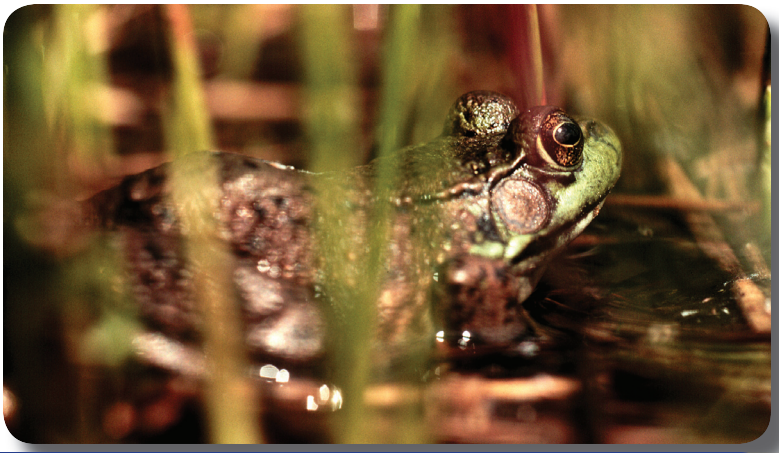


Development of Tools to Address Groundwater in Comprehensive Planning

Prepared by:

Lynn Markham
Land Use Specialist
Center *for* Land Use Education

ChinChun Tang
Project Planner
Center *for* Land Use Education

Bobbie Webster
Project Planner
Center *for* Land Use Education

Chuck Dunning
Hydrologist
U.S. Geological Survey

September 2005

Center *for* Land Use Education

TABLE OF CONTENTS

LIST OF FIGURE AND TABLES

ACKNOWLEDGEMENTS

We would like to thank the Wisconsin Groundwater Research Program in the Water Resources Institute for funding this project; and Anna Haines and Rebecca Roberts, Center for Land Use Education; Kevin Masarik, Central Wisconsin Groundwater Center; and Dave Lindorff, Wisconsin Department of Natural Resources for reviewing the final report. We also thank the members of the advisory committee (see Appendix F) for their constructive advice and encouragement. Key contributions were provided by:

- Dana Jensen, Vandewalle & Associates
- Pam Lazaris, Planning Service & Solutions, LLC
- Paul Ohlrogge, UW-Extension Community, Natural Resource and Economic Development Educator, Iowa County
- Jim Vanderbrook, Wisconsin Department of Agriculture, Trade and Consumer Protection
- Sally Kefer, Land Use Team Leader, Wisconsin Department of Natural Resources
- Dave Lindorff, Wellhead Protection Team Leader, Wisconsin Department of Natural Resources
- Kevin Masarik, Groundwater Specialist, Central Wisconsin Groundwater Center, University of Wisconsin – Stevens Point
- Ed Morse, Groundwater Specialist, Wisconsin Rural Water Association

PROJECT SUMMARY

Title: Development of Tools to Address Groundwater in Comprehensive Planning

Project I.D.: WRI #: WR04R005; GCC #: 05-BMP-01

Investigators:
Lynn Markham, Land Use Specialist, UW-Stevens Point, Center for Land Use Education (CLUE)
Charles Dunning, Hydrologist, U.S. Geological Survey – Water Resources Discipline, Middleton, WI
Chin-Chun Tang, Project Planner, UW-Stevens Point, CLUE
Bobbie Webster, Project Planner, UW-Stevens Point, CLUE

Period of contract: 7/1/2004 – 6/30/2005

Background/Need:
Groundwater, lakes, rivers, streams, and wetlands are among Wisconsin's greatest natural resources. Fish, wildlife, and plants depend on these water resources to give them life. In order for communities to plan for the future, it is essential that both the quantity and quality of groundwater be protected. Land use decisions can have significant and unanticipated consequences for groundwater resources. Declining water levels and reductions in water quality have already occurred in many parts of the state.

Legislation adopted in Wisconsin in 1999 requires that by January 1, 2010 all communities that make specified land use decisions base those decisions on a comprehensive plan. Despite widespread understanding among groundwater scientists and planners that groundwater needs to be addressed throughout a comprehensive plan, there have been no efforts to track how groundwater is being addressed in the plans.

Objectives:
The objectives of this project are to improve local groundwater planning efforts, and more importantly implementation efforts, by providing examples of high quality plans and real-life examples illustrating how local governments have implemented their plans.

Methods:
We reviewed comprehensive plans that were completed after 2000, submitted to the Wisconsin Department of Administration, and adopted by their respective communities. Our plan review consisted of two phases: Phase I was a preliminary review where we broadly examined how groundwater is being covered in each of the nine comprehensive planning elements. Phase II was a detailed review where we selected a small pool of plans based on the preliminary results to analyze the types of data, policies, and goals included in the plans. In each phase, templates for gathering and analyzing data from the plans were developed with guidance from the advisory group. To minimize any inconsistency between reviewers, an intercoding reliability score was calculated for each plan

Results and Discussion:
In the Phase I review, content analysis on 79 adopted plans found the word "groundwater" appeared most frequently in the agricultural, natural, and cultural resources element of plans, followed by the utilities and community facilities element. The housing and transportation elements, respectively, contain little to no mention of groundwater. Four plans did not mention groundwater in any element.

In the Phase II review, the types of groundwater-related goals, policies and data were analyzed in 29 plans. The number of groundwater-related goals mentioned in these plans was limited. The average number of groundwater goals per plan was 1.4. The average number of groundwater related policies per plan was 8.5. The most common policy category was waste management while the least common policy category was remediation. Only a few of the plans had policies that provide clear information about who will implement the policy and by when. The most common groundwater data include surface watersheds, soil types, and groundwater susceptibility. The least common groundwater data include impervious surface inventory, changes in water table depth, and estimated community groundwater pumping rate.

Our plan review yielded a number of interesting results. The importance of groundwater varies by community and those communities with moderate or high groundwater susceptibility had significantly higher groundwater goal scores than communities with low groundwater susceptibility. We also found communities in counties that have a groundwater protection plan and communities with municipal water systems included more groundwater data in their plan than communities without these resources. Finally, data scores did not correlate with goal or policy scores; nor did goal scores correlate with policy scores.

