), or present within (C) the area. Record all observations by filling in the appropriate bubbles on the **Physical Habitat** form.

- In the littoral zone, "adjacent" is defined as found within a hypothetical plot of equal size to the right or left of the sampling plot. This plot will be 10m deep by 15m wide.
- In the drawdown zone, when present, "adjacent" is defined as found within a hypothetical plot of equal size to the right or left of the drawdown plot. This plot will be variable in depth, depending on the size of the drawdown zone, but will always be 15m wide.
- In the riparian zone, "adjacent" is defined as found within a hypothetical plot of equal size to the right, left, or behind of the sampling plot. The area defined as adjacent to the riparian plot will each be 15m deep by 15m wide.

Do not mark "P" if it is already marked "C" in that zone (only mark the more influential). Human Disturbances absent (0) and within-plot (C) are straightforward. For Present but outside or adjacent to the plots (P), use these guidelines:

a) A disturbance is marked "P" if the disturbance is seen entirely outside of any of the plot zones, but is adjacent to (i.e., abutting left or right hand side of the entire Littoral-Drawdown-Riparian plot and is within 15m on either side).
b) A disturbance is marked "P" if the disturbance is seen entirely outside of any of the plot zones, but is visible looking on-shore through the three plot zones (Littoral, Drawdown, and Riparian)
c) So, a single disturbance might be marked "P" in both the Riparian-Littoral and the Drawdown zones.
d) If there is a drawdown plot, the presence of a human influence item WITHIN THE LITTORAL PLOT is recorded as "C" in the DRAWDOWN portion of the form.
e) If there is NO DRAWDOWN PLOT (ie., the riparian plot abuts on the water, then human disturbances in the littoral plot are recorded by entering "C" in the Riparian portion of the form).

Note: Typically only Docks/Boats, Landfill/Trash, and maybe Buildings (boathouses) will be commonly observed within the drawdown plot and its adjacent littoral area. For example, if a boat is laying aground in the Drawdown Zone, mark it "C" in the Drawdown Zone. A boat anchored offshore in the littoral zone is also marked "C" for the drawdown plot, because the littoral zone in this case abuts the drawdown zone. However, if there is no drawdown zone, all littoral disturbance items are included on the riparian zone portion of the form.

6.1.11 Invasive Plants and Invertebrates

Record if any invasive plant or invertebrate species listed in Table 6.2 have been observed within the PHab plot. Check the boxes on the **Invasive Plants and Invertebrate** form for any species observed within the littoral, shoreline, or riparian plots. Please see APPENDIX F.

Table 6.2 Invasive plants and invertebrates.

Plants	curlyleaf pondweed	water starwort
	common reed	water hyacinth
	Eurasian watermilfoil	yellow floatingheart
	purple loosestrife	European pepperwort
	Russian-olive	alligatorweed
	reed canarygrass	European waterstarwort
	Canada thistle	giant salvinia
	multiflora rose	water fern
	narrowleaf cattail	water-chestnut (European)
	Brazilian waterweed	tamarisk
	brittleleaf naiad	deeprooted sedge
	parrot feather milfoil	Japanese or giant knotweed
	mimosa	miramar weed
	hydrilla	Brazilian peppertree

Invertebrates	zebra or quagga mussel Asian clam	rusty crayfish

6.2 Macrophyte Assemblage Characterization

6.2.1 Summary of Method

Macrophyte depth, density, growth form, and maximum depth of plant colonization will be estimated using the following rapid assessment protocol. Macrophyte data will be recorded at individual sample points stratified by lake depth and lying along transects. You will characterize macrophyte assemblages at five transects in each lake. Transects will run perpendicularly from shore, extending through the midpoint of every other PHab station to ultimately reach up to halfway across the lake. Sampling points will be placed along each sampling transect at water depths of 0.5 m and 1 m, and will continue lakeward along the transect with additional points placed at every additional meter of depth gained. Single rake tows using a double-sided rake sampler will be taken at each point on the transect.

6.2.2 Equipment and Supplies

Table 6.3 indicates the equipment and supplies needed for the macrophytes assemblage characterization.

Table 6.3 Equipment and supplies – macrophyte assemblage characterization

Type	Item	Quantity
Form	NLA 2012 Macrophyte Assemblage Characterization	1
Collection	Rake sampler (attached to rope) Depth finder	1 1

The rake samplers are each constructed of two rake heads welded together, bar-to-bar, to form a double-sided rake head. The rake head is 13.8 inches (35 centimeters) long, with approximately 14 tines on each side. You will attach this double-sided rake head to a rope; this rake head should also be weighted with approximately 5 pound of weight (Figure 6.2).

Figure 6.2 Examples of rake sampler used for macrophyte assemblage characterization.

6.2.2.1 Rope Sampler

To make the rake sampler shown in the photograph, we removed the handles from 2 standard bow rakes (available at most hardware stores), and welded the rake heads together bar-to-bar. If welding is not an option, the rake heads may be attached to one another with either hose clamps or cable ties. The rope sampler pictured here has a short piece of steel tubing welded to the rake head to serve as a handle through which 40 feet of rope is attached. Attach this rake head to a ≥ 14 m rope. In order to ensure a quick vertical descent to the lake bottom, attach a light weight (~5lb) to the rake head, away from the tines. For depth recording, mark the rope in one meter increments.

6.2.3 Locating the Macrophyte Transects

6.2.3.1 Transect Placement

Place transects perpendicularly to the shoreline, running through the PHab anchor point and ending halfway across the lake (midpoint between starting and directly opposite shores).

Place a minimum of 6 points per transect stratified by water depth, with the first point at 0.5m depth (±0.2m), the second at 1m depth (± 0.2m), then continuing lakeward at regular 1m depth intervals until one of stop criteria apply.

6.2.3.2 Stopping a Transect

Due to varying lake morphometry, it will sometimes make sense to stop sampling before the transect ends at the halfway point. For example, on very deep lakes, it is not necessary to sample beyond the littoral zone. On very large lakes, it is impractical to sample the entire transect length even if it is entirely littoral. If any one of the following stop criteria is met during sampling, take a rake tow and end the transect. **If the minimum 6 points have not been sampled, turn 180 degrees and distribute the remaining points evenly while heading along the transect back to shore.**

6.2.3.2.1 Stop Criteria

A. Transect reaches halfway to the opposite shore (Figure 6.3). On a lake that is 100% littoral, transects are typically sampled to the halfway point.

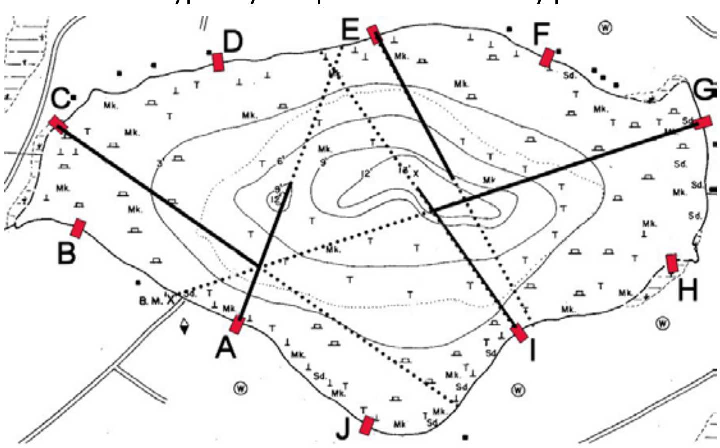


Figure 6.3 Transect placement (dotted lines) and sampled portions of those transects (solid lines).

B. Littoral-profundal transition occurs, putting you deeper than the maximum depth of macrophyte colonization (Figure 6.3, Figure 6.4, Figure 6.5). Two sample points without plants suggest the littoral-profundal transition, in which case the transect is ended after the 2 uncolonized points are sampled.
   a. Do not stop sampling until you are reasonably certain you have exceeded the maximum depth of plant colonization (as identified in section 6.2.4.2). You may use visual observations while on the lake as well as information collected on any PHab transects.
   b. If you are reasonably certain you have reached the maximum depth of plant colonization, you can stop the transect after two consecutive points without macrophytes.

Caution: it is not uncommon to sample two points without macrophytes near shore (e.g. due to wave scour), but have submerged macrophytes growing in deeper water.

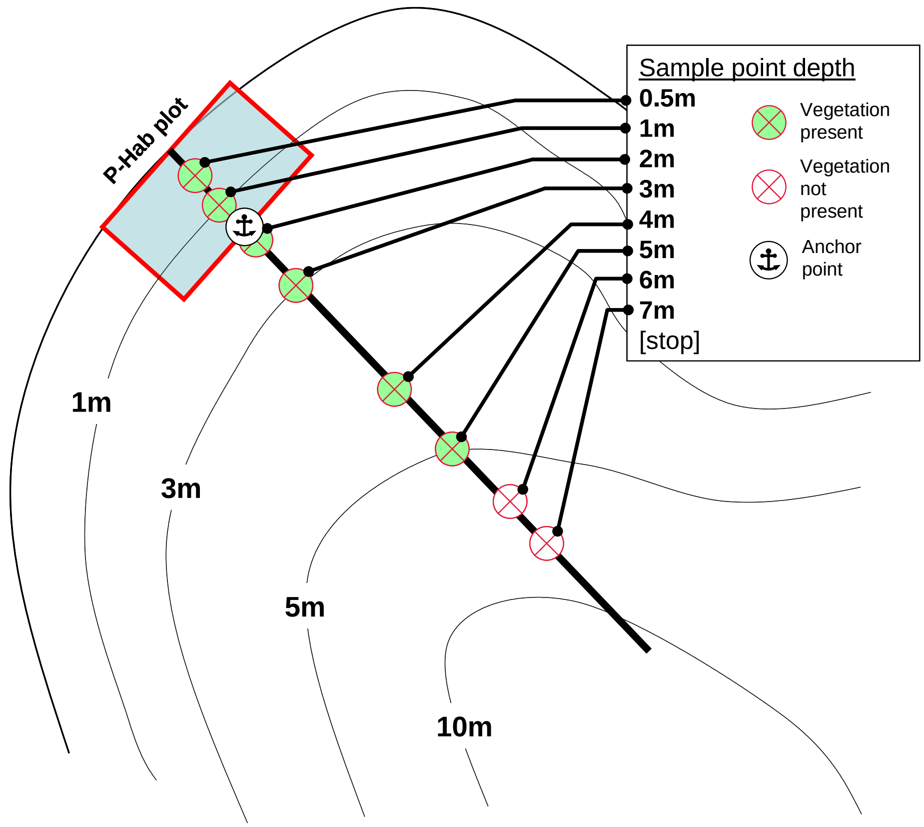


Figure 6.4 Sample point placement in a deep lake.

C. 9 minutes have passed at slow-no-wake speed with no additional points sampled.
   a. In large, shallow systems, depth may not increase to allow for the placement of additional depth-stratified points, but traveling all the way out to the halfway point may be time-prohibitive.
   b. Nine minutes traveling at slow-no-wake speed (~3-4 mph) is approximately 1000 m. This defines a maximum transect length as determined by travel time.

In summary:

1. Sample along each transect until you reach the midpoint; if you have at least 6 sample points, STOP.
2. If you hit the littoral-profundal transition (confirmed by two consecutive samples having no plants present) before you get to the midpoint and:
   - you have at least 6 sample points, STOP
   - you do not have at least 6 sample points, turn 180 degrees and distribute the remaining points evenly along the transect back to shore
3. If you exceed the maximum transect length as defined in Section 6.2.3.2.1, STOP.

6.2.3.3 Point Placement Along the Transect

Points are placed along the length of the transect and are stratified by depth. A minimum of 6 points will be sampled per transect, regardless of lake morphometry or clarity. Use a depth finder to determine point placement. Place points within ±0.2m of the designated depth target.

A. Place the first point on the transect in 0.5m (±0.2m) water depth. Choose a location that is as close to the PHab anchor point as possible.
B. Moving lakeward, sample the second point on the transect when depth increases to 1m (+0.2m) water depth.
C. Sample the third point on the transect in 2m (±0.2m) of water.
D. Sample the fourth point on the transect in 3m (±0.2m) of water. Continue taking points at each 1m increase of water depth until one of the stop criteria applies.
    a. If you have not already, take a rake tow at that location. If you have not sampled 6 points, turn around 180 degrees and face back toward shore.
    b. If you do not find plants at the end of the transect, and you are beyond the maximum depth of macrophyte colonization: Return to the greatest depth that you have observed plants on that lake (visually or at any transect).
    c. Sample points along the transect toward shore, aiming for an even spatial distribution until you reach the minimum total of 6 points in that transect (Figure 6.5). In this example, after reaching halfway to the other shore, the fourth sample point is taken in 3m of water. Since the minimum 6 points per transect has not been satisfied, the field worker turns and travels back to shore along the transect. Two additional points evenly distributed along the transect are sampled on the return trip

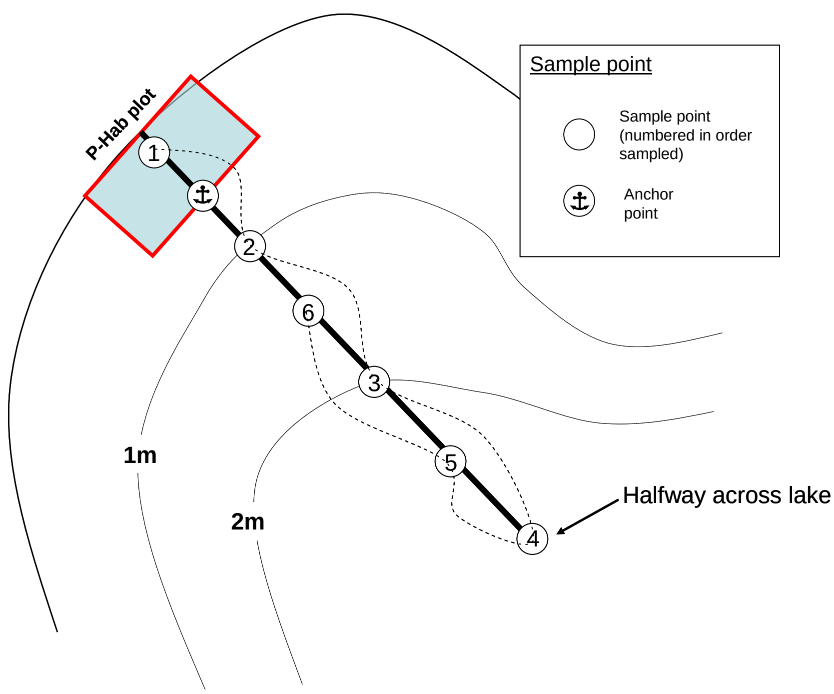


Figure 6.5 Point placement on a transect that ends before 6 points are sampled.

6.2.4 Macrophyte Assemblage Characterization

6.2.4.1 Data Collection

At each point, record depth, density of plants on the rake, density of filamentous algae on the rake, and plant growth forms present.

A. Navigate to the first PHab plot, anchor, and complete existing NLA methodology (characterization of physical habitat, cover, etc…, as well as collection of macroinvertebrates).
B. Navigate to the first macrophyte transect sample point (water depth at 0.5 m).
    a. Lower the rake-on-a-rope sampler until it rests on the sediment surface. You will see the rope go slack when the rake hits the bottom. Record depth to the nearest 0.1m. NOTE: record the actal depth of the sampling point, which should be ±0.2m of the target depth.
    b. You will drag the rake sampler along the substrate for a linear meter, using short tugs on the rope.
    c. With a smooth and continuous motion, you will pull the rake sampler back up into the boat. Do not stop and start movement, or the plants may fall off the rake head.
    d. Record plant rake density, including macrophytes, Charophytes, and moss (rankings from 0 through 3 as described below). Include in your estimations any macrophytes that are dislodged by the rake, touched by the rake, or floating at the surface in the 1-m long strip that you rake, even if they are not collected on the rake head.
        0. No plants present
        1. Less than 25% of the rake is full

        2. 25% to 100% of the rake is full

        3. 100% of the rake is full (no tines visible)

    e. Record filamentous algae rake density on the same scale (0-3) if the filamentous algae presence is obvious. Very small amounts of filamentous algae may be present in nearly all rake tows, so only record filamentous algae as present if there would be enough to roll into an approximately nickel-sized ball.
    f. If vegetation is present:
        i. Use the Growth Form Key (Figure 6.6) to determine growth form of all plants sampled with the rake, floating at the surface, or touched by the rake even if they do not detach or if they fall off the rake head. This is particularly relevant when sampling emergents or free floating plants.

ii. Do not count filamentous algae as a growth form, in the plant density rating, or in determining maximum depth of plant colonization.

g. Invasives

i. If an invasive species listed on your **Invasive Plants and Invertebrate** form is seen or sampled on the macrophyte transect, record the species as present at that PHab plot and flag it as observed outside of the PHab plot.

Plant Growth Form Key (see Figure 6.7 for illustrations)

1. a. Plant stems extending above or leaves visible on the surface of the water, submersed leaves absent .... 2.
1. b. Submersed leaves present, floating leaves present or absent .... 4.

2. a. Floating leaves absent, leaves and/or stem extending above water .... EMERGENT
2. b. Leaves floating on or just under the water's surface .... 3.

3. a. Leaves free floating, neither rooted to bottom nor attached to tuber .... FREE FLOATING
3. b. Plant rooted in sediment or attached to tuber........ FLOATING LEAF

4. a. Bladders present, borne on leaves or root-like branches........ SUBMERSED – BLADDERWORT
4. b. No bladders present........ 5.

5. a. Plant small and free floating, stem not apparent (*Lemna trisulca*) .... FREE FLOATING
5. b. Plant not as above .... 6.

6. a. Submersed plants having short stature (< 20cm) and compact growth form. Leaves originating from a single point at the base of the plant (basal) or plant consisting of short stalk with no apparent leaves .... SUBMERSED – COMPACT
6. b. Plants with well-developed stems or leaves extending into the water column. Leaves originating at the base or on stems (opposite, alternate, or whorled) .... 7.

7. a. Submersed leaves fine, less than 1 mm wide. If dissected, leaflets each less than 1 mm wide. .... SUBMERSED – FINE
7. b. Submersed leaves broad, over 1 mm wide .... SUBMERSED – WIDE

Figure 6.6 Plant Growth Form Key

C. Sample remaining points (minimum of 6 per transect).
   a. Visually select a navigation point on the opposite shore in the direction of the transect and navigate slowly lakeward.
   b. Use a sonar unit to assess depth.
   c. Take samples stratified appropriately by depth (at 0.5 and 1m, thereafter every meter, ensure you are within ±0.2m of each depth target).
   d. Sample until one of the stop criteria applies.
   e. NOTES
      i. If a sample point is inaccessible due to an obstacle (e.g. swim area, dock, watercraft) move the *point* off the transect to the nearest possible accessible area in that depth range. Rake as close to the original point as possible (i.e. immediately adjacent to the swim area or under the edge of the dock) so that the impact of disturbance is captured. If equidistant, move the transect to the right (facing shore). Resume sampling along the transect as soon as possible.
      ii. If depth along the transect begins to decrease during sampling, continue on until either greater depths are encountered or one of the stop criteria applies (e.g., always sample points deeper than your previous point).
      iii. Similarly, if an island intersects the transect, simply stop, navigate around the island, then resume sampling on other side, travelling along the original transect line until depth increases enough to place the next sample point.
      iv. If transects are placed in channels attached to the lake, inlets, or outlets, sample as usual, keeping the transect perpendicular to the shore of the channel and running it out to the channel midpoint.

6.2.4.2 Estimating Maximum Depth of Plant Colonization (MDC)

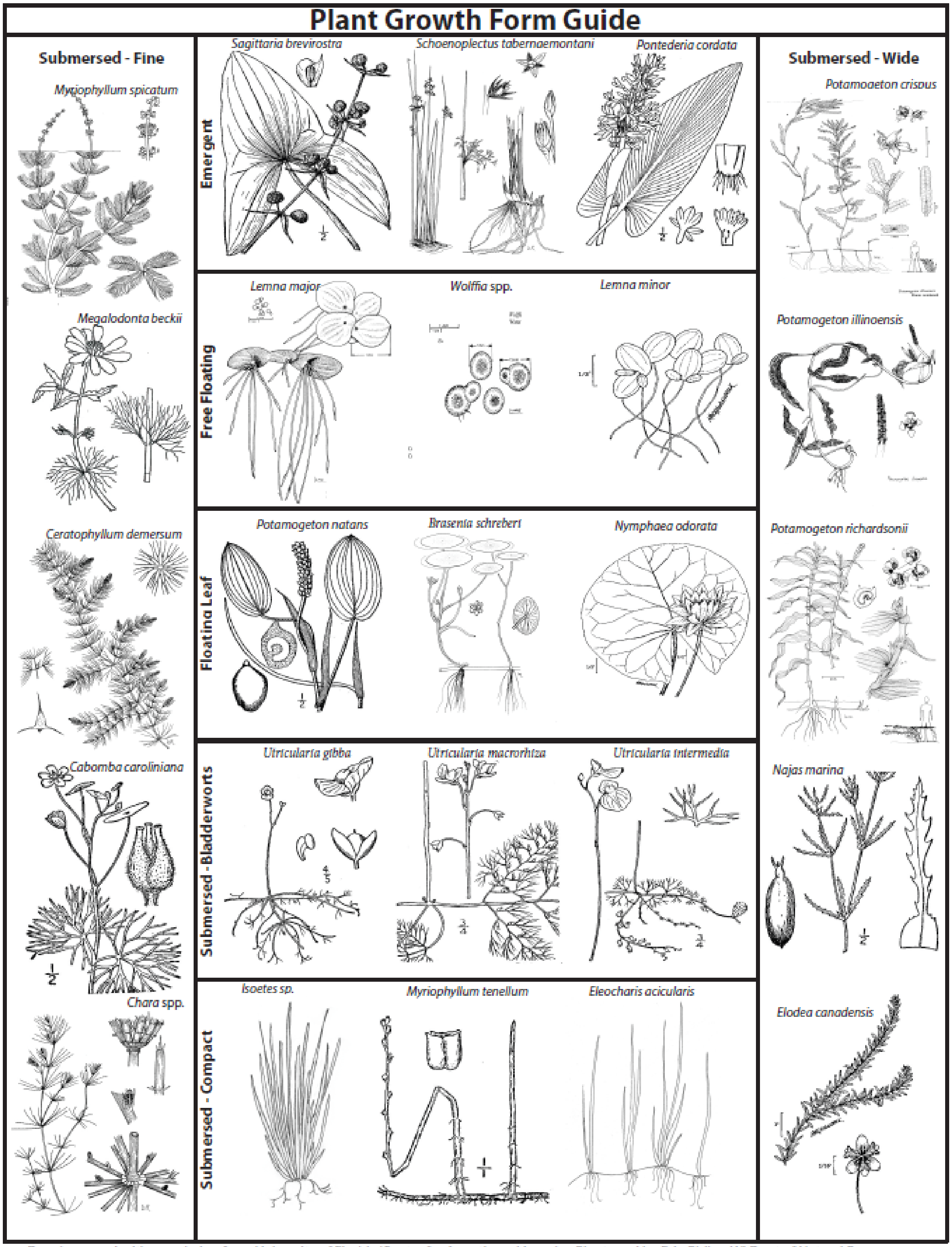
In situ measurements of nutrient concentrations and water clarity tend to fluctuate over the course of a growing season. The use of single-event sampling data from a seasonally dynamic variable includes a significant risk of misrepresenting environmental conditions. Submersed aquatic plants reflect cumulative environmental conditions by integrating, for example, water clarity conditions over a long-term seasonal scale. Maximum depth of colonization (MDC) is one metric we can use to capture integrated information about lake water clarity.

A. MDC is equal to the deepest depth at which plants are found.
   a) To ensure an accurate estimation, the littoral-profundal transition must be sampled at least five times at each site.
B. If the index station is over 12 m deep, begin your first MDC transect there prior to starting your macrophyte transects.
   a) Check depth. If depth is over 12m, begin transect and skip to step d. If depth is less than 12m, take a rake sample.
   b) If macrophytes occur, note this on the datasheet and go to the first PHab location for sampling.
   c) If macrophytes do not occur, navigate to shore in the direction of your first PHab location.
   d) As depths approach 12m, take a rake sample to look for the presence of macrophytes, and then again with every meter in depth lost. Stop when plants are observed, recording the depth to the nearest 0.1 meter.

C. Following your macrophyte transects, if you still have not sampled the littoral-profundal transition five times, navigate back to the index station and complete as many additional transects as necessary to estimate MDC, navigating in several different directions (i.e., north, south, west, east).
   a) If your index station had macrophytes present, and a deeper basin is present on the lake (e.g. you are sampling the index station on a reservoir) once the macrophyte transects are completed, you can complete any additional MDC transects needed at the deep basin, provided it is not too close to a dam and is safe to sample.
   b) Complete as many transects as needed to estimate MDC on at least five transects (including the PHab transects and your initial MDC transect).
   c) The deepest depth encountered with plants growing during the entire survey is the lake's MDC.

6.2.4.3 Optional Enhancements

A. Sample macrophytes at all 10 PHab locations. Ten transects will yield a more complete picture of the macrophyte community in a given lake. When sampling all ten transects, you are likely to pick up an additional growth form of macrophytes on one of every three lakes sampled. It is also less likely that MDC transects will need to be used, which may compensate for some of the added time to sample the optional five transects (~50 minutes).
B. Estimate of species richness
   a. Record the number of morphologically distinct species on each rake tow. At the end of the survey, record the number of morphologically distinct species encountered lakewide.
      i. It is not necessary to have detailed taxonomic knowledge to do this – just count the number of plants that appear to be different. Those with taxonomic knowledge should sample from this perspective and lump cryptic species (e.g. duckweeds, thin-leaf pondweeds).
      ii. For the lakewide count, simply place each newly encountered macrophyte into a bucket with water or a ziplock bag kept in a cooler, and count at the end of the day.



Drawings used with permission from University of Florida/Center for Aquatic and Invasive Plants and by Erin Ridley, WI Dept of Natural Resources.

Figure 6.7 Macrophyte Growth Form Guide

6.3 Littoral Chlorophyll-a, Algal Toxin, and Phytoplankton Sample Collection

6.3.1 Summary of Method

Prior to collecting physical habitat and macroinvertebrate samples at the "J" habitat station, collect water samples for chlorophyll-*a*, phytoplankton, and algal toxins. These consist of grab samples collected at about 0.3 m below the water surface from a point within the littoral plot that is 1 m deep.

6.3.2 Equipment and Supplies

Table 6.4 provides the equipment and supplies needed for field operations to collect, chlorophyll-*a*, phytoplankton (cyanobacteria), and algal toxin samples at the "J" habitat station.

Table 6.4 Equipment and supplies – littoral chlorophyll-a, phytoplankton (cyanobacteria), and algal toxin samples.

Type	Item	Quantity
Form	NLA 2012 Littoral Sample Collection	1
Documentation	Labels: algal toxins, phytoplankton (cyanobacteria), chlorophyll A	3
Collection	Poly bottle (2 L, brown, labeled LITTORAL) – chlorophyll A, algal toxins, phytoplankton (cyanobacteria)	1
	Gloves (latex/nitrile, non-powdered)	1 pair
Storing and preserving	HDPE bottle (1 L, white, narrow-mouth) – phytoplankton (cyanobacteria)	1
	HDPE bottle (500 mL, white, wide-mouth) – algal toxins	2
	Wet ice	As needed
	Lugol's solution	5-10 mL
	Cooler	1

6.3.3 Sampling Procedure

Collect two 2 L grab samples from 0.3 m below the water surface using a 2 liter brown bottle (labeled Littoral Chlorophyll). The first grab will be used to fill bottles for the phytoplankton (cyanobacteria, 1-L bottle) and algal toxins (500 mL bottle) samples. The second grab will be used for the chlorophyll-*a* sample and will be taken to shore for filtering.

1. Make sure the container for phytoplankton and algal toxins samples have completed labels attached and that the labels are completely covered with clear tape.
2. Put on surgical gloves (non-powdered). Do not handle any food, drink, sunscreen, or insect repellant until after the water samples have been collected.
3. Move slowly within the littoral plot until you locate a point that is 1m deep.
4. Rinse the brown poly bottle and cap three times with small volumes of lake water. Discard each rinse on the opposite side of the boat.
5. Fill the 2 L brown poly bottle by inverting and submerging to a depth of 0.3 m below the water surface, avoiding surface scum, vegetation, and substrates. Point the mouth of the container away from the body or boat. Right the bottle allowing it to fill completely and raise it up through the water column. Cap tightly and mix contents thoroughly.
6. Fill the 1 L phytoplankton sample container from the 2L brown bottle, allowing enough headspace to add 5 mL of Lugol's solution. Add 5 mL of Lugol's solution to the 1 L phytoplankton bottle. Cap the bottle and invert until well mixed. The sample should resemble the color of weak tea. If needed, add additional Lugol's 2-3 mL at a time.

7. Fill the 500 mL algal toxin container from the 2 L bottle. Cap tightly. Place the bottle in the cooler on wet ice.
8. Fill the 2L brown bottle a second time using the procedure in step 5. Cap tightly. This is the littoral chlorophyll sample, which will be filtered on shore (see section 7.2). Place the bottle in the cooler on wet ice.
9. Immediately after sample is collected, place in cooler to minimize exposure to light and place on ice until filtration can be initiated.

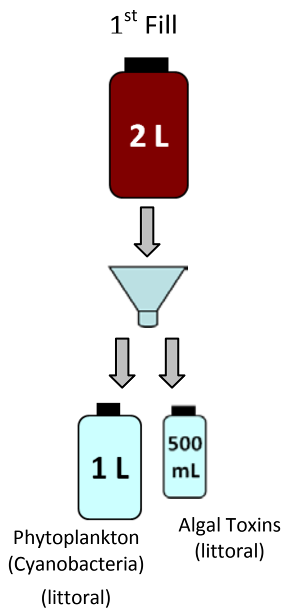


Figure 6.8 Littoral sampling of chlorophyll-a, phytoplankton (cyanobacteria), and algal toxins.

6.4 Benthic Macroinvertebrate Sampling

6.4.1 Summary of Method

Benthos are collected using a semi-quantitative sampling of multiple habitats in the littoral zone of lakes using a 500 µm mesh D-frame dip net (Figure 6.9). Sample collection is stratified on the following specific habitat types: rocky/cobble/large woody debris; macrophyte beds; fines (including mud, sand, or silt); and leaf packs.

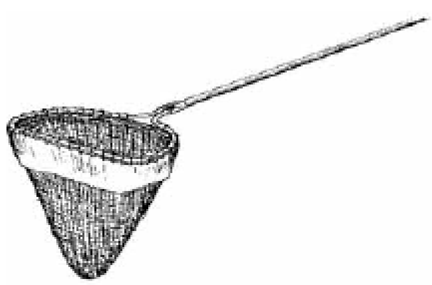


Figure 6.9 D-frame net (500 µm mesh) used for collecting benthic macroinvertebrates.

6.4.2 Equipment and Supplies

Table 6.5 provides the equipment and supplies needed for field operations to collect benthic macroinvertebrates.

Table 6.5 Equipment and supplies – benthic macroinvertebrate collection.

Type	Item	Quantity
Form	NLA 2012 Littoral Sample Collection	1
Documentation	Labels: Benthic samples	1
	Scissors	1
Collection	Kick net (500 µm D-shaped, modified) with 4 foot handle	1
	Spare net(s) and/or spare bucket assembly for end of net	As needed
	Bucket (5 gallon capacity, plastic)	1
	Sieve bucket (500 µm)	1
	Watchmakers' forceps	1
	Squirt bottle (1 L Nalgene) – lake water	1
	Spoon (stainless steel)	1
	Funnel	1
	HDPE bottle (1 L, white, wide-mouth)	1 or more
	Ethanol (95%)	2 gal
	Gloves (latex/nitrile, non-powdered, box)	2 pair
Storing and preserving	Cooler	1
	Plastic electrical tape	As needed

6.4.3 Sampling Procedure

6.4.3.1 Site Selection and Sample Collection

The process for selecting the PHab stations is described in Section 6.1 Physical Habitat . All benthic samples should be collected from the dominant habitat type within the 10 m x 15 m littoral zone component of each of the PHab stations (Figure 3.2). The sampling process is described below.

NOTE: At station J, collect samples from the water column (sections 6.3 and 6.4) before collecting the benthos sample.

6.4.3.2 Sample Processing in the Field

Use a 500-µm mesh sieve bucket placed inside a larger bucket full of lake water while sampling to carry the composite sample as you travel around the lake. Once the composite sample from the collections from all of the PHab stations is sieved and reduced in volume, store in a 1 L jar and preserve with 95% ethanol. Multiple jars may be required if detritus is heavy. If more than one jar is used for a composite sample, use the "extra jar" label provided; record the SAME sample ID number on this "extra jar" label. The sample ID number is also recorded with a lead pencil (No. 2) on a waterproof label that is placed inside each jar. If a sample requires more than one jar, make sure the correct number of jars for the sample is recorded on the **Littoral Sample Collection** form. Record information for each composite sample on the form.

Check to be sure that the pre-numbered adhesive label is on the jar and covered with clear tape. Place the samples in a cooler or other secure container for transporting and/or shipping to the laboratory (SeeAPPENDIX D: SHIPPING GUIDELINES).

6.4.3.2.1 Benthic macroinvertebrate sampling

1. After locating the sample site according to procedures described in the physical habitat section, identify the dominant habitat type within the plot from the classifiers below:

- Rocky/cobble/large woody debris
- Macrophyte beds
- Fines (including mud, sand or silt)
- Leaf pack

2. After identifying the dominant habitat type, use the D-frame dip net (equipped with 500-µm mesh) to sweep through 1 linear meter of the dominant habitat type at a single location within the 10 m x 15 m littoral zone sampling area, making sure to disturb the substrate enough to dislodge organisms.
    - If the dominant habitat is rocky/cobble/large woody debris it may be necessary to exit the boat and disturb the substrate (e.g., overturn rocks, logs) using your feet while sweeping the net through the disturbed area.
    - Because a dip-net is being used for sampling, the maximum depth for sampling will be approximately 1m (the length of the dip-net handle); therefore, in cases in which the depth of the lake quickly drops off, it may be necessary to sample in the nearest several meters to the shore.
3. After completing the 1m sweep, remove all organisms and debris from the net and place them in a bucket following sample processing procedures described in the following section.
4. Proceed to the next sampling station and repeat steps 1-3. The organisms and detritus collected at each station on the lake should be combined in a single bucket to create a single composite sample for the lake. After sampling at all PHab stations is complete, process the composite sample in the bucket according to procedures described in the following section. One to five bottles should be sufficient to hold the composited sample from each lake.
    - If there is a large amount of debris accumulating in the composite sample, remove debris between sampling stations, after the debris is inspected, picked, and/or washed to ensure no organisms are lost.
    - If your first collection results in too much debris, discard it, move location within the same habitat station, and take another sample.
    - It is recommended that crews carry a sample bottle containing a small amount of ethanol with them to enable them to immediately preserve larger predaceous invertebrates such as hellgrammites and water beetles. Doing so will help reduce the chance that other specimens will be consumed or damaged prior to the end of the field day.

6.4.3.2.2 Preparing composite samples for benthic macroinvertebrates

1. Pour the entire contents of the bucket through a sieve (or into a sieve bucket) with 500 µm mesh size. Remove any large objects and wash off any clinging organisms back into the sieve before discarding.
2. Using a wash bottle filled with clean lake water, rinse all the organisms from the bucket into the sieve. This is the composite sample for the lake.
3. Estimate the total volume of the sample in the sieve and determine how large a jar will be needed for the sample (1 L) and how many jars will be required.
4. Fill in a sample label with the Site ID and date of collection. Attach the completed label to the jar and cover it with a strip of clear tape. Record the sample ID number for the composite sample on the **Littoral Sample Collection** form. For each composite sample, make sure the number on

the form matches the number on the label.

5. Wash the contents of the sieve to one side by gently agitating the sieve in the water. Wash the sample into a jar using as little water from the wash bottle as possible. Use a large-bore funnel if necessary. If the jar is too full, pour off some water through the sieve until the jar is not more than half full, or use a second jar if necessary. Carefully examine the sieve for any remaining organisms and use watchmakers' forceps to place them into the sample jar.
6. If a second jar is needed, use a pre-printed additional benthos label or, if needed, fill in a sample label that does not have a pre-printed ID number on it. Record the ID number from the pre-printed label prepared in Step 4 in the "SAMPLE ID" field of the label. Attach the label to the second jar and cover it with a strip of clear tape. Record the number of jars required for the sample on the **Littoral Sample Collection** form. **Make sure the number you record matches the actual number of jars used.** Write "Jar *N* of *X*" on each sample label using a waterproof marker ("*N*" is the individual jar number, and "*X*" is the total number of jars for the sample).
7. Place a waterproof label inside each jar with the following information written with a number 2 lead pencil:
    - Site ID
    - Collectors initials
    - Type of sampler and mesh size used
    - Number of stations sampled
    - Name of lake
    - Date of collection
    - Jar N of X (see above)
8. Completely fill the jar with 95% ethanol (no headspace). It is very important that sufficient ethanol be used, or the organisms will not be properly preserved. Existing water in the jar should not dilute the concentration of ethanol below 70%. **NOTE:** Prepared composite samples can be transported back to the vehicle before adding ethanol if necessary. In this case, fill the jar with lake water, which is then drained using the net (or sieve) across the opening to prevent loss of organisms, and replaced with ethanol at the vehicle.
9. Replace the cap on each jar. Slowly tip the jar to a horizontal position, then gently rotate the jar to mix the preservative. Do not invert or shake the jar. After mixing, seal each jar with plastic tape.
10. Store labeled composite samples in a container with absorbent material that is suitable for use with 70% ethanol until transport or shipment to the laboratory.

