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Measuring Progress Of Estuary Programs

Highlights

Measuring Progress of Estuary Programs

HIGHLIGHTS

Estuary

An ***Estuary*** is a coastal area where fresh water from rivers and streams mixes with salt water from the ocean. Many bays, sounds, and lagoons along the coasts are estuaries. Portions of rivers and streams connected to estuaries are also considered part of the estuary. The land area from which fresh water drains into the estuary is its watershed and affects the health of the estuary.

Outcome

An ***Outcome*** is an action or occurrence that happens outside the estuary protection program but that is likely to have occurred at least in part because of an estuary protection activity.

Indicator

An ***Indicator*** is a particular characteristic or reference marker used to measure whether an outcome is being achieved.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 17 1995

THE ADMINISTRATOR

Dear Colleagues:

Estuaries -- the coastal areas where fresh water from rivers and streams mixes with salt water from the ocean -- are a major national resource and economic asset in this country. The protection of the 100 estuaries in the U.S. is a vital national concern.

Through the National Estuary Program (NEP), the U.S. Environmental Protection Agency brings together citizens, business representatives, scientists, state and local officials, and environmental organizations to arrive at common-sense plans for protecting 21 of these vital coastal areas. These plans, called Comprehensive Conservation and Management Plans, recommend actions to achieve specific goals.

This manual is intended to help managers in the National Estuary Program to assess environmental progress and communicate to citizens about efforts undertaken and successes achieved. An informed and involved citizenry is essential to the success of environmental protection.

Protecting estuaries means controlling pollution from a great variety of sources -- in the air, in the water, and on land. For this reason, the National Estuary Program provides an important model as our nation moves beyond piecemeal, pollutant-by-pollutant regulation to more a comprehensive "ecosystem" approach to environmental protection.

The procedures presented in this manual for assessing environmental trends and communicating with the public have been developed and field-tested by the Urban Institute of Washington, D.C. We expect they will be useful both within the National Estuary Program and for managers of watershed protection and other environmental efforts outside the NEP.

Sincerely,

Carol M. Browner

Acknowledgments

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persons were involved in the preparation of this manual. While space does not permit listing all of them, their important roles are acknowledged, with our thanks. In addition, a national steering committee representing state and local agencies, academia, industry, and public interest organizations, helped guide the development of the procedures and reviewed the draft manual. Following is a list of the members of our steering committee whom we thank for their guidance:

Committee Members

Mr. Robert Bendick, New York State Department of Environmental Conservation

Mr. Jeff Benoit, U.S. Department of Commerce

Mr. Hal Bickings, Aquaculture Natural Resources

Dr. Rick Burroughs, University of Rhode Island

Dr. Joseph Costa, Buzzards Bay National Estuary Program

Mr. John Costlow, Duke University

Mr. Richard Eckenrod, Tampa Bay National Estuary Program

Mr. Bill Eichbaum, World Wildlife Fund

Ms. Eugenia Flatow, Coalition for the Bight, New York

Mr. Kevin P. Gildart, Bath Iron Works, Maine

Mr. Andy Manus, Delaware Department of Natural Resources and Environmental Control

Ms. Nancy McKay, Puget Sound Water Quality Authority

Mr. Steve Ritchie, California Regional Water Quality Control Board

Ms. Dixie Sansom, Former Florida State Representative

Ms. Amy Zimpfer, U.S. Environmental Protection Agency

Ex-officio

Jim Burgess, U.S. Department of Commerce

Elizabeth Jester-Fellows, U.S. Environmental Protection Agency

Marian Mlay, U.S. Environmental Protection Agency

Finally, we extend our gratitude to the Richard King Mellon Foundation of Pittsburgh, Pennsylvania, and to the Mary Flagler Cary Charitable Trust, for their generous support of the Agency's efforts to help its estuary programs evaluate their progress.

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Measuring Progress of Estuary Programs

HIGHLIGHTS

The roughly 100 estuaries in this country are a major national resource and economic asset and their protection is a vital national concern. Organizations in many of these estuaries have established programs aimed at their protection. Twenty-one estuaries now participate in the U.S. Environmental Protection Agency's National Estuary Program.

The 1990s have become the decade of "accountability." Federal and state governments have been required by legislation to monitor and report on program results or progress. Common sense dictates that estuary protection officials regu-

larly track the results or progress of their efforts at improving and maintaining the quality of estuary waters. To the extent that many estuary programs use similar procedures for assessing their progress, such information can also provide a *national* perspective on progress in estuary protection.

