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Helping People Put Knowledge to Work

Figure 1. Volunteers Sampling Benthic Macroinvertebrates

IN THIS ISSUE

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PROJECT SPOTLIGHT

Getting the Most From Volunteer Monitoring

Steven A. Dressing, *Tetra Tech, Inc.*

Introduction

There are hundreds of volunteer monitoring programs across the country, and the U.S. Environmental Protection Agency (USEPA) and others have supported these efforts over the years with technical guidance documents that address monitoring objectives, study design, sampling methods, quality assurance/quality control, and data analysis and presentation (USEPA, 1997). In its guidance, however, USEPA is careful to point out that recommended monitoring methods differ from site to site because of varying program goals, site characteristics, and volunteer interest and training. This article explores some of the possibilities for ensuring that volunteer monitoring achieves its objectives in a cost-efficient manner. The focus will be on monitoring performed for either problem assessment or for evaluation of projects or management practices (BMPs), but the basic principles should apply more broadly.

Purpose and Objectives

Volunteer monitoring is usually performed for one of the following purposes:

- Education of citizens
- Community involvement
- Problem assessment
- Source identification
- Evaluation of BMPs/projects
- Long-term trend assessment

Clearly, volunteer monitoring has benefits that go well beyond basic data collection, so it is not the intent of this paper to imply that all volunteer monitoring efforts must attain the same level of scientific rigor described herein. Whatever the purpose, however, monitoring program efficiency depends upon a clear statement of objectives (USDA, 2003). A common problem among volunteer groups is jumping into collection and analysis of samples without developing a study design or having considered the questions to be addressed by the collected data (Behar, 1997). Examples of objectives potentially relevant to volunteer monitoring groups include:

- To identify stream segments with the highest nutrient concentrations in Chipmunk Creek Watershed (assessment).
- To determine the effect of stream restoration on stream habitat and macroinvertebrate populations in Bubbling Brook (evaluation).

Volunteer Monitoring

Pros

Very Low Cost
Enthusiastic Volunteers
Located in Watersheds
Citizen Education
Citizen 'Ownership' in Water Quality

Cons

Training Needs
Quality Assurance/Quality Control
Precision and Accuracy of Methods

End Uses of Monitoring Data

While statement of clear objectives is an important first step in defining data needs, it is also very important to consider the end uses of the data. For example, a reasonably good screening level analysis to identify subwatersheds with high nutrient concentrations in Chipmunk Creek watershed could be achieved with two sampling events (one high flow and one low flow) at the mouth of each segment of interest. If the data were to be used to zero in on specific sources of nutrients in the watershed, however, then more sites would be needed to measure concentrations upstream and downstream of suspected sources. It may also be necessary to sample under low and high flow conditions several times over a year if seasonally-variable activities like cropland tillage or fertilizer application might be important source activities, and even better to measure flow at each site to estimate relative loads from each suspected source. Measurement of annual loads is considerably beyond the scope of most volunteer monitoring programs, but it is fairly simple to obtain a rough estimate of relative loads using a handful of measurements of instantaneous loads over a representative time frame. Further, if there is an expectation that government agencies will take action based upon the monitoring results, then it is very important

EDITOR'S NOTE

There are numerous volunteer water quality monitoring programs in the United States. These programs increase community ownership in local water quality, encourage environmental awareness and stewardship, and provide low-cost data to government agencies. In order to get the most out of volunteer monitoring, certain guidelines need to be followed. In this issue of *NWQEP NOTES*, our feature article discusses some common pitfalls and effective strategies for volunteer monitoring programs. As with professional monitoring, most important is having a clearly stated objective with the end use of the data in mind. A clear objective helps identify the variables that need to be monitored and the methods for collection and analysis. Various volunteer monitoring methods for chemical and biological factors are discussed, including variations in method performance. The importance of quality assurance and quality control for volunteer monitoring is described, and cost benefits are illustrated. Examples of volunteer monitoring programs in the U.S. are used throughout the article.

Volunteer monitoring clearly plays a valuable role in water quality protection. It is in the best interest of state and federal governments to work in partnership with the volunteer community to ensure that efforts are conducted as effectively as possible in the safeguarding of our Nation's waters.

As always, please feel free to contact me regarding your ideas, suggestions, and possible contributions to this newsletter.

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that the data collection and analysis methods are clearly documented and meet minimum criteria set by the agencies.

Similarly, evaluation of stream restoration at Bubbling Brook could be accomplished with annual habitat and macroinvertebrate assessments at sites above, within, and below the restored stream segment before and after restoration (assessment should be conducted in same season each year, e.g., Spring). If, however, the plan was to use the results of such monitoring to improve stream restoration procedures and design, then more detailed measurements would be needed.

