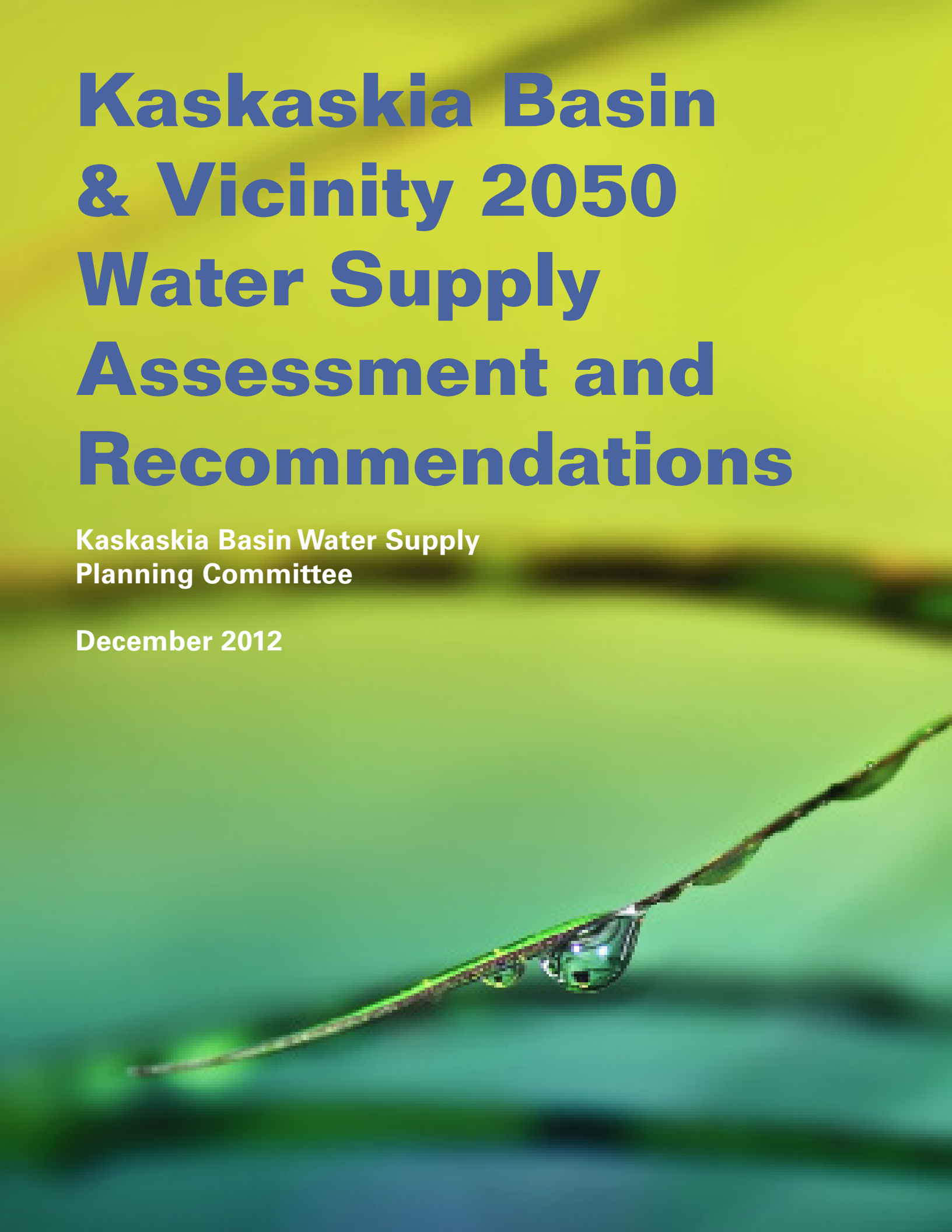
Kaskaskia Basin & Vicinity 2050 Water Supply Assessment and Recommendations

Kaskaskia Basin Water Supply Planning Committee

December 2012



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Comprehensive Evaluation and Plan for the Regional Water Supply of the Kaskaskia River Basin through 2050

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Comprehensive Evaluation and Plan for the Regional Water Supply of the Kaskaskia River Basin through 2050

This plan has been a collaborative effort undertaken by a consortium of partners (planning committee) who share a mutual interest in ensuring a stable supply of water for the benefit of the future growth of the many communities located within the planning area, and the State of Illinois Department of Natural Resources Office of Water Resources, the Illinois State Water Survey who prepared the associated water supply study, and Southern Illinois University Carbondale who prepared the demand forecast. Representatives serving on the planning committee include:

Larry Hasheider, Chair, Kaskaskia Watershed Association
Steve Jurgens, Vice Chair, Environment
Rob Amling, Counties
Ted Beier, Recreation
Tom Beyers, Soil & Water Conservation Districts
Greg Birchler, Navigation
Darrell Brinkmann, Farm Bureau
Todd Harris, Industry
Judith Joy, General Public
Greg Kintz, Small Business
Kevin Leifer, Agriculture
Larry Reuss, Electric Utility
Alan Stuemke, Water Utilities
Bill Teichmiller, Rural Water Districts
Vacant, Water Authorities
Matt Willman, Municipalities

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} **Find these items on the attached CD.**

Appendix 5: Prairie State Allocation Agreement
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Executive Summary

The Comprehensive Evaluation and Plan for the Regional Water Supply of the Kaskaskia River Basin through 2050 (referred to as "the Plan") is aimed at assessing the water supply and the water demands within the Kaskaskia Basin through the year 2050. This includes analyzing and evaluating various scenarios involving potential changes in water demands and the water supply, including federal and community reservoirs, and identifying impacts from the specific scenarios.

The geographic area for the Plan includes counties within and adjacent to the Kaskaskia watershed. Those counties outside the watershed were included because they are part of a smaller watershed, not likely to receive regional planning efforts and because water use and demands in these counties affect use and demands of water within the Kaskaskia Basin. A small portion of the northern Kaskaskia watershed was excluded from this study because water supply and demands in that area have been previously considered in the Mahomet regional water supply plan.

The Plan is a result of the Governor's Executive Order 2006-01 which called for stakeholder-driven, collaborative, regional watershed planning that analyzed use and demands of water resources. This document represents the third regional water supply plan completed for use in the State of Illinois. Because diverse and significant uses such as energy creation, agricultural production and extensive recreation and wildlife habitat conservation activities occur in the watershed, the Kaskaskia Basin merits the time and energy of such a plan.

The Plan was produced by a committee composed of stakeholders from a variety of backgrounds (e.g., agriculture, industry, environment, and counties) and geographic areas within the Kaskaskia watershed. The committee began meeting in November of 2010. Throughout 2011 and early 2012, committee members met monthly to discuss various topics ranging from public water supply to wildlife considerations to water use by the industrial and commercial sector. In the spring of 2012 the committee drafted The Plan.

The planning process and creation of this report were driven by the committee with the assistance of technical advisors and planning facilitators. The technical committee included representatives from the US Army Corps of Engineers, Illinois State Water Survey, and Illinois Department of Natural Resources - Office of Water Resources. The planning team was composed of personnel from HeartLands Conservancy, Hoelscher Engineering, and SCI Engineering. Two reports – a water supply report prepared by the Illinois State Water Survey and a water demands report prepared by Dr. Dziegielewski of Southern Illinois University – also guided committee members in the preparation of this report.

The Plan contains the key facts that were derived from presentations made during the committee's monthly meetings and from the water supply and demand reports that were prepared in conjunction with and as support for the presentations. The information in The Plan does not represent a complete detailed replication of those documents and individuals or organizations searching for further detail for a specific topic contained herein should obtain the complete, original documents. The outline below presents an overview of The Plan's content.

- Chapter 1 establishes the purpose of the Kaskaskia Basin water supply committee and discusses the mandate from the state that led to the formation of regional water supply committees. The planning area is described and a detailed record of the planning process is presented.
- Chapter 2 communicates baseline information such as water law and water allocations in the Kaskaskia Basin. Chapter 2 also includes information on the institutional governance and technical assistance that exist within the Basin.
- Chapter 3 presents data on the water cycle. Specifically, Chapter 3 introduces Kaskaskia Basin water supply and demands in relation to climate, weather, and drought.
- Chapter 4 more deeply explores the issue of water supply in the Kaskaskia Basin. Sources of both groundwater and surface water are analyzed to determine the water supply from existing systems. Community water supply systems and the two (2) federal reservoirs within the study area, Carlyle Lake and Lake Shelbyville, are assessed.
- Chapter 5 documents the data generated during a three-scenario demand analysis. General water demands are documented as well as demands related to the following specific sectors:
    - Coal mining and processing
    - Self supplied water for power generation
    - Public water supply
    - Self supplied domestic use
    - Self supplied industrial and commercial
    - Irrigation, environmental, and agricultural demands
- Chapter 6 records information related to federal water control operations, specifically, recreation, fish & wildlife, and navigation.

Based on this information gathered by the committee, recommendations are made for future management of the Kaskaskia Basin regional water supply. Continued regional cooperation, supporting localized conservation measures, and promoting drought preparedness emerge as key components of future water supply management. As a result of the efforts of the Committee members, the future water management in the Kaskaskia basin has a well defined

plan based on applicable scientific research and professional practical experience from individuals with expertise and interest in water supply and demand.

Glossary of Terms

ISWS – Illinois State Water Survey

USACE – United States Army Corps of Engineers

ICCI – Illinois Clean Coal Institute

IDNR (OWR) – Illinois Department of Natural Resources (Office of Water Resources)

KWA – Kaskaskia Watershed Association

KRPD – Kaskaskia Regional Port District

IWIP – Illinois Water Inventory Program

PWS – Public Water Supply

MGD – Million gallons per day

CFS – Cubic foot per second

CFS/MGD conversion: 1 million gallons per day (MGD) = 1.55 cubic feet per second (CFS)

DCEO – Department of Commerce and Economic Opportunity

NGVD – National Geodetic Vertical Datum, NGVD is considered equivalent to mean sea level

Satellite system – A smaller public water supply provider that purchases their water from a larger community system, located outside of the corporate boundaries of that larger community.

Weather – The state of the atmosphere with respect to wind, temperature, cloudiness, moisture, pressure, etc.

Climate – An aggregation of weather events; the composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.

Water Supply –The availability and sustainability of an adequate and dependable water resource; Water storage and releases from reservoirs or other bodies of water (or groundwater) provide for water supply

Water Availability – suitable or ready for use; of use or service; readily obtainable; accessible

Water Demand – The main driver of future water demand in the public-supply sector is population served. The data on future increases in resident population of the study area counties were obtained from DCEO.

The terms **Kaskaskia Basin** and **Kaskaskia Study Area** are used to describe the greater Kaskaskia watershed. Kaskaskia Study Area is more commonly used in the Water Demands Report; Kaskaskia Basin is more commonly used in the Water Supply Report. They both refer to the area described in Figure 1, page 3.

Key highlight – This term is used to denote a phrase(s) the committee felt to be of particular importance, a piece of information which is meant to be highlighted or receive primary attention from the reader.

Chapter 1: Introduction

1-A Purpose

The purpose of this report is to present a coordinated regional water supply plan, valid through the year 2050, which has been developed by a regional water supply planning group (Committee). The planning process, associated studies and final report shall serve as a foundation to constituent group(s) that will manage, distribute and/or utilize the region's water supply. The Kaskaskia Watershed Association, Inc. has played a key role in the development of this report as part of its function is to represent the watershed and promote the enhancement and protection of its diverse natural resources.

The Kaskaskia Watershed Association (KWA) was created in the 1990s to represent the entire watershed while recognizing the uniqueness and diversity within the river. Their goal is to develop, enhance and protect the ecological and socio-ecological values of the natural resources of the watershed by addressing complex issues including erosion, siltation, recreation, fish & wildlife, flood damage reduction, water supply, industry, navigation and economic development. KWA is therefore uniquely qualified to unite individual sectors that will be capable of advancing water supply planning and implementation in the future.

1-B Mandate

Governor's Executive Order 2006-01 charged locally-based regional water supply planning groups with developing a water supply plan. The directive encouraged a plan that focuses on ascertaining water availability, or supply, and forecasting future water demand and potential deficits. In addition, the plan should include recommendations for the future management of the region's water supply. Affiliated state agencies include the Illinois State Water Survey (ISWS) and the Illinois Department of Natural Resources Office of Water Resources (IDNR-OWR). See Appendix 1 for more information.

1-C Planning Area

The Kaskaskia River watershed reaches nearly across the width of Illinois, laterally, and lies between southern and central Illinois horizontally (see Figure 1). It extends in the northeast (Champaign County) to the southwest (Randolph County). The study area (for the Water Demand study) includes the entire counties of Christian, Shelby, Moultrie, Douglas, Coles, Cumberland, Montgomery, Bond, Fayette, Effingham, Jasper, Clinton, Marion, Clay, Richland, Washington, Wayne, and Randolph, and the parts of Macoupin, Madison, St. Clair and Monroe counties which are located within the Kaskaskia watershed. For purposes of this initiative the planning area has been increased beyond the reaches of the

Kaskaskia River Watershed to include portions of the Embarras and Little Wabash watersheds to the east, as well as portions of the South Fork Sangamon watershed to the west. Portions of the Kaskaskia River watershed in Champaign, Piatt, and Macon counties have been previously studied within “A Plan to Improve the Planning and Management of Water Supplies in East-Central Illinois”, and as such demands forecasted for this area is not duplicated within this report.

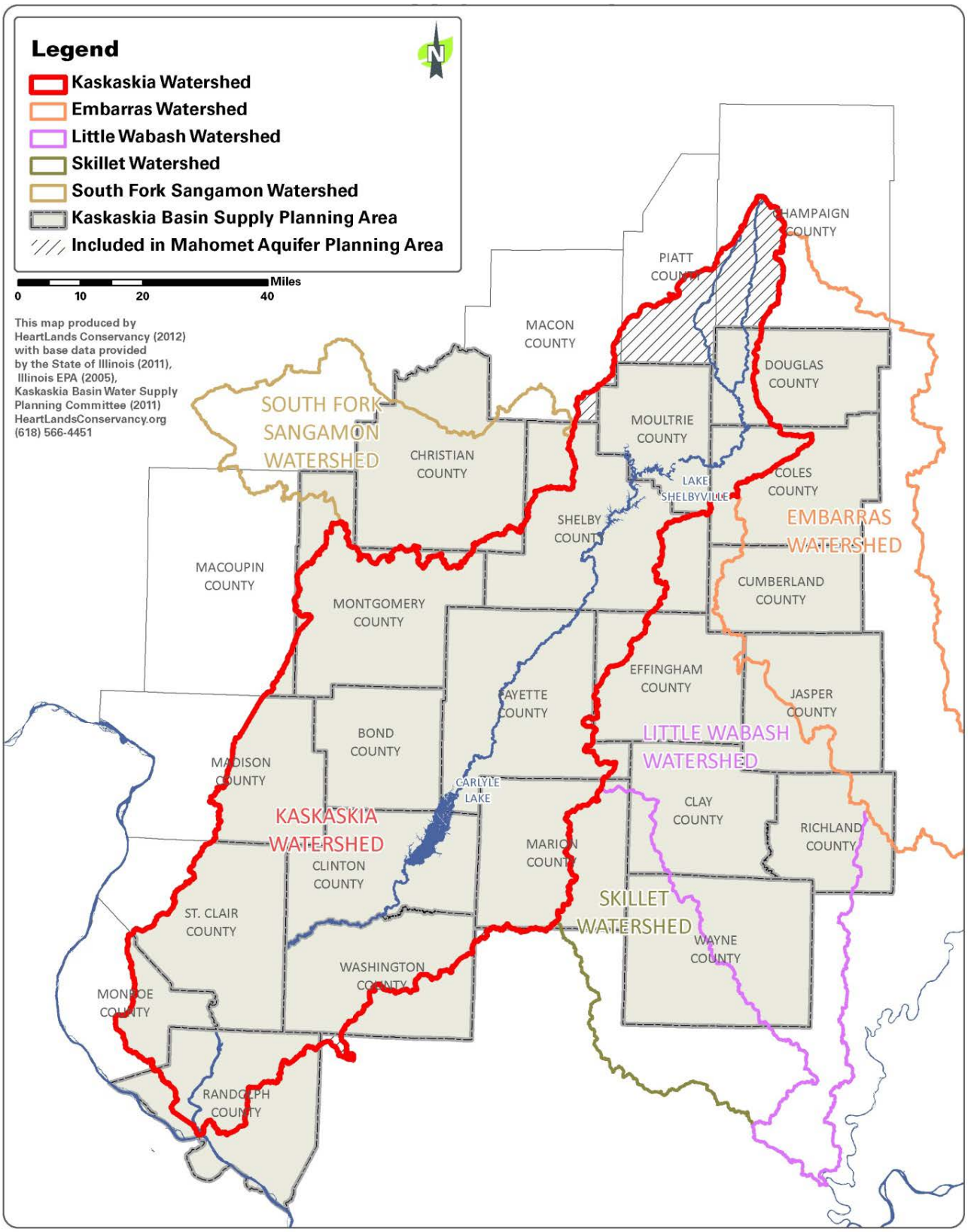

Figure 1. Kaskaskia Basin Water Supply Planning Area

1-D Planning Process

The planning process consisted of four major components: (1) a committee composed of stakeholders from throughout the Kaskaskia area, (2) technical reports prepared by experts in the fields of geography and water resources, (3) presentations made by committee members and other relevant professionals at regular meetings of the Committee, and (4) the final report, here, that documents that significant amount of data and insight provided through the committee meetings, presentations, and reports.

1-D1 Committee

Bringing together relevant stakeholders was fundamental in constructing a Committee knowledgeable of the planning area and localized or industry-based water issues. Specific interest areas were identified (see Table 1) and identification of nominees were based on representing those interests, commitment to the Committee, previous water-supply planning experience and ensuring that geographical representation was achieved. Potential Committee members were solicited via letter; solicitation focused on water-related groups active in the region and other individuals, as recommended by the Kaskaskia Watershed Association Board of Directors and others. Those contacted wrote letters of application to participate on the Committee.

Table 1. Committee member interest areas

Agriculture	Municipalities
County Boards	Navigation
Electrical Utilities	Recreation
Environmental	Rural Water Districts
Farm Bureau	Soil & Water Conservation Districts
General Public	Small Business
Industry	Water Authorities *
Kaskaskia Watershed Association	Water Utilities

* Water Authorities were approached, but chose to not appoint a person to serve on the Committee.

HeartLands Conservancy (formerly Southwestern Illinois Resource Conservation & Development) was commissioned to facilitate the Committee, assist the Committee in development of a comprehensive water supply plan, and assist the committee in providing outreach associated with the development of said plan.

Technical assistance was provided to the Committee by the following individuals and agencies:

- Gary Clark, P.E., Director, Illinois Department of Natural Resources – Office of Water Resources (Retired)
- Frank Pisani, P.E., Water Supply Planner, Illinois Department of Natural Resources – Office of Water Resources
- Dr. Ben Dziegielewski, Principal Investigator, Southern Illinois University Carbondale
- H. Vernon Knapp, Senior Hydrologist, Illinois State Water Survey
- George Roadcap, (Hydrogeologist), Illinois State Water Survey

- H. Allen Wehrmann, (Head of the Center for Groundwater Science), Illinois State Water Survey
- Robert Wilkins, Carlyle Lake & Kaskaskia River Operations Project Manager – US Army Corps of Engineers

Meetings of the Committee were held monthly, with the exceptions of May and October, and were open to the general public. Minutes to the meetings, and presentations made, were posted on the internet (www.heartlandsconservancy.org), as well as being distributed electronically to individuals that expressed interest in the project.

Representatives of individual interest areas were responsible to solicit input, technical guidance and data from within their respective area. Additionally staff from HeartLands Conservancy made numerous presentations to stakeholders throughout and following the planning process.

1-D2 Technical Reports

Two major technical reports were also commissioned within this planning process with an intention of providing the Committee with the data necessary to fully understand current and future (through 2050) water demands as well as water availability. Results from these reports are cited extensively throughout this plan.