This report is a companion document to "Measuring Progress of Estuary Programs: A Manual" and provides a summary of how to develop and implement such an outcome monitoring process. Specifically, we examine procedures for regularly tracking progress of estuary protection efforts undertaken by governments, businesses, households, and boaters. We also present procedures for translating information on actual bay quality into a "Bay Quality Index" developed from available data on environmental monitoring and other sources such as closures to shellfishing and swimming.

Estuary program officials need information to help determine where improvements are needed and whether improvement efforts have led to desired results. Such information will increase the accountability of estuary protection programs to elected officials and the public, help develop and justify budget requests, and help communicate to citizens and the media the progress being made.

Monitoring the status of an estuary is a complex undertaking. Measuring water and living resource quality at all times, in all locations, and at all depths is infeasible. However, a desire for perfection and scientific precision should not deter the use of outcome indicators and data collection procedures that provide "roughly right" information. We emphasize that, for estuary program officials, partial knowledge about progress is better than no knowledge.

The material presented here is based to a large extent on pilot efforts undertaken by the National Estuary Programs in Buzzards Bay, Massachusetts and in Tampa Bay, Florida in 1992 and 1993. The outcome monitoring procedures described were developed over a 14-month period by Urban Institute staff and personnel from both estuary programs.

For estuaries participating in the National Estuary Program, the required Comprehensive Conservation and Management Plan defines the purpose and component parts of the estuary protection program and the aims of monitoring its programs. Other estuaries likely have, or will have, a management plan to which the monitoring system described in the manual can be related.

Below, a discussion of how to identify meaningful outcome indicators is presented, and we set forth a way to track progress of estuary protection efforts of governments, businesses, households, and boaters. We then suggest how to analyze and report the outcome data collected, and caution readers about the limitations of the outcome monitoring process outlined in this report.

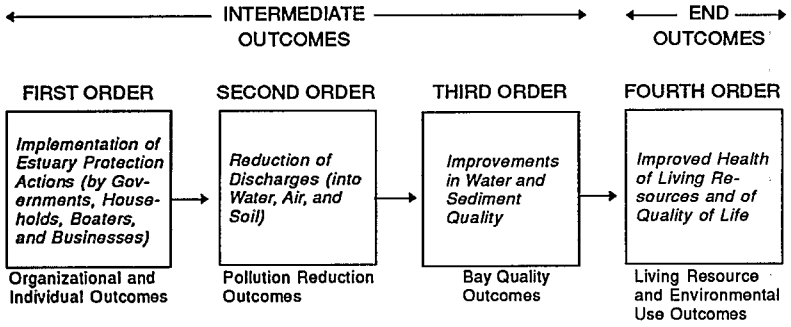
IDENTIFYING MEANINGFUL OUTCOME INDICATORS

The word "outcome" is used throughout the manual to refer to an action or occurrence that happens *outside* the estuary protection program but that is likely to have occurred at least in part because of an estuary protection activity. When designing an outcome monitoring process, the first step is to identify outcome indicators, being careful to divide them into intermediate and end outcomes. Intermediate indicators typically mark some action or behavior undertaken by persons or organizations that can affect bay quality but do not represent the end results, such as the condition of living resources in the bay.

As shown in the chart on the next page, which maps the estuary protection chain of events, four categories or orders of outcome indicators are especially relevant to estuary protection activities.

Information about the change in behavior on the part of governments, businesses, households, and boaters can be obtained through the Government Action Checklist and the business, household, and boater surveys described below.

Estuary Protection Chain of Events



Data on the health of living resources—the extent to which the health of fish, other wildlife, habitat, and vegetation has changed—are of particular concern to the public because they indicate whether or not the estuary can support individual uses such as swimming and shellfishing.

The table on the following page presents an illustrative set of outcome indicators that estuary protection officials can use to measure progress in estuary protection efforts.

TRACKING THE ACTIONS OF GOVERNMENTS: THE GOVERNMENT ACTION CHECKLIST

The Government Action Checklist (GAC) is a vehicle for annually monitoring the overall progress that local governments are making in their efforts to protect an estuary. The Tampa Bay National Estuary Program (NEP) is using the GAC process to develop a schedule for its Comprehensive Conservation and Management Plan (CCMP); having already completed its CCMP, the Buzzards Bay Project is using the GAC process to help measure progress in meeting the goals of the CCMP.

