

Designing Your Monitoring Strategy: Basic Questions and Resources to Help Guide You

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Getting Started in Volunteer Water Quality Monitoring?

This factsheet focuses on helping new program coordinators get their programs up and running. Our goal is to provide you with questions to consider, steps to follow, examples of what's worked and direct you to some of the many resources available to assist you in your monitoring efforts.

There are numerous potential monitoring program goals and monitoring activities available to meet those goals. It is essential to accurately identify what you want your volunteer monitoring to accomplish and how you want your data to be used before you consider specifically what and how you want to monitor. In fact, **the first step in determining *WHAT* to monitor is deciding *WHY* you want to monitor.**

Why Extension Volunteer Water Quality Monitoring Programs Got Started

Volunteer water quality monitoring encompasses a wide range of activities, meeting a diversity of needs. Replies to a recent inquiry of Extension-based volunteer monitoring programs provided a variety of reasons for starting a program. They included:

- To create a long term, credible, data set (address need for data), often due to a lack of watershed monitoring by state or other agencies;
- To educate the public about water quality issues;
- To develop and educate youth (school-based and other youth programs);
- To create consistency in methods, data management, and coordinated use of data between basins, volunteer groups, and agencies;
- To address public interest about why and how monitoring is done and what the results mean;
- To foster community involvement with water resources;
- To respond to a crisis in the shellfish industry caused by poor water quality conditions;
- To address concerns about drinking water quality in private wells.

The program design process discussed in this module includes several basic components:

1. defining the question(s) to answer (e.g. is the water safe for swimming?),
2. characterizing how the data will be used (e.g., education or regulatory compliance), and
3. identifying the resources available for accomplishing your goals.



This is the fourth in a series of factsheet modules which comprise the **Guide to Growing CSREES Volunteer Monitoring Programs**, part of the *National Facilitation of Cooperative State Research Education Extension Service (C.S.R.E.E.S.) Volunteer Monitoring Efforts* project. Funded through the U.S.D.A. C.S.R.E.E.S., the purpose of this four-year project is to build a comprehensive support system for Extension volunteer water quality monitoring efforts nationally. The goal is to expand and strengthen the capacity of existing Extension volunteer monitoring programs and support development of new groups. Please see <http://www.usawaterquality.org/volunteer/> for more information.



The Value of a Technical Steering Committee

Lynette Seigley of the IOWATER program, which has had an advisory board since its inception, has high praise for the steering committee approach. Lynette tells us that participating agencies/members on the IOWATER board have increased through time. Currently members include, but are not limited to, representatives from the Iowa Farm Bureau, Iowa Environmental Council, Iowa Department of Natural Resources, Area Education Agencies, Iowa Water Pollution Control Federation, Izaak Walton League, Natural Resources Conservation Service, Iowa Department of Agriculture and Land Stewardship, University of Iowa Hygienic Lab, Iowa Association of Naturalists, Iowa Conservation Education Council, Iowa Student Environmental Coalition, Iowa State University Extension, and Trees Forever.

This large and diverse board serves many roles. One important role is as a sounding board for new ideas or program changes to IOWATER. According to Lynette, "We rely on the board for input on program direction, ways to market the program, suggestions for changes, and ideas on how to keep volunteers involved. The IOWATER program has benefited tremendously from the input of its advisory board."

Educating Yourself:

An understanding of the basics of water quality is critical in volunteer monitoring program development. The United States Department of Agriculture (U.S.D.A.) National Extension Water Quality Database (<http://hermes.ecn.purdue.edu/water/>) is an excellent resource for identifying local water quality experts and also contains a wide range of general water quality factsheets and publications. The United States Environmental Protection Agency (U.S.E.P.A.) Office of Water also has a variety of general water quality informational resources available at their website (<http://www.epa.gov/ow/>). In addition, you will want to learn more about the specifics of water quality monitoring. A very good primer for developing an understanding of non-point source pollution monitoring is the chapter on water quality monitoring in *How to Monitor Rangeland Resources* by Nader et al (1999). This chapter is available in pdf format (358 K) on the web at http://animalscience.ucdavis.edu/extension/RangelandResources/pdfs/water_quality_monitoring.pdf

