A Guide to Understanding the Hydrologic Condition
of Wisconsin’s Lake Superior Watersheds

prepared for
Wisconsin Lake Superior Basin Partner Team

with funding from
Great Lakes Commission – Great Lakes Basin program for Soil Erosion & Sediment Control
Ashland, Bayfield, Douglas & Iron County Land Conservation Committees
University of Wisconsin Extension Service Basin Education Program
University of Wisconsin Sea Grant
United States Department of Agriculture Forest Service

with
Grant Oversight Committee and Technical Work Group

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Project Overview

The Lake Superior Basin Partner Team developed a watershed health strategy aimed at slowing the flow in the Lake Superior Basin. The focus of the strategy was to develop a model watershed management guidance that would be promoted across the entire basin. To aid in developing the guidance, the group selected a pilot area from the Wisconsin portion of the basin to try out the approach, determine the best information sources, and identify important features that may be common throughout the basin, as well as assessing the hydrologic condition of the pilot area. The pilot report, *Assessing the Hydrologic Condition of the Marengo River Watershed*, outlines the steps taken to assess the hydrologic condition of the pilot area, provides information about the hydrologic condition of the pilot area, and companions this *Guide to Understanding the Hydrologic Condition of Wisconsin’s Lake Superior Watersheds*. 
A Guide to Understanding the Hydrologic Condition of Wisconsin’s Lake Superior Watersheds

**Watershed** – the land that drains to a particular lake or stream

Most of the time, watersheds cross many political boundaries, sometimes making management quite complicated. Here, the watershed boundaries cross county lines as well as several township lines.

Marengo River Watershed Basemap
Community GIS, Inc. / Stable Solutions LLC

◆ Introduction

Watersheds come in many scales – from the area that drains to a little stream, to the over 49,000-square-mile watershed of Lake Superior itself. Watersheds connect what happens on the land to the quality and quantity of water in rivers, streams, lakes, wetlands, and within the ground (groundwater). A large watershed, such as Lake Superior’s, is often called a basin.

In the Lake Superior region, we value our clean water, farms and forests, and communities founded on the wealth of natural resources. Lake Superior, its coastal wetlands, and its tributary streams are vitally connected.

What’s the Problem?

Our watersheds are surprisingly fragile and streams show the effects of land changes over the last hundred or so years. The streams have changed shape and character and carry a heavy load of sand and sediment. Some streams support fewer or different kinds of fish.

Water quickly runs off the clay soils in Wisconsin’s Lake Superior basin. To some extent, high erosion in this area is natural. But land use changes and wetland draining have increased the volumes and rate that water runs off the land from rainfall and snowmelt. The result is flooding, erosion, and sedimentation – the leading cause of water quality and habitat impairment in the Lake Superior watershed.

Have you ever noticed eroding bluffs and stream banks along our rivers and streams? The sand and sediment from this erosion can smother fish habitat, change the stream channel, and build up at the river mouth. Have you experienced washed out roads or flooding? All are symptoms of the watershed problems in our region. A Wisconsin study of Fish Creek concluded that flooding doubled and sedimentation increased five fold after the clear-cutting, fires and intense farming following the turn of the twentieth century. One hundred years later, we know more about best management practices in forestry and farming, forests have re-grown, and sedimentation is slowing down – it is still, however two times higher than in pre-settlement times.

Sand and Clay delivered DAILY into Lake Superior and its Bays:

<table>
<thead>
<tr>
<th>By Fish Creek:</th>
<th>2 dump truck loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>By the Nemadji River:</td>
<td>23 dump truck loads</td>
</tr>
<tr>
<td>By the Bad River:</td>
<td>50 dump truck loads</td>
</tr>
</tbody>
</table>

What’s the Problem? _________________________________________________________________________________________________________________________________________________
Assessing Your Watershed’s Hydrologic Condition

Watershed planning, starting with hydrologic condition assessment is a way for citizens, local governments, and natural resource agencies to work together to protect the resources we value. A watershed often crosses jurisdictions, so watershed planning complements but doesn’t replace Town and County plans.

A very important step in watershed planning, particularly in the Lake Superior basin, is a hydrologic condition assessment. An understanding of a watershed’s hydrology tells us about the circulation and movement of water, including how much water, when it flows, and how fast it moves. More specifically, it tells us how land management practices affect the quantity, quality, timing, and velocity of water runoff and flow throughout a watershed. This assessment can help you make land management decisions during a watershed planning process.

How Does Hydrologic Condition Assessment Fit Into a Watershed Plan?

Ideally it is the first step, so a group looks at how climate and the land combine to influence the water flow—quantity, quality and timing throughout the watershed. It evaluates what options could improve habitat, lessen flooding, erosion, and sedimentation. Armed with this information, citizens can develop a vision of what they want their watershed to look like; and conversely what they don’t want in their watershed. In watershed planning, groups would examine other issues beyond the watershed’s hydrology.

These issues would include an inventory of special natural resources, and an examination of pollution and its sources in the watershed. A watershed plan should look at future changes in land use or development patterns. The idea of watershed planning is to work toward a legacy for our children and grandchildren.

Watershed Planning & Implementation Process

1. Build Partnerships
2. Characterize the Watershed
3. Finalize Goals and Identify Solutions
4. Design an Implementation Program
5. Implement Watershed Plan – take actions!
6. Measure Progress & Make Adjustments

Hydrologic Assessment is an important part of characterizing the watershed and identifying causes and sources of pollution for the Lake Superior basin.

Natural Resource Inventory is another important part of characterizing the watershed for planning.

Sand from high runoff events and land use changes, piles up in Lake Superior’s South Shore streams.
Many groups throughout the Lake Superior basin are taking a keen interest in their watershed. A group of government, nonprofit, industry and citizen representatives called the Wisconsin Lake Superior Basin Partner Team developed this guide to help groups in the basin assess hydrologic condition because it is an important step in watershed planning.

