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MEMORANDUM

TO: PLANNING COMMISSION

FROM: KEN ONDICH, PLANNING / COMMUNITY DEVELOPMENT DIRECTOR

SUBJECT: COMPREHENSIVE PLAN AMENDMENT – WATER SYSTEM MODELING & STUDY - PUBLIC HEARING

DATE: DECEMBER 11, 2024

As the Planning Commission is aware, the City Council adopted the new Comprehensive Plan at the October 21st, 2024 City Council meeting. As discussed, it was known that within a few months the plan would need to be amended to add in the Water System Modeling and Study as an appendix.

The New Prague Utility Commission adopted the Water System Modeling and Study at their meeting on November 25th. Staff is recommending that the Water System Modeling and Study be added to the new comprehensive plan as an appendix, similar to the Sanitary Sewer Feasibility Study.

<u>Staff Recommendation</u>

I recommend that the City Council hear the presentation and hold the required public hearing. I also recommend that the Planning Commission forward a recommendation for approval to the City Council regarding the amendment to the Comprehensive Plan.

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MEMORANDUM

Date: October 22, 2024

To: Bruce Reimers – New Prague Municipal Utilities

From: Mitchell Swanson, P.E.

Subject: Water System Modeling and Study - Summary
New Prague Municipal Utilities – New Prague, Minnesota
Project No.: 0M1.133584

The purpose of this memo is to summarize key points of the Water System Model and Study report which provides New Prague Municipal Utilities with relevant information regarding its water distribution system and recommendations for future improvements associated with the growing community. The report examined the existing 2024 water distribution system and the future 2044 water distribution system. Planned growth areas are based on the city's Comprehensive Plan. Population projections resulted in the following water demand projections.

Table 2.1 – Water Demands

Year	Population Projection	Projected Average Daily Demand (MGD)	Projected Maximum Daily Demand (MGD)
2024	8,768	0.833 (579 gpm)	1.749 (1,215 gpm)
2044	14,125	1.342 (932 gpm)	2.818 (1,957 gpm)

I. Design Criteria

Design requirements include the water supply wells' firm pumping capacity being equal to the maximum daily demand of the city. Firm pumping capacity is the total pumping capacity with the largest well out of service. Storage capacity requirements involve equalization storage for average daily demand and additional storage for fire protection. Pressure throughout the distribution system should stay above 35 psi during average daily demands and above 20 psi during maximum daily demands. Fire flow capacities should be 1,000 gpm for residential areas and 3,500 gpm is considered adequate for commercial and industrial areas; however, the fire marshal and ISO should be consulted to verify required capacities for insurance purposes. A water model of the existing and future system was developed to evaluate pressure and fire flow throughout the system.

II. Existing System Evaluation

The Public Utility operates the supply wells seen below in Table 3.1. The firm capacity of the wells is 2,410 gpm or 3.47 MGD. The existing distribution system's storage capacity was reviewed and determined to be deficient by 0.25 MG. Model results of the existing system show that pressures are within the recommended range and fire flows were above 1,000 gpm, except for the southwest pressure zone. Recommendations for the existing system are to add additional storage for fire flow capacity and improve fire flows to the southwest zone with larger pumps, a fire pump, or looping the southwest and southeast zones together. Looping is not anticipated to occur until the city has growth on the south side.

Table 3.1 – Supply Well Summary				
Well No.	**Feeds**	**Aquifer**	**Year Constructed**	**Capacity (gpm)**
1	WTP No. 1	Tunnel City	1925	510
2	WTP No. 1	Tunnel City	1938	400
3	WTP No. 1	Tunnel City	1948	500
4	WTP No. 2	Mt. Simon	1988	500
5	WTP No. 3	Tunnel City	2002	500
6	WTP No. 3	Mt. Simon	2007	1,000
			Total Capacity:	**3,410 gpm (4.91 MGD)**
			Firm Capacity:	**2,410 gpm (3.47 MGD)**

III. Future System Evaluation

The future system assumes that Water Treatment Plant No. 2 is decommissioned. Well No. 4 is a Mt. Simon well, in 2021, the DNR limited the construction of new Mt. Simon wells; therefore it is recommended this well be maintained. It was not, however, used in the following evaluation. Topographic maps were used to delineate pressure zone boundaries.

Evaluating the storage capacity showed that the future system requires 1.0 MG of additional storage capacity. Based on the maximum daily demands shown above, the recommended firm pumping capacity is 1,957 gpm.

Treatment Plants No. 1 and No. 3 meet the capacity of future maximum daily demand; however, if the largest well is out of service, the capacity of Treatment Plant No. 3 drops to 500 gpm. This results in the treatment plants pumping 1,500 gpm, which is less than the maximum daily demand. It is therefore recommended that an additional well be installed near Water Treatment Plant No. 3 with a minimum capacity of at least 500 gpm.

While Water Treatment Plant No. 1 may be maintained, it is prudent to keep land north of Water Treatment Plant No. 3 for expansion purposes when Treatment Plant No. 1 is eventually decommissioned. When Treatment Plant No. 1 is decommissioned, additional wells need to be added to Treatment Plant No. 3 with a minimum combined capacity of 1,500 gpm to meet future maximum daily demands and replace the wells supplying Treatment Plant No. 1. The capacity of Treatment Plant No. 3 would also need to be expanded by an additional 1,000 gpm for a total capacity of 2,000 gpm.

The model of the future system showed pressures were in the desired range and all fire flow capacities were above 1,000 gpm.

IV. Opinion of Probable Cost

The cost estimates provided in this section are preliminary cost estimates using 2024 costs. Water supply, storage, and treatment improvement costs should be evaluated during the preliminary engineering of each item.

