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Second National Symposium on Water Quality Assessment

Meeting Summary

October 16-19, 1989
Fort Collins, Colorado

MEETING SUMMARY

NATIONAL SYMPOSIUM ON WATER QUALITY ASSESSMENT
FORT COLLINS, COLORADO
OCTOBER 16-19, 1989

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1. SYMPOSIUM OVERVIEW

The second National Symposium on Water Quality Assessment was held on October 16-19, 1989, in Fort Collins, Colorado. The overall objective of the meeting was to bring together water quality professionals to exchange information and ideas about the collection, analysis, management, and use of water quality information, particularly to assess nonpoint source (NPS) problems in the Western U.S.

Geoffrey Grubbs, Director of EPAs Assessment and Watershed Protection Division (AWPD), opened the first day's plenary session, and Carol Jolly, Water Quality Program Manager of the Washington Department of Ecology, delivered the keynote address. Three speakers followed, each considering a different aspect of the symposium's central theme - NPS monitoring and assessment. Attendees then broke out into seven discussion groups and spent the remainder of the day in working session.

The second day was largely dedicated to technical presentations (some 27 in all) and conclusion of the workgroup discussions. After the evening banquet, Larry McDonnell of the University of Colorado Natural Resources Law Center spoke on the issue of providing sufficient water quantity while ensuring good water quality, a frequently contentious issue in the West.

The third day opened with an Overview of NPS Bioassessment by Professor James Karr of Virginia Polytechnic Institute and State University followed by 12 technical sessions on lab and field biological monitoring methods. At the noon luncheon, John Armstrong of EPA Region X spoke on some of the lesser-known impacts of the Valdez oil spill on the local Alaskan populace. The afternoon was dedicated to 9 additional technical presentations and a concurrent poster session (15 posters). The day ended with an evening reception in the poster gallery.

On Thursday morning, the final technical sessions were conducted (10 presentations), followed by the workgroup summaries and recommendations. Tim Stuart of AWPD provided closing remarks and the symposium was adjourned. Many attendees remained, however, to join one of the three field trips conducted that afternoon.

This meeting summary contains Carol Jolly's keynote address, Professor Karr's presentation on bioassessment, a transcript of Larry McDonnell's dinner speech, abstracts of all the oral and poster presentations, and the summaries/recommendations of the seven workgroups. The appendices include the original agenda, a summary of symposium evaluations submitted by attendees, and a complete list of attendees with addresses and phone numbers.

2. KEYNOTE ADDRESS

MAKING MONITORING MORE EFFECTIVE

Carol Jolly
Assistant Director
Water and Shorelands
Washington State Department of Ecology

Thank you for inviting me to open your National Symposium on Water Quality Assessment. The 3 days of this symposium will focus on design, collection and analysis of water quality monitoring data; all highly technical subjects. As Assistant Director for water and shorelands programs at the Washington Department of Ecology, I deal most often with more subjective issues related to water quality protection such as intergovernmental coordination and communicating both the need for assessment and the results of monitoring studies to decision-makers and citizens.

Today I want to discuss improved coordination in water quality assessments and why we need to improve the transfer of water quality information from scientists to decision-makers and citizens and some ways we can do this.

We can never do enough monitoring. More and better data is always being sought by local, state and federal agencies; decision-makers in congress, state legislatures and local governments; environmental activists; regulated industries; and citizens who are asked to pay for cleanup programs and prevention.

With increasing demands for water quality information and limited resources to meet these demands, coordination makes good sense. However, there are reasons we don't work more across agencies when we design studies.

First of all, we all want monitoring programs to address our specific needs. Each agency has its specific mission and targets its programs to meet these. Also, with insufficient resources, priorities get addressed first and one agency's top priority may be another's low priority effort. Finally, coordination is time consuming and drains our already limited resources.

We can surmount the problems associated with coordination. And several of the programs you'll be hearing about at the symposium reflect this. Our timber, fish, and wildlife approach is one example. Another example occurred in 1987 when Washington joined the Environmental Protection Agency and the states of Idaho and Montana in a coordinated water quality assessment of the Pend Oreille and Clark Fork river basins. This study was specifically funded in the 1987 reauthorization of the Clean Water Act. Each state received some federal funds to participate and each state was able to design its part of the study to meet its specific needs. EPA regions 8 and 10 are providing coordinators who are responsible for information-sharing and organizational details, and each state contributed some of its federal seed money to hire a technical writer so the studies' results could be shared among the participants and with the public.

Ideally, our assessments of water quality are used by decision-makers when they set priorities, allocate funds, and develop pollution controls and are understood by citizens. However, in reality, decisions at all levels of government are too often made with no water quality data or at best, inadequate data, and citizens decide whether to support or oppose water quality programs based more on their perceptions than on our studies.

Most of this conference focuses on nonpoint sources of pollution, and it is generally acknowledged that controlling this pollution will require different approaches than the regulatory systems used to control point sources. Milt Russell, former Assistant Administrator of EPA, in a 1987 article on "Environmental Protection for the 1990s" captured this reality when he wrote that:

> "In this new phase of environmental progress, action comes only when the polluters choose to impose change on themselves and their fellows. Those who are part of the problem are also those who must agree upon and carry out the solution. This is not a situation amenable to command and control; it is one that demands coalition and consensus."
> [Environment, v.29, No.7, Sept. 1987, P.35]

To increase the use of water quality assessments by decision-makers and the general public, we can do several things:

- Design studies to answer questions that people are asking.
  - People look to us to describe trends. Are our waters getting worse or better or are we simply holding the line?
  - Help them understand how different management alternatives will affect water quality: for example, a coordinated study of Puget Sound wetlands and stormwater management is now underway in Washington. This is a long-term study designed by local, state and federal agencies and the University of Washington which was designed to answer questions about consequences of various approaches to managing wetlands and how they will affect the quality of stormwaters reaching waterways.
- We need to increase our efforts to translate technical data into information people can use.
  - Don't expect users to dig the information out.

- Issue a "popular" version for every technical report. For example, several years ago we did a popular summary of our 305(b) report in an effort to inform more people about the trends and status of water quality in Washington. It was very well received.

- Identify segments of the public who need your information and interpret your results to address each group's concerns.
- Use a variety of methods to disseminate information about your studies, such as personal contacts, radio public service announcements, and legislative testimony. Get assistance from your in-house information staff.

• Report the results of our studies back to the public.

  - In the 1970s, we found extensive dissolved oxygen problems in a reservoir on the Spokane River. We funded a study by Eastern Washington University, which found that the Spokane wastewater treatment plant was the source. Ecology helped the plant upgrade treatment to remove 85 percent or more of the phosphorus loading. Continued monitoring showed that water quality was improving. Because this is a major river in a populated area, the work got a good deal of media coverage. We need to make sure that when monitoring turns up a problem and then we take corrective action and end up improving water quality, that people know the important role of monitoring and know that the water body is now better off as a result of that work.

  - When we lack all the data we feel we need as scientists, we often must rely more on our professional judgement.

I just recently received the EPA-Soil Conservation Service's May 1989 publication "The Rural Clean Water Program: A Report." If you haven't seen it yet, I would recommend it to you. It was written by Charles Little, who is an experienced writer, knowledgeable about land use and environmental issues. It describes, in easily understood language, the 9-year old program to demonstrate the effectiveness of various BMP's in tackling agricultural problems from irrigated and dry lands and from animal wastes.

It's effective because it's well written. It candidly describes what worked and what didn't and it explains problems and solutions in ways a reader can identify with. Let me read to you what Chuck says about monitoring, because it's so relevant to our symposium:

> "On the monitoring front, in a small but significant fraction of the projects, the evaluative effort has been frustrating at best, hopeless at worst. In more than a few areas, no baseline data were collected at all. In others, a shift in project objectives caused scientists to give up in despair. In a few, the organizations charged with monitoring responsibility simply failed to do their part. In some cases, monitoring personnel have followed their own star, which has often proved irrelevant to the

actual needs of the project. The upshot is that in many projects the effectiveness of the management practices installed may never be known."

But he contrasts this with a description of the circumstances in the successful projects.

"As for monitoring, when the project evaluative system was well coordinated with field work, as it was in a good many projects, variations in results could be accounted for and tactical decisions on practices made, even strategic ones that could lead to adjustments in overall project design. Indeed, it would seem that, as a practical matter, usable monitoring results had as much to do with the integration of monitoring techniques with field operations as with the sophistication of the research approach."

Coordination and communication are not the reasons most of you were drawn to the research profession. But they are crucial to obtain the financial support we need to conduct monitoring; make sure our results are used by decision-makers; and build a citizenry that is well enough informed about water quality that they will support appropriate and needed water quality programs.

Thomas Jefferson said, about 170 years ago:

"I know of no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take from them, but to inform their discretion."
[Letter to WM. Charles Jarvis, 28 Sept. 1920]

It's up to us to take the needed extra step in providing that information.

Thank you again for the opportunity to be here. I look forward to learning a lot while I'm here.

3. Technical Session Abstracts

3. TECHNICAL SESSION ABSTRACTS

INTRODUCTION

INTEGRATED NPS MONITORING PLANS AND AGENCY COORDINATION

Donald M. Martin
Idaho Operations Office, Region 10
U.S. Environmental Protection Agency

The Clean Water Act has mandated for almost twenty years that the states should be the focal point for water pollution control. Section 313 indicated long ago, that federal agencies should cooperate and comply with state's water quality standards, such as the nonpoint source "feedback loop" and antidegradation. More recently, Section 319 has reiterated that message in the form of federal consistency. Federal agencies have again been directed to actively participate in the development and implementation of the states' nonpoint source management programs. Federal agencies need direction and encouragement from the states in order to be active and effective partners in the abatement of nonpoint source pollution.

An integrated framework is needed to produce and implement effective NPS monitoring programs. The components of this framework include land based field audits of BMP implementation, water quality monitoring focused on beneficial uses and shared databases. A coordinated monitoring program requires the technical expertise of various disciplines: hydrologist, fisheries biologists, foresters, agricultural engineers, soil scientists, etc. The success of such an effort requires interagency cooperation and coordination, which is the basis of an effective nonpoint source monitoring program.

MONITORING AQUATIC RESOURCES IN WASHINGTON

Dave Somers
Tulalip Tribal Fisheries

Abstract Not Available

SESSION 1: NPS MANAGEMENT AND ANTIDEGRADATION

IMPLEMENTING IDAHO'S ANTIDEGRADATION POLICY AND DRAFT SEDIMENT CRITERIA INTO A MONITORING STRATEGY

William H. Clark
Division of Environmental Quality
Idaho Department of Health and Welfare

In August 1988 an Antidegradation Agreement for Idaho was finalized. This landmark agreement was reached after months of negotiations between timber, mining and agricultural interests, Indian tribes, and the conservation community. The key provisions of the agreement include: Basin area meetings held biennially across the state to discuss water quality and to allow citizens to nominate stream segments of concern, and development of a coordinated monitoring program to maximize water quality data collection efforts in Idaho. The program will address trends in major river basins, beneficial uses, and best management practice effectiveness monitoring in the state.

Draft sediment criteria have been produced to facilitate instream monitoring of BMP effectiveness for protection of beneficial uses. The criteria include turbidity, inter-gravel dissolved oxygen, and cobble embeddedness.

The approach to antidegradation could apply elsewhere. Our sediment criteria may apply best to states with salmonid streams but the rationale may have wide application.

NEGOTIATING ANTIDEGRADATION POLICIES

Frank Gaffney
Northwest Renewable Resources Center

Mediated negotiations are becoming much more commonplace, especially in the West, to resolve complex natural resource policy issues. After years of trying to adopt an antidegradation implementation policy, Idaho ultimately succeeded by using a consensus process with the assistance of a mediator. The final agreement is a combination of regulation and process and was actively promoted through the 1989 session of the Idaho Legislature by a coalition of industry and environmental interests.

This presentation will discuss the negotiation process utilized in Idaho as described by one of the mediators involved. It will also describe other successful natural resource negotiations in Alaska and Washington. Information will be presented on how policy makers can assess the opportunity for successful negotiations to resolve policy conflicts.

IDENTIFYING OUTSTANDING RESOURCE WATERS

Jim Overton
North Carolina Division of Environmental Management

The antidegradation policy of North Carolina's Environmental Management Commission states the intention to "maintain, protect, and enhance water quality within the State...". All waters are classified according to existing use and standards to protect for those uses incorporated within the regulations. Furthermore, the commission considers the present and anticipated uses of waters with quality higher than the standards, and "will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters".

Outstanding Resource Waters (ORW) and High Quality Waters (HQW) are two supplemental classifications developed to support the intent of the antidegradation policy. Waters and watersheds with these classifications are provided additional protection from point and nonpoint source pollution through management strategies.

Prior to addition of supplemental classifications (HQW, ORW), use attainability analyses are conducted to verify excellent water quality. A determination of the existence of one or more outstanding resource values is also required for ORW. Existing impacts including land use and permitted discharges within the watershed are also reviewed. The scope of information gathering varies according to the existing database, type and size of waterbody. This report outlines case examples incorporating variables that are inherent in the process of determining appropriate waters receiving these supplemental classifications.

WHEN DEGRADATION IS INEVITABLE: WIN WIN IS NOT ALWAYS POSSIBLE

James D. Jensen
Montana Environmental Information Center

Nonpoint source water pollution management needs considerably more than monitoring data, methods for information transfer and good intentions. It must have the critical tools necessary for change: The authority for enforcement and the will to enforce.

Section 319 of the Federal Clean Water Act of 1987 provides the legal basis for implementing nonpoint source programs and sets forth certain requirements that the states must meet to qualify for assistance under the Act. Beyond the requirements, the Act provides flexibility for the states to adopt either a regulatory or non-regulatory approach as their vehicle to accomplish pollution management goals. Montana has (predictably) adopted a non-regulatory approach and the EPA has signed off on it.

This is a fatal flaw. The EPA should have reviewed previous non-regulatory programs in Montana for their efficacy prior to signing off on the non-regulatory approach. If the state could not prove this method will work, then the EPA should have required a regulatory scheme. The timber, agriculture and mining interests have the political influence necessary to keep regulation and thereby enforcement to a minimum. Only the EPA can provide the counter balance necessary to place these tools in the hands of Montana's water quality professionals.

IDAHO'S ANTIDEGRADATION POLICY: AN EXAMPLE FOR OTHER STATES?

Jim Weber
Columbia River Inter-Tribal Fish Commission

Idaho's attempts to adopt and implement an Antidegradation Policy have had a long and fractious history often characterized by animosity between industry groups and state and federal water quality regulatory agencies. In Idaho, this hostility increased to the point that no state or federal agencies were allowed to participate in the negotiations leading to the Antidegradation Agreement. Thus, Idaho's Antidegradation Agreement is an example of what can happen when interest groups are turned loose to agree on an implementation plan for a policy they did not develop.

A significant benefit of the agreement is that it provides relatively clear guidance to the state as to what is considered "politically feasible." Thus, the agreement defines a process for identifying priority waters, public participation, and monitoring. On the other hand, the reliance on a consensus process leaves significant issues unaddressed. For example, there are no definitions of "high quality waters" or "full protection of beneficial uses." The determinations of "political feasibility" might have been significantly different if the relevant state and federal agencies had participated throughout the process. The EPA has a key role in giving the states the guidance and support they need to develop plans that will implement all aspects of the EPA's Antidegradation Policy.

SESSION 2: ASSESSING SEDIMENT AND TISSUE CONTAMINATION

NATIONAL BIOACCUMULATION STUDY

R. A. Yender
Office of Water Regulations and Standards
U.S. Environmental Protection Agency

Analysis of fish tissue can reveal the presence of bioaccumulative pollutants that otherwise escape detection through routine monitoring of water alone. Contaminants detected in fish not only indicate toxic pollutant insult to aquatic life, but also can pose a significant risk to human health from exposure through fish consumption. The National Bioaccumulation Study, initiated by EPA in 1986 as an outgrowth of the National Dioxin Study, is a one-time screening effort to determine the prevalence of bioconcentratable pollutants in fish and to identify correlations with sources of these pollutants. Composite fish samples collected from approximately 400 sites nationwide were analyzed for concentrations of sixty-three contaminants, including dioxins and furans, PCBs, p,p′ DDE, and Chlordane. Locations sampled included sites near significant industrial, urban, or agricultural activity; background sites in relatively unpolluted areas; and sites selected statistically from the U.S.G.S. NASQAN network. Special attention was given to locations with pulp and paper mills using chlorine for bleaching. A whole composite sample of a representative bottom-feeding species and a fillet composite sample of a representative sport fish species were collected from each site and analyzed using methods specially developed by EPA's Environmental Research Laboratory in Duluth. Preliminary results and interpretation of the data will be presented. Results of this study will reveal bioaccumulative pollutants, sources, and some specific locations warranting further study.

CALIFORNIA STATE MUSSEL WATCH (SMW) PROGRAM

Timothy Stevens
Division of Water Quality
California State Water Resources Control Board (State Board)

State Mussel Watch (SMW), a bioaccumulation monitoring program, was begun in 1977 in response to the inability to detect many chemical pollutants suspected to be present in ambient waters. The original goal of SMW was to provide a means to assess coastal marine water quality. Later, SMW served to help Regional Water Quality Control Boards in California locate and characterize specific areas of contamination, and to provide monitoring information for NPDES dischargers. Transplanted (60% of samples) and resident (25%) mussels and transplanted clams (10%) are sampled at approximately 130 sites each year in bays, harbors, estuaries, and on the open coast. Seven permanent resident mussel or clam sites are utilized for reference and to collect animals for transplantation. Substances analyzed for include 13 trace elements and approximately 70 synthetic organic compounds (pesticides, tributyltin, PCBs, and PAHs). Results are made available annually to the Regional Boards and to the public. The SMW Program is currently undergoing a period of internal and external critical review. Important planning considerations include: changes to program methodologies, improving validity of observed trends, maximizing usefulness of the analyzed substance list, the need for applicable tissue criteria, development of means to link tissue to ambient concentrations, increasing scientific input into the program, and the need to bolster long-term trend monitoring procedures.

SEDIMENT CLASSIFICATION METHODS COMPENDIUM, AND GENERAL ACTIVITIES OF EPA'S SEDIMENT OVERSIGHT COMMITTEES

Michael Kravitz
Assessment and Watershed Protection Division
U.S. Environmental Protection Agency

EPA's Office of Water Regulations and Standards formed two Agency-wide oversight committees (steering and technical) in the summer of 1988 to identify, coordinate and provide guidance on activities relating to the assessment and management of sediments contaminated with toxic chemicals. A recent product of the Technical Sediment Oversight Committee - Sediment Classification Methods Compendium - is an "encyclopedia" which describes various methods used to evaluate sediment contamination, their associated advantages and limitations, and existing applications. It is intended to serve as a common frame of reference to answer the "how clean is clean" question for particular sediments. The document is presently under review by EPA's Science Advisory Board and Regional Water Management Division and Environmental Services Division Directors. Assessment methods may be classified as numeric or descriptive. Numeric methods are chemical-specific and can be used to generate numerical sediment quality criteria, while descriptive methods cannot be used alone to generate numerical sediment quality criteria for particular chemicals. Some approaches comprise at least two methods; e.g. the Sediment Quality Triad approach employs bulk sediment toxicity testing, benthic community structure analysis, and concentrations of sediment contaminants. This presentation will summarize current sediment quality assessment methods and their potential applications to decisions regarding the assessment and remediation of contaminated sediment. Other ongoing activities of EPA's sediment oversight committees will also be briefly discussed.

SEDIMENT AND FISH TISSUE CONTAMINATION IN THE PIGEON RIVER

Q. J. Stober
Region 4
U.S. Environmental Protection Agency

The bioaccumulation of dioxin (2,3,7,8-TCDD) in fish presents a risk to human health and can serve to evaluate NPDES permit limitations. A synoptic study was conducted to assess dioxin contamination in the Pigeon River, an interstate water, receiving bleached Kraft pulp and paper mill effluent. Water, sediment and fish were sampled in the river from above the mill outfall to 100 miles downstream including Waterville (500 acres) and Douglas (30,600 acres) reservoirs. Dioxin was not detected in water but found at 13 ppt in sediment from Waterville Reservoir located 25 miles downstream of the mill. Concentrations were less than 1 ppt or undetected in sediment at subsequent downstream river and reservoir stations.

Nineteen species of fish were categorized as sportfish (predators) or bottom feeders and analyzed as composite and single fillets and composite and single wholebody samples. Dioxin was not detected above the mill outfall except for an estimated concentration of 0.8 ppt in a composite wholebody white sucker. Average composite fillet concentrations ranged from 7.7 to 11.3 ppt in Waterville Reservoir. Dioxin concentration in single fillets from sport species in Waterville Reservoir ranged from 10 to 80 ppt. Further downstream, composite fillet samples ranged from 0.2 to 6.2 ppt while concentrations dropped to 0.1 ppt in Douglas Reservoir (60 to 100 miles downstream). Wholebody samples declined from a maximum of 92.1 ppt 5 miles below the mill to about 1.6 ppt in Douglas Reservoir.

A human health risk assessment was conducted which indicated that very low concentrations of dioxin contamination in fish were unacceptable even at consumption rates of 6.5 g/d. The information was presented in the format of meals per unit time over a range of upper bound risks estimated from 10^{-3} to 10^{-6}. Each state then arrived at risk management actions which advised the public against the consumption of fish from the Pigeon River. This study has provided a better understanding of sampling strategies necessary to adequately assess dioxin contamination of fish in aquatic environments.

DREDGED MATERIAL DISPOSAL SITE MONITORING IN NEW ENGLAND

Thomas J. Fredette
DAMOS Program Manager
New England Division
U.S. Army Corps of Engineers

The Disposal Area Monitoring System (DAMOS) is a large multidisciplinary environmental monitoring program instituted in 1977 by the New England Division of the U.S. Army Corps of Engineers to assess and minimize the environmental impact of dredged material disposal at over ten sites in New England waters. DAMOS is but one of the inter-related components of dredged material management which includes project evaluation, site designation, monitoring, and site management. DAMOS studies are used to technically support and verify decisions made in each of these other components. In order to carry out this task the DAMOS Program has been designed using a tiered model, addressing specific questions that are needed to effectively manage the sites and assure environmental compliance. The program described here is adapted to the particular requirements of the New England region, but the approach can be applied to other regions and monitoring needs.

CONTAMINATED DREDGED MATERIAL: TESTING AND MANAGEMENT STRATEGIES

Craig Vogt
Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency

For the past 12 years, dredged material disposal in the ocean has been carefully managed at EPA through implementation of the Marine Protection, Research, and Sanctuaries Act. The MPRSA gives EPA responsibility for setting criteria to protect human health and the marine environment from disposal of waste materials in the ocean. The Clean Water Act also regulates the disposal of dredged material in fresh and estuarine waters, with a similar goal of environmental protection. Coordination and consistency between these two programs has been a recently identified goal of EPA.

EPA has long recognized that dredged material should not be managed solely on a permit-by-permit basis and that broader and more comprehensive measures are needed. To meet the rising challenges of in-place sediment toxics and to arrange for the best placement of those dredged materials that may not meet stringent criteria for open water disposal, EPA began developing a series of manuals and procedures for responsible management of dredged material. This development work spans program offices, statutory responsibilities, and existing regulatory activities in order to establish a comprehensive planning process for dredged material.

In this process, EPA is developing a series of guidance manuals associated with dredged material consistent with the MPRSA and CWA. These are the **Dredged Material Testing Manual** to determine a specific material's suitability for open-water disposal, a **Management/Decision Making Strategy** that provides a structure to evaluate alternatives and factors to be considered for each alternative, and a **Site Designation, Management, and Monitoring Manual** for the MPRSA and CWA.

In addition to these guidance documents, an intra-agency Technical Committee and a Steering Committee have been formed to facilitate management decision making in the arena of in-place toxics.

EVALUATION OF BMP EFFECTIVENESS

CLASSIFICATION OF RIVERINE-RIPARIAN COMPLEXES FOR MONITORING BMP EFFECTIVENESS

William S. Platts
Don Chapman Associates

Classification of riverine-riparian habitats when placed in context with their surroundings will provide an effective basis for BMP selection, application, and monitoring. If managers are to fulfill their responsibilities as BMP stewards, they must first know the capability of the land and waters they manage in order to select the compatible BMP. Second, they must know how to apply the BMP, and especially how to monitor the BMP for effectiveness. To finalize the process they must know how to mitigate the adverse impacts because most often a non-point source prevention BMP does not work.

Even though monitoring is an after-the-fact approach, a prognostic approach is necessary to set the evaluation process for a successful monitoring solution. For a monitoring approach to be successful it must inventory, assess capability, predict outcomes, and communicate needed actions to decision makers.

The classification system described nestles land units, both natural and artificial, for cumulative monitoring and integrates climate, geology, hydrology, geomorphology, and biotic control all at one time. The classification system is discussed as to how it can improve monitoring by identifying the existing state, the natural state, the cultural state, the potential state, and time periods between states. The system also identifies the family of variables that have the most power of analysis, depending on the type of nonpoint activity being monitored.

CLASSIFICATION OF RIVERINE/RIPARIAN HABITAT AND ASSESSMENT OF NONPOINT SOURCE IMPACTS: NORTH FORK HUMBOLDT RIVER, NEVADA

Sherman E. Jensen
Whitehorse Associates

An approach to classification of riverine/riparian habitat (RRH) and assessment of nonpoint source (NPS) impacts was developed and applied in a study of the North Fork Humboldt River in northeastern Nevada. Geographical variables influencing the inherent form and functions of RRH were identified. Maps of Ecoregions, geologic districts, landtype associations, landtypes and valley-bottom types were used to identify RRH of similar potential. Inventories on land forms and vegetation types were used to identify areas of similar existing state (i.e. condition). Measurements of stream and channel attributes were used to assess the condition of RRH relative to a continuum of states ranging from nearly natural to severely impacted. The approach is expected to be useful for identifying RRH that will respond similarly to management and for evaluating the condition of RRH relative to its ecological potential in other areas of the West.

RECOGNITION OF CRITICAL RIVERINE/RIPARIAN HABITATS

Jeff Cederholm
Washington Department of Natural Resources

Lack of recognition of critical riverine and riparian habitats has resulted in extensive salmonid habitat degradation in Pacific Northwest rivers and streams. Only relatively recently has woody debris, originating in riparian zones, been recognized as providing important salmonid habitat characteristics in riverine areas. The input of trees and other woody debris is multifunctional, in that it provides a stable spawning gravel environment, structure for pools, and a source of cover. It wasn't long ago that most logs and other woody debris was systematically cleared from water courses.

Another aspect of habitat recognition has to do with the importance of small floodplain tributaries with swamps and ponds at their headwaters, known as "wall-base channels". These wetlands provide significant winter refuge for juvenile coho salmon, which benefit by gaining improved winter growth and survival over non-immigrants. Even today these habitats are not commonly recognized for their importance, and they are often filled in with waste spoils, or blocked by improperly designed culvert installations. Some wall-base channel enhancement techniques will be discussed, and a training video is available.

MONITORING EFFECTIVENESS OF BMPs: THE IDAHO EXPERIENCE

Tim Burton
U.S. Forest Service, on detail to:
Environmental Protection Agency & Idaho Department of Health and Welfare

Nonpoint source monitoring in the State of Idaho is designed to answer two basic questions: Are BMPs implemented as designed? and do BMPs effectively protect beneficial uses? Water quality audits are used to derive simple, qualitative answers to these questions. BMPs are audited on a state-wide basis for implementation, design, and effectiveness from a random sample of projects every 4 years. In addition, supporting agencies audit at least 10% of projects on an annual basis.

Sediment is the most prevalent nonpoint source pollutant, impacting mostly spawning and rearing of resident and anadramous salmonids. The State is now working to develop water quality criteria and monitoring protocols to protect these instream beneficial uses.

An extensive literature search, and tests of monitoring protocols, have led to the application of several physical habitat parameters including: substrate embeddedness, inter-gravel dissolved oxygen/inter-gravel fine sediment/bioassays of embryo incubation and survival to emergence, and residual depth as measured by thalweg profiles.

The water quality criteria and monitoring techniques apply to all salmonid habitats where fine sediment is a known limiting factor causing reductions in rearing space by filling pools and inter-gravel cover or aggravating reproduction by reducing the flow of oxygen to incubating eggs, and/or entombing alevins and preventing successful emergence.

SESSION 3: INLAND WETLANDS AND RIPARIAN ISSUES

ASSESSMENT OF WETLAND IMPACTED BY MINE WASTES, INLAND WETLANDS AND RIPARIAN ISSUES

David J. Cooper
Dept. of Environmental Sciences and Engineering Ecology
Colorado School of Mines

Heavy metals are usually present at some concentration in waters of the Rocky Mountain West. The heaviest concentrations occur in waters impacted by metal mining activities, but moderate concentrations may also be found in water from drainages where no mining has occurred. Because outcropping bedrock in many portions of the Rocky Mountains is heavily mineralized the background metal concentrations of water in many drainages may have been high in pre-mining times. Mining activities have been most intense in these heavily mineralized areas, thus adding to the problem. Presently, it is unknown whether existing water quality criteria for heavy metals in the Rocky Mountains are realistic or not, because we do not know what background metal concentrations would have been.

Preliminary surveys of wetlands in the Peru Creek and Snake River drainages in Colorado have been done. We studied wetlands fed by water from mine adits, water with naturally high concentrations of heavy metals, and water that was relatively clean. The results indicate that plants actively accumulate certain metals, and the health of plant species and the composition of plant communities is controlled by the concentration of metals in the water supply. The relationships however, are not simple or linear, and many questions remain to be answered.

TEN YEARS OF CHANGES IN WATER QUALITY OF A PRAIRIE WETLAND COMPLEX IN THE MISSOURI COTEAU, NORTH DAKOTA

Jim LeBaugh
U.S. Geological Survey

Abstract Not Available

VERTEBRATES AS INDICATORS OF LAND-USE CHANGES IN THE WETLAND, STREAM AND RIPARIAN PORTIONS OF WATERSHEDS

Robert P. Brooks
School of Forest Resources
Pennsylvania State University

Are disturbance factors reflected in a measurable way within biotic communities that inhabit wetland, stream and riparian systems? If faunal communities do reflect the accumulation of incremental changes occurring in watersheds, then perhaps regional assessment models can be developed to detect and predict the "environmental health" of watersheds. Recent studies in Pennsylvania showed that the composition of vertebrate communities differed when reference and disturbed watersheds were compared. These differences were

associated with increasing human impacts as one proceeded downstream in a disturbed watershed rather than with changes associated with hierarchical differences from headwaters to mainstreams in a reference watershed. The detection of a particular indicator species with a sampling regime that is limited by time and funds is highly questionable. Thus, it was hypothesized that examining the structure of functional groupings of organisms, such as response guilds would be more useful. Analyses are underway to determine which groups and guilds are most affected by anthropogenic alterations to aquatic landscapes. The development of a reliable, inexpensive method for determining how a watershed is perturbed is necessary before such a tool will be widely and effectively applied by regulatory agencies. Based on our preliminary findings, biological monitoring, in conjunction with analyses of landscape patterns, hydrology, and water quality can be a useful tool for developing protection and restoration strategies for these important environments.

