Phase I: Determining the Mahomet Aquifer's Eligibility for Sole Source Designation

August 31, 2012

LAYNE CHRISTENSEN COMPANY

THIS PAGE IS INTENTIONALLY LEFT BLANK

CONTENTS

Introduction 1

U.S. EPA Designation 1

Features of the Mahomet Aquifer (Guidance Document Section 3.2.1) 2

Aquifer Boundaries 2

Recharge 5

Overlying Aquifers are Included in the Designation 6

Delineate the Boundaries of the Aquifer Service Area (Guidance Document Section 3.2.2.) 6

Alternatives to the Mahomet Aquifer (Guidance Document Section 3.2.3.) 8

Current Drinking Water Sources 8

Potential Alternative Sources 9

Potential Alternative Groundwater Sources 10

Potential Alternative Surface Water Sources 14

Legal Availability of Alternative Sources 16

Economic Analysis of Potential Alternative Drinking Water Sources 18

Costs of Alternative Surface Water Supplies 19

Conclusion and Recommendations 19

References 23

Appendix A – Population Served by Community Water Supplies 25

THIS PAGE IS INTENTIONALLY LEFT BLANK

INTRODUCTION

The Mahomet Aquifer is an economically important, regional drinking water supply. The buried valley that defines the aquifer extends across several states and it is the primary source of drinking water for municipalities and homeowners in 14 counties of Illinois. Across east-central Illinois the aquifer is so prolific that it also provides water to agriculture and industry. Beyond its use for drinking water, it is a critical resource for the many self-supplied commercial, industrial, and agricultural users that rely upon it for cooling, process water, and row-crop irrigation.

According to the Illinois State Water Survey, the aquifer provides an estimated 220 million gallons of water per day (Mgd) to communities, industry, agriculture, and rural wells in Illinois. Given its significance to central Illinois' water resources and economy, for the last 50 years the Illinois State Water and Geological Surveys have been working to map, monitor, and model the aquifer system to understand it and to anticipate the impacts of potential future uses of the aquifer (Visocky and Schicht, 1969; Kempton et al., 1991; Holm, 1995; Wilson et al., 1998; Hollinger et al., 2000; Roadcap and Wilson, 2001; Burch, 2008; Wehrmann et al., 2011; Roadcap et al., 2011).

The aquifer has been studied for decades and many different groundwater users are organized and committed to its protection. Recognition of the value of this resource brought together a consortium of cities to determine whether the Mahomet Aquifer is eligible for Sole Source Aquifer designation by the U.S. Environmental Protection Agency. This document is an analysis of the Mahomet Aquifer's eligibility for sole source aquifer designation.

U.S. EPA DESIGNATION

The U.S. EPA's designation of a sole source aquifer is one way to help protect groundwater that complements other local and state programs to prevent groundwater contamination. Some of the text from the U.S.

EPA's guidance for Sole Source Aquifer protection explains how federal designation affects development:

> "designation provides for EPA review of Federal financially assisted projects planned for the area to determine their potential for contaminating the aquifer. Based on this review, no commitment of Federal financial assistance may be made for projects "which the Administrator determines may contaminate such aquifer," although Federal funds may be used to modify projects to ensure that they will not contaminate the aquifer."

In order to determine if the Mahomet Aquifer is eligible for the Sole Source Aquifer designation, we have completed Sections 3.2.1 through 3.2.3 of Phase I – Petition Preparation of the guidance documents (U.S. EPA, 2010). These sections of the report discuss whether the aquifer being considered for sole source designation meets the statutory criteria. The requirements for assessing if the aquiver can even be considered for designation are:

- Definition of aquifer boundaries
- Description of the area served by the aquifer
- Determine whether the aquifer is sole or primary source of drinking water

The remainder of this report is our analysis of each of these different requirements. Based on the information presented here we are confident that the boundaries of the aquifer are well-established, documented and clear, the service area is mapped and understood, and there are no economically viable alternatives to this supply for the communities in this part of Illinois. It is our conclusion that this petition is likely to succeed.

Features of the Mahomet Aquifer (Guidance Document Section 3.2.1)

Aquifer Boundaries

The Mahomet Aquifer is composed of buried sand and gravel deposits that fill a wide bedrock valley beneath portions of a 14-county area of

east-central Illinois. The buried bedrock valley that defines the edges of the Mahomet Aquifer continues to the east into 12 counties in north-central Indiana. The perimeter of the aquifer is clearly illustrated in Figure 1, which was taken from U.S. Geological Survey (USGS) Ground-Water Atlas of the United States (Lloyd and Lyke, 1995). This aquifer system is also known as the Mahomet-Teays (or more simply, the Mahomet) in Illinois, and as the Teays-Mahomet in Indiana.

In Illinois the Mahomet Aquifer is hydrogeologically distinct from the upstream extension of the same buried valley fill in Indiana. The Illinois side of the Mahomet Aquifer is more productive, has less clay, and has more sand and gravel than the Indiana portion of the aquifer. Because there are fewer alternative sources of supply in Illinois (Indiana has large rivers and more shallow aquifers), the Mahomet Aquifer is more critical to the communities in Illinois as a drinking water resource.

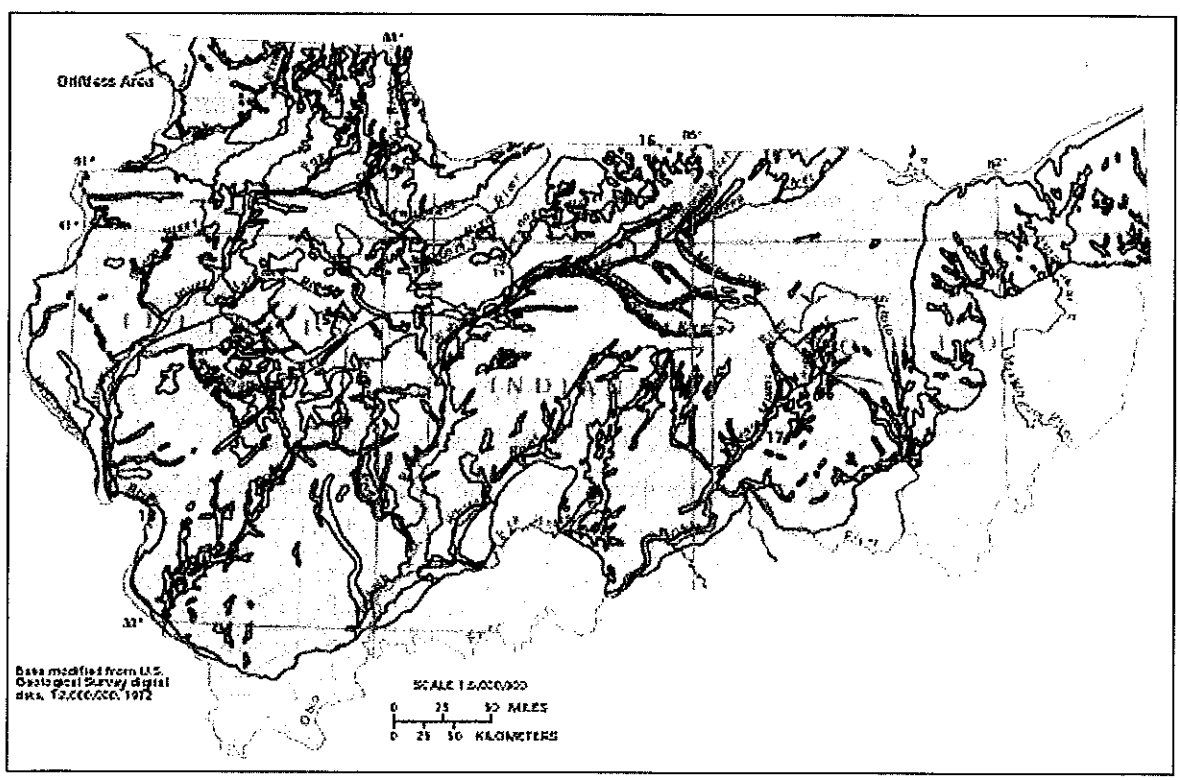

Figure 1. Aquifers in the unconsolidated deposits of the Central Lowland Province (from Lloyd and Lyke, 1995).