We also developed five case studies highlighting rural Wisconsin communities that have implemented groundwater protection or remediation measures:

- Municipal well remediation and water conservation: City of Waupaca
- Groundwater education about water quality of private wells and associated policy development: Iowa County and towns therein
- Payments to farmers to grow low nitrogen input crops near municipal well: City of Waupaca
- Municipal well remediation and wellhead protection ordinance: City of Chippewa Falls and Chippewa County
- Groundwater study included in comprehensive plan and groundwater ordinance addressing future development adopted: Town of Richfield, Washington County

Conclusions/Implications/Recommendations:

Based on our review of plans and development of case studies, we recommend the following actions to enhance how groundwater is addressed comprehensive plans:

- Increase citizen activism to heighten the priority of groundwater in local communities
- Hire local government staff and consultants that value groundwater
- Provide education about the costs of groundwater contamination and depletion
- Provide education to help plan writers better interpret and use groundwater information
- Improve the accessibility of groundwater data to plan writers
- Provide funding to support further groundwater studies

Related Publications:

Comprehensive Planning in Wisconsin: Are Communities Planning to Protect Their Groundwater? Part I, Land Use Tracker, Spring 2005

Comprehensive Planning in Wisconsin: Are Communities Planning to Protect Their Groundwater? Part II, Land Use Tracker, Winter 2005

Key Words: groundwater, planning, goal, objective, policy, case study, community

Funding: In addition to funding from the University of Wisconsin System, staff salaries were provided by the Center for Land Use Education and the U.S. Geological Survey.

INTRODUCTION

Groundwater, lakes, rivers, streams, and wetlands are among Wisconsin's greatest natural resources. Fish, wildlife, and plants depend on these water resources to give them life. People depend on these waters for many things, including drinking water, waste assimilation, and recreation. Land use decisions play a key role in groundwater protection, as they can have significant and unanticipated consequences for groundwater resources. Declining water levels and reductions in water quality have already occurred in many parts of the state (Meine, 2003).

Legislation adopted in 1999 (s. 66.1001, *Wisconsin Statutes*) and amended in 2004 requires that by January 1, 2010 all communities that make specified land use decisions base those decisions on a comprehensive plan.

Despite widespread understanding among groundwater scientists and planners that groundwater needs to be addressed throughout a comprehensive plan, there have been no efforts to track how groundwater is being addressed in the plans, particularly since adoption of the comprehensive planning law in 1999. Gathering this information is also important because the quality of plans and resources of the planning agency have been found to drive successful plan implementation (Laurian et al., 2004).

Scope Of This Project

The Center for Land Use Education together with the U.S. Geological Survey evaluated adopted Wisconsin comprehensive plans to understand the extent of groundwater coverage and efforts to protect and manage groundwater in comprehensive plans. Our plan review consisted of two phases: Phase I was a preliminary review where we broadly examined how groundwater was being covered in each of the nine comprehensive planning elements. Phase II was a detailed review where we selected a small number of plans based on the preliminary results to analyze the types of data, policies, and goals included in them. In addition, we also conducted several case studies to document exemplary efforts to protect groundwater.

PROCEDURES AND METHODS

Preliminary Review

We used a database of in-progress and completed comprehensive plans from the Department of Administration (DOA) as of April 2004 to identify comprehensive plans that were completed after 2000 and submitted to the DOA. Only adopted plans were selected for review, which totaled 84 plans for 88 communities. We were able to obtain 79 such plans, which are listed in Appendix B.

We conducted an initial content analysis to determine the extent to which groundwater was covered in these 79 plans. The two reviewers counted the frequency appearance of the word "groundwater" or "ground water" in each element of a plan.

Detailed Review

Based on the preliminary review results and analysis we selected 32 plans with the greatest coverage of groundwater – that is, with the largest number of 'groundwater' hits - to review in more detail. Of these

plans 29 were reviewed and analyzed. One consideration during the detailed review selection process was that plans from the same preparer should be avoided[1] so we limited the number of plans from any single author to five.

A plan review template was established in Excel to allow the two reviewers to compile the above parameters independently. The template included three separate spreadsheets; one for issues and goals, one for policies, and one for data. A project advisory group including planners, UW-Extension educators, local government officials and staff and other groundwater specialists was assembled and met multiple times to provide content suggestions for these spreadsheets. The items under each were developed using advisory committee feedback and *Groundwater and its Role in Comprehensive Planning: Comprehensive Planning and Groundwater Fact Sheet 1*.

The issue and goal template recorded any groundwater related goals and scored them with a one or a two based on how directly the goal was related to groundwater. This template also served as a place to simply record groundwater related issues that were identified in the plan, usually in the Issues and Opportunities element. Issues are referenced in the policy template.

Goals were scored with a one or a two; a one was for somewhat groundwater related goals and a two was for directly groundwater related goals. For example, a goal to "coordinate the municipal sewer, water, stormwater and other infrastructure development" would be scored with a one because it is indirectly related to groundwater. A goal to "limit groundwater pollution" would be scored with a two because it is directly related to groundwater.

The policy template had ten categories of policies that the two reviewers looked for: Water Supply, Wellhead Protection, Stormwater Management, Agricultural Practices, Waste Management, Land Conservation, Development Restrictions, Educational Programs, Remediation, Intergovernmental Cooperation and Mining.

See Appendix C for the specific policies under each policy category.

Besides noting the category of a policy, the policy template also scored a policy's language on how passive or active it was, with a one for passive or a two for active. For example if a policy said "encourage water conservation" it would be scored with a one. A policy that said "ensure a 20% decrease in residential water use" would be scored with a two. The policy template also recorded whether a policy addresses any issues identified in the plan, whether a policy indicates who is responsible for implementing it and whether the policy indicates a target date for implementation. The full list of data categories and types in the data template is in Appendix D. The data template also recorded whether the data was presented in text, chart, or map format and whether a reference to groundwater is made when the data is presented.

The plan review templates were revised several times based on test reviews of three plans that were then discarded from the sample, bringing our detailed review sample to 29 plans.

[1] This is based on the assumption that plans by the same preparer are likely to be similar - in terms of the types of groundwater data included, the extent of groundwater coverage, and types of goals and policies recommended in the plans – since preparer is likely to use a cookie-cutter approach to plan writing.