In addition to reading about water quality and monitoring, development of a technical steering committee comprised of a variety of water quality professionals can be an effective means of augmenting your knowledge and ensuring that you keep up-to-date on water quality information and current research. Nearly half of Extension-based volunteer monitoring programs responding to a 2001 inquiry (<http://www.uwex.edu/ces/csreesvolmon/NationwideInquiry/TypesActivities.pdf>) reported that they relied upon a technical steering committee to assist in program development. In addition to providing technical information, steering committees also build credibility for your program and foster partnerships with outside agencies or organizations.





Defining the Questions You Want to Answer

The questions that you want to answer and the type of environment (Table 1) that you are concerned about determine the parameters that you should monitor (Table 2). It is not enough to be simply “concerned about water quality”, but rather you need to know what *in particular* are you interested in learning about the water.

Table 1: Types of Environments

| | | |
|----------------|--------------------|------------|
| River / Stream | Land | Marine |
| Lake / Pond | Reservoir | Coral reef |
| Wetland | Beach | Air |
| Estuary | Groundwater / well | |

For example if you know that a specific stream once had a healthy trout population which now seems to have declined, your question might be “is the water quality adequate for trout?” To answer that question you would need to know a bit about trout and the conditions necessary to support them (e.g., what is the range of water temperatures that are tolerable, what is a trout’s diet). By identifying the indicators of healthy trout waters you determine potential parameters to monitor to help determine why your population has declined. Because trout are very sensitive to changes in dissolved oxygen levels, water temperature, and pH these parameters are most often assessed to identify acceptable trout waters. Physical habitat values such as the presence of pools, riffles and runs, snags and other structures, or availability food in the form of various macroinvertebrate species could also be assessed, especially if the water quality were found adequate for trout survival and reproductive success.

Table 2: Potential Monitoring Parameters

Watershed Assessments

| | |
|---------------------|------------------------------|
| Land use survey | Construction site inspection |
| Photographic survey | Habitat assessment |

Physical / chemical Parameters

| | |
|---|------------------|
| Temperature | Dissolved oxygen |
| Alkalinity | pH |
| Salinity | Phosphorus |
| Nitrogen | Hardness |
| Flow/water level | Chloride |
| Turbidity | Metals |
| Secchi transparency | Pesticides |
| Rainfall | Hydrocarbons |
| Conductivity | Toxicity |
| Stream channel morphology | |
| Biological oxygen demand (B.O.D.) | |
| Total suspended or dissolved solids (T.S.S./T.D.S.) | |

Biological Parameters

| | |
|-----------------------------------|-------------------------|
| Macroinvertebrates | Wildlife |
| Bacteria | Chlorophyll |
| Phytoplankton | Fish |
| Shellfish | Exotic/invasive species |
| Aquatic or terrestrial vegetation | |



Land Use Impacts Water Quality



If you have a concern that certain land uses or activities in your watershed may be impacting water quality you may be able to focus your monitoring efforts. Many land uses have specific types of water quality impacts associated with them. For example, excess lawn fertilizers and pet waste often result in runoff from residential areas containing high levels of bacteria and phosphorus or nitrogen. Table 3, adapted from the U.S.E.P.A.'s *Volunteer Estuary Monitoring: A Methods Manual*, available online at <http://www.epa.gov/owow/estuaries/monitor/> contains a list of land uses and potential water quality impacts.