Future Potential Demands and Coal Development Potential in Kaskaskia River Basin in Illinois – analyses existing water demands as well as future water-demand scenarios for all major user sectors in the 22-county regional planning area. The objective of this report was to determine future water demands during the period from 2010 – 2050 and compare the sector demands with potential water needs. Principal Investigator for this report was Dr. Ben Dziegielewski, Southern Illinois University Carbondale.

Water Supply Assessment For Kaskaskia River Watershed Development: Phase I Technical Report – provides an overview of management criteria and understanding of the constraints and policies used in conducting analysis and making decisions concerning water use within the planning area. Information includes an understanding of surface water and groundwater availability within the study area, as well as hydrologic models simulating the hydrology within the planning area. This report was prepared by the Illinois State Water Survey.

1-D3 Additional Data

Significant additional data was provided to the Committee through a series of presentations which occurred throughout the planning process. Information provided within these presentations will also be heavily cited throughout this report. A schedule of presentations is provided in Table 2.

Copies of the presentations, minutes, and reports related to the planning process can be found online at www.heartlandsconservancy.org. A copy of the final report will be stored (a hard copy or electronically) at the offices of the Illinois Clean Coal Institute, Illinois Department of Natural Resources office library, HeartLands Conservancy library, and the Illinois State Water Survey. To request a copy of any presentation or report you may contact HeartLands Conservancy online or at (618) 566-4451.

Table 2. Schedule of Water Supply Committee presentations

Meeting	Topic	Presenter	Date
1	Overview of the Kaskaskia Basin Water Supply Study	Gary Clark	November 2010
2	Water Supply Demand Study	Dr. Ben Dziegielewski, SIU Carbondale	March 2011
3	Holland Regional Water System Projected Water Demands	Bill Teichmiller, EJ Water Cooperative	April 2011
3	Gateway Water Company Projected Water Demands	Wally Cox, Henneghan & Associates	April 2011
4	Water Supply Demand Study (Coal Mining and Power)	Dr. Ben Dziegielewski, SIU Carbondale	June 2011
5	Federal Project and Authorities	Joan Stemler, USACE	July 2011
6	Water Supply Availability and Background	Vern Knapp, ISWS	August 2011
7	State Water Authorities, Permits and Policies	Gary Clark, IDNR	September 2011
8	State Water Supply Storage Agreements	Frank Pisani & Gary Clark, IDNR	November 2011
9	River Withdrawals for Waterfowl Impoundments; Kaskaskia Regional Port District	Bob Hammel, IDNR Ed Weilbacher, KRPD	December 2011
10	Groundwater and Surface Water Availability under Projected Water Demand Scenarios Part I Recreation	Vern Knapp, ISWS Ted Beier	February 2012
11	Groundwater and Surface Water Availability under Projected Water Demand Scenarios Part II	Vern Knapp, ISWS	March 2012

1-D4 Report Structure

- Baseline Information:
  1. A summary of existing laws, policies and property rights, water supply and water demand
  2. Water cycle, climate, geography and hydrology
  3. Water Supply – a review of how water resources are distributed and consumed
  4. Future water demand/withdrawal
- Key Highlights will be presented to demonstrate the current knowledge of water resources in the Kaskaskia River Watershed.
- Recommendations will be presented in an effort to minimize potential future drought impacts.
- A Framework for Action will be ascertained and action items will be clearly defined to influence future management plans for the Kaskaskia River Watershed.

The Committee requested, and the KWA accepted ownership of this report. It was the vision of the committee that a regional entity such as KWA act as a voice for the document: actively working towards the implementation of recommendations made herein and updating the document as needed to ensure its relevance for acceptable continued watershed management. The KWA discussed the report at their June 2012 meeting and voted to take ownership and work towards applying the outcomes and recommendations from this plan to the work they currently undertake in the Kaskaskia Basin.

Chapter 2: Baseline Information

2-A Water Law, Governance, Water Allocations

Water law, governance, and water allocations have been broken down into two separate categories that follow. (1) Current laws, regulations, and property rights are exisiting pieces of Illinois legislature that control how individuals, groups, and industry may obtain and use water. (2) Water allocations will discuss water allocated to various users from federal reservoirs and river withdraws.

2-A1 Current Laws, Regulations, & Property Rights

While the states around us all have some level of regulation or registration of water use, Illinois waterways are not offered similar service. At this time, there is no comprehensive statute, statewide statute or comprehensive regulatory review for water or water development projects in Illinois (IDNR, OWR presentation, Meeting 7).

Illinois does have other authorities that it uses in lieu of statewide or comprehensive regulatory authority.

- **Common Law Riparian Rights:** States that first all natural (necessary to survival) wants of water must be satisfied, after that, users with riparian property may use water for artificial (increase comfort/propriety) wants in just proportions.
- **River, Lakes and Streams Acts:** Passed in 1911 by the General Assembly. Authorizes public water (only 8% of Illinois waterways are "public) protection, and floodway construction permits
- **Water Authorities Act:** This Act is carried out by a special purpose unit of local government, governed by 3 trustees appointed by the County Board. Powers include: inspection/registration of wells, permits for additional wells, regulate water use during shortages, levy taxes and sell bond. This Act exempts agricultural, irrigation and domestic use. As of 1999, there were only 15 such Water Authorities, covering a minority of Illinois, none of which are located within the planning area.
- **Water Use Act of 1983:** This Act requires public notice of planned withdrawals over 100,000gpd. In four central Illinois counties (Kankakee, Iroquois, Tazewell and McLean) it also authorizes regulated groundwater emergency restrictions. This Act unified (state-wide) water use rights under the same common law doctrine. In 2009, mandatory water use reporting to the State Water Survey (SWS) was added.
- **Municipal Code and Special Districts:** Gives municipalities, special districts, River Conservancy Districts, and Water Authorities the authority to develop water sources with some authorities allowing for development outside of corporate limits (with condemnation powers).
  - **In the Kaskaskia Basin,** federal authorities support navigation uses, the federal Clean Water Act (Section 404, true for all federal waters), and regulates dredge fill in wetlands. Federal Statutes regulate flood control, water supply and navigation uses.

- **Level of Lake Michigan Act:** Regulates diversion of water from any of the Great Lakes – applies to Chicago-area water regulation, not Kaskaskia basin water use, regulation, planning, etc.
- **Kaskaskia River Watershed and Basin Act:** The Department of Natural Resources may make agreements with any agency of the United States, any municipality or political subdivision of this State or any public or private corporation, person or association for, the formulation of plans, acquisition of rights of way, and the construction, operation and maintenance of any navigation, flood control, drainage, levee, water supply and water storage, including regulation, distribution and use, and other water resource improvements and facilities in connection with the development of the Kaskaskia River watershed, including restriction of use or withdrawal of water from the Kaskaskia River below Carlyle Dam or providing for replenishment of withdrawn water, provided however, the Department shall not charge for the use or withdrawal of water from the Kaskaskia River, except that the Department may recoup from water users an amount required to pay federal operation and maintenance charges incurred as a result of water withdrawal from Lake Shelbyville and Carlyle Lake.

The Department, on behalf of the State of Illinois as local sponsor for federally authorized and developed Kaskaskia River basin projects, shall have jurisdiction and supervision over any and all phases of developments and improvements in such basin, including, but not limited to nonfederal participation requirements in connection therewith, and full authority and control over any and all lands acquired in connection with the development of the Kaskaskia River watershed and may, in the discretion of the Department, grant easements, lease for a period not to exceed 50 years, sell, transfer or convey, exchange, develop, or otherwise utilize such lands in the interest of the State of Illinois insofar as the same is not inconsistent or in conflict with the purpose for which acquired by the Department. (615 ILCS 75/1) (from Ch. 19, par. 41.1)

Key Highlight: Illinois does not have a comprehensive water law. Current Illinois water is limited to the following areas.

- In stream flow protection – statewide
- Drought and emergency management
- Groundwater development – domestic well impacts
- Recreation stream access
- Codification of water quantity laws
- Future needs for public water systems (smart growth)

For more information on State Water Authorities, Permits, and Policies, please see the IDNR-OWR presentation from September 2011, available through HeartLands Conservancy (www.heartlandsconservancy.org).

2-A2 Water Allocations

Water allocations are presented here in two categories. First allocations from the Federal Reservoirs and project purposes of these reservoirs are presented. Second, state river withdraws are discussed.

2-A2-1 Federal – Reservoirs and Kaskaskia River Navigation Project

State water supply allocations from the Federal Reservoirs within the Kaskaskia River basin are by agreement with the State of Illinois DNR/OWR, authorized within the Kaskaskia River Watershed and Basin Act, and not by permit. At the time of the construction of two federal reservoirs Lake Shelbyville and Carlyle Lake the State of Illinois invested in a portion of the joint-use storage pool equating to 13.9% (24,714 acre-feet) of the joint-use storage pool at Lake Shelbyville and 14.2% (32,692 acre-feet) of the joint-use storage pool at Carlyle Lake.

A total of nine facilities are currently covered under agreement for State (IDNR) water supply allocations from either Lake Shelbyville or Carlyle Lake. Under normal to slightly drier than normal conditions Holland Energy, Holland Regional, Prairie State Generating Company, and Dynegy-Baldwin Energy Complex may continue to withdraw directly from the Kaskaskia River without the necessity of a water supply release from the federal reservoirs.

Energy:

Dynegy*	14.35 mgd avg. /58.0 mgd max.
Holland Energy*	8.00 mgd max
Prairie State**	13.35 mgd avg. /18.0 mgd max

Public Water:

Holland Regional*	5.00 mgd avg. / 7.5 mgd max
Gateway	4.00 mgd avg. / 6.3 mgd max

Irrigation:

4 Golf Courses	0.65 mgd avg.

* May withdraw directly from the Kaskaskia River during dry conditions.

**The allocation amount for Prairie State is 13.35 mgd for the first 10 years of their agreement (through 2013). Following 10 years, their allocated amount will be reevaluated by IDNR, but if changes are made the new amount is guaranteed to not be less than 9.5 mgd. For more information see Appendix 5, Prairie State Generating Co. Final Agreement).

Key Highlight: 100% of the state's share of the joint-use storage pool at Lake Shelbyville and Carlyle Lake are currently under allocation agreements; however no water user is currently withdrawing at the full allocation amount covered under contract.

Key Highlight: Water supply allocations to the two regional public water supply systems provide for reasonable future domestic and municipal growth.

Key Highlight: There is an economic disincentive for contracted water users to request a withdrawal or release from either reservoir, in that they would then initiate a reoccurring annual billing for a proportionate share of all future USACE reservoir operation and maintenance costs.

The US Army Corps of Engineers maintains three projects within the planning area, with the following purposes:

Lake Shelbyville:	Flood Control	68%
	Recreation	13%
	Water Supply	7%
	Navigation	7%
	Fish & Wildlife	5%
Carlyle Lake:	Flood Control	65%
	Recreation	18%
	Water Supply	9%
	Navigation	6%
	Fish & Wildlife	2%

Kaskaskia Navigation Project: The Kaskaskia River Navigation Project is not as easily represented for percentages of project purposes. While the Kaskaskia Navigation Project was originally charged with a 100% navigation purpose, USACE personnel have evolved management of the Kaskaskia River to consider flood control, recreation, and fish & wildlife as well.

Water will be held and released within the two reservoirs in a manner consistent with a Water Control Plan, in an effort to maximize flood damage reduction benefits that extend to the Kaskaskia River Basin downstream of the projects, as well as that portion of the Mississippi River basin located between Chester, IL and Cairo, IL.

Releases for the purpose of water quality (dissolved oxygen), at a minimum rate of 10 cfs for Lake Shelbyville and 50 cfs for Carlyle Lake, are made and may be increased as necessary to maintain minimum state standards.

Releases necessary to maintain a minimum 9' depth within the Kaskaskia Navigation Project will be made to sustain navigation. Minimum water quality releases are made to maintain the Dissolved Oxygen (DO) levels and enhance downstream river conditions. State standards set DO levels of 4 parts per million (ppm) or higher. The minimum discharge may be raised regardless of pool levels if necessary to meet state DO standards.

As non-riparian owners, the cities of Salem and Keyesport, Illinois and Texaco, Inc. (sold to Centralia, Illinois) had riparian owner rights established via state specific means.

The lock sited at the lower end of the Kaskaskia Navigation Project releases between three and eight million gallons per lockage (barge or recreational use) depending on the height of the Mississippi River.

Each foot of volume in the lock contains 377,000 gals. Based on the differential between the Mississippi River and the maximum regulated pool will determine the volume of water used in each lockage. Lockages are expected to increase significantly over the next 10 years with the increased business activity for the new Prairie State power plant and for other potential new development. A potential coal mine could open in the region that will greatly add to the lockages.

Key Highlight: Storage allocation is fixed by Congressional action. Reallocation of storage capacity within the three federal projects would take Congressional action and need to be deemed feasible by a study to the respective water control plans. (Reallocation could impact other project purposes.)

Key Highlight: The available water supply from the two largest reservoirs, Carlyle Lake and Lake Shelbyville, is fully allocated. Roughly 80 percent of the total yield allocation is for three power plants, with the largest two being coal-fired plants located on the most downstream reaches of the Kaskaskia River.

Key Highlight: Storage volume is fixed based in federal (Congressional) authorization and any changes to the allocations would require (1) a study of all impacts and (2) congressional reauthorization (Arlan Juhl).

Key Highlight: The allocations from federal reservoirs through 2050 were based on an assumed loss in the State storage as a result of sedimentation (Knapp, personal correspondence).

2-A2-2 State River Withdraws

There are five known PWS systems which withdraw water as a primary source from the lower Kaskaskia River downstream of the Carlyle Dam. These systems include the Village of Evansville, SLM Water Commission, Kaskaskia Water District, City of Carlyle, and the City of Sparta. (See SWS Contract Report 2012-01, Appendix C). The average annual usage of the five PWS systems (as reported to the ISWS for 1998-1999) is about 5.1 mgd. In an extensive dry period during summer into early fall, usage can be much greater than average due to extensive lawn and garden watering, car and home washing, swimming pool use, golf course irrigation, etc. Peak usage for such dry seasonal periods can be two times the average usage. Thus, according to an analysis by DNR/OWR, such seasonal periods could result in the five PWS systems withdrawing 10.2 mgd from the lower Kaskaskia.

Further analysis by DNR/OWR show expected future withdrawals based on a reasonable population growth rate of the areas served by these PWS systems is an average annual usage estimated at 6.4 mgd and the peak usage at 12.8 mgd out to the year 2040. This assumes the highest county based population growth rate of 0.65 percent per year (St. Clair County) as applied to all five systems to the year 2040 and that the average per capita use will remain the same.

An analysis was also conducted by DNR/OWR to consider the water supply demands of these five systems on the flows of the lower Kaskaskia River and while maintaining the protection of navigation releases. Note that none of these five systems are under contract for State-owned water supply storage and therefore would not have the benefits of a protected water supply release for their use during a drought or emergency.

Contract language contained in the July 6, 1983 contracts for water storage space in the Appendix C – Authorities, Water Allocations and Analyses C-26 Shelbyville Reservoir Project (Contract DACW43-83-C-0009) and in the Carlyle Lake Project (Contract DACW43-83-C-0008) can be found in Appendix 2. OWR conferred with the USACE on the language to mean that whenever there is a navigation release, the amount of that release minus the estimate of evaporation and transpiration losses associated with that volume of release in transport down the river channel must be protected to ensure its use for navigation within the navigation channel and for lockages. The key to protecting releases and managing the existing PWS withdrawals is the quantity of natural inflow to the river system downstream of Carlyle Dam.

An assessment of the natural inflows downstream of the Shelbyville dam to Carlyle Lake and downstream of the Carlyle dam to the Lock and Dam was made to determine allowable usages by the State. This assessment also considered the State usage of this (excess) inflow allowable

no matter where the usage would take place. In other words State usage of the summation of the natural inflow could take place anywhere along the channel segments as long the volumes associated with the respective navigation releases are made available into Carlyle lake (Shelbyville releases) or within the navigation channel (Carlyle releases). OWR's analysis of low flow events indicate that the water withdrawals by the five PWS systems could continue without restrictions if the current and projected levels of water use by these five systems remain reasonable.

Following this assessment, DNR/OWR's adopted a policy for existing PWS systems on public waters that would not require a cessation or limitation of withdrawal upon the river reaching a specified low flow unless the system were to serve a major new user or geographical area. Though a specific restricted use value will not be specified, provisions for permit modifications (including withdrawal restrictions) may be instituted, as may be determined necessary to satisfy the IDNR's responsibilities under the Kaskaskia River Watershed and Basin Act. Again it should be noted that none of the existing PWS systems on the lower Kaskaskia River entered into an Agreement with the State to secure water supply storage from Carlyle Lake.

Key Highlight: PWS systems downstream of Carlyle Dam should be allowed to utilize up to the natural contributory flow downstream of Carlyle without charge during a federal navigation release. The five PWS systems should be able to meet future (to year 2040) expected reasonable demands up to at least the 50-year drought event without restriction.

2-B Institutional Organization & Governance

The Kaskaskia River Basin has a drainage area of roughly 5750 square miles within the State of Illinois, which supports agriculture, recreation, navigation, public water supply, natural resources, industry, power generation and coal mining.

- A largely rural watershed, agriculture accounts for over 80% of the land cover.
- The three federal projects, Kaskaskia River, Carlyle Lake, and Lake Shelbyville, and adjoining state properties, provide flood control, support boating, hunting & fishing, and millions of annual visits. Total economic impact – recreation benefits - surrounding these sites exceeds $150M annually.
- The Kaskaskia Regional Port District reports that the Kaskaskia Navigation Project is one of the few projects in the country with increasing tonnage trends. Tonnage is expected to increase to 1.5 to 2.0 million tons over the next two years (2012-2014) and greater than 2 million tons after 2014. 2012 grain exports are projected to be 22,000,000 bushels with a product value of $221 million. High value lower volume products are also shipped that include coil steel and components.
- Public water supply is fragmented between urban (Metro East and Champaign area) and rural systems, some small community systems are finding it to be no longer economically feasible to maintain and operate their existing systems.

- Significant natural resources occur within the Kaskaskia, and in particular in the area between Carlyle and Fayetteville, which supports one of the largest contiguous (40,000 acres), bottomland, hardwood forest blocks in the entire Midwest.
- When compared to power generation and public water supply, industrial water usage is relatively small. Unless new sources of water storage are identified and built industrial development within the Kaskaskia study area may remain limited.
- There are three major power generation facilities within the Kaskaskia study area that rely on water withdrawals from the river.
- Coal reserves are extensive within the boundary of the study area; however the mine permit process, in conjunction with limited water reserves, may prohibit expansion of the mining industry.

Beyond the KWA, water supply planning is currently limited to individual sectors such as power generation, public water supply, industry and communities. As the state's allocation of water supply storage (within Lake Shelbyville and Carlyle Lake) that is available for use has already been fully allocated, the potential for conflicts in the future is real. As such, the development of this document, as well as the associated water supply and demand studies, should be viewed as the first step in the future management of water supply within the Kaskaskia River basin.

2-C Technical Assistance

Technical Assistance: Technical assistance for the management of water resources in the Kaskaskia River Basin may be provided by academic institutions or agencies that are aware of the issues that affect water supply and demand in the region. The following organizations assist with water management in various ways:

- The Illinois State Water Survey – Has many existing reports and the ability to update studies & models related to water supply and demand in Illinois.
- U.S. Army Corps of Engineers – Staff work day-to-day with water resource and recreation issues, have published numerous studies (e.g., sedimentation, water control).
- Illinois Department of Natural Resources – Office of Water Resources works with various regional groups through water supply planning processes.
- Illinois Environmental Protection Agency –has some authorities pertaining to water use, grant programs for restoration or water-related activities.
- Illinois Department of Commerce & Economic Opportunity – works with economic development and planning grants including coal interests.
- HeartLands Conservancy – creates and publishes reports on environmental issues, facilitates various partnerships with stakeholders on water quality & resource management issues.