Even when monitoring is done solely to educate the public and increase community involvement in water quality issues, there can be vast differences between the needs for beginning versus experienced volunteers. While neophytes may be satisfied by simply getting their feet wet and making a few measurements of any sort, experienced volunteers may want to dig deeper and create datasets that allow them to target trouble spots or measure improving conditions in the watershed.

Monitoring Variables

There is much guidance currently available that addresses the selection of monitoring variables (USEPA, 1993; USDA, 2003; USGS, 2008). One of the best ways to improve the cost efficiency of any monitoring effort is to trim the number of variables down to only those necessary to meet monitoring objectives. All too often variables are included in monitoring programs by default, yielding little or no additional information in the end. Monitoring variables should be dropped from monitoring plans if they are redundant of other monitored variables (e.g., salinity or conductivity), the wrong variable for the stated purpose (e.g., orthophosphate when total phosphorus is needed for use support assessment), unrelated to the monitoring objective (e.g., nutrients when sediment is the targeted pollutant), or unrealistic (e.g., nitrite in a riffle area). Volunteer monitoring is not research, so it is not always necessary, for example, to analyze samples for multiple forms of nitrogen and phosphorus. Keep the variable list simple and focused.

One area that will not be discussed in this article is the tracking of land use and land treatment (LU/LT) which is typically one of the weakest aspects of watershed monitoring efforts. Photopoint monitoring, for example, is a very useful approach for tracking growth of riparian areas and requires ability that many volunteers will have (Hall, 2001). In fact, it is quite likely that volunteers may provide more expertise than the state or federal employees who normally monitor water quality. Serious consideration should be given to using volunteers for LU/LT tracking to complement water quality monitoring efforts.

Monitoring Methods

Determination of monitoring methods is a basic consideration when selecting monitoring variables. Many methods used by volunteer groups are quite good. For example, in a comparison of current "bacteria kits" against each other and versus certified lab analyses, it was determined that IDEXX, Coliscan Easygel® (incubated) (Figure 2) and 3M Petrifilm® all performed well in describing when bacteria counts are above and below the USEPA criterion of 235 cfu/100 mL (Wolfson, 2007). Volunteers preferred the Coliscan Easygel® (incubated) and 3M Petrifilm methods over IDEXX, which is considerably more expensive. Other readily available kits that perform well include those for dissolved oxygen (D.O.) and pH.

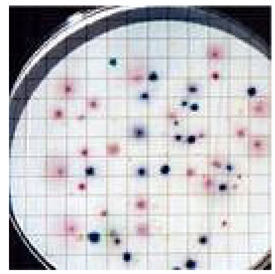

Figure 2. Coliscan Easygel (www.micrologylabs.com)

Other methods used by volunteers, however, are not as good for meeting some monitoring objectives. For example, semi-quantitative test strips that measure nitrate or nitrite concentrations in intervals of 0.15 mg/L or more may not be sensitive enough to identify hot spots in a watershed (Figure 3), let alone detect small increases or decreases over time. Available test kits that measure orthophosphate concentration from 0 to 1.0 mg/L in 0.1 and 0.2 mg/L increments or from 1 to 10 mg/L in 1 and 2 mg/L increments, however, may be suitable for assessment purposes.

Figure 3. Hach Nitrate and Nitrite Test Strips (www.hach.com)

Detection limits for many monitoring kits are either not provided or are misrepresented in product literature (Rathbun, 2006). A true detection limit is the smallest concentration distinguishable from zero, but vendor literature on test kits often reports "sensitivity" rather than true detection limits. All too often the sensitivity limit is reported as zero, yet the true method detection limit (MDL) would be the midpoint between zero and the first increment on the test strip or color comparator. The lower limit for which the test is accurate, the limit of quantitation (LOQ), is then 3 times the MDL (Loftus, 2008). Before selecting test kits commonly sold to volunteer monitoring groups, it is important to gather background data on water quality in the watershed to determine whether the true range and sensitivity of kits will be suitable for the situation.

