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Preface – Water Study Report

The Water Study Report (WSR) provides information to the reader about the choices before the Village Board of Western Springs in regard to the future source and treatment for potable water. The report has been prepared by the Water Study Group (WSG) with the assistance of the Finance Committee, the Ad-Hoc Water Group and engineering consultants, and has been reviewed by the Village's Infrastructure Commission and Public Works & Water Committee, both of which have invited comments from village residents. See Appendix 7 for the membership of these bodies.

The preparation of WSR was prompted by the recognition that a substantial financial expenditure was needed to continue the current water production system (WPS) using deep aquifers and lime-softening treatment. The 1998 report of the Ad-Hoc Group proposed improvements to the WPS that included replacement of components that were reaching the end of their design lives and the addition of other components that would improve the operation of the system and the quality of the finished water. The costs of these improvements were estimated at that time to be about $1.2M. Later, additional improvements were recommended that raised the estimated cost to about $2.5M or $3.0M. The Village applied to the Illinois EPA (IEPA) to finance a large portion of the improvements, but so far the loan has not been approved due to higher priority projects within the state. In the course of the subsequent nine years, key WPS components have come ever closer to the end of their useful lives. Also other water production options became worthwhile investigating. In late 2005 the Village decided that it should wait no longer for the IEPA loan approval and should conduct a comprehensive study of the possible sources of water, either the current deep aquifers or Lake Michigan, and of processes for treating aquifer water, if it were selected as the source.

The Village had investigated on several occasions the possibility of changing from deep aquifers to Lake Michigan as its source. These investigations had been rather cursory both because the capital cost of connecting to a nearby supplier of lake water was clearly higher than the capital cost of improving the existing system, and because the operational cost of buying lake water from a supplier was higher than the cost of producing water from the deep aquifers. Presently the capital costs are not obviously in favor of the current WPS.

The costs of alternate treatment processes, such as reverse osmosis and ion exchange, are much lower now than during the previous 1998 WPS study. This study evaluates these processes, as well as the lime-softening one, in its assessment of the deep aquifer option.

Other considerations favor another examination of the choice of the water source, such as effects of hardness and the long term availability of deep aquifer water. These issues, along with other issues associated with lake and deep aquifer water are assessed in the report, but the main reason for preparing the WSR now was the need for large near-term expenditure to assure the residents of a reliable, high quality supply of water.

The ten chapters of the report present (1) background information on the WPS, (2) multiple designs of the WPS, three with deep aquifer water and another with lake water as its source, (3) the estimated costs of each design, (4) the predicted performance of the water distribution with each design, (5) quantifiable benefits/drawbacks of each design, (6) non-quantifiable or intangible benefits/drawbacks of each design, (7) construction schedules for each design, (8) financing of each design, (9) Infrastructure Commission's review of the WSR and comments received from residents and (10) Public Works & Water Committee's review of the WSR.

Most chapters are summaries of the information obtained on the particular topic, and the detailed information is found in the appendices referenced in the chapters. Eight appendices follow the ten chapters in the main body of the WSR.

Note that a version of the WSR will be submitted to the Village Board without a recommendation to approve it. If requested by the Board, the WSG would ask for the recommendation of the Committee and/or Commission.

Chapter 1: Introduction and Background Information

The Water Study Report (WSR) presents information to the Western Springs Village Board for its decision on the water production system (WPS) that will supply the needs of the Village for the coming decades. As explained in the Preface, key components of the existing WPS are close to end of their expected lives, and large expenditures will be required either to renovate the existing WPS using water from deep aquifers, to introduce a new treatment process but retain the remainder of the existing WPS, or to contract with and connect to a supplier of Lake Michigan water. The WSR presents background information on the existing WPS, the design, cost and schedule of the three options for a new WPS, the quantifiable and non-quantifiable benefits of the options, the impacts on the water distribution to the users of the options, the financing of the options and the reviews of the draft WSR by the Infrastructure Commission and the Public Works & Water Committee.

The ground rules for developing each option are:

(1) the proposed WPS will supply adequate, high quality water at a competitive price with high reliability;
(2) different consultants will optimize their designs to meet Rule (1); multiple consultants contributed to the RO option, one of which performed the Lake Michigan option,
(3) all costs and benefits (where possible) will be calculated in $/1000 gallons, with the capital items amortized over a 20 year period.
(4) specifics on the quantity, quality and reliability of the water in Rule (1) will be discussed later.
(5) all consultants promote their option under Rule (2) to produce the most competitive designs.
(6) high cost components such as wells and transmission mains have an expected life much longer than 20 years, so the costs using Rule (3) will be greater than expected but will allow the options to be compared on a uniform basis.

Basic Requirements for the Water Production System (WPS)

A WPS consists of those components used to obtain the water from its source, to treat it as needed and to deliver it to reservoirs that feed the distribution system. As stated to above, any WPS must satisfy requirements for quantity, quality, reliability and economics. Each of these requirements is discussed below for the Village's WPS.

1. <u>Quantity</u> The WPS must meet the continual demand of its users for water, as it changes by the hour, by the day and by the season. Almost all of the water users are residents, and most of them live in single family residences. However, two large users are institutions, LTHS and the WS Service Club. The total annual production is about 500 million gallons (MG), and the total sales are about 400 MG. The difference is due to unmetered uses (e.g. fire suppression) and leakage in the distribution system. Usage, both day-to-day and year-to-year, is most strongly affected by the weather. The average daily production is approximately 1.3 MG. In the winter, it is about 1.0 MG. During the summer it goes up to around 1.6 MG with many days exceeding 2.0 MG. To date, the highest demand days approach 3.0 MG. The daily demand has two peaks, one in the morning from 6AM to 9AM and another in the evening from about 5PM to 8PM. Usage during the night (midnight to 6AM) is very small. Hourly water demand can change by a factor of almost ten during the day, and daily demand can change by

as much as a factor of four over the year. Obviously, a WPS must possess a great deal of flexibility in meeting such a range in demands. The presence of a long term trend in annual water demand in Western Springs is difficult to determine because the large effect of the weather masks the smaller ones. The number of user households is not expected to change significantly. The recently annexed subdivision of Timber Trails will not use village water, no further annexations are foreseen, and very few vacant buildable lots exist within the municipal boundaries. The water usage per household may increase, as homes with hot tubs, Jacuzzis, irrigation systems, and other high usage devises replace the older homes with standard bathtubs, garden hoses, etc. Appendix 8

2. Quality One part of quality is satisfying USEPA requirements, which are set to protect the health of the public. The other part of quality deals with non-health issues, such as taste, appearance and effects on piping, fixtures, appliances, etc. Historically the Western Springs WPS has met the health requirements without special treatments. Currently radium exceeds the maximum allowed concentration in one of the Village's aquifer sources, but is removed sufficiently in the softening process to produce finished water well below the USEPA limit. Lake water must be fluorinated to meet the USEPA requirements, while deep aquifer water naturally contains fluorides within required concentrations.

   Since Western Springs constructed its treatment plant in 1932, the main process was lime softening the aquifer water which currently contains about 16.5 grains (282 mg/L) of hardness. The current plant softens that water to about 142 mg/L of hardness. The treatment has not consistently achieved the desired softness, but has removed iron to a satisfactory level. Calcium deposits can result from the unsoftened water (heating calcium bicarbonate) and by changes with the stability of calcium carbonate in the distribution system. Stains from iron are usually not a problem although they can occur under certain conditions. No treatment is needed to improve the taste of the water from the aquifers.

   Lake water is treated to remove suspended solids that produce turbidity or murkiness. Typically a coagulant is added to bring the solids to the surface where they are removed by skimmers and filters. Lake water hardness runs between 7.5 and 8 grains (129-137 mg/L). Lake water taste and odor may vary with the seasons, and would be most noticeable during late summer.

3. Reliability WPS must be very reliable because water is vital to the community it serves. Even though numerous equipment failures and "acts of God" have occurred in Western Springs over the years, the WPS has never failed to provide the residents with adequate water. The key ingredient of high reliability is redundancy in WPS components needed to provide water to the residents. Examples of redundancy in the current WPS are three wells with one having emergency electrical power, three high lift pumps and three large reservoirs.

4. Economics The current cost of producing finished water in Western Springs is slightly more than $2.00/1000 gallons. This cost does not include the distribution to the users, the metering or the billing, which about doubles the cost. The average household pays about $360/year for water. The cost of lake water varies from supplier to supplier, as will be covered in Chapter 2. The cost range for suppliers within several miles of Western Springs is $2.26 to $2.81/1000 gallons. The capital cost of a transmission main for Lake Water or the associated equipment for aquifer water treatment must also be factored into this calculation.