Illustrative Outcome Indicators[a]

INDICATOR	UNIT OF MEASURE	ORDER[b]	SOURCE
Overall Summary Outcome Indicators			
Governments scoring 75% success on the "Government Action Checklist"	Number of Governments	1	Government Action (GAC) Survey
Households with at least one problem behavior	Percent of Respondents	1	Household Survey
Boaters with at least one problem behavior	Percent of Respondents	1	Boater Survey
Businesses reporting reduction in hazardous waste discharged	Number	2	Business Survey
Amounts of pollutants discharged	Various Units	2	Agency Report
Overall water quality	Water Quality Index	3	Combination of Water Quality Factors
Overall bay quality	Bay Quality Index	4	Combination of Living Resource Factors
Reducing Toxic Indicators			
Household hazardous waste collection	Number of Towns, Number of Events, and Amount Collected	1	GAC Survey
Oil recycling programs	Number of Towns	1	GAC Survey
Integrated pest management programs	Number of Farms, Number of Acres	1	GAC Survey

(continued)

Illustrative Outcome Indicators (continued)

INDICATOR	UNIT OF MEASURE	ORDERb	SOURCE
Reducing Toxic Indicators (continued)			
Businesses participating in pollution prevention activities	Number, Percentage	1	Business Survey, Local Agency Records
Outfalls with toxics exceeding NPDES permit	Number, Percentage	2	Federal Data
Toxics substituted or eliminated	Pounds	2	State Data
Fishing closures due to toxics	Acres	4	State Data
PCB concentrations in sampled fish	Percent with Excess Concentrations	4	State Data
Preventing and Managing Oil Spills			
Municipalities with oil spill coordinators with defined responsibilities, job descriptions, and requisite training	Number, Percentage	1	GAC Survey
Municipalities with developed protocols in place (e.g., Mutual aid pacts) that are compatible with coast guard regional plan	Number, Percentage	1	GAC Survey
Municipalities with appropriate equipment	Number, Percentage	1	GAC Survey
Boatyard/marinas with oil containment and cleanup equipment on site and with an active response plan	Number, Percentage	1	Boatyards and Marinas, GAC Survey
Oil spills that are responded to effectively by following response plan (overall assessment of event by spill coordinator, harbormaster, state, or local programs)	Number, Size	2/3	Local, State and/or Federal Government

Managing Sewage and Septage			
Nitrogen-loading limits added to NPDES permits	Number of Towns	1	GAC Survey
Businesses adopting pre-treatment and pollution prevention programs	Number of Businesses	1	Business Survey
Towns with program for licensing septage haulers	Number of Towns	1	GAC Survey
Days businesses did not meet npdes limits and were in substantial non-compliance	Number of Days, Number of Businesses	2	Federal Data
Untreated sewage discharged directly into bay	Gallons	2	State Data
Managing Stormwater and Agricultural Runoff			
Remedial stormwater BMPS in place	Number of Volumes	1	GAC Survey
Educational measures for farmers developed to control agricultural runoff	Number of Towns	1	GAC Survey
Bylaw changes for new developments (subdivision regulations)	Number of Towns	1	Planning Boards
Remediation of illegal septic tie-ins	Number of Towns	1	GAC Survey
Sewer overflows	Number, Volume	1/2	Local Agency Records
Managing Boat-related Wastes			
Identification of no-discharge areas	Number of Towns	1	GAC Survey
Availability of pump-out facilities[c]	Number of Towns	1	GAC Survey
Boaters who report using pump-outs regularly	Percentage	1	Boater Survey
Regulation of MSD chemical additives	Number of Towns	1	GAC Survey
Enforcement actions taken for illegal discharges	Number of Towns	1	GAC Survey

(continued)

Managing Nitrogen			
Nitrogen-loading standards adopted by towns	Number of Towns	1	GAC Survey
Use of BMPs by farmers	Number of Farms	1	GAC Survey
Embayments exceeding nitrogen-loading standards	Number	3	Environmental Monitoring
Amount of seagrass	Acreage	4	State Data
Managing On-Site Septic Systems			
Septic system regulations requiring inspection and upgrade prior to title transfer	Number of Towns	1	GAC Survey
Noncomplying systems identified and remediated	Number of Towns	1	GAC Survey
Innovative/alternative systems installed	Number of Such Systems	1	Local Agency Records
Septic systems "x" ft. from coastal area	Number of Systems	1	Local Agency Records
Incidence of identified overflows	Number of Systems with Overflows	2	Local Agency Records
Assessing Shellfish/Finfish Resources			
Shellfishing areas closed	Acres	4	Environmental Monitoring
Shellfish/finfish kills	Number, Size	4	State and Local Agency Records
Incidence of Diseased Shellfish/Finfish	Percentage of Species, Number of Occurrences	4	State Data

a. This exhibit is a modified version of tables developed by the Buzzards Bay Project (Massachusetts).
b. "Order" refers to the four orders. Order 1 = indicator of behavior; 2 = indicator of amount of pollutants discharged into the bay; 3 = indicator of bay water quality; 4 = indicator of the health of bay living resources.
c. Item included in Government Action Checklist.