Table 5.1 shows probable costs for water supply and storage improvements. While maintaining Treatment Plant No. 1 would save capital costs compared to expanding Treatment Plant No. 3, there is additional risk when using a facility that is over 84 years old and supply wells that are over 76 to 99 years old. As improvements are made, the condition and capacity of Treatment Plant No. 1 and the associated wells should be evaluated to determine the long-term viability of the supply and treatment. The land north of Water Treatment Plant No. 3 should be kept for expansion purposes when Treatment Plant No. 1 is eventually decommissioned.

While constructing a ground storage tank in the form of a clearwell would save capital costs, there are additional operation and maintenance costs associated with pumps required to pump the water into the distribution system and associated power consumption. The clearwell could be the site of the future Treatment Plant No. 3 expansion when Treatment Plant No. 1 is decommissioned. The storage tank costs utilized for this report should be re-evaluated at the time of design to ensure it is sized correctly and that the proper reservoir is constructed.

Table 5.1 – Opinion of Probable Cost – Water Supply and Storage

Item	Cost Estimate – Clearwell	Cost Estimate – Water Tower
Construct 1,000 gpm Well	$1,200,000	$1,200,000
0.5 MG Tower – South Zone	$3,750,000	$3,750,000
Alternative: 0.5 MG Clearwell [(1)] – Water Treatment Plant No. 3	$2,000,000	-
Alternative: 0.5 MG Tower – Water Treatment Plant No. 3	-	$4,250,000
Subtotal	**$6,950,000**	**$9,200,000**
25% Contingency	$1,750,000	$2,300,000
20% Admin/Engineering/Legal	$1,750,000	$2,300,000
TOTAL	**$9.5M – $11.5M**	**$12.5M – $15M**
[(1)] Ground storage tanks and clearwells have additional O&M costs associated with pump maintenance and power consumption compared to elevated storage tanks.		

Table 5.2 provides probable cost opinions to install the future watermains and includes mobilization, street restoration, and other associated costs; however, they do not account for smaller diameter lateral watermains and service lines to homes and businesses associated with future developments.

Table 5.2 – Opinion of Probable Cost - Watermain		
Watermain Size	**Linear Feet**	**Cost Estimate**
6-inch	1,480	$140,000
8-inch	309,220	$29,380,000
10-inch	116,660	$11,670,000
12-inch	23,720	$2,500,000
16-inch	160	$30,000
	Subtotal	**$43,720,000**
25% Contingency		$10,000,000
20% Admin/Engineering/Legal		$10,000,000
	TOTAL	**$60M – $65M**

Table 5.3 provides cost opinions for the expansion of the 10th Ave. booster station improvements and additional PRV stations. The 10th Ave. booster station improvements involve replacing the existing pumps with slightly larger pumps, removing the pressure tank, adding fire pumps, replacing pipe and valves, and electrical improvements. The PRV station costs include the structure, pressure reducing valve, piping, and isolation valves.

Table 5.3 – Opinion of Probable Cost –Booster Station, and PRV	
Item	**Cost Estimate**
10th Ave. Booster Station Improvements	$500,000
PRV Structure and Valve (approx. $60,000 each)	$250,000
Subtotal	**$750,000**
25% Contingency	$200,000
20% Admin/Engineering/Legal	$200,000
TOTAL	**$1M – $1.5M**

If Water Treatment Plant No. 1 is decommissioned, then Treatment Plant No. 3 should be expanded to increase its capacity by 1,000 gpm. Table 5.4 provides cost opinions for the expansion of Water Treatment Plant No. 3. This includes additional building space, filter equipment, and electrical equipment.

Table 5.4 – Opinion of Probable Cost – Water Treatment Expansion	
Item	**Cost Estimate**
Water Treatment Plant No. 3 Expansion	$10,000,000
Subtotal	**$10,000,000**
25% Contingency	$2,500,000
20% Admin/Engineering/Legal	$2,500,000
TOTAL	**$13.5M – $16.5M**

V. Phase Implementation

Planning for significant infrastructure requires a robust capital improvements plan (CIP) to couple proper timing of new and replacement system components with the ability to absorb associated costs. A three-phase approach is recommended to balance financial preparedness with the needs described in this report. Note an updated rate study is often necessary to align income with proposed system improvement expenditures.

Phase I includes the construction of a supply well and clearwell at Water Treatment Plant No. 3 and the expansion of the water distribution system in the immediate five-year horizon. In the following 10 years, the city should plan to address Phase II, which includes additional storage needs and further expansion of the distribution system. This sequencing allows the funding source time to build adequate funds. Phase III includes any improvements to the distribution system that remain after 15 years. This phasing assumes Treatment Plant No. 1 is maintained and an expansion of Treatment Plant No. 3 is not required until after this phasing sequence.

Note that increasing pipe size in the network is a substantial part of the future need. It is typically most efficiently accomplished by incorporating it into future street reconstruction projects to the extent possible. Pipe sizing in growth areas can simply incorporate recommended diameters as part of the initial street and municipal infrastructure construction. Storage and pressure boost components may need to be accelerated to permit growth in certain areas.

Table 6.1 – Recommended Phasing of Water System Improvements	
Phase I - Supply Well, Clearwell, and Water Distribution Expansion	$25M
Phase II - Additional Tower and Further Distribution Expansion	$25M
Phase III - Remaining Improvements to Distribution System	$25M
Total Anticipated Probable Costs Over Next 20+/- Years	**$75M**

Water System Modeling and Study

New Prague Municipal Utilities | New Prague, Minnesota

0M1.133584

October 22, 2024

Real People. Real Solutions.