7.0 FINAL LAKE ACTIVITIES

Prior to leaving the lake, make a general visual assessment of the lake and its surrounding catchment. This assessment is based on the collective observations of all crew members. The objective of the lake assessment is to record field crew observations of catchment and lake characteristics that are useful for future data interpretation, ecological value assessment, development of associations, and verification of stressor data. These observations and impressions are extremely valuable.

In addition, review all data forms and sample labels for completeness, accuracy, and legibility. Mare sure all samples are labeled, sealed, and properly preserved. Activities described in this section are summarized in Figure 7.1.

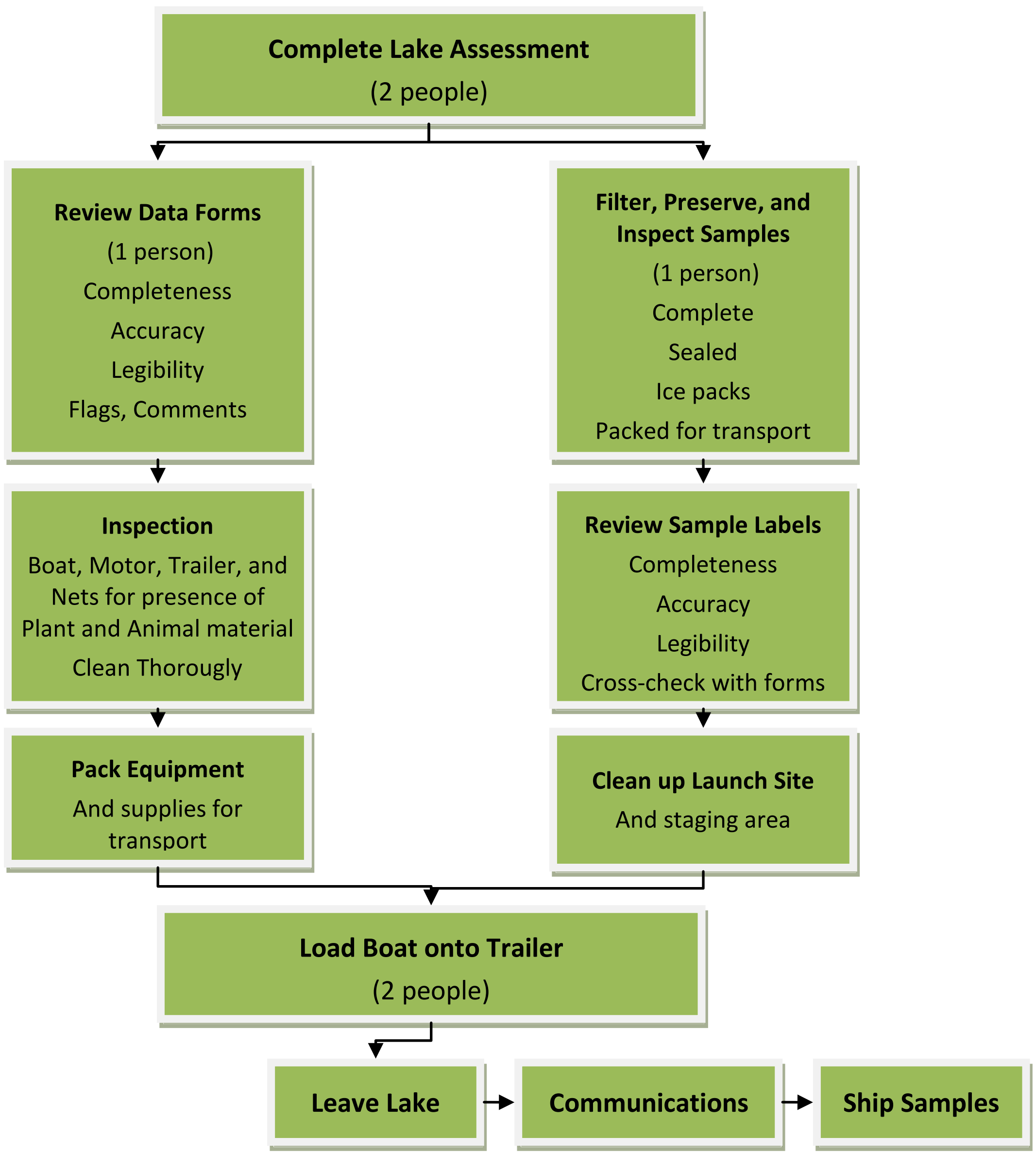


Figure 7.1 Final lake activities summary

7.1 General Lake Assessment

Complete the **Assessment** form at the end of lake sampling, recording all observations from the lake that were noted during the course of the visit by all crew members. This form is designed as a template for recording pertinent field observations. It is by no means comprehensive, and any additional observations should be recorded in the comments section. The form consists of five major sections: 1) Lake/Catchment Site Activities and Disturbances Observed, 2) General Lake Information, 3) Shoreline Characteristics, 4) Qualitative Macrophyte Survey, and 5) Qualitative Assessment of Environmental Values.

7.1.1 Lake/Catchment Site Activities and Disturbances Observed

Record any of the sources of potential stressors listed in Table 7.1 on the **Assessment** form, that were observed while on the lake, while driving or walking through the lake catchment, or while flying over the lake and catchment. For activities and stressors that you observe, rate their abundance or influence as low (L), moderate (M), or heavy (H) on the line next to the listed disturbance. Leave the line blank for any disturbance not observed. The distinction between low, moderate, and heavy will be subjective. For example, if there are two to three houses on a lake, circle "L" for low next to "Houses." If the lake is ringed with houses, rate it as heavy (H). Similarly, a small patch of clear-cut logging on a hill overlooking the lake would rate a low ranking. Logging activity right on the lake shore, however, would get a heavy disturbance ranking. The section for "Lake Site Activities and Disturbances Observed" includes residential, recreational, agricultural, industrial, and lake management categories.

7.1.2 General Lake Information

Observations regarding the general characteristics of the lake are described in Table 7.2. Record these observations on the **Assessment** form. The hydrologic lake type is a very important variable for defining subpopulations for acidic deposition effects. Note any flight hazards that might interfere with either low-altitude fly-overs by aircraft (for future aerial photography or videography) or landing on the lake for sampling purposes (either by float plane or helicopter). When estimating the intensity of motor boat usage, in addition to the actual number of boats observed on the lake during the visit, use other observations such as the presence of boat houses, docks, and idle craft.

7.1.3 Shoreline Characteristics

Shoreline characteristics of interest during the final lake assessment are described in Table 7.1. Record observations related to this portion of the assessment on the **Assessment** form. To estimate the extent of major vegetation types, limit the assessment to the immediate lake shoreline (i.e., within 20 m of the water). Also estimate the percentage of the immediate shoreline that has been developed or modified by humans.

Table 7.1 Site activities and disturbances observed during final lake assessment.

Observe lake activities or disturbances listed and record as L (low), M (moderate), or H (heavy) intensity on the Assessment form (except as noted below):	
Residences	Presence of any houses and residential buildings around the lake.
Maintained Lawns	Presence of any maintained lawns around the lake.
Construction	Presence of any recent construction in the immediate area around the lake or signs of recent sedimentation events (depositional fans).
Pipes/Drain	Presence of any pipes or drains feeding into or out of the lake. If known, record the type of activity with which the pipe is associated (e.g., storm sewer, plant intake) in the "Comments" section on Side 2.

Observe lake activities or disturbances listed and record as L (low), M (moderate), or H (heavy) intensity on the Assessment form (except as noted below):	
Dumping	Any evidence of landfill or dumping around the lake, including garbage pits and informal dumping of large amounts of trash or cars and appliances along roads or lakeshore. This does not include small amounts of litter. If informal dumping areas exist, note that they are informal sites in the "Comments" section on Side 2.
Roads	Presence of any maintained roads in the immediate area around the lake.
Bridges/Causeways	Presence of any bridges or causeways across or in the immediate vicinity of the lake.
Sewage Treatment	Presence of sewage treatment facility.
Hiking Trails	Presence of formal hiking trails around the lake.
Parks, Campgrounds	Presence of organized public or private parks, campgrounds, beaches or other recreational areas around the lake.
Primitive Parks, Camping	Presence of informal or primitive parks, camping areas, beaches or other recreational areas (e.g., swimming holes) around the lake.
Resorts	Level of resort activity; this could include motels, resorts, golf courses, and stores.
Marinas	Presence of any marinas.
Trash/Litter	Relative abundance of trash or litter around the lake.
Surface Films, Scum or Slicks	Relative abundance of surface films, scum, or slicks on the lake.
Cropland	Presence of cropland.
Pasture	Presence of pastures.
Livestock Use	Presence of livestock use.
Orchards	Presence of orchards.
Poultry	Presence of poultry operations.
Feedlot	Presence of feedlot or concentrated animal feeding operations.
Water Withdrawal	Any evidence of water withdrawal from the lake.
Industrial Plants	Any industrial activity (e.g., canning, chemical, pulp) around the lake or in the catchment. Describe the type of industry in the "Comments" section on Side 2.
Mines/Quarries	Any evidence of mining or quarrying activity in the catchment or around the lake.
Oil/Gas Wells	Any evidence of oil or gas wells in the catchment or around the lake.
Power Plants	Presence of any power plants.
Logging	Any evidence of logging or fire removal of trees in the lake area.
Evidence of Fire	Any evidence of forest fires in the lake area.
Odors	Presence of any strong odors.
Commercial	Any commercial activity (e.g., convenient stores, shopping centers, restaurants) around the lake or in the catchment.
Liming	Any evidence of liming activities.
Chemical Treatment	Presence of any chemical treatment facilities.
Angling Pressure	Estimate of the intensity of fishing activity in the lake.
Drinking Water Treatment	Presence of any drinking water treatment facilities.
Macrophyte Control	Any evidence of dredging or other activities to control macrophyte growth; describe these in the "Comments" section on Side 2.
Water Level Fluctuations	Any evidence of water level fluctuations due to lake management.

Observe lake activities or disturbances listed and record as L (low), M (moderate), or H (heavy) intensity on the Assessment form (except as noted below):	
Fish Stocking	Any evidence of fish stocking in the lake.
Record any other oddities observed or additional information for any specific activity in the "Comments" section on Side 2.	

Table 7.2 Hydrologic lake type observed during final lake assessment.

Hydrologic Lake Type	Note if there are any stream outlets from the lake, even if they are not flowing. If no lake outlets are observed, record the lake as a seepage lake. If the lake was created by a manmade dam (not that a dam is present just to raise the water level), record the lake as a reservoir. Otherwise record the lake as a drainage lake.
Outlet Dams	Note the presence of any dams (or other flow control structures) on the lake outlet(s). Differentiate between artificial (man-made) structures and natural structures (beaver dams).
Low Elevation Flight Hazards	If there are any hazards (above tree level) that would interfere with low elevation aircraft flights or landing on the lake, check "Yes;" otherwise check "No." Examples include radio towers or power lines.
Motor Boat Density	Record your impression of the density of motor boat usage on this lake (high or low). If there is a restriction on the size of motor boat engines, check "Restricted." If motor boats are banned, check "Banned." Consider the day of the week and weather in your assessment as well as the number of boathouses, idle craft. Count jet skis and any other motorized craft, which could stir up the lake, as motor boats.
Swimmability	Record a subjective impression about the aesthetics of swimming in this lake (swimmability) along the range of "good" to "not swimmable."
Lake Level Changes	Examine the lake shoreline for evidence of lake level changes (e.g., bathtub ring). If there are none, check "zero;" otherwise try to estimate the extent of vertical changes in lake level from the present conditions based on other shoreline signs.

Table 7.3 Shoreline characteristics observed during final lake assessment.

Check percent of shoreline characteristics:	
Forest	Deciduous, coniferous, or mixed forest, including sapling vegetation.
Grass	Meadows, lawns, or other open vegetation.
Shrub	Shrub vegetation
Wetland	Forested and non-forested wetlands (submerged terrestrial vegetation).
Bare Ground	Non-vegetated areas such as beaches, sandy areas, paved areas, and exposed rock.
Agriculture	Cropland, orchard, feedlot, pastureland, or other horticultural activity.
Shoreline Modifications	Actual shoreline that has been modified by the installation of riprap, revetments, piers, or other human modifications.
Development	Immediate shoreline area developed by human activity; include lawns, houses, stores, malls, marinas, golf courses, or any other human-built land use.

7.1.4 Qualitative Macrophyte Survey

Aquatic macrophytes (aquatic plants large enough to be seen without magnification) are important indicators of lake trophic status. The most important indicator for this survey is the percentage of the entire lake area (not just near the shore) covered with macrophytes, as perceived by observers. For both "emergent/floating" and "submergent" coverage, choose one of the four percentage groupings (0-25%, 25-50%, 50-75%, 75-100%), on the **Assessment** form. In some cases, it will be fairly easy to estimate the percentage from observations made at the PHab stations. In other cases, it will be an educated guess, especially if the water is turbid. After recording the areal percentage of macrophyte coverage, record the density of the plants in the observed macrophyte beds as absent, sparse, moderate, or high. Record your estimates on the **Assessment** form.

7.1.5 Waterbody Character

Rate the ***waterbody character*** which is the physical habitat integrity of the waterbody and is largely a function of riparian and littoral habitat structure, volume change, trash, turbidity, slicks, scums, color, and odor. The NLA 2012 attempts to define water body character through two attributes: degree of human disturbance and aesthetics. Rate each of these attributes on a scale of 1 to 5. For development, give the lake a "5" if it is pristine, with no signs of any human disturbance. A "1" would indicate that a lake is highly disturbed; for example, the entire lake is ringed with houses, seawalls, docks, etc. For aesthetics (whether the lake is appealing or not) base the decision on any factors about the lake that disturb you (trash, algal growth, weed abundance, overcrowding). Circle the number that best describes your opinion about how suitable the lake is for recreation and aesthetic enjoyment today:

1. Enjoyment is nearly impossible.
2. Level of enjoyment is substantially reduced.
3. Enjoyment is slightly impaired.
4. There are very minor aesthetic problems; it is otherwise excellent for swimming, boating, and enjoyment.
5. It is beautiful and could not be any nicer.

7.1.6 Qualitative Assessment of Environmental Values

The primary goal of this study is to assess three major ecological values with respect to lakes: trophic state, ecological integrity, and human use. Based on your field experience, record your own assessment of these values on the **Assessment** form. Write comments on these values in this section.

- ***Ecological integrity*** is the ability to support and maintain a balanced, integrated, adaptive community with a biological diversity, composition, and functional organization comparable to natural lakes of the region. Record your overall impression of the "health" of the biota in the lake. Note any possible causes of impairment. The presence of higher order consumers (fish-eating birds and mammals) is an indication of a healthy food web and should be noted here. Similarly, the absence of an organism that you might expect to see is an important observation.
- ***Trophic state*** is the rate or amount of phytoplankton and macrophytes produced or present in a lake. Give your visual impression of the trophic status as oligotrophic (little or no biomass in the lake water), mesotrophic (intermediate amounts of biomass in the lake water), eutrophic (large amounts of biomass in the lake water), or hypereutrophic (choked lake, with more biomass than water). Give your overall impression of algal abundance and general type (e.g., filamentous). List any observed potential nutrient sources to the lake (e.g., septic tanks and agricultural runoff).
- Suitability for ***human use*** is the ability to support recreational uses such as swimming, fishing, and boating. Record your overall impression of the lake as a site for recreation. Note any possible causes of impairment. Note the presence or absence of people using the lake for recreational activities.

Use the comments section on the **Assessment** form to note any other pertinent information about the lake or its catchment. Here the Field Crew can record any observations that may be useful for future data interpretation.

7.2 Processing the Chlorophyll-*a* Samples

7.2.1 Equipment and Supplies

Table 7.4 provides the equipment and supplies needed to process the two Chlorophyll-*a* samples (one each from the index site and J site).

Table 7.4 Equipment and supplies – chlorophyll-*a* processing.

Type	Item	Quantity
Form	NLA 2012 Index Sample Collection	1
	NLA 2012 Littoral Sample Collection	1
Documentation	Labels: Chlorophyll A samples	2
	Outer Chlorophyll A bag	1
Processing	Poly bottle (2 L, brown, labeled INDEX)	1
	Poly bottle (2 L, brown, labeled LITTORAL)	1
	Centrifuge tube (50 mL, screw top) in ziploc bag	2
	Filter forceps (flat blade)	2
	Filtration chamber (with filter holder)	1
	Filtration flask (with silicone stopper and adapter)	1
	Filtration pump (hand vacuum)	1
	Gloves (latex/nitrile, non-powdered, box)	1 pair
	Graduated cylinder (250 mL)	1
	Squirt bottle (1 L Nalgene) – de-ionized (DI)	1
	Test tube holder	1
	Whatman 0.7 µm GF/F glass fiber filter	2
Storing and preserving	Cooler	1
	Electrical tape	As needed
	Foil squares	2
	Zip top bags (1 qt)	2

7.2.2 Procedures for Processing the Chlorophyll-*a* Samples

The procedures for processing two chlorophyll-*a* samples are presented below. Whenever possible, sample processing should be done in subdued light, out of direct sunlight.

1. Put on surgical gloves.
2. Place a glass fiber filter in the filter holder apparatus with the grid side down. Do not handle the filter with bare hands; use clean forceps.
3. From the Index site chlorophyll-*a* sample, shake the bottle to homogenize the sample, measure and pour 250 mL of water into the filter holder, replace the cap, and pump the sample through the filter. Take care not to exceed 7 inches of Hg in the vacuum gauge on the filtration pump. If 250 mL of lake water will not pass through the filter, change and discard the filter, rinse the apparatus with DI water, and repeat the procedures using 100 mL of lake water. NOTE: If the water is green or turbid, use a smaller volume to start with.
4. Observe the filter for visible color. If there is visible color, proceed; if not, repeat steps 3 & 4 until color is visible on the filter or until a maximum of 2,000 mL have been filtered. Record the actual sample volume filtered on the Index or Littoral Sample Collection form and on the

sample label. Rinse the graduated cylinder and upper portion of the filtration apparatus thoroughly with DI water to include any remaining cells adhering to the sides and pump through the filter. Monitor the level of water in the lower chamber to ensure that it does not contact the filter or flow into the pump.

5. Disconnect the upper portion of the filter apparatus from the lower portion. Remove the filter from the holder with clean forceps. Avoid touching the colored portion of the filter. Fold the filter in half, with the colored side folded in on itself.
6. Place the folded filter into a 50 mL screw-top centrifuge tube and cap. Record the sample volume filtered on a chlorophyll-*a* label and attach it to the centrifuge tube (do not cover the volume markings on the tube). Ensure that all written information is complete and legible. Cover with a strip of clear tape. Double check that the “total volume of water filtered” on the Index or Littoral Sample Collection form matches the total volume recorded on the sample label.
7. Remove the filter holder silicone stopper and adapter from the filtration flask. Pour off water from the bottom chamber.
8. Rinse filter chamber components thoroughly with DI water.
9. Repeat steps 2 through 8 for the littoral site sample.
10. Wrap the tubes in aluminum foil and place both in a re-sealable plastic bag. Place the completed outer label on the outside of the bag. Place this bag between two small bags of ice in a cooler.
11. Thoroughly rinse the graduated cylinder and both brown sample collection bottles and caps with tap water and store for next sample event.

7.3 Preservation of Samples

Preserve the samples as specified in the Shipping Guidelines. Record the preservation information on the index and littoral sample collection forms.

7.4 Preparation of Samples for Shipping

General information is available in section 4.3.2 Shipment of Samples and Forms. Information is also available in

APPENDIX D: SHIPPING GUIDELINES. General steps that apply to samples are the following:

- Purge the Cubitainer® of any air bubbles, seal the cap tightly and wrap electrical tape clockwise around the cap. Place the Cubitainer® in a cooler with sealed 1-gal plastic bags of ice.
- Seal all pertinent caps tightly.
- Wrap electrical tape clockwise around the caps, and then place the bottles in the cooler with sealed 1-gal plastic bags of ice. Note: do not tape the sediment mercury or dissolved carbon samples. These samples should not be removed from their respective bags after collection.

7.5 Data Forms and Sample Inspection

After the **Assessment** form is completed, the Field Crew Leader reviews all of the data forms and sample labels for accuracy, completeness, and legibility. This will be done whether you are using electronic field forms or paper forms. The other crew member inspects all sample containers and packages them in preparation for transport, storage, or shipment.

Ensure that all required data forms for the lake have been completed. Confirm that the Site ID, crew ID, and date of visit are correct on all forms. On each form, verify that all information has been recorded accurately, the recorded information is legible, and any flags are explained in the comments section. Ensure that written comments are legible, with no "shorthand" or abbreviations. After reviewing each form initial the upper right corner of each page of the form. If using an electronic form, initials are entered on the “Review and Save” screen.

Ensure that all samples are labeled, all labels are completely filled in, and each label is covered with clear plastic tape. Make sure that all sample containers are properly sealed.

7.6 Launch Site Cleanup

Load the boat on the trailer and inspect the boat, motor, and trailer for evidence of weeds and other macrophytes. Clean the boat, motor, and trailer as completely as possible before leaving the launch site. Inspect all nets for pieces of macrophyte or other organisms and remove as much as possible before packing the nets for transport. Pack all equipment and supplies in the vehicle and trailer for transport; keep them organized as presented in the equipment checklists (APPENDIX B: EQUIPMENT & SUPPLIES). Lastly, be sure to clean up all waste material at the launch site and dispose of or transport it out of the site if a trash can is not available. See Section 4.3 for additional information and follow appropriate state, tribal or other applicable protocols.

8.0 FIELD QUALITY CONTROL

Standardized training and data forms provide the foundation to help assure that data quality standards for field sampling are met. These methods for field sampling and data collection are the primary guidelines for all cooperators and field crews. In addition, repeat sampling and field evaluation and assistance visits will address specific aspects of the data quality standards for the NLA 2012.

8.1 Repeat Sampling

Approximately 10% of the target sites visited will be revisited during the same field season by the same field crew that initially sampled the lake. The primary purpose of this "revisit" set of sites is to provide variance estimates that can be used to evaluate the survey design for its potential to estimate status and detect trends in the target population of lakes. The revisit will include the full set of indicators and associated parameters. The time period between the initial (Visit 1) and repeat visit (Visit 2) to a lake should be as long as possible.

The repeat visit sites were selected by taking the first 2007 resample site for each state (panel ID = "NLA07RVT2") and first new 2012 site for each state (panel ID = "NLA12RVT"). This makes up 96 lakes (10% of the lakes) from the entire draw of lakes for the survey. If a site selected for repeat sampling is dropped, then the alternate assigned to replace it should be revisited.

8.2 Field Evaluation and Assistance Visits

No national program of accreditation for field work currently exists. For this reason, a rigorous program of field evaluation and assistance visits has been developed to support the NLA 2012.

8.2.1 General Information

Evaluation and assistance visits will be conducted with each field crew early in the sampling and data collection process, if possible, and corrective actions will be conducted in real time. These visits provide both a quality check for the uniform evaluation of the data collection methods and an opportunity to conduct procedural reviews, as required, minimizing data loss due to improper technique or interpretation of field procedures and guidance. Through uniform training of field crews and review cycles conducted early in the data collection process, sampling variability associated with specific implementation or interpretation of the protocols will be significantly reduced. The visit also provides the field crews with an opportunity to clarify procedures and offer suggestions for future improvements based on their sampling experience preceding the visit. The field evaluations, while performed by a number of different supporting collaborator agencies and participants, will be based on the uniform training, plans, and checklists. This review and assistance task will be conducted for each unique field crew collecting and contributing data under this program; hence no data will be recorded to the project database that was produced by an 'unaudited' process or individual.

The field evaluations will be based on the evaluation plan and field evaluation checklist. The checklist is included in APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST.

One or more designated EPA or Contractor staff members who are qualified (i.e., have completed training) in the procedures of the NLA 2012 field sampling operations will visit trained state, tribal, contractor, and EPA field sampling crews during sampling operations on site. If membership of a field crew changes, and at least two of the members have not been evaluated previously, the field crew must be evaluated again during sampling operations as soon as possible to ensure that all members of the field crew understand and can perform the procedures.

The purpose of this on-site visit will be to identify and correct deficiencies during field sampling operations. The process will involve the following preparation steps and field day activities.

Additionally, conference calls with crews may be held approximately every two weeks to discuss issues as they come up throughout the sampling season.

8.2.2 Preparation Activities

1. Each Field Crew Evaluator will schedule an assistance visit with their designated crews in consultation with the QA Officer, Regional NLA Coordinator, and respective Field Sampling Crew Leader. **Evaluators should be prepared to spend additional time in the field if needed (see below).** Ideally, each Field Crew will be evaluated within the first two weeks of beginning sampling operations, so that procedures can be corrected or additional training provided, if needed.
2. Each Field Crew Evaluator will ensure that field crews are aware of their visit plans and all capacity and safety equipment will be provided for the Field Crew Evaluator.
3. Each Field Crew Evaluator will need to bring along the following in Table 8.1.

Table 8.1 Equipment and supplies – field evaluation and assistance visits.

Type	Item	Quantity
Form	APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST (sent from EPA)	1
Documentation	NLA 2012 Field Operations Manual NLA 2012 Quality Assurance Project Plan Clipboard Pencils (#2, for data forms)/Pen Field notebook (optional)	1 1 1 1 1
Gear	Field gear (e.g., protective clothing, sunscreen, insect repellent, hat, water, food, backpack, cell phone)	As needed

8.2.3 Field Day Activities

1. The Field Crew Evaluator will review the **FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST** with each crew during the field sampling day and establish and plan and schedule for their evaluation activities for the day.
2. The Field Crew Evaluator will view the performance of a field crew through one complete set of sampling activities as detailed on the checklist.
   - Scheduling might necessitate starting the evaluation midway on the list of tasks at a site, instead of at the beginning. In that case, the Field Crew Evaluator will follow the crew to the next site to complete the evaluation of the first activities on the list.
   - If the field crew misses or incorrectly performs a procedure, the Field Crew Evaluator will note this on the checklist and *immediately point this out so the mistake can be corrected on the spot*. The role of the Field Crew Evaluator is to provide additional training and guidance so that the procedures are being performed consistent with the FOM, all data are recorded correctly, and paperwork is properly completed at the site.
3. When the sampling operation has been completed, the Field Crew Evaluator will review the results of the evaluation with the field crew before leaving the site (if practicable), noting

positive practices and problems (i.e., weaknesses [might affect data quality]; deficiencies [would adversely affect data quality]). The Field Crew Evaluator will ensure that the field crew understands the findings and will be able to perform the procedures properly in the future.

- The Field Crew Evaluator will review the list and record responses or concerns from the field crew, if any; on the checklist (this may happen throughout the field day).
- The Field Crew Leader will sign the checklist after this review.

8.2.4 Post Field Day Activities

1. The Field Crew Evaluator will review the checklist that evening and provide a summary of findings, including lessons learned and concerns.
    - If the Field Crew Evaluator finds major deficiencies in the field crew operations (e.g., less than two members, equipment, or performance problems) the Field Crew Evaluator must contact the EPA NLA 2012 Project Lead. The EPA NLA 2012 Project Lead will contact the EPA NARS QA Project Officer to determine the appropriate course of action.
2. The Field Crew Evaluator will retain a copy of the checklist and submit to the NARS IM Center.
3. The EPA NLA 2012 Project Lead and EPA NARS QA Project Officer or authorized designee will review the returned Field Evaluation and Assistance Visit Checklist, note any issues, and check off the completion of the evaluation for each field crew.

8.2.5 Summary

Table 8.2 summarizes the plan, checklist, and corrective action procedures.

Table 8.2 Summary of field evaluation and assistance visit information.

Field Evaluation Plan	The Field Crew Evaluator: • Arranges the field evaluation visit in consultation with the QA Officer, Regional NLA Coordinator, and respective Field Sampling Crew Leader, ideally within the first two weeks of sampling • Observes the performance of a crew through one complete set of sampling activities • Takes note of errors the field crew makes on the checklist and immediately point these out to correct the mistake • Reviews the results of the evaluation with the field crew before leaving the site, noting positive practices, lessons learned, and concern
Field Evaluation Checklist	The Field Crew Evaluator: • Observes all pre-sampling activities and verifies that equipment is properly calibrated and in good working order, and protocols are followed • Checks the sample containers to verify that they are the correct type and size, and checks the labels to be sure they are correctly and completely filled out • Confirms that the field crew has followed NLA protocols for locating the lake and determining the index site on the lake • Observes the index site sampling, confirming that all protocols are followed • Observes the littoral sampling and habitat characterization, confirming that all protocols are followed • Records responses or concerns, if any, on the Field Evaluation and Assistance Checklist
Corrective Action Procedures	• If the Field Crew Evaluator's findings indicate that the Field Crew is not performing the procedures correctly, safely, or thoroughly, the Evaluator must continue working with this Field Crew until certain of the crew's ability to conduct the sampling properly so that data quality is not adversely affected.

	• If the Field Crew Evaluator finds major deficiencies in the Field Crew operations the Evaluator must contact the EPA NLA 2012 Project Lead.

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APPENDIX A: CONTACTS

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APPENDIX B: EQUIPMENT & SUPPLIES

Base Kit

A Base Kit will be provided to the field crews for all sampling sites that they will go to. Some items are sent in the base kit as extra supplies to be used as needed.

Item	Quantity	Protocol
Bottle brush	1	Sediment Core
Centrifuge tube (50 mL, screw top) - extras	2	Chlorophyll A
Core plug	2	Sediment Core
Corer head (gravity, with cable and messenger)	1	Sediment Core
Core tube	2	Sediment Core
Electrical tape*	1	General
Filtration chamber (with filter holder)	5	Chlorophyll A
Filtration flask (with silicone stopper and adapter)	1	Chlorophyll A
Filter forceps (flat blade)	6	Chlorophyll A
Foil squares (package)*	1	Chlorophyll A
Funnel	1	Water samples
Gloves (latex/nitrile, non-powdered, box)	1	General
Graduated cylinder (250 mL)	1	Chlorophyll A
HDPE bottle (125 mL, white, wide-mouth) – extras	6	Zooplankton
HDPE bottle (1 L, white, wide-mouth) – extras	6	Benthics
H_2SO_4 (ampoules) – extras	5	Nutrients
Integrated sampler device (MPCA design)	1	Water Samples
Kick net (500 µm D-shaped, modified) with 4 foot handle	1	Benthics
Kit: Dissolved carbon supplies in ziploc bag: - Poly syringe (60mL) with attached 3-way stopcock	 2	Dissolved Carbon
Lugol's solution (250 mL bottle)	1	Phytoplankton
Meter stick (cm)	1	Secchi
NLA 2012 Field Operations Manual	1	All
NLA 2012 Quick Reference Guide	1	All
NLA 2012 Quality Assurance Project Plan	1	All
Packing tape (roll)*	1	General
Pail (narcotizing/concentrating chamber)	2	Zooplankton
pH paper (box)*	1	Nutrients
Pipette with bulb	2	Phytoplankton
Plankton net (50 µm)	1	Zooplankton
Plankton net (150 µm)	1	Zooplankton
Poly bottle (2 L, brown, labeled INDEX)	1	Chlorophyll A
Poly bottle (2 L, brown, labeled LITTORAL)	1	Chlorophyll A Algal Toxins Phytoplankton (cyanobacteria)
Rubbermaid action packer	1	General

Scoopula (plastic)	5	Sediment
Secchi disk (20 cm diameter) with weight	1	Secchi
Sieve bucket (500 µm)	1	Benthics
Small tote with lid	1	General
Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1	Depth Secchi Zooplankton
Spatula (2.5 inch, plastic, putty knife)	1	Sediment Core
Spoon (stainless steel)	1	Benthics
Squirt bottle (1 L Nalgene) – for de-ionized (DI) water	1	General
Squirt bottle (1 L Nalgene) – for lake water	1	General
Surveyor's tape (50m)	1	Physical Habitat
Syringe (60 mL) with tubing siphon overlying water	1	Sediment Core
Tape strips (3M, pack)*	2	General
Test tube holder	1	Chlorophyll A
Watchmaker's forceps	1	Benthics
Whatman 0.7 µm GF/F glass fiber filter (box)	1	Chlorophyll A
Zip top bags (1 gal, box)*	1	General
Zip top bags (1 qt, box)*	1	General
Vacuum filtration pump	1	Chlorophyll A

*Items may need to be replenished by field crews during field season

Site Kit

A Site Kit will be provided to the field crews for each sampling site. Please submit an electronic **Request Form** well in advance of field sampling to request the Site Kits. Each site kit will also include necessary coolers and shipping supplies for all samples collected. Some items may not be used at all sites and should be held until the end of the field season. These site kits include:

Item	Quantity	Protocol
Cubitainer® (4L)	1	Water Chemistry
Centrifuge tube (50 mL, screw top) in ziploc bag	2	Chlorophyll A
CO_2 (Alka seltzer) tablets	2 packets	Zooplankton
Cooler liners	1 per cooler	General
Kit: Dissolved carbon supplies in ziploc bag: - Serum bottles: • un-acidified (blue tape for CO_2 and CH_4) • pre-acidified (pink tape for DIC) - Water isotope bottle (10mL) - Syringe filter (0.45 µM) - Needles	 1 1 1 1 3 (1 is spare)	Dissolved Carbon
Kit: Sediment Mercury pre-cleaned supplies in ziploc bag: - Transfer pipette tip (plastic) - Screw top Jar (125 mL, plastic)	 2 2	Sediment Mercury
FedEx Overnight shipping labels	2	WRS Samples

		Chilled Batched Samples
FedEx Ground shipping label	1	Non-chilled Batched Samples
FedEx Express shipping labels	1	Data Packs
HDPE bottle (60 mL, white, wide-mouth)	1	Triazine
HDPE bottle (125 mL, white, wide-mouth)	2	Zooplankton
HDPE bottle (250 mL, brown, wide-mouth)	1	Nutrients
HDPE bottle (500 mL, white, wide-mouth)	2	Algal Toxins (index & littoral)
HDPE bottle (1 L, white, narrow mouth)	2	Phytoplankton (cyanobacteria) (index & littoral)
HDPE bottle (1 L, white, narrow-mouth)	2	Benthics
H_2SO_4 ampoules	1	Nutrients
Screw top jar (60 mL, plastic)	1	Sediment Dating
Screw top jar (15 mL, plastic)	2	Sediment Diatoms

Forms & Labels

Field forms (paper or electronic) and labels will be supplied by the NARS IM Center.

Item	Quantity	Protocol
Field forms packet: NLA 2012 Verification NLA 2012 Index Profile (front & back) NLA 2012 Index Sample Collection (pages 1-3) NLA 2012 Physical Habitat (front & back) NLA 2012 Macrophyte Assemblage Characterization (front & back) NLA 2012 Littoral Sample Collection (front & back) NLA 2012 Invasive Plants and Invertebrate NLA 2012 Assessment (front & back) NLA 2012 Site and Sample Status/Water Chemistry Lab Tracking NLA 2012 Tracking – Batched Samples NLA 2012 Tracking – Packets	1	General
Labels packet (for samples)	1	General

Field Crew Supplied Equipment

This equipment will need to be supplied by the field crew.

Item	Quantity	Protocol
Access permission documents/permit (if required)		Site Evaluation
Barometer or elevation chart to use for calibration	1	Calibration
Binoculars	1	Physical Habitat
Bleach (or bleach alternative)	1	General
Buckets (5 gallon capacity, plastic)	2	Benthics
Access instructions	1	Site Evaluation
Buoy (for marking observation point)	1	Physical Habitat
Calibration cups and standards (for multi-parameter meter)	1	Calibration
Calibration QC check solution (for multi parameter meter,	1	Calibration

pH and conductivity)		
Clinometer	1 (optional)	Physical Habitat
Clipboard	1	General
Depth Finder (hand-held or boat mounted sonar)	1	Index Site Profile
Electronic data capture devices (tablet/phone/computer) with NARS App and extra battery pack (if needed)	1-2 (optional)	General
Ethanol (95%)		Benthics Zooplankton
Extruder rod (1 ¼ in. PVC, 75 cm long) with cap	1	Sediment Core
NLA 2012 Fact Sheets (http://water.epa.gov/type/lakes/assessmonitor/lakessurvey/upload/NLA-2012-Fact-Sheet-for-Communities.pdf)	20	General
Field gear (e.g., protective clothing, sunscreen, insect repellent, hat, water, food, backpack, cell phone)		General
Field notebook (optional)	1	General
Field thermometer (not mercury)	1	General
GPS unit (with manual, reference card, extra battery)	1	Site Verification Physical Habitat
Kick net (500 µm D-shaped, modified) with 4 foot handle (back-up)	1	Benthics
Laser rangefinder (for estimating drawdown)	1 (optional)	Physical Habitat
Map wheel or string (for measuring shoreline distances on site map)		Physical Habitat
Multi-parameter water quality meter (with temperature, pH, and DO probes)	1	Index Site Profile
Net(s) and/or bucket assembly for end of net (back-up)	1	Benthics
Permanent marker (fine tip, for labels)	1	General
Pencils (#2, for data forms)	2	General
Pen	1	General
Plankton net (80 µm, NLA 2007 design)	1	Zooplankton
Plankton net (243 µm, NLA 2007 design)	1	Zooplankton
Rake sampler (to be attached to rope)	1	Macrophyte
Scissors	1	General
Screwdriver		
Sectioning stage	1	Sediment Core
Sectioning tube (6 cm, 2.5 in ID, line marked 2 cm from bottom of tube)	1	Sediment Core
Shipping tape	1	Shipping
Site maps (set of 3)	1	Site Evaluation
Sounding rod (3 m , marked in 0.1 m increments, calibrated, PVC)	1	Physical Habitat
Surveyors rod	1 (optional)	Physical Habitat

Tub (shallow) or dish pan	1	Sediment Core
Water (deionized)		General
Water (lake)		General
Wet Ice		Shipping

Boat Equipment List

This is suggested boat equipment.

