

I. Introduction

Research and monitoring is one of the over-arching themes of the Great Lakes Regional Collaboration. Each sub-committee was tasked with developing their coordination strategy within this overarching issue. This background paper focuses on the research and monitoring needs of the nonpoint source (NPS) pollutants control.

II. Background

Nonpoint source pollutants, their damage and their control, are uniquely in need of extensive research and monitoring. NPS pollutants usually do not cause damage at their site of origin but are transported from their source to some other location by air and water. Damages occur both during the transportation phase and the deposition phase of the delivery process. This makes the control process extremely difficult. Without knowing *what* pollutants are in the water and air columns, at *what levels* they are present in those columns and what levels cause damage to what ecosystems, and *how* and what management practices (MPs) are need *where*, control and coordination among responsible agencies is a difficult if not impossible task.

Research can provide us with those answers to what is being damaged, what levels of pollutants cause that damage, and what and how many reduction practices placed where will provide the needed load reductions at the point of damage.

Monitoring of the air and water columns is necessary to provide researchers with information to determine the what, where and how portion of NPS control. It can also provide agencies the information required to assess progress toward reducing nonpoint source pollutants reduction goals. Research and monitoring has been conducted in the past but not in any comprehensive systems approach and never over the long-term.

III. Research Needs

The perspective from which this section is written is based on starting with the damages caused by NPS pollutants and following the pollutant stream back up through the water or air shed to its source and finally to control efforts. This process has been divided into four sections: damages, delivery and sources, interruption/reduction of delivery and sources, and implementation enhancement. Each of these sections requires a specialized and distinct type of research that, however, also needs to be part of a systems approach to research.

Damages

NPS pollutants cause damage both to the environment and to the economy. They cause damage both during the transportation phase of the pollutant and when the end deposition phase. They damage humans and other species living in and using the lakes, rivers and

bays by both direct toxic effects and indirectly by damaging habitat. They also cause economic damage by increasing the cost to use the air and water by necessitating additional investments to remove the pollutants. They increase the costs of goods transportation by ship as well as the cost to use pleasure craft. They also decrease the recreational use of the beaches and water through beach closing and causing an unsightly viewscape.

Research is needed to scientifically identify what species/ecosystems are being damaged by nonpoint source pollution and by what amount. Because this effort will probably be very site specific, the studies will have to be conducted, at the maximum, on a river basin or lake basin scale. For example, wildlife officials believe walleye fry are being reduced because of high sediment loads during spring runoff in the Maumee and Sandusky River basins in the Western Lake Erie Basin. We need research to know what levels of turbidity, for how long, and when, harm Walleye fry and to what levels the turbidity must be reduced in order to mitigate the damage.

- ***Recommendation: Research is needed to scientifically identify what species/ecosystems are being damaged by what nonpoint source pollutant.***

Research also is needed to identify what economic activities are being damaged by nonpoint source pollution and by what amount. Because this is also site specific, this has to be on a river basin by river basin basis. For example, the Port of Duluth needs to be dredged because of sediment being deposited in the shipping channel. We need research to know if it is more economically to reduce sediment flowing into the harbor or periodically dredge.

- ***Recommendation: Research is needed to scientifically identify what economic systems are being damaged by what nonpoint source pollutant.***

Delivery and Sources

There is a need to know exactly where on the landscape the pollutants come from and what is the delivery/transportation process. If you don't know where the sources of the pollutants are on the landscape and you don't know the path they take to the point where they are causing damage, there can be no efficient means to control the pollutants nor coordinate that control.

Sources

Once a particular environmental or economic damage has been identified and the pollutant that caused the damage is identified, the source of pollutant needs to be identified. Research is particularly needed to identify the sources of the nonpoint pollution on the landscape. Most of the mitigation of NPS pollutants will take place at the source location.

- ***Recommendation: Research is needed to identify the sources of the nonpoint pollution on the landscape.***

Delivery

However, not all of the pollutants can be reduced sufficiently at the source. Therefore, there is a need to know how the pollutants are transported from the source to the point of damage. For example, sub-surface drainage used extensively within the basin may be a short-circuit delivery system for many water borne NPS pollutants.

- ***Recommendation: Research is needed to identify the method and process of transport of the nonpoint pollution from the landscape to the point of damage.***

Interruption/reduction of Delivery and Sources.

Once you know that a NPS pollutant is causing damage and you know the sources and methods of delivery, there is a need to research how to reduce the sources and interrupt the delivery. While there is research in this area, it is general in nature and not site specific to each Great Lakes river basin. There is now an on-going attempt by the USDA to quantify agricultural MP effectiveness (nationally with some case study watersheds on the Great Lakes basin) but it needs to be augmented.

Reduction of Sources

The less you have of a potential pollutant at a particular location the lower the chance that it will be delivered into the environment. Therefore, there is a need to reduce the amount of mercury in coal, reduce the amount of pesticide and fertilizer used in agriculture and lawn care, reduce the amount of pet wastes and other animal wastes and reduce the amount of runoff. This may involve efforts to find a more efficient use or entire elimination of the pollutant especially if the pollutant is being introduced into the area.

- ***Recommendation: Research is needed on how to reduce the amount of potential pollutants in the environment.***

Interruption of Delivery

There is a need to know what MPs and how many MPs are needed where to interrupt the delivery of NPS pollutants in the most efficient manner possible. For example, you can't remove soil in order to reduce the sources of sediment but you can interrupt the delivery process. Also little is known of the effects of combinations of MPs to interrupt the delivery system.