Description of the Current Water Production System (WPS)

The current WPS consists of three wells, a treatment plant, four storage tanks, the connecting water mains and the associated equipment. These components are described briefly here, but a more detail descriptions were taken from the 1998 WSR and placed in Appendix 2 of this report.

Well #1(Burlington at Wolf) is a shallow well drilled 385 feet into a limestone formation in 1924. Its capacity is about 1000 gallons per minute (GPM), and its static water level has risen over the last twenty years. Although the water meets health requirements, it is extremely hard water (55 grains, 942 mg/L) and would be used only in an emergency, such as the failure of the other two wells. It is seldom used to supply water to the residents. It was rehabilitated in 2006 and prior to that in 1996.

Well #3 (north side of Village Hall) is a deep well drilled 1603 feet into a sandstone formation in 1955. Its capacity is about 1240 GPM and its static water level has risen over the last twenty years. The well has the highest radium level of the Village's three wells, but since it has natural fluoride (at the proper level), low sodium and good taste it is the primary source of water for the Village. It was rehabilitated last in 2003 and prior to that in 1996. An emergency diesel generator would supply electricity to Well #3 only, if needed.

Well #4 (public works yard) is a deep well drilled 1913 feet into a sandstone formation in 1966. Its capacity is about 1100 GPM and its static water level has risen over the last twenty years. Although it has more sodium than Well #3, the quality is its water is good and the well serves as the primary backup when the system demand exceeds Well #3's capacity or when Well #3 is unavailable. It was rehabilitated last in 1998 and prior to that in 1990.

On 90% of the days during a year, Well #3 or Well #4 has the capacity to meet the water demands, including that for fire suppression. On an average day of 1.3 million gallon (MG) demand, the well operates from mid-morning to evening. The morning and evening peak demand periods are met by a combination of "new" production from the well and "old" production stored in the four tanks. At the end of the operating day all tanks are filled for the next day. On the day of the historical peak demand (3.0 MG) Well #3 ran 24 hours and Well #4 about 20 hours.

In the aquifer options three wells would be required, and in the lake option one well would probably be kept in a stand-by mode. Operation of the wells under both the aquifer and lake options is discussed in Chapter 2.

Current Condition of the Water Plant

The main purpose of the treatment plant is to remove calcium hardness (calcium bicarbonate) from the water using the lime-softening method and to add chlorine as a disinfectant. As an added benefit, the lime-softening process reduces the amount of radium and iron to acceptable levels in the water to levels. The major components of the treatment plant include; (1) the lime, alum, carbon dioxide and chlorine feed systems, (2) the spiractor, (3) the accelator or clarifier, (4) the recarbonation basin, (5) the sand filters (four) and (6) the low service (two) and high (three) lift pumps. Greater detail is taken from the 1998 report and placed in Appendix 5.

The four storage tanks are in chronological order of construction the clearwell, the reservoir, the elevated tank and the standpipe. They provide water during periods in which the demand exceeds the current plant production of the wells. The periods include the morning and evening peak usages and unplanned events, such as those due to fire suppression and large main breaks. All tanks are filled before the start of the next day's morning peak. In addition to their storage function, the elevated tank and standpipe help regulate the water pressure in the distribution system.

Both the elevated tank and standpipe will remain in the WPS, regardless of the decision on the water source, i.e. aquifer or lake. The clearwell and the reservoir would remain with the decision in favor of the lime treatment option, and the reservoir and the clearwell would either remain or be replaced at another location with the choice of the RO option The reservoir but not the clearwell might be part of the WPS in the Lake Michigan option.

Decisions in the Chicago Area between Aquifer and Lake Water

The city of Chicago has relied on lake water almost since its incorporation, while most suburban communities used either shallow or deep wells until the 1950s. Western Springs and other suburbs with open land experienced population growth in the '50s and '60s and, along with this growth, an increased demand for water. The demand exceeded the capacity of the aquifer of existing wells and the water levels in those wells dropped year after year. Western Springs decided in the '50s and '60s to drill two wells into the deep aquifers to obtain reliable and adequate sources of water. At first most of the other suburbs also expanded their well water supply, but then shifted to lake water in the '80s. As explained in the Lake Water Report (Appendix 1) and summarized in Chapter 2, suburbs may receive specific allocations of lake water through international and state bodies. As the number of users of lake water has grown in the past several decades, Western Springs is one of only a few communities in the Chicago area to use deep aquifers as their primary water source. The closest one to Western Springs is Lemont, and most of the other suburbs lie west of the Fox River. Over the period since other villages have abandoned their wells, the water level in the Village's two deep wells #3 & #4 have risen 98 ft and 124 ft, respectively. The basic reasons that Western Springs has previously chosen to continue with its deep aquifer source are (1) an ample amount of good quality water in the aquifers, (2) the relatively long expected lives of its two main wells, (3) the high cost of connecting to a supplier of lake water, (4) an existing water treatment plant, and (5) the rise in the aquifers in this area over the last twenty years.

The study was not able to obtain any documentation of the reasons that the other suburbs chose lake water in the '80s. Any reports on the decision have been discarded over the intervening 20 to 25 years, and those who participated in the decision have retired. The reason that two communities (Plainfield and Shorewood) have recently decided to switch from aquifer to lake water is (1) the expense of meeting new water standards, (2) concern about the sustainability of their aquifer source, and their expanding populations that will increase the demand on their WPSs. The Plainfield and Shorewood examples are explored in further detail in Appendix 1.

Chapter 2: Physical Description of Proposed Lake Water And Aquifer Systems

The following subsections detail the proposed lake and aquifer systems. The first section focuses on a connection to McCook for the supply of water from Lake Michigan. The other three options focus on continued use of the aquifers. Since the deep aquifer wells produce hard water and the radium level in one of the wells exceeds the MCL (Maximum Contaminant level), treatment is necessary. The subsequent subsections contain descriptions of (1) an overhaul of the existing lime softening plant, (2) construction of a Reverse Osmosis (RO) treatment, and (3) construction of an Ion Exchange (IonX) treatment.

Lake Michigan Water Supply

In March 2006, Baxter & Woodman, Inc. (B&W) submitted a Lake Michigan Feasibility Study to the Village, which determined that allocation, supply, and distribution of Lake Michigan water are technically and fiscally possible. In December, 2006 B&W submitted a Lake Michigan Water Supply Study which reviewed the requirements for obtaining and keeping a Lake Michigan water allocation; investigated the system and operational changes associated with this water supply; and selected a preferred Lake Michigan water supplier. Specifically, this study focused on the following areas:

- Detailed review of the water allocation process;
- Ability to supply water during peak demand times and emergencies;
- Case studies of two other communities that recently switched from groundwater supplies to Lake Michigan water;
- Water quality and level of service provided by selected Lake Michigan water supplier;
- Scope and cost of improvements required to supply Lake Michigan water; and
- Village's degree of control over Lake Michigan water supply system.

Lake Michigan Water Allocation History

Lake Michigan has been an important source of drinking water for Chicago-area residents since the mid-1800s. Litigation over Chicago's diversion from Lake Michigan began almost immediately. Legal action culminated in a 1967 Supreme Court Decree, which ordered that Chicago's total diversion from Lake Michigan not exceed 3,200 cubic feet per second (cfs) – the equivalent of 2,068 million gallons per day (mgd) – over a 40-year averaging period. Illinois' diversion consists of three components: domestic pumpage from Lake Michigan used for potable water supply and not returned to the lake; stormwater from the 673-square-mile Lake Michigan watershed; and the direct diversion of Lake Michigan water into the Chicago Sanitary and Ship Canal (CSSC). As of January 2005, there were 205 domestic allocations, for a total daily average consumption of 1,272 mgd or 1,968 cfs, which represents approximately 62 percent of Illinois' total allowable diversion from the lake.

Illinois began exceeding its diversion limit of 3,200 cfs in 1983, and this practice continued through 1996, resulting in a significant water debt. Several improvements have been made to the direct diversion system since 1996. These changes have allowed Illinois to divert substantially less Lake Michigan water than allowed by the Supreme Court Decree, which is leading to repayment of the water debt, and should help Illinois to avoid another water debt in the future. In response, IDNR is considering applications for new water allocation permits from communities seeking an alternative to their existing water supplies. IDNR has confirmed that it is possible for the Village to reinstate its allocation by following the application process and submitting a formal letter of petition.