Submitted by:
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Certification

Water System Modeling and Study

For

New Prague Municipal Utilities
New Prague, Minnesota
0M1.133584

October 2024

PROFESSIONAL ENGINEER
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: Mitchell Swanson
Typed or Printed Name: Mitchell Swanson
Date: 10/22/2024 License Number: 57833

Reviewed by:
Signature: D. Joseph Duncan II
Typed or Printed Name: D. Joseph Duncan, P.E.
Date: 10/22/2024 License Number: 26100

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I. INTRODUCTION

A. PURPOSE

The purpose of this report is to provide New Prague Municipal Utilities with relevant information regarding their water distribution system and recommendations for future improvements associated with the growing community. Recommendations are based on input from utility staff and an evaluation of water system requirements in accordance with the current recommended design practices. New Prague Municipal Utilities may utilize the information gathered in this report to establish priorities, plan, fund, and implement future water system improvements.

This study evaluates the following:

- The existing distribution system and recommended improvements
- A future system for planned growth areas and needed improvements

B. REPORT ORGANIZATION

This report is structured in six sections to adequately address New Prague Municipal Utilities' existing water system and future needs. Section I is the introduction; Section II describes the design criteria used to evaluate the system; Section III outlines the existing water system and the ability of the current water system to meet existing water demands and performance requirements; Section IV presents an evaluation of the proposed future water system and the ability of the proposed water system to meet future water demands and performance requirements; Section V presents 2024 cost estimates for the proposed improvements; and Section VI outlines a schedule for the phasing of the proposed improvements.

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II. WATER SYSTEM DESIGN CRITERIA

A. GENERAL

This section develops the performance criteria under which the water system will be evaluated and designed. This involves an evaluation of historical water use, water supply, and storage requirements, required fire flows, and distribution system pressure requirements. This section will form the design basis of the Water System Study. A water model of the New Prague Public Utilities water distribution system was developed to simulate the performance of the water distribution system. The water model will be instrumental in identifying issues with the existing distribution system and expanding the system for future developments in the city.

B. DESIGN PERIOD

Typically, water systems and the infrastructure are designed for a 20-year design period, as there are significant capital improvements required to improve hydraulic capacity, efficiency, or replace process components. Therefore, the design period for this study will go through 2044.

This plan should be revisited and updated as necessary to ensure that the system implementation is keeping pace with development, forecasted populations, and water demands. Generally, every 10 years the recommendations and capital improvements should be refined based on new data and population projections.

Another tool that is useful for water use planning purposes is the Minnesota Department of Natural Resources (DNR) Water Supply Plan (WSP). The WSP is required every 10 years by each community serving more than 1,000 people. The WSP must be approved by the DNR, and the Metropolitan Council as required by law. Since the WSP is also required every 10 years, it is recommended the utility review this study and its proposed improvements when preparing the WSP. New Prague's last WSP was done in 2019, so the next one will be due in 2029.

C. PLANNING AREA

The utility provided planned growth areas as shown in the city's Comprehensive Plan and a future land use map to define the planned growth areas.

D. POPULATION AND WATER DEMAND

Historical water demand was provided by the utility and reviewed in the 2019 Water Supply Plan. The WSP shows an average per capita demand of 95 gallons per capita per day to account for all residential, commercial, and industrial flows. This per capita demand is used with the population projections to project future average daily demands. The WSP shows an average peaking factor of 2.1 for the last five years of data, this is used to predict maximum daily demands from average daily demand projections. The 2019 WSP also showed that demand is typically 65% for residential and 35% for commercial and industrial use.

Future projections for water usage are based on New Prague's 2019 Water Supply Plan's growth rate for future projections of approximately 2.4% annually. The latest population estimate from the Minnesota State Demographics Center's population estimates for the City of New Prague was used as a starting population for the projections. The latest population estimate was for 2022, as seen in the projection table below. These projections are used to determine future water use and go through 2044 for the 20-year design period. The current 2024 average daily demands are estimated at 0.833 MGD with maximum daily demands of 1.749 MGD. Future 2044 average daily demand is estimated at 1.342 MGD with a maximum daily demand of 2.818 MGD. Population projections and the associated water demands are summarized in Table 2.1.

Table 2.1 – Water Demands			
Year	**Population Projection**	**Projected Average Daily Demand (MGD)**	**Projected Maximum Daily Demand (MGD)**
2022	8,340	0.792	1.664
2023	8,552	0.812	1.706
2024	8,768	0.833 (579 gpm)	1.749 (1,215 gpm)
2025	8,990	0.854	1.793
2026	9,216	0.876	1.839
2027	9,447	0.897	1.885
2028	9,683	0.920	1.932
2029	9,924	0.943	1.980
2030	10,170	0.966	2.029
2035	11,473	1.090	2.289
2040	12,898	1.225	2.573
2044	14,125	1.342 (932 gpm)	2.818 (1,957 gpm)

It is important to consider changing trends in the amount of growth expected in the industrial and commercial sectors. The 95 gallons per capita per day includes commercial and industrial flows based on when the City of New Prague maintains the current distribution of 65% residential use and 35% commercial use; however, if the ratio changes, then demand projections will need to be updated.

E. WATER SYSTEM REQUIREMENTS

1. Water Supply Requirements

A general engineering practice to determine the required water supply capacity is to ensure that the firm pumping capacity of the wells is sufficient to meet the maximum daily demand. Firm capacity is defined as the sum capacity of all wells, with the largest well out of service.

