

BASELINE LAKES STRATEGY & PROTOCOL

DRAFT - REVISED 11/15/02 (Simonson)

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Lakes Monitoring Strategy

Goal

The goal of the lakes monitoring strategy is to determine the status of and trends in fisheries and ecosystem health and condition as measured by fish population and community characteristics and lake trophic status. The focus of the lakes monitoring program is to evaluate the effects of human use, such as broad scale changes in land use, shoreline development, and fishing, on lake resources. We will sample all high-visibility waters and a sub-sample of other waters. The information collected will provide:

- A context for comparing data collected from all lakes and the capacity to compare similar lakes to each other.
- Information from trends lakes that will generate a context to compare lake health through time.
- An inventory of lake condition and health.
- An answer to initial questions about the impacts of stressors on fish communities and trophic status within individual lakes.
- A screening tool to initiate further field investigations to confirm apparent water quality or fisheries problems.
- A standardized set of spatial and temporal data that can be compared to current lake conditions.
- The capacity to make a statewide determinations about the overall health of our lake resources.

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There are five objectives that are critical to the success of a lake monitoring program. The first two short-term objectives are necessary to fully implement the baseline lakes monitoring program as proposed in Objectives Three through Five.

Objective 1. Develop and Evaluate a Statewide Lake Stratification Framework

Approach/design

Target Lake Population:

The monitoring program will focus primarily on assessing status and trends in Tier I lakes, defined as > 100 acres in surface area with public access. Sampling of Tier II lakes (< 100 acres with public access) is included on a reduced scale.

The design of the program includes both status and trend lakes. The status lakes provide spatial data needed for baseline monitoring and statewide assessments. By sampling these lakes on a six-year rotation, we can augment the trend lakes. The trend lakes will be monitored every year for water quality, and every three years for fish. This will provide information on inter-annual variability as well as trends in lakes representative of the lake strata defined below. Regional staff should select lakes to be sampled for trends to be representative of each of the lake strata (discussed below).

Lake Classification:

- Lakes will be hierarchically stratified according to physiography (basin and ecoregion), hydrology (seepage, headwater drainage, and lowland drainage types, including impoundments), and morphometry (shallow and deep). Additional limnological parameters that will be needed to refine this initial stratification include calcium, magnesium, nitrate+nitrite, total Kjeldahl-N, color, and total alkalinity. These measures will be collected during the first sampling of each lake.
- Stratification of lakes is necessary to minimize variance among lakes in fisheries and water quality metrics related to morphometry, hydrology, and geologic setting. This will permit us to better understand the effects of outside influences (i.e. climate and human use) on lake status. Therefore, stratification for the purposes of baseline monitoring will not include measures that we plan to test as drivers of ecosystem health, such as current or future watershed and riparian land-use, recreational potential, or development. In addition, stratification allows us to efficiently extrapolate information to non-sampled lakes.

Anticipated Results

- Identify distribution and characteristics of the population of Tier I (>100 acres with public access), and Tier II lakes proposed in the stratification framework.
- Collate existing data on lakes within target basins and design field sampling to fill in gaps in the data.
- Refine stratification framework as necessary.

Benefits:

- Sets the foundation for lake monitoring efforts, both for measuring status and trends.
- Provides a high-resolution stratification scheme with robust classes that are sensitive to inferences on the effects of human activities on lake ecosystem health.
- Uses existing knowledge where practical and involves field staff in refining database.
- Provides inference on the condition of non-sampled Tier I and Tier II lakes.
- Minimizes variability due to geomorphic factors, thus increasing power to detect effects of external drivers that affect ecosystem health of state waters.

Objective 2. Identify and refine metrics to appropriately assess the health of fisheries and ecosystems in lakes. Determine properties of metrics, including robustness, variability, and sensitivity to changes in lake ecosystem health.

Metrics Related to Ecosystem Health:

We have identified three groups of metrics that provide different endpoint measures of the effects of stressors (e.g., fishery exploitation, riparian development, and watershed land use change) on ecosystem health. These metrics are easily measured and well understood, as they are either currently used by FH staff or are in the process of development. Together, they will provide some redundancy as measures of ecosystem health and offer complementary measures of lake ecosystem function.

A complete sampling protocol should commence in the spring of 2000, and all three metrics should be sampled during the same calendar year for each lake on the plan. These metrics should be considered the minimum. During the first biennium we will also explore the usefulness of metrics to measure angler harvest and habitat changes.

