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Is the State of Illinois Prepared for Water Shortages?

Recommendations for a New Approach to Water Governance

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Water is a universal need, so planning sustainable water management should be equally broad and participatory. An online discussion forum, "Glass Half Full," will allow conference participants and other interested parties to continue reviewing Dr. Wittman's white paper and contribute to an action plan for establishing a statewide framework for water supply planning. The forum is online at www.glasshalffull.pbwiki.com.

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Purpose

In recent years Illinois has made significant process toward inclusive regional water supply planning. However, it remains unclear as to what the specific goals of water planning are, as well as to how regional planning authorities, local jurisdictions, and the state government should interact and share responsibilities. The purpose of this paper is to outline the qualities of an effective statewide plan and framework for regional water supply planning, and to provide background and justification for recommendations on how to structures those systems.

Introduction

Because it is a requirement for all life, water is arguably our most precious natural asset. As our population grows and our communities spread outward, the importance of this resource to the culture, economy, and way of life even in areas previously considered water-rich is becoming apparent. Drought, flood, and contamination make headlines, but sustainable water planning and management can mitigate these crises, and must be a public priority even in periods of relative calm. Sustainability has come to mean many things, but for the purposes of this paper, sustainability is a question whether or not the state has enough water, in the right places, to support the full range of uses (residential, agricultural, industrial, commercial, ecological) we would like for the foreseeable future. If not, we must ask why not. Is it a question of supply, demand, or both? This paper sets out the criteria for a state water plan grounded in this idea of sustainability.

New demands on water from population growth, settlement patterns, and other economic variables in the Midwest have brought the importance of water into public view in new ways. As our nation developed and expanded westward from the Atlantic coast, the availability of fresh water determined the location of communities and the potential value of land. However, current patterns of settlement and population are no longer dictated by the location of viable water supplies. In the past two decades, extended droughts have shown that even cities and regions that normally have ample rainfall can be economically and ecologically vulnerable to shortage. Not recognizing that water shortage could result in unacceptable economic loss and ecological damage is not a risk, it is ignorance. There is often social culpability behind every 'natural' disaster, frequently from a lack of planning and foresight. The consequences are real:

- The 1988 nationwide drought is estimated to have cost the U.S. over $10 billion.
- The recent drought in Georgia and North Carolina has caused at least $1 billion in damage, while demonstrating that growth without preparation can give an entire region an economic black eye. Assuming that we define shortage as the difference between demand and supply, it is clear that growth in water use has made economically prosperous regions vulnerable to shortage.
- According to the Illinois State Climatologist, heavy rain over an eight day period in January 2008 was 334% of normal amounts, leading to severe flooding and millions

of dollars in damages.

Illinois needs to act now. The risks of not planning are too great and the costs of planning are so small that we all have an obligation to begin this process. However, because the climate is *relatively* humid and water supplies are *relatively* abundant, U.S. states east of the Mississippi River generally have less experience managing and regulating water supplies. This landscape has allowed communities in the middle of the country to think about shortages as short-term crises rather than a long-term planning issue. Recently, however, Illinois and the Midwest more broadly may have reached a "tipping point" beyond which demand will increasingly outpace supply.

A New Planning Element – Sustainability

We need a new way to think about and plan for water supplies. What used to matter occasionally now needs constant attention. We need a way to integrate some of the basic problems of community development and a new way to consider the future. One way to describe development that can be maintained for the long-term is "sustainable." In water resource planning, sustainability integrates the values and goals that need to be reflected in order to meet the challenges of growth and the potential for shortages. Sustainable development reduces the risk of conflict by guaranteeing everyone's future.

Natural resource sustainability is commonly defined as "meeting current needs without compromising the opportunities of future generations to meet their needs" (Brundtland Commission, 1987). This seemingly simple concept is a challenge to implement, particularly in the context of water resources and water supply. In order to know if the water supply is adequate we need to measure what is being used, gauge how much is available and predict what will happen in the future. Without technical data and models it is difficult to ascertain what quantity of water use is sustainable. To determine whether current water use can be sustained over a given period, we need to predict future demand and supplies. This requires econometric growth models coupled with information about sources of water, the amount and timing of withdrawal, and the way water is returned to natural systems.

In addition to predicting future demand, any effective sustainable water plan needs to incorporate knowledge about available supplies. Currently, in Illinois, no water management agency has the necessary authority or statutory responsibility to lead a large-scale hydrologic investigation effort that examines all uses and all withdrawals. This is largely because neither water permitting nor water usage reporting are required by the state, which in turn inhibits thorough understanding of past, current, or future water scenarios. Effective water supply management requires that water use records are adequately comprehensive, conservation is a principle of management, and in-stream flow requirements are known in order to predict the consequences of new withdrawals. If there is insufficient water resource monitoring or water use reporting, neighboring water users may inadvertently harm each other by reducing flows, threatening water quality,

damaging aquatic ecosystems or increasing well interference. It is in the best interest of all water users to collaborate to allow cooperation between water users to achieve a sustainable water supply through the next century.

Governance for Water Supply Planning

Ignoring the potential for shortages may be one of the few certain threats to our future. Fortunately, what is required does not demand new scientific discoveries, extraordinary amounts of money or additional international treaties (discussed below). The work is technologically sophisticated but, like most engineering, it is manageable, straight-forward, and predictable. The most difficult aspect of any new approach to dealing with our water supply is that it requires the community of users to reconsider the availability of what many see as an infinite resource.

Responding to the challenges of growth and the memories of shortage, states in the middle of the country are beginning to change the way they evaluate, manage, and use water resources. Michigan recently invested in a groundwater availability mapping program. Kentucky has been working for over a decade to develop county and regional water supply plans. Although Minnesota has been involved in water supply planning for many years, over the past two years it clarified its role in regional and local water supply planning efforts. Indiana is currently revising its statewide water shortage plan. Illinois is in the middle of a multi-year process of regional water supply planning in two very different parts of the state.

The key to effective policy in the Midwest is recognition of the fact that the climate makes it possible for all water users to be satisfied most of the time. Water supply planning requires societal choices that are naturally constrained by regional geography and climate. When people cooperate and act in their *collective* self-interests, the risks of shortage can be minimized or eliminated. This is a problem of management and regulation that has solutions bounded only by governance and hydrology. To reduce our collective risk, we need to know how much water we use, how much water there is in different regions, and establish a public process to prioritize the uses of water within any region.

Balancing interests is the traditional role of government. Public agencies have the ability to arbitrate disputes, set priorities, and establish processes that are "fair" to the participants. Most importantly, government has the power and responsibility to provide funding that will implement the law.

Across the country, water supply

Governance is Key

In March of 2000, the Global Water Partnership, a partnership of government agencies, public institutions, private companies and others created to support countries in the sustainable management of water, declared that:

"The water crisis is mainly a crisis of governance. Working towards effective water governance requires an enabling environment and appropriate institutional structures that allow stakeholders to work together for effective water management. Financial practices should be realigned to support the sustainable use of resources."

planning and governance have shifted from technical, quantitative, supply-driven, centrally controlled management to more demand-sensitive, qualitative, regional, participatory, integrated approaches (Viessman and Feather, 2006). In most areas that have evolving water policies, the motivations for these changes have been recognition of resource scarcity (sometimes including climate change predictions), an increasing number of water users, urbanization and the public call for more sophisticated water management systems.

Illinois has not been idle. The state has taken some important steps in the right direction towards regional water supply planning that attempts to be inclusive and open, while maintaining a technical credibility needed to reach consensus on priorities. More needs to be done, however. This paper acknowledges these recent efforts while raising important questions about the next phase of the process of water supply planning in Illinois:

- What are the necessary elements of any water supply planning process?
- What are the qualities of an effective plan?
- What current law governs water use in the state?
- Are current laws adequate to ensure viable future resources?
- Which jurisdictions need to be responsible for water supply planning?
- Does the technical infrastructure of the state need to change?
- How do we account for the needs of the natural system?
- How does water supply planning connect to land-use planning?
- Are there special challenges that we should anticipate?
- How does agriculture fit in this picture?
- How should the state implement a water management program?

