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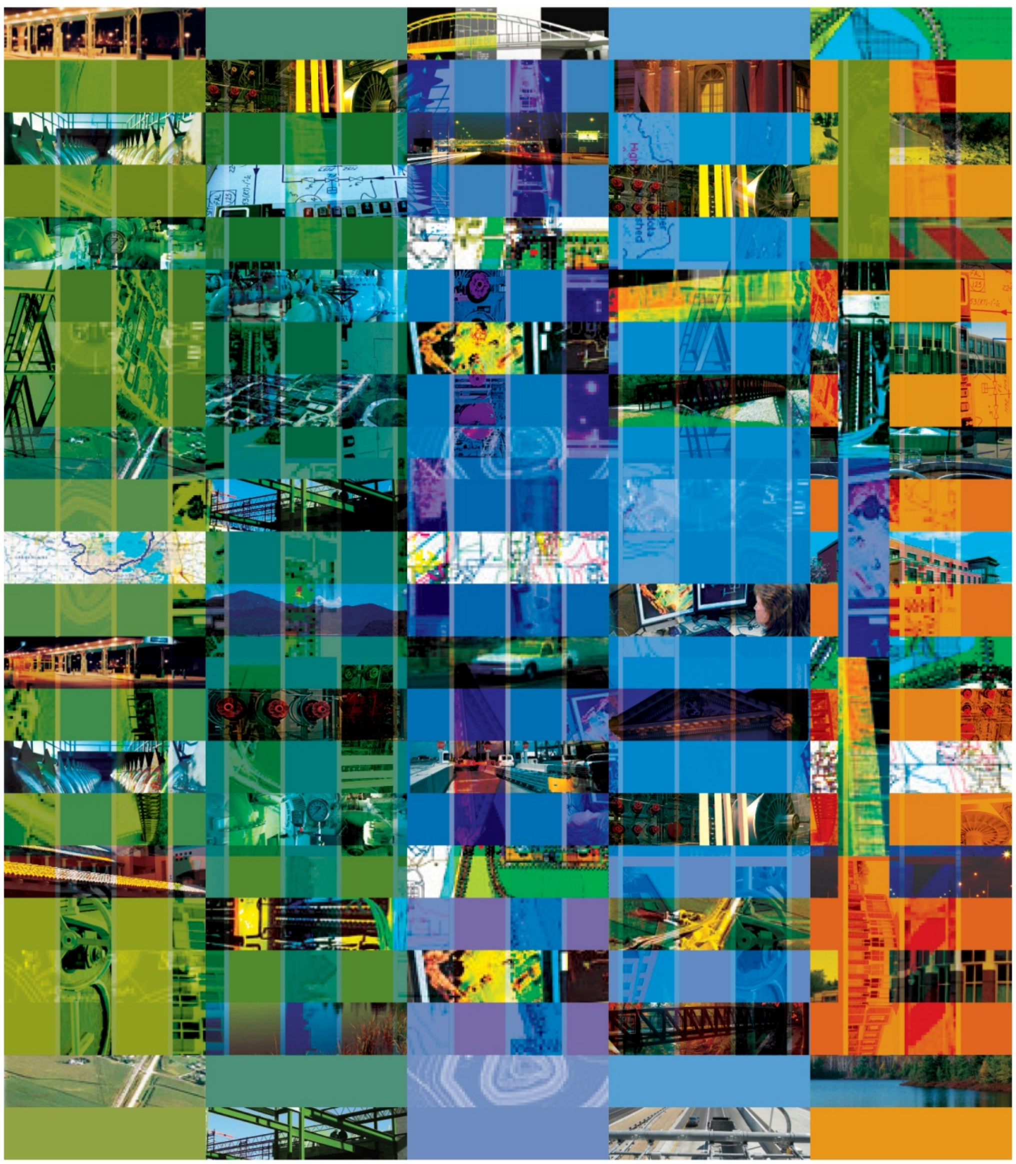
Water Model Calibration and Alternative Water Supply Evaluation



Report

Village of

Channahon, IL

May 2021

STRAND ASSOCIATES®

STRAND ASSOCIATES®
Strand Associates, Inc.®
1170 South Houbolt Road
Joliet, IL 60431
(P) 815.744.4200

May 21, 2021

Mr. Ed Dolezal, Director of Public Works
Village of Channahon
24555 South Navajo Drive
Channahon, IL 60410

Re: Water Model Calibration and Alternative Water Supply Evaluation
Village of Channahon, Illinois

Dear Ed,

Enclosed are two copies of the final Water Model Calibration and Alternative Water Supply Evaluation.

Please call 815-744-4200 with questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Chris J. Ulm, P.E.

Enclosure: Report

c/enc: Jeff Barrett, Streets and Utilities Superintendent, Village of Channahon

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Report for

Village of Channahon, Illinois

Water Model Calibration and Alternative Water Supply Evaluation

LICENSED PROFESSIONAL ENGINEER
CHRIS J. ULM
062-053675
STATE OF ILLINOIS

MAY 21, 2021
exp 11/21

Prepared by:

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Joliet, IL 60431
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May 2021

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TABLE OF CONTENTS

Page No.
or Following

TABLES

TABLE OF CONTENTS Continued

Page No.
or Following

FIGURES

SECTION 1
INTRODUCTION

1.01 PURPOSE AND SCOPE

The purpose of this study and report is to calibrate the Village of Channahon, Illinois' (Village) water model created in 2019 and to evaluate two alternative sources of water supply for the Village. The new model will be operated to observe current system conditions.

Additionally, as part of this study, the feasibility of two alternative sources of water supply, the City of Joliet (Joliet) and the Illinois River, are evaluated. Past water utility records, presently known conditions, and projected future growth and development patterns were used to establish projected water demand patterns at full build-out of the Village.

As part of the overall water system evaluation, a computer model of the distribution system was developed and is available for future distribution system evaluation. This report and the associated computer model should be periodically reviewed and updated to reflect changes in the Village's water system.

The study area includes portions of the Village presently supplied by Channahon Water Utility, areas presently supplied by Joliet, areas currently within the Village's boundaries but supplied by private wells, as well as future areas that may require service in accordance to projected future development. This area is further defined and discussed in Section 4.

The scope of the study includes the following specific items:

1. Water Model Calibration

    a. Conduct an initial project meeting in person with the Village to gather data and to review scope and schedule.

    b. Allocate demands in the Village's existing water model using Village-provided 2019 metered sales information, separated by meter physical address.

    c. Incorporate Village-provided supervisory control and data acquisition (SCADA) control set points into the existing water model.

    d. Collect flow and pressure readings during Village-conducted fire flow testing for up to ten locations.

    e. Perform a steady-state calibration of the water model using Village's field fire flow testing results and Village-provided SCADA system information, including booster and well pump flows and storage facility water levels during testing.

    f. Review the existing water system performance using the steady-state calibrated water model for current maximum-day demands. Develop pressure and available fire flow contour maps from steady-state simulations.

g. Prepare a draft report section summarizing the model creation, calibration, and current day analysis and submit to Village for review. Attend one meeting in person with the Village to review the draft report section and collect comments.

2. Alternative Water Supply Evaluation

a. Analyze historical population and water usage trends and estimate future demands based on information supplied by Village, including anticipated timing of anticipated developments, anticipated land use, and population forecasts.

b. Perform a water supply and storage capacity analysis to review the ability of the existing system to provide the water demand estimates for each pressure zone.

c. Discuss the alternative option of Joliet as the water supply source. Perform an analysis using the water model for potential system improvements that may be needed to distribute the water supply with supply connections at McLindon Road and United States (US) Route 6 and Patricia Lane and US Route 6. Perform an analysis using Joliet water model for the potential improvements needed to its potential regional distribution system that provides capacity for Village’s supply from Joliet’s Proposed Regional Delivery Point at Fairmont Avenue and Garvin Street in Joliet. Discuss potential improvements for minimum water storage and redundant supply standards. Prepare opinion of probable cost (OPC) for the potential improvements based on modeling results.

d. Discuss the alternative option of the treatment of the Illinois River as a water supply source. Use publicly available Illinois River water quality data to develop a conceptual treatment process that treats the water to current drinking water standards. Develop a conceptual plan and facility sizing for the intake and treatment plant, located near Tabler Road and US Route 6. Perform an analysis using the water model to simulate the potential system improvements needed to distribute the treated water supply. Communicate with Illinois State Water Survey (ISWS) to collect its input on the low flow withdrawal rates. Discuss potential improvements for minimum water storage and redundant supply standards. Prepare OPC for the potential improvements based on modeling results.

e. Develop possible water rate calculations for the two water supply alternatives. Break down Village rate structure into production and distribution. Water rate to purchase water from Joliet at the Regional Delivery Point shall be provided by the Village.

f. Prepare final report summarizing alternative evaluation.

1.02 ABBREVIATIONS AND DEFINITIONS

CDWM	Chicago Department of Water Management
Chicago	City of Chicago
Compact	Great Lakes–St. Lawrence River Basin Water Resources Compact
GIS	geographic information system
gpcd	gallons per capita per day
gpm	gallons per minute
HMO	hydrous manganese oxide
hp	horsepower
I-55	Interstate 55
I&M	Illinois and Michigan
ISWS	Illinois State Water Survey
IEPA	Illinois Environmental Protection Agency
Joliet	City of Joliet
MSL	mean sea level
MG	million gallon
MGD	million gallons per day
O&M	operation and maintenance
OPC	opinion of probable cost
PE	population equivalent
psi	pounds per square inch
SCADA	supervisory control and data acquisition
Strand	Strand Associates, Inc.®
TDH	total dynamic head
US Route 6	United States Route 6
WTP	water treatment plant
WWTP	wastewater treatment plant
Village	Village of Channahon

SECTION 2
EXISTING WATER SYSTEM SUMMARY

2.01 GENERAL DISTRIBUTION SYSTEM OVERVIEW

The Village's water distribution system serves approximately 7,496 people through 3,076 connections in the Village-supplied system and approximately 630 people through approximately 265 connections with the Joliet-supplied system. The system consists of five wells, two water treatment plants (WTP), and three elevated storage tanks. The East System is supplied by Joliet through a single connection. The Village's three pressure zones are the West, East, and Central Pressure Systems. Figure 2.01-1 shows the Village's existing water system.

2.02 WELL SUPPLY AND TREATMENT

A. West Pressure System

1. Well House No. 4

Well House No. 4

Well No. 4 is located at 26754 McKinley Woods Road, just south of US Route 6 on the west side of McKinley Woods Road. Constructed in 1993 and upgraded in 2002 to increase its capacity, the well is rated for 1,000 gallons per minute (gpm) at 900 feet total dynamic head (TDH).

Well No. 4 is located outside of its well house in a pitless adapter. The well has a 22-inch outer casing from ground level down to a depth of 190 feet. The well also has a 16-inch inner casing from ground level down to a depth of 1,462 feet. The resulting annular space is grouted with cement grout. A 15-inch bore hole extends from the bottom of the 16-inch casing to an approximate depth of 1,674 feet.

This well is pumped with a Byron-Jackson 12MQH pump with a 300 horsepower (hp) motor. The water produced by this well contains excess levels of radium compared to the Illinois Environmental Protection Agency (IEPA)-mandated radium levels. The water pumped from this well is piped 3,500 feet north along McKinley Woods Road to WTP No. 1, located at 26223 McKinley Woods Road. The WTP treats the high radium water using pressure aeration and hydrous manganese oxide (HMO) addition followed by iron and manganese filtration for iron and radium reduction. The water is then treated with chlorine gas before entering the distribution system.

2. Well No. 6

Well House No. 6 is located at 26223 McKinley Woods Road, south of US Route 6 and just north of the Commonwealth Edison power line crossing. This site also contains WTPs Nos. 1, 2, and Tower 2, a 250,000-gallon elevated storage tank. Constructed in 2006, Well No. 6 is rated for 1,000 gpm at 787 feet TDH.

Tower 2

The well is constructed with 24-inch casing from ground level down to 137 feet below the surface. There is an 18-inch casing from ground level down to 1,534 feet. The resulting annular space is filled with cement grout. There is a 17-inch bore hole from 1,532 feet down to 1,625 feet.

The well is pumped with the same motor as used in Well No. 4, a Byron-Jackson 12MQH with a 300 hp motor. Once pumped, the well supply is treated on-site at WTP No.2. Elevated levels of radium and iron are removed through pressure aeration, HMO addition, and filtration. The water is disinfected with chlorine gas and sent to the distribution system. In the event of a power failure, WTP No. 2 is equipped with a backup natural gas generator that is capable of supplying power to Well No. 6 and WTPs Nos. 1 and 2.

B. Central System

Well Nos. 2, 3, and 5 are all located at 25662 Majestic Drive and operate together to provide water to the Central System. They are described as follows:

1. Well No. 2

Well House No. 2 is located north of the intersection of Majestic Drive and North Crest Drive. The well house contains Well No. 2, as well as the discharge piping and controls for Well Nos. 2, 3, and 5.

Well No. 2 was constructed in 1990 and is rated for 200 gpm at 136 feet TDH. However, as indicated by the Village staff, pumping more than 95 gpm during dry periods can cause drawdowns to extend to the pump. Because of this, Village staff limits the flow to 95 gpm.

The well has an 8-inch-diameter casing from the surface to a depth of 45 feet and an 8-inch screen from the casing down to 55 feet. It is pumped by a Johnson five-stage vertical turbine, Model 8 AC pump.

2. Well No. 3

Also located at the Majestic Drive site, Well No. 3 was constructed in 1993. The well has an 18-inch casing from 7 feet below ground level to a depth of 498 feet. The well also has a 12-inch casing extending from 7 feet below ground level to 498 feet. The resulting annular space is filled with cement grout. A 12-inch bore hole extends from the bottom of the 12-inch casing down to 895 feet.

Well No. 3 was rehabilitated in 2005. It is now fitted with a Byron-Jackson Model 10WALC pump with a 75 hp motor. The pump is rated for 320 gpm at 658 feet TDH. The water produced by the well has radium levels exceeding IEPA limits. In order to reduce the level of combined radium in the finished water, Well No. 3 production is limited and mixed with the water from shallow wells Nos. 2 and 5 in an effort to produce a finished water with an acceptable level of combined radium.

3. Well No. 5

Well No. 5 was constructed in 2005 at the southwest corner of the Majestic Drive site. The well has a 12-inch casing from grade level down to 40 feet. The well has a 12-inch screen from 40 to 54 feet. The well is driven by a Christensen Model 7WAHC pump with a 20 hp motor. The pump is rated for 250 gpm at 180 feet TDH. However, flows from the pump are restricted due to increased drawdowns in dry periods and flow must be restricted to maintain water levels above 40 feet, the top depth of the bowls.

4. Booster Station

A belowgrade booster station along Bridge Street near Parkview Lane acts as an interconnect between the Central System and West System. The station allows water to flow from the West System through a ball valve into the Central System when needed to meet water demands. The station is equipped with two Aurora 6x6x9A, Series 340/360 end suction pumps. These pumps are rated at 750 gpm with a total exterior head of 50 feet. The pumps each have a 15 hp motor. The pumps are intended to pump water from the Central System up into the West System. This booster station was originally designed with the intention of transferring water from the Central system to the West System when earlier plans were to receive finished water from Joliet for use throughout the Village. Because the direction was shifted to rely on its own water supply in 1999, the booster station is now primarily used to supply water from the West System to the Central System via the 16-inch interconnect and the ball valve.

The capacities of the major water facilities in the water system are summarized in Table 2.02-1. The Central System has a total well capacity of 395 gpm or 0.57 million gallons per day (MGD) and a firm capacity of 200 gpm or 0.29 MGD. The West System has a total well capacity of 2,000 gpm or 2.88 MGD and a firm capacity of 1,000 gpm or 1.44 MGD. The total well capacity for the combined system is 2395 gpm or 3.45 MGD and the firm well capacity of the combined system is 1,395 gpm or 2.01 MGD.

	Total Supply (gpm)	MGD
Well No. 2	95	0.14
Well No. 3	195	0.28
Well No. 5	105	0.15
Total	395	0.57
Firm Capacity*	200	0.29
Well No. 4	1,000	1.44
Well No. 6	1,000	1.44
Total	2,000	2.88
Firm Capacity*	1,000	1.44
Central System	395	0.27
West System	2,000	2.88
Total	2,395	3.45
Firm Capacity*	1,395	2.01

*Firm pumped supply is calculated with the largest pump out of service.

Table 2.02-1 System Well Capacity

C. East System

The East Pressure System is supplied by Joliet's Water System from a 12-inch connection. The East Pressure System is not connected to the Central Pressure System. A future connection could be made near Youngs Road and US Route 6.

2.03 PUMPING AND STORAGE FACILITIES

A. West System

Storage for the West System consists of two elevated tanks. One tank, Tower 2, is a 250,000-gallon elevated water spheroid constructed in 1993 with an overflow elevation of 729.3 feet mean sea level (MSL). This tank is located on the same site as WTP Nos. 1 and 2 and Well No. 6.

The second of two elevated tanks in the West system is located just southwest of Ridge Road and US Route 6. This elevated tank with a spheroid shape is Tower 3 and has a capacity of 500,000 gallons. The overflow elevation is 731.5 feet MSL.

B. Central System

The system's third elevated storage tank is located in the Central Pressure zone and has a capacity of 750,000 gallons with an overflow elevation of 696.5 feet MSL. This storage tank is Tower 4.

