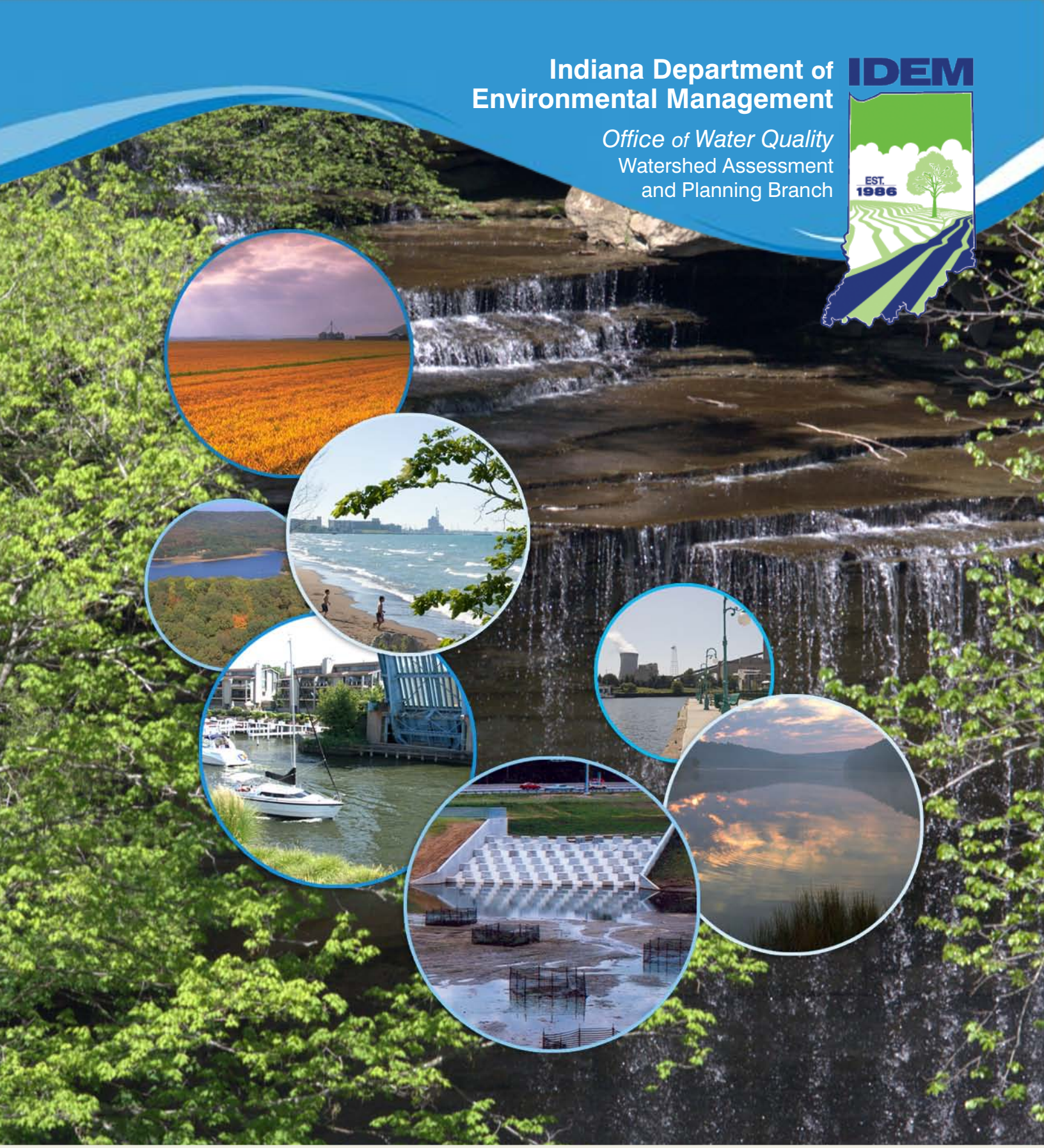
Indiana Department of
Environmental Management

Office of Water Quality
Watershed Assessment
and Planning Branch



INDIANA WATERSHED PLANNING GUIDE - 2010

Indiana Watershed Planning Guide

September 2010

Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch

Developed with the participation of:
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www.watersheds.idem.IN.gov

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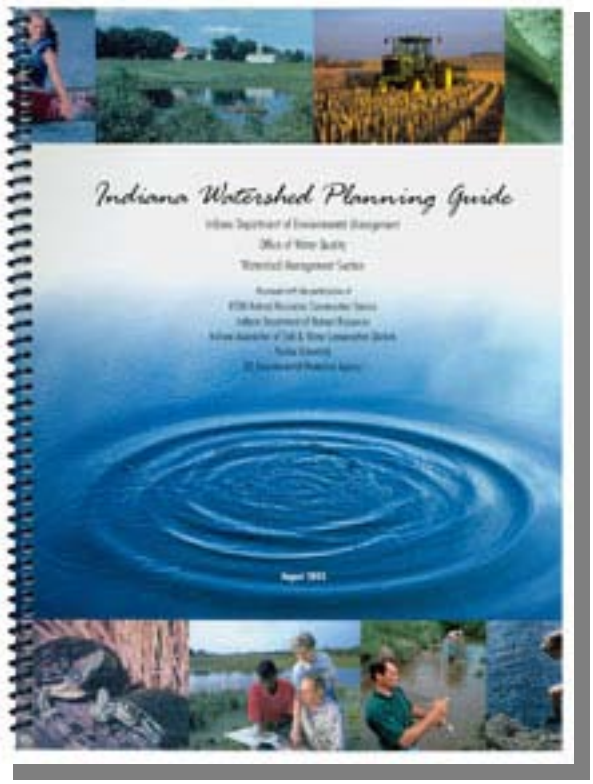

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Tips for Achieving Watershed Planning Success

1. There's more than one way. Your partnership-building and plan-writing experience probably won't be as orderly as it looks in this guide. You may complete the steps in different ways or in different order, unless you are required to fulfill specific grant guidance. This is okay. It's not possible to write a one-size-fits-all prescription for watershed planning—everyone's situation is different.

2. Read this guide! It will do you absolutely no good if you don't open and read it. The lists of sources and references are starting points—we expect you to add more. Successful groups do their homework. Remember to visit the online toolkit, which has expanded references and resources.

3. Focus on a manageable area. The smaller the watershed, the better the group can relate to it, and the faster it will react to change. If you are dealing with a large watershed (more than 10,000 acres or so), identify critical areas or priority subwatersheds to tackle rather than trying to address everything everywhere.

4. Include everyone. Leaving people out may have undesirable consequences in the future. Bring all interests to the table in the beginning. If, along the way, you discover stakeholders who are not represented, invite them to join the group as soon as you can.

5. Find leaders. There are leaders in every community. They're made, not born. Good leaders help the group reach consensus, encourage new ideas, promote open communication, listen patiently and with open minds, and make sure everybody has a chance to talk. They also make sure there's coffee.

6. Teach each other. Everyone is an expert at something. Master gardeners can teach homeowners about the benefits of low- or no-phosphorus fertilizer. Bankers can help the group develop a budget.

7. Always ask why. This is the easiest way to discover the concern behind an opponent's position, the cause of an environmental problem, or the reason for poor attendance at meetings. If you don't ask, you won't find out.

8. Share your success. Tell each other, the community, your sponsors, everybody. You are doing something important! You deserve the attention, and it can help lead to even greater success.

9. Strive for consensus. Don't ask, "Do you like this?" Instead ask, "Can you live with this?" Consensus does not have to mean total agreement, but does need total support.

10. Embrace conflict. Don't dance around it. Conflict generates energy. Properly harnessed, conflict can spur new ideas; bring new people into the partnership, and reinvigorate the group.

11. Bite your tongue. Be patient. The watershed didn't get to where it is yesterday, and you won't fix it tomorrow. Be nice to each other. You may need that loud guy on your side in a discussion next month, and if he's committed enough to be at every meeting, he deserves your respectful attention.

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Introduction

Ask a watershed group whether they've developed a watershed plan. If they have, they'll proudly pull it out to show you. If they have not, here's what you might hear:

"We can't seem to get started."

"It's not anyone's job, and anyway, nobody has the time."

"We have a plan…it's in our head…
well, in somebody's head."

"We're too busy fixing the watershed!"

If you're hearing these phrases and you have a desire to improve water quality, maybe you're the person to organize a watershed group. This document is made for people who want to help improve water quality but who may not have the expertise and experience.

Why is it Important to Write a Watershed Plan?

Due to the deplorable state of the nation's surface waters in the late 1960s and early 1970s, U.S. lawmakers, at the urging of citizens, charged the nation with cleaning up and protecting U.S. surface waters in the Federal Water Pollution Control Act of 1972. We've come a long way since then, instituting permit limits for pollution discharge and dredging contaminated sediments. But we still have work to do. Watersheds, being easily defined, serve as logical landscape units for environmental management. Approaching nonpoint source pollution in a watershed framework helps communities evaluate and prioritize problems affecting ground and surface waters. Watershed planning connects the community's decision making to sensible data collection and defensible analysis. Recording those decisions in a watershed plan increases the probability that the problems will be addressed.

Top 10 Reasons for Developing a Watershed Plan

People develop watershed plans in order to:

1. Improve the quality of life for people in the watershed by helping to ensure clean water and healthy natural resources.
2. Create a record of the watershed group's decisions.
3. Inform the community and market the effort to new partners.
4. Help the effort grow bigger and last longer.
5. Provide a way to track progress with measurable results.
6. Enable the community to get additional agency support.
7. Empower the local community to create change.
8. Make it easier to obtain grant funds.
9. Provide the partners with a tangible success story.
10. Use grant funds to leverage existing programs.

When is a Group of People Ready to Write a Plan?

- □ When the group works together with mutual respect and trust;
- □ When all major interests in the watershed are represented; and
- □ When the members of the group can make and support their own decisions.

What's the Purpose of the Indiana Watershed Planning Guide?

- ☐ To assist local groups in developing successful watershed plans;
- ☐ To establish a common approach for watershed planning throughout Indiana; and
- ☐ To help you answer the four great watershed planning questions:

1. Where are we now?
2. Where do we want to be?
3. How are we going to get there?
4. How will we know when we've arrived?

What's in This Guide?

This guide is intended to steer you through the process of developing a watershed plan. Many similar documents exist; in fact nearly every state has some version. However, this guide is written for people in Indiana by people in Indiana. It applies to the kinds of plans you can expect to be involved with in partnership with agencies that provide funding in Indiana.

This guide is not intended to supersede existing watershed management grant guidance or the requirements of specific programs. However, it is intended to provide basic information that is compatible with Indiana's watershed grant programs.

In this guide, you'll find an overview and recommendations for each planning phase. Each chapter addresses a different phase, and specific plan components are listed at the end of each chapter. Planning steps are discussed in chronological order, and this is also the order in which the plan elements are usually written. Many organizations enter the planning process at different phases, and you can use this guide wherever or whenever you start.

This revision of the guide was created to be interactive. You'll find opportunities to click on or mouse-over words for definitions and tools that will link you to additional online resources. Because of this increased functionality, IDEM will not be printing hard copies of this edition (but you may print your own if you want)!

To get you started on the right path, the first chapter contains information on why watershed groups succeed or fail and how to avoid common pitfalls.

What you will not find here are detailed technical instructions on monitoring, modeling, mapping or specific implementation measures. Many excellent handbooks and Web sites already exist on technical topics. See Appendix D, "Resources," and the online toolkit for more information.

What's the Best Way to Use This Guide?

How much you rely on this guide depends on your role in the planning process. Here are some ways to use it:

Watershed coordinators

You will probably write sections of the actual watershed plan and bear responsibility for gathering and organizing most of the information. Follow this guide chapter by chapter to learn what information your plan needs to contain, how to gather it, and what you and the group should do next. There are hyperlinks throughout, and in the online toolkit, to help you with planning specifics.

Steering committee members

You will be making decisions that are recorded in the plan. Use this guide to familiarize yourself with the general content of watershed plans, to see what's coming next, and to help you with setting goals and analyzing data. This guide will also help you understand the work that's to be done by others, such as the watershed coordinator and committee members.

Stakeholders

Browse this guide and read the parts that interest you. As the watershed effort unfolds, use the guide as a reference to help you see where you fit in the process and what you can contribute.

Agency staff

The guide is a how-to document that also identifies contributions that are best made by agency staff. Use it to become familiar with the project and the local steering committee's needs so you will know what kind of assistance they may expect from you.

Terms Used in This Guide

It is easy to use words like "watershed," "nonpoint source" and even "planning" without realizing that everyone doesn't define these terms the same way you do. Before we can discuss watershed planning, we need to clarify a few terms.

Watershed

A watershed is the area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or ground water. Depending on the scale of the discussion, you could refer to the watershed of the Mississippi River, or the watershed of a farm pond. You may hear terms such as "river basin" or "drainage" used interchangeably with "watershed."

Hydrologic unit code (HUC)

Hydrologic unit codes were developed by the U.S. Geological Survey (USGS) in cooperation with the U.S. Water Resources Council and the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Most federal and state agencies use this coding system. HUCs are a way of cataloging portions of the landscape according to their drainage. Landscape units are nested within each other and described as successively smaller units.

The HUC attached to a specific watershed is unique, enabling different agencies to have common terms of reference and agree on the boundaries of the watershed. These commonly understood boundaries foster understanding of how landscapes function, where water quality problems should be addressed, and who needs to be involved in the planning process.

The entire country has been mapped to the 8-digit hydrologic unit code level (about 2,211 watersheds). Indiana is divided into 39 watersheds at this level. For example, all of the land area draining into the Upper White River is in one 8-digit HUC. These larger watersheds have been divided into 10-digit watersheds and smaller 12-digit watersheds. In Indiana, these larger watersheds were originally divided into 11-digit watersheds and smaller 14-digit watersheds. The Indianapolis USGS office completed these delineations in the mid-1990s and based them on Indiana-specific characteristics of hydrography. USGS has since completed delineating the nation's watersheds at the 10- and 12-digit HUC levels, providing a seamless national map with consistency across state boundaries.

It is important to remember that watersheds refer to surface water only. Ground water, which is the source of much of our drinking water, is influenced by surface water but it occurs in underground aquifers, not watersheds. The Indiana Department of Natural Resources' Division of Water provides maps and geographic information system (GIS) products related to the aquifers of Indiana. Indiana's aquifers have also been grouped in common hydrogeologic settings according to their geology, vulnerability, etc. The Office of Indiana State Chemist and the Indiana Geological Survey provide maps online. When addressing water quality issues, both ground and surface water should be considered.

For information about watershed groups and hydrologic unit codes, visit the Indiana Watershed Finder online. For water monitoring locations of Indiana streams, lakes and ground water, visit the Indiana Water Monitoring Inventory online. For additional watershed information, visit U.S. EPA's Surf Your Watershed Web site.

Nonpoint source (NPS) pollution

Nonpoint source pollution is the pollution of ground and surface water that results from various human activities. Unlike pollution from factories and sewage treatment plants (*i.e.,* point sources), NPS pollution comes from many widespread sources. Soil particles, fertilizers, animal manure, pesticides, oil, road salt, fecal material from failing septic systems, pet waste, and debris from paved areas are transported over the landscape by storm run-off, snow melt and wind. Eventually entering streams, wetlands and lakes, or penetrating into ground water, these pollutants damage aquatic habitats, harm aquatic life, and reduce the capacity of water resources to be used for drinking water and recreation. Because NPS pollution doesn't come out of a pipe that's easily located, it has to be managed differently than facilities with site-specific permits. That's why so many of the measures directed at controlling NPS pollution are voluntary, and why so many people need to be involved.

Planning

Planning is an orderly, logical process by which a diverse group of people can reach defensible decisions based on objective data. Done right, planning prevents jumping directly from the problem to the solution without facing reality along the way. In the case of watershed planning, planning also means recording decisions made by the group along with enough information so the community at large can understand what the group is doing and why they are doing it.

Acronyms Used in This Guide

Some of the acronyms used in this guide are listed below. Additional acronyms are listed in Appendix E, "Glossary of Acronyms and Terms." Information about the agencies mentioned in this guide can be found in Appendix C, "Agencies and Organizations Directory."

CES	Cooperative Extension Service
FWS	U.S. Fish and Wildlife Service
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
ISDA	Indiana State Department of Agriculture
NGO	Nongovernmental Organization
NRCS	Natural Resources Conservation Service
RC&D	Resource Conservation and Development
SWCD	Soil and Water Conservation District
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Chapter 1: Building Local Partnerships

The watershed planning process doesn't happen in a vacuum. Although you, as a single individual, may be a talented technical writer who could sit down and crank out a fabulous watershed plan all by yourself, it's likely that no one would ever pay any attention to it. And if an agency or organization writes a plan for "the good of the people," or because they are the ones who "know best," the same thing can happen. In fact it *has* happened, over and over, and this is why many uneven table legs are propped up with attractive spiral-bound watershed plans that never changed a thing.

To have a chance at actually restoring and protecting water quality through planning, all of the major interests in the watershed need to be engaged in the process. Building a functional partnership is both the hardest and most rewarding part of watershed projects. Compared to this, the science stuff is easy!

Why Form Watershed Partnerships?

- Build strength in numbers – People have identified water-related needs or problems they cannot address alone, and you can get more done when working in a team.
- Increase resources – By pooling resources, partners can tackle the problem more effectively.
- Diversify expertise – Partners can draw on expertise and information from a wide range of people who live on the land and know the local community.
- Bring everyone along – Involving all the partners with an interest in the project means it will be more acceptable to the community and easier to sustain.
- Create solutions – Working through issues with a diverse group helps find solutions you might not have thought of.

What Makes a Watershed Partnership Successful?

- Broad representation – All interests in the watershed are represented. No one is excluded.
- Local knowledge – Many people who actually live and work in the watershed and who know how things work on the local level are involved.
- Effective communication – Communication is the primary tool to resolve conflict and reach agreement. Conflict is reduced when everyone understands the issues and each other's needs and concerns.
- Common vision – A shared community vision builds long-term support. With the public fully involved in planning and decision making, personal responsibility and commitment are increased.
- Collaborative decision making – Decisions are usually made by consensus, and everyone's needs are heard. By working to address all concerns, groups often come up with creative solutions that are widely accepted.
- Pooled resources – Practical management of resources is improved by meshing the efforts of several agencies and organizations.
- Coordination – Some person, either hired or volunteer, shoulders the job of coordinating meetings, communications, events, relationships with agencies and other tasks.

What Can Make a Watershed Partnership Fail?

- Unresolved conflict – Key group members are unwilling to work at resolving conflict and/or opposing groups refuse to talk or associate (*e.g.,* a lake association vs. the farmers in the watershed).
- Lack of clear purpose – Problems are not clearly defined or are not felt to be critical.
- Vague goals – Goals or time frames are either unrealistic or poorly defined.
- Incomplete group – Key interests or decision makers are not represented or refuse to participate.
- Unequal partnership – Some interests have a disproportionate amount of power, not all partners stand to benefit, or members are not being given credit for their contributions.
- Lack of commitment – Financial and time requirements outweigh potential benefits, or some members are not comfortable with the level of commitment required.
- Basic value conflict – One or more partners have irreconcilable differences with no room for negotiation.

Bring Everyone to the Table

The watershed planning process can derail in a hurry if key stakeholders are not invited to the table or won't stay at the table after being invited. You'll need representatives of any group that you expect to change something, gain something or lose something as a result of watershed plan implementation. If you can think of groups that affect or are affected by the water quality in the area, invite them.

Full and balanced representation of all interests in the watershed promotes trust. This means that all major interests are represented, but no one interest dominates the group. When large audiences need to be represented or there is a group of organizations with common interests (such as environmental groups or agricultural commodity groups), you can ask that they identify one or two people to represent them all. This keeps the steering committee from growing unmanageably large.

If water quality problems in the watershed are not obvious, or if they are poorly understood, it can be difficult to persuade people to commit time and energy to the project. Often a small core group, such as a soil and water conservation district board or a natural resource conservation group, wants to get a project rolling but recognizes that more folks need to be on board.

How to Get People to Join the Project and Stay With It

The best way to get people to come to a steering committee meeting is through personal contact. If each member of the core group of stakeholders would personally invite several more people to come to the next meeting, the steering committee would rapidly grow to a workable size. Written invitations are fine, but no piece of paper will ever substitute for a personal visit. Sometimes it is necessary to provide transportation to your guests, but your effort will be worthwhile when they add their contribution to the project.

To identify stakeholders to serve on the steering committee, ask:

- Who could be affected, positively or negatively, by the group's decisions?
- Who are the people that may have to change their behavior or manage their land differently based on the group's decisions?
- Who could provide technical assistance, develop communication pathways and act as a liaison to local political bodies?

Brainstorm a list of all these people. Identify members of your core group who can contact them personally. One personal message is worth a hundred envelopes in the mail. Develop a recruitment package to leave with them after the meeting. A page or two is enough. Include the following information:

- Purpose statement – If the group already has a charge or mission statement, use that. Otherwise, just let the recipient know why this committee is being formed.
- Goals and objectives – These still may be pretty vague; that's okay. Or, you can state that they are being invited to help identify goals.
- Description of the group – State the name of the sponsor and why the group exists.
- Major issues – State two or three of the major issues/concerns that brought the group together.
- Major programs and activities – If none have occurred yet, mention a few that are planned or being considered.
- Funding sources – Indicate if the group is empowered to handle money and if it is benefiting from a grant, matching funds or services from project partners, or district funds.
- Expectations – State what the steering committee members (or subcommittee members, or project volunteers) are committing to.
- Benefits of being on the steering committee – Set forth what's in it for them and for the community.

Some groups solicit for steering committee (and other volunteer committee) members during public "kick-off" meetings designed to introduce the effort to the community. This is a fine strategy, but the steering committee should also include a few people that you've identified ahead of time who are dedicated to the effort.

How to Keep Committees Vital and Effective

Ask these questions regularly as the project progresses:

- Should new groups or individuals be brought into the partnership?
- Are there enough interests represented to make good decisions that the community will support?
- Are the best people present to fill the roles that have been identified?

Encourage Participation

- Establish a clear sense of direction so people know what to expect.
- Give people specific things to do, and support their effort with technical assistance and resources as needed. The group needs to set clear deadlines and identify who is responsible for tasks.
- Appeal to people's sense of stewardship. Show how the problems in the watershed affect residents—in economic and social terms as well as environmental.
- Tell prospective members what will be expected of them and how much time they will be expected to commit.
- Hold meetings at a time that is convenient for your group—people who are representing an agency or organization might prefer to meet during the daytime, while many volunteers need to meet in the evenings or on weekends.
- Bring food (even if it's just a light snack). Committee members need time to interact one-on-one or in small groups. Goodwill develops around the coffee and cookies, sometimes much more than during the actual meeting.
- Recognize the group and its members publicly so the community knows who is representing them. Use all available media to give the project a presence in the community.
- Hold site visits, stream walks, canoe trips and driving tours—people need to get outside and share camaraderie in a natural setting within the watershed area!

Prevent Burnout

- Make sure meetings are necessary, effective and worthwhile.
- Prepare, prepare, prepare! Talk to your stakeholders ahead of time, prepare agendas, and think about room setup well in advance of the meeting.
- Document and celebrate progress. People feel valued when their work is acknowledged.
- Use rewards and incentives for continued participation: T-shirts, hats, pens, coupons for local restaurants, county road maps, or whatever works in your community. A nice T-shirt bearing a logo is both a reward and an advertisement for the group.
- Do hands-on projects to give members a sense of ownership (*e.g.,* tree planting, trash pickups, stream bank plantings).
- Maintain a stable group structure, with accountability by and to members. It is very frustrating to group members when different representatives show up for meetings after a long absence, forcing the group to spend valuable time bringing them up to speed.
- Identify specific benefits to landowners and participants.
- Keep track of accomplishments and be sure to promote milestones to members and the community.
- Start with small projects that will provide early successes. Do something, even if it's just to pile into a van and get to know the watershed.
- Spend enough time together to develop personal relationships in the partnership; this will glue things together when conflicts and obstacles arise.
- Make sure there's plenty of food and coffee, and have some fun!

Partnership Structure

There is no set structure for a watershed group, but many involve one or more of the following components:

Sponsor or board of directors: The sponsor or board of directors is usually the body that is administering any grant money or other funding that the group has obtained. Generally, it is the sponsor who came up with the idea of having a watershed project in the first place. The sponsor is responsible for guiding the overall nature of a particular project but might not be involved in day-to-day operations.

Steering committee: Since the sponsor or board may have other responsibilities, or may not embody all the stakeholders in the project area, a steering committee is usually created to carry out specific projects. (The steering committee may also be called an advisory group, taskforce, or whatever you like.) The job of the steering committee is to make decisions, plan, broadly represent the interests and citizens in the watershed, and maintain close ties with the sponsor, usually through representation. For example, one or more people from the sponsoring organization can sit on the steering committee.

Chairperson: Steering committees need a chairperson (not the watershed coordinator) to conduct meetings, lead decision making, and make sure everything is done fairly.

Recorder: There also needs to be a recorder (not the chairperson) who regularly takes minutes at meetings and types them up.

Size: In general, a steering committee with an odd number of people, somewhere between 7 and 15, works best, but this is not set in stone. There need to be enough members to be sure that decisions can be made at each meeting. It is helpful for the steering committee to have designated members, so that decision making is effective and consistent. However, in most groups the public is welcome to attend and take part in discussions. Determining who is and who is not "on" the steering committee is usually wise, because different people may show up at every meeting. It can slow the business of the group if previous decisions are rehashed because someone has not been there for several months.

Subcommittees: The steering committee can create subcommittees, work groups or taskforces to carry on its work. While it is important for the subcommittee chair or a designate to sit on the steering committee to report on the activities of the group, not all subcommittee members need to be on the steering committee or attend its meetings. This allows people with specialized interests to engage in only the activities that they enjoy most. Subcommittees may be ongoing or may last only until their task is completed.

Watershed coordinator: If the group has a coordinator, that person is usually hired or contracted by the sponsor but spends most of his or her time working with the steering committee and subcommittees. The coordinator's job is to carry out the wishes of the steering committee and the sponsor. Coordinators normally should not lead or open meetings, nor should they make or participate in the group's decisions. Their primary job is to make sure all the parties involved in the watershed project know what is going on and can carry out their responsibilities easily. Coordinators may collect and compile information, take care of the logistics of all activities, distribute newsletters, interact with the media, develop maps, write portions of the watershed plan at the steering committee's direction, market the plan to the community, make presentations, and do a lot of the leg work of moving the project forward. Since a coordinator's job may have a lot of gray areas, frequent and open communication with all participants in the project is extremely important. Frequent networking with other coordinators is also important and good for morale.

Facilitator: A facilitator is a person who can make a meeting run smoothly, help a group resolve conflict, assist the decision-making process and guide public meetings. A good facilitator can bring out the best in a group, help meetings stay on track, channel conflict into useful energy, assist a group in developing effective ways to work together and generally ease the process of partnership formation and decision making. Coordinators are sometimes called on to facilitate, although this can be very tricky; it's best to find someone from outside the group. There are commercially available facilitators, and trained facilitators are also available from several federal and state agencies. Contact your local SWCD, or NRCS, IDNR, ISDA, Purdue University Cooperative Extension Service (CES) or IDEM for lists of their personnel who are trained facilitators and who will provide this service as their time and other duties permit. Your group may want to use a facilitator only occasionally, when there are sticky decisions to be made, or for public meetings. Some facilitation duties, such as time keeping and staying on track with the agenda, can be assigned to steering committee members.