2. Storage Requirements

The principal purpose of storage is to provide the ability to equalize pumping rates during periods of variable rate demand and to provide water for emergency fire service. Adequate storage allows a reduction in the size of the pumps required to supply a community because peak demands are diminished by the reserve provided in storage. Storage is typically provided in elevated tanks for communities the size of New Prague, to provide storage and a pressure source while the wells are not pumping. A good rule of thumb is to have sufficient storage so that average daily demand turns over the water within a couple of days to prevent freezing during the winter season.

The primary reasons for providing water storage are as follows:

- To equalize pressure in the distribution system.
- Provide water for fire protection.
- Other emergency reserve requirements (pump failure, power failure, etc.)

The typical design approach is to consider the recommended minimum storage volume for each storage component of equalization, fire demand, and emergency reserve, then sum the equalization volume and the larger volume of fire protection or emergency volume, as it is unlikely that water would be required for multiple emergencies at any given time. Storage for equalization is recommended to equal average daily demand. Storage for fire protection depends on zoning with a standard for residential areas being 3,500 gpm for 3 hours based on the International Organization for Standardization (ISO) Public Protection Classification grading for insurance purposes. Storage for emergency use is recommended to be equal to 60 percent of the average daily demand; however, emergency storage recommendations may be mitigated with backup generators.

3. Watermain Sizing Requirements

Ten States Standards recommends a minimum watermain size of 6 inches for providing fire protection and serving fire hydrants, with larger mains required, if necessary. In addition, velocities in long watermain segments should be between 2 and 10 feet per second (fps) with average flows less than 5 fps, with 10 fps being acceptable during emergency withdrawals for short durations.

4. Pressure Requirements

Water pressures are subject to individual preference. What some may view as adequate pressure may be viewed as too much or too little pressure. Municipalities are challenged with balancing pressure with demand and capacity of the system along with the conservation of water. Typically, higher pressures equate to higher flow rates but increase the volume of water lost through cracked and broken pipes.

Ten States Standards recommends the minimum working pressure in the distribution system to be 35 psi with normal working pressures ranging from 60 to 80 psi. The Minnesota Department of Health (MDH), along with Ten States Standards, requires the system to maintain a minimum pressure of at least 20 psi at ground level at all points in the distribution system under all flow conditions. This ensures there is adequate water pressure in the event of a long-term power failure or during an emergency.

5. Fire Flow Recommendations

Recommended available fire flow is determined by the International Organization for Standardization (ISO) and varies based on building size and occupancy. The minimum recommended fire flow for residential areas is 1,000 gpm; however, dead-end watermains and small-diameter watermains may not be able to achieve these flow rates. Generally, a fire flow of 3,500 gpm is considered adequate for commercial and industrial areas; however, the fire marshal and ISO should be consulted to verify the actual required fire flow for insurance purposes.

F. WATER DISTRIBUTION MODEL

A water model for the New Prague Public Utility's water distribution system was developed using Innovyze's InfoWater Pro 2024 water modeling program. The model is used to identify problem areas in the existing system and to show the impacts of future improvements to the system. Possible issues with the existing system include areas with pressures above or below the recommended pressure levels, pipes with high velocities or headloss, and inadequate fire flow protection. The existing system's performance is discussed in Section III and the proposed future system's performance is discussed in Section IV. The models are used to create distribution system maps, pressure maps of average daily demands and maximum daily demands, and maximum daily demand's fire flow maps as provided in Section III and Section IV. The water model may be used as a tool to evaluate whether additional infrastructure is required in the distribution system.

III. EXISTING WATER SYSTEM

A. GENERAL

The New Prague water system consists of six (6) active wells, three (3) water treatment plants, two (2) elevated storage tanks, two (2) booster stations, one (1) pressure reducing valve (PRV), and a system of trunk and lateral watermains varying in sizes from 6 inches to 16 inches. There is also one (1) ground storage tank that is not utilized. The New Prague water system consists of three (3) pressure zones - there are two small pressure zones located on separate hills, and both are fed through booster stations from the main pressure zone. The pressure zones are separated by the booster stations, closed valves, and the PRV. The existing watermain distribution system and major water system infrastructure are presented in Figure 3.1.

B. WATER SUPPLY

The Public Utility supplies drinking water from six groundwater wells. Wells 1, 2, 3, and 5 draw water from the Tunnel City (previously called the Franconia Ironton Galesville FIG) Aquifer. Wells 4 and 6 draw water from the Mt. Simon Aquifer. Wells 1, 2, and 3 send water to Water Treatment Plant No. 1. Well No. 4 sends water to Water Treatment Plant No. 2. Wells 5 and 6 send water to Water Treatment Plant No. 3. Table 3.1 summarizes the wells and their capacity. The typical life span for a municipal well is approximately 40 to 60 years without significant rehabilitation. Wells 1, 2, and 3 have exceeded the typical life span and Well No. 4 is approaching the lower end of a typical life span.

Table 3.1 – Supply Well Summary

Well No.	Feeds	Aquifer	Year Constructed	Capacity (gpm)
1	WTP No. 1	Tunnel City	1925	510
2	WTP No. 1	Tunnel City	1938	400
3	WTP No. 1	Tunnel City	1948	500
4	WTP No. 2	Mt. Simon	1988	500
5	WTP No. 3	Tunnel City	2002	500
6	WTP No. 3	Mt. Simon	2007	1,000
			Total Capacity:	**3,410 gpm (4.91 MGD)**
			Firm Capacity:	**2,410 gpm (3.47 MGD)**

Firm well capacity is defined as the total pumping capacity of the wells with the largest well out of service. New Prague's firm well capacity is 2,310 gpm or 3.33 MGD, which exceeds the city's existing maximum daily demand of 1.749 MGD. Therefore, New Prague's Municipal Utilities has sufficient supply well capacity and no additional supply wells are needed for the existing system.