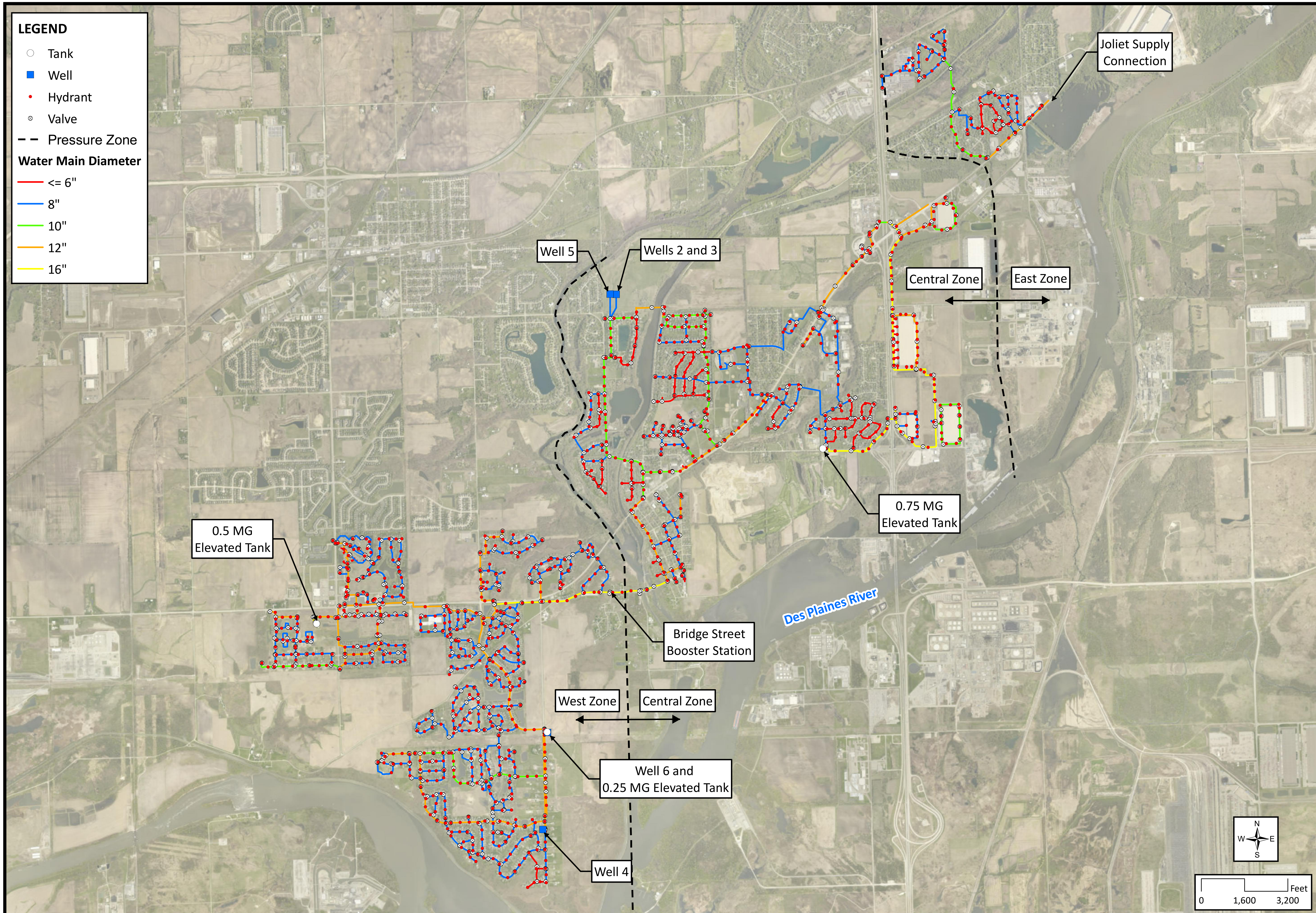
Tower 4

C. East System

The East System floats on Joliet's system with the closest storage tank being Joliet's Rock Run elevated tank with an overflow elevation of 772 feet MSL.

2.04 DISTRIBUTION SYSTEM OVERVIEW

The water distribution system consists of approximately 76 miles of ductile iron pipe ranging from 2 to 16 inches in diameter. A 16-inch pipe running along Bridge Street connects the West System and Central System. A 10- and 16-inch water main pass below Interstate 55 (I-55) to supply the industrial area east of I-55. Figure 2.01-1 shows water main diameter throughout the Village's system.



EXISTING VILLAGE WATER SYSTEM

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

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FIGURE 2.01-1
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SECTION 3
WATER SYSTEM MODEL

This report summarizes the services completed in calibrating the Village's water system model, including the analysis of the existing water system under maximum and fire flow conditions.

3.01 WATER MODEL CREATION

A computer model of the Village's water distribution system was created using WaterGEMS CONNECT software. The existing distribution system was imported into the model through the software's Model Builder tool with Geographic Information System (GIS) shapefiles provided by the Village. Attributes incorporated in these shapefiles include water main diameter, hydrant locations, and isolated valve locations. Water storage tanks, wells, and pumps were added to the model by Strand Associates, Inc.® (Strand). Tank elevations within the model were updated based on record drawings provided by the Village. Three-point pump curves were entered into the model based on manufacturer pump curves to most accurately simulate their effect on the distribution system. Strand updated the model pipe network to reflect recent water main installations within the Village. Village-provided SCADA control set points were also incorporated into the water model. Elevations were assigned to junctions based on 2-foot topographic Grundy and Will County contour maps that were imported to the model using the software's Terrain Extractor tool.

The Village provided 2019 demand data for all metered customers, which was converted to gpm. This information was geocoded into a GIS point shapefile and imported into the model using the software's LoadBuilder tool. LoadBuilder was then used to assign demands from the shapefile to the nearest water main junction in the model.

3.02 WATER MODEL CALIBRATION

The model's results were checked against observed conditions in the system in order to properly calibrate the hydraulic model and simulate the existing pipe network. These conditions were obtained through field testing of hydrants throughout the distribution system. On October 2, 2020, eight field fire flow tests were conducted. On October 29, 2020, two additional tests were conducted on Village fire hydrants that are directly supplied by Joliet. The locations of these field flow tests were chosen to provide a representative sample of the conditions in the entire distribution system.

A minimum of two hydrants were used for each field flow test: one monitoring hydrant and one flowing hydrant. Before the flowing hydrant was opened, a pressure gauge was attached to the monitoring hydrant to record the static pressure at the hydrant. This pressure gauge and the hydrant were both air purged before a static pressure reading was taken. For the two fire flow tests conducted with water supplied by Joliet, the pressure was also monitored at the Joliet-Channahon interconnect. This pressure was used to determine the hydraulic grade at the interconnect.

After recording the static pressure, the flowing hydrant was opened using one 2.5-inch outlet. A residual pressure reading was taken at the monitoring hydrant. If the pressure at the monitoring hydrant dropped more than 10 pounds per square inch (psi), the test was considered complete. If the pressure drop was less than 10 psi, an additional 2.5-inch outlet or 4.5-inch outlet was opened. A pressure reading was taken at the flowing hydrant using a pitot tube and gauge. Fire flow tests 1, 2, 5, and 6 had only one 2.5-inch outlet opened on the flowing hydrant while fire flow tests 3, 4, and 9 had two 2.5-inch outlets flowing. Fire flow tests 7, 8, and 10 had one 4.5-inch outlet open.

After completing the field flow tests, the flows from the hydrants were calculated. This calculation was done using the pitot tube and gauge reading observed from the flowing hydrant and the diameter of the open outlet. Hydrant flow was calculated using the following equation:

$$Q = (29.83)(C)(D^2)(P^{0.5}) = \text{flow in gpm}$$

C = outlet discharge coefficient (typically 0.9 for 2.5-inch-diameter outlets and 0.75 for 4.5-inch-diameter outlets)
D = diameter of the outlet in inches
P = pitot pressure in psi

Calibration of the hydraulic model was done through the modification of roughness coefficients (C-factors) in the distribution system based on conditions such as pipe size, location, age, and material. A computerized model is considered calibrated when static and residual pressures predicted by the model are within 5 psi of the observed field tests results.

During each field flow test, operating data including elevated tank levels and pump status was obtained from the Village’s SCADA system. This data was used to set the boundary conditions of the model. Static and residual scenarios were created within the model for each of the ten recorded fire flows.

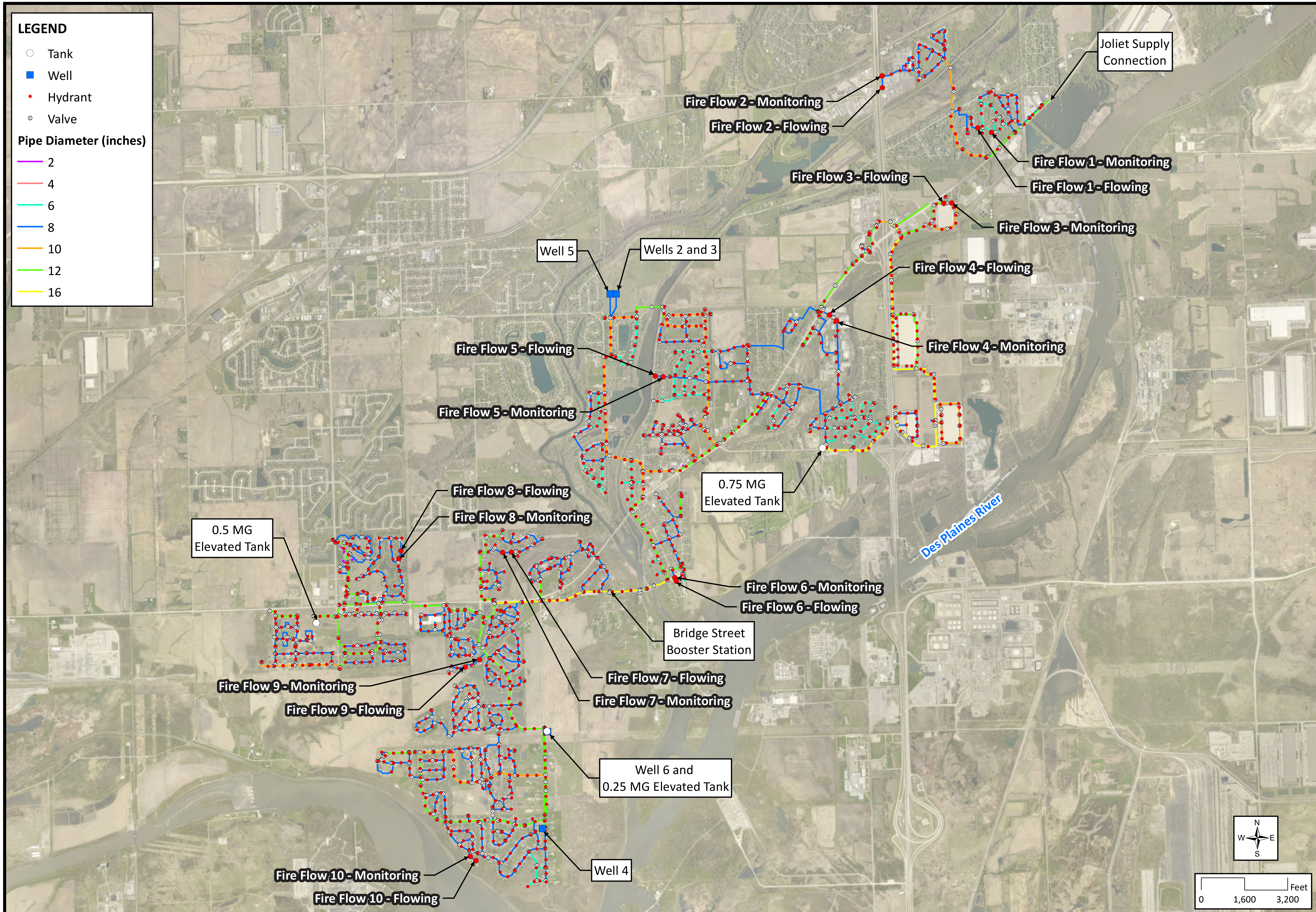
Static and residual pressure results from the model simulations are presented with the field observed pressures for comparison in Table 3.02-1. The testing locations for each field flow test are shown in Figure 3.02-1 and pipe age by decade is shown in Figure 3.02-2.

Test Number	Flowing Hydrant Location	Field Static Pressure (psi)	Modeled Static Pressure (psi)	Field Residual Pressure (psi)	Modeled Residual Pressure (psi)	Field Measured Flow (gpm)
1[1]	South Anna Drive	102	102	71	78	1,300
2[2]	Southeast Frontage Road	96	98	58	39	1,175
3	Empire Millwork Parking Lot	58	61	42	47	1,807
4	South Northern Illinois Drive	62	63	48	48	1,776
5	West Tow Path Lane	61	62	42	39	1,048
6	Fryer Street	68	68	48	43	1,007
7	West Ravine Woods Drive	54	55	33	38	1,503
8	Mallard Drive	49	50	26	31	1,755
9	West Old Stage Lane	49	49	38	41	1,300
10	River Bluff Drive	50	51	29	34	1,695

[1] Fire flow test could not be calibrated within range without decreasing C-factors to unreasonable values.
[2] Fire flow test could not be calibrated within range without altering water main connections or water main sizing.

Table 3.02-1 Model Calibration Results

To bring the differences between the modeled and field pressures into acceptable calibration levels, C-factors were adjusted within the model based on pipe size, material, and age. For this calibration, age was the primary consideration in determining C-factors, as older pipes typically deteriorate and tuberculate over time, leading to lower C-factors. Table 3.02-2 displays the C-factors assigned to water main in the model.



FIRE FLOW TEST LOCATIONS

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

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FIGURE 3.02-1
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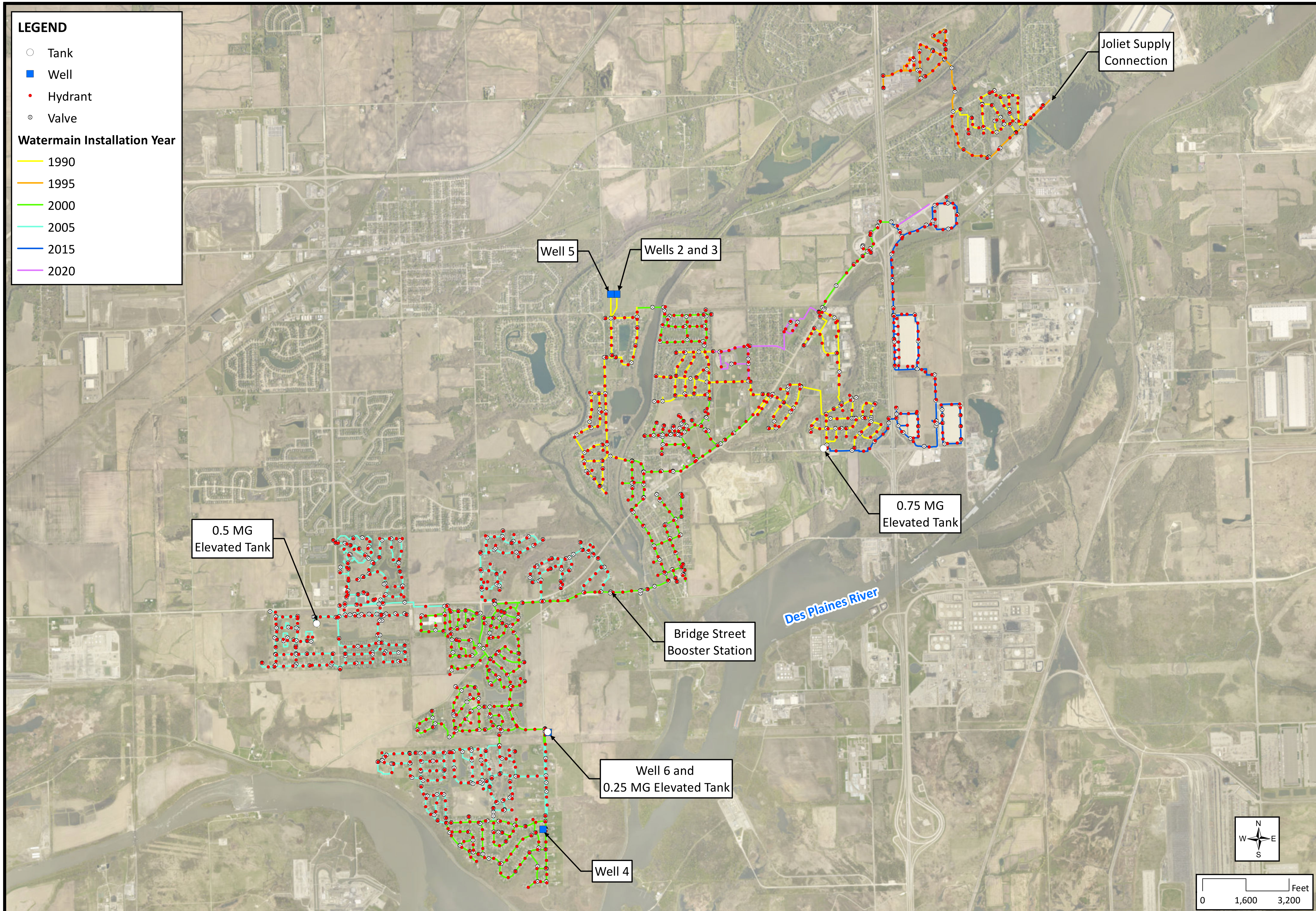

WATERMAIN INSTALLATION YEAR

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

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FIGURE 3.02-2
6437.120

Installation Year	C-Factor
1990	115
1995	115
2000	125
2005	125
2015	130
2020	140

Table 3.02-2 Water Model C-Factors

After applying the C-factors previously described, all but two model calibration tests were brought into calibration. A system pump curve was entered into the model at the Joliet-Channahon interconnect that represented the flow and head conditions monitored in the field at the interconnect when opening and closing a nearby hydrant. When comparing the pressures at the interconnect in the field during fire flows to the pressures in the model during fire flows, the system pump curve created in the model was unable to match the field head conditions. This is likely due to additional pumps turning on in the Joliet system that increased head conditions between Fire Flows 1 and 2. Table 3.02-1 shows a modeled residual pressure 7 psi higher than the field residual pressure for Fire Flow 1 from the East zone. As seen in Table 3.02-1, Fire Flow 2 had a modeled residual pressure 19 psi less than the field residual pressure. Because the field conditions are outperforming the model in the East zone north of the Illinois and Michigan (I&M) Canal, the model calibration for this region could be seen as conservative. This could be caused by an unknown pipe connection within the Village's system or a larger diameter water main being present in the water system than what is shown in GIS.

Based on the field testing and model simulations mentioned previously, the hydraulic model is considered calibrated for steady-state simulations.

3.03 EXISTING SYSTEM MODELING RESULTS

The present-day water model was analyzed under several demand and flow scenarios. Three types of steady-state simulations were performed with this model: an average day domestic demand (nonfire) simulation, a maximum day domestic demand simulation, and a fire flow simulation.

A steady-state simulation evaluates the behavior of the system at a specific point in time under static conditions. In this type of simulation, the behavior of pumps, elevated tank, and the overall supply and storage relationship can be analyzed. This type of simulation is useful for determining pressures within the distribution system and flow rates under the different demand conditions.