The origin of the Teays bedrock valley continues to be the subject of considerable debate and research. Well log data have been used to map the bedrock valleys, and for the past 50 years hydrogeologists have interpreted these data to develop a better understanding of the preglacial landscape below the thick glacial deposits of the Midwest. Research on this particular aquifer over the past several decades suggests that the pre-glacial Teays River drainage probably had its headwaters east of the Appalachian Mountains. From the headwaters it flowed westward through Ohio, Indiana, and finally into Illinois where the Teays River once flowed into the ancestral Mississippi. Outwash deposits from the retreating glaciers filled the bedrock valley during glacial retreat. Because the aquifer generally occupies the deepest sections of the valley, thickness varies from a few feet at the valley walls to more than 150 feet along the valley's central axis (Roadcap et al., 2011).

In Illinois, the Mahomet-Teays Aquifer extends from the Indiana border near Hoopeston to the Illinois River near Havana (Figure 2). In some places, the valley broadens to several miles across; at the downstream end at the confluence with the ancient Mississippi (the modern Illinois River), the aquifer is at least 40 to 60 miles wide. In Illinois the generally accepted limit of the aquifer system places the edge of the Mahomet Aquifer at the 500-foot contour of the bedrock surface. The most productive sand and gravel that fills the bedrock valley commonly occupies the deeper portions of the now-buried valley; saturated thickness varies from less than 50 to just under 200 feet (Roadcap et al., 2011). These boundaries reflect the most recent work of the Illinois State Water and Geological Surveys to define and characterize the aquifer for all of the water users in the area.

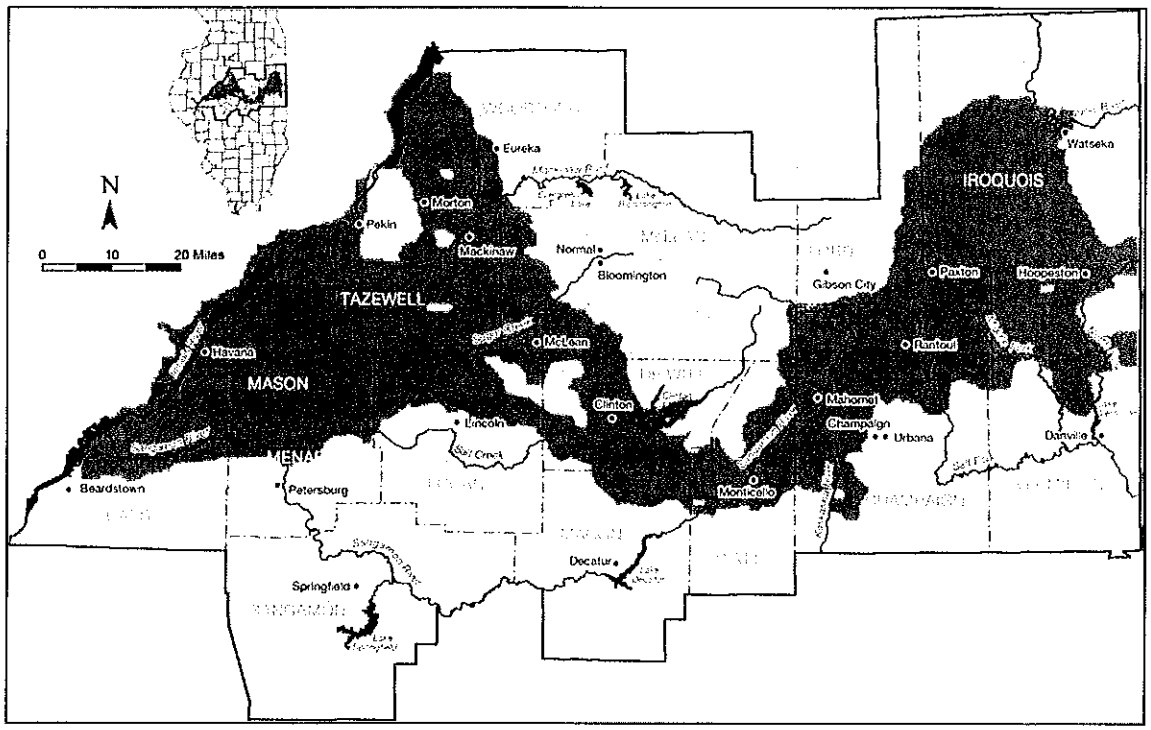

Figure 2. Boundaries of the Mahomet Aquifer in east-central Illinois (from Roadcap et al., 2011).

Recharge

A three-dimensional groundwater flow model of the aquifer, created for water supply planning purposes, found that there was substantial spatial variation of recharge and recharge rates (Roadcap et al., 2011). The spatially varying recharge sources come from two principle sources:

- percolation of precipitation excess through overlying geologic materials
- leakage of streamflow along selected reaches where the upper aquifer is hydraulically connected to the Mahomet Aquifer

The eastern portion of the Mahomet Aquifer is confined by as much as 200 feet of glacial till (including the shallow Glasford Aquifer). Average annual recharge has been estimated to vary from 5 inches/year to less than 0.5 inch/year (Roadcap et al., 2011). The high rates predominantly occur where there are interconnections to shallower coarse-grained materials and streams.

On the western side of the aquifer, nearer to the Illinois River in Mason and Tazewell counties, the land surface elevation falls toward the Illinois River. Here the confining layers are absent and permeable aquifer materials outcrop at the land surface. The aquifer becomes unconfined and recharge is high - exceeding 12 inches/year (Roadcap et al., 2011).

Based upon the current understanding of the aquifer, recharge from beyond the boundaries of the aquifer is not significant (Roadcap et al., 2011). Therefore, extension of the Sole Source designation beyond the boundary of the aquifer due to recharge locations outside the area of the physical boundary of the aquifer is not a part of this petition.

Overlying Aquifers are Included in the Designation

Geologic investigations of the aquifer system indicate that there is a complex glacial setting of intertill aquifers that overlie the deeper Mahomet Aquifer. Given the complexity of the glacial setting, a conceptual model of water movement into and within the aquifer has been developed based upon existing data and knowledge (Roadcap et al., 2011). For the purposes of this petition, the Mahomet Aquifer system includes the buried Mahomet sands as well as the overlying aquifers. Consequently, designation of the Mahomet aquifer as a Sole Source Aquifer also includes the overlying hydrostratigraphic units as one hydrogeologic system.