Item
Anchor (with 75 m line or sufficient to anchor in 50 m depth)
Boat horn
Boat plug (extra)
Bow/stern lights
Emergency tool kit
Fire extinguisher
First aid kit
Gas Can
Hand bilge pump
Life jackets
Motor
Oars or paddles
Second anchor for windy conditions and littoral sampling (w/ 75m line)
Sonar unit
Spare prop shear pin
Type IV PFD (throwable life saving device)

APPENDIX C: SAMPLE FIELD FORMS

Verification

NLA 2012 VERIFICATION

Reviewed by (initial): ______

Site ID: NLA2012- | Visit: ○ 1 ○ 2 | Date: ___ / ___ / 2 0 1 2

Site Name: | Mode of Access: ○ Vehicle ○ Hike-in ○ Aircraft | Field Crew:

LAKE VERIFICATION INFORMATION

Lake shape compares with map? ○ YES ○ NO

Is there public access? ○ Yes ○ No

Access Description:

Lake verified by (Mark all that apply): ○ GPS ○ Local Contact ○ Signs ○ Roads ○ Topo. Map

○ Other (Describe Here):

○ Not Verified (Explain in Comments)

Coordinates		Latitude	Longitude	Type of GPS Fix:
MAP	Decimal Degrees NAD 83	.	— .	
LAUNCH SITE	Decimal Degrees NAD 83	.	— .	○ 2D ○ 3D

If these are not actual launch site coordinates, explain below:

DID YOU SAMPLE THIS SITE? ○ YES ○ NO

If NO, mark one reason and explain below: ○ Not Visited ○ Non-target ○ Inaccessible ○ Other(Explain below):

GENERAL COMMENTS

DIRECTIONS TO LAKE & LAUNCH SITE (from nearest main road or town):

LAUNCH SITE DESCRIPTION

PERSONNEL

Name:	Name:
Leader:	

03/21/2012 NLA Verification 0366605051

Index Profile

NLA 2012 INDEX PROFILE (Front)

Reviewed by (initial): ______

Site ID: NLA2012-   Date: ___ / ___ / 2 0 1 2   Time of Arrival at Index Site (hh:mm): ___ : ___

Coordinates	Latitude	Longitude	Type of GPS Fix:
INDEX SITE Decimal Degrees NAD 83	___ . ___	— ___ . ___	○ 2D ○ 3D

Precipitation: ○ NONE ○ LIGHT ○ HEAVY   Surface Conditions: ○ FLAT ○ RIPPLES ○ CHOPPY ○ WHITECAPS

Odor: ○ YES ○ NO   Description:

Scum: ○ YES ○ NO   Description:

Index Site Depth (m): ___ . ___   Comments:

Method Used: ○ LINE ○ SONAR ○ POLE ○ ESTIMATE

CALIBRATION INFORMATION

Instrument manufacturer and model:

Instrument ID number: Operator:

TEMPERATURE	Thermometer Reading (°C)	Sensor Reading (°C)	Comments
	___ . ___	___ . ___	

DO	Elevation	OR	Barometric Pressure (mm Hg)	Calibration Value	Displayed Value	Flag
	(m)			___ . ___ ○ mg/L ○ %	___ . ___ ○ mg/L ○ %	

pH	Cal. STD 1 Description	Cal. STD 1 Value	Cal. STD 2 Description	Cal. STD 2 Value
		___ . ___		___ . ___

Calibration Verified with Quality Control Sample (QCS)

QCS Description	QCS True	QCS Measured	Flag
	___ . ___	___ . ___	

CONDUCTIVITY	Cal. STD 1 Description	Cal. STD 1 Value	Cal. STD 2 Description	Cal. STD 2 Value

Calibration Verified with Quality Control Sample (QCS)

QCS Description	QCS True (µS/cm @25°C)	QCS Measured (µS/cm @25°C)	Flag

Flag	Comments

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

03/21/2012 NLA Profile   9149175365

NLA 2012 INDEX PROFILE (Back)

Reviewed by (initial): ______

Site ID: NLA2012-

Date: ___ / ___ / 2 0 1 2

Submitted data via eFile ○

DISSOLVED OXYGEN, TEMPERATURE, AND pH PROFILE

Mark if conductivity is temperature-corrected ○

Intervals (m): Surface to 20 m = every 1 m; 20-50 m = every 2 m; last reading 0.5 m above bottom[a]

[a] If the site depth is <3 m, take readings at the surface, every 0.5 m, and 0.5 m above bottom.

[b] METALIMNION = The region of the profile where the temperature changes at the rate of 1 °C or greater per meter of depth. Indicate the depth of the top of the metalimnion with a 'T', and the bottom of the metalimnion (when the rate change becomes less than 1 °C per meter) with a 'B'. After the metalimnion is encountered, take readings every 1 m until bottom of the metalimnion is reached.

Depth XX.X	O_2 (mg/L) XX.X	Temp. (°C) XX.X	pH XX.X	Cond. (µS/cm@ 25°C) XX	Meta-limnion[b] (T, B)	Flag	Depth XX.X	O_2 (mg/L) XX.X	Temp. (°C) XX.X	pH XX.X	Cond. (µS/cm@ 25°C) XX	Meta-limnion[b] (T, B)	Flag
Surface													
							Dup Surface						

Is the Duplicate O_2 reading within ±0.5 mg/L of the initial surface reading? ○ YES ○ NO

Calibration Verified: ○ YES ○ NO

Flag	Comments

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

03/21/2012 NLA Profile

3682175361

APPENDIX C: SAMPLE FIELD FORMS

Index Sample Collection

NLA 2012 INDEX SAMPLE COLLECTION (Page 1 of 3) Reviewed by (initial): ____

Site ID: NLA2012- ____ Date: __ / __ / 2 0 1 2

SECCHI DISK TRANSPARENCY
* NOTE: If euphotic zone depth is < 2 m (secchi < 1 m), take multiple "short" integrated samples.

Depth Disk Disappears	Depth Disk Reappears*	Comments	Clear to Bottom
__ . __ (m)	__ . __ (m)		○

DEPTH OF INTEGRATED SAMPLE (TYPICALLY 2 M) ____ m

CHEMISTRY (CHEM)
(Target Volume = 4L) NoSampleCollected ○

Sample ID	Comments

ALGAL TOXIN (Microcystin) (MICX)
(Target Volume = 500mL) NoSampleCollected ○

Sample ID	Comments

TRIAZINE PESTICIDE SCREEN (TRIA)
(Target Volume = 60mL) NoSampleCollected ○

Sample ID	Comments

NUTRIENTS (NUTS)
(Target Volume = 250mL) NoSampleCollected ○

Sample ID	Number of Ampoules	Ph <2	Comments
		○	

PHYTOPLANKTON (PHYX)
(Target Volume = 1000mL) NoSampleCollected ○

Sample ID	Lugols	Comments
	○	

CHLOROPHYLL-a (CHLX)
(Target Volume = 1000mL; max vol = 2000 mL) NoSampleCollected ○

Sample ID	VolumeFiltered (ml)	Comments

Use comment section to explain: Suspect measurement, observations or no measurements taken.

03/21/2012 NLA Index Sample Collection 8410616646

NLA 2012 INDEX SAMPLE COLLECTION (Page 2 of 3)

Reviewed by (initial): ______

Site ID: NLA2012-   Date: ___ / ___ / 2 0 1 2

DISSOLVED CARBON (unacidified) (CARU)
(Target Volume = 15mL)

No Sample Collected ○

Sample ID	Comments

DISSOLVED CARBON (pre-acidified) (CARP)
(Target Volume = 15mL)

No Sample Collected ○

Sample ID	Comments

DISSOLVED CARBON ISOTOPE (ISOT)
(Target Volume = 10mL)

No Sample Collected ○

Sample ID	Comments

Zooplankton Coarse (150 micron mesh) (ZOCN)

No Sample Collected ○

Sample ID	Length of tow:	Number of Jars	Narcotized (CO_2)	Preserved (ETOH)	Comments
	○ 1 5m tow ○ 5 1m tows ○ 2 2.5m tows ○ 10 0.5m tows		○	○	

Zooplankton Fine (50 micron mesh) (ZOFN)

No Sample Collected ○

Sample ID	Length of tow:	Number of Jars	Narcotized (CO_2)	Preserved (ETOH)	Comments
	○ 1 5m tow ○ 5 1m tows ○ 2 2.5m tows ○ 10 0.5m tows		○	○	

Zooplankton Coarse (243 micron mesh) (ZOCR)

No Sample Collected ○

Sample ID	Total length of Tow (m)	Number of Jars	Narcotized (CO_2)	Preserved (ETOH)	Comments
			○	○	

Zooplankton Fine (80 micron mesh) (ZOFR)

No Sample Collected ○

Sample ID	Total length of Tow (m)	Number of Jars	Narcotized (CO_2)	Preserved (ETOH)	Comments
			○	○	

Use comment section to explain: Suspect measurement, observations or no measurements taken.

03/21/2012 NLA Index Sample Collection

7910616640

APPENDIX C: SAMPLE FIELD FORMS

NLA 2012 INDEX SAMPLE COLLECTION (Page 3 of 3) Reviewed by (initial): ____

Site ID: NLA2012- ____ Date: __ / __ / 2 0 1 2

SEDIMENT CORE SAMPLES
(Target Core Length = 45cm)

	Latitude	Longitude	
Decimal Degrees NAD 83	___ . ______	– ___ . ______	○ Index ○ Other

Length of Core: ____ cm Bottom of Core: ____ to ____ cm

SEDIMENT MERCURY TOP (SEDH)
(Target Volume = 50mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DIATOMS TOP (SEDT)
(Target Volume = 5mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DATING (SEDD)
(Target Volume = 40mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT MERCURY BOTTOM (SEDG)
(Target Volume = 20mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DIATOMS BOTTOM (SEDB)
(Target Volume = 5mL) No Sample Collected ○

Sample ID	Comments

Use comment section to explain: Suspect measurement, observations or no measurements taken.

03/21/2012 NLA Index Sample Collection 0911616644

Littoral Sample Collection

NLA 2012 LITTORAL SAMPLE COLLECTION

Reviewed by (initial): ______

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

BENTHIC MACROINVERTEBRATES (BENT) NoSampleCollected ○

Sample ID	Number of jars	Preserved (ETOH)	Comments
		○	

STATIONS

SUBSTRATE CODES: R - Rocky/Cobble/Woody debris; M - Macrophyte beds; F - Fines (sand, mud, organic); L - Leaf Pack; O - Other (Flag and explain in comments)
COLLECTION CODES: B - Boat; W - Wading

A	B	C	D	E	F	G	H	I	J		
Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O	Sub ○R ○M ○F ○L ○O
Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W
Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag

Flag	Comments

CHLOROPHYLL-a (CHLL)
(Target Volume = 1000mL; max vol = 2000 mL) NoSampleCollected ○

Sample ID	VolumeFiltered (ml)	Comments

PHYTOPLANKTON (PHYL)
(Target Volume = 1000mL) NoSampleCollected ○

Sample ID	Lugols	Comments
	○	

ALGAL TOXIN (Microcystin) (MICL)
(Target Volume = 500mL) NoSampleCollected ○

Sample ID	Comments

Use comment section to explain: Suspect measurement, observations or no measurements taken.

03/21/2012 NLA Littoral Sample Collection 4553059090

Physical Habitat

NLA 2012 PHAB (Front)

Site ID: NLA12- Date: __ / __ / 2 0 1 2 Reviewed by (initial): _____

STATION: ○ A ○ B ○ C ○ D ○ E ○ F ○ G ○ H ○ I ○ J STATION RELOCATED: ○

IS IT AN ISLAND? Yes ○ NO ○ DROPPED: ○ NEW STATION (K, L, etc.) ____

DEPTH AT STATION (10 m offshore) ____ . __ (m) NAD 83 (Decimal Degrees) LAT: ___ . _____ LONG: ___ . _____

ShorelineFlooding: Yes ○ NO ○ Depth: ____ . __ (m) Horizontal Dist.: ____ . __ (m)

Drawdown: Yes ○ NO ○ Height: ____ . __ (m) Dist: ____ . __ (m)

Bank Angle (see diagram below): ○ Flat (<5°) ○ Gradual (5-30°) ○ Steep (30-75°) ○ Near vertical/undercut (>75°)

LITTORAL ZONE

Surface film type: ○ None ○ Scum ○ Algal Mat ○ Oily ○ Other ____ Flag:

Substrate Odor: ○ None ○ H_2S ○ Anoxic ○ Oil ○ Chemical ○ Other ____

Substrate Color: ○ Black ○ Gray ○ Brown ○ Red ○ Other ____

SUBSTRATE 0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%) 3 = Heavy (40-75%) 4 = Very Heavy (>75%)

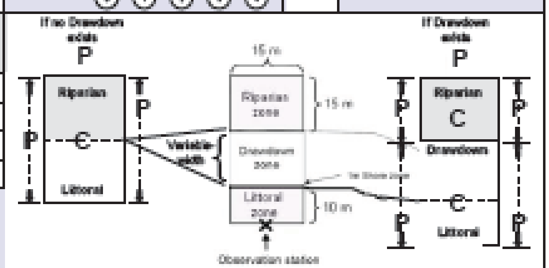
Littoral Bottom		Flag	1 Meter Shore Zone	Flag
Bedrock (>4000mm; larger than a car)	0 1 2 3 4		0 1 2 3 4	
Boulders (250-4000mm; basketball-car)	0 1 2 3 4		0 1 2 3 4	
Cobble (64-250mm; tennis ball-basketball)	0 1 2 3 4		0 1 2 3 4	
Gravel (2-64mm; ladybug to tennis ball size)	0 1 2 3 4		0 1 2 3 4	
Sand (0.06 - 2mm; gritty between fingers)	0 1 2 3 4		0 1 2 3 4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0 1 2 3 4		0 1 2 3 4	
Woody Debris	0 1 2 3 4		0 1 2 3 4	
Organic (Leaf Pack, Detritus)	0 1 2 3 4		0 1 2 3 4	
Vegetation or Other	0 1 2 3 4		0 1 2 3 4	

BANK ANGLE CLASSES

AQUATIC MACROPHYTES

Littoral — Do macrophytes extend lakeward? ○ Yes ○ No

Littoral		Flag
Submergent	0 1 2 3 4	
Emergent	0 1 2 3 4	
Floating	0 1 2 3 4	
Total Aquatic Macrophyte Cover	0 1 2 3 4	



FISH COVER

Littoral		Flag	Drawdown	Flag
Aquatic and inundated Herbaceous Veg.	0 1 2 3 4		0 1 2 3 4	
Woody Debris/Snags > 0.3 m Dia.	0 1 2 3 4		0 1 2 3 4	
Woody Brush/Woody Debris <0.3 m dia. (alive or dead)	0 1 2 3 4		0 1 2 3 4	
Inundated Live Trees >0.3 m dia	0 1 2 3 4		0 1 2 3 4	
Overhanging Veg. within 1 m of Surface	0 1 2 3 4		0 1 2 3 4	
Ledges or Sharp Dropoffs	0 1 2 3 4		0 1 2 3 4	
Boulders	0 1 2 3 4		0 1 2 3 4	
Human Structures - Docks, Landings, etc	0 1 2 3 4		0 1 2 3 4	

Flag codes: K = No measurement made, U = Suspect measurement., F1,F2, etc. = misc. flags assigned by each field crew. Explain all flags in comment section on back page.

03/21/2012 NLA Phab (Front) 2484315782

NLA 2012 PHAB (Back)

Site ID: NLA12- Date: __ / __ / 2 0 1 2 Reviewed by (initial): ____

STATION: ○ A ○ B ○ C ○ D ○ E ○ F ○ G ○ H ○ I ○ J NEW STATION (K, L, etc.) ____

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%) 3 = Heavy (40-75%) 4 = Very Heavy (>75%)

Canopy (>5m) Riparian ○ Deciduous ○ Coniferous ○ BroadleafEvergreen ○ Mixed		FLAG	Drawdown ○ Deciduous ○ Coniferous ○ BroadleafEvergreen ○ Mixed	FLAG
Big Trees (Trunk >0.3 m dBH)	0 1 2 3 4		0 1 2 3 4	
Small Trees (Trunk <0.3 m dBH)	0 1 2 3 4		0 1 2 3 4	

Understory (0.5-5m) Riparian ○ Deciduous ○ Coniferous ○ Broadleaf Evergreen ○ Mixed		FLAG	Drawdown ○ Deciduous ○ Coniferous ○ Broadleaf Evergreen ○ Mixed	FLAG
Woody Shrubs & Saplings	0 1 2 3 4		0 1 2 3 4	
Tall Herbs, Grasses, & Forbs	0 1 2 3 4		0 1 2 3 4	

Ground Cover (<0.5m) Riparian		FLAG	Drawdown	FLAG
Woody Shrubs & Saplings	0 1 2 3 4		0 1 2 3 4	
Herbs, Grasses and Forbs	0 1 2 3 4		0 1 2 3 4	
Standing Water or Inundated Vegetation	0 1 2 3 4		0 1 2 3 4	
Barren, Bare Dirt, Litter Duff or Buildings	0 1 2 3 4		0 1 2 3 4	

Human Influence 0 = Not Present P = Present outside plot C = Present within plot

Riparian		FLAG	Drawdown	FLAG
Buildings	0 P C		0 P C	
Commercial	0 P C		0 P C	
Park Facilities/Man-made beach	0 P C		0 P C	
Docks/Boats	0 P C		0 P C	
Walls, dikes or revetments	0 P C		0 P C	
Trash/Landfill	0 P C		0 P C	
Roads or Railroad	0 P C		0 P C	
Power lines	0 P C		0 P C	
Row Crops	0 P C		0 P C	
Pasture/Range/Hay Field	0 P C		0 P C	
Orchard	0 P C		0 P C	
Lawn	0 P C		0 P C	
Other (Flag and explain in comments)	0 P C		0 P C	

Flag	Comments	Flag	Comments

Flag codes: K = No measurement made, U = Suspect measurement, F1,F2, etc. = misc. flags assigned by each field crew. Explain all flags in comment section.

03/21/2012 NLA Phab (Back) 9121370698

Macrophyte Assemblage Characterization

Reviewed by (initial): ______

NLA 2012 MACROPHYTE ASSEMBLAGE CHARACTERIZATION (Front)

Site ID: NLA2012-   Date: __ / __ / 2 0 1 2

Phab Plot	Point	Depth	Plant Rake Density	Fil. Algae Density	Macrophyte Growth Form E	FL	FF	SB	SC	SF	SW	Fill if MDC reached	Comments
	1		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	2		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	3		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	4		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	5		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	6		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	7		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	8		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	9		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	10		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	11		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	12		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	1		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	2		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	3		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	4		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	5		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	6		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	7		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	8		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	9		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	10		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	11		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	12		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	1		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	2		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	3		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	4		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	5		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	6		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	7		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	8		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	9		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	10		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	11		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	12		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	

03/21/2012 NLA Macrophyte Assemblage Characterization

2132293877

Reviewed by (initial):______

NLA 2012 MACROPHYTE ASSEMBLAGE CHARACTERIZATION (Back)

Site ID: NLA2012-

Date: ___ / ___ / 2 0 1 2

Phab Plot	Point	Depth	Plant Rake Density	Fil. Algae Density	Macrophyte Growth Form E	FL	FF	SB	SC	SF	SW	Fill if MDC reached	Comments
	1		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	2		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	3		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	4		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	5		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	6		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	7		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	8		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	9		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	10		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	11		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	12		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	1		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	2		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	3		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	4		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	5		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	6		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	7		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	8		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	9		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	10		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	11		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	
	12		0 1 2 3	0 1 2 3	○	○	○	○	○	○	○	○	

Deepest Part of Lake: __________ (m)

Plants observed ○ Y ○ N
If Yes, stop, lake is 100% littoral

	Depth at which plants observed	Direction:
MDC 1		
MDC 2		
MDC 3		
MDC 4		
MDC 5		

03/21/2012 NLA Macrophyte Assemblage Characterization

8704293878

APPENDIX C: SAMPLE FIELD FORMS

Invasive Plants and Invertebrates

NLA 2012 INVASIVE PLANTS AND INVERTEBRATES (Front)

Reviewed by (initial): ______

Site ID: NLA2012- Date: ___ / ___ / 2 0 1 2

STATIONS	A		B		C		D		E		F	
SPECIES	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG
NONE OBSERVED	○		○		○		○		○		○	
Curlyleaf pondweed	○		○		○		○		○		○	
Common reed	○		○		○		○		○		○	
Eurasian watermilfoil	○		○		○		○		○		○	
Purple loosestrife	○		○		○		○		○		○	
Russian-olive	○		○		○		○		○		○	
Reed canarygrass	○		○		○		○		○		○	
Canada thistle	○		○		○		○		○		○	
Multiflora rose	○		○		○		○		○		○	
Narrowleaf cattail	○		○		○		○		○		○	
Brazilian waterweed	○		○		○		○		○		○	
Brittleleaf naiad	○		○		○		○		○		○	
Parrot feather milfoil	○		○		○		○		○		○	
Mimosa	○		○		○		○		○		○	
Hydrilla	○		○		○		○		○		○	
Water starwort	○		○		○		○		○		○	
Water hyacinth	○		○		○		○		○		○	
Yellow floatingheart	○		○		○		○		○		○	
European pepperwort	○		○		○		○		○		○	
Alligatorweed	○		○		○		○		○		○	
European waterstarwort	○		○		○		○		○		○	
Giant salvinia	○		○		○		○		○		○	
Water fern	○		○		○		○		○		○	
Water-chestnut (European)	○		○		○		○		○		○	
Tamarisk	○		○		○		○		○		○	
Deeprooted sedge	○		○		○		○		○		○	
Japanese or giant knotweed	○		○		○		○		○		○	
Miramar weed	○		○		○		○		○		○	
Brazilian peppertree	○		○		○		○		○		○	
Zebra or quagga mussel	○		○		○		○		○		○	
Asian clam	○		○		○		○		○		○	
Rusty crayfish	○		○		○		○		○		○	
OTHER (Note in comments)	○		○		○		○		○		○	

Flag	Comments

Flag codes: U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comments section.

03/21/2012 NLA Invasive Plants and Invertebrates

8998518154

NLA 2012 INVASIVE PLANTS AND INVERTEBRATES (Back)

Reviewed by (initial):______

Site ID: NLA2012-   Date: ___ / ___ / 2 0 1 2

STATIONS	G		H		I		J					
SPECIES	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG
NONE OBSERVED	○		○		○		○		○		○	
Curlyleaf pondweed	○		○		○		○		○		○	
Common reed	○		○		○		○		○		○	
Eurasian watermilfoil	○		○		○		○		○		○	
Purple loosestrife	○		○		○		○		○		○	
Russian-olive	○		○		○		○		○		○	
Reed canarygrass	○		○		○		○		○		○	
Canada thistle	○		○		○		○		○		○	
Multiflora rose	○		○		○		○		○		○	
Narrowleaf cattail	○		○		○		○		○		○	
Brazilian waterweed	○		○		○		○		○		○	
Brittleleaf naiad	○		○		○		○		○		○	
Parrot feather milfoil	○		○		○		○		○		○	
Mimosa	○		○		○		○		○		○	
Hydrilla	○		○		○		○		○		○	
Water starwort	○		○		○		○		○		○	
Water hyacinth	○		○		○		○		○		○	
Yellow floatingheart	○		○		○		○		○		○	
European pepperwort	○		○		○		○		○		○	
Alligatorweed	○		○		○		○		○		○	
European waterstarwort	○		○		○		○		○		○	
Giant salvinia	○		○		○		○		○		○	
Water fern	○		○		○		○		○		○	
Water-chestnut (European)	○		○		○		○		○		○	
Tamarisk	○		○		○		○		○		○	
Deeprooted sedge	○		○		○		○		○		○	
Japanese or giant knotweed	○		○		○		○		○		○	
Miramar weed	○		○		○		○		○		○	
Brazilian peppertree	○		○		○		○		○		○	
Zebra or quagga mussel	○		○		○		○		○		○	
Asian clam	○		○		○		○		○		○	
Rusty crayfish	○		○		○		○		○		○	
OTHER (Note in comments)	○		○		○		○		○		○	

Flag	Comments

Flag codes: U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comments section.

03/21/2012 NLA Invasive Plants and Invertebrates

8578518158

Assessment

NLA 2012 ASSESSMENT (Front) Reviewed by (initial): ______

Site ID: NLA2012-   Date: __ / __ / 2 0 1 2

LAKE/CATCHMENT SITE ACTIVITIES AND DISTURBANCES OBSERVED
(Intensity: Blank=Not observed, L=Low, M=Moderate, H=Heavy)
BLANK FIELD INDICATES ABSENCE: ○

Residential	Recreational	Agricultural	Industrial	Lake Management
Residences	Hiking Trails	Cropland	Industrial Plants	Liming
Maintained Lawns	Parks, Campgrounds	Pasture	Mines/Quarries	Chemical Treatment
Construction	Primitive Parks, Camping	Livestock Use	Oil/Gas Wells	Angling Pressure
Pipes, Drains	Resorts	Orchards	Power Plants	Drinking Water Treatment
Dumping	Marinas	Poultry	Logging	Macrophyte Control
Roads	Trash/Litter	Feedlot	Evidence of Fire	Water Level Fluctuations
Bridges/Causeway	Surface Films, Scums, or Slicks	Water Withdrawal	Odors	Fish Stocking
Sewage Treatment			Commercial	

(Each item has L / M / H options.)

GENERAL LAKE INFORMATION

Hydrologic Lake Type: ○ Reservoir ○ Drainage (outlets present) ○ Seepage (no outlets observed)

Outlet Dams: ○ None ○ Artificial ○ Natural

Low Elevation Flight Hazards: ○ Yes ○ No

Motor Boat Density: ○ High ○ Low ○ Restricted ○ Banned

Swimability: ○ Good ○ Fair ○ Not Swimmable

Lake Level Changes: ○ Zero ○ Elevation Change = ______ m

SHORELINE CHARACTERISITCS (% of shoreline)

Forest ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Grass ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Shrub ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Wetland ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Bare Ground ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Agriculture ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Shoreline Mods (docks, riprap) ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

Development (Residential & Urban) ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

QUALITATIVE MACROPHYTE SURVEY

Emergent/Floating Coverage (% Lake Area) ○ <5% ○ 5 to 25% ○ 26 to 75% ○ >75%

Submergent Coverage (% Lake Area) ○ <5% ○ 5 to 25% ○ 26 to 75% ○ >75%

Macrophyte Density ○ Absent ○ Sparse ○ Moderate ○ High

WATERBODY CHARACTER

Pristine ○ 5 ○ 4 ○ 3 ○ 2 ○ 1 Highly Disturbed

Appealing ○ 5 ○ 4 ○ 3 ○ 2 ○ 1 Unappealing

03/21/2012 NLA Assessment   2481024922

NLA 2012 ASSESSMENT (Back)

Reviewed by (initial): ______

Site ID: NLA2012-

Date: ___ / ___ / 2 0 1 2

QUALITATIVE ASSESSMENT OF ENVIRONMENTAL VALUES

Ecological Integrity: ◯ Excellent ◯ Good ◯ Fair ◯ Poor

General Assessment:	
Wildlife Observed:	

Trophic State: ◯ Oligotrophic ◯ Mesotrophic ◯ Eutrophic ◯ Hypereutrophic

Visual Assessment:	
Algal Abundance & Type:	
Nutrient Sources:	
Other:	

Recreational Value: ◯ Excellent ◯ Good ◯ Fair ◯ Poor

Conditions and Local Contacts:	
Observations (e.g. accessibility, boating, fishing, swimming, health concerns):	

COMMENTS

03/21/2012 NLA Assessment

2636024924

Site and Sample Status/Water Chemistry Lab Tracking

NLA 2012 SITE AND SAMPLE STATUS/WATER CHEMISTRY LAB TRACKING

Site ID: NLA2012- Visit#: ○ 1 ○ 2 Date Collected: ___ / ___ / 2 0 1 2

State of Site Location: ______ Crew: ______

Sender: ______ Sender Phone: ___ - ___ - ___

Shipped by: ○ FedEx ○ UPS ○ Hand Delivery ○ Other: ______

Airbill/Tracking Number: ______ Date Sent: ___ / ___ / 2 0 1 2

Site Status - Is Site Sampleable?

○ YES - Proceed to Sample Status

○ NO - Select ONE reason from list below and skip Sample Status:

○ Not Visited ○ Inaccessible ○ Non-Target ○ Other: ______

Sample Status - Water Chemistry Lab Samples

Sample ID	Sample Type	Sent to WRS	Sent to State (Note in Comments)	Not Collected	Comments
	CHEM	○	○	○	
	CHLL	○	○	○	
	CHLX	○	○	○	
	NUTS	○	○	○	
	SEDG	○	○	○	
	SEDH	○	○	○	

Sample Status - Batch Samples

Sample Type	Sent to GLEC	Collected & Retained	Sent to State	Not Collected	Sample Type	Sent to GLEC	Collected & Retained	Sent to State	Not Collected
BENT	○	○	○	○	SEDB	○	○	○	○
CARP	○	○	○	○	SEDD	○	○	○	○
CARU	○	○	○	○	SEDT	○	○	○	○
ISOT	○	○	○	○	TRIA	○	○	○	○
MICL	○	○	○	○	ZOCN	○	○	○	○
MICX	○	○	○	○	ZOFN	○	○	○	○
PHYL	○	○	○	○	ZOCR	○	○	○	○
PHYX	○	○	○	○	ZOFR	○	○	○	○

Field Form Status Field Data Submission via: ○ Electronic APP ○ Paper Forms

Water Chemistry Lab	Completed by Lab	Send completed forms to:	Tracking Related Inquiries:
Attn: Phil Monaco, Dynamac c/o U.S. EPA 1350 SE Goodnight Ave Corvallis, OR 97333 Phone: 541-754-4720 Email: monaco.phil@epamail.epa.gov	Date Received: ___/___/___ ______ Received by: ______	EMAIL: sampletracking@epa.gov FAX: 541-754-4637 VOICE MESSAGE CENTER: 541-754-4663	Marlys Cappaert Phone: 541-754-4467 Michelle Gover Phone: 541-754-4793

04/09/2012 NLA Tracking - Site and Sample Status

0303519337

Tracking – Batched Samples

NLA 2012 TRACKING - BATCHED SAMPLES

○ GLEC ○ STATE LAB

Site ID: NLA2012- Visit#: ○ 1 ○ 2 Date Collected: __ / __ / 2 0 1 2

State of Site Location: __ Crew: __

Sender: __ Sender Phone: __ – __ – __

Shipped by: ○ FedEx ○ UPS ○ Hand Delivery

Airbill/Tracking Number: __ Date Sent: __ / __ / 2 0 1 2

Sample ID	Sample Type	# of Containers	Comments

GLEC	State Lab	Send completed forms to:	Tracking Related Inquiries:
Great Lakes Environmental Center 739 Hastings Street, Traverse City, MI 49686 Phone: 231-941-2230 Email: NLA2012@glec.com	STATE LAB NAME STATE LAB ADDRESS CITY STATE ZIP CODE	EMAIL: sampletracking@epa.gov FAX: 541-754-4637 VOICE MESSAGE CENTER: 541-754-4663	Marlys Cappaert Phone: 541-754-4467 Michelle Gover Phone: 541-754-4793

04/09/2012 NLA Tracking - Batched

8514597111

Tracking – Packets

NLA 2012 TRACKING - PACKETS

Sender: ____________ Sender Phone: ___ - ___ - ____

State of Site Location: ____ Crew: ____

Shipped By: ○ FedEx ○ UPS ○ Hand Delivery Date Sent: __ / __ / 2 0 1 2

Airbill/Tracking Number: ____________

Site ID	Date Sample Collected MM/DD/YYYY	Visit	Comments
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	
NLA2012-		○ 1 ○ 2	

Packet Lab	Completed by Lab	Send completed forms to:	Tracking Related Inquiries:
Attn: Marlys Cappaert c/o USEPA - WED Division 200 SW 35th St Corvallis, OR 97333 Email: cappaert.marlys@epa.gov	Date Received: ___/___/______ Received by: __________	EMAIL: sampletracking@epa.gov FAX: 541-754-4637 VOICE MESSAGE CENTER: 541-754-4663	Marlys Cappaert Phone: 541-754-4467 Michelle Gover Phone: 541-754-4793

NLA Tracking - PACKS 03/21/2012 7419180000

Request Form

NLA 2012 REQUEST FORM

DATE OF REQUEST:	04/11/2012	DATE ITEM(S) NEEDED:	
REQUESTERS NAME:		BEST WAY TO CONTACT YOU:	
CREW:		PHONE (O):	(C):
AFFILIATION:		EMAIL:	
REGION:	▼	SHIPPING ADDRESS:	
STATE:	▼		

FILL IN ALL APPLICABLE FIELDS. PLEASE GIVE US ADVANCE NOTICE IF POSSIBLE, AND KEEP IN MIND THAT WE CANNOT SHIP TO P.O. BOXES. THANKS!

SUPPLIES REQUEST

- ☐ DATA FORMS
  - ☐ FULL PACKET — QTY: ____
  - ☐ SPECIFIC FORMS — TYPE: ____ ▼ QTY: ____
    - TYPE: ____ ▼ QTY: ____
- ☐ SAMPLE LABELS
  - ☐ FULL SITE SHEET — QTY: ____
  - ☐ BENTHIC EXTRA JARS — QTY: ____
  - ☐ BENTHIC IN JAR — QTY: ____
- ☐ FIELD SUPPLIES
  - ☐ FULL SITE KIT — QTY: ____
  - ☐ CARBON KIT — QTY: ____
  - ☐ SPECIFIC SUPPLIES — TYPE: ____ ▼ QTY: ____
    - TYPE: ____ ▼ QTY: ____

OTHER COMMENTS OR QUESTIONS?

FOR IM USE

FORWARDED TO:		FORWARDED TO:	
AT:		AT:	
DATE:		DATE:	
RESOLUTION:		RESOLUTION:	
DATE RESOLVED:		DATE RESOLVED:	

Save Form | Submit Form | 5407428550

SAVE FORM WITH UNIQUE ID FOR YOUR RECORDS, THEN USE BUTTON TO SEND COMPLETED FORM TO SAMPLETRACKING@EPA.GOV

APPENDIX D: SHIPPING GUIDELINES

General Shipping Guidelines

Before shipping, it is very important to preserve each sample as directed in the sample collection portion of the appropriate chapter in the NLA 2012 FOM. General directions for sample processing, shipping and tracking are found below:

- Preserve the samples as specified for each indicator before shipping.
- Be aware of the holding times for each type of sample.
- Always line the cooler with a large, 30-gallon plastic bag.
- When shipping samples preserved with ethanol, surround the jars with crumpled newspaper, vermiculite, or other absorbent material.

When ice is used for shipment:

- Ensure that the ice is fresh before shipment, and use adequate amounts of ice to ensure samples will remain cold for up to 36 hours.
- Contain the ice separately within numerous 1-gallon re-sealable plastic bags.
- White or clear bags will allow for labeling with a dark indelible marker. Label all bags of ice as "ICE" with an indelible marker to prevent misidentification by couriers of any leakage of water as a possible hazardous material spill.
- Place samples and bags of ice inside the cooler liner and seal the cooler liner.
- Secure the cooler with strapping tape.

Tracking Forms

A Tracking Form must be filled out to accompany each sample shipment. Be very careful to fill in the information correctly and legibly, especially the Site ID, and Sample ID numbers. Use the codes on the bottom of the form to indicate sample type. The Tracking Form is to be placed in a resealable plastic bag and included inside the shipping container. Seal the shipping container. Submit the Sample Tracking Form to the NARS IM Center to indicate that samples will be in transit to the lab. Tracking forms must be submitted the same day that the samples are shipped.

Shipping Addresses

USEPA Lab, Corvallis, Oregon (Chlorophyll-a, Nutrients, Water Chemistry, Sediment Mercury)
Attn: Phil Monaco, Dynamac
c/o U.S. EPA
1350 SE Goodnight Ave
Corvallis, OR 97333

USEPA Data Management Center, Corvallis Oregon (Data Packet)
Attn: Marlys Cappaert, SRA
c/o U.S. EPA, NHEERL-WED
200 S.W. 35th Street
Corvallis, OR 97333

Great Lakes Environmental Center (All other samples)
739 Hastings Street
Traverse City, MI 49686

Sample preservation, packaging, and holding times.