RIPARIAN EVALUATIONS

William S. Platts
Don Chapman Associates

The evaluation and monitoring of riparian systems is much larger than just looking at the stream channel, the stream bank, or the adjacent riparian system. These three habitats must be monitored, but not by themselves. For long term management the universe of concern includes the complete valley and its basin. With a quarter million dams now in place, heavy livestock grazing occurring over the west, along with other land uses such as urbanization and irrigation storage and withdrawal, there has been and will be large changes in how streams and lakes function. This function cannot be tracked and managed by looking at narrow slices of the habitat, as most of the presently used inventories and monitoring methods do.

Almost all valleys and their channels reflect their historic flow patterns. The future condition of these valleys and their riverine-riparian systems depends on the applied flow regimes. Therefore, maintenance flows (both natural and artificial) are going to determine the present and especially the future productivity of the resulting habitat. Without proper management of maintenance flows, flood plains can disappear, riparian temperatures can increase or decrease, colluvial processes can dominate fluvial ones causing decrease in valley width and size.

The factors controlling form and condition of the valley and its riparian habitat are discussed with changes that occur in riparian systems when this form and condition are not maintained. Methods for evaluating and monitoring these changes are presented by identifying the flow regimes and floodplain storage patterns needed to maintain valley form and condition.

USE OF RIPARIAN DATA TO MAKE MANAGEMENT DECISIONS

Wayne Nelson
SAIC

Abstract Not Available

WATERS IGNORED BY AMBIENT MONITORING PROGRAMS: A NATIONAL REVIEW OF BIOMONITORING OF WETLANDS

Paul R. Adamus
NSI Technology Services Corporation

An EPA synsthesis report on biomonitoring of inland wetlands will be released next summer. The report will describe, in general terms, the options for sampling approaches. Appropriate techniques will be referenced by wetland type, region, contaminant type, and taxa which are the object of sampling. Advantages and disadvantages of use of various taxonomic groups will be noted and promising indicator taxa and community metrics for wetlands will be noted. Preliminary findings of the review suggest that vegetation, non-insect invertebrates, and birds may be the most suitable indicators of the ecological condition of regional wetland resources, but additional testing is needed. Despite the extraordinary biotic value of wetlands and their extensive acreage in many regions, our review indicates that, compared with rivers and lakes, few inland wetlands have been the object of regular, sustained biomonitoring.

SESSION 4: MARINE AND ESTUARINE MONITORING

ENVIRONMENTAL MONITORING IN THE NATIONAL ESTUARY PROGRAM

Thomas M. Armitage
Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency

In 1985, the U.S. Congress directed the Environmental Protection Agency (EPA) to undertake environmental programs in estuaries of national significance. Assessment and planning activities are being undertaken in all of these estuaries as part of the EPA's National Estuary Program. The primary goal of the National Estuary Program is to restore the physical, chemical and biological integrity of the nation's estuaries. A major objective of the National Estuary Program is to develop within five years, for each estuary in the program, a Comprehensive Conservation and Management Plan (CCMP). Environmental monitoring has become an integral part of CCMP development and implementation, and it is expected that all estuaries in the national program will be extensively monitored.

As estuary programs are developing CCMPs, monitoring activities are initially focused on: filling critical data gaps; providing a baseline for status and trends analyses and management actions; and providing estimates of the degree of variability in physical, chemical, and biological parameters that will continue to be monitored after the CCMP is completed. After the CCMP for each estuary is in place, a major monitoring effort will be focused on assessing management actions implemented as part of the plan, and documenting trends of change in the estuary. The states in which the NEP estuaries lie have the primary responsibility for implementing the estuary monitoring programs. However, they have begun to enlist the help of EPA. Efforts are also being made to involve citizen groups in the estuary monitoring programs.

Designing a monitoring program for an estuary presents problems that are not encountered in many fresh water systems. The number and diversity of estuarine ecosystem components to be monitored is often much greater than those in fresh waters, and varying salinity and hydrodynamic conditions require the development of unique methods and sampling designs. A conceptual framework for the design of estuarine monitoring programs is being developed by the Office of Marine and Estuarine Protection. This conceptual framework will require planners to identify valued ecosystem components and sources of perturbation in their estuaries, and to specify the direct and indirect mechanisms by which the components are affected.

Estuary monitoring programs have already been initiated as part of five estuary programs in the National Estuary Program. In each case, a major objective of these monitoring programs is to correlate environmental perturbations with effects on valued ecosystem components.

DEVELOPMENT AND IMPLEMENTATION OF A REGIONAL ESTUARINE MONITORING PROGRAM

Andrea E. Copping
Puget Sound Water Quality Authority

The Puget Sound Ambient Monitoring Program (PSAMP) was developed to be a comprehensive and coordinated monitoring program that would characterize and document conditions and trends in environmental variables in Puget Sound and the surrounding watershed.

PSAMP will assess conditions over time of the water, sediments, fish, shellfish, benthos, birds, marine mammals, and nearshore habitat. These data are stored in a microcomputer-based data management system and linked to a Geographic Information System.

PSAMP was designed by a committee of water quality professionals representing affected and interested parties from the public and private sector. The program is implemented with state funds, by five state agencies, with a sixth acting as the coordinating body. Management of PSAMP is by the state agencies, EPA, tribes and local government, with technical input from a range of other public and private concerns.

An active citizens' monitoring program is an integral part of PSAMP.

The process for the development and implementation of PSAMP, as well as the program itself will be discussed.

FLEXIBLE AND REGIONAL MONITORING: A DISCHARGER'S PLEA

John Dorsey
Environmental Services Division
City of Los Angeles

Marine monitoring programs associated with NPDES permits need to have a degree of flexibility to adjust to changing environmental conditions and management concerns. If a program is too rigid, resources are wasted in acquiring information not useful to regulatory and management personnel. When problems are found and solutions developed, or when new questions arise, then programs need to be adjusted to incorporate these situations.

As monitoring practitioners assess results of local programs, they must have available to them regional information. Such data would help explain variation caused by regional-wide trends verses site-specific anthropogenic sources.

Examples of the need for flexibility and regional comparisons are presented using the City of Los Angeles' monitoring program associated with the Hyperion Treatment Plant. This facility discharges 360 MGD of mixed primary and secondary effluent (avg. suspended solids = 35 mg/l) into Santa Monica Bay five miles offshore at a depth of 60 m. The monitoring program was significantly changed in 1987 with promulgation of a new NPDES permit. Changes were made based on problems with the previous program, and a degree of flexibility was written into the permit. The new program was extensive in scope, costing around 1.5 million dollars annually. Since inception of the program, we have realized that other changes should be made due to changing environmental conditions, better analytic capabilities, and better information on the usefulness of various measurements. These changes are discussed for the water quality, sediment chemistry, infaunal and trawling programs. Examples also are provided on how regional information would greatly enhance assessment of these data.

It is essential that regulatory and discharger technical staffs closely work together on development of monitoring programs, and analyses and assessment of resultant data. such cooperation should result in more cost-effective programs having sharper focuses on important questions.

A WATER QUALITY MONITORING PROGRAM FOR HAWAII'S SURFACE WATERS

Eugene T. Akazawa
State of Hawaii Department of Health

The Department of Health is developing a water quality monitoring program for the State of Hawaii. Section 305(b) of the Clean Water Act requires that states report biennially on the quality of their surface waters. Monitoring programs are required as conditions of the Section 106 grants program. Moreover, there are important public concerns about the quality of Hawaii's surface and recreational waters: 1) is the water safe to swim in? 2) are fish and other organisms safe to eat? 3) what is the quality of Hawaii's waters, and is it degrading over time? The State of Hawaii water quality monitoring program is specifically designed to address those public concerns. The base of the monitoring program is a network of approximately 200 shoreline and ocean stations that will be sampled at least once a year for bacteria (coliforms and enterococci) and for water quality parameters. Many of the stations will be sampled weekly for bacteria and monthly for water quality. A number of other monitoring components will be layered over the baseline network. Toxics monitoring, including water quality based biotoxicity testing, hot spot monitoring, water quality limited segments monitoring, quality assurance, laboratory development, research, and public participation/education are all part of the state monitoring program. In particular, the monitoring program will coordinate and supplement the monitoring programs of NPDES ocean dischargers to assess and report on the impacts of those activities on health risk and on natural communities in the marine environment.

REGIONAL APPROACHES TO MONITORING: A SOUTHERN CALIFORNIA CASE STUDY

Ed Liu
Region 9
U.S. Environmental Protection Agency

A large portion of the ocean monitoring in southern California is conducted to evaluate the impacts of various NPDES permitted discharges on the ocean environment. It is estimated that the annual budget for ocean monitoring by NPDES permittees who discharge into the Southern California bight from Point Conception to the Mexican border exceeds $14.5 million dollars. The monitoring programs of the various dischargers are concentrated around their own discharge outfalls, and there are generally only a few far-field or reference stations. However, many of the public concerns about ocean discharge impacts on the environment have spatial and temporal scales that extend beyond the scope of a single discharge monitoring program. For example, questions such as: Is the water safe for swimming and other recreational activities? Are fish and shellfish safe to eat? and Are ocean discharges degrading the marine environment over time?, are difficult for regulators to respond to because they are regional questions that have large spatial and long temporal scales. Regional monitoring approaches that link and coordinate the various discharge monitoring programs by synchronizing sample collection times and by adding reference stations, may be one way to use existing monitoring activities to address public concerns.

MONITORING THE 106 MILE SITE

Susan Hitch
Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency

The 106 Mile Deepwater Municipal Sludge Site (106 Mile Site) receives sewage sludge from nine municipalities in New York and New Jersey. The EPA under the Marine Protection, Research, and Sanctuaries Act and the Ocean Dumping Ban Act is responsible for permit issuance, compliance, site management, site monitoring as well as enforcement of permit violations.

The existing monitoring plan for the site is designed to generate data for EPA's decision makers to determine if permit conditions are being met, and to ensure the protection of the marine environment through site management. Permits may be continued, modified, revoked or terminated on the basis of monitoring data.

The 106 Mile Site is located beyond the edge of the Continental Shelf making it the most distant ocean dumping site manage by EPA. Because of its location, the site has received little attention from State agencies and the majority of the baseline and monitoring activities have been Federally-funded and implemented. In addition to its remoteness, the site is very deep and occupies approximately 100 square nautical miles. These factors necessitate "blue water" capability in sampling equipment used for monitoring purposes.

EPA is diligently implementing the Ocean Dumping Ban Act in coordination with NOAA and the Coast Guard. This coordination has resulted in sharing of research vessel equipment and survey time and an enhanced working relationship. In addition, the three agencies responsible for site monitoring, research, and surveillance have developed a joint monitoring, research, and surveillance strategy to oversee the last of the sewage sludge dumping and will sign a Memorandum of Understanding on these agreements this Fall.

SESSION 5: INTEGRATED FIELD ASSESSMENTS

EPA'S RAPID BIOASSESSMENT APPROACH -- AN ASSESSMENT OF BIOLOGICAL IMPAIRMENT IN THE CONTEXT OF HABITAT QUALITY

Michael T. Barbour
EA Engineering, Science, and Technology

James Plafkin
Assessment and Watershed Protection Division
Office of Water Regulations and Standards
U.S. Environmental Protection Agency

EPA's Rapid Bioassessment Protocols recommend the use of both community structure and habitat measures to assess impairment of designated aquatic life uses. Fish and benthic community assessments are based on integrated analyses of several parameters or metrics, each of which reflects a somewhat different aspect of community integrity. An assessment of habitat quality is also critical for assessment of biological impairment. An understanding of habitat conditions allows interpretation of both the current status and the biological potential of stream communities. Reference conditions are used as the basis for determining biological impairment adjusting "expectations" for a given locality or particular ecosystem, and characterizing temporal variability. This discussion focuses on EPA's benthic protocols and habitat assessment approach for interpretation of biological impairment. An overview of the approach and particulars of the assessment strategy are given.

OREGON'S BIOASSESSMENT PROGRAM

Rick Hafele
Oregon Department of Environmental Quality

Oregon's bioassessment program has been expanding in recent years. It has grown from general observations of macroinvertebrates near point sources to a comprehensive approach utilizing habitat assessments along with qualitative and/or quantitative macroinvertebrate sampling. Methods similar to EPA's protocols for Rapid Bioassessments have been used. The techniques have recently been used to assess both point source and nonpoint source pollution problems in 3rd to 5th order streams.

The methods used for bioassessments in Oregon will be described. Also, results from several studies will be presented, and the problems and benefits of the Oregon bioassessment program discussed.

MODIFICATION AND ASSESSMENT OF AN INDEX OF BIOTIC INTEGRITY TO QUANTIFY STREAM QUALITY IN SOUTHERN ONTARIO

R. J. Steedman
Ontario Ministry of the Environment, Canada

A multivariate measure of stream quality, the Index of Biotic Integrity (IBI), was adapted to southern Ontario and calibrated to watershed land-use on a variety of spatial scales. The fish fauna at 209 stream locations on 10 watersheds near Toronto, Ontario, was sampled to provide biological information for the IBI. Watershed urbanization, forest cover, and riparian forest were measured from topographic maps, and related to IBI estimates by linear regression. Of the biological measures tested, species richness, local indicator species (brook trout and *Rhinichthys* spp.), abundance of large piscivores, fish abundance and incidence of blackspot disease were found to contribute significantly to information provided by IBI estimates. Linear models based on measures of watershed urbanization and forest cover accounted for 11-78% of the variation in IBI scores, depending on the spatial scale of the analysis. Significant IBI/land-use relationships were found with whole-basin IBI estimates from individual steam reaches. Land use immediately upstream of sample stations was most strongly associated with stream quality as measured by the IBI.

The IBI seems able to provide quantitative, mappable information about ecosystem states at a variety of spatial scales, ranging from the reach to the basin. Because the IBI responds to structural degradation relevant to regional fish faunas, it is frequently able to satisfy an information need that is presently not met by conventional water quality monitoring, nor by microcontaminant assessment. In this sense, the IBI helps to bridge time and space scales represented by water chemistry at one extreme, and landscape ecology at the other.

ASSESSING IMPACTS OF SEDIMENT ON TARGET BENEFICIAL USES

Steve Bauer
Division of Environmental Quality
Idaho Department of Health and Welfare

The state of Idaho has adopted a control strategy, the feedback loop, to address the impact of nonpoint sources of pollution. The feedback loop refers to a process of applying best management practices (BMPs), monitoring their effectiveness in protecting beneficial uses, and subsequently modifying the BMPs as needed. The central key to this process has been missing. What is the appropriate criteria for sediment and how do we measure its impact on beneficial uses as the basis for the feedback loop?

The most sensitive uses in the Intermountain West are trout and salmon fisheries and domestic water supplies. Based on a review of the literature we propose several potential criteria. Criteria based on turbidity, cobble embeddedness, and inter-gravel dissolved oxygen is suggested for protection of fisheries. A more restrictive turbidity criteria is recommended for small communities which depend on surface water supplies. Protocols for measuring these parameters will be presented.

INTEGRATED BASIN ASSESSMENT: UPPER ILLINOIS RIVER BASIN PILOT PROJECT OF THE NATIONAL WATER QUALITY ASSESSMENT PROGRAM

Stephen F. Blanchard
U.S. Geological Survey

The U.S. Geological Survey began a National Water-Quality Assessment pilot program in 1986. The goals of the program are to: 1) provide a nationally consistent description of current water-quality conditions; 2) define long-term trends in water quality, and 3) identify, describe and explain, to the extent possible, the major factors that affect observed conditions and trends. The Upper Illinois River basin in Illinois, Indiana, and Wisconsin is one of seven pilot projects selected to test and refine assessment concepts and procedures. In addition to an analysis of available data, surface-water field activities include 1) periodic and event sampling at 8 fixed-stations; 2) synoptic surveys at 20 to 500 sites for selected water-quality characteristics in water, bottom sediment, and biota, and 3) studies of selected stream reaches. Information resulting from the major work elements will be synthesized to describe the current water-quality conditions and trends. Ancillary data, such as land use and pesticide application rates, will be used to identify causative factors.

SUPERFUND ECOASSESSMENTS

M. D. Sprenger
D. W. Charters
Environmental Response Team
U.S. Environmental Protection Agency

R. Preston
Region 3
U.S. Environmental Protection Agency

The proposed revisions to the National Contingency Plan calls for identification and mitigation of environmental impacts at hazardous waste sites and the selection of removal and remedial actions that are "protective of environmental organisms and ecosystems". In order to meet this objective it is necessary to carefully evaluate the specific site characteristics, including the ecosystem potentially impacted and the contaminants of concern; the appropriate and available methods for evaluating the potential impacts, and how the data generated is to be used. Several examples of integrated environmental assessments, at Superfund sites, will be presented to illustrate the utility of properly planned and implemented ecological assessments. In addition, the implications of the results, of these studies, on the remedial actions proposed for the sites will be discussed.

SESSION 6: LAB BIOMONITORING

AMBIENT TOXICITY ASSESSMENTS IN A REGIONAL WATERSHED

John W. Arthur
Environmental Research Laboratory - Duluth
U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency laboratory at Duluth, MN has been participating in a regional water quality study conducted by the U.S. Geological Survey in the upper Illinois River Basin. The role of the Duluth laboratory was to conduct ambient toxicity assessments in this watershed. Sediment and surface water samples were collected over two and eight time periods, respectively, in seven waterways within the basin. Five kinds of toxicity tests were conducted with organism responses ranging from total mortality to a stimulatory growth effect. Repeated sampling over time has shown the sediment pore water samples to be much more toxic than the surface water samples. Greatest toxicity occurred in two of the seven waterways. The ambient toxicity findings corroborate biosurvey findings and state use designations for these waterways.

SEDIMENT TOXICITY TESTING

Peter M. Chapman
E.V.S. Consultants

Sediment toxicity tests (bioassays) are conducted, generally in the laboratory, by exposing biological systems to field collected sediments by one of three principal exposure routes (whole sediments, elutriates, extracts). Although such tests can be affected by a number of variables (e.g., sediment storage and handling) and modifying factors (e.g., sediment characteristics, route of exposure, organisms used), they presently provide the only relatively simple and inexpensive effects-based measure of sediment contaminant bioavailability. There importance in environmental assessment and management is expected to increase over time, as will their usefulness in prioritizing environmental problems and determining environmental relevance in terms understandable not just to scientists, but to the public, and which are also usable by managers and regulators.

MULTITROPHIC LEVEL ASSESSMENTS OF SEDIMENT AND WATER QUALITY

G. Allen Burton, Jr.
Wright State University

There are several approaches which are widely used in assessments of water and/or sediment quality. Degradation in aquatic systems is frequently defined by elevated contaminant concentrations, altered community indices, or toxicity to single surrogate species. The strengths and weaknesses of these and other approaches can best be examined by conducting intensive surveys whereby the various assessment approaches are compared with each other and validated by comparisons to *in situ* conditions. Our studies have examined several, geographically diverse, freshwater systems which receive a variety of point and nonpoint source pollutants. In-stream chemical concentrations and biological indices have been compared with laboratory and in situ toxicity assay responses. The multitrophic level test battery has consisted of various surrogate and indigenous species: *Pimephales promelas*, *Ceriodaphnia dubia*, *Daphnia magna*, *Hyalella azteca*, *Selenastrum capricornutum*, *Lemna minor*, and indigenous microbial enzyme activities (several key oxido-reductases and hydrolases).

Each test system has been the most sensitive to water or sediment toxicity on at least one occasion. The test battery responses effectively define zones of contamination. The test assays respond similarly only in samples which are acutely toxic. Samples containing less contamination have provided responses ranging from acute lethality to chronic reproduction or growth effects, and/or no effects, depending on the test species and the test site. Responses also varied between in situ and laboratory assays, indicating the significance of collection and exposure conditions on quality assessments. These studies have further established the need for multitrophic level assessments and validation of currently used approaches.

PREDICTIVE ABILITIES OF ENVIRONMENTAL PROTECTION AGENCY SUBCHRONIC TOXICITY TEST ENDPOINTS FOR COMPLEX EFFLUENTS

Thomas P. Simon
Central Regional Laboratory
U.S. Environmental Protection Agency

Seven endpoints from three EPA subchronic toxicity tests were evaluated for their abilities to predict impacts from various complex effluents. Compared were the subchronic fathead minnow embryo-larval survival and teratogenicity test, fathead minnow larval growth and survival, and Ceriodaphnia reproduction and survival tests for Standard Industrial Classification (SIC) codes from 75 Region V point source dischargers. Statistical methods were used to compare coefficients of correlations for endpoints within and between tests, determine trends among process types, and establish predictions of endpoints suitable for each of the major process types.

THE USE OF CULTURED HEPATOCYTES IN SCREENING WASTEWATERS FOR GENOTOXIC EFFECTS

Randy L. Jirtle
Duke University Medical Center

There exists the need for short-term biological assays to test wastewaters and leachates for potential human health impact. These assays must be able to detect both carcinogenic and procarcinogenic agents, and must have sufficient sensitivity so as not to require sample extraction and concentration of such agents. We have recently defined cell isolation and culture conditions which enable us to use primary cultures of both rat and human hepatocytes for genotoxicity testing. The test assays include unscheduled DNA synthesis (UDS), micronuclei formation and sister chromatic exchange (SCE). Of these hepatocyte assays, SCE has proven to be the most sensitive. For example, elevated levels of SCE are observed after a 3 hr exposure to 10^{-12} M aflatoxin B_1. This is 1 to 2 orders of magnitude more sensitive than other indicator cell systems which use the metabolizing activity of liver microsomes. In view of the high sensitivity of the hepatocyte SCE assay, we tested the utility of this system to screen the genotoxic potential of treated domestic and industrial wastewaters. The SCE chromosome was found to be related to wastewater concentration in a dose response manner, and concentrations as low as 0.1% were shown to cause a significant increase in SCE above background. In conclusion, SCE in cultured hepatocytes can be used to screen the genotoxic potential of wastewaters, and may hold a number of advantages over other short-term assays presently employed for human health risk assessment.

ALGAL BIOASSAYS TO DEVELOP PHOSPHORUS WASTELOAD ALLOCATIONS

Thomas Stockton
North Carolina Division of Environmental Management

The Algal Growth Potential Test (AGPT) was developed by the Environmental Protection Agency (EPA) to provide a standard method for determining the potential of natural waters and wastewater to support or inhibit algal growth. The test can provide useful information regarding 1) the growth-limiting nutrients; 2) the biological availability of growth limiting nutrients; and 3) the growth response to changes in concentrations of growth-limiting nutrients. The North Carolina Division of Environmental Management (NCDEM) has employed, with the assistance of EPA, the AGPT to evaluate the impact of placing phosphorus limitations on several large NPDES municipal wastewater discharges into poorly flushed lake headwater and cove areas. Whole lake empirical eutrophication models previously employed by NCDEM cannot fully address the problems associated with these localized impact areas. This report outlines a case example of NCDEM's approach to developing effluent nutrient limitations using intensive AGPT and nutrient sampling.

PHOSPHORUS LOADING TO THE TUALLATIN RIVER, OREGON

Bruce Cleland
Region 10
U.S. Environmental Protection Agency

The Tualatin River, located in northwest Oregon near Portland, is used by area residents for many purposes. The Tualatin drainage is over 700 square miles and includes most of Washington County. Over the last 30 years, Washington County has grown from 50,000 to over 250,000 people. The growing population overwhelmed existing sewage treatment plants in the late 1960's. In the 1970's, inadequate sewage treatment plants were closed and replaced with two regional advanced wastewater treatment facilities. However, even current high levels of wastewater treatment have not been enough. River flow and nonpoint source pollution are two other major factors which affect water quality in the Tualatin.

The uses of the Tualatin are currently threatened by deteriorating water quality. Heavy algal growth in the slow-moving river is fed by nutrients from sewage treatment plants, residential and agricultural fertilizers, and urban stormwater runoff. A law suit filed against EPA in 1986 highlighted the need for further action beyond the current advanced wastewater treatment.

Between 1986 and 1988, the State of Oregon conducted an intensive study of the Tualatin River. The results of this work led to the adoption of phosphorus and ammonia limits for the Tualatin River. Based on these limits, which included a compliance date, TMDLs and implementation plans are currently being developed by several state and local agencies. These plans will address treated sewage, urban stormwater runoff, and agricultural runoff. Procedures developed for the Tualatin are also being used to address problems on other water quality limited segments in Oregon.

TMDL FOR DILLON RESERVOIR: PARTITIONING POINT SOURCES AND NONPOINT SOURCES

William M. Lewis, Jr.
University of Colorado

Lake Dillon is a large water supply reservoir located at an elevation of 9,000 ft. in the resort area of Summit County, Colorado. Prior to 1980, watershed development approximately doubled total phosphorus loading of the reservoir, despite the use of tertiary treatment for phosphorus removal at all major point sources. An intensive study of nonpoint sources for phosphorus was initiated in 1980-81 and has continued to the present. The studies have emphasized a mass balance approach for the analysis of specific land uses and have been integrated by the use of a land use-phosphorus loading model. Use of the model has facilitated prioritization of investments in recovery of nonpoint source phosphorus.

DIFFERENTIATING NATURAL AND FOREST MANAGEMENT-RELATED SEDIMENT AT A BASIN SCALE IN THE DESCHUTES RIVER, WASHINGTON

Kathleen Sullivan, Ph.D.
Weyerhaeuser Company

The Deschutes River located in the Cascades Range of western Washington has been a focus of attention for sedimentation, and fisheries issues associated with forest management in its headwaters. In the decades after 1950, an extensive gravel road network has been constructed and over 50% of the basin has been logged and regenerated, with much of that activity occurring since 1970. Although no comprehensive basin sediment study has been conducted, a large volume of information on erosion and water quality has been gathered at long-term monitoring sites, project evaluations, and research studies in the basin by a number of agencies. Synthesis of this information reveals the importance of natural and management-related sources of sediment and helps to provide water quality protection by identifying best management practices. This paper discusses the utility of various types of monitoring in evaluating natural and management-related sedimentation effects in a relatively large basin (150 mi^2) managed as commercial forestlands.

OHIO'S USE OF GEOGRAPHICALLY-BASED BIOCRITERIA

Chris O. Yoder
Division of Water Quality Planning & Assessment
Ohio Environmental Protection Agency

Ohio EPA recently proposed inclusion of biological criteria ("biocriteria") in its water quality standards regulations. Biocriteria are based on the measurable characteristics of aquatic communities and focus on structural and functional attributes. Ohio EPA uses fish and macroinvertebrates to assess biological integrity in Ohio's surface waters. This represents a significant progression in Ohio's WQS regulations, which singularly relied on a chemical approach in assessing surface water quality in the past. While chemical and emerging bioassay techniques remain essential elements of the program, inclusion of biocriteria has significantly broadened the scope of surface water assessment and protection in Ohio.

Biological criteria were derived by utilizing the results of sampling conducted at least impacted regional reference sites. This design reflects the practical definition of biological integrity as the biological performance of the natural habitats of a region. Further organization was accomplished using Omernik's ecoregions of which Ohio contains five. Ecoregions in Ohio were particularly useful because the base component maps are detailed and well-supported by past research. Fish and macroinvertebrate data from more than 300 Ohio reference sites were used to establish attainable, baseline expectations within the framework of a tiered system of aquatic life use designations.

Biocriteria provide the impetus and opportunity to recognize and account for natural, ecological variability in the environment. One result is having quantitative biological criteria that portray differences between ecoregions, river and stream sizes, and aquatic life use designations. This represents a shift from the traditional chemical approach in which a single criterion was often applied unilaterally to these different situations.

Biocriteria are applied primarily as an ambient assessment tool and are the principal arbiter of aquatic life use attainment or non-attainment in Ohio.

Program uses include water quality based permitting, water quality standards, basic monitoring and reporting, nonpoint source assessment, natural resource damage assessment, and general problem discovery. An area of recent investigation is to define "impact signatures" which may lead to the general definition of impairment types by examining the response of the aquatic community to various environmental perturbations.

REGIONS FOR EVALUATING ENVIRONMENTAL RESOURCES

James M. Omernik
U.S. Environmental Protection Agency
Research Laboratory

Alisa L. Gallant and Robert M. Hughes
NSI Technology Services Corporation

The need for regional frameworks for making assessments of environmental resources has been recognized for many years. In the absence of suitable available schemes for resource assessment, particularly aquatic resources, the U.S. Environmental Protection Agency's Corvallis, Oregon laboratory developed, tested, and applied approaches for defining regional frameworks to meet both multi- and single-purpose needs. Ecoregions have been developed to facilitate the assessment of existing patterns and trends in the extent and quality of environmental resources and their relationships with natural and human-related characteristics. Aggregations of ecoregions have been defined and subregions are being developed to allow more meaningful assessments to be made at national and local scales. Approaches have also been developed for delineating regions for the inventory, management, and monitoring of specific problems or environmental characteristics, such as acidification of surface waters and lake eutrophication. Ecoregions as well as special purpose regions have distinct advantages and limitations. To avoid their misuse and insure the best design of new special purpose regions requires development of a clearer understanding of the nature of regions and boundaries and closer working relations between regional geographers and resource managers at all levels of government.

REFERENCE REACH APPROACH IN METRO-DENVER TO CHARACTERIZE EFFLUENT IMPACTS ON BIOTA IN S. PLATTE RIVER

William M. Lewis, Jr.
University of Colorado

A reference reach approach was used in establishing site-specific standards for oxygen, unionized ammonia, and chlorine in the South Platte River below Denver. Quantitative estimates were made of the fish species composition in the South Platte and, for comparison, in tributaries of the South Platte and in the Arkansas River. Relationships were established between physical habitat characteristics and fish community composition. An expected fish community composition was then estimated for standardized habitat conditions in the absence of water-quality impairment. The expected community composition was compared statistically to the observed composition of fish communities, corrected for physical habitat characteristics, on the South Platte River at various distances from the major effluent outfall at Denver. The use of this approach allowed site-specific identification of the zone of effluent influence on fish communities. Matching of the zone of influence to water chemistry data for the South Platte served as a basis for the proposed site-specific water-quality standards.

INTEGRATING ECOREGION CONCEPTS INTO STATE LAKE MANAGEMENT PROGRAMS

Bruce Wilson
Minnesota Pollution Control Agency

The aquatic ecoregion approach as developed by the U.S. Environmental Protection Agency's Environmental Research Laboratory at Corvallis has been used by a number of states to improve the management of their streams. In addition to this application, Minnesota has elected to use the ecoregion framework in developing lake management strategies. This paper focuses on integrating the ecoregion concept into state lake management programs. Potential applications will be addressed, and appropriate examples from Minnesota's experience provided. The following will be discussed: (a) use of the ecoregion framework as a basis for analyzing existing data as required in the context of Section 305(b) or 319 reports; (b) developing monitoring programs for "representative/minimally impacted" lakes to characterize the range in trophic status to be expected among different types of lakes in each region; (c) determining the range of uses of lakes and defining "most sensitive uses," and (d) determining the expectations of lake users in terms of recreation and aesthetics and evaluating citizen complaints regarding lake water quality. As expectations may vary across a state it becomes important to identify regional patterns.