Consistency Between Reviewers

In order to minimize any inconsistency between reviewers that could arise if each plan was reviewed by one person, an intercoding reliability score was calculated for each plan. Due to the fact that the variation between reviewers was considerable as a result of the wide variations in the format of these plans, we double-coded the policy section of all twenty-nine plans. As for the data section, which was much more straight forward, we randomly selected eighteen plans for double-coding (62% of plans). The intercoding reliability score for the data section is 90% (Berke, 2000).

Case Studies

The advisory group for this project identified Wisconsin communities that have taken steps to protect and/or remediate their groundwater. Based on these suggestions, initial contacts were made and case study communities were chosen based on the following factors:

- Focus on communities that are small, or not "urban." Small communities were chosen because larger communities have more staff and resources available for addressing groundwater issues.
- Describe a variety of groundwater protection/remediation tools
- Focus on tools could be used in many Wisconsin communities
- Seek case studies where there are existing resources for communities who are interested in this tool
- Tools may be broad or specific (i.e. watershed protection or well remediation). For specific tools, groundwater protection should be the main goal in implementing it.
- Achieve a balance between communities that focus on prevention and those that focus on remediation.

The interview questionnaire is provided as Appendix E.

Based on the criteria above and responses from initial contacts, five communities were chosen for case studies, phone interviews were conducted and taped with approval from interviewees, case studies were drafted, sent to interviewees for editing and approval and finalized.

Limitations to Review Process

Comprehensiveness
We reviewed the plans using a template we developed based on the recommendations from the advisory committee. The list of policies we included in the template is based on what the advisory committee believed to be sound policies to be included in comprehensive plans, thus there may be some policies that were overlooked.

Human error
For plans that were reviewed in hard copy form, there is a higher possibility that some coverage of groundwater could have been missed due to human error. In both hard copy and electronic versions of plans, reviewers relied on their reading of a plan, which is usually several hundred pages, thus there was a chance of missing an issue, goal, policy, or piece of data.

Plan format
The organization of a plan was another limitation. Since there is no standard format for comprehensive plans, there is substantial variation in terms of how the nine required elements are presented. Reviewers

could not use a standard review method to find the information they were looking for.

Interpretation of policy's context

Another limitation affecting the analysis of our information was that some policy statements did not fall clearly under any of the ten categories (or the sub-policies under each category) we established. Thus, reviewers had to interpret the context of the policy statement and determine to which category (or the sub-policy) to assign the statement that was under review. Based on the preliminary intercoding reliability test for policies, reviewers sometimes varied greatly in their interpretation of the policy statements that were being reviewed. As a result, to ensure consistency between the reviewers, all policy statements were double-coded (reviewed by two different people).

Single point of view

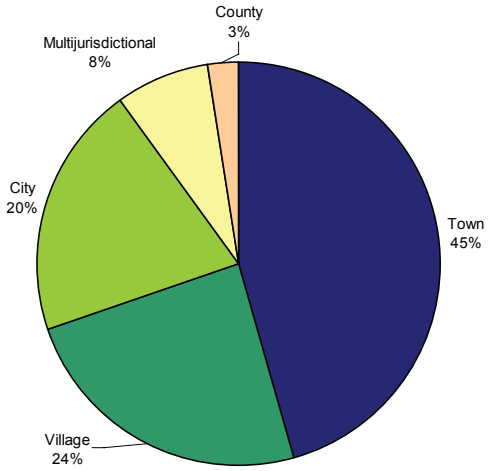
Most of the case studies are based on an interview with one person chosen based on their knowledge, involvement and perceived neutrality. Other people in the communities may have different viewpoints.

RESULTS AND DISCUSSION

Preliminary Plan Review Results

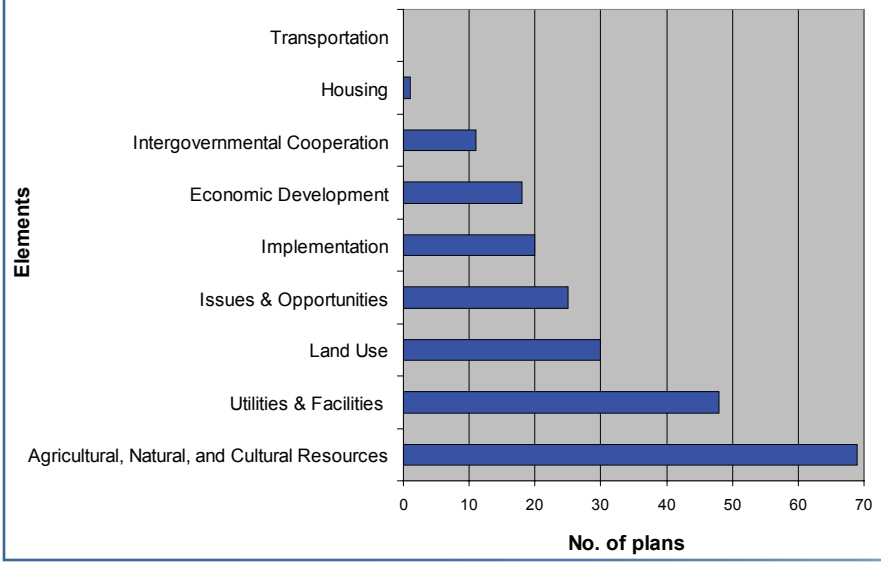
Of the 79 comprehensive plans we reviewed, the majority of plans were completed by towns, followed by villages and cities, mirroring the actual ratios of each type of municipality in Wisconsin. Figure 1 shows the breakdown of plans by community type.

Figure 1: Breakdown of plans by community type



We conducted preliminary content analysis on the 79 plans to determine the extent to which groundwater is covered in each plan. First, we counted how frequently the word "groundwater" appeared in each element of the plans. Figure 2 shows the results. As expected, the agricultural, natural, and cultural resources element contains the most extensive coverage of groundwater. Four plans did not mention groundwater at all. It is important to note that using

Figure 2: Number of comprehensive plans mentioning groundwater in each element



the word "groundwater" as the sole code word may underestimate the extent to which groundwater is covered in these plans, since alternate language could have been used. The purpose of the detailed review in Phase II is to capture these details.