Data from the Willow Creek subwatershed of the Sycamore Creek, Michigan, Section 319 National Monitoring Program project are used to illustrate the potential performance of semi-quantitative test strips (Suppnick, 1999). Figure 4 shows NO_3+NO_2 data reported by the project that were analyzed in a lab (Lab) and values that would result if the same samples were analyzed using a commonly available test kit (Kit1) with the following incremental values for nitrate (assumed for both nitrate and nitrite): 0, 0.5, 2, 5, 10, 20, and 50 mg/L. Interestingly, the project detected a statistically significant downward trend in NO_3+NO_2 after adjusting for flow and seasonality, a result not visible from the Kit 1 results. Figure 5 shows the results of using a second test kit (Kit 2) that tests for NO_3+NO_2 from 0 to 3 mg/L in the following increments: 0, 0.15, 0.3, 1, 1.5, or 3 mg/L. In both Figures 4 and 5 it is assumed that monitors assign incremental test strip values to each sample. Kit 2 gives better results than Kit 1 but seems to indicate a 50% reduction in NO_3+NO_2, from 3 mg/L down to 1.5 mg/L, whereas the true reduction was 26%, from 2.3 mg/L to 1.7 mg/L. Figure 6 assumes the ability to assign mid-point values between the test strip values of Kit 2, resulting in the following incremental values: 0, 0.075, 0.15, 0.225, 0.3, 0.65, 1, 1.25, 1.5, 2.25, and 3 mg/L. This application of Kit 2 gives results that more closely track those from the laboratory testing, but because the increments of Kit 2 are unequal there is an implied greater resolution when interpolating at the lower end of the range, something that may be an artifact of this analysis but not possible in practice.