Delineate the Boundaries of the Aquifer Service Area (Guidance Document Section 3.2.2.)

With a few exceptions, the Mahomet Aquifer service area coincides with the buried bedrock valley (Figure 3). However, Illinois American Water Company in Champaign provides water to several communities outside the boundary of the aquifer, located predominantly in eastern and southern Champaign County and farther south in Douglas, Coles, and Cumberland counties. These include the communities of Champaign, Urbana, Savoy, St. Joseph, Bondville, and Pesotum as direct service locations. Wholesale customers of Illinois American Water Company in

Champaign include: Tolono, Sidney, Philo, Seymour Water District, Tuscola, Arcola, and Embarras Area Water District. Cerro Gordo (Piatt County), Petersburg (Menard County), and Virginia (Cass County) also withdraw water from the Mahomet but lie outside the recharge area.

Normal withdraws water from the Mahomet but is not included as part of the service area for purposes of the petition because 50% or more of a community's water must come from the petitioned aquifer to be considered part of the service area. Likewise, Decatur only withdraws water from the aquifer under emergency conditions and therefore is not included in the petition.

In the future, the service area boundaries may grow due to more communities relying on the Mahomet Aquifer as a source. Because surface waters in this part of the state are vulnerable to drought, the larger communities in the region, including Bloomington and Decatur, have already identified the Mahomet Aquifer in their long-term supply plans. In this area of Illinois, the Mahomet Aquifer is also the water source that most communities plan on using to meet future growth in demand.

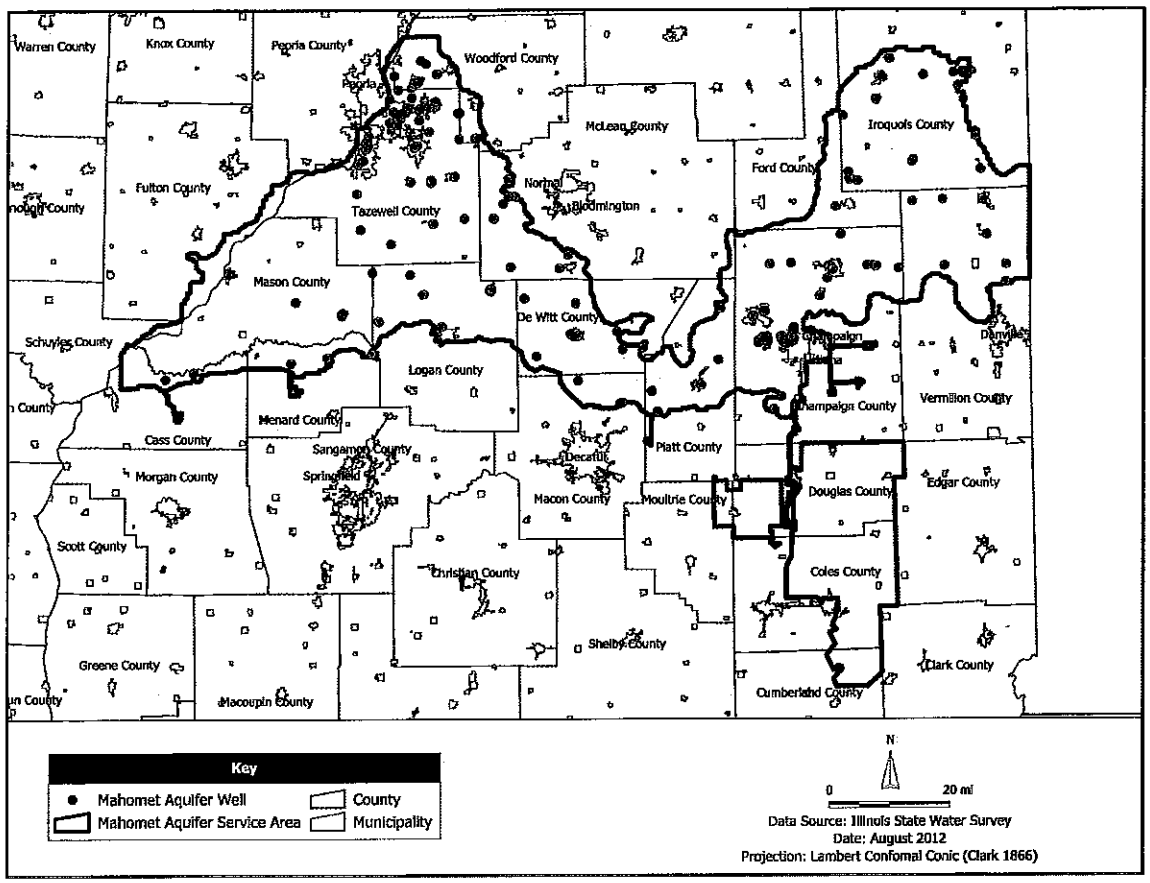

Figure 3. Mahomet Aquifer recharge boundary and service area boundary.

Alternatives to the Mahomet Aquifer (Guidance Document Section 3.2.3.)

While the uses of the aquifer go beyond municipal drinking water, the Sole Source designation is reserved for aquifers that are the principal source for drinking water in the area. As required by the U.S. EPA, we identified the current sources of water in the region and all of the potential alternative sources that could be used.

Current Drinking Water Sources

In 2010, the aquifer provided an estimated 53 Mgd to some 120 public water supplies serving over 400,000 people (Table 1 and Appendix A). The Mahomet Aquifer provides 100% of the water to the service area today (Table 2), and demand is only expected to increase over the next 50 years (WHPA, 2008).

Table 1. Current drinking water sources for the Mahomet Aquifer service area (data from ISWS, in gallons/day for the year 2010, unless otherwise noted)

Source/Use	Public Water Supply (Community & Non-community)	Private and Other	Total
Petitioned Aquifer	53,148,762	4,311,408*	57,460,170
Other Aquifers	0	0	0
Surface Water	0	0	0
Transported from outside	0	0	0
Total	53,148,762	4,311,408*	57,460,170

*Data is from Kenny et al., 2009; data is reported for 2005, which is the latest available data.

Table 2. Current Drinking Water Sources for the Aquifer Service Area (in %)

Source/Use	Public Water Supply Percent (Community & Non-community)	Private and Other Percent	Total Percent
Petitioned Aquifer	92.5	7.5	100.0
Other Aquifers	0	0	0
Surface Water	0	0	0
Transported from outside	0	0	0
Total			100

Potential Alternative Sources

Since the aquifer serves as the sole source of water to the service area, we must determine whether potential alternative sources 1) could provide enough water to replace the Mahomet Aquifer 2) are legally available and 3) are economically feasible. We found that there was either a lack of adequate, near-by supply or there are no economically feasible alternative sources of water. These two factors explain why the Sole Source Designation is being sought for the Illinois portion of this aquifer. The rest of this section describes and explains the potential alternative sources we evaluated and how they were eliminated.