Detailed Plan Review Results

From the 79 preliminary reviewed plans, we selected 29 plans that contained the greatest coverage of groundwater. All of these communities rely on groundwater for drinking water. The detailed review examined the types of goals and policies that are included in the plans, as well as the type and format of groundwater-related data and information.

Among these communities seven have low susceptibility to groundwater contamination while 22 communities have moderate to high susceptibility. Our scoring system shows that average data and policy scores are similar for both low and moderate/high susceptibility communities. However, the average goal score is evidently higher for the moderate/high susceptibility communities. Eighteen communities in the study have municipal sewer service, thirteen have municipal water service/wells, 22 have agriculture, and fourteen have mining activities.

Plan goals related to groundwater

A goal is a general statement describing a desired outcome in a community (CLUE, 2005). The number of groundwater related goals mentioned in these plans was limited. On average, each plan contained 1.4 groundwater-related goals. Twelve plans in the review sample (41%) did not contain any groundwater-related goals. Figure 3 shows the number of goals and policies per plan.

Plan policies related to groundwater

Policies describe courses of action used to ensure plan implementation and to accomplish goals (CLUE, 2005). Often one goal will have two or more policies listed under it, which would help achieve that goal. For instance, if a community goal is "protect groundwater quality," an associated policy may be "develop a manure storage ordinance." On average, each plan contained 8.5 groundwater-related policies. The number of policies per plan is shown in Figure 3.

Figure 3: Number of groundwater goals and policies in the 29 plans reviewed in detail

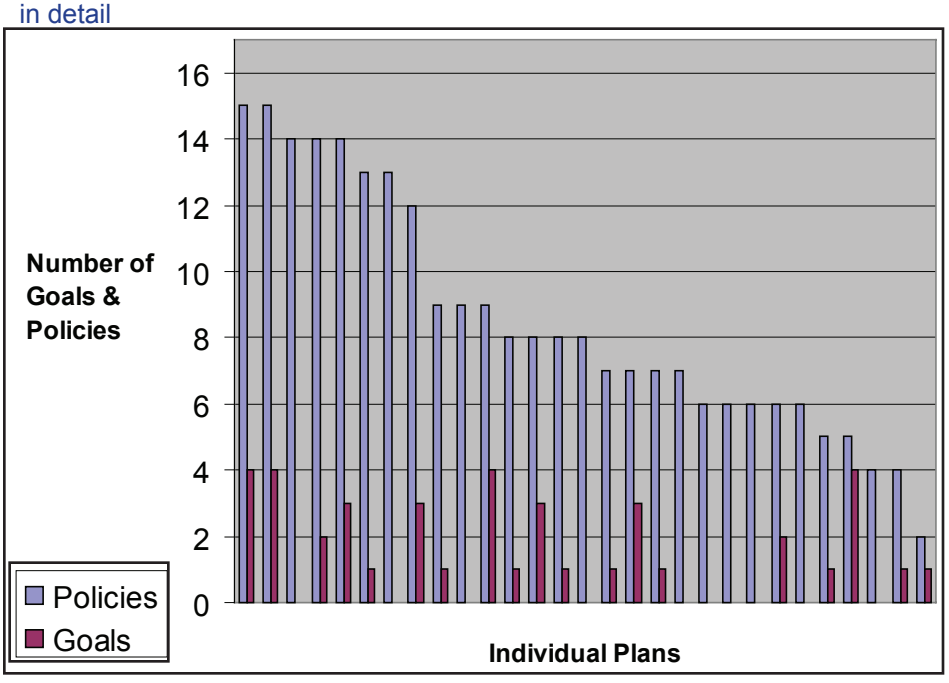


Figure 4

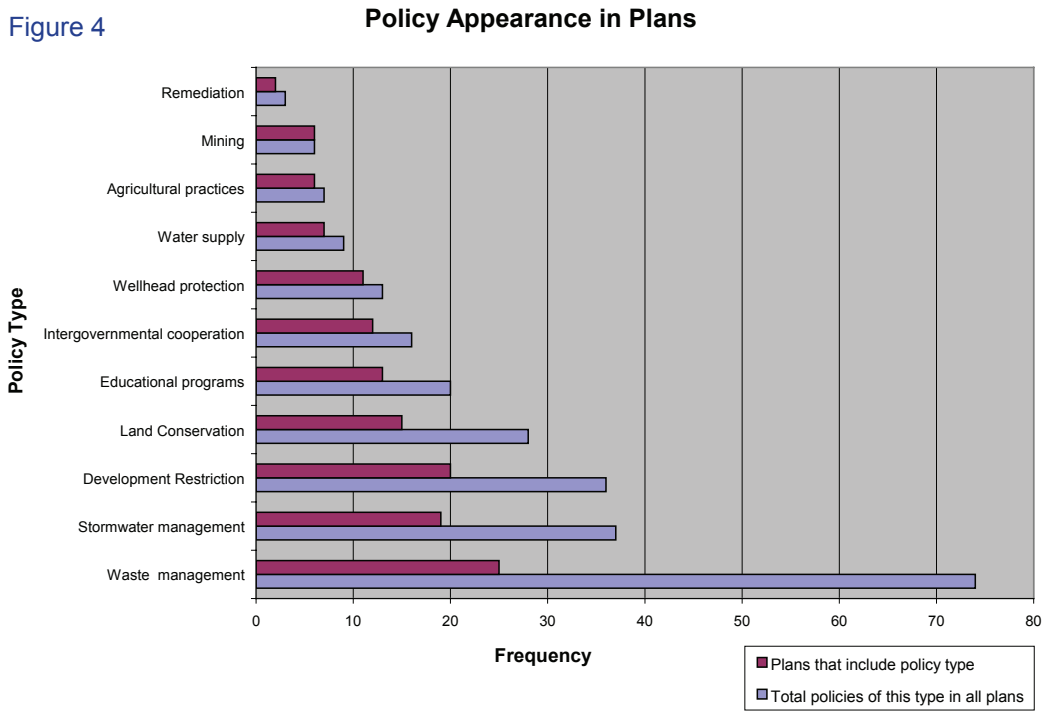


Figure 4 shows the policy categories examined and the number of plans in which they occurred. The most common policy category was *waste management*. (See Appendix C for the specific types of policies included in these categories). The average policy score was 1.43; average indicating that the policies overall were on the weak side.