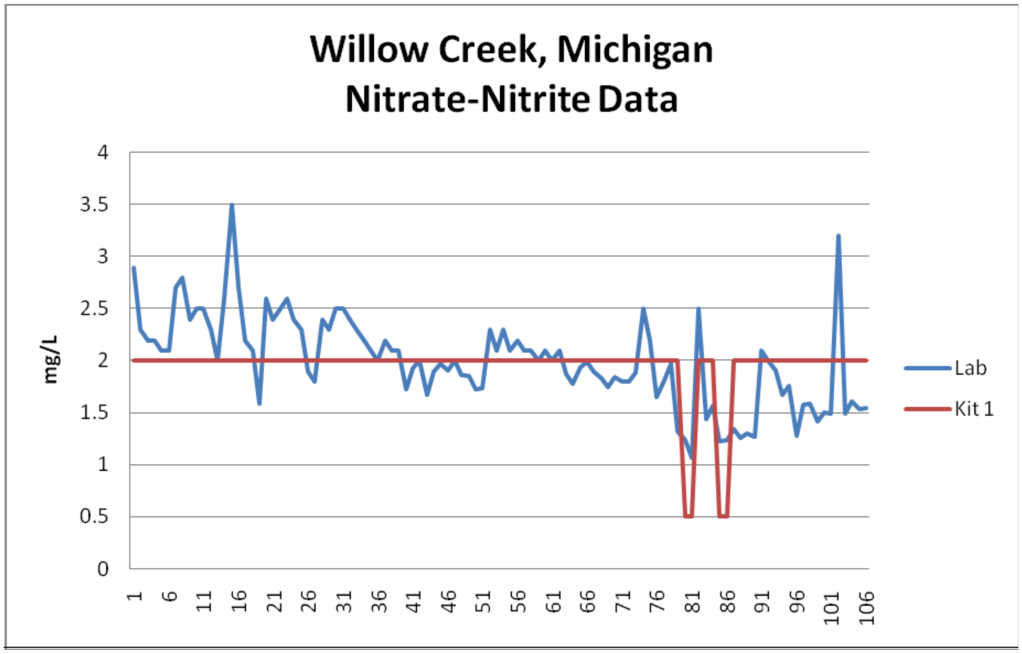

Figure 4. Laboratory versus test kit 1 results

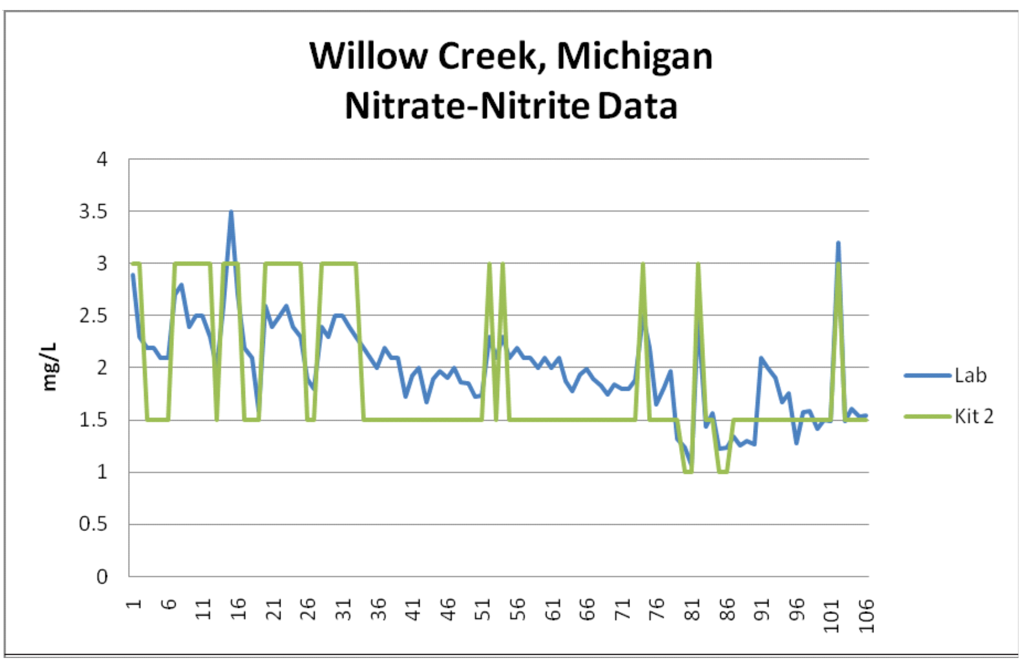

Figure 5. Laboratory versus test kit 2 results

Benthic macroinvertebrate assessment methods are available that closely follow those recommended by USEPA. For example, some volunteer groups work under the supervision of professional aquatic biologists to perform intensive biosurveys based on USEPA's Rapid Bioassessment Protocols (RBPs), a rigorous approach that can be used to detect small impacts and subtle changes over time by identifying organisms to the family level (USEPA, 1997). The River Watch Network is one group using this type of approach (Dates and Byrne, 1997). A less rigorous streamside biosurvey methodology modeled after a protocol developed by Ohio Department of Natural Resources has also been used by a large number of volunteer programs, including the Ohio Stream Quality Monitoring Project (http://www.dnr.state.oh.us/Home/Scenic_Rivers/sqm/sqm_main/tabid/980/Default.aspx). Under this method, trained volunteers collect and identify macroinvertebrates at the order level in the field. Macroinvertebrate community structure is evaluated using three general sensitivity categories, and habitat is characterized using a modified Stream Habitat Walk (USEPA, 1997).

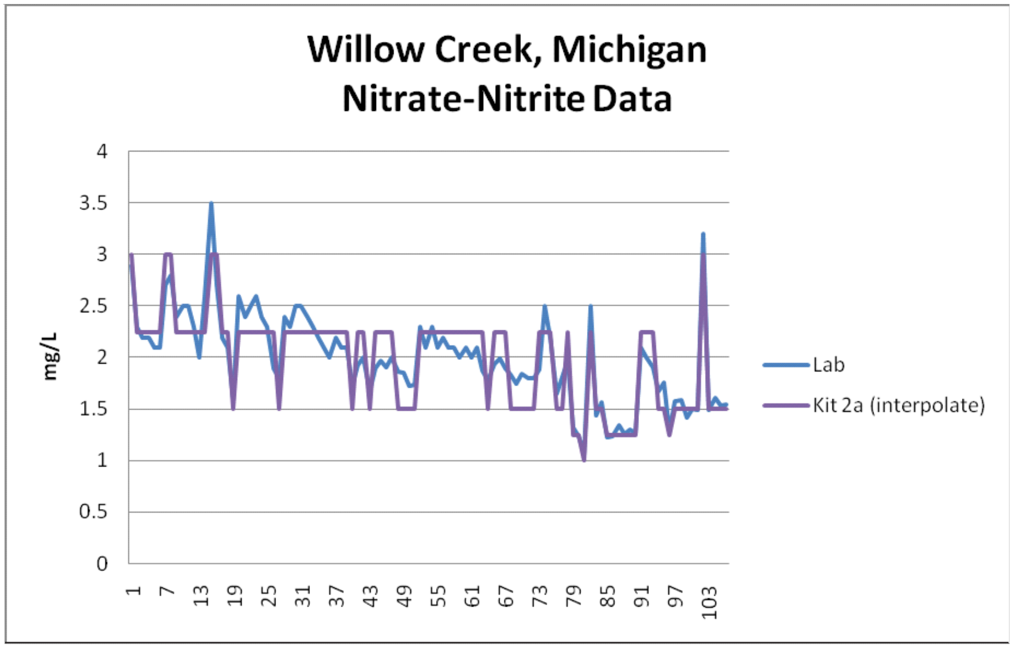

Figure 6. Laboratory versus test kit 2 (with interpolation) results

In Michigan, volunteer macroinvertebrate data are used for screening analysis (Rathbun, 2006). Measurements of embeddedness and channel morphology, application of the Bank Erosion Hazard Index, and monitoring with erosion pins are all done by volunteers with follow-up by experienced state staff. Comparison of benthic macroinvertebrate monitoring results from volunteers and professionals has shown that volunteers are quite capable of yielding comparable findings.