2-D Baseline Key Highlights

- Illinois does not have a comprehensive water law. The regulatory jurisdiction purview with respect to water in Illinois is limited.
- 100% of the state's share of the joint-use storage pool at Lake Shelbyville and Carlyle Lake are currently under allocation agreements; however no water user is currently withdrawing at the full allocation amount covered under contract.
- Water supply allocations to the two regional public water supply systems provide for reasonable future domestic and municipal growth.
- There is an economic disincentive for contracted water users to request a withdrawal or release from either reservoir, in that they would then initiate a reoccurring annual billing for a proportionate share of all future USACE reservoir operation and maintenance costs.
- Storage allocation is fixed by Congressional action. Reallocation of storage capacity within the three federal projects would take Congressional action and need to be deemed feasible by a study to the respective water control plans
- The available water supply from the two largest reservoirs, Carlyle Lake and Lake Shelbyville, is fully allocated. Roughly 80 percent of the total yield allocation is for three power plants, with the largest two being coal-fired plants located on the most downstream reaches of the Kaskaskia River.
- The percentage of volume allocated to the State water supply storage is fixed by federal (Congressional) authorization and any changes to the allocations would require (1) a study of all impacts and (2) congressional reauthorization.
- The allocations from federal reservoirs through 2050 were based on an assumed loss in the State storage as a result of sedimentation.
- Water use from the 5 PWS systems downstream of Carlyle Dam and any future reasonable growth falls within the total amount of the natural contributory flow. Contributory flow ($\geq$30 cfs) is much greater than that used by the 5 PWS systems and also provides for some of the water needs for the Kaskaskia Lock & Dam and the two power plants.

Chapter 3: The Water Cycle and Water Supply

Water supply, in the most basic sense, is controlled by the water cycle. The water cycle is a concept used to explain how water travels from the atmosphere to land, underground and back into the atmosphere again. The Illinois State Water Survey has produced a figure that illustrates the basic tenets of the water cycle (see Figure 2).

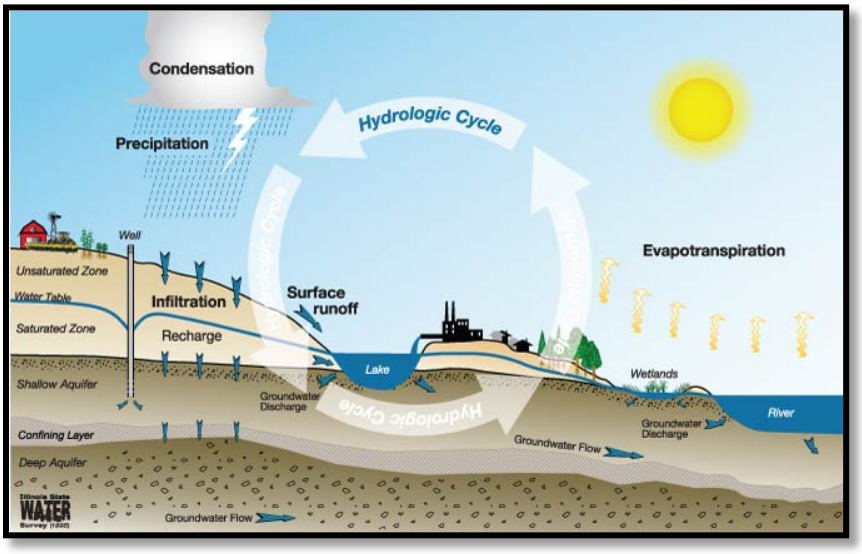

Figure 2. Water cycle diagram

Water reaches the Kaskaskia Basin through precipitation, either rain or snowfall. Some precipitation will become surface runoff and flow directly into rivers, lakes, reservoirs, and streams; but most of the precipitation infiltrates permeable surfaces on the ground, adding to soil moisture. The largest part of that soil moisture will return to the atmosphere through either evaporation or transpiration, commonly referred to in one term “evapotranspiration”, wherein water molecules take on a gaseous form. The water molecules in the atmosphere eventually condense into liquid form (condensation) before falling back to the ground. Surplus moisture in the soil will percolate down to the water table becoming shallow groundwater. Some shallow groundwater is discharged back into a body of surface water (e.g., river, reservoir) while other groundwater continues downward to recharge aquifers and other lower groundwater units. The process of infiltration and percolation through the soil and shallow groundwater may “clean” the water to some extent – depending on (1) the original quality of the water and (2) the depth and vegetative/mineral composition of the ground the water infiltrates.

The spatial and temporal distribution of water within the water cycle, which determines the amount available for water supply at any location and time, is largely controlled by two primary factors. The first is the physical characteristic of the water-bearing elements of the land surface and sub-surface. But the driving factor, and the focus of this chapter, is the climate and local weather patterns.

The Kaskaskia Basin on average receives about 40 inches of precipitation per year. Under such average climatic conditions, water availability is scarcely a concern. But no single year acts like the average; instead, wide ranges of climatic outcomes are the norm, and the occurrence of periodic droughts can substantially impact both water availability and the demand for water. In the future it can be expected that periodic droughts will continue to occur. While the severity and duration of future droughts is not known, their impact on water supply and demand can be estimated by examining the historical weather and hydrologic records. An additional uncertainty which must be considered is the potential that the certain aspects of the climate could change within the 2050 water planning horizon.

3-A Drought

About once in ten years, on average, the Kaskaskia region experiences moderate drought during which the 12-month precipitation can fall below 30 inches, substantially reducing the amount of water available in surface waters and shallow groundwaters. Agriculture can also be impacted severely if particularly low precipitation amounts take place during the heat of the growing season (June-August). About once in 50 years, extreme droughts have occurred in which the 12-month precipitation can be as low as 20 inches, with drought conditions lasting 2-3 years. The most severe historical droughts of this type in Illinois took place in the 1890s, 1930s, and 1950s.

Growing season precipitation deficits during many of these droughts were approximately 40 percent below normal. For the purpose of water demand analysis, it was assumed that during future droughts the 1971-2000 precipitation for the growing season would be reduced by 40 percent to represent a worst-case historical drought (Dziegielewski, 2010).

Estimated effects of drought are:

- Public supply withdraws would increase by 3%
- Irrigation and agricultural withdraws would increase by 14%
- Self-supplied domestic withdrawals would increase by 3%

In determining adequacy of water supplies during drought, such expected increases in water demand must typically be considered (Knapp et al., 2011).

Key Highlight: Significant drought events occurring during the planning period will likely increase water demand. Managers should be prepared for increased demands from various sectors during periodic droughts.

Key Highlight: Water demand will be affected by changes in weather patterns and conditions. Changes in average temperature and precipitation will affect long term water demand and management.

3-B Climate Change

The estimates of future water withdrawals presented in "Water Demands" (see following chapter) assume normal weather conditions; specifically, the values of air temperature and precipitation (Dziegielewski, 2010). Water supply findings, presented here, (Knapp et al., 2011) were also based on historical weather conditions such as air temperature, precipitation patterns, and streamflow records.

Because of the uncertainty in predicting variations or oscillations in the regional and global climate, the "average" weather climate conditions used in planning the water demand & supply presented in this report may change during the planning period. (Knapp et al., 2011). Some climate models indicate that by 2050, there may be a possible average annual temperature departure of up to +6° F for the 1971-2000 long-term normal in Illinois. Other climate models indicate a possible departure from 1972-2000 normal annual precipitation in Illinois in a range from -5 inches to +5 inches per year (Dziegielewski, 2010).

To date, climate models have not been able to address specific scenarios such as what changes might be expected to happen during extreme multi-year droughts. However, it is reasonable to expect that future demand and supply will be affected. For the purposes of this planning document potential effects to water demands have been evaluated using the range of temperature and precipitation scenarios identified above. The effects of these changes will vary by user sector, depending on each sector's sensitivity of water withdrawals to air temperature and precipitation (Dziegielewski, 2010). Using the above assumptions, estimated effects of the potential variation in climate for three various sectors within the Kaskaskia River Basin Planning Area are provided in Table 3, below.

Table 3. Weather scenario impacts on various water use sectors

	Weather scenario impact on the following water use sectors: (relative to normal weather withdraws or demands)		
Weather Scenario:	Public Water Supply	Irrigation & Agriculture	Self-Supplied Domestic
Air temperature increase by 6° F, Precipitation increases 2.5 inches	4.2 mgd (6.3%) increase in demand	1.0 mgd (3.3%) decrease in demand	4.8 mgd (11.7%) increase in demand
Air temperature increases by 6° F, Precipitation decreases 3.5 inches	5.63mgd (8.4%) increase in demand	3.3 mgd (10.5%) increase in demand	8.2 mgd (19.8%) increase in demand

Key Highlight: Water demand will be affected by changes in weather patterns and conditions. Changes in average temperature and precipitation will affect long term water demand and management.

For more information on sensitivity to climate change and drought, see Attachment 3: "Future Water Demands…Final Technical Report, Appendix H"

3-C Water Cylce and Supply Key Highlights

- Water demand will be affected by changes in climate conditions. Changes in average temperature and precipitation will affect long term water supply, demand, and management.
- Significant drought events occurring during the planning period will likely increase water demand. Managers should be prepared for increased demands from various sectors during periodic droughts.

Chapter 4: Water Supply

Ensuring that a consistent supply of water is available for the multiple and varied uses within the Kaskaskia Basin, including agriculture, recreation, navigation, public water supply, natural resources, industry, power generation and coal mining, is paramount to ensuring healthy future economic growth within the basin. While the two major reservoirs offer significant protection along the main river channel, extended droughts, or drought conditions which commence in the winter or spring months may limit the ability of the reservoirs to reach full summer pool.

The last extreme multi-year drought in the Kaskaskia region was in 1953-1955; since then there have been shorter drought episodes that have been locally intense but generally have not severely threatened reservoir supplies in the region. For these and other reasons, there has been concern about the development of large water supply systems across the state, especially those serving the energy sector (e.g., power plants, ethanol production, and coal gasification).

The information within this section focuses on the four primary sources of water supply within the Kaskaskia River Basin:

- The two large federal reservoirs; Carlyle Lake and Lake Shelbyville and low flow releases from these reservoirs;
- Water supply reservoirs on tributary streams;
- Direct withdrawals from tributary streams (there are currently no intakes/withdrawals from tributary streams);
- Groundwater from within the Kaskaskia basin.

Daily streamflow data, collected, processed and published by the U.S. Geological Survey (USGS), remain the primary source of information for determining water availability from streams. Reservoir yield analyses, performed by the ISWS using USGS data and climate records, is the main source of information for determining water availability during drought from the numerous water supply reservoirs in the region. The ISWS yield analyses for Lake Shelbyville and Carlyle Lake, used by IDNR as a factor in setting the allocation limit of the reservoirs, were also revisited in this study (Knapp, et al., 2011).

4-A Water Supply Sources

The four primary sources of water supply within the Kaskaskia River watershed are: 1) the two large federal reservoirs (Carlyle Lake and Lake Shelbyville) and low flow releases from these reservoirs; 2) water supply reservoirs on tributary streams; 3) direct withdrawals from tributary streams; and 4) groundwater from within the Kaskaskia River valley. Of these, the two federal reservoirs represent by far the largest water sources within the watershed, with a combined yield during severe drought conditions of 42 million gallons per day (mgd). As recently as 2002, the water supply from the two federal reservoirs had been largely untapped. However, with recent allocations administered by IDNR-OWR for use with electricity generation, coal mining and regional water supplies, the available water supply from the federal Carlyle Lake and Lake Shelbyville is now fully allocated. It can be argued that recent developments in the energy sector have been the driving force toward the full water supply allocation from the reservoirs, as roughly 80 percent of the total yield allocation is for three power plants, with the largest two

being coal-fired plants located on the most downstream reaches of the Kaskaskia River (Knapp et al. 2011).

Key Highlight: The designated water supply (State) storage in the two federal reservoirs represent the largest individual water sources within the watershed, with a combined yield during severe drought conditions of 42 mgd – reflects state's water supply storage (see Table 4, below, for more information).

Key Highlight: The water supply yield of the State storages in the federal reservoirs alone is roughly equivalent to the yields of all other community reservoirs supply systems in the study area combined (Knapp, personal communication).

4-A1 Surface Water

Many of the water supply reservoirs in the region were constructed by communities in direct response to water supply shortages that were experienced during the most severe drought periods. Based on these experiences, the droughts occurring in the 1890s, 1930s, and 1950s are considered to be the three (3) most severe statewide drought periods in Illinois. However, streamflow records were not collected during the earliest 1890s drought, and only limited records are available during the 1930s drought. Thus, much of the region's estimates of water availability are based on data and experiences from the 1950s drought, which is considered to be the worst of the historical droughts (Knapp et al., 2011).

4-A2 Groundwater

Except along the river, the geology over much of the Kaskaskia River watershed is largely unfavorable for the development of groundwater systems that supply water for more than a few households. For many communities the historical development of groundwater supplies has been problematic, often resorting to a large number of shallow wells or a long pipeline to a distant aquifer. Although rainfall is plentiful, the lack of suitable aquifer material and the widespread presence of heavy clay soils prevent the infiltration and storage of water in usable quantities. With the exception of the Mahomet Aquifer in the headwaters region, the principal sources of groundwater in the basin are the sand deposits that are associated with the modern Kaskaskia River valley, or Kaskaskia Aquifer, where surface water is also plentiful (Knapp et al. 2011).

Key Highlight: For communities, the use of groundwater from major aquifers may have advantages over surface water (e.g., lower treatment costs). However, the geology of much of the Kaskaskia River Basin is unfavorable for high-capacity groundwater systems.

Key Highlight: A sand and gravel aquifer associated with a major stream can provide a source for water supply for a community. However, the probability of finding sustainable and reliable sand and gravel aquifers to provide water supply to a community decreases further away from major streams.

For more information on Groundwater in Bedrock and Glacial Aquifers, please see Attachment 4: Water Supply Assessment for Kaskaskia River Watershed Development.

4-A3 Water Supply from Existing Systems

Yield estimates for community surface water supplies were most recently estimated by the ISWS in 2010. Data uncertainties were evaluated by the ISWS in determining the yield for each community, such that each community's yield estimate was developed on a probabilistic basis. The designated 50% yield value is the best (most likely) estimate for the water supply system; however, there is also roughly a 50% probability that the estimate is either overestimated or underestimated compared to the "true" yield, which is an unknown value. With the designated 90% yield, there is only a 10% chance that the yield estimate is too low; thus the community can have 90% confidence that the yield amount could be provided during the selected drought. In the most recent analysis, the ISWS has turned to yield estimates that are based on the worst historical drought, rather than a yield estimate based on drought frequency analyses, such as the 50-year drought, which in themselves are uncertain and difficult to accurately estimate. The 1953-1955 drought is the worst drought on record for most surface water supply systems in the Kaskaskia region (Knapp et al., 2011) and was used for the basis for the 2010 ISWS yield estimate analyses.

For more information, see Attachment 4: Water Supply Assessment for Kaskaskia River Watershed Development, Table 1, p. 17 which lists the 50% and 90% yield estimates with the drought of record for community surface water systems in the region.

Also in the attached report are tables of demand/yield in water supply throughout the Kaskaskia Basin. The report indicated that larger communities' water demands are not exceeding the yield of their existing water delivery systems. However a number of small systems are considered inadequate or at-risk. The ISWS report indicates that in the future, smaller systems may find it necessary during extreme drought to interconnect or haul water from the larger systems which appear to have sufficient surplus yield.

Visit www.isws.illinois.edu/data/ilcws/drought.asp to view information on Drought Vulnerability of Illinois' Community Surface Water Systems.

Key Highlight: The 1953-1955 drought is the worst drought in the Kaskaskia region with recorded data. ISWS has based most recent yield estimates for surface water supply on this worst drought rather than on drought frequency analyses, as was done in the past.

4-A4 Community Water Supply Systems

Communities with water systems with Impounding Reservoirs will experience a decline in yield estimates because of sedimentation. In addition, some demand estimates (Dziegielewski) did not include the service to satellite systems that is now occurring; demands for these communities providing satellite services have been increased. Overall, there are uncertainties in reservoir storage; because of this, a lower confidence limit was

used. Traditionally, a 50% confidence value is given in assessing water demand/supply. For this study (Knapp et al.) a 90% confidence value was used. Based on this 90% interval, systems were rated as:

- **Adequate:** 90% confidence that the system will meet expected demands without a threat of shortage during a drought of record
- **Marginal:** Meets expected demands of the drought of record with 90% confidence; however, the potential of shortages in the later stages of drought may lead the community to adopt extraordinary measures
- **At-Risk:** 10%-50% chance that a system will not meet expected demands during a drought or record
- **Inadequate:** Greater than 50% chance the system will not meet expected demands during a drought of record

For systems that withdraw from the Kaskaskia River, no expected supply limitations are predicted (Knapp et al.). For more information on this topic, view the February and March 2012 presentations by ISWS on Water Availability, available at www.heartlandsconservancy.org.

Key Highlight: Three community water supply systems were deemed to be "inadequate": Altamont, Coulterville and Farina.

Key Highlight: In addition, the following community water supply systems were deemed to be "at-risk": Fairfield, Mount Olive, and Staunton. Hillsboro and Litchfield are only considered "at risk" by 2050 under the "most resource intensive" water use scenario (see Chapter 5 for more on water use scenarios).

4-A5 Revised Yield Assessments for Carlyle Lake and Lake Shelbyville

The primary difference between the previous (2001) ISWS yield estimates for the reservoirs and this study is that computations for this study were performed using daily time intervals (instead of monthly), surcharge storage effects were considered, and increased effluent inflows to the lakes were considered (adding 1.6 mgd to Shelbyville yield). Both estimates (2001 and 2010), include an assumption of 5 mgd loss in yield by 2050 due to sedimentation in the storage of the joint use pools, see Table 4 below.

Table 4. Comparison of 2001 & 2012 yield estimates in State storage

2001 Assessment	2012 Assessment	Change in Yield Estimate*
50-year yield		
Shelbyville 21 mgd*	Shelbyville 23 mgd	+2.0 mgd
Carlyle 31 mgd*	Carlyle 31.5 mgd	+0.5 mgd
100-year yield		
Shelbyville 15 mgd	Shelbyville 20 mgd	+5.0 mgd
Carlyle 21 mgd	Carlyle 27 mgd	+6.0 mgd

*Although this may be interpreted as a total yield of 52 mgd, estimates would be reduced by: (1) a 5mgd to account for expected reservoir capacity losses by 2050 and, (2) an additional 4.5 mgd which is the amount of the water supply yield which must be obligated toward the State's share of maintaining the minimum water quality releases from the two reservoirs. If you take the 52 mgd yield depicted here and subtract the 9.5 mgd (capacity loss and State's share described above), you end up with 42.5 mgd, the amount listed as the State's water supply on page 21.

The new yield estimates for the federal reservoirs are based on the following analytical changes:

- Changing the water budget calculations (and input data) from monthly to daily time increments
- Adjusting reservoir inflow from historical records to reflect upstream effluents and other changes in flow conditions (such as the additional flow provided by Champaign's treated wastewater).
- Withdrawals and releases are no longer to be debited from the State's water supply storage during Decembers when the Corps is in the process of drawing-down the lake levels to the winter pool elevation.
- The computation of drought frequency was revised based on the additional years of hydrologic data and also recognize the 1895 drought as one of the three worst droughts in the past 120 years.

To view simulated lake levels for the three worst historical droughts please see the February 2012 presentation by ISWS available at www.heartlandsconservancy.org.

Key Highlight: Revised assessment for the federal reservoirs reveal slightly increased 50-year and 100-year yields for both Shelbyville and Carlyle Lakes. However, with both the 2001 and current assessment there is a projected 5 mgd loss in yield by 2050 due to sedimentation of the total storage in the combined joint-use pools (February 2012 ISWS presentation).

4-B Future Water Availability

The Kaskaskia River may be the most managed river in Illinois. Water storage and releases from two federal reservoirs control flooding, ensure navigation and water quality, and provide for water supply, fish and wildlife conservation, and recreation. Numerous water withdrawals occur along the river and from the reservoirs, providing for public water supply and industrial needs. The Kaskaskia Lock & Dam maintains the navigation pool, providing for bulk transport of goods and for recreation. Effluent discharges from municipal systems and industries, and cooling water returns from power plants occur along the main channel and its tributaries.