- **Trophic Status Indices (TSI)** → We will assess trophic status by measuring the following water quality variables during the period of peak stratification (usually around the month of August): total phosphorus (TP), Secchi disk transparency, chlorophyll, dissolved oxygen profiles, temperature profiles, and color. Other water quality parameters (calcium, magnesium, total alkalinity, total Kjeldahl nitrogen, and nitrate+nitrite) will be assessed for use either in the lake

stratification framework or for incorporation into the TSI. In addition, to help with the development of phosphorus loading models, a spring total phosphorus sample will be collected from each lake.

- **Fish IBI** → Currently under development, the IBI uses characteristics of littoral zone fish assemblages as an index of environmental health. This type of metric has proven to be a sensitive indicator of riparian and watershed land use changes, and it can be calibrated to reflect other water quality problems. The fish IBI will be developed by compiling a species list using a combination of sampling gears and by evaluating proportional abundances of species or guilds of fishes that may be sensitive to anthropogenic influences.

Gamefish → Gamefish sampling will be conducted during the fall. We will estimate the relative abundance of all fish species sampled, size structure of targeted gamefish populations, and an index of target gamefish growth.

Anticipated Results:

- Identify robust, efficient, sensitive, and reliable metrics.
- Use existing data and data collected as part of Objective 1 to develop statistical distributions of metrics within lake strata for Tier I and II lake populations.
- Further refine the fish IBI and use additional habitat measures (i.e. macrophyte distributions, Floristic Quality Index, etc.) to aid in interpretation of lake index values.
- Determine the appropriate frequency and intensity of metric sampling to meet the goals of trends and status parts of lake monitoring strategy.

Benefits:

- Increases confidence that proposed metrics are appropriate, will meet goals of monitoring program, and are statistically robust.
- Provide standardized and consistent methods and data to evaluate statewide fisheries management activities.

Objective 3. Design Baseline Plan for Condition Monitoring

Components:

- Develop a statistically sound sampling scheme for determining status of Tier I lakes within each lake strata on a rotating frequency of six years.
- Develop a statistically sound sampling scheme for determining status of Tier II lakes within each lake strata.
- Incorporate appropriate duplication to evaluate variability associated with field sampling and within-season components.
- Identify the health and condition of each sampled lake.
- Develop a work plan to minimize sampling variability between field crews and use department resources efficiently to encourage participation of all interested personnel.
- Integrate the new strategy with existing Water Division monitoring programs, including the treaty fisheries assessment, and volunteer monitoring.
- Link metrics to watershed and shoreline land use information.

Benefits:

- Provides spatial data within a stratified design to develop an index of statewide lake condition.
- Allows tracking of statewide lake condition over time.
- Contributes towards development of a comprehensive data set on the state's lakes that can be used for project planning and individual lake assessments.
- Provides inferences on the condition of non-sampled Tier I and II lakes.
- Provides information on the attainment status of lakes for aquatic life use designations.

Objective 4. Design an efficient monitoring program that assesses trends in the metrics measuring the ecosystem health of the state's lakes.

Components:

- Develop a sampling design that incorporates the appropriate frequency and intensity of sampling to evaluate inter- and intra-annual variability in metrics among lakes in each stratum.
- Include lakes from both Tier I and II lake populations, with Tier I lakes comprising a bigger component of the program.
- Design a program that allows detection of trends in lakes from both Tier I and II populations.

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Benefits:

- Provides a continuous record for representative lakes from each stratum as a context for interpreting inter-annual variability related to extrinsic factors (e.g., climate; see Objective 3).
- Provides information on long-term trends in a representative subset of lakes across the state.

Objective 5. Determine the status of and trends in human uses of lake resources. Document the links between human actions and lake ecosystem health.

Components:

- Develop reliable metrics to assess lake habitat changes.
- Develop in-lake habitat assessment metrics that evaluate long term status of and trends in lake health.
- Determine interactions between biotic and habitat features and develop a model to understand these linkages.
- Provide assessment of human use in conjunction with other biotic/abiotic sampling events.
- Develop reliable measures of human uses of lake resources and link these to lake condition.

- Assess baseline riparian and watershed land use practices and link these to their effects on wetland and lentic systems.
- Develop a scaled-down creel survey event that is a companion to lake ecosystem health assessment.
- Concentrate on angler harvest information on a broad number of lakes.
- Develop or locate standard GIS layers on land use changes.

Benefits:

- Develops linkages between biotic indicators and in-water habitat.
- Data is collected in conjunction with other efforts and augments existing fish management goals and objectives.
- Collects regional and local information on human uses.
- Uses habitat as a complementary measure of ecosystem health.
- Develops understanding of baseline land use issues.
- Builds on existing monitoring programs.
- Integrates new strategy with existing Water Division monitoring programs, including treaty fisheries assessment and volunteer monitoring.