A fire flow simulation provides an instantaneous snapshot of the amount of water available at hydrants in the system while maintaining a minimum of 20 psi residual pressure. The model simulates a separate fire event at each fire hydrant in the system and increases the flow until either the hydrant itself or any point in the system reaches the 20-psi residual pressure threshold. Very high available fire flows (more than 4,000 gpm) are not considered realistic, but rather indicate areas of very strong hydraulic connectivity.

A. Steady State Average Day Demand

The average day domestic demand condition, equaling 477 gpm or 0.687 MGD, was modeled using a steady-state analysis with all well pumps off, Bridge Street Booster Station off, and the elevated tanks set to 10 feet below their overflow elevations. The model projected pressures in the system range from 40 to 108 psi. The lowest pressures occur within the 16-inch water main near the I-55 crossing and the 8-inch water main on Old Kerry Grove and Edinburg Court in the West Zone. The low pressure is a result of the water main being located at a relatively high elevation. The areas of high pressure occur in the East zone supplied by Joliet. Pressures within this zone range from 97 to 108 psi. These high pressures are a result of low elevations relative to Joliet's system. The maximum pressure within the Village's West and Central Zones is 85 psi, which is not considered excessive. Figure 3.03-1 displays the resulting pressure contours from this analysis.

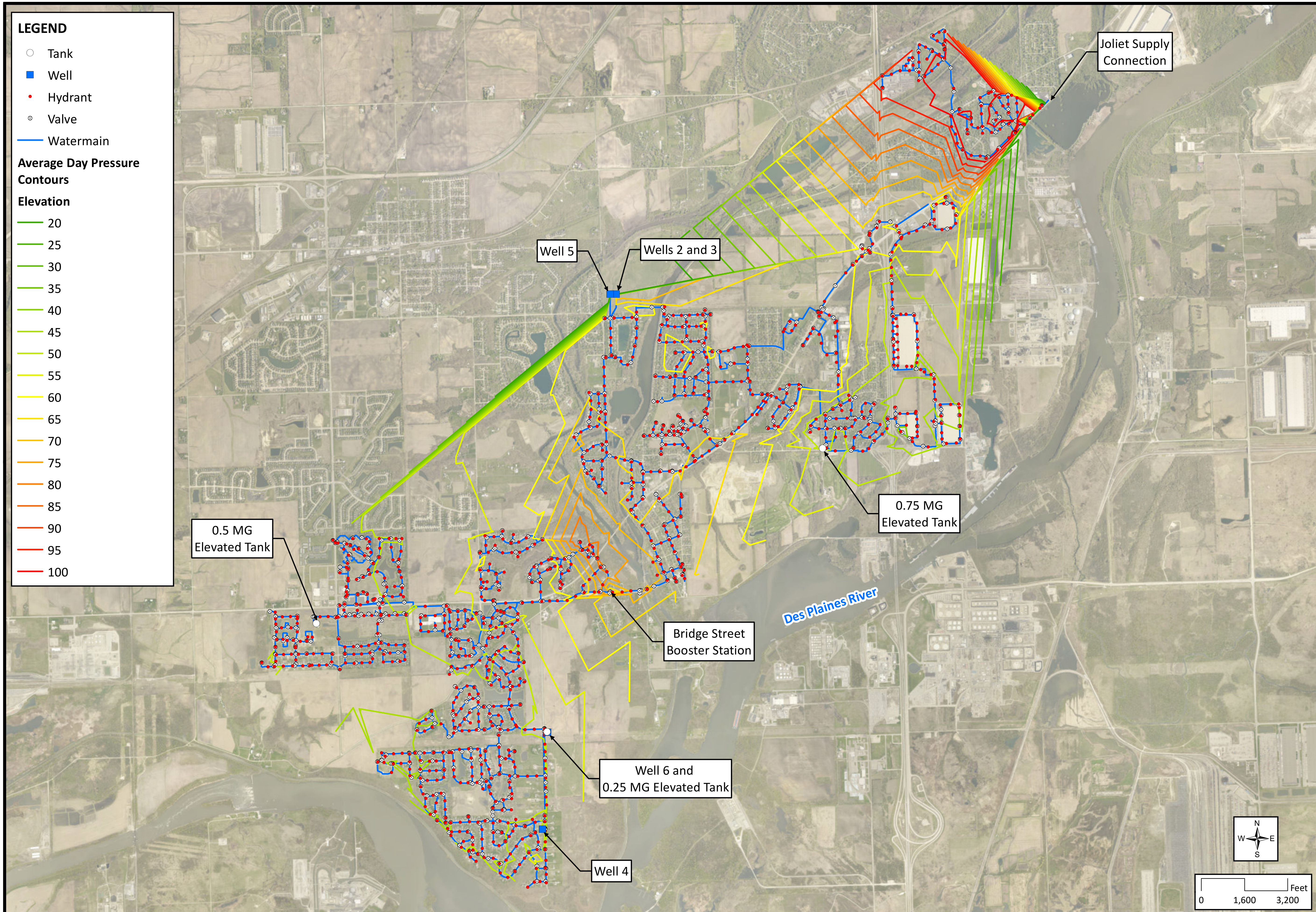
B. Steady-State Maximum Day Demand

The maximum day domestic demand condition, equaling 1,044 gpm or 1.503 MGD, was modeled using a steady-state analysis with all well pumps off, Bridge Street Booster Station off, and the elevated tanks set to 10 feet below their overflow elevations. The model projected pressures in the system still range from 40 to 108 psi. The high- and low-pressure locations are the same as the average day demand scenario. Figure 3.03-2 displays the resulting pressure contours from this analysis.

C. Steady-State Fire Flow Analysis

A steady-state fire flow analysis was completed in the model using the maximum day domestic demand condition. This modeled simulation had no wells operating, Bridge Street Booster Station off, and the elevated tanks were set to 10 feet below their overflow elevations. The model-projected available fire flow, which was based on a 20-psi residual pressure threshold, ranged from 902 to 5,000 gpm. Fire hydrants with the lowest fire flows tend to be located in the western part of the existing Central Zone. Available fire flow can be anticipated to increase when additional wells are brought into service. These fire flow values represent the amount of fire flow available at the end of the hydrant lead and do not take hydrant losses into consideration. Typically, the available fire flow will be highest near elevated storage, wells, and large-diameter transmission main in the Village. Figure 3.03-3 shows the model-generated available fire flow throughout the system.

Available fire flow at a single hydrant will be limited by the diameter of the hydrant outlet and the type of firefighting equipment used. These values should not be used as an expectation of available single hydrant fire flow if the hydrant is fully opened, as the model calculates available fire flow by forcing the minimum system residual pressure down to 20 psi.



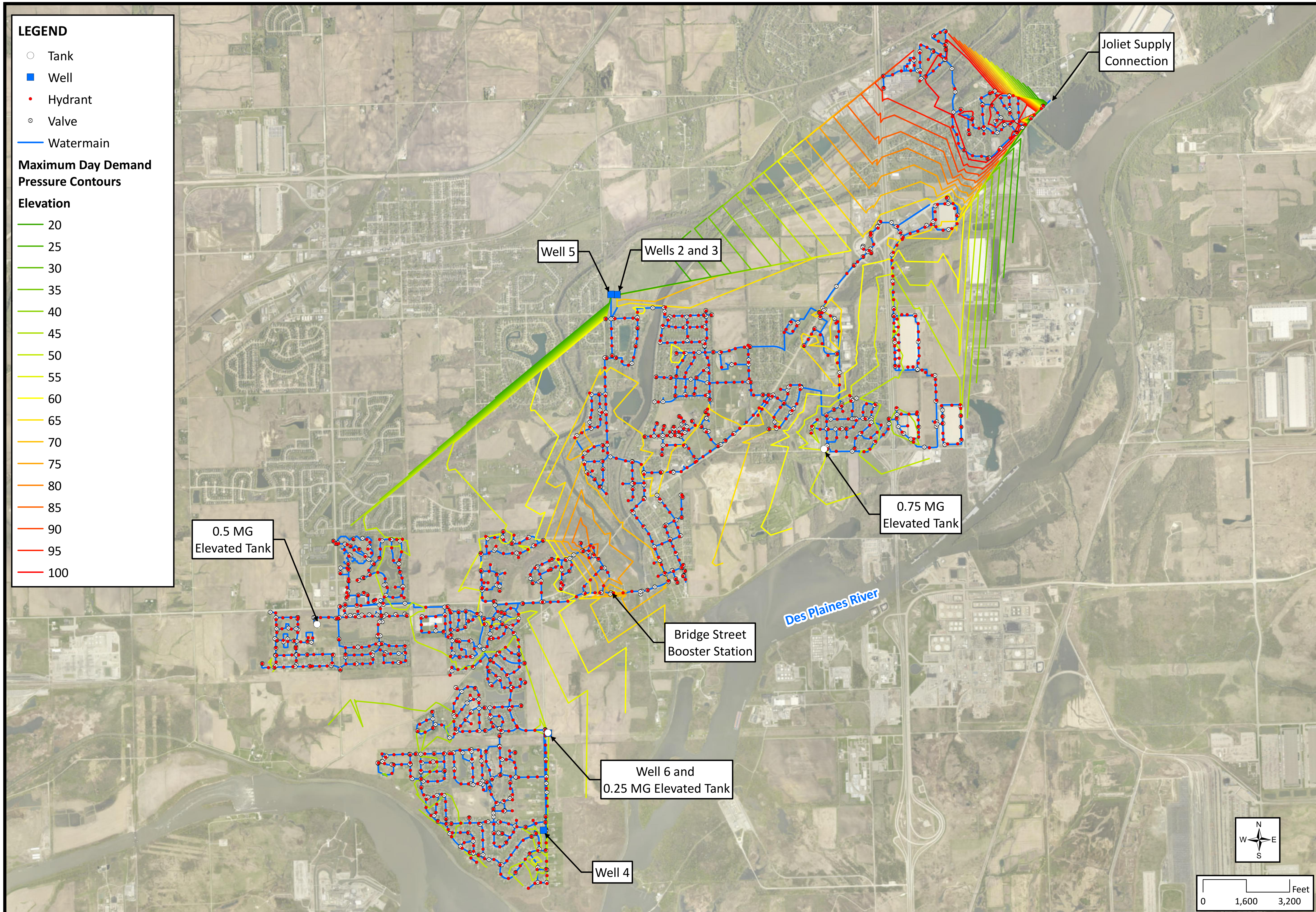
AVERAGE DAY DEMAND PRESSURE CONTOURS

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 3.03-1
6437.120

Path: \\strand.com\projects\JOL\6400--6499\6437\120\Drawings\GIS\Maps\Report Figures\Figure 3.03-1_Average Day Demand Pressure Contours_11 x 17.mxd User: KelseyG Date: 11/20/2020 Time: 3:28:35 PM



MAXIMUM DAY DEMAND PRESSURE CONTOURS

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 3.03-2
6437.120

Path: S:\JOL\6400--6499\6437\120\Drawings\GIS\Maps\Report Figures\Figure 3.03-2_Maximum Day Demand Pressure Contours_11 x 17.mxd User: Danc Date: 4/7/2021 Time: 3:52:59 PM

MAXIMUM DAY DEMAND AVAILABLE FIRE FLOW

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION

VILLAGE OF CHANNAHON

GRUNDY AND WILL COUNTY, ILLINOIS

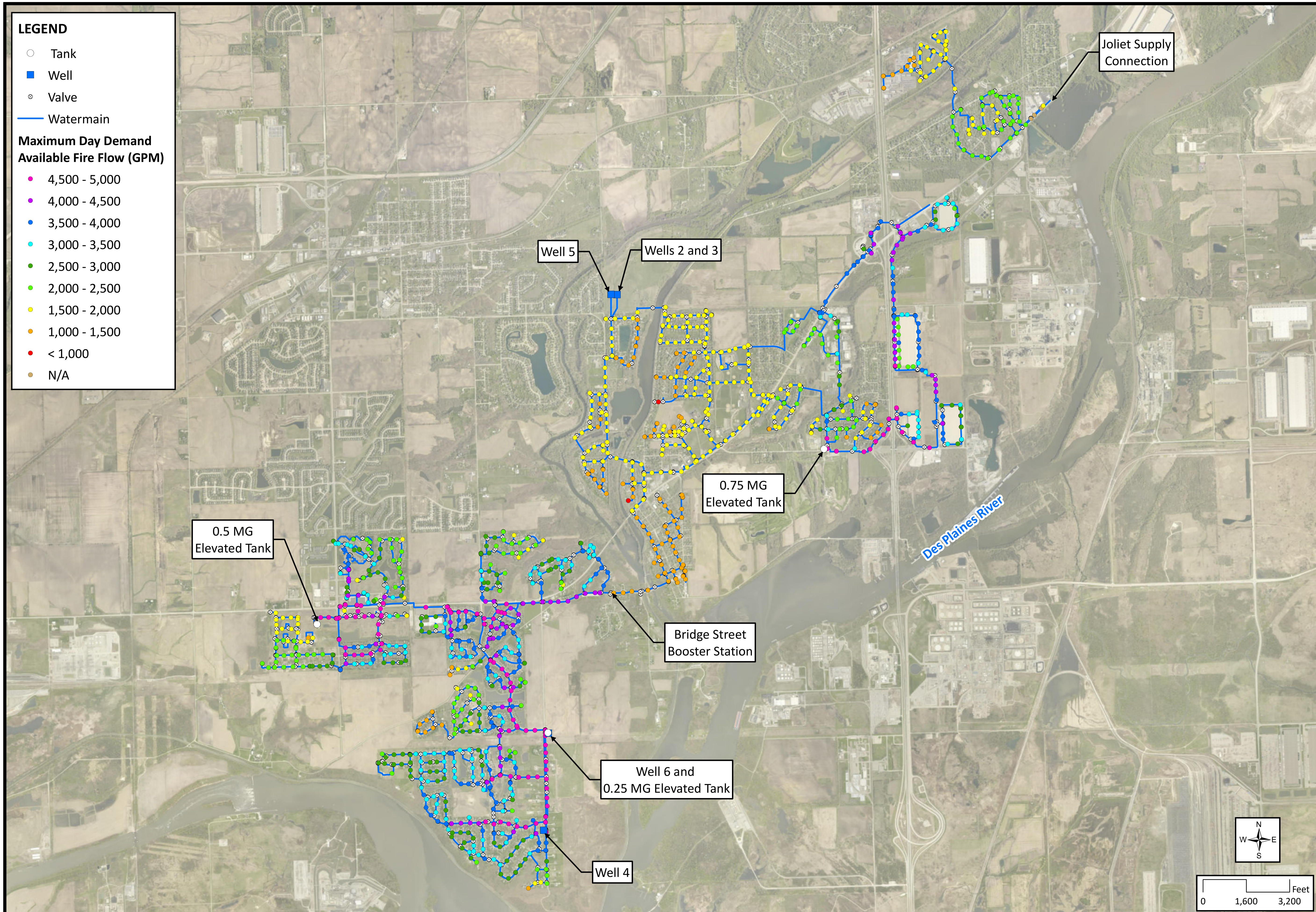


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FIGURE 3.03-3

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Path: S:\JOL\6400--6499\6437\120\Drawings\GIS\Maps\Report Figures\Figure 3.03-3_Maximum Day Demand Available Fire Flow_11 x 17.mxd User: Danc Date: 4/1/2021 Time: 8:36:37 AM

SECTION 4
HISTORICAL AND PROJECTED WATER DEMANDS

This section will investigate the historic water demand trends and develop projected demands at full build-out of the Village, based upon projected population equivalent (PE) projections. Water demands at full build-out of the Village will be based on the summation of the current demands in the water system, the addition of currently unserved areas of the existing developed areas of the Village, and the addition of water demands in undeveloped areas that will be based on population equivalents for the anticipated land usage types.

4.01 HISTORIC WATER DEMAND TRENDS

The Village's existing water distribution system is split into three pressure zones, as discussed in Section 2. The West Zone extends from McLindon Road east to the I&M Canal. The Central Zone extends from the I&M Canal east to one-half mile east of I-55. The East Zone extends from Patricia Lane east to the Village's eastern boundary. There is an anticipated future Far West Zone that extends from the Village's western boundary west to McLindon Road. This area has been previously studied and some findings from that study will be incorporated into this analysis. The West and Central Zones are served by the Village's wells and the historic data collection and analysis is combined for these zones. The East Zone is supplied by Joliet, so the data can be analyzed separately for this zone.

In 2019, the Village's wells served 3,220 service connections in the West and Central Zones and Joliet supplied water to 271 service connections in the East Zone. Using the approximation of 3.2 people or PEs per connection, it results in a service population of 10,304 people in the West and Central Zones and 867 people in the East Zone.

The wells supplied an average of 0.67 MGD in 2019 while the Village purchased an average 0.072 MGD from Joliet to supply the East Zone. These quantities result in a per capita daily water use of approximately 65 gallons per person per day in the well supplied zones and 83 gallons per capita per day (gpcd) in the East Zone. The five-year average of overall average day demand for all three zones and the resulting average water usage per capita is 0.728 MGD and 68 gpcd.

The highest maximum day demand in the West and Central Zone in the past five years occurred in 2016 with 1.598 MGD. The highest estimated maximum day demand in the East Zone in the past five years occurred in 2018 with a calculated 0.165 MGD. The East Zone maximum day demand (because it is supplied by Joliet and only monthly totals are available for analysis) must be estimated based on the maximum to average day demand ratio for the West and Central Zones. This study uses the five-year average ratio, 2.26, for that calculation. The five-year total maximum day demand for the Village was 1.757 MGD, with a resulting 2.59 maximum to average day ratio.

Table 4.01-1 shows the typical average and maximum day water demands in total and from each zone as well as the maximum to average day rations and per capita water use calculation over the years 2015 to 2019. Water use data was based on data provided by the Village.