This guide organizes a step-by-step process, from putting together a workgroup, finding watershed information, creating maps and rating features to making conclusions about what you found. It is based on the United State’s Department of Agriculture and United State’s Department of the Interior’s Framework for Analyzing the Hydrologic Condition of Watersheds (Framework) and adapted to the unique needs of the Lake Superior Basin. This unique guide tells you specifically where to go for information in the Lake Superior Basin, how to get it, and what to do with it once you have it. Follow this guide step by step, using the tables and initial conclusions about the Wisconsin Lake Superior Basin, and you’ll be led through a hydrologic assessment process your group can understand, and more importantly learn from. The hydrologic condition assessment can help groups draw conclusions for discussion during the watershed planning process and narrows down the activities that are most affecting the timing of water, amount of water and quality as it relates to sediment in your watershed.

The Marengo River Watershed Test Case

The Team used the Framework to analyze the hydrologic condition of the Marengo River watershed in central Ashland and Bayfield Counties as a test case.

You can see examples of some of the Marengo test case results throughout this guide. The Marengo River Watershed Test Case shows the analysis of the hydrologic condition of the Marengo River watershed. By doing the test case, the Team documented where to find information, options for mapping, and how to rank and evaluate factors that affect quantity, quality, and timing of water runoff.

To Get Started with This Guide

The guide is organized into six steps:

In appendices of this guidebook (contained on the project CD) you will find templates to help you complete the six steps, the Marengo River Watershed Test Case Report, definitions, acronyms, glossary of terms, basin contacts and references.

Now, call your friends, roll up your sleeves, and get to work!
Once you’ve decided to assess your watershed’s hydrologic condition, it is important to get the right people together to help you review and interpret the information you will collect. A good cross section of people with varied interests, expertise, and experiences makes for a good review team that reflects local knowledge.

Essential team members include people that live in the watershed, natural resource management professionals, local and tribal leaders, sports and recreation enthusiasts, agricultural producers, and other local leaders. Requirements for most members are to have the time to devote to the project and be open to diverse opinions. Special skills you may want some of the team members to possess are hydrology, soils, water, forestry, agriculture, transportation, and computer skills.

**Hydrology** – the science of understanding the properties, distribution, and circulation of water on or below the earth’s surface and in the atmosphere.
Natural resource management professionals meet early in the assessment to discuss information that will be used to assess the hydrologic condition of the Marengo River Watershed.

Steps to Assembling a Review Team

1. Decide the skills you want and who will make up the Review Team.

2. Develop a summary of the project clearly defining the reasons for the project and have a tentative timeline and level of commitment in mind.

3. Once a list is made, and you have an idea what you want to accomplish, make personal phone calls to potential participants to explain the project and solicit interest. Offer to answer questions or supply additional information.

4. Follow up phone calls with a postcard or letter announcing an informational meeting and requesting attendance. Explain the skills that you will need from workgroup members. See example of postcard in appendix.

5. Host an informational meeting and informal discussion about the project. Solicit participation in reviewing watershed information and analyzing the hydrologic condition.

6. Outline the timeline and meeting schedule for potential participants.

7. Set the first meeting date.

Suggested Skills needed for the Work Group:
- hydrology
- natural resources
- watershed resident
- town road official
- computer
- someone to record findings
- someone interested in maps
- other interested individuals.

Stakeholders at the Ashland Town Hall in Highbridge hear about the Marengo River Watershed Test Case (January 2006)


**STEP 2**

A Picture is Worth a Thousand Words –

Mapping Your Watershed

Get a bird’s eye view of your watershed is an excellent way to see relationships between land uses and features (i.e. topography, land cover, land use, etc.) in a watershed.

Maps provide this key element and help people better visualize their watershed. Maps also spur more discussion than any data sheet ever will.

**GIS**

Geographic Information Systems, commonly known as GIS, allow users to lay information over base information. For example, a base map of the watershed may include streams, roads, town and county lines, and property boundaries. A second layer may contain the outline of the watershed and within that area, soil types. GIS allows you to layer information and look specifically at the information you want to see; it also shows trends or highlights common geographical concerns.

Computers make the GIS process easier. Resource managers used to use special mapping paper overlays that you would manually use to do the same thing you can do on a computer today. Each map provides different information to help with a comprehensive evaluation of the region.

**Map Scale**

Not all maps are created equal – map scales change what you are able to see on your printed map. Scale is the relationship between the distance on the map and the distance on the ground.

What is Map Scale?

Selecting the appropriate scale depends on the size of the sheet of paper and the accurate placement of features you need to see.

Large is Small – Simply defined, scale is the relationship between distance on the map and distance on the ground. A map scale usually is given as a fraction or a ratio – 1/10,000 or 1:10,000. It means that 1 unit of measurement on the map – 1 inch or 1 centimeter – represents 10,000 of the same units on the ground. If the scale were 1:63,360, for instance, then 1 inch on the map would represent 63,360 inches, or 1 mile, on the ground (63,360 inches divided by 12 inches equals 5,280 feet, or 1 mile). The first number (map distance) is always 1. The second number (ground distance) is different for each scale; the larger the second number is, the smaller the scale of the map. “The larger the number, the smaller the scale” sounds confusing, but it is easy to understand.

For example, a map of an area 100 miles long by 100 miles wide drawn at a scale of 1:63,360 would be more than 8 feet square. To make the map a more useful size, either the scale used or the area covered must be reduced.

The most important consideration in choosing a map scale is its intended use. An engineer may need a very detailed map to locate sewer lines, underground lines and streets. A commonly used scale for this purpose is 1 inch : 600 inches (or 1 inch on the map equals 50 feet on the ground). A watershed planner, on the other hand, may need to see more area rather than more detail and would choose a 1:12,000 or 1:24,000 map scale.
You can build many maps using free information found on the web. The Wisconsin Department of Natural Resources recently made available the Surface Water Data Viewer, a map application that provides surface water resource information for Wisconsin waters that is designed for the public to use. This application will give you the minimum information you need to help develop your study of the timing, quality and quantity of water flow in your watershed.

Examples of maps that a “do it yourselfer” can produce using the WI DNR Surface Water Viewer website:
http://maps.dnr.state.wi.us/imf/dnrimf.jsp?site=SurfaceWaterViewer
### Table 2.1: Basic Map Information for do-it-yourselfers.