Table 3. Common water quality impacts potentially associated with selected land uses

| Source | Common Pollutants / Impacts |
|---------------------------------|---|
| Cropland | Turbidity, total solids, nutrients, thermal impacts, pesticides |
| Grazing land | Fecal bacteria, turbidity, nutrients, thermal impacts |
| Forestry | Turbidity, total solids, thermal impacts |
| Mining | Alkalinity, pH, total dissolved solids |
| Industrial/commercial discharge | Turbidity, total solids, conductivity, pH, toxics |
| Sewage treatment plants | Dissolved oxygen/biochemical oxygen demand, turbidity, total solids, conductivity, nutrients, fecal bacteria, thermal impacts, pH |
| Construction | Turbidity, total solids, thermal impacts, dissolved oxygen/biochemical oxygen demand, toxics |
| Suburban/Urban runoff | Turbidity, nutrients, thermal impacts, conductivity, dissolved oxygen/biochemical oxygen demand, bacteria, metals, petroleum hydrocarbons |
| Lawns/golf courses | Nutrients, turbidity, total solids, bacteria, toxics |
| Septic systems | Fecal bacteria, nutrients, dissolved oxygen/biochemical oxygen demand, conductivity, thermal impacts |
| Marinas/boat usage | Nutrients, bacteria, toxics |

Characterizing How the Data will be Used

To refine your selection of parameters, it is critical that you determine *HOW* your data will be used. According to national surveys of volunteer monitoring programs, volunteer data have three main uses: 1) education, 2) problem identification and 3) local decisions (*The Volunteer Monitor* Spring 1994; <http://www.epa.gov/volunteer/spring94/index.html>). Extension-associated volunteer monitoring programs reported similar data uses. Water quality protection, public and landowner education, compilation of long-term data profiles, youth environmental education and identification of pollution problems were reported as major objectives of the majority of Extension-based volunteer monitoring efforts (<http://www.uwex.edu/ces/csreesvolmon/NationwideInquiry/SummInitInqFinal.pdf>).

You will need to further focus these broad data uses in order to select appropriate monitoring parameters and procedures that meet your program's data objectives. For example if the objective of your program is to teach middle school children about what lives in the creek, a simple method for gathering and identifying macroinvertebrates could be used. If, however, your objective is to learn about what lives in the creek in order to determine if there is adequate food to support trout, a method that permits you to quantify specific macroinvertebrates might need to be employed.

Also remember that most data have multiple uses and often multiple users. Therefore, clearly defining your program's data goals will likely require communication with other potential data users, especially if you plan to compare your results to state or federal standards. Typically agencies define which procedures are "accepted" for monitoring various parameters. If you would like your data to be used to determine whether a particular waterbody is meeting that agency's criteria you will have to use those procedures. But if your goal is to collect purely educational data, or to help an agency target its monitoring efforts to particular waterbodies, you may be able to use other simpler or less expensive methods.

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Identifying Your Available Resources

When designing your program it is important to review and consider the resources (human and financial) you have available. Ideally all monitoring programs would use state-of-the-art research grade equipment to collect and analyze samples. However that is unlikely to be within the financial and technical capacity of many programs. It is equally unrealistic to expect that your volunteers will contribute unlimited hours of service weekly, especially if the tasks assigned are repetitive or extremely complex. You will need to assess your list of potential parameters and procedures that address your water quality concerns carefully to determine which are in fact possible given the resources available to your program.

Once resources have been determined, you need to reassess your chosen monitoring parameters and procedures to determine whether they are appropriate for your data uses. For example, many monitoring programs are concerned about nutrient enrichment that often leads to algal blooms and low oxygen conditions. Therefore, these programs would obviously choose to monitor nutrients, typically phosphorus and/or nitrogen. There are a number of methods available, ranging from simple field kits to sophisticated laboratory analysis. Unfortunately, while field kits generally are inexpensive and easy to use, they seldom have detection limits low enough to measure the nutrient levels, particularly phosphorus, commonly found in natural waters in many areas.

For the University of Rhode Island (U.R.I.) Watershed Watch Program accurate measurements of nutrient levels are necessary for achieving its goals of obtaining surface water quality information to ascertain current conditions, to detect trends, and to encourage management decisions that are based upon water quality information. Fortunately being housed within the Natural Resources Science Department of a state university allowed access to research-grade analytical equipment. Further, Program Director Linda Green had extensive experience as a bench chemist. This combination of material (access to expensive instruments), and technical (Linda's experience) resources, combined with financial (partial program support of U.R.I. Cooperative Extension) allowed the program to establish its own laboratory, capable of meeting the stringent data and data quality needs of the program and its partners. A similar set of circumstances resulted in the University of New Hampshire Lay Lakes Monitoring Program also having its own laboratory.