This paper will address each of these questions and make recommendations about how we need to proceed. The state is at a critical point in a pilot planning process — a major driver of this paper to be discussed later — and throughout the nation other states are beginning regional planning projects of their own. In the last two decades the number of states that are engaged in water supply planning has more than doubled (Viessman and Feather, 2006). This paper attempts to look ahead in order to see what is around that corner so we can make the most of the resources, time, institutions, talents, and goodwill that have been invested in this effort. The first part of this analysis considers the qualities of an effective planning process, then compares them to the Illinois' current planning paradigm.

Requirements for Water Supply Planning

States engage in planning for different reasons. Some states are working to achieve a single purpose while others have developed integrated planning processes. However, the process of planning, regardless of the intent, has the same elements. These include:

- Clearly defined goals and monitoring of outcomes

- An understanding of the resource
- Active stakeholder participation
- Regional scale planning
- Solutions that adapt to new conditions
- Practical implementation plans

In 2006, the State of Illinois embarked on a pilot planning process that includes many of these elements. Before 2006, however, any activities related to these planning elements were not coordinated in any meaningful way. Some of these planning elements are directly addressed in the current regional planning initiatives, while others are beyond the scope of the pilot projects now underway. Based on our experience working with water supply planning programs in many other states, there seems to be a set of factors that determine whether these planning elements can be achieved. These factors are, for the most part, principles that reflect the need for a technically credible beginning point for the discussion, a reasonable geographic scale that makes planning meaningful, trust among the stakeholders in the process, and equity among the entire water-user community.

Planning for shortages requires planning for both the prospect of growth and the potential for drought. While each state has a particular setting that changes the emphasis of the plan, the success of any particular state's approach for dealing with shortage is determined by how well the affected area responds when the event occurs. Is there economic shock? Are there serious environmental problems? If the problems are anticipated and there is an effective contingency plan, the risk of adverse impacts due to shortage should be reduced.

The following describes some of the factors that affect the success of water supply plans and explains why each is required for a regional planning effort to succeed.

Clearly Defined Goals

A common problem faced by any organization is demonstrating success without having clearly defined goals. Clearly articulated goals make it possible to measure the performance of any program in a way that can be balanced against whatever time or resources are needed to meet the objectives. Many western states have well-established long-term water supply goals that guide their efforts. For example, in many states the goal is determining whether water is available for new users. East of the Mississippi, however, most water supply planning is related to preparing for droughts or other water shortages of limited duration. Consequently, the emphasis is on regionalization, infrastructure, and determining the priority for different water users. In any case, there can be no successful state or regional program that does not have a well-understood and unambiguous purpose with a set of goals that follow naturally from that objective. One of the stated goals of any plan should be sustainability.

Most modern water supply plans use a 30 – 50 year planning horizon to assess

sustainability of the anticipated uses. The concept of sustainability is that our choices about how we use water today should not reduce the range of choices we have in the future. As a practical matter, long-term thinking requires that the planning process incorporates a specific time frame to evaluate proposed or anticipated withdrawals based on their ability to produce the needed water without adverse effects over that period. In many states, water supply plans that are designed to account for the effects of existing and anticipated water uses on the resource for the subsequent period also include the effects of climate change. This requires assumptions about the demographic and economic changes that may take place as well as anticipated changes in water use and availability.

An Understanding of the Resource

A water supply plan is a description of how to manage the water budget. The water budget analysis needs to be based on observations and data that are not subject to debate or argument. The conflicts that arise over prioritizing water use options are difficult enough without the added burden of uncertainty regarding the amount of water withdrawn by each user and how much the resource can supply.

Since water supply planning is a process of reconciling the demand for water with the available supply, it requires an accurate estimate of the withdrawal and the dimensions of the resource. Accurate information that is both credible and sanctioned by a state institution is needed to limit potential conflicts among water users. Further, water use information needs to be provided at a temporal scale that is appropriate for planning. Because shortages of water can often be transient or seasonal, water use information is needed on at least a monthly basis. Water supply planning and demand analysis is a technical undertaking and most states that have successful programs use a variety of technical staff and consultants to manage this effort. Comprehensive, accurate, timely data are the supports on which effective planning is built. Successful planning hinges on synthesizing comprehensive reports of uses, supplies and distribution patterns.

Historically, the focus of attention in water supply planning has been on developing supply to meet growing demand. However, in the past decade all of the states that are actively encouraging water supply planning have recognized the obvious benefits of managing demand as one way to reduce the risk of shortage. In fact, many areas of the country have seen that demand management is the most cost-effective "source of supply" available to most communities. Recent research suggests that the effectiveness of demand management is most apparent when accompanied by increasing block rate structured water pricing (Kenney at al, 2008). This approach to water pricing helps send a signal that links water use and cost. This has been shown to magnify the impact of water conservation public information campaigns. These policies are very effective in areas with predominantly residential, commercial and industrial uses; surprisingly only 17 communities in northeastern Illinois use an increasing block rate water pricing approach..

One leader in demand management is the group of utilities that serve the Puget Sound area of Washington State. This region has seen per capita water demand decrease as a result of well-funded educational campaigns along with infrastructure improvements. This approach (reducing peak demands and unaccounted for water loss) allows the cooperating utilities to spend much less on water supply development and attend to the serious problems attributed to climate change. However, without readily available supply and demand data, the benefits of increasing block rate pricing are mitigated.

From a water budget perspective, it does not matter whether water pumped from a deep aquifer is used for manufacturing, cooling water, or public supply. The only relevant information is how much water is pumped, when, where, and how is it discharged. The state of Illinois does not require that water use be reported. Reporting is voluntary, and the quality, consistency, and dependability differs between industrial, commercial, residential, and agricultural uses. In other Midwestern states there is no differentiation in reporting requirements between water users. This equity assures that all water use is considered when planning and is one of the fundamental principles of water supply analysis. From the resource perspective, water use is water use.

In these other states any person withdrawing water from the state-owned supply has the same obligation to report that use to the state. In some states (notably California) there is a different reporting requirement for groundwater and surface water withdrawals and this difference has caused significant problems. In California groundwater use does not require an application for an appropriated claim to the resource and the connection between groundwater and surface water is not recognized. However, in many Midwestern states such as Indiana, and in southern states, including Arkansas, all water users, including agriculture and industry, are required to report their water use, regardless of source and use. Reporting all water use is less an issue of equity than it is of accounting.

Active Stakeholder Participation

In the past, many states conducted water supply planning as a top-down survey process. Water supply planning was done by the staff at state agencies rather than by the water users. In every state that has recently developed water supply plans, the planning process is distributed and participatory and each water user group is involved. In Virginia, Texas, and Wisconsin, water supply planning is supported by state agency staff but the work is conducted by representatives of the water user community. This broad perspective provides water users with a voice that reflects their varied interests and concerns; this allows state-wide planning to reflect the diversity of needs across the state.

In Illinois, this approach is reflected at the regional level as multiple interests participate in discussions about water supply. Until recently, however, that conversation has occurred primarily in the political arena. The shift in focus that was initiated by the regional planning process has forced some of the primary stakeholders to listen to other perspectives, consider the limitations on the resource and weigh their own responsibility to reach consensus. When all parties are sitting at the same table it is clear that the

regional resource must satisfy the needs of many users and the ecosystem.

In the end, the quality of the plan is directly related to the quality of the data, assumptions that form the basis for predictions, the diversity of involvement in formulating the strategies for managing shortage, and the degree to which it reflects the broader public interest. While technical credibility of the work is necessary, the best plans will be those that reflect the broadest range of interests. Local governments, water utilities, agricultural producers, commercial interests, industrial water users, power companies, and environmental advocates all need to be represented in order for the plan to have any chance of success. The foundation of an effective stakeholder-driven plan is that it will be developed by consensus. This does not mean that all parties are unanimous or they share the same values. Instead, a consensus process is flexible and inclusive and the results are mutually shared responsibilities and shared control of the outcome. In a consensus process the participants are the decision makers and consequently all participants are committed to implementation of the agreement.