The IDNR-OWR has either performed or contracted for numerous studies for the Kaskaskia River Basin to establish plans to meet water supply requirements, in consideration of navigation and impacts to recreation and fisheries (Knapp et al., 2011). As recently as 2002, the water supply from the two federal reservoirs had been largely untapped. However, with recent allocations administered by IDNR-OWR for use with electricity generation, coal mining and regional water supplies, the available water supply from Carlyle Lake and Lake Shelbyville is

now fully allocated (Knapp et al., 2011). Analyses of the community reservoir supplies in the region indicate that most systems appear to have an adequate supply, i.e. with less than a 10% chance that shortages would be experienced during a drought of record condition. However, there are still reservoir systems in the region that are considered inadequate or at risk of water shortages. Most of these systems serve small communities that potentially could haul water or possibly interconnect with a larger system if faced with the threat of water shortage (Knapp et al., 2011).

Key Highlight: The Kaskaskia River and federal reservoirs, Lake Shelbyville and Carlyle Lake provide adequate water supply for a variety of uses under the guidance of the U.S. Army Corps of Engineers Water Control Plans (July 2011 presentation by USACE).

Key Highlight: Reservoirs on tributary streams: The Water Supply Assessment for Kaskaskia River Watershed Development (ISWS) indicates that the Kaskaskia Basin has adequate existing water delivery systems/supply, exempting those small systems mentioned above that are at-risk or inadequate in drought events. Two additional systems (Hillsboro & Litchfield) are not currently considered at risk but may be by 2050. (February 2012 ISWS presentation)

Key Highlight: DIRECT WITHDRAWLS: Limited legal authority to take direct river withdrawals, per riparian laws. (September 2011 IDNR presentation) For public water supply systems that do direct withdraw from the Kaskaskia River, no limitations are expected under current State policy that will allow for normal water supply growth and expansion. Added service to new systems or major industrial users will be limited.

Key Highlight: GROUNDWATER: Groundwater is not a viable water supply option for the majority of the planning area due to lack of geographic/hydrologic features that sustain groundwater use. In areas where groundwater is consistent, groundwater systems can provide primary (small communities) or complimentary supply of water (for larger communities) (Knapp).

4-C Supply Key Highlights

- The designated water supply (State) storage in the two federal reservoirs represent the largest individual water sources within the watershed, with a collective yield during severe drought conditions of 42 mgd.
- The geology of much of the Kaskaskia River Basin is unfavorable for high-capacity groundwater systems.
- The probability of finding sustainable and reliable sand and gravel aquifers to provide water supply to a community decreases further away from major streams.
- The available water supply from the two largest reservoirs, Carlyle Lake and Lake Shelbyville, is fully allocated.

- The 1953-1955 drought is the worst drought in the Kaskaskia region with recorded data. ISWS has based most recent yield estimates for surface water supply on this worst drought rather than on drought frequency analyses, as was done in the past.
- Three community water supply systems were deemed to be "inadequate": Altamont, Coulterville and Farina.
- Community water supply systems were deemed to be "at-risk": Fairfield, Mount Olive, and Staunton.
- Hillsboro and Litchfield are only considered "at risk" by 2050 under the "most resource intensive" water use scenario. The other systems listed above are already at risk or inadequate.
- Revised assessment for the federal reservoirs reveal slightly increased 50-year and 100-year yields for both Shelbyville and Carlyle Lakes. However, with both the 2001 and current assessment there is a projected 5 mgd loss in yield by 2050 due to sedimentation of the total storage in the combined joint-use pools.
- The Kaskaskia River and federal reservoirs, Lake Shelbyville and Carlyle Lake provide adequate water supply for a variety of uses under the guidance of the U.S. Army Corps of Engineers Water Control Plans.
- The Kaskaskia Basin has adequate existing water delivery systems/supply, exempting those small systems mentioned above that are at-risk or inadequate in drought events.
- Limited legal authority to take direct river withdrawals, per riparian laws.
- For public water supply systems that do direct withdraw from the Kaskaskia River, no limitations are expected under current State policy that will allow for normal water supply growth and expansion. Added service to new systems or major industrial users will be limited.

Chapter 5: Water Demands

Water demands will be evaluated in this chapter from a three scenario approach in which water demands are estimated under various circumstances that do not predict future circumstances but give stakeholders and managers a range of possible settings for which to plan. Water demands for six specific sectors (see section 5-B) are analyzed under the three scenario approach to give stakeholders and mangers a better idea of how these multiple scenarios affects industry, public, environmental, and other sectors differently. The water demands presented here are not accurate representations of what the Kaskaskia area's future holds but rather starting points from which planners and managers may base future projects.

5-A Current & Future Water Demand Scenarios

Any assessment of water demands necessarily depends on the measurement and estimation of water use. In practice it is impossible to know precisely all water uses – there are many different types of water users and specific purposes of use and only some uses are metered. For uses which are not metered, various estimation methods are usually employed to determine the quantity of water use (Dziegielewski).

The historical county-level water withdrawal data for benchmark years 1985, 1990, 1995, 2000 and 2005 were obtained from the ISWS and the USGS compilations. The data allowed developing initial estimates of water withdrawals and deliveries for the following six major sectors (Attachment 3: Future Water Demands and Coal Development Potential in Kaskaskia River Basin in Illinois):

- Coal mining and processing sector
- Thermoelectric power generation
- Public supply sector
- Self-supplied domestic sector
- Self-supplied commercial and industrial sector
- Irrigation and agriculture sector

The available data and their quality are considered to be adequate for the purpose of developing future scenarios of water demand. The techniques for developing future water demand varied by sector and included unit-use methods, multiple regressions, and mass balance estimation of irrigation demands. These techniques provide future water demand numbers as a function of demand drivers (i.e., population, employment, coal production, power generation, irrigated acreage, depending on user sector) and variables which influence average rates of water demand (e.g., weather conditions, price of water, income, employment mix). However, the change in water demand will not be strictly proportional to changes in demand drivers. The increases or decreases in future demand will also depend on the future values of explanatory variables such as price, income, or weather conditions (Dziegielewski). See

Attachment 3, Table 1 in the Summary Report, p. 7 for more information on the Drivers of Water Demand.

5-A1 Three Scenario Approach

Estimates of future water demands, prepared by Dr. Dziegielewski were prepared for three different scenarios. The scenarios were defined by varying assumptions regarding the future values of demand drivers and explanatory variables. The purpose of the scenarios is to capture future water withdrawals under three different sets of future conditions. The scenarios do not represent forecast or predictions, nor set upper and lower bounds of future water use. Different assumptions or conditions could result in withdrawals that are within or outside of this range (Dziegielewski). A listing of assumptions for each of the three scenarios is given in Table 5, below.

A baseline scenario (CT – current trend) was included to illustrate a continuation of historical trends with no dramatic changes in factors relative to water supply in the Kaskaskia Basin. A Less Resource Intensive Scenario (LRI Scenario) represented water supply conditions in a future where water intensive activities (e.g., cropland irrigation, power generation, etc.) are minimized. Finally, a More Resource Intensive Scenario (MRI Scenario) was constructed to study future water demand and supply with increased water intensive activities and growth in the Kaskaskia basin. The assumptions used in formulating the scenarios are not connected (i.e., causally linked). For example, the assumption of the higher growth rate of income is not related to the assumption of higher water prices (Dziegielewski).

Key Highlight: The main drivers of future water demand are population and economic growth which are indirectly represented in this study by employment and development of new industrial and power plants (Attachment 3: Future Water Demands…In Kaskaskia River Basin).

This is reflected in the three scenarios constructed to view future water demands under various conditions.

Table 5. Variables used in future water demand scenarios

Factor	Baseline (CT)	Less Resource Intensive (LRI Scenario)	More Resource Intensive (MRI Scenario)
Total population	Official projections	Official projections	Official projections
Mix of commercial/ industrial activities	Current trends	No increase in water-intensive industry	Increase in water-intensive industry
Median household income	Existing projections of 0.7 %/year growth	Existing projections of 0.5 %/year growth	Higher growth of 1.0 %/years
Coal mining and processing	Five new mines, one CCS and one CTL plant to be built	No new coal conversion plants, reduced mine production	New mines and coal conversion plants, maintained mine production
Power generation	Two new plants within study area	One new power plant existing generation declines	Five new power plants in study area
Water conservation	Continuation of historical trend	50% higher rate than historical trend	50% lower than historical trend
Future water prices	Future price increases (1.5%/year)	Higher future price increases (2.5%/year)	Recent increasing trend (0.9%/year) will continue
Irrigated land	Constant cropland increasing golf courses	Constant cropland + no increase in golf courses	Increasing cropland + increasing golf courses
Livestock	Baseline USDA growth rates	Baseline USDA growth rates	Baseline USDA growth rates
Weather (air temperature and precipitation)	30-year normal (1971-2000)	30-year normal (1971-2000)	30-year normal (1971-2000)

5-A2 General Water Withdrawals

Under the baseline or current trends (CT) scenario, total withdrawals (excluding once-through flows in power plants) would increase from the weather adjusted value of 159.6 mgd in 2005 to 221.5 in 2050. Most of this increase represents growth in withdrawals for power plant makeup water and public supply sectors (See Attachment 3, p. 11).

Under the assumptions of the LRI scenario, total withdrawals (excluding once-through flows in power plants) would increase by 20.0 mgd, 178.7 in 2050. Most of this decrease comes from lower demands in power makeup and public supply sectors (Dziegielewski).

Finally, under the MRI scenario, total withdrawals (excluding once-through cooling flows in power plants) would increase to 291.8 mgd in 2050. The total increase would be 133.1 mgd. The main reasons for the increase are the assumptions leading to a large increase in makeup water requirements as well as assumptions of lower price increases and lower conservation, combined with a higher rate of growth in median household income.

Key Highlight: The results in the following table show that by 2050 total water withdraws, or demands, could increase from 2005, 159.6 mgd to: 178.7 mgd under LRI scenario, 221.5 mgd under CT scenario, and up to 291.8 mgd under the MRI scenario.

Table 6. 2050 total water withdraws

Scenario/ Sector:	2005 Reported Withdrawals (mgd)	2050 Normal Withdrawals (mgd)
CT- Current Trends (Baseline)		
Public Supply	58.1	70.5
Self-supplied I&C	7.1	9.6
Self-supplied Domestic	19.0	23.2
Irrigation and Ag	25.2	31.9
Coal Mining	2.8	10.1
Power Plants [f]	512.7	541.5
Power Plant Makeup [f]	47.4	76.2
Total w/o Once-through*	159.6	221.5
LRI – Less Resource Intensive		
Public Supply	58.1	66.0
Self-supplied I&C	7.1	7.7
Self-supplied Domestic	19.0	18.8
Irrigation and Ag	25.2	28.4
Coal Mining	2.8	1.5
Power Plants [f]	512.7	384.9
Power Plant Makeup [f]	47.4	56.3
Total w/o Once-through*	159.6	178.7
MRI – More Resource Intensive		
Public Supply	58.1	75.4
Self-supplied I&C	7.1	20.8
Self-supplied Domestic	19.0	33.9
Irrigation and Ag	25.2	38.6
Coal Mining	2.8	24.9
Power Plants [f]	512.7	558.7
Power Plant Makeup [f]	47.4	98.2
Total w/o Once-through*	159.6	291.8

* Once-through refers to non-consumptive water use from power plants, in which the water passes through the power plant but is returned without change in quantity to the source of its origin. For example, the water withdrawn from Baldwin Lake and circulated through the power plant is returned back to the lake (albeit at a higher temperature). The power plant "make-up" category accounts for water that is consumed by the power plants (including forced evaporation). In Demand projections, it was assumed that any new power plants, developed by 2040, will not use once-through cooling; their only reported water use will be that needed for make-up and evaporation towers. That is why the projected increases are so small compared to the current reported uses that include once-through water.
[f] Power plants withdrawals (both once-through and makeup) include only withdrawals from Kaskaskia basin.

Key Highlight: The three major withdraw sectors are public water supply, power generation, and coal mining and processing.

Table 7. General water withdrawals 2005 -2050

User sector:	2005 Water Demand*	2050 Water Demands		
		CT Scenario	LRI Scenario	MRI Scenario
Coal mining and processing sector	2.8 mgd	Increase to 10.1 mgd	Decrease to 1.4 mgd	Increase to 24.9 mgd
Power generation sector**	47.4 mgd	Increase to 76.2 mgd	Increase to 56.3 mgd	Increase to 98.2 mgd
Public water supply sector	58.1 mgd	Increase to 70.5 mgd	Increase to 66.0 mgd	Increase to 75.4 mgd

*2005 Water Demands in this Chapter are weather-adjusted values
** Most of the projected increase would represent the consumptive use that is associated with makeup water for cooling towers.

To view more information on general water demands, see Appendix 3, Executive Summary.

Key Highlight: The results of the analysis of future water demand scenarios show that total water supply needs in the 22-county study area will continue to increase to meet the demands of growing population and the associated growth in the economy of the region. However, the growth in total water demand could be faster or slower depending on which assumptions and expectations about the future conditions will prevail (Dziegielewski, 2010).

5-A3 Future Influences

Other findings of the study pertain to additional factors which could alter future water demands in the study area. The main factors are future weather patterns and periodic droughts. Future demands in all sectors are likely to be higher if future annual average air temperature increases and/or annual precipitation decreases. Also, future demands will likely increase during future droughts given a re-occurrence of a worst historical drought, with a 40 percent deficit in precipitation during the summer growing season. In summary, the overall recommendation based on the results of this study is to encourage the Committee to recognize the need to create and maintain an expanded knowledge base about both the regional and local water demands by all sectors and subsectors of water users (Dziegielewski, 2010).

Key Highlight: A knowledge base of water demands by all sectors is needed to support a regional long-term water management program in the Kaskaskia region (Dziegielewski, 2010).

5-B Water Withdrawals

Water withdrawals for six sectors will be presented in the following sections. The analyses and statements provided here are drawn primarily from a report entitled "Future Water Demands and Coal Development Potential in Kaskaskia River Basin in Illinois," Appendix 3 of this report. The "Future Water Demands…in Kaskaskia River Basin" report was prepared for the Illinois Clean Coal Institute by a professional outside the Kaskaskia Basin Water Supply Committee. The report provides an understanding and awareness of potential water demand scenarios for (1) coal mining and processing, (2) self-supplied water for power generation, (3) public water supply, (4) self-supplied domestic, (5) self-supplied industrial & commercial, and (6) irrigation, environmental, and agricultural demands.

5-B1 Coal Mining & Processing

The coal mining activity in the Kaskaskia basin dates back to the middle of the 19th century. In total, 1,662 coal mines have operated since 1842. The most intensive period of coal mining in terms of the number of active mines was between 1880 and 1940. Most coal mines existed in Macoupin, Madison, Randolph and St. Clair counties. Historical data on coal production in the 22-county study area show a significant decline in total production after 1991 (see Appendix 3, Appendix B for more information).

- **Coal Mines:** Since the year 2000, 4 mines were closed or temporarily idled and in 2009 only three mines were operating. In 2009, IDNR Office of Mines and Minerals approved six new mine permits and three new mines awaited approval (DCEO, 2010). Also, there were eight mining permits under completeness review. For more information on recent development in existing and proposed mines see Appendix 3, Appendix B, p. B-3 & B-4.

- **Processing Plants:** Some mining operations also include coal preparation plants. These plants are usually located at or near coal mines and in some cases one preparation plant can serve multiple coal mines. The available information shows one existing coal preparation plant in Randolph County and one existing plant located on the Randolph/Perry county line operated by Knight Hawk Coal Company.
- **Coal Conversion Plants:** New coal conversion plants will require significant quantities of water for coal processing and cooling. Several coal conversion plants have been proposed for locations within the 22-county study area. Some of these proposals have been abandoned or became inactive while others may still be under consideration.

  Recently, one coal conversion plant was approved and another remained under consideration. The Taylorville Energy Center plant was to be built in Christian County and the FutureGen coal gasification plant was planned for a site near Mattoon in Coles County. Both plants would use municipal effluent as a source of cooling and process water. Taylorville plant would obtain treated effluent from the Sanitation District of Decatur. A similar secure water source is potentially available for FutureGen from two wastewater treatment facilities (Mattoon and Charleston wastewater plants), which when combined with the construction and operation of an onsite reservoir, would ensure an adequate water supply to the plant. For information on 4 abandoned or inactive coal conversion plants see Appendix 3, Appendix B, p. B-5 & B-6.

- **Coal Related Water Demands:** Coal mines usually require access to a source of water for such mining processes as dust suppression during the cutting process. Water is also used for coal washing, sanitary use by employees and other uses at the mine site. The actual amounts of water used vary because of differences in operating practices and site-specific circumstances. In addition to coal preparation at the coal mining sites, further coal processing may include coal gasification, liquefaction and other coal conversion processes.

Key Highlight: The amount of freshwater mining withdrawals decreased by about 50% between 1985 and 1995 then began to increase in 2005.

To view Mining Withdrawals by County see Appendix 3, Appendix B, p. B-8.

Key Highlight: The available estimates of the current water withdrawals by the three operating coal mines indicate total withdrawals of:

• Monterey/Shay #1	Macoupin County	2.364 mgd
• Gateway	Randolph County	1.778 mgd
• Crown III	Macoupin County	0.184 mgd
• Total		4.336 mgd

In terms of the outlook for future production of Illinois coal, it is reasonable to assume that the production will rebound in the near term once the mines that are under construction, as well as the permitted mines, start production.

Key Highlight: In the long term, the production of Illinois coal should continue to grow because of two factors: (1) the high coal reserves in Illinois and (2) new demands for coal by coal conversion plants.

See Appendix 3, Appendix B, p. B-12 for more information.

Dr. Dziegielewski developed generation and withdrawal estimates from the coal sector under the three scenarios developed for demand forecasting (see the table below). For details on the assumptions used in each scenario please see Appendix 3, Appendix B, p. B-13 & B-14.

Key Highlight: The results of the assumptions for each of the three scenarios on water withdrawals for coal mining and processing are:

Table 8. Water withdrawals for the coal mining and processing sector

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	4.34 mgd	11.61 mgd	+07.27 mgd
LRI Scenario		01.14 mgd	- 02.19 mgd
MRI Scenario		24.89 mgd	+ 20.56 mgd

5-B2 Self Supplied Water for Power Generation

Water withdrawn by electric power plants is classified by the USGS as thermoelectric generation water use. It represents the water used in the production of heat-generated electric power. The heat sources may include fossil fuels such as coal, petroleum, natural gas, or nuclear fission. The main use of water at power plants is for cooling.

The three major types of thermoelectric plants include: conventional steam, nuclear steam, and internal combustion plants. In internal combustion plants, the prime mover is an internal combustion diesel or gas-fired engine. In conventional steam and nuclear steam power plants, the prime mover is a steam turbine and water is used primarily for cooling and condensing steam after it leaves the turbine. The “waste” heat removed in the condenser is transferred to the surrounding environment through a combination of evaporation and sensible heating of water. The wet cooling systems fall into two broad categories: once-through cooling systems and closed-loop (or recirculating) systems.

Key Highlight: Since no steam or condensation cooling is involved, almost no water is used by internal combustion power generation (Dziegielewski, 2010).

According to the inventory of electric generators maintained by the Energy Information Agency (EIA), there are 34 generation facilities in the 22 counties of the Kaskaskia Basin study area (although some generators are located outside of the study area in the four western counties). Total nameplate capacity of the 34 plants is approximately 8,000 MW. Of the total number of plants, there are eight large plants which account for nearly 92 percent of total generation capacity.

See Appendix 3, Appendix C, p. C-1, C-2, & C-5 for more information on the generation capacities of all existing, proposed, and inactive plants.

Total Reported Thermoelectric Water Withdrawals: The USGS National Water Use Information Program reported thermoelectric withdrawals in six of the 22 counties which are included in the study area.

Key Highlight: Total thermoelectric water withdrawals by county during 2005 were 2,267 mgd. In 2007, total water withdrawals by power plants totaled 3,134.5 mgd. The historical data on reported water withdrawals shows an increase from 1995 (1,823.6 mgd) of about 25% or 466 mgd to 22,889.7 mgd in 2000 (see Appendix 3: "Water Demands…In Kaskaskia River Basin, Appendix C, p. C-4 & C-5).

Key Highlight: All plants appear to be once-through (see Table 6 of this report for more information on once-through cooling) plants that pump water directly to the condensers and then return it back to the river or lake (except Holland Energy which is an internal combustion plant).