Tips for Successful Steering Committees

Leadership: Leadership should emerge from within the group. Leadership roles (chair, subcommittee chairs, etc.) should be filled by citizens from the local community. Don't forget to include citizens from the community who may have technical expertise to bring to the group. If state or federal agency personnel are assisting the group on behalf of the agency, it is rarely appropriate for them to have a leadership role once the partnership is fully developed. Likewise, the watershed coordinator is not an appropriate person to lead meetings or make decisions for the group; it would put them into an impossible position. Unless they live in the community and are participating as a citizen stakeholder, agency personnel (NRCS, IDNR, ISDA, FWS, USDA Forest Service, CES, IDEM) may participate as technical advisors but do not normally make decisions or vote.

Ground Rules: Effective committees set ground rules to establish how they will conduct business. Typical ground rules might be:

- Start and end meetings on time.
- Speak one at a time, and do not interrupt each other.
- Everyone has a right to be heard.

Ground rules can also be used to establish meeting dates, specify rotating tasks, and state how the group will make decisions or resolve conflicts. They can be as elaborate or simple as the group wants them to be. The group should develop ground rules whenever they are needed. It is a good idea to post ground rules at each meeting.

What is Consensus? Do We Need It?

Consensus is a collective opinion arrived at by a group of people working together under conditions that permit open communication and a supportive climate, so that everyone in the group feels they have had their fair chance to influence the decision. When a decision is made by consensus, all members understand the decision and are prepared to support it.

Consensus decision making is based on the fundamental belief that each person has a piece of the truth. Consensus is the way a group of equals makes decisions. It is built through a web of reciprocal relationships where each individual rules (and is ruled by) the larger community. "Consensus" means "to give consent."

Consensus decision making has its limitations. It will not work in every situation, but it can be achieved if these five things are in place:

1. **A common purpose:** All members share a common vision and mission.
2. **A willingness to share power:** Group members understand and embrace consensus decision making.
3. **Informed consent:** Members are willing to go along with a decision, even if they are not totally in favor of it. ("I can live with that.")
4. **A strong agenda**: The group is committed to following a structured process.
5. **Effective facilitation:** The meetings are kept on track and moving forward.

The stages of consensus decision making are *introduction, discussion* and *decision*.

Introduction: The introduction of a proposal or course of action focuses only on questions about its content—not on its merits. The introduction establishes the facts.

Discussion: The discussion can start with a clarification of the principles behind the proposal (why these things are being proposed). Next, the group works to resolve any concerns they may have about the proposal. Finally, the facilitator or chairperson should see if it is time to make a decision by testing for consensus.

Decision: In the consensus process, no votes are taken. As the group arrives at the point of decision, each participant has three options: to block, to stand aside, or to give consent.

When a participant wishes to block, this prevents the decision from going forward for the time being. Blocking is a very serious step and should only be taken when the participant genuinely believes that the pending proposal, if adopted, would violate the morals, ethics or safety of the whole group. When people elect to block a proposal, ask them to explain their reasons. If possible, the group tries to resolve their concerns. If the person does not remove his or her block, the decision does not move forward; it is at a complete standstill.

If there are no blocks or all blocks have been resolved, the group is then asked if anyone wishes to stand aside. A person stands aside when he or she cannot personally support the proposal, but feels that it would be acceptable for the rest of the group to adopt it. This choice absolves the person from any responsibility for implementing or participating in the decision. The names of those who stand aside should be recorded in the minutes. If there are more than a few people standing aside, the group should start over or table the decision. If the group continues with the decision, support for it will be too weak and may result in loss of members.

If there are no blocks and no more than one or two stand-asides, the facilitator or chairperson will state, "We have consensus." To give consent does not necessarily mean that every participant is in total agreement with every aspect of the proposal. It does mean that each person is willing to support the decision and stand in solidarity with the group despite their reservations. Once consensus decisions are made, they can only be changed by reaching another consensus.

In the real world, consensus means that everybody in the group understands the decision, that everyone has had a chance to say how they feel about it, and that members who still disagree or have doubts nevertheless are willing to say in public that they will give the decision a try, and agree not to sabotage it. Agreeing to do something by consensus does not mean that you love it; it means you can live with it.

If you work toward consensus, people are more likely to commit to the decision. Consensus provides an opportunity for win-win solutions, requires members to listen and understand each other, and helps resolve conflict. The downside is that consensus takes more time than voting, and to be successful, every decision-making member must speak up and participate. Working this way may require you to use an unbiased facilitator, at least while you learn the process and get to trust each other.

Experience has shown that long-term projects are more likely to be successful and have better energy if they operate by consensus. It is worth "going slow now so we can go fast later." You'll learn how to harness the energy of conflict and how to be open with one another, making it easier to deal with barriers and challenges in the future. Here are some sources for more information on the consensus process:

1. Selected references on collaborative decision making and natural resource management: http://www.uwyo.edu/enr/ienr/info.asp?p=7073 .

2. Real example of consensus-related ground rules for a group: www.dca.state.ga.us/development/PlanningQualityGrowth/programs/downloads/GroundRules.pdf .

3. Consensus and group dynamics papers and checklists: www.vernalproject.org/papers/Process.html .

When People are the Problem

It would be naive to think that watershed group members are any more polite, mature or tolerant than the rest of the population. In any large group, there will be conflict. Open conflict can be managed; sniping, backbiting and political maneuvering are tougher. As a coordinator, leader, volunteer or advisor to a watershed group, you may encounter all sorts of less-than-productive behavior. A wise facilitator or leader may be able to defuse some of the effects of conflict, especially if the feuding parties can be brought together to air their differences out loud in a safe setting. Often just getting to know each other better helps to build trust and allows participants to "agree to disagree," instead of being openly hostile to each other.

Many excellent handbooks and guides are available to assist groups in developing into successful partnerships. Watershed coordinators might also benefit from Purdue University's Natural Resources Leadership Development Institute. Refer to the hyperlinks throughout this guide and the online toolkit.

Planning Review – Chapter 1

These are the items you will be able to insert into your plan outline or template after working through the sections in this chapter. The items won't be complete, because you will add information throughout the planning process, but you can get a start on these.

- ☐ List partners that are developing the actual plan, along with a brief history of how and why they came together and their roles and responsibilities.

- ☐ List the major stakeholder groups represented or engaged in the planning process.

- ☐ Describe the structure of the group that made decisions in the planning process (*i.e.*, steering committee, SWCD board, etc.). Describe supporting subcommittees and what they accomplished.

- ☐ Provide information on the outreach and education methods used to get the public to participate in the planning process.

Chapter 2: Thinking Together

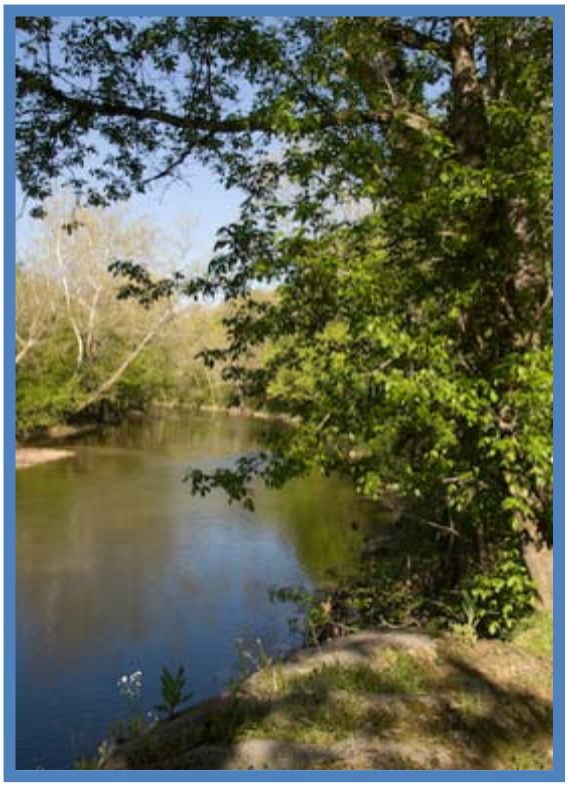
Once a group of interested people has decided to work together to develop a watershed plan, they need real work to do; otherwise, why have all those meetings? The early work of a group has a lot to do with getting to know and trust each other. In this chapter, you'll work on airing concerns, expressing a shared vision and mission, identifying potential problems from the list of concerns, and generally learning how to work effectively together.

What is Your Community Concerned About?

Airing your concerns, developing a practical, clear vision, and agreeing on measurable goals aren't easy. However, experience shows that groups can't plan successfully unless they plow their way through these steps. When you cut away the jargon, all you are trying to do is answer some fairly simple questions:

What concerns us about our watershed?
How do we want it to be different?
What are the things we want to change?
What are we worried about?

When people are stirred up enough to attend a public meeting or commit to being a regular member of a group, it is usually because they feel that something is wrong and they want to fix it. They also may participate in order to prevent their own interests from being compromised. They may be curious, apprehensive, angry or determined. You can be sure they have opinions!



Early in the group's formation, it is extremely important to get people's concerns out in the open and onto paper. For many groups, this happens through public meetings or at steering committee meetings. At this stage in the process, all concerns, opinions, worries, reservations and passionate convictions are created equal. This is not a time for judgment or criticism. Since offering solutions at this stage often results in controversy, try to help folks focus on their root concerns. Air these thoughts in a non-threatening forum where people will feel comfortable. For some groups, this will mean placing voiced concerns on flip charts at the front of the room during a public meeting. For others, it will mean collecting concerns on note cards or via postcards, during interviews in a more informal setting (*e.g.,* a stakeholder's home) or through surveys.

Once all the concerns about natural resources, economic issues and social issues in the watershed have been expressed, you can go through various exercises to help refine the list and focus on the things that people have in common. If the watershed is large or falls naturally into several different areas, hold meetings in several locations to make sure everyone gets to speak their piece. The core group that is emerging to take the lead in developing a watershed plan should be sure to capture all of these concerns and retain a record of them.

Example:

Clean Up Crawdad Lake meets to work on their vision and goals. First, they list concerns. A recorder writes concerns on flipcharts and tapes them to the wall. They go around the room several times until everyone has said something and no one has anything further to contribute. When sidetracking discussions occur, the facilitator heads the group back on track. There's a list of 32 items on the charts—everything from "I'm afraid to let my kids play in the stream" to "I just bought my house last year and already it dropped in value." The facilitator asks if some of the concerns can be grouped without losing any important detail. With the agreement of the person offering each concern, the facilitator moves the items into clusters. The group might decide to reframe the statements or not.

The facilitator gives everyone five sticky paper dots (or whatever variant is being used) and everyone goes up and "votes" for their most pressing concerns. During a break, the results are tallied and discussed when the meeting resumes. Things are reframed some more, and the end result is a ranked list of concerns, possibly with items similar to these:

1. Fishing has been bad in the last few years.
2. There might be dangerous pesticides or germs in the lake.
3. Sediment is making the lake cloudy and choking up the upper end where the creek drains in.
4. Property values are suffering.
5. Farmers are under economic stress and farmland is shrinking.

Positions vs. Concerns

Be sure to stress that people should state their needs or interests, not their positions. When someone takes a position, they are "for" or "against" something and likely to be speaking from emotion rather than fact. Position-taking polarizes groups and creates unproductive conflict.

Examples:

Position: "This plan is going to put me out of business!"
Concern: "I'm concerned that this project could result in more regulation."

Position: "Those farmers are poisoning the creeks."
Concern: "I'm worried about whether chemicals in the water could make my children sick."

You can see that the discussion following a concern will be more productive than the discussion (or argument) that follows a position. It's helpful to ask position-takers why they feel the way they do. Keep asking "why" again and again. Gradually you will determine what the person actually needs, and that can be stated as a concern.

Example:

A dairy farmer takes a position about not making him fence his cows away from the creek. He has many reasons why it just can't be done, and he'll rally all the farmers against this project if anybody suggests it. The facilitator politely starts to ask why. The farmer responds, "Because the fences will just wash out anyway," or "Because willows will grow on the banks, and then we'll have floods," or "Because it'll cost too much," or "Because I won't have any water for my cows." The facilitator rephrases, "You need to be sure that you still have a water source for your cows." It turns out that's the farmer's real, and legitimate, concern. It's added to the list.

Where Do You Go From Here?

Developing a good list of prioritized concerns ensures that the voice of your community is integrated with scientific information. It also ensures your efforts are grounded in areas where you'll have plenty of community interest and energy. At the same time, it's important to make sure that your community concerns are not just perceived, but actually have more than a grain of truth to them.

Identify Potential Problems: Picking Apart the Concerns

Intentionally identifying potential problems is a planning tool that helps you bridge the gap from obtaining information to setting concrete goals. Understanding the problems can clarify your thinking and help a group move forward. A clearly identified problem should address these questions:

1. What is the problem or issue?
2. What do we believe caused the problem?
3. What do we want to change?
4. What information is missing?

Note: It's been particularly difficult for groups working with U.S. EPA funds to understand what IDEM and U.S. EPA mean when they say "problems, causes and sources." Everyone seems to have a different interpretation of what these terms mean. So, for IDEM's purposes, think of your "problems" as the things that you or the wildlife are kept from doing because of pollution or potential land use changes in the watershed—these are often tied to the water's designated uses. The "cause" of the problem is very often a particular pollutant, but might also be a lack of awareness or loss of something (like wetlands or riparian corridor). The "source" is the location or activity that the cause(s) came from (like livestock in the stream or failed septic systems).

When Do You Identify Problems?

Problem identification can be used at least twice in the planning process. The group can draft a set of problems to address early, when they have listed their concerns and are trying to formulate a vision and understand data collection needs. Later, the group can revisit (and probably reword) these problems after the watershed inventory and assessment are complete and the group has better information to work with.

What Else Do We Need to Know?

Identified problems should be nonjudgmental and promote a clear understanding of the watershed. Note that "problem" does not always mean there is something wrong with the water. The "problem" may be recognizing a threat to high quality water, acknowledging an economic or social condition, or identifying an area that needs to be protected.

Okay, How Do We Do It?

To identify a potential problem, look at each concern on your list. Turn it into a specific, practical, objective and non-emotional statement that does not contain assumptions. State a cause if you can, but make it clear if there's no data yet to support your supposition by saying "we think" or "it appears." Then decide what the group wants to see change. This will help the group to establish what they want the future condition of the watershed to be.

Example:

Concern: Fishing has been bad in the last few years.
Problem: The game fish population in Crawdad Lake watershed is declining. We think it's because the fish don't have a good breeding habitat.

What you want: A fish population healthy enough to make the watershed a good place to fish.

Additional information you need: What is the actual fish population? Is the decline due to lack of breeding habitat, or is it something else? What population would sustain normal fishing pressure?

Example:

Concern: Failing septic systems.
Problem: The health department and residents in the watershed state that many septic systems are not working and pollutants are going into streams. We do not know for sure why this is happening or where these systems are.

What you want:
1. To establish the facts concerning septic systems in the watershed.
2. To have all systems functional and nonpolluting.

Additional information you need: How many systems are failing? Where are they? Why are they failing? Is pollution entering streams or ground water?

Notice that there aren't any numbers attached to anything yet. You don't have enough information at this point to be that specific. Can you see how going through this exercise can help the group be more effective in gathering information?

As you are looking over your concerns, identify those that are outside the scope of the project, and will, therefore, not be addressed. You will want to make sure to express a clear connection between concerns, problems, causes, sources, goals, targets and indicators throughout the plan. You will continue working on these as the planning process proceeds.

Vision: How Do We Want Things To Be in the Future?

A group without a vision is similar to a family on vacation without a road map. They may see some neat things and enjoy themselves, but never get to where they planned to go, and there could be a lot of conflict about which roads to take!

A vision is a statement about what the future will look like if all your problems can be solved. Don't make it too long or too fancy, or carve it on stone tablets.

Here are some of the things a vision should do:

1. Give meaning to the work that you expect from people.
2. Evoke clear and positive mental images of "what it should be like around here."
3. Create pride, energy and a sense of accomplishment.
4. Link the project with the results.

Here are some things a vision can be:

1. Simple.
2. Engaging to the heart and spirit.
3. An assertion of what we want to create.
4. A living statement that can change and expand.
5. A springboard.

Your group likely had some kind of vision when it formed, even if it hasn't been written down. It's important that all stakeholders buy into the vision, though, so you'll want to check in with them and revise the wording, as appropriate.

Crafting a vision is hard work, since it reaches to the heart of what people believe. Hours have been spent debating the merits of one word against another; that's why a vision should be closer to five words than to fifty. It's important that everyone involved at this stage can live with the vision, even if they don't love the way it turned out. Make sure that everyone's interest is met, without getting hung up on positions.

There are lots of books and Web sites that can help with the visioning process. It doesn't matter how you go about it as long as the product makes sense at the end. One simple method is to list all the "what you want" statements that the group developed along with each problem statement and string them together, then try to smooth out the language. Using that reasoning, the Crawdad Lake folks could have come up with something like this:

"A clean and healthy Crawdad Lake enjoyed by a thriving community."

They might elaborate on it to encompass the passions of some of the members:

"Our vision of the future: The healthy ecosystem of Crawdad Lake provides recreation for surrounding communities, helping them to maintain a strong economic base and excellent quality of life."

Once a draft vision statement is up on the flipchart, the group can test it by asking:

- Can it be accomplished? Is it doable?
- Has everybody been honest about what they want?
- Is this vision authentic?
- Is it worth getting excited about?
- Will people care about it?
- If achieved, will it make this a better place?
- Do people have something to gain from it?
- Is it short, clear, and memorable? (In other words, can we put it on a T-shirt?)

It's been said that a vision and/or mission statement should be short enough to put on a T-shirt. But T-shirts aren't the only way that you can advertise your group and its mission. Think about putting your mission on cups, reusable bags, ink pens, magnets and all published materials. Portions of your mission and/or vision statement may even become a part of the group's brand.

Every member of the group should be able to remember the vision (another reason to keep it short), and should be able to support it. It is worth the time spent to get to that point, as it will make the rest of your work much easier.

Mission Statements

A vision statement expresses how the group wants things to be. A mission statement expresses how the group will do business in order to achieve the vision. If the vision statement is clear, then writing the mission statement should not take long. Some groups bypass this altogether, if their vision and focus are very clear. However, it's worth the time to clarify why this particular group has come together at this time to accomplish this particular work.

Keep in mind that you're not writing vision and mission statements just to have something impressive on the wall. These are working documents that keep the group focused. If they need to change or be made clearer in future, do it; after all, they belong to your group.

To formulate the mission statement, ask:

- Who are we?
- Who or what do we work for?
- What do we offer?

To test the draft statement, ask:

- Is it clear and understandable to all the stakeholders?
- Is it brief and memorable?
- Is it unique to this group?
- Does it reflect the group's core values?
- Is it broad enough to be flexible, without being fuzzy?
- Will it help us make decisions?

Sample mission statements:

"The Upper Arkansas Watershed Council, as representatives of interested parties, will foster improved communication, collaboration, education and scientific understanding, and will develop strategies and make recommendations to local communities to conserve, protect and enhance watershed natural resources for the use and enjoyment of present and future generations."

"The Crooked River Partnership will promote stewardship of the Crooked River watershed and its resources to ensure sustainable watershed health, functions and uses for optimal conservation and economic benefits."

Not every watershed initiative becomes an established organization, but you still need to move together toward a common end. Don't get bogged down in creating vision and mission statements (or even bylaws, for that matter); if your ad hoc group is comfortable simply having a stated purpose for your work together, that's really all you need.

For some groups, the watershed management plan for a small watershed is the entirety of what the group does. For others, particularly those who are working at a larger scale, there are logistical matters that they will need to tackle in order to accomplish their mission. As you are completing the planning process, there are a couple of ways to handle group development needs and goals. Sometimes, it is easy and desirable to include things like staffing, funding and volunteer management into the goals of your watershed management plan. Other times, it is easier to write a strategic organizational plan that is separate from the watershed management plan. While you are visioning and writing a mission, it is important to establish whether or not the watershed management plan will incorporate your organizational needs, or if you will focus it solely on water quality goals and objectives.

Setting Goals for Your Group vs. Water Quality Improvement Goals in Your Plan

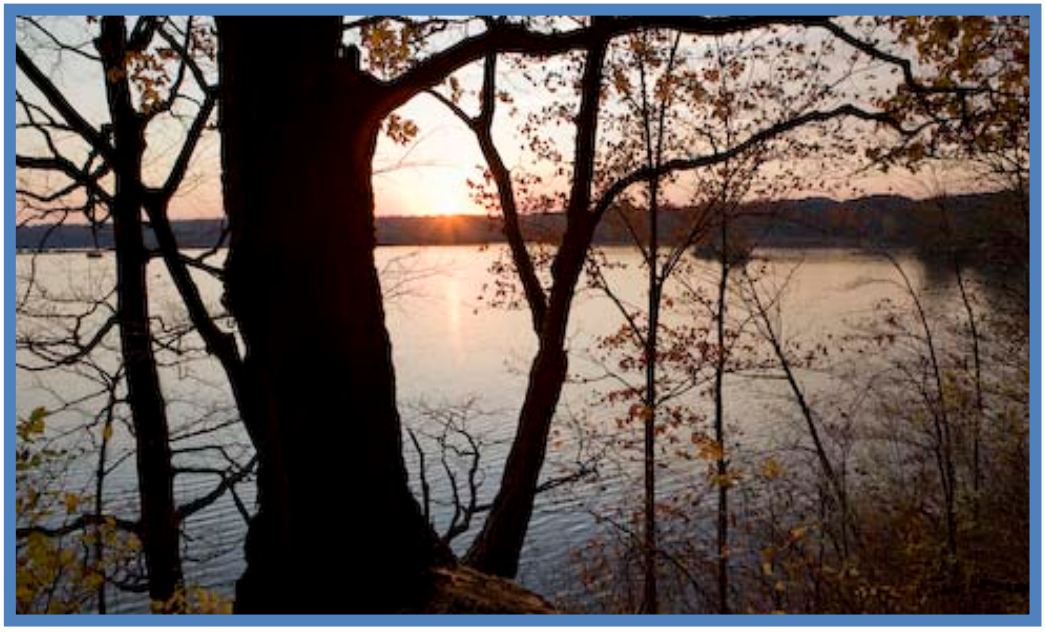
So far, the group has defined the problems in the watershed as well as they can with limited information. They've developed a vision and mission, and people are probably eager to go out and do something. But in order to be effective with the actions you take— in order to promote (and achieve) your vision—you need clear and measurable goals. Goals tell you where you are going. The value of clear goals is that they encourage decision making, motivate people, focus the energy and resources of the group, and make it possible to measure progress. People in the community will want to know what you are going to do; having at least a few concrete goals will help them understand how you intend to move forward.
It is fine to have a few goals that set the direction of your group, such as "to do a watershed inventory," "to analyze water quality information," "to conduct educational events," or "to develop the watershed management plan by [date]." However, in developing a watershed management plan, you will need to formally develop water quality improvement goals based on your inventory, sampling data and water quality standards, which you will read about in Chapter 6.

Planning Review – Chapter 2

These are the items you will be able to start inserting into your plan outline or template after working through the sections in Chapter 2. Add to them during the planning process.

- ☐ Describe how concerns were expressed (at meetings, through conversations, in surveys), and list the concerns.

- ☐ The mission, vision or purpose statement of the group who developed the plan should be placed so the reader sees it easily.



Chapter 3: The Watershed Inventory

When you developed your list of community concerns and identified potential problems as described in the previous chapter, you probably started to realize how much information you don't have. This chapter is about the steps needed to fill in those gaps. You'll learn the features of your watershed, how it functions and activities that might be contributing to nonpoint source pollution. The watershed inventory and assessment will likely take up more time and energy than anything else you do, but spending time evaluating and planning now will save valuable resources in the long run.

Sometimes the investigation process will show that concerns that were voiced were groundless. For example, a homeowner may worry that the creek his children play in is loaded with pesticides because there are farms in the area. If your investigation finds this is not the case, the concern shouldn't just be dropped. Address it in the plan with an explanation that this legitimate concern was found not to be a problem. In the same way, problems will probably surface that no one voiced as concerns. Address these as well, simply noting that they were not identified until the investigation was completed.

How to Investigate a Watershed

Before you can figure out how to get to a destination, you need to know your starting point. To find out the nature and condition of your watershed and identify threats to future water quality, the group needs to investigate everything about the project area that could influence planning decisions.

This investigation should include the following steps:

- Watershed inventory: This is a collection of information and observations about the watershed, much like a business inventory of assets and liabilities. This can include existing studies and reports as well as the observations and data that the group gathers during the current planning process. Specific information about water quality monitoring is in Chapter 4.
- Analysis: After the inventory is completed, you need to analyze what was collected to assess its scope and accuracy and identify any holes or needs for further information. Chapter 5 covers the analysis process.
- Developing goals: Use the results of your inventory and analysis to refine the problems that were identified in Chapter 2 and develop goals for water quality improvement. These important steps are discussed in Chapter 6.

The Purpose of a Watershed Inventory

Think of the watershed inventory as a way of gathering data and showing relationships between the current watershed conditions and the concerns and issues you've identified. You don't need to gather every piece of data, but you do want to gather enough to bring together a holistic picture of the watershed as a dynamic system. The watershed isn't just a piece of the landscape—it is teeming with life, history, change and complexity. To understand how it "works," you need to immerse yourself in it.

By now, the group will already have voiced concerns and probably structured itself into a central decision-making or advisory body with some peripheral workgroups or subcommittees. You should be able to answer these questions:

- What are the community's concerns?
- What is the "desired future condition"?
- What data are needed to prove or disprove concerns about natural resources, social conditions and economic trends?
- What do we already know?

If the group's concerns, vision and information needs aren't clear, try to clarify them by gathering basic inventory information, but also consider going back to Chapter 2 for a little more work on those items.

With answers to these questions, your inventory is ready to begin. The inventory does not need to be an exhaustive study. If information you gather clarifies resource concerns, helps the group understand cause and effect relationships, and gives you confidence in your decisions, then the inventory is sufficient. The watershed inventory should meet these four objectives:

1. Provide data that enable a group to make informed resource management decisions.
2. Establish benchmark conditions that can be used later to determine the effects of installed practices.
3. Collect sufficient data and information to analyze and understand the interactions between people and natural resources in the watershed.
4. Characterize both land and water resources.

In order to meet these four objectives, a good comprehensive watershed inventory will incorporate data from three sources. Collecting existing data should be the first step. After that, the remaining components—the desktop survey, the windshield survey and water quality monitoring—can be incorporated into the inventory sequentially, simultaneously, by watershed, or as time allows.

Watershed Inventory Tips

Now that you know the purpose of a watershed inventory, you're ready to collect existing data and survey your watershed. As you progress through your inventory, keep the advice below in mind.

- Don't let the data drive the process. Just because you have information on a topic doesn't mean it's important, and lack of data is no excuse to avoid a concern. Let the concerns, goals, investigation and the group's growing understanding of the watershed drive your plan.

- Be aware of the "endless data loop." It is not possible to ever fully understand all the processes at work in the watershed. There may be a temptation to continually seek more data before making any decisions. This can go on for years! Rely on visual observation, the input of specialists, the data you can reasonably collect, and the group's judgment.

- If the project is funded by a program grant (*e.g.,* Section 319 or Lake and River Enhancement Program), there will be concrete guidelines on what information you need. If the project is not grant supported, the group needs to decide for itself how far to go. Looking at agency requirements for watershed plans may help.

- The people who will be working on the inventory should discuss the level of detail needed. Think about the type of information you need, and how much work or money will need to be invested. For some issues, it might be well worth it to drive every road in the watershed; for other kinds of information, looking at aerial photos may be sufficient. For example, if only one tributary of a river has development, it would make sense to look carefully for storm drain outlets there. However, such a search might be time wasted in the rest of the watershed. Certainly, you don't want to turn down good information, but concentrate the most effort on what will give you the most return.