Regional-scale Planning

Water, whether in rivers, lakes, or aquifers, does not conform to traditional political boundaries. One of the reasons that new policies and legal frameworks for water governance can fall short of expectations is that we have few regional institutions which can better and more fairly address hydrologic complexities. Municipalities are simply too small to deal with water systems, while states are too large to deal with differences in usage from region to region. While the state can and should be responsible for setting some overall goals – better data monitoring, reduced per capita water usage, etc. – how those goals are realized will need to differ between regions according to the interests, uses, and hydrologic underpinnings of that region. Demand management strategies, for example, will be substantially different in a predominantly agricultural region than in a more urbanized one. Regional-scale planning facilitates this kind of contextually-sensitive decision making, while also reducing some of the competition over resources that often occurs at the local level.

Regional governance is new and the problems being addressed do not fit naturally within municipal or county boundaries. Historically in the U.S., water supply problems east of the Mississippi River have been addressed locally by the water supplier. However, since water demand increases and available water supply declines within hydrologic regions, the problem of shortage needs to be addressed at that same scale. Multiple cities and counties need to cooperatively evaluate their demand and compare that to the supplies that they use collectively. This analysis needs to account for the prospect of regional drought, the increased withdrawals from economic growth, as well as unanticipated water use from any new industrial application (e.g. ethanol production).

Regional discussions of water shortages are new to most of the state. (Chicago has been dealing with Great Lakes water issues for several decades.) However, the fundamental issues are familiar to the *local* water users who are the ones directly involved in the new

regional planning process. The scale of hydrologic problem-solving makes regional planning necessary but that does not mean that inter-jurisdictional processes are simple. Regional decision-making structures require consensus and cooperation, and decisions must be backed by some degree of authority. Consequently, implementation of any new governance system at that scale takes more time and requires more public involvement. While it may be true that regional authority is not common in much of Illinois, recent experience suggests that visionary leadership and recognition of common interests will overcome this problem. However, statewide goals and a statewide framework for regional water supply planning is needed in order to determine what the regional planning groups will be striving for and how neighboring regions will relate to each other.

Solutions that Adapt to New Conditions

There is no perfect law, policy, or program and it is clear from our review of various state programs around the country that water use and availability is changing. No matter when it gets started or how well it is planned, any effective water supply program will need to adapt and adjust to new conditions and issues as they arise. If the resource is already heavily developed, the difference between sustainable supply and demand may be diminishing.

The technical sophistication of water supply planning will necessarily evolve with the understanding of the scope and scale of the problems of shortage. Implementation of a water supply plan means that for any regional supply (e.g., a reservoir, river basin or aquifer) the effects of new users need to be determined. Regular updates help to maintain the perspective within the planning process and help to stabilize institutions that rely on those forecasts. Regular revisions of regional water supply plans should be synchronized with county comprehensive planning. In other states (e.g., Virginia and Texas) the statutory requirement is that regional water supply plans are revised on a 5-year schedule. Given the cost and effort associated with development and management of water plans, a five-year revision schedule seems to be appropriate for most states.

Practical Implementation Plan

A plan that cannot be implemented has no practical value. Any planning effort that is not funded appropriately, like any other important state economic development infrastructure, is bound to fail. A bridge that is not inspected poses a risk. Communities that rely on water supply infrastructure without plans for shortage are also at risk. The only way to minimize risk is to understand the potential for shortage and to determine beforehand how the different water users can respond when that occurs. This requires funding to help facilitate the process of regional planning.

Broadly speaking, there are three common strategies for implementing state programs:

1. regulations with mandates

2. voluntary cooperation
3. incentives that may be related to prices or the market.

Based on a review of other state planning programs it seems that each of these strategies fits separate elements of a multi-jurisdictional, state-regional-local water governance program. The implementation strategy employed needs to be a reflection of the nature of the problem being addressed. For example, it might be necessary to mandate that each region requires rate structures for water purveyors that could be deployed in the event of a regional water shortage. The rate structure, however, could be established to reflect the relative risk of shortage in each region. This means that a basin with low water use and plenty of water would be less likely to initiate a drought pricing system than an area that has increasing demands and limited supplies. In this example the incentive would reflect the current difference between existing supplies and peak demands.

Performance Measurement

Water supply planning at any level – federal, state, regional, local – needs to be a self-reflective process that includes frequent monitoring and assessment of certain goals. In the absence of clear goals, as is currently the case, no real performance measurement is possible. Developing indicators for each of the six qualities of an effective plan would help to ensure that investments of time and money were as prudent and transparent as possible, that priorities were treated as such, and that conflicts between jurisdictions could be mediated in an objective manner.

Water Law and Policy in Illinois

Like most of its Midwestern neighbors, Illinois has no constitutional guidance and limited statutory language to support water supply planning. Historically, local municipal jurisdictions oversee water supplies, generally without any way to consider other regional water users or the natural boundaries of the water resource. While the western states work with an appropriation of water rights, water law in the rest of the U.S. is often described as regulated riparianism.

Regulated Riparianism and Annual Voluntary Reporting

For surface water, Illinois water law follows the so-called "riparian principle," which means that if any party has land with direct access to a stream or lake (in the riparian area along the water), they have the property right to use as much water as needed without harming their neighbors. Only large withdrawals of groundwater (greater than 100,000 gallons annually) are regulated by the Illinois Water Use Act of 1983 which requires notification and review of likely impacts before construction – but not water use reporting.

Within this regulatory context, there is no statutory authority for a state agency to obtain information about water use or to manage supplies in aquifers or surface water sources.

Unlike most of the neighboring states that require monthly reporting by all water users, in Illinois annual water use is voluntarily reported to the Illinois State Water Survey (ISWS) by high-capacity users. The voluntary nature of the reporting makes it impossible to determine how much actual use is at any given time. Further, unless a neighbor notices a problem with their well, there is no way that the state can limit water withdrawals.

Lake Michigan and the Great Lakes Compact

— Some 6.8million residents of Illinois rely on Lake Michigan as their source of water. Lake Michigan water that is used in Illinois is diverted to the Mississippi River watershed. That diversion is governed by a 1967 U.S. Supreme Court decree and by the Great Lakes Charter, an agreement between the United States and Canada signed in 1985. While significant progress had bben made since 1985 in restoring the health of the Great Lakes Basin, the ecosystem still remains at considerable risk. To provide additional protections to the Great Lakes, the governors of the eight states that border the Great Lakes — Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, New York, and Wisconsin — and the premiers of the Canadian provinces of Ontario and Quebec signed the Great Lakes Water Resources Compact n December 13, 2005 by. The agreement requires approval of each of the state legislatures before final approval by Congress. The Compact strengthens the provisions of the Great Lakes Charter and provides unprecedented protections for the Great Lakes–St. Lawrence River Basin, placing constraints on who can use the water, how much is available to them, and providing a framework for each state and province to enact protective laws. The Compact includes a ban on new diversions of water outside the Great Lakes Basin with limited exceptions.

Minnesota was the first state to ratify the Compact in 2007. Illinois became the second state when Governor Blagojevich signed legislation on August 17, 2007. In 2008, both Indiana and New York ratified the compact. Legislation is waiting for the governor's signature in Michigan and legislation is pending in the remaining states.

The Illinois Department of Natural Resources (DNR) is charged with equitably allocating Illinois' limited supply of Lake Michigan water. The objectives of Illinois' allocation program are:

- To make the greatest amount of Lake Michigan water available for domestic water supply.
- To use Lake Michigan water to preserve groundwater resources for communities in northeastern Illinois who will not have access to a Lake Michigan water supply.
- To make long-term water commitments so that communities receiving an allocation for the first time can secure financing to build distribution systems.
- To carefully consider the competing needs of all water users in the region so that allocations promote the efficient development of water supplies in the region in light of long range needs and objectives.
- To require all users of Lake Michigan water to conserve and manage this

resource.

Water Authorities

One of the laws that governs water use in the state is the Illinois Water Authorities Act of 1951. The Act has been used to manage conflict with municipal or industrial water users that are attempting to pump from the same regional water supplies by allowing a local entity to monitor and allocate water use in a specific geographic location to meet demands of many users. There are currently 16 water authorities established in Illinois. The majority of the water authorities are located in east-central Illinois where high-capacity water users have access to several sources of groundwater, including the Mahomet Aquifer.