The Discovery Farms Trained Sampler Program in Wisconsin (www.discoveryfarms.org) opted for a combination of field test kits and to contract with an established laboratory at the University of Wisconsin. The goal of the program is to collect baseline data to determine the quality of surface waters of working farms, and to provide information regarding agricultural best management practices (B.M.P.s) to researchers in order to reduce the impacts from farming. Since field kits would not produce analytical results precise enough to meet their data objectives, an analytical laboratory is used for a number of chemical analyses on samples collected seasonally. This seasonal data allowed program staff to develop reliable baseline information and to detect trends resulting from the implementation of B.M.P.s recommended through the program. The Discovery Farms Program considered the value of this information worth the expense of paying the laboratory for those analyses, but opted to limit the number of samples to reduce costs. To help engage the local community while providing an overall assessment of stream conditions, volunteers use field test strip kits to analyze nitrate and ammonia during bi-weekly sampling events. Assuming that values found with the test strips should be either very low or zero, volunteers can quickly identify any problems that that might need immediate actions. If higher values are detected through this bi-weekly sampling process, corrective actions can be taken immediately, rather than having to wait for the seasonal laboratory results. This combination of rapid-response field test strip kit and precise and accurate laboratory analyses enables The Discovery Farms to meet both long-term data objectives (base line and trend development) as well as education and environmental protection objectives.

Some local groups with the Water Action Volunteers (W.A.V.) program in Wisconsin have partnered with local wastewater treatment plants (W.W.T.P.s) to help analyze samples for which precise results were needed. By law, W.W.T.P.s must monitor effluent for a variety of constituents so many facilities have certified in-house labs. One W.A.V. group was particularly concerned about fecal coliform bacteria contamination, and another was interested in total suspended solids. Both found that the local W.W.T.P. was willing to accept samples for analysis as a public service. However, one caution with W.W.T.P.'s relates to limits of detection. Because nutrient levels in wastewater tend to be quite high, the methods often used by W.W.T.P. labs have fairly high limits of detection – often higher than ambient nutrient levels found in surface waters. As with any lab that you might choose to partner with or to hire, it is important that you understand what analytical methods are used and what the detection limits are in order to determine whether they meet your data objectives.

Resource Evaluation (continued)

If your goals are similar to those of the programs highlighted on the previous page, but similar options are not available for analyzing your samples, you may have to reevaluate your study design to see if other indicators are available that better meet both your resources *and* data uses. On the other hand, if your goal is to simply identify areas of concern for follow-up monitoring or to educate students about water quality issues, field kits or other simpler, less expensive equipment may be available.



Tools to Help You Evaluate Your Program Design

A number of resources exist to help you match your program goals and resources with appropriate monitoring activities. Bringing information together from some of these, we created a monitoring matrix (http://www.usawaterquality/volunteer/Outreach/monitoring_matrix.pdf) that includes information about a variety of monitoring activities, data objectives, equipment and supplies needed, education and volunteer training required, frequency of monitoring and quality assurance standards. It is based upon one designed by the recently ended *Watch Over Washington* program.

Another good resource is the *Waterwatch Tasmania Equipment Guide*, which is both an equipment guide and offers a comparison between method types. This 34-page guide can be found at http://www.tas.waterwatch.org.au/pdf/Equipment_Guide_2003.pdf. While some of the equipment or field kits included in this guide are not available in the United States (e.g. Merck kits), it provides an excellent overview of equipment and methods.

Focusing largely on professional methods, but with applicability to volunteer programs, the National Environmental Methods Index (N.E.M.I. <http://www.nemi.gov>) is a clearinghouse of environmental monitoring methods. The N.E.M.I. database contains method summaries for laboratory and field protocols for regulatory and non-regulatory water quality analyses, including performance data such as precision, accuracy, and relative cost.