Lab	Sample Type	Sample ID	Location	Sample Target Volume	Container	Preparation/ Preservation	Shipping Time Frame	Packaging for Shipping
WRS Lab - Corvallis, OR	Water chemistry (raw, unfiltered site water)	CHEM	Index	4 L	Cubitainer (4 L)	Wet ice in field	Immediate (ship within 24 hours of sampling)	**WRS Cooler** with wet ice OVERNIGHT
	Nutrients	NUTS	Index	250 mL	HDPE bottle (250 mL, brown, wide-mouth)	Acid ampoule pH paper check Wet ice in field		
	Chlorophyll-a	CHLX	Index Collection	2 L	Poly bottle (2 L, brown, labeled INDEX)	Wet ice in field		
			Index Processing	Stain on filter – max 2 L filtration	centrifuge tube (50 mL), in zip-top bag	Wet ice in field (after filtration)		
		CHLL	Littoral Collection	Filter in 50 mL centrifuge tube (or less)	Poly bottle (2 L, brown, labeled LITTORAL)	Wet ice in field		
			Littoral Processing	Stain on filter – max 2 L filtration	centrifuge tube (50 mL), in zip-top bag	Wet ice in field (after filtration)		
	Sediment mercury	SEDH	Index Top	60 mL (majority of top slice)	Screw top jar (125 mL, plastic)	Wet ice in field		
		SEDG	Index Bottom	20 mL (portion of bottom slice)	Screw top jar (125 mL, plastic)			
Chilled Batch Sample Lab (GLEC – Traverse City, MI)	Algal toxins	MICX	Index	500 mL	HDPE bottle (500 mL, white, wide-mouth)	Wet ice in field	Batch up to 1 week maximum	**Chilled Batched Cooler** with wet ice OVERNIGHT
		MICL	Littoral	500 mL	HDPE bottle (500 mL, white, wide-mouth)			
	Dissolved CO_2 and methane (unacidified)	CARU	Index (selected lakes)	15 mL	Serum bottle (blue tape)	Wet ice in field		
	Dissolved CO_2 and methane (pre-acidified)	CARP	Index (selected lakes)	15 mL	Serum bottle (pink tape)			
	Dissolved Carbon Isotope	ISOT	Index (selected lakes)	10 mL	Bottle (10mL)			
	Phytoplankton	PHYX	Index	1 L	HDPE bottle (1 L, white narrow mouth)	Lugol's added in field		
		PHYL	Littoral	1 L	HDPE bottle (1 L, white, narrow mouth)			
	Sediment dating	SEDD	Index Bottom (natural lakes only)	40 mL	Screw-top jar (60 mL)	Wet ice in field		

	Sediment diatoms	SEDT	Index Top	5 mL	Jar (15 mL)	Wet ice in field		
		SEDB	Index Bottom	5 mL	Jar (15 mL)			
	Triazine screen	TRIA	Index	50 mL	HDPE bottle (60 mL, white, wide-mouth)	Wet ice in field		
Non-Chilled Batch Sample Lab(GLEC – Traverse City, MI)	Benthic invertebrates	BENT	Littoral	All organisms in grabs	HDPE bottle (1 L, white, wide-mouth)	95% ethanol added in field (at least 500 mL per bottle)	Batch up to 2 weeks maximum	**Non-Chilled Batched Cooler** with absorbent material No Ice GROUND
	Zooplankton (coarse – 150 µm)	ZOCN	Index	Vertical tow(s) 5 meter total length	HDPE bottle (125 mL, white, wide-mouth)	95% ethanol added in field		
	Zooplankton (coarse – 50 µm)	ZOFN	Index	Vertical tow(s) 5 meter total length	HDPE bottle (125 mL, white, wide-mouth)			
	Zooplankton (coarse – 243 µm)	ZOCR	Index (2007 resamples only)	Vertical tow from 0.5m to surface	HDPE bottle (125 mL, white, wide-mouth)			
	Zooplankton (coarse – 80 µm)	ZOFR	Index (2007 resamples only)	Vertical tow from 0.5m to surface	HDPE bottle (125 mL, white, wide-mouth)			
WED – Corvallis, OR	Data packet		All completed data forms		Envelope	Checked by crew leader and put in order Copy or scan all forms for your records	Batch up to 2 weeks	Provided envelope

APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Personnel and Base Site Activities (Page 1 of 3)

Evaluation Date: __ / __ / 2 0 1 2

EVALUATORS

Name	Organization	Phone

Site ID: NLA2012-   Lake Name:

Location:

FIELD CREW MEMBERS   Crew ID:

Name	Organization	Phone

OTHER OBSERVERS PRESENT DURING EVALUATION

Name	Organization	Phone

BASE SITE ACTIVITIES

Global Positioning System Receiver	Yes	No	Not Applicable	Flag
Were the batteries checked?	○	○	○	
Was a re-initialization check required?	○	○	○	
Were other tests or checks required as recommended in operating manual?	○	○	○	

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Personnel and Base Site Activities (Page 2 of 3)

Site ID: NLA2012- Date: / / 2 0 1 2

Multi-Probe	Yes	No	Not Applicable	Flag
Was the electrode stored properly?	○	○	○	
Were the meter red lines, zeroes, readings steady?	○	○	○	
Membrane inspection: temperature, DO and pH checks conducted correctly before using?	○	○	○	
Was the DO calibration done at the lake?	○	○	○	
Was the multi-probe calibrated for pH and conductivity (if measured) at the base location or before traveling to the site (whichever is appropriate for the unit)?	○	○	○	
Were pH and conductivity (if measured) checked for performance against a QCCS solution (at the beginning of the week whenever sampling is occurring, as described in the field manual, minimum of 2x, before first and after last lake sampled)?	○	○	○	
Containers/Labels				
Were labels affixed to containers when required?	○	○	○	
Were labels completed where feasible and appropriate (before or after collection) using a permanent marker (pencil for benthos inside jar label) and covered with clear tape?	○	○	○	
Preservatives and Other Solutions				
Were stock preservatives prepared if required (recipes available)?	○	○	○	
Were the benthic invertebrate and zooplankton preservatives ready for transport?	○	○	○	
Was the preservative for phytoplankton ready for transport?	○	○	○	
Was the pH/conductivity quality control check sample solution ready for transport?	○	○	○	
Other Equipment and Supplies				
Was the Equipment Checklist used at the base location?	○	○	○	
Was the Electronic Request Form sent or phoned in to "home base" or directly to the Field Logistics Coordinator?	○	○	○	
Were equipment and supplies clean, in verified working order, and organized for transport?	○	○	○	
Was an electronic data capture device used to collect data? Was it loaded with the NARS App?	○	○	○	
Site Information and Access				
Were individual site packets, including directions to the site and topographic maps, available and organized?	○	○	○	
Was the site access information/permission letter available?	○	○	○	
Was the landowner contacted prior to site visit?	○	○	○	
Were other key contact persons notified (e.g., Regional Coordinator, State or Tribal contacts)?	○	○	○	

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APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Personnel and Base Site Activities (Page 3 of 3)

Site ID: NLA2012- Date: ___ / ___ / 2 0 1 2

Vehicle	Yes	No	Not Applicable	Flag
Were the vehicle lights, turn signals, and brake lights checked?	○	○	○	
Were there any operational problems?	○	○	○	
Were emergency kit-jumper cables, first aid kit, etc. available?	○	○	○	
Was there an extra set of keys for the vehicle available and with a different person?	○	○	○	
Boat				
Was the trailer and hitch inspected prior to departing to the site to ensure that the trailer was securely fastened?	○	○	○	
Were the electronic connection and brake lights for the trailer checked?	○	○	○	
Was the boat(s) in good working order and inspected before departure?	○	○	○	
Was there any additional emergency equipment (e.g., shovel, fire extinguisher, etc.)?	○	○	○	
Were PFDs available for all passengers?	○	○	○	
Conductivity (OPTIONAL)				
Was the QC check conducted correctly before field measurement, using a DI water rinse, rinse bottle, and test bottle of QC solution?	○	○	○	
Was the measured conductivity of QCC solution recorded?	○	○	○	
Does the crew understand what to do in case of an unacceptable QC check?	○	○	○	
Was the temperature of the solution recorded (if meter does not provide temperature-corrected values)?	○	○	○	
Was the QC solution recently replaced? (2-3 weeks)?	○	○	○	
Was the conductivity measurement made at a representative location within the stream (near X-site, flowing water, mid-depth, etc.)?	○	○	○	
Was a measured conductivity value recorded correctly on the field form?	○	○	○	
Were the meter and probe stored correctly after use?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Lake Verification

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

Lake Verification at the Launch Site	Yes	No	Not Applicable	Flag
Was the site information sheet available for the lake?	○	○	○	
Were the lake coordinates recorded on the verification form?	○	○	○	
Was a detailed description of the final part of the route to the lake recorded?	○	○	○	
Was the lake classified correctly (e.g., target vs. non-target vs. inaccessible)?	○	○	○	
Was the Verification Form completed for sites not visited and for sites visited but not sampled?	○	○	○	
Was a site map printed for use at the lake?	○	○	○	
Were the shoreline station locations and launch site location marked on the site map?	○	○	○	

Lake Verification at the Index Site Location	Yes	No	Not Applicable	Flag
Was the lake verified via GPS coordinates or map information and recorded on the verification form?	○	○	○	
Was the lake evaluated to see if it meets study requirements (e.g., > 1 m deep)?	○	○	○	
Was the index location determined using sonar or bathymetric map?	○	○	○	
Were the GPS coordinates of index location recorded on the form?	○	○	○	
Were photographs of the site taken (if appropriate)?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Index Site Sampling (Page 1 of 4)

Site ID: NLA2012-   Date: __ / __ / 2 0 1 2

Temperature, Dissolved Oxygen, and pH	Yes	No	Not Applicable	Flag
Was the depth measured at the index location, and the intervals calculated before probe was placed in the water?	○	○	○	
Were the site conditions properly recorded?	○	○	○	
Was the probe calibrated during the initial site activities?	○	○	○	
Was an operation manual available for the meter?	○	○	○	
Were the measurements at each depth interval conducted and recorded according to the protocol on the Index Profile Form?	○	○	○	
Did the probe touch the bottom of the lake?	○	○	○	
Was a duplicate reading taken at the surface after the profile was completed?	○	○	○	
Was the probe stored correctly after the measurement?	○	○	○	
Were the top and bottom of the metalimnion marked on the form where the water temperature changes 1 degree per meter?	○	○	○	
Secchi Disk Transparency				
Was the Secchi disk being used a black and white patterned disk?	○	○	○	
Was the calibrated line visibly marked in half meter intervals?	○	○	○	
Was the measurement taken from the shady side of the boat?	○	○	○	
Was the recorder wearing sunglasses or a hat?	○	○	○	
Was a viewscope used?	○	○	○	
Water Sample Collection and Preservation				
Were gloves worn?	○	○	○	
Was the integrated sampler rinsed three times at the index point?	○	○	○	
Was the euphotic zone correctly defined by the crew based on Secchi depth measurements?	○	○	○	
If the euphotic zone < 2 m, was the sample collected from within the euphotic zone only?	○	○	○	
Were labels for all containers securely attached and covered with clear tape?	○	○	○	
Was the lake ID correctly labeled on each container?	○	○	○	
Was the Cubitainer® expanded by water pressure, not by inflating or pulling apart sides?	○	○	○	
Were fingers kept away from the inner surface of the cap and container opening during sample collection?	○	○	○	

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Index Site Sampling (Page 2 of 4)

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

Water Sample Collection and Preservation (continued)	Yes	No	Not Applicable	Flag
Was the first Cubitainer® mixed thoroughly before pouring off into the 2 L bottle for chlorophyll-a filtration, 1 L bottle for phytoplankton, 500 mL bottle for algal toxins (microcystin), 60 mL for triazine, and 250 mL for nutrients samples?				
Are the sample jars clearly labeled for each indicator?				
Were approximately 5-10mL of Lugol's added to the 1 L bottle for phytoplankton preservation?				
Was the sample a "weak-tea" color?				
Were all bottles placed in a cooler on ice until the site work was complete?				
Zooplankton Sample Collection				
Were the mesh sizes clearly marked on the zooplankton nets and buckets?				
Were the nets inspected before use for holes or tears?				
Were the nets each attached to a line visibly marked every 1 m?				
Was the net carefully lowered through the water in an upright position?				
If the lake is < 2m deep and the Secchi disk was visible at the bottom of the lake, was a second tow conducted?				
Was the net pulled to the surface at a steady, constant rate (about 1 ft or 0.3 m/second)?				
At the surface, was the net dipped into the water to rinse organisms to the cod end?				
Was the outside of the net carefully rinsed at the surface with a squirt bottle or similar tool?				
Was the second net towed from the other side of the boat or the opposite end?				
Was the lake ID pre-recorded on the sample label?				
Was the mesh size used on the jar?				
Were the samples collected from each net mesh size treated as two, unique samples (different sample ID numbers)?				
Were the samples narcotized?				
If the volume of zooplankton in the bucket exceeded 60 mL, was a second jar used?				
If so, were the jars labeled properly? (i.e., Extra jar, and 2 of 2 added)				
Was approximately 65 mL of ethanol added to the jar?				
Was the length of the tow recorded on the sample collection form?				
Was the lid wrapped in electrical tape?				
Was this procedure followed separately for each net?				
Was the Index Sample Collection Form completed correctly for zooplankton? Does the information on the form match the information on the label for each sample?				

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Index Site Sampling (Page 3 of 4)

Site ID: NLA2012-   Date: ___ / ___ / 2 0 1 2

Sediment Diatom and Mercury Sample Collection	Yes	No	Not Applicable	Flag
Were the containers properly labeled for top, bottom, and sediment cores?	○	○	○	
Was the corer cleaned from the last site visit after arrival to this lake site?	○	○	○	
Were gloves (powder-less) worn throughout this procedure?	○	○	○	
Was the core taken from an area of undisturbed sediments?	○	○	○	
Was the core 45 cm in length?	○	○	○	
Was the water-sediment interface maintained while placing the stopper in the bottom of the corer?	○	○	○	
Was the corer kept in a vertical position while the slices were extracted?	○	○	○	
Was the total length of the core measured to the nearest 0.1 cm?	○	○	○	
Was the water at the top of the core carefully removed with a siphoning tube, so the top sediments were not disturbed?	○	○	○	
Was the crew careful to ensure that the sampling kit did not come in contact with anything other than the sediment sample?	○	○	○	
Were the samples split into mercury and diatom samples?	○	○	○	
Was the sediment sample placed immediately on ice?	○	○	○	
Was the top 2 cm of the core transferred to the mercury sample container labeled "TOP?"	○	○	○	
For natural lakes, was the sectioning apparatus rinsed before the bottom slice was extracted?	○	○	○	
For natural lakes, was the sediment extruded until the bottom of the stopper was 7 cm from the top of the coring tube? Was the tube marked at 7 cm?	○	○	○	
For natural lakes, were the next 2 cm extruded and discarded?	○	○	○	
For natural lakes, were the next 2 cm extruded and kept as the "BOTTOM" slice?	○	○	○	
Was this interval correctly recorded on the Index Sample Collection Form?	○	○	○	
Were the labels secured with clear plastic tape?	○	○	○	
Was the corer cleaned and rinsed with lake water after all samples were collected?	○	○	○	

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Index Site Sampling (Page 4 of 4)

Site ID: NLA2012-   Date: ___ / ___ / 2 0 1 2

Dissolved Carbon Sample Collection (not all lakes)	Yes	No	Not Applicable	Flag
Were syringes used?	○	○	○	
Was sample taken under water?	○	○	○	
Were air bubbles removed from syringe?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Physical Habitat Evaluation (Page 1 of 3)

Site ID: NLA2012-　　Date: ___ / ___ / 2 0 1 2

Bank Features	Yes	No	Not Applicable	Flag
Was the bank angle correctly interpreted and recorded?	○	○	○	
Was the high water mark correctly identified?	○	○	○	
Were the horizontal and vertical distances from the current waterline correctly estimated or measured and recorded (in meters)?	○	○	○	
Site Selection and Location				
Were physical habitat sites selected randomly and distributed evenly around the lake perimeter?	○	○	○	
Were physical habitat sites located accurately (using GPS, lake outline, or topography) and the plots properly lain out?	○	○	○	
Were physical habitat sites adjusted reasonably and only when necessary?	○	○	○	
Was the site map marked appropriately for the adjusted stations?	○	○	○	
Was an observation vantage point established at 10 m off the shore and on centerline of the plot?	○	○	○	
Was the water depth at 10 m off shore measured with a sounding or sonar and recorded accurately (including units)?	○	○	○	
Bottom Substrates				
Were bottom substrates visually observed or probed with a sounding pole throughout littoral plot and the 1 meter shoreline zone?	○	○	○	
Were the categories of bottom substrates interpreted correctly?	○	○	○	
Did the categorical levels of bottom substrates potentially add up to 100%?	○	○	○	
Aquatic Macrophytes				
Were aquatic macrophytes correctly categorized and characterized?	○	○	○	
Was the total macrophyte coverage consistent with coverage in the individual categories?	○	○	○	
Fish Cover				
Were the elements of fish cover properly identified and quantified?	○	○	○	
Canopy, Understory, and Ground Cover Vegetation				
Were the canopy, understory, and ground cover correctly and completely characterized for the riparian and drawdown zone (if present)?	○	○	○	
Were the vegetative types consistent with coverage categories?	○	○	○	
Human Influence				
Were the human influences properly identified within or near the plot for the riparian and drawdown zones (if present)?	○	○	○	

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Physical Habitat Evaluation (Page 2 of 3)

Site ID: NLA2012- Date: / / 2 0 1 2

Whole PHab Form	Yes	No	Not Applicable	Flag
Were the site and date information complete?	○	○	○	
Was one habitat form completed per station (additional forms included for new sites, e.g., islands)?	○	○	○	
Were data flags used appropriately and explained adequately throughout the form?	○	○	○	
Was the form reviewed and initialed?	○	○	○	
Were the comments legible?	○	○	○	
Benthic Macroinvertebrate Sample Collection				
After locating the sample site, was the dominant habitat type identified within the plot?	○	○	○	
Was a D-frame dip net (equipped with 500 µm mesh) used to sweep through 1 linear meter of the dominant habitat type at a single location within the 10 m x 15 m littoral zone sampling area, making sure to disturb the substrate enough to dislodge organisms?	○	○	○	
If the dominant habitat is rocky/cobble/large woody debris, did the crew member conducting the sampling exit the boat and disturb the substrate (e.g., overturn rocks, logs) using his/her feet while sweeping the net through the disturbed area?	○	○	○	
After completing the 1-meter sweep, were organisms and debris removed from net and placed in a bucket?	○	○	○	
Were the organisms and detritus collected at each station on the lake combined in a single bucket to create a single composite sample for the lake?	○	○	○	
Invasive Plants & Invertebrates Species				
Were the species correctly marked or "none observed" marked?	○	○	○	
Littoral Sample Collection (J Site)				
Was this the first thing done at the J site? (before any other sample collection)	○	○	○	
Was the chlorophyll A (littoral) bottle rinsed 3 times before being filled?	○	○	○	
Was the sample bottle inverted to 0.3 m below the surface before being filled?	○	○	○	
Was the first grab shaken and used to fill the phytoplankton and algal toxins containers?	○	○	○	
Was a second grab taken for the chlorophyll A filtration?	○	○	○	
Were all samples placed on ice in the cooler?	○	○	○	

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Physical Habitat Evaluation (Page 3 of 3)

Site ID: NLA2012- Date: / / 2 0 1 2

Macrophyte Assemblage Characterization	Yes	No	Not Applicable	Flag
Were 6 points sampled along each transect?	○	○	○	
Were 5 transects sampled, density classified, and growth form categorized?	○	○	○	
Were 5 MDC's taken to establish the MDC for the lake?	○	○	○	

Flag	Comments

04/11/2012 NLA 2012 AV: Physical Habitat Evaluation Page 3 of 3 1740130174

2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Final Lake Activities (Page 1 of 5)

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

General Lake Assessment	Yes	No	Not Applicable	Flag
Were any of the sources of potential stressors recorded that were observed while on the lake, while driving or walking through the lake catchment, or while flying over the lake and catchment?	○	○	○	
For activities and stressors that the crew observed, was their abundance or influence listed as low (L), moderate (M), or heavy (H) rated on the line next to the listed disturbance?	○	○	○	
Was the box on the assessment forms checked to denote blanks as zeros?	○	○	○	
Was the section "Lake Site Activities and Disturbances Observed" completed including residential, recreational, agricultural, industrial, and lake management categories?	○	○	○	
Were observations regarding the general characteristics of the lake recorded?	○	○	○	
Was the hydrologic lake type recorded?	○	○	○	
Were flight hazards noted that might interfere with either low-altitude fly-overs by aircraft (for future aerial photography or videography) or landing on the lake for sampling purposes (either by float plane or helicopter)?	○	○	○	
When estimating the intensity of motor boat usage, in addition to the actual number of boats observed on the lake during the visit, were other observations such as the presence of boat houses, docks, and idle craft recorded?	○	○	○	
Were all six characteristics estimated and the section "General Lake Information" completed?	○	○	○	
When the extent of major vegetation types was estimated, was the assessment limited to the immediate lake shoreline (i.e., within 20 m of the water)?	○	○	○	
Was the percentage of the immediate shoreline that has been developed or modified by humans estimated?	○	○	○	
Were all eight shoreline categories completed and the section "Shoreline Characteristics" estimated?	○	○	○	
Was the areal percentage of macrophyte coverage for the three categories estimated and the section "Qualitative Macrophyte Survey" completed?	○	○	○	
Was the waterbody character rated?	○	○	○	
Was the waterbody character defined using degree of human development and aesthetics attributes?	○	○	○	
Were the three ecological values (i.e., trophic state, ecological integrity, and recreation) assessed?	○	○	○	
For ecological values, was the overall impression of the "health" of the biota in the lake recorded and any possible causes of impairment noted?	○	○	○	
For trophic status, was a visual impression of the trophic status including overall impression of algal abundance and general type provided?	○	○	○	
For trophic status, were any observed potential nutrient sources to the lake listed?	○	○	○	
For recreation, was the overall impression of the lake as a site for recreation recorded?	○	○	○	
For recreation, were possible causes of impairment, or the presence or absence of people using the lake for recreational activities recorded?	○	○	○	
Was the comments section used on the Lake Assessment Form to note any other pertinent information about the lake or its catchment?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Final Lake Activities (Page 2 of 5)

Site ID: NLA2012- Date: / / 2 0 1 2

Processing the Chlorophyll-a Sample	Yes	No	Not Applicable	Flag
Were surgical gloves worn?	○	○	○	
Was a glass fiber filter placed in the graduated filter holder apparatus?	○	○	○	
Was the filter handled with forceps?	○	○	○	
Were 250 mL of water poured into the filter holder, the cap replaced, and the sample pumped through the filter?	○	○	○	
If 250 mL of lake water did not pass through the filter, was the filter changed, the apparatus rinsed with DI water, and the procedures repeated using 100 mL of lake water?	○	○	○	
Was the upper portion of the filtration apparatus rinsed thoroughly with DI water to include any remaining cells adhering to the sides and pumped through the filter?	○	○	○	
Was the level of water monitored in the lower chamber to ensure that it did not contact the filter or flow into the pump?	○	○	○	
Was the filter observed for visible color?	○	○	○	
If there was not, did the process proceed until color was visible on the filter or until a maximum of 2,000 mL were filtered?	○	○	○	
Was the actual sample volume filtered recorded on the Index and Littoral Sample Collection Forms and on the sample label?	○	○	○	
Was the bottom portion of the apparatus removed and the water poured off from the bottom?	○	○	○	
Was the filter removed from the holder with clean forceps?	○	○	○	
Was the filter folded in half, with the colored side folded inward?	○	○	○	
Was the folded filter placed into a 50 mL screw-top centrifuge tube and capped?	○	○	○	
Was the sample volume filtered, recorded on a chlorophyll label, and attached to the centrifuge tube?	○	○	○	
Was all written information complete and legible?	○	○	○	
Was the label covered with a strip of clear tape?	○	○	○	
Does the "total volume of water filtered" on the Index and Littoral Sample Collection Forms match the total volume recorded on the sample label?	○	○	○	
Was the tube wrapped in aluminum foil and placed in a self-sealing plastic bag?	○	○	○	
Was this bag placed between two small bags of ice in a cooler?	○	○	○	
Were the filter chambers rinsed with DI water?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Final Lake Activities (Page 3 of 5)

Site ID: NLA2012- Date: / / 2 0 1 2

Data Forms and Sample Inspection	Yes	No	Not Applicable	Flag
After the Assessment Form was completed, did the Field Crew Leader review all of the data forms and sample labels for accuracy, completeness, and legibility?	○	○	○	
Did the other crew member inspect all sample containers and packages in preparation for transport, storage, or shipment?	○	○	○	
Did the crew ensure that all required data forms for the lake were completed?	○	○	○	
Was it confirmed that the Site ID and date of visit are correct on all forms?	○	○	○	
On each form, was it verified that all information was recorded accurately, the recorded information was legible, and any flags were explained in the comments section?	○	○	○	
Was it ensured that written comments are legible, with no "shorthand" or abbreviations?	○	○	○	
After reviewing each form, was the upper right corner of each page of the form initialed?	○	○	○	
Were sample labels checked for completeness, correctness, and covered with clear plastic tape?	○	○	○	
Were all sample containers checked to ensure that they were properly sealed?	○	○	○	
Will the coolers be shipped with fresh bags of ice in cooler; ice bags labeled as "ICE"?	○	○	○	
Will the coolers be shipped by overnight courier ASAP after collection (generally the next day)?	○	○	○	
If samples will be held after collection, will they be kept cold and in darkness?	○	○	○	
Were the zooplankton nets and buckets rinsed at least three times with the DI water?	○	○	○	
Launch Site Cleanup				
Were the boat, motor, and trailer inspected for evidence of weeds and other macrophytes?	○	○	○	
Were the boat, motor, and trailer cleaned as completely as possible before leaving the launch site?	○	○	○	
Were all nets inspected for pieces of macrophyte or other organisms and as much as possible was removed before packing the nets for transport?	○	○	○	
Were all equipment and supplies packed in the vehicle and trailer for transport and kept as organized as presented in the equipment checklists?	○	○	○	
Was all waste material at the launch site cleaned up and disposed of or transported it out of the site if a trash can is not available?	○	○	○	
Miscellaneous				
Do the crew members know the NARS IM contact information?	○	○	○	
Do the crew members have suggestions/problems concerning the sampling procedures, forms, lodging, logistics, etc.?	○	○	○	

Flag	Comments

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Final Lake Activities (Page 4 of 5)

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

Areas of Strength

Areas of Concern

Was the crew debriefed on the results of the evaluation by the evaluator?	Yes ◯	No ◯

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2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist
Final Lake Activities (Page 5 of 5)

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

Comments of Team Being Evaluated

Signatures:

Evaluator / DATE	Field Crew Leader / DATE
Printed Name	Printed Name
Field Crew Member / DATE	Field Crew Member / DATE
Printed Name	Printed Name
Field Crew Member / DATE	Field Crew Member / DATE
Printed Name	Printed Name
Field Crew Member / DATE	Field Crew Member / DATE
Printed Name	Printed Name
Field Crew Member / DATE	Field Crew Member / DATE
Printed Name	Printed Name

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APPENDIX F: INVASIVE PLANTS AND INVERTEBRATES

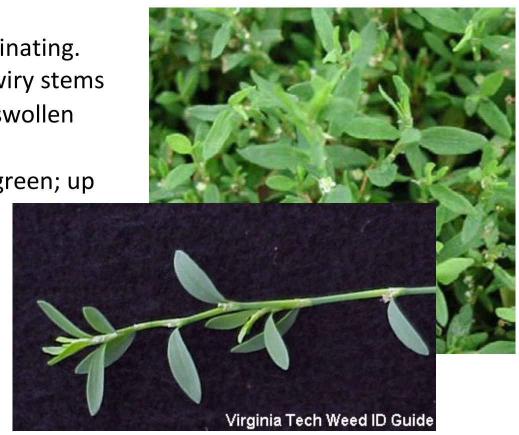
Common name	Scientific Name
curlyleaf pondweed	*Potamogeton crispus* L.
common reed	*Phragmites australis* (Cav.) Trin. ex Steud.
Eurasian watermilfoil	*Myriophyllum spicatum* Linnaeus
purple loosestrife	*Lythrum salicaria* L.
Russian-olive	*Elaeagnus angustifolia* L.
reed canarygrass	*Phalaris arundinacea* L.
Canada thistle	*Cirsium arvense* (L.) Scop.
multiflora rose	*Rosa multiflora* Thunb. ex Murr.
narrowleaf cattail	*Typha angustifolia* L.
Brazilian waterweed	*Egeria densa* Planch.
brittleleaf naiad	*Najas minor* All.
parrot feather milfoil	*Myriophyllum aquaticum* (Vell.) Verdc.
mimosa	*Albizia julibrissin* Durazz.
hydrilla	*Hydrilla verticillata* (L. f.) Royle
water starwort	*Myosoton aquaticum* (L.) Moench
water hyacinth	*Eichhornia crassipes* (Mart.) Solms
yellow floatingheart	*Nymphoides peltata* (Gmel.) Kuntze
European pepperwort	*Marsilea quadrifolia* L.
alligatorweed	*Alternanthera philoxeroides* (Mart.) Griseb.
European waterstarwort	*Callitriche stagnalis* Scop.
giant salvinia	*Salvinia molesta* D. S. Mitchell
water fern	*Salvinia minima* Baker
water-chestnut (European)	*Trapa natans* L.
tamarisk	*Tamarix* spp. L.
deeprooted sedge	*Cyperus entrerianus* Boeckl.
Japanese or giant knotweed	*Fallopia japonica* or *F. sachalinensis*
miramar weed	*Hygrophila polysperma* (Roxb.) T. Anders.
Brazilian peppertree	*Schinus terebinthifolius* Raddi
zebra or quagga mussel	*Dreissena polymorpha* or *D. rostriformis bugensis*
Asian clam	*Corbicula fluminea*
rusty crayfish	*Orconectes rusticus*

SHORELINE/RIPARIAN SPECIES

Purple loosestrife (*Lythrum salicaria* L.)

- Square, woody stem and opposite or whorled leaves. Leaves are lance-shaped, stalkless, and heart-shaped or rounded at the base.
- Plants are usually covered by a downy pubescence.
- Loosestrife plants grow 4-10 feet high and produce a showy display of magenta-colored flower spikes throughout much of the summer.
- Flowers have five to seven petals.
- Invades many wetland types, including freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches.

Knotweed (*Polygonum aviculare*)



- Resembles a grass with long, dark green leaves when germinating. Later forms a flat mat up to 2 feet in diameter on slender wiry stems
- Papery sheath at each node that gives stems a knotted or swollen appearance.
- The leaves are alternate; small, narrowly oval; dull, bluish green; up to 1¼ inches long and 1/3 inch wide.
- Flowers are small, borne in clusters in leaf axils. The buds are purplish opening to white to yellow flowers during June through October. Germinates in early spring; grows through autumn.

Flowering rush (*Butomus umbellatus*)

- Flowers grow in umbrella shaped clusters; each individual flower has 3 whitish pink petals.
- Produce flowers in very shallow water or on dry sites.
- Green stems that resemble bulrushes but are triangular in cross section.
- Erect leaves; leaf tips may be spirally twisted.
- Grows to about 3 feet in height.

Common reed (*Phragmites australis)*

- **Appearance:** Common reed is a tall, perennial grass that can grow to heights of 15 ft. (4.6 m) or more. Broad, pointed leaves arise from thick, vertical stalks.
- **Foliage:** Leaves are 6-23.6 in. (15-60 cm) long, 0.4-2.4 in. (1-6 cm) wide, flat and glabrous.
- **Flowers:** The flower heads are dense, fluffy, gray or purple in color and 5.9-15.7 in. (15-40 cm) long.
- Flowering occurs from July to October.
- **Fruit:** The seeds are brown, light weight, and about 0.3 in. (8 mm) long.

Russian olive (Elaeagnus angustifolia L.)

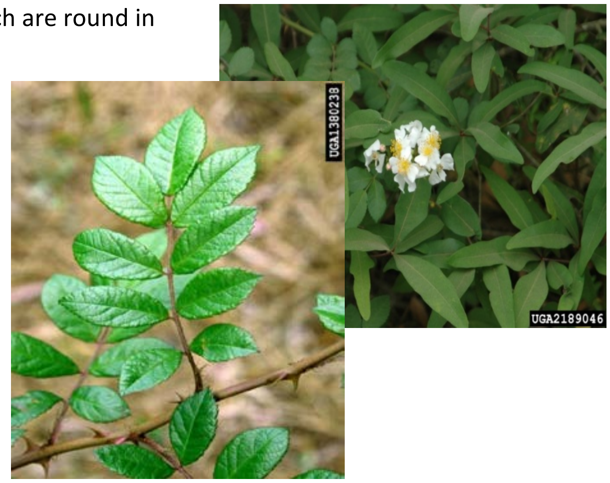
- Russian-olive is a small, usually thorny shrub or small tree that can grow to 30 feet in height.
- Stems, buds, and leaves have a dense covering of silvery to rusty scales.
- Leaves are egg or lance-shaped, smooth margined, and alternate along the stem.
- Highly aromatic, creamy yellow flowers appear in June/July and later replaced by clusters of abundant silvery fruits.

Reed canary grass (*Phalaris arundinacea*)

- Appearance: Reed canary grass is a cool-season perennial grass that grows to 6 ft. (1.7 m) tall. Reed
- Canary grass is variable in morphology, so characteristics may depend upon the habitat.
- Foliage: Leaf blades are flat, 1-4 ft. (0.3-1.2 m) long, up to 0.75 in. (1.9 cm) wide, glabrous and taper gradually.
- Flowers: The spreading flower/seed heads arise from hairless stems and can be green, purple, or brown in color and usually 3-6 in. (7.6-15.2 cm) in length. Flowering occurs from May to July.
- Fruit: The inflorescence color changes from green to purplish to tan as the seeds mature.

Multiflora rose (Rosa multiflora)

- **Appearance:** Multiflora rose is a multi-stemmed, thorny, perennial shrub that grows up to 15 ft. (4.6 m) tall. The stems are green to red arching canes which are round in cross section and have stiff, curved thorns.
- **Foliage:** Leaves are pinnately compound with 7-9 leaflets. Leaflets are oblong, 1-1.5 in. (2.5-3.8 cm) long and have serrated edges. The fringed petioles of multiflora rose usually distinguish it from most other rose species.
- **Flowers:** Small, white to pinkish, 5-petaled flowers occur abundantly in clusters on the plant in the spring.
- **Fruit:** Fruit are small, red rose hips that remain on the plant throughout the winter.



Canada thistle (*Cirsium arvense* L.)

- Canada thistle is an herbaceous perennial with erect stems 1½-4 feet tall, prickly leaves and an extensive creeping rootstock.
- Stems are branched, often slightly hairy, and ridged. Leaves are simple, lance-shaped, irregularly lobed with spiny, toothed margins and are borne singly and alternately along the stem.
- Fragrant, rose-purple to lavender, or sometimes white flower heads appear from June through October, and occur in rounded, umbrella-shaped clusters.

Mimosa (*Albizia julibrissin)*

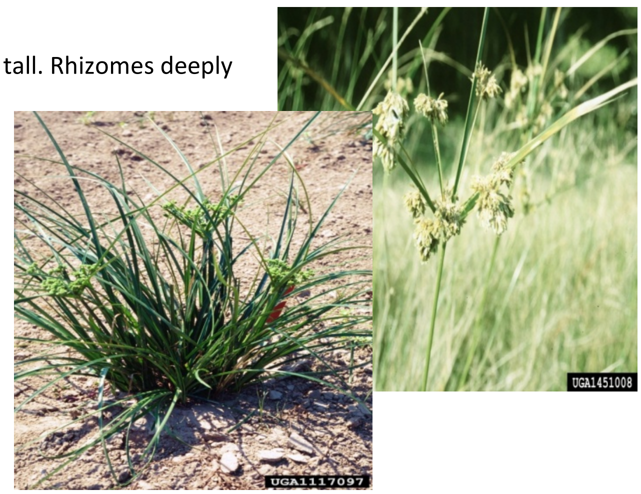
- **Appearance:** Mimosa is a small tree that grows from 10 to 50 ft. (3-15.2 m) in height. It often has multiple trunks.
- **Foliage:** It has delicate-looking, bi-pinnately compound leaves that resemble ferns. Leaves close in the evening (nyctinastic movement).
- **Flowers:** Flowering occurs in early summer, when very showy, fragrant, pink flowers develop in groups at the ends of the branches. The flowers are sometimes called powder puffs.
- **Fruit:** Fruit are flat, 6 in. (15.2 cm) long seed pods that develop in the late summer.

Tamarisk or Salt Cedar (*Tamarix ramosissima*)

- Most saltcedars, or tamarisks, are deciduous shrubs or small trees growing to 12-15 feet in height and forming dense thickets.
- Saltcedars are characterized by slender branches and gray-green foliage. The bark of young branches is smooth and reddish-brown. As the plants age, the bark becomes brownish-purple, ridged and furrowed.
- Leaves are scale-like, about 1/16 inch long and overlap each other along the stem. They are often encrusted with salt secretions.
- Pink to white flowers appear in dense masses on 2-inch long spikes at branch tips from March to September.

Deeprooted Sedge (*Cyperus entrerianus)*

- A robust grass-like plant that grows up to 40" tall. Rhizomes deeply set, thick.ark purple to black leaf bases.
- Leaves basal, glossy, and flat or Vshaped.
- Leaf bases dark purple to black.
- Inflorescence terminal, with 5-11 elongate rays, ending in densely clustered spikelets.



LITTORAL SPECIES

Curly pondweed (*Potamogeton crispus* L.)

- Plants may grow up to 2 meters long. Very abundant from April to June.
- Leaves are 3 cm to 10 cm long, broad, linear and finely toothed, with undulated (curly) margins.
- Leaves are dark green with a reddish hue and have small teeth along the margins. Arranged alternately or slightly opposite on flattened, branched stems.
- Flowering occurs late spring-early summer; Plants begin to die-off in midsummer after vegetative buds are produced.

Zebra Mussel (*Dreissena polymorpha*)

- < 50 mm
- Color patterns vary; may be striped or have dark or light colored shells and no stripes
- Typically found attached to objects, surfaces, or each other by threads underneath the shells
- Forms dense mats that clog industrial water intakes and discharge pipes

Eurasian watermilfoil (*Myriophyllum spicatum* L.)

- Stems grow to the water surface, usually extending 3 - 10, but as much as 33, feet in length. Frequently forms dense mats.
- Long, slender, branching, hairless stems become leafless toward the base. Feathery appearance
- New plants may emerge from each node (joint) on a stem, and root upon contact with mud.
- Grayish-green leaves, finely divided, occur in whorls of 3-4 along stem, with 12-16 pairs of

  fine, thin leaflets about 12 inches long
- Small yellow, 4-parted flowers on a spike that projects 2-4 inches above the water surface.