Lake Michigan Water Allocation Requirements

The Lake Michigan allocation process is regulated by the Illinois Administrative Code and administered by the IDNR. Major components of the permit applications are:

- Description of geographic area and number of people to be supplied;
- Uses to which the allocation will be put and proportion of allocation that goes to each use;
- Description of existing water system and any proposed improvements;
- Location of wastewater effluent discharges within the water supply area;
- Description of water quality and quantity available from all current sources, and the quantity prospectively available from each source; and
- Anticipated future needs during the proposed allocation period, including projected changes in land use, population, and per capita water use.

In order to receive and maintain a lake water allocation permitees must comply with several requirements imposed by the Department of Natural Resources (DNR) including: water conservation which includes metering, monitoring and possibly watering bans; water use restrictions which limit water usage from May 15 to September 15 and the total amount of water which can be used per year; groundwater usage which requires permittees to establish a program to phase out aquifer usage; storage requirements which equal two times the average daily usage (Western Springs would meet this 2,480,000 gallon requirement); and the requirement for an emergency redundant system such as a connection to a neighboring community.

Lake Michigan Water Treatment and Quality

All potential suppliers evaluated in this report receive treated Lake Michigan water from the City of Chicago's Jardine Water Purification Plant. Activated carbon is added to the water in the plant's intake basin to remove objectionable tastes and odors, and then the water is screened to remove large debris. Alum and polymer are then added upstream of coagulation-flocculation-sedimentation process basins. After sedimentation, the water flows to sand filters, and the final step is fluoride and chlorine addition. Finished water flows from a large clear well through tunnels to several pumping stations, where it is distributed to Chicago and over 100 surrounding suburbs.

Lake Michigan is considered a high quality surface water source. As a surface water source, the raw water has higher turbidity and more variable temperature than Western Springs' existing groundwater supply, and is more vulnerable to biological and chemical contamination, which is why it undergoes extensive treatment as described above. Unlike Western Springs' current water source, the lake water does not contain detectable levels of radium or any other radioactive element, and has low hardness, which makes softening of any kind (ion exchange, lime, etc.) unnecessary when treating this water source. Finished water and distribution system samples are taken frequently to ensure water safety. As Chicago's two most recent available chemical analyses show, water quality parameters in the treated lake water do not exceed any state or federal Maximum Contaminant Levels.

Potential Lake Michigan Water Suppliers

The B&W Feasibility Study evaluated several connection opportunities. The Water Supply Study focused on three of those connections; Burr Ridge, LaGrange Highlands, and McCook, before finally recommending a connection to McCook. At the request of the Infrastructure Commission B&W estimated the cost of a direct connection from the closest Chicago pumping station to Western Springs. The lower cost of water from Chicago did not compensate for the higher capital of the long transmission line, and the Village's Finance Director advised against assuming the large debt for constructing the line..

The Village of McCook receives Lake Michigan water from the City of Chicago, where a booster station pumps a maximum of 18 mgd through a 2.5-mile, 24-inch reinforced concrete transmission main to the Town of Cicero. Here, a second booster station pumps a maximum of 16 mgd through a 5.1-mile, 24-inch reinforced concrete transmission main to the Egandale Avenue Pumping Station on the eastern edge of McCook. The Egandale station, with a peak capacity of 16 mgd, is connected to a system of 16- and 24-inch water mains that serve McCook and the municipalities of Hodgkins, Countryside, and LaGrange. In 2005, pumpage from this station was approximately 7 mgd average and 8.5 mgd maximum. McCook provides chlorination as necessary to maintain appropriate residual in its distribution system.

B&W proposes that Western Springs construct a transmission main from McCook in cooperation with the communities of LaGrange Highlands and Indian Head Park. These two communities have expressed interest in constructing a transmission main directly from McCook if Western Springs were willing to share in the cost.

McCook does not have alternative water sources, but does have emergency measures in place to deal with potential interruptions in their water supply from Chicago. McCook's pumping station and the intermediate supply station in Stickney are only operating at about half of their peak capacity, which provides redundancy in case of pump failure. Additionally, a secondary transmission main running parallel to McCook's primary supply line from the Stickney pumping station provides redundancy in case of a supply main break. Furthermore, all pumping stations within McCook's supply chain and distribution system have at least two back-up power sources.

Since receiving their allocation, McCook has experienced a few water supply disruptions stemming from maintenance and emergency repairs, but in all cases, their water storage facilities (seven million gallons total) have been able to satisfy all demands until the disruptions ended. McCook does not impose restrictions on its customers unless the water supply from Chicago is curtailed. Since Illinois began improvements to the direct diversion system in 1996 (as discussed in Section 2), McCook has not experienced any water supply restrictions other than the summer lawn watering restrictions placed on all Lake Michigan water users by the DNR

McCook charges all customers $2.26/1,000 gallons for all water consumed. McCook has historically raised water rates only to pass on increases from its supplier, Chicago. In past years, rate increases from Chicago averaged less than three percent per year, but rate increases of about 15% annually have been announced by the city for 2008, 2009 and 2010. In 2008 McCook passed along a 12% increase to municipal customers ($0.25). They have indicated that the 2009 and 2010 increased will be 3% respectively ($0.06).

Infrastructure Improvements Required to Receive Lake Michigan Water

The Village of Western Springs' existing Water Model and a desktop engineering analysis were used to assist in determining the following for each potential supply community:

- Identify a connection point at each community;
- Locate a new water transmission main;
- Calculate the optimum transmission main size to minimize potential pumping requirements;
- Identify additional internal system improvements to receive Lake Michigan water, including pumping stations and pressure reducing stations, and
- Determine what improvements, if any, are required to the existing distribution system to maintain fire suppression flow rates.

A transmission main connection is available at the intersection of East Avenue and 55th Street on the west side of McCook. System pressure at this connection point is approximately 30 to 40 psi. The proposed transmission main route is west on 55th Street to Willow Springs Road, a distance of approximately 7,920 feet. At this point, LaGrange Highlands and Indian Park would branch off to the south, and Western Springs' transmission main would continue north on Willow Springs Road approximately 5,280 feet to the Village's standpipe (Figure 1). The segment of the transmission main running west along 55th Street would be 18-inch, and the segment running north along Willow Springs Road would be reduced to 16-inch.

Based on the pressure provided at the connection point, a booster pumping would be required to fill the Village's standpipe. McCook has already dedicated land for this purpose, so property acquisition would not be an issue. As previously stated, McCook can receive a maximum of 16 mgd from Chicago, so no upgrades should be needed in McCook's water supply.

A Lake Michigan receiving facility would also be required, consisting of a flow meter and control valve in a below grade vault that would control the flow rate from McCook. This facility would be located at the standpipe, and McCook would read the meter and bill Western Springs monthly. Maintenance of the transmission main would have to be negotiated with McCook, LaGrange Highlands, and Indian Head Park. The hydraulic head (pressure) produced by the new pumping station will be greater than that currently produced by the standpipe. Therefore, to prevent overfilling the standpipe while still providing sufficient hydraulic head to fill the elevated tank on the west side of the Village, an altitude valve will be required.

Deep Aquifer Supply

The alternate to lake water is staying on the deep aquifer. The Village currently has two deep wells and a shallow well. Although the deep wells have very good overall water quality, they still need to be treated for hardness and radium. There are several treatment methods available, and the WSG evaluated the three which best suited the Village's situation.

Lime Softening

The first method for treating the water is to stay with the current lime softening plant. As the 1998 study showed, this is a viable process. This alternative is attractive because the Village has operated a lime plant for several decades and can well evaluate the benefits and drawbacks of this type of treatment. Yet, the existing plant would need significant upgrades. Another attractive benefit is that the suggested upgrades could be phased in over several years. Additionally, the improvements have been organized to address the following:

1. Upgrades to maintain the plant in "as is" operation: this option includes replacing completely deteriorated system (accelator) and would not significantly increase production or treatment capabilities. The cost is estimated at approximately $1,000,000.
2. Additional emergency operation: this option would provide for pumps and generators at the 2 million gallon standpipe. Given its current operation, only the upper 1/6th of the standpipe is is used to maintain pressure and meet the demand in the water distribution system. This option would increase the storage supply, extending the length of time the Village could supply water if the production system failed. This cost is estimated at $745,000.
3. Overall operation improvement: this option requires significant overhaul and replacement of several treatment processes including; the change over to a liquid lime system, the change over to a liquid alum system, the change over to a liquid bleach system and the replacement of the recarbonation system, the decommissioning of the current water softener (spiractor), the construction of a sludge dewatering system, the replacement of plant electric transformers and main disconnect, and the upgrade to a variable frequency drive for well #3. Selection of this option would allow the plant to migrate towards a more automated operation which in turn will help produce a more consistent finished water product. This cost is estimated at $2,700,000.
4. Increased supply capacity: this option includes the drilling of a new deep well (Well #5). This option would increase the redundancy of the supply system and allow the Village to produce quantities of water beyond the projected peak demands of the Village. This cost is estimated at $800,000.
5. Increased purification capacity: this option includes the separation and reconstruction of two of the existing sand filters at the water plant and the construction of a remote treatment facility at the proposed well #5. This option would increase the purification capacity of the production system. This cost is estimated at $2,000,000.