C. WATER STORAGE FACILITIES

The Public Utility has two active storage tanks, both are 0.5 MG each for a total of 1.0 MG. There is also a 0.5 MG ground storage tank that is not currently in use.

Water storage requirements for the Public Utility using the approach described in Section II are summarized in Table 3.2. This analysis shows New Prague's existing system is deficient by 0.25 MG.

Table 3.2 – Existing System Storage Evaluation

		Current System
Fire Demand (gpm)		3,500
Maximum Daily Demand (gpm)	+	1,215
Total Coincident Demand (gpm)	=	4,715
Firm Supply (gpm)(1)	-	2,410
Withdrawal from Storage (gpm)	=	2,305
Fire Flow Duration (minutes)	x	180
Firefighting Storage (MG)	=	0.41
Equalizing Storage (average daily demand)	+	0.83
Total Storage Required (MG)	=	**1.25**
Available Storage (MG)	-	1.00
Storage Deficit (MG)	=	**0.25**

(1) Assumes existing firm capacity with all existing wells included, excluding the highest capacity well.

D. WATER TREATMENT FACILITIES

The Public Utility treats raw water at three (3) water treatment plants. Water Treatment Plant No. 1, the Main Street plant, is a pressure filter system with a capacity of 1,000 gpm that treats water from Wells 1, 2, and 3. Water Treatment Plant No. 2, the north plant, is a gravity filter system with a capacity of 500 gpm that treats water from Well No. 4. Water Treatment Plant No. 3, the south plant, is a gravity filter system with a capacity of 1,000 gpm that treats water from Wells 5 and 6. The water treatment plants have a combined total capacity of 2,500 gpm. Assuming the largest well is out of service, Water Treatment Plant No. 3 has a firm capacity of 500 gpm, making the firm capacity of all treatment plants 2,000 gpm. This shows that the treatment capacity of the facilities exceeds the current maximum daily demand.

Water Treatment Plant No. 1 was built in 1940, Plant No. 2 was built in 1988, and Plant No. 3 was built in 2002. Treatment facilities generally require improvement projects every 20 years to replace equipment and major improvements every 40 years to rehabilitate or improve structures. Treatment Plant No. 1 is over 80 years old, Treatment Plant No. 2 is nearing 40 years, and Plant No. 3 just passed 20 years of age. Water Treatment Plant No. 1 had an improvements project in the last 10-years. Treatment Plant No. 2 is in line with needing major improvements and Treatment Plant No. 3 with an improvement project to replace aging equipment.

E. WATER DISTRIBUTION SYSTEM

The existing distribution system consists of watermains varying from 6 to 16 inches in diameter. The existing system is split into three pressure zones. The static high-water level is 1,159.5 feet above mean sea level for the main north pressure zone. The other two zones are small zones fed by booster stations from the north zone and contain pressure tanks to maintain the desired pressures for those zones. The southeast pressure zone has a pressure reducing valve (PRV) that allows water to flow back into the main pressure zone should pressure in the main zone drop below the pressure setting of the PRV.

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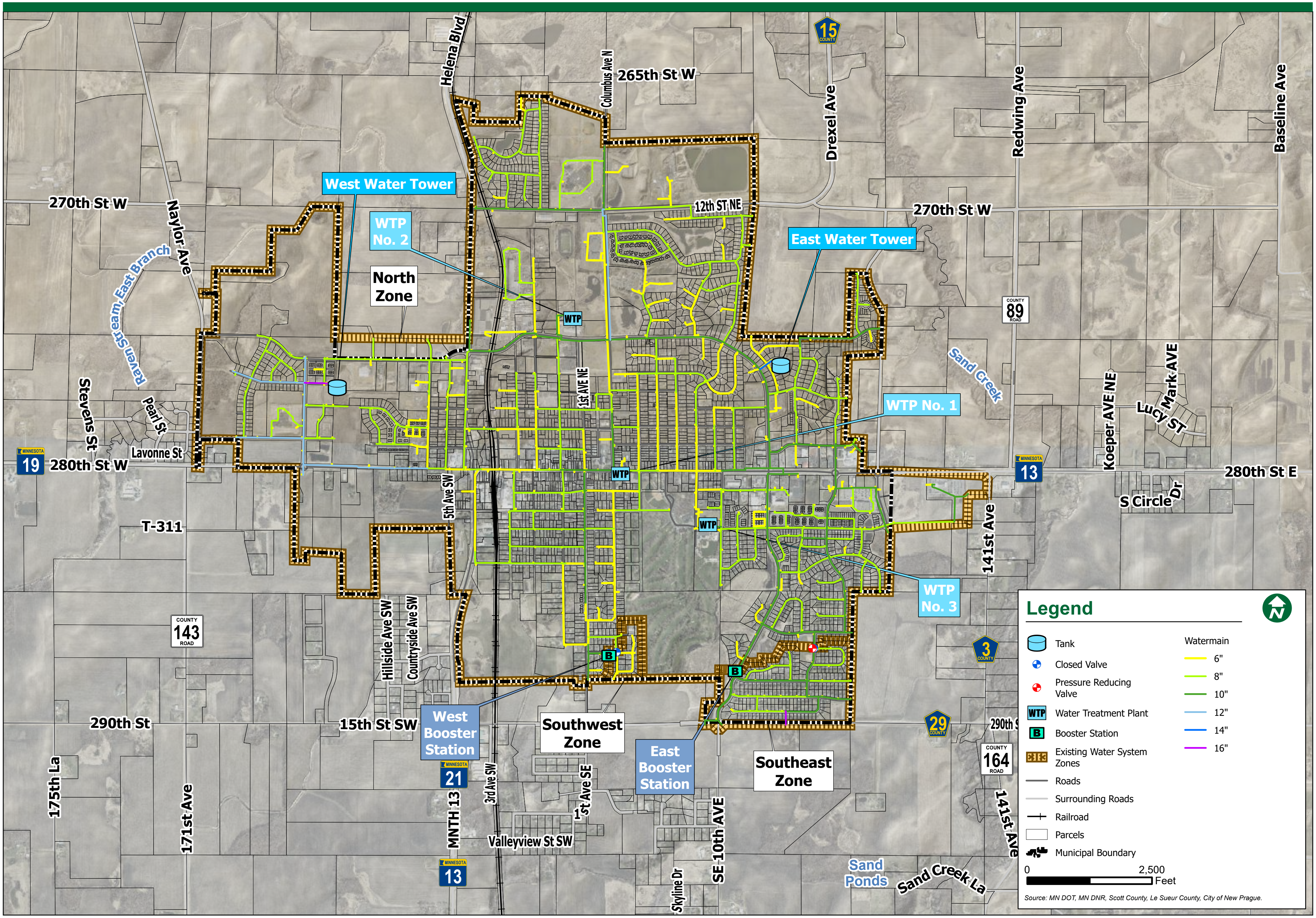
Figure 3.1- Existing Water Distribution System