Conducting a Watershed Inventory

Unless your watershed is very small, it's probably not realistic to expect one person to conduct the entire inventory. Even if your project has a full-time coordinator, the task is diverse enough that she/he will have to enlist the help of a subcommittee, several agency personnel, a consulting firm, or a multi-disciplinary workgroup formed just for this effort. The Natural Resources Conservation Service, Indiana Department of Natural Resources, Indiana Association of Soil and Water Conservation Districts, Purdue University Cooperative Extension Service, Indiana Department of Environmental Management, Indiana State Department of Agriculture and other agencies have specialists who can help with the inventory (see Appendix C, "Agencies and Organizations Directory," for contact information). Group members can recruit volunteers from the organizations they represent. Often, if you put out a call for help, people who live in the watershed but have no particular connection to the project will be interested in doing windshield surveys, walking streams, or sleuthing out historical information. Be sure to tap into school groups and university students who might be interested in focusing on your watershed in the course of their studies.

The people assigned to work on the inventory can use one or more of the tools hyperlinked throughout this guide or in the online toolkit to develop a plan of action. Since water quality monitoring or bioassessment is time consuming and takes special expertise, it usually makes sense to address the desktop and windshield surveys separately from the water quality monitoring, as long as the two groups stay in frequent communication.

In an ideal project where there is plenty of time, an inventory of land use and land characteristics would be conducted first, and that information would help in selecting water quality monitoring sites, sample parameters and sample timing. However, because of the inherent variability of watershed projects, there is no one defined method for conducting an inventory. A good place to start is with Purdue University's Watershed Inventory Tool for Indiana and IDEM's Watershed Management Plan Checklist (2009).

Regardless of how you organize your inventory process, one person should coordinate (not complete!) the overall effort and compile the information. Be sure to regularly back up computer-based data to an external hard drive, flash drive, or CD to avoid possible data loss.

1. Collecting Existing Data

Before collecting your own data, it's a good idea to see who else may have studies, reports and data you can use; always capitalize on other people's labor! Existing data can further your understanding of the watershed and reduce the amount of time you spend collecting data of your own. For instance, recent data may accurately show water quality conditions in the northern part of your watershed, thereby relieving the need for your group to spend valuable time and resources collecting water samples there.

The Watershed Inventory List at the end of the chapter lists sources that may have information about your watershed. Remember that not every source will be applicable to your watershed, nor is the list definitive; there may be different studies or reports available in your area. You might want to start with the "water quality studies and data" category.

Undoubtedly, some of the data you gather will spur questions from your group. During the inventory process, be sure to provide education for the group when they need it by bringing in agency technical personnel or other specialists. For example, if no one on the group is a forester, bring in the IDNR district forester to answer questions about forest resources in the watershed. Your IDEM watershed specialist can help you to find the appropriate people to help you.

2. Completing the Desktop Survey

A desktop survey is a method of collecting watershed field information using desktop tools such as maps, existing reports and plans, geographic information systems, mapping software such as Google Maps, Google Earth, IndianaMap, models and the Internet. Examples of collected information may include: miles of unbuffered streams, number of animal operations, locations of combined sewer overflows, and locations of dams and other hydromodifications. Much of the material collected during the desktop survey is available on the Internet, in libraries, or from municipalities. Check the Watershed Inventory List at the end of this chapter for hints on where to find information you are interested in. The less athletic members of your crew can shine here; or, this work can be done when the weather doesn't favor going into the field.

Geographic Information Systems

An important part of many desktop surveys is the use of a geographic information system (GIS), which is a computer-based tool for mapping features and events. GIS technology integrates statistical analysis with the unique visual benefits offered by maps. GIS works by storing information about the world as a collection of thematic layers that can be linked together by geography. You can ask simple questions like, "Where do the people live and work in my watershed?" or complex analytical questions like, "If we build a new highway here, how will the community be affected?" Two useful tools of a GIS are proximity analysis ("How many houses are within 500 feet of this stream and where are they?") and overlay analysis ("Show me the soils that coincide with agricultural land use."). GIS provides a simple way to compile all your information and present it to the public in an easily digested format that shows the spatial relationships between different components in your watershed.

If anyone involved in the project has the capacity to use GIS, by all means use it. While it isn't required for a good plan, being able to store and manipulate information in a GIS is efficient and saves time. You can produce maps and other information products that will help the group reach decisions and help promote the project in the community. With the addition of a handheld Global Positioning System (GPS) unit, or even a sharp eye and a good topographic map, you can map the location of sample sites, meeting places, residences, feedlots, pipe outfalls, conservation practices, eroding stream banks, storm sewers, wetlands or any other feature you have an interest in.

If your group does not have access to GIS, consider partnering with another group, agency, local government or university to gain access to this technology. Many agencies provide spatial data files on the Web that can be downloaded at no cost. If you can't access a GIS, try experimenting with IndianaMap, Purdue's Local Decision Maker, or Google Maps, which are online GIS tools that can be used without the purchase of special GIS software.

Modeling

Models are tools that allow a glimpse at future conditions based on existing conditions. Simple tools such as the Revised Universal Soil Loss Equation (RUSLE) can forecast soil loss. More complex models based on either continuous conditions or storm events can predict sediment delivery, nutrient loads and pollutant transport. If a total maximum daily load (TMDL) is being conducted in your watershed, models will be used to predict pollutant loads and transport, and target which parts of the watershed are critical sources. Other models can be used to compare existing conditions with proposed conditions, to develop "what-if" scenarios such as what could happen if land uses change or impervious area increases. Many models are integrated into GIS programs and use spatial data.

While the use of models is not required, they can provide valuable estimates about specific watershed conditions and scenarios. If you're interested in using a model, keep in mind that picking one depends on the desired application, input requirements, available data, and the skill level of the person who will run the model. The collection of any data needed to run the model should be an important part of your watershed inventory process. Chapter 5 has more information about models.

Most concerns that you have about your water resources are probably caused by activities on land. A detailed description of the watershed and what's going on there helps identify potential impacts on water quality and where they are located. To create this description, collect both general watershed information and information that relates specifically to your concerns—watershed boundaries, the location of streams, lakes, soils, residential areas, town limits, land use, county lines, roads, etc. Record and organize all of this information on maps so it can be analyzed and compared to the results of the windshield survey and water quality monitoring.

Below are several broad categories of information that will help you characterize your watershed so pertinent concerns can be investigated during the desktop survey. Remember—your watershed will likely have concerns and problems that do not fall under these broad categories!

Watershed Boundaries

Determine the limits of the watershed so you know exactly where you are working and what activities may affect the quality and quantity of your water. Watersheds are identified by hydrologic unit codes (HUCs). In addition to the name of your watershed, include the HUC so that others are clear about which watershed you are planning for. Be sure to include labels for the watersheds, streams and tributaries on your maps so that users of your plan have a point of reference for the implementation areas you'll define later in the plan.

Geology and Topography

Develop a description of the watershed, including general information about the geologic history (*e.g.,* glaciations, bedrock depth, types of underlying rock). Current geology identifies mining operations, oil or gas drilling, and other activities that cause geological changes. Describe the general nature of the land in terms of steep slopes, sinkholes, valleys, flood plains, caves and other unique land features.

A long, technical geological history and description is unnecessary. Include the information that will help you understand your watershed, such as geologic events that have created natural lakes, karst topography and coal/oil deposits.

Hydrology

Describe the stream systems in the watershed, including alteration of natural waterways through drainage or channelization and presence of dams or reservoirs. Identify and describe drinking water sources, aquifers and their condition, floodplains and wetlands in the watershed. Describe the extent of tile drainage in your watershed. Also discuss any recent major flooding events and how they affected your watershed.

At the time of this revision, many county surveyors' offices do not maintain GIS files of their regulated drainage ditches or "legal drains." Contact your county surveyor's office for more information related to drains maintained by the county.

Soils

Identify and describe the predominant soil types in the watershed. Note the presence and extent of highly erodible soils, hydric soils, and soils with limited septic system suitability. Make notes about those soils that are not fit for the current land use (*e.g.,* septic systems located in septic-limited soils).

Land Use

Identify and record the historical, current and future land use of the area in order to identify what types of human activities have affected and could affect the water resources in your watershed. Previous uses, such as an abandoned gas station, could cause impacts to water resources. Similarly, current land uses such as agricultural production, confined livestock operations, housing developments, or landfills could adversely affect water quality. You can get a glimpse into the future by looking at local planning documents, zoning maps, economic development plans, and any other plans that have been made at the local level. It is important to collect as much information as possible on these land uses. However, just because a land use has the *potential* to negatively affect water quality does not mean that it *does* affect it.

Potential land use changes will help identify future threats to the watershed. If your watershed is located in an area with the risk of urban sprawl, your management plan will need to address how you will work to protect the water quality and overall watershed health in a dynamic landscape.

Information on recreational resources, industrial development, deforestation, reforestation, reclamation and previous conservation activities helps you understand the watershed and the unique situations that need to be considered when developing the management plan.

Land Ownership

The current land ownership in the watershed will have major impacts on the options available for improvements in water quality. You can use county/regional plat books (usually found in soil and water conservation district or planning commission offices for a nominal fee) and the local planning office's GIS resources to identify large tracts of lands owned by one individual or company, as well as tracts of land in ownership other than "private," including state, federal, parks and military holdings.

Natural History

Use desktop tools (like Google Earth) to collect information about natural or planted forests, grasslands, prairies and riparian (streamside) vegetation by type, species, age classes and distribution (*e.g.,* 100 miles of riparian corridor has been planted with native warm season grasses in the past 20 years). Because much of Indiana's landscape has been altered, try to discover what the landscape was like before European settlement and where there may be potential for restoration of habitat, wetlands, prairie, forests, etc. You will also want to describe natural areas that remain in the watershed and warrant protection. In short, collect information on the current state of the natural ecosystems occurring in the watershed. The amount of detail needed will depend on your previously identified concerns. With the wide availability of GIS, your description can be very visual, using maps and illustrations whenever possible. If you are very GIS-savvy, you may also be able to create custom layers in desktop software.

Endangered and Invasive Species

Identify threatened and endangered species that may be in the watershed and describe what types of habitat they prefer. Include any easily accessible information about the condition of the species (*e.g.,* population size, legal status and impacts your project/other projects could have on it—be sure to keep it pertinent). The IDNR Division of Nature Preserves maintains the state Natural Heritage Database with information on locations of threatened and endangered species and plant communities. Identifying species that might be affected by your management actions (or inactions) will help you decide which actions to take. For example, if a federally listed threatened or endangered animal or plant is located in your watershed, there may be limits to what alternatives you can propose in the watershed management plan. You'll want to document those limits. Note the presence of exotic or invasive species as well. If there are problems with aquatic nuisance species, you may be eligible for participation in federal or state programs to address this concern.

Cultural Resources

The National Historic Preservation Act of 1966 requires that a cultural resource specialist be consulted about the presence of vulnerable cultural resources in the watershed when public funds are involved in project construction. Describe the early history of the area and any relevant recent history that will assist in the decision-making process for the watershed management plan. The IDNR Division of Historic Preservation and Archaeology is one source of this information.

3. Windshield Survey

A windshield survey refers to driving or biking the highways and byways, canoeing or hiking the streams, and using maps and forms to record what you see. It's best to drive in pairs to help document observations. Understanding as much as you can about the land and what happens on it will help to explain the results of water monitoring. Unless you know the watershed as a system of interacting stresses and strains, it will be tough to make effective decisions about what to change in order to improve water resources. Remember that most pollutant sources are on land. The windshield survey will help you identify both the sources and the activities associated with them. The method of recording data depends on how many observation points in the watershed you choose and what types of information you are recording. Example forms can be found in Purdue University's Watershed Inventory Tool for Indiana and the online toolkit. If time permits, do this exercise twice, once during the growing season and again when the leaves have fallen and crops have been harvested. You will be able to see things that you were not be able to see when the crops were in the fields and the leaves were on the trees.

Some resource issues, such as soil erosion on cropland or use of tillage practices, can be addressed with transects or other structured field observation procedures. Some natural resources have very clearly defined inventory methods; an example would be wetland identification. Exact observations on vegetation, soils and hydrology must be taken, and there are manuals explaining the process. Similar procedures exist for forestry, wildlife habitat, stream geomorphology, aquatic habitat and conservation tillage. Private consulting firms exist to conduct these professional analyses and would appropriately lead fieldwork of this nature. Agency personnel can also provide assistance; however, agency staffs may not have time to provide this level of assistance to individual groups. Local colleges and universities commonly have expertise in various areas of natural resources assessments and may also be appropriate sources to draw upon for this type of work and other kinds of technical assistance. They may also be stakeholders themselves. Since access to private land is required, landowner permission should be obtained in writing before crossing property lines.

It is commonly assumed that since all the water in rivers and streams belongs to the state that all rivers and streams are publicly owned. Not true! The IDNR's Division of Outdoor Recreation describes Indiana river use rights in its online Indiana Canoeing Guide.

Final Thoughts on Desktop and Windshield Surveys

Though this guide presents the desktop survey before the windshield survey, their order should not be considered static. Depending on a variety of factors—when your project starts, weather, budget, access to resources—it may be wise to begin one method before the other or to perform both methods at the same time. Keep in mind the ability of each method to inform the other. For instance, data collected during a windshield survey may benefit the creation of a GIS. Likewise, data found during the desktop survey may influence the best spots to take water quality samples. The bottom line is that these methods should be adapted to best fit your needs.

Notes on Using the Watershed Inventory List

The Watershed Inventory List is a list of inventory data, with sources and directions designed to help you complete the desktop and windshield surveys.

Gather all the items listed that pertain to your watershed, and you will build a library that helps your watershed group make solid decisions about water resource restoration and protection. Your investigation of both land and water constitutes the whole inventory of the watershed. You can start on this very early in the planning process.

First, go through the list as a group and identify items that you already have and items you need to collect to address identified concerns and problems. Strike out the items not relevant to your watershed.

For the items that you need, tackle the collection job by assigning people either to specific areas of the watershed (where they will collect everything on the list) or by assigning several people to each category of information, such as forestry or cultural resources. Set dates for bringing information back and sharing it with the group.

The list is not all-inclusive; it contains information that most watershed projects will need and that is available statewide. Your group will probably add items that are unique to the local area. Your group may also feel that not everything on the list relates to your watershed or your particular list of concerns and problems. This is fine! Remember, if you don't have a purpose for the data, it's probably not worth collecting.

Note on Web Addresses: We all know that addresses on the World Wide Web have the life span of a gnat. By the time you access this guide, some of the addresses in the list below will already have changed. When you reach a dead end, try shortening the address to reach the home page of the site and proceed from there, or go to your favorite Web browser and search on the subject.

Information	Origin	Internet Address or Source	Details
Watershed boundaries and area (hydrologic unit codes, or HUC)	USGS, NRCS and U.S. EPA	USDA Geospatial Data Gateway: http://datagateway.nrcs.usda.gov/	Request the 12-digit HUC dataset for Indiana. If using the GIS shapefile, the data table will contain the name, HUC and area of the watershed.
Geology – general	IGS NRCS	Indiana Geological Survey: www.igs.indiana.edu/geology/index.cfm IndianaMap (geology downloads): http://inmap.indiana.edu/dload_page/geology.html Indiana Online Soil Survey Manuscripts: http://soils.usda.gov/survey/online_surveys/indiana/index.html	Background information on Indiana geology is available on the IGS Web site. GIS data is available for bedrock geology and topography, surficial geology, and more. Soil surveys can be a good source of information on the geology and physiography of an area.
Geology – karst (sinkholes, caves)	IGS	IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html Background information about karst and karst landscapes: www.igs.indiana.edu/geology/karst/karstInIndiana/index.cfm	Karst-related datasets include density of cave entrances, dye lines, dye points, sinkhole areas, and sinking stream basins and springs.
Geology – mineral deposits and mine sites (coal, oil, gas, sand and gravel)	IGS IDNR	Background information on mineral deposit/mining topics: www.igs.indiana.edu/geology/index.cfm IndianaMap (coal downloads): http://inmap.indiana.edu/dload_page/coal.html IndianaMap (geology downloads) http://inmap.indiana.edu/dload_page/geology.html Division of Oil and Gas (general info):www.IN.gov/dnr/dnroil/ Division of Reclamation (general info):www.IN.gov/dnr/reclamation/	GIS data is available for coal mines, abandoned mine lands, oil and gas fields, abandoned sand and gravel pits, abandoned quarries, and active industrial mineral sites.

Information	Origin	Internet Address or Source	Details
Topography	USGS IGS	USGS store (topographic maps): http://egsc.usgs.gov/isb/pubs/booklets/usgsmaps/usgsmaps.html IndianaMap (reference downloads): http://inmap.indiana.edu/dload_page/reference.html Also check out the extra maps for southwestern Indiana and the Lake Michigan Rim.	What is the terrain like? Have there been significant changes to landforms due to mining, agricultural practices, development or natural disasters? Are steep slopes, glacial moraines, sinkholes or flat boggy areas typical of the watershed? Use topographic maps to determine the watershed boundaries if you're not using GIS. Manually record the locations of landscape features, livestock operations, new development, etc. on topographic maps as an aid to doing your inventory.
Rivers and streams	USGS and U.S. EPA	IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html IndianaMap (interactive map): http://inmap.indiana.edu/viewer.htm	A high resolution National Hydrography Dataset (NHD) is available.
Stream drainage area	IDNR, Division of Water Purdue University	Drainage areas of Indiana streams: www.IN.gov/dnr/water/4936.htm Online watershed delineation tool: http://pasture.ecn.purdue.edu/%7Ewatergen/owls/htmls/reg5.htm	IDNR's report includes drainage area for all Indiana streams having a drainage area of at least five square miles. Purdue's online tool delineates the watershed area draining to a point you select on an interactive map.
Stream context		Topographic maps, GIS maps, aerial photos and visual observation	Does the stream run through agricultural landscape, urban landscape or past factories?

Information	Origin	Internet Address or Source	Details
Lakes and reservoirs	USGS and U.S. EPA	IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html	A high-resolution lakes (NHD) layer includes lakes, ponds, reservoirs, swamps and marshes.
	IDNR	www.IN.gov/dnr/water/5068.htm	A list of public freshwater lakes in Indiana is provided.
	ILMS	Indiana Lakes Management Society: www.indianalakes.org/	Background information on lake issues, educational resources and links to Indiana lake organizations is provided.
Lake features		Topographic maps, GIS maps, lake associations and lake shore residents	Identify the streams that feed the lake. Delineate the watershed of the lake if needed. Determine the area of the lakes using the GIS data table or by measurement on the map. Ratio of drainage area to lake area may be significant. Determine if motorized watercraft are allowed on the lake. Are there no-wake zones? Are they enforced?
Dams	IDNR	IndianaMap (infrastructure downloads): http://inmap.indiana.edu/dload_page/infrastructure.html	Locate both existing dams and sites where dams have been abandoned. You can use GIS data layers and/or use aerial photos or topographic maps to mark dam locations. The GIS layer includes dams in Indiana that are under the jurisdiction of IDNR. It provides information on heights, drainage areas, reservoir capacities, relative hazard potentials and status of structures.

Information	Origin	Internet Address or Source	Details
Regulated or "legal" drains	County surveyor, local Municipal Separate Storm Sewer System (MS4)	Links to county GIS Web sites: www.igic.org/maps/index.html Useful background information on Indiana drainage issues: https://engineering.purdue.edu/~iwla/iwla/resources/Academy/Perspectives_Indiana_drainage_law.pdf	If there are any maps of the legal drain system, they will be in the surveyor's office. Sometimes this information is available on county GIS Web sites. MS4s have to map their conveyance system and may have labeled parts of that system which are also legal drains. Check the easement width, maintenance schedule and any local restrictions on trees or other features of riparian zones.
Impaired waters, 303(d) list	IDEM	Section 303(d) List of Impaired Waters: www.IN.gov/idem/4680.htm	Are there any streams on the Section 303(d) list? If so, what is the pollutant and is a TMDL scheduled?
High quality or designated waters	IDNR, Division of Water IDEM	Outstanding Rivers List for Indiana: www.IN.gov/legislative/register/20070530-IR-312070287NRA.xml.pdf Outstanding State Resource Waters (327 IAC 2-1-2): www.IN.gov/legislative/iac/T03270/A00020.PDF	
Wetlands	U.S. Fish and Wildlife Service National Wetlands Inventory	IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html Wetlands Mapper: www.fws.gov/wetlands/Data/Mapper.html	May not be 100 percent accurate. Land use maps will also help locate wetlands.

Information	Origin	Internet Address or Source	Details
Aquifers	IGS	IndianaMap (hydrology downloads) – hydrogeologic terrains and settings: http://inmap.indiana.edu/dload_page/hydrology.html	IGS has maps showing the 22 "hydrologic settings" in the state, with information identifying those which are most vulnerable to contamination from surface pollutants.
	Office of Indiana State Chemist	www.isco.purdue.edu/psmp/oiscmain.htm (See Appendix F for maps)	The Office of Indiana State Chemist's Pesticide Management Plan contains two maps that detail the vulnerability of aquifers in Indiana to nitrate and pesticide pollution.
	USGS	IndianaMap (hydrology downloads) – bedrock aquifers and unconsolidated aquifers: http://inmap.indiana.edu/dload_page/hydrology.html	
Ground water	IDNR	Ground Water Assessment Maps and Publications: www.IN.gov/dnr/water/3468.htm	This Web page contains a good collection of maps and reports, searchable by county.
Drinking water sources and protection plans (wellhead protection plans, source water protection plans)	IDEM, Drinking Water Branch	Source Water Assessment Program: www.IN.gov/idem/4288.htm Wellhead Protection Program: www.IN.gov/idem/4289.htm Alliance of Indiana Rural Water: www.inh2o.org/	IDEM mandates wellhead protection plans and writes source water assessments for public water supply systems. The Alliance of Indiana Rural Water works with small communities on their wellhead plans and helps produce source water protection plans. Public water supply susceptibility reports are available online and source water assessment plans are available from the IDEM Drinking Water Branch Virtual File Cabinet.

Information	Origin	Internet Address or Source	Details
Floodplains and floodways	IDNR, Division of Water FEMA (Federal Emergency Management Agency)	IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html Map Search: http://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations	Each county planning office and SWCD office has copies of printed FEMA flood zone maps used to determine the rate for flood insurance. The IDNR Division of Water is the agency responsible for delineating floodways and new floodplain boundaries when land uses change. FEMA determines flood insurance rates; an online mapping function allows you to view maps for your area. From the FEMA link, click on "Map Search" to begin zooming to your watershed.
Conservancy districts	IDNR, Division of Water	Community Assistance & Information: www.IN.gov/dnr/water/2459.htm	The IDNR Division of Water site has links to a list of conservancy districts, floodplain mapping information, rainfall info, and graphs showing water use trends by county.
Climate (precipitation, floods, storm events)	NOAA Indiana State Climate Office Midwest Climate Agency	National Climatic Data Center: www.ncdc.noaa.gov/oa/ncdc.html Storm Events database: www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms Purdue University meteorology climate data sets: www.agry.purdue.edu/climate/index.asp Rainfall Frequency Atlas of the Midwest: www.sws.uiuc.edu/pubdoc/B/ISWSB-71.pdf	Is there a history of flooding, severe tornadoes or other disasters? What is the typical rainfall pattern (which could help you understand water quality monitoring data)? The National Climatic Data Center Storm Events database can be searched by county and by event (storms, floods, tornadoes, etc.). It includes description of events and estimates of property/crop damage. Data is available from 1950 to the present.

Information	Origin	Internet Address or Source	Details
Stream flow gages	USGS	http://in.water.usgs.gov/ IndianaMap (hydrology downloads): http://inmap.indiana.edu/dload_page/hydrology.html	Real-time and historical flow data is available for viewing and download. GIS layer includes location of stream gages throughout the state.
Soils	NRCS Soil Survey	Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/ NRCS Geospatial Data Gateway: http://datagateway.nrcs.usda.gov/ Paper copies can be referenced at the county NRCS office in the agriculture service center or can be accessed online. http://soils.usda.gov/survey/printed_surveys/state.asp?state=Indiana&abbr=IN	List the predominant soil units in the watershed. Identify limitations. The survey also contains narrative information about the geology and landforms in the area.
Land use (area, percent of each land use category)	USGS, Land Cover Institute National Agriculture Statistics (NASS)	Land Use/Land Cover (LULC) data: http://landcover.usgs.gov/ NASS crop data: www.nass.usda.gov/research/Cropland/SARS1a.htm IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html	Calculate area of each land use for proposed or zoned land uses for comparison to present land use. Most land use data is in grid format; you will need ArcGIS or ArcView 3.x with Spatial Analyst to manipulate the data. Use aerial imagery to digitize present land use/ new development.

Information	Origin	Internet Address or Source	Details
Impervious area	USGS Purdue University University of Connecticut	IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html Long-Term Hydrologic Impact Assessment (LTHIA) model: http://danpatch.ecn.purdue.edu/~sprawl/LTHIA7/ Visual assessment, aerial photos NEMO (Nonpoint Education for Municipal Officials) – tools: http://nemo.uconn.edu/tools/impervious_surfaces/index.htm	Impervious area is an indicator of pressure on the aquatic ecosystem, and it is widely held that exceeding 10 percent impervious area in a watershed will have negative impact. Calculate the impervious area of each subwatershed and compare it to planned impervious area if zoning plans are built out. You can calculate impervious area just from land use maps, but it's better to visually confirm where large parking lots, roofs and other surfaces exist. Note whether there is storm water retention on large sites.
Landscape features (infra-structure)	U.S. Census TIGER files	Census page with links to numerous map products: www.census.gov/geo/www/maps/ IndianaMap (infrastructure downloads): http://inmap.indiana.edu/dload_page/infrastructure.html	Map roads, railroads, schools, churches, cemeteries and anything else of interest. If you don't choose to map these in GIS, most are shown on topographic or soils maps.
Landscape change	USDA Forest Service	North Central Research Station: http://ncrs.fs.fed.us/4153/deltaIMS/	Check out the Changing Midwest Assessment interactive mapping feature to see landscape changes from 1980 to 2000. The publication titled "The Changing Midwest Assessment: Land Cover, Natural Resources, and People" contains some useful background information.

Information	Origin	Internet Address or Source	Details
Population trends	U.S. Census Bureau	Census data for Indiana: www.stats.indiana.edu/topic/census.asp IndianaMap (demographic downloads): http://inmap.indiana.edu/dload_page/demographics.html	This Web site includes studies, reports and interactive mapping features. Look at the "block data" maps as well as the tables to see where concentrations of population are. You can find a lot of information in this material, including historical population figures.
Storm water (run-off from developed areas)	IDEM	Storm Water Permitting: www.IN.gov/idem/4896.htm	This site provides information on IDEM storm water permit programs: Rule 13 (MS4s) – Communities subject to "Storm Water Phase II" regulation had to develop plans containing some of the same material as watershed plans. Rule 5 – Construction sites one acre and larger must implement a sediment and erosion control plan.
Recreational land	IDNR, Division of Outdoor Recreation Golf courses Local parks	Research, Studies & Data: www.IN.gov/dnr/outdoor/2598.htm IndianaMap (infrastructure downloads): http://inmap.indiana.edu/dload_page/infrastructure.html	Information on recreational facilities and trails is available for download or viewing. Note in your inventory any large expanse of green land; these areas will have pollution potential (fertilizers, pesticides, grass clippings) as well as benefits (increased infiltration).
Subdivisions	County planning office		Locate developed subdivisions and those that are platted but not yet built. Which ones have storm water retention?