Hydrilla (*Hydrilla verticillata*)

- Forms dense colonies and can grow to the surface in water over 20 feet deep.
- Branches profusely; extends across surface forming thick mats.
- Leaves are blade-like about 1/8- 3/8 inch long with small tooth margins and spines on the underside of the midrib which make them feel rough.
- Leaves are usually 4 to 8 in a whorl.

Brazilian Waterweed (*Egeria densa* Planch)

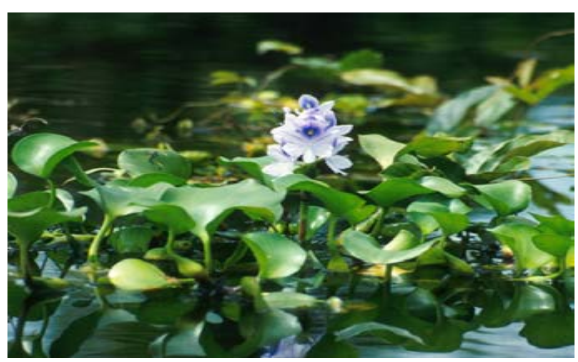
- Stems are elongate, slender, 2-3 mm thick, single or sparingly branched
- Leaves mostly in whorls of 4 at sterile nodes
- Leaves are nearly linear, very finely toothed on the margins, 1.4-2.5 cm long, 1.6-5.0 mm wide
- Flowers are 1.2-1.8 cm wide, unisexual Plants grow submersed, rooted in the substrate.
- Found in streams, ponds, lakes, and constructed lagoons (both still and flowing water)

European water chestnut (*Trapa natans L*)

- Upper floating leaves are diamond-shaped with toothed edges
- Leaves occur in clusters up to 20 inches across. Leafy stalks are inflated, spongy, up to 3 inches long
- 1/3 inch long flowers, solitary, white to light purple. Black, 4-horned, nut-like fruit is 1 inch wide and develops under water
- Found on quiet waters, forms extensive floating mats on water surface

Water Hyacinth (*Eichhornia crassipes*)

- Usually floats free in large masses but may be rooted in the mud.
- The plants may range from a few inches to as much as 3 feet in height.
- The leaves are 10-20 cm across, supported above the water surface by long, spongy and bulbous stalks
- They have slender rootstocks with rosettes of leaves and dark, fibrous, branching roots dangling beneath the plant. Flowers may be blue, violet, or white and are usually quite showy.



Parrotfeather (*Myriophyllum aquaticum*)

- Rooted, submerged (growing below the water) plants
- Bright green, stiff, feather-like foliage ("fir-tree-like") that can extend up to 1 foot above water's surface.
- Alternate or whorled leaves finely divided into many threadlike leaflets.
- Stem is stout and sparingly branched
- White flowers

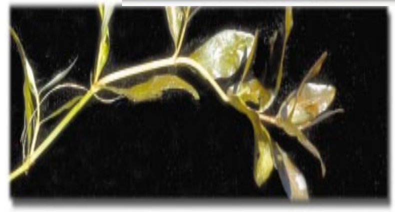
Yellow floating heart (*Nymphoides peltata*)

- Perennial, water lily-like plant that carpets the water surface with long-stalked, heart-shaped leaves.
- Showy five-petaled yellow flowers occur on long stalks and rise a few inches above water surface.
- Leaves average 3 to10 cm in diameter
- The fruit capsule is 2.5 cm long and contains numerous seeds. The seeds are oval and flat (about 3.5 mm long) and hairy along their outer edges.

Giant salvinia (*Salvinia molesta*)

- Small free-floating plant that grows in clusters and develops into dense, floating mats or colonies in quiet water.
- The floating leaves are oblong (0.5 to 1.5 inches long) with a distinct midrib along which the leaf may fold forming a compressed chain-like appearance.
- Upper surfaces of green leaves are covered with rows of white, bristly hairs.
- Leaf hairs have a single stalk that divides into four branches that reconnect at the tip, giving the hair a cage-like or egg-beater appearance.
- Underwater the leaves are modified into small root-like structures. The entire plant is only about 1 to 2 inch in depth.

Miramar weed (Hygrophila polysperma)



- Perennial aquatic herb with squarish stems ascending to creeping, mostly submersed, usually rooted in substrate; also roots freely at floating nodes.
- Leaves opposite, to 8 cm (3 in) long (aerial leaves smaller) and to 2 cm (0.8 in) wide, usually broader toward tip; sessile, with bases joined at node by ciliated flanges of tissue, the cilia (hairs) easily observed, to 1.5 mm long.
- Flowers small, solitary in uppermost leaf axils, nearly hidden by leaves, calyx 5-lobed, corolla bluish white, 2-lipped; 2 fertile stamens. Fruit a narrow capsule, splitting lengthwise to release tiny round seeds.
- **NOTE**: May be confused with small, opposite-leaved natives sometimes found submersed, such as *Ludwigia repens* and *Diodia* spp., but these without flanges at nodes (*Ludwigia)* or with flat-bristled flanges (*Diodia).* The native marsh species, *Hygrophila lacustris* (Schlecht. & Cham.) Nees is larger (aerial leaves to 15 cm long) and erect in habit, with larger flower s in axillary clusters along upper stems.

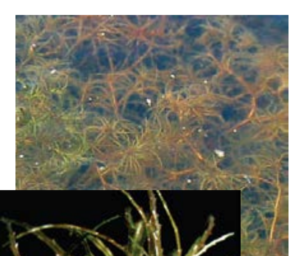
Narrowleaf cattail (*Typha angustifolia* L.)

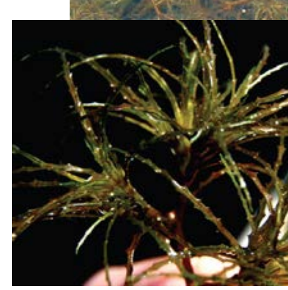
- Similar to broad-leaved cattail (*T. latifolia*) except that the staminate and pistillate portions of the spike are separated by 2 cm. or more of bare stem, the leaves are deep green and, overall, the plant is less robust. Also, the leaves typically extend beyond the spike. *T. angustifolia* generally occurs in deeper water than *T. latifolia*.
- T. angustifolia has long, slender, green stalks topped with brown, fluffy, sausage-shaped flowering heads.
- The spike is medium to dark brown.
- The basal leaves are thin with parallel veins running their long, narrow length. The leaves are 4-12 mm wide when fresh, 3-8 mm wide when dry.



Typha angustifolia *Typha latifolia* *Typha angustifolia*

Spiny naiad (*Najas minor*)





- Spiny naiad is a submersed aquatic plant found in slow-moving streams, ponds and Lakes that also may be referred to as slender, brittle, European or bushy naiad.
- Heavily-branched stems of the plant may reach up to 4 feet in length.
- Leaves are opposite, alternate or whorled around the stem and form “tufts” at the growing tip, giving the plant a bushy appearance. Leaves are thin, strap-shaped, 1-1.5in long, serrated and arch backwards.
- Leaves are stiff and maintain their shape out of the water.
- NOTE: Spiny naiad may be confused with native slender naiad. Serrations (spines) on spiny naiad are visible to the naked eye,

whereas spines on slender naiad are only visible under significant magnification.

Water starwort *(Myosoton aquaticum* L.) Synonyms: giant chickweed or water chickweed

- This adventive perennial plant is 2"-24" tall, branching occasionally. The stems are erect or spreading, and more or less hairy. The opposite leaves are up to 2" long and 1" across.
- Single flowers may develop from the leaf axils of the upper stems, while the remaining flowers occur in small clusters at the end of stems. Each flower is about ½" across when it is fully open, consisting of 5 white petals. Each flower is replaced by a seed capsule that is ovoid.
- The root system is fibrous and produces rhizomes, which enables this plant to form vegetative colonies.

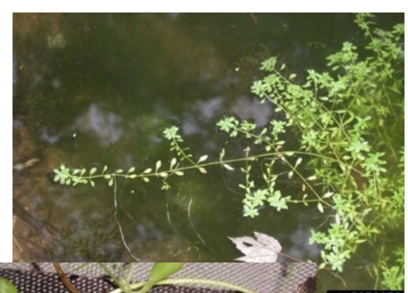
European pepperwort (*Marsilea quadrifolia*)

- Marsilea quadrifolia is a fern growing to 0.2 m. The plant requires moist or wet soil and can **grow in water.**

Alligatorweed (*Alternanthera philoxeroides*)

- Alligatorweed is a perennial, mat-forming member of the Amaranth family
- Stems are distinctly jointed and are hollow except at the nodes. The stems are light green in color with faint darker green parallel lines extending from one node to the base of the next.
- Leaves are oval to lance-shaped, have a prominent midrib, and are arranged opposite along the stem.
- Small, clover-like, white flowers are borne on short stalks attached in the leaf axils near the end of the stems. Flowering occurs from late April through October.

European or Pond waterstarwort (*Callitriche stagnalis*)



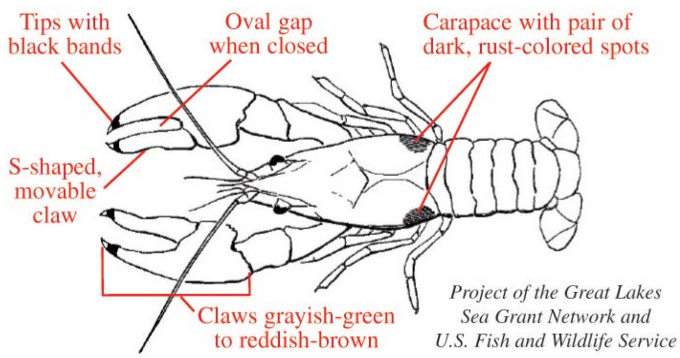
- Slender stems reach to the surface and form floating mats of leaves, which are often round to spoon-shaped but are variable in morphology. Plants are loosely rooted to the bottom with narrow underwater leaves and/or broadened floating leaves arranged in pairs along thin stems.
- Pond water-starwort usually has spoon-shaped floating leaves crowded at the stem-tip, whereas autumnal water-starwort has only narrow, underwater leaves.
- **Leaf:** Opposite. Narrow submersed leaves (up to 10 mm wide) with one rounded leaf tip are sometimes present. Oval or spoon-shaped floating leaves are up to 10 mm wide and are joined by tiny ridges at the base.
- **Stem:** Usually branched, rising to surface or sprawling.
- **Flower:** Tiny flowers lack sepals and petals and are located at the leaf bases on minute stalks. 2-4 tiny whitish bracts emerge from the flower base.

Water fern or Water spangles *(Salvinia minima)*

- Free floating, rootless aquatic fern. Horizontal, branching rhizomes float just below the water surface and produce, at each node, two floating to emergent leaves, and a third, submersed leaf that is dissected into filaments.
- Floating leaves are orbicular to oval in shape, with heart shaped bases and rounded to notched tips. Leaf length ranges from 0.4 to 2.0 cm.
- Smaller, orbicular leaves lie flat on the water surface; larger leaves become elongated and fold upright on the midrib

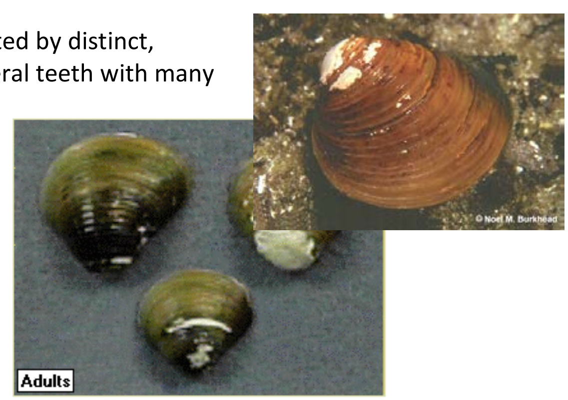
Rusty crayfish (*Orconectes rusticus*)

- Adults generally 3-5 inches (7.5-13 cm) long (nose to tail)
- Claws larger and smoother than other crayfish; usually without wart-like white bumps.
- Claws with oval gap when closed; no distinct thin slit or notch present.



Asian clam (*Corbicula fluminea*)

- Size<50 mm
- A small light-colored bivalve with shell ornamented by distinct, concentric sulcations, anterior and posterior lateral teeth with many fine serrations.
- The shell is ovate and deep at the hinge.
- Dark shell morphs exist but are limited to the southwestern United States.
- The inside of the shell is layered with polished, light purple nacre.



APPENDIX G: QUICK REFERENCE GUIDE

United States Environmental Protection Agency
Office of Water
Office of Environmental Information
Washington, DC

2012 National Lakes Assessment

Quick Reference Guide

KEY TO SECTION COLORS:

A. GENERAL INFORMATION .... YELLOW

B. LAUNCH SITE ACTIVITIES .... PINK

C. INDEX SITE ACTIVITIES .... BLUE

D. LITTORAL AND SHORELINE ACTIVITIES .... GREEN

E. FINAL SITE ACTIVITIES .... ORANGE

TABLE OF CONTENTS

NOTE TO USER: This Quick Reference Guide (QRG) is meant to be used in the field to give NLA 2012 Field Crews a list of the required sampling protocols at each lake. While comprehensive, the steps contained in this QRG are not as detailed as the descriptions found within the NLA 2012 Field Operations Guide (FOM). The user is assumed to have attending Field Training and completely read and understood the FOM before using this QRG at a field site.

A. GENERAL INFORMATION

NLA Contact Information

NLA 2012 Personnel to contact for specific types of questions and support needs

PERSONNEL	CALL
EPA Regional Coordinators	First, to ask any questions about NLA, including questions on field protocols Grant questions Schedule Field Assistance Visit
EPA HQ Project Management Team	Ask questions about site access, site evaluation, and site replacement Ask questions about shipping locations and sample handling procedures Ask questions about Field Methods Ask questions about Survey Design Ask questions about QA procedures Ask questions about Lab Methods If you can't reach Regional, IM or Field Logistics Coordinator If you are unsure who to call
PERSONNEL	**ONLY CALL**
Information Management Coordinator	Order field forms or site kits Submit a status report Notify EPA about change in sampling schedule Ask questions about submitting data packet If EPA Regional Coordinator directs you to them
Contract Logistics Coordinator	Order replacement items for site kits, base kits, or miscellaneous supplies Ask questions about shipping contract, or to order more shipping forms If EPA Coordinator directs you to them If you can't reach an EPA HQ or Regional Coordinator and it is urgent

NLA 2012 Contact information

TITLE	NAME	CONTACT INFORMATION
EPA HQ Project Lead	Amina Pollard, OW	pollard.amina@epa.gov 202-566-2360
EPA HQ Project QA Lead	Sarah Lehmann, OW	lehmann.sarah@epa.gov 202-566-1379
EPA HQ Logistics Lead	Marsha Landis, OW	landis.marsha@epa.gov 202-564-2858
Field Logistics Coordinator	Chris Turner, GLEC Inc.	cturner@glec.com 715-829-3737
Information Management Coordinator	Marlys Cappaert, SRA International Inc.	cappaert.marlys@epa.gov 541-754-4467 541-754-4799 (fax)

Regional EPA Coordinators

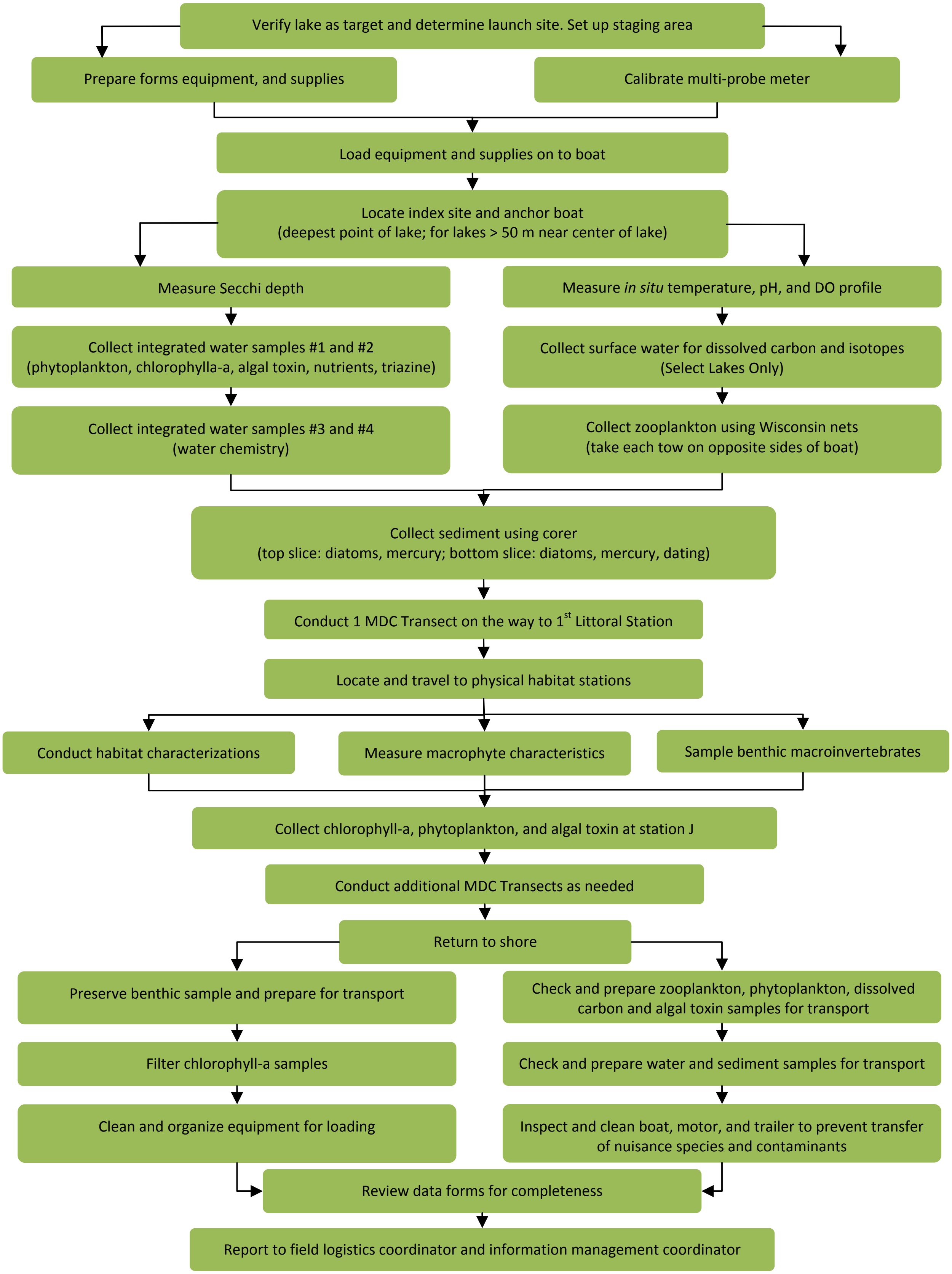
Region 1	Hilary Snook	snook.hilary@epa.gov	617-918-8670
Region 2	Jim Kurtenbach	kurtenbach.james@epa.gov	732-321-6695
Region 3	Frank Borsuk	borsuk.frank@epa.gov	304-234-0241
Region 4	Marion Hopkins	hopkins.marion@epa.gov	404-562-9481
Region 5	Mari Nord	nord.mari@epa.gov	312-886-3017
Region 6	Mike Schaub	schaub.mike@epa.gov	214-665-7314
Region 7	Gary Welker	welker.gary@epa.gov	913-551-7177
Region 8	Kris Jensen Jeff McPherson	jensen.kris@epa.gov mcpherson.jeffrey@epa.gov	303-312-6237 303-312-7752
Region 9	Sue Keydel	keydel.susan@epa.gov	415-972-3106
Region 10	Lil Herger	herger.lillian@epa.gov	206-553-1074

Data Recording Guidelines

Guidelines for recording field measurements and tracking information

ACTIVITY	GUIDELINES
Field Measurements	
Data Recording	Record observations and measurement values only on official NLA paper field forms (water-resistant) or electronic field forms. Use a writing instrument that leaves clear, dark text (e.g. a No. 2 pencil for field forms or a water and smear proof fine-point indelible marker for labels). If you make an error when recording data and changes are required, it is best to cross out the error with a single horizontal line and rewrite the correct information. Use a flag if there isn't enough room in the data field and write the correct information in the comments section. Complete all header information and record all data and sample id information requested on each form. Use the correct Crew ID that was assigned during field training. Use the formats specified. Print legibly (and as large as possible). Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.), but do not use slashes (i.e. lines drawn through the character). Printing in capital letters enhances legibility. For data that is recorded by filling in a data bubble, be certain to keep markings inside the circle while completely filling the bubble. In cases where information is to be recorded repeatedly on a series of lines (e.g., physical habitat characteristics), do not use "ditto marks" (") or a straight vertical line. Record the information that necessary in each area provided. When recording comments, print **legibly**. Make notations in comments field only; avoid marginal notes. Be concise, but avoid using abbreviations or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided. Do not doodle on the forms, including the margins.
Data Qualifiers (Flags)	Use only defined flag codes and record on data form in appropriate field. K = No measurement or observation made. Q = Failed quality control check; re-measurement not possible. U = Suspect measurement; re-measurement not possible. F_n = Miscellaneous flags (n=1, 2, etc.) assigned by a field crew Explain reason for using K or U flags and define F_n flag in the comments section of the data form. Ensure the F_n numbers are unique on the data form and matched to the flag definition. F_n flags and definitions are not linked from one form to the next, so definitions need to be rewritten on each sheet whenever necessary.
Sample Collection	
Sample Labels and Tags	Use a writing instrument that leaves clear, dark text (e.g., a No. 2 pencil or a water and smear proof fine-point indelible marker) to record information on all labels. Use the sample-type appropriate adhesive labels or tags with preprinted Site ID and Sample ID numbers for each sample. Be sure to fill in any requested information about the sample on the sample label or tag, and affix it to the outside of the sample container. Cover completed labels with clear tape. Place a waterproof label inside each benthic macroinvertebrate collection jar with the required information written with a No. 2 lead pencil
Sample Collection Information	Record that each sample has been collected on the appropriate data form. Be sure to record the Sample ID number from labels and tags in the appropriate fields on the data forms using the format requested on each data form.

NLA 2012 Daily operations summary



Base Kit Equipment List
(Reusable sampling equipment provided by EPA)

✓	ITEM	QTY	PROTOCOL
☐	Bottle brush	1	Sediment Core
☐	Centrifuge tube (50 mL, screw top) - extras	2	Chlorophyll-a
☐	Core plug	2	Sediment Core
☐	Corer head (gravity, with cable and messenger)	1	Sediment Core
☐	Coring tube	1	Sediment Core
☐	Electrical tape*	1	General
☐	Filtration chamber (with filter holder)	5	Chlorophyll-a
☐	Filtration flask (with silicone stopper and adapter)	1	Chlorophyll-a
☐	Filter forceps (flat blade)	6	Chlorophyll-a
☐	Foil squares (package)*	1	Chlorophyll-a
☐	Funnel	1	Water samples
☐	Gloves (latex/nitrile, non-powdered, box)	1	General
☐	Graduated cylinder (250 mL)	1	Chlorophyll-a
☐	HDPE bottle (125 mL, white, wide-mouth) – extras	6	Zooplankton
☐	HDPE bottle (1 L, white, wide-mouth) – extras	6	Benthics
☐	H_2SO_4 (ampoules) – extras	5	Nutrients
☐	Integrated sampler device (MPCA design)	1	Water Samples
☐	Kick net (500 µm D-shaped, modified) with 4 foot handle	1	Benthics
☐	Poly syringe (60mL) with attached 3-way stopcock	2	Dissolved Carbon
☐	Lugol's solution (250 mL bottle)	1	Phytoplankton
☐	Meter stick (cm)	1	Secchi
☐	Packing tape (roll)*	1	General
☐	Pail (narcotizing chamber / concentration bucket)	2	Zooplankton
☐	pH paper (box)*	1	Nutrients
☐	Pipette with bulb	2	Phytoplankton
☐	Plankton net (50 µm)	1	Zooplankton
☐	Plankton net (150 µm)	1	Zooplankton
☐	Poly bottle (2 L, brown, labeled INDEX)	1	Chlorophyll-a
☐	Poly bottle (2 L, brown, labeled LITTORAL)	1	Chlorophyll-a, Algal Toxins, Phyto
☐	Rope, 55 meter, for sediment corer in deep lakes	1	Sediment
☐	Scoopula (plastic)	5	Sediment
☐	Secchi disk (20 cm diameter) with weight	1	Secchi
☐	Sieve bucket (500 µm)	1	Benthics
☐	Small tote with lid	1	General
☐	Sounding line (50 m, marked in 0.5 m intervals) with clip	1	Depth, Secchi, Zooplankton
☐	Spatula (2.5 inch, plastic, putty knife)	1	Sediment Core
☐	Spoon (stainless steel)	1	Benthics
☐	Squirt bottle (1 L Nalgene) – for de-ionized (DI)	1	General
☐	Squirt bottle (1 L Nalgene) – for lake water	1	General
☐	Surveyor's tape (50m)	1	Physical Habitat
☐	Syringe (60 mL) with tubing siphon overlying water	1	Sediment Core
☐	Tape strips (3M, pack)*	2	General
☐	Test tube holder	1	Chlorophyll-a
☐	Watchmaker's forceps	1	Benthics
☐	Whatman 0.7 µm GF/F glass fiber filter (box)	1	Chlorophyll-a
☐	Zip top bags (1 gal, box and 1 qt, box)*	1 each	General
☐	Vacuum filtration pump	1	Chlorophyll-a

**Items may need to be replenished by field crews during field season*
† Some items are sent in base kit as extra supplies to be used as needed.

Site Kit Equipment List

(Consumable sampling equipment provided by EPA)

✓	ITEM	QUANTITY	PROTOCOL
☐	Cubitainer® (4L)	1	Water Chemistry
☐	Centrifuge tube (50 mL, screw top) in ziploc bag	2	Chlorophyll-a
☐	CO_2 (Alka seltzer) tablets	2 packets	Zooplankton
☐	Cooler liners	1 per cooler	General
☐	Kit: Dissolved carbon supplies in ziploc bag: - Serum bottles: • un-acidified (blue tape for CO_2 and CH_4) • pre-acidified (pink tape for DIC) - Water isotope bottle (10mL) - Syringe filter (0.45 µM) - Needles	 1 1 1 1 3 (1 is spare)	Dissolved Carbon
☐	Kit: Sediment Mercury pre-cleaned supplies in ziploc bag: - Transfer pipette tip (plastic) - Screw top Jar (125 mL, plastic)	 2 2	Sediment Mercury
☐	HDPE bottle (60 mL, white, wide-mouth)	1	Triazine
☐	HDPE bottle (125 mL, white, wide-mouth)	2	Zooplankton
☐	HDPE bottle (250 mL, brown, wide-mouth)	1	Nutrients
☐	HDPE bottle (500 mL, white, wide-mouth)	2	Algal Toxins (index & littoral)
☐	HDPE bottle (1 L, white, narrow mouth)	2	Phytoplankton (index & littoral)
☐	HDPE bottle (1 L, white, narrow-mouth)	2	Benthics
☐	H_2SO_4 ampoules	1	Nutrients
☐	Screw top jar (60 mL, plastic)	1	Sediment Dating
☐	Screw top jar (15 mL, plastic)	2	Sediment Diatoms

Each site kit will also include necessary shipping supplies for all samples collected.
Some items may not be used at all sites and should be held until the end of the field season.

Forms & Labels

✓	ITEM	QUANTITY
☐	NLA 2012 Site Verification	1
☐	NLA 2012 Index Site Profile (front & back)	1
☐	NLA 2012 Index Site Sample Collection (pages 1-3)	1
☐	NLA 2012 Physical Habitat Assessment (front & back)	10+
☐	NLA 2012 Macrophyte Assessment (front & back)	1
☐	NLA 2012 Invasive Plants & Invertebrates	1
☐	NLA 2012 Littoral Site Sample Collection (front & back)	1
☐	NLA 2012 Site Assessment (front & back)	1
☐	Labels packet (for samples)	1
☐	Tracking Forms (Status and Shipping)	3

Additional Equipment List

(Sampling equipment provided by Sampling Crew)

✓	ITEM	QUANTITY	PROTOCOL
☐	Access permission documents/permit (if required)		Site Evaluation
☐	Barometer or elevation chart to use for calibration	1	Calibration
☐	Binoculars	1	Physical Habitat
☐	Bleach (or bleach alternative)	1	General
☐	Buckets (5 gallon capacity, plastic)	2	Benthics
☐	Access instructions	1	Site Evaluation
☐	Buoy (for marking observation point)	1	Physical Habitat
☐	Calibration cups and standards (for multi-parameter meter)	1	Calibration
☐	Calibration QC check solution (for multi parameter meter)	1	Calibration
☐	Clinometer (optional)	1	Physical Habitat
☐	Clipboard	1	General
☐	Depth Finder (hand-held or boat mounted sonar)	1	Index Site Profile
☐	Electronic data capture devices (tablet/phone/computer) with NARS App and extra battery pack (if needed)	1-2 (optional)	General
☐	Ethanol (95%)		Benthics, Zooplankton
☐	Extruder rod (1 ¼ in. PVC, 75 cm long with glued cap)	1	Sediment Core
☐	NLA 2012 Fact Sheets	20	General
☐	Field notebook (optional)	1	General
☐	Field thermometer (not mercury)	1	General
☐	GPS unit (with manual, reference card, extra battery)	1	Site Verification, PHab
☐	Back up Kick net (500 µm D-shaped, modified)	1	Benthics
☐	Laser rangefinder for estimating drawdown (optional)	1	Physical Habitat
☐	Map wheel or string (for measuring on site map)		Physical Habitat
☐	Multi-parameter water quality meter	1	Index Site Profile
☐	Permanent marker (fine tip, for labels)	1	General
☐	Pencils (#2, for data forms)	2	General
☐	Plankton net (80 µm, NLA 2007 design)	1	Zooplankton
☐	Plankton net (243 µm, NLA 2007 design)	1	Zooplankton
☐	Rake sampler (double head, weighted, attachment for rope)	1	Macrophyte
☐	Scissors	1	General
☐	Sectioning stage	1	Sediment Core
☐	Sectioning tube (6 cm, 2.5 in ID, line 2 cm from bottom)	1	Sediment Core
☐	Site maps (set of 3)	1	Site Evaluation
☐	Sounding rod (3 m , marked in 0.1 m increments, PVC)	1	Physical Habitat
☐	Surveyors rod (optional)	1	Physical Habitat
☐	Tub (shallow) or dish pan	1	Sediment Core
☐	Water (deionized)		General
☐	Water (lake)		General
☐	Wet Ice		Shipping

Suggested crew equipment lists

✓	BOAT EQUIPMENT
☐	Anchor (with 75 m line or sufficient to anchor in 50 m depth)
☐	Boat horn
☐	Boat plug (extra)
☐	Bow/stern lights
☐	Emergency tool kit
☐	Gas Can
☐	Hand bilge pump
☐	Life jackets
☐	Motor
☐	Oars or paddles
☐	Second anchor for windy conditions and littoral sampling (w/ 75m line)
☐	Sonar unit
☐	Spare prop shear pin
☐	Type IV PFD (throwable life saving device)

✓	SAFETY EQUIPMENT
☐	Waders
☐	Gloves
☐	Sun-blocking Hat
☐	Other appropriate field clothing
☐	Safety glasses
☐	First aid kits
☐	Fire extinguishers
☐	Blankets
☐	Cellular/satellite phones or portable radios
☐	Anti-bacterial soap
☐	Clean water or ethyl alcohol
☐	Medications

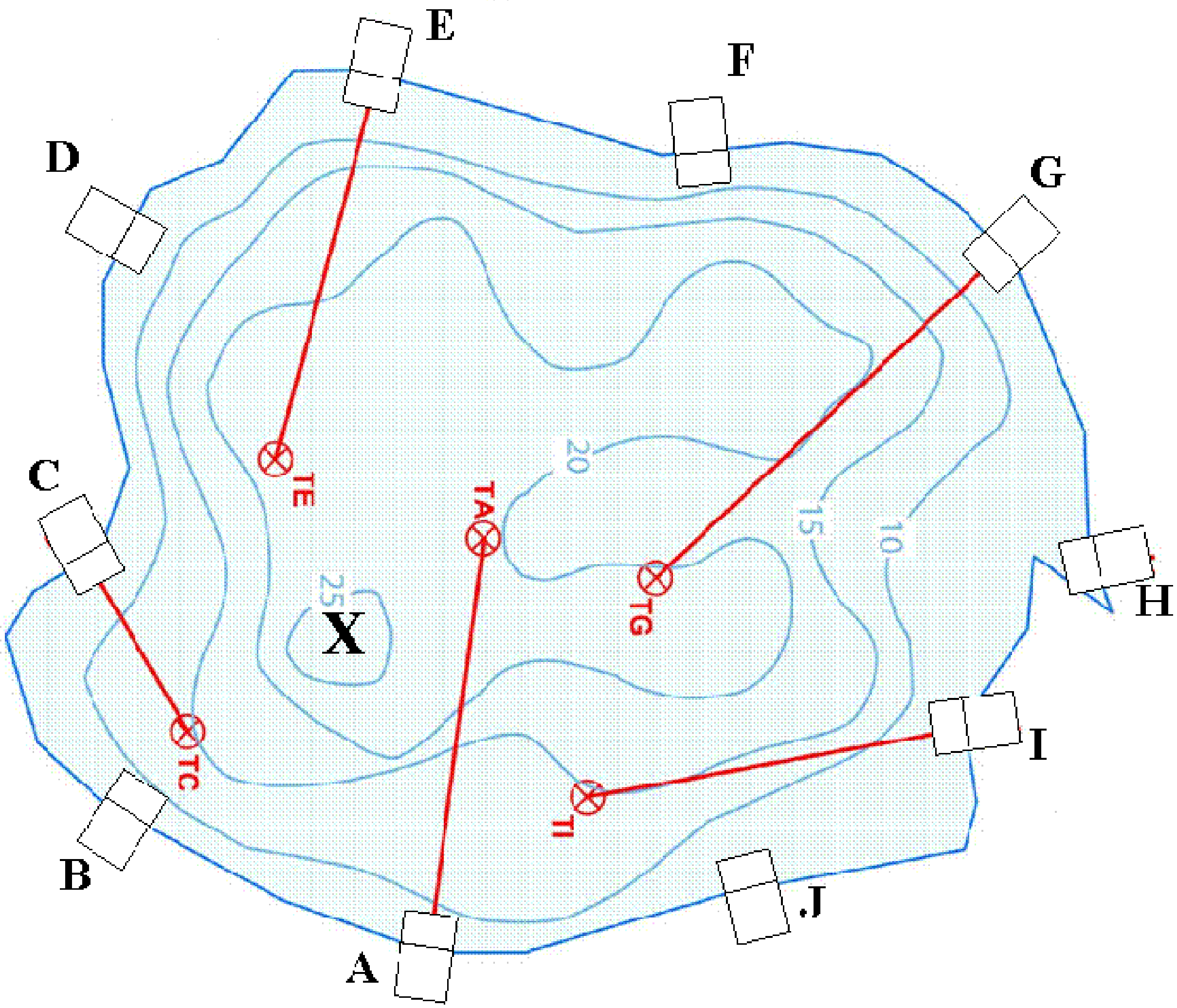
Recommended Safety Guidelines:

- Two persons must be present during all sample collection activities, and no one should be left alone while in the field.
- Minimize exposure to lake water and sediments as much as possible. Use gloves if necessary, and clean exposed body parts as soon as possible after contact.
- All electrical equipment must bear the approval seal of Underwriters Laboratories (UL) and must be properly grounded to protect against electric shock.
- Use heavy gloves when hands are used to agitate the substrate during collection of benthic macroinvertebrate samples.
- Use appropriate protective equipment (e.g., gloves, safety glasses) when handling and using hazardous chemicals
- Persons working in areas where poisonous snakes may be encountered must check with the local Drug and Poison Control Center for recommendations on what should be done in case of a bite from a poisonous snake.
- Any person allergic to bee stings, other insect bites, or plants (i.e., poison ivy, oak, sumac, etc.) must take proper precautions and have any needed medications handy (e.g., an “Epi-Pen”).
- Protect yourself against the bite of deer or wood ticks because of the potential risk of acquiring pathogens that cause Rocky Mountain spotted fever, Lyme disease, and other diseases.
- Be familiar with the symptoms of hypothermia and know what to do in case symptoms occur. Hypothermia can kill a person at temperatures much above freezing (up to 10°C or 50°F) if he or she is exposed to wind or becomes wet.
- Be familiar with the symptoms of heat/sun stroke and be prepared to move a suffering individual into cooler surroundings and hydrate immediately.
- Handle and dispose of chemical wastes properly. Do not dispose of any chemicals in the field.