There are six basic steps to formulating a Government Action Checklist:

1. Select the items to be assessed, that is, the set of activities that governments should undertake to maintain and improve the estuarine environment. Then group the items by useful categories of protection.

For instance, the Buzzards Bay Project used these categories:

- Nitrogen Action Plan,
- Protecting and Enhancing Shellfish Resources,
- Controlling Stormwater Runoff,
- Managing Sewage From Boats,
- Managing On-Site Wastewater Disposal Systems,
- Preventing Oil Pollution,
- Protecting Wetlands and Coastal Habitat,
- Planning for a Shifting Shoreline,
- Managing Sewage Treatment Facilities,
- Reducing Toxic Pollution,
- Conducting Pollution Remediation Projects in New Bedford.

The Tampa Bay NEP used these categories:

- Water Quality,
- Land Use,
- Septic Systems,
- Municipal Waste,
- Hazardous Materials and Hazardous Wastes,
- Stormwater,
- Conservation Measures,
- Boater Use and Boater Discharges,
- Oil Pollution and Emergency Response,
- Agricultural Industry,
- Other Industry,
- Shellfishing,
- Public Information/Technical Assistance,

- Intergovernmental Coordination,
- Miscellaneous.

2. Determine which communities will be included in the regular GAC assessments, that is, which local governments and at what level (city, county, etc.). For example, the Tampa Bay NEP decided to start with three major counties and three large cities, recognizing that some counties encompassed as many as 22 municipalities—a number thought to be unwieldy for the GAC process. Moreover, many of the counties were thought to have small impacts on bay quality. A number of the items on the Tampa Bay GAC refer to county-level activities that are not applicable to the towns. In contrast, the Buzzards Bay Project has targeted GAC monitoring for each of the communities that were signatories to the CCMP. The procedure currently covers 12 local governments. The Coalition for Buzzards Bay developed three versions of the GAC: one for coastal towns, one for inland towns, and a separate checklist for New Bedford—the only large city in the local area and its industrial manufacturing hub.

3. Operationally define checklist items for assessment purposes, and develop a rating scale for each item that captures whether local governments have achieved the intended activity/action (e.g., achieved fully, partially, or not at all).

4. Select the organization that will administer the ratings and develop the summary reports. The organization should be one that is perceived as being reasonably objective by the governments being rated and by the public. A regional council of governments, planning association, or university are probably appropriate.

5. Pilot test the assessment procedures. Rarely will the first version of the GAC survive unmodified as it undergoes a pilot test among selected local communities.

6. Determine the data analysis process and reporting formats.

TRACKING THE ESTUARY PROTECTION BEHAVIOR OF BUSINESSES

Businesses and industries, including agriculture, are often major contributors of pollutants to an estuary. Thus, they provide major opportunities for pollutant reduction. Progress in encouraging business and industry to adjust their operations in order to produce less hazardous polluting materials should be tracked, as should the actual magnitude of pollutants emitted.

Three ways to track progress in business-related estuary protection efforts include monitoring the data on pollutant loadings, conducting periodic surveys of businesses concerning their efforts to reduce hazardous waste, and—by using a Government Action Checklist—looking at the extent to which local governments urge businesses to use alternatives to hazardous materials, sponsor industrial pre-treatment programs, and implement agriculture pesticide/fertilizer best management practice (BMP) programs.

Before conducting a survey of businesses, estuary program officials need to resolve the following questions: Which businesses should be included? Which geographic areas should be covered? What topics should the surveys cover? Should local business groups be asked to help shape the questionnaire? Should different versions of the questionnaire go out to different types of businesses? Should the questionnaire be administered in person, by phone, or by mail? How many businesses should be surveyed and how can a high response rate be ensured?

