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Methods Matrix for Volunteer Stream Monitoring

Developed by

Rivers Council of Minnesota

in association with the

Watershed Partners

Strategic Planning Committee for

Coordinated Volunteer Stream Monitoring

in the Twin Cities Metro Area

ACKNOWLEDGEMENTS

Funding for this project was provided by the Metropolitan Council's Twin Cities Water Quality Initiative grant program. The matrix was developed as part of a strategic planning process that identified goals and strategies for coordinating volunteer stream monitoring in Minnesota's Twin Cities metropolitan area. The strategic planning committee operated was a subgroup of the Watershed Partners, a collaborative of over 40 organizations interested in water quality and education. Members of the strategic planning committee, together with Rivers Council of Minnesota staff, conceptualized and developed the matrix as a tool for identifying various levels and purposes of volunteer monitoring of area streams. The following people were instrumental in the conceptualization and development of the matrix:

Mary Gullickson	**Anoka Conservation District**
Julie Kingsley	**Rivers Council of Minnesota**
Melissa Lewis	**Minnesota Department of Natural Resources**
Barb Liukkonen	**University of Minnesota Water Resources Center**
Tricia Mangold	**Hennepin Conservation District**
Mike Meyer	**Metropolitan Council**
Kent Johnson	**Metropolitan Council**
Julie Westerlund	**Minnesota Department of Natural Resource**s

In addition to the above, other members of the Coordinated Volunteer Stream Monitoring steering committee reviewed and provided valuable input to the matrix.

Volunteer Stream Monitoring Methods Matrix

Introduction

Volunteers choose to monitor streams for a variety of reasons, and there's a variety of monitoring options that match the volunteer's goals, level of skill and available resources. For example, they may wish to simply 'see what's out there' for their own interest, or they may want to start up a long term database that will be used by a government unit or university for decision making in their watershed. Real world constraints on time, money, and skill level may limit the types of monitoring available to a given individual or group. An elementary school class is simply not capable of collecting the same type of information as a stream association with a sizeable budget.

A range of monitoring activities measures the physical, biological and chemical characteristics of streams and their watersheds. The information gathered by volunteers can be used in a variety of ways, each with its own value. It's very important that volunteers choose a monitoring activity that will allow them to meet their objectives for data collection while matching their skills and resources.

We have developed a matrix that assigns a 'purpose' and a 'level' to a variety of monitoring exercises. This matrix provides a framework for those who wish to monitor but don't know where to start, and to those who support monitoring programs, but don't know where a potential volunteer fits in. The matrix is to be used under the supervision of a Volunteer Monitor Coordinator. Under the guidance of the Coordinator any or all of the monitoring pieces may be used, one activity is not dependent on another and you can pick and choose activities that are appropriate for your monitoring team. The matrix gives examples of activities for the following traditional purposes of monitoring:

- Awareness and Education: introduces the monitoring group to the processes of stream ecology and the connection between land use and water quality

- Continuous Record of Ambient Conditions: establishes a baseline of conditions, either by recording physical indicators of habitat, or by monitoring chemical and/or biological indicators, over time

- Problem Investigation: examines a known or suspected source of a pollutant, or the effect of a land use practice on the water quality of a stream.

Volunteers may be interested in investigating problems, but may be young, or not have much time to devote to the process. It is possible to fit each monitoring purpose with each level of ability. We defined three levels for monitors, each having the minimum capacity:

-  Frog (Beginner): able to occasionally observe and record conditions measuring physical, biological or chemical indicators of stream health; results may not be consistent over time.

-  Stonefly (Student): able to routinely observe, measure and record conditions procedures using scientific equipment; results should be consistent over time.

-  Kingfisher (Master): able to routinely observe, measure and record conditions of physical, biological and chemical health, including following procedures using scientific equipment; results should be consistent over time, and to draw inferences and conclusion about the evidence provided by recorded results.

Matrix Purpose/Level	Outcome
Beginner/Awareness	Introduces concept relating to stream health
Beginner/Continuous	Observes stream health concept
Beginner/Problem	Makes inference about observed stream health concept
Student/Awareness	Explores concept
Student/Continuous Record	Records observations systematically about stream health
Student/Problem	Draws conclusion about stream health based on record of observations
Master/Awareness	Understands principles of stream health
Master/Continuous	Accurately records systematic observations of stream health over time
Master/Problem	Draws conclusions about stream health based on a variety of observations and indices

This matrix is also based on the three parameters of stream health: physical, biological and chemical. The U.S. Environmental Protection Agency describes the following applications derived from using various approaches to assess these water quality indicators:

Type	Approach	Applications
Physical	**Watershed survey**	Determines land use patterns; determine presence of current and historical pollution solutions sources; identify gross pollution problems; identify water uses, users, diversions, and stream obstructions.
	Habitat assessment	Determine and isolate impacts of pollution sources, particularly land use activities; interpret biological data; screen for impairments
Biological	**Macroinvertebrate sampling**	Screen for impairment; identify impacts of pollution and pollution control activities; determine the severity of the pollution problem and rank stream sites; identify water quality trends; determine support of designated aquatic life uses;
Chemical	**Water quality sampling**	Screen for impairment; identify specific pollutants of concern; identify water quality trends; determine support of designated contact recreation uses; identify potential pollution sources.