West and Central Zone						
Year	No. of Connections	Resulting PE*	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Maximum: Average Ratio	GPCD
2015	2,974	9,517	0.643	1.409	2.19	68
2016	2,984	9,549	0.608	1.598	2.63	64
2017	3,045	9,744	0.665	1.413	2.12	68
2018	3,139	10,045	0.703	1.491	2.12	70
2019	3,220	10,304	0.670	1.495	2.23	65
Average			**0.658**	**1.481**	**2.26**	**67**
East Zone						
Year	No. of Connections	Resulting PE*	Average Day Demand (MGD)	Maximum Day Demand (MGD)**	Maximum: Average Ratio	GPCD
2015	262	838	0.065	0.147	2.26	78
2016	263	842	0.071	0.159	2.26	84
2017	263	842	0.069	0.156	2.26	82
2018	263	842	0.073	0.165	2.26	87
2019	271	867	0.072	0.164	2.26	83
Average			**0.070**	**0.158**	**2.26**	**83**
Total of All Village Water Users						
Year	No. of Connections	Resulting PE*	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Maximum: Average Ratio	GPCD
2015	3,236	10,355	0.708	1.556	2.20	68
2016	3,247	10,390	0.678	1.757	2.59	65
2017	3,308	10,586	0.734	1.569	2.14	69
2018	3,402	10,886	0.776	1.656	2.13	71
2019	3,491	11,171	0.742	1.659	2.23	66
Average			**0.728**	**1.639**	**2.26**	**68**
Maximum					**2.59**	

*This assumes there are 3.2 people per home and three homes per acre on average.

**East Zone Maximum Day Demand is estimated based on similar average day to maximum day ration from West and Central Zones.

Table 4.01-1 Historic Water Use Trends

Figure 4.01-1 graphically shows the average day demands and maximum day demands in total and per zone from 2010 to 2019. The trends seem to reflect the slow, but positive growth of the community over the past ten years. While water saving fixtures and many of the community's lawns becoming established may be resulting in a flat line trend for the average day demands, the new lawns and construction activities may be the cause for increased trends in the maximum day demands.

The next parts of this section will add to the demands of this analysis to reflect future growth. For that analysis, through build-out, the demands for the areas served in 2019 will be assumed to remain consistent. The 2019 average and maximum day demands of 0.742 MGD and 1.659 MGD, respectively, will be used and service to currently unserved areas and projected demands to undeveloped areas will both be added to that demand to forecast the ultimate build-out demands for the Village.

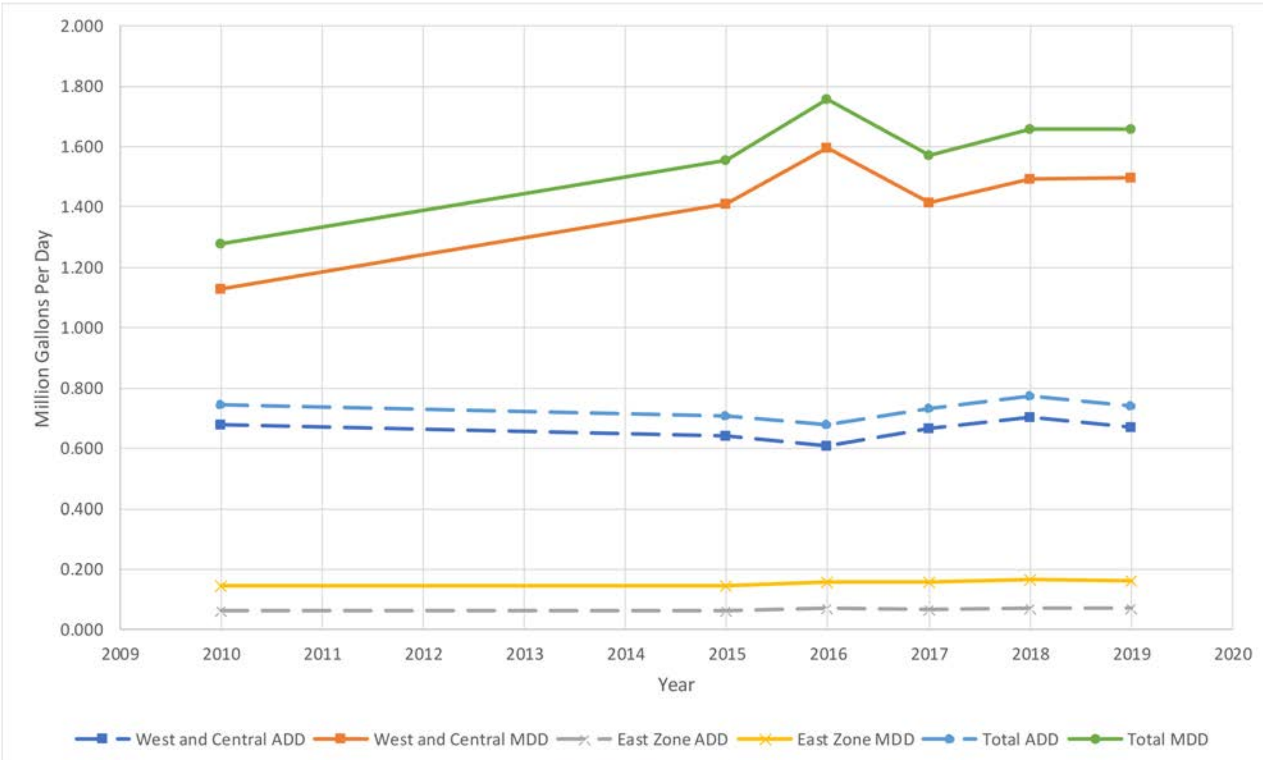
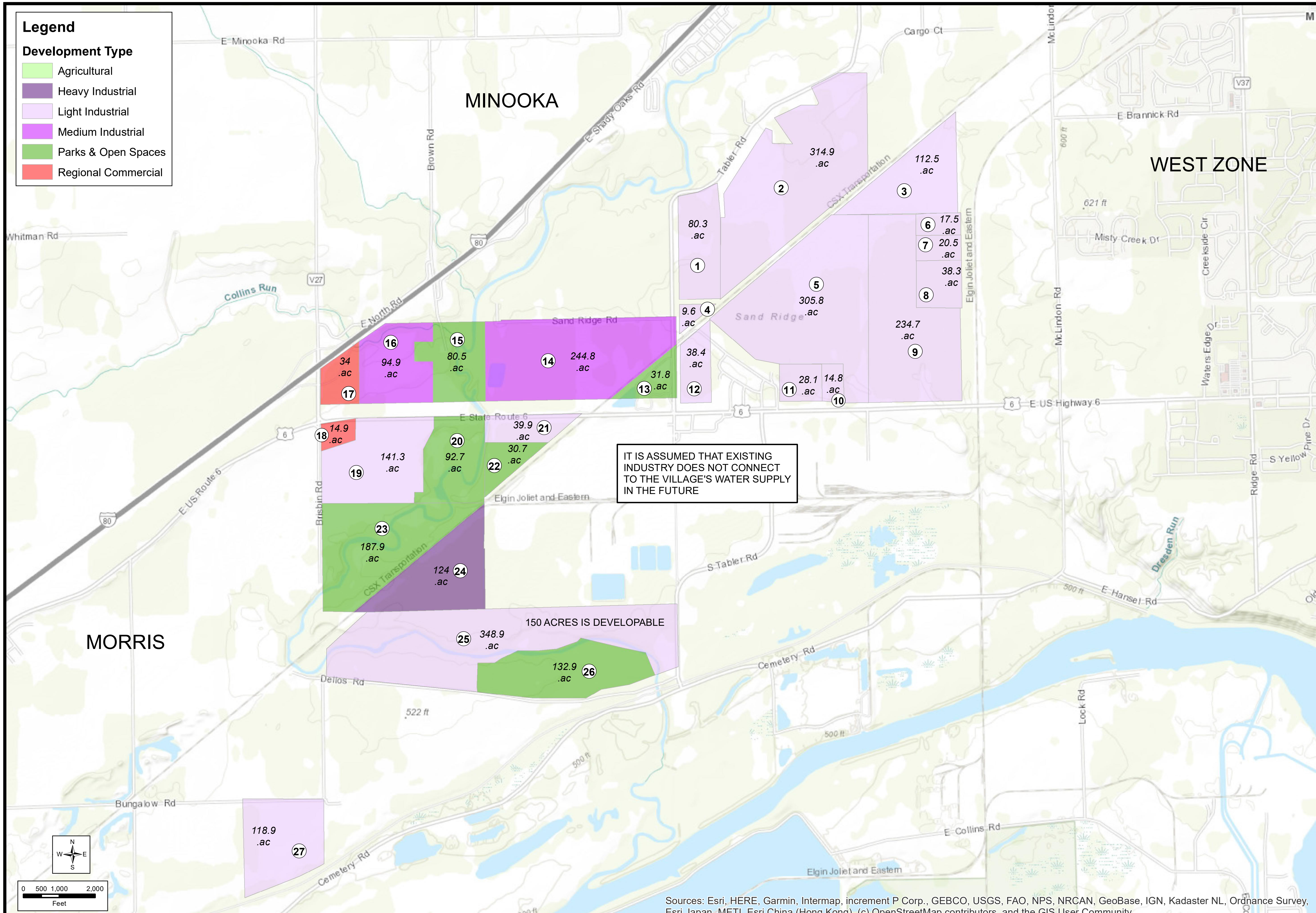


Figure 4.01-1 Historic Average and Maximum Demands Trends

4.02 CURRENT AND POTENTIAL SERVICE AREAS

As described in Section 4.01, the existing and future service areas of the Village are separated into four service zones. Each zone has areas that may develop in the future, or if currently developed, areas that may switch from their existing private wells to Village supplied water. These areas will be analyzed to determine their possible water demands after build-out, and that will be added to the existing service area demands to develop a projected ultimate build-out water usage.

The total anticipated are remaining for development or connection to the Village's water system is approximately 6,500 acres. Based on the projected land use determined with the recent Comprehensive Planning process, these areas can be split into projected land uses of commercial, residential, parks, agricultural, medical, and industrial. Based on the 2015 Far West Planning Study, the industrial areas can be further designated as light, medium, or heavy industrial. The resulting projected development type for the build-out areas can be seen in Figures 4.02-1, 4.02-2, and 4.02-3, which detail the Far West, West, and Central and East Zones, respectively. The Central and East Zones are analyzed together because, under the current ultimate build-out scenarios when they are no longer fed from two different sources, they will become one zone.



FAR WEST ZONE PROJECTED BUILDOUT

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
WILL AND GRUNDY COUNTIES, ILLINOIS

STRAND ASSOCIATES®

FIGURE 4.02-1
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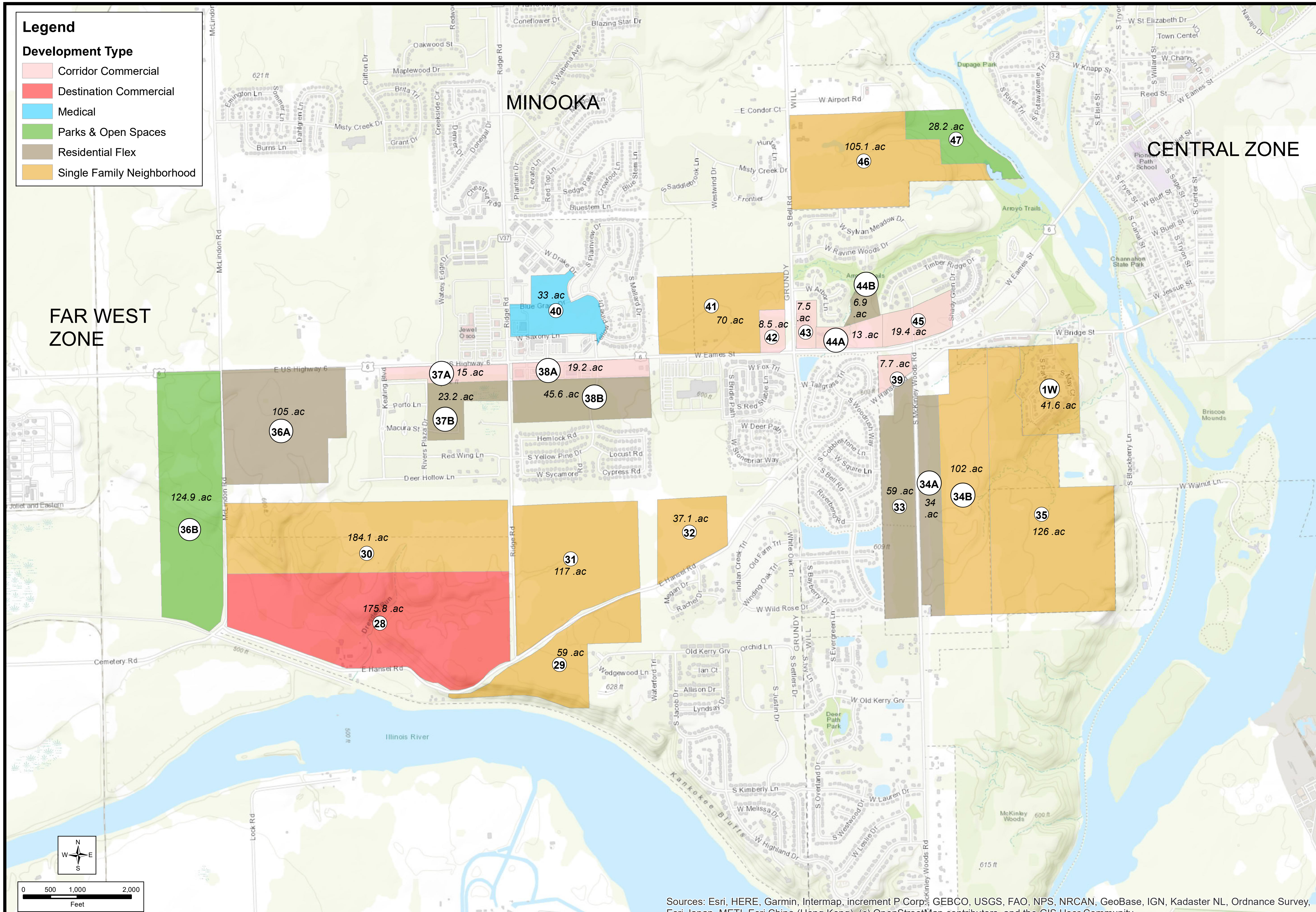

WEST ZONE PROJECTED BUILDOUT

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
WILL AND GRUNDY COUNTIES, ILLINOIS

STRAND ASSOCIATES®

FIGURE 4.02-2
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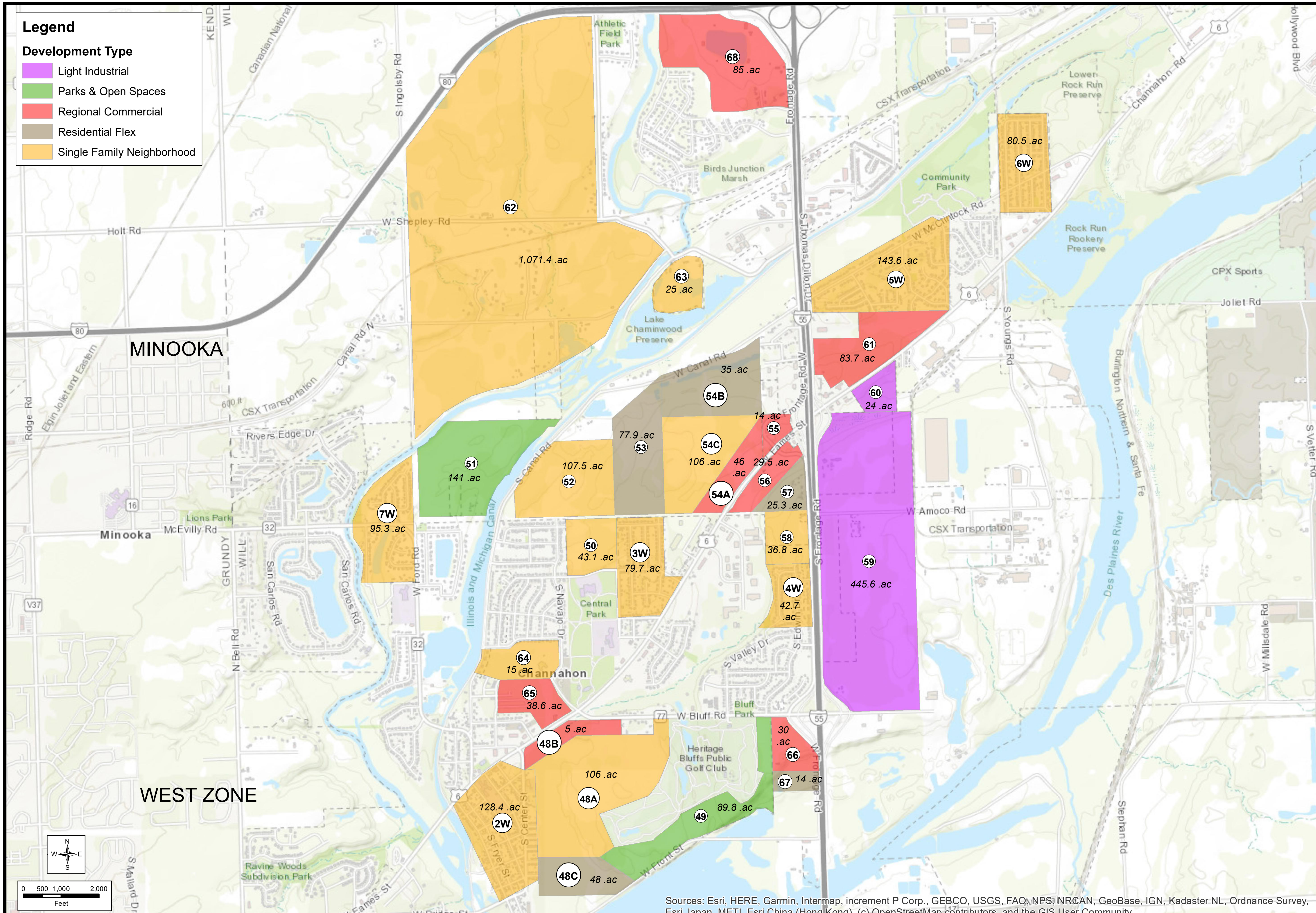

CENTRAL AND EAST ZONES PROJECTED BUILDOUT

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
WILL AND GRUNDY COUNTIES, ILLINOIS

STRAND ASSOCIATES®

FIGURE 4.02-3
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Each parcel was numbered to calculate the projected water demand at full build-out per parcel. The parcels that contain a "W" are existing Village areas that are built-out but are currently supplied water by private wells. All the parcels with a "W" are single-family developments.

This information will be used to project the ultimate build-out water demands in the next part of this section.