For more information on the Reported Thermoelectric Water Withdrawals see Appendix 3, Appendix C, p. C-4 & C-5.

Future Thermoelectric Water Withdrawals: Future withdrawals will depend on the level of future generation and also on the type of generators and cooling systems. Before constructing the future scenarios for the thermoelectric sector, it is helpful to examine the future trends in demand for electricity. According to the EIA, at the national level, total electricity sales to all sectors (i.e., residential, commercial, and industrial) are expected to increase. Nearly 90 percent of the local electric generation is exported. This result indicates that local demand for electricity will have little influence on the future level of generation. The future generation is determined through the use of assumptions about the proposed new power plants and likely curtailment of generation in the oldest existing plants. To view more detail on assumptions made for the various scenarios, see Appendix 3: "Water Demands…In Kaskaskia River Basin", Appendix C, p. C-9 & C-10.

Key Highlight: The results of the assumptions for each of the three scenarios on power generation-related water withdrawals are:

Table 9. Water withdrawals for power generation

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario*	2,072.1 mgd (estimate used in Supply forecast [Appendix 3])	2,095.4 mgd	+ 23.3 mgd
LRI Scenario**		1306.5 mgd	-765.6 mgd
MRI Scenario***		2,117.4 mgd	+ 45.3 mgd

* Most of the projected increase would represent the consumptive use that is associated with makeup water for cooling ponds or towers. Makeup water withdrawals would increase to 76.2 mgd in 2050, 60.6%.
** The use of makeup water would change only slightly from 47.4 mgd in 2005 to 56.3 mgd in 2050.
*** Most of the projected increase would represent the consumptive use that is associated with makeup water for cooling ponds or towers. The makeup water withdrawals would increase to 98.2 mgd in 2050, 107%.

See Appendix 3: "Water Demands…In Kaskaskia River Basin", Appendix C, p. C-10 & C-11.

5-B3 Public Water Supply

Public water supply is water delivered to individual residential, commercial, industrial, institutional, and governmental users by public water supply systems. Some or all water can also be purchased from a nearby system and delivered to users (Dziegielewski). The U.S. Environmental Protection Agency (USEPA) defines a "public" water system as a publicly-owned or privately-owned system that serves at least 25 people or 15 service connections for at least 60 days per year (USEPA, 2004a).

Not all users of water within a given geographical area rely on water delivered by public systems; some users have their own sources of supply and are considered to be self-supplied. The self-supplied users include industrial and commercial establishments that rely on their own wells or surface water intakes, as well as residential users who rely on private wells. The latter group of users is called the self-supplied domestic sector, and is included in the following section of this report.

Key Highlight: According to the USEPA data, there are 290 public water supply systems in the 22 counties in the study area. In 2005, these systems served the estimated population of 1,055,122 persons, as well as local businesses and institutions.

The comparison of total resident population in each county with population served by public systems implies that in 2005, an additional 120,341 people (or about 10 percent of total population in the 22-county area) were served by domestic wells and other sources in the self-supplied domestic sector.

Key Highlight: The total 2005 public water system use for the study area is 42.35 million gallons per day (mgd). An additional 15.73 mgd were used by the systems in county residual sub-areas.

The combined public-supply use in 2005 was 61.13 mgd and when divided by total population served of 558,495 persons, this total use was equivalent to the usage rate of approximately 104 gallons per capita per day (gpcd). Between 1985 and 2005, total public supply use has increased by 11.33 mgd or 24.2%. This implies average annual compounded growth rate of 1.0 percent. During the same period total population served has increased by 40 percent.

For more information on historical public supply water use, please see Attachment X, Appendix D, p. D-7 & D-8.

Current Withdrawals: To see public water withdrawals are listed by source (ground water and surface water) please go to Appendix 3, Appendix D, p. D-15 – D-17.

Key Highlight: The main driver of future water demand in the public-supply sector is population served. Total population for the study area was 1,050,122 in 2005. A linear extension was considered as the most reasonable assumption for extending the 2000-2030 populations projections, hence an estimated population of 1,239,023 in 2050.

Scenario Estimates*:* The data on future increases in resident population of the study area counties were obtained from DCEO. Other explanatory variables of future water demands include summer season temperature and precipitation, employment to population ratios, marginal price of water, and median household income.

For more information population projections, see Appendix 3, Appendix D, p. D-18 & D-19. For more information on other variables and assumptions made for the various scenarios, p. D-20 –D-26.

Key Highlight: The scenario outcomes are estimates of future public water supply withdrawals that could occur under these various estimated conditions:

Table 10. Water withdrawals for public water supply

	2005 (normalized) Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	56.5 mgd (estimate used in Supply forecast [Appendix 3])	66.9 mgd	+ 10.4 mgd
LRI Scenario		63.4 mgd	+ 06.9 mgd
MRI Scenario		71.9 mgd	+ 15.4 mgd

Key Highlight:

- Groundwater withdrawals would:
  - CT scenario + 25.9% (1.5 mgd)
  - LRI scenario +19.0% (1.1 mgd)
  - MRI scenario +34.5% (2.0 mgd)

- Surface water withdrawals would:
  - CT scenario +17.4% (4.1 mgd)
  - LRI scenario +11.1% (2.6 mgd)
  - MRI scenario +26.0% (6.1 mgd)

5-B4 Self-Supplied Domestic Use

Domestic water use includes water for normal household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, car washing, and watering lawns and gardens (Solley et al., 1998). A major percentage of water for domestic purposes is provided by public water supply system – a portion of users rely on self-supplied water (Dziegielewski).

Key Highlight: Nearly all of the self-supplied domestic withdrawals are reported to be from groundwater sources.

USGS estimates self-supplied domestic water use by multiplying the estimated self-supplied population in each county by a per capita water use coefficient. The self-supplied population is calculated as the difference between total county population and the estimated number of persons served by public-supply facilities that is obtained from Illinois EPA and other sources.

Key Highlight: The self-supplied domestic water-use coefficient in Illinois has been increased several times since the USGS first began reporting self-supplied domestic water use in 1960. The coefficient used in the 2005 report was 90 gallons per person per day.

Self-supplied domestic withdrawals have been reported by the USGS for every county, for every data compilation year. Total population (2005, reported by USGS) using self-supplied water for the 22 county study area is 210,509.

Key Highlight: Total self-supplied domestic water usage (2005, USGS) is 18.93 mgd.

Since the majority of self-supplied population is served by domestic wells, the future self-supplied domestic population in each county was estimated using the self-supplied population in 2005, the projected increase in total county population since 2005, and the

rate of installation of new domestic wells per 1,000 persons of the projected additional future population in each county. The historical data on domestic wells were analyzed in order to establish the trend in the number of new wells which are developed for each 1,000 persons of new population.

Key Highlight: For the 22-county study area, total self-supplied population is expected to increase between 2005 and 2050 from 210,509 to 240,613. This represents an increase of 30,104 persons (Dziegielewski, 2010).

Scenario Estimates: In all three scenarios, the self-supplied population growth is estimated based on the number of new well installations per 1,000 people of future county population. Therefore, self-served population is assumed to follow the county total population growth. For specific assumptions for each scenario see Appendix 3, Appendix E, p. E-4 & E-5.

Key Highlight: The outcomes of the three scenarios for self-supplied domestic demands include the following changes from 2005 conditions:

Table 11. Water withdrawals for self-supplied domestic

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	18.95 mgd (estimate used in Supply forecast [Appendix 3])	23.23 mgd	+ 4.29 mgd
LRI Scenario		18.80 mgd	- 0.80 mgd
MRI Scenario		33.89 mgd	+14.94 mgd

5-B5 Self-Supplied Industrial & Commercial

Industrial, commercial (I&C) and institutional water demand represents self-supplied water by industrial, commercial, and other nonresidential establishments (Dziegielewski, 2010). The industrial sub-sector includes water used for "industrial purposes such as fabrication, processing, washing, and cooling, and includes such industries as steel, chemical and allied products, paper and allied products, mining, and petroleum refining," and the commercial sub-sector includes water used for "motels, hotels, restaurants, office buildings, other commercial facilities, and institutions" (Avery, 1999).

Because self-supplied industrial and commercial (I&C) water withdrawal points (i.e., wells and surface water intakes) are distributed throughout the counties in the study area, the geographical areas of analysis are individual establishments and counties. County-level totals of self-supplied withdrawals have been compiled and reported by the USGS since

1985. For more information on historical self-supplied industrial and commercial water demand see Appendix 3, Appendix F, p. F-1 & F-2, Table 6.1.

For the entire 22-county study area, total self-supplied I&C withdrawals have been gradually increasing between 1985 and 1995 and then decreased considerably from the high 1995 value of 111.29 mgd to 35.53 mgd in 2005.

Key Highlight: According to the Illinois Water Inventory Program (IWIP) data, the 2005 total self-supplied withdrawals for the study area were 6.92 mgd. In terms of individual counties, about 90 percent of total self-supplied I&C withdrawals were reported to take place in Madison and St. Clair Counties and the data suggests that nearly all of the withdrawals (around 33 mgd total) in these two counties are outside the Kaskaskia Basin (Dziegielewski).

In addition to self-supplied water, industrial, commercial and institutional users also purchase water from public water supply systems.

Key Highlight: In 2005, total commercial/industrial deliveries from public water supply in the 22 counties were reported to be 14.98 mgd (Dziegielewski).

Scenario Outcomes: For all three scenarios, it is assumed that: (1) total county employment will follow the 2020-2050 projections, developed in this study based on Illinois Department of Employment Security (IDES) growth rates, (2) self-supplied portion of I&C water demand for each county will remain at the percentage levels observed in 2005, and (3) the proportions of groundwater and surface water in total self-supplied I&C withdrawals will remain at the percent fractions as reported for the year 2005(Dziegielewski).

For more information on water use relationships and the specific assumptions used in each scenario are described in Appendix 3: “Water Demands…In Kaskaskia River Basin”, Appendix F.

Under the current trends (or baseline) scenario, self-supplied I&C withdrawals are projected to increase from 6.92 mgd in 2005 to 9.58 mgd in 2050. This represents an increase of 2.66 mgd, or 38.4 percent. The total self-supplied withdrawals in 2050 would be 7.69 mgd under the LRI scenario, and 20.84 mgd under the MRI scenario.

Key Highlight: The Kaskaskia Basin share of I&C withdrawals in 2005 was estimated to be only 0.48 mgd of the total 6.94 mgd or approximately 7% of the total.

Table 12. Water withdrawals for self-supplied industrial and commercial

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	0.48 mgd (estimate used in Supply forecast [Appendix 3])	0.64 mgd	+ 0.16 mgd
LRI Scenario		0.47 mgd	- 0.01 mgd
MRI Scenario*		9.26 mgd	+ 8.78 mgd

* Under the MRI scenario five new biodiesel plants and ten ethanol plants are built.

5-B6 Irrigation, Environmental, & Agricultural Demands

The irrigation and agricultural (IR&AG) sector includes self-supplied withdrawals of water for irrigation of cropland and golf courses, as well as water for livestock and environmental purposes. In the USGS inventories of water demand, the designation of "irrigation" water withdrawals includes "all water artificially applied to farm and horticultural crops as well as self-supplied water withdrawal to irrigate public and private golf courses" (Solley et al., 1998). The Irrigation, Environmental, and Agricultural Sectors represent about 15.7% of the total water use (Dziegielewski, 2010).

Agricultural: Agricultural livestock water demand includes water for animals, feedlots, dairies, fish farms, and other on-farm needs. The categories of livestock water demand include water used to care for all cattle, sheep, goats, hogs, and poultry, including such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity (Avery, 1999).

Historical water withdrawals for livestock which were reported by the USGS; in 2005 total estimated withdrawals for livestock were 10.17 mgd. For the purpose of this study, the livestock water use was re-estimated based on updated livestock counts unit usage rates (see Appendix, Appendix G).

Key Highlight: The resultant updated total withdrawals for 2005 were 6.86 mgd.

Irrigation: The Illinois Water Inventory Program includes agricultural withdrawals for only large agricultural irrigation systems and urban irrigation landscapes such as parks and golf courses. Therefore, the reported data on water withdrawals are based on the inventory of the total acreage of irrigated area within each county. Similarly, water withdrawals for livestock are based on the reported numbers of livestock by type. A review of the historical data on irrigation and agriculture is presented in the following sections.

Key Highlight: The reported data show that in the 22 county study area, there are 5,251,661 acres of total cropland. Of that 5 million plus acres, there is a total of 10,528 acres of land under irrigation in 2007. Approximately 86% (or 9,054 acres) of total

irrigated land in the study area was in five counties (Clinton, Wayne, Madison, Monroe, and St. Clair). Between 1992 and 2007, the average annual rate of growth of irrigated cropland was 0.5 percent. (The data on irrigated land are collected and reported by the U.S. Department of Agriculture.)

The amount of water applied for irrigation is a function of the number of acres of cropland and golf course areas which are irrigated during the growing season. The estimates of historical irrigation of water demand are prepared by USGS by interpolating the census data on irrigated acres for the reporting years (i.e., 1985, 1990, 1995, 2000, and 2005) and then by determining irrigation withdrawals based on the rainfall deficit during the growing season. Appendix 3, Appendix G, Table 7.2 below shows the interpolated 2005 number of irrigated acres and estimated water withdrawals for both cropland and golf courses.

According to the USGS data compilation for 2005, the 22 county Kaskaskia study area had withdrawn an estimated 8.12 mgd of water for irrigation of cropland (Table 7.2). The largest withdrawals were reported for counties with the largest acreage of irrigated cropland. Golf course irrigation took place on a total of 3,100 acres and the estimated withdrawals were 3.16 mgd. For this study the USGS numbers were updated using the most recent 2007 Census of Agriculture.

Key Highlight: The updated estimates of water withdrawals were 7.68 mgd (for irrigation of cropland) and 2.36 mgd (for irrigation of golf courses).

The future acreage of irrigated land is separated into cropland and golf courses. The estimates of future water demand in the irrigation and agriculture sector are a function of the future estimates of irrigated area and summer rainfall deficit. The assumptions about the future changes in irrigated acreage are discussed in Appendix 3, Appendix G.

The future number of irrigated cropland acres can change as a larger or smaller proportion of the available cropland is irrigated. In the 22-county, 3.58 percent of total land area is in urban use, 67.2 percent is in cropland, and;

Key Highlight: Only 0.13 percent of total land area is in irrigated cropland. As of 2007, only 0.2 percent of total cropland was irrigated (i.e., 10,528 acres out of 5,251,661 acres of cropland).

The historical estimates of irrigated cropland acres in each county represent only a small percentage of total cropland, and do not show a consistent increasing trend since 1997.

Golf courses represent another irrigation sub-sector. There are 352 golf courses in the study area, as compared to the estimated total of about 750 golf courses in the State of

Illinois (Golfwebguide.com). A recent national inventory of golf courses prepared by National Golf Foundation (NGF) revealed that there was a negative net growth in golf facilities in 2006, with the number of golf courses closed (146) greater than the number of openings (119) (Chicagolandgolf.com). The 22-county study area inventory shows a total of 79 golf courses and 24 new courses built between 1990 and 2000.

Environmental: In addition to the irrigation and livestock watering uses of water reported by USGS, water is withdrawn for environmental purposes such as forest and prairie preserves, park districts, game farms, and other environmental uses. These environmental uses were identified from the IWIP data base and were added to the irrigation and livestock withdrawals.

Key Highlight: The total reported amounts of environmental withdrawals for the years 2002 and 2005 in the 22-county study area were 9.835 mgd and 8.325 mgd respectively.

Demand Scenarios: The future water demand for agriculture and irrigation can change depending on the future changes in demand drivers as well as assumptions about future gains in water-use efficiency. The following three scenarios are designed to capture future conditions of water demand in this sector. All three scenarios use normal weather conditions (Dziegielewski).

Key Highlight: The outcomes for the three scenarios related to environmental, irrigation, and agricultural water withdrawals are:

Table 13. Water withdrawals for irrigation, environmental, and agriculture

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	25.8 mgd (estimate used in Supply forecast [Appendix 3] for combined Irrigation, environmental, and agricultural withdrawals)	31.89 mgd	+ 6.09 mgd
LRI Scenario		28.29 mgd	+ 2.49 mgd
MRI Scenario		38.48 mgd	+12.68 mgd

For more specific projections:

Table 14. Water withdrawals for cropland

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	7.68	10.71 mgd	+ 2.53 mgd
LRI Scenario		8.18 mgd	+ 0.50 mgd
MRI Scenario		12.24 mgd	+ 4.56 mgd

Table 15. Water withdrawals for golf courses

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	2.36 mgd	3.50 mgd	+ 0.98 mgd
LRI Scenario		2.53 mgd	+ 0.17 mgd
MRI Scenario		3.95 mgd	+ 1.43 mgd

Table 16. Water withdrawals for livestock

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	6.86 mgd	9.36 mgd	+ 2.5 mgd
LRI Scenario		9.36 mgd	+ 2.5 mgd
MRI Scenario		9.36 mgd	+ 2.5 mgd

Table 17. Water withdrawals for environmental purposes

	2005 Water Withdrawal	2050 Water Withdrawals	Change, mgd
CT Scenario	8.32 mgd	8.32 mgd	0.0 mgd
LRI Scenario		8.32 mgd	0.0 mgd
MRI Scenario		13.02 mgd	+ 4.7 mgd

5-C Demand Key Highlights

- The main drivers of future water demand are population and economic growth which are indirectly represented in this study by employment and development of new industrial and power plants.
- The results in the following table show that by 2050 total water withdraws, or demands, could increase from 2005, 159.6 mgd to: 178.7 mgd under LRI scenario, 221.5 mgd under CT scenario, and up to 291.8 mgd under the MRI scenario.

- The three major withdraw sectors are public water supply, power generation, and coal mining and processing.
- The results of the analysis of future water demand scenarios show that total water supply needs in the 22-county study area will continue to increase to meet the demands of growing population and the associated growth in the economy of the region.
- A knowledge base of water demands by all sectors is needed to support a regional long-term water management program in the Kaskaskia region.
- The amount of freshwater mining withdrawals decreased by about 50% between 1985 and 1995 then began to increase in 2005.
- In the long term, the production of Illinois coal should continue to grow because of two factors: (1) the high coal reserves in Illinois and (2) new demands for coal by coal conversion plants.
- Since no steam or condensation cooling is involved, almost no water is used by internal combustion power generation.
- Total thermoelectric water withdrawals by county during 2005 were 2,267 mgd. In 2007, total water withdrawals by power plants totaled 3,134.5 mgd.
- All plants appear to be once-through plants that pump water directly to the condensers and then return it back to the river or lake (except Holland Energy which is an internal combustion plant).
- According to the USEPA data, there are 290 public water supply systems in the 22 counties in the study area. In 2005, these systems served the estimated population of 1,055,122 persons, as well as local businesses and institutions.
- The total 2005 public water system use for the study area is 42.35 million gallons per day (mgd). An additional 15.73 mgd were used by the systems in county residual sub-areas.
- The main driver of future water demand in the public-supply sector is population served. Total population for the study area was 1,050,122 in 2005 with an estimated population of 1,239,023 in 2050.
- Nearly all of the self-supplied domestic withdrawals are reported to be from groundwater sources.
- The self-supplied domestic water-use coefficient used in the 2005 report was 90 gallons per person per day.
- Total self-supplied domestic water usage (2005, USGS) is 18.93 mgd.
- For the 22-county study area, total self-supplied population is expected to increase between 2005 and 2050 from 210,509 to 240,613.
- According to IWIP data, the 2005 total self-supplied withdrawals for the study area were 6.92 mgd.
- In 2005, total commercial/industrial deliveries from public water supply in the 22 counties were reported to be 14.98 mgd.
- The Kaskaskia Basin share of I&C withdrawals in 2005 was estimated to be only 0.48 mgd of the total 6.94 mgd or approximately 7% of the total.

- The reported data show that in the 22-county study area a total of 10,528 acres of land were under irrigation in 2007. Approximately 86 percent of total irrigated land in the study area was in five counties (Clinton, Wayne, Madison, Monroe and St. Clair).
- Between 1992 and 2007, the average annual rate of growth in irrigated cropland acreage was 0.5 percent.
- The updated estimates of water withdrawals were 7.68 mgd (for irrigation of cropland) and 2.36 mgd (for irrigation of golf courses).
- Only 0.13 percent of total land area is in irrigated cropland. As of 2007, only 0.2 percent of total cropland was irrigated (i.e., 10,528 acres out of 5,251,661 acres of cropland).