Site Layout Components

STATION	LOCATION/SETUP	PARAMETERS MEASURED/COLLECTED
Index Site	Natural lakes 50 meters deep or less – find deepest spot in lake Natural lakes more than 50 meters deep – As close to center of lake as possible in water 50 meters deep Reservoirs - As close to center of reservoir as possible in water 50 meters deep or less. Use lake maps or other geographical information to approximate index site while in the office or base site. Record GPS coordinates for approximate location to speed the process of finding the index site once in the field. Once in the field, sonar or sounding line will be used to verify index site.	Water Quality (DO, temp, pH) , *in situ* Secchi disk transparency Chlorophyll-*a* Phytoplankton Triazine Pesticide Screen Nutrients Algal Toxins (microcystins) Water Chemistry Dissolved Carbon & Isotopes (*Select sites only*) Zooplankton Sediment Mercury Sediment Diatoms Sediment Dating (*Natural Lakes only*)
Littoral Stations (PHab Stations) 10 Stations Labeled A - J Only at lakes 10,000 hectares or less	10 evenly spaced stations placed around entire perimeter of lake. Randomly select a spot on the lake perimeter Measure entire perimeter of lake Divide by 10 Place first PHab station (A) at the random starting point Layout each subsequent PHab station (B-J) at the calculated interval Record GPS coordinates of each station If any single island shoreline equals 10-20% of perimeter shoreline, add 1 additional PHab Station. If island is 10-20% of perimeter, add 2 island stations.	**ALL STATIONS**: Littoral Habitat Characterization Riparian Habitat Characterization Invasive Plants and Invertebrates Benthic Macroinvertebrate Samples **ADITIONAL SAMPLES AT STATION J**: Phytoplankton Algal Toxins (microcystins) Chlorophyll-*a*
Macrophyte Transects 5 Transects Labeled: A, C, E, G, I Only at lakes 10,000 hectares or less	5 transects that begin at the centers of every other Littoral Station (A,C, E, G, I) and extend up to halfway across lake. Place each transect perpendicularly to the shoreline, starting at the center of the littoral station and halfway across the lake (midpoint between starting and directly opposite shores). Once in the field, a minimum of 6 points per transect will be placed, with the first point at 0.5m depth, the second at 1m depth, then continuing lakeward at regular 1m depth intervals until one of stop criteria apply (see Page D-3).	Macrophyte Assemblage Characterization Plant density (Rake grab sample Algae Density (Rake grab sample) Plant Growth Form

Example Site Layout



INDEX SITE (X)
•Temp, DO, pH profile, *in situ*
•Water Chemistry
•Nutirents
•Chlorophyll a
•Phytoplankton
•Triazine Pesticide Screen
•Algal Toxins
•Zooplankton
•Sediment Diatoms
•Sediment Dating
•Sediment Mercury
•Dissolved Carbon (selected lakes)

PHAB STATIONS (A-J)
•Physical Habitat
•Macroinvertebrates
•Invasives

5 MACROPHYTE TRANSCETS
•Macrophyte Assemblage

STATION J
•Chlorophyll a
•Phytoplankton
•Algal Toxins

ENTIRE LAKE
•General Assessments

Littoral Station Location Adjustments

General guidelines for locating or modifying shoreline location and littoral stations:

Locate station using maps, aerial photos, or GPS units.

Define shore as either the current waterline OR the boundary between open water and the edge of dense vegetation (terrestrial, wetland, or emergent vegetation) or extensive very shallow water (shoreline defined by limit for navigating your boat).

If the shoreline observed in the field differs from the mapped shoreline: mark "Station Relocated" and enter a comment on the Physical Habitat Characterization Form stating the apparent reason (e.g., drought, flooding, dredging).

If a PHab station is lost because of shoreline changes: mark "Station Relocated" at the top of the Physical Habitat Characterization Form, and position one or more new stations at approximately equal intervals.

If a station is eliminated, mark the "Station Dropped" box.

If the shoreline observed in the field differs radically from the site map and you are sure you are at the correct lake, sketch a new map on the back of the site map. Use a string to measure the new outline, divide it into 10 equal parts, and lay out the 10 station locations.

If a PHab Station change is required:

Trying to maintain the goal of 10 stations; options include:

a. relocate station(s) and adjust other stations as needed
b. Add station when necessary (more shoreline than expected) and assign new letter designation (i.e. K, L, etc.)
c. eliminate the station only if absolutely necessary

Note any changes to shoreline or littoral stations on site map:

- Draw all adjustments to the shoreline
- Indicate new locations of station(s)
- Cross out dropped station(s)
- Draw in newly added station(s)
- Redraw entire site map if lake is very different than expected

Use the data selection buttons of the Physical Habitat Characterization to describe the action you have taken:

- Station Relocated
- New Station (assign new letter - K, L, etc.)
- Station Dropped
- Explain the adjustments in the comments section

See Field Operations Guide Section 6.1.3 for more information

B. LAUNCH SITE ACTIVITIES

Equipment and Supply Preparation

See Pages A-4 through A-7 to ensure all items are ready for use
Be sure that an entire backup site kit (with all sample bottles, data forms and labels) is in the vehicle and ready for use if needed.

Stock Solutions

SOLUTION	USE	PREPARATION
Bleach (1%)	Clean nets, other gear, and inside of boat.	Add 40 mL bleach to 3,600 mL distilled water.
Lugol's*	Preservative for phytoplankton samples.	Dissolve 100 g KI in 1 L of distilled water. Dissolve 50 g iodine (crystalline) in 100 mL glacial acetic acid. Mix these two solutions. Remove any precipitates. Store in the dark.
95% Ethanol	Preservative for benthic invertebrate samples and zooplankton samples.	No preparation needed (use stock solution as is).

** Lugol's solution is provided in the base kit*

Instrument Checks and Calibration

✓	EQUIPMENT	PREPARATION
☐	GPS Unit	Check the batteries prior to departure Ensure map datum is set to NAD83 Perform manufacturer checks as necessary to ensure accuracy
☐	Multi-parameter Probe	Calibrate per manufacturer guidelines (Dissolved Oxygen to be calibrated at lake) Check the batteries prior to departure Perform QC Check as directed by manufacturer and/or lab protocols
☐	Electronic Data Capture Device (Optional)	Check the batteries prior to departure Ensure NLA Data collection Application is installed and functioning

Site Documentation

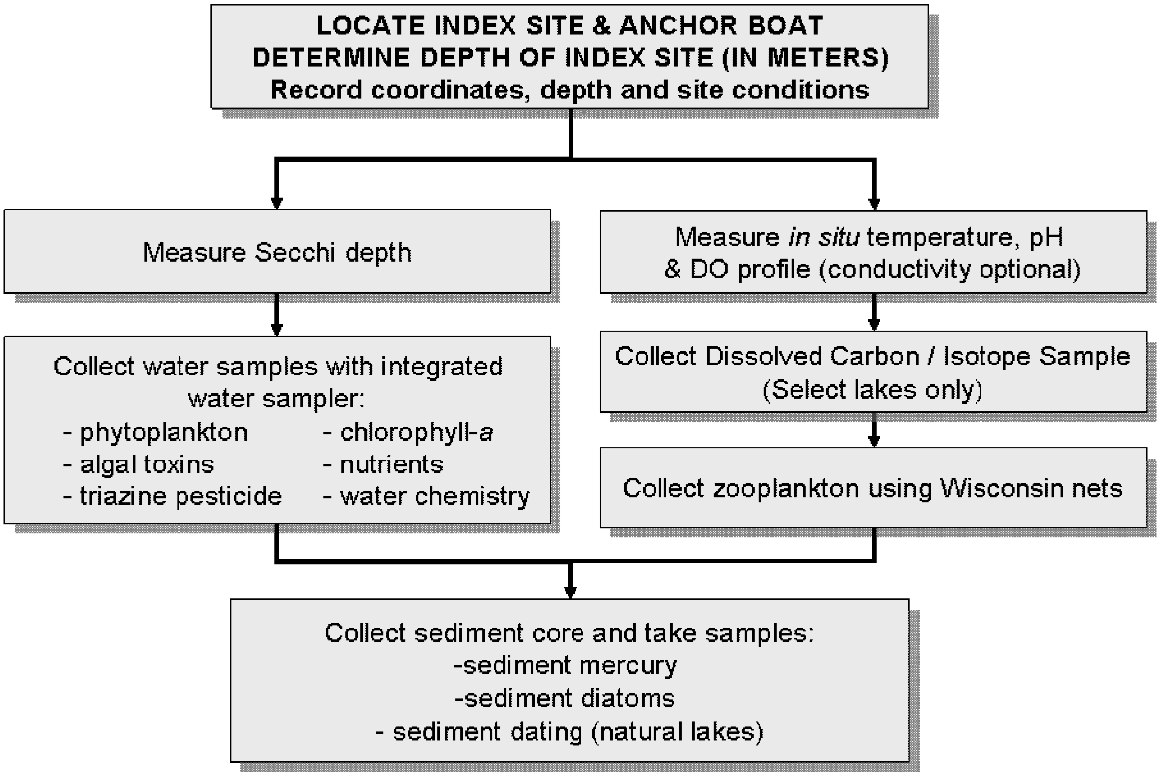
✓	EQUIPMENT	PREPARATION
☐	Maps	Site maps: Provided by EPA HQ Team Other Maps, Imagery, or GIS Data compiled by Field Crews
☐	Land Ownership Status, Requirements and Permissions for Access	Landowner identity and contact information. Results of communication with landowners. Documentation of permission to access private land. Permissions or instructions for crossing private (Notes on locked gates, pets, hunting activities, etc) For public land, response of relevant agency to notification that you will be accessing a site, and, if needed, permissions to do so.
☐	Permits	Permits or documentation for site access, or data collection activities
☐	Information for Accessing / Sampling Site	Driving and Hiking Routes to the Site Results from the Site Evaluation Preliminary plan for site layout

Lake Verification

1. Fill out header information on Lake Verification Form
2. Verify that you are at the correct lake
   - Map coordinates
   - Locational data from the GPS when possible
   - Signs
   - Conversations with local residents
   - Compare lake shape to that shown on map
3. Verify that lake meets all criteria for sampling
   - If not, then drop site and replace with next available replacement site
4. Record locational coordinates for the lake on the Lake Verification Form.
5. If GPS coordinates are obtained, check the GPS box and record the latitude, longitude, and the type of satellite fix (2D or 3D) for the launch site.
6. Compare the map coordinates given on the lake spreadsheet for the lake with the GPS coordinates displayed for the launch site, and verify that you are at the correct lake.
7. If GPS coordinates are not available, do not record any information, but try to obtain the information at a later time during the visit. A fix may be taken at any time during a lake visit and recorded on the form.
8. Record directions to the lake and a description of the launch site on the Lake Verification Form regardless of whether the site is sampled or not
9. Provide information about signs, road numbers, gates, landmarks, and any additional information you feel will be useful to another sampling crew in relocating this lake.
10. Describe the distance traveled (miles) between turns.
11. Describe the launch site:
    - Can the boat be launched with a trailer?
    - Are there fees?
    - Is the launch paved or does it consist of soft sand?
    - What landmarks are at the launch?
12. Record the sampling personnel
13. If the lake shape on the USGS topographic map does not correspond with the actual lake shape from your site map, and you cannot verify the lake by any other means, check "Not Verified" and provide comments on the Lake Verification Form.
14. At each lake, evaluate whether or not the lake meets the NLA operational definition of a "lake"
    - ≥ 1 ha in total surface area
    - ≥ 1000 square meters of open water
    - ≥ 1 meter in depth
    - Not saline (due to salt water intrusion or tidal influence)
    - Not used for aquaculture, disposal-tailings, mine-tailings, sewage treatment, evaporation, or other unspecified disposal use.

C. INDEX SITE ACTIVITIES

Overview of Index Site Sampling



Locating Index Site

Ideally the Index Site location has been estimated during desktop and field evaluation, and the field crew will simply need to confirm that the proposed location is correct.

Below are the basic guidelines for finding the Index Site:

- For natural lakes <50 deep, the Index Site is located at deepest point
- For natural lakes >50 m, the Index Site is located nearest the center of lake in ≤ 50 m
- For reservoirs, the Index Site is located at the center of reservoir in ≤ 50 meters water
- Chosen using sonar, bathymetric map and/or sounding
- *Knowing the deepest spot of a lake or reservoir may be useful in determining Maximum Depth of Plant Colonization (MDC) toward the end of the day.*
- Effort to locate Index Site should be limited to ~30 minutes

After finding the Index Site, anchor the boat to create a stable work area (two anchors may be needed). When anchoring boat, try to not disturb bottom any more than necessary.

See Field Operations Guide Section 4.2.2 for more information

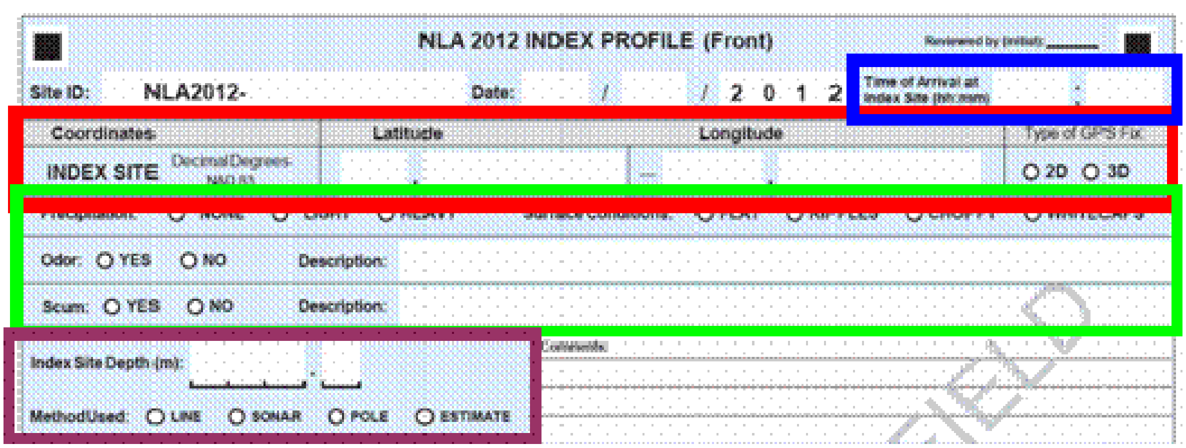
Index Site Initial Tasks

After arriving at Index site and anchoring boat, record the following:

<u>Index Profile Form</u>

1. GPS Coordinates & GPS Fix
2. Time of Arrival
3. Site conditions
    - Precipitation
    - Surface Conditions
    - Odor
    - Scum
4. Index Site Depth (nearest 0.1 meters)
    - When measuring depth, sonar may not be accurate enough (and may not read in meters). A sounding line with weight may be more accurate and the line can be marked and used for zooplankton line.
5. Index Site Depth Method

NLA 2012 Profile Index Site Form (Front)


NLA 2012 INDEX PROFILE (Front)
Reviewed by (initial):
Site ID: NLA2012-
Date: / / 2 0 1 2
Time of Arrival at Index Site (hh:mm)
Coordinates | Latitude | Longitude | Type of GPS Fix
INDEX SITE Decimal Degrees NAD 83
O 2D O 3D
Odor: O YES O NO Description:
Scum: O YES O NO Description:
Index Site Depth (m):
Method Used: O LINE O SONAR O POLE O ESTIMATE
Comments:

Temperature, DO and pH Profile

Multi-parameter Probe will be used to collect measurements of:

- Temperature (°C)
  Readings will be used to determine the **Top** and **Bottom** of the Metalimnion
- Dissolved Oxygen (mg/L)
- pH
- Conductivity (*optional*)

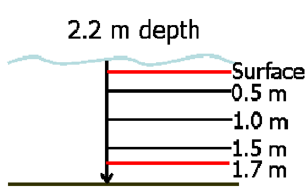
Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	NLA 2012 Index Site Profile	1
☐	Collection: Water column depth	Depth Finder (hand-held or boat mounted sonar) Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip OR Rod (calibrated) for very shallow lakes	1 1
☐	Collection: Profile measurements	Multi-parameter water quality meter (with temperature, pH, and DO probes) Sounding line (50 m, calibrated, marked in 0.4 m intervals) with clip	1

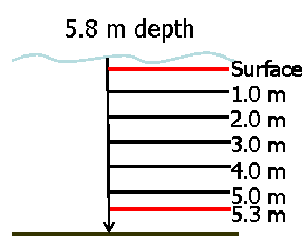
Profile Intervals

Take measurements at the following intervals:

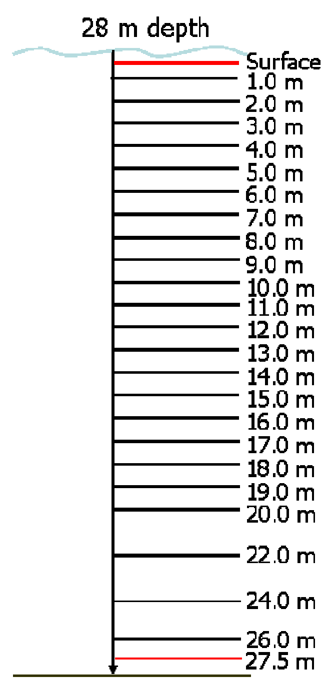
- Shallow sites (≤3 m)
  - Just below surface
  - 0.5 m intervals
  - 0.5 m from bottom



- Medium depths (3-20 m)
  - Just below surface
  - Every 1 m ending at 0.5 m from bottom



- Deep sites (>20 m)
  - Just below surface
  - Every 1 m up to 20 m
  - Then every 2 m ending at 0.5 m from bottom
  - *Every 1m **within** the Metalimnion*



NOTE: These diagrams are only examples.

REMINDERS:

- Intervals are dependent upon the Index Site depth, thus accurate measurement is important.
- Try not to let sonde touch bottom while sampling.
- Always have the first measurement just below surface, and the final measurement always 0.5 m from bottom.
- Mark sonde cable in 0.5 meter increments (Calibrate the cable as back-up for sonde depth sensor, if present).

Temperature, DO and pH Profile Sampling Procedure

After determining sampling intervals (see previous page):

1. Record depth of data in first column (to nearest 0.1 m)
   - "Surface" is pre-printed
2. Record measurements in adjoining columns
   - DO
   - Temp
   - pH
   - Conductivity (optional)
     - Indicate if conductivity is temperature corrected
3. Leave extra cells empty (no data)

NLA 2012 Profile Index Site Form (Back)

Depth XX.X	O_2 (mg/L) XX.X	Temp. (°C) XX.X	pH XX.X	Cond. (µS/cm@ 25°C) XX.X	Meta-limnion [b] (T, B)	Flag
Surface						

While sampling:

4. Determine the Metalimnion
   - The region of the profile where temperature changes at a rate of 1°C or more per meter
   - If the lake is thermally stratified:
     - ✓note the top (T) = rate of change ≥1°C/meter
     - ✓and bottom (B) = rate of change becomes <1°C/meter

       of the metalimnion in the Metalimnion column
5. Regardless of depth, take measurements at least every 1 meter **<u>while</u> <u>within</u>** the metalimnion (e.g. At depths between 20 and 50 meters, if within the metalimnion, take measurements at 1 meter intervals instead of 2 meter as prescribed).

   NOTE: If you suspect that the metalimnion exists but does not change at the specified rate, estimate the top and bottom of the metalimnion as best you can, flag the data form, and explain

After sampling all intervals:

6. Record a second set of measurements at the surface
7. Indicate whether the DO reading is within 0.5 mg/L of initial reading
8. Verify calibration and If DO is found to be out of calibration, re-calibrate and re-record DO measures

NLA 2012 Profile Index Site Form (Back)

Dup Surface						

Is the Duplicate O_2 reading within ±0.5 mg/L of the initial surface reading?	○ YES	○ NO
CalibrationVerified:	○ YES	○ NO

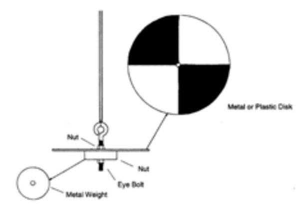
NOTE: If sonde data will be recorded and sent as an electronic file, indicate on top of form.

Secchi Disk Transparency

Equipment

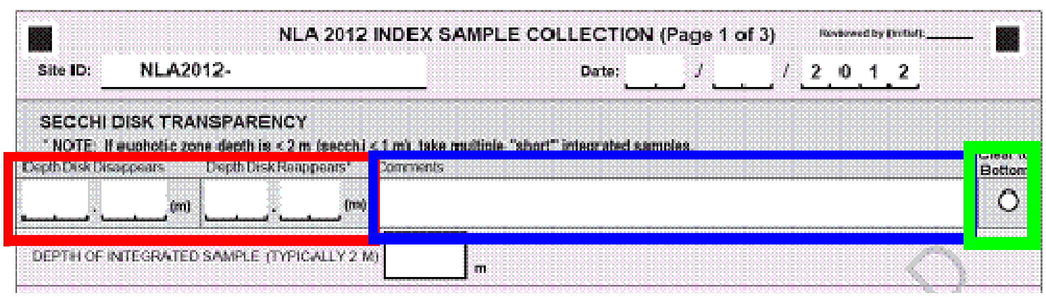
✓	TYPE	ITEM	QUANTITY
☐	Form	NLA 2012 Index Site Sample Collection	1
☐	Collection	Meter Stick (cm)	1
		Secchi Disk (20 cm diameter)	1
		Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1

Sampling Procedure



1. Lower disk on shady side of boat without viewing aids
2. Record depth that disk disappears
3. Record depth that disk reappears
   a. If the Secchi depth is <1.0 m, determine depths to the nearest 0.05 m
   b. Otherwise, determine depths to the nearest 0.1 m
4. Add comments, if any
5. Note if Secchi disk is still visible at bottom of the lake (i.e. both Secchi depths = water depth)

NLA 2012 Index Site Sample Collection Form (Page 1)



NLA 2012 INDEX SAMPLE COLLECTION (Page 1 of 3) Reviewed by (initial): ____

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

SECCHI DISK TRANSPARENCY

*NOTE: If euphotic zone depth is < 2 m (secchi < 1 m), take multiple "short" integrated samples.

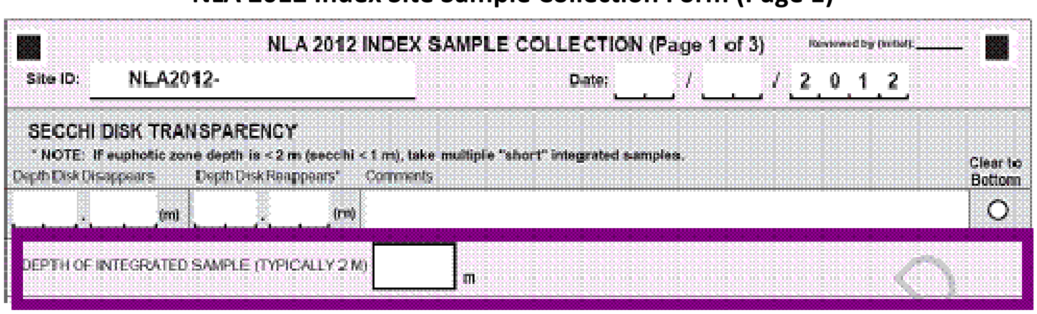
Depth Disk Disappears ___ . ___ (m) Depth Disk Reappears* ___ . ___ (m) Comments Clear to Bottom ○

DEPTH OF INTEGRATED SAMPLE (TYPICALLY 2 M) ____ m

Calculate the euphotic zone depth

1. Multiply the Secchi disk reappearance depth by 2.
2. Enter collection depth of integrated water samples (see page C-7 for collection)
   – If euphotic zone ≥ 2 m, then enter “2”
   – If euphotic zone < 2 m, then enter the depth of the euphotic zone
   - This entry indicates the depth at which the integrated water samples are collected, not necessarily the euphotic zone depth

NLA 2012 Index Site Sample Collection Form (Page 1)



NLA 2012 INDEX SAMPLE COLLECTION (Page 1 of 3) Reviewed by (initial): ____

Site ID: NLA2012- Date: __ / __ / 2 0 1 2

SECCHI DISK TRANSPARENCY

*NOTE: If euphotic zone depth is < 2 m (secchi < 1 m), take multiple "short" integrated samples.

Depth Disk Disappears ___ . ___ (m) Depth Disk Reappears* ___ . ___ (m) Comments Clear to Bottom ○

DEPTH OF INTEGRATED SAMPLE (TYPICALLY 2 M) ____ m

Dissolved Carbon and Water Stable Isotopes Sample Collection

- Using a syringe with stopcock and filter, collect 3 bubble-free water samples from a few centimeters below the lake surface (2 in serum vials and 1 in screw-top vial).
- Use a fresh needle for each sample. Collect the unacidified sample first, then the acidified sample, and finally the isotope sample (no needle needed). Store the samples on ice, but avoid freezing them.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	Index Site Sample Collection	1
☐	Collection	Serum bottles:	
		un-acidified (for CO_2 and CH_4) (Blue Taped)	1
		pre-acidified (for DIC) (Pink Taped)	1
		Water isotope bottle (10mL)	1
		Poly syringe (60mL) with attached 3-way stopcock	1
		Syringe filter (0.45 µM)	1
		Needles (2 for collection, 1 spare)	3

Sampling Procedure

1. Attach 3-way stopcock to 60 mL syringe, draw in 10 mL of water from a few cm below the water surface. Expel water underwater to rinse syringe. Repeat rinse.
2. With syringe still underwater, fill the syringe with lake water. If bubbles enter syringe, hold the syringe upright, tap side of syringe and expel air pocket using syringe plunger. Once bubbles are removed, close the stopcock to prevent air exchange with the sample.
3. Attach 0.45 µm syringe filter to the luer tip on the 3-way stopcock on the syringe. Make sure connection is tight by using locking ring on stopcock.
4. Attach the needle to the tip of the 0.45 µm filter. Make sure connection is tight.
5. Point syringe up, open stopcock and push plunger to expel air from filter and needle.
6. Once 5 mL of water has passed through the filter and needle, insert the needle into the first serum bottle (unacidified – blue taped) through the stopper, inject 15 mL of water into the bottle.
    - *NOTE: While injecting sample water into the bottles and removing needle, have the syringe pointed up.*
7. After injecting 15 mL into the bottle, keep pressure on the syringe plunger while you remove the syringe/needle from the bottle. **Hold needle base to avoid dislodging**.
8. Change needle and repeat Steps 4-7 with the (acidified bottle - pink taped).
9. Place samples on ice
10. Send used needles and filters with samples by placing in shipping package
11. Syringe and stopcock are to be reused
12. After collecting samples in both serum bottles, remove the needle and use the syringe with filter attached to collect a 10 mL isotope sample
13. Fill the bottle completely with water from the syringe and filter, creating a convex meniscus (additional water can be drawn from lake as needed)
14. Carefully replace lid on bottle and invert to ensure no air bubbles are in the vial
15. Pack the serum bottles, isotopes bottle, used needles and filter back into the original package.
16. Place the entire package on ice for shipment
    - *Syringe and stopcock are to be kept and reused*

Water Sample Collection (Index Site)

- Using a 2 m long integrated water sampler, collect water from the euphotic zone (or up to 2 meters max)
- Collect sufficient water quantity for:
  - Chlorophyll-*a* 2 L
  - Phytoplankton 1 L
  - Algal Toxins (Microcystins) 500 mL
  - Nutrients 250 mL
  - Triazine Pesticide Screen 60 mL
  - Water Chemistry 4 L

First 5 samples will be typically from Grabs 1 and 2, Water Chem typically from grabs 3 and 4

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	NLA 2012 Index Site Sample Collection	1
☐	Collection: Water Sample	Integrated sampler device (MPCA design) Funnel Gloves (latex/nitrile, non-powdered)	1 1 1
☐	Storing & Preservation	Cubitainer® (4L) – water chemistry HDPE bottle (60 mL, white, wide-mouth) – triazine HDPE bottle (250 mL, brown, wide-mouth) – nutrients HDPE bottle (500 mL, white, wide-mouth) – algal toxins HDPE bottle (1 L, white, narrow-mouth) – phytoplankton Poly bottle (2 L, brown, labeled INDEX) – chlorophyll A H_2SO_4 ampoules – nutrients pH paper – nutrients Wet ice Lugol's solution (250 mL bottle) Cooler	1 1 1 1 1 1 1-2 1 As needed 5-10 mL 1

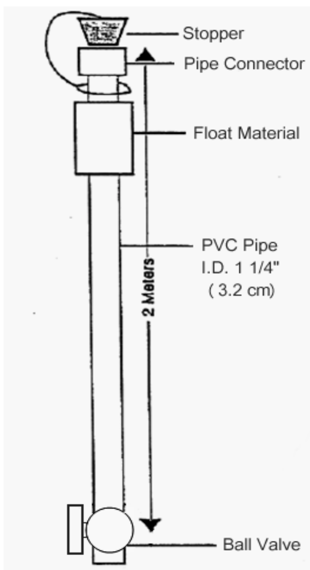
Sampling Procedure

1. Put on gloves
2. Rinse each of the collection bottles and Cubitainer with site water 3 times.
3. Remove rubber stopper and open valve. Rinse three times in lake.
4. Lower sampler vertically into lake. Stop when the upper end is just below the surface. If the euphotic zone is < 2.0 m deep, the integrated sampler will be lowered only to the depth of the euphotic zone.
5. Cap the upper end with the rubber stopper and slowly raise the sampler.
6. When the bottom of the sampler is near the surface, reach underneath and close the valve on the bottom end.
7. Lift the sampler into the boat, keeping it vertical. Place containers in shaded area of the boat to avoid exposing the sample to direct sunlight when dispensed.

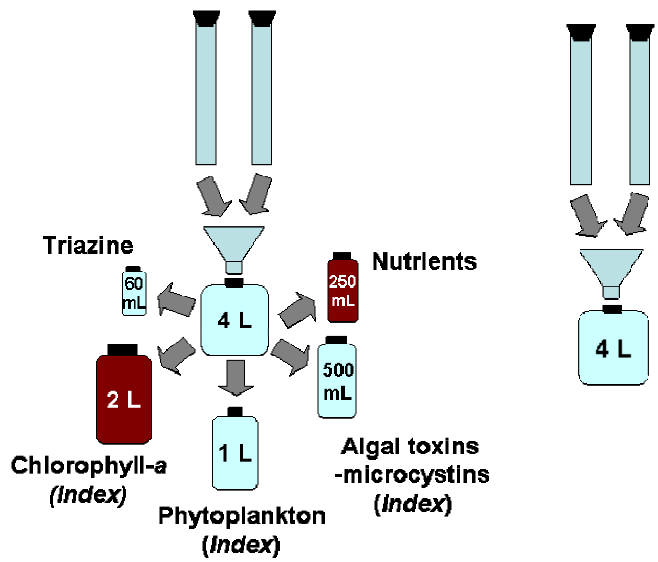
Water Sample Collection

1. Dispense water from integrated samples #1 and #2 (or more if needed) into pre-rinsed pre-labeled cubitainer with use of funnel
2. Collect approximately 4 L
3. Mix well
4. Pour samples into each of the 5 pre-labeled sample bottles (see diagram below)
5. Place all samples on ice
6. Dispense water from integrated samples #3 and #4 (or more if needed) into pre-labeled cubitainer with use of funnel
7. Collect 4 L
8. Purge all air before sealing
9. Place Water Chemistry sample on ice

Integrated Water Sampler



Sample Collection Diagram



Water Sample Processing

- Algal toxin and triazine samples need no processing (keep on ice)
- Water chemistry sample – ensure no air bubbles in cubitainer, keep on ice
- Chlorophyll-a sample will be filtered on shore after completing site, keep on ice until processed
- Phytoplankton sample - preserve with 5 mL of Lugol's solution (3 pipette's worth) to the 1 L phytoplankton bottle. Cap the bottle and invert until well mixed. The sample should resemble the color of weak tea. If needed, add additional Lugol's 2-3 mL at a time.
- Nutrients sample – acidify with acid ampoule(s) and test with litmus paper to ensure pH of < 2, keep on ice.

Water Sample Data

- Record the Sample ID for each of the collected water samples on the Index Site Sample Collection Form
- Record number of acid ampoules used to acidify nutrients sample
- Fill in the bubble to indicate that the sample's resulting pH is less than 2
- Indicate that Lugol's has been used to preserve phytoplankton
- Volume of chlorophyll sample filtered will be completed during post-sampling tasks
- Add any pertinent comments

Zooplankton Collection

- Collect zooplankton with vertical tows over the opposite sides of the boat
- All lakes will use 2 mesh sizes (50 and 150 μm) using 2012 protocols.
- 2007 resample lakes will take 2 additional samples (80 and 243 μm) using 2007 protocol
- Each sample will be narcotized, placed in separate bottles, and preserved with ETOH

Equipment

✓	TYPE	ITEM	QUANTITY 2007 RESAMPLE LAKES	QUANTITY 2012 NEW LAKES
☐	Form	Index Site Sample Collection	1	1
☐	Collection	Plankton net (50 μm) and collection bucket	1	1
		Plankton net (150 μm) and collection bucket	1	1
		Plankton net (80 μm) and collection bucket	0	1
		Plankton net (243 μm) and collection bucket	0	1
		Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip	1	1
☐	Storing & Preservation	HDPE bottle (125 mL)	2	4
		Squirt bottle (1 L Nalgene) – de-ionized (DI)	1	1
		Squirt bottle (1 L Nalgene) – lake water	1	1
		CO_2 (Alka seltzer) tablets	2 packets	2 packets
		Pail (Narcotizing Chamber)	1	1
		Ethanol (95%)		
		Zip top bags (sandwich size)		
		Electrical tape		

Comparison of Zooplankton Sampling – 2007 and 2012 Protocols

2012	2007
Mesh sizes = 50 and 150 μm	**Mesh sizes = 80 and 243 μm**
Start collection at depth based on water depth (see table)	**Start collection with mouth of net at 0.5 m from bottom**
Use fine and coarse mesh on opposites sides of boat	**Use fine and coarse mesh on opposites sides of boat**
The standard tow length for each net is 5m always. **In shallow lakes (<7m), multiple tows with each net are required to achieve the minimum cumulative tow length.** ***See below***	**Tow length is dependent upon water depth (water depth minus 0.5 m).** **When the depth of the index site is less than 2 m and the Secchi disk can be seen at the bottom, a second tow (0.5-1.5 m in length) is made and the samples are combined (cumulative tow length ≤ 3 m).**

Tow Length Determination for 2012 Zooplankton Protocol

Determine the number of **equal-length** tows required to achieve the standard cumulative 5 m tow on the Index Sample Collection form.

NOTE: Perform each tow in a different area of the water column.

Collections from multiple tows will be composited into a clean container and then filtered through collection bucket prior to narcotizing.

DEPTH OF LAKE (M)	DEPTH OF TOW	NUMBER OF TOWS
7	5 m	1
6	2.5 m	2
5	2.5 m	2
4	2.5 m	2
3	1 m	5
2	1 m	5
1 - 2	0.5 m	10

Zooplankton Sampling Procedure

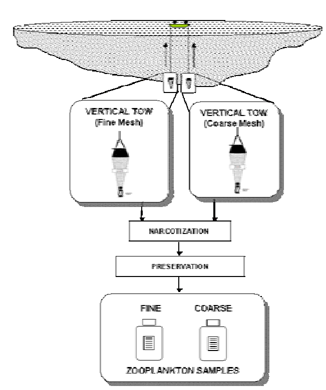
1. Attach the collection buckets to the "cod" end of the nets and secure. Make sure you attached the correct bucket to the correct net (i.e., the mesh sizes match).
2. Attach the bridled end of the plankton net to a calibrated line with markings every 0.5 m (i.e. Secchi disk line).
3. Carefully and slowly lower the first net in a constant upright position over the side of the boat.
4. Continue lowering the net to the correct depth (remember to account for the length of the bridle). If more than one tow is needed, be sure to take additional tows from different locations around the boat.
5. Retrieve the net by pulling back to the surface at a steady rate (0.3 m or 1 ft/s) without stopping.
6. At surface, move net up and down without submersing the mouth to rinse contents into collection bucket
7. Rinse again by spraying water against the outside of net
8. If additional rinsing is needed on the interior of the net, use a squirt bottle with DI water only to avoid introducing additional organisms
9. Remove bucket from net and concentrate contents by swirling collection bucket to remove excess lake water
10. Subsequent collections (other mesh sizes and/or 2007 protocol) are completed similarly

Sample Processing

1. After concentrating sample and removing collection bucket, place collection bucket in a 1 gallon pail filled with lake water and CO_2 tablets (2 Alka-seltzer) for approximately 1 minute
    - *Ensure all organisms are submerged. The CO_2 will narcotize the zooplankton and relax the body structures prior to preservation*
2. Rinse collection into pre-labeled 125 mL bottle with small amounts of DI water (goal is no more than 60-70 mL of sample and rinse water combined)
3. Fill bottle with ETOH and seal lid.
4. Repeat this process with each zooplankton sample collected

Zooplankton Data

- Record sample IDs for each zooplankton sample collected
- Indicate length of tow / number of tows
- Indicate number of jars for each sample (typically 1)
- Indicate if sample was narcotized and preserved
- Add any pertinent comments

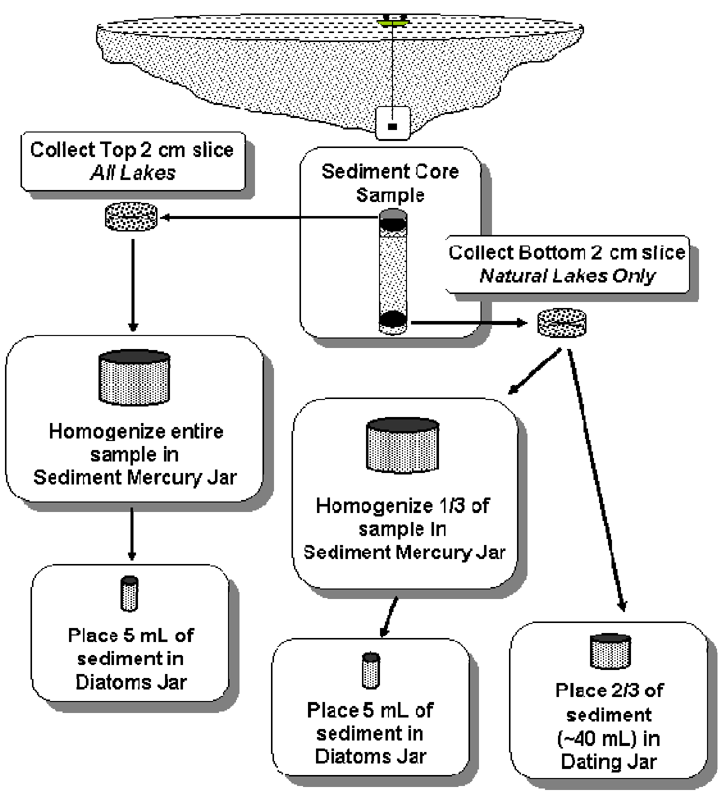


Sediment Core

- Collect a 45 cm long sediment core from undisturbed lake bottom using gravity corer
- A sectioning device is used to collect 2 cm slices from top and bottom of core (*top only in reservoirs*)
- Slices will be subsampled for:
  - mercury
  - sediment diatoms
  - dating (in natural lakes)

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	Index Site Sample Collection	1
☐	Collection: Sediment Core	Corer head (gravity, with cable and messenger) Core tube Sectioning tube Sectioning stage Extruder rod Spatula (1.5 inch plastic putty knife) Syringe (60 mL) with tubing siphon overlying water Core plug Gloves (heavy duty, leather or other material)	1 1 1 1 1 1 1 1 1
☐	Collection: Sediment Mercury	Kit: Sediment Mercury pre-cleaned supplies in bag: - Transfer Pipette (plastic) - Screw top jar (125 mL, plastic) Scoopula	 2 2 1-2
☐	Storage & Preservation: Sediment Diatoms	Screw top jar (15 mL, plastic)	1 in reservoirs 2 in natural lakes
☐	Storage: Sediment Dating	Screw top jar (60 mL, plastic)	1 (Natural Lakes)



Sediment Core Collection

1. Prepare sampling containers and pre-label containers when appropriate.
   <u>IMPORTANT</u>: only handle sediment mercury containers with clean gloved hands, and keep the containers in the provided plastic bags whenever possible
2. Assemble equipment, cock corer head mechanism
3. Slowly lower corer through water column to lake bottom
4. Raise and then lower corer, allowing it to settle into bottom sediments
5. Maintain tension on rope so corer does not tip sideways
6. Send messenger to trip suction mechanism
7. Slowly raise corer back to surface, until core tube and rubber seal are just below the water surface
8. Insert a core plug under the core sample (reach under water and tip device no more than 45 degrees)
9. Raise corer into boat in a vertical position, stand corer upright in tub or pan

Traits of Good Cores

- Surface layer is intact, with distinct sediment-water interface
- Sufficient core length (target = 45 cm)
- Core is intact, not broken in middle due to out-gassing from temperature changes

Sediment Slice Collection (Top)

1. Detach core tube from corer
2. Measure length of core to nearest 0.1 cm
   - *Subtract for stopper thickness*
   - Record on data form and labels
3. Position the extruder rod under the stopper at the base of the coring tube
4. Lower coring tube onto extruder, allowing water to flow away, until the sediment is approximately 1 cm below top of tube
5. Gently remove remaining water using syringe, siphon or pipette (do not disturb sediments)
6. Further extrude core until sediment is just below top of core tube
7. Secure sectioning stage onto top of coring tube. Place sectioning tube (marked with a line 2 cm from the bottom) on the stage directly over the coring tube.
8. Slowly extrude the sediment core into the sectioning tube until the top of the sediment reaches the 2-cm line on sectioning tube.
9. Slide the 2 cm section of sediment into a clean pre-labeled 125 mL container for the top mercury sample (a pre-cleaned plastic spatula may be used to aid in transferring the sample to the container).