REGIONAL APPLICATIONS OF BIOCRITERIA IN XERIC ENVIRONMENTS

John G. Wegrzyn
Arizona Department of Environmental Quality

Arizona faces critical water quality problems that are typical of states with xeric climates. Development of regional biocriteria for aquatic resources evolved in areas of the United States that characteristically have more abundant surface water resources than most western states, especially the arid states of the desert southwest. The Arizona Department of Environmental Quality (ADEQ) proposed to develop a regionalized approach to surface water quality standards. This strategy will lead to: 1) regional biocriteria and 2) regional numeric standards for specific constituent and contaminant parameters. ADEQ proposes a three year study that will divide the state into distinct ecological regions and will use biological indices that may include the Index of Biological Integrity (IBI) as a basis for establishing both biocriteria and numeric standards. This approach will allow Arizona to: 1) develop adequate water quality standards to protect its designated uses, 2) serve as the basis of a monitoring strategy to ensure that standards continue to support the designated uses over time, and 3) also serve as a basis for other pubic and private agencies and organizations to better manage natural resources associated with Arizona surface waters.

ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
THE SURFACE WATER PROJECT

Steven G. Paulsen
Environmental Research Center
University of Nevada

The Environmental Monitoring and Assessment Program (EMAP) is being designed by the EPA's Office of Research and Development to provide an integrated assessment of the status and trends in the Nation's ecological resources on a regional and national scale. A fully implemented program will identify: 1) the extent and condition of ecological resources (e.g., estuaries, lakes, streams, forests, deserts, wetlands, grasslands); 2) the percentages of these resources which are adversely affected by pollutants or other man-induced environmental stresses; 3) which resources are degrading, where, and at what rate; 4) the relative magnitudes of the most likely causes of adverse effects; and 5) whether control or mitigation programs are having their desired effect. The program is designed around a national statistical sampling network based on a systematic grid of sampling points which enables resources to be sampled in proportion to their occurrence and provides, with known confidence, statistical estimates of condition and the proportion of the resource with various conditions. Three categories of indicators of ecological condition are being used: 1) response indicators which are primarily biological measures of overall condition; 2) exposure indicators which represent a combination of physical, chemical and biological measures which can be related to pollutant exposure, habitat degradation, or other causes of poor condition; and 3) stressor indicators which are economic, social and engineering data that can be used to confirm diagnoses of probable cause of poor condition. Specific aspects of the lakes and streams component of EMAP will be presented.

SESSION 7: GROUNDWATER DISCHARGE TO SURFACE WATERS

NPS CONTAMINATED GROUNDWATER DISCHARGE TO SURFACE WATER

Chuck Job
Office of Groundwater Protection
U.S. Environmental Protection Agency

Nonpoint source (NPS) derived contamination of groundwater that is discharging to surface water can lead to exceedances of water quality standards. Best management practices for controlling NPS pollution may be ineffective unless this groundwater component is understood. As part of its technical assistance efforts to the states, EPA's Office of Groundwater Protection, with technical support from ICF, Inc. and Geraghty and Miller, is investigating the methods used for estimating NPS contaminated groundwater discharge to surface water. To date, the project has reviewed the literature to identify the major methods, contaminants, hydrogeologic settings and land uses. The major methods include seepage meter measurements, geophysical techniques, hydrograph analysis, and various modelling applications. Future activities leading to the development of methods to estimate NPS-contaminated groundwater discharge to surface water include:

1) Evaluation of each method for its use in different hydrogeologic settings in the United States. Case studies will examine differences in contaminant type, hydrogeologic setting, geologic conditions and type of affected surface water. Additional information from case studies will include land use, duration of contamination, climatic regime and seasonal flucations of groundwater elevations.

2) Evaluation of the technical and programmatic development necessary for potential use of these methods in incorporating groundwater contributions into the EPA/State wasteload allocation process.

AGRICULTURAL CHEMICALS IN GROUNDWATER: LESSONS LEARNED FROM THE SOUTH DAKOTA RURAL CLEAN WATER PROJECT

C. Gregg Carlson
Plant Science Department
South Dakota State University

John Bischoff and Alan Bender
Water Resources Institute
South Dakota State University

Scientific and social lessons learned from South Dakota RCWP are discussed. The following are conclusions that will be presented in detail. The time of sampling relative to time of application is more important than was originally thought. Macropore flow negates the use of traditional modeling methods to predict solute transport. Vulnerability of a specific water resource is determined by the soil and geology of the area of concern.

The timing of fertilizer and pesticide application relative to the time of precipitation is critical in determining impact upon ground water. The fertilizer and pest management capabilities of local farmers continues to lag far behind the knowledge of agronomic science. Many farmers feel a need to include ground and surface water protection into their management schemes but are not certain that they can make a difference. A prescriptive process that is designed to be included in farmer management plans and that was developed to address nonpoint agronomic pollution problems is presented.

IOWA'S BIG SPRING BASIN DEMONSTRATION PROJECT

John Littke
Iowa Department of Natural Resources

The Big Spring Basin, a 267 square km groundwater basin in northeastern Iowa, has been defined by studying the potentiometric surface in the Galena aquifer, dye-trace studies, and assessment of gaining and losing stream reaches. These data, combined with spring and stream gaging, show that 85 to 90 percent of the groundwater from the Basin is discharged at a single location; Big Spring. The Basin is entirely agricultural with minimal point-source impact, thus allowing for detailed study of an agricultural ecosystem. The project, begun in 1981, was initially designed to investigate the relationship between agricultural activities and groundwater quality. In 1986 a farm demonstration project was developed and included an intense, interactive public education program. Through various scales of monitoring, the environmental and economic impacts of changing farm practices are being evaluated. This data will be used to evaluate farm management practices that would improve farming efficiency and profitability while reducing the impacts on the environment from soil erosion, chemical and nutrient contamination of water supplies, and consumption of non-renewable energy resources.

INDICATORS OF SURFACE WATER SOURCES IN PUBLIC SUPPLY WELLS

Roy F. Spalding
Associate Director, Water Center
University of Nebraska

Methods need to be developed for assessing the proportion of surface water in alluvial high yield well fields. Regulations proposed under the Safe Drinking Water Act (SDWA) require that ground water sources influenced by surface water be evaluated for the need to install filtration and disinfection systems. Such systems would have the same requisites as those pumping from surface waters. The proposed regulations discussed in the Surface Water Treatment Rule (SWTR) of SDWA include water sources that are directly influenced by surface water.

The purpose of this proposal is multi-fold: 1) to develop a method to identify surface water induced by pumping ground water; 2) to determine the impact of surface water pesticide contamination during spring runoff events in a mixed surface and groundwater source; 3) to test associations of microbiologic, particulate and chemical parameters to the validated method (H/D); and 4) to predict the H/D methods applicability to other areas.

Validation of the proposed method using stable isotopes of hydrogen will necessitate extensive groundwater monitoring using specially installed multilevel samplers.

DESIGN, SAMPLING, AND DATA ANALYSIS FROM A MAJOR NPS NETWORK

Jeanne Goodman
South Dakota Department of Water and Natural Resources

The Oakwood Lakes-Poinsett Rural Clean Water Program/Comprehensive Monitoring and Evaluation project area is located in east central South Dakota. The objective of the Comprehensive Monitoring and Evaluation Project is to determine if the implementation of selected agricultural best management practices (BMPs) such as conservation tillage, and fertilizer and pesticide management can reduce nitrogen and pesticide levels in the groundwater system.

Monitoring is conducted at seven field sites which are 10 to 80 acres in size. Groundwater is sampled from 114 wells constructed in glacial tills and outwash. Samples are taken from all monitoring wells bimonthly and analyzed for nitrates and other indicator parameters. Samples are collected from selected wells biweekly during the growing season and monthly for the remainder of the year and are analyzed for pesticides. The land use, climate, vadose zone, and surface water runoff are also monitored.

"Geozones", a unique classification method, uses several parameters to characterize each well, which attempts to reduce variability of the data from the diversity of hydrogeologic environments being monitored. Groundwater data are statistically compared for farmed versus unfarmed sites, glacial till versus glacial sand and gravel, various geozones, for each site and for various wells.

SESSION 8: LAKE AND LARGE RESERVOIR ASSESSMENT

LAKE MONITORING: DEVELOPING STATE PROGRAMS AND MEETING FEDERAL REPORTING REQUIREMENTS

Donna F. Sefton
Region 7
U.S. Environmental Protection Agency

Several sections of the Clean Water Act (CWA) amendments of 1987 (e.g. 305(b), 314, 319) contain requirements for assessment of lakes and reservoirs. States are expected to increase the number of waters assessed by: tapping new data sources, adopting new monitoring techniques as they become available, and including "evaluated" waters in their assessments. A combination of agency and citizen-collected lake/watershed data can be used to document water quality status and trends, diagnose causes/sources of problems, guide implementation of watershed protection and lake restoration measures, and evaluate their effectiveness. Such lake monitoring activities not only help satisfy CWA reporting requirements, but serve to advance State natural resource programs as well. Lake assessment activities provide the framework for information/education and technical assistance programs to facilitate lake protection and management statewide. They also foster cooperation and local "grass roots" support for environmental programs. Examples of statewide lake assessment programs designed to meet Federal reporting requirements and state environmental objectives are provided.

CASCADE RESERVOIR WATERSHED PROJECT

Dale E. Anderson, Steven C. Chapra,
Patricia Klahr, and Tony Bennett[1]

The Cascade Reservoir Watershed Project is a multi-agency effort devoted to reversing the trend of increasing algae blooms and poor water clarity in Cascade Reservoir, Valley County, Idaho. The project is focusing on pollutant control practices which will reduce reservoir phosphorus loading throughout the 383,000-acre Cascade Reservoir watershed. The project is jointly administered by the Idaho Division of Environmental Quality and the Idaho Soil Conservation Commission, with technical assistance from the U.S. Soil Conservation Service and other state and federal agencies. Cascade Reservoir is a 26,488-acre impoundment of the North Fork Payette River located in west central Idaho. It is rated as the number one fishery in Idaho, based on user days.

The presentation provides a project overview, discussing the watershed plan development process. The focus will be on the water quality monitoring; how it is being approached and how it is being integrated with the watershed planning and reservoir modeling. Some key topics include: the watershed inventory, use of ambient and synoptic water quality surveys, estimating phosphorus load reduction, reservoir model development to provide information for water quality management decisions, and implementation monitoring.

Project implementation is targeted towards a voluntary program of agricultural pollution abatement and conservation of soil and water resources. Best management practices that are being evaluated for use in the watershed include improvements to on-farm water delivery system such as land leveling, conversion from flood irrigation to sprinkler irrigation, installation of pipelines, pasture renovation, improved irrigation water management, and riparian corridor restoration.

[1]Respectively; Manager, Environmental Services, Entranco Engineers; Professor, University of Colorado; Senior Water Quality Specialist, Idaho Division of Environmental Quality; Water Quality Planner, Valley Soil Conservation District.

FLAMING GORGE: U.S. BUREAU OF RECLAMATION

Jerry B. Miller
U.S. Bureau of Reclamation

Reservoirs have been classified as riverine, transitional, and lacustrine. Flaming Gorge Reservoir is a large lacustrine reservoir with distinct riverine and transitional sections. Satellite images of chlorophyll and suspended sediment clearly distinguish each section in Flaming Gorge Reservoir. Seasonal variations in dissolved solids and inflow temperature results in geochemically identifiable density currents in Flaming Gorge. Drawdown in Flaming Gorge Reservoir causes significant headcutting with a large release of phosphorus from the resuspended sediments. A recent change of operation in Flaming Gorge, decreasing drawdown in August and September, has significantly reduced this nutrient source and associated blue-green algal blooms. Understanding drawdown is a very important, but often overlooked mechanism, in determining internal nutrient recycling in reservoirs. The importance of this mechanism is related to other reservoirs, including Deer Creek in Utah. Deer Creek Reservoir has experienced much greater impact than empirical models predicted by a 25-35% reduction in inflow phosphorus. Blue-green algal blooms have been significantly reduced in Deer Creek Reservoir.

LONGTERM ASSESSMENT OF EUTROPHICATION IN LAKE TAHOE, CALIFORNIA-NEVADA

Charles R. Goldman
University of California, Davis

Abstract Not Available

WATER QUALITY MONITORING IN TVA RESERVOIRS

Ronald Pasch
Water Resources
Tennessee Valley Authority

The Tennessee Valley Authority (TVA) is attempting to develop and maintain an information base sufficient to provide a broad perspective on water resource conditions and issues throughout the Valley. Portions of the surface water monitoring strategy designed to accomplish this goal have been

in operation for a few years. These include: 1) Issues Analyses - compiling available information and identifying important water resource issues for specific watersheds; 2) Ambient Monitoring - physical, chemical, and biological monitoring in Valley streams and reservoirs; 3) Data Management - processing, analyzing, and reporting the results of ambient monitoring; and 4) Water Resource User Relationships - conducting educational activities to improve public awareness of, and participation in, water resource management.

Ambient monitoring is divided into two categories, fixed station watershed monitoring and reservoir monitoring. The fixed station network (implemented in 1986) is designed to evaluate conditions in tributary streams feeding the reservoir system. The program relies on physical and chemical measurements, toxicity testing of water and sediment, fish flesh analyses, and description of benthic and fish communities using appropriate indices.

Monitoring within reservoirs (to be implemented in 1990) consists of essentially the same elements. Description of plankton communities is included in reservoir monitoring because of their importance in that habitat. Also, the new Health Condition Profile has been included in reservoir monitoring to evaluate the extent of environmental stress experienced by key fish species. The program is envisioned to use a reservoir Index of Biotic Integrity when development is completed (anticipated in 3-5 years).

4. Bioassessment and Non-point Source Pollution: An Overview

4. BIOASSESSMENT AND NON-POINT SOURCE POLLUTION: AN OVERVIEW

JAMES R. KARR
HAROLD H. BAILEY PROFESSOR OF BIOLOGY
DEPARTMENT OF BIOLOGY
VIRGINIA POLYTECHNIC AND STATE UNIVERSITY
BLACKSBURG, VA 24061-0406

Two problems, non-point source pollution and continuing declines in the biological integrity of water resources, have been especially intractable in the water resource arena despite massive expenditures of public funds. Ironically, the perception of biological degradation in water resource systems stimulated current state and federal legislation on the quality of water resources, but that biological focus was lost in the search for easily measured physical and chemical surrogates.

Today, I begin with evidence of continuing degradation in the biological components of our water resource systems. I then turn to non-point sources including a summary of non-point effects on water resources in North America, including comments on why efforts to control non-point sources in the last two decades have not been very successful. Three additional subjects will be discussed in some detail: the strengths and weaknesses of several biological assessment approaches, selected challenges for the future, and my thoughts on important components of a successful non-point source program.

Where are we now?

Several lines of evidence lead to the conclusion that water resources have not improved as much as we would like. The National Wildlife Federation's review of trends in water resource quality from 1969 to 1979 showed a 17% decline. Although most would agree that this is not very robust analysis, the trend is clear. Several years ago we (Karr et al. 1985) analyzed the fish faunas of two midwestern rivers: Illinois River and Maumee River. Since 1850, two-thirds (67%) of the species have shown massive population declines (or been extirpated) in the Illinois River watershed and 43% were affected in the Maumee. A more detailed look at this data set shows that both watersheds experienced major degradation in their headwaters while large river segments were more influenced in the Illinois than Maumee (Karr et al. 1985). The primary factors responsible for degradation were agriculture, navigation, impoundments and levees, toxics, consumption of water, and introduction of exotics. I simply want to emphasize the point that degradation in the biological resources associated with our water systems in North America has been substantial and that degradation continues today.

Legislative History and the Non-point Problem

Public Law 92-500 charged us with the responsibility of restoring and maintaining the physical, chemical and biological integrity of the nation's waters. Most federal and state efforts to improve the quality of water resources concentrated on chemical and physical surrogates, with little effort to deal with the biological integrity of those resources. The situation continues despite recognition that the ability to sustain a balanced biological community is one of the best indicators of potential for beneficial use of a water resource. That fundamental principle will be a central theme of my presentation. Ignoring that principle resulted in early legislation and regulations that limited our ability to deal effectively with non-point sources, the particular subject of this conference. Fortunately, recognition of the weakness of the chemical and physical surrogate approach has increased in recent years as have interests in uses of direct biological monitoring to evaluate water resource quality.

Water quality problems during the last century and early in this century derived from disease organisms and organic pollutants (Karr in press). Funding for construction, technology development, and enforcement focused on point sources or, for domestic effluent, we made it a point source problem by collecting the effluent and using treatment systems before discharging the wastewater into a water body. Eventually the focus on disease and oxygen demanding waste expanded to include a growing list of toxic chemicals. As the scale and complexity of water resources problems increases, the focus for solutions should change from detailed concern with individual chemicals and species to environmental processes and patterns that control the dynamics of the entire water resource system. Thus, the approach to monitoring must evolve over time. The metrics and approaches must be modified to contend with the scale and complexity of the problems to be assessed.

Efforts to control non-point source pollution began in the early 1970's and continued through several generations of programs--Section 208, Model Implementation Program (MIP), and the Rural Clean Water Program (RCWP). These dealt primarily with agricultural non-point pollution. Additional efforts focussed on urban, construction, and forestry sources. Despite these efforts, the magnitude of the non-point source problem remains large (Thompson 1989, Karr in press). A recent USEPA report noted that 65% of impaired stream miles were limited by non-point sources and 76% of impaired lakes were impacted by non-point source problems. Eighty percent of water resource impairment is connected to non-point source problems according to a study by TVA.

Finally, the Association of Water Pollution Control Administrators assessed many U. S. lakes and found that 53% of those lakes were impaired by non-point sources.

Earlier efforts to resolve non-point source (NPS) problems were largely unsuccessful. First, they used a point source approach (chemical-specific toxicological criteria and water quality standards) to solve problems that often were not amenable to solution by that approach. Development of the more complicated total maximum daily load (TMDL) approach was generally a failure as well. Under TMDL, society apportions the treatment capacity of a water body to point and non-point sources. Unless this approach is modified to include ecological factors, it probably will not be effective at protecting the quality of water resources even if implemented carefully. Of course, even TMDL approaches will not be adequate when factors other than PS and NPS pollution limit water resource quality. Second, the implementation of best management practices (BMP's) was, and continues to be a principal approach to NPS control. The BMP approach is flawed for two reasons.

First, early lists of BMP's were based on complex mixes of goals relating to soil erosion control, production enhancement, and "channel stabilization," under the assumption that improved water resources would follow. I first saw this during my participation in the Black Creek study in Allen County, Indiana from 1973 to 1981 (Morrison 1981). While reduced soil erosion is an admirable goal it cannot be translated directly and inevitably into improvements in water resources. Stated simply, water resource protection must be based on rates of delivery of sediment to stream channels, not on erosion rates estimated by the Universal Soil Loss Equation. Further, the dogma built up about the value of those best management practices even for soil erosion, can be successfully challenged.

Second, application of individual BMP's does not yield the most effective best management system. What we should be doing is creating best management systems; that is, integrated sets of best management practices that work effectively together (Karr and Schlosser 1978).

Let me give you a couple of examples from my experience. In the Black Creek watershed in Indiana, a desilting basin was installed to trap sediments carried by the stream. We measured suspended solids in this desilting basin over a period of years (Table 1). Based on 20 paired samples, using a Wilcoxon test, total residue, turbidity, and total P all increased significantly ($P<0.05$) in transit through the desilting basin. When I first reported this to the project research group, they accused me of manufacturing data, suggesting that this was physically impossible. Two explanations may account for this pattern. Perhaps this basin was serving as a stagnant pond, with water column algal populations. The more likely alternative was that a carp population colonized this desilting basin and they continually resuspended material and kept the turbidity levels high through their feeding activity. The point is that a desilting basin as a way of managing sediment has secondary effects due to biological dynamics that cannot be predicted from simple, physical principles of channel hydraulics. An additional problem created by this desilting basin is that, within a couple years, a meandering channel begins to form as the basin fills with sediment. The basin must then be dredged, if it is to remain effective as a desilting basin. The instability that is created sends slugs of sediment downstream on a regular basis. In my opinion, this is not an effective BMP, although it was billed as a BMP.

As another example, we (Schlosser and Karr 1981) looked at watersheds in Illinois to evaluate the erosion potential of each region of the watersheds based on slope and other parameters from the universal soil loss equation. We then evaluated the water quality characteristics along stream channels to determine if the erosion potential and land use activity in each of these segments impacted water quality as the water flowed down that channel. The answer was "absolutely!" In the places that had very high erosion potential, water quality was lower. It was best in the areas that had very low erosion potential, as long as good stream channels were present. With degraded stream channels, watershed erosion potential was not a good predictor of the quality of water within that channel. So the treatment of the land, and ignoring or doing things (which often happened within that project) that destabilize channels in that area, may have been a positive for water quality followed by a negative. The negative was in the channel so the result was greater degradation, yielding net degradation rather than an improvement as a result of best management practices.

Table 1. Effects of desilting basin on water quality in Black Creek, Allen County, Indiana.

Parameter	Upper	Lower	Sign.*
Total Residue (MG/L)	545.2	591.2	<0.05
Turbidity (Jackson)	76.8	108.1	<0.005
Total P (MG/L)	0.33	0.52	<0.005

* Based on Wilcoxon paired-sample test using 20 paired samples

Several people analyzed costs for implementation of best management practices in the Black Creek watershed. From 1972-1977, 23% of treatment cost was for land treatment (crop residue management, grass waterways, terraces, minimum tillage) while 45% was spent on channel activities (channel "maintenance," removal of nearstream vegetation, grade stabilization) with a total cost of $519,000 (Karr and Schlosser 1978). Extrapolation of those costs often produced comments that land management programs designed to protect water resources were simply too expensive. On the contrary, I argued, we must be more careful to attribute costs to water quality if, and only if, they are effective at accomplishing that goal. BMP's that enhance production or even degrade water resources should not be included in cost of protecting water resources.

These examples illustrate the point that using the point-source approach to solve non-point source problems is like trying to fit the proverbial square peg in a round hole; it has not worked. We must seek new ways, new ideas, new methodologies to bring non-point source problems under control.

Another major point that I would like to make is that water quality is important but it is not identical to biological integrity or ecological integrity. What we should be focusing on is the more broadly conceived quality of the water resource. I think this can be illustrated by looking back to the dinner speech last night, where the speaker discussed water quality and water quantity and asked the question, "how do we combine the two?" It is difficult to combine them if we carry the historical baggage of solely trying to improve water quality. What we are trying to improve is the quality of water resources. I think when we begin to focus on improvement in the quality of water resources, we will escape the narrow focus imposed by a dominantly point source approach.

Two concepts are important in the development of this broader perspective:

> **biological integrity** - "the capability of supporting and maintaining a balanced, integrated, adaptive, community of organisms having a species composition and functional organization comparable to that of natural habitat of the region" (Karr and Dudley 1981).

> **ecological health** - "...a biological system--whether it is a human system or a stream ecosystem--can be considered healthy when its inherent potential is realized, its condition is stable, its capacity for self-repair when perturbed is preserved, and minimal external support for management is needed" (Karr et al. 1986).

By now it should be clear that many problems associated with water resources have not been adequately addressed. These include a growing list of toxics, non-point sources of pollution, and a variety of non-toxic effects like habitat degradation and altered stream flows. In my view, the limited use of biological factors in evaluating the quality of water resources perpetuates these problems and results in continuing declines in the health, the biological integrity, of water resource systems.

Biological Monitoring and Control of Non-point Sources

Section 319 of the Clean Water Act provides a clear mandate to manage non-point sources of pollution. We are, thus, on the threshold of new opportunities if we can be sufficiently emphatic and innovative about the needs for strong, effective NPS control programs. Most importantly we need to use our biological knowledge to guide those programs, but this requires us to overcome some bad habits.

The limited use of biology comes from several historical factors. First, water pollution engineers with construction and technology approaches have dominated water resource programs, a legacy from the Water Pollution Control Administration. We also were limited by the lack of a defensible definition of biological integrity, and I blame our inability to deal with that issue on biologists. Biologists have simply not been effective at articulating what we are trying to protect when we talk about protection of water resources. We lacked a standardized set of field methods, we lacked indexes that were successful, intuitively reasonable, and easily communicated to lawyers, engineers, planners and to the public at large. Biologists could talk to each other but we were not effective at talking to other people and providing ways of communicating the biology of water resource protection, and the extent to which human activities were responsible for degrading those resources. Finally, I think there have been some profound misconceptions about cost.

Ohio EPA recently compiled costs for completed water resource evaluations (Table 2). This tabulation puts to rest the old saw that biological monitoring is too expensive. Two other aspects of cost need to be dealt with as well. First, we must go beyond the cost of data collection and analysis, to think about the costs of sampling relative to the cost of building and operating treatment plants that may be unnecessary or poorly designed relative to local needs. There is no point in building and operating a treatment plant if that treatment plant is not going to solve the problem. Karr et al. (1985) provide an example of implementation of tertiary denitrification that probably had little benefit to the water resource.

We can develop more efficient and cost-effective programs through use of quality monitoring efforts, to replace expensive and generalized construction. Recent calls to phase out construction in the Clean Water Act of 1987 suggest more widespread recognition of this issue. Finally, the cost of a little bit of monitoring is cheap relative to the cost of bad management decisions. We made many bad management decisions concerning treatment plant construction. Many examples could be cited and most in this audience must be familiar with one or more.

Approaches to Biological Monitoring

I turn now to biological assessments. Many attempts to use biology in evaluation of the quality of a water resource have been made. The most extensively used involves toxicity testing, an approach that has been incorporated into both legislative and regulatory contexts. Simple, single-species toxicity tests have been supplemented by multispecies, microcosm, and model ecosystem approaches as well. Ambient biological monitoring has been used with some success for many years as have some uses of mathematical and conceptual models of the effects of pollutants and other factors on the

Table 2. Comparative cost analysis for sample collection, processing and analysis for evaluation of the quality of a water resource. Data from Ohio EPA, 1989 provided by C. O. Yoder.

	Per Sample[a]	Per Evaluation[b]
Chemical/Physical Water Quality		
4 samples/site	$ 1,436	$ 8,616
6 samples/site	$ 2,154	$12,924
Bioassay		
Screening (Acute-48 hour exposure)	$ 1,191	$ 3,573
Definitive (LC50[c] and EC50[d] - 48 & 96 hour)	$ 1,848	$ 5,544
Seven Day (acute and chronic effects - 7 day exposure single sample)	$ 3,052	$ 9,156
Seven Day (as above but with composite sample collected daily)	$ 6,106	$18,318
Macroinvertebrate Community	$ 824	$ 4,120
Fish Community	$ 740	$ 3,700
Fish and Macroinvertebrates (combined)	$ 1,564	$ 7,820

a - the cost to sample one location or one effluent; standard evaluation protocols specify multiple samples per location.

b - the cost to evaluate the impact of an entity; this example assumes sampling 5 stream sites and one effluent discharge.

c - dose of toxicant that is lethal (fatal) to 50% of the organisms in the test conditions at a specified time.

d - Concentration at which a specified effect is observed in 50% of organisms tested; e. g., hemorrhaging, dilation of pupils, stop swimming degradation of water resources. Not surprisingly, the principal users of each of those methods have been involved in territorial conflicts that result in defense of turf as a way of protecting jobs and resources. In the long run both the water resources and the use of biology in evaluation of water resources suffers by the perpetuation of those battles. Here, I attempt a brief review of the different biological approaches, including the strengths and weaknesses of each.

Single-species toxicity testing. Toxicity tests have long been the central foundation in water quality programs. Their strengths are well known and are central to their long-term use.

STRENGTHS:
1. Tests are rapid, easy to conduct, and not too expensive
2. Standardized procedures
3. Replication relatively easy
4. Convenient in regulatory context
5. Valuable screening tool
6. "Decisive" (but see below)

WEAKNESSES:
1. Low on realism
    a. different dynamics in natural environment
    b. organism adaptability not accounted for
    c. do not simulate species interactions and environmental influences
    d. ignore cumulative impacts
2. Cannot predict direction of errors
3. Choice of species awkward or inappropriate for certain habitats
4. Ignores transformation of compounds
5. Ignores higher level effects

I take issue with only one of the strengths listed here: "decisive." These tests can be very decisive but in many circumstances they are not useful in detecting many forms of degradation. I am reminded of the news a few days ago when Nancy Reagan commented on how she helped President Reagan make decisions about when he should fly or hold press conferences. The help of her astrologer certainly made her decisive. I do not mean to suggest that toxicity testing is not useful, only that decisiveness is not sufficient, especially if the decisions made have nothing to do with the resolution of a specific problem, i. e., if the primary problem is not even detected by that procedure. Single species toxicity testing is useful and decisive where it is appropriate, but where it is not sensitive to the kind of degradation being evaluated, its decisiveness is at best misleading and at worst dangerous for the resource.

Multiple-species toxicity tests. Multi-species testing can reduce the errors generated by dependence on single-species tests.

STRENGTHS:
1. Includes species interactions
2. More directly related to ecosystem consequences
3. With adequate controls, can be replicated
4. Bridge between single-species and field studies

WEAKNESSES: 1. Oversimplification of natural system
2. Components of natural system (biotic and environmental) missing
3. Inadequate consideration of cumulative impacts
4. Relevance of test species often not clear

Both single- and multi-species test systems have contributed materially to the reduction in water quality impacts of human activities. But for the reasons just noted, their use is not adequate for the protection of water resources. However, it is important to keep in mind that toxicology deals with effects at the level of the individual (Levin et al. 1989) while chemicals (and other human impacts) directly affect many biological functions (species interactions, population dynamics, nutrient processing, species richness).

Ambient biological monitoring. A variety of biological monitoring tools have been used for many years. Most simplistically, screening for microorganisms (fecal coliforms, etc.) has long been used to detect contamination of water resources. Similarly, benthic invertebrate communities have been studied, especially to detect degradation due to enrichment by oxygen-demanding wastes.

As the complexity of water resource problems have increased the need for more sophisticated approaches has grown. The target of protecting the quality of water resources, as opposed to just making water clean, requires society to identify the many different ways that humans impact those resources. I do not mean a list of chemicals or societal actions (e.g., channel alteration). Rather, I intend to concentrate on defining the primary classes of variables that humans impact that result in the degradation of the biological components of water resources. Five such classes of variables exist (Fig. 1):

1. Water quality - temperature, turbidity, dissolved oxygen, organic and inorganic chemicals, heavy metals, toxic, substances, etc.
2. Habitat structure - substrate type, water depth and current velocity, spatial and temporal complexity of physical habitat
3. Flow regime - water volume, temporal distribution of flows
4. Energy source - type, amount, and particle size of organic material entering stream, seasonal pattern of energy availability
5. Biotic interactions - competition, predation, disease, parasitism

Karr et al. (1986) provides a more detailed analysis of these factors and how human actions impact the quality of water resources through alterations of these aspects of natural systems. The water quality issue has been the primary subject of efforts from USEPA and equivalent state agencies. The Fish and Wildlife Service and the state fish and game agencies have treated habitat degradation and in recent years those same agencies evaluated altered flow regimes with the instream-flow methodology. Few have dealt with alteration of energy sources that drive stream biology, and most impacts of interspecific interactions have come from efforts to introduce exotics and/or through effects of harvest of top predators.