Questionnaires should be short, accompanied by a letter introducing the purpose of the survey, and should not be unduly complex or intrusive. Response rates can be increased by preceding the questionnaire with a substantial educational effort. The sample questionnaire on the next page was adapted

Illustrative Industry Questionnaire
(Based on one tested in New Bedford, Mass)

1. Does your firm have a current toxic material/ waste reduction plan?	❑ Yes	❑ No
2. Does your firm have specific toxic material/ waste reduction targets?	❑ Yes	❑ No
3. Do you believe that you and your firm have sufficient and clear information about the following:		
a. Toxic waste requirements?	❑ Yes	❑ No
b. Technical information on the toxic materials that your firm uses?	❑ Yes	❑ No
If yes to either (a) or (b), what information do you need?_____		
4. In the past 12 months have you done any of the following:		
a. Sent personnel to workshops or training sessions that contained a significant toxins reduction component?	❑ Yes	❑ No
If yes, approximately how many employee-days were spent? _____		
b. Organized employee teams to work on toxins/hazardous waste reduction?	❑ Yes	❑ No
c. Conducted an in-plant audit or assessment that contained a significant toxins reduction component?	❑ Yes	❑ No
If yes, who did the audit/assessment (check all that apply):		
❑ Your own staff		
❑ A consultant paid by your company		
❑ State personnel		
❑ Others (please specify) _____		
_____		
d. Initiated a recovery and reuse program for any item containing toxic/hazardous material?	❑ Yes	❑ No
If yes, what toxic/hazardous material?		
_____		

e. Eliminated or replaced the use of any item that contained toxic/hazardous material?	❑ Yes	❑ No
f. Changed the way you handle toxic hazardous wastes (such as by a pre-treatment or disposal method) so as to reduce the amount of waste discharged into the water and air?	❑ Yes	❑ No
5. Overall, have any of the above activities, or similar ones that you have used, actually enabled you over the past 12 months to actively reduce your company's:		
a. Use of toxic/hazardous materials?	❑ Yes	❑ No
b. Amount of toxic/hazardous materials discharged into the water and air?	❑ Yes	❑ No
6. How have these toxic/hazardous waste reduction strategies over the past 12 months affected your company's overall costs per unit of product (considering both operating and capital cost)? Please check one: ❑ Increased overall cost per unit of product produced ❑ Decreased overall cost per unit of product produced ❑ Neither ❑ Don't know		
7. What training and technical assistance, if any, would you like for your firm? _____ _____		

from one prepared by the Buzzards Bay Project/Urban Institute team after much research and input from EPA staff and local officials.

TRACKING THE ENVIRONMENTAL BEHAVIOR OF HOUSEHOLDS AND BOATERS

Households and boaters play major roles in estuary protection. Their actions can hurt or help the estuary's condition.

Households affect estuary quality by their use of fertilizers and pesticides, disposal of contaminants such as paint and cleaning materials, and upkeep of private septic systems. Boaters affect estuary quality by dumping waste, mishandling fuel, and damaging submerged aquatic vegetation with their propellers.

Improvements in behavior can be expected to lead to reduced amounts of contaminants discharged into the waters of the estuary and subsequently to improved water quality and life conditions for animals and vegetation. The best way to assess the status of, and changes in, household and boater estuary protection behavior is to survey them periodically about their environmental protection-related activities.

When examining changes in household and boater behavior from year to year, small observed differences are not likely to be as important to estuary program officials as large differences. This means that large household and boater samples yielding a high degree of precision are not likely to be needed.

Illustrative List of Potential Household and Boater Behavior Problems to be Covered in Surveys

- Handling of fertilizers;
- Handling of pesticides and herbicides;
- Handling of used oil, paint, and household chemicals;
- Lawn-watering;
- Handling of waste while boating;
- Handling of pet wastes;
- Type of mulch used;
- Cleaning of on-site septic systems;
- Stormwater runoff control;
- Water use.

How to Conduct Household Surveys about Environmental Behavior

1. Prepare questionnaire to be administered to households and consider hiring a local survey organization

to conduct the survey. Pre-test the questionnaire on a small number of households or boaters representing a cross-section of households to whom the questionnaire will be administered. In its household survey, the Tampa Bay NEP sought information on household composition, whether respondents owned or rented their homes, county of residence, and whether respondents lived in an apartment, condominium, or mobile home as distinct from a house—in order to exclude that group for questions relating to lawn fertilizers, pesticides, materials used for walk areas, and so on.

2. Identify appropriate listings of the household population and draw a random sample of households;

3. Consider ways to increase survey completion rates. These include keeping the questionnaire or telephone interview short, designing a user-friendly questionnaire, attaching a cover letter to the questionnaire that explains its purpose and is signed by a community person with favorable name recognition, using second and third mailings as well as follow-up phone calls, and offering an incentive such as a free publication for completing and returning the questionnaire.