Some benthic macroinvertebrate methods used by volunteers are far too qualitative or lack suitable quality control to be useful for much more than screening analysis or education purposes. For example, some groups include as options methods in which organisms are merely distinguished by color, size, and shape. In one example, a Macroinvertebrate Diversity Index is calculated as the number of "runs" over the number of organisms (Hoosier Riverwatch, 2005). All of these methods can be used for education, community involvement, and even initial screening purposes, but the more rigorous methods are needed for problem assessment and evaluation of practices or watershed-wide implementation projects.

Volunteer groups should carefully compare their methods with those used in their state or neighboring states to develop a clear understanding of the strengths and limitations of the tools they use. Working with state scientists and officials, volunteer groups should be able to clearly identify appropriate applications of their methods and opportunities or needs to alter methods to better achieve their monitoring objectives. In some cases it may be better to purchase meters and probes rather than test kits even though the initial expense is greater (see Costs below). It may also be more appropriate for volunteer groups to collect water and biological samples and transport them to a certified laboratory for analysis. For example, many volunteer monitoring groups do not test for total P because of the dangerous chemicals involved in the test; in those cases samples should be taken to a laboratory for analysis as is done in the Vermont Lay Monitoring Program where water samples are collected and preserved by volunteers but taken to a state laboratory for analysis (Warren and Lohner, 1984). The point is that unless the right methods are used to meet the monitoring objectives, the effort is wasted.

Quality Assurance

Quality assurance and quality control (QA/QC) are essential elements of any monitoring effort. In fact, USEPA requires quality assurance projects plans (QAPPs) of all projects the agency sponsors through grants, contracts, or other formal agreement (USEPA, 1997). The essence of a QAPP is establishment of a very tight link between clearly stated monitoring objectives and the data collection and analysis methods used to generate the data needed to satisfy those objectives. The jargon associated with QA/QC and QAPPs is knee deep and development of your first QAPP can be a painful and tedious experience. The result, however, of developing a solid QAPP is a high-quality roadmap for collecting and analyzing your data, including provisions for handling the unforeseen such as missed sampling events and otherwise lost or compromised data. The QAPP becomes the central documentation of your monitoring effort, supplemented, of course, by annual or more frequent reports that should be developed for every monitoring effort, volunteer or not. See USEPA's guidance on volunteer monitoring QAPPs for more information (http://www.epa.gov/volunteer/qappcovr.htm).

QAPP development can be simpler and less painful with assistance from knowledgeable people at the state and federal levels, and in some cases QAPPs have already been developed for volunteer monitoring groups. For example, the Vermont Lay Monitoring Program is a cooperative effort between Vermont Department of Environmental Conservation (DEC) and lake users in which DEC provides sampling equipment, trains volunteers, analyzes the samples, and interprets the data (http://www.anr.state.vt.us/DEC/waterq/lakes/htm/lp_lmp.htm).

Lake users, in turn, provide the boats, give their time, sample weekly during summer, and use accurate sampling techniques under a USEPA-approved QA/QC Plan. There are two levels of monitoring under this program; Basic monitors measure

Secchi disk transparency on a weekly basis and Supplemental monitors sample Secchi disk, chlorophyll-a, and total phosphorus (Warren and Lohner, 1984).

Another way to achieve suitable quality assurance is to provide standardized training and sampling equipment as is done in the Iowa volunteer monitoring program, IOWATER (http://www.iowater.net/). Under this program, the Iowa Department of Natural Resources (IDNR) offers various levels of training and equipment in support of the statewide volunteer monitoring program. The IDNR also screens the data and provides oversight, making it possible for the data collected to be used as part of Iowa's state water quality data base.

Cost

One of the greatest benefits of volunteer monitoring is the free labor. Costs for seven scenarios (and sub-scenarios) were estimated to illustrate the benefits of and opportunities for using volunteers in monitoring efforts (Table 1). Key items included in the cost analysis were salaries, equipment, supplies, and travel. Basic assumptions were made regarding watershed size (20,000 acres), number of monitoring sites, sampling trip distance, and salary ($27/hour for field staff).

The first five scenarios were single-year assessment efforts, while Scenarios 6 and 7 were six-year evaluation efforts. For Scenarios 1-5, costs were estimated under three sub-scenarios:

1. Volunteers did all work and analyzed samples using volunteer kits (e.g., Coliscan Easygel®) (Column A in Table 1)
2. Paid professionals did all work and took chemical samples to a laboratory for analysis (Column B in Table 1), and
3. Volunteers did all work but took chemical samples to a laboratory and/or used probes/meters in lieu of volunteer kits to improve data quality (Column C in Table 1).

The equipment needs for bug and habitat monitoring were assumed to be those identified by USEPA for the RBPs (Barbour, et al., 1999). Scenario 6 covers six years of monitoring using a high-end setup including a refrigerated automatic sampler and a bubble flow meter at a single site. Scenario 7 is a repeat of Scenario 6 but with no cost for new equipment. Column B for Scenarios 6 and 7 assumes all work is done by professionals while Column C assumes that professionals made only 12 sampling trips and used trained volunteers for all weekly trips.