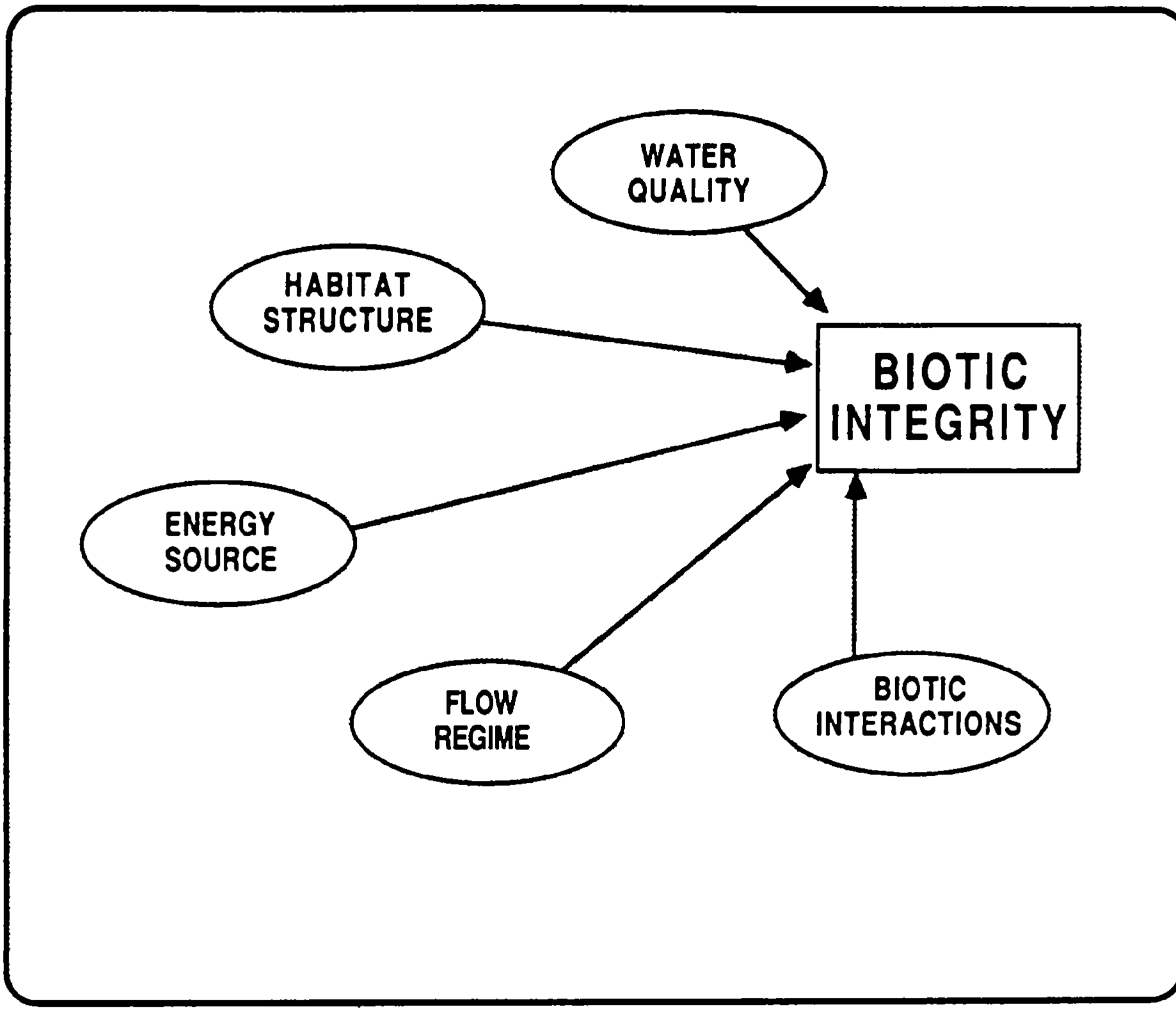

Figure 1. Five major classes of environmental factors that affect the integrity of an aquatic biota.

Overall, the determinants of water resource quality from a biological perspective are complex, and the simplistic EPA approach of making water cleaner is inadequate. To illustrate this, I often say, "We can make crystal clear, distilled water and run it down concrete channels and we will still not have quality water resources." We must evaluate all water resource degradation to identify the factors responsible for degradation and then treat the problem in the most cost-effective and efficient manner. Ambient biological monitoring offers unique opportunities to accomplish that goal.

STRENGTHS:
1. Integrates cumulative impacts from point source, non-point source, flow alteration, and other diverse impacts of human society
2. Integrates and evaluates the full range of classes of impacts (water quality, habitat structure, etc.) on biotic systems
3. Direct evaluation of resource condition
4. Easy to relate to general public
5. Overcomes many weaknesses of individual parameter by parameter approaches
6. Can assess incremental degrees and types of degradation, not just above or below some threshold
7. Can be used to assess resource trends in space or time

WEAKNESSES:
1. Considerable natural variation
2. Difficult to replicate
3. Need for more experimental and background work
4. Need to develop and test more comprehensive list of specific criteria

Biological monitoring is at a threshold in the ways that it can be used and in the potential for development of methodologies and indexes that can provide useful answers to water resource problems. One of the most important contributions of the recent growth in interest in biological monitoring has been recognition of the need to set standards as a function of local and regional expectations. Indeed, that should have been done for chemical and physical criteria as well. For example, total phosphorus standards should vary regionally and according to primary use among Minnesota lakes with values ranging from less than 15 to 90 ug/l (Minnesota Pollution Control Agency 1988).

Many examples of use of ambient biological monitoring have been documented in the past decade (Karr et al. 1986, Ohio EPA 1988, Steedman 1988). In the Scioto River near Columbus, Ohio a complex of water resource problems representative of many areas in the U. S. can be seen. Monitoring of the biota of the river over the last decade has shown substantial improvement in biological integrity in association with improvements in wastewater treatment plants (Fig. 2). However, because of the widespread degradation due to untreated factors (habitat degradation, non-point source pollution, input from combined sewer overflow), the biotic communities of the Scioto River adjacent to Columbus remain well below what might be expected in that region.

In my experience the most successful efforts to protect water resources using biological monitoring have incorporated the following characteristics of

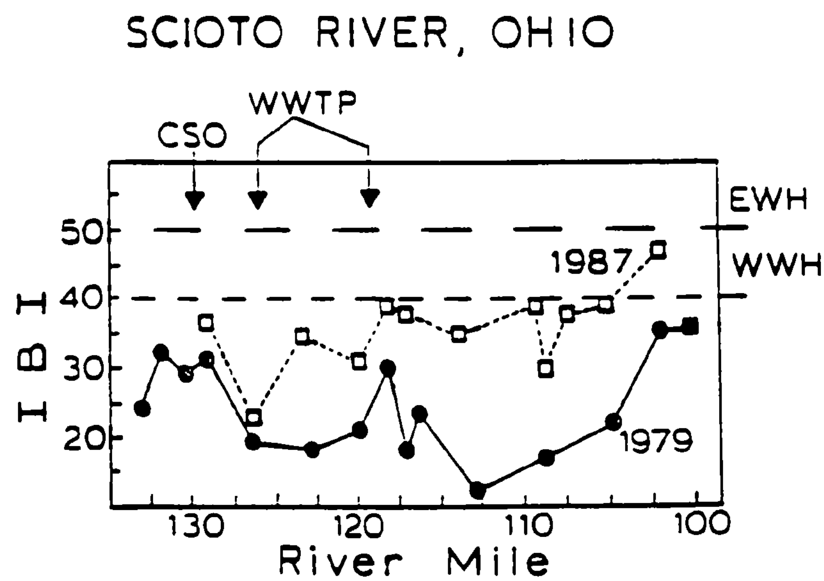

Figure 2. Longitudinal trend in IBI for the Scioto River, Ohio in and downstream from Columbus Ohio, 1979 and 1987. CSO = Combined sewer overflow; WWTP = Wastewater treatment plant inflow; WWH = Warmwater habitat; EWH = Excellent warmwater habitat. Stream flow is from left to right. (From Yoder 1989.)

biological systems: 1) their dynamics at a variety of relevant spatial and temporal scales and 2) appropriate metrics at three levels: a) ecosystem (productivity, decomposition, nutrient cycling, atmosphere/biosphere/geosphere interactions); b) population/community (community structure, species richness, species interactions, functional groupings, population structure); and c) health of individual organisms.

We must be innovative in incorporating these into water resource evaluations. Some can be incorporated directly and easily (e.g., population size, species richness) while others are more difficult or expensive to measure directly. For example, the total productivity of an ecosystem is very difficult to measure. We might seek ways to measure productivity, or a surrogate of productivity that is indirect but reliable. Alternatively, we might develop more cost effective ways to measure productivity by improvements in technology.

No one said 35 years ago that physical and chemical parameters do not work perfectly, therefore we will not use them. Similarly, ambient biomonitoring should not be rejected today because it is not a perfect replacement of physical and chemical monitoring or toxicity testing. Rather, biological studies at all levels complement existing approaches in ways that can be more cost effective and more accurate in detecting water resource degradation and correcting the factors responsible for that degradation. Ohio EPA (Yoder in press) recently compared chemical criteria and biological criteria with respect to their ability to identify aquatic use impairment at 431 sites in Ohio. Chemical and biological criteria agreed 54% of the time. Biocriteria identified impairment where chemical criteria did not identify impairment in 40% of cases. While many of the latter were impaired by nonchemical conditions, Yoder noted that inadequacy in the design of chemical monitoring programs also contributed to the underassessment of degradation when chemical criteria were used.

Mathematical and conceptual models. Models guide all aspects of our decisions about the regulation of water resource quality. Early conceptual models viewed the problem as one of controlling effluents from human society. As the kinds of human activities have increased, the need to broaden our conceptual approaches has increased as well. Unfortunately, that need has not been widely recognized and water resources continue to suffer, although the use of a broader conceptual framework is beginning to spread within the water resource community. Like conceptual models, mathematical models are limited in their success by the extent to which they mimic the actual dynamics of the system being modeled.

Empirical relationships have long been used in water quality analysis to generate mathematical models. These include both dilution models and models to predict dissolved oxygen levels or nitrogen, phosphorous, and suspended solids concentrations. Of course, all models, whether conceptual or mathematical, are only as good as the foundations from which they are developed. For example, as I noted above, water quality models based on USLE but not utilizing knowledge of delivery rates to stream channels will be flawed. Similarly, models based on understanding of physical processes but ignoring relevant biological dynamics will be flawed to the extent that biology impacts the conditions in the stream or lake. Finally, wetland systems, like streams, are variable in their ability to process pollutants.

Biological changes stimulated by those pollutants are not incorporated in models, primarily because of limitation on current knowledge (Bedford and Preston 1988). The strengths and weaknesses of models can be summarized as follows.

STRENGTHS:
1. Improves theoretical foundations and guides further research
2. Strengthens theoretical basis of extrapolation

WEAKNESSES:
1. Generally on understanding of system dynamics
2. Modelled processes must be general
3. Difficult to model dynamic, non-equilibrium system with heterogeneity (spatial and temporal) at various scales

Anyone familiar with the history of water resource programs will know of specific problems and solutions created by these approaches. My purpose here is not to cast aspersions on any of these. Rather, I hope to instill a healthy level of skepticism about any program or individuals that suggest that all problems can be resolved by any one of these approaches. Just like best management systems are essential for the protection of local water resources, a carefully formulated program of management of water resources must include all these monitoring approaches to be effective over the long term.

Challenges for the Future

The use of this knowledge requires both ecological research to strengthen the scientific background necessary to guide management programs and planning and policy decisions that allow use of that knowledge. Specifically, we need:

1. Increased research on ecological dynamics (e.g., to document ranges of natural and man-induced variation)
2. Development and testing of improved indexes of biotic integrity,
3. Use of a wider range of taxa in biotic assessments,
4. Expanded use of biotic integrity concepts to other ecosystem types (e.g., lakes, wetlands, estuaries, etc.),
5. Development of standardized sampling, and
6. Development of metrics that are sensitive to degradation

This last point brings to mind a major problem in many discussions on the use of biological monitoring. Often, people advocating biological monitoring speak in generalities about "indicators" such as fish or birds or benthic invertebrates. The selection of taxa to be used as indicators is perhaps the easiest task. I believe that, for the most part, any taxon could be selected and produce a reasonable level of insight about the water resources. The more difficult problem is development of a set of metrics that convert knowledge of the taxon into useful information. Too little attention has been given to the development of specific metrics, how they will be formulated and used to make strong inferences about ecosystem health and to support robust management decisions. For years many have argued that nothing could be done with fish or benthic invertebrates because field data based on these taxa were too variable to be useful. Recent advances with the development of IBI and similar approaches using invertebrates use the same data from fish community or benthic invertebrate samples that has been available for decades. The advances came because these new approaches provide innovative synthesis using metrics that allow us to express pattern in clear ways and overcome the problems of data variability.

I am dismayed to see the frequency with which biologists argue with each other about whether fish or diatoms or invertebrates are better for assessment. This hollow argument puts us in the position of fiddling while Rome burns. We need to have a wide diversity of metrics from as a wide a range of taxa and conceptual approaches within ecology as possible so that we can pick the best approach for each special circumstance.

At the policy and planning level we must avoid rejecting approaches that show promise but may not yet be perfected, we must avoid narrow taxonomic or conceptual dogma that might constrain exploration of approaches to protect water resources, and finally, we must insure that broad natural-resource goals are always at the forefront of programs and policies.

We can use several general principles to accomplish societal goals:

1. Be aware of the uncertainty inherent in all approaches,
2. Be aware of approaches driven by factors other than resource protection (e.g., the "decisive" criterion mentioned already), and
3. avoid the trap of too much sterile theory or unorganized data.

Many examples of bad theory guiding decisions could be cited. Further, biologists are perhaps most guilty of collecting unorganized data. One of the major advances in the past decade in protection of water resources is the progress made by biologists in documenting natural pattern, in finding ways to measure attributes of biological systems, and in the development of metrics that are both sound and effective at communicating the situation in streams to planners and decision makers.

Several times during this conference (e.g., workgroup sessions) individuals have asked - "What is the appropriate balance of monitoring approaches?" Hughes (in press) likened the situation to a stool, where the legs supporting the stool are the monitoring approaches (e.g., physical/chemical parameters, toxicity testing, ambient biomonitoring). In my view that analogy is inadequate. It is more appropriate to compare the situation to a tripod supporting a spotting scope. To see a distant bird (or focus on a water resource problem), one must adjust the lengths of the three legs to accommodate the terrain (or the nature of the water resource problem).

Components of a Successful Non-point Source Program

Much has been written in the past two decades about the needs of programs to control non-point source pollutants. As I have argued above, the common approach of using the conceptual foundations of point-source control efforts have not been adequate. Because of the complexity of the problem, I have neither the time nor the knowledge to produce a complete new program that will be both successful and acceptable. I can, however, outline a few of the most critical elements of such a program. These should include the following:

1. Knowledge of the dynamics of soil, water, and biotic systems,
2. Knowledge of the effects of human activities on these systems,

3. Technical assistance programs funded at a level that will insure their widespread availability and use,
4. Incentive programs to insure selective application of that assistance,
5. Regulatory and enforcement mechanisms to provide backup to voluntary programs.

Among the specific programs that should be included within these general guidelines are regulations, technical assistance, cost-sharing programs, low interest loans, tax incentives, cross compliance, selective application, classified streams, performance taxes, performance standards, design standards, and pricing mechanisms. For more details on these programs, two recent documents discuss these in greater detail (Karr et al. 1983, Thompson 1989).

Summary

In review, I would like to make five points:

1. Quality water resources, not water quality, should be the primary goal.
2. Past efforts to resolve NPS failed, not because of lack of commitment, but because the kind of technological approach and regulatory perspective that dominated PS control programs is simply not enough to control NPS, or to protect against water resource degradation in a larger context.
3. Protection of water quality demands a full tool box of approaches, each applied as appropriate to the specific situation.
4. Ambient biological monitoring, toxicity testing, conceptual and mathematical models and physical/chemical monitoring must be major components of that tool box.
5. Non-point programs should balance voluntary incentive-based programs with mandatory backup enforcement programs to insure that the water resources upon which society depends will not be abused by a few individuals.

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5. Workgroup Discussion Summaries and Recommendations

5. WORKGROUP DISCUSSION SUMMARIES

WORKGROUP 1: NONPOINT SOURCE MANAGEMENT AND ANTIDEGRADATION

I. BACKGROUND

EPA's requirements for State adoption of an antidegradation policy is contained in the Code of Federal Regulations at 40 CFR 131.12. These regulatory requirements have been in place since November 8, 1983, but the policy was first established by the Department of the Interior in 1968. The 1987 Clean Water Act Amendments noted the Federal antidegradation policy in Section 303(d)(4).

EPA believes that State antidegradation implementation plans should include provisions for mandatory application in a State's nonpoint source control program. However, no State has yet fully incorporated antidegradation implementation into its nonpoint source management program, although several are making significant progress.

II. KEY ISSUES

The first issue discussed was the availability of institutional arrangements to regulate nonpoint sources of pollution.

1. To stress the role of CWA Section 319, EPA pointed out that Section 319 consists of a 3-tiered approach: assessment, management plan and field implementation. Moreover, the process is iterative to continually refine efforts to control nonpoint source pollution.

2. Principal comments encouraged EPA to facilitate and motivate other Federal agencies to participate in maintaining water quality standards which includes antidegradation implementation.

The second issue discussed was antidegradation implementation plan development by the States and the necessity for guidance and other technical support. There were several significant comments:

1. EPA was encouraged to produce guidance describing implementation approaches in a technical transfer mode with examples. This approach was deemed superior to more general guidance.

2. Additional EPA guidance should clarify what EPA expects from its antidegradation policy concerning nonpoint sources; it should clear up definitions that have been "fuzzy" in previous guidance; and provide the specific elements that are sought.

3. EPA should take care to maintain internal consistency with its comments within its programs - for example, State water quality standards reviews and EIS comments.

The third issue was field implementation of antidegradation. This topic addresses how to measure and define the existing resource and the insults of nonpoint source pollution. Comments included:

1. The measurement of degradation - what to measure, when to measure it and for how long - are all issues needing guidance.

2. EPA's recommended approaches should encourage more consistency in the approaches used to implement antidegradation.

The fourth issue was monitoring for the purpose of implementing antidegradation. Comments included the following:

1. Rapid bioassessment methods when compared with physical-chemical methods may stretch resources and provide more information for less money.

2. Federal land management agencies could be a big help in collecting needed information; States, to the extent authorized, should work with and help to direct Federal agency monitoring.

3. Municipal and industrial ambient water monitoring data may help to define NPS effects.

4. EPA should modify the STORET Data System to more easily handle all of the different kinds of data being collected.

III. RECOMMENDATIONS

1. The discussions demonstrated that the conceptual basis for EPA's antidegradation policy has not been effectively communicated, especially for nonpoint sources.

2. Since antidegradation was not included specifically in EPA's section 319 guidance (only generic WQS), the section 319 management plans being submitted will not address it specifically.

3. EPA has a large educational effort ahead for antidegradation as well as WQS in general and must produce guidance and other information to convey that message.

4. All of those who work for regulatory agencies, both Federal and State, are urged to make an effort to learn about antidegradation. The increase in lawsuits about antidegradation since the 1987 CWA Amendments indicates that these efforts may have benefits.

WORKGROUP 2: TOTAL MAXIMUM DAILY LOADS FOR NONPOINT SOURCES

I. BACKGROUND

Total maximum daily loads (TMDLs) are required by Section 303(d) of the Clean Water Act and EPA regulations (40 CFR Part 130, 1/1/85). TMDLs are defined by these regulations as the sum of wasteload allocations for point sources and natural background. There is additional interest in NPS assessments and load allocation (LAs) due to 1) Section 319 of the CWA, 2) the recent GAO report on the need for additional emphasis on TMDLs, 3) current court action related to development and application of TMDLs, 4) and interest in considering the combined water quality effects of point and nonpoint sources.

The assessment and setting of LAs for NPSs can be complex due to the intermittent nature of the loadings from these sources and the fact that this loading often occurs at other than the low flows used for point source controls. Conventional Pollutants: techniques (e.g. mathematical models) and technical guidance documents are generally available for assessing and setting NPS LAs for conventional pollutants such as nutrients and biological oxygen demand in lakes, fresh water streams and coastal waters, although these techniques often require extensive amounts of data and generally do not address NPS loadings from individual sources. Technical guidance for estuaries is not yet final but is available in draft. Other Pollutants: specific techniques have generally not yet been provided for assessing and setting LAs for clean sediment and toxics from NPSs.

II. KEY ISSUES

1. Is a waterbody-based assessment and allocation process the best approach for integrating point and NPS loadings? Are other approaches available for determining needed loading reductions by point and NPSs?

2. Are non-steady state modeling approaches needed for LAs for toxics from NPSs? The new type of Water Quality Criteria which includes duration and frequency recommendations are apparently suitable for all receiving water flows (with the criteria concentration, duration, and frequency provisions still being subject to site-specific modification). Since these criteria consider the duration and frequency of criteria exceedances, do the models also need to consider these factors?

3. Must a LA always be quantified as a number, or should EPA allow a TMDL approach that allows setting the NPS LA as site-specific BMPs, when setting a specific number through modeling, etc., is not feasible? Under this approach, the NPS LA could be specified, in some cases, as site-specific BMPs, with follow-up monitoring of the water quality results of the BMPs and additional adjustments to the BMPS as needed over time. The TMDL would thus be developed using BMPs for LAs in cases where doing quantitative estimates using modeling is not yet feasible.

4. What types of changes are needed for existing models and technical tools to make the TMDL process more doable for NPS LAs? What type of technical training is needed?

III. RECOMMENDATIONS

Issue #1: A waterbody assessment-based process should be used to define and implement NPS TMDLs. There should be allowance for different levels of technical rigor supporting TMDLs. On one hand, there may be a clear quantification of maximum allowable loads and a clear pathway to controls. Yet, other TMDLs may be interim goals that are used to prompt "first level" controls where feedback monitoring may result in modification of the TMDL and controls. Lack of assessment data, lack of ability to clearly define loads, lack of ability to discern sources (all of these being component of the waterbody assessment process) should not be used as excuses to implement a "technology-based" approach where general performance requirements are applied without the benefit of a TMDL (e.g. county-wide erosion control ordinances). All approaches to NPS control should have some level of "compliance monitoring" to provide feedback.

Issue #2: Further guidance and additional tools are needed to perform NPS modeling that considers the dynamic nature of NPSs. These tools need to consider the timing and cumulative impact of NPSs and PSs alike and need to acknowledge the duration and frequency components of water quality criteria.

Issue #3: There should be flexibility in defining LAs (and the current EPA regulation on TMDLs provides for that flexibility). BMPs in themselves cannot constitute a "TMDL", but some measurement (e.g. pounds per day, level of toxicity, % reduction goals) tied to an in-stream water quality standard should be considered mandatory components of NPS LAs. Again, monitoring feedback is also an important component in implementing NPS LAs.

Issue #4: Further model development and training is needed to make the NPS TMDL process more doable. In particular, methods to discern sources (PS v. NPS v. natural background), define acceptable loads, and ways to allocate loads need to be explored further. In doing this, we should acknowledge the different needs with respect to 1) pollutant types (nutrients, pathogens, metals, other toxics, DO/BOD, temperature) and 2) water quality standards (e.g. physical, chemical, biological) since the methods for establishing NPS TMDLs are at different levels of development depending on the type of pollutant. Further development of certain water quality criteria (e.g. sediment criteria for both clean and contaminated sediment) are needed before proceeding with NPS TMDLs.

In addition to the recommendations given above, the following points were made in the workgroup:

- The roles of EPA and the States in establishing and implementing NPS/TMDLs needs to be re-evaluated.

- The minimum requirements for NPS/TMDLs need to be defined, keeping in mind the flexibility afforded through the current regulations. What does an approvable TMDL look like?

- The applicability of NPS/TMDLs at different scale levels (e.g. basin - subbasin - stream reach) needs to be investigated.

WORKGROUP 3: DESIGNING THE APPROPRIATE MIX FOR NPS ASSESSMENTS

I. BACKGROUND

The need to assess the extent of nonpoint source (NPS) pollution is not new. States have been required to report on NPS under sections 305(b) and 208, and most currently under section 319. Since the states have supposedly reported on the extent of the NPS problem, one might question the need for a discussion of NPS assessment. However, a large proportion of the NPS assessments were based upon far less than rigorous scientific analysis; that is, best professional judgement was used extensively and labeled as evaluated data. Furthermore, many of the waters assessed for section 319 have never been monitored routinely, suggesting that meaningful water quality and beneficial use information does not exist.

Now that NPS monitoring and assessment are becoming highly visible components of state monitoring programs, it is important for EPA to be responsive to state needs in this area. This workgroup is intended to provide a forum for the states to share their successes and concerns with EPA and other states. Also, this workgroup will discuss the various aspects of a viable NPS monitoring and assessment program as part of the overall state monitoring program.

II. KEY ISSUES

A. What strategy of monitoring techniques (biological, chemical and physical) are appropriate for NPS problem screening, trend monitoring, and evaluation of NPS controls?

B. What are the key limitations states face in adding a strong monitoring component to their overall monitoring program? What should EPA's role be?

C. What technical materials/assistance should EPA deliver in support of the states to develop the appropriate mix of monitoring techniques (e.g., biological, chemical and physical)?

III. RECOMMENDATION

A. ISSUE - Development of a Monitoring Strategy

- Recommendation - EPA should develop a Monitoring Strategy that includes:

  - A tiered assessment approach involving: 1) inventory, 2) beneficial use attainment analysis, and 3) evaluation of NPS controls.

- An inventory should have a preliminary screening of instream conditions, as well as an in-depth analysis which includes a mix of chemical, physical and biological parameters.

- Analysis of beneficial use attainment should adequately describe the health of the aquatic ecosystem in relation to some reference condition. This analysis would define the quality of the particular water resource against a previously described benchmark.

- An evaluation of the NPS controls is needed to determine if: 1) they were implemented, 2) they were effective, and 3) was the iterative NPS process (feedback loop) followed? The feedback loop provides for adaptive management. That is, NPS controls can be modified when monitoring has shown that beneficial uses are not being adequately protected.

- Sequential focusing can be utilized to evaluate the most sensitive beneficial uses. This allows for a strategy that defines the limiting factor for that particular beneficial use in a priority watershed with site-specific identification of the NPS problem.

B. ISSUE - Define the Key Limitations

- Recommendation - EPA should provide the guidance and research needed to accurately define the following:

  - Beneficial use designations; their implications are poorly understood.

  - What is meant by "full protection" in the antidegradation portion of the water quality standards regulations?

  - A system for determining what constitutes implementation of BMP's.

  - Ecological references at the regional and state specific level.

  - Appropriate training on the use of biological monitoring.

  - Acceptable approaches for developing and adopting biocriteria in state water quality standards to adequately protect designated beneficial uses.

  - The relationships between stressors and beneficial uses.

C. ISSUE - What Solutions are Available

- Recommendation - EPA should provide leadership in assisting the states to develop the following:

  - A comprehensive biological database system nationwide.
  - A NPS network - bulletin board system is needed to enhance interstate/EPA communication.
  - Integrate point source and NPS monitoring activities at all jurisdictional levels.
  - Identify EPA Regional ecological experts to assist the states.
  - Develop aquatic habitat measures that can be incorporated as criteria in states' water quality standards.
  - Develop state-specific ecological references.
  - Publicize the Ohio case history as an example of an integrated assessment strategy.

WORKGROUP 4: MONITORING PROGRAM GUIDANCE AND FRAMEWORK

I. BACKGROUND

EPA's Office of Water Regulations and Standards, with assistance from a Federal/State workgroup, is preparing two documents of interest to managers and staff with monitoring responsibilities:

1. A guidance document for State surface water monitoring programs; and

2. A "Monitoring Implementation Framework." Draft versions of the guidance and Framework are expected to be available in early 1990.

II. ISSUES

Monitoring Program Guidance

1. Is our strategy sound of directing the program guidance not just to the producers of monitoring data, but also to its users?

2. Do workgroup members have monitoring design recommendations that they want to see included in the guidance document?

Monitoring Framework

3. Is there support for preparing a "Monitoring Implementation Framework" that will serve as a five year plan listing specific monitoring-related projects that EPA needs to complete (e.g., research, guidance, and training) and specific implementation activities that could be taken to improve State monitoring programs?

4. What measures can EPA use to satisfy its §106(e) oversight responsibilities and ensure the adequacy of State monitoring programs?

5. What is the best mechanism for ensuring communication between EPA and States over monitoring programs?

III. RECOMMENDATIONS

1. Yes, it is vitally important to encourage communication between technical and field staff who supply monitoring information, and decision makers and other information users who can (and should) demand monitoring information. We should be sure to talk to information users in preparing the document.

2. Workgroup participants were generally satisfied with the "toolbox" approach being taken in the guidance document. The guidance will provide:

   - Discussion of the benefits of using monitoring data in a variety of program areas (e.g., in developing water quality standards, targeting waters in need of additional controls, determining permit limits, evaluation project or program effectiveness);

- General monitoring design recommendation emphasizing practical approaches requiring minimal resources (without automatically specifying "acceptable" methods), supplemented with case studies documenting specific monitoring approaches;

- Estimates of manpower, cost, skill, and hardware requirements;

- Annotated bibliographies listing more detailed technical references on various monitoring approaches.

One or more workgroup participants offered the following suggestions for specific topics they wanted addressed in the guidance:

- Discuss monitoring in all types of surface waters, and address hydrologic connections between surface and groundwaters;

- Provide details on how monitoring point source impacts differs from monitoring nonpoint source impacts;

- Discuss the value of developing and using regional goals or standards;

- Provide recommendations on cooperative monitoring;

- Be sure to address data management and presentation;

- Discuss the role of trend assessment in State programs.

3. There is support for preparing a "Monitoring Implementation Framework." Several workgroup participants would like EPA to clarify national assessment needs and set priorities that would help States justify monitoring activities that are vulnerable to budget cuts. There was some support for EPA making "evaluations of project or program effectiveness" a national monitoring priority.

4-5. There was widespread agreement that EPA needs to define a minimally acceptable program, but should not rely on "bean-counting" measures (e.g., minimum number of analyses or surveys, minimum number of biologists or other staff with specified skills) to satisfy its §106(e) oversight responsibilities. Several participants thought that workable "performance standards" could be developed (e.g., the program should deliver x kind of information). Participants also expressed a preference for general program "audits," but warned that they must be conducted by <u>knowledgeable</u> auditors.

WORKGROUP 5: BIOACCUMULATION/SEDIMENT MONITORING AND ASSESSMENT

I. BACKGROUND

Public concern about the impact of chemical contamination on water quality was heightened recently by the release of reports by the National Wildlife Federation (NWF) and the Greenpeace organization. The NWF concluded that the levels of PCB's and three organochlorines in Lake Michigan salmonids represented a significant health risk. While no one debated that there was a problem, most of the Lake Michigan states did not agree with NWF's assessment of the available fish tissue data for Lake Michigan. A major source of the contamination was identified by NWF as ongoing permitted discharges by industry. NWF's report is an example of how fish tissue monitoring data could be used to evaluate the validity of permitted discharge levels. It also illustrates the need for standardization of assessment techniques.

Greenpeace released a report linking the excess deaths found in a number of the counties along the Mississippi River to toxic substances in the water and air. This conclusion was reached even though Greenpeace identified the lack of valid environmental monitoring data as a major barrier to performing an evaluation. Because of this lack of data, it is impossible to dispute or confirm Greenpeace's evaluation. The report by Greenpeace illustrates the need for more and better data on chemical contaminants in aquatic systems (i.e., surface water, biota, and sediments).