Regular water quality monitoring informs citizens and agencies about the essential health of a water body, allowing for the best possible decision-making for its management. There is a great need for monitoring in Minnesota: no one monitors 80,000 of Minnesota's 92,000 miles of streams and rivers!

Are you interested in monitoring a nearby stream? First, determine your goals in monitoring; such as why do you want to monitor the stream or watershed? What age group of people will be working with you? What resources do you have available? Consider time, money, equipment, people power, and how often you are available (weekly, monthly, semiannually?)

Consider also whether you want to make a long-term commitment to stream monitoring (years)? What expertise or experience with streams or watersheds do you have? What is the location of the stream or river you wish to monitor?

The fact sheets associated with the activity listed on the matrix explain each activity's concept, equipment needed, time required and safety requirements. This will allow the user to find an activity that matches their available resources. Once a potential volunteer has answered the above questions, they should be able to use the matrix and fact sheets to navigate to the appropriate type of monitoring.

Most of the activities presented in this matrix are derived from the U.S. Environmental Protection Agency's *Volunteer Stream Monitoring: A Methods Manual*, 1997, EPA #841-B-97-003, which is available via the Internet at:
http://www.epa.gov/owow/monitoring/volunteer/stream/vms.html

The matrix and the activity sheets are designed to introduce volunteers or program coordinators to monitoring activities, or to help them plan a volunteer monitoring program. The goal of monitoring is to understand how the stream works, beginning with understanding the fundamental elements of the stream and its physical setting, and then reviewing biological processes and chemical variables. Each of these activities can be entered into individually. Collectively, these activities define a comprehensive program to understand a stream's health. Increasingly, professional water quality specialists and volunteer program coordinators are moving toward approaches that combine chemical, physical and biological monitoring methods to achieve the best picture of water quality conditions.

We recommend that you work with a technical person to advise you if you decide to develop a monitoring program. That advisor will help you select the skill level and activities appropriate for your area and for your monitoring abilities.

Safety: Always a Concern
The activities in the accompanying matrix are based either in a classroom, on land or in the water. The following precautions should always be taken before doing any land-based activities near a stream or river:

- ✓ Secure the permission of the landowner to access the river from his or her property, or find a spot that is publicly owned.
- ✓ Dress appropriately for the weather and the conditions. This should include gloves, hats, waders and a change of clothes, shoes and socks.
- ✓ Always work with a partner. Never work alone. Bring along a cell or wireless phone. Let someone know where you are going and when you should be back.
- ✓ Keep a first aid kit handy
- ✓ Listen to weather reports; don't go if severe weather is forecast.
- ✓ Never wade in swift or high water. Do not monitor if the stream is at flood stage.
- ✓ Anyone entering the water must wear a life jacket and waders.

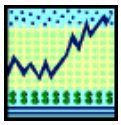
The following precautions should be taken by anyone working in a lab:

- ✓ Work in a clean, well-ventilated area.
- ✓ When using chemicals, always wear eye protection, gloves and lab apron.
- ✓ Know your equipment and sampling protocols in the field and in the lab.
- ✓ Avoid contact between chemical reagents and skin, eye, nose and mouth.
- ✓ Know how to use, store, clean up and dispose of chemicals.

Conclusion: Leaving the Matrix, Entering the Stream

This matrix is designed to help the volunteer continually evaluate his or her monitoring and activities relative to resources, abilities and objectives, which may change as involvement increases. This matrix is designed to both guide and support volunteers and to challenge them to broaden their watershed stewardship horizons.

Note: Activities in the Stonefly and Kingfisher Continuous Record and Problem Investigation should include a QA/QC component.

Monitoring Matrix	Awareness & Education 	Continuous Record 	Intensive Investigation of Site Specific Problems 
Frog 	Streamside walk Pg. 7 Measure Stream Velocity Pg. 7 Measure Stream Width Pg. 7 pH Test Strips Pg. 8 Keep a Trash Journal Pg. 7	Monthly or Weekly Stream Water Level Measurements Pg. 9 Photographic Record of Bank Riparian Areas Pg. 9 Streamside Biosurvey Pg. 9 Monthly or Weekly Water Temperature Measurements Pg. 10	Identify Potential Problem Sources Pg. 11 Visual Habitat Assessment Pg. 11 Measure Stream Velocity Pg. 11 Streamside Biological Survey Pg. 12 Grab Water Sample and Send to Lab Pg. 12
Stonefly 	Measure Stream Flow (Velocity and Volume) Pg. 13 Visual Habitat Assessment Pg. 13 Frog Watch Pg. 13 Participate in Fisheries Survey Pg. 14 User Perception Assessment Pg. 14 One Time Chemical Survey Pg. 14	Quantitative Habitat Assessment (2x/yr.) Pg. 15 Intensive Biological Survey (2x/yr) Pg. 15 Dragonfly Survey Pg. 16 Bi-weekly or Monthly Transparency Tube Measurements Pg. 16 Use Meters to Measure DO, pH, Turbidity, bi-weekly or Monthly Pg. 16	Pictures or Video of Site During Storm Event Pg. 17 Intensive Biological Survey Pg. 17 Weekly or Event-based Chemical Measurements Pg. 18
Kingfisher 	Detailed Map of Stream Inputs, Updated Land use, "Ground Truthing" Pg. 19 Detailed Biological Assessment Pg. 19 Measure Water Chemistry With Analytical Instruments and Send Samples to a Lab Pg. 20	Use Flow Meter to Develop a Dye Drip Rating Curve Pg. 21 Keep An Angler Diary Pg. 21 Chemical Sampling With Analytical Instruments. Pg. 22	Quantitative Habitat Assessment: Compare with Historical Data Pg. 23 Use Flow Meters to Measure Stream Flow During Storm Events and Develop a Rating Curve Pg. 23 Event-based Chemical Sampling With Analytical Instruments Pg. 23