<table>
<thead>
<tr>
<th>Watershed Features</th>
<th>Recommended Maps</th>
<th>Where Do-It-Yourselves Can Find the Information</th>
<th>More Advanced Information for GIS “Geeks”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vegetation</td>
<td>Institute of Water Research at Michigan State University - Digital Watershed Mapper <a href="http://www.iwr.msu.edu/dw">http://www.iwr.msu.edu/dw</a></td>
<td>Finlay’s Original Pre-European Settlement Vegetation GEODISC 3.0, a Geographic Information Datashing CD-ROM produced by the Wisconsin Department of Natural Resources. To purchase a copy call the DNR/GEO GIS Datasharing Request line: (608) 264-8916.</td>
</tr>
<tr>
<td></td>
<td>Soil Map &amp; Hydrologic Soil Group Map</td>
<td></td>
<td>Data obtained from the USDA/NRCS Office in Ashland, 315 Sanborn Avenue, Su. 100, Ashland, WI 54806 (715) 682-9117</td>
</tr>
<tr>
<td></td>
<td>5th &amp; 6th Level Hydrologic Units</td>
<td></td>
<td>USDA Forest Servic(Polygon Coverage), Forest Hydrologist, Chequamegon-Nicolet National Forest 1170 S. 4th Ave, Park Falls, WI 54552 715-762-5181</td>
</tr>
<tr>
<td></td>
<td>Lakes &amp; Rivers</td>
<td>Wisconsin Department of Natural Resources <a href="http://www.dnr.state.wi.us/maps/gis/geolibrary.html">http://www.dnr.state.wi.us/maps/gis/geolibrary.html</a></td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Surface Water Quality Data &amp; Ranking Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wetlands</td>
<td>GEODISC 3.0, a Geographic Information Datashing CD-ROM produced by the Wisconsin Department of Natural Resources. To purchase a copy call the DNR/GEO GIS Datasharing Request line: (608) 264-8916.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>County, Town &amp; Municipal Boundaries</td>
<td>GEODISC 3.0, a Geographic Information Datashing CD-ROM produced by the Wisconsin Department of Natural Resources. To purchase a copy call the DNR/GEO GIS Datasharing Request line: (608) 264-8916.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Parcel Mapping</td>
<td>County Land Records Departments</td>
<td>Bayfield County Land Records <a href="http://www.bayfieldcounty.org/landrerels">http://www.bayfieldcounty.org/landrerels</a></td>
</tr>
</tbody>
</table>
A little knowledge on where to look and how to use a computer, and you can put together a set of maps or images that will help you look at your watershed as a unit, instead of in pieces. To add additional information not available on websites, your group can also bring out the colored pencils and draw in important features or information. Just remember to keep your map legend updated.

**Finding a Professional**

More detailed map information can best be assembled by professionals. The extra datasets we used for the Marengo River Pilot Project are included in Table 2.2.

Professional GIS consultants are especially beneficial if you intend to keep a running database for information about your watershed or if you have additional information you want added to your maps that can’t be found anywhere else. They can also do the work for you, leaving you time to concentrate on the results of your study.

<table>
<thead>
<tr>
<th>Table 2.2: Beyond the Basics</th>
<th><strong>More Advanced Information for GIS “Geeks”</strong></th>
<th>Limitations</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional “Nice to have” Watershed Features</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Forest Age Class Maps for the Lake Superior Basin | ABIDI-LCD  
315 Sanborn Avenue, Suite 100, PO BOX 267, Ashland, WI 54806-0267  
Phone: (715) 682-7187 | Soon to be available on the Partner Team Website  
http://basineducation.uwex.edu/lakesuperior/ | Free |
| Special Features  
(Use expertise from your Work Group to Find Special Features) | High Risk Suspended Sediment Stream Data  
Digitized by Community GIS Services from information provided by USGS & BRNRD | Available only in special reports, in some instances, you can obtain the GIS data from sponsoring agency | May be small cost for publications or databases |
| Elevation 750 – 1050 from USGS Report  
Utilized 30-meter Digital Elevation Model (DEM) data in Arcview Spatial Analyst software to derive area where elevation exists from 750 feet and 1050 feet above Mean Sea Level (MSL). | | Must digitize by hand using USGS topographic map | |
| Hydrologic Soil Group GIS Data (also available on Web Soil Survey)  
USDA NRCS  
http://soildatamart.nrcs.usda.gov/ | Soils data for Ashland County at the time of this project was not SSURGO certified. The data had to be obtained from the USDA NRCS Office in Ashland, 315 Sanborn Avenue, Su. 100, Ashland, WI 54806  
(715) 682-9117 | | |

Other Free Internet “Mapware:"

- Terraserver (some free imagery, more available with membership)  
  ([http://www.terraserver.com](http://www.terraserver.com))

- Terraserver USA (free access to maps and aerial photographs of the United States)  
  ([http://terraserver.microsoft.com](http://terraserver.microsoft.com))

- Bayfield County Land Records Department  
  ([http://www.bayfieldcounty.org/landrecords/index.htm](http://www.bayfieldcounty.org/landrecords/index.htm))

Other Tools:

- Map Scale Calculator, Bureau of Economic Geology, University of Texas – Jackson School of Geosciences  
  ([http://www.beg.utexas.edu/GIS/tools/index.html](http://www.beg.utexas.edu/GIS/tools/index.html))
Example maps produced professionally for the Marengo River Watershed Test Case

Example: High Erosion Potential Areas in the Lake Superior Basin between Elevation 750 – 1,050 feet above sea level. Utilized 30-meter Digital Elevation Model (DEM) data in Arcview Spatial Analyst software to derive area where elevation exists from 750 feet and 1,050 feet above Mean Sea Level (MSL).

Marengo River Watershed Test Case Map Series. These maps are available online at basineducation.uwex.edu/lakesuperior/watershedmgmt.htm

Marengo Watershed Basemap

Comparative Analysis Hydrologic Unit
Hydrologic Soil Group
Land Use & Land Cover
Moderate & Steep Slope
Percentage Land Ownership

All maps in .pdf format unless otherwise requested
The focus of this hydrologic assessment tool is to help local citizens understand what is happening with runoff in their watershed. The Lake Superior basin has some particular concerns: water runs off the landscape very quickly for many reasons, including the soils and topography. Rapid water runoff from rain and snowmelt erodes stream banks, cuts channel beds and causes sediment, nutrients and other pollutants to accumulate in lakes, wetlands and streams. Changes due to fast runoff harm water quality and habitat. Assessing these hydrologic characteristics can help us see where we might “slow the flow” and improve or protect watershed health.