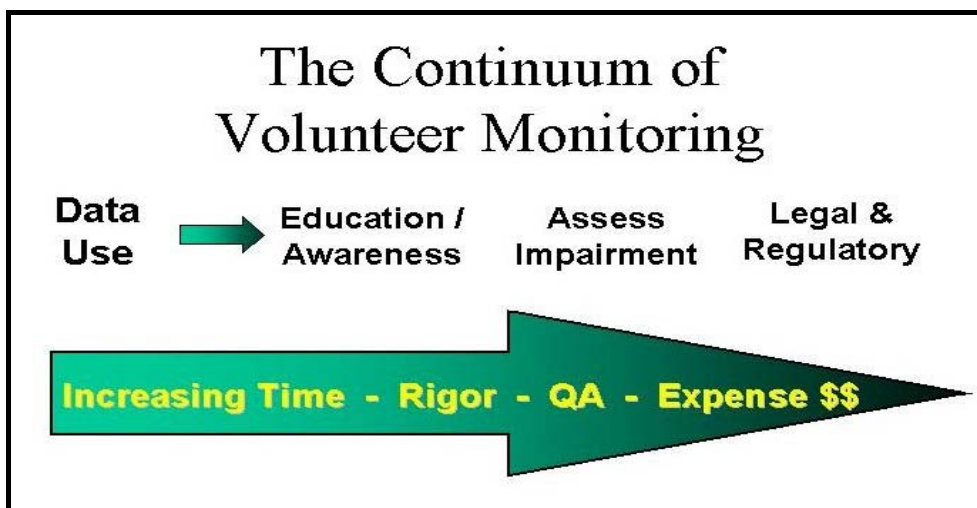


Figure 1. The Continuum of Volunteer Monitoring created by Geoff Dates of the River Network visually illustrates intended data use versus the resources required. By realistically assessing your data needs and resources, you can more practically set program goals and identify effective and reasonable monitoring parameters.

Now that you've determined exactly what you are going to monitor, you'll need to decide exactly *How* you will monitor. A variety of resources are available to draw from when developing your program's monitoring protocols. Many volunteer monitoring programs have successfully modified established monitoring methods or developed new methods that are supported by established scientific methodologies. When backed by strong quality assurance and quality control (QA/QC) procedures these 'volunteer' methods can be acceptable for many uses. *Standard Methods for the Examination of Water and Wastewater* (<http://www.standardmethods.org/>) is a good starting point for identifying many chemical and biological monitoring procedures. In fact, many volunteer monitoring methods are based upon those described in this manual. Using widely accepted monitoring procedures such as those in *Standard Methods*, or approved by the USEPA (<http://www.epa.gov/waterscience/methods/>) can be very important for data credibility.

Another tremendous source for information regarding monitoring methods is the Volunteer Monitoring Methods series by U.S.E.P.A. (<http://www.epa.gov/owow/monitoring/volunteer/>). This series includes methods for monitoring lakes, streams, and estuaries, as well as guidance for monitoring wetlands and QA/QC project plan development. Each manual describes in great detail methods appropriate for volunteers, and provides numerous references to a variety of volunteer monitoring programs and other methods. *The Volunteer Monitor* newsletter sponsored by U.S.E.P.A. publishes descriptions of new or innovative monitoring methods, as well as program management ideas and includes extensive contact information (http://www.epa.gov/owow/monitoring/volunteer/vm_index.html). *The Great North American Secchi Dip-in* website (<http://dipin.kent.edu/methods.htm>) also includes several methods for assessing water transparency and turbidity as well as other water quality indicators.

Once you have determined how you will monitor, you will likely want to create a monitoring procedures manual. Having a detailed written manual helps to ensure consistency between monitors and over time, and is an important quality assurance element for many programs. While you will want to prepare a monitoring manual specific to your program, there is no point in "reinventing the wheel". There are a large number of good resources from which to adapt materials. A search of the World Wide Web will uncover many hundreds. On the next page we have listed a selection of Extension-associated monitoring manuals to get you started.