Table 1. Estimated total cost for various monitoring scenarios

Scenario	Sampling Details	A. Cost for Volunteers with Volunteer Methods ($)	B. Cost for Professionals with "Best" Methods ($)	C. Cost for Volunteers with "Best" Methods ($)
1	4 sites, 1 year, E. coli - 5 samples/30 days	1,130	4,874	1,958
2	4 sites, 1 year, E. coli - 10 samples/30 days	1,300	7,440	2,904
3	4 sites, 1year, N, P, D.O., stage – 3 samples	1,120	7,272	2,665
4	4 sites, 1 year, N, P, D.O., stage – 20 samples	1,734	20,388	7,833
5	4 sites, 1 year, Bugs and habitat – 1 sample, no staff gage	741	7,101[a] 2,911[b]	
6	1 site, 6 years, Bugs and habitat – 1 sample, no staff gage, all new equipment		62,429	40,210
7	Scenario 6 with no new equipment		39,557	17,338

[a] Includes purchase of GPS, camera, 2 microscopes, and other equipment
[b] Assumes no new equipment purchases

Some findings from the cost analysis are:

- Volunteers can perform use support analysis with E. coli samples for $285-$325/site (Scenario 1 and 2, Column A)
- Using a D.O. probe and lab for N & P, volunteers can perform 3-sample Aquatic Life use support analysis and D.O. for under $700/site. (Scenario 3, Column C)
- Salary accounts for 1/3 to 2/3 of total costs when professionals do all of the work
  - 60-62% for Scenarios 1 and 2, Column B
  - 36-49% for Scenarios 3 and 4, Column B

The analysis also indicates that volunteers can obtain better quality data using better methods if they are able to handle the up-front capital costs of purchasing better equipment. Various meters and probes are available to measure D.O. ($480 to $800), turbidity ($700 to $1,100), and multiple parameters ($440 to $3,300) with accuracy and precision far exceeding that available from test strips and field kits often used by volunteer monitoring groups. While the capital cost of such devices is high relative to the cost of kits, the benefits of purchasing the better equipment include better data, more applications of the data, and the ability to make many more measurements using the same number of volunteers. For example, while it would take about 8 years of weekly sampling to break even when buying a $500 D.O. probe instead of a typical D.O. test kit, the probe can be used many times at the site while the kit is good for only one test at a time. Thus, the payoff for purchasing the probe is much greater, particularly when considering its potential as a training tool for volunteers.

Figure 7. Enthusiastic volunteers

Conclusions

Volunteer monitoring is an essential component of the Nation's surface water monitoring effort and contributes to the overall goal to increase citizen involvement in solving water quality problems in the U.S. The purposes of volunteer monitoring efforts range from basic education to problem assessment, trend analysis, and project evaluation, but all volunteer monitoring efforts can benefit from carefully crafted objectives and thoughtful selection of monitoring variables and methods.

There appears to be great opportunity for volunteer groups and state and federal agencies to work together to capitalize on the free and often highly skilled labor provided by volunteer groups. Volunteer data should in many cases be useful for screening analysis, trend analysis, and evaluation of projects if data collection and analysis conform to a well-written QAPP or equivalent document. The use of volunteer data for use support analysis and source identification can be problematic, however, because of the resulting actions that could be required of regulatory agencies. Still, good data should always be considered by regulatory agencies regardless of the source.

Volunteer monitoring groups should seriously consider replacing many of the test kits they use with more sophisticated, but still simple to use, field monitoring equipment. Volunteer monitoring is here to stay, so it is entirely reasonable to consider the relative cost of equipment versus test kits over the long term rather than focusing on the much higher capital costs of probes and meters. Strategies to phase in better equipment should benefit all volunteer monitoring groups.

For More Information

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References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. http://www.epa.gov/owow/monitoring/rbp/ accessed February 12, 2008.

Behar, S. 1997. How to Monitor a River – and more, http://207.136.217.220/displayarticle.cfm?selectedarticle=195, Connect, 10(4), Synergy Learning International, Inc., Brattleboro, VT (accessed January 10, 2008).

Dates, G. and J. Byrne. 1997. Living Waters, Using Benthic Macroinvertebrates and Habitat to Assess Your River's Health. River Watch Network.

Hall, F.C. 2001 Ground-based Photographic Monitoring. Gen. Tech. Rep. PNW-GTR-503. http://www.fs.fed.us/pnw/pubs/gtr503/, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, 340 p. (accessed January 10, 2008).