4. Administer questionnaire by a combination of mail and telephone;

5. Track returns and carry out a second mailing or phone call to non-respondents about three weeks after the first mailing;

6. Conduct telephone reminders or phone interviews to non-respondents in order to achieve the targeted response rate (we suggest 50 percent);

7. Tabulate responses;

8. Prepare report on findings, including both the numerical results and a summary of the main findings. An illustrative report format for household survey responses, using hypothetical data appears on the following page.

Illustrative Report Format for Household Survey Responses (Hypothetical Data)

Percentage of respondents that reported disposal, in the past 12 months, of motor oil, paints, or chemicals at (a) county collection sites; (b) local service stations; (c) into sewer or storm drains.

	Number of Respondents	DISPOSITION		
		County Collection Sites	Local Service Stations	Sewer or Storm Drains
Total Number of Respondents	200	90	70	40
Percentage of Total	100%	45%	35%	20%
County A	60	67%	25%	8%
County B	75	27%	53%	20%
County C	65	31%	38%	31%
One-Person Household	35	43%	43%	14%
Two-Person Household	65	38%	39%	23%
Three-Person Household	100	50%	30%	20%
Owners	120	67%	25%	8%
Renters	80	13%	50%	37%

An example of how the Tampa Bay NEP summarized its main household survey findings appears on the following page. This format can also be used for reporting the findings of the business survey.

Summary of Survey Findings: Tampa Bay Household Environment Survey, 1992/1993

- Forty-two percent either do not have or do not know if they have water flow saving devices.
- Forty-five percent do not have a displacement device in their toilet; another 11 percent do not know if they do or not.
- Twenty-five percent of those surveyed who had disposed of oil, paint, or chemicals in the past 12 months reported disposing of them in their sewer or outside storm drain.
- Seventy-two percent are separating their trash for recycling; 25 percent are not.
- Twenty-four percent of dog owners never pick up their animal wastes; 14 percent do it "sometimes."
- While only 9 percent do not use slow-release fertilizers, 30 percent do not know if they do or not.
- Forty-eight percent use pesticides to control yard pests; 50 percent use pruning.
- Seventy-three percent have mostly, or some, native or drought resistant plants and trees; 17 percent are not sure if they do or not.
- Regarding new foliage planted, 21 percent said they are not drought resistant varieties; another 29 percent said they didn't know if they were or not.
- Twenty-six percent said they do not group plants according to fertilizer/watering needs; another 31 percent did not know if they did or not.
- Although only 7 percent have septic systems, of these, 67 percent pump out residues later than the recommended 3 to 5 years. Additionally, 67 percent use cleaning compounds and 34 percent use a garbage disposal.

DEVELOPING A BAY QUALITY INDEX

The purpose of a Bay Quality Index (BQI) is to provide a sound, reliable composite indicator of an estuary's overall health. The index should be clear and useful to public and private officials and to the public at large. It should permit the monitoring of trends in estuary quality over time, help identify aspects of bay quality that need extra attention, and enhance the ability of estuary program officials to communicate needs and progress to citizens and the media. A BQI is not intended as a scientific tool but as a management and policymaking tool.

Federal and state governments are already using a variety of environmental indices. For example, the State of Ohio has developed an "Index of Biotic Integrity." This uses data on the number of different types of species and the total number of species to produce an overall biological assessment of the quality of streams. The Hillsborough County Environmental Protection Commission in Florida has been annually updating a water quality index. It was used as a starting point for both the Buzzards Bay Project and Tampa Bay NEP to develop their Bay Quality Indices. The Hillsborough index also serves as a model for some of the procedures discussed in this report.

A BQI is likely to receive special attention from the media because of its apparent simplicity, just as overall air pollution indices in cities have achieved considerable acceptance by the media, the public, and even the technical community.

Four steps are needed to develop a BQI:

1. Select the components to include in the index. Examples of components for a BQI focusing on condition of living resources are presented to the right.