Lake Monitoring Guidelines

Fisheries Surveys

Tier I (> 100 acres, public access) Lakes

Summer Fish Community Assessments: During the summer (July and August), sampling of littoral zone fish communities will be conducted with mini-fyke nets. The number of randomly selected stations will be scaled to lake size. At least six sets should be used on lakes <500 acres, and at least 8 sets on lakes > 500 acres. The number of sets suggested here should be considered the minimum. Nets must be set by mid-afternoon and fished overnight. The number of each species captured should be recorded, with separate counts kept for young-of-year (YOY). Each net-set should be recorded on a separate data sheet (do not combine catches from more than 1 net on a data sheet).

Recommended nets are the same as those recommended for comprehensive surveys, and have two 3'x2' frames (3'x3' frames are also acceptable), four 2'-diameter hoops spaced 2' apart, and a 30"x 2' lead. Nets used should be 3/16"-mesh, died green, with 1"-mesh exclusion netting.

Fall Gamefish Assessments: Fall sampling is intended to provide biologists with an indication of the health of the fishery through estimates of gamefish and forage/non-game fish relative abundance (catch per effort), gamefish population size-structure (length-frequencies), an index of growth, and gamefish recruitment (young-of-year catch per effort). The electrofishing is conducted at water temperatures from 50 to 68 F. Centrarchid lakes should be completed first and muskellunge lakes should be completed last (muskellunge young-of-year catch rates tend to increase as temperatures decline). The electrofishing should be conducted according to the following protocols:

- Boom electroshocking will be conducted at night. Whenever possible, two experienced people should be used to dip fish.
- The entire shoreline should be divided into 2-mile segments. Within each 2-mile segment, all gamefish will be collected in a 1-½-mile **Gamefish station** and ALL fish will be collected in a ½-mile **Index station**. The minimum coverage needed for a successful survey is as follows:

Total Lake Shoreline (miles)	Required Sampling (2-mile segments)
4 miles or less	Entire shoreline/2 index stations
4 to 16 miles	2 gamefish stations/2 index stations
16 to 24 miles	3 gamefish stations/3 index stations
24 to 32 miles	4 gamefish stations/4 index stations
> 32 miles	5 gamefish stations/5 index stations

- The first 2-mile segment should be chosen randomly and the other 2-mile segments should be equally spaced around the lake to achieve uniform coverage. As a general rule, at least 25% of the total shoreline (or 25% of the 2-mile segments) of each lake should be sampled.
- Within each 2-mile segment, all gamefish species (including young-of-year) will be collected within the 1-½ mile **Gamefish station** and a minimum of 250 individuals of each species will be randomly selected and measured to the nearest 0.1 of an inch or centimeter. If panfish are abundant, they may be defined as non-gamefish species and collected only during the ½-mile **Index stations**, as described below. Scales should be collected from the most abundant gamefish (5 per 1/2" or 0.3" length group) or, at a minimum, scales should be taken from 10 individuals within 0.3" of the "stock" length and from 10 individuals within 0.3" of the "quality" length. At a minimum, the average age of "stock" and "quality" size fish will be computed for comparison across lakes. Weights may be measured and recorded for fish that are aged (not required). All data should be recorded on form 3600-186 for gamefish and nongame fish and 3600-190 for panfish (See Appendix A). *The investigator should record the data from each 1-½ mile gamefish station and each ½-mile index stations separately as described below.*

Fish Species to collect in Gamefish Stations; at least 10 individuals of each size (+/- 0.3") should be aged; e.g., 10 bass from 7.7" to 8.3" and 10 from 11.7" to 12.3" should be aged.

Gamefish Species	Structure	Stock Size	Quality Size
Largemouth Bass; Smallmouth bass	Scales	8"	12"
Muskellunge	Scales	20"	30"
Northern Pike	Scales	14"	21"
Walleye	Scales	10"	15"
Sauger	Scales	8"	12"
Catfish*	Spines	11"	16"
Sunfish*	Scales	3"	6"
Crappie*	Scales	5"	8"
Yellow Perch*	Scales	5"	8"

* Aging optional. If abundant, may be collected only in the Index Station.

- Within each 2-mile segment, a ½-mile **Index station** will be delineated where ALL species (including gamefish species) will be collected, identified, and counted. If panfish were defined as non-gamefish species, then a minimum of 250 individuals of each species will be randomly selected and measured. All data should be recorded on form 3600-186 for gamefish and nongame fish and 3600-190 for panfish (See Appendix A). *Data from each ½ - mile index station (including any gamefish species*

collected) should be recorded separately and should not be combined with data from the larger 1-1/2 mile gamefish station.