Hoosier Riverwatch. 2005. Volunteer Stream Monitoring Training Manual, http://www.in.gov/dnr/riverwatch/trainingmanual/, Indianapolis (accessed January 10, 2008).

Loftus, T. 2008. Method detection limits, http://www.lagoonsonline.com/laboratory-articles/mdl.htm, Lagoon Systems in Maine, Maine Department of Environmental Protection (accessed January 14, 2008).

Rathbun, J. 2006. *QA*/QC Issues with Screening-Level Monitoring Methods, 14th National Nonpoint Source Monitoring Workshop, September 24-28, 2006, Minneapolis, MN.

Suppnick, J. 1999. Water Chemistry Trend Monitoring in Sycamore Creek and Haines Drain, Ingham County, Michigan 1990-1997. MI/DEQ/SWQD-99/085, Surface Water Quality Division, Michigan Department of Environmental Quality.

USEPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, EPA 840-B-92-002 January 1993, Office of Water, U.S. Environmental Protection Agency, Washington, DC.

USEPA. 1997. Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, http://www.epa.gov/volunteer/stream/stream.pdf, Office of Water, U.S. Environmental Protection Agency, Washington, DC (accessed January 8, 2008).

USDA. 2003. National Water Quality Handbook, http://policy.nrcs.usda.gov/media/pdf/H_450_600_a.pdf, Natural Resources Conservation Service, U.S. Department of Agriculture, Washington, DC (accessed January 8, 2008).

USGS, 2008, National Field Manual for the Collection of Water-Quality Data Techniques of Water-Resources Investigations Book 9 Handbooks for Water-Resources Investigations, U.S. Geological Survey, http://water.usgs.gov/owq/FieldManual (accessed January 8, 2008).

Warren, S. and L. Lohner. 1984. Vermont Lay Monitoring Program Manual (Revised in 2000 by Amy Picotte and Staci Pomeroy), http://www.anr.state.vt.us/DEC/waterq/lakes/docs/lp_lmp-manual.pdf, Vermont Agency of Natural Resources, Vermont Department of Environmental Conservation, Water Quality Division, Waterbury, VT (accessed January 10, 2008).

Wolfson, L. 2007. E. coli Monitoring – Effective Techniques and Test Kits for Volunteers, Michigan State University, Michigan Clean Water Corps Conference, October 16, 2007, http://www.micorps.net/documents/wolfson_ecoli07.pdf (accessed January 8, 2008).

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INFORMATION

Center For Watershed Protection Releases Two Manuals of the Urban Subwatershed Restoration Manual Series for Free Download

In an effort to ensure that every community is equipped with the tools it needs to get started in watershed restoration, the Center for Watershed Protection is making its first two manuals of the Urban Subwatershed Restoration Manual Series available permanently for free download.

Manual 1*, An Integrated Framework to Restore Small Urban Watersheds,* examines the basic concepts and techniques of urban watershed restoration, and sets forth the overall framework used to evaluate subwatershed restoration potential. The second manual, *Methods to Develop Restoration Plans for Small Urban Watersheds*, outlines a practical, step-by-step approach to develop, adopt and implement a subwatershed plan in your community.

Manuals 1 and 2, released in 2005, accompany the latest manual of the series released in summer 2007 — *Urban Stormwater Retrofit Practices*. This 400+ page guidance is also available as a free download on the Center website. Download these three manuals by visiting the Urban Subwatershed Restoration Manual Series website: http://www.cwp.org/PublicationStore/USRM.htm

New EPA Report on Reducing Costs by Using Low Impact Development Practices

The U.S. Environmental Protection Agency has released a new report *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices,* which contains 17 case studies from across North America that show the economic viability of LID practices. Using these practices in construction projects can lower costs while improving environmental results.

LID practices are innovative stormwater management practices to manage urban stormwater runoff at its source. The goal is to mimic the way water moved through an area before it was developed by using design techniques that infiltrate, evapotranspirate, and reuse runoff close to its source. Some common LID practices include rain gardens, grassed swales, cisterns, rain barrels, permeable pavements and green roofs. LID practices increasingly are used by communities across the country to help protect and restore water quality.

The report highlights examples that, in most cases, reduce project costs while improving environmental performance. Total capital savings ranged from 15 to 80 percent, with a few exceptions in which LID project costs were higher than conventional stormwater management costs. As LID practices become more common, it is likely that they will become cheaper to use.

For a copy of the report, visit: http://www.epa.gov/owow/nps/lid/costs07/

New Ranking Procedure from Irish Environmental Protection Agency

A research report was recently published by the Irish Environmental Protection Agency on the development of a ranking procedure to help identify phosphorus loss potential from grassland agriculture and the subsequent likelihood of transport to adjacent water bodies. This relatively simple procedure can be readily used by watershed managers responsible for water quality protection and by agricultural advisors responsible for promoting best management practices for nutrient management. The Synthesis Report and Full Report are available for download from the Irish EPA website: http://www.epa.ie/downloads/pubs/research/water/. This website also contains a number of other research reports that address various aspects of diffuse nutrient pollution from agriculture.