The Framework for Analyzing the Hydrologic Condition of Watersheds is designed to help business and community leaders, local government officials, citizens and watershed management groups understand hydrologic conditions in their watersheds and identify potential causes and sources of pollution. It uses a specific framework that helps users identify the timing, quality and quantity of water in a watershed and is an important early step in developing a watershed management plan.

The process is divided into 6 steps:
1. Build Partnerships
2. Characterize the Watershed
3. Finalize Goals and Identify Solutions
4. Design an Implementation Program
5. Implement Watershed Plan – take actions!
6. Measure Progress & Make Adjustments

Determine the Runoff Questions

Finding data that will help you investigate the hydrologic condition of your watershed sounds like an overwhelming task. What’s important? How much data is enough? Where do you find the best information? These questions can literally stop the search before it starts. It helps to focus specifically on the task you want to accomplish. Ask your planning group and review team to develop a list of questions you would like answered. This list of questions will drive your search for information. Example questions for the Lake Superior basin include:

- Does farming influence water runoff? How?
• Do roads contribute increased runoff?
• Are there frequent road washouts? If so, what types of activities upstream may have contributed?
• How many acres of wetlands have been drained?
• Does groundwater contribute to river and stream flows?
• Is development increasing? If so, what type of development?
• Are logging activities occurring? If so, at what rate is it changing the forest composition?
• Are there areas where erosion and sedimentation are increasing?
• Are you losing fish habitat?
• Is your favorite duck hunting spot filled with sediment?

Save Time

Search for Information that Answers Your Questions

Once your group has determined what they need to know about the watershed, they can identify the information needed to support their decisions.

Much information is available but you may find that information you really wanted is not. Keep a list of this type of missing data to either submit to an agency or organization to address, or submit a project with your watershed group and develop the missing material on your own.

If you find yourself in the situation where information is just not available, use information from neighboring watersheds, focus on other priorities, ask different questions or collect the information on your own. You should continue to focus your search on questions you need answered.

Use What Has Already Been Done

One additional way to wisely use your time is to determine what has already been done. In pulling together your review team, you have created an invaluable source of information about watersheds, land use, and natural resources. Tap into their knowledge, locate the information that is already out there and use it!

All too often work is done and then set aside because of lack of funding or knowledge on how to proceed. This is the time to draw on all of the resources available to you to answer your watershed questions.

Organize, Organize, Organize!

All of the information available can seem a bit overwhelming, so it is helpful to organize this information into bundles:

a) Climate

Rain and snow, air temperature, evaporation and wind speed have a significant affect on any watershed. These factors can vary widely across the Lake Superior Basin and must be tempered with common sense and local knowledge of the watershed.

By itself, these pieces of information mean little; but plugged into a formula that will help you translate the rainfall and snowfall into flood flows, you have a powerful tool to assess the role climate conditions play in the health of your watershed!

Runoff of Marengo area Agricultural Field

S. Schultz, Stable Solutions LLC
### Climate

<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>WHO HAS THE INFORMATION</th>
<th>WHERE WE FOUND IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain</td>
<td>Wisconsin Climatological Office / UW Ashland Agricultural Research Station</td>
<td><a href="http://www.aos.wisc.edu/%7Esco/stations/470349.html">http://www.aos.wisc.edu/%7Esco/stations/470349.html</a></td>
</tr>
<tr>
<td></td>
<td>Wisconsin State Climatological Office</td>
<td><a href="http://www.aos.wisc.edu/%7Esco/data_links.html">http://www.aos.wisc.edu/%7Esco/data_links.html</a></td>
</tr>
<tr>
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<td>Wisconsin Climatological Office / UW Ashland Agricultural Research Station</td>
<td><a href="http://mrcc.sws.uiuc.edu/climate_midwest/historical/snow/wi/470349_ssum.html">http://mrcc.sws.uiuc.edu/climate_midwest/historical/snow/wi/470349_ssum.html</a></td>
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<tr>
<td>Wind</td>
<td>Wisconsin Climate Data</td>
<td><a href="http://www.aos.wisc.edu/%7Esco/windex.html">http://www.aos.wisc.edu/%7Esco/windex.html</a></td>
</tr>
<tr>
<td>Temperature</td>
<td>Wisconsin Climatological Office / UW Ashland Agricultural Research Station</td>
<td><a href="http://mrcc.sws.uiuc.edu/climate_midwest/historical/temp/wi/470349_tsum.html">http://mrcc.sws.uiuc.edu/climate_midwest/historical/temp/wi/470349_tsum.html</a></td>
</tr>
</tbody>
</table>

### b) Surface and Ground Water

There is little surface and ground water data for Wisconsin’s Lake Superior Basin streams. WDNR continues to monitor a limited number of streams while Tribal Natural Resources Departments, volunteers and UW-Extension have begun to collect information for many additional waters in the basin.

While this assessment process is looking at water, it is important to clarify that this process focuses on the flow, habitat quality and timing of water in a watershed.

The place to include water quality data will be during the next phase of the watershed planning process.

*Silver Creek Culvert Failure, 2003*

S. Schultz, Stable Solutions llc

*Silver Creek complete failure just 2 years later (October 2005).*
## Surface & Ground Water