Another source for widely applicable watershed assessment methods is the New England Regional Monitoring Collaborative (N.E.R.M.C.) (<http://www.umass.edu/tei/mwwp/nermc/>). N.E.R.M.C. developed a set of manuals, videos and training aids for volunteer groups covering five watershed assessment tools. Those tools are:

- *Watershed Natural Resources Inventory*
- *Rapid and Intensive Habitat Assessments*
- *Benthic Macroinvertebrate Streamside Assessment*
- *Intensive Benthic Macroinvertebrate Assessment*
- *Following the Flow: "Onsite Nonpoint Source Pollution Evaluation.*

The Massachusetts Water Watch Partnership, a NERMC partner and host of the N.E.R.M.C. website, itself has an excellent web site with an extensive set of links to a wide range of monitoring procedures and information (<http://www.umass.edu/tei/mwwp/>).



Selected Monitoring Procedures Manuals - Extension-associated Sources:

Alabama Water Watch - publications web page includes links to visual stream monitoring protocols, quality assurance plans for both chemical and bacteriological monitoring as well as other program-specific information available in pdf files. <http://www.alabamawaterwatch.org/awwp/pubs.htm>.

Hoosier Riverwatch Volunteer Stream Monitoring Training Manual (113 pp). This manual, developed in partnership between the Indiana Department of Natural Resources and Purdue University Agronomy Department, is written as a supplement to the Field Manual for Global Low-Cost Water Quality Monitoring (Stapp and Mitchell). It can be downloaded as individual chapters, or the entire manual as a zipped file (9256KB). <http://www.in.gov/dnr/soilcons/riverwatch/vsm/manual.html>

Massachusetts Water Watch Partnership - Lake Volunteer Monitoring Manual (77 pp). This manual includes biological, chemical, and physical monitoring methods. Detailed instructions and worksheets are a useful feature of this manual, as are informative graphics. It is available as a pdf file. <http://www.umass.edu/tei/mwwp/acrobat/lake%20manual.pdf>

Minnesota's Volunteer Stream Monitoring Partnership's Guide to Volunteer Stream Monitoring (108 pp). This manual provides extensive resources for program development as well as monitoring methods and data sheets. Activities are categorized by applicability for awareness and education, continuous record building or problem investigation. It is available in pdf format (451 K). <http://wrc.coafes.umn.edu/VSMP/pdf/activityguide.pdf>

Pacific Northwest Water Quality and Monitoring Program Workshop Guide and Participant Materials (404 pp, plus appendices). Designed as the companion to a 15-hour short course on water education and monitoring, this 17-module guide provides detailed information a wide range of topics from watershed education to getting the word out about water quality data. It is available as multiple pdf files from http://www.pnwwaterweb.com/Initiative/vol_moncontext.htm

University of Maine Cooperative Extension site offers access to Resources for Coastal Monitors and Educators including a listing of available resources (including reports, manuals, protocols, and videos) and links to online training modules. <http://www.ume.maine.edu/ssteward/resources.htm>

URI Watershed Watch: Factsheets and monitoring manuals for lakes, rivers, and aquatic plant monitoring are available from this site as multiple pdf files. http://www.uri.edu/ce/wq/ww/html/ww_resources.html

Utah Stream Team Manual (359 pp). This manual includes sections on designing your program, field preparation and investigation methods, and other program resources. <http://extension.usu.edu/publica/natrpubs/utahstreamteam.pdf>

Water Action Volunteers' Stream Monitoring Protocols. This factsheet series of monitoring procedures is available in pdf format. <http://clean-water.uwex.edu/wav/monitoring/factsheet.htm>



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Eleanor Ely: pages 2 lower, 3 upper, 4, 8, & 12

Elizabeth Herron: pages 2 upper, 3 lower, 5, 6, 7, 9, & 11



Selected Monitoring Procedures Manuals – Other sources:

Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams (33 pp). Produced by the Washington State Department of Ecology, this manual covers study design, field quality assurance, safety procedures, field operations, lab sample processing, data analysis and overall data management of benthic samples. <http://www.ecy.wa.gov/biblio/0103028.html>

Getting Started with TMDLs (97 pp) by Wesley Jarrell, Ph.D.