4.03 POPULATION TRENDS

The build-out zones described in Section 4.02 anticipate residential land use to grow in the future. In addition to population growth, the incorporation of the parcels that are supplied by private wells and taking over supply to the East Zone, currently supplied by Joliet, will result in an immediate increase in population serviced by the Village even without further land development.

In 2010, according to the United States Census Bureau, the Village had a population of 12,620. This rose to 13,086 by 2018 according to the same source. The Village has experienced a slowing in its population growth. This also shows in Table 4.01-1 and Figure 4.01-1 as the daily water demand trends remain relatively similar on a year-to-year basis, indicating slow growth.

With the projected acquisition or development of over 2,000 acres toward residential development, an increase in population is expected. According to the United States Census 2018 ACS 5-year Survey, the typical Village household has 3.11 residents living in it. With an average, medium density development of 2 to 2.5 residencies per acre, this would yield an additional 13,000 to 16,000 anticipated residents if all households were occupied at full build-out. This number is subject to change due to household density of development and a changing dynamic of people per household as new development is built.

4.04 PROJECTED WATER DEMANDS

To project the increased water demand because of build-out, each designated build-out land use was assigned a typical daily water use per acre. Recently completed studies in the Will County area used actual water usage data from light, medium, and heavy industrial developments to determine realistic current water usage per acre. Anticipated commercial, and parks and open spaces usages were developed using industry typical values. Residential used the Villages calculated number of PE per home and homes per acre to establish the PE per acre. A per capita, or PE, per day usage value of 85 gallons was used. Although the analysis in Section 4.01 showed that 68 gpcd is the five-year average, it also showed that 87 gpcd is possible in the East Zone. Using 85 gpcd per PE determined to be added with future growth will be conservative, but more importantly, account for users other than residential in areas. One justification for the higher water usage per PE in the East Zone compared with the Central and High Zones is the higher percentage of high water using industrial customers in the Ease Zone. Table 4.04-1 sows the resulting anticipated PE and water demands per acre for the various development types.

These values were used to develop average day water demand projections at completed build-out. Based on the findings from previous studies, land use specific maximum day demand to average day demand ratios were used to develop maximum day demand projections for the remaining service area. Again, this analysis was performed for the Far West Zone, the West Zone, and the combination of the Central and East Zones.

Development Type	PE/acre	gpd/acre	Example, Comment, and Source
Agricultural	0.0	0.0	Farm field
Corridor or Commercial	6.2	527.0	Strip mall and box store
Destination Commercial	2.6	221.0	
Heavy Industrial	40.0	3,400.0	Manufacturing
Light Industrial	0.7	59.5	Warehousing was 55 before
Medical	2.5	212.5	Used Ridge Road Medical Center, actual usage
Medium Industrial	2.6	221.0	Logistics
Parks and Open Spaces	0.2	17.0	Maybe a restroom or hose spigot per acre
Regional Commercial	15.0	1,275.0	Truckstop, car wash, and showers
Residential Flex	10.5	892.5	3 people per home x 3.5 homes per acre
Single-Family Residential	9.6	816.0	3.2 people per home x 3 homes per acre

Table 4.04-1 Anticipated PE and Water Demands per Acre by Land Type

A. <u>Far West Zone</u>

The Village's Far West Zone currently consists of mainly undeveloped land. In the projected build-out, this zone is anticipated to be mainly industrial developments. The anticipated demand here is a range of large industrial and big box warehouses with some commercial areas near I-55. A municipal WWTP is also envisioned in this zone. The remaining area is projected to be for parks and open spaces as well as agriculture. The projected build-out land usage can be seen in Figure 4.02-1. Table 4.04-2 shows the water demand calculations that are expected according to the build-out plan. These projections were made using the per acre water demands outlined in Table 4.04-1 and maximum demand ratios shown in Table 4.04-2. It should be noted that no existing industrial or residential areas were incorporated in this zone. It is assumed they will remain on their current water source.

B. <u>West Zone</u>

The West Zone currently has subdivisions with single- and multi-family residence and some commercially owned areas along US Route 6. Future development anticipates an expansion of the residential developments in this area as well as expanded commercial building along US Route 6. The build-out designations for the West Zone can be seen in Figure 4.02-2. Two types of residential build-out designations exist on this map. Single-family residential land is designated to parcels that will likely be developed into single-family households with a lower population density than Residential Flex, the other residential designation. Residential Flex parcels designate developments that will house multi-family units such as townhomes or apartments. Table 4.04-3 shows the expected water demands of a fully developed West Zone.

C. <u>Central and East Zones</u>

The Central and East Zone currently is primarily residential with some commercial along US Route 6 west of Interstate 55. East of Interstate 55 contains light industrial, commercial, and residential. The projected build-out of this area contains a mix of commercial, residential, and industrial land. In addition to the newly developed land, this zone ultimately contains the largest increase in PE, especially when incorporating the existing private well subdivisions into the water system. Figure 4.02-3 shows the projected build-out of the zone, parcels with a "W" in the name are parcels currently not serviced by the Village but are built out. Table 4.04-4 shows projected water demands of the Central and East zones upon full build-out.

Parcel No.	Development Type (According to 2019 Channahon Comprehensive Plan)	Total Area (acres)	Projected Demand (gpd/acre)	Projected Daily Demand (gpd)	Projected Maximum to Average Day Ratio	Projected Maximum Day Demand (gpd)	PE
1	Light Industrial	80.3	59.5	4,800	1.5	7,200	48
2	Light Industrial	314.9	59.5	18,800	1.5	28,200	188
3	Light Industrial	112.5	59.5	6,700	1.5	10,100	67
4	Light Industrial	9.6	59.5	600	1.5	900	6
5	Light Industrial	305.8	59.5	18,200	1.5	27,300	182
6	Light Industrial	17.5	59.5	1,100	1.5	1,700	11
7	Light Industrial	20.5	59.5	1,300	1.5	2,000	13
8	Light Industrial	38.3	59.5	2,300	1.5	3,500	23
9	Light Industrial	234.7	59.5	14,000	1.5	21,000	140
10	Light Industrial	14.8	59.5	900	1.5	1,400	9
11	Light Industrial	28.1	59.5	1,700	1.5	2,600	17
12	Light Industrial	38.4	59.5	2,300	1.5	3,500	23
13	Open Spaces	31.8	221	7,100	1	7,100	71
14	Medium Industrial	244.8	221	54,200	1	54,200	542
15	Parks and Open Spaces	80.5	17	1,400	3	4,200	14
16	Medium Industrial	94.9	221	21,000	1	21,000	210
17	Regional Commercial	34.0	1275	43,400	2.5	108,500	434
18	Regional Commercial	14.9	1275	19,000	2.5	47,500	190
19	Light Industrial	141.3	59.5	8,500	1.5	12,800	85
20	Parks and Open Spaces	92.7	17	1,600	3	4,800	16
21	Light Industrial	39.9	59.5	2,400	1.5	3,600	24
22	Parks and Open Spaces	30.7	221	6,800	1	6,800	68
23	Parks and Open Spaces	187.9	221	41,600	1	41,600	416
24	Heavy Industrial	124.0	3400	421,600	1.5	632,400	4216
25	Light Industrial	175.0	59.5	10,500	1.5	15,800	105
26	Parks and Open Spaces	132.9	221	29,400	1	29,400	294
27	Light Industrial	118.1	59.5	7,100	1.5	10,700	71
TOTAL		**2,758.8**		**748,300**		**1,109,800**	**7483**

Note:
Far West Average Day (MGD) = 0.75
Far West Maximum Day (MGD) = 1.11
Maximum to Average Ratio = 1.48

Table 4.04-2 Far West Zone Projected Additional Demands Through Build-out

Parcel No.	Development Type (According to 2019 Channahon Comprehensive Plan)	Total Area (acres)	Projected Demand (gpd/acre)	Projected Daily Demand (gpd)	Maximum to Average Day Ratio	Projected Maximum Day Demand (gpd)	PE
28	Destination Commercial	175.8	612	10,7600	1.5	161,400	1,076
29	Single-Family Residential	59.0	968	5,7200	2	114,400	572
30	Single-Family Residential	184.1	612	11,2700	2	225,400	1,127
31	Single-Family Residential	117.0	816	9,5500	2	191,000	955
32	Single-Family Residential	37.1	816	3,0300	2	60,600	303
33	Residential Flex	59.0	892.5	5,2700	2	105,400	527
34A	Residential Flex	34.0	892.5	3,0400	2	60,800	304
34B	Single-Family Residential	102.0	816	8,3300	2	166,600	833
35	Single-Family Residential	126.0	816	10,2900	2	205,800	1,029
36A	Residential Flex	105.0	892.5	9,3800	2	187,600	938
36B	Parks and Open Spaces	145.0	17	2500	3	7,500	25
37A	Corridor Commercial	15.0	527	8000	1.5	12,000	80
37B	Residential Flex	23.2	892.5	2,0800	2	41,600	208
38A	Corridor Commercial	19.2	527	1,0200	1.5	15,300	102
38B	Residential Flex	45.6	892.5	4,0700	2	81,400	407
39	Corridor Commercial	7.7	527	4100	1.5	6,200	41
40	Medical	33.0	212.5	7100	1	7,100	71
41	Single-Family Residential	70.0	816	5,7200	2	114,400	572
42	Corridor Commercial	8.5	527	4500	1.5	6,800	45
43	Corridor Commercial	7.5	527	4000	1.5	6,000	40
44A	Corridor Commercial	13.0	527	6900	1.5	10,400	69
44B	Residential Flex	6.9	892.5	6200	2	12,400	62
45	Corridor Commercial	19.4	527	1,0300	1.5	15,500	103
46	Single-Family Residential	105.1	816	8,5800	2	171,600	858
47	Parks and Open Spaces	28.2	17	500	3	1,500	5
1W	Single-Family Residential	41.6	816	34,000	2	68,000	340
TOTAL		**1,587.9**		**1,069,200**		**2,056,700**	**10,692**

Note:
West Zone Average Day (MGD) = 1.07
West Zone Maximum Day (MGD) = 2.06
Maximum to Average Ratio = 1.92

Table 4.04-3 West Zone Projected Additional Demands Through Build-out

Parcel No.	Development Code	Development Type (According to 2019 Channahon Comprehensive Plan)	Total Area (acres)	Projected Demand (gpd/acre)	Projected Daily Demand (gpd)	Maximum to Average Day Ratio	Projected Max Day Demand (gpd)	PE
48A	SFN	Single-Family Residential	106.0	816	86,500	2	173,000	865
48B		Regional Commercial	5.0	1,275	6,400	2.5	16,000	64
48C		Residential Flex	35.0	892.5	31,300	2	62,600	313
49	POS	Parks and Open Spaces	89.8	17	1,600	3	4,800	16
50	SFN	Single-Family Residential	43.1	816	35,200	2	70,400	352
51	POS	Parks and Open Spaces	141.0	17	2,400	3	7,200	24
52	SFN	Single-Family Residential	107.5	816	87,800	2	175,600	878
53	RF	Residential Flex	77.9	892.5	69,600	2	139,200	696
54A	RC	Regional Commercial	46.0	1275	58,700	2.5	146,800	587
54B		Residential Flex	35.0	892.5	31,300	2	62,600	313
54C		Single-Family Residential	106.0	816	86,500	2	173,000	865
55	RC	Regional Commercial	14.0	1275	17,900	2.5	44,800	179
56	RC	Regional Commercial	29.5	1275	37,700	2.5	94,300	377
57	RF	Residential Flex	25.3	892.5	22,600	2	45,200	226
58	SFN	Single-Family Residential	36.8	816	30,100	2	60,200	301
59	IND	Light Industrial	445.6	59.5	26,600	1.5	39,900	266
60	IND	Light Industrial	24.0	59.5	1,500	1.5	2,300	15
61		Regional Commercial	83.7	1,275	106,800	2.5	267,000	1,068
62	River Rd Corr	Single-Family Residential	440.0	81.6	36,000	2	72,000	360
63	Heron's Glen	Single-Family Residential	25.0	816	20,400	2	40,800	204
64	TC SF	Single-Family Residential	15.0	816	12,300	2	24,600	123
65	TC Com	Regional Commercial	20.0	1,275	25,500	2.5	63,800	255
66	55/bluff	Regional Commercial	30.0	1,275	38,300	2.5	95,800	383
67	S front and front	Residential Flex	14.0	892.5	12,500	2	25,000	125
68	Les Lake	Regional Commercial	85.0	1275	108,400	2.5	271,000	1,084
2W	SFN	Single-Family Residential	128.4	816	104,800	2	209,600	1,048
3W	SFN	Single-Family Residential	79.7	816	65,100	2	130,200	651
4W	SFN	Single-Family Residential	42.7	816	34,900	2	69,800	349
5W	SFN	Single-Family Residential	143.6	816	117,200	2	234,400	1,172
6W		Single-Family Residential	80.5	816	65,700	2	131,400	657
7W	SFN	Single-Family Residential	95	816	77,600	2	155,200	776
TOTAL			**2,650.1**		**1,459,200**		**3,108,500**	**14,592**

Note:
Central Zone Average Day (MGD) = 1.46
Central Zone Maximum Day (MGD) = 3.11
Maximum to Average Ratio = 2.13

Table 4.04-4 Central and East Zone Projected Additional Demands Through Build-out

D. Combined Water Demands

Table 4.04-5 summarizes the combined demand projection of the three build-out zones described previously with the existing 2019 data on water use from Village wells and Joliet. The combined projected average day water demand is 4.02 MGD with an average maximum day to average day demand ratio of 1.97 resulting in a projected maximum day water use of 7.93 MGD. Although this maximum to average day water demand ratio is less than current trends, this typically occurs as a community matures and reaches growth boundaries. Water saving fixtures, more commercial and industry water users, and reduction in new landscaping and outdoor water uses requirements all contribute to this common reduction.

Phase	Population Served or PE	Average Day (MGD)	Maximum Day (MGD)	Maximum: Average Ratio	Average Day (MGD)	Maximum Day (MGD)	Maximum: Average Ratio	Average Day (MGD)	Maximum Day (MGD)	Maximum: Average Ratio
Currently served by the Village	10,304				0.67	1.50	2.23	0.67	1.50	2.23
Switch East Zone from Joliet to the Village	867				0.07	0.16	2.26	0.07	0.16	2.26
Projected through build-out	32,767	0.75	1.11	1.48	2.53	5.17	2.04	3.28	6.28	1.92
Total at build-out	43,938	0.75	1.11	1.48	3.27	6.82	2.09	4.02	7.93	1.97

Table 4.04-5 Projected Demands, PE, and Maximum to Average Day Demand Projections at Build-out

Typically, water demand projections and PE growth projections for water studies are overly conservative. It is better to anticipate more growth and infrastructure needs, than experience more need than expected and not be able to meet it or need to restrict further growth. However, the next evaluation for this study will investigate the infrastructure needs and conceptual costs associated with switching the water source to either Lake Michigan via a regional water commission or the Illinois River via a Village owned water treatment facility. Because the infrastructure needs and costs will be very high compared with any past capital improvement the Village has encountered, the water demand patterns were developed with a high level of Village staff involvement and scrutiny instead of project current trends and demand patterns out into the future. Improvements for the two alternatives are based on the 2050 projected combined demands rather than 2080 projected full build-out to reduce costs associated with an overly conservative approach. A less conservative approach than usual was taken to more match what is observed in other communities as they grow to build-out. Because the infrastructure are so great, significantly oversizing can make a significant difference in project costs. The demand growth rate and infrastructure needs can be reassessed prior to 2050 to determine whether infrastructure improvements required for the projected full build-out are necessary.

More importantly, phasing of the infrastructure can be very important in the analysis and the resulting costs. If the infrastructure initially installed can serve the needs through the payback period of borrowed funds, this will reduce the initial costs, allow for future growth to take place with future borrowing, and allow for recalculations of ultimate demands and future needs. So, the growth rate was also assessed, and projections were made to forecast the anticipated future build-out timing.

Past growth rates were observed and graphed. The growth pattern that occurred between 2000 and 2010 seemed to be the fastest rate, but also a rate that the Village is able to realize. This rate was used to straight line trend to full build-out. This results in a projected full build-out year of 2080. Figure 4.04-3 shows the graphical representation of the population growth and the water demands growth at this rate. Table 4.04-6 shows the historic and projected data in approximately five-year increments.