For purposes of the U.S. EPA review, the potential alternative drinking water sources are those that are either currently used within the service area with remaining capacity or a water source that is, from a practical

and economic perspective "near" as defined in the Sole Source Aquifer Petition Guidance.

For purposes of the petition we defined "near" based on what other communities have determined to be economically viable transmission distances from a source of supply. The average distance for transmission in the area is 2.9 miles. This is the distance from the water source to the supply area for all water suppliers whose source lies beyond the city limits in the vicinity (e.g., Petersburg, Cerro Gordo, and Virginia). The service areas that were not included in the calculation of the average distance were those areas served by Illinois American Water-Champaign operations. The transmission distances from Illinois American Water-Champaign reflect the capital of an investor-owned system that can maximize efficiencies when serving areas further from the source. Communities that supply their own water generally do not have the capital needed to obtain water from distant sources.

Potential Alternative Groundwater Sources

Groundwater can come from unconsolidated sand and gravel aquifers or from bedrock aquifers. In central Illinois both types of aquifers exist near the Mahomet Aquifer but are generally low yield or vulnerable to drought. For areas outside the Mahomet Aquifer boundary, significant groundwater resources are not available. While there are aquifers adjacent to the Mahomet, they typically do not yield large quantities of water to wells - not enough to provide adequate quantities to satisfy demand requirements of communities like Champaign/Urbana (a combined ~22 Mgd).

Unconsolidated Aquifers

A map of Illinois sand and gravel well yields shows how quickly well yields decline beyond the boundary of the bedrock valley that defines the Mahomet Aquifer (Figure 4). In Figure 4, aquifer areas colored in tan highlight areas where wells yield greater than 500 gallons per minute (gpm), which are generally seen along Illinois' major modern stream systems (e.g., Mississippi, Rock, Fox, Illinois, Wabash rivers) and two ancient, buried valley systems: the Troy Valley in Boone and DeKalb

counties in north-central Illinois and the Mahomet-Teays Valley in east-central Illinois. With regard to the Mahomet Aquifer, the greatest well yields (>500 gpm) are found along the central axis of the Mahomet-Teays Valley where the aquifer is thickest and an area nearer the Illinois River where the aquifer broadens and is unconfined. Well yields in these areas actually commonly exceed 1,000 gpm. Along the flanks of this bedrock valley (shown in light green), well yields are less, but often exceed 100 gpm and provide significant water to numerous communities.

Beyond the edge of this bedrock valley (shown in red), where the Mahomet Aquifer is not present, well yields diminish rapidly and while the map portrays well yields of "100 gpm or more are possible", a review of high capacity well data suggests that these yields are only rarely found. In this area the shallower, thinner Glasford-age aquifers are used – these sand and gravel deposits lay more like a blanket across the region (as opposed to following the confinements of the bedrock valley). The Glasford sand and gravel deposits are not present throughout the area; hence sustained aquifer yields are often low. While some of these wells may be locally sufficient for smaller communities, their low production and increased sensitivity to drought make them inappropriate for larger communities that require 1 Mgd or more.

The experience of many community systems shows that, other than for small community and non-community supplies, development of a new groundwater supply outside the boundary of the Mahomet Aquifer is not practical. For communities the size of Normal and Champaign/Urbana, the development of new 4 Mgd and 20+ Mgd supplies from groundwater resources beyond the boundaries of the Mahomet Aquifer are not possible. Based on the history and experience of water supply development in the region, no viable alternative groundwater supplies exist that could replace the Mahomet Aquifer.

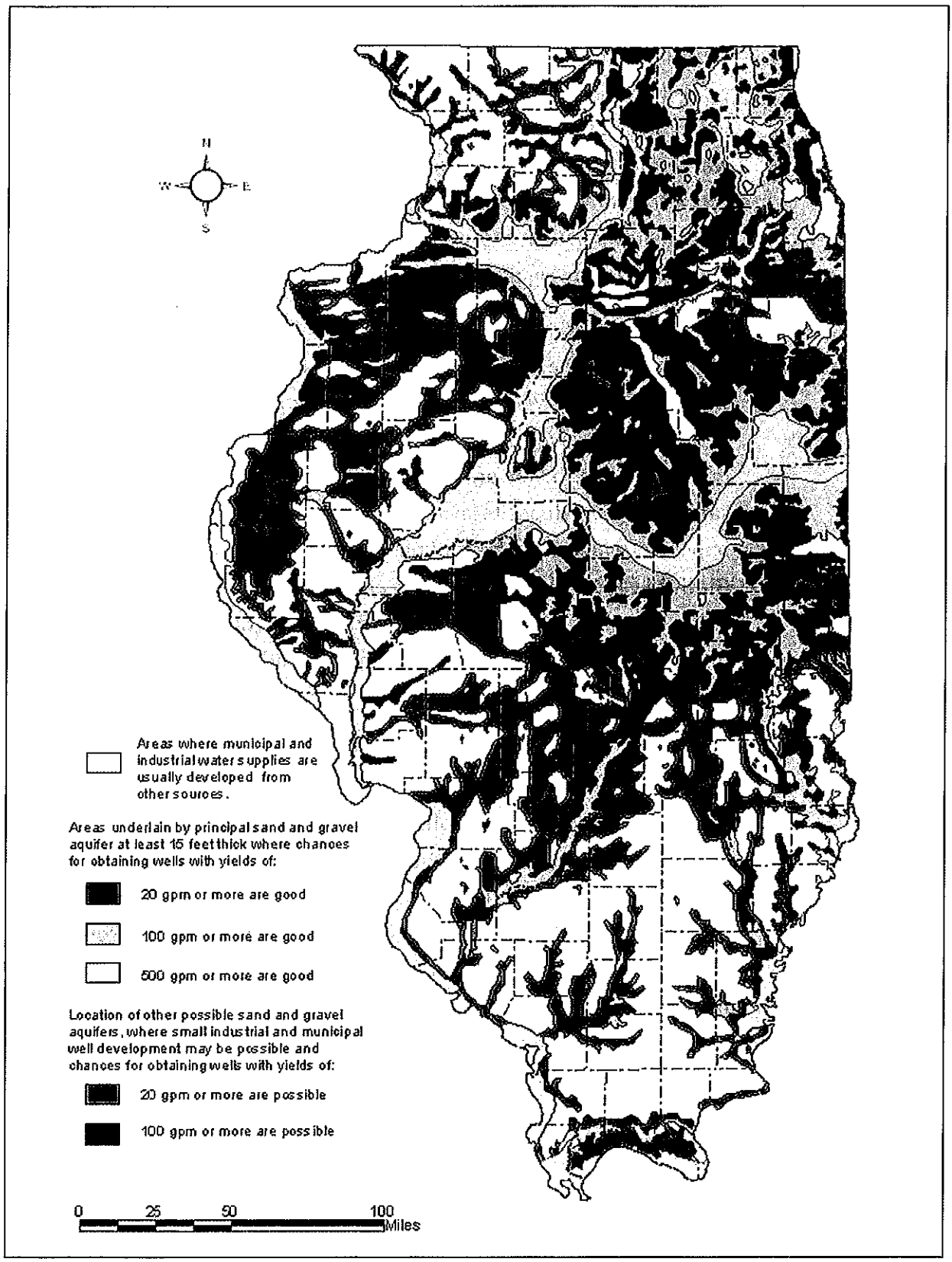

Figure 4. Yields of sand and gravel wells in Illinois (ISWS files).