List of data reviewed

- Surface watersheds
- Groundwater flow direction
- Groundwater time of travel maps
- Groundwater susceptibility (general)
- Soils
- Surficial deposits
- Type of bedrock
- Depth to bedrock
- Depth to water table
- Slopes greater than 12.5%
- Municipal wells - current production
- Municipal wells - capacity
- Private wells
- Estimated community GW pumping rate
- Change in depth of water table
- Impervious surface inventory
- Water quality reports
- Existing or potential contaminant sources, such as
  - Nitrates
  - Pesticides
  - Uranium
  - Petroleum products
  - Industrial chemicals
  - Sludge and wastewater disposal
  - Manure storage and spreading
  - Whey spreading
  - Feedlots
  - Septage disposal
  - Junkyards
  - Salt piles
  - Underground tanks
  - Pipelines
  - Highway deicing salt
  - Overpumping induced pollution (arsenic)
  - POWTs (septic systems, holding tanks, etc.)
  - Abandoned wells

Data compiled in the plans

Though the guiding principles of a comprehensive plan are the goals, objectives, and policies, the background information provided in the plan is valuable in educating and increasing awareness among residents about their community.

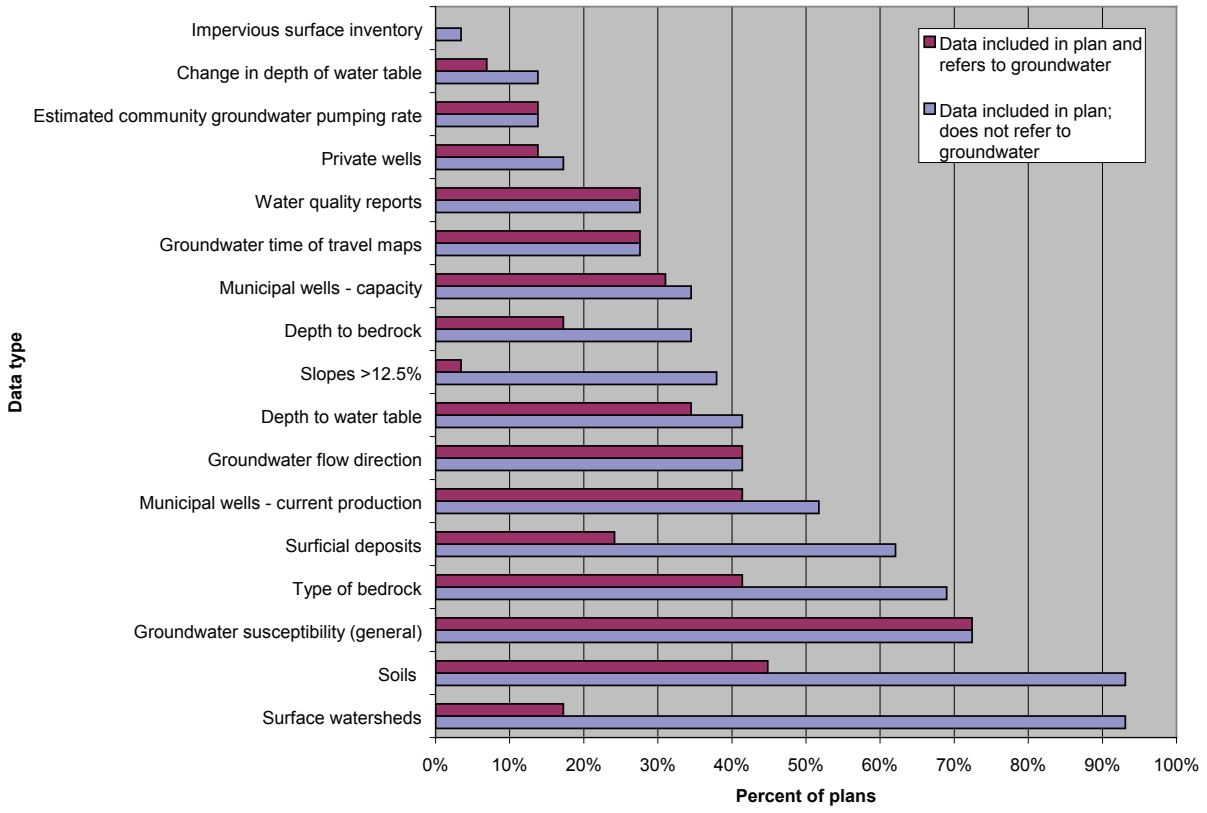
Four basic groundwater questions should be asked when preparing a comprehensive plan:

- Where does your community's groundwater come from? What land area contributes recharge to your community's well(s)?
- What geologic materials provide water for your community's well(s)? Are sensitive/susceptible areas within the recharge area identified?
- How much groundwater do your wells currently produce? Is this amount causing drawdown?
- What are the existing and potential contaminant sources that could impact your wells? (Wisconsin Department of Natural Resources, 2002b)

Based on these questions, we identified a list of data (see previous page) to look for when conducting the detailed review.

Figure 5 shows our findings. The most common groundwater data included in the plans addressed surface watersheds, soil types, and groundwater susceptibility.

Figure 5: Groundwater data in comprehensive plans



Case Study Results

The case study examples selected for this project highlight rural Wisconsin communities that have implemented groundwater protection and/or remediation measures.

Five case studies were written employing the methodology described. The case studies are in Appendix G and focus on the following topics and communities:

- Municipal well remediation and water conservation
- Groundwater education about water quality of private wells and associated policy development
- Payments to farmers to grow low nitrogen input crops near municipal well
- Municipal well remediation and wellhead protection ordinance
- Groundwater study included in comprehensive plan and groundwater ordinance addressing future development adopted

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Importance of groundwater varies by community
The extent to which groundwater is addressed in comprehensive plans varies significantly. Some plans contain extensive groundwater data and policies, while others have little. The type of data and policies in these plans are consistent across plans done by the same plan writers.

Communities with moderate or high groundwater susceptibility had significantly higher groundwater goal scores than communities with low susceptibility. However, these same communities do not have higher policy scores. This suggests that communities with moderate or high groundwater susceptibility are aware of potential groundwater problems, yet they may be unsure how to achieve their goals, may perceive barriers to achieveing their goals, or are unwilling to commit to policies in their plan.