Skill Level: Frog  

Purpose: Awareness and Education

Outcome: *Introduces concepts relating to stream health*

1. PHYSICAL MEASURES

Title: Measure Stream Velocity
Source: *Stream Flow;* Volunteer Stream Monitoring: A Methods Manual, EPA; pg. 135
Concept: *Stream flow influences biological processes.*
Activity: Use the float method to calculate the flow in a defined stretch of stream usually expressed in feet/second.
Time required: 10 minutes at each site
Preparation and materials required: Be sure to get permission from the landowner to enter the property, tape measure, orange, ball of heavy twine or string, two stakes, yard stick, waders, life jackets, stop watch
QA/QC: no

Title: Measure Stream Width
Source: *Stream Flow*; Volunteer Stream Monitoring: A Methods Manual; EPA; pg.135
Concept: *Stream flow influences biological processes.*
Activity: Measure the width of the stream at designated sampling sites
Time required: 10 minutes
Preparation and materials required: Permission of the land owner to enter the property, clip board and pencil, tape measure, waders, life jackets, 2 stakes
QA/QC: no

Title: Keep a Trash Journal
Source: Minnesota Department of Natural Resources, Adopt-A-River program
Concept: *To collect and record the amount of trash in a designated section of stream.*
Activity: Hold a clean up day on a section of stream. Keep track of the types and amount of garbage found to show to area businesses and landowners. Work with them to think of ways to keep trash out of the stream.
Time required: one afternoon
Preparation and materials required: Permission of landowner to access the stream area to be cleaned, waders, life jackets, gloves, garbage bags, first aid kit, notebook and pencil
QA/QC: no

2. BIOLOGICAL MEASURES

Title: Streamside Walk
Source: *The Visual Assessment*, pp. 25-29, Volunteer Stream Monitoring: A Methods Manual, EPA

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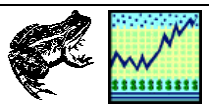
2. BIOLOGICAL MEASURES Cont.

Concept: *A stream is a product of its watershed.*
Activity: Answer questions about the stream, its physical characteristics and associated land uses. This is a fundamental and essential step to any monitoring program.
Time required: One hour to select questions to be answered and then up to several days to collect information desired, and another hour to review answers.
Preparation and materials required: Facilitator should be familiar with how to obtain information in the community; there may be a cost for obtaining some materials and maps.
QA/QC: no

3. CHEMICAL MEASURES

Title: ph Test Strips
Source: Hach Equipment Company
Concept: *To learn what the pH levels are in the stream and how pH effects the life in the stream.*
Activity: Collect a water sample in a clean bottle. Use pH strips to determine the acidity or alkalinity of the water by color comparison of the strip to the color chart on the back of the pH test strip container.
Time required: 10 minutes
Preparation and materials required: sample bottle, pH strips, waders, and life jackets
QA/QC: yes

Title: Temperature Measurements
Source: *Testing the Waters;* River Watch Network; pg. 77 - 83
Concept: *Temperature affects the rate of many of the streams biological and chemical processes.*
Activity: Face upstream at your sampling site with the thermometer in your shadow and submerse the thermometer at least four inches below the surface. Keep the thermometer underwater for at least two minutes to get the temperature. Repeat.
Time required: 10 minutes
Preparation and materials required: permission of the landowner, waders, life jackets, armored thermometer, clipboard, pencil and data sheet.
QA/QC: yes



Skill Level: Frog
Purpose: Continuous Record of Ambient Conditions
Outcome: *Observe stream health*

1. PHYSICAL MEASURES

Title: Monthly or Weekly Stream Water Level Measurements
Source: Minnesota Pollution Control Agency
Concept: *Records the variation in stream levels as influenced by precipitation.*
Activity: Place a stream gauge at the designated point in your stream. If a gauge is not available locate a fixed point where stream level readings can be taken. An example would be the top of a culvert. Keep a log of the weather conditions and the precipitation amounts.
Time required: 10 minutes, plus travel time to site
Preparation and materials required: tape measure, stream gauge, rain gauge, data sheets
QA/QC: yes

Title: Photographic Record of Bank and Riparian Areas
Source: *River Monitors Manual*, Rivers Council of Minnesota
Concept: *Water quality is determined by land use.*
Activity: A photographic record should be made of the overall stream sample area including the stream bank, stream bottom, vegetation both in and out of the stream, the overall landscape features, any problem areas and land use activities. This will create a benchmark for further comparison in the future.
Time required: 10 minutes at each site plus travel time. Should be done several times a year
Preparation and materials required: film, camera, notebook, maps to locate where pictures were taken
QA/QC: no

2. BIOLOGICAL MEASURES

Title: Streamside Biosurvey
Source: *Streamside Biosurvey;* Volunteer Stream Monitoring: A Methods Manual, EPA Pg. 61
Concept: *A stream is a product of its watershed.*
Activity: Collect and identify macroinvertebrates in the field by using kick or dip nets depending on the type of stream you are sampling, rocky or muddy bottom. Once the macroinvertebrates are sorted, identified and counted they will be returned to the stream.