The statute allows any contiguous area containing greater than 500 legal voters to form a "water authority" after a general election. Authorities are usually formed based on political boundaries as opposed to the natural boundaries of the resource which can be problematic for effective water supply planning.

The authority has the power to:

- inspect wells or other facilities
- require withdrawal and use information and data from well owners
- require well registration
- require permits for additional wells or withdrawal facilities
- require proper well abandonment
- regulate water during any actual or threatened shortage
- supplement the existing water supply, buy property, operate wells, treatment plants, and sell finished water
- levy a general tax within the geographic limits of the authority

Over the past several decades Water Authorities have created a patchwork of local controls that are designed to protect the non-municipal water users in each area. Because the law was initially intended to protect rural water users from the potential expansion of municipal development outside of city limits, the provisions of the Water Authorities Act do not apply to water used for agricultural purposes, farm irrigation, or for single family homes. In addition, there is no single source for water use information within water authorities in the state and there is no way to link the effects of use within one authority to use in adjacent wells.

The Illinois Water Authorities Act has allowed agricultural water users to effectively organize and advocate for agricultural water use rights. These authorities represent the interests of one of the most important elements of the economy and culture in rural Illinois. However, since the statute specifically prohibits any regulation or management of some types of water use, a water authority is incapable of solving the fundamental

problem of water supply management – balancing available supply to demands. Effective water supply planning should not be restricted to only certain water users .

From a regional water planning perspective, the existing Water Authorities in Illinois are anachronisms. They have been effective organizational structures for the voice of agricultural interests but they are not useful at the regional scale. The regulatory powers of the Water Authority however, are considerable and may be useful if they become available to a regional water supply planning group. While this law worked in 1951, new laws are needed to deal with the challenges of growth and potential shortage that we face today.

Regional Water Supply Planning - Executive Order 2006-1

Following the drought of 2005, Illinois Governor Blagojevich issued Executive Order 2006-01 to develop a statewide water supply planning and management strategy. The two areas selected to begin the process of developing Regional Water Quantity Plans were identified as the two Priority Water Quantity Planning Areas most at risk for water shortages and conflicts.

The East Central Water Supply Planning Committee comprises 15 counties that have access to the Mahomet Aquifer. The population of the east central region is increasing but the primary water use varies from public supply on the eastern side to primarily agricultural uses on the western side. In this region conflict could result from the variety of agricultural uses (both direct irrigation application as well as indirect uses related to ethanol processing) and increasing demand from municipal drinking water systems. In addition to providing a drinking water source for many smaller towns and rural areas in central Illinois, the Mahomet aquifer is the source of water for the larger communities in the region that have been using more water as they grow. As the agricultural economy in Illinois has grown stronger, irrigation has increased and and new ethanol production facilities are being constructed. It is unclear whether the regional aquifer will be able to satisfy the needs of growth for the next 50 years.

The Northeastern Illinois Regional Water Supply Planning Group comprises 11 counties in the extended metropolitan area of Northeastern Illinois that tap the deep bedrock aquifer system. Over the past several decades, population growth and the outward migration of people and jobs from the region's urban cores to suburban and ex-urban areas with large-lot development patterns have resulted in proportionate increases in the household demand for drinking water. The combination of residential growth, falling water levels in the deep bedrock aquifer, and limitations on Lake Michigan water, creates another set of unresolved questions about whether the demand will (or already has) outstripped the available supply. In northeastern Illinois, shallow aquifers and surface water sources are being used, but because the water use data are poor and the planning process has only recently begun, it is not clear what the final implications of that usage are.

For the regional planning process, knowledge of the available water supply in each area is being provided by the Illinois State Water Survey (ISWS) and the Illinois State Geological Survey (ISGS), the primary scientific research agencies for groundwater and surface water resources in Illinois. These two state agencies are responsible for updating and expanding the water resource information necessary for regional planning. The Illinois DNR administers the planning process, monitors the work of the ISWS and ISGS, distributes state funds to the Regional Planning Groups and directs the planning initiative. Other than the few statutes that outline the State's role in water use decision-making, there is no specific guidance the DNR uses to evaluate the suggestions made in the two regions.

Implications of Current Law

Like most of its counterparts in the Midwest, Illinois is operating with a set of statutes that were written to respond to different water supply conditions than the state is now facing. In fact, based on this review it appears that the various water laws in the state address a limited subset of the overall water supply problem. Existing water law does not regulate many water users and in fact, water used for commercial purposes is protected as "proprietary" under current rules while water use for irrigation (by far the largest water users in some parts of the state) is only voluntarily reported.

The 1983 Illinois Water Use Act does not recognize a connection between surface and groundwater. Consequently, in-stream flow requirements may only limit withdrawals directly from the stream and that limit is based on the low-flow requirements written into individual National Pollutant Discharge Elimination System (NPDES) permits or federal permits for power plant cooling. Withdrawals from alluvial aquifers that intercept water that would be discharged to a stream are not considered. These alluvial aquifer withdrawals may reduce flows either by reducing stream discharge or by pulling surface water out of the stream and into the aquifer as "induced recharge."

The Illinois Water Use Act of 1983 has been largely interpreted in litigation. The statute requires that water users notify the local Soil and Water Conservation District when a new well is expected to impact existing water users. Unfortunately, there is no formal mechanism for determining if an impact could occur (Clark 1985). This law has not been implemented in part because there has never been an established approach for determining, beforehand, whether a new well would harm existing water users. The Act differentiates between "natural" and "artificial" wants and has been interpreted by the courts in a way that gives some users (e.g., drinking water) priority over other uses (e.g., irrigation and manufacturing). This is contrasted by the fact that there is no legal requirement that all water users (including irrigation, power plants, manufacturing, and municipal drinking water suppliers) provide records of annual use so that one user can evaluate their potential affect on another.

The Illinois Water Authorities Act provides some protection for private well owners and agricultural interests from other high capacity water users. The boundaries of the authorities are flexible but inevitably fairly local. They are not, for the most part, defined by the dimensions of the water resource. Instead the boundaries are pragmatically political. In addition, the statutory limits on the ability to regulate, record, or manage agricultural water use make this law an unworkable device to implement effective regional water supply management.

The regional water supply planning work being done as a part of the Governor's Initiative is an attempt to develop a modern water supply program. Although funding is limited, the work being done shows promise and may chart the course for the future of water supply planning in Illinois. One of the key elements of the initiative was the specific provision that the the planning process would not alter existing water law. It is likely that existing state law will need to be changed to reflect the character of the problem and the urgency of securing our future water supplies. Many other states have been developing new water laws that require an assessment of existing and future water use in order to compare that to available water resources.

Roles and Responsibilities

State water management programs require a logical distribution of responsibilities among local government, regional planning authorities, and the state. In Illinois, most of the work of water management and planning has historically (and informally) been done by municipal water utilities and individual water users. While local governments may or may not be included in the planning process in different areas, to date the scale of water supply planning in Illinois has always been relatively local. Water supply, treatment, and distribution infrastructure has been managed by the developer, without reference or reporting to neighboring water users, let alone regional suppliers. Water supply development in the absence of any regulatory framework generally leads to retrospective analysis of problems and, ultimately, crisis management.

Because it has been more than two years since the January 2006 Governor’s Executive Order, at least in two important parts of the state, water users and many local governments have had the chance to grapple with the process of regional water supply planning. In each of the two pilot study regions, water users are considering how to estimate future water use and distribute that use through the year using limited historical water use information. This exercise has been a test of the ability to estimate future use, evaluateand propose future development and growth scenarios, and project future demands. Likewise, it has been a test of the State Water Survey as the technical institution responsible for integrating available data on hydrogeologic conditions and water use to model and predict future water availability in the two regions. The regional water supply planning groups have struggled with the difficulty of reaching consensus among water users regarding anticipated growth rates, consumptive use, the effects of price on demand, and the best approach to communicate with the public. The regions

have learned how to think about the problem while reviewing demand forecasting models that use anticipated population and economic growth to predict future water use.