October 2024



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F. EXISTING SYSTEM WATER MODEL

The existing system water model was developed to simulate the existing average daily demands and maximum daily demands. Figure 3.1 shows a map of the existing system's watermain sizes and major water system infrastructure.

1. Model Development

Watermain and water infrastructure were imported or otherwise added to the model. The distribution system network was reviewed for proper connections between the watermain, and the Public Utility was contacted to verify questionable intersections where the watermain may cross over instead of connecting. Tank water levels and pump settings were entered into the model elements.

Water demand was entered by providing specific demand to top users throughout the distribution system. The remaining demand was distributed between residential users and commercial/industrial users based on the land use map.

The model was then calibrated in comparison to hydrant tests that were conducted on June 25, 2024. Calibration results show that the model is a good approximation of the Public Utility's water distribution system. Once the model was calibrated, the existing system was analyzed for pressure, fire flow, pipe headloss, and flow velocities.

2. Model Results

The model shows pressures within the desired pressure range throughout the system for both average daily demand and maximum daily demand. Pressure results are summarized in Table 3.3. Figures 3.2 and 3.3 show the average daily demand pressure and maximum daily demand pressure for the existing system, respectively.

Table 3.3 – Existing System – Pressure Results

Pressure Zone	Pressures (psi)	
	Average Daily Demand	Maximum Daily Demand
North (Main) Zone	49 - 89, Avg. 70 ±7	43 - 83, Avg. 63 ±7
Southwest Zone	52 - 63, Avg. 56 ±3	47 - 58, Avg. 51 ±3
Southeast Zone	61 - 82, Avg. 71 ±5	57 - 77, Avg. 67 ±5

Available fire flow in the main north zone and southeast are over 1,000 gpm for all hydrants. The southwest zone consists of only six hydrants, four of which are below 1,000 gpm. Available fire flow results are summarized in Table 3.4. Figure 3.4 displays the maximum daily demand fire flow of the existing system.

Table 3.4 – Existing System – Fire Flow Results

Pressure Zone	Fire Flow
	Maximum Daily Demand
North (Main) Zone	1,000 - 5,000+, Avg. 3,400 ±1,100
Southwest Zone	700 - 1,700, Avg. 1,000 ±300
Southeast Zone	1,300 - 4,900, Avg. 2,400 ±700

Flow velocities are within acceptable ranges during maximum daily demands. There is elevated head loss, greater than 10-ft/1,000-ft headloss, along the discharge line of Water Treatment Plant No. 3 during maximum daily demands with all three pumps running. However, this is not the typical operation of the system, and elevated headloss for short periods of time is acceptable.