In monitoring water quality, data on chemicals in sediment and their bioaccumulation in the tissues of fish and other aquatic organisms represent a vital information source. These data reflect the long-term impact on the environment and provide a potential inventory of chemicals entering the environment. Data on contaminant levels in sediments and fish tissue can provide guidance on where to target monitoring of both point and non-point sources. They also may provide a way to validate the appropriateness of permit discharge levels. Evaluation of chemicals in water provides only a snap-shot view of contamination unless monitoring is done on a regular basis.

While there are strong advantages to using bioaccumulation/sediment data, there are also problems. Procedures for collection, laboratory analysis, and assessment of sediment and fish tissue samples vary widely. As with the NWF example above, this has led to widely varying conclusions on essentially the same data. Another disadvantage to these data is the monies and expertise needed to do the laboratory analyses.

II. KEY ISSUES

A. Collection of Biota/Sediment Samples

1) Questions/issues on sample collection included collection technique, number of collection sites, samples per site, and which species and which tissues should be collected.

2) Would it be beneficial for EPA and other federal agencies to develop a cooperative program with the states to monitor biota and sediment in the major river systems?

B. Laboratory Analysis

1) What standard analytical procedures still need to be developed?

2) Which chemicals should be analyzed?

C. Assessment of Results

1) How should health concern levels for contaminants in fish tissue be established?

2) To what extent is biota contamination due to sediment contamination?

III. RECOMMENDATIONS

ISSUE - Collection of Biota/Sediment Samples

Recommendation - That a guidance document for collection of biota samples be developed that:

- is cooperative effort of EPA, Fish and Wildlife Service, regional groups like Great Lakes Task Force and Mid America Fish Contaminants, environmental groups such as National Wildlife Federation, and state agencies.

- outlines tiered/phased approach to monitoring including use of fish health condition index.

- suggests which sampling scheme is appropriate for a specific purpose such as compliance, surveillance, etc. and which type of sample should be taken (i.e., fillets, whole fish, specific tissues, etc.)

- gives specific guidance on handling samples including how to prepare (i.e., filleting, skinning, trimming fat, etc.), wrap, preserve, and ship sample. This includes collection of liver and other body parts.

- identifies known databases on biota monitoring.

Recommendation - That EPA and the Fish and Wildlife Service increase the amount of biota monitoring being done and also improve the coordination of monitoring efforts by EPA, Fish and Wildlife Service, and state agencies.

Recommendation - That the Sediment Classification Methods Compendium be quickly finalized.

ISSUE - Laboratory Analysis

Recommendation - That a process be established for the Standardization and, when necessary, development of analytical methods for chemicals in biota and sediment samples. There should be wide distribution of these methods.
Recommendation - That a proficiency round-robin be established for laboratories doing analysis of chemicals in biota and sediment samples.

ISSUE - Assessment of Results

Recommendation - That EPA work with FDA, regional fish contaminant groups, environmental and state agencies to develop consensus guidance on the issuing of health advisories on chemicals in fish and shellfish. This should include the convening of a National Workshop on Fish Health Advisories.

Recommendation - That EPA coordinate research on what extent fish tissue contamination is due to sediment contamination. This research should address:

- other exposure routes
- habitat types
- species
- sediment type
- bioaccumulation factors
- bioconcentration factors

WORKGROUP 6: ENVIRONMENTAL INDICATORS

I. BACKGROUND

In the lead article of the May 1989 issue of the EPA Journal, EPA Administrator William Reilly wrote that the good news is, "...the Agency does an exemplary job of protecting the nation's public health and the quality of the environment.". The bad news is that he "...can't prove it.".

Reilly's comments highlight a major problem for many environmental managers. Although the programs they oversee are supposed to protect and improve.the environment, and extensive data collection efforts are mounted in support of these programs, it is often difficult to show that things are getting better (or worse). When asked to supply evidence of the effectiveness of their programs, many managers have to rely on administrative measures rather than system responses to demonstrate progress. Environmental indicators are measures that can be used to assess environmental results.

The development of national level indicators is a challenging problem. The workgroup on environmental indicators explored a range of topics related to indicator development, discussed the use and value of several candidate indicators, including fish tissue contamination, biological community measures, physical and chemical water quality indices, and loading estimates, as national indicators, and reviewed the status of EPA's surface water indicators project. Although the group did not arrive at any formal recommendations or conclusions, there was consensus on six issues related to national indicator development. The group also identified several constraints to indicator development, and discussed the information and guidance needed to implement national indicators. Finally, the group suggested several new approaches for furthering the development of indicators.

II. KEY ISSUES

The workgroup considered six concerns presented in the issue paper on indicator development. These were:

1. What are the most important institutional and scientific constraints limiting the development and use of indicators? How can these be overcome?

2. Are program managers hesitant to commit to using environmental indicators because of the fear of accountability? What can be done to mitigate this concern?

3. Is the development of national indicators of surface water quality realistic?

4. Assuming general agreement that indices of biological community structure are a valuable component of a comprehensive assessment of water quality, how should these be reported?

5. To what extent can existing environmental information and data collection programs be used in developing environmental indicators? Are new data collection programs needed? Are resources available to fund new collection programs?

6. Are loading estimates useful indicators?

POINTS OF CONSENSUS

1. There was general support for the idea of national environmental indicators that show the public and Congress where the quality of the water resource is good and where it falls below water quality standards and demonstrate if and where water quality is getting better or worse.

2. There was a clear preference for using measures of biological integrity over other indicators suggested. Group members emphasized that an environmental indicator, whether developed for local, regional, or national use, has to reflect the health of the aquatic resource as opposed to reporting on water quality in a strict physical/chemical sense.

3. There was a general feeling that physical and chemical measures of water quality used alone were inadequate as a national indicator because they can, in some cases, provide a misleading picture of the overall health of the water body. They should only be used in combination with biological measures. Single chemical measurements do not reflect overall water quality.

4. There was general agreement that loadings estimates, although on the input or source side of the continuum of environmental indicators, are useful measures of the pollutant stress being placed on the system and provide an indication of the effectiveness of regulatory programs. However, there are problems with the availability of data with which to make these loading estimates, particularly for nonpoint sources.

5. The workgroup felt that the development of national environmental indicators can take place within existing program frameworks, although there has to be better coordination of indicator development within these programs and possibly modification in the data collection and reporting requirements. A new program directing a new set of monitoring activities is not necessary.

6. The workgroup felt that an effort should be made to develop an integrated approach in reporting and using indicators. This approach would synthesize information drawn from a variety of physical/chemical and biotic indicators.

CONSTRAINTS

1. Data availability. The workgroup noted that there is a lot of data available to develop indicators, but it is often difficult to access, compile, and synthesize.

2. Comparability. The group pointed out that different monitoring parameters and methods are used in different states. This makes it difficult to compare and interpret information collected for a national indicator.

3. Consistency. Although EPA requires consistent reporting formats under 305(b), there is no requirement by EPA that states use consistent monitoring methods that can be converted into national indicators (it was noted that the CWA does not give EPA a mandate to require such monitoring).

4. Who is going to pay. The general feeling was that resources are not available at the state level to fund new data collection if additional monitoring is required by EPA.

INFORMATION NEEDS

The group identified the following information needs:

1. There is a need for a clear guidance from EPA regarding the suite of measurements that should be made to develop national indicators. Specifically mentioned were:

   - technical guidance - more information is needed on what type of biological community indices are appropriate; what type of physical/chemical water quality indices should be used;

   - guidance on interpretation of data;

   - guidance on how to define spatial and temporal representativeness; and

   - guidance on what is a minimum data set acceptable to support community structure measures;

It was noted that the recently released Rapid Bioassessment Protocols for Streams and Rivers contains guidance in some of those areas.

III. RECOMMENDATIONS

Several approaches were suggested by the group to further indicate development:

- As an interim step, it was suggested that appropriate environmental indicators be developed for existing national environmental data sets maintained by EPA programs and other Federal Agencies (e.g. Fish and Wildlife Service, U.S. Geological Survey, and the National

Oceanic and Atmospheric Administration). For example, a simple chemical index could be developed and applied to all USGS NASQAN stations, as a way to indicate water quality for the chemicals monitored at these sites. These indicators could be compiled to show the state of information on the current state of the environment. The limitations of these indicators might then serve as an incentive to EPA and Congress to allocate additional resources to improve the nation's ability to assess the quality of its surface water resource.

- It was also suggested that it might be useful to prepare a mock report showing the types of information or statements that one might make about the quality of the water resource if information were available. The exercise would highlight the current deficiencies in our data collection systems and ability to generate national environmental indicators.

- Finally, it was suggested that it might be useful to develop an index of indexes, similar to the Index of Leading Economic Indicators, that could summarize the status of the health of the aquatic resource. It was recognized that this would be an imperfect tool, but one that might be very useful for public information and education.

WORKGROUP 7: MARINE AND ESTUARINE MONITORING

I. BACKGROUND

Water quality problems in estuarine and marine waters have received increasing public attention. Legislation currently before Congress would require the development of comprehensive new monitoring programs for these waters. However, implementing monitoring programs for estuaries and near coastal waters presents many problems that are not encountered in fresh water systems. The number and diversity of estuarine ecosystem components to be monitored is often much greater than those in fresh waters, and varying salinity and hydrodynamic conditions require the development of unique methods and sampling designs.

Moreover, monitoring programs for estuarine and near coastal waters must provide ambient data supporting a wide range of water program needs. Guidance recently issued by EPA directs states to include near coastal water body segments in the 305(b) reporting process. Marine criteria and standards under development will require the collection of ambient data. Establishing total maximum daily loads, wasteload allocations, and load allocations for estuarine areas will require additional monitoring data. The state 304(l) lists may not adequately represent near coastal water bodies impaired by toxic discharges, and development of the 319 lists and plans for addressing nonpoint source problems must be supported by marine and estuarine monitoring programs.

The objective of this workgroup is to consider how state monitoring programs can provide data for trend analysis, reporting, and decision making in estuarine and near coastal waters.

II. KEY ISSUES

- Coastal waterbody segmentation, relation to 305(b) reporting.
- Indicators, types, regional vs. national focus.
- Marine and estuarine monitoring methodologies.
- Design of coastal vs. fresh monitoring systems.
- Validity of 304(l) listing process, understanding toxic impacts.
- National/regional coordination of monitoring systems.
- Public involvement.
- Citizen's Monitoring.

Segmentation

1. What is the purpose?

   - Reporting
   - Segmentation

2. Segmentation should be connected to the waterbody system.

3. 305(b) may not be the appropriate mechanism for reporting.

4. Need to connect with EMAP (Environmental Monitoring and Assessment Program).

5. Methodologies must be flexible according to unique physical characteristics. Some systems cannot be compared. Other factors must be taken into account including, population and salinity. Existing systems should be used as models.

6. Other opportunities for reporting include the proposed coastal legislation, the National Estuary Program, and other state activities (e.g., N.J. tourism data).

7. The next steps are to work with states to develop segmentation schemes. Use the State/EPA Agreements to accomplish this. Do pilot projects with interested states.

Indicators

1. New indicators are being used which provide information on toxics, oil spills, and ecological health (Puget Sound).

2. Existing data bases should be used such as the National Wetlands Inventory.

3. Some regions are using a regional focus - Region 9 for bioconcentration.

4. There should be interagency coordination, with agencies such as National Park Service, Fish and Wildlife Service, etc.

5. Data problems and gaps should be addressed. When you look for problems you often find them.

6. The next steps are to conduct technology transfer for different programs, support new research, and provide for state/EPA discussions.

Methodologies

1. Methodologies should focus on organics, looking at both tissue and sediments.

2. Protocols should be developed at both inter and intra agency levels.

3. Draft bioconcentration guidance should be developed.

4. Field sampling protocols should be developed and/or transferred.

5. EPA labs need to be better coordinated. In addition, a lab certification program is greatly needed to ensure consistent protocols and techniques.

6. Method comparison should be done around the country.

7. The next steps are to compile chapters to the OMEP Methods Compendium on organics and field sampling protocols, and begin to address the laboratory certification issue.

Design of Coastal vs. Freshwater Monitoring Systems

1. EMAP needs to be better understood as a tool. It may not be site specific enough.

2. Regions and States need more information on the status and findings of the National Academy of Sciences monitoring studies.

3. Time and space parameters need to be included in any monitoring guidance.

4. GIS systems should be further explored as tools to assist in coastal monitoring. What role do coordinates play?

Extent of Toxics; Validity of 304(l) Listing Process

1. Politics play a major role in designating water bodies.

2. Better information is needed on the impairment of beneficial uses, for example a summary of fish consumption advisories.

3. More information is needed on understanding impacts on the microlayer. A microlayer workshop was scheduled for Puget Sound in November 1989. Southern California is also doing some work on microlayer.

4. There is a need for further discussions to understand the validity of ranking waters. There was a discussion on the pros and cons of ranking certain waters, for example through the 304(l) process.

National/Regional Coordination of Monitoring Systems

1. A compendium with standardized QA/QC procedures is needed to support better national and regional coordination.

2. Regional agreement among states and dischargers is required to promote better regional coordination.

3. Permits can be used to reallocate and rearrange monitoring requirements. However, this requires cooperation between the discharger and the regulator.

4. Program coordination is resource intensive for regional staff.

5. EMAP should look at existing data to promote a strong national monitoring system.

6. Compliance monitoring should also be used to promote regional coordination.

Public Involvement

1. Everyone agreed that public involvement and understanding of monitoring information was essential to promote a better understanding of water quality issues. It was recommended that success stories and recovery stories be used to convey an ability to provide for successes. It is also critical to be sensitive to public perception.

2. The key issue here is the right people must develop materials. Sometimes press offices cannot transfer technical information accurately.

3. It is very important for monitoring managers to develop a good working relationship with the media to help promote positive communication networks.

Citizen's Monitoring

1. Puget Sound has had a successful citizen's monitoring program. One of its main accomplishments is putting people and agencies together. Certain parameters are more conducive to citizen's monitoring, for example nutrients. Information has not been used for enforcement purposes. Resource commitments are necessary to support citizen's monitoring.

2. The educational component is a strong outcome of citizen's monitoring.

3. Citizen's monitoring programs have to be aware of the safety and contamination issue.

III. RECOMMENDATIONS

1. Do pilot segmentation schemes with interested coastal states. This was the most contentious discussion in the workgroup. Opinions from the workgroup members echoed some of the same discussions we have had at the headquarters and regional levels since we first started talking about segmentation. The topic kept going back to 305(b). Most workgroup participants felt that 305(b) is not all it could be,

politics play a heavy role in states admitting where their problems are located. We should make 305(b) a more valid reporting mechanism. Most important in segmenting coastal areas is to work in a consultative process with the states.

2. Add sections on organics and field testing to our Methods Compendium.

3. Disseminate information on new indicators.

4. The next stages of the methods compendium should focus on organics, and field sampling protocols.

5. We should try to explore the use of EMAP in coastal systems and make it meet our needs.

6. We should continue to disseminate information on toxics monitoring. Puget Sound is hosting a microlayer workshop in November.

7. We should use the permit process to try and promote national and regional coordination of monitoring. The USGS Coordinating Committee should be made more useful.

8. Information on existing citizen's monitoring programs should be communicated to the regions and states (Puget Sound, Chesapeake Bay).

9. It is essential that monitoring information be transferred from monitoring programs to the public. A strong working relationship with the media is important. Success stories should be promoted.

6. Water Use: The Unfinished Business of Water Quality Protection

6. WATER USE: THE UNFINISHED BUSINESS OF WATER QUALITY PROTECTION

LARRY MACDONNELL
NATURAL RESOURCES LAW CENTER
UNIVERSITY OF COLORADO

It is a real honor to be invited here to speak to this National Symposium on Water Quality Assessment. The work you are doing to implement effective water quality programs is absolutely essential. The exchange of ideas and approaches here at this meeting has been impressive.

I am especially pleased to be able to speak to this group of water quality professionals. Normally I find myself at meetings primarily with lawyers. Now I have noticed that lawyers have become one of the favorite targets of jokes at these meetings. That did not bother me too much until one day not long ago my fourteen year-old daughter came home and asked me what is black and brown and looks good on a lawyer (Answer: A doberman pincher).

I know that some people think that lawyers are not as ethical as they should be. As someone who teaches law students, the ethics of the legal profession concern me a great deal. But I want you to know that lawyers are much more sensitive to this concern than ever before. For example, not long ago a lawyer of my acquaintance told me this story: A client came to him needing a will to be drawn-up. She was an elderly woman and there were some special matters concerning her estate that needed to be considered. My acquaintance drafted the will for his client. She was very pleased and took a $500 bill out of her purse and put it on the lawyer's desk as she was leaving. After the client left, the lawyer picked up the cash and discovered that there were actually two $500 bills stuck together. Immediately my acquaintance realized that he was faced with a major ethical dilemma: should he tell his partner about the extra $500 or not?

The topic I have been asked to address this evening is the water quality/water quantity relationship. This is a topic that people in the west, and especially here in Colorado, debate quite fiercely. Much has been written on the subject and we at the Natural Resources Law Center have just completed a draft report containing the findings from research we have done on this issue. I would like, tonight, to give you a summary of our findings and conclusions and <u>ask for your comments.</u>

We started with the self-evident proposition that all uses of water affect the quality of that water. Equally important, uses of water are dependent on the quality of the water. Given this direct and immediate relationship, we asked why water quality regulation does not address water use. We also asked why water allocation decisions so infrequently consider water quality. It seemed clear to us that both these things should be happening.

The geographic area of our analysis was the 19 western States partly or wholly west of the 100th meridian -- that magical dividing line west of which rainfall cannot be relied on to supply most of the water needed for agriculture.

We found that there has been very little systematic thinking about the ways that water use affects water quality. Based on our preliminary analysis, we characterized four kinds of effects:

1st - DEPLETION DEGRADATION: Where depletion of streamflows associated with water use increases the concentration of existing pollutants to the impairment of other uses and values of water.

Unsurprisingly, this appears to be the major water quality impact of water use in the arid west where streamflows already are low and there has been intensive development and use of the available flows.

An important example of water quality problems arising from streamflow depletions is the Bay-Delta situation in northern California. The flows from the Sacramento and San Joaquin River basins come together in a 738,000 acre area known as the delta and then empty into the San Francisco Bay. These rivers drain about 40% of the State of California. Annual average flows would be about 20 million acre-feet under undeveloped conditions. However, because of consumptive uses, in-basin and out-of-basin diversion of water, annual average flows are less than half this amount. One consequence of this drastic decline in normal flows is that salt from the Bay has moved up into the Delta adversely affecting agricultural and industrial activity in the area, harming drinking water supplies, and interfering with the migration and survival of certain fish species.

Another well-known example of large cumulative depletions of streamflows causing water quality problems is the Colorado River. In this basin, evaporation from reservoirs alone causes a loss of 2 million acre-feet of water each year. Total depletions in the basin now take roughly 9 million of the 15 million acre-feet available, on average, each year. Nearly half of the salinity in the Colorado River results from natural sources. The depletion of streamflows greatly concentrates the amount of salts in the River. Monetary damages from this salinity have been estimated at millions of dollars each year.

Depletion-related problems also are arising on a more site-specific basis. Let me give you an example from Colorado. Several years ago, the City of Pueblo filed an application with the water court for approval of an exchange it wanted to make. Pueblo proposed to exchange treated effluent from water it had imported into the Arkansas River basin from the west slope of Colorado. The transmountain-derived effluent would be exchanged for native Arkansas River water. One effect of this exchange would be to reduce flows in the Arkansas above Pueblo where the cities of Florence and Canyon City are located. These two cities objected to the exchange because the depletion caused by the exchange would increase pre-existing concentrations of contaminants such as salinity, adversely affecting drinking water supplies. They also were concerned that increased depletions would cause the water quality standards to have to be tightened, which in turn would mean that they would have to install additional treatment for their wastewater. The water court granted Pueblo's exchange but required that it not be operated if it would reduce the streamflows in this reach of the Arkansas below a specified minimum (essentially the 7Q10 flows).

This depletion issue is especially sensitive because most water uses in the west are consumptive. Some people seem to feel that because depletion is a consequence of water use, the water quality implications of depletion should not be considered. Indeed, it has even been suggested that a water right is nothing more than a right to deplete, and that therefore the depletive effects of a water right may not be addressed. I'll return to this point later.

A second type of water use - water quality effect - we described as physical alteration: where uses of water alter the physical characteristics of the water, causing impairment of other uses and values.

Impoundment of water for various uses can cause physical alteration of the water. Oxygen levels may be depleted; mineralization may be increased; temperature may be changed; sediment levels may be changed; supersaturation may occur.

For example, releases from Shasta Dam on the Trinity River in California in the summer are higher in temperature than desired for maintenance of salmon spawning in that area. California agencies have been battling with the Bureau of Reclamation to obtain releases of lower temperature water.

A third type of water use - water quality effect - we characterized as pollution migration: where uses of water cause pre-existing pollution to contaminate additional water.

A good example of this kind of problem is found in the Salt Lake Valley where very active pumping from a lower aquifer has created a reverse gradient causing contaminated water from the upper, more shallow aquifer to migrate to the lower aquifer. Continued uncontrolled pumping will result in contamination of this source which presently supplies about 40 percent of the drinking water for the Salt Lake City area.

Saltwater intrusion in coastal areas is another common example of water quality problems arising from the pumping of groundwater.

A fourth type of water use - water quality effect - we characterized as incidental pollution: where uses of water incidentally load pollutants but are not regulated.

The major example in the west is the addition of pollutants to both surface and groundwater in return flows and percolation of water used in irrigated agriculture. In many settings, the soils being irrigated contain high concentrations of contaminants which are picked up by the water and then moved to the stream or aquifer. Chemical contaminants from fertilizers and pesticides may also be carried to streams and aquifers as a result of irrigation. A dramatic example of this problem is provided by the selenium poisoning of fish and birds in the Kesterson Wildlife Refuge. High levels of selenium exist in the soils in this area of the central valley of California. Irrigation return flows caused the selenium to be washed out of the soils. These return flows ended up at Kesterson where they concentrated to lethal levels.

The Federal Clean Water Act does very little to help with these problems. Although its stated purpose is to restore and maintain the physical, chemical, and biological integrity of the Nation's waters, the Clean Water Act focuses almost exclusively on controlling discharges of pollutants from point sources. It is evident that congress in 1972 saw the water quality problem as caused by the discharge of pollutants from industries and cities. The remedy was a technological fix: require the clean up of industrial discharges and provide major grants to construct municipal wastewater treatment facilities. Now 17 years after the institution of this approach, it is clear that we were only looking at half the problem.

The problems of incidental pollution associated with irrigation were put aside by Congress in 1977 when it exempted irrigation from regulation as a point source. In two decisions by federal courts of appeal, other aspects of water use were determined not to be governed by the Clean Water Act. In National Wildlife Federation v. Gorsuch (1982), the circuit court upheld the EPA determination that dams are nonpoint sources; thus the physical alteration effects associated with dams are not subject to point source regulation. In National Wildlife Federation v. Consumer Power Company (1988), the court ruled that a hydro-electric facility was not subject to the point source requirements of the Clean Water Act. The essential rationale in these decisions is that these facilities do not by themselves add pollutants to water and thus do not fall within the activities that Congress sought to regulate under the Clean Water Act.

Moreover, in 1977 Congress adopted the so-called Wallop amendment declaring the policy of Congress that the authority of the States to allocate quantities of water within their jurisdiction is not superseded or impaired by the Clean Water Act. This amendment manifests Congress' intention to minimize involvement in water allocation decisions but does not preclude legitimate and necessary water quality regulation affecting water allocations.

Because of these limitations in federal law we turned our attention to approaches at the state level and identified four general ways in which the states may address the relationship between water quality and water quantity.

1st - The states can use the water allocation system itself to address the water quality effects of water use.

Thus water quality can be made an explicit consideration in water allocation decisions. In areas where streams are already water quality limited, additional depletions of water may not be acceptable. Depletion may be an inevitable consequence of most water uses but it seems to me that we may have reached the point in the west where we need to assure that any additional depletions are absolutely necessary. This may mean that new appropriations will have to demonstrate that the associated water use will satisfy some required level of efficiency. We may also want to consider some kind of a depletion tax on all new appropriations with the funds used to improve instream flow water values such as water quality and habitat for fish and wildlife.

Certainly where existing water rights may be impaired, most states would prevent new appropriations. New Mexico has done this in the case of requested changes in groundwater withdrawals where there was evidence that the change would harm other groundwater users.

States may impose conditions on new water uses requiring water quality protection. California now includes a condition in new appropriative permits stating that the quantity of water allocated may subsequently be modified if found to be necessary to meet water quality objectives in water quality plans.

Existing water uses that are wasteful of the resource could be declared nonbeneficial. Thus, a polluting water use could be restricted or even precluded for failure to satisfy the beneficial use requirement of western water law.

In several states the public trust doctrine is emerging as a means by which the water quality-impairing effects of water use may be controlled. California courts have explicitly tied the public trust doctrine in that State to the water quality problems in the Bay-Delta.

In recent years, western states have established programs to protect instream flows. Generally, minimum flows may be protected where necessary to support a fishery. Only a few states recognize water quality as a basis for protecting streamflows. Some argue that instream flows may not be protected for water quality purposes because "dilution is not the solution to pollution." In fact, maintenance of the assimilative capacity of streams is essential to maintaining the water quality of those streams. Unregulated, uncontrolled pollutants enter into our streams from a large number of sources. These include natural sources such as salt springs and human-induced sources such as abandoned mines and, of course, irrigation return flows.

Moreover, as discussed in the example of exchanges in the Arkansas River, the ability of dischargers to meet their permit requirements depends on the quantity of water in the stream. Total elimination of all contaminants is not technically or economically feasible at this time. In many locations, treated effluent represents an important water supply for downstream users. There is a need to assure that there will be enough assimilative capacity in the stream so that the water is adequate both in quantity and in quality.

2nd - The states can address the effects of water uses within their existing water quality programs.

As discussed today, nonpoint source programs are now being developed by many States in response to the 1987 amendments to the Clean Water Act. These programs should address the problems of incidental pollution associated with irrigation and physical alteration associated with hydrologic modifications. At this point, the process is proceeding largely on the basis of consensus and cooperation. Progress is being made in states like Idaho but in other states program development is not yet as far along.

The antidegradation policy now required in all state water quality programs offers an opportunity to review proposed water development plans in relation to their effect on weed quality. Any project needing a federal permit must receive a certification from the state that it will comply with state water quality requirements. This so-called 401 certification provides states with an excellent opportunity to protect water quality since almost all water development involves some kind of federal permit, such as a section 404 permit.

3rd - The states can integrate and coordinate water quality and water allocation responsibilities.

In most states, these responsibilities are in totally separate agencies. There is often little or no communication between personnel in these offices and typically very little effort to coordinate related activities.

Kansas is an example of a state that has developed coordination through its water planning process and through a Memorandum of Understanding between the Environment Division and the Water Resources Division by which the Environment Division identifies areas where water quality is a special concern and also provides recommended water quality conditions for water permit applications.

California has merged water quality responsibilities with water allocation responsibilities in a single agency - the State Water Resources Control Board. Permits for new appropriations require the water user to comply with water quality plans formulated by the Board and by nine regional boards.

4th - The states can make use of special water management areas for the purpose of protecting water quality.

It is important to remember that, for the most part, the quality of our waters meets the uses from which the water has been designated. Water quality problems often exist in relatively discrete and identifiable areas.

Many western states already have statutes authorizing the creation of a special water management area. In most of these states, water quality problems can be a basis for creating such an area. Once these areas are established, special management authority can be exercised. Typically, this includes the possibility of limiting new development of water. Generally it also allows some regulation of existing uses. One important limitation, however, is that in most states such areas can be established only for groundwater.

The Alaska Department of Natural Resources used this approach to establish a "Critical Water Management Area" just north of Juneau so that it could control pumping of groundwater causing saltwater intrusion. Kansas established an intensive groundwater use control area" for the Equus Beds aquifer near Wichita as a means of controlling pumping that was causing the spread of a plume of saline contamination.

Nebraska is attempting to have local natural resource districts create and implement water plans to deal with problems of groundwater contamination in state-identified "special protection areas". Groundwater quality problems related to fertilizer use have been identified in areas of that state.

We heard today about the process in Idaho for establishing streams of special concern. I find this approach of creating special management areas attractive for several reasons. First, it targets areas where problems exist or where special protection is desired. Second, it encourages a more comprehensive consideration of the problem. The sources of the problem can be identified. Approaches tailored to meet the problem can be devised. Finally, there seems to be more general acceptance of the need to control water use where necessary in such management areas.

Water quality control is incomplete. So long as we exclude water use from consideration for its water quality effects we will never have an effective program of water quality protection. Water use depletes streamflows essential for maintaining assimilative capacity and sustaining water quality. Water use can physically alter characteristics of water critical to certain uses. Water use can cause migration of pollutants, contaminating previously good quality water. Water use such as irrigation can add pollutants to streams and aquifers through return flows.

There are a variety of ways in which states can address these problems. In many cases there are existing laws and programs that could be utilized.

First, it seems to me, we must begin to explicitly recognize the nature and scope of the problem. We have focused too exclusively on controlling the discharge of pollutants from point sources.

As we begin to shift our thinking toward the protection of water quality as our objective, we will necessarily see the need to address all sources of water quality degradation, whatever their cause.

Inevitably we will recognize the multiple effects of water use on water quality. Gradually we are broadening our ideas about the values of water. We see it, even here in the west, not only in terms of the consumptive uses it enables, but also for the many nonconsumptive values it supports.

Second, water quality should be incorporated into state water planning processes.

Third, water quality considerations should be directly integrated into water allocation decisions. The water quality effects of new appropriations should be addressed as should the effects of changes and exchanges.

Fourth, minimum streamflows should be protected for water quality purposes.

Fifth, elements of water quality programs, such as the 401 certification process, should be used to insure full protection of state water quality requirements.

Sixth, special management areas should be used to protect high quality areas and to improve water quality in problem areas.

In these ways we can achieve the water quality objectives toward which we have been moving.

7. Poster Session Abstracts

7. POSTER SESSION ABSTRACTS

SECTION 305(B) WATERBODY SYSTEM

Chris Faulker
U.S. EPA Headquarters

The Waterbody System (WBS) is a software package designed to track water quality assessments and related information useful for managing water quality programs. It is not intended to store or analyze raw monitoring data. The WBS also facilitates State preparation of the biennial report on water quality status required by §305(b) of the Clean Water Act. Version 2.0 of the WBS software was released to State personnel in August of 1989. Presently, EPA is supplying training in the use of the system to interested water quality program managers, and contractor assistance to help States enter their water quality assessment data into the WBS.

SILVICULTURE BEST MANAGEMENT PRACTICES -- A COMPREHENSIVE ASSESSMENT

Barry Gay
Florida Department of Environmental Regulations

Silvicultural Best Management Practices (BMPs) have been the primary tool to prevent nonpoint pollution associated with forestry operations. These practices are viewed as voluntary in Florida if satisfactory compliance continues. The State's water quality agency designated the Florida Division of Forestry (DOF) as the lead agency responsible for assessing compliance. To address this charge, the DOF has conducted biennial compliance surveys since 1981. The survey consists of aerial site identification followed by on-the-ground inspections. A comprehensive questionnaire addresses each aspect of the timber operation with emphasis on access systems, site preparation techniques, and harvesting procedures. These inspections are conducted with the land manager and provide a valuable educational opportunity. To date, results from past surveys reflect a favorable level of compliance. In addition, these results provide useful information for targeting geographic areas in need of assistance and identifying specific practice needs. The survey technique has proved successful and will be valuable to address concerns pertaining to other specific watersheds, to other areas in which management guidelines are used, and to support land use options available to landowners.