Information	Origin	Internet Address or Source	Details
Sewers, unsewered areas	County planning office County health department		Locate where sewers are installed and where they are planned. Some municipalities have maps of sewer systems. Any area not sewered is probably served by septic systems (on-site waste disposal) or small package plants. Mapping Web sites such as Google Earth might allow you to locate clusters of unsewered buildings.
Regional sewer districts (RSD)	IDEM	List of RSDs: www.IN.gov/idem/files/rwsd_guide_districts.xls Map of RSDs: www.IN.gov/idem/files/rwsd_guide_map_rwsd.pdf	A map and list of RSDs in Indiana are available from IDEM.
Combined sewer overflows (CSOs) Sewer overflow events	IDEM	IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html Sewer bypass/overflow incident reports: www.IN.gov/idem/5105.htm	CSO outfall locations can be found in the NPDES pipe data layer. CSO and sanitary sewer overflow (SSO) reports are available from IDEM. The SSO reports are available online.
Roads	TIGER files County maps County highway department	IndianaMap (infrastructure downloads): http://inmap.indiana.edu/dload_page/infrastructure.html	Locate roads for your mapping inventory, and check to see if the county plans to widen or extend any roads. Note all bridges that could be used to observe streams or lakes. Find out what the county applies on the roads in winter (*e.g.,* salt, sand).

Information	Origin	Internet Address or Source	Details
Urban density	Gap Analysis Program (GAP) and other land use data Aerial photos	IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html	Identify areas with industrial/commercial use, high-density residential, low density residential and so forth.
Industrial facilities, industrial expansion	Local planning office, chamber of commerce IDEM, INDOT	IndianaMap (infrastructure downloads): http://inmap.indiana.edu/dload_page/infrastructure.html	Find out if any new industrial or commercial development is planned, and what impact it might have on land use and water resources. Available GIS layers include industrial parks, NPDES facilities and industrial waste sites.
Agricultural land	GAP data National Agriculture Statistics (NASS) cropland maps Visual observation County cooperative extension staff SWCD, NRCS, ISDA and IDNR field staff	IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html NASS crop data: www.nass.usda.gov/research/Cropland/SARS1a.htm	Use maps to identify cropland, pasture, farmsteads and feedlots; then visually check for changes in agricultural production, such as abandoned fields, expansion of animal production facilities, or operations changing over from one type of production to another. Cropland can also be digitized fairly easily on aerial photos.

Information	Origin	Internet Address or Source	Details
Livestock Confined feeding operations (CFOs) Concentrated animal feeding operations (CAFOs)	NASS Visual observation IDEM, Office of Land Quality	Livestock numbers by county: www.nass.usda.gov/in/ (can also look at historical trends) IndianaMap (environment/biology downloads) – CFO locations: http://inmap.indiana.edu/dload_page/environment.html	Determine number and type of livestock, or at least where livestock are raised. When inventorying livestock, don't forget horses, sheep, species such as llamas or ostriches, and kennels. Visual observation may be your best source of data. The CFO data layer also contains CAFOs, but they aren't differentiated in the attribute table. A shapefile with the CAFOs separated out can be requested from IDEM's Office of Land Quality.
Crops	NASS Cooperative extension	www.nass.usda.gov/in/ www.ag.purdue.edu/extension/Pages/Counties.aspx	For relative proportions of crops and types of crops, use the Agriculture Statistics data. The cooperative extension educator or co-op personnel may be able to add to this data, particularly if small amounts of crops are grown that do not show up in the agriculture statistics, such as tobacco, organic farming or seed crops.
Crops – tillage practices	ISDA	www.IN.gov/isda/2354.htm	Tillage transects are recorded every 2-3 years and in most counties go back nearly two decades. Transect provides information on percentage of corn and soybeans planted as no-till, conventional till and minimum till.

Information	Origin	Internet Address or Source	Details
Fertilizers, pesticides (agricultural use)	Cooperative extension Local dealers, crop advisors Office of Indiana State Chemist and Seed Commission-er	Summary reports of crop nutrients sold by county: www.isco.purdue.edu/	Cooperative extension, NRCS, IDNR (LARE), co-op, farm bureau, commodity organizations, livestock organizations, crop consultants, agricultural suppliers, machinery dealers and others can help you characterize fertilizer and pesticide use in the watershed. They will also be useful contacts when the watershed plan is implemented.
Non-private lands	USDA Forest Service Land trusts The Nature Conservancy IDNR, Indiana Heritage Trust	Federal lands: http://nationalatlas.gov/atlasftp.html #fedlanp Indiana land trusts: www.agriculture.purdue.edu/fnr/Extension/LandUse/LandTrusts.htm The Nature Conservancy in Indiana: www.nature.org/wherewework/northamerica/states/indiana/ List of protected areas: www.IN.gov/dnr/heritage/4422.htm	These Web sites provide information on managed lands and lands in state or federal ownership, land trust holdings and conservancies.
Forested land –public and private	IDNR, Division of Forestry Land use maps	General forestry information: www.IN.gov/dnr/forestry/ IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html For local information on forest and wildlife resources, contact consulting foresters, tree farmers, RC&D forestry committees, the USDA Forest Service, the timber industry, woodlot owners associations, and groups interested in bird watching or hunting.	Forested areas will be shown on your land use map. Identify state and federal forests, national parks, and other large tracts of publicly managed forested lands. Private lands can be assessed by overlaying the county plat maps (if they are digitized) with the land use coverage to determine where the forest landowners are located and the typical size of forested tracts. Discuss forest resources with the IDNR district forester for more information on timbering activity, forest diseases, and who's enrolled in the Classified Forest and Wildlands Program.

Information	Origin	Internet Address or Source	Details
Riparian buffers	NRCS	NRCS practice standards for buffers (and all other practices): http://efotg.nrcs.usda.gov/efotg_locator.aspx?maps=IN Click on your state and county, select Section IV (Practice Standards and Specifications) Part C and select your practice of interest.	Use aerial photos and visual observation. Consult with NRCS to determine where adequate riparian buffers exist along streams and where buffers are needed.
	Universities	Riparian forest buffers and related publications: www.unl.edu/nac/riparianforestbuffers.htm	
	SWCDs, aerial photos or Google Map	Description of riparian forest buffers and general information: www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm	
Endangered and threatened species	IDNR, Division of Nature Preserves	Division of Nature Preserves (general info): www.IN.gov/dnr/naturepr/npdirectory/index.html Natural Heritage Data Center: www.IN.gov/dnr/naturepreserve/4744.htm	Explore IDNR's Web site to get lists of species by county, as well as information on how to access heritage data (reports of where endangered species occur). These data are protected, and only general info can be given out. The Indiana Natural Heritage Data Center is perhaps the most complete site. Nature Serve only has plant information, and the U.S. Fish and Wildlife Service only has animal information.
	U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service (animals only): www.fws.gov/Midwest/Endangered/lists/indiana-cty.html	
	Nature Serve	Nature Serve (plants only): www.natureserve.org/explorer/servlet/NatureServe?init=Species	
Wildlife, general	IDNR, Division Fish and Wildlife	www.IN.gov/dnr/fishwild/ www.IN.gov/dnr/fishwild/2356.htm	IDNR's Division of Fish and Wildlife, district biologists, U.S. Fish and Wildlife Service, Quail Unlimited, Pheasants Forever, Audubon Society, Indiana State Trappers Association, Great Lakes Sport Fishing Council, Ducks Unlimited, and local hunting and fishing supply dealers are all good contacts for local information on wildlife resources.

Information	Origin	Internet Address or Source	Details
Cultural resources	IDNR, Division of Historic Preservation & Archeology NRCS Cultural Resources Specialist National Register of Historic Places Indiana State Museum County historical societies or local libraries	www.IN.gov/dnr/historic/ Indiana Cultural Resources Program: www.in.nrcs.usda.gov/technical/cultural_resources/cultural_resources.html www.cr.nps.gov/nr/ www.IN.gov/ism/ County History Preservation Society: www.countyhistory.com/	Historical information is used to set the context, the "sense of place," for your watershed plan. Note potentially significant areas of cultural concern: cemeteries, Civilian Conservation Corps (CCC) projects and places of importance in state and local history. Look for information relevant to water quality, such as locations of discontinued animal feeding operations, orchards, or industries operating before environmental regulations.
Geographic information	National Atlas IndianaMap	http://nationalatlas.gov/ http://inmap.indiana.edu/viewer.htm	The National Atlas Web site provides access to all sorts of useful facts, from climate to crime rates, at county resolution and above. It offers printable maps, interactive mapping and some data for downloading.
Satellite imagery	USGS Google Earth	http://glovis.usgs.gov/ http://earth.google.com/	Want to see Indiana from space? This global Landsat viewer lets you pick the date and place. Unfortunately, you can't download from this site. This site is for private use only. Use of Google Earth on a government computer requires a governmental use license agreement.

Information	Origin	Internet Address or Source	Details
Water quality studies and data	IDEM, Office of Water Quality	Indiana Water Monitoring Inventory: https://engineering.purdue.edu/~inwater/	Though it does not store actual raw data values, the inventory does include a map of monitoring sites and lists who collected the data, the parameters sampled, and who to contact to obtain the raw data. You can also upload your data collection information to this site.
		Water Monitoring: www.IN.gov/idem/4114.htm	This Web page contains links to reports, monitoring program descriptions and contact information. Individuals who are looking for actual data should specifically state they are interested in information stored in the Office of Water Quality Assessment Branch AIMS Database.
		Water Monitoring Programs: https://engineering.purdue.edu/~inwater/IDEM/	
		Total Maximum Daily Load Program: www.IN.gov/idem/4676.htm	
		Indiana Integrated Water Monitoring and Assessment Report – Section 305(b) and Section 303(d): www.IN.gov/idem/4679.htm	The Indiana Integrated Water Monitoring and Assessment Report is developed every two years and describes the condition of Indiana's lakes and streams, the Lake Michigan shoreline, and ground water.
	IDEM/IU–SPEA	Indiana Clean Lakes Program: www.indiana.edu/~clp/index.html	This Web site contains lake water quality assessment reports and volunteer monitoring data.
	IDEM, Office of Land Quality	Science Services Branch	OLQ only takes samples at facilities they are monitoring or that are out of compliance; there will not be a lot of available data.
	IDNR, Lake and River Enhanceme-nt Program	LARE Project Reports: www.IN.gov/dnr/fishwild/3303.htm	
	IDNR, Hoosier Riverwatch	Hoosier Riverwatch volunteer database: www.hoosierriverwatch.com/search.html	Reports and water monitoring data available.
	USGS – Indiana	http://in.water.usgs.gov/	

Information	Origin	Internet Address or Source	Details
Water quality standards, targets	IDEM	Water Quality Targets – guidance: www.IN.gov/idem/6242.htm	This Web page references Indiana water quality standards and suggested benchmarks for parameters that lack a water quality standard.
Municipal Separate Storm Sewer System (MS4) Plan	Local authorities, office varies widely	IDEM – currently designated MS4s: www.IN.gov/idem/5437.htm	Find out if your watershed contains an MS4 community. MS4 plans, or storm water quality management plans (SWQMPs), contain information that can be very useful for a watershed plan.
City/county master plans	Local authorities, probably planning department	List of county comprehensive land use plans: http://ldm.agriculture.purdue.edu/Pages/Resources/PlanIN.html	County comprehensive plans/city master plans provide a wealth of information that can be used to improve your planning efforts.
Watershed management plans	Local watershed groups	IDEM's watershed specialists: www.IN.gov/idem/6358.htm	While IDEM won't have every watershed management plan ever created, contacting the watershed specialist for your area is a good place to start.
Previous projects	Local, state and federal government Local groups	NRCS: www.nrcs.usda.gov Lake and River Enhancement (LARE): www.IN.gov/dnr/fishwild/3303.htm IDEM – Section 319 Program: www.IN.gov/idem/5225.htm	Find out if there were any Environmental Quality Incentives Program (EQIP) priority areas (NRCS), LARE Projects (IDNR), Section 319 projects (IDEM) or other local restoration or protection projects.
Urban retrofit plans	Local authorities, probably planning department		For information about this subject, link to the "Urban Stormwater Retrofit Practices" manual on U.S. EPA's Web site.

Information	Origin	Internet Address or Source	Details
National Pollutant Discharge Elimination System (NPDES)	IDEM U.S. EPA	IndianaMap (environment/biology downloads) – NPDES facility information: http://inmap.indiana.edu/dload_page/environment.html NPDES Compliance Database: www.epa-echo.gov/echo/	Find out if you have any NPDES facilities in your watershed and whether there have been any violations or compliance issues.
Septage waste and sludge application sites	IDEM	IndianaMap (environment/biology downloads) – Septage Waste Application: http://inmap.indiana.edu/dload_page/environment.html	IndianaMap has septage waste land application sites available online. Contact IDEM for municipal wastewater sludge land application sites.
Leaking underground storage tank (LUST)	IDEM	IndianaMap (environment/biology downloads): http://inmap.indiana.edu/dload_page/environment.html	This Web page provides locations of leaking underground storage tank sites.
Brownfields, remediation sites	IDEM U.S. EPA	IndianaMap (environment/biology download): http://inmap.indiana.edu/dload_page/environment.html U.S. EPA Envirofacts Data Warehouse: http://oaspub.epa.gov/enviro/ef_home2.land	
Pet/wildlife waste	Google or other map program	www.google.com http://glovis.usgs.gov	Locate park land and dog parks near streams or zoom into area of interest and type “park” or “dog park” in the search bar. Locate storm water ponds where geese and other wildlife congregate.

Additional Inventory Tools

Purdue University has developed the Watershed Inventory Workbook for Indiana, which is suitable for groups with very little technical experience. If volunteers are doing most of your inventory work, you'll want to use this. Be aware that it does not contain all the items needed for a plan that conforms to IDEM's Section 319 Watershed Plan Checklist, so you'll still need to follow the guidance for Section 319 grant funding.

Rapid resource appraisal is a method of leaning heavily on what local people know. For detailed instructions, read Conducting "Rapid Resource Appraisals" of Watersheds (scroll down to ID number PPC024). Rapid resource appraisal is very similar to the older coordinated resource management process. The goals of the exercise are to bring the steering committee in tune with the community's needs and concerns, and gain a good feel for the nature of the watershed.

A watershed inventory carried out in Vermont for a river system where recreation was the primary concern is available at www.rpc.windham.vt.us/gis/data/westriv/.

U.S. EPA's Watershed Academy Web offers more than 50 free, self-paced online training modules on watershed management, including various aspects of watershed planning. Study "watershed ecological risk assessment" in the Analysis and Planning Modules for a good overview of what you are trying to do with the inventory process and for some methods. Bookmark the site so you can come back and take a few more modules later.

Indicators – A First Look

Besides gathering data to answer your group's questions and assess the stated concerns, a watershed inventory may also be used to gather indicators. Indicators are parameters or criteria that can be used to assess the condition of something, like the health of a stream. For example, fish indices can be used as an indicator of water quality because certain fish cannot handle significant pollution, while others are very tolerant of pollution. The types of fish we see indicate the level of water quality. Indicators are used at several points in the planning process. In the inventory, we are looking for indicators that can tell us something about the current condition of the watershed and, perhaps, point to causes or sources of the problems that are occurring. Later, we'll see how indicators can be used to measure whether substantial progress is being made towards achieving a goal. Indicators can be as varied as the conditions they are measuring. Look to your problems and concerns to determine which indicators will be the most useful to your group. If "unmanaged growth" was voiced as concern, you could assess it by finding out the number of building permits, subdivision reviews, or occupancy permits granted in each of the last five years.

There are three basic types of indicators:

1. Environmental indicators are measurements of water quality, habitat, or some other criterion that tells you something about the health of the environment. They include such things as the amount of phosphorus or nitrogen in the water, population diversity of macroinvertebrates (animals without a backbone that can be seen with the naked eye, such as aquatic insects, snails, crayfish, mussels, etc.), the growth of algae in lakes, the turbidity of the water, occurrences of certain species, or the mercury content in fish tissue. These indicators require more time, resources and planning than administrative indicators do, but they usually are better for evaluating progress. When the group is developing goals, indicators should be identified that will assist in evaluating progress for each goal. Indicators must be appropriately selected to match the scale of information you are seeking. For instance, macroinvertebrates may tell you more about very local conditions within the past year or two and along one small stretch of stream, whereas fish move more through the stream system and live for a number of years, giving you a more general picture of conditions.

2. Administrative (or programmatic) indicators are beans that you can count: the number of permits issued, the number of grassed waterways installed, the number of acres converted to no-till corn, the weight of aluminum collected at a recycling center and so on. They are usually easy numbers to come up with, but they are often indirect indicators of what you really want to know. Counting the number of feet of grassed waterway is a useful measure of work done, but it will not tell you whether the amount of sediment entering the stream has actually decreased.

3. Social indicators document changes in attitude and behavior, which are correlated to the ultimate change in the factors influencing water quality. For instance, if the rate of overland sedimentation is a concern attributable to conventional tillage, you might survey farmer attitudes to conservation tillage. You can then launch an outreach and education campaign to change those attitudes (and hopefully, behaviors). This is measured by surveying the farmers again to see if anything has changed.

It is important to recognize that different indicators are suitable to document different types of outcomes. For instance, water quality parameters may take many years to change, so in the interim, it is useful to document social or administrative indicators to track water quality changes that are slowly happening. In all instances, be sure to include indicators that provide information on trends or ongoing conditions. For example, in assessing water quality, chemical measurements of what is in the water are valuable, but are only true for the moment the sample was taken. Therefore, many samples need to be taken over several years in order to get a valid picture of changing water quality. Biological measurements, such as the composition and diversity of macroinvertebrates in a stream, can provide more information about the water conditions over time. A single sampling event at key locations may give enough information to compare the health of various streams. Several indicators taken together are usually much better than having only one. You will have to choose what you can afford in terms of money and personnel. If the indicators you use during the inventory process are well thought out, and if you've carefully conducted your inventory, the measurements you take during the planning phase will provide the baseline for a continuing monitoring plan. This can be tricky, so do not be afraid to ask for help from an IDEM watershed specialist.

Planning Review – Chapter 3

When you have completed your inventory, you will be able to add the following items to your plan (assuming they are relevant to your watershed and its problems):

Watershed map: Using information collected about the watershed's characteristics, clearly identify watershed boundaries, streams, lakes, towns, county boundaries, roads and other features. Show the location of the project watershed within the 8-digit USGS boundaries. If the group has designated smaller subwatersheds within the project boundaries, show those as well. Identify watersheds using hydrologic unit codes (HUCs) as well as geographic names. Use more than one map if it is too cluttered.

Geology and topography: Describe the physical setting of the watershed. Include a brief description of both present geology and geologic history (*e.g.,* glaciations, karst). Summarize the general nature and location of topographical features (*e.g.,* prevalence of steep slopes, valleys, floodplains).

Improved technology allows you to make, save and share a map online using Google Maps.

Hydrology: Be sure to cover the various aspects of the area's hydrology, including major stream systems; how streams have been modified through drainage or channelization; presence of dams, reservoirs and drinking water sources; whether aquifers are vulnerable; and what is known about wetlands in the watershed.

Soils: Using the county soil survey, describe or list the predominant soil types. Note characteristics of soils that can affect water quality, such as highly erodible, hydric, poor for septic systems, etc.

Land use: Describe when the area was settled, historical land use, and current land use. Include areas slated for development, unique recreational resources, and other important features. Include a brief history of deforestation, industrial development, previous conservation efforts, or other activities that help in understanding the watershed and establishing a sense of place.

Land ownership: If there are significant tracts of land in ownership other than private (*e.g.,* state forest, national forest, land trust, parks, reservoirs, military holdings, etc.), they should be shown on a map and acknowledged in the planning process.

Natural history: Describe riparian buffers, unique areas needing preservation and areas with restoration potential.

Endangered and invasive species: List the threatened or endangered species that could occur in the area. If you can, describe the habitats the species prefer. Note the presence of exotic and invasive species.

Cultural resources: Describe the early history of the area and any relevant recent history that will assist in making decisions. Note potentially significant areas of cultural concern such as cemeteries, Civilian Conservation Corps (CCC) projects, and places of importance in state and local history. Look for information relevant to water quality, such as locations of discontinued animal feeding operations, orchards, or industries operating before environmental regulations.

Chapter 4: Water Quality Monitoring

Why Water Quality Monitoring?

The national water quality goals in the Clean Water Act (CWA) of 1972 include "fishable and swimmable" waters; elimination of polluting discharges; and protection of public water supplies, aquatic life and recreational activities. The terms "fishable and swimmable" reflect the European settlers' view that recognizes the right of the public to use the water for multiple uses. The Clean Water Act mandates that states report to Congress every two years on progress toward water quality goals; therefore, the states are required to monitor their water resources.

Since 1972, knowledge of water pollution sources and the ability to monitor water quality have expanded. The original CWA urged states to address severe problems caused by point source pollution, including discharges from industries, sewage treatment plants, and other commercial facilities. The exact sources were easy to identify and measure as "end-of-pipe" discharges.

In the 1980s, the CWA was amended to address nonpoint sources of pollution in addition to point sources. Nonpoint sources are sources that don't come from a single, easily identifiable "point" or source, such as a pipe. They include things such as fertilizer or manure run-off and septic system seepage. Section 319 of the CWA requires states to identify water bodies where nonpoint source pollutants have to be controlled in order to meet water quality standards. Under Section 319, funding from U.S. EPA for nonpoint source projects is channeled through the Indiana Department of Environmental Management.

Groups writing a watershed management plan that are funded under the Section 319 program are required to provide an assessment of the waterbodies in the watershed, as well as land use practices that might positively or negatively impact water quality.

Indiana also has a state-funded program to address water quality issues. The Lake and River Enhancement (LARE) Program is funded through boater registration fees and is administered by the Indiana Department of Natural Resources. This program also allows local groups, communities and lake associations to diagnose and treat watershed-related problems.

U.S. EPA also requires projects that are implementing a watershed management plan to have a way to measure success, which may be through water quality monitoring.

Water Quality – A Brief Overview

Following is a brief description of the major factors that determine or affect water quality. If your watershed group understands these factors, you will be better able to assess the water resources in your watershed and identify ways to effectively address the problems.

Habitat

"Habitat" encompasses all the physical characteristics of the stream bed, stream banks, vegetation in the stream, vegetation and land use in the area along the banks, the way the stream moves across the landscape, and what is carried into the stream (leaves, sediment, etc.). In lakes, habitat issues include vegetation, water clarity, the nature of the shoreline, and the material along the bottom. Vegetation along the bank of a waterbody filters nutrients and sediment out of the run-off that enters the water. Trees and large shrubs at the waterline shade the waterbody, lowering the temperature and reducing algal growth. Tree roots, fallen logs and large rocks in shallow areas provide cover and spawning sites for fish and other animals. Many sport fish species in Indiana streams require clean sand or gravel for nesting sites. Streams and lakes with muddy water

and eroding banks usually have fewer kinds of fish in them, and are dominated by carp and other less desirable species.

Biological Communities

Two groups of organisms can give you a picture of water quality conditions in the stream over a longer term. Aquatic macroinvertebrates (mostly juvenile insects, but also clams, snails and crustaceans) and fish are the most commonly monitored biological organisms. Both of these classes of animals contain species that are tolerant to water pollution and some species that are intolerant. The mix of tolerant and intolerant species tells you how clean the water is. Intolerant macroinvertebrate species are those that need high oxygen levels and breathe through gills, like mayfly nymphs or right-handed snails. Tolerant species, which take oxygen directly from the air, include left-handed (lunged) snails and rat-tailed maggots.

Fish are also sometimes sampled, but this requires a scientific collector's license and special equipment. Unless a watershed group has access to a local aquatic biologist, it is probably best to leave fish sampling to the experts.

Physical Characteristics

Temperature: Like humans, plants and animals are adapted to a particular range of temperature. In a hot environment, body processes speed up and organisms need more food and fluids, and use more energy to regulate body temperature. When it's cold, body processes and movement slow down. Animals will move to shaded or deeper, cooler water in summer. In addition, cold water holds more oxygen.

Turbidity: "Turbid" is a fancy word for "muddy" or "cloudy." Turbid water is hard for fish to eat and breed in, because it blocks vision and may clog their gills. Turbid waters usually contain a high sediment or algal load, which eventually settles out and buries good breeding and feeding sites for aquatic insects and fish.

Velocity: Water flowing at high speed (like streams immediately after storms) will erode stream banks. On the other hand, water moving too slowly may warm up and become stagnant.

Eutrophication: Eutrophication is the process that occurs when lakes or streams receive an excess of nutrients, usually nitrogen and phosphorus. This hyperfertility causes rapid growth of open water algae, attached algae and higher plants. The abundant plant material causes large daily swings in dissolved oxygen (high during the day when plants are producing oxygen, and low during the night when plants consume oxygen). When the plant material dies, decomposition of the plants depletes large amounts of oxygen, resulting in low dissolved oxygen levels (hypoxia) and death of animal life. The opposite of eutrophication is oligotrophy, when waters have a very limited amount of nutrients.

Shading: Lack of shade provides more sunlight for growing algae, contributing to lower oxygen levels and eutrophication. Shade also helps to regulate temperature.

Pollutants and Stressful Conditions

Sediment: Sediment can cause a cascade of negative effects in water. Soil particles absorb heat, increasing water temperature. Poor water clarity interferes with feeding of predators that hunt by sight (including many sport fish) and can cause hybridization of species that select mates by sight (*e.g.,* sunfish). The sediment clogs gills during breathing and feeding, smothers nests and eggs, and fills crevices in gravel beds. In addition, soil particles can carry unwanted nutrients (especially phosphorus) and attached toxic chemicals into the water. Erosion also carries dead plant and animal matter into water, increasing nutrient load and using up oxygen

during decomposition. Insects and other small organisms that thrive on decomposing plant matter increase in population, at the expense of other, more desirable organisms.

pH: The pH of the water measures relative amounts of dissolved acids and bases. Normal pH in Indiana waters ranges from 7 to 9 (neutral to slightly basic). When algae or plants consume carbon dioxide and produce oxygen, a chemical reaction may increase pH up to 10. Decay of plant or animal matter also can cause the pH to decrease to 6 (slightly acidic). Most Indiana waters are naturally hard, with a large capacity to resist changes in pH. There are some waters in southwest Indiana affected by acid mine drainage, and the resulting low pH is stressful or even toxic to aquatic life.

Oxygen: Oxygen is critical to sustaining life for plants and animals. Plants produce oxygen during the day but consume oxygen at night or in the absence of light. Low dissolved oxygen can disrupt an organism's development, kill eggs and embryos, increase the toxicity of some chemicals, and reduce energy available to find food, fight disease and reproduce. Animals that live or nest in shallow water are particularly susceptible to rapid changes in the amount of oxygen in water due to heating or decomposition.

Nutrients: Nutrients include any chemical that is required to increase the growth of plant or animal communities. On land and in salt water, most plant and algal populations are largely limited by the availability of nitrogen. In fresh water, most plant and algal populations are limited by phosphorus. Phosphorus is naturally found in certain kinds of rocks, and is recycled in living systems by the process of consumption and decay.

> *Phosphorus* is not directly toxic to plants or animals, but can kill fish or other oxygen-breathing animals through the indirect effect of increasing plant and algal populations. An overabundance of plants can produce so much oxygen in water that gas bubbles are seen on plant stems and leaves on sunny days (a condition known as supersaturation). The large plant mass consumes an equally large amount of oxygen at night and can drive oxygen levels to extremely low levels.
>
> *Nitrogen* occurs in water in four different chemical forms: organic, nitrate, nitrite and ammonia. Ammonia may exist in high concentrations in surface and waste waters but is usually low in ground water because it is the form that is associated with dead organic material and fecal matter. Ammonia can be toxic to fish, especially at high pH and high temperature. Ammonia decomposes into nitrate. Nitrate usually is low in surface waters but may be high in ground water or tile drainage. Nitrate can cause sickness and death in unborn or infant humans and animals through an effect commonly known as "blue baby syndrome." Nitrate can interfere with the ability of the blood to carry oxygen, causing the unborn or infant human or young animal to chemically suffocate. Nitrite is highly toxic but usually is found in small amounts and is rapidly converted into other forms. Organic nitrogen is present in carbon-based molecules and byproducts of plant or animal decay.