To meet the improvements above the Village would need to include various combinations of the following improvements: Depending on the improvements selected, the cost ranges from approximately $1,000,000 to $6,000,000. A detailed description of the projects above and their associated costs are contained in Chapter 3 and in Appendix 2.

Reverse Osmosis

Reverse Osmosis (RO), in this application, is the process of pushing water through a membrane that only allows pure water through to the other side. This option was briefly explored as part of the 1998 water study. At that time it was rejected due to the high capital and operational costs. Since the US Environmental Protection Agency's tightening of certain contaminant regulations in the past decade, the demand for RO has dramatically increased. Conversely, the growing market for these systems has dramatically decreased the costs of obtaining and operating an RO treatment facility.

An RO facility consists of a skid of multiple tubes (24-36 typically) approximately 20 feet long. Each tube contains membranes which trap the molecules larger than water. The membranes are continuously cleaned by water which cannot pass through the membrane, which forms the waste stream. The waste stream usually contains low levels of solids and does not require special permits and can be discharged to the sewer. RO tends to have a relatively large waste stream. Approximately 20% of the water sent to the unit is rejected and sent to waste. The "purified" 80% stream is called permeate. The permeate is essentially pure water. While it may appear counter-intuitive, pure water is not optimally potable. In order to return some of the beneficial characteristics of water including taste with some mineral content, and to reduce operating costs, the permeate is blended with untreated or raw water to achieve the desired finished product. The finished product could contain 30-70% raw water depending on final water parameters and well operation.

The physical description of the RO plant was developed from meetings with companies that manufacture or represent manufacturers of membrane and other RO equipment, with firms that design and build RO plants, from visits to RO plants in northern Illinois and from published information about the considerable number of RO plants that have begun operations in the last ten years.

Using samples from Well #3 and #4 General Electric Water Technologies predicted the performance of their membranes to remove the chemicals. Using these results the WSG performed parametric calculations of the flow streams of a RO plant to provide finished water for Western Springs. From these calculations GE determined the size of the RO equipment and its estimated cost. The WSG next solicited bids for a pilot plant test that would confirm the RO performance with Well #3 water, provide a plant layout and estimate the construction cost of a RO plant to serve Western Springs. The team of Baxter/Woodman (BW) and Corollo Engs. was selected from the three bidders to conduct pilot tests on a single membrane element and provided values for the performance of a RO plant and for its cost. To accelerate the schedule and reduce the consulting costs, the WSG specified that the plant layout and costs be based on a new facility located near Well #4 in the public works area. The results of the BW-Corollo tests, presented in the next chapter, determined that a RO plant would meet the performance criteria for the Village's water supply and estimated conservative plant costs. As will be discussed later, both the performance and cost projections are conservative, compared to an actual plant of approximately the same size treating about the same water composition.

Ion Exchange

Ion exchange (IonX) is a reversible chemical reaction wherein an ion (an atom or molecule that has lost or gained an electron and thus acquired an electrical charge) from solution is exchanged for a similarly charged ion attached to an immobile solid particle. These solid ion exchange particles are either naturally occurring inorganic zeolites or synthetically produced organic resins. The synthetic organic resins are the predominant type used today because their characteristics can be tailored to specific applications.

In the case of Western Springs, calcium, magnesium and radium would be exchanged for sodium ions. This system consists of multiple basins containing a synthetic resin. As the raw water passes through the resin, the ions are exchanged. Like RO, the treated water is blended with raw water to achieve the required final product. Unlike RO, IonX does not have a large waste stream. Instead, after several hours of operation, the resin is backwashed with a sodium brine to “wash away” the collected ions and regenerate the resin. The resin is designed to last 10 to 15 years.

The WSG visited an IonX plant and discussed this option with consulting engineers. This process has been rejected by the WSG for several reasons. As in 1998, there was concern over changing the chemistry of the water and increasing the sodium levels. Additionally, IonX is only good for exchanging ions and not for removing organic or dissolved solids. In speaking to other municipalities who rejected IonX in favor of RO, they cited the fact that RO can remove both organics and dissolved solids. Additionally, since RO is effective in removing contaminents down to extremely low levels, it enables a municipality to meet any foreseeable changes in EPA. IonX is only suited to react with ionic contaminants.

Chapter 3: Capital and Direct Operating Costs

The WSG has attempted to summarize costs for the above referenced water options. The costs are in 2006 dollars, though Lake Water costs were updated to reflect increases in water rates initiated by the City of Chicago. It is assumed the capital costs will be funded through a 20-year alternate revenue bond, which will be repaid through water rates. This will be further explained in Chapter 8. The end of this chapter also includes a table, which compares the costs between the various water options under consideration.

Lake Water

The most viable lake water option appears to be a direct connection to the Village of McCook. This option is financially possible due to the proposed cost sharing between Western Springs, LaGrange Highlands, and Indian Head Park. The cost of the infrastructure improvements would be prorated according to water usage. This equates to the Village contributing 58% of components that we shared to those shared capital improvements. Without this cost sharing, the total cost of the connection to McCook would be $5 million, with a cost sharing agreement, the Village's cost would be estimated at $3.7 million.

The Village also explored a connection directly to the city of Chicago. While this alternative would allow the Village to purchase water at a reduced rate, the capital cost of the main would exceed $12 million and is cost prohibitive. The entire Lake Water report as well as a detailed analysis of a direct connection to Chicago can be found in Appendix 1. A table comparing the three primary lake water options is below.

Table I. Capital Costs of Three Options for Connecting to Lake Water

	Option 1 Shared Costs With LGH & IHP	**Option 2** Western Springs With no sharing	**Option 3** Direct Connection To Chicago
Transmission Main			
55th & East to 55th & Gilbert	$927,000	$1,597,760	
55th & Gilbert to Standpipe	$1,053,800	$1,053,800	
Contingency (20%)	$396,160	$530,312	
Total Transmission Main Cost Estimate	$2,376,960	$3,181,872	$11,175,000
Receiving Station (incl. tank pump)	$722,500	$722,500	$722,500
Altitude Valve/ Piping	$140,000	$140,000	$140,000
Booster Station	$461,796	$796,200	$1,003,900
Grand Total	**$3,701,256**	**$4,840,572**	**$13,041,400**

In addition to the direct costs listed above, there are also operating cost associated with the lake water option. McCook currently sells water to other municipalities for $2.26 per 1,000 gallons. Over the past five years, the Village has pumped an average of 500,000,000 gallons per year. Purchasing that water would cost the Village approximately $1,130,000 per year. Of that 500,000,000, only 390,000,000 is sold to customers leaving 110,000,000 gallons in unaccounted water. This unaccounted for water is made up of natural loss of water throughout the system, plus municipal usage including main breaks and fire protection. The

110,000,000 gallons difference that the Village would need to purchase but cannot sell is accounted for in the financial calculations. The primary operating costs would include electricity for the booster station and limited chemicals (chlorine). These costs are estimated at $25,000 per year.

The lake water option also offers potential savings over the aquifer options. While these items will be itemized in a table later on, there should be approximately $500,000 per year in chemical savings as well as reduced electrical charges and a reduction in employees. The lake water option could also include the decommissioning of the water plant and the sale of that property.

For purposes of this study, we are utilizing the numbers associated with option #1 (cost sharing with LaGrange Sanitary District and Indian Head Park). Based upon the $3.7 million dollar expenditure and the associated $555,000 of engineering (15%) a bond issue just over $4.2 million would be required.

Lime Softening

The spreadsheet on the following page details the major renovations recommended for continuing lime softening in the existing treatment plant. The spreadsheet follows the outline laid out in Chapter 2 whereby each component improvement is attributed to project category. If this option were chosen, the WSG would recommend all of the improvements be included. It is anticipated that the drilling of an additional deep well and the associated remote treatment would be added in a second phase of improvements.