EVALUATION OF NON-POINT SOURCES OF POLLUTION AT THE FORT DARLING UNIT OF RICHMOND NATIONAL BATTLEFIELD PARK, VIRGINIA, USING A RISK ASSESSMENT APPROACH

Terry Craig
National Park Service

In 1975, 25 acres adjoining the Ft. Darling Unit of Richmond National Battlefield Park were donated to the National Park Service (NPS) by Chesterfield County, VA. The county operated a landfill on the acreage from

1963 to 1972, but it has subsequently been covered and revegetated. The Water Resources Division, NPS, is currently involved in a study to determine potential environmental risks from the landfill material and leachate that is seeping into a creek flowing through the park. The property around a nearby petroleum storage facility and an asphalt plant are also possible sources of contaminants.

Because the complexity of non-point pollution sources requires a thorough and systematic approach, a risk assessment method has been adopted for this study. An evaluation to determine whether existing use of this historic site can be preserved will involve the following: 1) a technical description of sources of the present or potential impact, including an estimate of the composition and quantity of any contaminants; 2) a description of the environment including geologic, meteorological and hydrologic characteristics and the biota exposed to any contaminants; 3) determination of the nature and distribution of any contaminants using information from past site investigations as well as water chemistry tests and toxicity and hydrologic studies; and 4) determination of the effect of any contaminants on the organisms or humans who may come in contact with them. Preliminary investigations of the landfill leachate using bioassays have revealed that no acute hazard exists at this time. However, initial priority pollutant analyses indicate the need for further study.

THE FEDERAL HIGHWAY ADMINISTRATION'S WATER QUALITY RESEARCH PROGRAM

Byron Lord
Federal Highway Administration

This past year, 1989, marks the completion of a major segment of the Federal Highway Administration's (FHWA) environmental research program. Since the early 1970's, FHWA has conducted a four-phased research program in non-point source pollution from highway runoff. Phase 1 identified the constituents of highway runoff and developed a database of highway runoff quality and quantity. Phase 2 identified the sources and migration patterns of highway runoff constituents and further developed the Phase 1 database. Phase 3 results indicated that highway facilities with low to medium average daily traffic (ADT) (less than 30,000 vehicles per day) exhibited minimal impact on receiving waters. Phase 4 has developed a new predictive procedure for estimating the pollutant loadings from highway sources, and has identified practical, effective, and implementable mitigation measures to reduce or eliminate the impacts from highway runoff.

Demonstrated during the poster session will be a probabilistic model which provides a procedure for estimating the pollutant loadings from highway stormwater runoff. The model estimates loadings for the major pollutants found in highway runoff. The model is based upon the analysis of 993 individual storm events from 31 highway sites.

USE OF SHORT-TERM-EXPOSURE BASKET SAMPLES FOR ECOLOGICAL ASSESSMENT OF METAL IMPACTS ON MACROINVERTEBRATE COMMUNITIES

James E. Pollard
Lockheed-ESC, Las Vegas, Nevada
and
Wesley L. Kinney
USEPA, EMSL-LV, Las Vegas, Nevada

The effectiveness of short exposure time using rock filled basket samplers was tested in a Montana stream with a clearly defined point source of metals. Baskets were exposed for 16 hours at four sites along the stream representing various levels of metal impact. Box samples and drift samples were collected from the same sites for comparison. All samplers collected a sufficient number of animals per sample unit at all sites along the metal impact gradient to demonstrate the deleterious effect of metals on the benthic community. The taxonomic composition of the various sampling methods, however, was quite different. Baskets were dominated by simuliids, while box and drift samples were dominated by mayflies. Most taxonomic groups were significantly reduced by the metal input to the stream with the exception of the Brachycentridae and Tipulidae. The effect on the chironomid community was not clearly demonstrated by basket samples due to the low numbers of animals collected, while box and drift samples collected sufficient specimens to demonstrate a sharp reduction of numbers for this group. These data indicate that short term exposure basket samples may be as effective as other macroinvertebrate monitoring methodologies in assessment of the ecological impact of pollutants on stream ecosystems.

Notice: Although the research described in this article has been supported by the United States Environmental Protection Agency under Contract Number 68-03-3249 to Lockheed Engineering and Sciences Company, it has not been subjected to Agency review and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred. The mention of trade names or commercial products does not constitute endorsement or recommendation for use.

DEVELOPMENT OF MAXIMUM SPECIES RICHNESS LINES: A COMPARISON OF METHODS

Nancy J. Hoefs,[1,2]
Terence P. Boyle,[1]
and
Kurt D. Fausch[2]

The relationship between species richness and stream size has been well documented in fish communities. Criteria used to assess the expected species richness needs to reflect this relationship. By plotting species richness as a function of stream size, a maximum species richness (MSR) line that includes 95 percent of the sites, can be used to define the upper boundary of the data. The MSR line describes the expected maximum number of species, or the potential number of species present at a nondegraded site of a given size. MSR lines are usually fitted by eye and, as such, are open to bias. The subjectivity associated with these lines makes comparison between

different MSR lines difficult. To avoid the subjectivity of this method, two statistical methods of estimating MSR lines were investigated. In the first, a modification of the least squares procedure, a MSR line is obtained by the addition of a constant, and refitting of a least squared line incorporating 95 percent of the original data. The second method, a nonparametric maximum likelihood approach, defines the parameters of a line describing the upper boundaries of the data using an unknown mixing distribution which accounts for the vertical spread of the points.

[1]Water Resources Division
National Park Service
Fort Collins, CO

[2]Dept. of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO

THE EFFECT OF TRIBUTARIES ON THE STRUCTURE AND FUNCTIONAL GROUPS COMPOSITION OF THE BENTHIC MACROINVERTEBRATE COMMUNITY IN THE SAINT CROIX RIVER, MN AND WI

Terence P. Boyle
and David R. Beeson,
Water Resources Division,
National Park Service, Fort Collins, CO

In order to monitor the potential effects of land use affecting natural resources in the Saint Croix National Scenic Riverway the mouths of five tributaries were selected for study. The study examined the premise that differences in the sub-basins and non-point source effects on water quality could be monitored at the mouths of tributaries in a point source fashion. Total phosphorous, total nitrogen, and coarse particulate organic matter were generally higher in the main stem of the river below the tributaries. The macroinvertebrate community was affected in the main river below the mouths of the tributaries by reduced diversity and increased numbers of shredders. The development of strategies to use macroinvertebrates upstream and downstream from major tributaries as indicators of sub-basin effects on water quality are discussed in the context of the River Continuum Concept.

A REGIONAL APPROACH TO WATER QUALITY MANAGEMENT

Andrew Kinney
NSI Technology Services Corporation

A regional approach for water quality management was developed in cooperation with the Environmental Protection Agency's Environmental Research Laboratory - Corvallis. This approach was developed to assist managers of aquatic and terrestrial resources to better understand the realistically attainable quality of their resources. The approach examines the spatial patterns of environmental resources and their associations with landscape characteristics or anthropogenic impacts to assess their extent, status, or trends. The regional approach increases the efficiency of research through the determination of homogenous regions by recognizing similarities among terrestrial factors including land use, land surface form, potential natural vegetation, and soils and their associations with impacts or stressors. A stratification that recognizes similarity among ecosystems and their causal factors, reduces variation present when

different ecosystems types are combined, as in political or hydrologic stratifications. The regional approach serves the same purpose as sample stratifications in experimental design; it increases precision of estimates for the same research effort. This approach has been employed by the EPA in their National Surface Water Survey, Ecoregions work, Clean Lakes Project, and Wetlands Research Program.

THE USE OF BIOCRITERIA IN THE OHIO EPA BIOLOGICAL MONITORING AND ASSESSMENT PROGRAM

Chris O. Yoder
Ohio EPA

Ohio EPA has operated a program of biological surveys since the late 1970s. Their initial purpose was to provide an integrated set of biological and chemical data for use in monitoring/reporting activities and the water quality standards (WQS) program. An outgrowth of this initial effort was the development of biological criteria ("biocriteria") as an ambient aquatic life use goal assessment tool. Biocriteria are currently being proposed as a part of the Ohio WQS regulations.

Concepts important to this approach include a practical definition of biological integrity, recognizing the characteristics inherent to chemical assessment ("bottom up" approach) and biocriteria ("top down" orientation), the role of ecoregions, and the regional reference site approach. These are important concepts in the development and application of biocriteria.

Current program uses of biocriteria include water quality standards, NPDES permitting, basic monitoring/reporting, nonpoint source assessment, enforcement/litigation, dredge and fill issues, and CSO/stormwater management. One new area of use is with Natural Resource Damage Assessments. Examples of biocriteria application are illustrated and include stream specific assessment, trend reporting and assessment, and providing information about rare and endangered species.

Fish and macroinvertebrate sampling procedures are also summarized with cost and resource requirements. The Index of Biotic Integrity (IBI), modified for application in Ohio, and the Invertebrate Community Index (ICI) are two of the principal evaluation tools used by Ohio EPA. Possible application of these methods to the Ohio River illustrates the potential of this approach for assessing large water bodies in the midwest.

LIMITATIONS OF THE INDEX OF BIOTIC INTEGRITY FOR ASSESSING DEGRADATION IN A WESTERN GREAT PLAINS WATERSHED

Kurt D. Fausch and Robert G. Bramblett
Dept. of Fishery and Wildlife Biology,
Colorado State University

We applied the index of biotic integrity (IBI) to the portion of the Arkansas River basin in the Southwestern Tablelands ecoregion, located in southeastern Colorado. The lotic systems in the basin are characterized by harsh flow regimes and low habitat diversity. As a result, the fish fauna is depauperate, consisting only of 26 native species in 8 families. Cyprinids make up half the fauna, while other families contribute three or fewer species. Most of the species have generalized habitat, trophic, and reproductive requirements, and the only two intolerant species are sporadically distributed. We found only nine IBI metrics that could be modified for the basin, due largely to the depauperate and tolerant ichthyofauna. We attempted to apply the index to the Purgatoire River in Pinon Canyon, a remote and relatively undisturbed canyon reach on a seventh-order Arkansas River tributary. However, fish community data collected over a six-year period indicate that natural fluctuations in abundance of red shiner, a tolerant omnivorous species, caused wide fluctuations in IBI scores despite lack of obvious changes in environmental quality. We therefore suggest that the IBI might be modified to include other taxa such as macroinvertebrates, while still retaining the underlying ecological framework, to increase its usefulness for monitoring water resource quality in the Arkansas River basin.

ILLINOIS VOLUNTEER LAKE MONITORING PROGRAM

Gregg Good,
Lakes Program Manager,
Illinois Environmental Protection Agency

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) began. One hundred forty-one volunteers and 87 lakes became the building blocks for a program that now has over 225 volunteers monitoring more than 150 lakes each year. From 1981-1988, volunteers have logged in over 24,000 hours of data collection services on over 400 Illinois lakes. The Illinois Environmental Protection Agency administers this program that is designed to create a public awareness of lake management, restoration, and preservation. In 1988, over 170 lakes were registered to be monitored for Secchi transparency, water color, suspended algae/sediment, and amount of macrophytes present, at least twice a month from May through October. Forty-nine lakes are also being sampled for water quality parameters including total and volatile suspended solids, ammonia-nitrogen, nitrate, nitrite-nitrogen, and total phosphorous once a month from May through October.

This exhibit is an overview of the Illinois VLMP, particularly the 1988 monitoring season. Awards received by the volunteers for exceptional service and examples of what/how data is collected are provided.

CITIZENS' STREAMWALK CHECKLIST AND DATA MANAGEMENT SYSTEM

Sally Marquis
U.S. EPA Region 10

Citizens throughout the Pacific Northwest Region are sampling rivers and streams in ever-increasing numbers. This is exciting and positive, but it has also created some problems. Quality assurance and quality control, water quality comparisons and trend monitoring are all virtually impossible, because they are utilizing a multitude of inconsistent sampling techniques. The objectives of this project are to help educate citizens about stream and riparian quality, to help them document and monitor the overall condition of sampled watercourses, and to provide the gathered information in a form which can be stored, evaluated, and made available to other users. The checklist is currently being used and modified by citizen's groups in the Puget Sound area. The data management system consists of a PC compatible dBase 3+ program for input and display.

ASSESSING NONPOINT SOURCE POLLUTION WITH REMOTE SENSING AND BIOMONITORING

Frank J. Sagona
Tennessee Valley Authority

The Tennessee Valley Authority (TVA) utilizes low altitude remote sensing and stream biomonitoring techniques to identify and locate individual nonpoint pollution sources (NPS) and to assess the cumulative impact on water resources. Assessment of this information provides a means to identify subwatershed areas that have a high potential for NPS impacts and to target technical and financial assistance to specific problem sites for treatment.

BIOLOGICAL CRITERIA

Robert M. Hughes and Jane Ely
NSI Technology Services Corporation

This poster outlines an alternative approach to current water quality monitoring and assessment. Several frequently mentioned concerns with current methods are listed, along with the advantages of biological criteria. Techniques for minimizing the influence of temporal and spatial variability are presented. Illustrations are given of biomonitoring cost efficiency, functional and structural measures of integrity, ecoregional patterns in fish assemblages, temporal and spatial evaluations of stream health, and the coordination of biocriteria with other criteria.

WATER QUALITY MONITORING FOR NONPOINT SOURCE MANAGERS

Steven Coffey and Michael Smolen
North Carolina State University

The purpose of a nonpoint source (NPS) land treatment project is to restore or protect the beneficial use or ecological integrity of a water resource. Watershed and water quality monitoring may be required to document the sources and impacts of NPS pollutants and track the effectiveness of their control. Eficient monitoring documents those changes in water quality parameters and land management directly related to project objectives and activities. Monitoring to support the manager's information needs is a step by step process that requires analysiss of project objectives, investigation of the problem, determination of approach aand development of a design before monitoring begins. Monitoring approaches include the measurement of pollutant flux and the assessment of the state of the resource such as habitat, chemical and biological features. The level of monitoring detail is determined from monitoring objectives and system variability. Use of historical data, experiemental design and statistical analyses are essential to formulating an effective monitoring program design.

Appendices

APPENDIX A

Symposium Agenda

AGENDA

National Symposium on Water Quality Assessment
October 16-19, 1989
Fort Collins, Colorado

Monday, October 16

10.00-1·00 Registration

1 00-3.30 **Introduction**
1 00-1:10 Welcome - Max Dodson, Director, Water Division, U S EPA Region 8
1 10-1:30 Opening Remarks - Geoff Grubbs, Director, Assessment and Watershed Protection Division, U S EPA
1·30-1:50 Keynote Address - Carol Jolly, Water Quality Program Manager, Washington Department of Ecology
1:50-2:00 Agenda, Logistics
2 00-2.20 NPS Monitoring. Overview - Debra Caldon, U S EPA Region 9
2:20-2:40 Integrated NPS Monitoring Plans and Agency Coordination - Don Martin, U.S. EPA-Idaho Operations Office
2:40-3·00 Monitoring Aquatic Resources in Washington Forest Lands - Dave Somers, Tulalip Tribal Fisheries
3.00-3:20 Questions and Answers
3·20-3:50 Overview of Workgroup Topics - Geoff Grubbs, Director, Assessment and Watershed Protection Division, U S EPA
3·30-3:50 Break
3 50-5.30 **Workgroup Sessions (All Workgroups)**
3·50-4:00 Breakout for Workgroups
4 00-5 30 Workgroup Discussions

7 30-9 30 Caucus with the EPA Steering Committee for Water Quality Data Systems (All Symposium Participants Welcome)

Tuesday, October 17

Concurrent Sessions

8·00-10:30 **Session 1: NPS Management and Antidegradation** - Chair, Jim Weber, Columbia River Intertribal Fish Commission
8.00-8·10 Session Overview, Chair
8:10-8:30 Implementing Idaho's Antidegradation Policy and Draft Sediment Criteria into a Monitoring Strategy - Bill Clark, Idaho Department of Health and Welfare
8 30-8:50 Negotiating Antidegradation Policies - Frank Gaffney, Northwest Renewable Resources Council
8 50-9:10 Identifying Outstanding Resource Waters - Jim Overton, North Carolina Division of Environmental Management
9:10-9:30 When Degradation is Inevitable· Win Win is Not Always Possible - Jim Jensen, Montana Environmental Information Center
9:30-9:50 Idaho's Antidegradation Policy An Example for Other States? - Jim Weber, Columbia River Inter-Tribal Fish Commission
9:50-10:10 Questions and Answers
10:10-10:30 Break

8:00-10:30 **Session 2: Assessing Sediment and Tissue Contamination** - Chair, Mike Kravitz, U S. EPA Headquarters
8:00-8:10 Session Overview, Chair
8:10-8:25 National Bioaccumulation Study - Ruth Yender, U.S. EPA Headquarters
8:25-8:45 California State Mussel Watch Program - Tim Stevens, California State Water Resources Control Board
8:45-9:00 Sediment Classification Methods Compendium - Mike Kravitz, U S. EPA Headquarters
9.00-9·20 Sediment and Fish Tissue Contamination in the Pigeon River, Jerry Stober, U S EPA Region 4
9.20-9:40 Dredged Material Disposal Site Monitoring in New England - Tom Fredette, US COE, New England Division
9:40-9:55 Contaminated Dredged Material Testing and Management Strategies, Craig Vogt, U S EPA Headquarters
9:55-10:10 Questions and Answers
10:10-10:30 Break

10:30-12:00 **Evaluation of BMP Effectiveness** - Chair, Phil Larsen, U.S. EPA-Corvallis
10:30-10:50 Classification of Riverine/Riparian Complexes for BMP Effectiveness - Bill Platts, Don Chapman Associates
10:50-11:10 Classification of Riverine/Riparian Habitat and Assessment of NPS Impact The North Fork Humbolt River, Nevada - Sherman Jensen, White Horse Associates
11:10-11:30 Recognition of Critical Riverine/Riparian Habitats - Jeff Cederholm, Washington Department of Natural Resources
11:30-11:50 Monitoring Effectiveness of BMPs The Idaho Experience, Tim Burton, Idaho Department of Health and Welfare
11:50-12:00 Questions and Answers

12:00-1:00 **Lunch**

Tuesday, October 17 (Continued)

Concurrent Sessions

1:00-3:50	**Session 3: Inland Wetlands and Riparian Issues** - Chairs, John Maxted, U.S EPA Headquarters and Paul Adamus, NSI Technical Services Corporation
1 00-1:10	Session Overview, Chair
1 10-1:30	Assessment of Wetlands Impacted by Mine Wastes, Inland Wetlands and Riparian Issues- David Cooper, Colorado School of Mines
1 30-1:50	Ten Years of Changes in Water Quality of a Prairie Wetland Complex in the Missouri Coteau, North Dakota - Jim Le Baugh, U.S. Geological Survey
1:50-2:10	Vertebrates as Indicators of Land-Use Changes in the Wetland, Stream, and Riparian Portions of Watersheds - Robert Brooks, Pennsylvania State University
2 10-2.30	Riparian Evaluations - William Platts, Don Chapman Associates
2.30-2:50	Break
2.50-3.10	Use of Riparian Data to Make Management Decisions - Wayne Nelson, SAIC
3.10-3.30	Waters Ignored by Ambient Monitoring Programs A National Review of Biomonitoring of Wetlands - Paul Adamus, NSI Technical Services Corporation
3 30-3 50	Questions and Answers

1 00-3.50	**Session 4: Marine and Estuarine Monitoring** - Chair, Ed Liu, U.S. EPA Region 9
1 00-1.10	Session Overview, Chair
1 10-1 30	Environmental Monitoring in the National Estuary Program, Tom Armitage, U S EPA Headquarters
1 30-1:50	Development and Implementation of a Regional Estuarine Monitoring Program - Andrea Copping, Puget Sound Water Quality Authority
1:50-2:10	Flexible and Regional Monitoring. A Discharger's Plea - John Dorsey, Hyperion Treatment Plant, City of Los Angeles
2 10-2.30	A Water Quality Monitoring Program for Hawaii's Surface Waters - Eugene Akazawa, Hawaii Department of Health
2.30-2:50	Break
2 50-3:10	Southern CA Bight Marine Ocean Monitoring - Ed Liu, U S EPA Region 9
3:10-3:30	Monitoring the 106-Mile Sludge Disposal Site - Susan Hitch, U.S. EPA Headquarters

3:50-5:30	**Workgroup Sessions (All Workgroups)**
3:50-4:00	Breakout for Workgroups
4.00-5:30	Workgroup Discussions

7:00 PM	**Banquet with Guest Speaker**

Wednesday, October 18

Afternoon Poster Session with an Evening Reception

8:00-8:40	**Overview of Bioassessment** - James Karr, Virginia Polytechnic Institute and State University
8 40-8:50	Questions and Answers
8:50-9:00	Breakout for Concurrent Sessions

Concurrent Sessions

9:00-11:50	**Session 5: Integrated Field Assessments**- Chair, Jim Plafkin, U S. EPA Headquarters
9 00-9:10	Session Overview, Chair
9:10-9:30	EPA's Rapid Bioassessment Appproach-An Assessment of Biological Impairment in the Context of Habitat Quality - Mike Barbour, EA Engineering Science and Technology
9.30-9 50	Oregon's Bioassessment Program - Rick Hafele, Oregon Dept. of Environmental Quality
9:50-10:10	Modification and Assessment of an Index of Biotic Integrity to Quantify Stream Quality in Southern Ontario - Robert Steedman, Ministry of the Environment, Ontario, Canada
10:10-10:30	Break
10:30-10:50	Assessing Impacts of Sediment on Target Beneficial Uses - Steve Bauer, Idaho Department of Health and Welfare
10 50-11:10	Integrated Basin Assessment, Upper Illinois River Basin Pilot Project of the National Water Quality Assessment Program - Steve Blanchard, U S Geological Survey
11:10-11:30	Superfund Ecoassessments - Ron Preston, U.S. EPA Region 3 - ESD
11:30-11:50	Questions and Answers

9:00-11.50	**Session 6: Lab Biomonitoring** - Chair, Tom Simon, EPA Region 5
9:00-9:10	Session Overview, Chair
9:10-9:30	Ambient Toxicity Assessments in a Regional Watershed - Jack Arthur, U.S. EPA-Duluth
9:30-9:50	Sediment Toxicity Testing - Peter Chapman, EVS Consultants
9:50-10.10	Discrimination of Sediment Toxicity in Freshwater Harbors Using a Multitrophic Level Test Battery -Allen Burton, Wright State University
10:10-10:30	Break
10:30-10:50	Predictive Abilities of EPA Subchronic Toxicity Test Endpoints for Complex Effluents - Tom Simon, U.S EPA Region 5
10:50-11:10	The Use of Cultured Hepatocytes in Screening Wastewaters for Genotoxic Effects - Randy Jirtle, Duke University Medical Center
11:10-11:30	Algal Bioassays to Develop Phosphorus WLA's - Tom Stockton, North Carolina Division of Environmental Management
11:30-11:50	Questions and Answers

Wednesday, October 18 (continued)

12 00-1:30 **Luncheon with a Speaker on The Valdez Oil Spill**

1 30-6:30 **Poster Session**

1 30-2:40 **Total Maximum Daily Loads: Point Sources and Nonpoint Sources** - Chair, Bruce Zander, U.S EPA Region 8

1 30-1:50 Phosphorus Loading to the Tuallatin River, Oregon, Bruce Cleland, U S. EPA Region 10

1.50-2:10 TMDL for Dillon Reservoir: Partitioning Point Sources and Nonpoint Sources - Bill Lewis, University of Colorado

2 10-2:30 Differentiating Natural and Forest Management-Related Sediment at a Basin Scale in the Deschutes River, Washington - Kathleen Sullivan, Timber, Fish and Wildlife

2 30-2.40 Questions and Answers

2 40-3:00 Break

3.00-5:15 **Regional Assessments** - Chair, Kathleen Sullivan, Timber, Fish, and Wildlife

3 00-3:20 Ohio's Use of Geographically-based Biocriteria - Chris Yoder, Ohio EPA

3.20-3 40 Regions for Evaluating Environmental Resources - Jim Omernik, U.S. EPA-Corvallis

3 40-4:00 Reference Reach Approach in Metro-Denver to Characterize Effluent Impacts on Biota in S. Platte River, Bill Lewis, University of Colorado

4 00-4 20 Regional Lake Assessments - Bruce Wilson, Minnesota Pollution Control Agency

4 20-4 40 Regional Applications of Biocriteria in Xeric Environments - John Wegrzyn, Arizona Department of Environmental Quality

4 40-5.05 Environmental Monitoring and Assessment Program: The Surface Water Project - Steve Paulson, University of Nevada

5:05-5:15 Questions and Answers

5 30-6:30 **Poster Session Reception**

Thursday, October 19

Concurrent Sessions

8.00-10:10 **Session 7: Groundwater Discharge to Surface Waters** - Chair, Jim Dunn, U.S. EPA Region 8

8·00-8:10 Session Overview, Chair

8:10-8:30 NPS Contamination of Groundwater Discharge to Surface Water - Chuck Job, U.S. EPA Headquarters

8.30-8:50 Agricultural Chemicals in Groundwater: Lessons from the South Dakota Rural Clean Water Project- Gregg Carlson, South Dakota State University

8:50-9·10 Iowa's Big Spring Basin Demonstration Project - John Littke, Iowa Geological Survey

9:10-9:30 Indicators of Surface Water Sources in Public Supply Wells - Roy Spalding, University of Nebraska

9:30-9:50 Design, Sampling, and Data Analysis from a Major NPS Network - Jean Goodman, South Dakota Department of Water and Natural Resources

9:50-10:10 Questions and Answers

10:10-10:30 Break

8.00-10:10 **Session 8: Lake and Large Reservoir Assessment** - Chair, Steve Chapra, University of Colorado

8.00-8:10 Session Overview, Chair

8.10-8.30 Lake Monitoring: Developing State Programs and Meeting Federal Reporting Requirements - Donna Sefton, U S EPA Region 7

8:30-8:50 Lake Restoration: Cascade Lake, Idaho - Dale Anderson, Entranco Engineers, Kirkland, Washington

8.50-9:10 Longterm Assessment of Eutrophication in Lake Tahoe, CA-NV - Charles R Goldman, University of California, Davis

9 10-9:30 Flaming Gorge: U.S Bureau of Reclamation - Jerry Miller, U S Bureau of Reclamation

9:30-9:50 Water Quality Monitoring in TVA Reservoirs - Ron Pasch, Tennessee Valley Authority

9:50-10:10 Questions and Answers

10:10-10:30 Break

10:30-12:10 **Workgroup Reports**

12:10-1:00 **Wrap-up**

1:00-6·00 **Field Trips**

Note: Because of the limited space available, there may be a need to restrict participation on the field trips. There will be a sign-up for field trips at registration to confirm your interest. The final selection for field trip participants will be made on Tuesday, October 17.

1. Observations of Impacts From Different Types of Land Use
2. Rapid Bioassessment Protocol (RBP): Hands on demonstration of EPA's RBP for macroinvertebrates and fish
3. Riparian Evaluation. A demonstration of recently developed guidance on riparian evaluation.
4. Hands on Demonstration of U S Forest Service's Programs for Monitoring Impacts from Forest Practices.

Workgroup Topics

1) **NPS Management and Antidegradation:** Workgroup Chairs: Kent Ballentine, EPA HQ, and Bill Clark, Idaho DHW.

   This workgroup will focus on the monitoring information needed to assess various antidegradation situations, particularly those involving nonpoint sources

2) **TMDLs/LAs for NPS:** Workgroup Chair: Bruce Zander, EPA Region 8.

   This workgroup will discuss the technical aspects of considering both point and nonpoint sources in the TMDL process

3) **Monitoring and Program Design for NPS Assessments:** Workgroup Chairs: Don Martin, EPA Idaho Operations Office, and Steve Bauer, Idaho DHW

   This workgroup will discuss those aspects of an overall State monitoring program that are particularly important for NPS assessments

4) **Monitoring Program Framework/Guidance:** Workgroup Chair: Bruce Cleland, EPA Region 10

   This workgroup will review and discuss key issues and implementation options regarding guidance on monitoring program objectives and design.

5) **Bioaccumulation/Sediment Monitoring and Assessment:** Workgroup Chair John Crellin, Missouri Department of Health

   This workgroup will review the need for technical guidance on assessing bioaccumulation and sediment contamination.

6) **Environmental Indicators:** Workgroup Chair: Kim Devonald, EPA HQ

   This workgroup will review the progress of EPA's indicators project and will develop recommendations on their appropriate selection, use, and value.

7) **Marine and Estuarine Monitoring:** Workgroup Chair Mary Lou Soscia, EPA HQ

   This workgroup will consider how State monitoring programs can provide/obtain the data needed to assess near coastal waters.

Poster Session - Wednesday Afternoon

- Evaluation of Nonpoint Sources of Pollution at the Fort Darling Unit of Richmond National Battlefield Park, Virginia, Using a Risk Assessment Approach.
- Water Quality Monitoring for Nonpoint Source Managers.
- Development of Maximum Species Richness Lines: A Comparison of Methods.
- The Effect of Tributaries on the Structure and Functional Groups Composition of the Benthic Macroinvertebrate Community in the Saint Croix River, MN and WI
- The Use of Biocriteria in the Ohio EPA Biological Monitoring and Assessment Program
- Limitations of the Index of Biotic Integrity for Assessing Degradation in a Western Great Plains Watershed
- Illinois Volunteer Lake Monitoring Program.
- Citizens' Streamwalk Checklist and Data Management System.
- Assessing Nonpoint Source Pollution with Remote Sensing and Biomonitoring.
- Use of Short-term Exposure Basket Samples for Ecological Assessment of Metal Impacts on the Macroinvertebrate Community.
- Biological Criteria.
- Stormwater Runoff Research and Technology
- Best Management Practices A Compliance Survey
- Water Quality Analysis System Demonstration On-Screen, Interactive Retrieval of Information From Multiple Water Quality Data Systems
- Steering Committee on Water Quality Data Systems Actions and Accomplishments.
- Section 305(b) Waterbody System: A State and National Database for Water Quality Assessment.

Reminder

Symposium Location

The symposium will take place at the University Park Holiday Inn in Fort Collins, Colorado To make reservations call (303) 482-2626

Transportation

An airport shuttle runs from Denver Stapleton Airport to the University Park Holiday Inn every hour from 8:00 AM to 9:30 PM. The fare is $13 each way. For information and reservations call (303) 482-0505.

Appendix B

Workgroup Discussion Papers

DISCUSSION PAPERS FOR THE SECOND NATIONAL SYMPOSIUM ON WATER QUALITY ASSESSMENT

WORKGROUP 1: NONPOINT SOURCE MANAGEMENT AND ANTIDEGRADATION

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chairs

R. Kent Ballentine
Office of Water Regulations and Standards
U.S. Environmental Protection Agency

Bill Clark
Division of Environmental Quality
Idaho Department of Health and Welfare

I Background

State adoption of an antidegradation policy has been a Federal requirement in the WQS program since the basic policy was established by the Department of the Interior on February 8, 1968.