BEDROCK AQUIFERS

The bedrock in this region of Illinois generally is incapable of providing large supplies of water (Roadcap et al., 2011). While adequate for domestic supplies, bedrock aquifers were not considered a significant source of groundwater in the 15-county water supply planning region (ibid). Groundwater that is suitable for domestic use may be obtained from the fine-grained sandstones or small, widely spaced fractures in the limestone or coal layers of the shallow Pennsylvanian rocks found near the bedrock surface. On the bedrock uplands where glacial deposits are typically thin and do not contain extensive sand and gravel aquifers, bedrock aquifers are important sources of supply for domestic wells.

Water supplies in parts of Iroquois County are obtained from the Silurian carbonate rocks. In general, the quality of groundwater in the bedrock decreases with depth. Groundwater in deep bedrock formations is too mineralized for most uses (Roadcap et al., 2011).

The bedrock lying immediately beneath the Mahomet aquifer regions is largely composed of Pennsylvanian- and Mississippian-aged rocks (Roadcap et al., 2011). A ridge of Silurian-Devonian rocks cut upward through the Pennsylvanian and Mississippian rocks beneath portions of Champaign, Ford, and Iroquois counties. This anticline extends south of Champaign County into Douglas County as well. As mentioned above,

Silurian carbonate rocks can provide moderate supplies. However, well yields are not large and water quality poor (Roadcap et al., 2011).

An illustration of the value of the bedrock aquifers as a source of drinking water is the history of Tuscola, Illinois' supply. For many years, 500 to 800 feet deep bedrock wells were used to supply water to the community water system in Douglas County. However, to meet the needs of Tuscola, seven to eight wells were required, each pumping between 20 and 50 gpm. The total dissolved mineral content of the water was typically in the 500 to 800 mg/L range. Numerous investigations were conducted to find adequate supplemental supplies to meet the growing demands in Tuscola. Finally, in 1994, Tuscola gave up on the deep aquifer and entered into an agreement with Northern Illinois Water Corporation (now Illinois American Water Company) to purchase Mahomet Aquifer

water, ending their use of Silurian-Devonian bedrock and decades of local water supply concerns.

Potential Alternative Surface Water Sources

There are two types of surface water that could be potential drinking water sources: reservoirs and free-flowing streams and rivers. Those rivers, streams, and reservoirs that have sufficient low flows and are near or lie within the Mahomet Aquifer are shown in Figure 6.

Reservoirs

Lake Vermilion serving Danville is the only water supply reservoir that lies over or near the Mahomet Aquifer. Reservoirs serving Springfield, Decatur, and Bloomington were assessed as not being near the petitioned aquifer, as defined by US EPA.

Reservoir yield analyses were recently completed and published by Roadcap et al. (2011). The 90 percent confidence yield estimates for Lake Vermilion for a 50-year and 100-year drought recurrence, based on projected losses in reservoir capacity are shown in Table 3. The average water demand for the last four years (2007-2010) for Danville is 8.1 Mgd and has been projected to increase to 9.0 Mgd by 2050 (WHPA, 2008). So, although Lake Vermilion currently has adequate capacity to serve Danville, its yield will diminish in coming years while Danville's demand is expected to increase. Therefore, it would not be appropriate to suggest there is additional capacity to serve as an alternate supply in the future.

Thus, no existing water supply reservoirs near or over the Mahomet Aquifer can serve as an alternative water source.

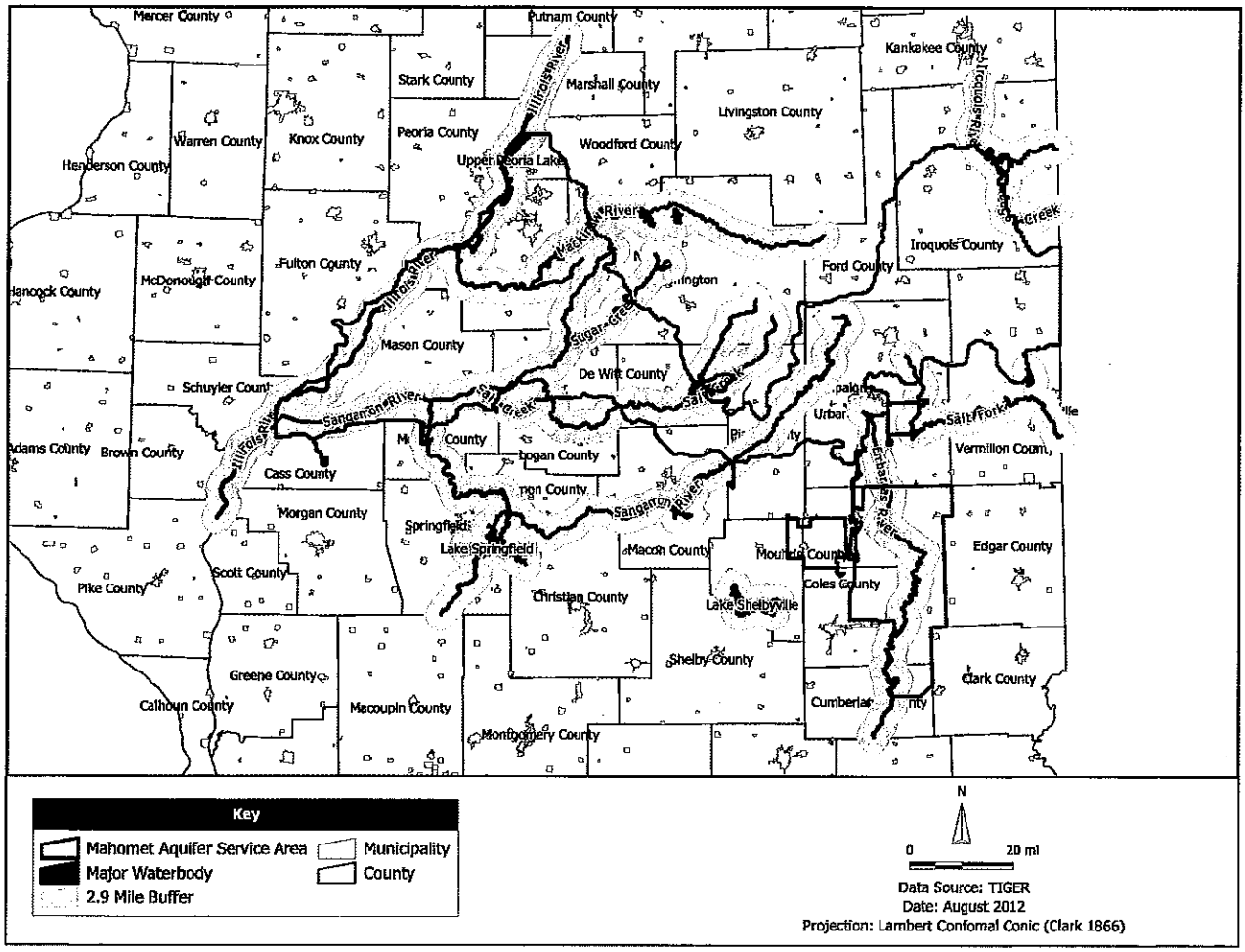

Figure 6. Streams and rivers near or within the Mahomet Aquifer service area that have sufficient low flow to be a potential source of community drinking water.