3. RECOMMENDED SYSTEM IMPROVEMENTS

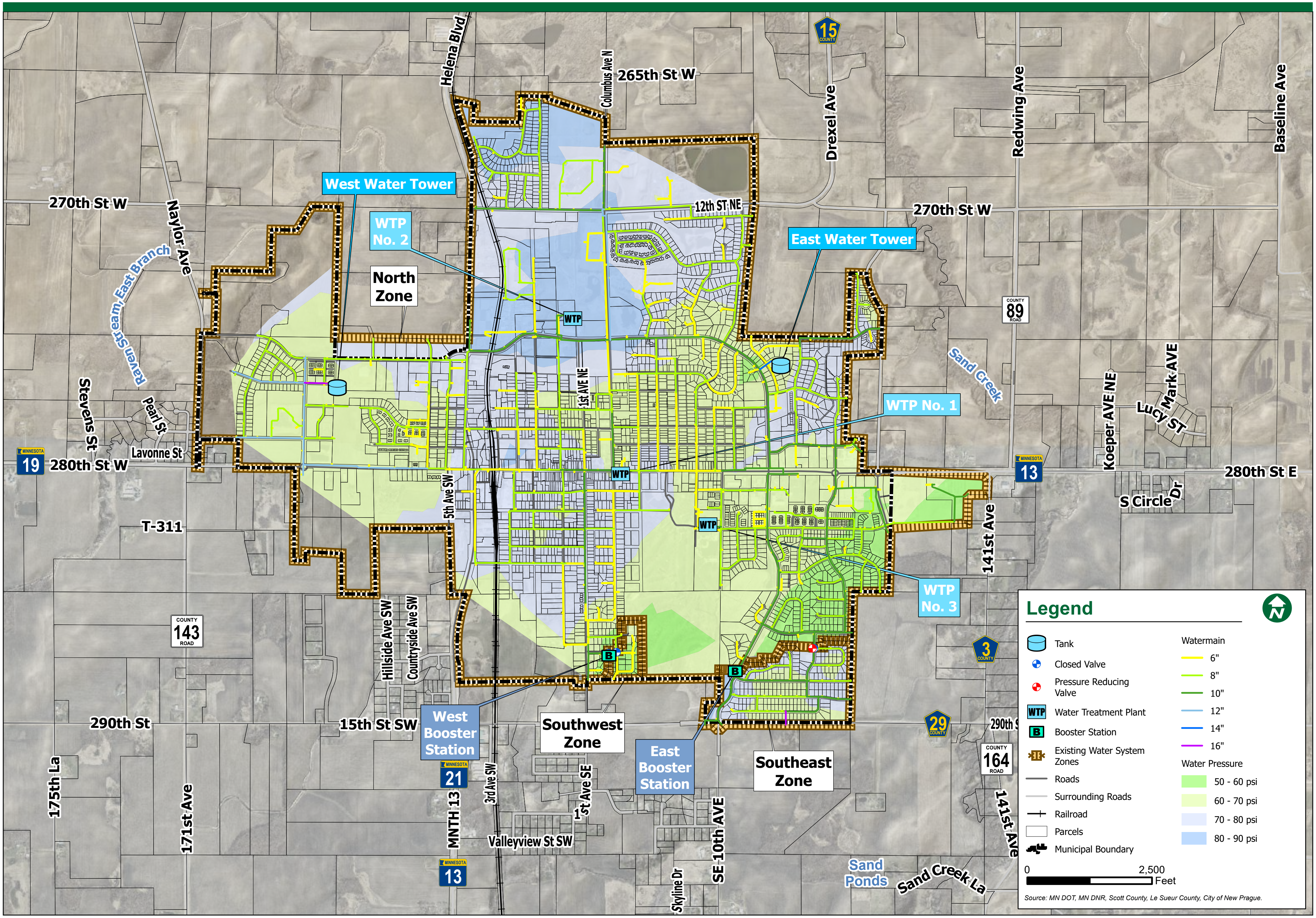
The model shows pressures throughout the distribution system are within acceptable ranges. Fire flow results show a few hydrants with fire flows below 1,000 gpm, all of which are in the southwest zone. Fire flows in the southwest zone could be improved by larger booster station pumps, the addition of a fire pump, or the consolidation of the southwest and southeast pressure zones into a combined southern pressure zone.

The storage analysis shows that the Public Utility is deficient by 0.25 MG in order to provide sufficient water for average daily demands and have additional storage for fire protection or other emergencies.

Figure 3.2 - Existing System - Average Daily Demand - Pressure

October 2024

BOLTON & MENK



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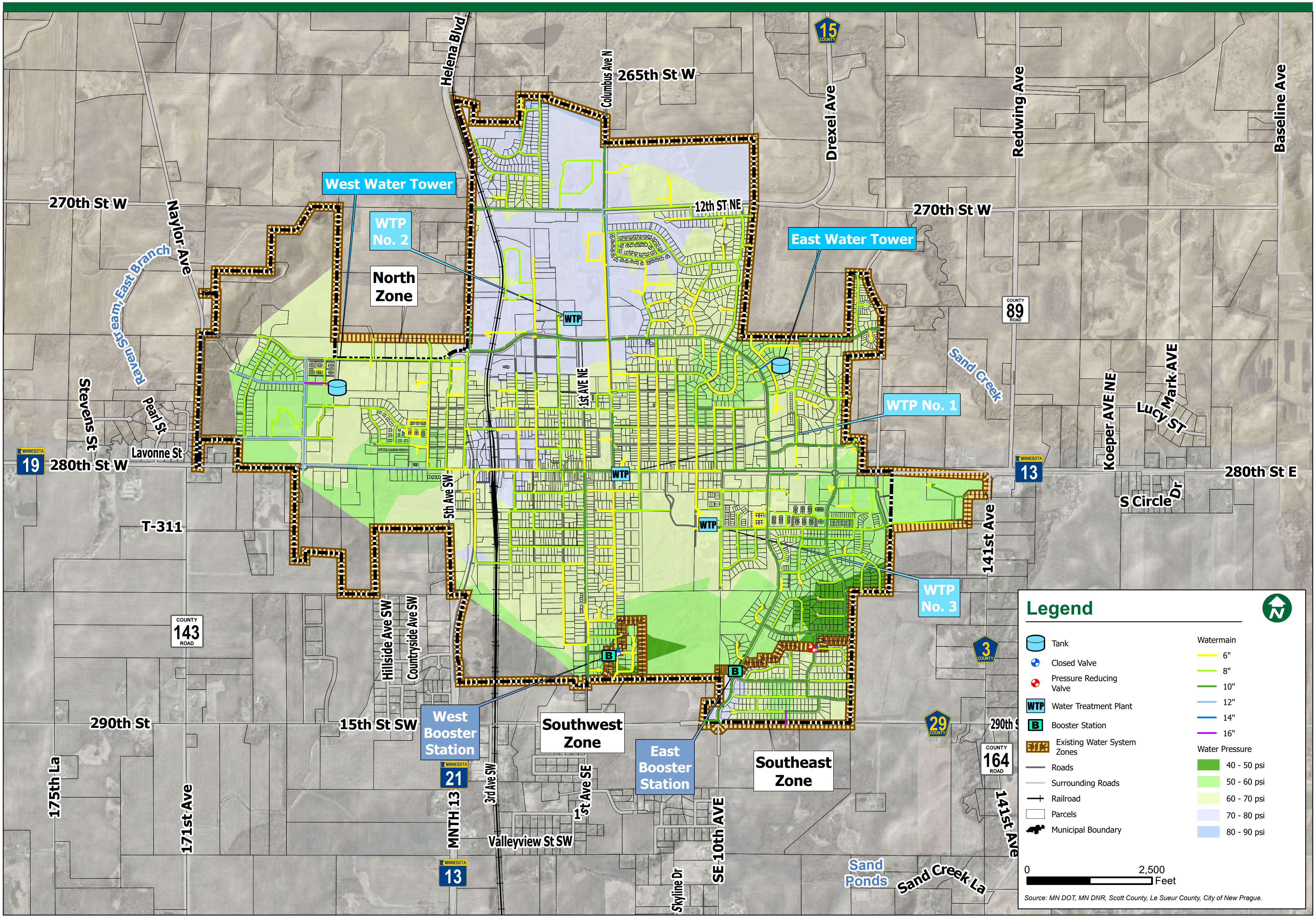
Future Water Systems Model