Sediment Slice Processing (Top)

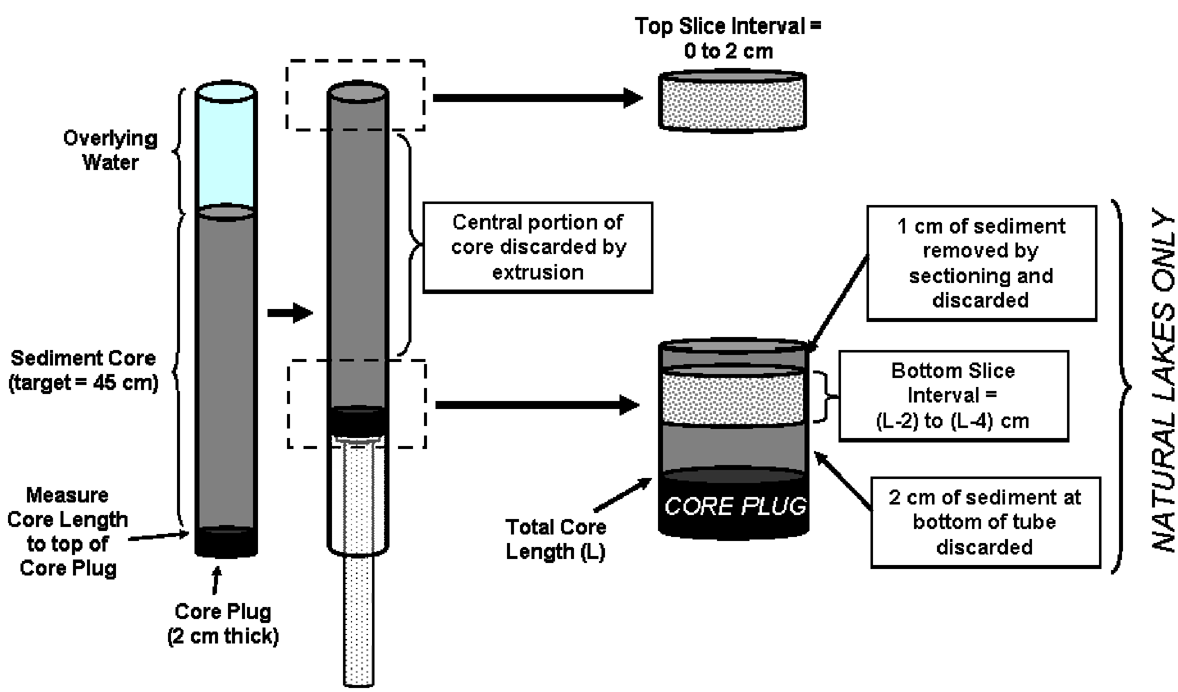
10. Using transfer pipette or pre-cleaned scoopula (rinsed with DI water), mix the sediment in mercury collection jar to homogenize
11. Withdraw a 5 mL sample from the homogenized sample. Transfer this 5 mL sample to the pre-labeled diatom container
12. The sediment remaining in the 125 mL container is the sediment mercury sample. Place the mercury sediment sample on ice and keep chilled until shipment.

Sediment Slice Collection (Bottom) In Natural Lakes ONLY:

1. Remove sectioning stage and rinse it, and sectioning tube in lake water thoroughly
2. Continue extruding the sample, discarding the central portion of sediment in tube, until bottom of stopper is approximately 7 cm (3 inches) from the top of the core tube
3. Rinse any sediment from your gloved hands, and re-affix the sectioning stage and sectioning tube to the top of core tube
4. Extrude the sample into the sectioning tube until the bottom of the stopper reaches lower black line at top of the coring tube (6 cm from top of tube)
5. Section the extruded sediment (approximately 1 cm) to achieve a clean cut, and discard
6. Rinse the sectioning tube with lake water
7. Carefully rinse sectioning stage (while still attached to core tube)
8. Replace sectioning tube on stage
9. Extrude sample until top of sediment is at the 2-cm mark on the sectioning tube.
10. Section this slice onto the stage.
11. **Collect 1/3** the 2-cm section of core material in the second 125 mL pre-labeled plastic mercury container
12. Collect the remainder of the slice (2/3) into the 60 mL sediment dating container
13. Discard the remaining 2 cm of sediment

Sediment Slice Processing (Bottom)

1. Using transfer pipette or pre-cleaned scoopula (rinsed with DI water), mix the sediment in mercury collection jar to homogenize
2. Withdraw a 5 mL sample from the homogenized sample. Transfer this 5 mL sample to the pre-labeled diatom container
3. The sediment remaining in the 125 mL container is the sediment mercury sample. Place the mercury sediment sample on ice immediately to freeze the sample and keep frozen until shipment.



Sediment Core Labels

- Ensure correct labels are attached to each container
- Record sampling interval for BOTTOM sample
  - Should be (L-2) to (L-4) cm

SEDIMENT DIATOMS BOTTOM (SEDB)
NLA2012- ________ Visit: ____
____/ ____/ 2012
___ - ___ cm interval
999011

Sediment Care Data

- If collection was at Index Site, fill “Index” bubble
- If collection was not at Index Site, fill “Other” bubble and provide GPS Coordinates
- Record total core length
- Record sample IDs for each sediment sample collected
- Record sampling interval for BOTTOM sample
  - Should be (L-2) to (L-4) cm
- Add any pertinent comments

NLA 2012 INDEX SAMPLE COLLECTION (Page 3 of 3) Reviewed by (Initial): ______

Site ID: NLA2012- Date: ___ / ___ / 2 0 1 2

SEDIMENT CORE SAMPLES
(Target Core Length = 45cm)

	Latitude	Longitude	
Decimal Degrees NAD 83	___ . ______	– ___ . ______	○ Index ○ Other

Length of Core: ____ cm Bottom of Core: ____ to ____ cm

SEDIMENT MERCURY TOP (SEDH)
(Target Volume = 50mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DIATOMS TOP (SEDT)
(Target Volume = 5mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DATING (SEDD)
(Target Volume = 35mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT MERCURY BOTTOM (SEDG)
(Target Volume = 20mL) No Sample Collected ○

Sample ID	Comments

SEDIMENT DIATOMS BOTTOM (SEDB)
(Target Volume = 5mL) No Sample Collected ○

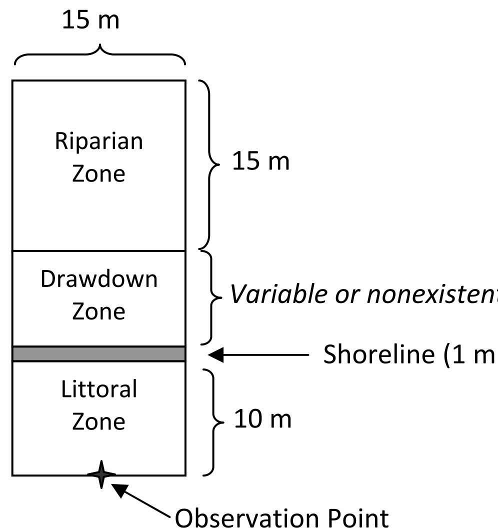
Sample ID	Comments

D. LITTORAL AND SHORELINE ACTIVITIES

Physical Habitat Characterization

Each lake that is sampled for NLA 2012 should contain 10 evenly spaced Littoral Stations (PHab Plots) around the perimeter of the lake. Each plot will measure 15 meters wide and will be broken down into the following characterization zones:

- littoral plot extending 10m out from the shoreline
- shoreline zone that is a 1 meter strip along the shore just above the present water line
- drawdown zone plot extending inland from the shoreline to the normal high-water level
  - o This is a variable distance inland depending on the degree of drawdown
  - o it may be negligible, and can be ignored if the lake is at its normal high water mark
- riparian plot that begins at the normal high water mark and extends 15m landward.



See Pages A-8 and A-9 for a description of PHab station placement, including a discussion of when island PHab stations should be added.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	**Form**	NLA 2012 Verification	1
		NLA 2012 Physical Habitat Characterization	10+
☐	**Collection**	Depth Sounder (hand-held or boat mounted sonar)	1
		Sounding rod (3 m , marked in 0.1 m increments, calibrated, PVC)	1
		GPS unit (with manual, reference card, extra battery)	1
		Rangefinder (for estimating horizontal drawdown)	1
		Clinometer (optional to measure vertical drawdown)	1
		Surveyors rod (optional for measuring vertical drawdown)	1
		Binoculars (for making observations of distant riparian)	1
		Map wheel or string (for measuring shoreline on site map)	1
		Anchor	1
		Buoy (for marking observation point)	1

General Data

- Record Station identifier
- Record if station was added, relocated, dropped, was unable to be sampled, or is on an island
- Measure the depth at the observation point
- Record coordinates of station
- Record any pertinent comments that will help explain the data

Physical Habitat Data

From an observation point 10 meters off-shore, characterize the following at each of PHab Stations:

Littoral Zone:

- Record presence or absence of water surface scums, algal mats, or oil slicks.
- Estimate areal cover of lake bottom substrate types
- Record sediment color and odor if possible.
- Estimate the areal coverage of aquatic macrophytes
- Estimate the areal cover of fish habitat

Shoreline Zone:

- Estimate areal cover of shoreline
- Estimate the angle of the shoreline bank

Drawdown Zone (if present)

- Estimate the vertical and horizontal distances between the present lake level and the high water line
- Estimate the potential cover of the various categories of fish habitat
- Estimate cover and type of vegetation from 3 layers
- Record the type of vegetation in the canopy and understory
- Estimate the areal cover of the vegetation,

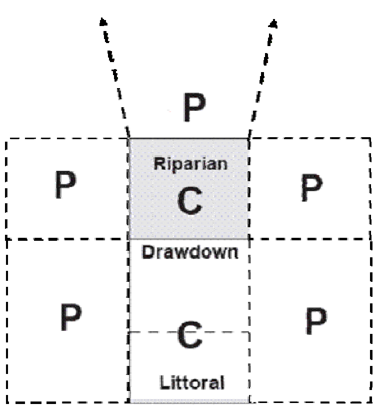
Riparian Zone

- Estimate cover and type of vegetation from 3 layers
- Record the type of vegetation in the canopy and understory

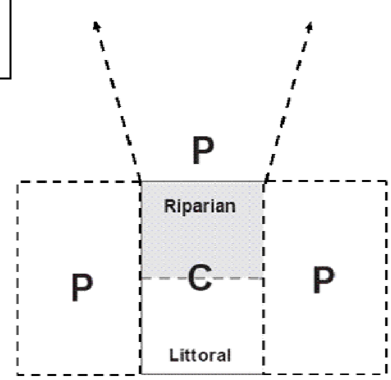
Human Influence Data

In addition to the physical habitat estimations above, make note of human influences observed in and/or near the riparian and littoral zones (combined) as well as the drawdown zone if it is present.

0 = Not Present
P = Present Outside Plot
C = Present Within Plot



Drawdown Zone Present



No Drawdown Zone Present

See Field Operations Guide Section 6.1 for more information

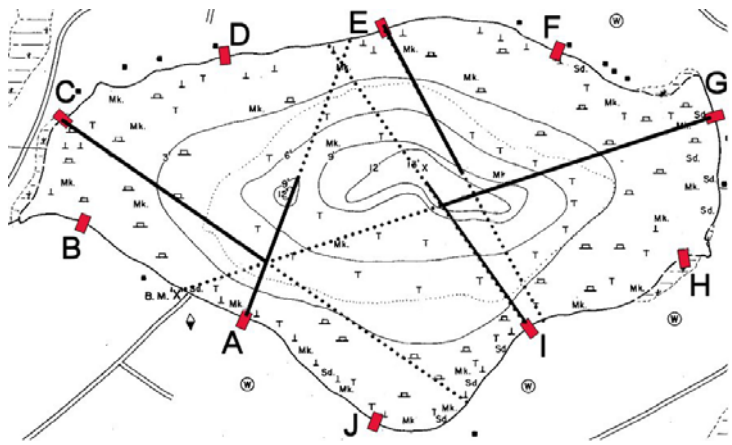
Macrophyte Assemblage Characterization

Macrophyte depth, density, diversity and growth form as well as presence of invasive species and maximum depth of plant colonization will be estimated using a double headed rake sampler attached to a rope.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	**Form**	Macrophyte Assemblage	1
☐	**Collection**	Rake sampler (attached to rope)	1

Transect and Sampling Point Layout



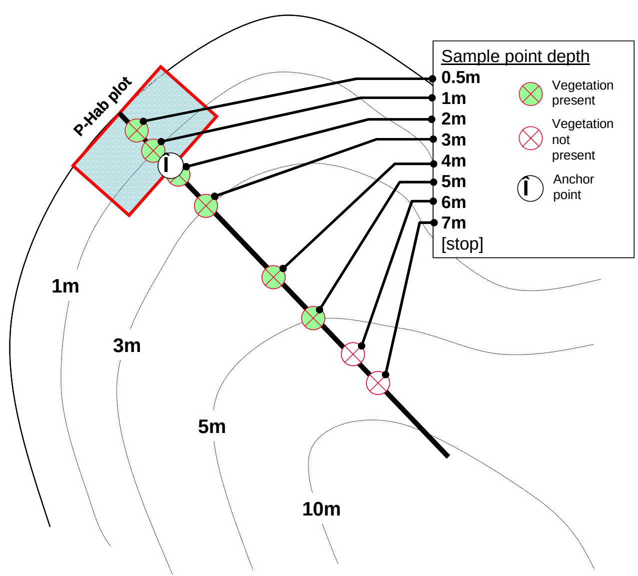
- Lay 5 transects perpendicularly from shore, extending through the midpoint of every other PHab station to ultimately reach up to halfway across the lake
- Place a minimum of 6 points per transect stratified by water depth, with the first point at 0.5m depth (± 0.2m), the second at 1m depth (± 0.2m), then continuing lakeward at regular 1m depth intervals
- Single rake tows will be taken at each point on the transect until one of the stop criteria apply. A rake tow will be performed at the location where the stop criterion applies.

Stop Criteria

A. Transect reaches halfway to the opposite shore.

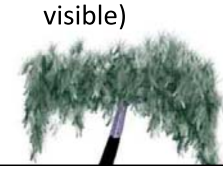
B. Littoral-profundal transition occurs, putting you deeper than the maximum depth of macrophyte colonization (often indicated by two consecutive rake samples having no plants present). *If evidence suggests that plants may be found further out, continue sampling. Initial MDC Transect may yield this evidence (See page D-16).*

C. 9 minutes have passed at slow-no-wake speed (approximately 1000 meters) with no additional points sampled.



Sampling Procedure

1. Navigate to the first macrophyte transect sample point (water depth at 0.5 m).
    a. Lower rake vertically through water column to *gently* rest on the sediment surface.
    b. Record depth to the nearest 0.1m
    c. Drag the rake sampler along the substrate for a linear meter, using short tugs on the rope.
    d. With a smooth and continuous motion, pull the rake sampler back up into the boat. Do not stop and start movement, or plants may fall off rake head
    e. Record plant rake density (include Charophytes) on a scale of 0-3. *Include any macrophytes dislodged or touched by the rake, or floating at the surface in the 1-m long strip.*

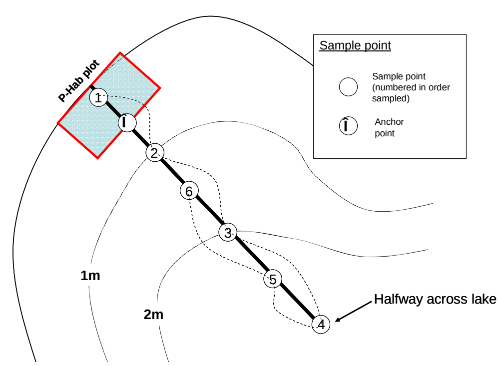
0 = No plants present	1 = Less than 25% of the rake is full	2 = 25% to 100% of the rake is full	3 = 100% of the rake is full (no tines visible)
			

    f. If filamentous algae presence is obvious (enough to roll into an approximately nickel-sized ball), record density on the same scale (0-3).
    g. If vegetation is present:
        i. Use the Plant Growth Form Key (Below) to determine growth form of all plants sampled with the rake, touched by the rake even or detached from the bottom by the rake.
        ii. Do not count filamentous algae as a species, in the plant density rating, or in determining maximum depth of plant colonization (see below).
    h. Invasives – note presence of invasive plants or animals identified (See next section)
2. Move to next sampling point (1.0 m depth) and sample using the same steps as above
3. Continue sampling points (every 1 meter of depth) until one the stop criteria apply
4. When one of the stop criteria applies, take a rake sample at that location

IF STOP CRITERIA APPLY AND A TOTAL OF 6 POINTS HAVE NOT BEEN SAMPLED:

5. Determine the number of additional sampling points required by subtracting the number of sampled points from 6.
6. Turn 180 degrees, face back toward shore.

7a. If you did not find plants at the end of the transect, and you are beyond the maximum depth of macrophyte colonization: Return to the greatest depth that you have observed plants on that lake (visually or at any transect) and proceed to Step 8.



7b. If you did find plants at the end of the transect, stay at the end of the transect and proceed to Step 8.

8. From the location determined in Step 7, evenly distribute the number of additional sampling points (as calculated in Step 5) along the transect toward shore, and among the original sampling points.

Plant Growth Form Key (see illustrations)

1. a. Plant stems extending above or leaves visible on the surface of the water, submersed leaves absent 2
1. b. Submersed leaves present, floating leaves present or absent....... 4

2. a. Floating leaves absent, leaves and/or stem extending above water .... EMERGENT
2. b. Leaves floating on or just under the water's surface 3

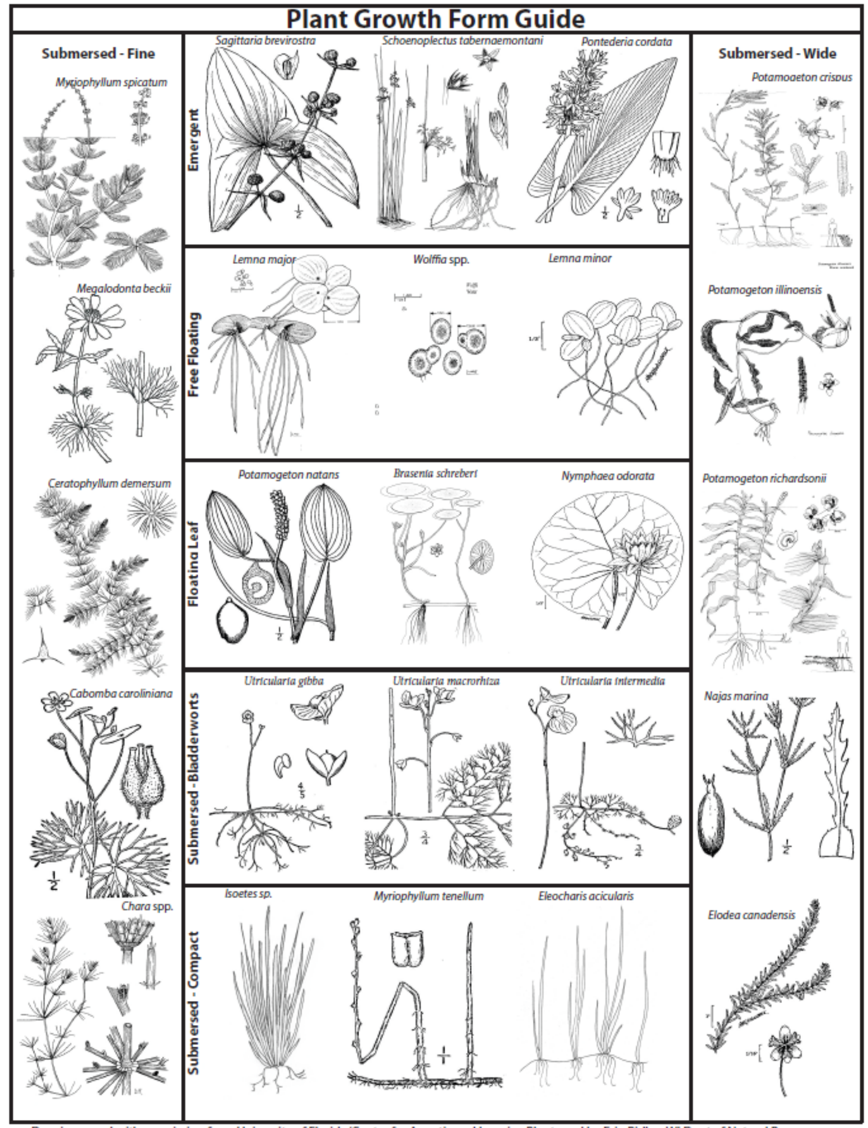
3. a. Leaves free floating, neither rooted to bottom nor attached to tuber .... FREE FLOATING
3. b. Plant rooted in sediment or attached to tuber .... FLOATING LEAF

4. a. Bladders borne on leaves or root-like branches...........................SUBMERSED – BLADDERWORT
4. b. No bladders present 5

5. a. Plant small and free floating, stem not apparent (*Lemna trisulca*)..................................... FREE FLOATING
5. b. Plant not as above... 6

6. a. Submersed plants having short stature (< 20cm) and compact growth form. Leaves originating from a single point at the base of the plant (basal) or plant consisting of short stalk with no apparent leaves ....SUBMERSED – COMPACT
6. b. Plants with well-developed stems or leaves extending into the water column. Leaves originating at the base or on stems (opposite, alternate or whorled 7

7. a. Submersed leaves fine less than 1 mm wide. If dissected, leaflets each less than 1 mm wide...SUBMERSED – FINE
7. b. Submersed leaves broad. over 1mm wide ...... SUBMERSED – WIDE



Drawings used with permission from University of Florida/Center for Aquatic and Invasive Plants and by Erin Ridley, WI Dept of Natural Resources.

Invasive Plants and Invertebrates

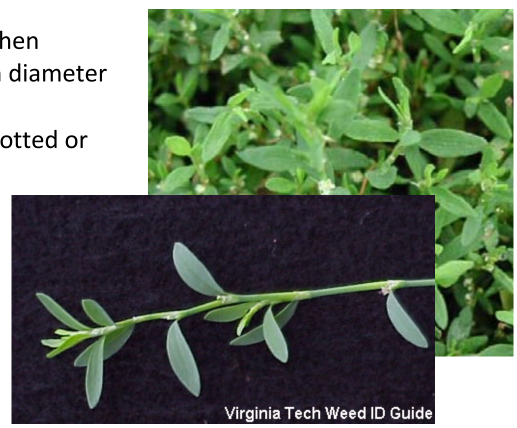
Record if any invasive plant or invertebrate species listed have been observed within the habitat plot(s). Check the boxes on the **Invasive Plants and Invertebrates** form for any species observed within the littoral, shoreline, or riparian plots. *(See FOM Appendix G for list of species with scientific names).*

Purple loosestrife (*Lythrum salicaria* L.)

- Square, woody stem and opposite or whorled leaves. Leaves are lance-shaped, stalkless, and heart-shaped or rounded at the base.
- Plants are usually covered by a downy pubescence.
- Loosestrife plants grow 4-10 feet high and produce a showy display of magenta-colored flower spikes throughout much of the summer.
- Flowers have five to seven petals.
- Invades many wetland types, including freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches.

Knotweed (*Polygonum aviculare*)

- Resembles a grass with long, dark green leaves when germinating. Later forms a flat mat up to 2 feet in diameter on slender wiry stems
- Papery sheath at each node that gives stems a knotted or swollen appearance.
- The leaves are alternate; small, narrowly oval; dull, bluish green; up to 1¼ inches long and 1/3 inch wide.
- Flowers are small, borne in clusters in leaf axils. The buds are purplish opening to white to yellow flowers during June through October. Germinates in early spring; grows through autumn.



Flowering rush (*Butomus umbellatus*)

- Flowers grow in umbrella shaped clusters; each individual flower has 3 whitish pink petals.
- Produce flowers in very shallow water or on dry sites.
- Green stems that resemble bulrushes but are triangular in cross section.
- Erect leaves; leaf tips may be spirally twisted.
- Grows to about 3 feet in height.

Common reed (*Phragmites australis)*

- **Appearance:** Common reed is a tall, perennial grass that can grow to heights of 15 ft. (4.6 m) or more. Broad, pointed leaves arise from thick, vertical stalks.
- **Foliage:** Leaves are 6-23.6 in. (15-60 cm) long, 0.4-2.4 in. (1-6 cm) wide, flat and glabrous.
- **Flowers:** The flower heads are dense, fluffy, gray or purple in color and 5.9-15.7 in. (15-40 cm) long.
- Flowering occurs from July to October.
- **Fruit:** The seeds are brown, light weight, and about 0.3 in. (8 mm) long.


Russian olive (Elaeagnus angustifolia L.)

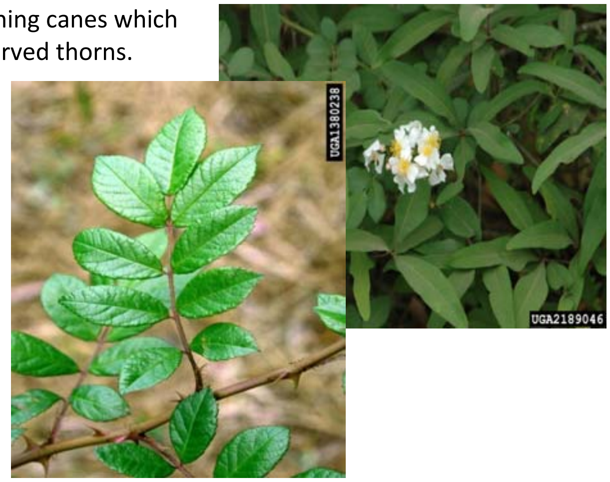
- Russian-olive is a small, usually thorny shrub or small tree that can grow to 30 feet in height.
- Stems, buds, and leaves have a dense covering of silvery to rusty scales.
- Leaves are egg or lance-shaped, smooth margined, and alternate along the stem.
- Highly aromatic, creamy yellow flowers appear in June/July and later replaced by clusters of abundant silvery fruits.


Reed canary grass (*Phalaris arundinacea*)

- Appearance: Reed canary grass is a cool-season perennial grass that grows to 6 ft. (1.7 m) tall. Reed
- Canary grass is variable in morphology, so characteristics may depend upon the habitat.
- Foliage: Leaf blades are flat, 1-4 ft. (0.3-1.2 m) long, up to 0.75 in. (1.9 cm) wide, glabrous and taper gradually.
- Flowers: The spreading flower/seed heads arise from hairless stems and can be green, purple, or brown in color and usually 3-6 in. (7.6-15.2 cm) in length. Flowering occurs from May to July.
- Fruit: The inflorescence color changes from green to purplish to tan as the seeds mature.

Multiflora rose (Rosa multiflora)

- **Appearance:** Multiflora rose is a multi-stemmed, thorny, perennial shrub that grows up to 15 ft. (4.6 m) tall. The stems are green to red arching canes which are round in cross section and have stiff, curved thorns.
- **Foliage:** Leaves are pinnately compound with 7-9 leaflets. Leaflets are oblong, 1-1.5 in. (2.5-3.8 cm) long and have serrated edges. The fringed petioles of multiflora rose usually distinguish it from most other rose species.
- **Flowers:** Small, white to pinkish, 5-petaled flowers occur abundantly in clusters on the plant in the spring.
- **Fruit:** Fruit are small, red rose hips that remain on the plant throughout the winter.



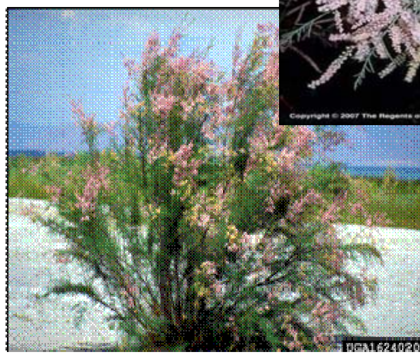
Canada thistle (*Cirsium arvense* L.)

- Canada thistle is an herbaceous perennial with erect stems 1½-4 feet tall, prickly leaves and an extensive creeping rootstock.
- Stems are branched, often slightly hairy, and ridged. Leaves are simple, lance-shaped, irregularly lobed with spiny, toothed margins and are borne singly and alternately along the stem.
- Fragrant, rose-purple to lavender, or sometimes white flower heads appear from June through October, and occur in rounded, umbrella-shaped clusters.

Mimosa (*Albizia julibrissin*)

- **Appearance:** Mimosa is a small tree that grows from 10 to 50 ft. (3-15.2 m) in height. It often has multiple trunks.
- **Foliage:** It has delicate-looking, bi-pinnately compound leaves that resemble ferns. Leaves close in the evening (nyctinastic movement).
- **Flowers:** Flowering occurs in early summer, when very showy, fragrant, pink flowers develop in groups at the ends of the branches. The flowers are sometimes called powder puffs.
- **Fruit:** Fruit are flat, 6 in. (15.2 cm) long seed pods that develop in the late summer.

Tamarisk or Salt Cedar (*Tamarix ramosissima*)



- Most saltcedars, or tamarisks, are deciduous shrubs or small trees growing to 12-15 feet in height and forming dense thickets.
- Saltcedars are characterized by slender branches and gray-green foliage. The bark of young branches is smooth and reddish-brown. As the plants age, the bark becomes brownish-purple, ridged and furrowed.
- Leaves are scale-like, about 1/16 inch long and overlap each other along the stem. They are often encrusted with salt secretions.
- Pink to white flowers appear in dense masses on 2-inch long spikes at branch tips from March to September.

Deeprooted Sedge (*Cyperus entrerianus)*

- A robust grass-like plant that grows up to 40" tall. Rhizomes deeply set, thick.ark purple to black leaf bases.
- Leaves basal, glossy, and flat or Vshaped.
- Leaf bases dark purple to black.
- Inflorescence terminal, with 5-11 elongate rays, ending in densely clustered spikelets.

Curly pondweed (*Potamogeton crispus* L.)

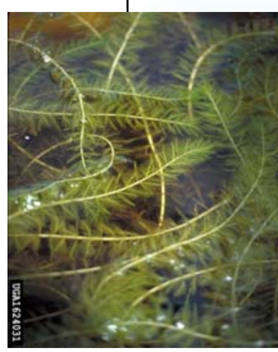
- Plants may grow up to 2 meters long. Very abundant from April to June.
- Leaves are 3 cm to 10 cm long, broad, linear and finely toothed, with undulated (curly) margins.
- Leaves are dark green with a reddish hue and have small teeth along the margins. Arranged alternately or slightly opposite on flattened, branched stems.
- Flowering occurs late spring-early summer; Plants begin to die-off in midsummer after vegetative buds are produced.

Zebra Mussel (*Dreissena polymorpha*)

- < 50 mm
- Color patterns vary; may be striped or have dark or light colored shells and no stripes
- Typically found attached to objects, surfaces, or each other by threads underneath the shells
- Forms dense mats that clog industrial water intakes and discharge pipes

Eurasian watermilfoil (*Myriophyllum spicatum* L.)

- Stems grow to the water surface, usually extending 3 - 10, but as much as 33, feet in length. Frequently forms dense mats.
- Long, slender, branching, hairless stems become leafless toward the base. Feathery appearance
- New plants may emerge from each node (joint) on a stem, and root upon contact with mud.
- Grayish-green leaves, finely divided, occur in whorls of 3-4 along stem, with 12-16 pairs of fine, thin leaflets about 12 inches long
- Small yellow, 4-parted flowers on a spike that projects 2-4 inches above the water surface.



Hydrilla (*Hydrilla verticillata*)

- Forms dense colonies and can grow to the surface in water over 20 feet deep.
- Branches profusely; extends across surface forming thick mats.
- Leaves are blade-like about 1/8- 3/8 inch long with small tooth margins and spines on the underside of the midrib which make them feel rough.
- Leaves are usually 4 to 8 in a whorl.

Brazilian Waterweed (*Egeria densa* Planch)

- Stems are elongate, slender, 2-3 mm thick, single or sparingly branched
- Leaves mostly in whorls of 4 at sterile nodes
- Leaves are nearly linear, very finely toothed on the margins, 1.4-2.5 cm long, 1.6-5.0 mm wide
- Flowers are 1.2-1.8 cm wide, unisexual Plants grow submersed, rooted in the substrate.
- Found in streams, ponds, lakes, and constructed lagoons (both still and flowing water)

European water chestnut (*Trapa natans L*)

- Upper floating leaves are diamond-shaped with toothed edges
- Leaves occur in clusters up to 20 inches across. Leafy stalks are inflated, spongy, up to 3 inches long
- 1/3 inch long flowers, solitary, white to light purple. Black, 4-horned, nut-like fruit is 1 inch wide and develops under water
- Found on quiet waters, forms extensive floating mats on water surface

Water Hyacinth (*Eichhornia crassipes*)

- Usually floats free in large masses but may be rooted in the mud.
- The plants may range from a few inches to as much as 3 feet in height.
- The leaves are 10-20 cm across, supported above the water surface by long, spongy and bulbous stalks
- They have slender rootstocks with rosettes of leaves and dark, fibrous, branching roots dangling beneath the plant. Flowers may be blue, violet, or white and are usually quite showy.

Parrotfeather (*Myriophyllum aquaticum*)

- Rooted, submerged (growing below the water) plants
- Bright green, stiff, feather-like foliage ("fir-tree-like") that can extend up to 1 foot above water's surface.
- Alternate or whorled leaves finely divided into many threadlike leaflets.
- Stem is stout and sparingly branched
- White flowers

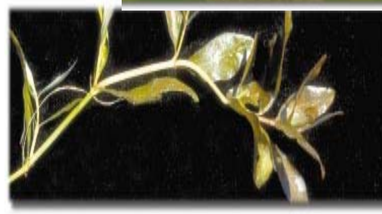
Yellow floating heart (*Nymphoides peltata*)

- Perennial, water lily-like plant that carpets the water surface with long-stalked, heart-shaped leaves.
- Showy five-petaled yellow flowers occur on long stalks and rise a few inches above water surface.
- Leaves average 3 to10 cm in diameter
- The fruit capsule is 2.5 cm long and contains numerous seeds. The seeds are oval and flat (about 3.5 mm long) and hairy along their outer edges.