Chapter 6: Water Control Operations

As part of the planning process, the U.S. Army Corps of Engineers provided a presentation on the Water Control Operations of the major water reservoirs, Carlyle Lake and Lake Shelbyville. Both of these are federal reservoirs authorized by the Flood Control Act of 1938 and modified by the Flood control Act of 1958. Carlyle was complete in 1967, Shelbyville in 1970. The Kaskaskia River Project is authorized by the River and Harbor Act of 1961, commercial navigation began in 1976. These federal projects are managed per a Water Control Plan which defines minimum, maximum, sometimes mandatory release based on various conditions. The reservoirs total capacity is divided among "pools:"

- **Inactive pool –** area designated to collect sediments
- **Joint Use/Conservation Pool –** used to provide water supply, fish & wildlife conservation, recreation, water quality enhancement and navigation
- **Flood Control Pool –** storage set aside to provide flood damage reduction
- **Induced Surcharge Pool –** Subset of Surcharge Pool; Storage set aside to transition from top of flood control pool to gates out of the water
- **Surcharge Pool –** allows for designated spillway floods
- **Freeboard –** addresses wave wash overtopping the dam

These federal projects have defined purposes:

- **Flood control** – flood damage reduction downstream either in the Kaskaskia River Basin or the Middle Mississippi River Basin.
- **Recreation** – provide best possible water condition to support recreational activities
- **Water Supply –** contract with the State of Illinois; Riparian rights were determined for the cities of Salem and Keyesport, Illinois and Texaco, Inc. The combined maximum water withdrawal for all three users is 13cfs (8.4 mgd).
- **Navigation** - maintain navigation on the Kaskaskia River Navigation Project and Middle Mississippi River. Decisions to release water for the navigation project purpose will be made by the Chief of Water Control Operations or designated person.
- **Fish & Wildlife Conservation** – provide optimum fish spawning conditions each spring and enhance waterfowl habitat

6-A Recreation

Recreation is a large industry in the Kaskaskia Basin; more specifically water-based recreation is very popular on sections of the Kaskaskia River as well as within federal reservoirs Carlyle Lake and Lake Shelbyville. Fishing, boating, sailing, camping, swimming, picnicking, hiking and biking often occur on or around these federal reservoirs. These activities are easily affected by changes –too much or too little- in water levels in the reservoirs (for more information see the February 2012 presentation on Recreation, available at www.heartlandsconservancy.org).

Key Highlights (Carlyle Lake only)

High Water

- Above 450 NGVD, sailing and racing are impaired because over half boat launching ramps are closed, boating regattas are cancelled.
- Above 454 NGVD, most lake-based recreation ceases; 95% of the campgrounds and 83% of boat launching ramps are closed.
- In 2011, Carlyle Lake had 79 days above 450, 30 days above 454, and 12 days above 456. This resulted in an overall 17-20% loss to recreation, equating to a loss of 13 million dollars.

Low Water

- At levels below 444 NGVD boating becomes significantly impaired, locations between Mile 4 and Mile 7 become hazardous, and marina ingress/egress becomes impaired.
- At levels below 443 NGVD, 3 of the 4 marinas on Lake Carlyle are inoperable, the remaining marina is restricted to small boats only, launching ramps become hazardous, and shallow areas appear around the Lake. (Ted Beier Presentation)

Key Highlight: The target water level range (for recreation) for the lake is elevation 444 to 450. Water levels above elevation 450 or below elevation 444 cause a decline in recreation opportunities with a corresponding loss in economic benefits.

For more detailed information on recreation facility closures due to high water and the quantified economic losses incurred, see July 2011 presentation available at www.heartlandsconservancy.org.

6-B Fish & Wildlife

The Carlyle State Fish &Wildlife Area is located at the north end of Carlyle Lake, where the Kaskaskia River empties into the lake. The Kaskaskia River divides the wildlife area into two parts – east and west side. The primary purpose of the site is the enhancement and protection of habitat to maximize wildlife conservation and provide recreational uses such as hunting fishing, trapping, wildlife observation and other compatible activities. This site is one of the top waterfowl hunting areas in the state and normally ranks number one or two in total duck harvest. It attracts hunters from across the Midwestern and Southern states. Habitat needs for both game and non-game wildlife, including threatened and endangered species, are taken into consideration. There are several factors that dictate how much water will have to be pumped into the wildlife area to achieve the desired results for waterfowl habitat. Chief factors among these are the rainfall amount the site receives during late summer and early fall. Even rainfall amount during actual pumping can cause fluctuations. Height of vegetation is also an important factor in determining water levels, as is the river and lake levels (IDNR presentation).

Key Highlight: Minimum release rates, in an effort to maintain state standards (IEPA) for dissolved oxygen levels in the river, are mandated from both Lake Shelbyville and Carlyle Lake.

Key Highlight: In the fall, water is pumped from the river into impoundments in wildlife management areas to enhance wildlife food plots and habitat as needed for the proper operation of the management areas. Any remaining impounded water is returned to the river system the following spring.

Likewise, at the northern portion of the Kaskaskia basin, the Shelbyville Fish & Wildlife Management Area (SWMA) is situated. The SWMA consists of five waterfowl areas. All of these areas are surrounded by low earth levees. The levees have multiple water control structures to manipulate water levels for waterfowl management.

The SWMA provides 2,000,000 duck use and 750,000 goose days annually. The numbers of waterfowl use days vary year to year due to inconsistent wetland habitat enhancement due to flooding. Many species benefit from the SWMA. Annually, the SWMA provides hunting opportunities for over 3,000 waterfowl hunter and over 3,500 upland hunters.

Key Highlight (Lake Shelbyville only): Constant flooding and silting cause levee damage and inconsistent water levels, inconsistent water levels make water management very difficult.

6-C Navigation

The Kaskaskia River Navigation project is a significant piece of water planning and management in the study area. The Kaskaskia River Navigation project was authorized by the River and Harbor Act of 1961; commercial navigation began in 1976. The Kaskaskia River Navigation project has since been modified to include project purposes of fish & wildlife (1966) and recreation (2000) (for more information see July 2011 presentation, available at www.heartlandsconservancy.org).

In addition, navigation is a specified project purpose of both Lake Shelbyville and Carlyle Lake. Water used to provide for navigation (and other uses, outlined above) comes from the joint-use pool of these reservoirs. Joint use water from Carlyle Lake and Lake Shelbyville is designated for the purpose of maintaining navigation on the Kaskaskia River Navigation project and the Middle Mississippi River between Chester, Illinois and Cairo, Illinois. Joint-use water may be released from Lake Shelbyville into Carlyle Lake to balance navigation storage available in each project and provide for supplemental flows in the Middle Mississippi and Lower Kaskaskia Rivers. The decision to release water for the navigation project purposes will be made by the Chief of Water Control operations or those purposes the Chief designates (Joan Stemler's presentation).

Key Highlight: The Kaskaskia Regional Port District reports that the Kaskaskia Navigation Project is one of the few projects in the country with increasing tonnage trends. Tonnage is expected to increase to 1.5 to 2.0 million tons over the next two years (2012-2014) and greater than 2 million tons after 2014. 2012 grain exports are projected to be 22,000,000 bushels with a product value of $221 million. High value lower volume products are also shipped that include coil steel and components.

6-D Water Control Operations Key Highlights

Carlyle Lake

- Above 450 NGVD, sailing and racing are impaired because over half of the boat launching ramps are closed, boating regattas are cancelled.
- Above 454 NGVD, most lake-based recreation ceases; 95% of the campgrounds and 83% of boat launching ramps are closed.
- In 2011, Carlyle Lake had 79 days above 450, 30 days above 454, and 12 days above 456. This resulted in an overall 17-20% loss to recreation, equating to a loss of 13 million dollars.
- At levels below 444 NGVD boating becomes significantly impaired, locations between Mile 4 and Mile 7 become hazardous, and marina ingress/egress becomes impaired.
- At levels below 443 NGVD, 3 of the 4 marinas on Lake Carlyle are inoperable, the remaining marina is restricted to small boats only, launching ramps become hazardous, and shallow areas appear around the Lake. (Ted Beier Presentation)
- Minimum release rates, in an effort to maintain state standards (IEPA) for dissolved oxygen levels in the river, are mandated from both Lake Shelbyville and Carlyle Lake.
- In the fall, water is pumped from the river into impoundments in wildlife management areas to enhance wildlife food plots and habitat as needed for the proper operation of the management areas. Any remaining impounded water is returned to the river system the following spring.

Lake Shelbyville

- Constant flooding and silting cause levee damage and inconsistent water levels, inconsistent water levels make water management very difficult.

Kaskaskia River

- The Kaskaskia Regional Port District reports that the Kaskaskia Navigation Project is one of the few projects in the country with increasing tonnage trends. Tonnage is expected to increase 1.5 to 2.0 million tons over the next two years (2012-2014) and greater than 2 million tons after 2014. 2012 grain exports are projected to be 22,000,000 bushels with a product value of $221 million. High value lower volume products are also shipped that include coil steel and components.

Chapter 7: Conclusion

It was important to the stakeholders that composed the Kaskaskia Water Supply Planning Committee to make this review of water supply and demands in the Kaskaskia River Basin. Regional water supply planning allows various users to come together and discuss the present state and future factors of the water resources they share. Envisioning the management of Kaskaskia area water resources through 2050 allowed the Committee to think strategically about long-term threats and opportunities. While the state of Illinois does not have a comprehensive set of regulations regarding water law, the Kaskaskia Basin has a number of organizations that offer technical assistance to water users. This report is the result of the hard work of many stakeholders and technical advisors that are concerned with the future of water resources within the Kaskaskia Basin.

From this plan we have determined that water supply in the Kaskaskia Basin is supplied by, primarily, surface water sources. We have analyzed the major use sectors of water: coal, power, public supply, industrial & commercial, environmental, agricultural, recreation, navigation, and flood control. Given a continuation of current trends (CT) in water demands, or a future that uses water resources less intensively (LRI), the reports used to develop this document indicate localized issues, but no regional water supply issues. However, if future water demands become more intense (MRI) (e.g., additional industry moves in) there may be communities or industries within the Kaskaskia Basin that experience water shortages (for more information on communities experiencing potential shortages see Chapter 4, Section Ad, “Community Water Supply Systems”).

The Committee feels strongly that those communities forecasted to be most sensitive to droughts be forewarned to allow adequate planning and preparation for the impacts from a severe drought. Drought preparedness is a concept the Committee feels all stakeholders should examine in light of the data provided within this report. Paired with grassroots conservation efforts, the Committee envisions individuals, organizations, and communities that are educated and realistically prepared to meet their future water needs.

This report marks a milestone of the Kaskaskia Basin Water Supply Committee; as it is the first step towards regional water supply management. As water supply and demand become critical issues, managers and stakeholders should refer to this plan and the associated reports for guidance. These reports will allow users and managers of water to quickly identify the key factors influencing both water supply and demand. In addition, the following section gives recommendations based on the findings presented above. It is the committee’s hope that this report initiates a regional approach to water management that is inclusive and on-going.

Chapter 8: Recommendations

Considering the baseline information presented in the previous chapters, the Kaskaskia area will not have major, or widespread, water issues until the occurrence of a severe drought or if additional stressors are added to the system in the future. At this time the Committee feels that priority should be given to three key components: (1) regional, cooperative management focused on the continued regional discussion of water quality & quantity; (2) support of conservation measures on a local level; and (3) drought preparedness, especially in communities where water shortages may occur in the event of a severe drought.

The Kaskaskia Watershed Association discussed and then voted to take ownership of this report and the recommendations, discussed below. As a regional entity, composed of stakeholders, with a mission to enhance the Kaskaskia watershed, the KWA was a natural choice to take ownership of this document. At their June 6, 2012 meeting, members of KWA met and discussed the possibility of taking ownership of the document. KWA members voted in favor of taking ownership of the document. Ownership of the document implies that the KWA membership will use the data provided herein, they will encourage other individuals and entities to refer to it (as appropriate) and they will begin to apply the findings and recommendations of this report.

No governance recommendations are made at this time due to the nature of the entity bringing the plan forward (i.e., the KWA) and their limited capacity to make regulatory or other governing changes to water management in the Kaskaskia basin. Also, there are no recommendations with respect to proposed changes to the federal Water Control Plans for Carlyle Lake, Lake Shelbyville, or the Kaskaskia River projects. Permanent changes to the Water Control Plans would take significant study and funding and, at this time, such changes are outside the capacity or mission of the KWA.

8-A Regional Management

The first recommendation of the committee is for the establishment of continued regional management of the Kaskaskia basin. Regular meetings of stakeholders that represent various use sectors and geographic portions of the watershed enhances communications among these various parts of the Kaskaskia basin. Cooperative, stakeholder meetings also ensure that diverse entities are communicating needs and sharing ideas. The current Committee feels that meetings, aimed at re-evaluating this Plan, should occur at a minimum of every five years. Regional stakeholders may wish to meet more frequently if there are pertinent issues that require more frequent discourse on water resources. Communication with the Illinois Department of Natural Resources, as well as the US Army Corps of Engineers, will be a core part of meetings regarding re-evaluations of this Plan. Other participants at the meeting(s) should

reflect the composition of the current Committee; they should come from throughout all areas of the basin, as well as represent all of the various sectors (described in Chapter 1, e.g., industry, public water, environment, recreation, agriculture, etc) of water use throughout the basin.

8-B Support of Local Water Conservation

The second recommendation of the committee is to ensure that a basic awareness and support system for local, on-the-ground, water conservation efforts is provided. While the committee did not feel it was within the scope of this report, the committee itself, or the KWA to undertake applying basic water conservation measures (e.g., low-flow plumbing fixtures, water pipe leak detection, etc.) the committee did wish to establish that they are fully supportive of entities that are implementing water conservation measures in their homes, business, or on their farms or golf courses.

8-C Drought Preparedness

The third recommendation of the committee is for the enhancement of drought preparedness throughout the Kaskaskia basin, especially in those communities which are forecasted to be most sensitive to drought. Outreach efforts should encompass the three (3) communities with water supply systems predicted to be "inadequate" in the case of a severe drought; Altamont, Coulterville and Farina (Chapter 4, pg. 21); the three (3) communities with water supply systems deemed to be "at-risk" of a water supply shortage in the case of a severe drought; Fairfield, Mount Olive, and Staunton; and, the two (2) communities with water supply systems which will be "at risk" by 2050 for the "most resource intensive" water use scenario; Hillsboro and Litchfield.

Outreach efforts related to drought preparedness for these "at-risk"communities, should include a two-prong approach. First, communication with leaders of the identified communities to provide the opportunity for the appropriate personnel (e.g., city administrator, mayor, etc) to gather the necessary information and organize it for the community's use. Second, educate the public in each community using a series of press releases, op-eds in the local paper, and/or other instruments such that the general public could be informed of the risks and opportunities associated with their water supply.

The KWA discussed these recommendations when they accepted ownership of this document. At this time, it is their intention to form a sub-committee composed of KWA member and interested members of the Kaskaskia Basin Water Supply Committee (whom prepared this report) to seek funding to begin implementing these recommendations. It is envisioned that

some time and materials may be donated to achieve the regional, stakeholder meetings and the drought preparedness outreach to selected communities.

This project was funded by Illinois Department of Natural Resources Office of Water Resources (IDNR-OWR) acting under the Governor's Executive Order 2006-01 which charged locally-based regional water supply planning groups with developing a water supply plan. The Illinois Clean Coal Institute, Illinois State Water Survey, and US Army Corps of Engineers provided additional support for research and documentation that contributed considerably to the project.

In addition, this project was completed as match for the St. Louis Regional Plan for Sustainability, as such, the following language is mandatory:

The work that provided the basis of this publication was supported by funding under an award with the U.S. Department of Housing and Urban Development through East-West Gateway Council of Governments. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government or East-West Gateway.

However, the US Department of Housing and Urban Development and East-West Gateway Council of Governments did not fund the Kaskaskia Basin Water Supply Committee or planning process.

CHARGE TO REGIONAL WATER SUPPLY PLANNING GROUPS

This paper seeks to outline some of the fundamental expectations of the Department of Natural Resources - Office of Water Resources (DNR-OWR) and the Scientific Surveys - for the Regional Water Supply Planning Groups (RWSPGs) and their facilitating agencies to support the regional water supply planning initiative outlined in the Governor's Executive Order 2006-01.

Adjustments to these expectations may occur during the planning process to assure that initial plans are produced in June 2009.

The water supply planning and management initiative described in the Executive Order 2006-01 orders that locally based regional water supply planning groups in two of the state's Priority Water Quantity Planning Areas be organized and participate in the development of a regional water supply plan. To develop a regional water supply plan requires two foundations: 1) knowledge of available water supply, and 2) forecasts or scenarios of future water demand. The State Water Survey and the State Geological Survey, Illinois' primary scientific research agencies for groundwater and surface water resources, have been assigned responsibility for updating and expanding water resource information in each Priority Water Quantity Planning Area. The regional water supply planning groups are assigned responsibility for the development of water demand scenarios to 2050.

- The State Water and Geological Surveys.

  Information on each region's currently available and possible future water supply will be provided by the State Water Survey with support from the State Geological Survey. The information will be compiled from existing data and reports, new studies, new and revised models, etc., to provide the regional planning group with information on the available water supply. It is anticipated that all areas in each region will not have the same level of detail with respect to available water resources.

  Certain water resource components have been targeted for detailed evaluation. In northeastern Illinois, the deep bedrock aquifer system underlying the entire region and the shallow sand and gravel and upper bedrock aquifers (shallow aquifers) and the Fox River in the Fox River Basin are targeted. In east-central Illinois, the Mahomet bedrock valley aquifer system and the Sangamon River are targeted.

  The Water Survey will develop a website and make available all relevant data and information via the internet. It also will determine current water withdrawals

and uses and identify and make preliminary evaluations of the impacts of drought, climate change, and other risks and uncertainties on the water resources in each planning region.

The Surveys will attend meetings of the RWSPGs, provide technical and scientific support, and engage in education and outreach on water supply planning.

The future water demand scenarios as developed and provided by the regional planning group will be compared by the State Water Survey to the available water supply scenarios to produce information on "water supply conflicts." Water supply conflicts may arise where future water demands may exceed water supply or where other influences or factors will affect future water supply. Water quality issues relevant to water supply planning will be addressed.

- The Chicago Metropolitan Agency for Planning (CMAP) and the Mahomet Aquifer Consortium (MAC).

The Chicago Metropolitan Agency for Planning in northeastern Illinois and the Mahomet Aquifer Consortium in east-central Illinois are contracted with DNR-OWR for receipt and disbursement of grant funds (i.e. fiscal agent) in behalf of and in support of the regional planning group activities. This includes providing support staff, project management, the hiring of consultants if necessary, covering certain meeting expenses and providing technical assistance to the regional group and planning process.

State law requires that DNR-OWR grant funds for RWSPG activities to a legal entity. In practice, OWR expects each RWSPG to take responsibility for conducting appropriate activities in support of the regional water supply planning initiative.

CMAP / MAC may and will provide guidance, technical analyses, and facilitation to and for the regional planning group as needed to help assure that the water supply planning process meets its charge in a timely manner within budget constraints.

- The DNR Office of Water Resources.

The DNR Office of Water Resources will attend each meeting of the RWSPGs to monitor progress and offer an appropriate level of guidance to RWSPG members. The OWR representative will be available to respond to questions as desired by RWSPG members, either during RWSPG meetings or individually.

The DNR Office of Water Resources will monitor progress of scientific work to be performed by the State Water Survey and State Geological Survey in support of the water supply planning initiative.

The DNR Office of Water Resources in coordination with the State Water Survey will act as needed to assure that activities and work by all involved entities are conducted in an integrated and mutually supportive manner.

The DNR Office of Water Resources, in coordination with the State Water Survey, will define a comprehensive program for state and regional water supply planning and management and develop a strategic plan for its implementation over the course of this 3-year pilot program.

