

3 DEVELOPING A WATER QUALITY MONITORING PROGRAM

This chapter presents some of the “nuts and bolts” involved in planning and setting up a marine water quality monitoring program, based on the experience of MYSound. Section 3.1 describes the initial information and contacts needed to begin the planning process. Section 3.2 provides suggestions for developing a strategy for the monitoring program—deciding “Who, Why, When, Where, What, and How.” Section 3.3 presents information about how to obtain funding for the program and the importance of partnerships in this regard.

3.1 PRELIMINARY INFORMATION GATHERING, NETWORKING, AND PLANNING

In designing and implementing an effective and efficient water quality monitoring program, the most important step is to develop a clear vision of the requirements for the effort, the scope of the effort, and who will participate. This requires some up-front information gathering, networking, and planning on the part of the project leaders and prospective partners, even before a project proposal is developed. As most monitoring projects originate with a few key stakeholders, these stakeholders must assume a leadership role in taking these initial steps.

The initial partners for the MYSound project were EPA and the University of Connecticut, along with the Connecticut Department of Environmental Protection (DEP). All three were already involved in monitoring efforts in Long Island Sound before the concept for the MYSound network was developed. Through their involvement with the Long Island Sound Study, the lead partners were familiar with the environmental issues in Long Island Sound. During informal discussions, the partners conceptualized a water quality monitoring effort that combined the more traditional point-sampling water quality surveys in the Sound with monitoring provided by continuous, real-time sampling stations. The partners also attended workshops and conferences on Long Island Sound issues to identify partners and funding opportunities.

Entities most likely to be interested in water quality monitoring include government environmental agencies (such as EPA and NOAA), state environmental agencies, policy-makers seeking to restore and protect marine environments, universities having a marine sciences department, aquaria, and marine environmental NGOs. These agencies and organizations can be identified and partnerships cultivated by informal networking at regional conferences and workshops. More specific information on their goals, activities, and monitoring programs can be obtained from their outreach literature and their Web sites.

In addition, information and ideas on monitoring technologies, data management methods and software, data presentation schemes, and communications and outreach programs can be obtained through literature and Web searches for marine monitoring programs nationwide. These organizations can then be contacted for additional information, and sought out at national monitoring conferences. The MYSound project conducted a nationwide monitoring search and produced a comprehensive database on marine monitoring programs, which was disseminated to other programs. This is also a good way of networking with other potential partnering organizations.

Once the various prospective partners have been identified, it is often useful to convene an initial planning session to collectively form a vision of what the monitoring network may look like. This can often be accomplished as part of another conference or workshop and serves as a brainstorming session. Such a meeting was held two years in advance of submitting the MYSound EMPACT proposal, but proved invaluable in bringing together the partnership and in acquiring seed money to begin the effort.

In developing its strategic plan, MYSound found that the following key issues needed to be addressed:

- What are the major problems and priorities in the specific estuary or sampling area?
- What sampling parameters or conditions might be monitored to characterize the status of the estuary?
- How large a monitoring program should be attempted based on partner capabilities and the general availability of funding?
- Who are the end users of the data, and how can the data best be managed and disseminated?
- Where are potential funding sources for the project? What in-kind resources are available?

Information gathered during the initial strategic planning meeting on these issues will help in formulating an overall monitoring program strategy and preparing proposals to potential funding sources. It will also allow the project leaders to sort out partners (active project participants) from stakeholders (data users and interested parties) and form a smaller partners' working group to begin the proposal development for the project.

3.2 DEVELOPING AN OVERALL STRATEGY (WHO, WHY, WHEN, WHERE, WHAT, AND HOW?)

Before embarking on the tasks of buying equipment, taking samples, and analyzing and compiling data, it is important to develop an overall strategy that will guide the effort. All too often, water quality monitoring efforts are started because of an emergent issue or because of the interest of an individual stakeholder, and then continued beyond the point where the issue is relevant or the interest remains. This constitutes data collection for its own sake, which may seem fashionable, but depletes program resources without providing further insight. To avoid this, MYSound developed its strategy by developing answers to the following questions:

- *Who should be conducting the monitoring effort—who is leading the effort and who is contributing to it?*

Traditionally, government agencies have directed and funded water quality monitoring efforts, while government laboratories, universities, or technical consulting companies provided the resources to carry out the work. This arrangement is often associated with performing an environmental assessment or checking for compliance. In some cases, individual government or university researchers monitor water quality as a component of investigating a specific scientific issue. Recently, environmental NGOs and educational institutions have conducted monitoring projects to identify and highlight pollution problems for environmental managers and the public, and as an educational tool. More recently, monitoring efforts have been conducted by a coalition of stakeholders contributing to the process. However, in all cases it is important for the stakeholders to have a clear vision of their motivation for participating in the monitoring effort, and their expectations for the results and benefits of the program.

MYSound Partners

U.S. EPA Region I

EPA Long Island Sound Office

Connecticut Department of Environmental Protection

Connecticut Department of Environmental Conservation

New York Department of Environmental Protection

Coalition to Save Hempstead Harbor

Save the Sound, Inc.