Table 3. Changes in Future Yield Estimates for the Danville Water Supply System Based on Projected Losses in Reservoir Capacity (from Roadcap et al., 2011)

Year	*90% yield (Mgd) at selected recurrence intervals*	
	50-year	*100-year*
1998	11.3	10.1
2010	10.5	9.5
2020	9.9	9.0
2030	9.4	8.6
2040	8.9	8.2
2050	8.5	7.8

Streams and Rivers

There are many streams and rivers that overlie or are near the Mahomet Aquifer service area. These include the: Illinois River; Mackinaw River; Sangamon River and its tributaries Salt Creek and Sugar Creek; Iroquois River and its tributary Sugar Creek; Embarras River; and Salt Fork that flows into the Vermilion River.

While these streams and rivers provide significant amounts of water, they are not near or accessible to all users within the Mahomet Aquifer service area (Figure 7 and Table 4). So for each community that was determined to be near a stream reach, an economic cost analysis was completed.

Table 4. Alternative Drinking Water Supply Sources (in gallons/day)

Source/Use	Public Water Supply (Community & Non-community)	Private and Other	Total
Petitioned Aquifer	57,400,000		
Other Aquifers	negligible	0	0
Surface Water			
-Illinois River near Beardstown*	2,360,000,000	0	2,360,000,000
-Salt Fork near Danville	20,300,000	0	20,300,000
-Embarras River near Greenup	3,360,000	0	3,360,000
Total	2,383,660,000	0	2,383,660,000

*total flows include the Mackinaw River and the Sangamon River and its tributaries so these flows are not called out specifically in this table.

Legal Availability of Alternative Sources

In Illinois, water law follows the Rule of Reasonable Use (Clark 1985):

> "Under the reasonable use doctrine of some states, a landowner is viewed as having the right to make any reasonable use of groundwater as long as it relates to some beneficial activity on the overlying land even though significant interference might result to

> the groundwater supplies of adjacent landowners... Under these rules a landowner's right to withdraw groundwater is only limited when the use unreasonably interferes with a neighbor's use... Three basic kinds of unreasonable interference with a landowner's right to use groundwater which are prohibited are well interference, monopolization, and diversion from surface water. In the situation of well interference, the test of liability is whether pumping has caused an unreasonable lowering of the water table or unreasonable reduction in artesian pressure. The Restatement does recognize that any use of groundwater will have some effect on an aquifer and that a reasonable drawdown must be allowed as a right. An unreasonable effect is believed to occur when a new user withdraws a disproportionately greater amount than others, causing wells to fail. A disproportionately large withdrawal may, therefore, be found unreasonable."

The implication of this rule of reasonable use is that there is nothing to prevent developing a new groundwater supply anywhere in the state. However, because most of the public supply systems recognize the social compact that is required for operation, larger municipal suppliers that use groundwater will take steps to anticipate and remedy impacts on local well owners. This has included the payments for lowering pumps, deepening wells, drilling new wells, and connecting to the public supply transmission main of affected landowners to avoid civil court proceedings.

However, water authorities are the only exception to rule of reasonable use. Water authorities have broad powers to manage the water resources within their jurisdiction including the power to regulate drilling new public supply wells. Water authorities have been established all over the state but most are located over the Mahomet Aquifer. These Authorities cannot regulate new domestic wells or wells used for agricultural purposes (70 ILCS 3715) but can regulate new municipal supplies. Therefore, it seems clear that where there are water authorities, EPA's definition of "constraints which may possibly be binding" applies. Since they are only possibly binding, we have not

eliminated these areas from the potential alternative sources under this criterion.

Economic Analysis of Potential Alternative Drinking Water Sources

Within the Mahomet Aquifer service area there are also several large rivers. These rivers are also not accessible to all communities and are not available to any non-riparian private users of the Mahomet (Table 4 and Figure 6). We used the Illinois State Water Survey estimates of the 7-day, 10-year low flows (ISWS, 1988 and 2002) to determine which rivers have the flows needed for public supply use. The Illinois River and its tributaries (the Mackinaw and Sangamon rivers) provide sufficient low-flows to provide an alternative supply to the Mahomet Aquifer (Table 4). The Salt Fork and the Embarras River also provide potentially sufficient flows for nearby communities. For all of the rivers except the Illinois River, there are reaches that do not have adequate flows for nearby users (Table 5). For the specific communities where low-flows are sufficient, an economic feasibility analysis was completed.

Table 5. Rivers and streams that do not provide sufficient low-flows to provide drinking water to nearby communities (source: ISWS).

Community/Public Water Supply	Estimated low-flow (gallons/day)	2010 pumping rate (gallons/day)
Champaign	0	21,783,981**
Danvers	0	143,726
De Witt	0	19,261
Mahomet	361,937	523,425
Minier	0	101,170
Philo	0	165,900*
Savoy	0	711,200*
Stanford	0	51,489
Tolono	0	420,000*
Urbana	0	5,014,450*
Villa Grove	0	361,550*

**2010 pumping for Illinois American Water-Champaign, which serves Champaign, Urbana, Savoy, St. Joseph, Bondville, Pesotum, Tolono, Sidney, Philo, Seymour Water District, Tuscola, Arcola, and Embarras Area Water District. *estimated values because these communities receive water from Illinois American Water or another water purveyor.

Costs of Alternative Surface Water Supplies

For surface water sources, we assumed that the minimum surface water treatment plant that would be constructed was 0.5 Mgd and that the 2010 demand (in gallons/day) would need to be doubled to account for maximum day capacities. All of our analysis calculated capacities rounded up to the nearest 0.5 Mgd. Another assumption in our work was that a municipal bond would be used to finance the infrastructure at a rate of 6.0% for 10 years. We used the U.S. EPA's 2007 Cost Modeling equations to determine costs (U.S. EPA, 2010) in a step-wise fashion.

We first calculated the largest capital expenditure (the filtration plant) and assumed that it would need to be a conventional filter plant including flocculation, sedimentation, filtration, waste handling, construction of the building, installation of raw water and finished water pumps, chemicals and mixing, unit processes, clearwell, disinfection, and process control systems. If the annualized cost/household was greater than 0.6% of the median household income, then the alternative source was economically infeasible. If the annualized cost/household was less than 0.4% of the median household income, then we estimated the cost of a surface water intake.

This approach was conservative because it does not include any of the operation and maintenance costs that are allowed as part of the economic feasibility assessment. Therefore, the total costs of building and operating a surface water treatment plant would be much greater than our estimated costs. Based only on these two costs, all alternative surface water sources were deemed economically infeasible (Table 6).