- The Regional Water Supply Planning Groups (RWSPGs)

DNR-OWR granted state funds for each RWSPG and CMAP / MAC to provide future water demand scenarios to the year 2050 for their respective regions. Why the regional groups? The RWSPG members have the best information regarding economic plans, future development, and ideas about growth for their region in the future. These growth plans and ideas for the future will require water supply. Because all water resources available for development have a finite capacity for supply, it is being left to the planning regions to recommend how best to accommodate the future water supply demands from a regional point of view. *The development and finalizing of water demand scenarios is the primary objective for the regional planning group desired by DNR-OWR.* DNR-OWR strongly suggests that this problem must be defined before meaningful solutions can be proposed.

Fundamentally, this is a WATER SUPPLY - WATER DEMAND STUDY.

Any other water issue(s) that the regional planning group may decide to examine is at its discretion.

DNR-OWR expects each RWSPG to take responsibility to cause the planning process outlined in the Executive Order to succeed. Success with the bottom-up water supply planning process depends on the RWSPG members. This is the opportunity for local leaders, thinking regionally, to take responsibility for the success or failure of preparing a reasonable, logical plan for meeting future growth of water demands.

Each RWSPG is charged with responsibility to make findings, decisions, or recommendations in a water supply plan that represent general consensus and that are in the best interest of the entire region represented.

DNR Office of Water Resources (DNR-OWR) charged the Chicago Metropolitan Agency for Planning (CMAP) and the Mahomet Aquifer Consortium (MAC) with soliciting members and with forming each regional group respectively. The RWSPG may draft governance bylaws or otherwise choose how they shall discuss, deliberate, and decide any relevant matter or issue that may come before them. The RWSPG may have technical advisors, appoint sub-committees of members and/or nonmembers to focus on a certain issue or question as needed or desired. The RWSPG meetings should be open to the public.

DNR-OWR also charged the CMAP and MAC to take initial steps to secure the necessary technical resources to work with each RWSPG to develop water-demand scenarios.

- The regional water supply plan

At the end of the planning period, DNR-OWR expects the regional planning group to develop a document, a regional water supply plan, that describes water supply and water demand issues of the region. Definition of and possible solutions to issues related to the probable areas of "water supply conflict" or areas of water supply deficit will be at the discretion of the regional planning group. The Executive Order indicates the overall planning effort should be consistent with existing laws, regulations, and property rights.

At this time, DNR-OWR suggests that the regional plan contain, but is not limited to, the following principal components:

A description of the planning region's currently available and possible future water supply. This section would draw extensively from the work done by the State Water and Geological Surveys in support of this initiative and include as appropriate their documents and deliverables.

A description of the planning region's water-demand scenarios. This section would draw extensively from the technical work done for consideration by the RWSPG. Technical products should be included as appropriate in this section or as an appendix.

A description of the water supply deficits or conflicts as found by work of the State Water Survey. Regional planning group findings regarding these conflicts should be included.

A description or listing of possible options for water supply/demand management as determined by the RWSPG to meet the future water needs. Technical and scientific support may be requested as needed from the SWS, SGS, CMAP / MAC, and DNR-OWR. This component should include any preferred option or recommendation and accurately reflect the desires and general consensus of the RWSPG.

The regional planning group is expected to use CMAP / MAC assistance for writing, editing, and printing the regional plan.

It is anticipated that additional planning and water quantity studies will occur in subsequent planning cycles in these regions as well as in other priority water quantity planning regions of the state. The ultimate goal is an integrated mosaic of regional water supply plans, appropriate for each region, that will guide planners and water supply entities in taking appropriate courses of action to provide and assure adequate water supply of clean water at reasonable cost for all of Illinois' citizens.

by Department of Natural Resources
Office of Water Resources
February 8, 2007

Appendix 2: Contract language contained in the July 6, 1983 contracts for water storage space

In the Appendix C – Authorities, Water Allocations and Analyses C-26 Shelbyville Reservoir Project (Contract DACW43-83-C-0009) and in the Carlyle Lake Project (Contract DACW43-83-C-0008)

Article 1C. (3) 3rd sentence:
"At the time of such navigation release, downstream consumptive use of Kaskaskia River water in excess of natural inflows is prohibited to the State and others unless such usage is replenished to the navigation system by pumping or other means or unless water is released for that purpose."

Article 4B. (2):
"Water withdrawals may be charged to the State's water supply storage space whenever navigation releases from the Shelbyville Reservoir are diverted, restricted, or otherwise appropriated by non-Federal interests, or whenever navigation releases from the Carlyle Reservoir are diverted, restricted, or otherwise appropriated by non-Federal interests. With the use of recorded release data from Carlyle Lake, outflows from actual lockages and estimates of evaporation and transpiration downstream from Carlyle Lake, the Regulation Office can estimate any diversions, restrictions, or appropriations (hereinafter called usages) that have been made by non-federal interests. The State shall be responsible for regular examination and control of non-Federal usage downstream from Carlyle Lake and may replenish any such usage to the navigation reach by pumping or other means. If any non-Federal usage is made and is not replenished to the navigation reach, thereby requiring an additional navigation release from Carlyle Lake, the amount of such usage shall be determined by the Regulation Office and shall be debited to the State storage in Carlyle and/or Shelbyville Reservoir, the selection of such storage location to be mutually made by the State and the Government."

AGREEMENT

This **AGREEMENT** ("Agreement") is made and entered into as of the 19th day of May, 2003, by and between the **STATE OF ILLINOIS**, acting through and represented by the State of Illinois, Department of Natural Resources (hereinafter referred to as "State of Illinois"), and **Prairie State Generating Company, LLC**, (hereinafter referred to as "Prairie State") (the State of Illinois and Prairie State are also referred to herein individually as a "party" and collectively as the "parties").

WITNESSETH

WHEREAS, the Flood Control Act of 1938 (Public Law 761, 75th Congress, 3rd Session), authorized the construction, operation, and maintenance of the dam and lake on the Kaskaskia River in the vicinity of the City of Carlyle, Illinois (hereinafter referred to as "Carlyle Lake"); and

WHEREAS, the Flood Control Act of 1958 (Public Law 85-500, 85th Congress, 1st Session), authorized the construction, operation, and maintenance of the dam and lake on the Kaskaskia River in the vicinity of the City of Shelbyville, Illinois (hereinafter referred to as "Lake Shelbyville"); and

WHEREAS, the State of Illinois has entered into a written contract dated July 6, 1983 with the United States of America known as "Contract Between the United States of America and the State of Illinois for Water Storage Space in the Carlyle Lake Project on the Kaskaskia River in the Vicinity of the City of Carlyle, State of Illinois," and designated as "Contract No. DACW43-83-C-0008" (such contract is hereinafter referred to as the "Carlyle Lake Contract"), a copy of which is attached hereto as Exhibit A; and

WHEREAS, the State of Illinois has entered into a written contract dated July 6, 1983 with the United States of America known as "Contract Between the United States of America and the State of Illinois for Water Storage Space in the Shelbyville Reservoir Project on the Kaskaskia River in the Vicinity of the City of Shelbyville, State of Illinois," and designated as "Contract No. DACW43-83-C-0009" (such contract is hereinafter referred to as the "Lake Shelbyville Contract"), a copy of which is attached hereto as Exhibit B; and

WHEREAS, pursuant to the Carlyle Lake and Lake Shelbyville Contracts, the State of Illinois has rights to certain storage space for water impounded in Carlyle Lake and Lake Shelbyville and rights to distribute or otherwise assign rights to such water to be withdrawn from Carlyle Lake and Lake Shelbyville or released into the Kaskaskia River to be used for municipal and industrial water supply; and

WHEREAS, pursuant to the Carlyle Lake and Lake Shelbyville Contracts, the State of Illinois has the right to order releases of water to be made from Carlyle Lake and Lake Shelbyville by the United States Government through the outlet works in the Carlyle Lake and Lake Shelbyville dams, to the extent that water storage space assigned to the State of Illinois will provide; and

WHEREAS, pursuant to the State of Illinois' plenary rights over the natural resources of Illinois, and pursuant to the Kaskaskia River Watershed and Basin Act, 615 ILCS 75/0.01 *et seq.*, the Illinois Department of Natural Resources, on behalf of the State of Illinois, is authorized to enter into agreements with private parties with respect to water supply and water storage and use in connection with the Kaskaskia River watershed; and

WHEREAS, Prairie State desires to have released a maximum of 18.0 million gallons per day ("mgd") of water from Carlyle Lake and/or Lake Shelbyville into the Kaskaskia River, up to a maximum annual average release of 13.35 mgd. Withdrawals will be made from an intake structure to be located in the South ½ of Section 18, Township 3 South, Range 7 West of the 3rd Principal Meridian in St. Clair County, Illinois, and will be made for the purpose of providing cooling water for a new coal-fired power plant; and

WHEREAS, Prairie State is willing to make payments, as provided for in this Agreement, for the right to the volume of Carlyle Lake and/or Lake Shelbyville water released for their usage under this Agreement; and

WHEREAS, Prairie State and the State of Illinois are willing to enter into an agreement for the State of Illinois to provide water to Prairie State, pursuant to the terms hereinafter set forth.

STATEMENT OF AGREEMENT

NOW, THEREFORE, in consideration of the premises and the covenants and agreements herein contained, and intending to be legally bound, the State of Illinois and Prairie State agree as follows:

1. Incorporation of Preambles.

The foregoing preambles are hereby incorporated by reference as if set forth fully herein.

2. Water Release.

The State of Illinois agrees to order the release of up to 18.0 mgd of water, but not more than a volume equivalent to an annual average release of 13.35 mgd, from Carlyle Lake and/or Lake Shelbyville into the Kaskaskia River during the first ten years this Agreement, for withdrawal and use by Prairie State for the purpose of supplying water to Prairie State's Power Plant. The term "average annual release" used in this Agreement is defined as average annual release in a federal fiscal year period, commencing on October 1 and ending on September 30. One year prior to the lapse of the first ten years of this Agreement, the State of Illinois shall, in its sole discretion, evaluate the water availability from the State-owned storage spaces within Carlyle Lake and Lake Shelbyville, and designate the maximum annual average which may be released for use by Prairie State during the next ten years of the Contract period in writing, the volume being no less than an annual average

release of 9.5 mgd. This reevaluation schedule shall be completed by the Department for each subsequent 10-year interval of this Agreement.

3. Water Release Procedure.

Upon the event that Prairie State decides to have water released from Carlyle Lake and/or Lake Shelbyville into the Kaskaskia River, the State of Illinois agrees, pursuant to its rights under the Carlyle Lake and Lake Shelbyville Contracts, to order the United States (represented by the U.S. Army Corps of Engineers) to release water from Carlyle Lake and/or Lake Shelbyville in accordance with this Agreement. The State of Illinois will use its legal authority and best efforts to coordinate with the U.S. Army Corps of Engineers (USACE) to ensure that such water is stored and released as requested by Prairie State is in accordance with this Agreement.

4. Protection of Kaskaskia River Minimum Flows

If Prairie State wishes to withdraw water from the Kaskaskia River when its flow is 69.3 cfs or less, (hereinafter "minimum flow circumstance"), as measured by USGS Gage Number 05594100 at Venedy Station, Prairie State must request a water supply release, per the procedures set forth in Section 3, for an amount equal to or greater than the amount of water Prairie State actually withdraws from the Kaskaskia River during the minimum flow circumstance. If a gage is installed at State Highway 13 Bridge or other suitable gage as mutually agreed to in writing, the existing 7-day, 10-year flow value will be determined at that gage location in establishing the minimum flow circumstance.

5. Protection of Navigation and other Water Supply Releases

The parties acknowledge that the USACE may make releases for navigation purposes from the navigation storage. The parties further acknowledge that the State of Illinois may request releases on behalf of other water supply contracted users or for other State authorized purposes. During periods of such releases, Prairie State agrees to restrict their withdrawals or request water releases on their behalf, to the extent necessary which ensures the protection of the quantity of flow released for such purpose(s). If Prairie State makes any withdrawal of water that is released for navigation purposes, for other contracted users, or for other State authorized purposes and which requires an additional release to be made from State storage, then the State of Illinois shall charge Prairie State for all Water Supply Costs associated with the additional release pursuant to Paragraph 9(d) herein. The State of Illinois agrees to notify Prairie State in advance of and upon cessation of the protected release(s) and agrees to provide Prairie State with the quantity of flow being released requiring protection.

6. Interruption in Water Supply.

The State of Illinois agrees that in the event that the State of Illinois becomes aware of an actual or potential reduction or interruption in the release of water from Carlyle Lake and/or Lake

Shelbyville as provided for by this Agreement for any period of time for any reason, the State of Illinois will use its best efforts to notify Prairie State as soon as possible after becoming aware of such an actual or potential reduction or interruption. Such notification shall include: (i) the date of the reduction or interruption in water release; (ii) the anticipated duration of the reduction or interruption in water release; (iii) the volume of the reduction or interruption in water release; and (iv) the reason for the reduction or interruption in water release.

7. **Allocation of Available Water.**

(a) The allocation of water being made available to Prairie State pursuant to this Agreement is based upon a projected water supply need associated with Prairie State's future project plans. Prairie State plans to construct a water withdrawal structure capable of pumping, at a minimum, 18 mgd of water supply from the Kaskaskia River by December of 2006. Further, Prairie State plans to construct a coal-fired electric generating facility capable of producing 1500 megawatts of electricity by December of 2009. In the event that the above future project plans change, which would change either the capacities or dates of the above stated project plans, then Prairie State agrees to provide written notice to the State of such changes. If the State determines that the allocation of water being made pursuant to this Agreement is no longer justified due to a change in project plans, then the State reserves the right to reduce the allocation of water available to Prairie State.

(b) The parties acknowledge that the State of Illinois may, subsequent to the date of this Agreement, enter into agreements or other arrangements with, or may issue permits to, third parties relating to the allocation, extraction, withdrawal or use of water from Carlyle Lake and/or Lake Shelbyville or the Kaskaskia River. However, the State of Illinois expressly agrees that in no case and under no circumstances will the State of Illinois enter into such agreements or arrangements, issue such permits, or take any other actions which, when taken either individually or in aggregate, result in the actual or potential allocation, extraction, withdrawal or use of water in excess of the total amount of water under the control of the State of Illinois pursuant to the terms and conditions of the Carlyle Lake and/or Lake Shelbyville Contract as of the date of this Agreement (any such action shall be referred to as an "Over Allocation"). In the event that the State of Illinois takes any such action resulting in an Over Allocation, the State of Illinois agrees to grant Prairie State priority rights to the storage, release and use of water over and against all parties to whom the Over Allocation was granted for the term of this Agreement, and the State of Illinois will use its best efforts and legal authority to ensure that any Over Allocation does not materially affect Prairie State's rights under this Agreement.

(c) The parties acknowledge that the State of Illinois may enter into agreements with other parties to allocate, secure or otherwise beneficially use water from Carlyle Lake and/or Lake Shelbyville for Domestic Water Use, as defined herein, and Non-Domestic Water Use, as defined herein, and that the State of Illinois is otherwise authorized and entitled to protect the health and safety of its citizens. Therefore, in the event of a declared water emergency, as declared by the Director of the Illinois Department of Natural Resources or other responsible state official, which results in an insufficient supply of water in Carlyle Lake and/or Lake Shelbyville to satisfy the water

allocated and used for both Domestic Water Use, as defined herein, and Non-Domestic Water Use, as defined herein, and which deficiency of Carlyle Lake and/or Lake Shelbyville water would pose a direct threat to the public health or safety of communities relying upon water from Carlyle Lake and/or Lake Shelbyville (such an event is referred to as a "Water Emergency"), then the State of Illinois reserves its rights to prohibit or restrict, on an equal or pro-rata basis respectively, by volume of water used for Non-Domestic Water Use, the use of all Carlyle Lake and/or Lake Shelbyville water for all Non-Domestic Water Use until the Domestic Water Uses for which Carlyle Lake and/or Lake Shelbyville water has been allocated are otherwise satisfied. A "Water Emergency" shall also be deemed to exist, and the State of Illinois may proceed to exercise its rights to prohibit or restrict water use, if the Director of the Illinois Department of Natural Resources makes a reasoned determination in accordance with applicable law that such withdrawal or release of water from Carlyle Lake and/or Lake Shelbyville for Non-Domestic Use will result in imminent, substantial and irreparable damage to natural resources. If the Director of the Illinois Department of Natural Resources makes a Water Emergency determination, Prairie State may seek to alleviate the water shortage, seek approval of the Director to mitigate any damages to natural resources and continue water use, or seek reconsideration of the determination. Any prohibition or pro-rata reduction allocation, as more fully set forth in the following paragraph, would apply on an equal percentage basis to the volume of all water used for Non-Domestic Use by each party receiving Carlyle Lake and/or Lake Shelbyville water.

If any party entitled to use water from Carlyle Lake and/or Lake Shelbyville has both Domestic Water Uses and Non-Domestic Water Uses (collectively "Total Water Use"), whether supplied in whole or in part by Carlyle Lake and/or Lake Shelbyville water, then the pro-rata reduction allocation of Carlyle Lake and/or Lake Shelbyville water applicable to such party's Non-Domestic Water Use during a Water Emergency shall be determined based on the percentage of such party's Total Water Use that constitutes Non-Domestic Water Use. Thus, for example, if a party's Total Water Use is singularly supplied by 10 mgd of Carlyle Lake and/or Lake Shelbyville water and such party uses 50% of that water (*i.e.*, 5 mgd) for Domestic Water Use, then the remaining 50% of that water (*i.e.*, 5 mgd) used for Non-Domestic Water Use will be subject to the Carlyle Lake and/or Lake Shelbyville water pro-rata reduction. Likewise, if a party supplements its existing water usage with Carlyle Lake and/or Lake Shelbyville water, then the percentage of that party's total Non-Domestic Water Use will be used to determine that party's pro-rata Carlyle Lake and/or Lake Shelbyville water allocation reduction. For example, if such a party utilizes 30 mgd from a source other than Carlyle Lake and/or Lake Shelbyville and supplements that amount with 10 mgd from Carlyle Lake and/or Lake Shelbyville, for a total of 40 mgd, and 50% of that Total Water Use (*i.e.*, 20 mgd) is for Non-Domestic Water Use, then 50% of that party's Carlyle Lake and/or Lake Shelbyville water (*i.e.*, 5 mgd) would be subject to a water allocation reduction during a Water Emergency.

(d) The State of Illinois agrees that all water allocation, water supply, or water use agreements, or modifications thereto, for water from Carlyle Lake and/or Lake Shelbyville entered into between the State of Illinois and any party (including, without limitation, a State agency) subsequent to the date of this Agreement will contain the same or stricter limitations on the use of, and such party's rights to, water during a Water Emergency as are herein imposed upon Prairie State.

In the event that any such agreement does not contain the same or stricter limitations on such third party's rights to water during a Water Emergency as are herein imposed upon Prairie State, then the limitations imposed upon Prairie State herein shall be waived by the State of Illinois and shall not be binding upon Prairie State.

(e) The term "Domestic Water Use" as used in this Agreement means use of water for household drinking, cooking, sanitary, health and similar purposes, as well as for medical facilities and fire protection; however, the parties agree that "Domestic Water Use" does not include use of water for any commercial or industrial uses, lawn sprinkling, commercial or non-commercial car washes, or recreation purposes (whether in a residential or other setting). The term "Non-Domestic Water Use" as used in this Agreement means any use other than Domestic Water Use. The term "Domestic Water Users" as used in this Agreement means those persons or entities using water solely for Domestic Water Use. The term "Non-Domestic Water Users" as used in this Agreement means those persons or entities using water for any use other than Domestic Water Use.

8. Term of Agreement.

This Agreement shall become effective upon execution by the parties and shall remain in full force and effect for a period of 40 years from the date first set forth above, unless otherwise terminated pursuant to the provisions of this Agreement.

9. Payment and Metering.

(a) Within 30 days of the parties' full execution of this Agreement, Prairie State shall pay to the State of Illinois the amount of $13,350.00, which amount represents a non-refundable payment to secure the water supply and other rights set forth in this Agreement. Beginning the year after the occurrence of the Initial Withdrawal Date, Prairie State shall begin payments in accordance with subparagraph (d) of this paragraph. The "Initial Withdrawal Date" is defined as the actual date upon which Prairie State begins to withdraw water pursuant to this Agreement.