Year***	Historic Population and *Projected PE*	Average Day Demand (MGD)				Maximum Day Demand (MGD)			
1990	4500				0.270				0.432
1995	6199				0.372				0.595
2000	7843				0.471				0.753
2005	11905				0.714				1.143
2010	12620		0.679	0.065	0.744		1.131	0.147	1.278
2015	12629		0.643	0.065	0.708		1.409	0.147	1.556
2016	12674		0.608	0.071	0.678		1.598	0.159	1.757
2017	12823		0.665	0.069	0.734		1.413	0.156	1.569
2018	13086		0.703	0.073	0.776		1.491	0.165	1.656
2019	13273		0.670	0.072	0.742		1.495	0.164	1.659
2020	13479	*0.000*	*0.670*	*0.072*	*0.742*	*0.000*	*1.495*	*0.164*	*1.659*
2030	*19292*	*0.125*	*1.091*	*0.072*	*1.288*	*0.185*	*2.356*	*0.164*	*2.704*
2040	*25105*	*0.249*	*1.513*	*0.072*	*1.834*	*0.370*	*3.217*	*0.164*	*3.750*
2050	*30919*	*0.374*	*1.934*	*0.072*	*2.381*	*0.555*	*4.078*	*0.164*	*4.796*
2060	*36732*	*0.499*	*2.355*	*0.072*	*2.927*	*0.740*	*4.938*	*0.164*	*5.842*
2070	*42545*	*0.624*	*2.777*	*0.072*	*3.473*	*0.925*	*5.799*	*0.164*	*6.888*
2080	*48358*	*0.748*	*3.198*	*0.072*	*4.019*	*1.110*	*6.660*	*0.164*	*7.934*

*Population projected in 2019 and 2018; Population of the Village, not population served.
**Assumes entire population served at 2050.
***Assumes 2050 is full build-out.
2010 average and max day from Water Inventory Worksheet

Table 4.04-6 Historic and Projected Maximum Day Water Demands and PE Projections

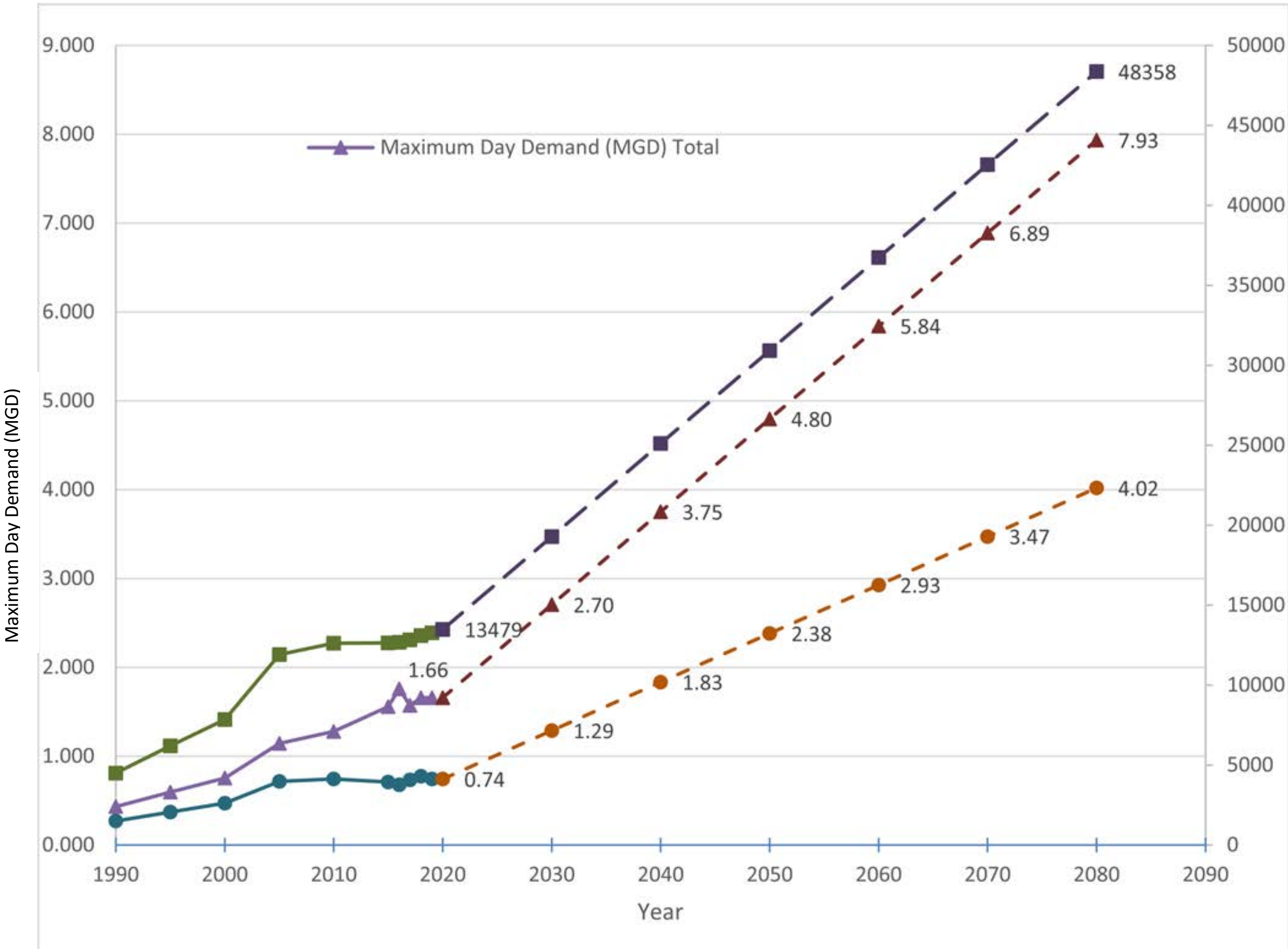


Figure 4.04-3 Historic and Projected Maximum Day Water Demands and PE Projections

SECTION 5
ALTERNATIVE WATER SUPPLY EVALUATION

This section presents an evaluation of two different water supply alternatives and develops conceptual possible capital costs and rates. The declining aquifer levels in the area and resulting water shortages deemed eminent by ISWS have led many municipalities in the region to explore alternative water sources. Projected water demand trends developed in Section 4 will be used to develop the conceptual alternative water supplies for evaluation.

5.01 IDENTIFICATION OF ALTERNATIVE SUPPLY ALTERNATIVES

Throughout the course of this study, regional alternatives for future water supply sources continue to develop and vary in efficacy. While there are a multitude of possible sources, the following four were determined to be most viable at the time of this study.

1. Lake Michigan via new regional water commission
2. Illinois River, Marseilles Pool, via new Village-owned intake and WTP
3. Lake Michigan via Joliet
4. Kankakee River via Kankakee River Agency.

The scope of the study was limited to the first two alternatives, only, which is appropriate because these are the only two options that have been developed by the supplier or are able to be fully developed without outside (supplier) input. Joliet has focused its evaluations and efforts on the details related to assembling a regional water commission. There has not yet been an evaluation of the details and possible connection and bulk water purchase costs associated with purchase of water from Joliet, as opposed to being a commission partner. Likewise, the Kankakee River Alliance does not currently have the Village in its purview as a customer or fellow member, so they are still in the process of calculating proposed connection and bulk water purchase costs.

The following is a more detailed description and evaluation of the current understanding of the two study alternatives, Illinois River and Lake Michigan via regional water commission. Improvements for the two alternatives are based on the 2050 projected combined demands rather than 2080 projected full build-out to reduce costs associated with an overly conservative approach as detailed in Section 4 of this report. The demand growth rate and infrastructure needs can be reassessed before 2050 to determine whether infrastructure improvements required for the projected full build-out are necessary. The projected average and maximum day demands for the year 2050 are 2.38 MGD and 4.80 MGD, respectively. This evaluation will discuss the water quality, water quantity and sustainability, level of Village control, required ongoing management, and conceptual cost.

5.02 LAKE MICHIGAN SUPPLY VIA REGIONAL WATER COMMISSION

A. <u>General Description of Alternative</u>

The City of Chicago (Chicago) Department of Water Management uses two WTPs to filter and purify Lake Michigan water. The WTPs each deliver water to deep tunnels that run beneath Joliet. Shafts drop to the tunnels and pumps bring the water to the surface where it is stored in ground reservoirs before being delivered to the system or their wholesale customers.

Joliet's area regional water commission is to be supplied water from the smaller of the two Chicago facilities, the Sawyer Water Purification Plant. One branch of this purification plant's tunnel systems extends to 84th Street and Kedvale Avenue on Joliet's west side. This will be the location that Joliet will sell water to the new regional water commission.

The new regional water commission will construct a 5 million-gallon (MG) reservoir and pumping station at the receiving point from Chicago near 84th Street and Kedvale Avenue. A large-diameter transmission main will then extend more than 30 miles, with a storage reservoir and booster pumping station along the way, before delivery to a receiving station within the regional water commission. From there, a pumping station will deliver the water to each regional water commission members. Currently, the commission will sell the water to the members through a single-metered connection, with additional connections available wholly at the cost of the member.

At or near the water supply connection location, it is likely that the Village will need a receiving facility, such as a storage tank and pumping station, to store and pump the water into the Village's distribution system. There would be a requirement that the Village maintain two times the average day in storage, so this facilities storage will help offset that, but it will also allow the water to be delivered at a steady rate, while the volume stored at this facility can fluctuate to meet peak demand periods on a given day. This facility may also need to adjust some chemical treatment in the water supply, such as boosting chlorine levels or adding corrosion control treatment.

Many system improvements may be necessary to convey the water throughout the distribution system. Currently, water is fed into the system at multiple locations from the various supply wells. When receiving all the water at one location, the current network of piping is not designed to distribute water throughout the Village. Therefore, some water main reinforcement and transmission mains will likely be required to maintain supply and pressure to all the Village's water customers.

Again, additional storage will also be required under this alternative. This storage should be in locations of higher demands or near major water users to assist in water turnover and reducing water age.

Figure 5.02-1 shows a possible schematic of this alternative emphasizing the infrastructure where cost is incurred.

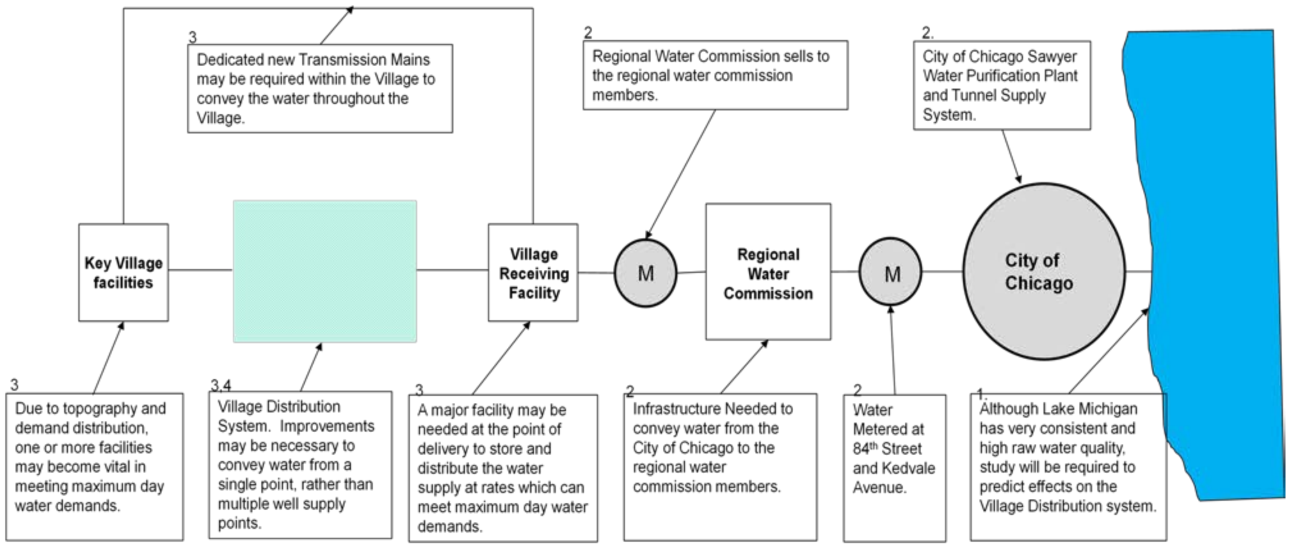


Figure 5.02-1 Conceptual Regional Water Commission–Lake Michigan Water Supply Schematic

B. Water Quality

Lake Michigan is a water supply source for a large portion of Northeastern Illinois. The water quality is very high and consistent. Currently, conventional treatment is able to meet and exceed all regulatory requirements. While emerging contaminants may someday require an additional process or processes to remove a currently undetected or unregulated contaminant, the same could be said for the other alternative. Many of the other issues that have affect the water quality of other surface waters or locations on Lake Michigan, such as algal blooms, accidental industrial releases, frazzle ice, and others, have not affected Chicago's facilities.

Whenever changing water sources, regulatory requirements mandate that water supplies perform study and testing of the change in water quality to attempt to predict how it will affect the distribution system. Flint, Michigan is a well-known case where the effects of different water quality caused severe corrosion of the water service piping, resulting is elevated lead levels, among other negative effects. Therefore, a Lead and copper corrosion control study will be required when switching sources. However, because the Village currently uses the same treatment method for the same water source, deep sandstone aquifer groundwater, as Joliet, the Village would benefit from Joliet's findings in its studies and be able to conduct a more efficient study. In 2020 dollars, the probable cost of the corrosion control study is $500,000, which includes an extensive pilot study with harvested piping and materials from within the Village's water system.

C. Sustainability and Water Quantity

Withdrawal from the Great Lakes for water supply is controlled a formal agreement, called the Great Lakes–St. Lawrence River Basin Water Resources Compact (Compact), between the states and territories that border the lakes. The Compact requires that water be removed for use only from entities that are within the lake's drainage boundary. A United States Supreme Court ruling grants Illinois permission to supply water outside of the lake's drainage boundary, thus diverting water away from Lake Michigan and draining to, ultimately, the Mississippi River and the Gulf of Mexico. The diversion is limited to 3,200 cubic feet per second. Illinois Department of Natural Resources is the regulating authority regarding this diversion limit, as such, they review and, if approved, grant water allocations to water supplies in Northeastern Illinois. These allocations are audited yearly and come with several requirements that restrict water usage and losses in order to maintain total withdrawals from Illinois below the mandated limit.

Currently, there is some remaining availability for additional Lake Michigan water allocations. Priority is being given to water supplies who are currently using the troubled sandstone aquifer. Lake Michigan offers ample sustainable water supply for the Village; however, once the water allocations are up to the mandated limit, the Village would no longer be allowed to access the water source.

Figure 5.02-2 from *Changing Groundwater Levels in the Sandstone Aquifers of Norther Illinois and Southern Wisconsin: Impacts on Available Water Supply,* compiled by ISWS, shows the extent in which Lake Michigan water extends into the suburban region in 2014. With additional municipalities on the northwestern suburban areas and in the Village, area switching from the groundwater aquifers to Lake Michigan for water supply, it could be possible that the withdrawal limit will be reached, soon.

If the Village chooses to switch to a Lake Michigan source, the effort associated with filing an application for an allocation is anticipated to be approximately $250,000 in 2020 dollars.

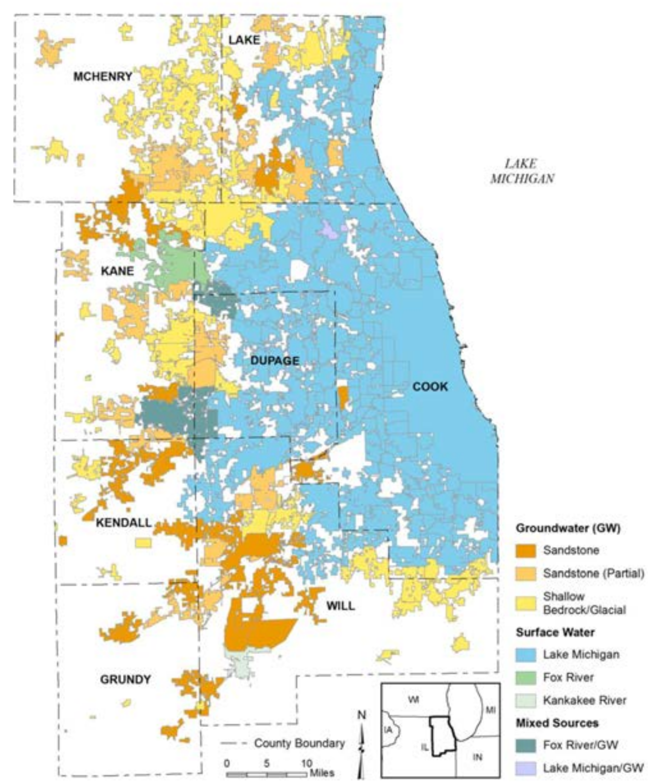


Figure 7: Source of municipal water used by each community in northeastern Illinois as of 2014.

Figure 5.02-2 2014 Northeastern Illinois Sources of Municipal Water Supply

D. Implementation Risk

If the Village choses to join the regional water commission, the risk of running out of water would be low. Joliet needs the alternative water supply by 2030, likely sooner than the Village, and they have already entered agreement with the Chicago to purchase the Lake Michigan water. The larger forces with greater desperation of timely and successful implementation and completion of the new source, greatly increases the likelihood that obstacles will be overcome, and the Village would have a Lake Michigan supply available soon after 2030.

E. Operation and Maintenance (O&M)

The supply of treated Lake Michigan water should reduce the Village's O&M costs. The energy required to pump and treat the existing supply groundwater would be reduced to the energy needed to pump a treated water supply from storage. Well and treatment equipment O&M costs are higher than those associated with additional pumps and storage tanks required for the alternative source. Chemical addition may still be needed, but significantly less quantity and operational complexity of the chemicals the Village currently uses to produce the water supply for distribution.

Water system distribution O&M efforts and costs should remain consistent current efforts and costs. A complete breakdown of the Fiscal Year 2019 to 2020 expenditures for the water system is in Appendix A. Based on this data, it is assumed that the annual cost for the Village to produce and treat water is approximately $690,000 per year in 2020, and it costs approximately $1,005,000 to distribute the water. So, when purchasing water from a regional commission, the cost for production will no longer be incurred, but the Village would continue to see approximately $1,005,000 to distribute the water in 2020.

F. Control

The regional water commission bylaws and membership details are still being developed. It is likely that, as a member, the Village would receive one vote on matters of business, but some other members may receive more than one depending upon community size. Regardless, the Village will not have full control over decisions regarding any matters of business outside of the infrastructure and operations within the Village.

G. Hydraulic Modeling Results and Required Improvements

In order to determine a total conceptual cost for this alternative, anticipated improvements needed to receive and deliver water throughout the Village must be assessed. Using the hydraulic water model to simulate the alternative supply situation, improvements were added iteratively until adequate maximum day demand pressures and fire flows were available throughout the system. This analysis was conceptual with many assumptions, so if this alternative is further analyzed, additional detail and refinement of these improvements would be necessary.

The Village's water distribution system is fed water from two distinct locations in the geographical center of the Village. The Well Nos. 4 and 6 combination site is on McKinley Woods Road, and the Well Nos. 2, 3, and 5 combination site is in Heritage Lakes Subdivision. Therefore, the current water system is very capable of distribution of water from the center of the Village, along the DuPage River to the current eastern and western extents of the water system.