Natural and human sources of nutrients in water include human sewage, fertilizer, and waste from livestock, wild animals and pets. Eroding soil can carry phosphorus and ammonia associated with decaying organic matter and animal waste. Drainage tiles carry nitrates dissolved in water. Decay of organic matter from leaves, grass clippings, wood, plants, dead animals and landfills can contribute organic nitrogen and phosphorus.

Pathogens (including bacteria): Pathogens (disease-causing organisms) are small, difficult to sample and identify, and dangerous to maintain for testing in the laboratory. Coliforms and fecal streptococci are two groups of bacteria found in the waste of all warm-blooded animals. Their presence in the water is an indicator of fecal contamination and perhaps other disease-causing organisms. *Escherichia coli*, or *E. coli*, is a single species of fecal coliform. U.S. EPA recommends using *E. coli* as the best indicator of health risk in water.

What Water Quality Standards Should Our Streams and Lakes Meet?

Water quality standards have been set for water occurring in two different circumstances—drinking water (also called tap water or finished water), and ambient water, which is still in its natural location (sometimes called raw water). Standards are set at the national level, and states adopt and amend those standards to meet their needs. Drinking water standards are designed to protect human health at all ages, and are usually far more stringent than ambient standards. For a clear explanation of drinking water standards, see Purdue University's article "Drinking Water Quality Reports."

Ambient water standards are recommended by U.S. EPA and developed by the states to meet their needs. Different states may have different criteria and standards. A list of recommended standards with good explanations is available on U.S. EPA's Web site. Indiana's water quality standards were revised in 1990, requiring all waters to meet full body contact recreation criteria (*E. coli* standard). Numerical criteria for all pollutants for which U.S. EPA had developed either human health or aquatic life ambient water quality criteria were added to the standards. All waters, with the exception of 34 streams or stream reaches that were designated for limited use, were designated for warm water aquatic life use (and a few for cold water fishery), full body contact recreational use, public water supply (where there are drinking water intakes from surface waters), industrial uses, and agricultural uses.

Indiana's water quality standards are laid out in Indiana Administrative Code (Title 327) and in each case were developed in rule and adopted by the Water Pollution Control Board. Look at 327 IAC 2-1-6 for surface water quality standards outside the Great Lakes Basin, 327 IAC 2-1.5-1 for water quality standards for the Great Lakes basin and 327 IAC 2-11 for ground water quality standards. In addition, for any waterbody that has a total maximum daily load (TMDL), target values for any parameter not currently included in 327 IAC will be included in the TMDL document.

While standards for dissolved oxygen, *E. coli*, and metals are easy enough to establish as a numeric limit, many potential pollutants are addressed only in narrative standards and do not have an associated numerical standard. Unfortunately the NPS pollutants and conditions you are most likely to deal with (nutrients, sediment, and habitat) are still in that category. This makes it tricky to set concrete goals for nonpoint source pollution. To quantify these problems, Indiana turns to designated uses. Designated uses are the things society should be able to expect from its water resources. In Indiana, all waters except a few very limited streams are expected to meet all three designated uses—waters should be safe for recreation, support appropriate aquatic life, and be usable as a drinking water source (*i.e.*, suitable to be treated for drinking). The Section 319 Program also has a guidance document outlining example targets for pollutants without a codified standard.

Designated Uses

Indiana's Integrated Water Monitoring and Assessment Report is published by IDEM every two years and states whether waterbodies support or do not support designated uses, and why. The 303(d) List of Impaired Waters is a table in that report which outlines the waterbodies that are impaired and require a total maximum daily load (TMDL) to be prepared. Impaired streams for which a TMDL has been completed are removed from the 303(d) list, but remain on the consolidated list as category 4 waterbodies (*i.e.*, impaired waterbodies for which a TMDL has been prepared).

What's a Metric? What's an Index?

A metric is basically a measurement, or a thing that is measured. An index is a list of metrics that relate a measurement to a level of quality. Numerous indices (the plural of index) have been developed to help assess the health or quality of biological systems. Indices allow valid comparisons from one place to another and from one time to another. Below are some common indices you'll run across:

- **Qualitative Habitat Evaluation Index (QHEI):** Metrics of habitat characteristics are recorded and a score is derived. The score is calibrated with others around the state to determine what is normal in this region. Indiana uses the Ohio EPA version of this method.
- **Macroinvertebrate Index of Biotic Integrity (mIBI):** These metrics describe the diversity, pollution tolerance, health and abundance of macroinvertebrates. This index is used in some types of rapid biological assessment.
- **Fish Community Index of Biotic Integrity (IBI):** This index is used to calculate and interpret the results of fish community data. The index is composed of 12 metrics that assess species, what they eat, what kind of habitat or conditions they require to breed, and actual fish condition and health. Indices have been developed for warm water, cold water and cool water fish assemblages.
- **Indiana Trophic State Index (ITSI) [for lakes]:** Physical, chemical and biological data gathered on each lake are combined into a multi-metric index. Eutrophy points are assigned to each parameter, and then totaled for a final ITSI score ranging from 0 to 75. The lower the score, the lower the levels and effects of nutrients.

To Monitor or Not To Monitor?

A watershed group needs reliable data to understand and prioritize problems. Although states are required to submit regular reports to Congress on water quality, data may not be available from state agencies at locations in the watershed that are critical to your projects' success. Due to the accuracy, methodology, consistency and specialized equipment necessary to collect reliable water quality data, some groups should consider using the expertise of trained professionals. These experts can help local communities working in a watershed obtain localized data to answer specific questions and meet the requirements specified by federal and state grants. Other groups partner with their local water and/or wastewater treatment facilities to obtain reliable results for specific parameters. Who collects and analyzes samples will depend upon what you are trying to use your data for. Parties who are interested in having IDEM use their data should contact the 305(b)/303(d) coordinator for information on how third-party data are used.

Properly trained in monitoring concepts, local volunteers can help educate the community about the connection between residents' actions and the future quality of life in the watershed. Skills in monitoring chemistry, biology and physical characteristics can be acquired through the Hoosier Riverwatch program, the Indiana Clean Lakes Program or other training geared to a volunteer audience. Volunteers usually know their watershed history better than nonresidents, are aware of potential problem areas and can reach sampling locations quickly after a significant event such as a heavy rainstorm or a chemical spill.

Alert and observant citizens are crucial as the local "eyes and ears" for such events, and these volunteers should contact the appropriate law enforcement or agency authorities immediately if they suspect a spill or other rapid, significant decrease in water quality.

While volunteers can reach a site when professionals are unavailable, it doesn't ensure that the test results provided by volunteer monitoring are adequate for a refined problem analysis, especially in situations where legal liability or regulatory violations are involved. Matching volunteer efforts with professional activities can reduce monitoring costs and thus increase the number of monitored sites while allowing the validation of local data with agency efforts.

Major Public "Water Monitors" in Indiana

The Indiana Department of Environmental Management monitors the streams and lakes of Indiana to comply with federal requirements. The state is divided into five large basins that are sampled in rotation. IDEM collects data for water chemistry, aquatic biology (both fish and macroinvertebrates), sediment, and fish tissue. (To request copies of data, contact IDEM's Office of Water Quality at (317) 232-8670.) These data are used to determine whether or not the waterbody can support aquatic life (bugs and fish) and whether it is safe to swim in; the data may also be used for the Indiana Fish Consumption Advisory. Every other year, IDEM sends an integrated water monitoring and assessment report (the 305(b) report) to U.S. EPA summarizing the condition of Indiana's waters. Included in that report is the 303(d) List of Impaired Waters which details waters that are not capable of supporting aquatic life and are unsafe for full-body recreation (such as swimming).

The U.S. Geological Survey (USGS) monitors four river basins in Indiana through the National Water Quality Assessment Program (NAWQA)—the White River, Miami, Maumee and Kankakee. Because USGS studies these watersheds to discover long-term trends and pollutant transport mechanisms in watersheds in general, there's something for every group on the NAWQA publications page. Check back often for new reports.

What is a 305(b) Report? *State water quality reports are called "305(b)" reports in reference to the section of the Clean Water Act that provides the requirement.*

Water utilities and industry have water monitoring requirements, and are often willing to share data with you. Drinking water utilities and wastewater treatment utilities may even be willing to assist you with analyzing your samples. For contact information on water utilities, go to U.S. EPA's Envirofacts Data Warehouse. This interactive site lets you look up a wide range of information and map it. For example, you can get a list of all water suppliers in your county, including restaurants and churches, and by clicking on the name, obtain contact information and a compliance report.

IDNR's Division of Fish and Wildlife conducts periodic fish community studies, primarily in waters with public access.

To help eliminate duplication of water monitoring efforts, Purdue University has created an online Water Monitoring Inventory for Indiana. Though it does not store actual raw data values, it does include a map of monitoring sites, and lists who collected the data, the parameters sampled and who to contact to obtain the raw data. You can also upload your data collection information to this site.

What Parameters or Conditions Should We Monitor?

The most suitable type of monitoring will depend on your study objectives and your resources. For example, if your objective is to gage the overall health of a stream, biological monitoring (e.g., macroinvertebrates, fish communities, etc.) will be very useful. If your goal is to determine the types of pollutants that may be impacting the system (e.g., nutrients, pesticides, etc.), chemical monitoring might be more appropriate. A combination of both types of monitoring may be needed to gain insight into the cause and effect relationships at work in the system. Both types of monitoring are discussed in more detail below.

Chemical monitoring: NPS pollution enters streams in the run-off from rain events, snowmelt, ground water, and even through the air. Water chemistry monitoring of NPS pollutants over time will reveal very general patterns that may correspond to seasonal rainfall. However, within these broad seasonal patterns, rainfall can vary significantly from day to day and week to week. Due to this short-term variability, water chemistry measurements provide only a "snapshot" of the water quality conditions. For example, the chemical conditions you detect the day after a heavy rain event will likely be very different than those you detect after two months with little/no rain.

For water chemistry measurements to yield useful information, they must be collected during the same season(s) and, more importantly, under similar flow conditions within those seasons.

Such data—commonly referred to as baseline data—can serve as a benchmark against which to gage future changes in water quality during the same seasons and similar flow conditions in a stream.

Which water quality parameters you collect will depend upon your concerns and land use potential for pollution. In general, run-off in agricultural areas may contain sediment, *E. coli*, nutrients and pesticides that could pollute the water. Run-off in urban areas may contain similar pollutants, albeit from different sources. In coal mining territory, testing for heavy metals may be warranted. In any setting, it's useful to collect dissolved oxygen, pH, turbidity and temperature data, as they can tell you vital information about why a stream may or may not be meeting its designated uses.

Water chemistry measurements are more meaningful when viewed within the context of stream flow. Stream flow (also referred to as discharge) is the volume of water flowing in a stream per unit of time. Without an understanding of the current flow conditions in a stream, it is difficult to put the numbers you get from monitoring into perspective. For example, the impact of the same amount of a given contaminant will be much greater in a stream during low flow conditions than during high flow conditions, when there is more water available to dilute the contaminant and transport it downstream. Flow is also important if you want to use your monitoring data to determine existing pollutant loads and load reductions needed to meet water quality standards and targets. More information on calculating loads can be found in Chapter 5.

The United States Geological Survey (USGS) has many gaging stations on streams throughout the state and may be able to provide continuous flow data for the stream(s) you are studying. Check the location of the nearest gage before finalizing your monitoring plan, if this will be your source of flow data. If you choose to estimate flow through your monitoring program, work with appropriate agency staff to make sure the data you'll get will work. There are ways to use USGS gage data even if the gage isn't located right where you sample. Obtaining an accurate measure of stream flow can be very time-consuming. Thus, it may be more realistic given your study's resources to use a substitute for stream flow. For example, you can obtain rainfall data for your sampling area from local/national weather service stations. There are also simple techniques available for approximating stream flow. Any one of these options would provide a first approximation of flow necessary for interpreting your results.

Biological monitoring: All biological studies should include habitat assessments. Habitat assessments (which commonly include stream flow measurements) are as important to biological studies as stream flow is to water chemistry studies. Biological data must be viewed within the context of habitat because regardless of how good water quality is in a given stream, aquatic organisms (fish, macroinvertebrates, etc.) cannot thrive without suitable habitat. The diversity and abundance of aquatic communities are directly linked to habitat availability. Habitat assessments are necessary in order to determine if impairments to aquatic communities are related to degraded habitat, some other factor that is not readily discernible, or both.

In addition to habitat assessments, your study may include a variety of other parameters, depending on your study goals and resources. These might include macroinvertebrates, fish communities, mussels and surveys of aquatic vegetation (particularly useful in lake monitoring). Note that with biological methods, it is important to choose a level of identification (family, genus or species) that is appropriate to your project goals. In general, the higher the level of identification (*i.e.*, more specific), the more sensitive the parameter will be to environmental conditions. Identification above the family level usually requires a trained taxonomist, which may or may not be consistent with your study's goals and resources. Be aware that the collection of fish and mussels in Indiana requires a scientific purposes license.

Where Should We Take Samples, and How Often?

Samples taken in the wrong place or at the wrong time can confuse your understanding of the watershed. Think carefully about what you want the data to tell you. In most cases, a group wants sampling data to help identify which tributaries carry the greatest (and least) load of NPS pollutants. This information will indicate where best management practices (BMPs) should be implemented to reduce those pollutants. When and where to sample depends on the type of monitoring you plan to do and the specific parameter(s) you are testing. Many environmental indicators are affected by seasonal and temporal variations. Recall that water chemistry parameters are very sensitive to stream flow variations. You should attempt to minimize these variations by sampling during similar flow conditions. Biological indicators are affected more by seasons than short-term fluctuations in stream flow. Because of this, your sampling events should be planned during similar seasons (usually summer or fall) to obtain the greatest diversity of organisms in your sample. Generally speaking, biological monitoring requires less frequent sampling than does chemical monitoring because there is less variation from month to month in the biological conditions of a stream than in its chemical conditions.

Monitoring for watershed planning is often a balancing act between an ideal sampling plan and the monitoring budget. Design your sampling plan carefully to answer your questions and get the most value out of your available resources. If all the waterbodies in the project area are streams and rivers, the obvious first group of sample sites is where tributaries join the main stem. However, depending on the location of point sources and the nature of land use in the watershed, additional sites may be needed to clarify what's going on.

If a lake or reservoir is involved in the project, its health must be determined. If the lake has been sampled in the past, possibly for the Indiana Clean Lakes Program or because there is a drinking water intake in the lake, there may already be enough data to identify problems within the lake. In that case, sampling can be concentrated in the contributing watershed. If little is known about the lake or reservoir water quality, contact both the IDNR Lake and River Enhancement and the IDEM Clean Lakes programs for guidance.

Methodology

For any type of water quality monitoring, there are often many methods available to test a given parameter. The method you choose depends upon your study objectives and your resources. Bear in mind that some methods are more or less sensitive than others. A very sensitive method will detect very small changes in the parameter being measured, while a less sensitive method may only detect very large or broad-scale changes. The idea of method sensitivity can be illustrated with the use of two weight scales, one that measures weight to the nearest pound and one that measures weight to the nearest ounce. While both provide an accurate measurement of weight, one is much more sensitive to small differences than the other. Method sensitivity should be considered when choosing sampling and analytical methods for the parameters you are measuring.

In field and laboratory equipment, method sensitivity is described by its detection limits, or the range of measurements over which you can expect accurate results. In biological studies, sensitivity of the method depends on the standard level of identification (i.e., family, genus or species) and the type of metrics you choose. A metric is how you evaluate your organism samples, which might include species diversity, abundance and/or relative tolerance to pollution.

Remember that choosing commonly used methods and parameters will enhance the comparability of your data with data generated by other studies. A review of major published articles and reports will provide information on commonly accepted parameters, established methods used in water quality monitoring and method sensitivity.

Data Comparability

You have probably dredged up previous studies and data for your watershed by now, so before designing your monitoring program, you need to determine if the old data can be used for comparison with what you intend to collect. Comparability represents the confidence with which your project data can be compared to other data sets. Comparability between data sets is achieved when similar sampling and analytical methods are used and documented. For example, data collected for the same parameter using different sampling and analytical methods may not be comparable. By the same token, data from two studies using the same methods are not comparable if they have very different goals for accuracy or precision. Thus, comparability is also dependent on having similar quality assurance objectives at the outset.

Quality Assurance

Quality assurance refers to the processes that are put into place during data collection, processing and analysis to provide the users of those data with confidence that the data are accurate. A quality assurance project plan (QAPP) describes every step of monitoring procedures and explains the reasoning behind them. Following carefully designed procedures means the data you collect will be credible and repeatable. IDEM's NPS/TMDL Section publishes QAPP guidance on its Web site. Hoosier Riverwatch has developed a QAPP for monitoring using their protocols. Other volunteer monitoring QAPP guidance is available on the Web. If you are using IDEM grant money to fund your water quality monitoring, you are required to complete a QAPP. Even if your group is not using IDEM grants, this guidance is a valuable aid to developing a sound water quality monitoring program. Completion of a QAPP also makes you eligible for future grant money.

Where Do We Go For Guidance?

A complete education in water monitoring is beyond the scope of this document. We strongly suggest you get technical assistance from the IDEM Office of Water Quality staff, other agencies, or professional consulting firms. Local colleges and universities commonly have expertise in various areas of natural resources assessments and may also be appropriate sources to draw upon for technical assistance. In addition, check out the following sources:

- IDEM External Data Framework
- IDEM Hoosier Riverwatch
- IDNR Division of Fish and Wildlife Lake and River Enhancement (LARE) Program has developed numerous resources for doing water quality assessments. Refer to DNR's Web site for the latest publications on lake assessments and other monitoring information.
- Indiana Water Monitoring Council
- Catalog of Monitoring Protocols used by Indiana Agencies
- NRCS's Web site for National Handbook of Water Quality Monitoring and manuals for stream habitat assessments
- Many advocacy and interest groups such as River Network, The Izaak Walton League of America's Save Our Streams program, North American Lake Management Society and others publish water resource assessment manuals and material for volunteers. A few minutes with your favorite Internet browser will turn up these and many more.

Planning Review – Chapter 4

Good documentation of water quality data is essential in setting goals, making decisions, and determining future actions.

- ☐ Summarize monitoring data in the text.
- ☐ Describe the monitoring effort, including methods, protocols and results. Reference any quality assurance project plans.
- ☐ Explain any indices or metrics used to express the results, such as Index of Biotic Integrity, lake trophic score, Qualitative Habitat Evaluation Index, etc.
- ☐ Indicate on a watershed map where data were collected.
- ☐ Identify water quality benchmarks (baseline data) for chemical, physical and biological parameters.
- ☐ Raw data can be included in an appendix; if there is a great deal of data that would be awkward to present in the plan, let readers know who to contact to view the data.

Chapter 5: Analysis

You've completed an inventory of the land and water resources in your watershed. Now what do you do to make sense out of the mountain of collected data?

First, meet with the people who have been working on other aspects of your watershed project. You all need to work together to fit these puzzle pieces into a clear picture of the watershed. It might make sense to establish new or different subcommittees to analyze various aspects of the watershed; just be sure to get back together and compare your conclusions.

Second, be very careful to be objective and nonjudgmental in your discussions. It is easy to point fingers or jump to conclusions, and much harder to come up with constructive solutions. Finger-pointing and stereotyping will only create adversaries where you need partners.

Analyzing Your Discoveries

For each component of your inventory (land use, biological, water quality monitoring, etc.) ask yourselves these questions:

- What have we learned about this facet of the watershed that we think is a problem?
- What have we learned that is positive and needs to be maintained or protected?
- Do we know enough to reach a decision about what needs to change?
- If not, what else do we need to find out?
- Who could help us bring about beneficial change?
- What's the priority for this problem or need? Is it an emergency, a serious but long-term problem, a minor issue, or something that just needs to be watched?
- If we think we have identified a problem, is it one we should address as a group or should we turn it over to somebody else (another interest group or an enforcement agency, for instance)?

Identifying problems, causes and sources has long been a measure on IDEM's Indiana WMP Checklist, but the definitions of each of these terms have stumped watershed groups for just as long!

For the purposes of this guide:

Problems: are the things that you/wildlife are kept from doing in the watershed because of pollution or change in land use—these are often tied to the water's designated uses. Often, problems exist due to one or more of the concerns and build on concerns by formally stating a condition or action that needs to be changed, improved or investigated further. It is appropriate that some concerns and problems will be identical. So, a problem would be the result of the stream not meeting water quality standards or designated uses (*e.g.,* "streams are unsafe for swimming").

Cause: refers to the chemical parameter (for water quality-based problems), physical condition, biological contaminant or condition leading to the problem (*e.g.,* lack of public awareness) that keeps a waterbody from meeting its designated uses.

There are several terms that are used synonymously or differently by different programs. For example, in some programs, "causes" and "stressors" are used interchangeably while "sources" are distinct, but in other programs "stressors" and "sources" are used interchangeably, while "causes" are distinct. Just be sure to use terms appropriate to the program under which you may be funded, and be sure your stakeholders have definitions of the terms you are using for your watershed.

Source: means an activity, facility or condition that results in or produces a cause of nonpoint source pollution. In determining whether or not something is a "problem," consult standards and criteria if they are available.

For example: To determine if water chemistry results indicate a problem, see if they violate state water quality standards. You may have to consult with IDEM, IDNR and others to establish this. If a state water quality standard doesn't exist, your group will have to choose a target. IDEM has examples of water quality targets on its Web site.

Determining problems with land resources can be more subjective than determining water resource problems. The Quality Criteria chapter in Section III of NRCS's online Indiana Field Office Technical Guide (FOTG) establishes the minimum conditions that are reasonable to achieve for land (and some water) resources. Water quality criteria are divided into quantity issues and quality issues, for both ground and surface water. Groups will want to check out NRCS's National and State Resource Concerns and Quality Criteria table, which lists natural resource concerns, provides a description of the concern and lists assessment tools you can use to evaluate the resource concerns. Note that the table sometimes demands data which may be difficult for most watershed groups to gather. That said, it does present scientifically sound criteria for designating a land resource issue as a problem. Groups unable to use the FOTG to determine land resource problems should allow their data to drive the decision making process. For example, in an area with high *E. coli* levels and multiple failing septic systems, a reasonable person may assume that lack of septic maintenance is a problem.

To evaluate aquatic habitat or riparian zone condition, refer to an established assessment process like Hoosier Riverwatch, NRCS's Stream Visual Assessment Protocol or U.S. EPA's Rapid Bioassessment Protocols, an index such as the Qualitative Habitat Evaluation Index or Watershed Assessment of River Stability and Sediment Supply (WARSSS) model (Rosgen), or other tools. Hopefully, you are already using some of these methods.

Zooming In: Questions and Suggestions for Further Analysis

Before proceeding to Chapter 6, here are some questions and issues about watershed inventory data to consider. Many of these topics overlap, and we certainly did not list all the ways this information could be analyzed. Let your group's concerns drive how you use your collected watershed inventory data.

Land Use and Land Ownership

1. **Find your audience:** Study the major land uses in the watershed and how they are distributed on the landscape. Identify the primary land use in the headwaters and along the main stem of each subwatershed. Depending on the water quality problems you've identified, these land uses should tell you who the audience is for your project. For example, if the primary land use in a tributary with a high phosphorous load is crop production, then you need to develop a way to contact that audience (crop producers in that subwatershed) in order to work with them to address water quality concerns.

    CAUTION: Just because there is a predominant land use does NOT mean the occupants or owners are "culprits" or "the problem." The water quality problem could be the result of prior land use, a spill, a discharge from a poorly managed point source or other events. Rule out as many possibilities as you can before settling on a probable source.

2. **Trends:** Study the present land use and compare it to the zoned or proposed land use. Take into account what you learned about impervious area, population changes, soils, flooding and drinking water sources. Which audiences will change? Will some land uses be eliminated? Different land uses have different potential for affecting the environment. What water quality risks might increase? What water quality risks might decrease?

3. What to do: Consider the impacts of each land use you inventoried (agriculture, forestry, residential, publicly managed, etc.) and the kinds of pollution, pressure or benefit these uses can cause. Think about potential changes that each entity might make to reduce negative impacts, and what resources there are for bringing about change.

4. Sewer and septic: Examine the maps of residential areas that are sewered or served by septic systems. Based on what you have learned and conversations with the county health department, do you think there are areas that need to be served by new sewers or areas that need improvements or maintenance to existing septic systems?

5. Construction: If there are numerous construction sites in the watershed, or areas that are developing rapidly, do you think there is a need to promote compliance with the Municipal Separate Storm Sewer System (MS4) rule and/or Rule 5? Do you see a need for changes in the way new homes are sited (*e.g.,* set back from streams and lakes, or avoiding steep slopes)? Has this need been discussed with the county planning department? Is there an opportunity to modify existing best management practices or storm water practices so they infiltrate more storm water than originally designed?

What is the MS4 Rule?

The MS4 rule (Rule 13) requires municipalities of a certain size to put practices and management tools in place that reduce polluted storm water. These practices and tools are outlined in the MS4 permit's six minimum control measures (MCMs):

1. Public Education
2. Public Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Storm Water Control
5. Post-Construction Storm Water Control
6. Good Housekeeping

If a construction project falls within the jurisdiction of an MS4, the plans must be submitted to the local MS4 authority (i.e., a town, city, university, military base, or other designated entity that is responsible for ensuring storm water management within its territory) or its designee for review. The MS4 regulatory authority is based on a local ordinance. This ordinance must meet the minimum requirements of 327 IAC 15-5 (Rule 5) and address the construction and post-construction phases of development.

For more information about the MCMs and how watershed and MS4 work complement each other, see IDEM's MS4/Section 319 Guidance or IDEM's Rule 13 Web page.

What is Rule 5?

Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities that disturb one or more acres. To comply with Rule 5, owners of a project are required to apply for a general National Pollutant Discharge Elimination System (NPDES) permit by submitting construction/storm water pollution prevention plans to the local SWCD or, where appropriate, to the local MS4 authority. For additional information on Rule 5 compliance, please refer to IDEM's Web site. Rule 5 is administered statewide; all projects are required to file a Notice of Intent with IDEM.

6. Impervious areas: If you have calculated the impervious area in subwatersheds, note whether any areas are approaching or have exceeded 10 percent impervious area. This is a well-documented breaking point; above 10 percent, the aquatic habitat in streams can be degraded by changes in hydrology. A comprehensive storm water management policy in the county can help to reduce this impact, but it becomes increasingly difficult to "fix" as the percentage of concrete, asphalt and roofing increases. Retrofitting existing subdivisions and commercial developments is possible, but planning for storm water management in new construction is much easier. If this looms as a problem in your watershed, discuss it with the city/county planning and city/county engineering departments. For more information about the effects of impervious area, refer to the Center for Watershed Protection's Impacts of Impervious Cover on Aquatic Systems publication. There is a wealth of information on this site, so spend some time on it!

Geology, Topography and Soils

1. Assess the terrain: Using your maps of geology, topography and soils, assess if these categories are distributed across the watershed in any unique manner. Perhaps there are areas with overwhelming karst geology or more hydric soils than initially thought. Are there highly erodible soils overlapping with steep topography?
2. What to do: When comparing current and future land use with the distribution of these categories, do any possible problems or opportunities come to light? Are unsewered communities spreading onto land with unsuitable soils for septics? Are there hydric soils on land that's already protected? Could those areas be restored into wetlands?