- ***Recommendation: Research is needed to learn how to interrupt the delivery of NPS pollutants.***

Implementation Enhancement.

After all the research to find the damages, sources, delivery systems, appropriate management practices and locations, if landusers or policy makers do not implement

anything no NPS pollutants will be controlled. Traditionally it has been difficult to motivate both groups to levels of actions that will mitigate NPS pollution damages. For example: why isn't continuous no-till being adopted by more landusers; why aren't zoning boards/developers adopting sustainable developments as the norm rather than requiring a variance; why are CAFO operators resistant to adopting value added processes to manage their waste products?

- ***Recommendation: Research is needed to be conducted on the economic and social impediments to adoption of long-term NPS reduction practices, policies and management.***

Strategy

Set up pilot projects to identify research needs. (Western Lake Erie Basin Project for example)

- Need to get big picture of the watershed, considering all NPS in the watershed.
- Must take a geomorphic perspective.
- Must have a multi-discipline effort.
- Must use decision support tools for evaluation.
- Do we need to centralize or coordinate model use in great lakes basin?

IV. Monitoring Needs

Monitoring is the continuous long-term collection of physical and chemical data from the air and water columns. This data is critical to scientist conducting all phases of NPS pollution research. It is critical to populate NPS sources, loads, delivery and damage models. It is critical to evaluating the efforts of NPS pollutant mitigation. Without monitoring, how do you know whether any reduction has occurred and by what amount? It is impossible and some would say negligent not to do so. There is no dedicated funding to ensure long-term sustainable monitoring of the current or future network.

The following are recommendations:

- Need to set up a comprehensive network to monitor NPS in each river and lake that includes buoys, autonomous underwater vehicles (AUVs), fixed underwater hubs, and static air and watershed monitoring systems.
- A comprehensive basic monitoring network to be funded 100% at the federal level.
- Need to do more partnerships to collect data - Federal agencies need to coordinate efforts and work to bring other state and local governments, academia,

and NGO monitoring efforts into a system that is well documented (metadata) and uses the strengths of each effectively.

- Need funding for “local cooperators” to read gauges and for engineering technicians to operate and service the monitoring networks.
- Need to look at/promote the development of remote sensing technology to monitor levels of NPS pollutants in the Great Lake waters.
- Need to require that monitoring is an integrated portion of funded NPS projects and is supported long-term.

V. Coordination and Barriers

Research

The President’s executive order details specific language in Section 3aviii to ensure the coordination of research within the basin. However, NPS pollutant research activities are scattered between various federal agencies such as the USGS and the USDA and universities. NPS research is generally conducted on a topical basis rather than an ecosystem basis. As a result, only pieces of the pollutant puzzle are studied at any one time at any one location. It takes years to develop a coherent picture and often pertinent pieces are never studied.

NPS research not only tends to be compartmentalized, it is often short-term. For example there are fish studies and pollutant transport studies and sources and loads studies but almost no studies of an entire ecosystem/watershed (perhaps because of the complexities and time frame and culture of the need to publish) for how it functions, how it interacts with outside influences, how it can be restored. This is the type of study that needs to be conducted on a coordinated scale. While researchers need to focus in on their piece of the puzzle, but the entire puzzle needs to be defined and coordinated.

Recommendation:

- ***Establishment of a Great Lakes NPS Research Clearing House Task Force. This task force will bring together research needs with researchers and funding organizations in a coordinated and comprehensive manner.***
- ***Establish a public accessible on-line reference of NPS research. Results from research is not easily available (although the CRES bibliographies are a start) to anyone outside of a research institute or university. It should not be difficult to find significant research on any NPS pollutant.***
- ***The Research Clearing House should establish a methodology for restoration agencies and organizations to submit their research needs and try and fulfill them as necessary.***

- *There is a disconnection between the need for research by implementers and the actual research being conducted. This is mainly due to funding. Research has to be funded and federal, state and local implementation agencies do not have the authorization or the resources to fund research. Money drives research not need for data.*

Monitoring

Monitoring responsibilities are also scattered throughout state and federal agencies. There is no comprehensive system. No one agency is in charge of the monitoring activities in the Great Lakes, so there are many different federal, state, local and private monitoring activities. They occur at different times and places and use different techniques.

Recommendation:

- *Establishment of a Great Lakes NPS Monitoring Task Force. This task force will have the authority to direct funding of the agencies to coordinate a comprehensive and sustainable Great Lakes monitoring system.*

VI. Available information

- National research council - <http://www.nas.edu/nrc/> USDA-ARS National Agricultural Library- CEAP review on research information- <http://www.nal.usda.gov/wqic/>

VII. Technical Issues

- There is a lot of information on the effects of MPs, but every site is different - haven't put them in decision support system for use.
- Verification of MPs in a real world setting is very difficult. For large watersheds there has not been enough MPs installed in a short enough time to verify if the MPs were successful.
- Need to "focus for effect" for MPs research in a watershed.
- Develop support policy tools.

VIII. Conclusions

The need for NPS pollutant research and monitoring in the Great Lakes is significant. It is basis from which needed scientific information is obtained. It will make the effort to mitigate NPS pollution damages more efficient. It will allow the tracking of progress. It will require coordination, increased funding and time.