Maritime Aquarium at Norwalk

Mystic Aquarium

Bridgeport Regional Vocational Aquaculture School

The Sound School

Spectrogram Corporation

U.S. Coast Guard Academy

Suffolk County Health Department

Connecticut Coastal Audubon Center

- *Why is the monitoring effort being undertaken?*

Monitoring can be conducted for many purposes, including:

- Characterizing waters and identifying changes or trends in water quality over time.
- Identifying specific existing or emerging water quality problems.
- Gathering information to design specific pollution prevention or remediation programs.
- Determining whether program goals—such as compliance with pollution regulations or implementation of effective pollution control actions—are being met.
- Responding to emergencies, such as spills and floods.
- Providing supplemental data for a research project.
- Documenting illegal discharges.
- Attracting public attention to a pollution problem.
- Providing an educational and outreach tool.
- Measuring the success of newly implemented water protection programs and facilities (such as upgraded sewage treatment plants).

Understanding and documenting the rationale is important for obtaining funding for, structuring, and evaluating the effectiveness of the monitoring effort.

- *When should the monitoring be conducted (how often and for how long)?*

Long-term monitoring to establish an environmental baseline for an estuary may require sampling over many years to delineate current status and trends. Monitoring to spot check for pollution problems and illegal discharges may occur randomly and be based on visual evidence that a problem exists or a discharge has occurred. Monitoring as part of a research project may be conducted for the period of time in which the phenomena of interest are being studied. Monitoring to raise public awareness or provide an educational experience may be conducted over a month or season, or be an ongoing effort, depending on the needs of the stakeholder in the specific situation.

- *Where should the monitoring be conducted (geographic extent of the monitoring)?*

Establishing an overall water quality baseline for an estuary may require sampling throughout the entire estuary, even if the samples or stations are widely separated. Monitoring to detect specific problems or uncover illegal discharges may involve sampling at pre-determined sites where the problem/discharge will be obvious (e.g., in a small cove directly downstream of a sewage treatment plant). Monitoring to raise public awareness may involve sampling near a well-recognized landmark and at a location where conditions are known to be representative of the estuary as a whole (e.g., a popular bathing beach). Monitoring for educational purposes may be conducted at points that are readily accessible to teachers and students.

Section 4.2 presents more detailed considerations of monitoring locations.

- *What parameters will be monitored?*

Characterizing the general water quality of an estuary can be accomplished by measuring temperature, salinity, DO, turbidity, and perhaps chlorophyll *a* as an indicator of nutrient enrichment. A more extensive investigation of an estuary where widespread pollution is known or suspected may require nutrient and indicator bacteria sampling as well. Sampling for toxic contaminants would be required if a known or suspected problem exists due to ongoing industrial discharges in the past or episodic spills of a particular material. The logical approach is to sample the least expensive set of parameters that provides an adequate data set to meet the goals and objectives (the “why”) of the monitoring program.

- *How will the monitoring be accomplished?*

There are three general methodologies to consider: sample capture and analysis in the laboratory, parameter measurement and recording on site using a portable instrument, or automated real-time measurement and data transmission using in situ sensors and telemetry. Table 2 provides an overview of which methodologies are feasible for the key water quality parameters discussed above.

In general, on-site sampling using a portable instrument is the simplest and least costly mode but only provides point sampling in space and time. Sample capture and laboratory analysis is somewhat more time consuming but is often done in conjunction with portable-instrument sampling as a QA/QC check. Deploying in situ monitoring stations is the most complex and expensive mode, but may be warranted if continuous or real-time time-series data are required to understand water quality dynamics. The important factors in selecting a monitoring mode are need for the parameter, budget, and level of technical expertise required to operate and maintain the equipment.

TABLE 2. GENERAL MODES AVAILABLE FOR MONITORING VARIOUS WATER QUALITY PARAMETERS

Parameter Monitored	Sample capture/ lab analysis	In situ with portable instrument	Remote in situ with sensor
Temperature*		X	X
Salinity*	X	X	X
Dissolved Oxygen*	X	X	X
Suspended Solids	X		X
Turbidity	X	X	X
pH & Alkalinity	X	X	X
Chlorophyll <i>a</i>	X	X	X
Nutrients	X		X
Toxics	X		
Indicator Bacteria	X		
Current Velocity		X	X

*Baseline suite of measurements taken by MYSound

In some cases, a combination of all three modes can be effectively employed. For instance, monitoring with portable instrumentation can provide good spatial coverage of basic parameters (T, S, DO, and turbidity) throughout the estuary at a reasonable expense with sampling conducted at selected sites and at a predetermined interval (e.g. weekly or monthly). Sample capture and laboratory analysis of selected parameters can provide QA/QC data for in situ sampling and spot check for toxic contaminants and indicator bacteria. Real-time, in situ monitoring can be conducted at strategically selected sites to provide insight into the dynamics of circulation and pollution problems, and to collect data during periods when on-site sampling is not feasible (e.g. winter and storm periods). This combined approach is the one currently being employed in Long Island Sound, with the on-site sampling being conducted by environmental agencies and volunteer water quality monitoring groups, and the real-time remote monitoring provided by the MYSound project.