<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>WHO HAS THE INFORMATION</th>
<th>WHERE WE FOUND IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed Boundaries</td>
<td>Wisconsin Department of Natural Resources</td>
<td><a href="http://www.dnr.state.wi.us/org/gmu/gmu.html">http://www.dnr.state.wi.us/org/gmu/gmu.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://www.dnr.state.wi.us/maps/gis/geolibrary.html">http://www.dnr.state.wi.us/maps/gis/geolibrary.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://www.epa.gov/surf/">http://www.epa.gov/surf/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://www.dnr.state.wi.us/org/water/data_viewer.htm">http://www.dnr.state.wi.us/org/water/data_viewer.htm</a></td>
</tr>
<tr>
<td>River channel description</td>
<td>Special reports by USGS</td>
<td>USGS reports not completed (Bad River or USGS)</td>
</tr>
<tr>
<td>Ground water movement</td>
<td>Wisconsin Ground Water Center</td>
<td><a href="http://www.uwsp.edu/cnr/gndwater/">http://www.uwsp.edu/cnr/gndwater/</a></td>
</tr>
<tr>
<td></td>
<td>Wisconsin Department of Natural Resources Drinking &amp; Ground Water Program</td>
<td><a href="http://dnr.wi.gov/org/water/dwg/index.htm">http://dnr.wi.gov/org/water/dwg/index.htm</a></td>
</tr>
<tr>
<td></td>
<td>Department of Natural Resources Habitat &amp; Fishery Tables</td>
<td><a href="http://infotrek.er.usgs.gov/wdnr_bio">http://infotrek.er.usgs.gov/wdnr_bio</a></td>
</tr>
<tr>
<td></td>
<td>Special Project Reports</td>
<td>USGS reports are available at <a href="http://infotrek.er.usgs.gov/pubs">http://infotrek.er.usgs.gov/pubs</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://groundwaterwatch.usgs.gov/StateMaps/WI.html">http://groundwaterwatch.usgs.gov/StateMaps/WI.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(<a href="http://water.usgs.gov/GIS/huc.html">http://water.usgs.gov/GIS/huc.html</a>)</td>
</tr>
<tr>
<td></td>
<td>Long-Term Hydrologic Impact Assessment Model (L-THIA)</td>
<td><a href="http://www.ecn.purdue.edu/runoff/lthianew">http://www.ecn.purdue.edu/runoff/lthianew</a></td>
</tr>
<tr>
<td></td>
<td>NRCS Technical Release 55 (TR-55)</td>
<td><a href="http://pasture.ecn.purdue.edu/~sedspec/tr55/tr0.htm">http://pasture.ecn.purdue.edu/~sedspec/tr55/tr0.htm</a></td>
</tr>
<tr>
<td>Existing Water Quality</td>
<td>Wisconsin Department of Natural Resources Surface Water Data Viewer</td>
<td><a href="http://www.dnr.state.wi.us/org/water/data_viewer.htm">http://www.dnr.state.wi.us/org/water/data_viewer.htm</a></td>
</tr>
<tr>
<td></td>
<td>Bad River Band of Lake Superior Chippewa Natural Resources Department</td>
<td>Personal contacts</td>
</tr>
<tr>
<td>Areas of known pollutants or issues</td>
<td>Wisconsin Department of Natural Resources Basin Reports</td>
<td><a href="http://www.dnr.state.wi.us/org/gmu/superior/BasinPlan/Watersheds.html">http://www.dnr.state.wi.us/org/gmu/superior/BasinPlan/Watersheds.html</a></td>
</tr>
<tr>
<td></td>
<td>Wisconsin Department of Natural Resources Surface Water Data Viewer</td>
<td><a href="http://www.dnr.state.wi.us/org/water/data_viewer.htm">http://www.dnr.state.wi.us/org/water/data_viewer.htm</a></td>
</tr>
</tbody>
</table>
c) Drainage Basin Characteristics

Drainage basin characteristics can have a major influence on the way water moves through a watershed. Some of these characteristics include the form and depth of the river channel, soil type, wetlands, physical features (i.e. hills and slopes) throughout the watershed, forest age, vegetation along the streambanks, current and past land use. All of these characteristics play a major role in the timing, quantity and quality of water moving through a watershed.

Sandy Verry, Hydrologist with the USDA Forest Service (retired), researched the relationship of the amount of open land in a watershed to the change in peak flow (bankfull flow). Verry showed that young forest (0-15 year age class) affect runoff rates in the same way that open land does. For that reason, percent open land is considered both unforested and forested land <16 years old. RESULTS: In a small watershed, with 50-60% open land, there is a marked increase in runoff rate.

Bankfull flow – maximum amount of discharge (usually measured in cubic feet/sec.) that a stream channel can carry without overflowing
Long profile reflecting geologic setting of the Marengo River Watershed in relation to the Bad River Watershed. The Marengo is a tributary to the Bad River. Channel characteristics can be seen in the photos in each geologic area: Headwaters, Transition, and Clay Plain. These types of studies help us to understand how erosion takes place and what the results are. For instance, we see levee (or streambank) building, rather than channel cutting in the clay plain area where sand deposition is occurring.

(Used with permission from USGS & BRNRD, 2006.)

Levee building as a result of sand deposition in the Marengo River. Disconnects river from floodplain creating more volume of runoff retained in river channel and subsequently higher velocity of runoff. (Used with permission from USGS & BRNRD, 2006.)

This is how we bundled information to evaluate the hydrologic condition in the Marengo River Watershed Test Case:

- Climate
- Surface & Ground Water
- Drainage Basin Characteristics
Divide & Conquer

Now, armed with a good understanding of what is needed and why, group members will be able to better draw conclusions and come to understand how timing, quality and quantity of water affects your watershed. Ask members of your REVIEW TEAM (from Step 1) to divide into 3 groups, each working on one of the bundles – climate, surface & ground water, and drainage basin characteristics; and bringing the information back to the entire group.

Roll Up Your Sleeves and Get to Work!

Identifying these key factors will help you determine how water affects your watershed – climate, surface & groundwater and drainage basin characteristics. Some of this information can be used in watershed models that can help you further understand your watershed.

Read on for more information about how Hydrologic Models can help evaluate your watershed.

Modeling Tools

A model helps you predict water movement in your watershed and can help your group run land use scenarios and determine what affect different land uses may have on your watershed. Models are tools you can use, but running models is not a necessary part of doing hydrologic assessment.

For the Marengo watershed test case, we used the National Flood Frequency Program because we were interested specifically in peak water discharge for our analysis of water movement through the watershed.

- National Flood Frequency Program
  (level of difficulty: medium)

The National Flood Frequency Program (NFF) was developed by the US Geological Survey to help assess the peak discharge of water from a watershed. Factors necessary for this model include:
- drainage area (expressed in square miles)
- watershed area (expressed in acres)
- length of the watershed (expressed in miles)
- top elevation (expressed in feet)
- bottom elevation (expressed in feet)
- slope (expressed in feet per mile)
- soil permeability (expressed in inches/hour)
- annual snowfall (expressed in inches)
- storage area (expressed in percent of watershed available for water storage [i.e. wetland area])

National Flood Frequency Program Model for the Trout Creek – Brunsweiller River subwatershed of the Marengo River Watershed.
These factors combine in the model to provide the user with a peak discharge expressed in **cubic feet (of water) per second (CFS)**. Why is this important? The amount of water passing through the lowest elevation of a watershed gives the user an idea of how fast water is running off the land and through the watershed. Watersheds can be broken down into smaller units and similar models run to help pinpoint exactly which areas of the larger watershed are causing increased runoff volumes and velocity. Once that is determined, planners can identify sources of land use issues contributing to the increases and begin to address those areas.