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2. BIOLOGICAL MEASURES cont.

Time required: One hour, sampling should be done twice a year in spring and fall
Preparation and materials required: identification books and keys for macroinvertebrates**,** nets, buckets, sorting trays, tweezers, eyedroppers, kick/dip nets, waders, life jackets, data sheets.
QA/QC: yes

3. CHEMICAL MEASURES

Title: Monthly or Weekly Water Temperature Measurements
Source: *River Monitors Manual*, Rivers Council of Minnesota
Concept: *The rates of biological and chemical processes are dependent on temperature.*
Activity: Take the temperature in the main current of the stream. Hold the thermometer in your shadow 4 inches below the surface for at least two minutes. Record your results. The air temperature and weather conditions should also be recorded. Follow your monitoring schedule for how often you should sample.
Time required: 10 minutes at each site plus travel time
Preparation and materials required: armored thermometers, waders, life jacket, data sheet, watch with second hand.
QA/QC: yes

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Skill Level: Frog
Purpose: Intensive Investigation
Outcome: *Makes inference about observed stream health concepts*

1. PHYSICAL MEASURES

Title: Identify Potential Problem Sources
Source: *The Visual Assessment:* Volunteer Stream Monitoring: A Methods Manual, EPA pg. 29
Concept: *Identifying and monitoring potential problem areas or pollution sources.*
Activity: Walk the stream bank and look for areas of stream bank erosion from lack of vegetation, construction, or animal use. Check the appearance and odor of the water. Identify storm sewers and other sources of pollution that empty into the stream, such as factories and/or feedlots. Use land-use, city, county or watershed maps to help pinpoint problem areas without leaving the classroom. Document on-site field observations.
Time required: One to two hours, plus travel time
Preparation and materials required: Obtain appropriate maps and/or aerial photographs in advance (may take two to six weeks).
QA/QC: yes

Title: Visual Habitat Assessment
Source: *Stream Habitat Walk;* Volunteer Stream Monitoring: A Methods Manual, EPA pg. 43
Concept: *Easy to use approach for identifying and assessing the elements of a stream's habitat*.
Activity: Delineate and sketch your sample site. Locate your site on a topographical map. Record the streams physical and biological characteristics on data sheets. This survey focuses on human alterations to the watershed. Volunteers, with help from the Monitoring Coordinator, should report problems such as fish kills, sloppy construction practices or spills they have identified during their assessment.
Time required: 1 to 2 hours plus travel time to site
Preparation and materials required: topographical maps, data sheets, waders, life jacket, tape measure
QA/QC: yes

Title: Measure Stream Velocity
Source: *Stream Flow;* Volunteer Stream Monitoring: A Methods Manual, EPA, pg. 134
Concept: *Stream flow influences biological processes.*
Activity: Use the float method to calculate the flow in a defined stretch of stream. Calculate the average cross-sectional area of the stream, measure the travel time of the float and calculate the flow of the stream in feet/second.
Time required: 30 minutes per site plus travel time

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1. PHYSICAL MEASURES cont.

Preparation and materials required: 2 pair of waders and life jackets, heavy twine, two stakes, tape measure, watch with second hand, orange or apple, data sheet.

QA/QC: yes

2. BIOLOGICAL MEASURES

Title: Streamside Biological Survey

Source: *Intensive Stream Biosurvey;* Volunteer Stream Monitoring: A Methods Manual, EPA, pg.86

Concept: *A baseline of data is gathered for comparison in the future if changes or problem areas or situations are identified.*

Activity: Habitat assessment and macroinvertebrate sampling are done but is more rigorous then the stream habitat walk. Volunteers need to be trained in habitat and macroinvertebrate sampling and identification. A trained stream biologist needs to be involved in the process.

Time required: 2 –3 hours for sampling, 3-5 hours for identification of macroinvertebrates

Preparation and materials required: waders, life jackets, kick/dip nets, white sorting trays, alcohol, specimen bottles, tape measure, hand lens, buckets, string, stakes, orange or float, reference maps, spray bottle, data sheets, trained biologist

QA/QC: yes

3. CHEMICAL MEASURES

Title: Grab Water Samples and Send to a Lab

Source: Metropolitan Council

Concept: *For quality control and quality assurance samples should be sent to a certified lab to verify tests done by volunteers.*

Activity: A water sample should be taken according to the procedures established by the Metropolitan Council in sample bottles provided by the lab. The samples should be placed in coolers with ice and transported to the lab as soon as possible.