EPA's current requirements for State adoption of antidegradation policy is 40 CFR 131.12 which was promulgated on November 8, 1983. EPA's requirements are now supported by statutory language (see CWA 303(d)). The regulation requires that "the state shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy.." (40 CFR 131.12(a)).

Last year EPA (Office of Water Regulations and Standards) audited State adopted requirements:

- While all States have at least rudimentary policies, many need amendments to fully comply with Federal requirements, and current triennial reviews are improving State compliance statistics.

- While only a few states have antidegradation implementation plans, several are now in the process of developing such plans.

EPA believes that State antidegradation implementation plans should include provisions for mandatory application in a State's nonpoint source program. However, no State has yet fully incorporated antidegradation implementation into its nonpoint source management program, although several are making significant progress (e.g., Idaho).

II Discussion Points

1. Institutional Arrangements

Federal requirements for State antidegradation policies (40 CFR 131.12) require that the State "shall assure that there shall be achieved ... all cost-effective and reasonable best management practices for nonpoint source control." Antidegradation implementation should now be incorporated into the State NPS management program required by Section 319 of the CWA and be incorporated into the work plans of the implementing agencies (i.e., forestry, agriculture, construction, highways, etc.). In its recent audit of State antidegradation policies, OWRS noted deficiencies in the application of antidegradation to nonpoint source control programs, frequently because authority had not been conferred by State legislatures. EPA's Section 319 guidance encourages States to seek the necessary authority from their respective legislatures.

- How are State antidegradation requirements in WQS implemented by agencies other than the one adopting the requirements? By grant agreements, MOUs, governor's commissions?

- What kinds of coordination mechanisms exist? How can the process be improved? What is optimum?

2. Antidegradation Implementation Plan Development

40 CFR 131.12 calls on States to identify the methods for implementing antidegradation. EPA is strongly encouraging States without implementation plans to develop such plans for both point and nonpoint sources. EPA is developing National guidance on antidegradation implementation. Several EPA Regions have developed guidance (Regions I, V, IX). Consideration of antidegradation and other methods of attaining and maintaining water quality standards (e.g., BMPs) should now be incorporated into the State's Section 319 NPS management program. (See EPA's NPS guidance, p. 11 et seq.)

- What kinds of additional guidance is needed to develop effective antidegradation implementation plans for NPS generating activities? Can coordination among Federal, State and local agencies be effective?

3. Field Implementation

Antidegradation implementation, or antidegradation analysis, is a public process where decisions that may result in reduced water quality are analyzed to see if ... "allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located." Simply stated, project alternatives are examined to see if changes can reasonably be made to reduce or eliminate reductions in water quality and if not, whether the project is deemed sufficiently important to accept the water quality degradations.

Antidegradation implementation depends on having sufficient data so as to be able to define "existing uses" and to identify and designate high quality waters including outstanding natural resource waters. Without the benefit of requirements contained in permits for monitoring water quality, monitoring relies on Government agencies and cooperative land owners/lessees to perform the necessary observations and testing.

- Is the baseline information available to effectively ascertain current water quality and to predict future water quality assuming various land use activities? What kinds of data need to be considered in an antidegradation analysis?

- How can such information be accumulated cost effectively in areas where it is not currently available?

- Is the antidegradation analysis process sufficiently described by EPA's guidance to focus information collection efforts?

4. Monitoring

An antidegradation analysis is predicted on predictions of the water quality/habitat condition resulting from various land use and BMP applications. Monitoring data are analyzed subsequently to see if actual water quality standards are attained, and if not, to determine what changes in BMPs are necessary. Because there is more incentive to document the costs of the controls rather than to document maintenance and enhancement of environmental quality, additional incentives are needed to induce environmental monitoring.

- Are incentives available to induce land owners/lessees to fairly evaluate both costs and environmental quality in the control of NPS? Are there incentives other than cost sharing, e.g., gathering information for a use attainability analysis or developing information justifying new and possibly less expensive controls for future applications?

COMMENT FORM

WORKGROUP 1: NONPOINT SOURCE MANAGEMENT AND ANTIDEGRADATION

Key Questions

1. Institutional Arrangements

    - How are antidegradation requirements in State WQS implemented by agencies other than the one adopting the requirements?

    - What coordination mechanisms exist and how can they be improved?

2. Antidegradation Implementation Plan Development

    - What quidance is needed to develop effective antidegradation implementation plans for NPS generating activities?

3. Field Implementation

    - What kinds of data need to be considered in an antidegradation analysis? Is the necessary baseline information typically available?

    - How can needed information be gathered cost effectively?

    - Is EPA's current guidance sufficient to focus information collection efforts?

4 Monitoring

    - What are useful incentives to land owners, lessees, etc. to monitor the "environmental results" of NPS controls?

WORKGROUP 2: TOTAL MAXIMUM DAILY LOADS FOR NPS

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chair

Bruce Zander
Water Management Division
Region 8
U.S. Environmental Protection Agency

I Background

Total maximum daily loads (TMDLs) are required by Section 303(d) of the Clean Water Act and EPA regulations (40 CFR Part 130, 1/1/85). TMDLs are defined by these regulations as the sum of wasteload allocations for point sources and load allocations (LA) for nonpoint sources and natural background. There is additional interest in NPS assessments and LAs due to section 319 of the CWA, the recent GAO report on the need for additional emphasis on TMDLs, and interest in considering the combined water quality effects of point and nonpoint sources.

The assessment and setting of LAs for NPS can be complex due to the intermittent nature of the loadings from these sources and the fact that this loading often occurs at other than the low flows used for point source controls. Conventional Pollutants: Techniques, e.g., mathematical models, and technical guidance documents are generally available for assessing and setting NPS LAs for conventional pollutants such as nutrients and biological oxygen demand in lakes, fresh water streams and coastal waters, although these techniques often require extensive amounts of data and generally do not address NPS loadings from individual sources. Technical guidance for estuaries is not yet final but is available in draft. Other Pollutants: Specific techniques have generally not yet been provided for assessing and setting LAs for clean sediment and toxics from NPS.

II Discussion Points

1. Is a waterbody based assessment and allocation process the best approach for integrating point and NPS loadings? Are other approaches available for determining needed loading reductions by point and NPS?

2. Are non-steady state modeling approaches needed for LAs for toxics from NPS? The new type of Water Quality criteria with duration and frequency recommendations are apparently suitable for all receiving water flows (with the criteria concentration, duration and frequency provisions still being subject to site-specific modification). Since these criteria consider the duration and frequency of criteria exceedances, do the models also need to consider these factors?

3. Must a LA always be quantified as a number, or should EPA allow a TMDL approach that allows setting the NPS LA as site-specific BMPs, when setting a specific number through modeling, etc., is not feasible? Under this approach, the NPS LA could be specified, in some cases, as site-specific BMPs, with follow-up monitoring of the water quality results of the BMPs and additional adjustments to the BMPs as needed over time. The TMDL would thus be developed using BMPs for LAs in cases where doing quantitative estimates using modeling is not yet feasible.

4. What types of changes are needed for existing models and technical tools to make the TMDL process more doable for NPS LAs? What type of technical training is needed?

COMMENT FORM

WORKGROUP 2: TOTAL MAXIMUM DAILY LOADS FOR NPS

Key Questions

1. Is a waterbody based assessment and allocation process the best approach for integrating point and NPS loadings?

2. Since the new type of WQ criteria consider the duration and frequency of criteria exceedances, do the models also need to consider these factors?

3. Must a LA always be quantified as a number, or should EPA allow a TMDL approach that allows setting the NPS LA as site-specific BMPs, when setting a specific number through modeling, etc., is not feasible?

4. Under this approach, the NPS LA could be specified, in some cases, as site-specific BMPs, with follow-up monitoring of the water quality results of the BMPs and additional adjustments to the BMPs as needed over time?

5. What types of changes are needed for existing models and technical tools to make the TMDL process more doable for NPS LAs? What type of technical training is needed?

WORKGROUP 3: MONITORING AND PROGRAM DESIGN FOR NPS ASSESSMENTS

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chairs

Don Martin
Water Division
U.S. Environmental Protection Agency

Steve Bauer
Division of Environmental Quality
Idaho Department of Health and Welfare

I Background

The 1987 Amendments to the Clean Water Act (CWA) served as a strong reminder of the need to include nonpoint source (NPS) monitoring as an integral part of state monitoring programs. States were required under section 319 to "identify those navigable waters within the State which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements" of the CWA. The need to assess the extent of NPS problems is not new; it can also be found under section 208 and section 305(b).

Back in the days of burning and foaming rivers the need to assess the extent of NPS problems may not have been evident, particularly in the industrialized areas of the United States. Now, however, point source dischargers have been controlled to a large extent, creating a new perspective from which we determine our assessment needs. The states have reported in their 1988 section 305(b) reports that NPS pollution is the major cause of the remaining surface water quality problems in the Nation.

Since the states have already reported the extent of the NPS problem, one might question the need for a workgroup discussion on NPS assessments. A large proportion of the NPS assessments was based upon far less than rigorous scientific analysis; best professional judgment was used extensively. Many of the waters assessed for section 319 had never been monitored routinely; meaningful water quality data do not exist. In addition, problem-screening efforts may not generate adequate information from which to base a clean-up program.

Now that NPS monitoring and assessment are highly visible components of state monitoring programs it is important for EPA to be responsive to state needs in this area. It is also important for states to share their concerns and successes with other states. EPA asks that this workgroup discuss various aspects of including a viable NPS monitoring and assessment program as part of the overall state monitoring program.

II Discussion Points

The discussion should focus on the following series of questions:

1. What biomonitoring techniques are appropriate for NPS problem screening, trend monitoring, and evaluation of NPS controls?

    - Is physical/chemical monitoring still needed? For what?

    - How can the recommended problem screening approaches lead to the development of watershed pollution control strategies?

    - What are some of the "do's" and "don'ts" regarding the use of biomonitoring techniques for screening, trend monitoring, and control evaluations?

    - Can biomonitoring techniques be used for on-site evaluation of NPS control measures (e.g., on-farm)? How?

2. What is the proper mix of biomonitoring and chemical/physical monitoring for problem screening, trend assessments, and control evaluations?

3. What are the most cost effective ways to assess waters for NPS impacts in remote areas? What are the requirements to perform these assessments?

4. What are the key limitations states face in adding a strong NPS monitoring component to there overall monitoring program? How do states propose to address these limitations? What should EPA's role be?

5. What technical materials/assistance should EPA deliver in support of those monitoring techniques listed under #1 above?

6. What roles can other federal agencies (e.g., USGS, BOR, USFS, BLM) perform?

7. Which agency or group should take the lead in coordinating NPS monitoring data bases? How do the states achieve this coordination?

COMMENT FORM

WORKGROUP 3: MONITORING AND PROGRAM DESIGN FOR NPS ASSESSMENTS

Key Questions

1. What biomonitoring techniques are appropriate for NPS problem screening, trend monitoring, and evaluation of NPS controls? Is physical/chemical monitoring still needed? For what?

2. What is the proper mix of biomonitoring and chemical/physical monitoring?

3. What are the most cost effective ways to assess waters for NPS impacts in remote areas?

4. What are the key limitations states face in adding a strong NPS monitoring component to there overall monitoring program? How do states propose to address these limitations? What should EPA's role be?

5. What technical materials/assistance should EPA deliver in support of those monitoring techniques listed under #1 above?

6. What roles can other federal agencies (e.g., USGS, BOR, USFS, BLM) perform?

7. Which agency or group should take the lead in coordinating NPS monitoring data bases?

WORKGROUP 4: MONITORING PROGRAM FRAMEWORK/GUIDANCE

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chair

Bruce Cleland,
Environmental Services Division
Region 10
U.S. Environmental Protection Agency

I Background

There has been much discussion of the need to improve EPA and State monitoring programs - in the 1987 EPA report Surface Water Monitoring: A Framework for Change, in discussions at last year's National Symposium on Water Quality Assessment, and elsewhere.

EPA's Office of Water Regulations and Standards, with assistance from a Federal/State workgroup, is preparing two documents of interest to managers and staff with monitoring responsibilities: (i) a guidance document for State surface water monitoring programs; and (ii) a "Monitoring Implementation Framework." Draft versions of the guidance and Framework are expected to be available in early 1990.

The program guidance is being written for State water quality personnel with responsibility for data collection and analysis, and for those who could benefit from using monitoring information in their programs (e.g., in developing water quality standards, targeting waters in need of additional controls, determining permit limits). The guidance document will discuss the benefits of considering monitoring information in ten or so water quality program areas, discuss monitoring design considerations in each area, and where possible, recommend specific monitoring approaches The document will make extensive use of case examples to illustrate successful uses of monitoring information in various water quality program areas.

The "Monitoring Implementation Framework" will serve as a five year plan listing specific monitoring-related projects that EPA needs to complete (e.g., research, guidance, and training) and specific implementation activities that could be taken to improve State monitoring programs. EPA hopes that the process of developing this Implementation Framework will result in consensus on future directions for the monitoring program.

At the October workgroup meeting, we will:

- give a brief presentation on the two documents;
- be looking for input on the approach being taken and the contents of the program guidance;

discuss elements of the Monitoring Implementation Framework.

II Discussion Points

Monitoring Program Guidance

1. **Is our strategy sound of directing the program guidance not just to the producers of monitoring data but to its users?** (e.g., managers of permits, nonpoint source, standards and other water quality programs)

2. **Do workgroup members have monitoring design recommendations that they want to see included in the guidance document?** (e.g., sources of information, how to decide what constitutes an adequate amount or quality of data, recommended spatial/temporal designs, choice of indicators, need for ancillary data to interpret water quality data, useful data analysis or presentation techniques)

Monitoring Framework

3. **In what areas does EPA need to develop research, guidance, or training? Can the workgroup suggest priorities?** (e.g., sample collection and analysis, survey/network design and data analysis)

4. **What measures can EPA use to satisfy its 106(e) oversight responsibilities and ensure the adequacy of State monitoring programs?** (e.g., minimum number of analyses or surveys, minimum sampling or analytical capabilities, minimum number of biologists or other staff with specified skills, minimum effort devoted toward priority objectives)

5. **What is the best mechanism for ensuring communication between EPA and States over monitoring programs?** (e.g., the current EPA/State mid year review process, less frequent monitoring program reviews, monitoring regulations)

COMMENT FORM

WORKGROUP 4: MONITORING PROGRAM FRAMEWORK/GUIDANCE

Key Questions

1. Should the Monitoring Program Guidance be directed as much to data users as to data producers?
2. What important program design considerations should be included in the guidance?
3. What are the most important research, guidance, and training needs for the monitoring program for the next 5 years?
4. What measures can EPA use to satisfy its 106(e) oversight responsibilities and ensure the adequacy of State monitoring programs?
5. What is the best mechanism for ensuring communication between EPA and States over monitoring programs?

WORKGROUP 5: BIOACCUMULATION/SEDIMENT MONITORING AND ASSESSMENT

WHITE PAPER FOR DISCUSSION PUPOSES ONLY

Workgroup Chair

John Crellin
Missouri Department of Health

I Background

Public concern about the impact of chemical contamination on water quality was heightened recently by the release of reports by the National Wildlife Federation (NWF) and the Greenpeace organization. The NWF concluded that the levels of PCB's and three organochlorines in Lake Michigan salmonids represented a significant health risk. While no one debated that there was a problem, most of the Lake Michigan states did not agree with NWF's assessment of the available fish tissue data for Lake Michigan. A major source of the contamination was identified by NWF as ongoing permitted discharges by industry. NWF's report is an example of how fish tissue monitoring data could be used to evaluate the validity of permitted discharge levels. It also illustrates the need for standardization of assessment techniques.

Greenpeace released a report linking the excess deaths found in a number of the counties along the Mississippi River to toxic substances in the water and air. This conclusion was reached even though Greenpeace identified the lack of valid environmental monitoring data as a major barrier to performing an evaluation. Because of this lack of data it is impossible to dispute or confirm Greenpeace's evaluation. The report by Greenpeace illustrates the need for more and better data on chemical contaminants in aquatic systems (i.e., surface water, biota, and sediments).

In monitoring water quality, data on chemicals in sediment and their bioaccumulation in the tissues of fish and other aquatic organisms represent a vital information source. These data reflect the long-term impact on the environment and provide a potential inventory of chemicals entering the environment. Data on contaminant levels in sediments and fish tissue can provide guidance on where to target monitoring of both point and non-point sources. They also may provide a way to validate the appropriateness of permit discharge levels. Evaluation of chemicals in water provides only a snap-shot view of contamination unless monitoring is done on a regular basis.

While there are strong advantages to using bioaccumulation/sediment data, there are also problems. Procedures for collection, laboratory analysis, and assessment of sediment and fish tissue samples vary widely. As with the NWF example above, this has led to widely varying conclusions on essentially the same data. Another disadvantage to these data is the monies and expertise needed to do the laboratory analyses.

As the presentations at this National Symposium on Monitoring will demonstrate, bioaccumulation and sediment monitoring data can be a significant contribution to addressing water quality problems. This workshop will provide the opportunity for states to share concerns and successes. It will also be possible to propose, discuss, and recommend ways to maximize the usefulness of bioaccumulation and sediment data.

II Discussion Points

Workshop discussions will focus on the following issues/problems:

1. Collection of Fish/Sediment Samples

   - How many collection sites and how many samples per site are adequate?
   - Is there a need for a standard collection protocol?
   - When should whole fish and when should edible portions be collected?
   - Which species and size of fish should be targeted?
   - Would it be beneficial for EPA and other federal agencies to develop a cooperative program with the states to monitor fish tissue and sediment in the major river systems?

2. Laboratory Analysis

   - What Standard analytical procedures still need to be developed?
   - Which chemicals should be analyzed?
   - Should some of the resources now spent on analysis of samples be spent on developing and standardizing techniques for identifying new chemicals?

3. Assessment of Results

- How should health concern levels for contaminants in fish tissue be established?

- To what extent is fish tissue contamination due to sediment contamination?

- How may Accumulation Factors or other techniques be used to develop sediment "criteria" that protect against fish tissue contamination? Will the approach work for different contaminants/species/regions?

- How may sites be prioritized as to level of concern?

COMMENT FORM

WORKGROUP 5: BIOACCUMULATION/SEDIMENT MONITORING AND ASSESSMENT

Key Questions

1. Sample Collection

   - How should samples be collected?
   - How many samples and how many sites need to be collected?
   - What species and what tissues should be collected?
   - Are cooperative sample collection programs needed? feasible?

2. Lab Analysis

   - What standard analyses still need to be developed?
   - Which chemicals need to be analyzed?

3. Assessment of Results

   - How should tissue levels of concern be set?
   - To what extent is tissue contamination due to sediment contamination?
   - How should Accumulation Factors be used to develop sediment "criteria"?
   - How can sites be prioritized as to levels of concern?

WORKGROUP 6: ENVIRONMENTAL INDICATORS

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chair

Kim Devonald
Office of Policy, Planning, and Evaluation
U.S. Environmental Protection Agency

I Background

In the lead article of the May issue of the EPA Journal, EPA Administrator William Reilly writes that the good news is, "... the Agency does an exemplary job of protecting the nation's public health and the quality of the environment". The bad news is that he "...can't prove it.".

Reilly highlights a major problem for many environmental managers Although the programs they oversee are supposed to protect and improve the environment, and extensive data collection efforts are mounted in support of these programs, it is often difficult to show that things are getting better (or worse), i.e., that the program is working. When asked, by their superiors, or by state or Federal lawmakers, or by the public, to supply evidence of the effectiveness of their programs, many managers have to rely on administrative measures (such as the number of permits issued) rather than system responses to demonstrate progress.

Reilly's article also sends a signal to EPA and state program managers that there is increasing interest at the top level of EPA to find ways to measure environmental results. Environmental indicators are one of the tools that can be used to do this. However, there are many issues related to identifying and using environmental indicators that have to be resolved. Five of these issues are listed below:

II Discussion Points

1. What are the most important constraints limiting the development and use of indicators? Are they institutional or scientific? How can these be overcome?

The use of environmental indicators to measure environmental change is not a new idea. discussion of the need for indicators to link public policy with environmental reality can be found in articles and reports dating from the early 1970s, yet little can be quantitatively said about whether surface water quality is improving on a national basis. Factors cited as obstacles to indicator development include 1) limited resources; 2) lack of institutional requirements; 3) fear of accountability; 4) lack of understanding of how indicators would be used; and 5) the difficulty of measuring change in complex natural systems with only a few metrics. Are these the most important roadblocks preventing the development of indicators, and if so, how can they be removed?

1a. Are program managers hesitant to commit to using environmental indicators because of the fear of accountability? What can be done to mitigate this concern?

This question explores in more detail an issue raised in Question 1. One frequently described use for environmental indicators is to evaluate the success or effectiveness of a particular regulatory program. However, many indicators are affected by environmental factors beyond the control of the manager. The manager may be concerned (justifiably) about supporting the use of an indicator over which he or she has little control but which could reflect negatively on his or her effectiveness as a manager It has been suggested that program managers should not be held accountable for the magnitude of environmental change. Rather, they should be held responsible for knowing and being able to demonstrate that changes are occurring, and for being able to explain why it is believed improvements are or are not occurring. For example, eutrophication has diminished because NPS phosphorus loads were decreased: or eutrophication has not diminished even thought phosphorus loads have decreased, because this was a year of unusually low precipitation and stream flow. Is this a realistic expectation?

2. Is the development of national indicators of surface water quality realistic? What will be the major problems in implementing national indicators?

There are several examples of individual state and regional programs that are successfully using indicators to measure the status and trends in surface water quality, evaluate program effectiveness, target problem areas, and communicate progress to the public. The use of indicators in EPA Region 10 and the development of a set of environmental indicator indices by the Maryland Department of the Environment are two examples. Can these and other programs' successful use of indicators be used as models to develop national indicators, or are indicators developed for individual programs too site-specific.

3. Assuming general agreement that indices of biological community structure are a valuable component of a comprehensive assessment of water quality, how should these be reported?

Measures of biological community structure such as the techniques used for the rapid bioassessments of streams, the index of Biotic Integrity and the Invertebrate Community Index are used in many state programs to measure the health of surface waters. Should measures such as this be added as a required element in 305(b) reports (e.g., a community structure score for some subset of water body segments)? Should states incorporate measures of "biological integrity" (community structure and function) into their definition of use support?

4. To what extent can existing environmental information and data collection programs be used in developing environmental indicators? Are new data collection programs needed? Are resources available to fund new collection programs?

   Few of the existing surface water data collection programs were designed with the explicit objective of providing information to be used to evaluate status and trends in water quality. Managers trying to adapt these existing data for use as environmental indicators frequently encounter problems (poor documentation, changes in analytic procedures, lack of spatial and temporal representativeness, and constraints on data access and manipulation) inherent in using data collected for one purpose to support a different objective. However, initiating new monitoring programs specifically for collecting environmental indicator data is exBpensive. What balance can be struck to collect the information needed to develop useful indicators?

5. Are loading estimates useful indicators?

   Ideally, an indicator measures some type of environmental endpoint or impact. However, data on this type of indicator is often expensive to collect and difficult to interpret because of the influence of many confounding factors. As an indicator, pollutant discharge estimates are at least two steps removed (transport and fate, and actual impact) from providing a true picture of environmental impacts. However, they are directly related to the objectives of many existing regulatory programs, i.e., controlling the discharge of pollutants, and, at least for point sources, there is an extensive data collection program in place. Should loading estimates be used as environmental indicators, and what are the advantages and limitations of their use?

COMMENT FORM

WORKGROUP 6: ENVIRONMENTAL INDICATORS

Key Questions

1. What are the most important constraints limiting the development and use of indicators? Are they institutional or scientific? How can these be overcome?

2. Are program managers hesitant to commit to using environmental indicators because of the fear of accountability? What can be done to mitigate this concern?

3 Is the development of national indicators of surface water quality realistic? What will be the major problems in implementing national indicators?

4. Assuming general agreement that indices of biological community structure are a valuable component of a comprehensive assessment of water quality, how should these be reported?

5 To what extent can existing environmental information and data collection programs be used in developing environmental indicators? Are new data collection programs needed? Are resources available to fund new collection programs?

6. Are loading estimates useful indicators?

WORKGROUP 7: MARINE AND ESTUARINE MONITORING

WHITE PAPER FOR DISCUSSION PURPOSES ONLY

Workgroup Chair

Mary Lou Soscia
Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency

I Background

Water quality problems in estuarine and marine waters have received increasing public attention. Legislation currently before Congress would require the development of comprehensive new monitoring programs for these waters. However, implementing monitoring programs for estuaries and near coastal waters presents many problems that are not encountered in freshwater systems. The number and diversity of estuarine ecosystem components to be monitored is often much greater than those in fresh waters, and varying salinity and hydrodynamic conditions require the development of unique methods and sampling designs.

Moreover, monitoring programs for estuarine and near coastal waters must provide ambient data supporting a wide range of water program needs. Guidance recently issued by EPA directs states to include near coastal water body segments in the 305(b) reporting process. Marine criteria and standards under development will require the collection of ambient data, and establishing total maximum daily loads, wasteload allocations, and load allocations for estuarine areas will require additional monitoring data. The state 304(l) lists may not adequately represent near coastal water bodies impaired by toxic discharges, and development of the 319 lists and plans for addressing nonpoint source problems must be supported by marine and estuarine monitoring programs.

The objective of this workgroup is to consider how state monitoring programs can provide data for trend analysis, reporting, and decision making in estuarine and near coastal waters.

II Discussion Points

1. What indicators of coastal water body impairment should be measured for effective status and trend reporting? Can we effectively include measures such as shellfish bed closures, miles of closed beaches and debris collected in the 305(b) reporting process? What are the other measures to be considered for effective reporting?

2. How can near coastal waters be segmented for status and trend reporting and inclusion in EPA's water body system?

- How important is a uniform segmentation scheme? What criteria can be used to develop segmentation?

In order to include near coastal waters in EPA's water body system, it will be necessary to segment them. It is, however, more difficult to develop a segmentation scheme for coastal and near coastal waters than for rivers and streams. Biological and physical oceanographic factors may be used to segment coastal waters. Salinity and temperature regimes, the effect of freshwater inflow relative to tidal influence have been proposed as segmentation criteria. Jurisdictional boundaries have also been proposed for segmentation.

3. What are the main technological constraints in designing and implementing monitoring programs for near coastal waters?

- Have acceptable methodologies been developed for analysis of conventional and nonconventional pollutants? What can EPA do to assist in making standard methods available for use in near coastal waters? EPA is currently developing a compendium of methods for estuarine and marine environmental studies. Methods for nutrient evaluation have been selected for inclusion in the compendium. What other methods might be selected?

- How must the design of monitoring programs for near coastal waters be different from the design of monitoring programs for fresh water systems?

4. Although we continue to hear that the problem of toxic discharges to near coastal waters is a severe problem, existing 304(l) lists indicate that only 20 percent of the water bodies impaired by toxic contamination are near coastal water bodies. New York-New Jersey Harbor was not included on the 304(l) list despite suspected toxic contamination of this water body. What must be done to develop better lists? Can more data be collected to support model development for assessing the extent of toxic contamination in near coastal waters?

5. Is there a need for increased regional or national coordination of state monitoring programs in estuarine and near coastal waters to describe status and trends in these waters? How might this be accomplished?

In the Chesapeake Bay Region, the EPA's Chesapeake Bay Program Liaison Office has effectively coordinated the monitoring activities of three states to support a bay-wide assessment program. In the Puget Sound region, existing state agency monitoring programs have been expended, and are being coordinated by the Puget Sound Water Quality Authority.

COMMENT FORM

WORKGROUP 7: MARINE AND ESTUARINE MONITORING

Key Questions

1. What indicators of coastal water body impairment should be measured for effective status and trend reporting? Can we effectively include measures such as shellfish bed closures, miles of closed beaches and debris collected in the 305(b) reporting process? What are the other measures to be considered for effective reporting?

2. How can near coastal waters be segmented for status and trend reporting and inclusion in EPA's water body system?

3. How important is a uniform segmentation scheme?

4. What are the main technological constraints in designing and implementing monitoring programs for near coastal waters?

5. Have acceptable methodologies been developed for analysis of conventional and nonconventional pollutants?

6. How must the design of monitoring programs for near coastal waters be different from the design of monitoring programs for fresh water systems?

7. How can better data be collected to support model development for assessing the extent of toxic contamination in near coastal waters?

8. There is a need for increased regional or national coordination of state monitoring programs in estuarine and near coastal waters to describe status and trends in these waters. How might this be accomplished?

APPENDIX C

Evaluation of Symposium

EVALUATION OF SYMPOSIUM

SUMMARY OF COMMENTS AND RECOMMENDATIONS MADE BY PARTICIPANTS

A total of 69 evaluations were received.

Question 1: **The meeting's primary objective was to bring together water quality professionals to exchange information and ideas about the collection, analysis, management, and use of surface water quality information. Do you feel this objective was met?**

Answer: The participants felt overwhelmingly that these objectives were satisfied. Some commented that there was an absence of management-level personnel from EPA Headquarters. Others wanted more time (i.e., at the breaks or extra work groups) to discuss ideas and exchange information.

Question 2: **What were your objectives for attending this meeting? Do you feel your objectives were met?**

Answer: The participants' objectives fell mainly into two categories: 1) to generally find out what programs are being conducted at the Federal and State level, and 2) to learn specific methods of data collection and analysis for NPS assessments. The majority of the respondents felt category 1 was met but some felt the presentations were too general to meet their specific objectives in category 2.