2. Determine the way in which these components are to be combined into

Examples of Components for a Bay Quality Index Focused on Condition of Living Resources (A Fourth-Order Outcome)

- Extent of shellfish bed closures or restricted use/consumption advisories;
- Extent of beaches closed to bathing or having other restrictions due to unnatural causes;
- Acreage of seagrasses;
- Number of fish kills;
- Fish populations;
- Populations of selected mammals and birds;
- Extent of algae blooms;
- Extent of offensive noxious odors;
- Prevalence of fish abnormalities due to unnatural causes, based on tissue samples;
- Number of cases of human illness due to consumption of contaminated seafood;
- Citizen ratings of estuary attractiveness.

the index. This involves transforming the values for each component into a common unit of measurement, combining these normalized values into an overall index value, and applying "weighting factors" that reflect each parameter's importance as an indicator of the health of the bay. The respective weights can then be multiplied by each of the "normalized" values of the BQI components and added together to produce the latest value of the BQI. The weights used in the Hillsborough County index are as follows:

Example of BQI Components and Their Weights

PARAMETER	WEIGHT
Percentage of Saturation Dissolved Oxygen	.212
Chlorophyll "a"	.167
Total Coliform	.167
Effective Light Penetration	.111
Total Phosphorus	.111
Total Kjeldahl Nitrogen	.111
Biochemical Oxygen Demand	.111
Sum of Parameter Weights	1.000

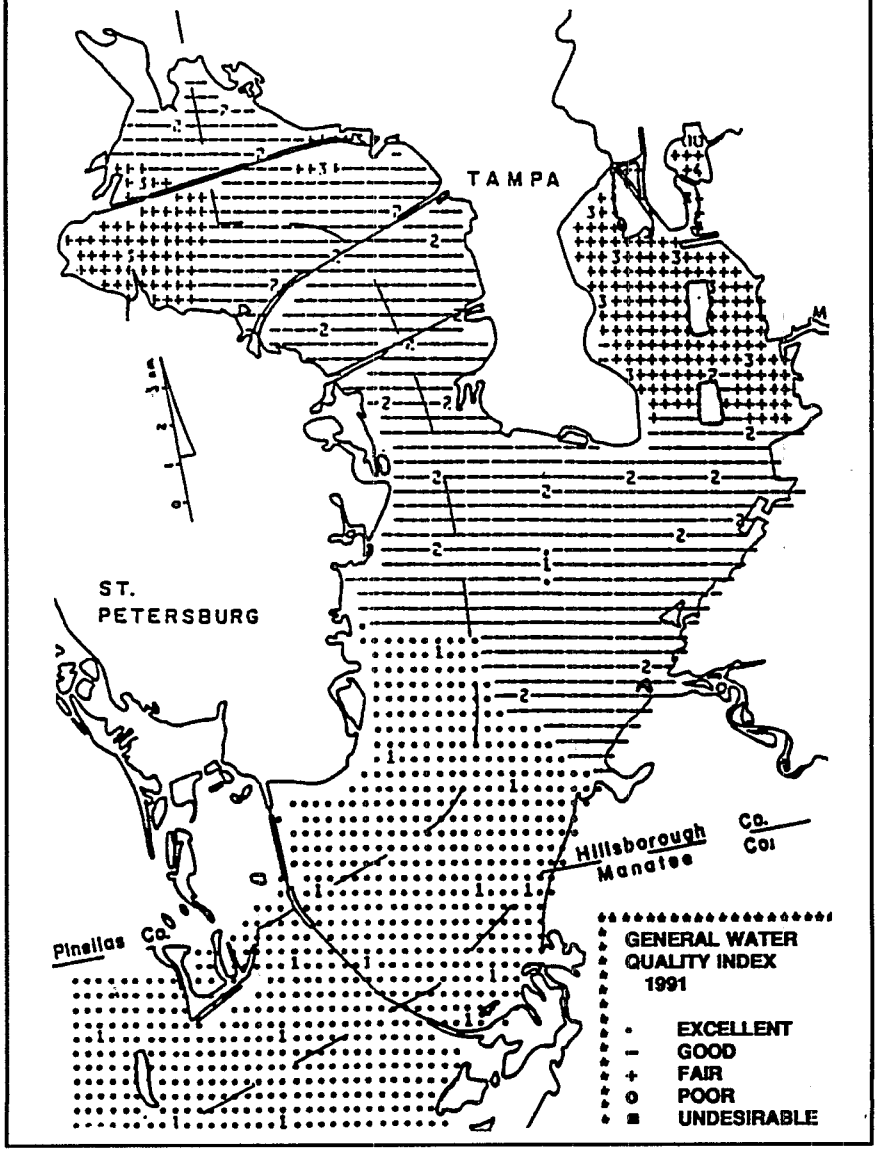
Source: Richard Boler, ed. 1992. "Surface Water Quality, Hillsborough County, Florida, 1990-1991." Tampa, Fla.: Hillsborough County Environmental Protection Commission (September), p. A-2.