The NFF is available free online along with companion instructions and data sources needed to model your watershed (you will need most of the base data prior to using the model, including the watershed drainage area; watershed length; bottom and top elevation; and calculation of slope, which is the change in elevation/length of the watershed): [http://water.usgs.gov/software/nff.html](http://water.usgs.gov/software/nff.html)

**L-THIA (level of difficulty: easy)**

L-THIA stands for Long –Term Hydrologic Impact Assessment and was developed by researchers and planners at Purdue University. The assessment tool helps community planners, developers and citizens model both short and long-term impacts of land use changes on their watershed. The program helps to quantify the impact of land use change on the quantity and quality of their water.

This tool uses the land use and a soil characteristic input by the user along with thirty years of precipitation data to determine the average impact that a particular land use change or set of changes will have on both the annual runoff and the average amount of several non-point source pollutants. You can actually compare existing conditions with the expected condition following development. The L-THIA model can be found on the web at: [www.ecn.purdue.edu/runoff](http://www.ecn.purdue.edu/runoff)
L-THIA has two screens that accept information. Those new to land use planning can easily use the Basic Input version. Detailed Input gives more land use options. A little practice will have you using the Detailed Input in no time.

- **TR-55** *(level of difficulty – moderate; assistance may be available from USDA-NRCS or ABDI-LCD)*

This version of the Natural Resources Conservation Service's Technical Release 55 (TR-55) provides simplified procedures for estimating runoff and peak discharges in small watersheds.

While this TR gives special emphasis to urban and urbanizing watersheds, the procedures apply to any small watershed in which certain limitations are met. This tool will return the peak rate of runoff and the depth of runoff, computed using the NRCS runoff curve number (RCN) method). This simplified version can be found on the web at: [www.ecn.purdue.edu/runoff/sedspec](http://www.ecn.purdue.edu/runoff/sedspec)
Identify Data Gaps

It is possible that you won't find detailed information about your watershed. But, it is still possible to evaluate hydrologic condition without it. When information isn't available, identify those information gaps and include them in your report. This list of needs can be included in your watershed plan and passed on to natural resource managers. Or, your local watershed group can develop plans to act on those needs.

The Bigger Picture

Remember, this is just an assessment of the water runoff and flow patterns in your watershed. A comprehensive plan for your watershed will most likely require additional information to fully understand the watershed, beyond how the water moves about the land.

This can be accomplished through additional study of your watershed that may include:

- information obtained from the study of water movement in the watershed (this guidance)
- human impacts (i.e. population, distribution, size, density, growth or loss, land use, etc.)
- natural resource inventory (i.e. trout habitat, rare communities, exotic species, etc.)
STEP 4
Putting Pen to Paper – Rating Your Watershed Features

Learn:
- how to rate watershed features
- how to determine what features are important
- the importance of explaining your ratings
- how to select the most important watershed features from your rating

Which features are having the biggest impact on the amount and timing of flow and habitat quality in your watershed? Keep in mind that although every feature plays a role in how water moves through a watershed, some features may play a larger role in the way water moves through your watershed.

For example, each feature will have a particular influence on the amount and speed of water running over the land. The focus of this study is: Slow the flow; specifically the timing and amount of water flow in a watershed.

How to Rate Watershed Features

After you have found information about watershed features in Steps 2 and 3, your workgroup should come together and rate the features based on the information found.

Rating is done subjectively: that is, features are rated against each of the other features as to their importance and influence on the flow, habitat quality and/or timing of water in the watershed.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Relative Influence on Flow, Habitat Quality, or Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Slight/None</td>
</tr>
</tbody>
</table>

and/or timing of water in the watershed. Subjective ratings can also be based on the evaluator’s personal knowledge and observations of the watershed. Ratings range in importance from their influence on the flow, habitat quality, and timing of water in the watershed.

Subjective rating – factors are rated against each of the other factors as to their importance and influence on the flow, habitat quality and/or timing of water in the watershed.
What Features are Important?

To rate features, your group should ask

- What features are increasing water flow in your watershed?
- Could land management slow the speed of water runoff in your watershed?
- Could land management reduce the volume of water runoff in your watershed?
- Could some land management changes visually improve the watershed?
- Which land uses or watershed features have the greatest impact on quality, timing and flow in your watershed?
- Is there historic or baseline information available to determine if your watershed has changed over time?

By asking these questions for each of the features you will be rating, your group will be able to organize each feature according to a high, medium, or low rank. This should reflect what is happening in your watershed.

Table 4.1: Marengo River Pilot Watershed Rating Table

<table>
<thead>
<tr>
<th>Climate</th>
<th>Flow</th>
<th>Habitat Quality</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Duration</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Frequency</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Intensity</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Snow</strong></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>snowfall/snowmelt</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>(spring break-up)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Evapotranspiration</strong></td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(Annual Monthly Daily, Hourly)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1 shows the subjective ratings for climate factors from the Marengo Watershed test case. Rain amount was given a high rating for its effect on water flow, timing, and habitat quality in this watershed.

Explain Your Ratings

Along with deciding if a feature has a high, medium or low rank, you’ll want to provide a rationale or explanation for those rankings, backed up with the data and information you collected. The rationale should be detailed and provide enough information on the discussions that took place that someone could look back and understand the basis for the ratings.
CLIMATE

Rainfall directly impacts stream flow on Lake Superior’s Clay plain. This is especially apparent once heavy clay soils are saturated or frozen with almost zero infiltration. Streams rise and fall in direct relation to the amount, duration and frequency/intensity of rainfall events.