Oregon Graduate Institute of Science and Technology for YSI Environmental Products Group. This manual includes sections on developing stakeholder involvement in the Total Maximum Daily Load issue, as well as volunteer and student monitoring. It is available as a pdf file. http://www.georgialegalwatch.org/glw%20web%20pages/pdfs/CWP/101Workshop_GettingStarted.pdf

Monterey Bay (CA) Sanctuary Citizen Watershed Monitoring Network, Central Coast Regional Citizen Monitoring Guide (120 pp). A comprehensive guide to monitoring stream and also marine sites. The guide is available in a pdf format, but is rather large (32.7 MB). It is broken into four pdf documents, and will take approximately 2 hours to download with a 56 K modem. The files are compressed, so you will need to either already have the software or download it from the site to use the files. <http://www.mbnms.nos.noaa.gov/monitoringnetwork/protocols.html>

San Francisco Bay Area Regional Volunteer Monitoring Program website site http://www.sfei.org/ccrs/ccrs_protocols.htm offers links to pdf files for protocols used to collect volunteer monitoring data in the San Francisco Bay Area. These include:

- Quality Control and Quality Assurance Plan (100k)
- Birds - Outlines procedures used to conduct quarterly bird surveys (32k)
- Vegetation - Provides descriptions of methods used to assess tree and understory plant cover (275k)
- Water Quality - Set of protocols describes processes used assess basic physical and chemical parameters of streams (142k)
- Fish Habitat (2 files) - Adapted from California Department of Fish and Game methods, describes methods used to assess cold water fish habitat (994k & 1,520k)
- Reptiles & Amphibians - Describes a standardized method for assessing reptile and amphibian populations in stream habitats (38k)

Virginia Citizen's Monitor Methods Manual: A Document from Efforts of Citizens for Water Quality (80 pp). This manual includes biological, chemical, physical, and visual monitoring methods. There are sample QA/QC and monitoring plans, as well as field date sheets in the appendices. It is available as a pdf file from the Alaskan Department of Environmental Conservation website (yes, Alaska!). [http://www.state.ak.us/dec/dawq/datamonitor/pdf/vdeq\(1999\).pdf](http://www.state.ak.us/dec/dawq/datamonitor/pdf/vdeq(1999).pdf)

Volunteer's Guide for Monitoring New England Salt Marshes (164 pp). This guide is primarily designed for habitat monitoring, rather than water quality monitoring. It includes study design elements as well as methods for monitoring the plants, animals and tidal influences of salt marshes. It is available as a pdf file. <http://www.state.ma.us/czm/smcomplete.pdf>



Ensuring Quality

Developing good quality assurance and quality control (QA/QC) procedures, and ideally a written plan, is a critical component of developing a volunteer monitoring program. Without it, it is difficult to show that the data gathered are usable. Documentation of QA/QC procedures are so important that programs receiving U.S.E.P.A. funds are required to submit QA/QC project plans for approval. The U.S.E.P.A. provides a document to assist with the development of these plans and to help create a strong quality assessment strategy. *The Volunteer Monitor's Guide to Quality Assurance Project Plans* is available online in several pdf files at: <http://www.epa.gov/owow/monitoring/volunteer/qappcovr.htm>.

A number of volunteer monitoring organizations have published Quality Assurance Project Plans on their websites, several of which are listed below. The New England Region U.S.E.P.A. site has links to examples of approved Quality Assurance Project Plans available at (http://www.epa.gov/region01/measure/qapp_examples/index.html).