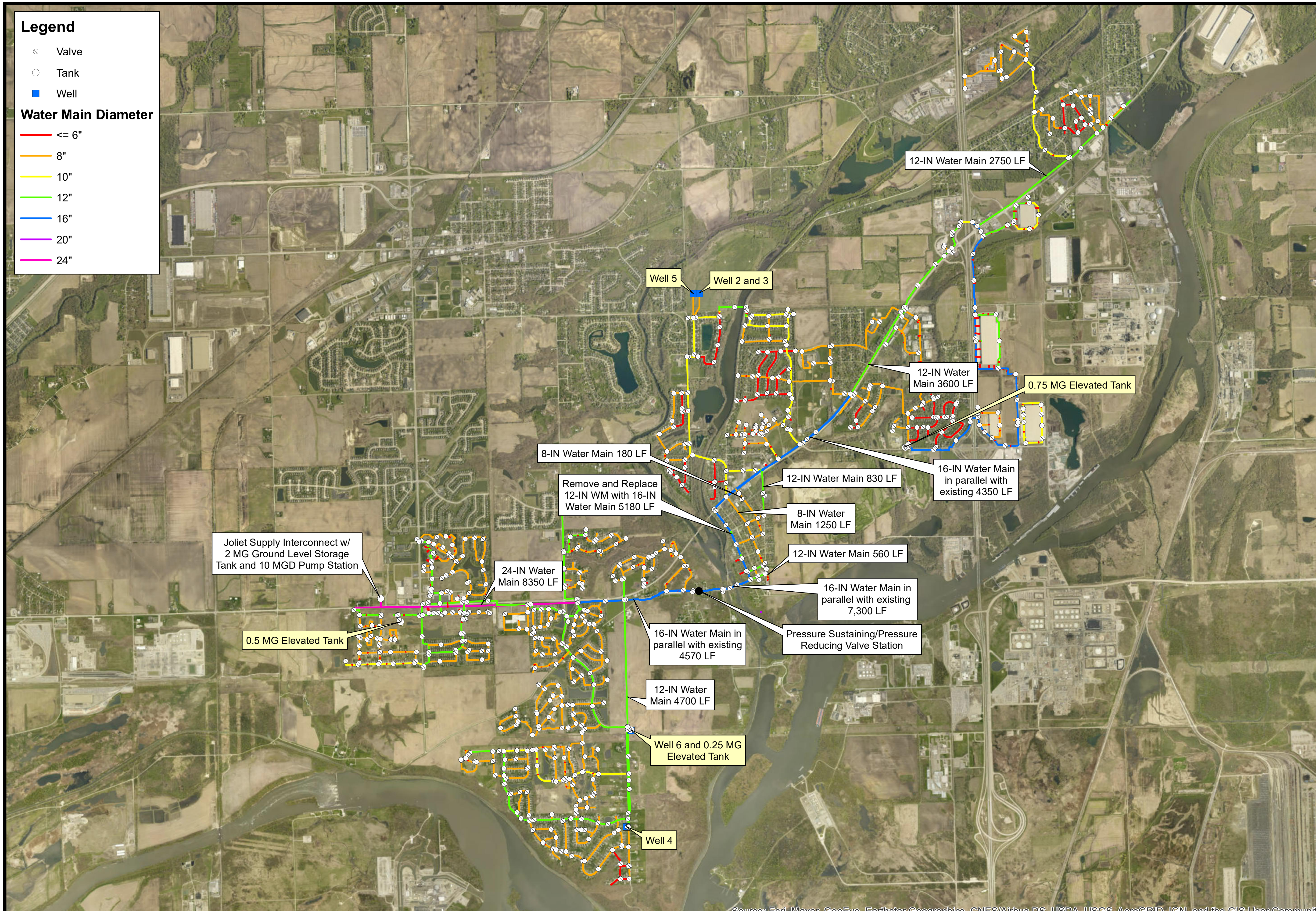
The desire to have any future regional water commission supply located as near as possible to Ridge Road and US Route 6, the Village's highest elevations and most hydraulically efficient area to receive water for distribution, was conveyed to Joliet and Joliet is currently studying the regional water commission routing to meet that desire. As of March 2021, Joliet foresees a cost of $4.00 per thousand gallons and a maximum connection cost of $17,132,896 per year 2050 maximum day demand rate. Joliet is attempting to find ways to reduce the connection costs, but using this information to develop costs, the Village's 2050 maximum day demand of 4.80 MGD results in an anticipated connection cost of $82,237,900.

For the purposes of modeling the future scenarios, a 2 MG water storage tank and 10 MGD pumping station was used as the receiving and primary pumping station.

Chicago requires that water systems that they supply maintain a minimum two times the average day demand in storage. This allows the Village to continue to provide water either throughout possible short-term service disruptions or for a long enough period of time to activate emergency supply sources, such as standby wells or neighboring water supplies. In order to meet this requirement for the 2050 average day demand of 2.38 MGD, the Village must add a total of 3.5 MG of water storage to the current 1.5 MG, bringing the total water storage to 5 MG. For the purposes of modeling the future scenarios, a 2-MG water storage tank and 7-MGD pumping station will be used as the receiving and primary pumping station. In addition to the receiving facility storage, it was envisioned that the Village would need storage east of the DuPage River to serve a pumping station that delivers water to the Central and East Zones A 1.5-MG storage tank was assumed near the DuPage River with a 3-MGD pumping station to assist meeting demands in the Central and East Zones. Finally, a new Pressure Adjusting Station between the West and the Central Zones may be required to pass flows at a higher rate than the current station on Bridge Street can handle.

The previously listed facilities were added to the model and the ultimate build-out demand scenarios were simulated to determine water distribution system improvement required to convey the water supply. While facilities such as pumping stations and storage tanks can be phased in over time, so they can be smaller in the earlier growth years, water distribution piping should use the ultimate demands at build-out to size for buried piping anticipated useful life of 70 to 100 years. Additional facilities needed to meet the Far West Zone demands were assumed to be the same for both options, and can only be determined as the area develops, so no facilities, only the anticipated demand, was considered west of McClindon Road.

Figure 5.02-3 shows the resulting facility and infrastructure needed to receive water from a regional water commission and convey it through the distribution system at adequate pressures and firefighting flows. Although some of the water main needed may be able to be installed by development at developers cost, this evaluation will assume that the timing will force the Village to install these segments. The OPC for these improvements in 2020 dollars is shown in Table 5.02-1.



CITY OF JOLIET WATER SUPPLY CONNECTION NEAR RIDGE ROAD

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 5.02-3
6437.120

Path: S:\JOL\6400--6499\6437\120\Drawings\GIS\Maps\Report Figures\Figure 5.02-3 Regional Water Commission 11 x 17.mxd User: Danc Date: 5/19/2021 Time: 2:16:12 PM

Facility Improvements			**OPC**
2-MG Storage Tank			$1,750,000
7-MGD Pumping Station			$1,400,000
1.5-MG Storage Tank			$1,500,000
3-MGD Pumping Station			$1,000,000
Pressure Adjusting Station			$750,000
Subtotal Facility Improvement Costs			$6,400,000
		Contingency (20%)	$1,280,000
		Engineering and Legal (20%)	$1,280,000
		Total Facility Improvement OPC	**$8,960,000**
Water Main Improvements	**Cost ($ per linear foot [LF])**	**Quantity (LF)**	**OPC**
8-inch Water Main Addition	$190	1,430	$271,700
12-inch Water Main Addition	$230	12,440	$2,861,200
16-inch Water Main Addition	$300	21,400	$6,420,000
24-inch Water Main Addition	$460	8,350	$3,841,000
Subtotal Facility Improvement Costs			$13,393,900
		Contingency (20%)	$2,678,780
		Engineering and Legal (20%)	$2,678,780
		Total Water Main Improvement OPC	**$18,751,460**
		Total Village Distribution System Improvements OPC	**$27,711,460**

Table 5.02-1 Internal Distribution System Improvements for Lake Michigan Supply via Regional Water Commission

These results are conceptual and conservative. Refinement will be necessary if this alternative is further pursued.

H. <u>2020 Opinion of Probable Capital Cost and Annual O&M Cost</u>

Table 5.02-2 shows the compiled engineer’s opinion of probable 2020 costs developed for this alternative. At this time, switching to the regional water supply with Joliet could result in capital costs of approximately $111,650,000 and a probable annual O&M cost of $1,143,557.

Item	Description	Capital Cost (2020 Dollars)	Annual O&M Costs (2020 Dollars)
1	Preliminary Engineering		
	Allocation Process	$250,000	
	Lead and Copper Corrosion Control Study	$500,000	
		$750,000	
2	Water Commission Buy-in		
	Infrastructure Connection Charge	$82,171,752	
	($17,132,896 per year 2050 MGD capacity requested)		
		$82,171,752	
3	Village Distribution System Improvements		
	Additional Storage and Pumping Facilities	$8,960,000	
	Distribution and Transmission Main Improvements	$18,751,460	
	Annual O&M (0.5% of capital cost per year)		$138,557
		$27,711,460	$138,557
4	Village Distribution System Operations		$1,005,000
Total Engineers OPC Cost		**$111,638,212**	**$1,143,557**

Delivery Charge: $4.00 per kgal in 2020 dollars, 2% escalation anticipated.
Kgal=per thousand gallons

Table 5.02-2 Regional Water Commission Water Supply Alternative–Current Capital and Annual O&M Probable Cost

I. Conceptual OPC and Rate

For the summary of the probable costs associated with the implementation of switching to a regional water commission for the supply, the previous costs opinions were developed in 2020 dollars, for those improvements necessary to meet the 2050 demands. Because 2020 dollars were used to establish the cost opinions, a conceptual rate was developed using 2020 demands and rate payers or PE. Then, the probable cost for improvements and the conceptual rates were escalated to 2030 dollars and for 2030 demands and 2030 PE. For consistency with Joliet's analysis presented on January 12, 2021, a rate of increase of 3.5 percent was applied to the cost for inflation and construction, which matched recent studies by Joliet regarding regional water commission charges. In accordance with correspondence received April 12, 2021, the 2020 volumetric wholesale purchase rate used is $4.00 per kgal and it is anticipated to escalate at a rate of 2 percent per year. The resulting conceptual 2030 water rates per 1,000 gallons are shown in Table 5.02-3.

Item	Description	Capital Cost[1,4]	Annual Cost[1,2]	2020 Rate Impact[3]	2030 Rate Impact[5]
1	Preliminary Engineering				
	Allocation Process	$250,000	$13,600		
	Lead and Copper Corrosion Control Study	$500,000	$27,200		
		$750,000	$40,800	$0.15	$0.12
2	Purchase from Water Commission				
	Delivery Charge ($4.30 per kgal in 2020 dollars)			$4.00	$4.90
	Infrastructure Connection Charge ($17,132,896 per year 2050 MGD capacity requested)	$82,171,752	$4,467,800		
		$82,171,752	$4,467,800	$16.49	$13.40
3	Village Distribution System Improvements				
	Additional Storage and Pumping Facilities	$8,960,000	$487,200		
	Distribution and Transmission Main Improvements	$18,751,460	$1,019,600		
	User Connection Fees[6]	($9,082,813)	($493,900)		
		$18,628,648	$1,012,900	$3.74	$3.04
4	Village Distribution System Operations			$3.57	$5.03
Total Conceptual Rate ($/kgal)				**$27.95**	**$26.49**

[1]All costs and rates in 2020 dollars.
[2]Uses annual percentage rate of 3.5 percent and term of 30 years for payback.
[3]Uses assumed 2020 average day demand of 0.74 MGD.
[4]Capital Costs include 20 percent Professional Services and 20 percent Contingency.
[5]Uses 2030 dollars and 2030 average day demand.
[6]Assumes increase in PE of 17,470 (30,919 [year 2050]) to 13,479 [year 2020]) with 3.2 PE per connection and $5,000 fee per connection.

Table 5.02-3 Conceptual Water Rate Analysis for Lake Michigan Water Supply via Regional Water Commission

As mentioned, many items are based on the latest information from Joliet regarding the water commission connection costs and purchase rates, which is still under investigation. Also, the more members involved with a commission, the lower the rates and connection costs will be. This study used the regional commission scenario with the fewest members; therefore, these amounts could go down in the future. Also, the required system improvements to convey the water throughout the Village may be reduced if the Village works with developers to install water mains, potentially larger than they may need for their development, which help convey the needed water. Village staff continues to work with Joliet to explore ways to optimize the design of this alternative and reduce the connection and purchase costs.

Comparison of the resulting conceptual rate with the current rate and the other alternative is provided in a later part of this section.

5.03 ILLINOIS RIVER, MARSEILLES POOL, VIA NEW VILLAGE-OWNED INTAKE AND WTP

A. General Description of Alternative

When investigating alternative water sources in the Village, the river system that creates the community's name is an obvious consideration. Joliet's recent efforts and investigations allow the Village to focus on the optimal surface water choice and eliminate the others because of water quality and quantity limitations. Joliet studied four rivers that are in the Village area, the DuPage River, the Des Plaines River, the Kankakee River, and the Illinois River. For the Illinois River, they studied both upstream of the Dresden Dam, known as the Dresden Pool, and downstream of the Dresden Dam, known as the Marseilles Pool. The Kankakee River water quality was favorable for a water supply, but the quantity made it unfavorable for the higher demands of Joliet or the region. The Illinois River, specifically the Marseilles Pool, was the most favorable river for water supply for Joliet, when weighing the water quality and quantity.

Because the Marseilles Pool is within the Village, this would be an easily accessible source. The potential Village property east of Tabler Road and south of US Route 6, purchased for a possible future WWTP site, was assumed to be the location of a new WTP. The WTP will initially be sized to treat the 2050 maximum day demand projections, plus the required 20 percent excess capacity, for a total treatment capacity of 6 MGD. The WTP would be upgradable in the future to meet the ultimate maximum day demand plus 20 percent for a 10 MGD total capacity.

Because of the contaminants found in the Illinois River, the WTP would use advanced treatment processes in addition to typical surface water treatment processes. Figure 5.03-1 shows a graphical representation or schematic of the treatment processes assumed, which include granular activated carbon contactors to remove polyfluoroalkyl substances and other potential emerging contaminants. Clearwell storage and a high service pumping station would be required to pump the treated water to the Ridge Road and US Route 6 area for distribution. Given the processes and facilities shown, the probable cost of the WTP in 2020 dollars is $61,922,000.

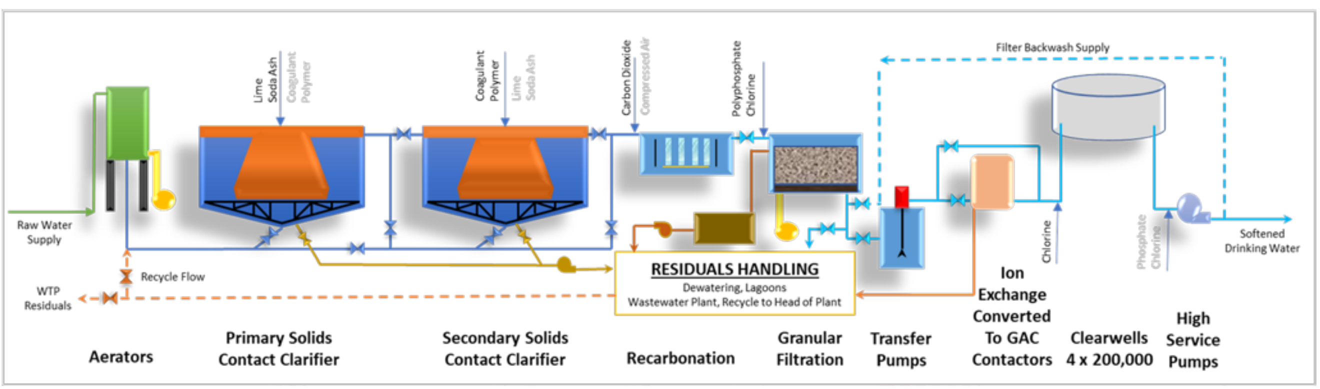


Figure 5.03-1 Conceptual Advanced WTP Schematic

With the WTP location selected and phasing determined, the intake and raw water pumping stations were located south of the WTP. Future wastewater treatment outfalls may have to be relocated further downstream, or, better yet, could outfall into the I&M Canal if regulating agencies allow. The intake, raw water pumping station, and raw water transmission main will be sized for the 10 MGD ultimate required capacity. The intake and raw water transmission main are anticipated to have a 2020 probable cost of $14,768,000.

Many system improvements may be necessary to convey water from the WTP throughout the distribution system. Currently, water is fed into the system at multiple locations from the various supply wells. When receiving all the water at one location, the current network of piping is not designed to distribute water throughout the Village. Therefore, some water main reinforcement and transmission mains will likely be required to maintain supply and pressure to all of the Village's water customers.

Additional storage will also be required under this alternative. This storage should be located in areas of higher demands or near major water users to assist in water turnover and reducing water age.

Figure 5.03-2 shows a possible schematic of this alternative emphasizing the infrastructure where cost is incurred.

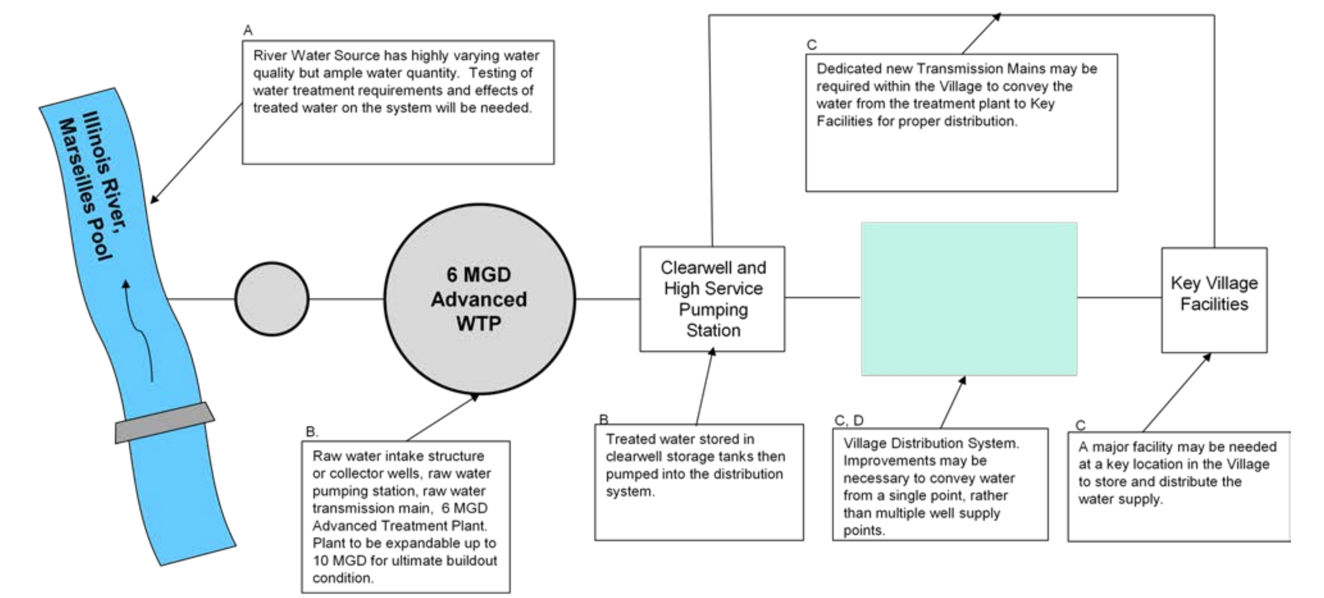


Figure 5.03-2 Conceptual Illinois River Water Supply Schematic

B. Water Quality

The water quality in the Illinois River fluctuates significantly throughout the year. This is due to environmental and climate factors like heavy rains, droughts, and snow melt. Human factors, such as salting operations and accidental, malicious, or negligent discharges and spills, can cause impacts to the river water quality. Many wastewater treatment plants (WWTP), essentially the entire Chicago-land area within and east of the DuPage River tributary, which can have an effect on the baseline water quality of the river. One advantage that the Marseilles Pool has over the Dresden Pool is the water quality is somewhat more consistent in the Marseilles Pool due to the mixing of the three tributary rivers, which occurs within the Dresden Pool. Although complete mixing is not necessarily achieved, the variability is lower in the Marseilles Pool.