Based on observations made while developing the case studies, nearly all communities that are engaged in groundwater protection efforts have had groundwater problems. One exception was a prevention effort led by a local citizen who was a hydrogeology professor. Because local governments often have many issues to deal with and at least the perception of limited resources, groundwater protection is often not a high priority until problems become apparent.

Availability of groundwater data and the ability to interpret it varies
The type, format, and extent of groundwater information in comprehensive plans is generally limited. When groundwater data or maps are included in plans, little or no attmpt is made to interpret the data. This may be explained in part by the fact that groundwater data is incomplete or inaccessible locally or on a state-wide level. When data is available, plan preparers may not know how to interpret it.

In those communities where groundwater data is available, communities generally made an attempt to incorporate it in local comprehensive plans. We found, for example, that communities located in counties that have produced a groundwater protection plan, incorporated more groundwater information in their comprehensive plans. In addition, communities with municipal water systems (and therefore at least one person responsible for water testing and reporting) included significantly more groundwater data in their plan than communities without municipal water systems.

Policy frequency depends on regulations and local land uses
Groundwater-related policies that are required by state or federal law appeared more frequently in local plans than other policies. Conversely, policies that are resource or issue dependent, such as those related to remediation, mining, or agriculture appear less frequently. Communities that are not facing these issues are unlikely to include them in a local plan.

Weak linkages exist between data, goals and policies
The groundwater data scores did not correlate with goal or policy scores achieved by local communities. This suggests that communities do not consistently require a minimum level of groundwater data before developing goals and policies. We also found that the groundwater goal scores do not correlate with the policy scores. Some communities are including groundwater goals, but are not taking it to the next step by developing associated policies. At the opposite end of the spectrum, some plans include multiple groundwater policies yet include no groundwater goals.

These findings may result from the very expansive nature of comprehensive planning. Communities can easily overlook groundwater or other issues when developing their comprehensive plan, particularly if there is no local champion willing to speak out about groundwater. These findings may also be related to the fact that groundwater planning is complex and new to many communities and planners.

The Wisconsin comprehensive planning law adopted in 1999 requires plans to include goals, objectives, policies, maps and programs for the conservation and effective management of groundwater. While most of the plans we reviewed contained basic groundwater-related data and a smattering of groundwater goals and policies, much remains to be done. Specifically, all plans should include data about current groundwater quality and quantity, groundwater flow direction and potential sources of contaminants. Based on this enhanced data set, local goals and policies should be developed to address local groundwater issues. Planning for groundwater is a long-term community endeavor with many valuable and indispensable benefits.

Recommendations

Based on our review of comprehensive plans, development of community case studies and discussions with key players in groundwater planning, we provide the following recommendations for improving the groundwater component of comprehensive plans.

Increase citizen activism to heighten the priority of groundwater in local communities
The development of a comprehensive plan is steered heavily by local participation. One way to ensure that a comprehensive plan addresses groundwater issues is to invite residents with a strong interest in groundwater to actively participating in the process. Community activism that brings attention to groundwater can spark effective goals and policies.

Hire local government staff and consultants who value groundwater
Groundwater protection measures achieved by many of the communities featured in the case studies were spurred by the actions of a single individual that valued groundwater and persistently sought opportunities to provide education, funding and other resources. Groundwater protection and remediation efforts also depend on support from local government officials and their constituents.

Improve the accessibility of groundwater data to plan writers
Data collection during a comprehensive process may be overwhelming (imagine collecting information

on all nine elements). Data that is convenient, easily accessible and in a format that can be directly utilized in a plan will encourage plan writers and citizen planners to include groundwater data. Increasingly, scientists will need to find ways to better translate scientific information into jargon-free language understandable by the public.

Provide education to help plan writers better interpret and use groundwater information
Most professional planners and community members lack training in groundwater planning. Outreach workshops designed to educate professional and citizen/volunteer planners on how to interpret and use groundwater information would address this need.

Provide funding assistance to support further groundwater studies
Based on the detailed plan review, groundwater data related to grouindwater time of travel, impervious surfaces, and potential contaminants are lacking. These types of information require additional funding to research and investigate.

Provide education about the costs of groundwater contamination
Based on the observation from the community case studies that groundwater protection is often not a high priority until problems become apparent, it may be beneficial to provide education illustrating the costs of groundwater contamination and associated remediation. While the case studies illustrate this to a limited extent, a study of the fiscal impacts of contaminated groundwater in Wisconsin communities may be more effective to demonstrate the cost avoidance potential of groundwater protection measures.

REFERENCES

Berke P, Conroy M. Are We Planning for Sustainable Development? *Journal of the American Planning Association,* Winter 2000, Vol. 66, Issue 1, p21.

Center for Land Use Education (CLUE), 2005, *Land Use Resource Guide - A guide to preparing the land use element of a local comprehensive plan*, p.40.

Laurian, L., Day, M., Backhurst, M., Berke, P., Ericksen, N., Crawford, J., Dixon, J., and Chapman, S. (July 2004). What drives plan implementation? Plans, planning agencies, and developers. *Journal of Environmental Planning and Management, 47* (4), p.555-577.

Meine, Curt ed. *Wisconsin's Waters: A Confluence of Perspectives*. Transactions of Wisconsin's Academy of Sciences, Arts and Letters, Vol. 90, 2003.

Wisconsin Department of Natural Resources (WDNR), 2002a, *Groundwater and Its Role in Comprehensive Planning: Comprehensive Planning and Groundwater Fact Sheet 1*. Wisconsin Groundwater Coordinating Council, 4 pp.

Wisconsin Department of Natural Resources (WDNR), 2002b, Resources To Help You Protect Your Drinking Water Supply: Comprehensive Planning and Groundwater Fact Sheet 2. Wisconsin Groundwater Coordinating Council, 4 pp.

APPENDIX A: AWARDS, PUBLICATIONS, REPORTS, PATENTS AND PRESENTATIONS

Publications

1. Comprehensive Planning in Wisconsin: Are Communities Planning to Protect Their Groundwater? Part I, Land Use Tracker (Newsletter for the Center for Land Use Education), Spring 2005
2. Comprehensive Planning in Wisconsin: Are Communities Planning to Protect Their Groundwater? Part II, accepted by Land Use Tracker, Winter 2005
3. Comprehensive Planning in Wisconsin: Are Communities Planning to Protect Their Groundwater? submitted to Water Resources IMPACT, September 28, 2005.