Time required: 10 minutes each site plus travel time

Preparation and materials required: sample bottles provided by the lab, labels, cooler And ice, tape, data sheets, waders, life jackets

QA/QC: yes

Skill Level: Stonefly 
Purpose: Awareness and education
Outcome: *Explores concept*

1. PHYSICAL MEASURES

Title: Measure Stream Flow (velocity and volume)
Source: *Stream Flow*; Volunteer Stream Monitoring: A Methods Manual, EPA, pg. 134
Concept: *Flow is a function of water volume and velocity. It is important because of its impact on water quality and the living organisms and habitats of the stream.*
Activity: Measure and calculate the stream flow using the float method. Calculate the Average cross-sectional area of the stream, measure travel time, calculate the flow by using the equation: Flow = $\frac{ALC}{T}$ Repeat the process several times.
Time required: 20 minutes per site plus travel time to site
Preparation and materials required: stakes, heavy string, waders, life jacket, watch With a second hand, orange, tape measure, measuring stick, twist ties
QA/QC: yes

Title: Visual Habitat Assessment
Source: *Stream Habitat Walk*; Volunteer Stream Monitoring: A Methods Manual, EPA pg. 48
Concept: *To increase awareness of the diversity and quantity of organisms in the bank and riparian habitats of the sample stream.*
Activity: Complete the habitat characterization components of the stream walk for 25 yard sections of stream noting the in-stream characteristics, the stream bank, channel and local watershed characteristics.
Time required: 2-3 hours of field observations plus travel time to the sites.
Preparation and materials required: data sheet, identification keys and books, tape Measure
QA/QC: yes

2. BIOLOGICAL MEASURES

Title: Minnesota Frog Watch
Source: Hamline University & Minnesota DNR frogs@hamline.edu 651/523-2812
Concept: *Use frog calls to monitor populations at key breeding times.*
Activity: Participants are assigned to pre-selected routes, as part of the national survey, and will be asked to conduct nighttime listening surveys on three evenings per year between April and July. Training materials, including audiotape, maps and data forms, are provided.

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2. BIOLOGICAL MEASURES cont.

Time required: Two to four hours
Preparation and materials required: Volunteers need a vehicle and valid driver's license, good hearing, an interest in toad and frog conservation, a willingness to learn frog calls, and a desire to participate in the program for multiple years.
QA/QC: yes

Title: Participate in Fisheries Survey with MN DNR Fisheries Biologists
Source: Minnesota Department of Natural Resources, Regional Fisheries Office
Concept: *Fish indicate characteristics and conditions of streams.*
Activity: Assist professionals in counting fish populations.
Time required: Four to eight hours
Preparation and materials required: Consult with professional staff
QA/QC: yes

3. CHEMICAL MEASURES

Title: User Perception Assessment
Source: Metropolitan Council and Minnesota Pollution Control Agency
Concept: *To measure sediments and nutrients of a stream that indicate the impacts of land use activities on water quality.*
Activity: Select one of several parameters to describe stream appearance and select one measure of how suitable the stream is for recreation or aesthetic enjoyment.
Time required: one hour
Preparation and materials required: Metropolitan Council or MPCA training and data sheets
QA/QC: yes

Title: One Time Chemical Survey
Source: Hach test kits for instructions and supplies
Concept: *Introduction to the use of chemical test kits for doing standardized sampling procedures and equipment so data is comparable from site to site. This information can then be used as baseline data.*
Activity: Dependent on the number and types of test you will conduct. The Hach company provides the methods, safety measures and QA/QC for each test kit.
Time required: Two hours for sampling and testing plus travel time to the site
Preparation and materials required: Hach kits, water sample bottles, waders, life jackets, eye goggles, gloves
QA/QC: yes

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Skill Level: Stonefly  

Purpose: Continuous Record

Outcome: *Systematically records observations about stream health*

1. PHYSICAL MEASURES

Title: Quantitative Habitat Assessment, Two Times a Year

Source: *Intensive Biosurvey,*Volunteer Stream Monitoring: A Methods Manual, EPA pg. 105

Concept: *To evaluate the condition of your stream it should be compared to the optimal conditions in your region, also called the reference condition.*

Activity: Work with the stream biologist to gather reference condition benchmarks for your region. Perform the habitat assessment data collection for the Intensive Stream Biosurvey on your sample sites. Determine the habitat index score and the percent similarity to the reference score then you will be able to determine the stream habitat quality rating.

Time required: 10 hours, twice a year

Preparation and materials required: identification books and keys, waders, life jackets, tape measure, buckets, sample bags, data sheets

QA/QC: yes

2. BIOLOGICAL MEASURES

Title: Intensive Biological Survey, Two Times a Year

Source: *Intensive Biosurvey,* Volunteer Stream Monitoring: A Methods Manual, EPA pg. 86

Concept: *Use macroinvertebrates as a screening tool to identify water quality problems and teach volunteers about stream ecology.*

Activity: Streamside Biosurvey volunteers are trained to use special nets and standardized sampling protocols to collect organisms from a measured area of stream habitat. Volunteers identify collected organisms, usually to the order level, and sort them into taxonomic groups based on their ability to tolerate pollution. Using this information, volunteers can then calculate a simple stream quality rating of good, fair or poor**.** A trained stream biologist should be used throughout the sampling and identification.