In the past the institutions and agencies responsible for different elements of water resource development and water quantity (ICCG 2002) have lacked coordination, The Illinois Department of Natural Resources is the administrative agency responsible for resolving water use conflict but it uses the technical resources of the Illinois Geological and Water Surveys. The Illinois Environmental Protection Agency protects water quality and helps define the needs of natural areas but it is not directly tied to water supply decision making. The federal government also plays a role in water resource analysis. The U.S. Geological Survey adds to the discussion by estimating unreported water use and working for various levels of government collecting data that helps describe large-scale hydrologic processes that may determine the options for water supply. None of these agencies has the statutory mission of planning for water shortages, let alone the budget, staff or regulations to guide the collection of comprehensive water use data. In fact, the state's role has historically been to collect data that can be used by those who are concerned about a local problem.

Recent experience with regional planning has given the various stakeholders a chance to experience cooperative planning based on a stable technical basis and consensus decision-making. However, it is not clear how either the state or municipalities will relate to regional plans, and vice versa. Neither the state nor the regional planning groups had any previous experience in regional planning, and thus the regional planning groups had to define the planning process, methodology, and goals of the planning process. Moving forward, ideally as regional planning groups are established throughout the remainder of the state, these functions will be the shared responsibility of state and region. The table below outlines potential responsibilities for local, regional, and state authorities, as well as the current status of the activity in question.

Table 1.Potential responsibilities for jurisdictions involved in water supply planning

Jurisdiction	Responsibilities	Current Activity?
Local	Infrastructure planning	■
	Establish prices for residential use	■
	Integrate water planning with comprehensive land use planning	●
	Performance assessment	▲
Regional	Determine regional priorities	●
	Develop consensus on strategies to meet planning goals	●
	Define future growth and use scenarios	●

	Make recommendations on development of significance to regional water use	●
Shared by Regional/State	Define the regional planning process	●
	Determine objectives for water supply planning	▲
State	Establish rules and authority for water planning	▲
	Collect water use data, project supply and demand	●
	Financial and technical support	●
	Develop technical expertise on water management strategies in order to assist regions and states	▲

Current activity	■ is well established responsibility ● reflects recent or limited experience ▲ a role that has not existed previously

Current Planning Challenges

The 2002 report on Integrated Water Supply Planning and Management (ICCG, 2002) attempted to look ahead at the water supply problems that could be facing the state in the future. It suggested that the effects of climate change as well as the impact of increased ethanol production needed additional study. The challenges described below are based on the fact that 1) the Great Lakes Compact is likely to be ratified by all of the Great Lakes States in the not-too-distant future; 2) there is now consensus on the fact of climate change but it is not clear how it could affect water resources; and 3) ethanol has become one of the important markets for the agricultural economy in the Midwest.

Great Lakes

As more Western States come to terms with their indigenous shortage of water and begin considering more distant sources of supply, the states and provinces in the Great Lakes Basin need to protect their collective future by carefully managing the resource. The Great Lakes Charter of 1985 and now the Great Lakes Annex of 2001 were designed to articulate a regional policy that "... would protect, preserve, restore and improve the Great Lakes for the use and benefit of its citizens." In 2005 the Great Lakes Governors signed the Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement and then called for the legislative enactment of the companion Great Lakes – St. Lawrence River Basin Water Resources Compact.

The Compact provides a framework for enacting laws to protect the Lakes. The Compact and the Agreement work together to encourage efficient use of existing resources and the need for conservation strategies in any development. The Compact is designed to articulate the terms of an agreement that balances the need for economic development and environmental protection. Elements of the interstate compact include the following:

- Economic Impact: Development will be fostered through the sustainable use and responsible management of Basin waters.

- No New Diversions: There will be a ban on new diversions of water from the Basin. Limited exceptions could be allowed, such as for public water supply purposes in communities near the Basin, but exceptions would be strictly regulated.

- Consistent Standards: The States and Provinces will use a consistent standard to review proposed uses of Basin Water.

- Regional Scale Planning/Review: Management and Regional goals and objectives for water conservation and efficiency will be developed and they will be reviewed every five years. Each State and Province will develop and implement a water conservation and efficiency program.

- More Data Needed: The collection of technical data will be strengthened and the States and Provinces will share the information, which will improve decision-making by the governments.

- Public Support Needed: There is a strong commitment to continued public involvement in the implementation of the agreements.

The the agreements and the Compact were developed through a formal collaborative process involving all of the state and provincial governments (see Figure). Reaching agreement was not simple and much of the success of the process is attributable to a system of decision-making that included policy and technical professionals, stakeholders, the rights of Tribes and First Nations and a systematic committee structure. The Governors were represented by a Management Team that was advised by the Water Management Working Group. The Working Group had separate subcommittees that developed the agreement, another that proposed standards for reviewing proposals for new withdrawals, and another that developed the international Sustainable Water Resources Agreement. There were also three teams that were organized to provide special advice on legal issues, Tribal/First Nation rights, and communications for public outreach. The working group also employed the staff of various federal level agencies as a “Resource Committee” and an “Advisory Committee” was established to facilitate the consideration of the various stakeholders in the Basin.

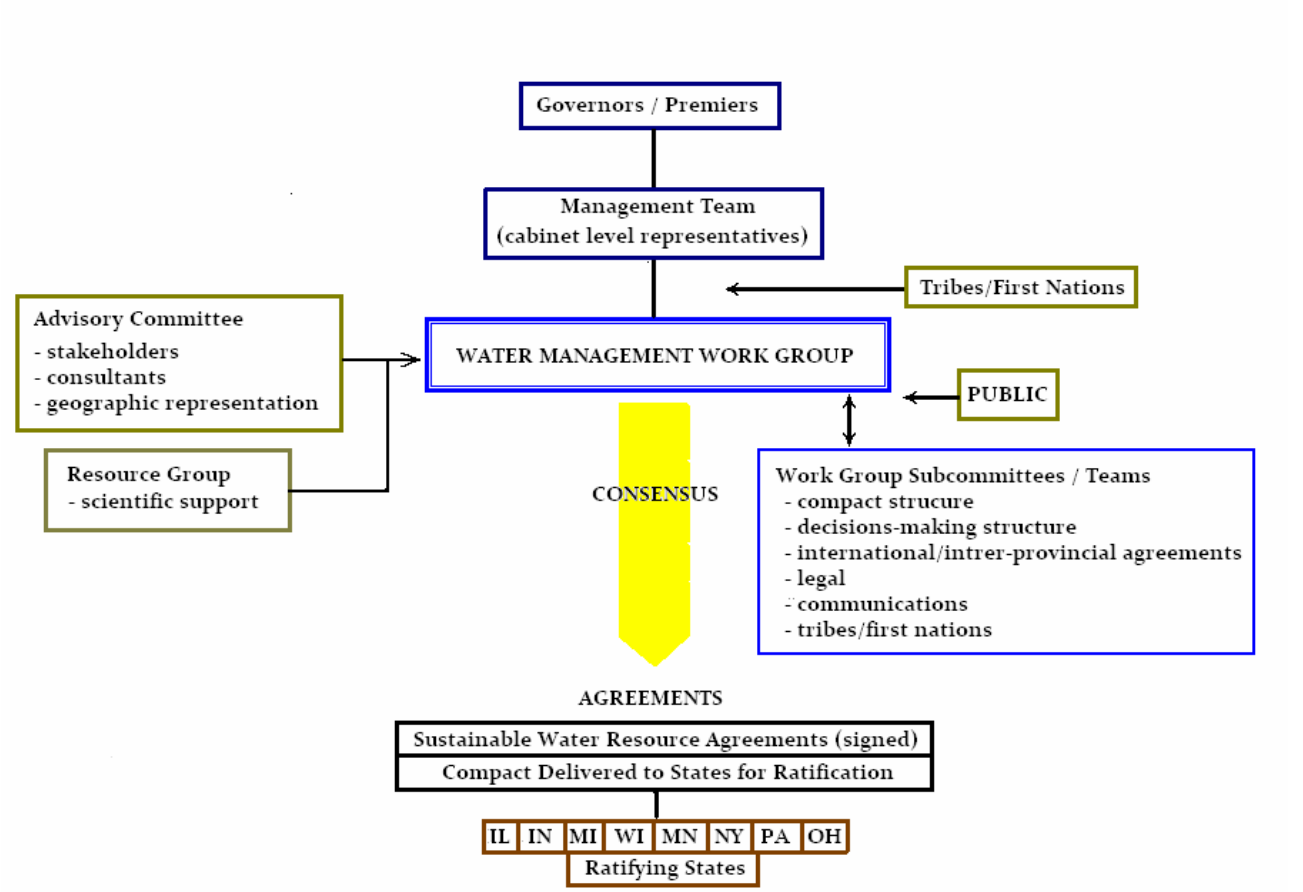

Figure 1: Organizational and Procedural Flow Chart that Explains the Development of the Great Lakes Compact Agreements