Streams and Lakes

1. Study your map: Look at the location of streams or lakes that you know or suspect are impaired. Can you relate any impact of the land uses with known or suspected impairments? If your project has been monitoring water quality, can you relate what you know from your land inventory to the water chemistry and biology results?
2. Land uses: Are there streams that you believe may be threatened by existing or changing land uses?
3. Plan for the future: Do any sample sites need to be added to future sampling plans based on what you now know about the watershed?

Wetlands

1. Study your map: On your map of wetlands, does it appear that many wetland locations have the potential to be threatened by land use changes? Look at the areas surrounding wetlands, and at areas contributing drainage. Consider overall water supply issues; water in wetlands is a major source of aquifer recharge.
2. Look for restoration opportunities: Are there areas that used to be wetlands that you think might be suitable for restoration? Wetlands provide tremendous benefits in the watershed. Properly managed wetlands can:

- Reduce or prevent flooding by collecting and storing surface water run-off from rain events.
- Purify the water by transforming or storing many nonpoint source pollutants like sediment, nutrients and certain heavy metals.
- Protect stream channels by slowing run-off and evenly distributing its energy.
- Recharge the ground water resources that most Hoosiers use for drinking water.
- Provide excellent habitat for countless fish and wildlife species.

Look for opportunities to restore or create wetlands or to link existing wetlands together.

Natural History, Endangered Species and Invasive Species

1. Stream buffers: Pay attention to where buffers are missing and if those areas overlap with poor water quality. Be careful not to ignore other data though. You may have good water quality but poor aquatic habitat or species diversification in areas without buffers. Land use and land ownership are also important considerations when prioritizing the protection and/or creation of stream buffers.
2. Evaluate potential projects: Depending on your concerns and what the watershed inventory data shows, other natural history features such as soil characteristics and existing, as well as historic, natural areas should be analyzed for their potential as future projects, worthiness for protection, or proximity and potential to enhance existing natural areas.
3. Research: If your group is concerned about endangered or invasive species, you'll want to pay close attention to a variety of information. Depending on the issue, water quality, in-stream habitat and riparian habitat may all warrant a close look. Remember to consider land use and land ownership; there may be parks, concerned landowners or other partners willing to volunteer their land to endangered or invasive species projects.

A Final Word About Watershed Inventory Data Analysis

We've grouped broad categories of data to make some simple observations, but don't get too focused on doing the same with your data. Remember, every watershed is different! There may be links between data in your watershed that we've never considered, and you don't want to miss those because you're rigidly grouping data sets together.

Here's one more piece of advice: don't underestimate the importance of taking land use and land ownership into account. Remember, you can't do anything without landowner support. Understanding who that owner is and how his or her land is currently used (or will be used in the future) has to be understood and respected.

Calculating Pollutant Loads

In previous chapters, we have discussed loads with respect to creating a water quality monitoring program, but now we need to discuss analyzing that data. The ways to analyze your loading data are probably as endless as the types of data you can choose to collect. If you have funding, be sure to figure out what kinds of loads you may be required to calculate. U.S. EPA and IDEM, for instance, require that current, target and reduction loads all be calculated. This focus on load reduction is related to the requirements for states to develop total maximum daily loads (TMDLs) on impaired waters. At a minimum, we recommend calculating current loads, which can be useful in comparing relative amounts of nonpoint source pollution across your watershed. Loads can be calculated using your monitoring data or literature data, or by using a model. U.S. EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters has a whole chapter devoted to the topic of estimating pollutant loads (scroll down to Chapter 8)—it is a great reference, and it goes into much more detail than we are able to include here.

Note: *Not all problems lend themselves to load calculation. Sediment, nutrient, metal and pesticide loads can be developed. However, if the target is an improvement in habitat indicated by the mIBI or an increase in riparian vegetation, the targets won't be expressed in terms of loads. There will be some problems you can quantify in loads and some you cannot.*

Calculating Pollutant Loads Using Monitoring Data

A pollutant load is the mass or weight of pollutant transported in a specific unit of time from the source to a waterbody (*e.g.,* Skunk Creek has a phosphorous load of 200 tons per year at its confluence with the Copper River). You will need flow data (volume of water per unit of time that passes a certain point, such as a bridge) and concentration data (the concentration of the pollutant, usually given as milligrams per liter or micrograms per liter, at the same time the flow was measured). The flow data can be collected as part of your monitoring program, or possibly obtained from the network of USGS flow gaging stations. There are ways to use USGS gage data even if the gage isn't located right where you sample.

Don't panic. *Load calculation is just common sense. The biggest hurdle is lack of data. Knowing the load at a certain point in the watershed helps you set targets, express the severity of the problem and differentiate one tributary from another.*

The basic steps for determining pollutant load are:

1. Measure water discharge or flow (*e.g.,* cubic feet per second).
2. Measure pollutant concentration (*e.g.,* milligrams per liter).
3. Calculate pollutant loads (multiply discharge and concentration over the time frame of interest, usually a day or a year).

The key challenge in measuring loads is determining when to sample to obtain the best data. Depending on the pollutant, the amount transported into streams and lakes during snowmelt and storm events is often many times greater than during periods of low flow (*i.e.*, dry weather conditions). This is especially true of nonpoint source pollutants. However, this doesn't relieve you of the need to sample during dry weather, because if pollutant loads are high at that time, it will tell you that the source is most likely a direct discharge (such as from a faulty septic system or poorly managed wastewater treatment plant).

Depending on the number of water quality sampling points your project has, you may be able to compare current loads coming off different land uses (agricultural vs. urban, for instance), loads from different subwatersheds, or even loads from different tributaries. Since loads are a function of pollutant concentration, they may also be helpful when crafting watershed goals if you have a desired concentration target your group wants to meet.

Calculating Pollutant Loads Using a Model

If you don't have sufficient water monitoring data to calculate loads, or if you are interested evaluating the effects of management practices or land use changes on pollutant loads, there are many watershed models that you can use. Agencies, universities and consultants are usually equipped to run one or more models that could assist you. Be aware that the product of a model is only as good as the quality of the data it was built on, and some models are extremely data intensive. Modeling is not for the faint of heart.

These models are commonly used for watershed planning:

Spreadsheet Tool for Estimating Pollutant Load (STEPL) calculates nutrient and sediment loads and load reductions that result from the implementation of various best management practices (BMPs).

STEPL calculates the load for different sources at the field or watershed level.
Users can specify and update the BMP list.
Users can use the BMP calculator to estimate combined BMP efficiencies for complex BMP arrangements.

Long-Term Hydrologic Impact Assessment (LTHIA) is designed to help quantify the impact of land use changes on the quantity and quality of water.

LTHIA uses land use and soil characteristics along with thirty years of precipitation data.
The model determines the average impact that a particular land use change or set of changes will have on annual run-off and average amount of several NPS pollutants. Without making land use changes, LTHIA can be used to evaluate current conditions. Land use changes reflect "what if" scenarios.

Soil and Water Assessment Tool (SWAT) computes pollutant loads from agricultural and urban sources and estimates of the impact of management practices on water quality. While gathering the data is not too bad, running the model properly is tricky and requires calibration with field data.

Many other models exist, although some of them require intense calibration and very specific inputs. For information on the various models available and tips for selecting one that's right for your watershed and needs, see Chapter 8, Estimate Pollutant Loads, in U.S. EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters. You can also talk to an agency representative and get their perspective on what model might be right for you and your group.

Calculating Target Loads

Once you have calculated existing pollutant loads for your watershed, you can use the water quality targets your group selected to calculate your target loads and determine what kind of load reductions you will need in order to reach your target loads. For current suggested methods of load calculation, and assistance in developing loads, contact IDEM's Watershed Assessment and Planning Branch.

Identifying Problems

Review the concerns you identified in Chapter 2. Add any new ones necessary to reflect what you learned during the watershed inventory. Use the information gathered during the inventory to determine which of the concerns are problems.

Example:

Concern	Related Watershed Inventory Information	Problem
Fishing has gotten worse in recent years.	Data collected by IDNR show the fish population in Crawdad Lake has been declining for the last 5 years.	Concern is valid. Fish populations are declining.
Sediment is making the lake cloudy and choking up the upper end where the creek drains in.	Excessive sedimentation and embeddedness were observed at several sites along Mudbug Creek during the windshield survey. Lake residents have photographically documented sediment plumes coming into the lake after rain events. Water quality monitoring conducted during the project showed total suspended solids (TSS) concentrations in Mudbug Creek were above the 80 mg/L target when samples were collected after storm events. Mudbug Creek had the highest TSS load of all the tributaries.	Concern is valid. Excess sediment in the lake may be contributing to declining fish populations. (Note: This problem statement defines sediment as a potential cause of the declining fish populations.)
Lake and streams might not be safe for recreation due to pathogens and pesticides.	Skunk Creek and Possum Creek are on the 303(d) list for E. coli. Water quality monitoring conducted during the project showed E. coli concentrations in Skunk, Possum and Mudbug Creeks were above the E. coli standard of 235 colony forming units (cfu) per 100 mL during at least 7 of the 10 sampling events. Mudbug Creek samples were above the standard for all 10 sampling events. Pesticide sampling was not conducted as part of the project due to the cost, so we were unable to verify whether pesticides are currently in Crawdad Lake and the streams.	Mudbug Creek is not safe for recreation due to pathogens. Skunk and Possum Creeks are not safe for recreation at times due to pathogens. The concern related to pesticides requires further investigation.
Livestock have access to streams.	Livestock with access to streams were observed at 15 locations throughout the watershed during the windshield survey.	Concern is valid. Livestock access may be a contributing source of sediment, E. coli and nutrients. (Note: Livestock is a source, not a cause of the problem.)

Identifying Causes

With problems identified, you're now ready to move onto causes. A cause is a "chemical parameter (for water quality-based problems), physical condition, biological contaminant" or "condition leading to the problem" (e.g., lack of public awareness) that keeps a waterbody from meeting its designated uses. Causes of water quality problems are often the result of a specific pollutant. You may find that some of your causes and problems are identical. Clarifying causes is important because it helps you and your group focus on each problem's origin. Knowing a problem's origin makes source identification much easier.

Let's use the first problem in the previous chart from page 71 as an example:

> People in the Crawdad Lake watershed were concerned that fishing had gotten worse in recent years. Data collected by IDNR showed that fish populations were declining, and that their concern was indeed a problem. Working with IDNR, and conducting an extensive inventory and monitoring program, they established that the cause of the decline in fish was habitat degradation. The degradation was a result of sediment washing into the stream and covering the fish's breeding areas.

Identifying Sources

In all the tangle of advice we're presenting, try not to lose sight of the connection between the concerns your group had at the beginning, the problems you identified, what's causing the problems, the sources, and how those sources will be addressed.

Remember: For planning purposes, think of your problems as the things that you/wildlife are kept from doing in the watershed because of pollution or land use change—these are often tied to the water's designated uses. The "cause" of the problem is very often a particular pollutant (e.g., sediment, E. coli, etc.), but might also be a lack of awareness or loss of a particular land use (e.g., wetlands). The "source" is the location or activity that the pollutant(s) came from (e.g., livestock in the stream or failed septic systems).

Let's flesh out our "fish populations are declining" problem as an example.

> People in the Crawdad Lake watershed determined that the fish populations were declining as a result of sediment washing into the stream and covering the fish's breeding areas. The source of the sediment might be farming, construction or stream bank erosion. To determine specific sources, the watershed group looked at their watershed inventory data. Since the group had conducted an extensive windshield survey and had walked many of the streams, they knew that stream bank erosion was a problem at over 25 sites, half of which showed evidence of trampling by livestock. The tributary with the highest TSS concentrations and loads was Mudbug Creek, where extensive development and construction had been occurring for the last two years. High TSS loads were measured in Possum Creek as well, where row crop was the only land use. Tillage transect data showed that over 70 percent of the crops in Possum Creek were conventionally tilled. In this example, identified sources are bank erosion (some due to livestock), new construction and conventional tillage.

Of course, your cases will rarely be that simple, and in many watersheds, multiple land uses need to be addressed in hopes of "catching" the primary source. However, the point is to continually consider the entire chain of concern, problem, cause and source in order to understand the dynamics of the watershed.

Regulated Pollutant Sources

Point source pollution isn't usually addressed by local groups, since there is a regulatory agency (IDEM) to oversee it. However, if you believe there are problems with specific discharges, request assistance from IDEM in assessing whether the facilities are in compliance with their permits. You may want to stay in contact with IDEM to be sure those complaints or concerns are followed up.

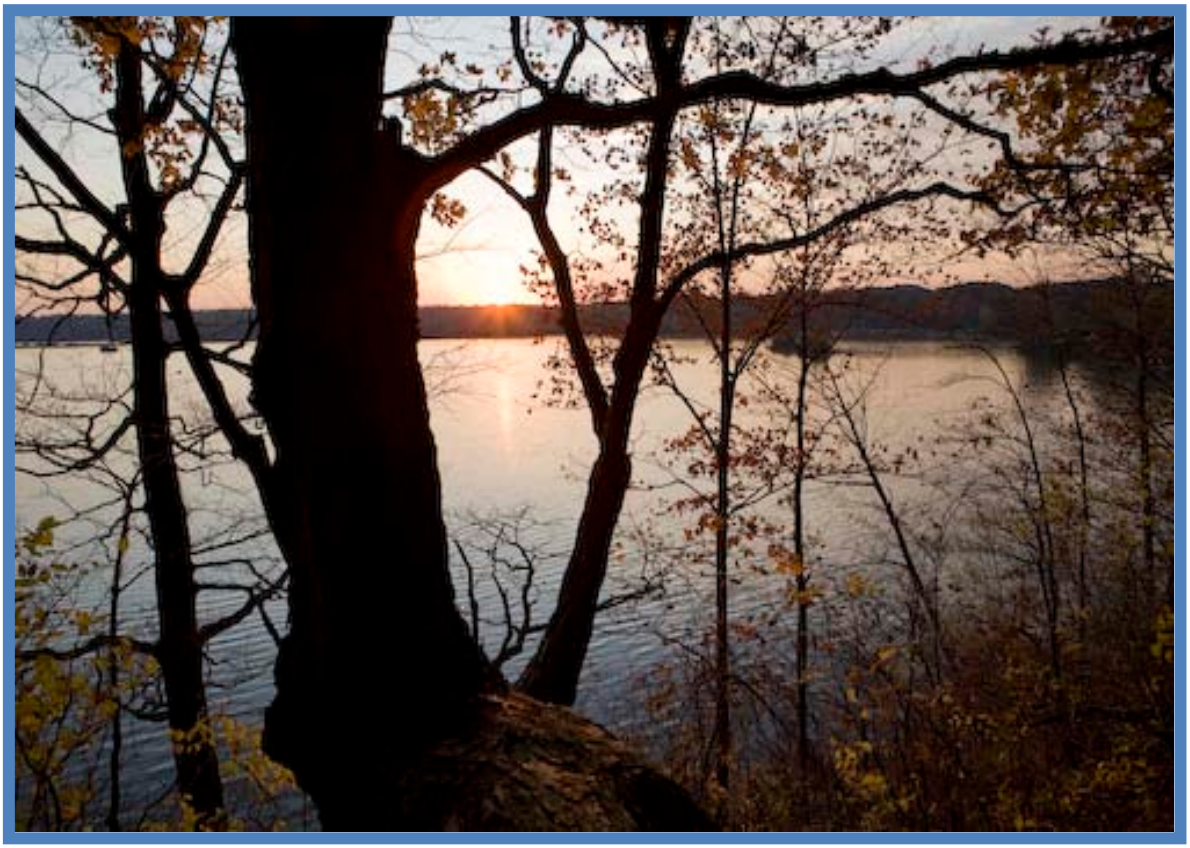
Prioritizing Problems

List all of the problems that you have come up with, and prioritize them based on:

1. **Urgency:** What will happen if the problem isn't fixed?
2. **Feasibility:** Is it something that the group can fix or influence? Does it need to be turned over to someone else?
3. **Location:** Does the problem occur all over the watershed or only in certain areas? Can you map it or associate it with something on the map?

You may go through this exercise several times as you learn more, incorporate new monitoring data into your decisions, and decide as a group what you are prepared to act on.

The final list of prioritized problems will be used to fine-tune the group's goals, and will then evolve into actions that the group resolves to implement, forming the backbone of the watershed plan.



Planning Review – Chapter 5

You can start working the following into your plan outline now:

- ☐ Include information already on record before you started your investigation.
- ☐ Describe designated uses and any additional desired uses the local group wants from streams and lakes in the watershed.
- ☐ Identify waters on the 303(d) impaired waterbody list; include information about your watershed from the 305(b) report. If there are impairments, summarize the state water quality standards that are violated, including any numeric criteria that need to be included in goals.
- ☐ List the studies and reports the group was able to find on the watershed and briefly summarize what they said.
- ☐ Summarize the findings of the watershed inventory and water quality monitoring. See Chapters 3 and 4 for details.
- ☐ Describe water quality impairments and threats, including specific pollutants, changes in land use, hydrologic changes, and other stressors.
- ☐ State the problem clearly, followed by the probable cause, location of the problem, and extent of the problem.
- ☐ Identify probable sources of pollutants or conditions that are causing water quality impairment. Explain how sources were determined.
- ☐ Discuss and identify specific sources for each pollutant or condition that is causing a problem. Document why you believe these are the sources and what the evidence is.
- ☐ Describe the sources in enough detail to show the part of the watershed where they occur. *For example:* give the number of dairy farms in each subwatershed, or the number of acres of cropland needing improved tillage methods and how those acres are distributed in the watershed, or the number and location of construction sites in each tributary watershed.
- ☐ Include enough information to explain the magnitude of the source. *For example,* state that there are 45 stream miles, of which 17 have good riparian cover, 10 have fair cover, and 18 are in need of restoration. This is more meaningful than just saying 18 miles of stream corridor need restoration.
- ☐ Establish water quality targets and calculate existing and target pollutant loads.

Chapter 6: Setting Goals for Success

Now that you've identified problems, their causes and their sources, and established existing loads and target loads for the watershed, it's time to craft measurable goals. These goals will drive the group's decisions, actions and progress from here forward.

While the format is up to the group, goals need to incorporate the following elements:

- A problem, pollutant or condition;
- The present load or nature of that problem, pollutant or condition;
- The target load or condition; and,
- When the group expects that target to be met.

Goals typically include a timeframe and a measurable component so that you know how much you want to do by when. For water quality goals, if water quality standards exist for the pollutant, the goal, at minimum, should be to meet the water quality standard. If a TMDL has been written for the watershed, the goal, at minimum, should be to reach the pollutant load reduction called for by the TMDL. While you are developing your goals, also be thinking about how you will evaluate your progress—what indicators will you track? It's a lot to think about at once, but, come evaluation time, you'll be glad you did!

Some goals are not easily measured or tracked, but are still important. Some examples include education and flood reduction goals. It is acceptable to include these types of goals into the plan without including a quantity and timeframe. For example, "Reduce flooding in the Crawdad Lake watershed" is a perfectly acceptable goal.

You might find it helpful to write out a statement that will tie together your problems, causes, sources, critical areas, existing loads and targets.

Example:

Here's how the Crawdad Lake watershed group took an identified problem and turned it into a goal statement:

> With the information obtained during the investigation phase, the group knows that the land use in the watershed is predominantly agricultural in the headwaters and urbanizing nearer the mouth of the watershed. There is some stream bank erosion, but modeling, load calculations and visual observation show that the largest volume of sediment is coming from agricultural cropland where soybeans are produced. The most critical non-agricultural erosion problem is from construction projects in the Mudbug Creek subwatershed.
>
> Fish populations are declining in the watershed due to habitat degradation caused by sediment washing into the streams and covering up the fish breeding areas. The watershed inventory showed that: 70 percent of the cropland in the Possum Creek subwatershed was conventionally tilled; stream bank erosion was a problem at over 25 sites; and extensive development and construction had been occurring for the last two years along Mudbug Creek. The estimated total suspended solids (TSS) load for the watershed is 100 tons per year, which is above the target of 25 tons per year.

This statement covers quite a bit of territory. You can use this information to now create a broad water quality-related goal statement, such as:

> *Sediment Reduction Goal Statement:* "Excess total suspended solids (TSS) has been identified as a problem for aquatic habitat. We want to reduce the TSS load in the watershed from 100 tons per year to 25 tons per year within 20 years."

In order to make your goals manageable, you'll want to break them down into subtasks, also called "objectives." Using the goal above, some sediment reduction objectives might be:

- "Decrease sediment loads from cropland."
- "Decrease sediment loads from the construction projects."

Are All Goals Created Equal?

Prioritize your goals. Once the group has crafted all of its goals and objectives, the list may look a little scary. There is no harm in stepping back for a few minutes to determine feasibility, appropriateness and relative urgency of each goal.

At the end of the discussion, the group should have a prioritized list of goals that they feel confident in addressing. "Prioritized" may mean, for example, "ranked from 1 to 8," or just "high, medium and low." With the list of goals on the table, ask yourselves:

- *Can we fix it?* If a problem is clearly beyond the scope of the group, such as cleaning up a Superfund site, table it. If it is doable, but not by your group, refer it to the appropriate party.
- *Are people willing to do it?* If the "fix" involves land use changes or management changes that are not presently acceptable to the community, or if the residents are just not concerned or committed on this issue, consider giving the goal a lower priority or postponing it until a later date. Concentrate now on developing a track record of successes to increase your profile in the community, or wait until you have more resources at hand.
- *Will it help us realize our vision?* If the goal is manageable, but doesn't clearly relate to your mission and vision, consider finding another home for it.
- *Will the resources stretch that far?* If you expect to receive a $100,000 grant and meeting this goal will probably take $500,000, you may need to narrow the critical area, increase the timeframe, or recognize the need to pursue additional resources.

If the answer to all these questions is an unqualified "yes," then the goal deserves a high priority. Try not to have a large number of goals that are all high priority, since it may make it tough to allocate funds and manpower.

What Happens If We Don't Meet Our Goals?

U.S. EPA uses the term "adaptive management" when discussing watershed restoration. It means using the best information you can to develop realistic goals, implementing measures to meet those goals, and then adjusting the plan periodically as monitoring tells you whether progress is being made. Another term is "iterative solution," which means getting as close as you can to an answer with the methods and information available, and then tweaking the process and adjusting the answer when new information surfaces.

The goals in your watershed plan are as good as you can make them, but no one expects them to perfectly predict the future. Within a five-year span, so many variables (*e.g.,* weather, land use, agency programs, personnel, regulations) can enter into the planning process that it would be unrealistic to think that you can achieve every goal on schedule. Through monitoring and annual evaluation of the plan, goals should be adjusted and refined to fit the evolving story of your watershed.

Planning Review – Chapter 6

Continue working on these items:

- □ While the format is up to the group, remember that goals need to incorporate the following elements:
  1. A problem, pollutant or condition;
  2. The present load or nature of that problem, pollutant or condition;
  3. The target load or condition; and,
  4. When the group expects that target to be met.

- □ Since discussion of goals can be lengthy, create a table in the text or appendix showing: goals, objectives under each goal, present condition, target condition, target date, and indicator to be used for measuring progress. (This is different from an action plan, which shows who will carry out each task.)

- □ Try to express a clear connection between concerns, problems, causes, sources, goals, targets and indicators throughout the plan.

Chapter 7: Critical Areas and Prioritizing Actions

By now the group is well on its way to formulating the actions and changes that will be recommended in the plan. To be effective, this decision process needs to be recorded in the plan. Stating what you finally decide to do is not enough; the plan must show a clear train of thought leading from concerns, fact-finding and problem identification to goals, objectives and evaluating progress. The people who read the plan need to see valid cause-and-effect connections in order to have confidence in supporting the plan.

If you have been working your way through this guide, you will have already established the connection from public concerns and investigation to problem identification and goals. The next step is to determine what actions need to be taken in order to meet those goals.

Identifying Critical Areas

Much of the watershed planning process consists of making tough choices. Since watershed projects rarely have unlimited resources, it's important to know where in the watershed your dollars and hours can be spent to greatest effect. Prioritizing and identifying critical areas enable you to get the biggest change for your efforts. Critical areas for improvement are the parts of the watershed where you think the most improvement can be made using the fewest resources. You can also designate critical areas for protection in the watershed to prevent degradation of the resource. Designating critical areas can be complicated, as people tend to want to make everything a priority. However, as a wise watershed planner once said:

If everything is a priority, then nothing is a priority.

Such advice sometimes is hard to follow, especially at the end of a planning process when groups are anxious to start putting best management practices on the ground. To throw out another corny but accurate witticism:

The watershed wasn't polluted in a day, nor will it be cleaned up in a day.

When selecting critical areas, keep four things in mind:

1. You may not have resources to address the biggest problems right away.
2. Not everyone will want to cooperate with you and help implement the plan.
3. Those willing to help may not be ideal candidates for the goals and objectives of your watershed management plan.
4. If you have a funding source, it may have a specific definition of what a critical area can (or cannot) be.

For each goal, examine where in the watershed the goal applies. Refer to maps and inventory information. Ask yourselves:

- What is the location or type of land use where the problem is worst or most common?
- What is the audience that has the power of change in this issue? If best management practices are required on private lands, where are willing landowners located?
- Which streams, lakes or aquifers exhibit documented impairments?
- What can we afford to do in 1, 3, 5 or 10 years? Many watershed plans work within a 3- to 5-year timeframe, reasoning that within 3-5 years, they will make a significant impact on the focus area, and can then move on. It also takes about 3-5 years to see evidence of change.

Example:

Let's continue our Crawdad Lake watershed example and see how they designated critical areas. Let's use the group's sediment goal as an example:

"Excess total suspended solids (TSS) has been identified as a problem for aquatic habitat. We want to reduce the TSS load in the watershed from 100 tons per year to 25 tons per year within 20 years."

Location: The group knows that row crop fields are located mostly in the upper reaches of Mudbug Creek subwatershed. Referring to inventory data, they determine that there are 75 stream miles, including Skunk and Possum Creek and their tributaries, where most of the row crop fields are concentrated. Extensive development and construction has been concentrated along Mudbug Creek.

Audience: Visual observation showed that at least half of the soybean fields and nearly all of the corn fields are conventionally tilled. Visual observation of construction sites showed that less than half had appropriate erosion control measures in place.

Impairment: Habitat and aquatic life data in these watersheds show that there are high sediment levels. In addition, Mudbug Creek has the highest TSS load in the entire Crawdad Lake watershed.

Timeframe: Because the SWCD just hired an urban specialist to assist with education and Rule 5 inspections, and since there are cost-share programs to help farmers improve tillage practices, it's reasonable to expect change in 3 to 5 years, although it may take up to 7 years to reach the goal.

Keep in mind that there is no "right" or "wrong" way to define critical areas, unless you have a grant. In that case you need to follow the agency's definition exactly! That said, even U.S. EPA is broadening its definition of critical areas.

Therefore, the critical area, or target area, for this goal is the land drained by Mudbug Creek, with the greatest emphasis placed on Skunk and Possum Creeks.

Protection Areas: *U.S. EPA now encourages watershed groups to designate "protection areas." These are areas where water quality is so good that the area deserves protection from future actions which may threaten that quality. The idea behind protection areas is to preserve the parts of your watershed which currently are healthy. Consider including protection areas into your group's watershed management plan!*

It is far more effective to promote specific land management changes with a well-defined audience in a target area than to aim a generalized program at the whole watershed. Some groups have a hard time prioritizing their implementation area—after all, what if landowners in the critical area do not *want* to change their management practices? However, if you involve potential implementers in your planning efforts (and you should), you should be able to get a feel for whether or not they are willing to actually change the management of lands under their control. There are many ways to determine critical areas. If you're having trouble with this part of the planning process, consider asking an agency representative for help.