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MEETINGS

Meeting Announcements — 2008

May

11th National Mitigation & Ecosystem Banking Conference: Banking on the Environment (*formerly* National Mitigation & Conservation Banking Conference): May 6-9, 2008, Jacksonville, FL. Telephone: 703-548-5473. Website: http://www.mitigationbankingconference.com

Sixth National Water Quality Monitoring Council Conference: Monitoring – Key to Understanding Our Waters: May 18-22, 2008, Atlantic City, NJ. Website: http://www.wef.org/monitoring

9th Annual Nonpoint Source Pollution Conference: Progress Through Partnerships: Collaborating to Protect Our Watersheds: May 19-21, 2008, Groton, CT. Website: http://www.neiwpcc.org/npsconference

June

Low Impact Development (LID) Summit: June 23-25, 2008, Asheville, NC. Website: http://www.bae.ncsu.edu/workshops/lid_summit/

2008 AWRA Summer Specialty Conference, Riparian Ecosystems & Buffers: Working at the Water's Edge: June 30-July 2, 2008, Virginia Beach, VA. Website: www.awra.org

July

2008 UCOWR/NIWR Annual Conference – International Water Resources: Challenges for the 21st Century and Water Resources Education: July 22-24, 2008, Durham, NC. Website: http://www.ucowr.siu.edu

August

7th annual StormCon – the North American Surface Water Quality Conference & Exposition: August 3-7, 2008, Orlando, FL. Website: http://www.StormCon.com

Building Sustainable Communities for the 21st Century: August 12-14, 2008, Charleston, SC. The first Southeast Region Quality Growth Conference, sponsored by Southeast Watershed Forum, NOAA's Coastal Services Center, U.S. Fish and Wildlife Service, the Gulf of Mexico Program, TVA and other agencies and organizations. Website: http://www.southeastwaterforum.org/roundtables/default.asp

September

16th National Nonpoint Source Monitoring Workshop – Getting the Point About Nonpoint: September 14-18, 2008, Columbus, OH. See full announcement and call for abstracts on page 10.

November

2008 Southeast Regional Stream Restoration Conference, November 3-6, 2008, Asheville, NC. Website: http://www.ncsu.edu/sri

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16th National Nonpoint Source Monitoring Workshop

Getting the Point about Nonpoint

September 14-18, 2008
Marriott Renaissance Hotel
Columbus, Ohio
http://streams.osu.edu/conf.php

Call for Papers: Abstracts (500 words max) are due by **April 4, 2008**. Requirements for submission are available on the website. Please make your submissions online or by email to dambrosio.9@osu.edu.

About the Conference: The National Nonpoint Source (NPS) Monitoring Workshop is an important forum for sharing successes and improving communication regarding management and monitoring of NPS pollution control projects.

By bringing together NPS personnel from state, federal, Tribal and municipal governments, private sector, academia, environmental groups and local watershed organizations, the workshop will focus on innovative solutions to NPS issues, effective monitoring techniques, demonstrations of new technologies, application of Best Management Practices (BMPs), and lessons learned from Section 319 National Monitoring Program projects and other watershed projects from throughout the United States.

The workshop also will provide a number of technical workshops and tours. Technical workshops will include topics such as monitoring Low Impact Development (LID) projects, stream morphology analysis tools, and bio-assessment tools. Tours will include Conservation Effects Assessment Project (CEAP) monitoring sites, stream restoration sites, alternative urban and agricultural BMPs, and much more.

Specific topics of interest to be highlighted at the 16th annual workshop will include:

- ⇨ Stream Restoration & Renaturalization Project Monitoring
- ⇨ Alternative Agricultural Best Management Practices
- ⇨ Urban NPS & Stormwater Management Practices
- ⇨ TMDL & Watershed Action Plan Implementation
- ⇨ Bio-Assessment & Water Quality Monitoring Tools & Methodology
- ⇨ Lake and Coastal NPS Issues
- ⇨ Linking Water Quality Changes to Best Management Practices
- ⇨ Social Indicators Associating with Monitoring Behavioral Changes

Applicants will be notified of the selection committee's decisions by May 16, 2008. Successful applicants are required to provide completed presentations by August 15, 2008. Oral presentations are limited to 20 minutes.

All speakers must register in advance for the conference (discounted registration fees will apply).

Contact:

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The NCSU Water Quality Group publications list and order form can be downloaded by clicking on the link below:

http://www.ncsu.edu/waterquality/issues/pub_order.html

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