Conclusion and Recommendations

While there are potential alternative sources of water to the Mahomet Aquifer for some communities and public water suppliers, there are no economically feasible alternative sources. All domestic users and some communities or public water supplies have no other near-by sources that

could provide drinking water. Therefore, <u>we recommend continuing the process of petitioning for sole source designation.</u>

In the petition for the sole source designation, we recommend

1. Including the overlying aquifers as part of the petition because they are hydraulically connected to the Mahomet Aquifer
2. Excluding the mapped area that is west of the Illinois River because it is not hydraulically connected to the rest of the Mahomet Aquifer

Table6. Economic feasibility analysis of alternative surface water sources.

Community/Public Water Supply	Connections (Households)	Low-flow estimate (gallons/day)	2010 pumping rate (gallons/day)	Design capacity for surface plant	Conventional Filter Plant (2007$)	Surface Water Intake (2007$)	Total costs in 2010 dollars	Annual Cost (10 years, 6% interest)	Annual Cost/ household	2010 Median Household Income (MHI)	0.4% of MHI (2010)	0.6% of MHI (2010)	Economically feasible?
Armington	167	155,116	27,165	0.500	2,193,377	--	2,303,045	$312,910	$1,874	$50,417	$202	$303	No
Bath	130	2,085,664,612	45,500	0.500	2,193,377	--	2,303,045	$312,910	$2,407	$21,830	$87	$131	No
Camargo	187	329,622	65,450	0.500	2,193,377	--	2,303,045	$312,910	$1,673	47250	$189	$284	No
Chandlerville	307	153,823,420	42,220	0.500	2,193,377	--	2,303,045	$312,910	$1,019	$44,886	$180	$269	No
Clinton	3200	3,231,584	854,607	2.000	5,838,240	802,160	6,972,420	$947,329	$296	$40,132	$161	$241	No
Creve Coeur	2306	1,938,950,677	690,623	1.500	4,487,872	662,096	5,407,466	$734,701	$319	$42,567	$170	$255	No
East Peoria	7677	1,938,950,677	2,756,762	6.000	15,942,340	1,669,264	18,492,184	$2,512,495	$327	$51,841	$207	$311	No
Embarras Water District	1370	2,197,477	479,500	2.000	5,838,240	--	6,130,152	$832,891	$608	$41,833	$167	$251	No
Fisher	740	174,506	159,485	0.500	2,193,377	318,168	2,637,122	$358,300	$484	$62,269	$249	$374	No
Goodfield	325	1,292,634	85,271	0.500	2,193,377	--	2,303,045	$312,910	$963	$77,946	$312	$468	No
Green Valley	285	16,287,186	47,104	0.500	2,193,377	--	2,303,045	$312,910	$1,098	$43,438	$174	$261	No
Hartburg	168	9,177,700	40,500	0.500	2,193,377	--	2,303,045	$312,910	$1,863	$42,500	$170	$255	No
Havana	1552	2,026,203,458	267,422	0.500	2,193,377	318,168	2,637,122	$358,300	$231	$31,688	$127	$190	No
Hopedale	390	323,158	83,348	0.500	2,193,377	--	2,303,045	$312,910	$802	$44,750	$179	$269	No
Kenney	190	4,330,323	21,942	0.500	2,193,377	--	2,303,045	$312,910	$1,647	$35,750	$143	$215	No
Kilbourne	147	142,836,033	51,450	0.500	2,193,377	--	2,303,045	$312,910	$2,129	$43,571	$174	$261	No
Sangamon Valley PWD (Lake of the Woods)	1550	264,990	341,627	1.000	3,097,606	505,195	3,782,941	$513,980	$332	$39,730	$159	$238	No
Lincoln	5890	17,385,924	775,716	2.000	5,838,240	802,160	6,972,420	$947,329	$161	$39,438	$158	$237	No
Mackinaw	1200	2,520,636	225,188	0.500	2,193,377	318,168	2,637,122	$358,300	$299	$61,083	$244	$366	No
Marquette Heights	1120	1,927,963,290	181,894	0.500	2,193,377	318,168	2,637,122	$358,300	$320	$53,790	$215	$323	No
Mc Lean	379	8,402,120	82,380	0.500	2,193,377	--	2,303,045	$312,910	$826	$45,625	$183	$274	No
Middletown	199	24,560,042	19,496	0.500	2,193,377	--	2,303,045	$312,910	$1,572	$42,500	$170	$255	No

Community/Public Water Supply	Connections (Households)	Low-flow estimate (gallons/day)	2010 pumping rate (gallons/day)	Design capacity for surface plant	Conventional Filter Plant (2007$)	Surface Water Intake (2007$)	Total costs in 2010 dollars	Annual Cost (10 years, 6% interest)	Annual Cost/ household	2010 Median Household Income (MHI)	0.4% of MHI (2010)	0.6% of MHI (2010)	Economically feasible?
Milford	650	2,520,636	164,348	0.500	2,193,377	--	2,303,045	$312,910	$481	$37,452	$150	$225	No
Monticello	2311	1,486,529	665,600	1.500	4,487,872	662,096	5,407,466	$734,701	$318	$57,141	$229	$343	No
New Holland	155	10,534,965	21,572	0.500	2,193,377	--	2,303,045	$312,910	$2,019	$45,417	$182	$273	No
North Pekin	718	1,927,963,290	111,677	0.500	2,193,377	--	2,303,045	$312,910	$436	$46,848	$187	$281	No
Oakford	200	142,836,033	70,000	0.500	2,193,377	--	2,303,045	$312,910	$1,565	$53,906	$216	$323	No
Oakland	560	1,292,634	196,000	0.500	2,193,377	--	2,303,045	$312,910	$559	$36,447	$146	$219	No
Pekin	14480	1,927,963,290	5,736,268	11.500	28,900,611	2,576,307	33,050,764	$4,490,540	$310	$41,913	$168	$251	No
Petersburg	1920	57,974,625	334,247	1.000	3,097,606	505,195	3,782,941	$513,980	$268	$39,156	$157	$235	No
Sidney	567	14,283,603	198,450	0.500	2,193,377	--	2,303,045	$312,910	$552	$50,700	$203	$304	No
St Joseph	2104	14,283,603	736,400	1.500	4,487,872	--	4,712,266	$640,246	$304	$62,207	$249	$373	No
Watseka	2500	11,633,704	649,589	1.500	4,487,872	662,096	5,407,466	$734,701	$294	$33,058	$132	$198	No
Woodland	130	2,326,741	20,356	0.500	2,193,377	--	2,303,045	$312,910	$2,407	$37,727	$151	$226	No

REFERENCES

Bruns, T. M. and W. J. Steen. 2003. Hydrogeology of the Lafayette (Teays) Bedrock Valley System, North-Central Indiana Water Resource Assessment. Indiana Department of Natural Resources, Division of Water.

Burch, S. L. 2008. Development of an Observation Well Network in the Mahomet Aquifer of East-Central Illinois. Illinois State Water Survey Data Case Study 2008-01, Champaign, IL.

Clark, G. R. 1985. Illinois Groundwater Law: The Rule of "Reasonable Use". State of Illinois, Department of Transportation, Division of Water Resources.

Herzog, B. L., S. D. Wilson, D. R. Larson, E. C. Smith, T. H. Larson, and M. L. Greenslate. 1995. Hydrogeology and Groundwater Availability in Southwest McLean and Southeast Tazewell Counties. Part 1: Aquifer Characterization. Illinois State Geological Survey and Illinois State Water Survey Cooperative Groundwater Report 17. Champaign, IL.