Presentations

1. Comprehensive Planning in WI: Are Communities Planning to Protect Their Groundwater? American Water Resources Association Wisconsin conference in Delavan March 3, 2005.
2. Comprehensive Planning in WI: Are Communities Planning to Protect Their Groundwater? Local Government subcommittee of the Wisconsin Groundwater Coordinating Committee, Madison, April 26, 2005.
3. Comprehensive Planning in WI: Are Communities Planning to Protect Their Groundwater? tailored to the Columbia County comprehensive planning process Portage, August 24, 2005.
4. Comprehensive Planning in WI: Are Communities Planning to Protect Their Groundwater? tailored to the Town of Greenville comprehensive planning process, Greenville, September 13, 2005

APPENDIX B: COMPREHENSIVE PLANS REVIEWED

COMMUNITY	TYPE C=city T=town V=village Co = county	COUNTY	DETAILED REVIEW (X = yes)
Rice Lake	C	BARRON	
Bayfield	C	BAYFIELD	X
Clover	T	BAYFIELD	
Wrightstown	V	BROWN	X
Howard	V	BROWN	X
Ashwaubenon	V	BROWN	
Eaton	T	BROWN	X
Scott	T	BURNETT	
Stockbridge	V	CALUMET	
Brillion/Brillion	C/T	CALUMET	X
Thorp	C	CLARK	
Columbus	C	COLUMBIA	
Sun Prairie	T	DANE	X
Waunakee	V	DANE	X
Springfield	T	DANE	X
Mazomanie	T	DANE	
Berry	T	DANE	X
Cottage Grove	T	DANE	X
Dane	T	DANE	
Beaver Dam	T	DODGE	
Emmet	T	DODGE	
Sturgeon Bay	C	DOOR	
Nasewaupee	T	DOOR	X
Brussels	T	DOOR	
Tainter	T	DUNN	X
Colfax	V	DUNN	
Ludington	T	EAU CLAIRE	
North Fond du Lac	V	FOND DU LAC	
Paris	T	GRANT	
Tennyson, Potosi	V	GRANT	
Livingston	V	GRANT	
Fennimore/Fennimore	T/C	GRANT	X
Albany	T	GREEN	
Barneveld	V	IOWA	
Jefferson	Co	JEFFERSON	
Sumner	T	JEFFERSON	X

Watertown	T	JEFFERSON	X
Watertown	C	JEFFERSON	
Franklin	T	KEWAUNEE	
Algoma	C	KEWAUNEE	X
Shullsburg	C	LAFAYETTE	
Belmont	V	LAFAYETTE	
Lincoln	Co	LINCOLN	
Mishicot	V	MANITOWOC	X
Manitowoc Rapids	T	MANITOWOC	X
Kiel	C	MANITOWOC	X
Pound/Coleman	T/V	MARINETTE	
Grover	T	MARINETTE	
Oak Creek	C	MILWAUKEE	
St. Francis	C	MILWAUKEE	
Sparta/Sparta	T/C	MONROE	X
Oakdale	V	MONROE	
Wilton	T/V	MONROE	
Gillett	T	OCONTO	
How	T	OCONTO	
Little River	T	OCONTO	
Maple Valley	T	OCONTO	
Oconto	T	OCONTO	
Hortonville	V	OUTAGAMIE	
Freedom	T	OUTAGAMIE	X
Prescott	C	PIERCE	
Milltown	T	POLK	
St. Croix Falls	C	POLK	
Mount Pleasant	T	RACINE	
Lake Delton	V	SAUK	
Bass Lake	T	SAWYER	X
Plymouth	C	SHEBOYGAN	
Cedar Grove	V	SHEBOYGAN	
Roberts/Warren	V/T	ST. CROIX	X
Somerset	V	ST. CROIX	X
Trempealeau	V	TREMPEALEAU	
Hillsboro	C	VERNON	
Manitowish Waters	T	VILAS	X
Summit	T	WAUKESHA	
Sussex	V	WAUKESHA	
Marion	C	WAUPACA	
Oshkosh	T	WINNEBAGO	X
Menasha	T	WINNEBAGO	X
Nekimi	T	WINNEBAGO	X

APPENDIX C: POLICY CATEGORIES AND POLICIES

1	Water supply
1.1	**Long-term planning** to determine if enough water is available for future development
1.2	Water conservation measures
1.3	Quantity standards for new or existing high capacity wells
2	Wellhead protection
2.1	Wellhead protection plan
2.2	Identify potential contaminant sources
2.3	**Prohibit uses with the potential to contaminate groundwater** - Wellhead protection ordinances that prohibit or prescribe BMPs for these uses
2.4	Identify and/or protect areas for new municipal wells
2.5	Well construction standards (quality)
2.6	Fill abandoned wells
2.7	Limits on new development and/or uses allowed in groundwater recharge areas if recharge areas are separate from the wellhead protection zone
3	Stormwater management
3.1	Stormwater plan
3.2	**Promote infiltration** - limit impervious surfaces and/or encourage raingardens
3.3	**Treatment of stormwater runoff** to remove contaminants before discharge to ground or surface water.
4	Agricultural practices
4.1	Limits on agricultural crops allowed in designated areas
4.2	Agricultural nutrient management plans
4.3	Limitations on agricultural pesticide use
4.4	Manure storage ordinances
5	Waste management
5.1	Wastewater plan (facilities)
5.2	Group septic system standards
5.3	Locate new development or specific types of new development in areas with sewer service
5.4	**Encourage advanced wastewater treatment systems** (local communities are not allowed to require more protective standards than COMM 83, but may encourage them)
5.5	**Hazard waste collection** - Clean Sweep or other programs