Time required: 10 hours, twice a year

Preparation and materials required: waders, life jackets, collection bottles, alcohol, forceps, eyedroppers, kick/dip nets, sorting trays, identification keys and books, buckets, eye goggles

QA/QC: yes

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2. BIOLOGICAL MEASURES

Title: Dragonfly Survey
Source: *Citizen's Monitoring Guide;* Northern Minnesota Dragonfly Survey Project Dr. Janet Rith-Najarian, Rivers Council of Minnesota
Concept: *Dragonflies are an indicator species. Monitoring the types and numbers of dragonflies present at your site can show your streams health.*
Activity: Volunteers participate in the Northern Minnesota Dragonfly survey project to sample the dragonfly population at their sample sites.
Time required: 2 – 3 hours for sampling and identification
Preparation and materials required: butterfly nets, data sheets, identification books and keys
QA/QC: yes

3. CHEMICAL MEASURES

Title: Bi-weekly or Monthly Transparency Tube Measurements
Source: MPCA Citizen Stream Monitoring Program Instructions 507/389-1925
Concept: *A straightforward measurement of stream conditions***.**
Activity: Use a transparency tube to routinely measure water transparency in the warm weather season; share results with MPCA database.
Time required: Two hours for training; less than one hour for measurement
Preparation and materials required: Transparency tube, data forms and MPCA training
QA/QC: yes

Title: Use Meters to Measure DO, Temperature, pH, Turbidity Bi-weekly or Monthly
Source: Metropolitan Council
Concept: *To use analytical instruments for continuous monitoring of water quality established by the Metropolitan Council*
Activity: Follow the Metropolitan Councils procedures and protocols for using analytical equipment to determine the dissolved oxygen, temperature, pH and turbidity at sample sites.
Time required: Two hours for sample collection and testing
Preparation and materials required: Testing kits, eye goggles, gloves, sample bottles, thermometer
QA/QC: yes

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(see Page 4)

Skill Level: Stonefly 

Purpose: Problem Investigation

Outcome: *Draws conclusion about stream health based on record of observations*

1. PHYSICAL MEASURES

Title: Take Pictures/Video of Effects of Storm Event

Source: *River Monitors Manual,* Rivers Council of Minnesota

Concept: *It is important to record the effects that storm events have on your sample site.*

Activity: During storm events take video footage or photographs showing the changes that occur and what problems are caused by increased precipitation

Time required: 15 minutes plus travel time to the site

Preparation and materials required: Knowledge of recent and historic stream and weather conditions, camera and film, data sheets to record weather

QA/QC: no

2. BIOLOGICAL MEASURES

Title: Intensive Biological Survey

Source: *Intensive Biosurvey;* Volunteer Stream Monitoring: A Methods Manual, EPA, pg. 86

Concept: *Metrics are used to analyze and interpret biological data by condensing lists of organisms into relevant biological information. In order to be useful, metrics must be proven to respond in predictable ways to various types and intensities of stream impacts.*

Activity: Review metrics and select appropriate measures for the stream being studied. Generally, metrics fall into the categories of (1) taxa richness and composition (2) pollution tolerance and intolerance (3) feeding ecology, and (4) population attributes.

Time required: Up to eight hours for review and selection; additional time to review with biological advisors, such as MN DNR fisheries biologists, MPCA water quality specialists, biology professors from local university or college, or biology teachers.

Preparation and materials required: kick/dip nets, sample jars, alcohol, waders, life jackets, buckets, forceps, data sheets, eye goggles

QA/QC: yes

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3. CHEMICAL MEASURES

Title: Weekly or Event-based Chemical Measurements

Source: *River Monitors Manual,* Rivers Council of Minnesota

Concept: *Monitoring after a rain event allows you to detect potential changes in stream condition related to precipitation and runoff. As a general rule of thumb, a rainfall of approximately ½-inch in a relatively short period of time can result in a significant runoff event.*

Activity: Take measurements daily for up to five days following a significant rainfall event to monitor runoff. Once you have monitored a few rainfalls, use your best judgment to determine when a rainfall is significant, and how long stream conditions change in response to a rain event.

Time required: One to two hours, depending on number of sampling locations.

Preparation and materials required: testing kits, data forms, eye goggles, gloves, waders, life jackets

QA/QC: yes

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Skill Level: Kingfisher 

Purpose: Awareness and Education

Outcome: *Understands principles of stream health*

1. PHYSICAL MEASURES

Title: Detailed Map of Stream Inputs and Updates on Land-Use Changes, "Ground-Truthing"

Source: *How to Conduct a Stream Survey;* Volunteer Stream Monitoring: A Methods Manual, EPA, pg. 25

Concept: *Graphically chart all the stream inputs to show the cumulative impact on the stream. Create a current map of the sample area for comparison with historical data to show changes in land use and the correlation to changes in water quality.*

Activity: Obtain topographic maps of your stream sites and mark all stream inputs. Gather historical land use data and maps and compare changes that have occurred.