(b) For purposes of maintaining an accurate record of the water released into the Kaskaskia River on Prairie State's behalf, Prairie State agrees to have furnished and installed, prior to the Initial Withdrawal Date and at Prairie State's sole cost, reasonably necessary meters or measuring devices satisfactory to the State of Illinois. Such meters or devices shall be available for inspection by the State of Illinois at all reasonable times and upon reasonable notice to Prairie State.

(c) Following the Initial Withdrawal Date, releases of water into the Kaskaskia River made at Prairie State's request pursuant to this Agreement, will be metered and tracked by the Regulation Office of the USACE in accordance with Article 4B of the Carlyle Lake Contract and/or Lake Shelbyville Contract.

(d) After the Initial Withdrawal Date, Prairie State shall be billed by the State of Illinois for Prairie State's proportionate share of the actual experienced Water Supply Costs incurred by the

State of Illinois pursuant to the Carlyle Lake and/or Lake Shelbyville Contract. The State shall, in its sole discretion, determine the proportionate share. Billing shall commence when the USACE bills the State of Illinois for releases into the Kaskaskia River requested by Prairie State and shall continue on an annual basis thereafter for the term of this Agreement, unless otherwise assigned pursuant to Paragraph 12(c) of this Agreement. For purposes of this Agreement, "Water Supply Costs" shall mean all charges to the State of Illinois calculated pursuant to the formulas set forth in Articles 6B, 6C, 6D, and 6E of the Carlyle Lake Contract and/or Lake Shelbyville Contract in the forms attached hereto as Exhibits A and B, respectively.

(e) For charges pursuant to Article 6C of the Carlyle Lake Contract and/or Lake Shelbyville Contract (*i.e.*, "Annual Operation and Maintenance Costs"), Prairie State shall make a check payable to the Finance & Accounting Office, USACE and submit this check to the State of Illinois within 30 calendar days of receipt of its annual bill. For charges pursuant to Articles 6B and 6D of the Carlyle Lake Contract and/or Lake Shelbyville Contract (*i.e.*, "Major Replacement Cost" and "Major Rehabilitation and Dam Safety Assurance Programs Costs," respectively), Prairie State may, at its option, submit payment (check payable to the Finance & Accounting Office, USACE) to the State of Illinois either in lump sum at the time such costs are billed or in annual installments in accordance with an amortization schedule not to exceed 25 years with interest on the unpaid balance in accordance with Articles 6B and 6D of the Carlyle Lake Contract and/or Lake Shelbyville Contract.

(f) The payment obligations set forth in this paragraph 9 and in paragraphs 10 and 11 of this Agreement include all payments required by Prairie State for the water storage, withdrawal and use rights set forth under this Agreement. Prairie State shall not be required to make any other payment(s) to any other party (including without limitation any other governmental entity or private party) in consideration for the rights set forth under this Agreement.

10. <u>Kaskaskia River Basin Restoration Payment</u>.

The State of Illinois has identified potential operational and recreational impacts associated with water supply storage releases from Carlyle Lake and Lake Shelbyville. The parties recognize the State of Illinois' interest in the protection of other lake resources as well as to supply water for industrial and other purposes and, Prairie State is willing to support the State of Illinois' efforts to implement appropriate environmental protection and mitigation activities which may be determined beneficial. Therefore, Prairie State agrees to pay $150,000.00 to the State of Illinois, or a designee of the State's choice. Payment will be made as follows: (i) $75,000.00 within 30 days of the parties' full execution of this Agreement; and (ii) $75,000.00 on or before the first anniversary of the parties' full execution of this Agreement.

11. <u>Future Domestic Water Use Capacity Increases</u>.

(a) The State of Illinois has determinated that there may be a future need for additional Domestic Water Use supply capacity at Carlyle Lake and/or Lake Shelbyville and that such

additional Domestic Water Use capacity should be funded on a proportionate basis by the current and future Non-Domestic Water Users of Carlyle Lake and/or Lake Shelbyville water. Therefore, Prairie State agrees that if (i) existing capacity for all water supply from Carlyle Lake and/or Lake Shelbyville allocated and reasonably expected to be used for municipal and industrial water supply under the Carlyle Lake and/or Lake Shelbyville Contract is fully allocated, and (ii) the State of Illinois determines after reasonable study that additional capacity for Domestic Water Use is required to supply Domestic Water Use reasonably anticipated to exist during the term of this Agreement, Prairie State will pay a proportionate share of the State of Illinois' costs ("Capacity Increase Costs") to increase reservoir capacity sufficient to supply up to, but not more than, an additional 13.35 mgd for such increased Domestic Water Use supply. Prairie State's proportionate share of the State of Illinois' Capacity Increase Costs will be based on the amount of Non-Domestic Water Use water allocated to Prairie State under this Agreement relative to the total amount of water withdrawn or released from Carlyle Lake and/or Lake Shelbyville or the Kaskaskia River that is used by any party for Non-Domestic Water Use, whether that Non-Domestic Water Use results from water allocated directly to Non-Domestic Water Users (such as industrial or commercial users) or to a public or private water supplier who then supplies water to Non-Domestic Water Users. Prairie State will not be obligated to pay any amount associated with Capacity Increase Costs for capacity increases above 13.35 mgd. Additionally, Prairie State has no obligation to make any payments relating to capacity increase projects for Non-Domestic Water Use supply.

(b) Prairie State's payment schedule for Capacity Increase Costs will be the same as for payments for "Major Replacement Cost" and "Major Rehabilitation and Dam Safety Assurance Programs Costs" under this Agreement; *i.e.*, Prairie State may, at its option, pay Capacity Increase Costs in a single lump sum or in annual installments in accordance with an amortization schedule not to exceed 25 years. Prairie State's obligations under this sub-paragraph, including payment of any outstanding balance on annual installment payments, shall terminate upon termination of this Agreement.

(c) The State of Illinois agrees that all water allocation, water supply, or water use agreements, or modifications thereto, for water from Carlyle Lake and/or Lake Shelbyville entered into between the State of Illinois and any party (including, without limitation, any State agency) subsequent to the date of this Agreement, without regard to whether said party is a Non-Domestic Water User, a Domestic Water User, or a public or private water supplier, will contain the same or stricter provisions concerning payment obligations and cost sharing allocation among Non-Domestic Water Users with respect to Capacity Increase Costs as are imposed upon Prairie State under this Agreement. In the event that any such agreement does not contain the same or stricter provisions concerning payment obligations and cost sharing allocation among Non-Domestic Water Users with respect to Capacity Increase Costs as are herein imposed upon Prairie State, then the payment obligations and cost sharing allocation imposed upon Prairie State herein shall be waived by the State of Illinois and Prairie State shall have no further obligation to pay for any costs related to Capacity Increase Costs, including payments of any outstanding balance on annual installment payments. The State of Illinois further agrees that all Non-Domestic Water Users will be treated equitably with respect to allocation of Capacity Increase Costs, whether they obtain water directly

from Carlyle Lake and/or Lake Shelbyville or the Kaskaskia River, or indirectly from a Public Water Supplier or other party obtaining water directly from Carlyle Lake and/or Lake Shelbyville or the Kaskaskia River.

12. **Termination.**

(a) Prior to the Initial Withdrawal Date, Prairie State may terminate this Agreement for any reason and in its sole discretion upon 30 days' written notice to the State of Illinois. Such termination shall release Prairie State and the State of Illinois from any and all obligations under this Agreement.

(b) In the event that Prairie State has not fully constructed a water withdrawal structure capable of pumping at a minimum, 18 mgd of water supply from the Kaskaskia River by December 31, 2006, (which date shall be referred to as the "Pre-Operation Termination Date"), this Agreement shall terminate, except, Prairie State may extend the Pre-Operation Termination Date by one (1) year upon payment by Prairie State to the State of Illinois the amount of $13,350.00 and upon the agreement of the State of Illinois, which agreement shall not be unreasonably withheld. In the event that Prairie State has not fully constructed a coal-fired electric generating facility, capable of producing 1500 megawatts of electricity by December 31, 2009, (which date shall be referred to as the "Full-Operation Termination Date"), this Agreement shall terminate, except, Prairie State may extend the Full-Operation Termination Date by one (1) year upon payment by Prairie State to the State of Illinois the amount of $13,350.00 and upon the agreement of the State of Illinois, which agreement shall not be unreasonably withheld. Thereafter, the parties may agree to further extensions of either the Pre-Operation Termination Date or Full-Operation Date, upon such terms and conditions as the parties may mutually agree. Any termination under this subparagraph shall release Prairie State and the State of Illinois from any and all obligations under this Agreement.

(c) In the event that Prairie State ceases withdrawal of water from the Kaskaskia River after the Initial Withdrawal Date, Prairie State may terminate Prairie State's obligations under this Agreement upon 30 days' written notice to the State of Illinois if, prior to such termination, Prairie State identifies a party: (i) that is willing to accept assignment of all of Prairie State's rights, duties, and obligations under this Agreement; and (ii) that meets with the approval of the State of Illinois, which approval shall not be unreasonably withheld. The State of Illinois will assist Prairie State with the identification of acceptable assignees. Should Prairie State terminate this Agreement as provided in this subparagraph (c), Prairie State shall be released from its obligations under this Agreement.

13. **Changes in Law.**

The parties acknowledge that changes in applicable federal or state law enacted after the date of this Agreement may affect the rights of the parties to this Agreement. This includes, but is not limited to, the potential clarification of the State of Illinois' rights to restrict, and private parties' rights to withdrawal and use of water released from Carlyle Lake and/or Lake Shelbyville and other Illinois water bodies. In the event of such a change in applicable law, Prairie State or the State of

Illinois may request amendment of this Agreement to conform to such a change, or to clarify the rights of the parties as a result of such a change.

14. Limitations.

(a) The parties agree that the State of Illinois will act subject to the terms and provisions of the Carlyle Lake Contract and/or Lake Shelbyville Contract, the Kaskaskia River Watershed and Basin Act, and other applicable laws.

(b) The State of Illinois reserves its legal rights to take such actions with respect to the release of water pursuant to this Agreement as may be reasonably necessary to preserve life and property.

15. Right to Transfer or Assign.

Prairie State may transfer or assign any or all of its rights and obligations under this Agreement at any time during the term of the Agreement, whether before or after the Initial Withdrawal Date, as herein defined, to any of the following parties:

(a) Any subsidiary, parent or other related corporate entity of Peabody Energy Corporation;

(b) Any lending institution providing financing in whole or in part related to the construction and operation of the Prairie State Facility; or

(c) Subject to satisfactory demonstration to the State of Illinois that the water use will remain consistent with the original usage as intended solely for the purpose of providing for a coal-fired power plant, any other party upon the approval of the State of Illinois, which approval shall not be unreasonably withheld.

16. Successors and Assigns.

Notwithstanding anything to the contrary, this Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns.

17. Water Quality.

Prairie State recognizes that this Agreement provides for storage space for, release of, and use of raw water only. The State of Illinois makes no representation with respect to the quality of water and assumes no responsibility therefor, or for treatment of the water.

18. Force Majeure.

Neither party shall be liable to the other for failure to perform its obligations hereunder if and to the extent that such failure to perform is caused by or results from causes beyond its control, including, without limitation, natural changes in the Kaskaskia River Channel, strikes, lockouts, or other industrial disturbances; civil disturbances; fires; floods; acts of God; acts of a public enemy; but excluding the financial inability of such party to perform its obligations under this Agreement and excluding the acts or omissions of such party's agents or subcontractors.

19. Water Supply Pumping Alternative

The State of Illinois reserves the right to examine an alternative, for up to the full amount of water supplies to Prairie State pursuant to this Agreement. This alternative would involve the construction of a pump station to be located at the Kaskaskia River Lock and Dam, whereby water would be pumped over the lock and dam into the navigation pool to serve the water supply needs of entities withdrawing from the navigation pool. Should this alternative prove feasible, the State of Illinois reserves the right to provide up to the full amount of the water to be supplied to Prairie State pursuant to this Agreement by means of this pump station. Should the State choose to provide Prairie State with water supply from this alternative source, the State of Illinois will, in its sole discretion, determine new payment obligations to Prairie State, the amount for which shall not exceed the amount which would have been incurred had the requested water supply been released from Carlyle Lake and/or Lake Shelbyville storage, as identified under Section 9, "Payment and Metering." All other terms and conditions of this Agreement shall remain in full force and effect except for Paragraph 7(b).

20. Notices.

Any notice required or permitted to be given to either party shall be deemed to be received by such party (i) three (3) days after deposit in the United States Registered or Certified Mail, Return Receipt Requested, or (ii) one (1) business day after deposit with a nationally recognized overnight delivery service for next day delivery, or (iii) upon personal delivery to the party to whom addressed provided that a receipt of such delivery is obtained, or (iv) upon successful transmission by telecopy, in any case addressed to the parties at the following addresses:

If to State of Illinois:

Illinois Department of Natural Resources
Office of Water Resources
One Natural Resources Way
Springfield, Illinois 62702-1271
Attention: Director Donald R. Vonnahme
Telecopy No.: (217) 785-5014

If to Prairie State:

Prairie State Generating Company
701 Market Street
St. Louis, Missouri 63101-1826
Attention: Dianna Tickner, President
Telecopy No.: (314) 342-7602

or to the parties at such other addresses or telecopy numbers as they may designate by notice to the other party as herein provided.

21. Governing Law.

This Agreement and the legal relations of the parties shall be governed by the laws of the State of Illinois applicable to agreements negotiated, executed, delivered, and fully performed in such state.

22. Captions.

Headings of particular sections are inserted only for convenience and are in no way to be construed as part of this Agreement or as a limitation of the scope of the sections to which they refer.

23. Severability.

The various terms, provisions and covenants herein contained shall be deemed to be separate and severable, and the invalidity or unenforceability of any of them shall in no manner affect or impair the validity or enforceability of the remainder hereof.

24. Waiver.

(a) No waiver of the terms, conditions and covenants of this Agreement shall be binding and effective unless the same shall be in writing signed by the parties.

(b) A waiver of any breach of the terms, conditions and covenants of this Agreement shall be for the one time only and shall not apply to any subsequent breach.

25. Authority to Execute.

Each of the undersigned certifies, by his/her signature, that he/she is authorized to execute this Agreement on behalf of his/her respective party and that he/she possesses authority to bind his/her party to the terms and conditions set forth herein. Execution of this Agreement does not indicate and shall not be construed as a waiver by either party of any statutory, common law, or other rights which either party has or may have under applicable law.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed and to become binding and effective as of the day and year first set forth above.

STATE OF ILLINOIS

RECOMMENDED:

Donald R. Vonnahme, Director
Office of Water Resources
Department of Natural Resources
Date: 24 April 2003

APPROVED:

Joel Brunsvold, Director
Department of Natural Resources
Date: 5-19-03

APPROVED:

James E. Fisher

James Fisher ~~John Bandy~~, Chief Fiscal Officer (Actg)
Department of Natural Resources

Date: 5/12/03

APPROVED:

~~Stanley Yonkauski Jr.~~ Jonathan Furr
~~Acting~~ Chief Legal Counsel
Department of Natural Resources
Date: 5-9-03

Prairie State Generating Company, LLC

APPROVED:

Dianna Tickner
Dianna Tickner, President
Date: 22 April 2003

APPROVED:

Authorized Business Agent
Date: 4-22-03

EXHIBIT A

Contract Between the United States of America and the State of Illinois
for Water Storage Space in the Carlyle Lake Project on the Kaskaskia River
in the Vicinity of the City of Carlyle, State of Illinois -
Contract No. DACW43-83-C-0008 dated July 6, 1983 (the "Carlyle Lake Contract")

[Attached]

EXHIBIT B

Contract Between the United States of America and the State of Illinois
for Water Storage Space in the Shelbyville Reservoir Project on the Kaskaskia River
in the Vicinity of the City of Shelbyville, State of Illinois -
Contract No. DACW43-83-C-0009 dated July 6, 1983 (the "Lake Shelbyville Contract")

[Attached]

Appendix 6 Public Comments

- Executive Summary and 1B Mandate. Executive Order 2006-01 does not specify 2050 as a time horizon for planning.
- P. 8. Key Highlight and P. 14 2-D highlights. Only partial authority exists ,,,,, Authority for what?
    - Explain what the 6 bullet points are. Are these the items covered under present authority?
- P. 13, line 9.Up to at least the 50-year drought. Emphasis throughout the report is on worst-case drought. Can these systems meet future demands during a worst-case drought?
- P.15. 4th bullet. Sedimentation loss through 2040. P. 22 says sedimentation loss through 2050.
- Water Cycle, P. 16.
    - It is wrong to state that the precipitation remaining after runoff infiltrates the ground. That water returns to the atmosphere through evaporation and transpiration should appear as the second sentence in this paragraph. That usually amounts to about 2/3 of precipitation. It is then correct to state that after evaporation, transpiration and runoff that the remaining water infiltrates the ground.
- Clarification and consistency of use of some key terms would be helpful. , e.g., weather, climate, water supply, water availability and water demand.
    - Climate is an aggregation of weather events. Thus, climate and weather affect the water cycle and make the study of water difficult. Climate, weather and drought DATA AND INFORMATION may be used .....
- P. 17. It states that the average weather conditions may change by 2050. The examples given in Table 3 and the Key Highlight are for climate change. Climate models indicate that there may be a temperature increase of more than +6 degrees. +6 deg deliberately excludes the more severe temperature increase indicated by some models. Table 3 should be for CLIMATE scenario impacts. The Key Highlight talks about water supply being affected by changes in weather, but 3-A only talks about water demand. I suggest restricting the Highlight to water demand and highlight water supply issues later on when you have talked about the impacts of weather and climate on water supply and availability.
- 3-B Drought. The Key Highlight talks about the effects of drought to water supply, but the 3 estimated effects of drought only address water demand and withdrawals. These bullets should be described as the estimated effects of droughts on water demand (or withdrawals).
    - It states that the most severe historical droughts in Illinois took place in the 1930s and 1950s. On pages 20 and 23 it says that the most severe droughts were in the 1890s, 1930s and 1950s. On page 21 it states that the 1953-1955 drought is the worst on record in the Kaskaskia region and Illinois. On page 24 it states that the 1953-1955 drought is the worst in Illinois. I suggest be consistent in stating what were the worst-case droughts in the Kaskaskia region and state if these are based on precipitation or streamflow records. Worst-case droughts in Illinois occurred in different years in different regions and lowest precipitation for Illinois as a whole

or in other regionsdoes does not necessarily equate to worst-case drought in the Kaskaskia region.

- 3-C Water Supply Key Highlights. Again, the discussion so far has focused only water demand. Water supply is the subject of Chapter 4.
- Chapter 4: Water Supply
    - 4-A. What is the reference for a collective yield during severe drought condtions of 42 mgd? Table 4 shows a 2012 collective yield of 54.5 mgd for a 50-year yield and 47 mgd for a 100-year yield. What is a severe drought. What is the collective yield for a worst-case drought?
    - P. 20 goes from surface water to groundwater and back to surface water. It would be better to put all the surface water points together before groundwater.
- 4-A1 Groundwater Key Highlight. It states that groundwater is more sustainabl than surface water during droughts. Is this true? The discussion above gives the impression that shallow wells and wells in the river valley are problematic. Don't shallow wells and valley sands dry out during severe droughts?
- 4-A5. The reservoir yield estimates are based on drought frequency. On page 21 it states that ISWS analysis is based on worst case historical droughts and 90 % confidence level, rather than on drought frequency and 50 % confidence level. What are the reservoir yield estimates at the 90 % confidence level for a drought of record? This is perhaps the most important data needed in your evaluation and management. The Highlights on pages 24 and 25 talk about the federal reservoirs providing adequate water supply for a variety of users - - provide = present tense. Can the federal reservoirs provide adequate water supply for a variety of users in a worst-case drought and with increased water demand in the future?
- Page 24 says there are 6 reservoir systems considered inadequate or at risk. Are the 8 at risk and inadequate community systems listed on page 22 not all reservoir systems?
- Chapter 5: Water Demands
    - I suggest that everywhere where 2005 water withdrawals are given you state explicitly whether these are for reported or weather adjusted values.
    - Pages 27 and 36. Table 5. Did DCEO provide official population projections all the way through to 2050?