The first phase of the project would cost approximately $5.3 million dollars depending on how the waste stream is handled. The remaining $2.5 to $3 million for the drilling and treatment of well #5 would take place around 2012 when the some existing alternate revenue (water) bonds are retired. This would free up the ability to issue new alternate revenue bonds to cover the Phase 2 expenditure. Engineering is estimated at an additional 15% which would bring the Phase 1 total to $6.1 million.

The operational cost of the plant would be very similar except for a slight increase in the cost of lime (replacing hydrate lime with liquid lime). The goal of the upgraded plant is to increase the consistency of the finished water by giving the operation better equipment. In turn this will also lead to more automation of the plant. It is not being recommended that the plant be completely automated at this time.

The complete Ad Hoc report on the Lime Softening Upgrade can be found in Appendix 2.

AD HOC COMMITTEE 2006 - WATER PRODUCTION SYSTEM POTENTIAL PROJEC

Village of Western Springs, Illinois

PROJECT COST ALLOCATION TABLE - Tabulation 15 March 2006

ID	#	COMPONENT DESCRIPTION	ESTIMATED PROJECT COST ($)	PROJECT CATEGORY: ON-GOING OPERATIONS & MAINTENANCE	ADDITIONAL EMERGENCY OPERATION CAPABILITY	OVERALL OPERATION IMPROVEMENT	INCREASED SUPPLY CAPACITY	INCREASED PURIFICATION CAPABILITY	"AS-IS" OPERATION
		CHEMICAL SYSTEMS							
C	1	Alum system replacement	$ 75,000			$ 75,000			
C	2	Chlorination system replacement	$ 40,000			$ 40,000			
C	3	Source 1 chlorination system installation	$ 15,000					$ 15,000	
C	4	Source 4 chlorination system installation	$ 15,000					$ 15,000	
C	5	Source 5 chlorination system installation	$ 15,000			$ 15,000			
C	6	Recarbonation difusion system replacement	$ 20,000			$ 20,000			
C	7	Ph monitoring system	$ 30,000			$ 30,000			
		SOURCE SYSTEMS							
S	1	Aquifer source 5 system	$ 800,000				$ 800,000		
S	2	Shallow aquifer source #1 decommissioning	$ 90,000			$ 90,000			
S	3	Aquifer source systems O&M		$ 25,000					
		PURIFICATION SYSTEMS							
P	1	Accelator replacement	$ 900,000						$ 900,000
P	2	Sand Filters 1 & 2 rehabilitation	$ 80,000						$ 80,000
P	3	Sand Filters 3 / 4 rehabilitation	$ 80,000						$ 80,000
P	4	Sand Filters 3 / 4 separation	$ 165,000					$ 165,000	
P	5	Spiractor subsystem removal	$ 30,000						$ 30,000
P	6	Recarbonation subsystem replacement	$ 35,000			$ 35,000			
P	7	Purification Plant influent flow metering	$ 30,000			$ 30,000			
P	8	Filter washwater pump subsystem replacement	$ 12,000						$ 12,000
P	9	Additional high lift pump for distribution / backwash	$ 55,000			$ 55,000			
P	10	Softening solids User Fees	$ 300,000			$ 300,000			
P	11	Replace hydrated lime system	$ 90,000			$ 90,000			
P	12	Purification Production O& M		$ 775,000					
		DISTRIBUTION SYSTEMS							
D	1	Standpipe emergency pump system	$ 150,000		$ 150,000				
D	2	Standpipe emergency pump O&M	$ 10,000		$ 10,000				
		TREATMENT SYSTEMS							
T	1	Remote water purification facility	$ 1,400,000					$ 1,400,000	
T	2	Remote water purification facility O&M	$ 300,000					$ 300,000	
T	3	Purification Plant solids dewatering system	$ 350,000			$ 350,000			
T	4	Purification Plant solids building	$ 1,000,000			$ 1,000,000			
T	5	Purification Plant solids dewatering O&M	$ 40,000			$ 40,000			
		ELECTRICAL SYSTEMS							
E	1	Purification Plant Transformer Replacement	$ 110,000			$ 110,000			
E	2	Aquifer pump #3 variable frequency drive	$ 400,000			$ 400,000			
E	3	Purification Plant Emergency power conversion	$ 200,000		$ 200,000				
E	4	Standpipe emergency generator	$ 150,000		$ 150,000				
E	5	Standpipe emergency generator O&M	$ 15,000		$ 15,000				
E	6	Aquifer pump system 5 emergency generator	$ 200,000		$ 200,000				
E	7	Aquifer pump system 5 emergency generator O&M	$ 20,000		$ 20,000				
		Totals	$ 7,222,000	$ 800,000	$ 745,000	$ 2,680,000	$ 800,000	$ 1,895,000	$ 1,102,000

Production gallons/year **450,000,000**

Reverse Osmosis

The design and cost information on a RO plant for Western Springs was obtained through a series of contacts with membrane suppliers (in large part GE), from engineering firms (McClure in large part), from pilot plant tests (by Baxter Woodman and Corollo Eng.) and from professional sources (publications, authors, etc). The conceptual plan for the 2.4 mgd capacity RO plant consists of two RO units producing about 500 gpm of permeate each. For the purpose of this study only, the plant is located in the public works area and consists of connections to Wells #3 and #4, pre-treatment filters, a by-pass line, a feed pump for each RO unit, post-treatment, a holding tank (clearwell) and two high-lift pumps. Support equipment such as Clean-In-Place unit, waste disposal, instruments and control system, electrical transformer, etc. are also included. The layout is shown in Appendix B of the BW/Corollo report in Appendix 3of the WSR.

The report describes an operational mode in which Well#3 production is feed into both RO units and Well#4 production is blended with the permeate from the RO units to produce 2.4 mgd of finished water. The flow rate of the waste or concentrate stream is 0.25 mgd. The finished water satisfies the EPA limits for radium and fluoride, and has a hardness of 133 mg/L (7.7 grains) and TDS (total dissolved solids) of 415 mg/L (24.2 grains). The predicted performance was based on the single element test and is conservative relative to that at an actual RO plant with similar well water composition. The cost estimates below are based on the calculated plant performance and thus should also be conservative relative to those of an actual plant, i.e., the Spring Valley RO plant which was visited by the Water Study Group and is comparable to the production level of Western Springs.

The cost for a new plant as described above is $6.9 million. It is possible that cost could be reduced by resizing the plant or by reusing and retrofitting the existing treatment plant. Because it is easier to estimate the cost of a new plant, a cost of $7.1 million was used to represent a new plant and the associated engineering. As with lake water, there will be a reduction in labor and chemicals with the RO option. The comparative costs are summarized in table 3 below.

Annual Costs of Three Options in First and Fifth Years

Annual expenditure data presented for the lake water, RO-treated aquifer water and lime-treated aquifer water are compiled in Table III below. Costs are estimated in current year dollars for both the first and fifth years of operation. Most operating costs increase from the first to the fifth year due to wage and price escalations. An important exception is the production personnel costs for the RO and lake options, where fewer operators will be needed as the operations become routine and personnel either retire or are reassigned to other positions. The table also shows the debt from previous and new capital purchases being reduced during the five years due to payments from water revenues.

Note to readers:
The table entitled "A Snapshot of Annual Water/Sewer Fund Expenditures in 2008" is still in the process of revision. This interim table replaces that in the previous draft of the Water Study Report and will, in turn, be replaced by the final version when the 2008 cost of the Spring Valley plant is received. The text below comments on the current version of the table and will be incorporated into Chapter 3 of the final version of the report.

Comments on the Expenditure Table
The expenditures in the column "Current Plant" are the actual numbers from the Finance Department for the water and sewer in 2007. Note that cost per 1000 gallons is $6.93, but the Village charges only $6.10/1000 gallons. If the current plant were to continue in operation without modification or replacement, the water/sewer rate should still increase by $0.83/ 1000 gallons, as indicated by the last number in the column.

Three options for a new source and/or treatment - improved lime treatment, RO treatment and lake water source - are considered during their first and fifth years of operation. As explained in the Water Study Report (WSR), one consultant estimated the cost of a "custom-designed, high-end" RO plant, and another consultant provided the cost of a "pre-packaged, low-end" RO plant they built in 2002 for Spring Valley, IL. Single cost estimates were provided for the lime and lake options. The table lists the expenditures of the options with both the high($7M)- and low($5M)- end construction costs for the RO option. The builder will provide in the near future the cost of a low-end plant in 2007 dollars to be consistent with the construction costs in the other columns. A conservatively estimated cost of $5M is used until the builder supplies the number. The sewer expenditures are the same for all options.