Developing a Monitoring Strategy: Key Points and Lessons Learned from MYSound

- To develop an effective plan for a comprehensive estuarine monitoring network, it is important to understand the nature and dynamics of estuaries in general, and also understand the details of the particular estuary, embayment, harbor or river where monitoring stations are being placed. Fortunately, a number of water quality studies that can provide this basic understanding have already been completed on many estuaries.
- In structuring an estuarine monitoring program, several key questions must be addressed. These questions include:
 - Is there a problem?
 - If so, how serious?
 - Does the problem affect only a portion of the estuary, or the entire body of water?
 - Does the problem occur sporadically, seasonally or year round?
 - Is the problem a naturally occurring phenomena or is it caused by human activity?
- A monitoring program may include a wide range of physical, chemical, and biological parameters. However, the greater the number of parameters measured, the greater the expense and logistics requirements. Therefore, program managers must have a clear understanding of the reason for including each parameter, and be selective in choosing them. Because hypoxia occurs in portions of Long Island Sound, particularly western Long Island Sound, MYSound has chosen temperature, salinity, and dissolved oxygen as the main parameters of interest.

3.3 FUNDING AND OTHER CONSIDERATIONS

Once the goals, objectives, scope, and participants for the project have been identified, the project partners are in a position to market the concept and seek funding for the monitoring network. This requires identifying, tracking, and responding to funding opportunities that present themselves. One way to market the concept is by developing a “concept paper” that describes the effort and the participants. MYSound developed several versions of such a paper, ranging from two to five pages. This document forms the basis of the follow-on proposal, and can be also be widely distributed to potential funding organizations and stakeholders. In addition, the “concept paper” can be used as the basis for presentations at workshops and meetings. This will help identify funding opportunities, because funding agencies and stakeholders can alert the project team to relevant solicitations. Routine checks can also be made of the Web sites of key agencies and funding organizations such as NOAA, EPA, and the National Science Foundation (NSF).

In seeking funding, it is not necessary (or desirable) that the project be supported from a single source. Because the monitoring network concept has components that can be developed as discrete projects, it may be possible to establish the “network” as several integrated “projects.” In some cases, this allows individual project partners to acquire portions of the necessary funds by targeting agencies and organizations who have traditionally sponsored their programs. For instance, a university marine science department may seek a portion of the funding from NSF, while a volunteer monitoring group may seek funding from a national environmental NGO. Obtaining funding from several sources also helps ensure the longer term sustainability of the project (discussed in detail in Chapter 7).

Many solicitations for marine monitoring programs in recent years have required or given special preference to efforts that have multiple partners, involve private entities (including NGOs and private companies), and support education and public outreach and awareness efforts. EMPACT is a prime example of such a funding source, as is the National Ocean Partnership Program (NOPP).

Many solicitations also require a cost-share on the part of the project participants, either in actual dollars or by providing labor and infrastructure to the project at no cost or at a reduced rate. These solicitation attributes should be taken into account in the initial planning of the project to secure the necessary partner commitments to rapidly produce a successful proposal.

Developing a Water Quality Monitoring Program: Key Points and Lessons Learned

- **Up-front networking among agencies, institutions, and organizations is an important first step in establishing a water quality monitoring program. For MYSound, establishing a dialogue on monitoring requirements for Long Island Sound over the years allowed the partners to quickly formulate the concept of a water quality monitoring effort that combined the more traditional point-sampling water quality surveys in the Sound with monitoring provided by continuous, real-time sampling stations.**
- **Initial literature and Web searches can provide valuable information and ideas on monitoring technologies, data management methods and software, data presentation schemes, and communications and outreach programs.**
- **A key step in building a marine monitoring program is building a coherent strategy for the program. Developing an implementation plan for the project requires answering the Who, Why, When, Where What, and How of the monitoring program.**
 - *Who should be conducting the monitoring effort both in terms of who is leading the effort and who is contributing to the effort?*
 - *Why is the monitoring effort being undertaken?*
 - *When should the monitoring be conducted (how often and for how long)?*
 - *Where should the monitoring be conducted (geographic extent of the monitoring)?*
 - *What parameters will be monitored?*
 - *How will the monitoring be accomplished?*

Each of these questions must be carefully considered to ensure that the project is properly focused, realistic in scope and complexity, efficient, and affordable.

- **The key factors for successfully obtaining both start-up and maintenance funds are marketing, networking, and partnering. Marketing the concept will help identify potential stakeholders. Networking with stakeholders will lead to formation of partnerships. Partnerships will broaden the funding and in-kind support base, which is favorably regarded by many agencies and organizations that provide funding to water quality monitoring projects.**