3. Identify those values of the index that represent the various levels of bay quality such as excellent, good, fair, or poor.

4. Select the sub-indices likely to be useful. These include sub-indices for various geographic segments of the estuary and for groups of components such as living resources, support of desired uses of the bay, and water quality. While an overall index for the estuary is of interest to elected officials and the public, the sub-indices and individual environmental indicators are more useful to government and private sector personnel. The

exhibit below illustrates an attractive way to report geographical information. Such a map can also include data on sub-indices such as the condition of fish and support for desired uses.

Bay Quality Index by Section of Tampa



Cost

Environmental monitoring can be very expensive for a local program. Estuary programs will need to concentrate scarce resources on those index components, locations, and times that represent key "pressure points" for the estuary.

The ultimate test for determining the worth of the time and cost required is whether estuary protection personnel are able to use the information to help them more effectively allocate resources for estuary protection and to communicate bay quality outcomes to the public.

ANALYZING AND REPORTING OUTCOME DATA

Outcome data that have taken time, effort, and resources to collect are useless unless appropriately analyzed and effectively presented. In the manual we suggest specific ways to analyze and report the findings from each data collection effort described—the Government Action Checklist, and the business, household, and boater surveys. Estuary protection programs will want to combine the data obtained from these efforts by using a format like the one shown below, and compare the findings from the various outcome indicators against the goals identified in the estuary program's long-range plan.

A "Summary of Survey Findings," similar in format to the summaries recommended for each separate data collection effort and drawn from those summaries, should do two things. It should report the extent to which targets set by the estuary program have been achieved during the current reporting period, and it should compare the outcome information for the current reporting period to that for the previous period(s).

Estuary program and community officials will likely find the outcome information more useful if the Summary of Survey Findings is accompanied by explanatory information to help identify factors believed to have contributed significantly to the main findings.

Illustrative Outcome Indicators: Overall Summary

INDICATOR	UNIT OF MEASURE	ORDER	PREVIOUS PERIOD'S VALUE	LATEST PERIOD'S VALUE	TARGET FOR PERIOD
Governments That Have Met at Least 75% of the Terms on the "Government Action Checklist"	Number of Governments	1			
Households With at Least One Problem Behavior	Percent of Respondents	1			
Boaters With at Least One Problem Behavior	Percent of Respondents	1			
Businesses Reporting Reduction in Hazardous Waste Discharged	Number	2			
Amounts of Various Pollutants Discharged into the Bay	Various Units	2			
Overall Water Quality	Water Quality Index	3			
Overall Bay Quality	Bay Quality Index	4			
Comments/Explanatory Information:					

Readers should be aware of several limitations to the outcome monitoring process outlined in the manual. These are listed below.

Lack of Causal Information. Outcome data provide a "scorecard" but do not generally provide a sound basis for praising or criticizing estuary protection activities. Outcome information is vital for understanding what has been happening and what progress is being made, and for helping to identify where future attention and resources are needed. But to obtain information on *why* the outcomes are as they are, or why changes over the last reporting period have occurred, estuary personnel will need to conduct more in-depth examinations.

The Need for Periodic Outcome Information. One year of information will serve as baseline data for comparisons for future years. But it will be of somewhat limited value by itself in identifying trends, unless the estuary program has been fortunate enough to have prior-year data on outcome indicators.

The Delayed Effects of Program Actions. Some estuary protection actions cannot be expected to lead to quick, substantive changes. For example, major problems caused by the presence of toxins or excessive nitrogen may take years to correct. Both the source of the problem as well as accumulated damages must be corrected.

Cost. Establishing an outcome monitoring process requires staff time and time on the part of many advisory groups representing citizens, technical experts, and special interests in the community. However, once the procedures become routine, the effort required should be reduced considerably.

Implementing an outcome monitoring process is hard work and is not something that an estuary program can do overnight. It will minimally take a year to establish such a process, and probably two to three years to fully implement it. Estuary

protection, however, is a long-run proposition. Doing it well requires continuous, long-term attention.

Ultimately, an outcome monitoring process needs to stand the test of cost-effectiveness. If the information is not used to help estuary program officials improve their work, or if it does not provide funders or the public with relevant information that they can understand and utilize, the results will not be worth the costs. It is therefore imperative that estuary program staff design and implement an outcome monitoring process with great care, keeping in mind at all times that the purpose of the endeavor is to provide officials and the public with clear and meaningful information that they can use to improve estuary protection.

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