General 25-year, 24-hour precipitation is 4.66 inches (USGS, 2002)
Annual Precipitation ranges from 30.02 – 33.46 inches per year (USGS, 2002)

Snow
There is great variability in the Marengo Watershed as a portion of the pilot areas is in the snow belt and a portion is not. Neighboring watershed comparisons –

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Precipitation (USGS, 2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad River</td>
<td>94.5 – 96 inches</td>
</tr>
<tr>
<td>Trout Brook tributary near Marengo</td>
<td>91.5 inches</td>
</tr>
<tr>
<td>White River near Ashland</td>
<td>66.1 inches</td>
</tr>
</tbody>
</table>

Air Temperature
Annual mean max., min., and average temperatures for the years 1971 - 2000
(seasonal mean temperatures will vary)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Max.</th>
<th>Min.</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fahrenheit</td>
<td>51.3</td>
<td>29.7</td>
<td>40.5</td>
</tr>
</tbody>
</table>

Evaporation/Transpiration
No information source found

Wind (spring)
Wind speeds and direction early in the spring contribute to both the amount and timing of flow in the Marengo Watershed and all along Lake Superior’s clay plain for that matter. Average wind speeds are 10 miles per hour.

Additional Information regarding Weather

Example of Marengo River Test Case Rationale

Selecting the Features You Can Influence

Some features are important to how water moves through a watershed; but not much can be done about them (i.e. climate, geology). Others however, could be altered by changing how we manage the land and those are the features you’ll want to single out for this hydrologic condition study that should be included in a watershed management plan.

Be critical of the information so you can get down to the three or four features that have the biggest impact on the hydrology of your watershed and address the questions you asked early on in the process.

You may find yourself asking why bother finding some of the information when you can’t do anything about it. Even though you are not able to influence all of the features in your watershed, you still need to know the resulting data to prepare the baseline information and plan for reasonable actions to help watershed health. Remember, even though you can’t change it, you can change what you do in the watershed because of that feature.

USGS found that peak snow melt timing has shifted from April to March. This was determined by following long-term trends. While there is no action that can change this, management actions may change because of it. (2006)

Spring runoff in this road ditch causes improperly installed and used silt fence to fail. Silt fence is not to be used as a check dam.

S. Schultz, Stable Solutions Inc
Table 4.1 shows important watershed features found in the Marengo River Watershed Test Case. This information is needed for Steps 5 & 6. Those highlighted in green we can affect, and those in red we cannot affect through land use changes. (The rating numbers represent relative influence on flow, quality or timing.)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Flow</th>
<th>Quality</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLIMATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rain</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Amount</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Duration</td>
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</tr>
<tr>
<td>Frequency</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Intensity</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Snowfall / Snowmelt</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Air Temperature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annually, Monthly, Daily, Hourly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Minimum</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Evaporation</strong></td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Wind (spring break-up)</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>SURFACE WATER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flood events</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Impoundments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructed</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>DRAINAGE BASIN CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watershed Morphometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Geometry (cross section)</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Topography (slope, aspect, drainage density) (1050-750 feet above sea level)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Wetlands / Riparian Areas</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Soils</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrologic Soil Group / Infiltration</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Geology</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Vegetative Cover (forest Age Class &amp; Cover)</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Riparian Buffers</strong></td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Human Influence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>limited/no info</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Road Ditches</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock Grazing</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Nutrient Management</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Cropland (tillage, pasture, cropping sequence, &amp; surface drainage, etc.)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Groundwater Extraction</td>
<td>limited/no info</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Urban / Residential</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Other – high risk areas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
STEP 5
Which Watershed Features Get the Spotlight – Selecting Important Features

Learn:

- how to select the watershed features that can be influenced by management
- how to determine the impact important watershed features have on quality, flow or timing of water in your watershed
- what watershed data is important to have to manage the quality, flow & timing for each watershed feature

The work you have done so far will help you select the management practices that will best improve the hydrologic condition (or amount, quality and timing of flow in) of your watershed. Let’s recap – you have already:

1. Put together a team of people to help with assessing the timing, quality and amount of flow in your watershed.
2. Identified the maps that would be helpful for your review and prepared the maps
3. Asked questions to determine what information you need and found the information for your watershed
4. Rated the watershed information as to its importance for quality, amount and timing of water in your watershed and prepared a written explanation of the ratings.

It’s time to narrow down the information to what your group sees as having the biggest impact on the hydrologic condition of your watershed.

Selecting Watershed Features That You Can Work On

All of those watershed features that were rated “1” for the three biggest hydrologic impacts or features – flow amount, habitat quality and timing of flow – should be pulled from the rating table and listed in table 5.1 below.

Apply the question at right to the watershed features. If the answer is “yes,” then include in the list of important watershed features. If the answer is “no,” do not include in the list because we cannot influence these features.

Can a change in land management influence how much and how fast water moves through the watershed, or how water affects habitat?

Transfer these watershed features to Table 5.1 and assign a significance tag to each feature as they relate to the flow amount, quality and timing of water in the watershed.

Table 5.1 Summary Table

<table>
<thead>
<tr>
<th>Watershed Features</th>
<th>Flow Amount</th>
<th>Quality (related to sediment)</th>
<th>Timing</th>
<th>Overall Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Focus on the affect the feature would have on the amount, habitat quality and timing of flow in your watershed. Discussions among your workgroup should yield a reasonable rating on the effect and would be expressed in Significant or Not Significant. This will give you a good final list or product and an idea how important each of the features is to the hydrologic condition of your watershed. This information should then be passed on to those involved in the watershed planning process.

What do you do with the rest of the important factors that management can’t affect? The information you gathered is useful in watershed planning because it helps to determine the limitations and opportunities for future changes and improvements in the watershed.

**Example of factors land management cannot affect:**

According to a USGS/BRNRD report, “...trends suggest that spring breakup and snowmelt-related flows are occurring earlier in the season than they were 50 years ago.” The spring break-up we experience in April 10 years ago, we now experience in March.

While we cannot change this fact, we can potentially manage our lands differently to account for this change.