Climate Change

Groundwater resources are already under pressure because of increased demand from population growth, settlement patterns, and other economic variables. In some areas global climate change could increase this pressure by reducing regional surface water availability and altering groundwater recharge and use. The most recent data and modeling results suggest that the effects of regional climatic change on water availability will not be evenly distributed. Regional and local modeling experience, along with published reports of changes in the effects of recent annual droughts indicates that what ever impacts are felt in the hydrologic system, they will cascade from surface waters to the regional aquifers. If climate shifts begin to increase the duration of dry periods or cause more intense regional rainfall, those changes will be observed first in the streams that drain the landscape. Higher flood flows or more frequent dry spells will shift the flow duration curve in streams and alter the ecosystems while changing the reliability of surface water as a source of supply.

The effects of climate change on low transmissivity aquifers (both local and regional) will also be important and there may be a rapid reduction in local groundwater availability. However, where the deeper regional aquifers are covered by overlying high transmissivity glacial aquifers, they will be protected from climate change by the buffering effect of leakage through the system. While reductions in recharge may alter water levels and flows in the upper aquifers, the effect of such a change will be reduced where the shallow aquifers are more transmissive or the water levels in the aquifers are controlled by many surface water features that are maintained by runoff and shallow groundwater discharge. For the State of Illinois, this means that regions with multiple aquifer systems and more rivers (in the North) are less likely to experience loses from climatic change compared to the unglaciated areas further south, where there are fewer aquifers to store recharge and only a few reservoirs to store runoff for the dry seasons of the year.

Substantial reduction in recharge (due to climate change) is unlikely to affect the production potential of the regional aquifer system where the bedrock is currently used by high-capacity wells. For the most part, these are the areas where the aquifer system is both transmissive and water level declines have stabilized. However, in areas further from streams, where the upper aquifers are absent, severe reductions in leakage (recharge) could dry up streams. The reduction in perennial streams will cause a positive feedback process that could magnify the head losses in the deeper aquifer. In effect, this means that any reduction in recharge could alter current use in areas where the regional bedrock aquifer is already an unsustainable source of water.

The impacts of a long-term reduction in recharge to the regional bedrock aquifers is almost entirely masked by changes in groundwater use. The amount of water entering the regional aquifers will depend on the impacts that occur in the overlying aquifers. Research has shown that local details may be required to sensibly predict local climate change impacts. Rather than attempt to simulate flow in the entire region in great detail, statistically significant changes in either the stream flow or shallow aquifer water levels can be used as the “canary in the coal mine” – helping us anticipate any impacts of the cumulative reductions (or increases) in regional water budgets. This information can only be exploited if enough geographically distributed, high-quality data is collected to use as a baseline for comparison. Monitoring shallow and deep aquifer water levels, as well as stream flows in headwater areas that are first affected by seasonal drought, is critical to mapping the vulnerability of our water supply and designing a technically sophisticated climate change response plan.

Water-resource risk assessment and planning are currently based on the assumption that precipitation and streamflow fluctuate within an constant envelope of variability. But all of the recent data suggest that the anthropogenic change of Earth's climate is altering the annual average precipitation as well as the variation of each value (Kerr, 2008). The problem is not only that the assumption of climate stability is embedded in our

assessment of the resource, we are not sure how to incorporate the work of the water manager in the analysis.

When water becomes scarce, a rapid exchange of information is necessary between the scientific realm and water managers. New, higher-resolution models could then represent surface- and ground-water processes more explicitly. These models need to include water infrastructure and water users, including the agricultural and energy sectors. Models can be used to interpolate between observations, but even this should be done cautiously. Instead, the most recent research suggests that we update the analytical strategies used for planning when the record is shifting.

Ethanol

With the increasing cost of petroleum there has been a surge in new investment in alternative forms of renewable energy. Federal subsidies for biofuel production and a variety of legislation promoting renewable energy research, development, and production have guaranteed prices for ethanol that are designed to help the country take steps to move away from our current dependence on fossil fuels.

This shift has provided a favorable economic development opportunity in the Upper Midwest, but it is not without ecological and economic costs. Currently, ethanol from corn is the primary biofuel being produced in the United States. Illinois in the heart of the corn belt is ideally situated to be a center for the ethanol industry. State legislation is currently being considered to create multiple economic incentives to make ethanol production in Illinois competitive with neighboring Midwest states. The rapid rise of the ethanol market has implications for water supply planning that are related to both the high water demands of the manufacturing facilities and the potential to increase irrigation during dry years to assure reliable crop production. In effect, the price for corn will make it harder for traditionally dry-land farmers to take risks with their yields. Irrigation may become a "smart" economic investment in areas that had traditionally relied on natural precipitation.

Currently, seven ethanol plants operate in Illinois, with four new projects under construction, and one expansion. The new and expanding plants are anticipated to produce an additional 348 million gallons of ethanol per year (Center for Agricultural and Rural Development, 2008) (http://www.card.iastate.edu/research/bio/tools/ethanol.aspx). The manufacturing process includes a consumptive use of water primarily from evaporation during cooling and wastewater discharge. Modern ethanol plants are designed to recycle water within the plant. Most plants require between three and six gallons of water for each gallon of ethanol produced. Using a conservative estimate of four gallons water per gallon of ethanol produced (this does not include water for irrigation), Illinois could be facing an increase in water demand of approximately 1.4 billion gallons per year from the new production facilities.

In Illinois, the siting process for ethanol plants is done at the local level. A number of factors are considered in the siting decision for these plants, including roads, pipelines, and the distance to competing facilities. These siting factors are important to water supply planning because these facilities require substantial volumes of water and they need to be located in areas that can accommodate this demand. The site permitting process is an opportunity to provide incentives to the ethanol industry to become more water efficient by requiring the evaluation of the impact of the facility on water availability now and in the future.

Across the state, ethanol plants may be located in areas that already have marginal supplies and could cause water supply conflicts. When the incentive for irrigation withdrawals is combined with the continuous need for process water, the potential for these facilities to affect local or regional aquifers is clear. To mitigate the potential for regional conflict, ethanol manufacturers should attempt to utilize water from alternative sources before accessing traditional drinking water sources. For example waste water reuse should be explored before accessing available surface water and shallow groundwater. This policy would be more sustainable, and relatively deep groundwater would not be pumped and then discharged as waste water into streams where it alters surface water flows, aquatic ecosystems, and requires a new discharge permit.

While the demand for water from the ethanol manufacturing facility is substantial, the regional shift toward more corn production may have cumulative impacts on Illinois' water resources. Minimizing the distance corn must travel to an ethanol plant is essential to decreasing the production costs of ethanol. Thus, as these manufacturing facilities are scattered across the state, it can be expected that the supply of corn being grown in that region will increase.

This shift in production may come in two forms. First, there will be an incentive for farmers to devote more of their land to corn production, which will have effects on water quality and quantity. Because corn does not fix its own nitrogen, fertilizer may be applied. Consequently, as crop rotation is phased out and the acres of corn increase, the amount of water required per acre of farmland will increase as will the chemicals that may be added to increase or maintain crop yields. This feedback suggests that the ambient water quality may also be at risk. Depending on the effectiveness of best management practices, this new corn production could increase nutrient loading and eutrophication from nutrient runoff may increase in reservoirs and streams.