Developing Management Objectives

Be prepared to propose a range of alternatives. With the aid of technical agencies and individuals, try to brainstorm every possible alternative for addressing goals, no matter how wild some of them may seem. Sound out all those people who have been trying to tell you how to fix things since the first meeting! Try to get a variety of alternatives on the table without prejudging whether they can work.

Let's use the sediment goal from the Crawdad Lake watershed and see what kind of alternatives they came up with.

"Excess total suspended solids (TSS) has been identified as a problem for aquatic habitat. We want to reduce the TSS load in the watershed from 100 tons per year to 25 tons per year within 20 years."

- Promote a cost-share program that pays for equipment needed for conservation tillage.
- Hire an agricultural best management practices promoter to educate farmers about cover crops, filter strips, conservation tillage, and other sediment-reducing BMPs.
- Offer easements for establishing riparian areas along streams and ditches that run through farmland.
- Hold yearly erosion control workshops for developers.
- Write newspaper articles that explain the benefits of keeping sediment out of the stream.
- Start a demonstration area showcasing erosion control management practices and offering technical assistance.
- Meet with developers, show them the water quality data, and ask them to offer solutions.

Analyzing and Choosing

Once the group has listed every conceivable method for reaching its goals, analyze the alternatives and decide which ones best fit the situation. Ask yourselves these questions:

- Does this alternative address our primary concerns?
- Will it help us meet our goal?
- What will be the positive and/or negative effects on the environment?
- Can we measure the effects, and what indicators will we use?
- How long will it take to see results, and where will we set our milestones?
- What will this approach cost in terms of money and manpower?
- Do we have (or can we get) the technical expertise to do this?
- Will this approach be acceptable to the people in this watershed? Did we do a social indicators survey?
- Will this approach complement other projects that we already plan to do? Are we leveraging our resources?

Based on those questions and the ensuing discussion, the Crawdad Lake watershed group might select the following alternatives:

- Meet with the developers and farmers in the watershed to share information and ask for reactions to the alternatives we are considering.
- Seek the assistance of a BMP specialist to develop site-specific conservation plans with agricultural owners.
- Start an education program focusing on urban influences, specifically developers. The program should offer erosion control workshops and demonstrations of properly installed and maintained BMPs. Future education efforts will be identified with the help of the developers and other stakeholders.
- Promote existing cost-share programs that can be used to offset the economic burden of installing agricultural BMPs.

What are Best Management Practices (BMPs)?

The term "best management practice" or "BMP" applies to structural and management practices used in agriculture, forestry, urban land development and industry to reduce the potential for damage to natural resources from human activities.

Best: In every field of work, there are several methods for reaching a goal. The best practice for a specific site considers the impact on natural resources, efficiency, economics, and the needs of the individual operation. It is not enough to simply present a laundry list of practices. A best management practice must have been selected through a conscious planning process that balances natural resource needs with human needs.

Management: This is the way we do business or carry out work. A group of practices is incorporated into a management system. For instance, a logger implements riparian buffers and water bars to lessen the impact of timber harvesting on natural resources; the logger learns to manage his work differently to protect a valued resource.

Practice: A practice is a prescribed manner of doing or building something, with standards and specifications developed by an agency or institution with expertise in the relevant fields. A practice may be structural (something that is built or involves changes in land forms or equipment) or it may be managerial (a specific way of using or handling resources).

The following references may contain appropriate practices to be used in Indiana:

- NRCS Field Office Technical Guide (FOTG): This guide contains standards and specifications for conservation practices, average annual cost estimates, soils information for each county, planning considerations, conservation practice effects and more. The online version is the official version.

- Adjuncts to the FOTG: These publications include the Engineering Field Handbook (Part 650 of the National Engineering Handbook), which contains design methods for the practices described in the FOTG; the National Agronomy Manual; the Agricultural Waste Management Field Handbook (Part 651 of the National Engineering Handbook); and the National Planning Procedures Handbook. Local agriculture service centers will also have these documents in hard copy. Contact NRCS field staff for assistance.

- Indiana Storm Water Quality Manual: Developed by IDNR and partner agencies, this resource contains practices for construction sites. There is a copy in each SWCD county office. This document was revised in 2007.

- Logging and Forestry BMPs for Water Quality in Indiana: The IDNR Division of Forestry's Web site contains best management practices for the timber industry and private woodlot owners.

- Indiana Drainage Handbook: Developed by a consortium of agencies and organizations, this manual contains practices for all aspects of agricultural and non-agricultural drainage activities.

- Low Impact Development Manual for Michigan: This manual has chapters designed to educate elected officials, planners, consultants, businesses and citizens about low impact development and how it can be incorporated into local planning documents and ordinances. The manual also provides in-depth standards and specifications for several urban BMPs as well as native plant lists, calculations for infiltration and run-off rates and information on maintenance.

As you evaluate and select your BMPs and measures, don't forget to consider how they relate to your pollutant load reduction goals. Estimating the pollutant load reduction from a BMP along with the estimated cost can help you get an idea of how much it will cost to implement your plan and reach your goals. Using models such as the Spreadsheet Tool for Estimating Pollutant Load (STEPL) (see Chapter 5) or the Region 5 Load Estimation Spreadsheet, you can estimate sediment and nutrient load reductions for BMPs.

You may not be able to estimate load reductions for all BMPs and measures (*e.g.,* education and outreach). For more information about estimating load reductions, see Chapter 11.3 in U.S. EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters, or contact IDEM's Watershed Assessment and Planning Branch for assistance.

Going Beyond Nonpoint Source Pollution

In addition to practices aimed at nonpoint source pollution, your group may have concerns about other possible impacts on water quality.

Point sources have distinct discharge points such as municipal or industrial discharge pipes. Each discharger has a permit on record with IDEM. Discharge permits are reviewed and adjusted every five years. Changing the amount or nature of point source discharges may be beyond the group's scope, but some alternatives might include getting involved in the public hearing process for new permits, requesting compliance records, or working with local industry to promote more effective technology.

Flooding, like point sources, is another issue you may want to consider. Flooding is becoming a problem in more and more Hoosier watersheds. As more of Indiana is developed, the increase in impervious surface area creates additional flow that our stream and river channels cannot transport. One solution is to use infiltration practices that direct storm water back into the ground (rather than into a pipe and then into the nearest stream) in new developments and redevelopment. Infiltration practices, and the design philosophies behind them, help recharge our ground water and reduce flooding, and they are often less expensive than traditional storm water practices. Some of these new philosophies include encouraging cluster housing in new subdivisions, promoting regional storm water management, advocating rezoning in certain environmentally sensitive areas, and educating municipal planners and engineers about infiltration practices. For more information, visit U.S. EPA's Web site.

Information Resource

U.S. EPA's nonpoint source pollution Web page contains vast amounts of useful information, including NPS pollution sources listed by category. Click on any one and you will be taken to another list of manuals, handbooks and other resources, including extensive information on alternatives, measures and BMPs.

Planning Review – Chapter 7

By now the group is well on its way to formulating the actions and changes that will be recommended in the plan. To be effective, this decision process needs to be recorded in the plan.

- ☐ Use information from your watershed inventory, along with your list of sources and loads, to determine the critical areas in your watershed. Identify the parts of the watershed (specific subwatersheds, specific land uses, or other defined areas such as "all subdivisions without storm water control") where sources of problems can be treated, mitigated or reduced. Show these areas on a map. Identify critical areas where measures need to be applied most urgently.

- ☐ When designating critical areas, remember to consider the stakeholders in those areas and whether they will cooperate to implement the plan.

- ☐ Resist the temptation to make the entire watershed critical, but don't overlook healthy areas that perhaps should be designated critical because they deserve protection.

- ☐ Explain the train of thought for the group's prioritization and targeting approach.

- ☐ Describe what needs to be implemented or changed to achieve the goals of the watershed plan. This may include planning activities, local ordinances, BMPs, etc. State which alternatives the group has elected to pursue and why.

- ☐ Connect measures to the appropriate goals.

- ☐ For best management practices recommended in the plan, identify applicable standards and specifications, and which agency maintains those standards.

- ☐ Describe the impacts of the measures that were considered, both positive and negative. Include economic and social impacts as well as environmental impacts.

- ☐ Using methods appropriate to your situation, calculate loads for the pollutants that will be reduced. Show how these calculations led to the determination of critical areas and formulation of goals.

    1. For agricultural land, calculate or model sediment and nutrient loads. Describe the methods or models used to perform calculations, and any considerations necessary for understanding the results.

    2. For non-agricultural land, calculate impervious area and any pollutant loads for which there is adequate information.

- ☐ If loading isn't an appropriate way to measure targets, express the change you are trying to achieve as clearly as possible. An example would be habitat improvement; instead of a load reduction, the change could be expressed as improvement in a habitat index.

- ☐ Describe any legal matters, including permits, easements, agreements with landowners, land acquisition, or other legal actions that have to happen in order to make the plan work.

Chapter 8: Implementation

In the previous chapter, your group selected objectives to go with each goal that you are pursuing. Your next step is to flesh out these goals and objectives into an action plan that will serve as the basis of plan implementation. In other words, you need to add in the who, what, why, where and how to each goal, or the goal may never be accomplished!

Action Plans

You might hear this part of a plan referred to as an "action register," "action strategy" or some other name. We'll call it an action plan because that's what it is. Action plans lay out the details of all the tasks that need to be accomplished for the plan to become reality. This is the "how-we're-going-to-get-there" part. It's also the part of the planning process where people start hiding behind the chairs to avoid getting selected for uncomfortable or difficult jobs. Many watershed plans fall short of completion because the action plan is left out.

Why do you need an action plan? Because it will:

- Increase the likelihood that the plan will be implemented effectively and on time;
- Prevent the group from underestimating the time and resources needed to get a task done;
- Show when complex tasks need to be broken down into parts; and,
- Prevent people from being "volunteered" for work without knowing about it.

Constructing an Action Plan

Make a table with column headings such as: Goal, Objective, Task, Start Date, End Date, Responsibility, Resources, Products and Milestones.

The sample plan on the next page uses the example goal statement from Chapters 6 and 7.

Following are brief descriptions of each column:

Objective: The "subgoals" selected by the group to accomplish the respective goals.
Tasks: Further breakdown of objectives go to an implementable level.
Milestone: The work items that have to be carried out to accomplish each objective. Milestones need to be tied to a schedule.
Cost: Resources, manpower, equipment, etc. needed to carry out the task. You want to try to be as accurate as you can here. Look at Purdue University Cooperative Extension Service's custom rates pamphlet and USDA's not-to-exceed rates for technical services to get an idea of how much practices will cost. You can use Plan2Fund, a watershed-specific tool that can help you keep track of expenses and income, to track your progress toward completion. Listing these needs will help you when filling out grant application budget sheets and requesting other funds.
Possible Partner: The person, organization or agency that is to carry out each task.
Technical Assistance: Specific expertise or skill set which may be needed to achieve a task.
Products: Tangible or intangible output of the task.

Sample Action Plan

Action Plan for TSS Goal:

Excess total suspended solids (TSS) has been identified as a problem for aquatic habitat.

We want to reduce the TSS load in the watershed from 100 tons per year to 25 tons per year (a 75 percent reduction) within 20 years.

Objective	Tasks	Start Date	End Date	Milestone	Cost	Possible Partner (PP) and Needed Technical Assistance (TA)	Products
Cost-share on conservation tillage for crop fields	Develop and implement a Section 319 cost-share program	2010	2015	By September 2010, develop a Section 319 cost-share program	$500	PP = SWCD	Approval to implement program
	Promote current Farm Bill programs	2010	2015	By July 2010, be using existing SWCD/NRCS educational materials to inform landowners about no-till	¼ of a full time staff = $10,000/year	PP = SWCD and NRCS	Timely conservation information received by all producers in the watershed.
	Supplement Section 319 cost-share funding for no-till	2011	2015	By December 2010, identify non-Section 319 sources of no-till financial assistance	Volunteer based		Additional funding for cost-share program received
	Every year, implement 200 acres of no-till. Use all known funding sources	2010	2015	200 acres of no-till implemented in each year	Equipment modification costs: $2,500 per planter; technical service provider (TSP) costs: $300	PP = watershed group (WG) TA = steering committee to help discuss program with landowners and TSP to write conservation plans	At least 1,000 acres of no-till implemented
	Monitor for improvement	2015	2015	Begin monitoring TSS in 2015 to measure possible reductions	$175/sample	PP = city wastewater plant runs samples TA = university designs monitoring	Progress report
Educate the highway department on sediment reduction	Educate contractors of the highway department through annual workshops	2010	2015	By December 2010, hold an erosion control workshop	$2,500/yr	PP = WG and MS4 coordinator	Workshop; names of contractors to include in future education
	Install BMP demos	2010	2015	By December 2010, locate a site for demo BMPs	Volunteer based		
				By November 2011, install demo BMPs	$1,500-$3,000	PP = WG and MS4 coordinator TA = engineer to design BMPs	At least one structural and one vegetated practice demonstrated
	Influence highway department policy	2012	2015	By July 2012, meet with highway department to discuss direction of education program	N/A	PP = highway department	At least one meeting with superintendent of highway department

It could be that some of your goals will take some time to achieve. That's okay! Acknowledge the conditions or pollutants that will take longer than 3-5 years to address, and briefly discuss how they will be handled (*e.g.,* through longer range projects, plan evaluation, follow-up monitoring, etc.). Whatever you do, don't leave them out because they will be difficult to address.

A Note on Permits for Implementation Projects and Other Legal Matters

As you are planning your implementation, be aware that the installation of several BMPs (especially those that require work below the ordinary high water mark) will require permits from IDEM, IDNR and/or the U.S. Army Corps of Engineers. Before you begin *any* work, make sure that you contact these agencies to find out whether or not a permit is required prior to installation of the BMP. The permitting process may take some time (up to 120 days, in some cases), so you'll want to plan accordingly.

Also, there is some paperwork and cost involved in setting up easements, land acquisitions, and some types of agreements with landowners. Account for these costs and the assistance required in your action plan.

Planning Review – Chapter 8

- ☐ Discuss the proposed sequence of implementing measures, time requirements for implementing the plan, responsibility for carrying out tasks, and milestones for checking that implementation is on schedule. Include a schedule for implementing management measures.

- ☐ Create an action plan that lists tasks, when each task will be done, who is responsible for it, and what sources of support there are.

- ☐ Include a timeline showing milestones for about 3 to 5 years of implementation. Show what percentage of each task will be completed each year, or when programs will be completed; the point is to indicate how you will assess progress in your work.

- ☐ Estimate financial resources and technical assistance needed to implement the plan.

- ☐ Estimate the cost of implementing each part of the plan.

- ☐ When feasible, include sources for any cost figures used, and the general rationale behind the estimates. Concentrate on developing estimates for the high-priority tasks the group wants to carry out within the next 3 to 5 years.

- ☐ Indicate what agencies, programs, or organizations you will go to for support for each part of the plan. Also indicate agencies that will be expected or requested to provide technical assistance, such as NRCS or ISDA.

- ☐ In your schedule, take into account the time needed to apply for permits, especially for wetland or floodplain work.

- ☐ List the agencies or bodies that have jurisdiction over permits, easements, etc.

Chapter 9: Are We There Yet?

You've been writing your plan as you go through the planning process. The action strategy is done. You're ready to print this puppy and finally start doing stuff, right? Well, take a deep breath, because you're not quite ready yet.

Two vital planning tasks remain—choosing how to monitor progress in the watershed and deciding how the plan will be updated and adapted to changes in the community and the watershed. Using indicators for each goal, the group should develop a monitoring program and decide how to evaluate progress. Each goal in your plan came from a concern and will eventually lead to some action. Remember that watershed planning consists of determining where you are now, where you want to be in the future, how you're going to get there, and how you will know when you've arrived.

Indicators Revisited – What Did We Change?

The trick to measuring progress effectively lies in selecting good indicators. An indicator is a fact or datum that can be measured to show the rate of change, such as turbidity (the amount of silt or other "stuff" in the water). Indicators tell you whether things have gotten better or worse and by how much. In Chapter 4, we talked about selecting appropriate indicators when you are designing your monitoring strategies. At this stage, focus on identifying indicators appropriate to each goal. This chapter helps describe how to use indicators to develop an ongoing monitoring program.

Developing an Indicator

Let's go back to the Crawdad Lake watershed group's goal to reduce sediment load from cropland by 75 percent in 20 years. They plan to bring a cost-share program to the watershed to provide an incentive for farmers to increase no-till acreage and to reduce fall tillage on conventionally tilled acres. It would be easy and convenient to measure the number of acres converted to no-till as your indicator. However, the goal is to reduce sediment load. In order to measure that, the group could monitor a number of different things (the indicators are in bold):

- Return to the sites where qualitative habitat evaluation indices (see Chapter 4) were completed, and observe **sediment deposition.** This is a valuable systemic measure, but it may take a very long time for some parts of the stream to show improvement if there is a lot of sediment bed load working its way through the system.
- Directly measure **turbidity** and/or **total suspended solids** at appropriate points along the stream. While turbidity is usually due to suspended sediment, it can also be due to algae; it won't be known whether the sediment is new to the system or resuspended from some area upstream. Also, if samples don't coincide with rainfall, the results may not reflect what is really happening.
- Use models to forecast **sediment yields** based on land use, soils, changes in management, installation of practices, and so forth. This is a useful way to predict what may happen ("what-if"). However, it won't tell you what *really* happens.
- Visually observe **water clarity** during rainstorms at points where sediment load is known to enter the stream. This is useful anecdotal information but it is not a very sensitive way to measure change.
- Measure **total suspended solids** above and below sites where practices are being implemented, being careful to include samples taken during rainfall events. This is a great way to document localized change, although it may not tell you what is happening in the whole system.

The group needs to weigh the urgency of the goal, information about causes and sources, financial and personnel limitations, and time constraints, and then select one or more indicators and measurement methods that will give them confidence in assessing change. When the group has developed as many goals as they see fit, determined their priorities, and linked each goal to some measure(s) of change, it's likely that certain indicators will overlap or mesh. For instance, visiting a site to assess the biological community, habitat, sediment deposition, and land use change can be combined into one or two events per year, and the results may serve to measure progress for several goals.

More Examples of Indicators

Regulatory or program indicators:

- Number of permits reissued with new limits (administrative)
- Number of point sources in substantial noncompliance (administrative)
- Elapsed time from permit violation reports to compliance (administrative)
- Amount of fertilizer sold or used (administrative)
- Number of communities enacting storm water ordinances (administrative)
- Number of public water systems with source water protection plans (administrative)
- Number of citizens reached with public education efforts (administrative)

Change in threat or potential:

- Reduction in nutrient loadings from each type of point and nonpoint source (environmental)
- Stability and condition of riparian vegetation (environmental)
- Percent impervious surface upstream (administrative)
- General erosion rate upstream (environmental)
- Amount of toxics discharged by spills (environmental)
- Number of businesses and households that have altered behaviors or processes to reduce pollutants (social)
- Size of wetlands or riparian habitat acres (administrative)

Water quality change:

- Pollutant concentrations in water columns, sediments and ground water (environmental)
- Pollutant loads (concentration multiplied by flow) (environmental)
- Frequency of restrictions on water uses (beach closings, boil water alerts) (administrative)
- Percentage of stream miles supporting each designated use (environmental)
- Percentage of miles with impaired or threatened uses (environmental)
- Percentage of citizens who rate major waterbodies as usable for various recreational activities (social)

Ecosystem health:

- Macroinvertebrate and fish community indices (environmental)
- Reduction in waterborne disease in humans (environmental)
- Habitat quality indices (environmental)

Monitoring Plans

Develop a plan for monitoring the selected indicators. If water quality or biological monitoring have already been part of your work (to assess the watershed and establish baselines), then you may choose to continue what you have been doing. Add or delete sample parameters, sample locations, sample frequency, etc. as needed to make the monitoring strategy work for you in tracking progress. Remember, if you want to be able to compare your baseline to current conditions, it's important to use the same methods to collect the information. For example, if you collected turbidity as a clarity indicator for your baseline, you should collect turbidity as an indicator to monitor progress. If you start collecting suspended sediment concentration instead, you cannot compare the two, even though both are valid measurements of suspended particulates.

Recognize that chemical and biological conditions may vary greatly between years due to differences in weather or other conditions not related to land use. A long-term data set is very valuable for distinguishing changes due to land use from natural year-to-year variation in water chemistry and biological communities. Comparisons with carefully-selected "control" streams or watersheds can be vital in making these distinctions. Search the U.S. EPA website for a publication titled "Paired Watershed Study Design" - publication number : 841F93009. If water quality standards are being used to quantify goals, then the indicators should include the criteria on which the standards are based. The Watershed Assessment and Planning Branch within IDEM's Office of Water Quality can help you identify these.

Not all indicators will be in the water; you may be monitoring land use change, the width and extent of riparian vegetation, or other factors that could be tracked with aerial photography or satellite imagery. Still other indicators could be tracked by interviewing agricultural producers or residents who are targeted by an education campaign.

Whatever the indicators, describe the sampling methods, sample sites, sampling frequency, and analysis methods. Identify who is responsible for each indicator, how and when results will be reported, and where funding will come from. (Sound familiar? Yes, this is another action plan.)

Review Your Plan Regularly

Agree on a regular time, perhaps quarterly, when the group will pull out the watershed plan, blow off the dust, and review what it says. Watershed plans should be living documents that can be changed or added to as needed. After all, you wrote it! You have the right to scribble in the margins, add new pages, and cross things out.

Schedule an annual work session when the steering committee will convene and go through the action plan and goals to see what has been accomplished. This is also the time to adjust goals and amend the action plan to reflect new information or changes in the watershed.

When the group accomplishes some piece of the plan, celebrate and let the community know about it. Celebrations need not be expensive; most people enjoy sweets at a steering committee meeting or a cookout at one of the member's homes. You'll also want to proudly voice your accomplishment: write a letter to the editor, post a marquee on your agency's (or someone else's!) sign, or create a display for a public space.

Recognize the people who helped. Hold an event in their honor or just send a "thank-you."

Plan to revise the plan. Plans are often written with a certain time frame in mind. Three to five years seems to be as much of our lives as we want to envision being tied up in a project. State at the end of the watershed plan when it will be revised or considered finished. This lets the community and the members know what to expect.

Planning Review – Chapter 9

Describe the indicators you selected to determine progress toward each goal of the plan. Include applicable water quality standards. Select interim, measurable milestones as well as final achievement indicators. Include criteria to determine if load reductions are being achieved.

- □ Where applicable, select indicators that will show change in the aquatic ecosystem, such as benthic macroinvertebrate indices, fish community indices, or habitat evaluations.

- □ If water quality standards or water quality targets are used in your goals, review state water quality criteria and select indicators that will show when water quality has been restored.

- □ "Interim, measurable milestones" are criteria levels such as concentration of total phosphorus or dissolved oxygen that can be measured to show how the system is moving toward restoration. The object is to measure continuous change, rather than waiting five years and then finding out whether anything happened. This is why it is important to establish networks of volunteer monitors or permanent monitoring stations in your watershed. Evaluating the rate of change that is occurring will assist in modifying the plan.

- □ For specific load reductions that have been estimated, monitor the parameters (sediment yield, TSS, pesticides, etc.) that will allow you to calculate actual pollutant loads. This may require sampling above and below sites where practices are being installed, or comparing data from similar tributaries. The object is to see whether the estimated load reductions are in fact occurring.

Describe how indicators will be monitored to evaluate the effectiveness of implementation efforts. When water quality standards and criteria are selected as indicators, describe how water quality will be monitored. Monitoring for other goals may include spot-checking, landowner participation, adoption of practices, or other measurements.

- □ Describe the sampling methods, sample sites, sampling frequency, and analysis methods.

- □ For indicators other than water quality (such as rate of conservation tillage adoption, miles of riparian forest, or indicators of behavior change) describe the measuring methods, including how the location of practices or improvements will be recorded.

- □ Discuss follow-up for installed practices, and who is responsible for maintenance.

- □ Decide when the watershed plan will be re-evaluated, who will do it, and who is responsible for revisions or adaptations to the plan. What will happen if a TMDL is completed or revised?

- □ Check with IDEM to find out if a TMDL is scheduled for your watershed. If feasible, integrate sampling and load reductions into TMDL program activities.

Chapter 10: Where Do We Go From Here?

Sustaining the Effort

Projects tend to sag a little after the watershed plan is written and accepted by the community. It was a lot of work to get this far! Loss of energy can be the result of having to wait for implementation funding, uncertainty about who's responsible for what, and the natural tendency of folks to drift away after putting in one or two years of effort on one thing.

To avoid too much of an energy crisis, schedule some event or activity that's due to occur two to three months after the plan is completed. This could be a kickoff event for one of the programs or measures in the plan, a river cleanup, or the beginning of a new round of sampling. Try to inject some fun into the event and open it to as many interested parties as you can.

Remember that people show up for things when they know what they are expected to do…and there needs to be something for them to do! Try to engage people in *finite* tasks; let them know how long the task will last and what they are contributing by joining in. There's a big difference between "We need someone to market the buffer program in the Mudpuppy watershed" and "Joe, would you visit with the McCoy brothers and Ted McCaskill about the buffer program before next Thursday, and call me back to let me know what they said? Here's a brochure you can give them that has all the program information." The first option is likely to send Joe running out the door because it sounds big and open-ended. The second option is pretty doable, and Joe will probably agree.

Use all the techniques for keeping people engaged that were suggested for forming groups in the beginning. Communicate regularly with the group and with the community so the project doesn't sink out of sight. While monthly meetings are probably no longer required, there still need to be a few regular events during the year that get people together to talk and share information. Lastly, don't neglect that annual plan evaluation.

Significance of Having a Plan

What does it mean to be a community that has a watershed plan? Aside from pride in the accomplishment, the benefits include:

- **Ability to apply for funding:** Section 319 funds require a plan for implementation eligibility. Foundations and other funding sources will want to see the plan as proof that you are organized and know what you are doing. And, having all your facts in one document will make the act of filling out the forms much easier.
- **Continuity:** When key people move on or fall away from the project, those who take their place will be able to get up to speed by reading the plan. Also, while the plan will adapt to change over time, the original goals will not be lost when new people enter the project, since the will of the community is recorded in the plan.
- **Seeing progress:** Before the plan was written, programs may have been implemented willy-nilly in the watershed. By focusing your efforts in key locations, progress can be measured and assessed. The community can learn what works and what doesn't, how long it really takes to get things done, and how much things cost.
- **Agency assistance:** The plan makes it clear to agencies what the community wants to accomplish. Agencies can then tell you what programs they offer that may help fulfill goals. Help may be more forthcoming, too, since everything is written down and they can be sure of what the community wants.

The Plan as a Set of Silver Spurs

Having written a plan, the sponsors and volunteers who were involved can't easily ignore what it says. After all this effort, it would be awful to let the document gather dust, and if it's a good plan that is not likely. Remember that the plan is not an end in itself! Your whole purpose in writing it was to create change, so the sponsors, movers, shakers and leaders in the community need to accept responsibility for implementing it. Don't let the plan sink into obscurity.

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning Branch

WATERSHED MANAGEMENT PLAN

CHECKLIST INSTRUCTIONS

June 2009

This Appendix lists the requirements for the completion of a watershed management plan that will meet U.S. EPA's Nine Key Elements and IDEM's Watershed Management Plan Checklist. Plans developed following these criteria can be submitted to IDEM for review and if approved, can be used to develop implementation plans for on-the-ground watershed improvement work.

Click the link above to go to the electronic version that is on the IDEM website at:

www.IN.gov/idem/files/319_wmp_checklist_2009.doc

Appendix B - Funding Matrix

Want to get started working in your watershed to improve water quality?

There are numerous grants and other funding sources available to help you get your project moving. This Appendix contains internet links that summarize sources, and gives information on eligibility, funding deadlines, and important contact information.