Time required: Two days to a week, depending on depth of information required

Preparation and materials required: topographical maps, markers, other maps

QA/QC: yes

2. BIOLOGICAL MEASURES

Title: Detailed Biological Assessment

Source: *Intensive Biosurvey*; Volunteer Stream Monitoring: A Methods Manual, EPA pg. 86

Concept: *A rigorous method for using habitat assessment and macroinvertebrate count to yield credible information on subtle stream impacts and water quality trends.*

Activity: Macroinvertebrates are collected in the field and returned to the lab for analysis, and a portion are identified to the taxonomic family level. After identification, a series of indices, or metrics, are calculated to provide a broad range of information about the stream site. A trained stream biologist should verify all procedures and identifications and make sure that proper QA/QC measures are followed so the data is credible.

Time required: Up to four hours in the field, and up to eight hours in the lab

Preparation and materials required: Biological advisor, training in methodology and identification, waders, life jackets, identification keys and books, buckets, kick/dip nets, alcohol, sample bottles, eye goggles

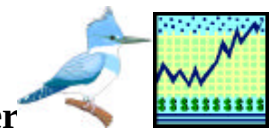
QA/QC: yes

Don't Forget About Safety!

(see Page 4)

3. CHEMICAL MEASURES

Title: Measure Water Chemistry with Analytical Instruments and Lab Analysis
Source: Metropolitan Council
Concept: *Use standard methods to analyze water samples incorporating QA/QC so data is acceptable for agency use*
Activity: Collect samples, using standard methods and QA/QC established by the Metropolitan Council to analyze water samples in the lab, and report results.
Time required: One to two hours for sampling and up to four hours in the lab
Preparation and materials required: Meters, chemical reagents, sampling equipment, lab, eye goggles, gloves, apron, waders, life jacket, sample bottles
QA/QC: yes

Skill Level: Kingfisher 

Purpose: Continuous Record

Outcome: *Accurately records systematic observations of stream health over time*

1. PHYSICAL MEASURES

Title: Use Flow Meters/Dye Drip to Develop a Rating Curve
Source: Metropolitan Council
Concept: *To determine the flow of the sample stream and what effects that flow will have on the physical attributes of the stream.*
Activity: Set up a flow meter or a dye drip station according to the Metropolitan Council's guidelines to determine stream flow.
Time required: one hour plus travel time
Preparation and materials required: flow meter or dye drip station, waders, life jacket, data sheets
QA/QC: yes

2. BIOLOGICAL MEASURES

Title: Maintain an Angler Diary
Source: Minnesota DNR regional fisheries office
Concept: *A season's fishing experience provides valuable information.*
Activity: Record the date, weather conditions, number, size and kind of fish caught, time spent fishing, and type of bait used. This gives an overall picture of fish health in the stream and is important information for the Department of Natural Resources Fisheries section.
Time required: Minimal
Preparation and materials required: notebook, DNR forms, fishing pole and tackle
QA/QC: yes

3. CHEMICAL MEASURES

Title: Chemical Sampling With Analytical Instruments
Source: Metropolitan Council
Concept: *Use analytical instruments following standard procedures and QA/QC procedures to provide credible data for use by agencies and government bodies.*
Activity: Collect samples and analyze in the lab using standard methods, QA/QC protocols established by the Metropolitan Council.
Time required: Up to four hours in the field and up to eight hours in the lab
Preparation and materials required: Sampling equipment, chemical reagents, eye goggles, apron, gloves, analysis equipment, lab, appropriate training and advisor
QA/QC: yes

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(see Page 4)

Skill Level: Kingfisher 

Purpose: Problem Investigation

Outcome: *Draws conclusions about stream health based on a variety of observations and indices*

1. PHYSICAL MEASURES

Title: Quantitative Habitat Assessment: Compare With Historical Data
Source: *Intensive Biosurvey;* Volunteer Stream Monitoring: A Methods Manual, EPA pg. 86
Concept: *Shows the changes that have occurred over time related to land-use.*
Activity: Conduct the Intensive Biosurvey by delineating the habitat assessment boundries, do general characteristics and land use inventories and compare to historical data to note changes and any correlations to water quality changes.
Time required: varies, one to two days depending on depth of research
Preparation and materials required: Advisor, topographic maps, historic maps, history of the area, data sheet
QA/QC: yes

Title: Use Flow Meters To Measure Flow During Storm Events and Develop a Rating Curve
Source: Metropolitan Council
Concept: *To observe and record changes that occur during storm events and how those changes may affect the stream in the future.*
Activity: Monitor storm events using guidelines established by the Metropolitan Council using flow meters to record data. Record weather conditions also.
Time required: dependent on length of the storm
Preparation and materials required: data sheets, flow meter, wader, life jacket
QA/QC: yes

3. CHEMICAL MEASURES

Title: Event-based Chemical Sampling with Analytical Instruments
Source: Metropolitan Council
Concept: *Conducting chemical sampling during storm- events will show the influences of runoff on the stream and can document problem areas.*
Activity: Set up a schedule as to duration and sites to be sampled during storm events. Use analytical instruments to conduct the water chemistry tests using standard procedures and QA/QC according to the Metropolitan Council's guidelines.
Time required: dependent on the length of the storm event
Preparation and materials required: analytical sampling equipment, waders, life jackets, sample bottles, eye goggles, gloves, data sheets
QA/QC: yes

Don't Forget About Safety!