Increased demand for corn for ethanol production may also impact water use by shifting current non-row crop agriculture lands to corn. Land formerly set aside as riparian buffers along stream corridors, erosion control breaks and wildlife habitat may be put into production. Conversion of land to row-crops will increase the use of irrigation, fertilizers, pesticides, and herbicides and generate more runoff, and soil erosion. Without proper controls and management, the downstream consequences of this new agricultural market may include increases in suspended sediment in rivers and increases in the

sedimentation rates of reservoirs.

While ethanol production using corn grain was the first response by to addressing increased petroleum prices and the political ramifications of addressing homeland security issues, other opportunities are also being researched. There is a potential for energy-efficient cellulosic material to displace corn. This alternative energy source has lower environmental impacts, as well as fewer impacts on food prices.

In order to capture the potential benefits of biofuels without suffering unintended consequences Illinois needs a comprehensive energy, land use, and water use policy. Any legislative incentive program for ethanol production should integrate each of these policy areas. This policy should account for the potential for indirect hydrologic impacts that may accompany a spike in the market from ethanol production. Background information about existing rural water use is needed to establish a statistically significant baseline to use in determining trends in use or availability. When adequate stream flow, water quality, and water use information have been obtained, siting decisions for ethanol production facilities can be optimized to reduce environmental risk while maximizing returns to the rural economy.

Increased corn production will mean:

- more irrigation water use
- more fertilizer use
- increases in runoff and soil erosion
- loss of riparian buffer ecosystems near surface water
- land converted to corn production that is currently wildlife habitat

Ethanol facilities:

- use about 4 gallons of water for each gallon of ethanol produced – throughout the year
- if this comes from groundwater the new withdrawals can lower water levels
- located primarily in the Midwest
- ethanol production facilities should not located where water is no readily available

Agricultural Water Use

In Illinois and most of the Midwest, agriculture is an important part of the economy. Where groundwater is available, agriculture is often an important seasonal water user, especially during drought years. In that part of the state where aquifers underlie farm land, irrigation can be an insurance policy that protects the investment against weather-related losses, especially as the price for commodities increase.

Agriculture is important to regional water budgets because, where drain tiles are not used and conservation practices are employed, the farm landscape can allow for deep

percolation of soil moisture and aquifer recharge. Unfortunately, some farm practices are less than ideal (from a water supply perspective) and agricultural development may, in some cases, lead to aquifer depletion, contamination and conflict.

Determining the Value of Water

There is a substantial body of literature describing the difficulty of determining the economic value of water (Agudelo 2001, FAO 2004, Moss et al 2003, NRC 1997). The research that has been done generally suggests that , as the availability of water decreases, its value increases. However when immediate needs are met the economic value of water is relative to other commodities in the market. In the eastern United States the only time we pay a price for water is the capital costs of development, treatment, and delivery.

In the State of Illinois, water supplies include streams, lakes, reservoirs, shallow aquifers and deep regional aquifers. In many locations water users decide which of the sources makes the most sense as their source of supply based on water quality issues and water availability. Generally, groundwater is less subject to the variations of climatic variation but yields from individual wells can vary. Surface water supplies are vulnerable to climate variation and withdrawals from streams can impact aquatic life. However, in comparison to groundwater, changes to surface water flows from diversion or drought are temporary and contamination that occurs can be diluted in a relatively short time.

It has been suggested that surface water and groundwater have different values and that difference should be reflected in the priority or timing of use (Moss et al, 2003). For example, many water utilities that have both groundwater and surface water supplies use their groundwater only after they have used all of their surface water resources (Laramie Water Utilities, 2005). Groundwater is used as a natural buffer against drought and consequently the value of high-quality aquifers increases when surface water supplies have been depleted. Further, deep regional aquifers are usually filled with water that is between 100 and 1,000 years old. Often these aquifers were recharged before human development and the water is both pristine and non-renewable. *As a matter of policy, where the option exists, ancient groundwater should only be used when the shallow, younger water has been depleted or in combination with the development of the shallow aquifer*.

One concept in the collection of ideas used to organize the problem of water shortage, the source of supply should be seen as having increasing value based on its age and time for recharge to occur. As groundwater becomes less available it costs more to get it out of the ground and what remains is worth more because it is a part of a shrinking supply. So the less there is the more it is worth and the more it costs to get it. This explains why we collectively chase water tables down to the bottom of the aquifer. There is no disincentive to do so. The last drop of water will have infinite value.

This analysis suggests that there should be a spectrum of value reflected in the price we

pay for our water resources. Stormwater (floodwater) is considered a nuisance.There should be incentives for developing it and using it for recharge in shallow aquifers. Stream flow during the wet season is similarly less valuable because it is available when few need the water. Shallow aquifers hold the least valuable groundwater because that water is vulnerable to contamination. Deep regional aquifers are generally filled with old pure water that is precious water in part because no matter what we do now, it is in reserve for future generations.

Environmental Flows – Ecosystem Water Needs

The ecosystem uses of water need to be considered along with the anticipated future withdrawals needed to satisfy additional demands. The only way to understand the potential for conflict with the natural system is to first evaluate the needs of the wetlands and riparian/streams.

From a water use perspective this is a water user that can not be ignored – natural systems need to have a right to water resources. Considering the pace of habitat loss and land-use conversion in rapidly growing (or agriculturally dominated) parts of the state, it is clear that, like the water resources themselves, the ecosystems that depend on water are also threatened by growth and competition for water. This means that wetlands and riparian zones, as well as aquatic habitat all have "rights" to enough water to maintain their health as indicated by some measure of biodiversity. Environmental flows are the amounts of water required to maintain healthy ecosystems. The environmental flows are usually measured by:

- flow regime
- frequency
- timing
- magnitude
- duration

Each of these measures of aquatic ecosystem health and sustainability are directly associated with in-stream aquatic habitat. However, it is clear from the literature on water resource impacts that both surface and groundwater water resource development can damage wetlands and riparian areas that are also important habitat for terrestrial plant and animal species. What estuaries are to the marine environment – highly productive breeding grounds for a variety of flora and fauna – wetlands are to the terrestrial ecosystem. In several coastal states, regulators adopted a simple rule of thumb for environmental flows: except in severe drought, streams should not be reduced below 20 percent of their average annual flow. However, given the variability of aquatic and wetland ecosystems health and function in Illinois, the only way to determine the impact of any proposed development is systematic monitoring. Watershed analysis and holistic management need to be the goal of any resource development optimization system.

Water resource development altering and damaging ecosystem health is becoming a more

common problem in urban and ex-urban settings. The impacts of water resource development on wetland ecosystems are part of a normal planning process. In fact, the Water Resources Development Act of 2000 (Public Law 106-541) explicitly calls for the assessment of water resource development that is connected to the Florida Everglades Restoration project.

As water use increases in Illinois and throughout the Midwest, there needs to be additional attention to the impacts on base flows to streams and water levels in critical wetland areas. Water supply planning needs to consider the effects of new withdrawals on poorly understood aquatic environments as well as the linked terrestrial ecosystems. Wetlands, riparian zones, and the larger natural landscape are being protected by specific regulatory guidelines in Texas and California where these states are engaged in regional water supply planning. These efforts, supported by peer reviews from the National Academy of Science, are helping protect natural resources that depend on fresh water for survival.

Linking Water Supply Planning to Land-use Planning

Land-use planning is one of the primary applications of any water supply plan. Land-use plans are designed to create the healthy spaces and landscapes that natural and human communities need to thrive. In forward-looking jurisdictions, comprehensive land-use planning includes water resources as a major element (e.g., *Kane County 2030 Plan*). The purpose of comprehensive land-use planning is to express the community's vision of their future. Like any other planning exercise, the land-use planning process evolves as growth occurs.