Tier I (> 100 acres, public access) Lakes

Fall Gamefish Assessments: Only fall gamefish assessments will be conducted on Tier II lakes (see above); no summer mini-fyke netting will be conducted on these lakes.

Spring Gamefish Population Estimates

In order to calibrate and “ground truth” recent changes in the protocol (a move from spring to fall electrofishing), each Fisheries biologist with a Baseline Lakes workload is asked to conduct a more comprehensive survey on one of the baseline lakes sampled in each year of the biennium. The choice of the lake will be left up to the biologist, but generally, if baseline data indicate a fishery-related problem, a more detailed analysis can be completed within the same fiscal year (the following spring).

Population abundance and population size- and age-structure of the predominant gamefish species should be estimated based on the Comprehensive Survey guidelines. Generally, northern pike and walleye are marked, measured, and scales are taken from ice-out to peak spawning (40-50 F) using fyke nets; recaptures are made using electrofishing within the spawning period (45-50 F). For bass, fish are marked, measured, and scales are taken during pre-spawn using electrofishing (55-60 F) – walleyes are also collected at this time, if they were marked earlier, to complete a total population estimate. Recaptures are also made with electrofishing during and after the spawning period, within 2 weeks of the marking run (60-69 F). Either a single-census estimate can be made, or multiple-recapture periods can be used to calculate a Schnabel-type estimate if the initial number of recaptures is low. Muskellunge population estimates should be conducted using fyke nets during the spawning period in two consecutive years, with first year for marking and the second year for recapture.

Training and Quality Assurance

Training of field staff for consistency in data collection and recording is critical to the success of the baseline-monitoring program. Training in taxonomy, deployment of field gear, and general program implementation will be made available to all staff annually. A layer of quality assurance to maximize data integrity will be initiated through a data screening process built into the statewide database. All monitoring protocols employed will, at a minimum, meet the Department’s data standards as developed by the Aquatic and Terrestrial Resources Inventory (ATRI) Team.

Water Quality Monitoring

Tier I and Tier II Status Lakes

Water quality monitoring of lakes will focus primarily on the collection of total phosphorus samples in the spring and the components of the TSI (total phosphorus, Secchi disk, and chlorophyll *a*) in the summer. In addition to the components of the TSI, other water quality parameters, also measured once during the summer, include conductance and pH, and field profiles for dissolved oxygen, temperature, and conductivity.

Additional limnological parameters will be sampled on a one-time basis in order to refine the initial lake classification. These include calcium, magnesium, nitrate+nitrite, total Kjeldahl-N, color, and total alkalinity. These measures will be collected once during the first summer sampling visit to each lake. Once these parameters have been determined for a lake, they will not be determined on subsequent visits.

Procedures for Spring TP Sample Collection

Total phosphorus (TP) samples should be collected in the spring. Bottles, forms, and instructions for shipping samples are available from the local lake coordinator.

What you need:

- 250 mL bottle from SLH (sample bottle with field number and lake name filled in)
- Sulfuric acid ampoule for preserving sample (from SLH)
- pH indicator paper to check pH of sample
- SLH form 4800-015 with highlighted areas to be filled out in the field.
- Ziploc bags
- Sharpie pen
- Cooler
- Plastic gloves
- A 250-mL bottle containing water marked 'ICE' and pre-frozen with water.

How to collect sample:

- Lakes should be sampled in spring prior to thermal stratification.
- The sampling station should be preferably away from shore near mid-lake.
- Rinse 250-mL bottle three times with lake water by dipping below the surface as far as you can reach.
- Fill bottle to neck (not to top) with lake water, dipping bottle as far as you can reach below the surface to avoid collecting material on the surface.
- Put capped bottle in a ziploc bag and store in a small cooler. It's important to keep samples cool and away from contamination.

- On shore, add amount of sulfuric acid to acidify to pH < 2. This can be an ampoule of acid from the SLH, or a certain number of drops of acid (i.e., 8 as in NOR). Check with lake coordinator for proper amount for your region's lakes.
- Mark sample bottle with yellow sticker as being acidified with sulfuric acid. Pour a bit of acidified water sample onto tip of pH indicator paper to ensure you've acidified sample to pH < 2. Be cautious as sulfuric acid eats holes in clothes, etc. Firmly cap bottle.
- Place all acidified bottles in a single ziploc bag in cooler with ice bottle. Keep samples cool not frozen. Refrigerate them if not shipping the same day.