**For the Marengo River pilot watershed, these are the watershed features that affect hydrology and that we thought could be affected through land use management:**

- areas with greater than 50 or 60% open land (open land [agriculture] – young forest [0-16 yr age class])
- Areas within 750 and 1,050 feet above sea level in elevation
- Livestock grazing areas
- Row crop areas
- Road systems
- Drained wetlands (surface drainage for agriculture)
- High-risk areas for suspended sediment contributions

**Sediment-laden runoff from graveled town roads creates turbid conditions in streams resulting in sediment covering in-stream habitat, reduced oxygen availability for fish and wildlife, and pollutant loading.**

**Wetland restoration and tree planting.** Restoring or enhancing wetlands may help to temporarily reduce peak runoff events. Wetlands with drawdown capability are an even better alternative because water can be released during dry periods to make room for additional water storage later. Tree planting in nonproductive agricultural areas can reduce the amount of nonproductive open land and may help to reduce runoff rates in the future. However, this by no means is an effort to get rid of agricultural lands. It is a tool that could be used to take problem areas out of agricultural production, plant to trees and potentially manage timber on portions of traditionally farmed marginal lands.

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Learn:
- Identify changes by looking at historic and current information
- How to determine the recovery potential of important watershed features if land use management changes are made
- How to use this valuable hydrologic information to help in watershed planning

Walk Back in Time

You have put together all of the information you can. Let's compare the current condition with our known historic conditions. Again, it's tough in the Lake Superior basin to find information; find and use what you can and don't sweat the rest.

This is a good time to quantify and compare historic information with current information for the main factors you found in Step 4 that influence the flow, habitat quality and timing of water in the watershed (see example table above).

Now that you have identified and rated the factors influencing the flow amount, quality and timing in your watershed, and determined which had the most significant impact on the hydrology, it's time to compare the reference levels and current levels to determine if there are any trends. To do this you should

1. Create a column in a table with current information using information you found during the Finding Watershed Data step.

2. Create a column in a table with historic information using the information you found during Step 3 or during this step 6.

If you don't find any baseline information, don't worry. Record the fact that you could not find any information and move forward with what you have.

<table>
<thead>
<tr>
<th>Watershed Features</th>
<th>Current Information</th>
<th>Historic Information</th>
<th>Overall Affect on the Watershed (from Table 5.1 translated to a numerical value)</th>
<th>Recovery Potential</th>
<th>Rating Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-1

![Field Prior to Conservation Practices (1962)](image1)

![Same Field Four Years Later (1966)](image2)
Historic information used for the Marengo River Watershed Pilot area included some that showed pre-European settlement. This information is used for comparative purposes only and is in no way intended as the desired condition, or that we should move the restoration toward that level. These type of reference levels are simply the conditions expected if the watershed operated without significant human influence.

Use the ratings from Table 5.1 and translate to a numerical value as follows:

<table>
<thead>
<tr>
<th>Overall Affect on the Watershed</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>1</td>
</tr>
<tr>
<td>Moderately Significant</td>
<td>2</td>
</tr>
<tr>
<td>Slight / no difference</td>
<td>3</td>
</tr>
</tbody>
</table>

Determine the “recovery potential.” In other words, determine whether it is likely that through changes in land management for each of the important watershed features, you can affect the hydrology of the watershed. (Table 6.1)

You should have all the information you need, let’s compare the current information with the historic information you found and whether there is a chance for recovery.

Reducing sediment runoff and tracking from construction sites and maintaining vegetation or Best Management Practices that reduce sediment runoff from construction sites help to improve the hydrologic condition of watersheds, whether in a rural or more urban setting.

Ashland, S. Schultz, Stable Solutions llc

Protecting town roads from runoff damage can also incorporate fish and wildlife habitat improvements. This town road located in Morse in central Ashland County was a continual problem (shown in inset before restoration). Grant funding helped to improve this road by placing rock lining with boulder weirs directing the current away from the bank and a black top surface to reduce the chance of more gravel washing into Ballou Creek. The project saves the town money and reduces sedimentation to a Class I Trout Stream.

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**Recovery potential** – lies somewhere between the current watershed conditions and the historic or reference conditions.
East Altamont Road, Town of Lincoln road failure, Marengo River, 2004.
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East Altamont Road, Town of Lincoln following sediment removal, root wad installation for habitat improvement and bank protection, 2005.

Inundated road ditch during spring 2005 runoff event. Swirling at the entrance or exit of culverts can eat away the road bank and cause the culvert to fail. Proper culvert installation is important to help reduce the potential for failure. Additional upland practices to store some of the water for slower release would reduce the amount of water these culverts would need to pass.
S. Schultz, Stable Solutions llc

Proper road ditch maintenance can have a major impact on the stability of the road ditch and the culverts associated with them.
What if You Can’t Find Any Information?

Sometimes you may only be able to find one or two pieces of information and you may need assistance drawing conclusions. Rely on your work group and their expertise to help you make conclusions, no matter the amount of data available.

Make Recommendation to Agencies

This process would be easy if all the resources you needed were available and groups just needed to plug in the data. That is definitely not the case in the Lake Superior Basin. Don’t be shy about letting your local natural resource managers that there needs to be some work done.

Where to From Here

The valuable hydrologic information you have found will be a great starting point for your watershed planning process. Again, we focused here on how water affects your watershed’s condition by the amount, timing and quality of the flow entering and moving through the watershed.

Even if information is difficult or impossible to find, you can still create a big picture view of your watershed. This big picture view will be critical for natural resource planning and restoration.

This analysis will help you understand the lay of the land and that is the foundation of every land use, watershed or comprehensive plan. The Marengo River Watershed Test Case shows the hydrologic assessment for that project. Step 6 of that analysis (Table 6.1A) lists recommendations for the watershed planning process resulting from the hydrologic assessment. Some examples are management of open lands and identification of high risk areas for sediment contributions.

A hydrologic assessment will indicate the features that are most important for amount and timing of water flow in the watershed and its affect on habitat quality. It also provides an understanding of which features can be influenced by management and which have the most recovery potential.

This information will jump start your watershed planning – where you develop goals and identify the actions you want to take to protect your watershed.

Watershed Planning & Implementation Process

1. Build Partnerships
2. Characterize the Watershed
3. Finalize Goals and Identify Solutions
4. Design an Implementation Program
5. Implement Watershed Plan – take actions!
6. Measure Progress & Make Adjustments

Hydrologic Assessment is an important part of characterizing the watershed and identifying causes and sources of pollution for the Lake Superior basin.

Natural Resource Inventory is another important part of characterizing the watershed for planning.
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