Land use and water supply planning naturally connect in part because there is a need for communication between the various city utilities already preparing for growth in the region. The linkage between water supply planning and land use needs to exist any time there is consideration of alternative water supplies. As new water sources are included in the water supply portfolio in a region, the impacts on competition from development of that source need to be considered in the urbanization growth models. Other considerations that can be incorporated into planning are the effects of recycling, reuse, and water conservation. Each of these approaches to reducing demand on existing resources can be integrated into comprehensive plans. Demand management systems and conservation-based low impact development (LID) can all find their way into county comprehensive plans as a part of infrastructure planning.

The steps required for water supply planning only partly depend on location. Regardless of the climate or the local growth rates the primary objective of planning remains the same – to compare supply to demand so that the community can make informed choices about development. Making these choices requires that public officials and representatives understand some of the consequences of growth on infrastructure, know the limits of local and regional resources and be able to consider the trade-offs between

different development options. The need for planning is demonstrated by the following:

- Rapid ex-urban growth near cities has moved water demand away from the central, high-capacity infrastructure and out into less densely populated parts of the state. Municipal water utilities developing water supplies outside of the incorporated areas are competing for limited resources with homeowners who often pump local groundwater. Either longer distribution mains will be needed from central treatment plants or more distributed sources need to be developed to satisfy the growth. Infrastructure cost, water quality, and the long-term reliability together determine the value of any source.

- Regional drought planning needs to be included in any future development scenarios. The drought-produced low flows in surface water systems can shift demand to groundwater. In order to plan for growth and avoid conflict, it is important to evaluate the effects of extended drought on both streamflows and aquifer water levels.

- In order to be effective the public process needs to be open, public and transparent.

Illinois' role in planning is evolving and the state should be responsible for providing technical data and information for regional resource planning projects. The technical role is natural for state agencies who manage water use data and water resource information. Regional authorities and municipal utilities, on the other hand, have historically used planning as a way to anticipate the costs of expansion, but in the regional context, there needs to be an explicit consideration of regional growth.

In other states — notably California and Virginia — land-use planning at the county scale needs to comport with the regional water supply planning that is done for each water supply region in the state. This way every county plan reflects the availability of water as described in the water supply plan and the regional water supply plan accounts for the planned growth that may occur in each of the communities in the region.

Regional land-use planning integrates the objectives of the communities with the limitations and resources that are available to any one community. From a planning perspective the most difficult challenge is dividing up the jurisdictional frames of reference to accommodate the aquifers and river basins that extend beyond local borders.

Findings and Recommendations

The essence of water supply planning is accounting. In order to determine whether water shortages can be addressed with additional supplies or reduced demand, we need to know something about current conditions. Specifically it is necessary to estimate how much

water is currently being used by each major sector of water user (e.g., industrial, agricultural, public supply), how much the amount of water used by each sector is changing and how it compares to the amount of water available in any location. Both the spatial distribution and timing of use and availability are relevant to resolving conflicts but in many cases the quality and integrity of the institutions are critical to success

The State must act now to define goals and build planning capacity

The State of Illinois has a long way to go before it has the institutional infrastructure to support regional water supply planning but it has taken the first steps. The regional water supply planning experience has been mixed but it appears that a diverse set of local and water use interests can work together to define their common problem. It is necessary that the state, with input from regional groups, define overall objectives – for conservation, demand reduction, implementation of pricing policies, etc. – then for the regional groups to determine how a mix of regulation, voluntary programs, and incentives may be used to guide the various water users towards those goals. The state made a wise decision to begin the process of planning with two different water supply planning regions and it needs to support these groups by funding subsequent activities and additional regional planning efforts. Establishing goals will give greater direction and purpose to regional planning, while regional planning will give make state goals more likely to come to fruition.

Water use reporting needs to be mandatory for all users

There are no state water supply planning programs in the United States that do not require accurate information on water use. Water use records for public water supplies going back over a century may be historically interesting but from a hydrological perspective these data are only one part of the water use in an area. Industrial water use, agricultural irrigation, commercial supplies all need to be reported along with the withdrawals by public drinking water suppliers. Only when we know how much we use will we be able to relate that use to demographic variables and price to better predict how demand may change in the future. Water use reporting is the first step in responsible water management.

Build upon the strengths of the State Surveys

The most important head-start that Illinois has in creating a new water supply planning process is that there is institutional credibility in water resources that is the envy of neighboring states. However, these institutions need to have a new component added to their existing missions that supports water supply planning. The Illinois State Water Survey and the Illinois Geological Survey need to be the "go-to" agencies responsible for developing databases of information critical to regional planning. They are also the place where the technical staff have the expertise to prescribe appropriate methodologies for evaluating the water resource availability (e.g., data requirements, modeling, calibration, prediction).

Planning needs to emphasize demand management and conservation

Much of the water supply infrastructure that exists today is designed to meet the maximum load on the system. In most years and in most communities the peak use occurs somewhere in the middle of the summer. There are currently few disincentives to reduce water use during the driest parts of the year. As a general rule, the price per unit volume of water decreases with increasing use. Water supply planning should emphasize the fact that conservation is one of the least expensive ways to bring available supplies in line with increasing demands. Decreasing rate structures are one of the impediments to conservation outreach efforts. Recent research indicates that it takes more than a few years to alter community water use behavior so the sooner it is included in the larger discussion, the better.

Implementation will require funding for regulation, voluntary compliance, and incentives

The 2002 DNR report on integrated water planning suggested that the difficulty in planning could be circumvented by relying on regional consortia that have already identified a potential problem using a common resource. By starting with these already organized groups (which is essentially what the regional planning process did) it was seen as being politically less tangled and manageable. Water supply planning and management is always going to be difficult. It requires a clear goal, a collection of cold hard facts, some funding for competent technical staff and thoughtful, empathetic stakeholders. It is important that some of the implementation strategy is based on incentives, which may include new water pricing systems.

Additionally, in order for the statewide system described in this paper to succeed, a stable stream of funding will need to be identified or created. The state should explore funding mechanisms that are equitable and dependable, without relying disproportionately on one water user group. Ideally, should this funding come from some sort of fee or tax, would be directly linked to uses of water that are inconsistent with state water supply goals.

Methods are needed to determine the values of different water supplies

At this time there is no differentiation between any source of water. Because customers are only required to pay the costs of transmission and treatment there is no incentive to alter the way we think about and use the deep regional aquifers that could be drought buffers. Integrated water management balances each of these sources of supply and the demands that will be placed on them. At least as a first step, the state should consider funding some research on the problem of pricing that reflects the current understanding of water valuation as described in the most recent literature.

The State needs to expand groundwater and surface water monitoring

One of the purposes of setting a goal is to see if you are moving forward or backward. A

goal that could be envisioned would very likely be something along the lines of "stabilize water supplies during drought." Then a set of methods would be selected that would be designed to reach that goal. If water supply management requires an understanding of the resource, we ought to know how much water we have in storage and how that has changed over time. Demonstrating success may be as simple as a hydrograph.

Techniques should be developed to determine the water needs of ecosystems

In 2006, the State of Texas realized that it was basing its consideration of ecosystem needs on an incomplete set of ecological data and a set of untested assumptions. To resolve this situation the state commissioned the help of the National Academy of Sciences (NAS) who reviewed the proposed approach to determining environmental flows. This cycle of analysis lead to a Texas-specific set of guidelines that could and should be replicated in Illinois. Relative to the overall program budget for the water supply planning, the costs were modest and there was no other party who could appropriately fund the NAS research. In association with the recent development of Total Maximum Daily Load (TMDL) projects, environmental flows could be established in Illinois as a natural baseline for ecosystem integrity.

Integrate water supply planning into land-use planning

The mark of failed planning is a moratorium on development. Conversely, the holy grail of comprehensive land-use planning is associating land use with all of the other natural and structural aspects of community development to make better long-term decisions. One of the reasons to do water supply planning is that it can be used as a new source of information about the landscape that could be relevant to infrastructure investment and community growth.

The regional water supply planning groups will be finishing their work over the next 15 months. As their work progresses, it will be important for the state to establish a statewide framework for water supply planning that will allow other regions within the state to create their own plans. Funding for these areas, as well as funding for implementing the two plans currently being created, will be critical. Equally critical for successful implementation will be a clear delineation of roles and responsibilities and a commitment to conservation and sustainability.

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