5.6	**Landfill siting** - located and designed to protect surface and groundwater
5.7	Urban service or sewer service areas
6	Land Conservation
6.1	**Land acquisition** to protect groundwater
6.2	**Limit road salt use** (usually sodium chloride = NaCl) or use alternative forms of salt to decrease groundwater contamination
6.3	**Encourage/require low groundwater impact land covers** such as forest/woods, prairie, native vegetation (MFL, CRP, CREP, EQIP, local programs)
6.4	**Conservation subdivision standards** that require a portion of the land to be maintained in low groundwater impact land cover.
6.5	**Encourage conservation easements** that protect groundwater through maintaining native vegetation or other means
7	Development restriction/Land regulation
7.1	**Large lot sizes** to protect groundwater for areas with private on-site wastewater disposal systems
7.2	Limit/prevent new residential development in areas with contaminated groundwater
7.3	Encourage land uses that have the potential to pollute groundwater in areas with contaminated groundwater
7.4	Limit residential and commercial fertilizer and pesticide use (one option is through limiting lawn area)
8	Educational programs
8.1	Drinking water testing program
8.2	Other groundwater monitoring program
8.3	Groundwater Guardian program
8.4	Other groundwater education program
9	Remediation
9.1	**A contingency plan for immediate cleanup** to avoid/mitigate groundwater contamination
9.2	Long-term groundwater clean up (brownfields)
10	Intergovernmental cooperation
10.1	Coordination on any of these issues with other local governments
11	Mining
11.1	Water quality
11.2	Water quantity

APPENDIX D: DATA CATEGORIES AND TYPES

What municipal services and local land uses exist?
Municipal water service
Municipal sewer service
Agriculture
Mining
Where does your community's groundwater come from?
Surface watersheds
Groundwater flow direction
Groundwater time of travel maps
Groundwater susceptibility (general)
Soils
Surficial deposits
Type of bedrock
Depth to bedrock
Depth to water table
Are sensitive/susceptible areas within the recharge area identified?
Slopes >12.5%
How much groundwater do your wells currently produce?
Municipal wells - current production
Municipal wells - capacity
Private wells
Estimated community GW pumping rate
Change in depth of water table
Impervious surface inventory
What are the existing and potential contaminant sources that could impact your wells?
Nitrates
Pesticides
Uranium
Petroleum products
Industrial chemicals
Sludge and wastewater disposal
Manure storage and spreading
Whey spreading
Feedlots
Septage disposal
Junkyards
Salt piles
Underground tanks

Pipelines
Highway deicing salt
Overpumping induced pollution (arsenic)
POWTs (septic systems, holding tanks, etc.)
Abandoned wells
Does the quality of the groundwater from your wells meet drinking water standards?
Water quality reports

APPENDIX E: CASE STUDY QUESTIONNAIRE

Case Study Questions for Groundwater Planning Project

What questions are we trying to answer with these case studies?

- Does this type of groundwater protection tool work?
- What does it address?
- Why/how does it work?
- What resources are needed?
  (Check the interviewee's website before interview if possible.)

Introduction

1. Location

2. What groundwater protection strategy was implemented?
   a. Define this tool – *how does it work? Ask for more information to be sent or e-mailed – written description used in its implementation*

Overview/Analysis – People, primary issues and decisions

3. When did this take place?
   Was the tool implemented as part of a plan (e.g. comprehensive, groundwater, or land & water conservation plan)? If so, what goals/objective was it trying to achieve?

4. What was the situation at the time the groundwater protection strategy was put in place?
   Or, did any issues spark the implementation of this tool?
   a. Had there been land use changes? *Development, fragmentation, parcelization, sprawl, development pressure, annexations, new industry etc.*
   b. Any changes with groundwater quality?
   c. What was the economic and political climate like?

5. Who was involved, players?
   Who provided leadership in the change/policy development? *At all levels government, resource managers, public, citizen group, government committee or department, etc.*

6. Why did these people act? *Protect for recreation, tourism, protect economic base, water quality*

7. How did those involved decide what to do? *Public meetings, committee meetings, surveys,* etc.
   a. What other tool options did they consider? What were advantages, disadvantages of some of the options? *Cost, time, resources, interest, etc. Or, why were these tools not chosen in the end? (I suspect there won't be enough time to get into details about the advantages and disadvantages of unselected tools.)*

Decision and effects

8. What was their decision? *Probably the tool we are talking about*
   a. Who was for/against the decision? Why?
   b. How did you convince people who were against it? Or do they still disagree?

9. How much did it cost to implement this strategy? If additional money was spent where did it come from? *Grants, Allocated State money, donations,*
   a. Did you have to hire new staff? What kind of skills did the person need to have to do the work? Did they require training? How much time was spent on the project?
   b. Did you seek any external assistance to help? Was seeking for the assistance easy or difficult?

10. How did people react to the groundwater protection strategy? Did approving and implementing it change the political climate?

11. What were the results on groundwater and on the community? Was it effective? Before vs. after. How long has the change been in place?

12. What would have happened if this type of planning or management was not practiced?

Lessons Learned

13. Suggestions for others trying to do something similar? Anything you would do differently?

14. Do you think there are certain criteria for whether this arrangement would work in a community?

15. Other similar situations you know of? Similar local governments

16. Do you have any additional comments that we have not asked about?

Case study documentation

17. Photos/sketches/maps?

18. Specifics/ specific measurements/ numbers/ specifics on funding/ clarifications?

APPENDIX F: ADVISORY COMMITTEE MEMBERS

We thank the following people for serving on our project advisory committee.

Nancy Eggleston, Wood County Groundwater Specialist
Dana Jensen, Vandewalle & Associates
Sally Kefer, Land Use Team Leader, DNR
Tom Larson, Director of Regulatory and Legislative Affairs, Wisconsin Realtors Association
Pam Lazaris, Planning Service & Solutions, LLC, Private planning consultant
Dave Lindorff, Wellhead Protection Team Leader, DNR
Clarence Malick, County Board Chairman, St. Croix County, Wisconsin
Peter Manley, UW-Extension Community, Natural Resource and Economic Development (CNRED) Educator
Kevin Masarik, Groundwater Educator, Central Wisconsin Groundwater Center, UW-Stevens Point
Ed Morse, Groundwater Specialist, Wisconsin Rural Water Association
Dave Neuendorf, UW-Extension CNRED Educator
Paul Ohlrogge, UW-Extension CNRED Educator
Ray Schmidt, Portage County Groundwater Specialist
Aaron Schuette, Senior Planner, Brown County Planning Commission
Jane Silberstein, UW-Extension CNRED Educator
Gary Van Hoof, Town Chairman, Town of Freedom, Wisconsin
Jim Vanderbrook, Wisconsin Department of Agriculture, Trade and Consumer Protection

APPENDIX G: CASE STUDIES