Send samples to SLH:

- Fill out SLH form 4800-015 (see slhform.ppt for examples and instructions on how to fill out this form for spring phosphorus grab samples).
- Store sample cooled (not frozen) until shipment
- Ship sample on ice with completed lab sheet to the SLH in a mailer or cooler.
- Contact your lake management coordinator for specific information.

Procedures for Summer Water Quality Sampling:

This protocol covers methods for baseline water quality monitoring during the late summer index period (i.e. mid-July to August).

Go metric where possible; otherwise consider 3 feet as the interval unit for measurement in profiles and water sampling depth. Be sure to note on field sheets (see accompanying pdf file) whether you use feet or metric units.

Field procedures:

- Anchor boat over deepest point in the lake basin.
- Note weather conditions, including whether it is sunny/cloudy, raining, wind speed and direction, etc.
- Measure dissolved oxygen, temperature and conductance at 1 meter (or 3 feet) intervals from surface (0) to the nearest whole meter off the bottom. If you have the capability, also measure pH at 1 meter. Record measured depth at sample site. Note that conductance values will have to be corrected to 25°C. It is best to record uncorrected conductance then use corresponding temperature data to apply a correction factor. Note also that if you start measurements from the bottom you *must* end up with comparable values for 0, 1, 2... meter depths or 0, 3, 6, 9... foot depths.
- Measure Secchi disk transparency to nearest tenth of a meter or ½ foot.

- **{NEW!!}** All water samples will be collected with an integrating column sampler to 2 meters depth. This is a change from last year when we sampled the entire epilimnion. All rejoice! Use the integrating water column sampler (see additional notes below) to collect a composite water sample as follows:
 - Rinse the integrating sampler and compositing jug three times with lake water before sample collection.
 - After rinsing, lower the integrating sampler vertically at a relatively slow speed to 2 meters depth. After reaching 2 m pull sampler up vertically.
 - Empty the contents of the integrating sampler into the compositing jug by pushing ball valve end against the bar installed across the jug's mouth. This pops the ball valve up releasing water in the pipe.
 - When emptying water from the integrating tube sampler into the composite jug, do not allow water to run over your hands or get contaminated.
 - The 2 m integrating sample collects ~1 liter of water. Combine as many separate sample pulls as needed to have enough water to fill water sample bottles (i.e. 2 – 250 mL bottles and 1 – quart bottle) and filter for chlorophyll. If a single epilimnetic sample doesn't provide enough volume for samples and chlorophyll filtration (see guidelines in Appendix D), collect additional samples and add to the composite.
 - After gently mixing the water in the composite container, fill three sample bottles to the neck and preserve as follows. Make sure to mark the labels of these bottles appropriately.
 - 250 mL polyethylene bottle to the neck for TP, TKN and nitrate+nitrite-N; acidify with sulfuric acid.
 - 250-mL polyethylene bottle for calcium and magnesium; acidify with nitric acid.
 - **{NEW}** 1-quart plastic bottle for color and alkalinity (keep these samples in the dark as much as possible).
 - **{NEW}** Store the remaining composite water in a plastic amber bottle pre-rinsed three times with lake water. Keep this bottle in a cooler on ice for later chlorophyll filtration described later in Appendix D. Filtration should be done back at your closest laboratory site. Whole samples may be sent to the State Lab of Hygiene for filtration if they are sent the same day they are collected and processed within about 24 hours. NOTE: we do not encourage filtration on site in the boat.

- To store water for later filtration for chlorophyll, we're suggesting you use 1 or 2 L wide-mouth amber bottles made of polyethylene that can be ordered relatively cheaply from Fisher or VWR Scientific. These amber bottles have the benefit of preventing light exposure to the sample, which can break-down chlorophyll. If you reuse these bottles from day to day, rinse with deionized or milli-Q water after filtration is complete, and rinse 3 times with lake water before filling with water from the composite jug.
- We are using the SLH laboratory color data from the DNR baseline monitoring program to calibrate the range of colors on a strip used by the State of Ohio. If adequate, this "Custer color strip" will be used in the future by lake volunteer monitors. To estimate color using the Custer color strip, raise the Secchi disk to $\frac{1}{2}$ the transparency depth. Hold color strip over boat and, comparing the color patches on the strip with the **white** portion of the Secchi disk, record the closest color match.

Clean-up

At the end of the day, rinse all composite containers and tube samplers with deionized water and allow to dry. Hang tube samplers with ball end at top to allow water to drain out.