The costs of water/sewer are calculated for the options in the last three rows. In the first of the three rows, the "total cost per 1000 gallons" uses the common units, which is also the units used in calculating the water/sewer bills of the residents. The second row shows the change in cost from the current charge for water/sewer, i.e., $6.10 per 1000 gallon. However, these costs for the options are based on 100% recovery of expenditures, while the current cost is not, as discussed above. The third row shows how much of the change is due to the selected option, so the difference between the second and third rows is simply the $0.83/1000 gallons of currently unrecovered expenditures.

Note: An attempt was made to express the costs in terms of a "typical" water bill in Western Springs. Water usage varies widely among the residents and with the season of the year, so the concept of a numerical average does not convey any useful information. Suggestions for presenting a "typical" impact of the options on current water/sewer bills are welcome.

Table III. Annual Expenditures Itemized for Operating and Costs during the First and Fifth year of Operation for the Three Options.

A SNAPSHOT OF ANNUAL WATER/SEWER FUND EXPENDITURES IN 2007$

	Currrent	First Year (2007)				Fifth Year			
	Plant	**Lime**	**RO (high)**	**RO (low)**	**Lake**	**Lime**	**RO (high)**	**RO (low)**	**Lake**
Water									
Administration[1]	$270,786	$270,786	$270,786	$270,786	$270,786	$280,264	$280,264	$280,264	$280,264
Production[2]	$996,172	$996,172	$757,280	$757,280	$342,500	$1,072,690	$595,500	$595,500	$123,500
Capital Repair	-	-	-	-	-	$25,000	$5,000	$5,000	$5,000
Water Purchase[3]	-	-	-	-	$1,130,000	-	-	-	$1,356,000
Distribution (includes $50K capitol)[4]	$252,113	$252,113	$252,113	$252,113	$252,113	$260,937	$260,937	$260,937	$260,937
Meter Reading (includes $25K meter repl)	$82,436	$82,436	$82,436	$82,436	$82,436	$98,923	$98,923	$98,923	$98,923
Annual Debt Service (existing)	$581,323	$581,323	$581,323	$581,323	$581,323	$507,013	$507,013	$507,013	$507,013
Annual Debt Service (new)[5]	-- none --	$387,889	$445,118	$317,942	$267,071	$387,889	$445,118	$317,942	$267,071
Bond Issued	-- none --	6.1M	7M	5M	4.2M	6.1M	7M	5M	4.2M
Sewer	$520,643	$520,643	$520,643	$520,643	$520,643	$600,000	$600,000	$600,000	$600,000
GRAND TOTAL	**$2,703,473**	**$3,091,362**	**$2,909,699**	**$2,782,522**	**$3,446,872**	**$3,232,716**	**$2,792,755**	**$2,665,578**	**$3,498,708**
PRICE PER 1000[6]	**$6.93**	**$7.93**	**$7.46**	**$7.13**	**$8.84**	**$8.29**	**$7.16**	**$6.83**	**$8.97**
Gross change from current price per 1000[7]	**$0.83**	**$1.83**	**$1.36**	**$1.03**	**$2.74**	**$2.19**	**$1.06**	**$0.73**	**$2.87**
Part of change due to increase cost of Option per 1000[8]		**$0.99**	**$0.53**	**$0.20**	**$1.91**	**$1.36**	**$0.23**	**$0.10**	**$2.04**

(1) Actual 2007 Administration costs. 3.5% increase added to fifth year

(2) Actual 2007 Production costs include personnel and chemicals

(3) Water purchase assumes 20% increase by year five from Chicago rate increases

(4) Actual 2007 Distribution Costs. 3.5% increase added to fifth year

(5) Assumes uniform bond payments. 2.5% Interest over 20 years.

(6) Numbers based off of 390M gallons sold and 500M gallons produced.

(7) Current price per 1000 gallons is $6.10

(8) Costs of option above/below 2007 cost per 1000 gallons

Chapter 4: System Distribution Analysis

The Western Springs Water Model was used to confirm recommended transmission sizes and connection points, and to ensure adequate system operating pressures for the lake water option. Water modeling results indicate the transmission system from Chicago must deliver water at a minimum pressure of 51 psi at the standpipe in order to fill both the standpipe and one-million-gallon elevated tank on the west side of town. That pressure is similar to the Village's current operating pressure.

The fire flows produced in the lake water supply alternative were compared to the base line water model from the Village's current water system. The available fire suppression flow rates were only minimally different. The worst case was an original fire suppression flow rate of approximately 8,200 gpm that was reduced to about 7,000 gpm.

The proposed plan to use the standpipe as a receiving point allows the system to float off of the pressure supplied by the booster station of the supplier. The WaterCad model was used to establish what pressure was required to fill the standpipe and then operate the system. It's important to note that this will result in similar operations to existing system. Instead of the water treatment plant providing supply pressure, the connection to a supplier provides the supply pressure.

Earlier analysis considered different supply points that may have affected the distribution system. By utilizing a connection point at the standpoint, significant distribution changes are minimized.

Chapter 5: Quantifiable Benefits of the WPS options

In addition to differences in the capital and operating costs of the lake and aquifer options, the three options for a WPS also differ in other ways that can be quantified in terms of $/1000 gallons. Seven areas of differences have been identified, and each will be discussed below. Although the differences can be quantified, only very approximate data are available for the quantification, so the results are presented in a table at the end of the chapter in terms of broad ranges of benefits or penalties. The details of the calculating them are given in Appendix 6.

1. System Capacity – The amount of water that the Village can sell to its residents is limited by either contractual agreements or the capacity of the WPS. The greater the amount of water the Village sells, the lower the rate it can set to pay for the fixed costs of the total system, such as the distribution system, some labor costs, etc. A lower rate of an option is a quantifiable benefit of that option. In the lake option the water amount is limited by the agreements with the DNR and our immediate supplier, which is proposed to be the Village of McCook. The daily average amount would be 1.2 MGD and the peak daily amount is twice that, or 2.4 MGD. In the aquifer options the sales are limited by the peak output of the wells or about 3.0 MGD. Plant production records show that on an average an additional 400,000 gallons of aquifer water would be sold on four days in a year when the demand exceeds 2.4MG. The benefits are estimated in Appendix 6 using the marginal costs of the additional water produced from both the lime-softening and RO processes, and the results presented in the table at the end of this chapter.

2. Impacts of Water Restrictions – Some municipalities impose water use restrictions to meet the allocations of lake water by the IDNR, such as limiting the hours of lawn watering and car washing or requiring water saving appliances. No restrictions are imposed under the aquifer options. One impact of watering restrictions is the possibility of damage to landscaping. For example, during the drought in the summer of 2005 many lawns suffered from the lack of water due to the restrictions and needed extensive repairs the following spring. The second impact of restrictions is the reduced revenues from water sales. The cost of repairing damaged landscaping can only be roughly approximated because of the uncertainty in predicting droughts and the lack of data on costs attributed to repairing drought damage. Estimation are given in Appendix 6, and the results presented in the table at the end of this chapter. Data on the reduction in use due to restrictions has not yet been obtained. When it becomes available, this part of the report will be revised, and the results added to the table below.

3. Hardness, Total Dissolved Solids and Suspended solids – Hardness in water shortens the life of many components and appliances that are part of a home's water system. Examples are water service lines, pipes, filters, valves, faucets, water heaters, humidifiers, etc. Total dissolved solids produce a solid film on glasses and dishes in the drying cycle of a dishwasher, which can result in a permanent loss of appearance. Changes in water temperature and chemistry cause some dissolved chemicals to precipitate out. Fluctuating hardness levels, changes in the Langelier Index ($CaCO_3$ stability), treatment by-products ($CaCO_3$, $Mg(OH)_2$, $Al(OH)_3$), misc. iron and silica compounds all play a part in problems that occur in distribution The cost associated

with this damage is difficult to determine for each option, but a very approximate estimate is calculated in Appendix 6 and presented in the table below.

4. Reliability of Supply – Under the lake water option, the Village would not have a lake water source independent of McCook, because both of our emergency connections, i.e., LaGrange and Indian Head Park, also receive water from McCook. Even though McCook is a highly reliable supplier of water, Well #3 would need to be kept in stand-by service to provide the reliability of a second independent source of water. In the case of aquifer water, reliability is currently satisfied by the connections to the LaGrange and Highlands Water District and stand-by Well#1. When Well#5 is brought into production, it will have emergency power that will satisfy the reliability requirements. The lake water option has a quantifiable cost "penalty" of maintaining Well#3, which is estimated in Appendix 6 and given in the table below.