You can get this information from IDEM Watershed Specialists Funding Matrix [XLS] .

Click the link above to go to the electronic version that is on the IDEM website at:

www.IN.gov/idem/nps/files/watershed_funding_matrix.xls .

The U.S. EPA also offers a searchable index of funding sources, at http://cfpub.epa.gov/fedfund/ .

Appendix C - Agencies and Organizations Directory

Below are the principal agencies and organizations that can assist with watershed protection and restoration in Indiana.

	IASWCD	IDNR	IDEM	SWCDs
	Indiana Association of Soil and Water Conservation Districts	**Indiana Department of Natural Resources**	**Indiana Department of Environmental Management – Office of Water Quality**	**Soil and Water Conservation Districts**
Reason for existing	Not for profit organization representing 92 SWCDs	State legislation, relationship with SWCDs, fish and wildlife management	Clean Water Act, state legislation, rules and standards, delegations from U.S. EPA	State legislation
Who is served	SWCDs	Private landowners, local and state government, partner agencies	Citizens of Indiana	Landowners and other citizens in their county
What the agency does	Provide coordination, education, and a unified voice for 92 SWCDs in statewide and national advocacy of resource management issues	Provide technical and financial assistance to conserve and manage fish and wildlife, streams and lakes, and woodlands	IDEM Offices of Water, Land, and Air Quality enforce laws and standards; promulgate regulation; promote pollution prevention; and provide monetary grants for projects.	Identify local natural resource issues; serve as point of contact for technical, financial, and educational assistance to landowners and citizens to address those issues.
Funding	Dues from SWCDs and grants	State funds, fees and revenue diversions	State funds, Clean Water Act funds, permit fees and fines	State funds, local county budgets, grants
Structure	Office in Indianapolis	County field offices; state office	Four regional offices and state office	County offices
Who agency reports to	To SWCDs	To governor and Indiana State Legislature	To governor, Indiana State Legislature and U.S. EPA	To landowners in the county and county government
Expertise, services and products	Articulate conservation needs to local, state, and federal decision makers; build relationships with agencies and organizations that provide conservation assistance; provide tools to SWCDs to use in promoting their services; coordinate training and educational opportunities for SWCD supervisors, employees, and members of the Indiana Conservation Partnership.	Various divisions provide technical guidance for management, conservation and protection of lakes, streams, woodlands, fish and wildlife, and urban and agricultural lands. The department provides technical, educational and financial assistance for agriculturally-focused "watershed land treatment" projects that effectuate watershed management, and also provides administrative guidance to SWCD leaders and staff.	OWQ Watershed Management Section administers the Clean Water Act Section 319 Nonpoint Source (NPS) Program (federal funding for NPS assessment, prevention, education, and restoration); promotes watershed management through education, information transfer, and technical assistance.	Develop and deliver environmental education programs; through partnerships with NRCS and IDNR, enable private lands conservation assistance; promote cost-share and incentive programs to private landowners; assist local government with natural resource conservation.
Contacts	Jennifer Boyle Warner Executive Director Jennifer-boyle@iaswcd.org (317) 692-7374 225 S. East Street Suite 740 Indianapolis, IN 46206 www.iaswcd.org	Division of Fish and Wildlife 402 W. Washington Street Room W265 Indianapolis, IN 46204-2739 (317) 232-4200 FAX (317) 233-3882 www.IN.gov/dnr	Andrew Pelloso NPS/TMDL Section Chief (317) 308-3178 apelloso@idem.in.gov Hotline (800) 451-6027 Watershed information: www.IN.gov/idem/4342.htm	Each county in Indiana elects a soil and water conservation district board of supervisors. Contact information for county SWCD offices can be found in the Soil and Water Conservation Districts Online Directory at www.IN.gov/isda/2408.htm or in your local telephone directory.

	NRCS	Purdue Extension	U.S. EPA
	U.S. Department of Agriculture – Natural Resources Conservation Service	**Purdue University – Cooperative Extension Service**	**United States Environmental Protection Agency**
Reason for existing	Federal conservation legislation, links with local SWCDs, and other agricultural and "Farm Bill" legislation	Land Grant University legislation to make research and education available to all state citizens.	Clean Water Act, Clean Air Act and other legislation
Who is served	Private landowners; groups and organizations; communities; local, state and federal governments; SWCDs; partner agencies	All residents and businesses of Indiana, local government, partner agencies	Congress, the states
What the agency does	Provide technical and financial assistance to landowners and local government to conserve natural resources. For program information: www.in.nrcs.usda.gov/programs/. For technical information: www.in.nrcs.usda.gov/technical/.	Provide educational information related to agricultural and natural resources needs. Assist individuals, groups, communities, and local and state government in developing and carrying out programs in agriculture, community, youth and business development.	Administers and enforces regulations requiring states to carry out programs and issue permits related to Clean Water Act, Clean Air Act and other acts. Administers some permit programs directly.
Funding	U.S. Department of Agriculture appropriations bill, Commodity Credit Corporation funds	A "cooperative" effort of federal, state and county funds; grants	Congressional appropriation
Structure	County USDA service center field offices and multi-county workteam offices, as well as state and regional offices; research and development centers and institutes; plant materials centers; and national office in Washington, D.C.	State offices, county offices, research and education teams, cooperative agreements with other agencies and organizations. Water quality "Common Interest Group" focuses water quality efforts.	Headquarters and 10 regional offices. Indiana is in Region 5, administered from Chicago.
Who agency reports to	To Congress	To state legislature, county government, USDA, and the citizens of Indiana	To Congress
Expertise, services and products	Soil and water conservation planning and technical assistance including soils, agronomy, biology, engineering, etc. for soil erosion control, water quality, nutrient management and pest management, and grazing land management; wetland determination, wildlife habitat and wetland restoration. NRCS administers USDA programs for private land conservation (Environmental Quality Incentives Program, Wildlife Habitat Incentives Program, Forestry Incentives Program and others)	Education, training, leadership development, and delivery of agricultural and natural resource programs to citizens and local governments. Assistance for farmers (*e.g.,* farm profitability, nutrient and pest management, Farm*A*Syst assessment program) and local government (*e.g.,* land use, fiscal impacts, feasibility studies). Serve on the area plan commission in most counties. Disseminate research findings to clientele. Provides watershed training via the Indiana Watershed Leadership Academy.	Passes grant moneys through to the states to assist in implementing some required programs such as Sections 319, 104(b)(3), 205(j), and 106. Promulgates rules to carry out legislation passed by Congress. Develops criteria for the states to use in establishing water quality and air quality standards.
Contacts	State Office: (317) 290-3200 Conservation Programs in Indiana: www.in.nrcs.usda.gov/programs Technical Resources: www.in.nrcs.usda.gov/technical Field Staff (district conservationists): www.in.nrcs.usda.gov/contact/directory/field_offices.html	County offices: www.ag.purdue.edu/Extension/Pages/Counties.aspx State contacts for water quality: Jane Frankenberger., Extension Water Quality Coordinator frankenb@purdue.edu or (765) 494-1194 Laura Esman Water Quality Program lesman@purdue.edu (765) 496-6331 www.ecn.purdue.edu/SafeWater	Region 5, Chicago: (800) 621-8431 Region 5 – Water: www.epa.gov/region5/water/ Wetlands, Oceans and Watersheds: www.epa.gov/owow/

Appendix D - Resources

General

Gateway to the National Extension Water Quality Database
http://wateroutreach.uwex.edu/education/search.cfm

NEMO
Nonpoint Education for Municipal Officials is a program targeted toward developing environmentally conscious land use plans and ordinances in growing urban areas. http://nemo.uconn.edu/

National Library for the Environment
(hosted by the National Council for Science and the Environment)
www.ncseonline.org/index.cfm?& CFID=7785776&CFTOKEN=61866334

Building Working Groups

Program Organizing Guide
Whether organizing a new program or evaluating an existing program, this manual takes you through 11 steps to help organize successful programs in just 24 pages. The cost is $10.00 plus shipping and handling. Call River Network at (503) 241-3506 for more information. https://rivernetwork.org/marketplace

U.S. EPA's Capacity Building Resources Web site for Watershed and Restoration Projects
(a full toolkit) www.epa.gov/owow/nps/capacity/index.htm

Meetings and Ground Rules

Basic guide to conducting meetings www.mapnp.org/library/misc/mtgmgmnt.htm#anchor639767

One of a set of modules on reaching consensus http://www.sustainability.uconn.edu/index.html

Social Sciences Team Publications
This Web page includes helpful factsheets on running meetings, running public meetings, conflict resolution, community listening, focus groups, and any other social skill you might need.
www.ssi.nrcs.usda.gov/publications

Outreach and Education

U.S. EPA NPS Pollution Outreach Web site www.epa.gov/owow/nps/outreach.html

Getting in Step: A Guide for Conducting Watershed Outreach Campaigns
This revised and updated guide provides the tools needed to effectively identify, engage, and involve stakeholders throughout a watershed to restore and maintain healthy environmental conditions. Key concepts highlighted in the guide include the following:

- Identifying driving forces
- Forming a stakeholder group
- Differentiating between positions and needs
- Keeping the process moving forward
- Dealing with conflict and hidden agendas
- Making decisions using a consensus-based approach

For an online training module built around this book, visit U.S. EPA's Web site at www.epa.gov/watertrain/gettinginstep/. To download the guidebook, visit the Web at www.epa.gov/owow/watershed/outreach/documents/getnstep.pdf.

Great Web Sites to Study

Smithsonian Environmental Research Center
This site features a talking "radio duck" giving reports on the Chesapeake Bay.
www.serc.si.edu/education/

Water Resources Education Network (based in Pennsylvania)
http://palwv.org/wren/pubs/pubshed.html

Ohio Watershed Academy's outreach module
http://ohiowatersheds.osu.edu/owa/library/libmod11.html

Good education ideas from Santa Barbara County, California
http://www.sbprojectcleanwater.org

Community education approach used by Connecticut http://www.sustainability.uconn.edu/index.html

Technical Information on Monitoring

Basic overview
Visit U.S. EPA's monitoring site at www.epa.gov/owow/monitoring/

Designing Your Monitoring Program
http://www.portal.state.pa.us/portal/server.pt?open=514&objID=554209&mode=2

Study Design Workbook
This 39-page workbook covers decision making during the monitoring process. It provides guidance in selecting water quality indicators, methods and locations; participants; schedules and quality assurance programs. The cost is $10.00 plus shipping and handling. Call River Network at (503) 241-3506 to order.
https://rivernetwork.org/marketplace/

Indicators

Measuring community sustainability
(This site suggests many interesting indicators.)
http://ncrcrd.org/LinkClick.aspx?fileticket=hkoHxss/CTI=&tabid=87

Indicators selected for measuring the health of the Great Lakes ecosystems
www.on.ec.gc.ca/solec/indicators2000-e.html

Environmental Indicators for Agriculture
http://www.oecd.org/document/28/0,3343,en_2649_33793_39681244_1_1_1_1,00.html

Analysis

Seeing the Big Picture
Conservationists working with an individual landowner need to be familiar with the larger landscape where the farm is located; like a hawk on an updraft, they need to "see" the farm fields in the context of land uses all around the farm, perhaps even miles away. In the same way, a watershed plan for 9,000 or 75,000 acres also fits into a larger landscape, and many land uses and ecological niches are interwoven within the watershed. How can we grasp some of the intricacies of these landscapes without drowning in details?

These three references can help you gain perspective:

Conservation Corridor Planning at the Landscape Level – Managing for Wildlife Habitat
(published by NRCS, 8/1999)
Written primarily as a wildlife habitat planning tool, this document has a lot to offer watershed planning as well. It looks at linkage of corridors and habitat as a way to gain sustainability in a landscape. Since streams and rivers are also corridors, much of the material applies whether wildlife is one of your concerns or not. Through case studies and discussion of design principles, the manual leads to a better understanding of why the riparian areas of your watershed are so important to the health of the whole system. The handbook is available at the NRCS Agricultural Wildlife Conservation Center Web site.

Understanding the Landscape
(published by NRCS, Colorado State University and Oregon State University, 9/2002)
The NRCS Wildlife Habitat Management Institute developed this course in conjunction with the NRCS Soil Quality Institute, Colorado State University and Oregon State University to help conservationists and land managers understand the connectivity of ecological processes in order to apply resource management principles on managed lands in a more holistic and sustainable manner. Through a series of 3 DVDs—12 lectures and 5 case studies—you will be introduced to the components of land management at a landscape scale. There is a huge amount of information, but the format makes it possible to pull out parts of the material and use them independently. The five case studies, shown with extensive clips from local people, would each make great kick-off pieces for a steering committee diving into a planning project. The DVDs can be ordered on the Indiana NRCS Web site (click on the "Publications" link).

Stream Corridor Restoration Handbook
(published by the Federal Interagency Stream Corridor Restoration Working Group, 10/1998)
All the technical and scientific information that was not included in this guide—from geomorphology and hydrology to indicators and restoration design—is included in the Stream Corridor Restoration Handbook. Much of the information may be complex because of its technical nature, but there is something here for everyone, from the lay person to the consultant. The most important thing you may gain from using it is an understanding of when stream bank stabilization is feasible and when it's better to leave well enough alone (and use the dollars toward some better purpose). The handbook is available on the Web at http://www.nrcs.usda.gov/technical/stream_restoration/.

Practices and Measures

NRCS Electronic Field Office Technical Guides
(Read the intro, and then go to the section on practices and standards to become familiar with BMPs, primarily for agriculture.)
http://efotg.nrcs.usda.gov

Other BMP Sites

Measures for Stormwater Phase II implementation
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

Best Management Practices for Pork Production
www.epa.state.il.us/p2/fact-sheets/hog-facts.html

Sustainable Agriculture Virtual Library
www.floridaplants.com/best.htm

Forestry BMPs
www.fnr.purdue.edu/inwood/past%20issues/WhatisaForestryBMP.htm

More agriculture BMPs
www.epa.gov/agriculture/tpol.html

Appendix E - Glossary of Acronyms and Terms

Acronyms

303(d)	The specific list of waters that are impaired and require a total maximum daily load (TMDL) report to be developed; state
305(b)	State water quality reports; state
319	Section 319 of the Clean Water Act (also provides funding associated with Sections 104 and 205j); federal, through IDEM
ATSDR	Agency for Toxic Substances and Disease Registry; federal
BIA	Bureau of Indian Affairs; federal
BLM	Bureau of Land Management; federal
BMPs	Best Management Practices; term
CES	Cooperative Extension Service; state
CEQ	Council on Environmental Quality; federal
CRP	Conservation Reserve Program; program of NRCS
CSO	Combined Sewer Overflow; term
CTIC	Conservation Technology Information Center; private
CWA	Clean Water Act; federal
CZARA	Coastal Zone Administration and Remediation Act; federal
DC	District Conservationist (of NRCS); federal employees
DI or DOI or USDI	U.S. Department of the Interior; federal
EQIP	Environmental Quality Incentive Program; program of NRCS
FOTG	Field Office Technical Guide; NRCS manual
FSA	Farm Service Agency; federal

FWS	U.S. Fish and Wildlife Service; federal
GIS	Geographic Information System; term
GPS	Global Positioning System; term
HEC	Hoosier Environmental Council; private
HUC	Hydrologic Unit Code; term
IACT	Indiana Association of Cities and Towns; private
IASWCD	Indiana Association of Soil and Water Conservation Districts; private
IBI	Index of Biotic Integrity (Fish Community), term
IDEM	Indiana Department of Environmental Management; state
IDNR	Indiana Department of Natural Resources; state
IFA	Indiana Finance Authority; state
IFB	Indiana Farm Bureau; private
ISDA	Indiana State Department of Agriculture; state
ISDH	Indiana State Department of Health; state
IWPG	Indiana Watershed Planning Guide; state publication
LTHIA	Long-Term Hydrologic Impact Assessment; analysis tool
LARE	Lake and River Enhancement; program of IDNR
MACOG	Michigan Area Council of Governments; public
MIBI	Macroinvertebrate Index of Biotic Integrity; term
MRBC	Maumee River Basin Commission; quasi-public
NACD	National Association of Conservation Districts; private
NEPA	National Environmental Protection Act; federal

NGO	Nongovernmental Organization; term for private organization
NOAA	National Oceanic and Atmospheric Administration; federal
NPDES	National Pollutant Discharge Elimination System; federal
NPS	National Park Service; federal
NPS	Nonpoint Source; term
NRCS	Natural Resources Conservation Service; federal
NAWQA	National Water Quality Assessment; report and federal program
OISC	Office of Indiana State Chemist; state
ORSANCO	Ohio River Sanitary Commission; quasi-federal
OSM	Office of Surface Mining Reclamation and Enforcement; federal
OWQ	Office of Water Quality (within IDEM); state
QAPP	Quality Assurance Project Plan; term
QHEI	Qualitative Habitat Evaluation Index; term
RC&D	Resource Conservation and Development (program of NRCS); federal/private
RD	Rural Development (within USDA); federal
RRA	Rapid Resource Appraisal; term
RUSLE	Revised Universal Soil Loss Equation; equation
SHPO	State Historic Preservation Office; state
SJRBC	St. Joseph River Basin Commission; quasi-public
SPEA	School of Public and Environmental Affairs (Indiana University); state
SRF	State Revolving Fund; loan program of IFA (monies are federal, passed through the state)

SWAT	Soil and Water Assessment Tool; model
SWCD	Soil and Water Conservation District; state
TMDL	Total Maximum Daily Load; term
TNC	The Nature Conservancy; private
TSS	Total Suspended Solids; term
TVA	Tennessee Valley Authority; federal/private
USACE	U.S. Army Corps of Engineers; federal
USDA	U.S. Department of Agriculture; federal
U.S. EPA	U.S. Environmental Protection Agency; federal
USGS	U.S. Geological Survey; federal
WATER Committee	Watershed Agency Team for Enhancing Resources; former multi-agency group that acted as a forum for watershed issues
WEPP	Water Erosion Prediction Project; model
WQ	Water Quality; term
WRP	Wetlands Reserve Program; program of NRCS

Terms

303(d) List: The specific list of category 5 waters from the 305 (b) Report that are impaired and need restoration in order to meet state water quality standards. The 303(d) List is prepared by IDEM every two years and approved by U.S. EPA. Category 4 waters (impaired waters for which a TMDL has been written) are also impaired but are not placed on the 303(d) list.

305(b) Report: A report prepared by IDEM every two years detailing how Indiana waters compare to the state's water quality standards.

Action Plan: A chart or some other tool used by an entity to guide the implementation of its goals. Action plans organize and display goals, objectives, responsible parties, milestones, and any other information the entity chooses.

Best Management Practice (BMP): Structural and management practices used in agriculture, forestry, urban land development, and industry to reduce the potential for damage to natural resources from human activities.

Cause: An event, agent, or series of actions that produces a problem. Causes of water quality problems are usually identified as a specific pollutant parameter. Sometimes causes and problems are identical.

Concentration: A measure of how much of a given substance is mixed with another. In the watershed world, a concentration is usually how much of a pollutant is mixed with water and is typically expressed as milligrams of pollutant per liter of water (mg/L).

Concern: An issue or topic that a stakeholder believes is relevant to the watershed. All concerns need to be documented and, through the planning process, the steering committee will decide which concerns are related to actual problems, which concerns are not actual problems, and which are outside the scope of their project. Sometimes concerns and problems are identical.

Consensus: A collective opinion arrived at by a group of people working together under conditions that permit open communication and a supportive climate, so that everyone in the group feels they have had their fair chance to influence the decision. When a decision is made by consensus, all members understand the decision and are prepared to support it.

Critical Area: A watershed area that data shows should be a focus of restoration efforts or designated for protection due to its relative high quality when compared to the rest of the watershed.

Desktop Survey: A method of collecting watershed field information using desktop tools such as maps, existing reports and plans, GIS, mapping software such as Google Maps and Google Earth, and the Internet. The purpose of the desktop survey is to help describe and quantify information pertaining to stakeholder concerns. Examples of collected information may include: miles of unbuffered streams, number of animal operations, location of combined sewer overflows, and location of dams and other hydromodifications. Often, a desktop survey will be combined with a windshield survey, the general knowledge of a steering committee, and other data sources to help describe and quantify watershed characteristics. Desktop surveys are referred to as a "Tier One" collection method in the Watershed Inventory Workbook for Indiana.

Embeddedness: The "degree to which fine sediments surround course substrates on the surface of a streambed" (Sylte, T.L. and Fischenich, J.C., 2002).

Eutrophication: Excessive nutrients in a lake or other body of water, usually caused by run-off of nutrients (animal waste, fertilizers, sewage) from the land, which causes a dense growth of plant life; the decomposition of the plants depletes the supply of oxygen, leading to the death of animal life.

Geographic Information System (GIS): A computer-based tool for mapping features and events. GIS technology integrates statistical analysis with the unique visual benefits offered by maps. GIS works by storing information about the world as a collection of thematic layers that can be linked together by geography. These layers are called "shapefiles" and can be downloaded for free from many different Web sites.

Goal: A specific result which an entity wants to accomplish. Within watershed management, government agencies have different requirements for how goals are structured, usually to mirror agency priorities. Most entities, public or private, would agree that a good goal answers how much improvement is sought, how long it will reasonably take, and how improvement will be measured.

Hydrologic Unit Code (HUC): A watershed designation system created by the U.S. Geological Survey (USGS) to identify each drainage basin in the United States from largest to smallest. USGS uses a series of digits to label each HUC— the smaller the watershed, the more digits in the HUC number.

Hydromodifications: Activities that change a waterbody's physical structure as well as its natural function. Examples include (1) siting, operation, maintenance and removal of dams; (2) draining/filling wetlands for urbanization, agricultural practices (e.g., drainage ditches), livestock grazing, and building roads; and (3) channelization and channel modification undertaken for flood control (e.g., levees or flood walls), navigation, drainage improvement and reduction of channel migration potential. Hydromodification is one of the leading sources of impairment in streams, lakes, estuaries, aquifers, and other waterbodies in the United States. It can cause problems such as changes in flow, increased sedimentation, higher water temperature, lower dissolved oxygen, degradation of aquatic habitat structure, loss of fish and other aquatic populations, and decreased water quality.

Index: A list of metrics that relate a measurement to a level of quality. Numerous indices (the plural of index) have been developed to help assess the health or quality of biological systems. Indices allow valid comparisons from one place to another and from one time to another. Common watershed indices include the mIBI and QHEI.

Indicator: A parameter or criteria that can be measured to determine whether substantial progress is being made towards achieving a goal. There are many different types of indicators, each designed to measure a specific type of goal. The most common watershed indicators are "administrative," "environmental" and "social."

Load: The mass or weight of pollutant transported at a specific point in a stream over a specific length of time. Loads are calculated by multiplying pollutant concentration by stream flow and are typically expressed as pounds or tons of pollutant per year. Either the unit of weight or length of time may be changed to a different unit through additional calculation.

Measure: Another word for "objective" or "task."

Metric: A measurement or a thing that is measured. Common watershed metrics include water quality, macroinvertebrate habitat, and land use.

Milestone: A defined point in a plan or process that is used to determine whether progress is being made and whether the process is running on schedule.

Mission Statement: A short but complete description of the overall purpose and intentions of an organization. It states what is to be achieved, but not how this should be done.

Municipal Separate Storm Sewer System (MS4): A conveyance or system of conveyances (sewers, roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, storm drains) that is usually owned or operated by a city, county, or association. Population areas of a certain size must have an IDEM-approved MS4 plan that details, through six different measures, how storm water pollution will be minimized within the MS4 area.

Nonpoint Source (NPS) Pollution: The pollution of ground and surface water that result from the variety of ways that humans use the land. Unlike pollution from factories and sewage treatment plants ("point sources"), NPS pollution comes from widespread sources and typically enters waterways through the movement of storm water (run-off).

Objective: Specific and focused strategies that, if achieved, will help a project achieve its goals. Examples of objectives include installing BMPs, completing measures, securing funding, and organizing a volunteer base.

Planning: An orderly, logical process by which a diverse group of people can reach defensible decisions based on objective data. Done right, planning prevents jumping from the problem directly to the solution without facing reality along the way. In the case of watershed planning, planning also means recording the decisions made by the group, along with enough information that the community at large can understand what the group is doing and why they are doing it.

Point Source: A single identifiable localized source of pollution. Point sources of water pollution are often factories or municipal wastewater treatment plants.

Problem: An issue that exists due to one or more concerns. Problems build on concerns by formally stating a condition or action that needs to be changed, improved, or investigated further. Sometimes concerns and problems are identical.

Quality Assurance Project Plan (QAPP): A document that describes in detail the objectives of a project and the specific procedures that will be followed to ensure the data generated will serve those objectives. Most watershed projects will have a QAPP for their water monitoring program. In this case, the QAPP will have details about how, where, and when samples are collected, how they are transported, and how they are analyzed.

Regulated Drainage Ditch: A ditch with an easement placed upon it so a municipal official (usually a county surveyor) may access the ditch for maintenance purposes. Maintenance, which usually entails clearing of channel obstructions and dredging, is financed by fees paid by local property owners. The amount of fees influences the maintenance schedule.

Retrofit: Opportunities to add a water quality benefit to an existing site, structure, or BMP. Examples of retrofits include adding a rain garden to a property, installing rain barrels at a house, or retrofitting a dry pond with wetland features.

Rule 5: A regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. The requirements of Rule 5 apply to all persons who are involved in construction activity (which includes clearing, grading, excavation, and other land-disturbing activities) that results in the disturbance of one (1) acre or more of total land area. As part of Rule 5 compliance, individuals need to submit erosion reduction plans and successfully implement those plans during construction activity.

Source: An activity, material, or structure that results in a cause of nonpoint source pollution. Sources should be described in enough detail to show the part of the watershed where they occur and, when applicable, what their magnitude is across the watershed.

Stakeholder: A person (or group) who is responsible for making or implementing a management recommendation, who will be affected by the recommendation, or who can aid or prevent its implementation.

Steering Committee: A group of stakeholders whose responsibilities are to make decisions, to plan, to broadly represent the interests and citizens in the watershed, and to maintain close ties with the sponsor, usually through representation.

Target: Another word for "goal."

Total Maximum Daily Load (TMDL): A total maximum daily load is a calculation of the maximum daily pollutant load a stream can receive and still meet water quality standards. A TMDL is calculated using data on nonpoint and point sources of pollution and includes a margin of safety. IDEM produces TMDL reports for Category 5 waters. These reports include information on the watershed and potential sources.

Vision Statement: A statement about what the future will look like, if all your problems can be solved.

Watershed: Area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or ground water - organized by USGS. Depending on the scale of the discussion, you could refer to the watershed of the Mississippi River, or the watershed of a farm pond. You may hear terms such as "river basin" or "drainage" used interchangeably with "watershed."

Watershed Inventory: A comprehensive inventory that quantifies, describes, and summarizes available monitoring and other watershed data. The goal of the watershed inventory is to discover the true current conditions of the watershed and clearly identify the link between stakeholder concerns and those watershed conditions by compiling and examining available data and deciding which of the stakeholder concerns are supported by the data, unsupported by the data, or outside the project's scope.

Windshield Survey: A method of collecting watershed field information by driving around the watershed (or parts of it) and observing areas or practices of concern. The purpose of the windshield survey is to describe and quantify information pertaining to stakeholder concerns. Examples of collected information may include: miles of unbuffered streams, number of animal operations, location of combined sewer overflows, and location of dams and other hydromodifications. Often, a windshield survey will be combined with a desktop survey, the general knowledge of a steering committee, and other data sources to help describe and quantify watershed characteristics. Windshield surveys are referred to as a "Tier Two" collection method in the Watershed Inventory Workbook for Indiana.

Appendix F - Index

Appendix G - Map of 8-Digit Hydrologic Unit Code Areas in Indiana