- **Note:** It is **very** important to rinse out all composite containers at the end of the day. We need to prevent any contamination of the water chemistry samples, particularly since we're measuring constituents like calcium and magnesium that may be in very low concentrations.

Quality Assurance

It is important to get an idea of the field precision of our chemical measures. To get this useful data we suggest the following:

- Field replicates for all chemical samples and chlorophyll should be collected at a rate of 10%. The easiest way to do this, and to keep it relatively random, is to keep track of samples and every tenth lake collect a duplicate set. Note that this second set of samples needs to have a unique field number
- If there are two observers in the boat, have both people make observations of Secchi disk and Custer color strip value on replicate lakes.

- Notes on meter calibration, etc. should be kept in a project notebook.
- **{NEW}** Roughly once a week during the field season, send a set of blanks to the State Lab for all variables except chlorophyll. To do this, get milli-Q water, rinse the integrating sampler three times, fill it, empty it into a pre-rinsed composite jug, then pour water into the three sample bottles. Essentially, you're following the same procedure as you would for a lake sample. Remember to give this set of samples a unique field number.

SLH Inorganic Test Request Form:

Use the SLH Inorganic Test Request form 4800-015 (R 12/00) available on the intranet at the address given below. You can use form filler to customize and save your form except for the field parameters added at the end of the day.

<http://intranet.dnr.state.wi.us/int/es/science/ls/fpm/download/>

The SLH Inorganic Test Request form needs to have the following information included in addition to the usual stuff (like your name, date, time, lake name, county, WBIC (water body number), STORET number etc.).

- **{NEW}** On page two make sure you indicate the top of sampling interval as 0.0 meters and the bottom of the sampling interval as 2.0 meters.
- Check boxes for the following chemical tests:
 - Under plastic quart bottle check:
 - Color
 - Chlorophyll *a*, uncorrected. Write in the volume of water filtered.
 - Alkalinity, pH and Conductivity
 - Under 250 mL Bottle for Nutrients or Metals (Acidify with nitric acid) check:
 - Calcium
 - Magnesium
 - Nutrients Bottle 250 mL (Acidify with sulfuric acid) check:
 - Tot.-Phosphorus
 - Total Kjeldahl-N
 - NO₂+NO₃ as Nitrogen
- If you collect a replicate set of samples you will need to fill out a separate Inorganic Test Request, giving the second set of samples a unique field number, which you write on both the sample bottles and the Request Form.

Gear List:*Meters, field measuring devices.*

- Meter(s) for measuring dissolved oxygen, temperature and conductance profiles and, if available, pH (at 1 meter only). If lines for DO/temperature meter are in feet, mark sampler in 1-ft intervals, or redo DO/temp lines to go metric!!!
- Black/white Secchi disk with line calibrated in meters (to 0.2 m units) or feet.
- Custer color strip
- Depth finder

Water sampling gear:

- Integrating water sampler to sample top 2 meters of water.
- Composite bottle (and spare) fitted with emptying device that dislodges the ball check valve in the tube sampler. A half gallon jug works well.

*Chlorophyll filtration (see Appendix D for complete list of gear):**Sample bottles and preservatives:*

- 250 mL polyethylene bottle and nitric acid ampoules for Ca and Mg
- 250 mL polyethylene bottle and sulfuric acid ampoules for TP, TKN, and nitrate+nitrite-N
- 1-quart plastic bottle for total alkalinity/conductance/pH and color.
- 1 or 2 L plastic amber bottle for storing water for chlorophyll filtration

Miscellaneous:

- SLH shipping coolers, inorganic test requests, ice bottles
- Coolers and ice to store samples on in the field and during transport
- Marking pens, pens, label tape, etc.
- Field data forms (see 'water quality baseline form.pdf' file for example).

Notes on the Integrated Sampler:

Jim Klosiewski, NOR-Rhineland (715-365-8992) is the expert who has put in long hours developing the integrated sampler (or chloropolski). He has put together some useful files on how to construct the integrated sampler and how to use them in the field.

- A file describing sampler construction and use is available on the FH common drive under \monitoring\baseline lakes as 'Integrating_water_sampler_ver3_04_2001.doc'.