5. Sale of Surplus Property – With the lake option the treatment plant, with the exception of the 500,000 gallon reservoir, would become surplus and assumed to be sold. The lime-softening option would not result in any sale of surplus space at the treatment plant. The RO option with the plant located in the existing treatment plant would allow the sale of the building space except for the clarifier, the HLPs, emergency power connections, Cl injection system and the reservoir, while the RO option with a new plant in the public works area would result in the treatment plant become surplus with the possible exception of the reservoir. Appendix 6 contains the estimated sale price, demolition cost and building space rates, which are used to calculate the benefits that appear in the table below.

6. Timing of the Capital Improvements – In the lake water option all capital expenditures need to be made at the beginning of the project mostly for the main from McCook to the standpipe. In both aquifer options the capital expenditure for Well#5 may be delayed years after the expenditures for a new or renovated treatment process. The benefit from the time delay in committing the construction cost for the aquifer option is calculated in Appendix 6 and shown in the table below.

(Bill, To be consistent Item #6 should apply only if the costs of the optional capital expenditures are included in the water costs ($/Kgal) for the aquifer options. I don't think they are for the RO option and don't know whether they are for the lime option. I have amended above Item #5 to take into account locating the RO plant in the public works area. The same comment applied to Item #5 for the RO plant in the public works area.)

Table IV. Benefits or Penalties of the Three Options

	Lake	Lime	RO
System Capacity		+1	+1
Water Restrictions	-2		
Impact of Hardness		-2	
Reliability of Supply	-1		
Surplus Property	+1		+1
Timing of Costs		+4 (?)	+3 (?)

Table V. Impacts on Price per 1,000 Gallons

	Lake	Lime	RO
System Capacity		**Small Pos.**	**Small Pos.**
Water Restrictions	**Medium Neg.**		
Impact of Hardness		**Large Neg.**	
Reliability of Supply	**Small Neg.**		
Surplus Property	**Small Pos.**		**Small Pos.**
Timing of Costs		**Medium Pos. (?)**	**Medium Pos.(?)**

Price Impact per 1,000 Gallons
Large: $0.25 - $1.00 **Medium: $0.10 - $0.25** **Small: $0.01 – $0.10**

Chapter 6: Intangible Issues in the Choice of the Water Option

Some factors that may influence the decision between lake and aquifer water cannot be quantified into a cost or benefit in terms of $/1000 gallons. In some cases there is no quantitative measure, such as taste of one source versus another; and in others there is no information to make a judgment, such as the amount of water available from a source in the future. In this chapter, these issues will be presented to be sure that the reader is aware of them and may (or may not) include them in his/her evaluation of the options.

1. Taste and Odor of Lake and Aquifer Water – Residents in Western Springs have many occasions to drink lake water, when they visit almost any of the municipalities in the Chicago area. Most of those who have been asked do not mention a significant difference between lake and aquifer water. A few do express a preference for one or the other, and some of those have a strong dislike of the other source. Chemical analyses have shown that aquifer water has more dissolved salts (minerals) in it than lake water, but lake water has more issues with algal (MIB and Geosmin) and bacterial activity., Both meet the EPA health requirements.

2. Control over the Supply and Cost of Water – Purchasing lake water from a supplier on a stated price schedule and stated quantity is done under a long term, renewable contract. The basic quantity is determined by DNR, which is part of an international (Canada) government bureaucracy. The price is negotiated when a contract is signed or renewed. There is some recourse to increases in prices, but the supplier can pass along justifiable costs. The purchaser would probably be faced with a large capital expense to connect to another supplier, if he did not renew the contract with the current supplier. The experience of most purchasers of lake water has been good, but there are exceptions. The supplier of aquifer water is the municipality itself, so there is no price negotiation or connection to another supplier. Of course, that does not mean that prices will not increase, nor that there will always be an adequate supply in the aquifer.

3. Long Term Availability of Water Source – The answer to this issue is beyond current knowledge, but a few facts should be mentioned about the lake and aquifer sources. It is very difficult to imagine the Great Lakes running dry, but its waters are being rationed (or allocated) now, and new communities (e.g., west of the Fox River) are looking to the lake for their water. If Western Springs were to receive an allocation, it would keep it forever but the amount could change. The history of aquifers (broadly known as ground water) shows that the shallow wells were first used. As the population using these wells grew substantially, new wells were then drilled to the deep aquifers. Over time, the water level in the Chicago area wells dropped and as lake water became available most villages switched their source. Western Springs did not, and the level of water in our wells has risen. Presently the water levels in the deep wells of towns west of the Fox River have dropped, as the general population has grown in those areas. At this time, no one knows for sure how the use of the deep aquifers west of the Fox River will impact the deep wells in Western Springs. It is possible that, at some point, restrictions on water from the deep aquifers will be imposed just as there is not with lake water.

4. Ability to Respond to External Changes – The basic issue here is whether a small town like Western Springs would be better off in a large group of lake water users or in the small group of aquifer users in this area. As an arbitrary example, assume that US government wanted to mandate a big change in water regulation. IDNR and the State of Illinois have financial and political resources to resist any negative impact on users in the Chicago area, but Western Springs and the few other towns using aquifers do not. Currently there are no such issues, so the matter is hypothetical but for how long?

5. Future EPA Regulations – New EPA and other regulations can have a major impact on water production system, as witnessed by those that had to reduce the amount of radium when the EPA began enforcing the allowable amount of radium. Hundreds of communities had to purchase and install new treatment equipment to meet this requirement. To our knowledge the EPA is not now planning any major change in the drinking water regulations that would impact the lake and aquifer choice, but changes cannot be predicted 20 years ahead. Changes in regulations general affect either surface (i.e., lake) or ground (i.e., aquifer) water, but not both. One area of possible future regulation of surface water is that of organic compounds, which may be part of the runoff from industrial plants or farms. Another is mercury in the atmosphere that comes to the ground in rain. Changes in ground water may be in the area of metals, such as zinc, aluminum, or sodium, for which the EPA now has advisory (non-mandatory) guidelines. Changes in allowable concentrations of discharge streams would impact the aquifer options, most likely in terms of costs. Since future changes in the EPA regulations are not known, these issues are presented as intangible ones.

6. Number of Suppliers – In one way a large number of suppliers is good for the customer because it encourages competition. For lake water there is only one ultimate source, but there are many local suppliers available to the Village. For aquifer water systems there are several suppliers of treatment equipment and several firms that drill wells, although one is dominant in our area. Both options require significant amounts of electricity and a modest amount of labor. Based on this information the impact of changes in operating and maintenance costs would not differ greatly between the options with the possible exception of the waste discharge costs of the lime softening process. MWRD now takes the waste at a significant cost to the Village, and alternate disposal means are not now attractive.

   In different way, a large number of members in the supply chain of lake water is not good, because the costs and performance of each would be passed along to us with little or no choice of alternate suppliers.

7. Reliability of Electrical Power - Aquifer options already have an emergency power for Well#3 to supply water to distribution. The suppliers of lake water also have emergency power for pumping, but any cost of increasing the reliability of electric power of the suppliers would be passed on to the communities that buy the water from them. However, no plans are known at this time to increase the reliability of their systems, so the possibility of increased cost of lake water is an intangible issue.