Question 3: **What aspects of the meeting did you like best? (Ranked in order of most frequent responses)**

Answer:

- Workgroups
- Poster sessions (specifically the computer demonstrations)
- Variety of topics presented
- Opportunity to network with people in other agencies on an informal basis
- Field trips
- Technical sessions on bioassessment, field asssessment, evaluation of BMP effectiveness
- Diversity of attendees
- Facilities
- Concurrent sessions
- Luncheon and dinner speakers

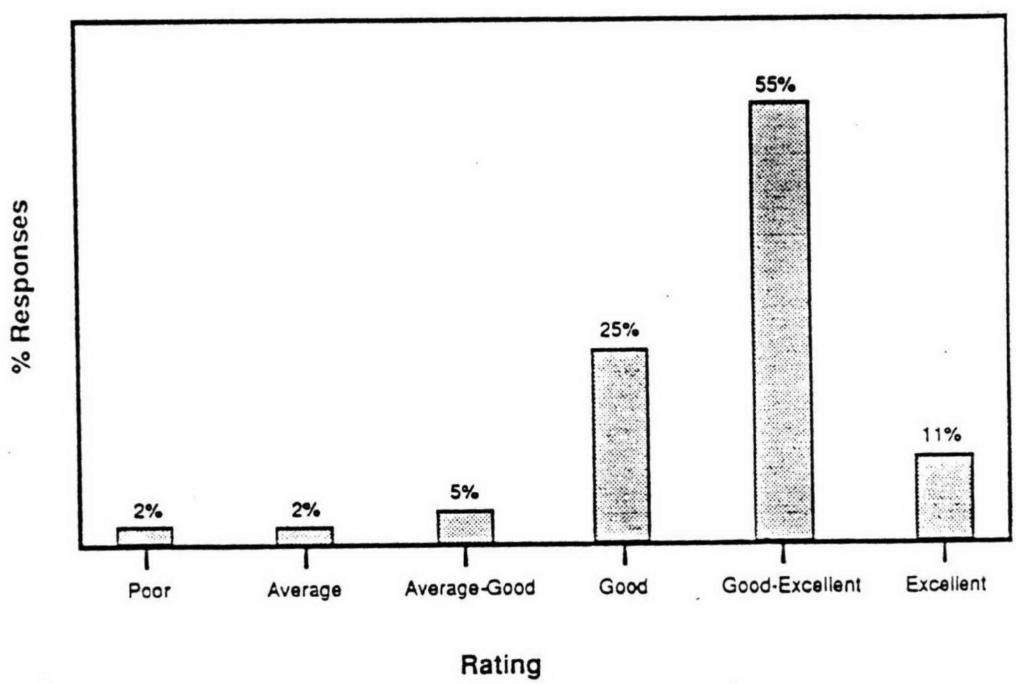
Question 4: What aspects of the meeting did you like least?
(Ranked in order of most frequent responses)

Answer:

- Long hours (too much information presented; not enough time allotted for networking)
- Some workgroup leaders did not seem open to ideas/suggestions from the audience
- Not enough time allotted for workgroups to develop their recommendations
- Absence of EPA managers
- Opening session
- Conflicting concurrent sessions (particularly 5 and 6)
- Some presentations were unfocused with poor visual aids
- Audio visual problems (i.e., lights)

Question 5: How do you rate the meeting overall? (Excellent, Good to Excellent, Good, Average to Good, Average, Poor)

Answer: Over 55% of the respondents rated the symposium good to excellent. The scores are shown below.



Question 6: Please provide suggestions for follow-up meetings and identify issues that you feel were not adequately covered during the meeting.

Answer: <u>General Suggestions</u>

- Provide handouts of slides and overheads from the speakers' presentations

- Have fewer presentations and longer breaks
- Schedule field trips earlier in the symposium
- Invite more speakers from industry
- Have a copy machine available to participants
- Provide questions and answers after each presentation
- Screen the quality of oral presentations (i.e., visual aids and presentation quality)
- Provide training for workgroup leaders in facilitating discussions
- Separate technical and policy issues (have one day reserved for a technical workshop)

Training

- Provide training workshops on:

  STORET
  Writing 404/401 permits
  Rapid Bioassessment
  Assembling 305(b) reports
  WBS

Issues to be included

- Include talk on how states are coping with the decline of Federal dollars
- Additional discussions on monitoring strategies (i.e., examples of multi-media or ecological level monitoring)
- Integrated lab and field assessments
- Session on establishing guidelines and procedures for lab and field methodologies
- More emphasis on sampling design issues
- Runoff from industrial sources
- Development of QA/QC procedures for NPS monitoring and data analysis
- Tech transfer - How do we improve information transfer from the scientist to the manager/regulator?

APPENDIX D

Attendance List

Paul Adamus
Corvallis ERL, Wetlands Program
200 SW 35th Street
Corvallis, OR
97333
503/757-4666

Nadine Adkins
Agricultural Engineering Department
Colorado State University
Fort Collins, CO
80523

Mark Albee
EDF
5655 College Avenue
Oakland, CA
94618
415/658-8008

Lynn Almer
U S Bureau of Reclamation
P O Box 25007
Denver, CO
80225-0007
303/236-9336

John Armstrong
U S. EPA Region 10
1200 6th Avenue
Seattle, WA
98101
206/442-1368

Jack Arthur
US EPA-ERL
6201 Congdon Blvd.
Duluth, MN
55804
218/720-5565

Eugene Akazawa
Hawaii Department of Health
645 Halekauwila St , 2nd Floor
Honolulu, HI
96813
808/548-6355

Dale Anderson
Entranco Engineer, Inc.
5808 Lake Washington Blvd,NE Suite 200
Kirkland, WA
98033
206/827-1300

Kevin Anderson
WA Dept. of Ecology
(MS V-11)
Olympia, WA
98504
206/438-7062

Larry Antosch
Ohio EPA
1800 Watermark Drive
Columbus, OH
43266-1049
614/644-3075

Andrew Archuleta
US FWS - Wagar Bldg Rm 202
Colorado State University
Fort Collins, CO
80523
303/491-6412

Thomas Armitage
U S EPA (WH-556F)
401 M Street, SW
Washington, DC
20460
202/475-7378

Joni Armstrong
US FWS
2617 East Lincoln Way - A
Cheyenne, WY
82001
307/772-2374

Gary Arnold
Oregon of Environmental Quality
1712 SW 11th
Portland, OR
97201
503/229-5983

R Kent Ballentine
U S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/475-7323

Roger Bannerman
WI Dept of Natural Resources
P O Box 7921
Madison, WI
53707
608/266-9278

Mark Barath
U.S. EPA 3
841 Chestnut Bldg.
Philadelphia, PA
19106
215/597-7817

Mike Barbour
EA Engineering, Science and Technology, Inc.
15 Loveton Circle
Sparks, MD
21152
301/771-4950

Dale Bates
US EPA Region 7
25 Funston Road
Kansas City, KS
66115
913/236-3881

Steve Bauer
Idaho Dept. of Health and Welfare
450 W State Street
Boise, ID
83720
208/334-5867

Robert Baumgartner
Oregon of Environmental Quality
1712 SW 11th
Portland, OR
97201
503/229-5877

John Bender
NE Dept. of Environmental Control
P.O Box 98922
Lincoln, NE
68509-8922
402/471-4201

Susan Benzie
MI Dept of Nat Resources
P.O. Box 30028
Lansing, MI
48909
517/335-4193

Dan Beyers
Larval Fish Laboratory
Colorado State University
Ft. Collins, CO
80523
303/491-5295

Steve Blanchard
USGS
102 E Main Street, 4th Floor
Urbana, IL
61801
217/356-8812

Mark Blosser
DE Sept of Nat. Res. and Env Ctrl
89 Kings Hwy
Dover, DE
19903
302/736-4590

Eve Boss
U.S. EPA Region 6
1445 Ross Avenue
Dallas, TX
75202
214/767-7145

Terry Boyle
National Park Service
332 Aylesworth Hall-CSU
Ft Collins, CO
80523
303/491-1452

Steve Brady
USDA SCS and Forest Service
3825 E. Mulberry
Ft. Collins, CO
80524-8597
303/498-1744

Randy Braun
U.S. EPA Region 2
Woodbridge Avenue
Edison, NJ
08817
201/321-6692

Stephen Brinkman
Colorado Division of Wildlife
317 W Prospect
Ft Collins, CO
80526
303/484-2836

Robert Brooks
Forest Resources Lab
Pennsylvania State University
University Park, PA
16802
814/863-1596

Bob Bukantis
MT Water Quality Bureau
A 206 Cogswell Bldg.
Helena, MT
59620
406/444-2406

Allen Burton
Wright State University
3640 Colonel Glen Road
Dayton, OH
45435
513/873-2201

Tim Burton
Idaho Dept. of Health and Welfare
450 W State Street
Boise, ID
83720
208/334-6504

Dan Butler
OK Conservation Commission
2800 N Lincoln, Suite 160
Oklahoma City, OK
73105
405/521-2384

Dave Buzan
TX Water Commission
P O Box 13087
Austin, TX
78736
512/463-8471

Debra Caldon
US EPA Region IX (W-3-2)
215 Fremont Street
San Francisco, CA
94105
415/974-0894

Gregg Carlson
Plant Sciences Dept.
SD State University
Brookings, SD
57006
605/688-5121

Jeff Cederholm
Washington Dept. Natural Resources
Forest Land Management
Division,MQ-11
Olympia, WA
98504

David E. Chalk
Soil Conservation Service
511 NW Broadway - Rm 248
Portland, OR
97209 -3489
503-326-2826

Peter Chapman
EVS Consultants
195 Pemberton Avenue
Vancouver, BC
Canada V7P 2R4
604/986-4331

Steve Chapra
CADWES, Suite B
2945 Center Green CT South
Boulder, CO
80301
303/492-3972

Stephen Chick
USDA-SCS
655 Parfet Street, Rm E200C
Lakewood, CO
80215-5517
303/236-2886

Rick Claggett
US EPA Region 8
999 18th Street
Denver, CO
80202-2405
303/293-1572

William Clark
Idaho Dept of Health and Welfare
450 W State Street
Boise, ID
83720
208/334-5860

Bruce Cleland
US EPA 10 ES-097
1200 6th Avenue
Seattle, WA
98101
206/442-2600

Steve Coffey
North Carolina State University
615 Oberlin Road Suite 100
Raleigh, NC
27605
919/737-3723

Robert W Cooner
AL Dept of Environmental Management
1751 Cong W L Dickinson Drive
Montgomery, AL
36109
205/271-7935

David Cooper
Colorado School of Mines
3805 Silver Plume
Boulder, CO
80303
303/499-6441

Andrea Copping
Puget Sound Water Quality Authority
217 Pine St , Suite 1100
Seattle, WA
98010
206/464-7934

Emelise Cormier
LA Dept of Environmental Quality
P O Box 44091
Baton Rouge, LA
70804
504/342-6363

Terry Craig
National Park Service
332 Aylesworth Hall-CSU
Fort Collins, CO
80523

Bill Creal
MI Dept of Nat Resources
P O Box 30028
Lansing, MI
48909
517/335-4181

John Crellin
Missouri Department of Health
1730 E Elm Street
Jefferson City, MO
65102
314/751-6079

Pat Davies
Colorado Division of Wildlife
317 W Prospect
Ft. Collins, CO
80526
303/484-2836

Wayne Davis
U S. EPA 5
536 S Clark Street 10th Floor
Chicago, IL
60181
312/886-6233

Chris Deacutis
RI Dept of Environmental Management
291 Promenade Street
Providence, RI
02908
401/277-6519

Roger Dean
U.S EPA Region VIII
199 18th Street
Denver, CO
80202-2405
303/293-1571

Kim Devonald
U.S. EPA (PM-222A)
401 M Street, SW
Washington, DC
20460
202/382-4900

Dave Dillon
OK Water Resources Board
'00 NE 10th Street
Oklahoma City, OK
73152
105/271-2541

Bill DiRienzo
WY DEQ
Herschler Bldg., 4th Floor W
Cheyene, WY
82002
307/777-7081

Randy Dodd
RTI
P.O. Box 12194
Research Triangle Park, NC
27709
919/541-6491

Max Dodson
U S EPA Region VIII
199 18th Street
Denver, CO
80202-2405
303/293-1542

John H Dorsey
Hyperion Treatment Plant
12000 Vista Del Mar
Playa Del Rey, CA
90293
213/648-5272

Nancy Driver
National Park Service
332 Aylesworth Hall-CSU
Fort Collins, CO
80523

Don Duff
U S Forest Service
324 25th Street
Ogden,UT
84401
801/625-5662

Bob Duffy
Dept of Ecology
(MS PV-II)
Olympia, WA
98504-8711
206/438-7093

Judith A. Duncan
Oklahoma Dept. of Health
P O Box 53551
Oklahoma City, OK
73152
405/271-5240

Jim Dunn
U S. EPA Region VIII (WM-GW)
199 18th Street
Denver, CO
80202-2405
303/293-1796

Lawrence Edmison
OK Dept. of Pollution Control
P.O. Box 53504
Oklahoma City, OK
73152
405/271-4468

Ihsan Eler
U.S EPA Region V (5-SMQA)
536 Clark Street
Chicago, IL
60605
312/886-6249

R C Erickson
U S EPA Region 8
999 18th Street
Denver, CO
80202-2405

Ben Eusebio
U S EPA Region X (ES-097)
1200 Sixth Avenue
Seattle, WA
98101
206/442-0422

E J Fanning
WY DEQ
Herschler Bldg , 4th Floor W
Cheyene, WY
82002
307/777-7074

Dan Farrow
U S EPA
401 M Street, SW
Washington, DC
20460
202/382-4906

Kurt Fausch
Dept of Fish and Wildlife
Colorado State University
Ft Collins, CO
80523
303/491-6457

Dennis Fewless
ND Dept of Health
1200 Missouri Avenue #203
Bismarck, ND
58502-5520

Sarah Fowler
U S. EPA Region 8
999 18th Street
Denver, CO
80202-2405
303/293-1575

Tom Fredette
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA
02254-9149
617/647-8563

Ronald French
Metro Denver Sewage Disposal Dist.
6450 York Street
Denver, CO
80229
303/289-5941

Rod Frederick
U.S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7051

Toby Frevert
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL
62794-9276

Frank Gaffney
NW Renewable Resources Center
710 2nd Avenue
Seattle, WA
98704
206/623-7361

Erv Gasser
National Park Service
3215 E. Broad St.
Richmond, VA
23223
804/226-1981

Mary Gessner
US FWS
Arlington Square, Room 330
Washington, DC
20240
703/358-2148

Robert George
U.S. Bureau of Reclamation
P O. Box 25007
Denver, CO
80225
303/236-3777

James Giattina
U S EPA Region V (5WQS-TUB8)
536 Clark Street
Chicago, IL
60604
312/353-2154

Charles R. Goldman
Environmental Studies
University of California
Davis, CA
95616
916/752-1557

Gregg Good
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL
62794-9276
217/282-3362

Jeanne Goodman
SD Dept of Water and Natural Resources
523 E Capital Avenue
Pierre, SD
57501
605/773-3296

Daniel Greenlee
Tahoe Regional Planning Agency
P.O Box 1038
Zephyr Cove, NV
89448
702/588-4547

Geoffrey Grubbs
U.S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7040

Robert Gumtow
WY DEQ
Herschler Bldg , 4th Floor W
Cheyene, WY
82002
307/777-7098

Roy Gunnell
Utah Bureau of Water Pollution Control
P O Box 16690
Salt Lake City, UT
84116-0690
801/538-6146

Rick Hafele
OR Dept of Environmental Quality
1712 SW 11th Street
Portland, OR
97201
503/229-5983

Karen Hamilton
US EPA Region VIII (8WM-SP)
999 18th Street
Denver, CO
80202-2405
303/293-1576

Jon Harcum
Tetra Tech
10306 Eaton Place, Suite 340
Fairfax, VA
22030
703/385-6000

Bill Harned
Utah Bureau of Water Pollution Contrc
P O Box 16690
Salt Lake City, UT
84116-0690
801/538-6146

Warren Harper
USDA Forest Service
9364 Robnel Place
Vienna, VA
22182
703/759-6793

Jim Harrison
US EPA Region 4
345 Courtland Street
Atlanta, GA
30365
404/347-5242

Jim Harvey
CO Dept. of Health
4210 E. 11th Avenue
Denver, CO
80220
303/331-4558

Vern Helbig
U..S EPA Region 8
999 18th St Suite 500
Denver, CO
80202
303/293-1585

Roland Hemmett
U.S EPA Region 2
Woodbridge Avenue
Edison, NJ
08837
201/321-6687

Susan Hitch
U.S. EPA (WH-556F)
401 M Street, SW
Washington, DC
20460
202/475-7178

Nancy Hoefs
335 Aylesworth Hall NW
Colorado State University
Ft, Collins, CO
80523
303/491-1513

Paul Hogan
Mass. Division of Water Pollution Control
Lyman School, Route 9
Westborough, MA
01581
508/366-9181

Terry Hollingsworth
U.S. EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7111

Thomas Holloway
U S EPA Region VII
25 Funston Road
Kansas City, KS
66115
913/236-3884

Mac Holman
U S EPA Region VI
1445 Ross Avenue
Dallas, TX
75202
214/655-2289

John Houlihan
US EPA Region 7
726 Minnesota Avenue
Kansas City, KS
66101

Dallas Hughes
US Forest Service
P O Box 3623
Portland, OR
97208-3623
503/326-3307

Robert Hughes
U S EPA- Corvallis
200 SW 35th Street
Corvallis, OR
97333
503/757-4666

Ron Huntsinger
Bureau of Land Management
18th and C St. NW
Washington, DC
20240

Roy Irwin
US Fish and Wildlife Service
819 Taylor Street, Room 9A33
Fort Worth, TX
76102
817/334-2961

Thomas Jackson
US FWS
134 Union Blvd , Rm 525
Lakewood, CO
80225
303/236-8180

Eric Janes
Bureau of Land Management
33478 Alta Vista Drive
Evergreen, CO
80439
303/236-0170

David Jennings
OK Dept of Pollution Control
P O Box 53504
Oklahoma City, OK
73152
405/271-4468

Jim Jensen
MEIC
P O Box 1184
Helena, MT
59624
406/443-2520

Sherm Jensen
Whitehorse Associates
Box 123
Smithfield, UT
84335
801/563-6100

Thomas Jewett
USDA-SCS
100 East B Street - Room 3124
Casper, WY
82601
307/261-5224

Randy Jirtle
Duke University Medical Center
Room139
Durham, NC
27710
919/684-2770

Chuck Job
U S EPA
401 M Street, SW
Washington, DC
20460
202/382-7771

Clarence Johnson
US Fish and Wildlife Service
18th and C St. NW
Washington, DC
20240
703/358-1710

Carol Jolly
Dept. of Ecology
St. Martins College (MS PV-II)
Olympia, WA
98504
206/438-7494

Charles Kanetsky
U.S. EPA Region 3
841 Chestnut Bldg.
Philadelphia, PA
19107
215/597-8176

James Karr
Department of Biology
VA Polytechnic Institute and State University
Blacksburg, VA
24061-0406
703/231-4139

William Kepner
US Fish and Wildlife Service
10613 N. 33rd Avenue
Phoenix, AZ
85029
602/261-4720

Connie King
Eastman Kodak
Kodak Colorado Division
Windsor, CO
80551
303/686-0537

Wesley Kinney
US EPA Region 8
999 18th Street
Denver, CO
80202
303/236-5072

Donald Klemm
U.S. EPA
3411 Church Street
Cincinnati, OH
45244
513/533-8114

Robert Kramer
EPA Region 3
841 Chestnut Bldg
Philadelphia, PA
19107
215/597-8330

Todd Kratzer
DE River Basin Commission
P O Box 7360
West Trenton, NJ
08628
609/883-9500

Mike Kravitz
U S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/475-8085

Jim Kurtenbach
U.S EPA Region 2
Woodbridge Avenue
Edison, NJ
08837
201/321-6695

Willie Lane
US EPA Region 6 (6 ESA)
1445 Ross Avenue
Dallas, TX
75202-2733
214/655-2289

Phil Larsen
U.S. EPA - Corvallis
200 SW 35th Street
Corvallis, OR
97333
503/757-4666

Jim LeBaugh
U S. Geological Survey
Denver Federal Center, Bldg 53
Lakewood, CO
80225
303/236-4989

Wayne Leininger
Range Science Department
Colorado State University
Fort Collins, CO
80523
303/491-7852

Paul Leonard
EA Engineering Science
15 Loveton Circle
Sparks, MD
21152
301/771-4950

William Lewis
EPO-Biology, Box 334
University of Colorado
Boulder, CO
80309
303/492-6378

Ed Liu
EPA Region IX (W-3-2)
215 Fremont Street
San Francisco, CA
94105
415/974-8351

Lee Liebenstein
WI DNR
P O. Box 7921
Madison, WI
53707

John Littke
Iowa Dept of Natural Resources
123 N Capitol
Iowa City, IA
52242
319/335-1578

Byron Lord
Pavements Division - FHA, HNR-20
6300 Georgetown Pike
McLean, VA
22101-2296
703/285-2345

James Luey
U.S. EPA Region V (5WQS-TUB-8)
230 S. Dearborn Street
Chicago, IL
60604
312/886-0132

Larry MacDonnell
Natural Resources Law Center
University of Colorado
Boulder, CO
80302
303/492-1287

Charlie MacPherson
Tetra Tech, Inc.
3746 Mt. Diablo Blvd., Suite 300
Lafayette, CA
94549
415/283-3771

Fred Mangum
U.S Forest Service
324 25th Street
Ogden,UT
84401
801/378-4928

Diana Marsh
AZ Dept Environmental Quality
2655 E Magnolia
Phoenix, AZ
85034
602/392-4020

Dan Martin
U S. Fish and Wildlife Service
222 South Houston, Suite A
Tulsa, OK
74127
918/581-7458

Don Martin
U.S. EPA - Idaho Operations Office
422 W. Washington Street
Boise, ID
83702
208/334-9498

John Maxted
U.S. EPA (A-104F)
401 M Street, SW
Washington, DC
20460
202/382-5907

Bruce McCammon
US Forest Service - Mt. Hood Nat Forest
315520 SE Woodard Road
Troutdale, OR
97060
503/695-2276

Ellen McCarron
Fl Dept of Environmental Regulations
2600 Blaristone Rd
Tallahassee, FL
32301
904/488-0782

Robert McConnell
Colorado Dept of Health
4210 E. 11th Avenue
Denver, CO
80220
303/331-4578

Glenn McDonald
US Forest Service
WA Dept of Ecology (PV-11)
Olympia, WA
98504-8711
206/438-7057

Dennis McMullen
Tech Applications
3411 Church Street
Cincinnati, OH
45244
513/533-8114

Daniel Merkel
U.S EPA Region VIII
999 18th Street, Suite 500
Denver, CO
80202
303/293-1584

Maureen Merkler
Kentucky Division of Water
18 Reilly Road
Frankfort, KY
40601
502/564-3410

David Meyer
City of Fort collins
3036 E Drake Road
Fort Collins, CO
80525
303/493-8367

James Miller
US GAO - Rm 1992
915 Second Avenue
Seattle, WA
98174
206/442-5604

Jerry Miller
USBR
P O Box 11568
Salt Lake City, UT
84147
801/524-5454

Gerald Montgomery
US EPA Region 10
1200 Sixth Avenue
Seattle, WA
98101
206/442-2596

Robert Morehouse
U.S EPA Region 1
JFK Bldg. (WQP-2109)
Boston, MA
02203
617/565-3513

Gil Murray
Timber Assn of America
1311 I Street
Sacramento, CA
95814
916/444-6592

Wayne Nelson
SAIC
14062 Denver W. Parkway #52
Golden, CO
80401

Tom Nesler
Colorado Division of Wildlife
317 W Prospect
Ft. Collins, CO
80526
303/484-2836

Bruce Newton
U S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7074

Peter Nolan
US EPA ESD
60 Westview Street
Lexington, MA
02173

Leonard Nowak
US EPA Region 4
345 Courtland Street
Atlanta, GA
30365
404/347-5242

Corky Ohlander
U S Forest Service
P O Box 25127
Lakewood, CO
80225
303/236-9606

Jim Omernik
U S. EPA - Corvallis
200 SW 35th Street
Corvallis, OR
97333
503/757-4666

Cecilia Ornellas
HI Dept of Health
645 Halekauwila Street - 3rd Floor
Honolulu, HI
96813
808/548-6767

Toney Ott
U.S. EPA Region VIII (8WM-SP)
999 18th Street, Suite 500
Denver, CO
80202
303/293-1573

Jim Overton
NC Division of Environmental Management
P O Box 27687
Raleigh, NC
27611
919/733-5083

Loys Parrish
U.S EPA Region 8
P O Box 25366 Denver Federal Center
Denver, CO
80225
303/236-5064

Harry Parrot
USFS
310 W Wisconsin Avenue
Milwaukee, WI
53203
414/291-3652

Greg Parsons
Colorado Dept. of Health
4210 E 11th Avenue
Denver, CO
80220
303/331-4756

Ron Pasch
TVA
270 Haney Building
Chattanooga, TN
37402
615/751-7309

Steve Paulson
University of Nevada - Las Vegas
4505 S Maryland Parkway
Las Vegas, NV
89154
702/739-0838

Kevin Perry
Tetra Tech
10306 Eaton Place, Suite 340
Fairfax, VA
22030
703/385-6000

Tom Pitts
Tom Pitts and Associates
1124 N. Harrison
Loveland, CO

303/667-8650

James Plafkin
U S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7005

Bill Platts
Chapman Associates
3180 Airport Way
Boise, ID
83705
208/383-3401

Robert Plotnikoff
Dept. of Ecology
(LH-14)
Olympia, WA
98504
206/753-2830

James Pollard
Lockheed Engineering
1050 E Flamingo Rd., Suite 209
Las Vegas, NV
89119
702/734-3367

Wayne Praskins
U.S. EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7010

Beth Pratt
Dept. of Environmental Quality
Herschler Bldg, 4th Floor W
Cheyenne, WY
82002
307/777-7079

Ronald Preston
U S EPA Region III-ESD
303 Methodist Bldg
Wheeling, WV
26003
304/233-2315

Pedro Ramirez
US FWS
2617 E Lincolnway - A
Cheyenne, WY
82001
307/772-2374

Jonathan Rea
CA Dept of Forestry
P O Box 944246
Sacramento, CA
94244-2460
916/323-5158

John Rector
U.S Forest Service
630 Sansome Street
San Francisco, CA
94111
415/556-1564

Will Roach
U S. FWS
17629 El Camino Real, #211
Houston, TX
77058
713/750-1700

Glenn Rodriguez
U S. EPA Region 8
P.O. Box 25366 Denver Federal Center
Denver, CO
80225
303/236-5064

Richard Ruelle
US Fish and Wildlife Service
P O Box 986
Pierre, SD
57051
605/224-8693

Frank Sagona
TVA
311 Broad Street, Room 2705
Chattanooga, TN
37401
615/751-7334

William Samuels
SAIC
1710 Goodridge Drive
McLean, VA
22102

Steve Saunders
Dept of Ecology
(MS- PV11)
Olympia, WA
98504
206/438-7086

Tim Savisky
EPA Region 4
108 College Station Rd Apt H-111
Athens, GA
30605
404/369-8240

Duane Schuettpelz
WI DNR
P O Box 7921
Madison, WI
53707

Elizabeth Scott
RI DEM
83 Park Street
Providence, RI
02903
401/277-3434

Donna Sefton
US EPA Region VII
726 Minnesota Avenue
Kansas City, KS
66101
913/236-2817

Louis D Seivard
VA Water Control Board
2111 N Hamilton Street
Richmond, VA
23230
804/367-6308

Lawrence Shepard
US EPA Region 5 (5WQS TUB8)
230 Dearborn Street
Chicago, IL
60604
312/886-0135

Thomas Simon
Central Regional Laboratory
536 S Clark Street
Chicago, IL
60605
312/353-5524

Alan Smart
U.S. EPA Region 10 (WD-139)
1200 Sixth Avenue
Seattle, WA
98101
206/442-2579

James Smith
Agricultural Engineering Department
University of Wyoming
Laramie, WY
82071

Stephen Smith
U.S. Fish and Wildlife Service
900 Clay Street
Vicksburg, MS
39180
601/638-1891

Dave Somers
Tulalip Tribal Fisheries
3901 Totem Beach Road
Marysville, WA
98270
206/653-0220

Mary Lou Soscia
U S. EPA (WH-556F)
401 M Street, SW
Washington, DC
20460
202/475-7109

Roy Spalding
Institute of Agriculture and Natural Resources
University of Nebraska
Lincoln, NE
68583-0844
402/472-7558

Kendra Stallcup
OK Conservation Commission
2800 N. Lincoln, Suite 160
Oklahoma City, OK
73105
405/521-2384

Robert Steedman
Ontario Ministry for the Environment
435 James Street
Thunder Bay, Ontario
Canada P7C5G6
807/475-1215

Don Steffeck
Environmental Contamination Division-USFWS
330 Arlington Square Building
Washington, DC
20240
703/358-2148

Ivars Steinblums
Siskiyou Nat. Forest
P O Box 440
Grants Pass, OR
97526
503/479-5301

Peter Stender
US Forest Service
324 25th Street
Odgen, UT
84401
801/625-5368

Tim Stevens
SWRCB
901 P Street
Sacramento, CA
95814
916/322-0216

Daniel Stewart
ND Dept. of Health
1200 Missouri Avenue #203
Bismarck, ND
58502-5520
701/224-2354

Jerry Stober
U.S. EPA Region IV
College Station Road
Athens, GA
30613
404/546-2489

Tom Stockton
NC Dept. of Natural Resources and Community Dev.
P O Box 27687
Raleigh, NC
27611-7687
919/733-7015

Rob Striegel
USGS 413
Box 25046
Denver, CO
80225
303/236-4993

Richard Stroud
US Fish and Wildlife Service
1002 NE Holladay
Portland, OR
97323
503/231-6223

Tim Stuart
U.S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7074

Kate Sullivan
WTC 2H4
Weyerhauser Company
Tacoma, WA
98477
206/924-6191

Nancy Sullivan
U.S. EPA Region 1
JFK Bldg. Room 2103
Boston, MA
02203

Kathy Svanda
Minn Pollution Control Agency
520 Lafayette Road
St. Paul, MN
55155
612/296-8856

Larry Svoboda
US EPA
P.O. Box 25366
Lakewood, CO
80225
303/236-5102

Diane Switzer
U.S EPA
60 Westview Street
Lexington, MA
02173
617/860-4377

Phill Taylor
U.S. EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7046

Peter Tennant
ORSANCO
49 E. 4th Street
Cincinnati, OH
45202
513/421-1151

Howard Thomas
USDA-SCS
511 NW Broadway - Room 248
Portland, OR
97209
503/326-2841

Nelson Thomas
U.S EPA-ERL Duluth
6201 Congdon Blvd.
Duluth, MN
55804
218/720-5702

Steve Tralles
MT Water Quality Bureau
A-206 Cogswell Bldg.
Helena, MT
59620
406/444-2406

M J Trlica
Range Science Department
Colorado State University
Fort Collins, CO
80523
303/491-5655

Dave Vana-Miller
US EPA Region VIII
P.O. Box 25366
Lakewood, CO
80225
303/236-7372

Dale Vodehnal
US EPA Region 8
999 18th Street
Denver, CO
80202-2405
303/293-1565

Craig Vogt
U S. EPA (WH-556F)
401 M Street, SW
Washington, DC
20460
202/475-7130

Ernie Watkins
U.S. EPA
401 M St., SW
Washington, DC
20460
202/382-5667

James Weber
Columbia River Inter-Tribal Fish Commission
975 SE Sandy Blvd Suite 202
Portland, OR
97214
503/238-0667

John Wegrzyn
AZ Dept of Environmental Quality
2655 W Magnolia,#200
Phoenix, AZ
85034
602/392-4040

Bruce Wilson
MN Pollution Control Agency
520 Lafayette Road
St Paul, MN
55155
612/296-9210

Hal Wise
U.S. EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7109

John Wolfe
US FWS
1002 NE Holladay
Portland, OR
97232-4181
503/231-6223

Lane Wyatt
NW Colorado Council of Gov.
P.O. Box 739
Frisco, CO
80443
303/668-5445

Ruth Yender
U.S EPA (WH-553)
401 M Street, SW
Washington, DC
20460
202/382-7062

Chris Yoder
Ohio EPA
1030 King Avenue
Columbus, OH
43212
614/466-1488

Carl Young
U.S. EPA Region VI
1445 Ross Avenue
Dallas, TX
75202
214/655-2289

Bruce Zander
US EPA Region VIII (8WM-SP)
999 18th Street, Suite 500
Denver, CO
80802-2405
303/293-1580

John Zogorski
South Dakota School of Mines
Rapid City, SD
57701
605/394-2437