Giant salvinia (*Salvinia molesta*)

- Small free-floating plant that grows in clusters and develops into dense, floating mats or colonies in quiet water.
- The floating leaves are oblong (0.5 to 1.5 inches long) with a distinct midrib along which the leaf may fold forming a compressed chain-like appearance.
- Upper surfaces of green leaves are covered with rows of white, bristly hairs.
- Leaf hairs have a single stalk that divides into four branches that reconnect at the tip, giving the hair a cage-like or egg-beater appearance.
- Underwater the leaves are modified into small root-like structures. The entire plant is only about 1 to 2 inch in depth.

Miramar weed (Hygrophila polysperma)

- Perennial aquatic herb with squarish stems ascending to creeping, mostly submersed, usually rooted in substrate; also roots freely at floating nodes.
- Leaves opposite, to 8 cm (3 in) long (aerial leaves smaller) and to 2 cm (0.8 in) wide, usually broader toward tip; sessile, with bases joined at node by ciliated flanges of tissue, the cilia (hairs) easily observed, to 1.5 mm long.
- Flowers small, solitary in uppermost leaf axils, nearly hidden by leaves, calyx 5-lobed, corolla bluish white, 2-lipped; 2 fertile stamens. Fruit a narrow capsule, splitting lengthwise to release tiny round seeds.
- **NOTE**: May be confused with small, opposite-leaved natives sometimes found submersed, such as *Ludwigia repens* and *Diodia* spp., but these without flanges at nodes (*Ludwigia)* or with flat-bristled flanges (*Diodia).* The native marsh species, *Hygrophila lacustris* (Schlecht. & Cham.) Nees is larger (aerial leaves to 15 cm long) and erect in habit, with larger flower s in axillary clusters along upper stems.

Narrowleaf cattail (*Typha angustifolia* L.)

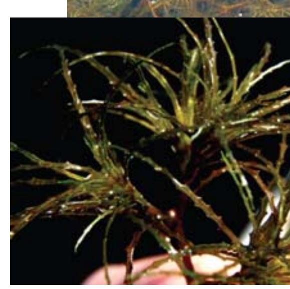
- Similar to broad-leaved cattail (*T. latifolia*) except that the staminate and pistillate portions of the spike are separated by 2 cm. or more of bare stem, the leaves are deep green and, overall, the plant is less robust. Also, the leaves typically extend beyond the spike. *T. angustifolia* generally occurs in deeper water than *T. latifolia*.
- T. angustifolia has long, slender, green stalks topped with brown, fluffy, sausage-shaped flowering heads.
- The spike is medium to dark brown.
- The basal leaves are thin with parallel veins running their long, narrow length. The leaves are 4-12 mm wide when fresh, 3-8 mm wide when dry.


Typha angustifolia


Typha latifolia


Typha angustifolia

Spiny naiad (*Najas minor*)

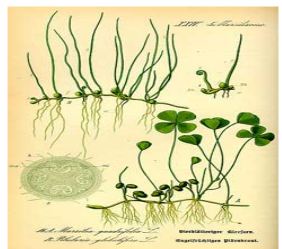
- Spiny naiad is a submersed aquatic plant found in slow-moving streams, ponds and Lakes that also may be referred to as slender, brittle, European or bushy naiad.
- Heavily-branched stems of the plant may reach up to 4 feet in length.
- Leaves are opposite, alternate or whorled around the stem and form “tufts” at the growing tip, giving the plant a bushy appearance. Leaves are thin, strap-shaped, 1-1.5in long, serrated and arch backwards.
- Leaves are stiff and maintain their shape out of the water.
- NOTE: Spiny naiad may be confused with native slender naiad. Serrations (spines) on spiny naiad are visible to the naked eye, whereas spines on slender naiad are only visible under significant magnification.

Water starwort *(Myosoton aquaticum* L.) Synonyms: giant chickweed or water chickweed

- This adventive perennial plant is 2"-24" tall, branching occasionally. The stems are erect or spreading, and more or less hairy. The opposite leaves are up to 2" long and 1" across.
- Single flowers may develop from the leaf axils of the upper stems, while the remaining flowers occur in small clusters at the end of stems. Each flower is about ½" across when it is fully open, consisting of 5 white petals. Each flower is replaced by a seed capsule that is ovoid.
- The root system is fibrous and produces rhizomes, which enables this plant to form vegetative colonies.

European pepperwort (*Marsilea quadrifolia*)

- Marsilea quadrifolia is a fern growing to 0.2 m. The plant requires moist or wet soil and can **grow in water.**



Alligatorweed (*Alternanthera philoxeroides*)

- Alligatorweed is a perennial, mat-forming member of the Amaranth family
- Stems are distinctly jointed and are hollow except at the nodes. The stems are light green in color with faint darker green parallel lines extending from one node to the base of the next.
- Leaves are oval to lance-shaped, have a prominent midrib, and are arranged opposite along the stem.
- Small, clover-like, white flowers are borne on short stalks attached in the leaf axils near the end of the stems. Flowering occurs from late April through October.

European or Pond waterstarwort (*Callitriche stagnalis*)

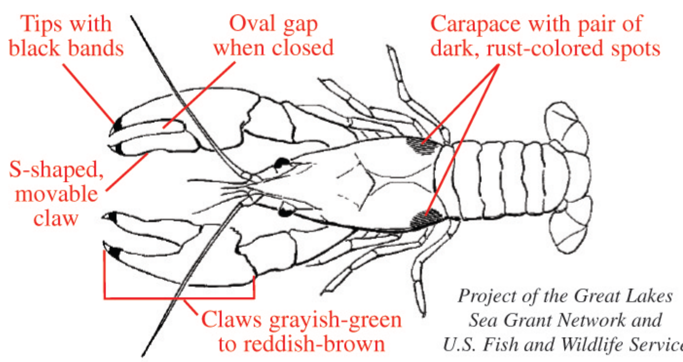
- Slender stems reach to the surface and form floating mats of leaves, which are often round to spoon-shaped but are variable in morphology. Plants are loosely rooted to the bottom with narrow underwater leaves and/or broadened floating leaves arranged in pairs along thin stems.
- Pond water-starwort usually has spoon-shaped floating leaves crowded at the stem-tip, whereas autumnal water-starwort has only narrow, underwater leaves.
- **Leaf:** Opposite. Narrow submersed leaves (up to 10 mm wide) with one rounded leaf tip are sometimes present. Oval or spoon-shaped floating leaves are up to 10 mm wide and are joined by tiny ridges at the base.
- **Stem:** Usually branched, rising to surface or sprawling.
- **Flower:** Tiny flowers lack sepals and petals and are located at the leaf bases on minute stalks. 2-4 tiny whitish bracts emerge from the flower base.

Water fern or Water spangles *(Salvinia minima)*

- Free floating, rootless aquatic fern. Horizontal, branching rhizomes float just below the water surface and produce, at each node, two floating to emergent leaves, and a third, submersed leaf that is dissected into filaments.
- Floating leaves are orbicular to oval in shape, with heart shaped bases and rounded to notched tips. Leaf length ranges from 0.4 to 2.0 cm.
- Smaller, orbicular leaves lie flat on the water surface; larger leaves become elongated and fold upright on the midrib

Rusty crayfish (*Orconectes rusticus*)

- Adults generally 3-5 inches (7.5-13 cm) long (nose to tail)
- Claws larger and smoother than other crayfish; usually without wart-like white bumps.
- Claws with oval gap when closed; no distinct thin slit or notch present.



Asian clam (*Corbicula fluminea*)

- Size<50 mm
- A small light-colored bivalve with shell ornamented by distinct, concentric sulcations, anterior and posterior lateral teeth with many fine serrations.
- The shell is ovate and deep at the hinge.
- Dark shell morphs exist but are limited to the southwestern United States.
- The inside of the shell is layered with polished, light purple nacre.

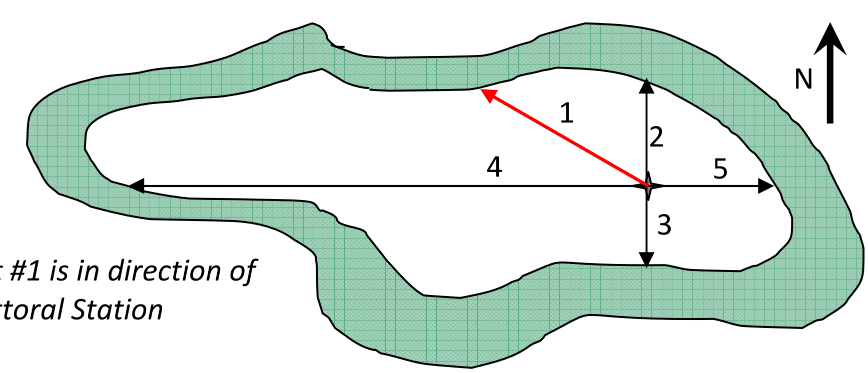
Estimating Maximum Depth of Plant Colonization (MDC)

Equipment

✓	TYPE	ITEM	QUANTITY
☐	**Form**	Macrophyte Assemblage	1
☐	**Collection**	Rake sampler (pole or rope mounted)	1

- MDC is equal to the deepest depth at which plants are found.
- To ensure an accurate estimation, the littoral-profundal transition must be sampled **at least five times** at each site.
- Ideally this transition will be encountered while sampling Macrophyte Assemblage Characterization transects and will be noted on the Macrophyte Assemblage form
- One MDC Transect will be performed upon leaving the index site (or from a deep area of the lake if the index site is not at least 12 meters deep, and deeper water is available) in the direction of the first Littoral Station to be sampled, following the steps below:
    1. Check depth. If depth is over 12m, begin transect and skip to step d. If depth is less than 12m, take a rake sample.
    2. If macrophytes occur, note this on the datasheet. If this is the deepest portion of the lake, you need not continue with MDC Transects. MDC = maximum lake depth.
    3. If macrophytes do not occur, navigate to shore in the direction of your first PHab location.
    4. As depths approach 12m, take a rake sample to look for the presence of macrophytes, and then again with every meter in depth lost. Stop when plants are observed, recording the depth to the nearest 0.1 meter.
- **After completing your macrophyte transects, if you still have not sampled the littoral-profundal transition five times**, navigate back to the index station (or deep water site, see above) and complete as many additional transects as necessary to estimate MDC, navigating in several different directions (i.e., north, south, west, east).
    - Complete as many transects as needed to estimate MDC on at least five transects (including the PHab transects and your initial MDC transect).
    - The deepest depth encountered with plants growing during the entire survey is the lake's MDC.

Start at the index site or deepest portion of the lake, perform 1 MDC Transect initially. 0-4 additional transects may be needed.



MDC Transect #1 is in direction of first Littoral Station

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates will be collected from the dominant habitat type at each of the 10 m x 15 m littoral plots. Sampling will be performed using a 500 µm mesh D-frame dip net to sweep through a 1 linear meter sampling area. Samples from all littoral plots will be composited in a sieve bucket.

NOTE: At the last PHab station (Station J), collect samples from the water column before collecting the benthos sample.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	Littoral Site Sample Collection Form	1
☐	Documentation	Labels: Benthic samples Scissors	1 1
☐	Collection	Kick net (500 µm D-shaped, modified) with 4 foot handle Bucket (5 gallon capacity, plastic) Sieve bucket (500 µm) Watchmakers' forceps Squirt bottle (1 L Nalgene) – lake water Stainless steel spoon HDPE bottle (1 L, white, wide-mouth))	1 1 1 1 1 1 1+
☐	Storing and preserving	Ethanol (95%) Plastic electrical tape	As needed

Sampling Procedure

1. Identify the dominant habitat type within the plot from the classifiers below:
   - Rocky/cobble/large woody debris
   - Macrophyte beds
   - Fines (Organic fine mud or sand)
   - Leaf pack
2. Use the D-frame dip net to sweep through 1 linear meter of the dominant habitat type, making sure to disturb the substrate enough to dislodge organisms.
   - If the dominant habitat is rocky/cobble/large woody debris it may be necessary to exit the boat and disturb the substrate (e.g., overturn rocks, logs) using your feet while sweeping the net through the disturbed area.
   - Because a dip-net is being used for sampling, the maximum depth for sampling will be approximately 1 m (the length of the dip-net handle); therefore, in cases in which the depth of the lake quickly drops off, it may be necessary to sample in the nearest several meters to the shore.
3. After completing the 1-m sweep, remove all organisms and debris from the net and place them in a sieve bucket which is within a 5 gallon bucket of water.
4. Proceed to the next sampling station and repeat steps 1-3, compositing all samples in the same sieve bucket
5. After all littoral plots are sampled, the composite benthos sample will be placed into one or more 1 liter bottles and preserved with ETOH (at least 500 mL per bottle).

Littoral Water Sample Collection (Station J)

Prior to collecting physical habitat and macroinvertebrate samples at the last littoral habitat station (J), collect water samples for, chlorophyll-*a*, phytoplankton, and algal toxins. These consist of grab samples collected at about 0.3 m below the water surface from a point within the littoral plot that is 1 m deep.

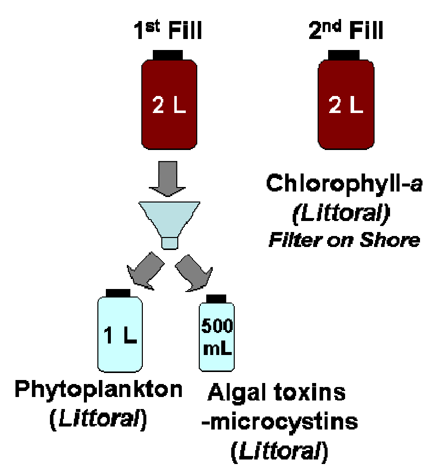
Collect two 2 L grab samples from 0.3 m below the water surface. using a 2 liter brown bottle (labeled Littoral). The first grab will be used to fill bottles for the phytoplankton (1 L bottle) and algal toxins (500 mL bottle) samples. The second grab will be used for the chlorophyll-*a* sample and will be taken to shore for filtering.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	Littoral Site Sample Collection	1
☐	Documentation	Labels: algal toxins, phytoplankton, chlorophyll a	3
☐	Collection	Poly bottle (2 L, brown, labeled LITTORAL) Gloves (latex/nitrile, non-powdered)	1 2
☐	Storing and preserving	HDPE bottle (1 L, white, narrow-mouth) – phytoplankton HDPE bottle (500 mL, white, wide-mouth) – algal toxins Wet ice Lugol's solution Cooler	1 1 As needed 5-10 mL 1

Sampling Procedure

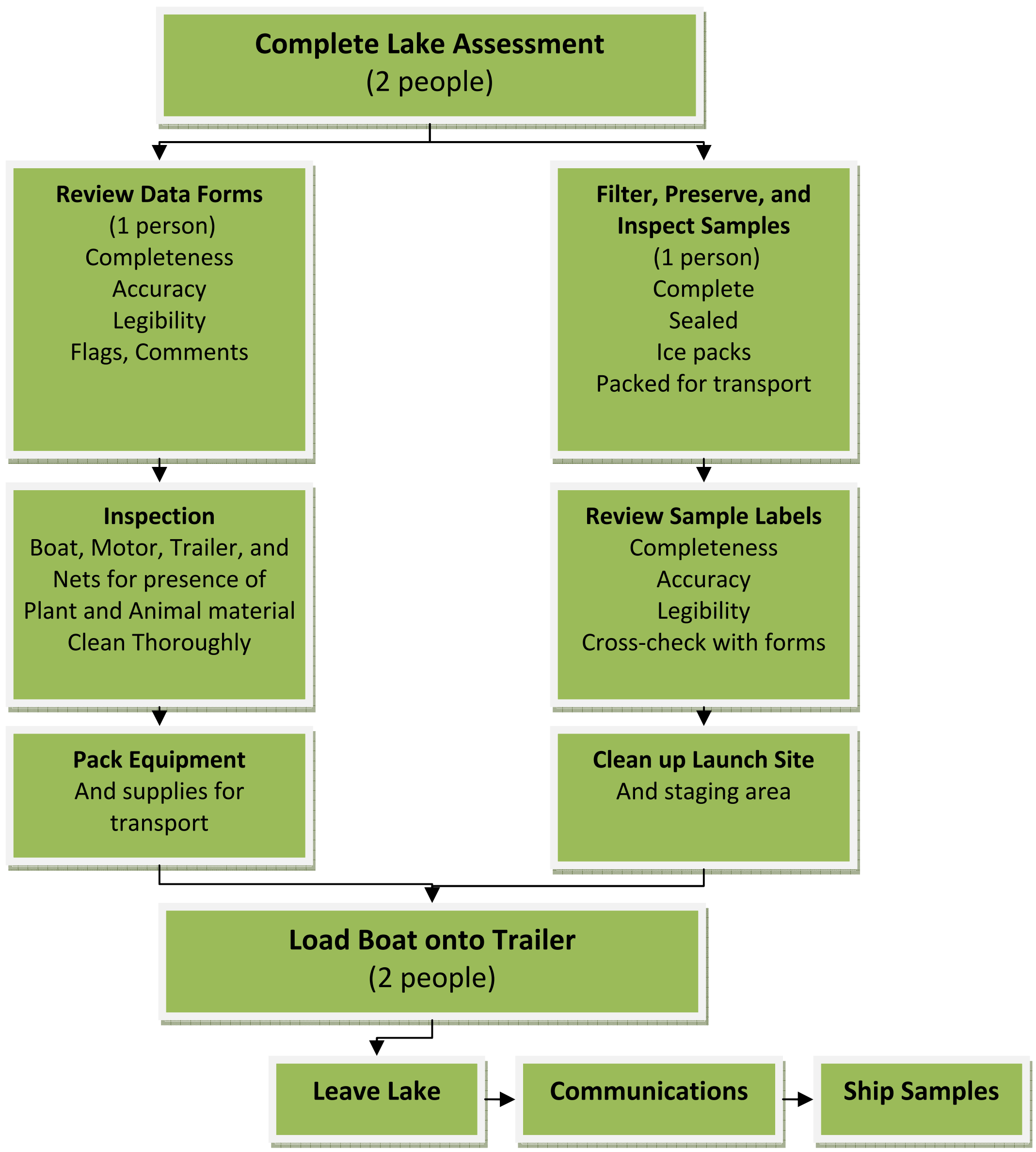
1. Make sure the container for phytoplankton and algal toxins samples have completed labels attached and that the labels are completely covered with clear tape.
2. Put on gloves (non-powdered).
3. Move slowly within the littoral plot until you locate a point that is 1m deep.
4. Rinse the brown poly bottle and cap three times with small volumes of lake water. Discard each rinse on the opposite side of the boat.
5. Fill the 2 L brown poly bottle by inverting and submerging to a depth of 0.3 m below the water surface, avoiding surface scum, vegetation, and substrates. Point the mouth of the container away from the body or boat. Right the bottle allowing it to fill completely and raise it up through the water column.
6. Fill the 1 L phytoplankton sample container from the 2L bottle, allowing enough headspace to add 5 mL of Lugol's solution. Add a small amount of Lugol's solution (5mL) until the sample resembles weak tea (If needed, add additional Lugol's 2-3 mL at a time), invert gently to mix, cap tightly, and place the bottle in the cooler with sealed 1 gallon plastic bag of ice.
7. Fill the 500 mL algal toxin container from the 2 L bottle. Cap tightly. Place the bottle in the cooler on wet ice.
8. Fill the 2 L bottle a second time using the procedure in Step 5. Cap tightly. This is the littoral chlorophyll sample, which will be filtered on shore. Immediately after sample is collected, place in cooler to minimize exposure to light and place on ice until filtration can be initiated.



E. FINAL SITE ACTIVITIES

After completion of sampling at a lake, there are a number of final site activities that the sampling crew must perform. These will be typically be done once the crew returns to the boat launch and includes the following:

- Completing General Lake Assessment Form (see FOM section 7.1)
- Filtering the Index and Littoral Chlorophyll-a samples
- Compositing benthos sample and preserving with ethanol
- Ensuring phytoplankton sample is preserved with Lugol's solution
- Ensuring zooplankton and benthos samples are preserved with ethanol
- Packing all samples either for shipping or holding
- Reviewing data forms and labels for completeness/legibility
- Decontaminating equipment and cleaning up launch site
- Making note of equipment and supply needs

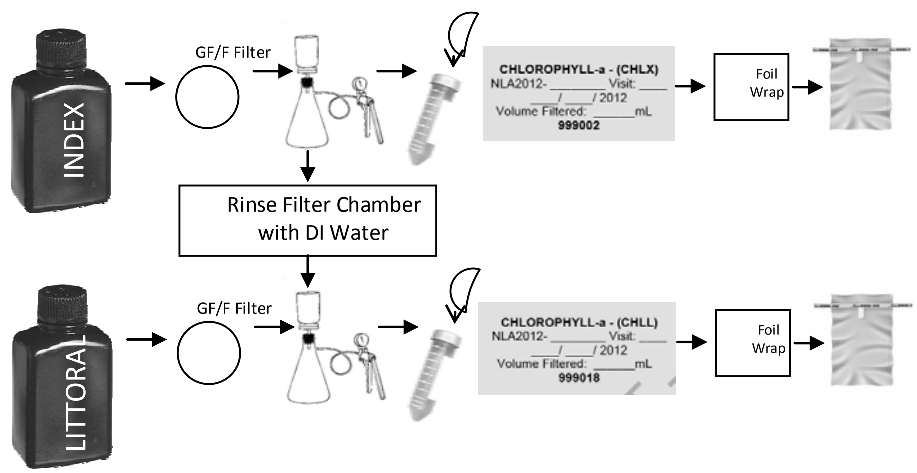


Filtering the Chlorophyll-*a* Sample

Both the Index and Littoral chlorophyll-*a* samples will be filtered using the same type of filters, apparatus and technique. Both samples will be filtered until a readily visible stain can be seen on the filter (up to 2 L max). Be sure to thoroughly rinse the filtering apparatus with DI water between samples.

Equipment

✓	TYPE	ITEM	QUANTITY
☐	Form	Index Site Sample Collection Littoral Site Sample Collection	1 1
☐	Documentation	Labels: Chlorophyll a samples	
☐	Processing	Poly bottle (2 L, brown) – with water samples Centrifuge tube (50 mL, screw top) in ziploc bag Filter forceps (flat blade) Filtration chamber (with filter holder) Filtration flask (with silicone stopper and adapter) Filtration pump (hand vacuum) Gloves (latex/nitrile, non-powdered, box) Graduated cylinder (250 mL) Squirt bottle (1 L Nalgene) – de-ionized (DI) water Test tube holder Whatman 0.7 µm GF/F glass fiber filter	2 2 2 1 1 1 1 pair 1 1 1 2
☐	Storing and preserving	Cooler Electrical tape Foil squares	1 As needed 2



Filtering Procedure

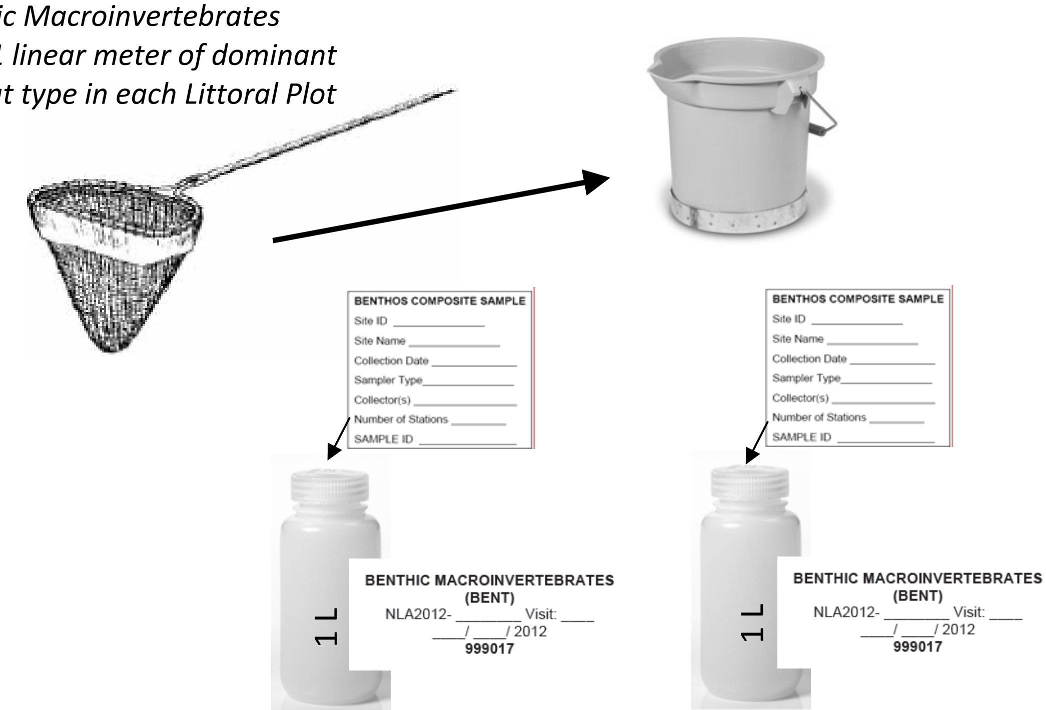
1. Put on gloves. Place a glass fiber filter in the filter holder apparatus with forceps, gridded side down.
2. Shake sample bottle to homogenize the sample
3. Measure and pour 250 mL of water into the filter holder, replace cap, and pump sample through the filter. NOTE: If the water is green or turbid, start with a smaller volume.
4. Observe filter for readily visible color. If there is readily visible color, proceed; if not, repeat steps 2 & 3 until color is visible on filter or until a maximum of 2 L has been filtered.
5. Record the actual sample volume filtered on the Sample Collection Form and on the sample label.
6. Rinse the graduated cylinder and sides of filtration chamber with DI and pump through the filter.
7. Remove filter from holder with clean forceps. Avoid touching the colored portion of the filter. Fold the filter in half, with the colored side folded in on itself.
8. Place the folded filter into a 50 mL screw-top centrifuge tube and cap. Attach label to the centrifuge tube (do not cover the volume markings on the tube), and cover with clear tape.
9. Wrap the tube in aluminum foil and place in a re-sealable plastic bag. Place this bag between two small bags of ice in a cooler.
10. Rinse filter chambers with DI water.

Repeat steps 2 through 10 for the littoral site sample

Preparing composite samples for benthic macroinvertebrates

1. As benthic samples are collected, they are composited into a sieve bucket.
2. Remove any large objects and wash off any clinging organisms back into the sieve before discarding.
3. Fill in a sample label with the Site ID and date of collection. Attach the completed label to the jar and cover it with a strip of clear tape. Record the sample ID number for the composite sample on the Sample Collection Form.
4. Wash the contents of the sieve bucket into a jar using as little water as possible. Fill each jar not more than half full, use a second jar if necessary.
5. Carefully examine the sieve bucket for any remaining organisms and use watchmakers' forceps to place them into the sample jar.
6. If a second jar is needed, fill in a sample label that does not have a pre-printed ID number on it. Record the ID number from the pre-printed label prepared in Step 3 in the "SAMPLE ID" field of the label. Attach the label to the second jar and cover it with a strip of clear tape. Record the number of jars required for the sample on the Sample Collection Form. **Make sure the number you record matches the actual number of jars used.** Write "Jar *N* of *X*" on each sample label using a waterproof marker ("*N*" is the individual jar number, and "*X*" is the total number of jars for the sample).
7. Place a waterproof label inside each jar with the required information written with a number 2 lead pencil:
8. Completely fill the jar with 95% ethanol (no headspace). End concentration of ethanol should not be below 70%.
9. Replace the cap on each jar. Slowly tip the jar to a horizontal position, then gently rotate the jar to mix the preservative. Do not invert or shake the jar. After mixing, seal each jar with plastic tape.
10. Store labeled composite samples in a container with absorbent material that is suitable for use with 70% ethanol until transport or shipment to the laboratory.

Benthic Macroinvertebrates from 1 linear meter of dominant habitat type in each Littoral Plot



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NLA 2012 Sample Summary

COLLECTION LOCATION	SUBSTANCE COLECTED	COLLECTION DEVICE	COMPOSITING CONTAINER	COLLECTION VOLUME (TOTAL COMPOSITE)	FIELD PREPARATION
Index Site	Water from within the Euphotic Zone 2 meter max depth	Integrated Sampler (Grabs #1 and #2)	4 Liter Cubitainer	4 Liters	Shake to mix well
Index Site	Water from within the Euphotic Zone 2 meter max depth	Integrated Sampler (Grabs #3 and #4)	4 Liter Cubitainer	====	====
Index Site (Select Sites)	Water from a few cm below surface	60 mL syringe with 3-way stopcock and filter attached and NEW needle each time	====	====	====
		60 mL syringe with 3-way stopcock and filter attached and NEW needle each time	====	====	====
		60 mL syringe with 3-way stopcock with filter attached (NO needle)	====	====	====
Index Site	Zooplankton Vertical 5 meter tow	150 Micron Wisconsin net with collection bucket	Concentrate in attached collection bucket	====	Narcotize for 1 minute by placing bucket in narcotizing chamber with CO_2 tablets
Index Site	Zooplankton Vertical 5 meter tow	50 Micron Wisconsin net with collection bucket	Concentrate in attached collection bucket	====	Narcotize for 1 minute by placing bucket in narcotizing chamber with CO_2 tablets
Index Site (2007 resample sites only)	Zooplankton Vertical tow from 0.5 meters to surface	243 Micron Wisconsin net with collection bucket	Concentrate in attached collection bucket	====	Narcotize for 1 minute by placing bucket in narcotizing chamber with CO_2 tablets
Index Site (2007 resample sites only)	Zooplankton Vertical tow from 0.5 meters to surface	80 Micron Wisconsin net with collection bucket	Concentrate in attached collection bucket	====	Narcotize for 1 minute by placing bucket in narcotizing chamber with CO_2 tablets
Index Site	Sediment (TOP 2 cm section)	Gravity Sediment Corer	125 mL Screw Top Jar	2 cm Slice (approximately 65 mL)	Stir with pre-cleaned transfer pipette or plastic scoopula
	Sediment (BOTTOM 2 cm section)	Gravity Sediment Corer	60 mL Screw Top Jar	2/3 of 2 cm Slice (approximately 40 mL)	====
			250 mL Screw Top Jar	1/3 of 2 cm Slice (approximately 25 mL)	Stir with pre-cleaned transfer pipette or plastic scoopula
10+ Litorral Stations	Benthic Macroinvertebrates from 1 linear meter of dominant habitat type in each Litorral Plot	Modified D-frame Kick net (500 micron)	Seive Bucket inside 5 gallon bucket of water	====	Concentrate all 10+ station grabs in seive bucket
Final Littoral Station (Station J)	Water from 1 ft below surface	2 L Brown Nalgene Bottle Labelled LITORRAL		2 Liters	Shake to mix well
	Water from 1 ft below surface	2 L Brown Nalgene Bottle Labelled LITORRAL	====	====	====

SAMPLE		SAMPLE TARGET VOLUME	SAMPLE CONTAINER	PRESERVATION / PREPARATION	SHIPPING TIME FRAME	PACKAGING FOR SHIPMENT
CHLX Chlorophyll-a	Collection	2 L	2L Brown Nalgene Bottle Labeled INDEX	Wet ice in field		
	Processing	Readily visible stain on filter - max of 2000 mL filtration	Filter in 50 mL centrifuge tube	Wet ice in field after filtration	Within 24 hours	Ship in **WRS** cooler with wet i
PHYX Phytoplankton (Index)		1 L	1 L Narrow-mouth Nalgene Bottle	~5 mL Lugol's solution (Weak tea color) Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
TRIA Triazine Pesticide Screen		60 mL	60 mL Wide-mouth Nalgene bottle	Wet ice in field	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
NUTS Nutrients		250 mL	250 mL Brown Wide-mouth Nalgene Bottle	Add acid from ampule(s) provided. Use pH paper to ensure pH of <2. Wet ice in field	Within 24 hours	Ship in **WRS** cooler with wet ice
MICX Algal Toxin (Index)		500 mL	500 mL Wide-mouth Nalgene Bottle	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
CHEM Water Chemistry		4 Liters	Keep in 4 Liter Cubitainer	Purge as much air as possible Wet ice in field	Within 24 hours	Ship in **WRS** cooler with wet ice
CARU Dissolved Carbon Unacidified Vial (Blue taped)		15 mL	Serum bottle with BLUE tape	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
CARP Dissolved Inorganic Carbon Acidified Vial (Pink Taped)		15 mL	Serum bottle with BLUE tape	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
ISOT Water Stable Isotopes		10 mL	10 mL Vial	NO Air Bubbles Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
ZOCN Zooplankton (Coarse - 150 micron)		All Organisms in sample	125 mL Wide-mouth Bottle (additional if necessary - fill each only half full)	95% Ethanol to fill bottle	1-2 Weeks	Ship in **NON-Chilled Batched** cooler with absorbent material, NO ICE
ZOFN Zooplankton (Fine - 50 micron)		All Organisms in sample	125 mL Wide-mouth Bottle (additional if necessary - fill each only half full)	95% Ethanol to fill bottle	1-2 Weeks	Ship in **NON-Chilled Batched** cooler with absorbent material, NO ICE
ZOCR Zooplankton (2007 Coarse - 243 micron)		All Organisms in sample	125 mL Wide-mouth Bottle (additional if necessary - fill each only half full)	95% Ethanol to fill bottle	1-2 Weeks	Ship in **NON-Chilled Batched** cooler with absorbent material, NO ICE
ZOFR Zooplankton (2007 Fine - 80 micron)		All Organisms in sample	125 mL Wide-mouth Bottle (additional if necessary - fill each only half full)	95% Ethanol to fill bottle	1-2 Weeks	Ship in **NON-Chilled Batched** cooler with absorbent material, NO ICE
SEDT Sediment Diatoms (TOP)		5 mL (withdraw from composite with pipette or scoopula)	15 mL Screw Top Jar	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
SEDH Sediment Mercury (TOP)		60 mL (Remainder of composite)	Leave in 125 mL jar	Wet ice in field	Within 24 hours	Ship in **WRS** cooler with wet ice
SEDD Sediment Dating		40 mL	60 mL Screw Top Jar	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
SEDB Sediment Diatoms (BOTTOM)		5 mL (withdraw from composite with pre-cleaned syringe)	15 mL Screw Top Jar	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
SEDG Sediment Mercury (BOTTOM)		20 mL (Remainder of composite)	Leave in 125 mL jar	Wet ice in field	Within 24 hours	Ship in **WRS** cooler with wet ice
BENT Benthic macroinvertebrates		All organisms in grabs	1 L Nalgene Wide-mouth bottle(s) Fill **half-full** with sample only	95% Ethanol to fill bottle	1-2 Weeks	Ship in **NON-Chilled Batched** cooler with absorbent material, NO ICE
PHYL Phytoplankton (Littoral)		1 L	1 L Narrow-mouth Nalgene Bottle	~5 mL Lugol's solution (Weak tea color) Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
MICL Algal Toxin (Littoral)		500 mL	500 mL Wide-mouth Nalgene Bottle	Wet ice in the field Keep chilled (refrigerator or ice)	1-2 weeks (Keep **chilled** until Shipping)	Ship in **Chilled Batched** cooler with wet ice
CHLL Chlorophyll-a	Collection	2 L	2L Brown Nalgene Bottle Labeled LITTORAL	Wet ice in field		
	Processing	Readily visible stain on filter - max of 2000 mL filtration	Filter in 50 mL centrifuge tube	Wet ice in field after filtration	Within 24 hours	Ship in **WRS** cooler with wet ice

SHIPPING TIME-FRAMES

WRS – Ship with 24 hours

Batched Chilled – Ship within 1 Week

Batched Non-Chilled –Within 2 Weeks

NLA 2012 Shipping Summary

SHIPPING TIME-FRAMES

WRS – Ship with 24 hours
Batched Chilled – Ship within 1 Week
Batched Non-Chilled –Within 2 Weeks

"WRS" Samples

(1) 4 L Cubitainer
- CHEM

(1) 250 mL Brown bottle (Brown)
- NUTS

(2) 50 mL cent. tubes with filters
- CHLX
- CHLL

(2) 125 mL screw top jar*
- SEDH
- SEDG

*only 1 in reservoirs

Pack 1 site's worth of samples in Lined Cooler with ice in bags

SHIP WITHIN 24 HOURS (MONDAY – FRIDAY)

FedEx Express

PRIORITY OVERNIGHT

Chilled Batched Samples (PER SITE)

(2) 500 mL Wide-mouth bottle
- MICX
- MICL

(1) 60 mL Wide-mouth bottle
- TRIA

(2) 1 L Narrow-mouth bottle
- PHYX
- PHYL

(2) Glass serum vials†
- CARP
- CARU

(1) 10 mL vial†
- ISOT

(1) 60 mL Screw top jar‡
- SEDD

(2) 15 mL Screw top jars*
- SEDT
- SEDB

** only 1 in reservoirs*
† selected sites only
‡ natural lakes only

Pack up to 3 site's worth of samples in Lined Cooler with ice in bags

SHIP MONDAY – FRIDAY TO **GLEC**

FedEx Express

PRIORITY OVERNIGHT

Non-Chilled Batched Samples (PER SITE)

(2 or 4) 125 mL Wide-mouth bottle
- ZOCN
- ZOFN
- ZOCR (at 2007 Lakes)
- ZOFR (at 2007 Lakes)

(1or more) 1 L Wide-mouth Bottle(s)
- BENT

Pack 3-5 site's worth of samples in Lined Cooler with NO ICE

SHIP ANYTIME TO **GLEC**

FedEx Ground

GROUND

Completed Data Packs

All Data forms from a site, reviewed for completeness, legibility and accuracy

Make copies or scans as backup

Organize in order specified in FOM

Place in envelope or box with tracking form

SHIP ANYTIME TO **WED**

FedEx Express

See FOM Appendix E for detailed shipping guidelines

NOTES:

This page can be used to record notes with erasable marker or grease pencil as needed.