9 8. Impact ofPhysical Differences in Lake and RO-treated (new plant) Water compared to Lime-treated Water. Under the lake and RO (new plant) options water would enter the distribution system at a different location from the current one, which may result in changes in water pressure, flow rates and flow directions throughout the distribution system. The changes in pressures and flow rates in the system could result in main breaks, and the changes in flow direction could negatively impact the water quality over a period of time. another difference with lake and RO-treated water that may impact the distribution systems is. chemistry.. The differences in chemistry of these waters may result in dissolving some of the “protective” coating on the pipes and joints that has built up over many years and in corroding of the metal in the pipes themselves, which may introduce metals in the drinking water and/or result in breaks in the pipes. A few examples of problems with the distribution system caused by changing to lake water in the 1980s were recalled, but our consultants did not find any recent reports of main breaks, corrosion, etc. after switching from aquifer to lake water. Since distribution systems are not identical with respect to the factors that may result in problems with the introduction of lake and RO-treated water, no certainty exists whether there would be problems or not, and thus quantifying penalties are not attempted in this study. An impact just in the case of lake water results from its temperature varying from summer to winter, while aquifer water has a constant temperature. With lake water the pipes of distribution system would expand and contract during the year, which may result in breaks due to cyclic stresses. As in the case of chemistry difference, undocumented reports from the 1980’s attributed main breaks to the swings in water temperature after a switch to lake water was made, but more recent experiences have not supported this hypothesis Transition from the Current to the Selected Option for the WPS - During the transition from the current system of lime treatment of aquifer water to the selected option, the Village must continue to supply its customers daily with potable water reliably and free from significant temporary expenses. The conversion from the old WPS to the new one should appear seamless as possible to the users, even to the extent of blending the water from the old and the new system over a period of time to avoid any sudden changes in taste to the users and unexpected impacts on the distribution system. Consideration of the transitional period was brought to mind by the description of actual problems that occurred when a new municipal WPS replaced an old one. The old had been decommissioned, but the new one did not operated properly, so the town had to buy water on a temporary and expensive basis, while the problems with the new plant were solved. This situation caused undue expenses to the users, cast suspicion on the water from the new plant and gave the town a “black eye” from its mismanagement.

The lake water option seems unlikely to have problems during the transition because it would be built and tested before the current plant is decommissioned. It also may be possible to operate both systems for a short time to allow the residents and water system to adjust to the “new: water. The same evaluation is made for an entirely new RO plant that would be built and tested while the current one was still operating. Since both plants would be entirely under the control of the Village, the introduction of the ROI-treated water could be scheduled without outside approvals.

Placing the RO units in the existing WTP would necessitate removing some water treatment equipment, so a transitional period would exist in which the water would not be fully treated, although it would always meet the health standards. The same situation would occur in the case of the lime option, where treatment equipment would be removed and replace during the rehabilitation of the plant. Again the finished water would not be as fully treated as before, but would always meet the health standards. These types of transition have been successfully accomplished, but good planning is required. There is, however, an unknown possibility of unexpected problems that would force the Village temporarily to purchase replacement water.

In a relative assessment, the lake and entirely new RO plant options have better change of a good transition from the current to their implementation than the lime option or the RO units in the old plant. This possibility of a good transition has not been quantified, however, so the issue of transitional operation is placed in the intangible category.

Chapter 7: Schedules for Aquifer and Lake Water Systems

Reverse Osmosis

This option could have the shortest timeline for implementation. The first step would be to solicit proposals from design engineering firms and then award and design the new system. It is anticipated that could take approximately 6 months. since the Village has already conducted a pilot study, the results of that could be used to fast track the new design. Implementation would vary depending on whether a new plant were constructed, or if the exiting plant were retrofitted. Should the design be for a completely new plant, construction could occur at any time since the existing plant would stay in operation. The total design and installation time would be approximately two years. If a decision were made within the next few months, the new system could be operational by the spring of 2010.

If the existing plat were retrofitted, implementation would ideally occur in the slower fall and winter months and are anticipated at another year. The phasing would include replacing the existing transformers. The plant would then be set to run just on the spiractor. The RO installation process would require the demolition of the accelator and east filters. The new equipment would be located in this location. The internal piping of the plant would be modified to accommodate the new flows directly to the RO skids.

Lime Treatment

This option has been more extensively engineered than the others. Assuming the Village retains the existing consultant, this package could be assembled and out to bid in relatively short order, approximately 3 months. Should the Village choose to seek competitive proposals for consulting services, the process would likely be extended another 3 to 6 months.

Due to the complexity of this project and the required sequencing of the plant, the installation process could extend over one year. The first phase would be to replace the transformers and then install the new accelator. Subsequent projects would include the replacement of the lime and alum systems and the eventual construction of a sludge de-watering building. The final phase of the project would be the drilling of a third deep well and the construction of a remote treatment facility.

Lake Water

The lake water option would potentially have the longest time line because of the intergovernmental and permitting processes. The first phase would be negotiations with LaGrange Highlands and Indian Head Park to form an intergovernmental agreement for cost sharing. The second phase would be for Western Springs to apply for a new lake water allocation. It is anticipated that this would take 9 months to a year. This item could run concurrently with the intergovernmental negotiations.

Once the above items were complete, designs for the transmission main could be prepared and bid. It is anticipated this process could take 3-6 months. Once bids were prepared, easement agreements would need to be secured for the placement of the new main. It is anticipated that the main would run in State ROW. This process could take 6-9 months. The project would then be ready to be bid and constructed. In all, it is anticipated the total time from the

Village's selection of lake water as the new source for Western Springs to the actual receipt of water into the Village's system would take approximately 3 years.

Chapter 8: Financials

None of the three options presented can be implemented without issuing bonds. The current water/sewer financial reserves do not contain enough resources to pay for any of the discussed options outright.

Using debt (generally a General Obligation Alternate Revenue Source instrument) to finance projects instead of banking annual surpluses allows the Village to complete the project on a timely basis and structure the repayment over a 20 year period. A longer maturity schedule also assists in establishing a manageable annual payment amount without encumbering the resident with significant increases. The use of General Obligation Alternate Revenue Source Bond, while marketable, does require the Village to maintain 125% bond coverage.

Ideally, the Village would still pursue a low interest loan from the IEPA. This process is still considered debt issuance, but is more like a 20 year mortgage than the issuance of bonds. Although the Village was unsuccessful in its first attempt at a water loan through the IEPA, the Village did successfully secure an IEPA loan for sewer work in 2003. It is believed that the same formula can be followed to secure a new loan for the water production system.

It is unlikely the Village would ever secure an IEPA loan based upon need. Therefore, the Village would need to seek funds through the loan bypass system. This system is the same as the formal loan process except that bypass loans are only granted after compliance projects are funded. The IEPA has indicated that there is always sufficient bypass funding for several projects.

IEPA loans are generally funded over 15 to 20 years. The rates do not fluctuate daily like conventional mortgages, but are set annually by the IEPA. Yet, once a loan is secured, that rate is set for the life of the loan. In 2007 the loan rate was 2.5%. That rate was used in all of the financial calculations.

Historically, water demand has consistently, centered around 390,000 thousand gallons annually. Using that consumption as a benchmark, and the above interest rate, the water/sewer rate would need to increase by approximately 35 cents for every $100,000 of annual debt service payment. Please note that a Lake Michigan allocation may not allow the Village to sell additional water during period of drought because of mandated restrictions. These restrictions will reduce the Village’s ability to capture the needed revenue. Additionally, the Village does not sell all of the water that flows through the distribution system due to leakage in pipe joints and valves, main breaks, malfunctioning water meters (that read inaccurately), main breaks, and other municipal usage.

Chapter 9: Review by the Infrastructure Commission

The Water Study Report was reviewed by the Infrastructure Commission on multiple occasions. Several of the Commission's comments and recommendation were included in this final Water Study Report.

The Commission has not seen a copy of the final report for review and further recommendations.

Chapter 10: Recommendations by the Public Works and Water Committee

The Public Works and Water Committee (PW&WC) will make recommendations to the Board actions for completing the Water Study Report and producing the final report by August, 2007. At its April meeting the PW&WC recommended that the Village Board request bids for a pilot plant study of a RO treatment of Well#3 and Well#4 water. The purpose of the study is to confirm the technical feasibility of using RO process for treating our deep aquifers water and to obtain operating data for the design of the full scale plant. If the results of the study support the preliminary information the Village has on the RO process, the next step would be for WSG to incorporate the results into the WSR and for the PW&WC to review and present it to the Village Board for a decision on the water source and treatment..If the test results do not support the preliminary findings, the PW&WC will consider the next course of action to complete the WSR.

At almost all of its meetings since the inception of the WSG in October, 2005, the Public Works & Water Committee (PW&WC) has received and discussed reports on the water study. The PW&WC recommended to the Board awarding contracts to the consultants for studying the three options for the water source and treatment. On one occasion the kick-off meeting for the RO pilot plant tests was held at part of a PW&WC meeting. The Committee reviewed the draft WSR in April, 2007 and recommended its release to the Infrastructure Commission (IC) and, in turn, to the Board. The PW&WC also reviewed the final draft of the WSR in March, 2008 and recommended that it be presented to IC and the Board. At that time the PW&WC chose not to make a recommendation with respect to the choice of water source and treatment. As stated in the Introduction of this report, the intent of the WSG is to present the Board information on the three options and to await its decision on whether it wishes to receive a recommendation on the water source and treatment option.