Water Sample Handling and Shipping:

The DNR intranet website has a link to the WDNR field procedures manual (see address below), which provides details on sample handling, shipping, labeling, etc. Appropriate sections on preservation are included in Appendix C of this document. See the website at: <http://intranet.dnr.state.wi.us/int/es/science/lis/fpm/>

Tier I and Tier II Trend Lakes

A total of 56 lakes will be identified statewide to monitor long-term trends in lake condition and provide regional reference conditions for each defined lake class. These lakes should be distributed throughout the state with 18 lakes in NOR, 12 in both NER and SER, and seven each in SCR and WCR. ***Guidance for the statewide selection and sampling of trend lakes will be developed for implementation in the FY 2001/2002 biennium.***

Lakes should be selected as regionally significant by both the lakes and fisheries staff from a region with at least one lake in each of the defined lake classes. At least one lake should be selected to represent the “typical” condition of the lakes within a region and lake class if possible. In NOR, NER, and SER a lake from each class should also be selected that represents the “best” condition in that lakes class. Care must be taken when selecting trend lakes to ensure that the lakes selected represent the class and will over the long-term represent the trends for the Region. Lakes that have immediate problems or issues associated with them should be avoided in the selection process. If data is required for problem lakes they should be proposed as “special projects” and not used as regional trend lakes.

Once regional staff identifies trend lakes, GIS or aerial photography will be used to assess watershed and riparian and-use. This process should be repeated every seven to ten years. Minimally, trend lakes will be sampled for all baseline monitoring protocols on some regular frequency such as annually for water quality parameters and every 3 years for fisheries parameters. Additional parameters and sampling events, such as those associated with the historical ambient lakes monitoring program or fisheries comprehensive survey methods, may be conducted as deemed appropriate by regional fisheries and lake staff, provided adequate funding is available.

Other Important Optional Monitoring to be developed for the future. (guidelines not fully developed)

Littoral Zone Habitat/Macrophytes – Preliminary work on the utility of the FQI (Floristic Quality Index) for biomonitoring has been completed and additional studies are being developed. More information to come.

APPENDICES

Appendix A- DNR Field Forms: 3600-186 (generic), 3600-187 (gamefish), and 3600-190 (panfish) on the FH common drive under \monitoring\baseline lakes.

You may use any form you prefer, but make sure you collect all mandatory variables required in the FH database. On the F drive, the “.pdf” file is the form and the “.doc” file with the same number is the instructions on the reverse side. The baseline lakes group will discuss at a future meeting whether to include additional forms on the F drive. There are some nice ones around the state.

Appendix B – DNR field form for water quality on the FH common drive under \monitoring\baseline lakes as ‘water quality baseline form.pdf’

Appendix C: Description of Water Samples for SLH

Aliquots from Integrated Water Column Sample:

One 250 mL bottle for TKN, TP, and Nitrite+Nitrate-N, acidified with sulfuric acid

Preservation Notes For Total Kjeldahl-Nitrogen

Sample Size: 38 ml

Bottle Type: 250-ml polyethylene with white polypropylene cap

Preservative: H₂SO₄ to pH<2, Cool to 4 °C

Volume of Preservative: 1 mL 25% (9N) H₂SO₄/250 mL

Compatible With: COD (15 ml), Ammonia-Nitrogen (38 ml), Nitrate + Nitrite-Nitrogen (38 ml), Total Phosphorus (38 ml), Total 175 ml for all parameters

Special Notes: None

Preservation Notes For Total Phosphorus

Sample Size: 38 ml

Bottle Type: 250-ml polyethylene with white polypropylene cap

Preservative: H₂SO₄ to pH<2, Cool to 4 °C

Volume of Preservative: 1 mL 25% (9N) H₂SO₄/250 mL

Compatible With: COD (15 ml), Ammonia-Nitrogen (38 ml), Nitrate + Nitrite-Nitrogen (38 ml), Total Kjeldahl Nitrogen (38 ml), Total 175 ml for all parameters

Special Notes: None

Preservation Notes For Nitrate plus Nitrite-Nitrogen

Sample Size: 38 ml

Bottle Type: 250-ml polyethylene with white polypropylene cap

Preservative: H₂SO₄ to pH<2, Cool to 4 °C

Volume of Preservative: 1 mL 25% (9N) H₂SO₄/250 mL

Compatible With: COD (15 ml), Ammonia-Nitrogen (38 ml), Total Kjeldahl Nitrogen (38 ml), Total Phosphorus (38 ml), Total 175 ml for all parameters

Special Notes: None

1 Quart bottle with for color and alkalinity**Preservation Notes For Color and Alkalinity**

Sample Size: 150 ml

Bottle Type: Can use 1 quart bottle for color and alkalinity, remember to mark clearly. Preservative: Cool to 4°C.