(see Page 4)

VOLUNTEER STREAM MONITORING REFERENCES and RESOURCES

American Rivers
Grassroots River Protection
801 Pennsylvania Ave. SE
Suite 400
Washington, D.C. 20003
(202) 547-6900

Citizen's Monitoring Guide: Northern Minnesota Dragonfly Survey Project
Dr. Janet Rith-Najarian
Rivers Council of Minnesota
P.O. Box 1107
Walker, MN 56484
(218) 547-3583
Fax (218) 547- 3421
Email: riversmn@eot.com
http://www.riversmn.org

Color Guide to Common Dragonflies of Wisconsin
Revised Edition 1998
Karl and Dorothy Legler, Dave Westover
429 Franklin Street
Sauk City, WI 53583
(608) 643-4926
Email: karlndot@bankpds.com

Environmental Test Systems, Inc.
AquaChek – Nitrate/Nitrite test strips
P.O. Box 4659
Elkhart, IN 46514

Green Project – Global Rivers Environmental Education Network
Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools
Mark Mitchell and William Stapp
2050 Delaware Ave.
Ann Arbor, MI 48130
(313) 761-8142
http://www.econet.apc.org/green/

Hach Equipment Company
Water, Water Everywhere: Teachers guide, Water Quality Factors Reference and *Student Reading Unit*
P.O. Box 329
Loveland, CO 80539-0389
(800) 227-4224
water quality monitoring equipment

Izaak Walton League of America
707 Conservation Lane
Gaithersburg, MD 20878-2983
(800) BUG-IWLA
http://www.iwla.org

LaMott Equipment Company
P.O. Box 329
Chestertown, MD 21620
(800) 344-3100
water quality-monitoring equipment

Metropolitan Council Environmental Services
230 E. 5th St.
St. Paul, MN 55101
(651) 602-8382 Fax: (651) 602-8179
mike.meyer@mces.state.mn.us

Minnesota Department of Natural Resources (MN DNR)
General Information: 500 Lafayette Rd.
St. Paul, MN 55155
(612) 296-6157
Trails and Waterways: (651) 297-5476; *Adopt-A- River Program*
Non-Game Wildlife; Amphibian survey (651) 297-3764
Nongame Research Program: *Natural Areas: Protecting A Vital Community Asset; 1997*
Volunteer Programs: (651) 297-1449
Fisheries: (651) 296-3325

Minnesota Frog Watch
Hamline University
1536 Hewitt Ave.
St. Paul, MN 55104-1284
(651) 523-2812
http://cgee.hamline.edu/frogs/index.htm

Minnesota Office of Environmental Assistance
Waste Reduction and Household Hazardous Waste Fact Sheets
520 Lafayette Road N.
St. Paul, MN 55155-4100
(800) 657-3843
http://www.moea.state.mn.us

Minnesota Pollution Control Agency (MPCA)
1230 S. Victory Drive
Mankato, MN 56001
(800) 657-3864
http://www.pca.state.mn.us/water/csmp.html
Stream gauge information

Project SEARCH
An Identification Key to the Most Common Riffle-Dwelling Benthic Macroinvertebrates
1999 Minnesota Edition
Created by Mike Beauchene
Modified by Gary Montz
Hennepin Conservation District, MN
10801 Wayzata Blvd., Suite 240
Minnetonka, MN 55305
(612) 544-8572

River Monitors Manual
Mississippi Headwaters Board
Rivers Council of Minnesota
P.O. Box 1107
Walker, MN 56484
(218) 547-3583
Fax (218) 547-3421
Email: riversmn@eot.com
http://www.riversmn.org

River Watch Network
Testing the Waters: Chemical and Physical Vital Signs of a River
Living Waters: Using Benthic Macroinvertebrates and Habitat to Assess Your River's Health
153 State Street
Montpelier, VT 05602
(802) 223-3840
http://www.riverwatch.org

United States Environmental Protection Agency
Volunteer Stream Monitoring: A Methods Manual; EPA 841-B-97-003; November 1997
Rapid Bioassessment Protocols for Use in Streams and Rivers; Benthic Macroinvertebrates and Fish: EPA 440/4-89/001; May 1989
Generic Quality Assurance project Plan Guidance for Programs Using Community Level Biological Assessment in Wadable Streams and Rivers: EPA 841-B-95-004; July 1995
Region 5
77 W. Jackson Blvd.
Chicago, IL 60604
(800) 621-8431 or (312) 353-2000
http://www.epa.gov/region5

USGS Earth Science Information Center
507 National Center
12201 Sunrise Valley Drive
Reston, VA 220292
(800) USA-MAPS
source for topographical map

USGS Patuxent Wildlife Research Center
North American Amphibian Monitoring Program (NAAMP)
12100 Beech Forest Road, Suite 4039
Laurel, MD 20708-4039
(301) 497-5500
Fax: (301) 497-5505
http://www.im.nbs.gov/amphibs.html

Water Action Volunteers
Volunteer Monitoring Fact Sheets
Cooperative Extension Publications
630 W. Mifflin Street
Madison, WI 53703
(608) 262-3346
http://clean-water@uwex.edu/

Watershed Resources, Youth Stewardship Project
Rich and Susan Cairn
3715 45th Ave. S.
Minneapolis, MN 55406-2910
(612) 722-5806 Fax: (612) 722-6062
Email: cairn@tc.umn.edu.