Joliet performed research on the treatment required and requirements envisioned to use the Illinois River as a water source. Many major communities rely on rivers for potable water supply, so the Illinois River can be used to provide compliant potable water. Emerging contaminants would likely require an advanced treatment process, assumed to be granular activated carbon purification, to meet compliance. An 18-month pilot test and preliminary engineering study would be required to gain IEPA's acceptance that the plant processes can meet the variable raw water quality. This would entail constructing a small-scale plant to treat the river water with the proposed processes for an 18-month duration in attempt to show the processes can treat the water supply throughout the year with varying quality. Sampling, testing, and oversight would be extensive. This study is likely to cost approximately $2,000,000 in 2020 dollars.

A lead and copper corrosion control study will also be required to verify the finished water quality will not cause corrosion in the Village's distribution system. Because the Village will need to use the treated water from the pilot study previously described for the feed water in a test skid of harvested water pipes, the complexity would be significantly higher than with the Lake Michigan water supply option. This study is envisioned to cost $1,000,000 in 2020 dollars.

The raw water quality in the Illinois River's Marseilles Pool is significantly lower than Lake Michigan. Regulatory approval for its use would be arduous, but it is a possibility. Perhaps future management initiatives will help improve the raw water quality, and improvements in treatment technologies will improve finished water quality.

C. Sustainability and Water Quantity

Sustainability of the river is high. One concern with rivers as sources of water supply is the low flow periods on the river. During ISWS was consulted for input on the low flow period. For rivers and streams, IEPA determines the low flow condition as the lowest seven-day average flow occurring in a 10-year period, also referred to as the 7Q10 flow. Usually caused by extended drought, this flow amount would create the situation where withdrawals would need to cease from the river, and water users would need to find a different source of water until river flows increased.

The mean flow on the Illinois River in the Marseilles Pool is 6,486 MGD. The 7Q10 flow 1170 MGD, which is less than 20 percent of the mean flow. Compared with the Kankakee River, where low flows are less than 10 percent of the mean, this shows the support that the Lake Michigan supply and other supplements offer to bolster the rivers supply.

ISWS indicated that for the withdrawal amounts the Village is discussing, and the fact that the river upstream of the intake location is supported by Lake Michigan for navigation and many WWTPs, reaching low flow restrictions will be highly unlikely for the Village, but water quality during low flow conditions will likely be poor.

Regardless of the certainty of ample available water supply for the Village's needs, it will be recommended that the Village wells be maintained and available to be placed into service for either water quantity or water quality issues associated with the river.

D. Implementation Risk

The risks associated with implementing a river supply are higher than the other alternative. Regulatory approvals will be difficult. Separating the intake from potential sources of contamination or pollutants may add costs to the raw water transmission main and the raw water pumping. Environmentally sensitive areas, or contaminated corridors may add to the complexity, which the Village will have to overcome, unlike the other alternative.

E. O&M

O&M efforts and costs would increase with this alternative. The requirement to meet water quality standards is entirely the Village's responsibility. The cost for O&M of an advanced WTP is much higher than that of groundwater wells and associated treatment. More chemicals will need to be added, and more processes are involved resulting in more pumps and moving parts. It is envisioned that annual O&M of the WTP would at least double the Village's current operating costs. Annual O&M costs for the WTP are anticipated to be approximately $1,690,000 in 2020 dollars.

F. Control

This alternative would give the Village full control. All infrastructure is owned by and within the corporate limits of the Village. Decisions and approvals would be handled just as they are today with the Village's groundwater supply.

G. Hydraulic Modeling Results and Required Improvements

As with the Lake Michigan alternative, anticipated improvements needed to receive and deliver water throughout the Village must be assessed in order to determine. Using the hydraulic water model to simulate the alternative supply situation, improvements were added iteratively until adequate maximum day demand pressures and fire flows were available throughout the system. This analysis was conceptual with many assumptions, so if this alternative is further analyzed, additional detail and refinement of these improvements would be necessary.

The Village's water distribution system is fed water from two distinct locations in the geographical center of the Village. The Well Nos. 4 and 6 combination site is on McKinley Woods Road, and the Well Nos. 2, 3, and 5 combination site is in Heritage Lakes Subdivision. Therefore, the current water system is very capable of distribution of water from the center of the Village, along the DuPage River to the current eastern and western extents of the water system.

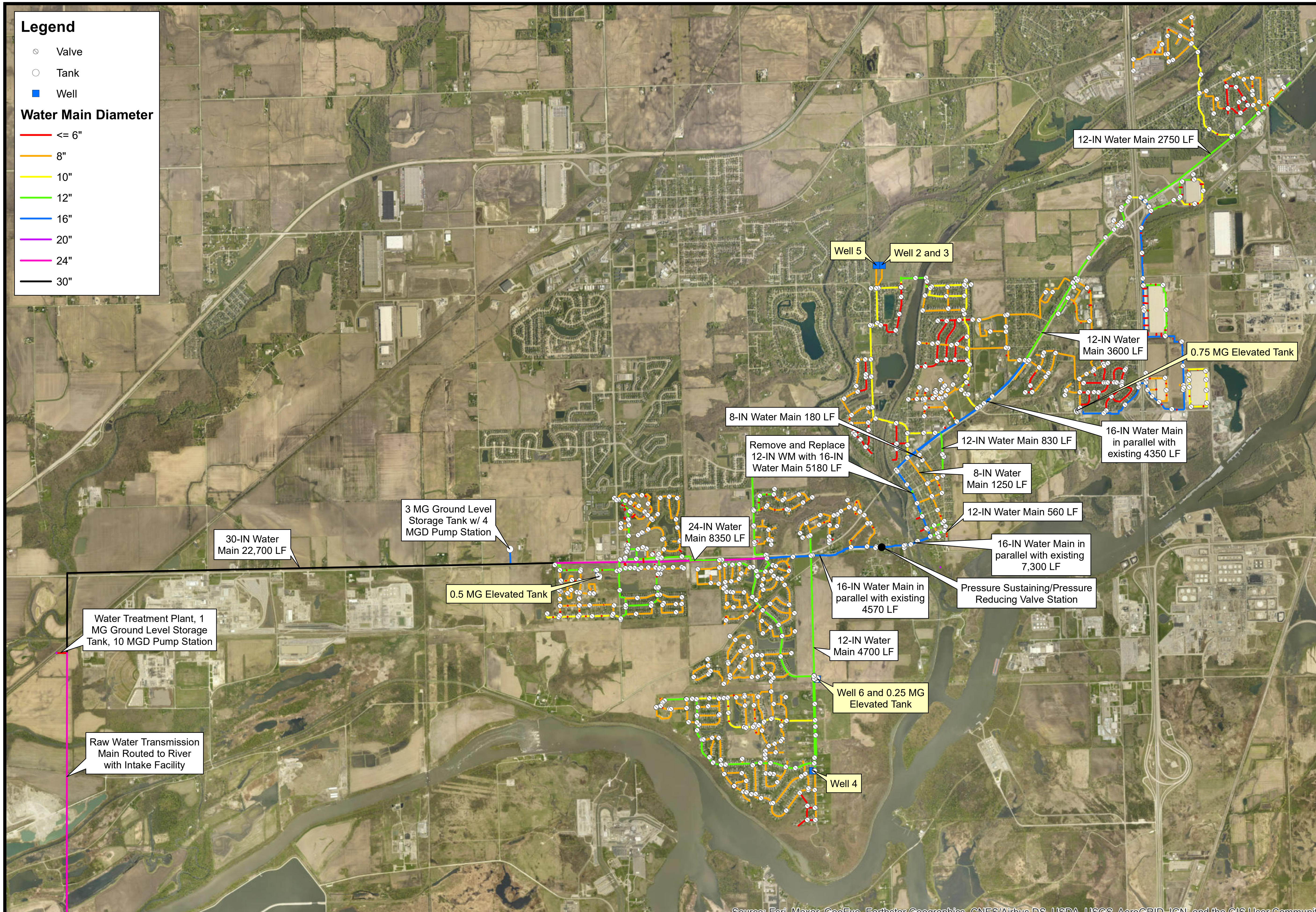
Because the Marseilles Pool is within the Village, this would be an easily accessible source. The potential Village property east of Tabler Road and south of US Route 6 was assumed to be the location of a new Advanced WTP. The WTP will initially be sized to treat the 2050 maximum day demand projections, plus the required 20 percent excess capacity, for a total treatment capacity of 6 MGD. The WTP would be upgradable in the future to meet the ultimate maximum day demand plus 20 percent for a 10 MGD total capacity.

With the WTP location selected, the intake and raw water pumping stations were located south of the WTP. Future wastewater treatment outfalls may have to be relocated further downstream, or, better yet, could outfall into the I&M Canal if regulating agencies allow. The intake, raw water pumping station, and raw water transmission main will be sized for the 10 MGD ultimate required capacity.

Following treatment, the water will be stored in a 1 MG clearwell before being pumped into the water system with a phased high service pumping station starting at 6 MGD, ultimately expanding to 10 MGD. A dedicated treated water transmission main will deliver the water to near Ridge Road. From Ridge Road, the hydraulic grade line will allow service to the extents of the system, however, to assist with emergencies and peak flows, a 3 MG storage tank and 7-MGD pumping station is added near Ridge Road. Also, because all demands east of the DuPage River will need to pass through the river corridor, a new 16-inch transmission main and pressure adjusting station will be needed parallel to the existing Bridge Street transmission main and station.

The previously listed facilities were added to the model and the ultimate build-out demand scenarios was simulated to determine water distribution system improvement required to convey the water supply. While facilities such as pumping stations and storage tanks can be phased in over time, so they can be smaller in the earlier growth years, water distribution piping should use the ultimate demands at build-out to size for buried piping anticipated useful life of 70 to 100 years.

Figure 5.03-3 shows the resulting facility and infrastructure needed to receive water from a regional water commission and convey it through the distribution system at adequate pressures and firefighting flows. Although some of the water main needed may be able to be installed by development at developers cost, this evaluation will assume that the timing will force the Village to install these segments. Table 5.03-1 summarizes the OPC for the improvements envisioned necessary to the Village's distribution system.



ILLINOIS RIVER AS FUTURE SUPPLY SOURCE

WATER MODEL CALIBRATION AND ALTERNATIVE WATER SUPPLY EVALUATION
VILLAGE OF CHANNAHON
GRUNDY AND WILL COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 5.03-3
6437.120

Facility Improvements			**OPC**
3-MG Storage Tank			$2,250,000
7-MGD Pumping Station			$1,400,000
Pressure Adjusting Station			$750,000
Subtotal Facility Improvement Costs			$3,650,000
		Contingency (20%)	$730,000
		Engineering and Legal (20%)	$730,000
		Total Facility Improvement OPC	**$5,110,000**
Water Main Improvements	**Cost per LF**	**Quantity**	**Cost**
8-inch Water Main Addition	$190	1430	$271,700
12-inch Water Main Addition	$230	12,440	$2,861,200
16-inch Water Main Addition	$300	16,830	$5,049,000
24-inch Water Main Addition	$460	8,350	$3,841,000
30-inch Water Main Addition	$510	22,700	$11,577,000
Subtotal Facility Improvement Costs			$23,599,900
		Contingency (20%)	$4,719,980
		Engineering and Legal (20%)	$4,719,980
		Total Water Main Improvement OPC	**$33,039,860**
		Total Village Distribution System Improvements	**$38,149,860**

Table 5.03-1 Internal Distribution System Improvements for the Illinois River, Marseilles Pool, via New Village-Owned Intake and WTP

These results are conceptual and conservative. Refinement will be necessary if this alternative is further pursued.

H. 2020 Opinion of Probable Capital Cost and Annual O&M Cost

Table 5.03-2 shows the compiled engineer's opinion of probable 2020 costs developed for this alternative. At this time, switching to the Illinois River, Marseilles Pool, for the source of the Village's water supply could result in capital costs of approximately $118,845,460 and a probable annual O&M cost of $2,880,000.

Item	Description	Capital Cost (2020 Dollars)	Annual O&M Costs (2020 Dollars)
A	Preliminary Engineering		
	River Water Treatment Pilot Study	$2,000,000	
	Lead and Copper Corrosion Control Study	$1,000,000	
		$3,000,000	
B	Raw Water Intake and Treatment		
	10-MGD Intake	$7,000,000	
	10-MGD Raw Water Transmission Main	$7,768,600	
	6-MGD Advanced WTP, Clearwell, and HS PS (2.5 MGD average)	$61,922,000	
	Annual O&M ($1.85/kgal)		$1,685,150
		$76,690,600	$1,685,150
C	Village Distribution System Improvements		
	Additional Storage and Pumping Facilities	$5,110,000	
	Distribution and Transmission Main Improvements	$33,039,860	
	Annual O&M (0.5% of capital cost per year)		$190,749
		$38,149,860	$190,749
D	Village Distribution System Operations		$1,005,000
Total Engineers OPC		**$118,845,460**	**$2,880,899**

Table 5.03-2 Illinois River Water Supply Alternative–Current Capital and Annual O&M Probable Cost

I. Conceptual OPC and Rate

Summarizing the probable costs associated with the implementation of switching to the Illinois River for the water supply, costs opinions were developed in 2020 dollars, for those improvements necessary to meet the 2050 demands. Because 2020 dollars were used to establish the cost opinions, a conceptual rate was developed using 2020 demands. Then, the probable cost for improvements and the conceptual rates were escalated to 2030 dollars and for 2030 demands. For consistency, a rate of increase of 3.5 percent was applied to the cost for inflation and construction, which matched recent studies by Joliet regarding regional water commission charges. The resulting conceptual water rates per 1,000 gallons are shown in Table 5.03-3.

Item	Description	Capital Cost[1]	Annual Cost[1,2]	2020 Rate Impact[3]	2030 Rate Impact[5]
1	Preliminary Engineering				
	River Water Treatment Pilot Study	$2,000,000	$108,800		
	Lead and Copper Corrosion Control Study	$1,000,000	$54,400		
		$3,000,000	$163,200	$0.60	$0.49
2	Raw Water Intake and Treatment[4]				
	10-MGD Intake	$7,000,000	$380,600		
	10-MGD Raw Water Transmission Main	$7,768,600	$422,400		
	6-MGD Advanced WTP, Clearwell, and HS PS	$61,922,000	$3,366,800		
	Annual O&M		$1,685,150		
		$76,690,600	$5,854,950	$21.61	$17.56
3	Village Distribution System Improvements				
	Additional Storage and Pumping Facilities	$5,110,000	$277,900		
	Distribution and Transmission Main Improvements	$33,039,860	$1,796,500		
	User Connection Fees[6]	($9,082,813)	($493,900)		
		$29,067,048	$1,580,500	$5.83	$4.74
4	Village Distribution System Operations			$3.57	$5.03
Total Conceptual Rate				**$31.62**	**$27.82**

[1]All costs and rates in 2020 dollars.
[2]Uses annual percentage rate of 3.5% and term of 30 years for payback.
[3]Uses assumed 2020 average day demand of 0.74 MGD.
[4]Capital Costs include 20 percent Professional Services and 20 percent Contingency.
[5]Uses 2030 dollars and 2030 average day demand.
[6]Assumes increase in PE of 17,470 (30,919 [year 2050]) to 13,479 [year 2020]) with 3.2 PE per connection and $5,000 fee per connection.

Table 5.03-3 Conceptual Water Rate Analysis for Illinois River–Marseilles Pool Water Supply

Comparison of the resulting conceptual rate with the current rate and the other alternative is provided in the next section.

5.04 ANALYSIS OF POSSIBLE RATE IMPACT

To understand the impacts of switching sources on the typical Village water customer, the conceptual rates calculated in the analysis was applied to a typical residential water customer bill. The typical residential water customer uses 5,000 gallons of water per month on average. For this water usage, they are currently charged $6.41 per 1,000 gallons used plus a $5 fixed fee. Therefore, the total monthly water bill is $37.05 on average. It should be noted that utility bills also include sanitary sewer and refuse and recycling that add to this water billing.

To remove the flat rate and develop an average “volumetric charge only” rate, the monthly average is divided by 5 kgal of usage that results in a weighted, volumetric only current rate of $7.41 per kgal. Escalating that to 2030 using an average 3.5 percent increase in water rates, when the new water supply being envisioned for this study, that would result in a rate of $10.45 per kgal or a monthly water bill of $52.26 for the average water user. This conceptual 2030 water rate assumes that the revenue generated by the 3.5 percent annual increases can maintain the current groundwater supply infrastructure, plus add any required new infrastructure.

The two alternatives that were evaluated resulted in 2030 conceptual rates which are very similar: $26.49 for Lake Michigan water via a regional water commission and $27.82 for Illinois River, Marseilles Pool water supply. These are approximately 5 percent different, which, at this phase of study, could be considered very similar costs, as supported by the similar results and costs in the 2020 capital cost analysis.

For the Lake Michigan via regional water commission, the resulting monthly water bill for the average water user could be $132.47 in 2030. For the Illinois River, Marseilles Pool water supply, the resulting monthly water bill for the average water user would be $139.12 in 2030.

Again, these rates are conceptual and based on many assumptions. Joliet continues to refine the regional water commission details and reduce the potential costs associated with that alternative. So, those costs are expected to reduce slightly.