Compatible With: Alkalinity & Conductivity (75 ml), BOD (150 ml, low level 900 ml), Nitrite-Nitrogen (38 ml), pH (38 ml), Dissolved Silica (38 ml), Total & Volatile Solids (75ml), Dissolved Solids (75m), Suspended Solids (250 ml or 1500 ml low level), Sulfate (38 ml), Surfactants (MBAS) (375 ml or 75 ml for non-compliance), Turbidity (38 ml), Total for all parameters 1,400 ml to 3,300 ml

Special Notes: None

One 250 mL polyethylene bottle with white cap – acidified with nitric acid for Ca and Mg**Preservation Notes For Metals – Ca and Mg**

Sample Size: 250 ml

Bottle Type: 250-ml polyethylene with white polypropylene cap

Preservative:HNO₃ to pH<2

Volume of Preservative: 1 mL 70% (16N) HNO₃ to pH<2

Compatible With: Need Whole Volume

Special Notes: None

Appendix D: 1004 CHLOROPHYLL SAMPLE FILTRATION (from DNR Field Procedures Manual)

A. Scope:

This procedure is for the *filtering* of surface waters to determine the chlorophyll content.

B. Safety:

NA

C. Equipment:

1. Membrane filtration apparatus.
2. Millipore SM 5.0 mm membrane filters (SMWP 0 470 47 mm diameter, 100/pack). Millipore, Bedford, MA 01730, 800-646-5476.
3. Vacuum source (hand or electric pump).
4. 1000 ml filtration flask.
5. 500 ml graduated cylinder.
6. Tubing.
7. Wash bottle.
8. Distilled water.
9. Tweezers.
10. Aluminum foil (4.25" by 3.5").
11. Zip lock bag (3" by 5").

D. Collection Procedures:

Collect the samples with the procedures given in the surface water sampling section. Be sure to store collected sample on ice and out of direct sunlight.

E. Sample Handling and Filtration:

This procedure should be conducted in the shade, out of direct sunlight. We actually recommend that filtering of samples kept on ice and in coolers is better done at the laboratory at the end of the day, not on site.

1. Place all the equipment on your work area.
2. Insert the bottom part of the filtering cup (membrane filtration apparatus) into the 1000-ml filtration flask. You may wish to wet the stopper first to get a good seal.
3. Attach the plastic tubing of the vacuum pump to the spout of the filtration flask.
4. Pick up one small membrane filter with the tweezers and place it on the center of the filter base (the black screen). Note that filters are white, divider sheets are blue -- be careful to use a filter! Squirt a small amount of distilled water on the filter to keep it in place. Do not touch the filter with your fingers while removing it from the bag or when placing it on the screen.

5. Carefully place the cup on top of the filter base. It is magnetic. Be sure that the filter does not move!
6. Determine the approximate volume of water to filter for the chlorophyll analysis, refer to table 1004-1. Match the Secchi depth you got today against the volume of water that should be filtered. *Gently* mix the sample by turning the bottle upside down several times (be sure to use a sealed amber container to store samples for filtration). Keep track of the total volume of water filtered.
7. To begin filtering, pour some of the measured water from the graduated cylinder into the filter apparatus.
8. Squeeze the hand pump or turn on the vacuum pump to move the water through the filter.
9. When you are finished filtering, separate the top cup from the filter base.
10. Using the tweezers, fold the filter paper in half so that the algae are on the inside. **Do not touch the algae with your fingers!**
11. Fold the filter paper in half again and wrap it in a piece of aluminum foil. Fold edges around sample to form a closed packet.
12. Place foil packet in zip lock bag.
13. Using a pencil, complete the information on a chlorophyll sticker. Attach the sticker directly to the zip lock bag. **BE SURE TO INCLUDE THE VOLUME FILTERED!**

Table 1004-1

Note: These are approximate guidelines -- you should filter as much water as you can.

Secchi Depth (meters)	Secchi Depth (feet)	Approximate Volume to Filter (mLs)
<0.3 m	< 1 ft	50 mLs
0.3 – 0.5 m	1-1.5 ft	100 mLs
>0.5 – 0.7 m	>1.5 - 2.25 ft	200 mLs
>0.7 – 1.0 m	>2.25 - 3.25 ft	300 mLs
>1.0 – 1.8 m	>3.25 - 6 ft	500 mLs
>1.8 – 3.0 m	>6 - 9.75 ft	800 mLs
>3.0 – 5.0 m	>9.75 - 16.5 ft	1000 mLs
> 5.0 m	>16.5 ft	1500 mLs

F. Documentation

Complete the Inorganic Test Request Form with the information on the sampling site, depth of integrated sample, and volume of sample filtered. Also see # 14 above.

G. References:

1. Wisconsin Department of Natural Resources, "Self Help Lake Volunteer Training Manual, Chemistry Monitoring Procedures", page 35, January 1995.