Quality Assurance Project Plan On-line Resources:

- What are Quality Assurance Project Plans? (4 pp). Prepared by the Hazardous Substance Research Centers, this factsheet is a good overview of QAPPs. It is available as a pdf file. http://www.envirotools.org/factsheets/fs_quality_assurance.pdf
- Preparing Quality Assurance Project Plans (QAPPs) (6 pp). Created by the Kansas Department of Health and the Environment to assist volunteer monitoring groups developing QAPP. It is available as a pdf file. <http://www.kdhe.state.ks.us/nps/QAPPGuidance.pdf>
- Alaska Stream Team Quality Assurance Project Plan (59 pp). Prepared in 2002 by the Environment and Natural Resources Institute and the University of Alaska. It is available as a pdf file. http://www.uaa.alaska.edu/enri/bmap/pdfs/ENRI_QAPP_2-02.pdf
- Cook Inlet Keeper Citizens Environmental Monitoring Program QAPP (20 pp). This US EPA approved plan was prepared for a marine ecosystem baseline monitoring program. It is available as a pdf file. <http://www.inletkeeper.org/qapp.htm>
- Forest Watch Quality Assurance Project Plan (Illinois Natural History Survey) (47 pp). While not water quality monitoring, this is a good example of the elements important in a volunteer monitoring QAPP. It is available as a pdf file. <http://dnr.state.il.us/orep/ecowatch/qa/fwqapp.pdf>
- Instructions for the use of the Model Quality Assurance Project Plans (QAPPs) (12 pp). Created by the California Environmental Protection Agency State Water Resources Control Board to assist volunteer monitoring groups developing QAPP. Available as a Word document www.swrcb.ca.gov/nps/docs/mod_qapp_instr_deg1101.doc
- Maine Volunteer Lake Monitoring Program: The QAPP ("Quality Assurance Project Plan") (11 pp). This plan has been reviewed and approved by the U.S. EPA, and can serve as an example of how a formal Quality Assurance Plan should be constructed. It is available as a pdf file. <http://www.state.me.us/dep/blwq/doclake/vmpqappb.pdf>
- QAPP for Sampling Suspended Sediment Concentrations and Turbidity in Sonoma Creek Watershed (11 pp). Sonoma Ecology Center. It is available as a pdf file. http://www.vom.com/sec/research/suspendedsed/pdf_qapp/appendix_b.pdf
- Quality Assurance Project Plan for Phase I of the San Luis Obispo Watershed Monitoring Program (31 pp). This QAPP was prepared following the guidelines in the US EPA *The Volunteer Monitor's Guide to Quality Assurance Project Plans*. It is available as a pdf file. http://www.kcbx.net/vv/land_con/monitors/qapp_fin.PDF

Additional Resources for Program Development:

Designing Your Monitoring Strategy: Basic Questions and Resources to Help Guide You

GLOBE is a worldwide hands-on, primary and secondary school-based education and science program. It offers students learning opportunities by monitoring various environments, and teachers professional development training, as well as guides, videos, and educational materials. http://www.globe.gov/globe_html.html

Environment Canada's site for their Ecological Monitoring and Assessment Network. It provides information about recommended monitoring protocols, online data sets, quality assurance/quality control, data management and much more. <http://www.eman-rese.ca/eman/ecotools/intro.html>

Marsh Monitoring Program Quality Assurance Project Plan (31 pp). Prepared for the U.S. E.P.A. and approved. It also can serve as an example of how a formal Quality Assurance Plan should be constructed. It is available as a pdf file. <http://www.bsc-eoc.org/mmpqualplan.html>

Massachusetts Department of Environmental Protection - Division of Watershed Management. This site has links to several pdf files including manuals for surveying lake watersheds, a guide to quality assurance project plans and data sheets. <http://www.state.ma.us/dep/brp/wm/volmonit.htm#guidebook>



Summary

Identifying exactly what your goals for your volunteer monitoring program are and how your data will be used are the first steps toward developing your monitoring plan. Once you have clearly articulated those objectives, it is a relatively straightforward process to identify appropriate monitoring activities, parameters and methods. A key point to remember as you go through this process and refine your selection is to be realistic about your resources and your expectations. You are also more likely to be successful if you start small and grow your program as resources and volunteer support increases. Remember, there are lots of resources to help guide you! Please contact us if you have any questions or need assistance in locating additional information.

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