Holm, T. R. 1995. Ground-Water Quality in the Mahomet Aquifer, McLean, Logan, and Tazewell Counties. Illinois State Water Survey Contract Report 579, Champaign, IL.ISWS maps (all of them)

Illinois State Water Survey. 1988 and 2002. 7-Day 10-Year Low Flow Maps. http://www.isws.illinois.edu/docs/maps/lowflow/maps.asp.

Illinois State Water Survey, Illinois Water Inventory Program. 2012. Water use data for 2009 and 2010.

Kempton, J. P., W. H. Johnson, P. C. Heigold, and K. Cartwright. 1991. Mahomet Bedrock Valley in East-Central Illinois; Topography, Glacial Drift Stratigraphy, and Hydrogeology. In Geology and hydrogeology of the Teays-Mahomet Bedrock Valley system. W. N. Melhorn and J. P. Kempton (eds), GSA Special Paper 258, 91–124.

Kenny, J.F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K., and Maupin, M.A., 2009, Estimated use of water in the United States in 2005: U.S. Geological Survey Circular 1344, 52 p.

Lloyd, O. B. Jr. and W. L. Lyke. 1995. Ground Water Atlas of the United States – Segment 10, Illinois, Indiana, Kentucky, Ohio, and Tennessee. U.S. Geological Survey Hydrologic Investigations Atlas 730-K.

Roadcap, G. S., and S. D. Wilson. 2001. The Impact of Emergency Pumpage at the Decatur Wellfields on the Mahomet Aquifer: Model Review and Recommendations. Illinois State Water Survey Contract Report 2001-11, Champaign, IL.

Roadcap, G. S., Knapp, H. V., and Wehrmann, H. A. 2011. Meeting East-Central Illinois Water Needs to 2050: Potential Impacts on the Mahomet Aquifer and Surface Reservoirs. Illinois State Water Survey Contract Report 2011-08, Champaign, IL.

U.S. EPA. 2010. 2007 Drinking Water Infrastructure Needs Survey and Assessment: Modeling the Cost of Infrastructure.

Visocky, A. P., and R. J. Schicht. 1969. Groundwater Resources of the Buried Mahomet Bedrock Valley. Illinois State Water Survey Report of Investigation 62, Champaign, IL.

Wehrmann, H.A., S.V. Sinclair, T.P. Bryant. 2004. An Analysis of Groundwater Use to Aquifer Potential Yield in Illinois. ISWS Contract Report 2004-11. http://www.isws.illinois.edu/pubdoc/CR/ISWSCR2004-11.pdf

Wilson, S. D., G. S. Roadcap, B. L. Herzog, D. R. Larson, and D. Winstanley. 1998. Hydrogeology and Ground- Water Availability in Southwest McLean and Southeast Tazewell Counties, Part 2: Aquifer Modeling and Final Report. Illinois State Water Survey and Illinois State Geological Survey Cooperative Ground-Water Report 19, Champaign, IL.

APPENDIX A – POPULATION SERVED BY COMMUNITY WATER SUPPLIES

THIS PAGE IS INTENTIONALLY LEFT BLANK

Public Water Supplier	Population Served
1. Alvin	300
2. Arcola (ILAW wholesales)	2750
3. Argenta	900
4. Armington	368
5. Atlanta	1649
6. Bayles Lake Lot Owners	461
7. Belmont Water Company	200
8. Bismarck Community Water District	900
9. Buckley	600
10. Caterpillar Trail PWD	4,400
11. Cerro Gordo	1,400
12. Chandlerville	845
13. Cisco	300
14. Cissna Park	825
15. Clinton	7,128
16. Country Lane MHP	50
17. Crescent City	630
18. Creve Coeur	5,900
19. Danforth	550
20. Danvers	1,183
21. De Witt	200
22. Deer Creek	700
23. Delavan	1,825
24. Dewey PWD	200
25. East Lynn Community Water Supply	112
26. East Peoria	22,638
27. Easton	350
28. Embarras Area Water District (ILAW wholesales)	3,125
29. Emden	452
30. Eureka	5,071
31. Fisher	1,647
32. Fountain Valley MHP	375
33. Forest City	287
34. Gifford	990
35. Gilman	1,793

Public Water Supplier	Population Served
36. Goodfield	700
37. Grandview MHP	300
38. Green Valley	728
39. Greenview	862
40. Groveland Township Water District	2430
41. Hartsburg	400
42. Harvard Hills Water Corp	250
43. Havana	3,577
44. Heyworth	2,800
45. Hoopeston	5,802
46. Hopedale	1000
47. Illinois American-Champaign	141,000
48. Kenney	374
49. Lake Iroquois Association	500
50. Lake Wildwind MHP	200
51. Lake Windermere Estates Subdivision	300
52. Lincoln	15,200
53. Loda	419
54. Ludlow	324
55. Mackinaw	3,000
56. Mahomet	5,785
57. Manito	1,733
58. Mansfield	949
59. Maroa	1,700
60. Marquette Heights	2974
61. Mason City	2,558
62. Mc Lean	830
63. Metamora	3,197
64. Middletown	434
65. Milford	1369
66. Mill Point MHP	200
67. Minier	1,244
68. Monticello	5,250
69. Morton	17,000
70. New Holland	333
71. North Pekin	1,573
72. North Tazewell PWD	8,300

Public Water Supplier	Population Served
73. Oak Ridge Sanitary District	240
74. Oakford (buys from Menard Rural Water Coop who buys from Petersburg)	309
75. Oak Lane Acres Subdivision	120
76. Onarga	1,409
77. Paxton	4,500
78. Pekin	35,000
79. Penfield PWD	150
80. Pesotum (direct service from ILAW)	
81. Petersburg	4,800
82. Philo (ILAW wholesales)	
83. Pleasant Plains MHP	42
84. Potomac	685
85. Prairie View Water Association	35
86. Rankin	650
87. Rantoul	13,000
88. Rossville	1,217
89. Saddlebrook Estates Subdivision	62
90. Sadorus	426
91. San Jose	696
92. Sangamon Valley PWD	4110
93. Savoy (direct service from ILAW)	
94. Seymour Water District (ILAW wholesales)	350
95. Sidney (ILAW wholesales)	
96. South Pekin	1,100
97. St. Joseph (direct service from ILAW)	
98. Stanford	670
99. Thawville	270
100. Thomasboro	1,233
101. Timberlan Subdivison	90
102. Tolono (ILAW wholesales)	2,700
103. Tremont	2,490
104. Tuscola (ILAW wholesales)	4,600
105. Urbana (direct service from ILAW)	
106. Valley View 4 and 6 Knolls Subdivision	230
107. Valley View Subdivision	100
108. Virginia	1760
109. Wapella	670

Public Water Supplier	Population Served
110. Washington	12,371
111. Washington Estates Inc	1,533
112. Watseka	5,500
113. Waynesville	452
114. Weldon	450
115. Wellington	264
116. West Prairie Water Company (Arcola wholesales)	1500
117. West Side MHP	100
118. White Heath Waterworks	660
119. Woodland	319
120. Youngs Hillcrest MHP	34
Total	**413,596**