New Prague Municipal Utilities

Figure 3.3 - Existing System - Maximum Daily Demand - Pressure

October 2024

BOLTON & MENK



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Future Water Systems Model

New Prague Municipal Utilities

Figure 3.4 - Existing System - Maximum Daily Demand - Available Fire Flow

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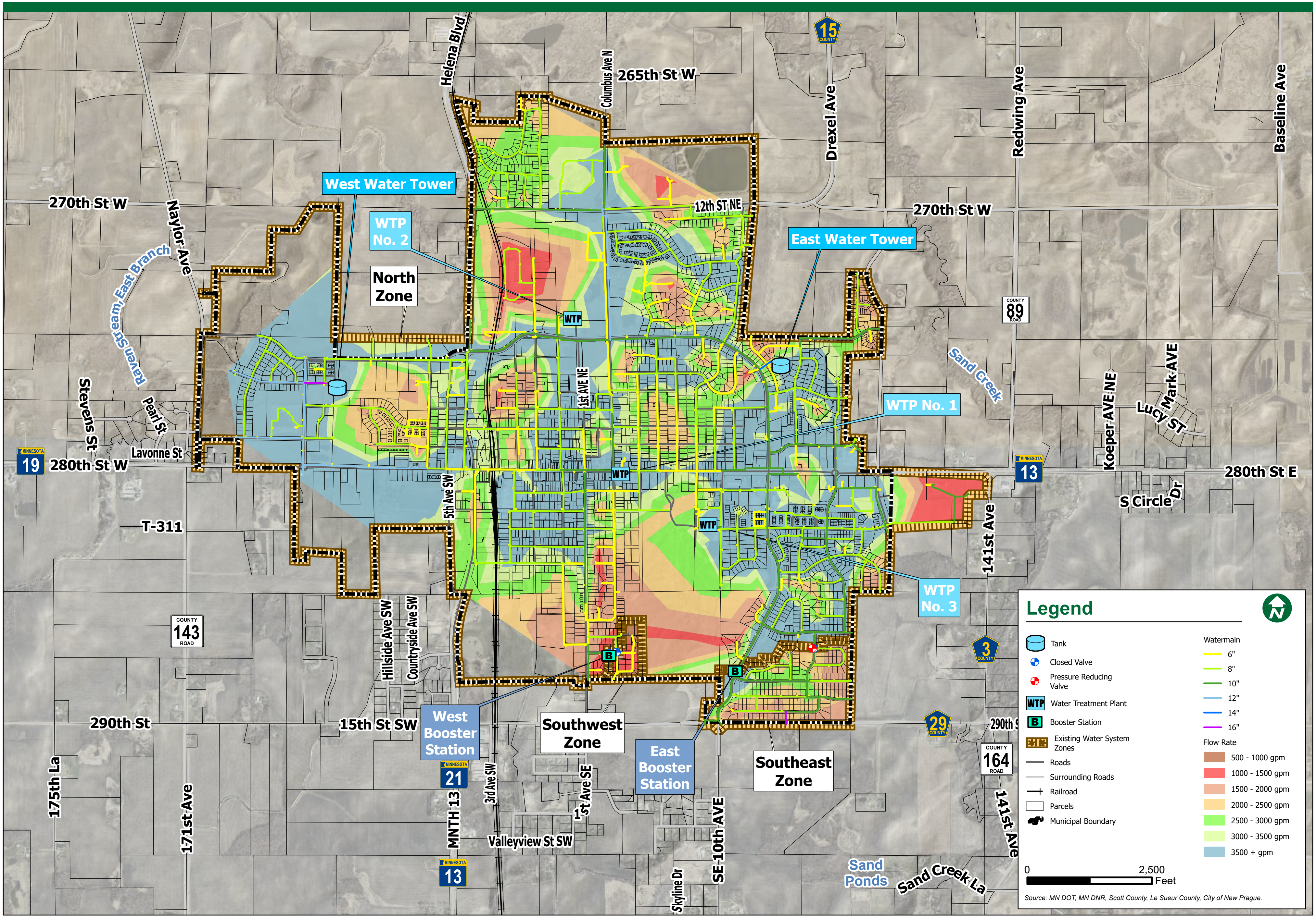

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IV. FUTURE WATER SYSTEM

A. GENERAL

This section details the proposed future water system for New Prague's planned growth areas and the infrastructure required to serve the proposed demand. The proposed improvements are based on the projected water demands and design criteria discussed in Section II.

The future water model assumes that Water Treatment Plant No. 2 is decommissioned due to the age of the facility. The wells associated with this treatment plant may have a raw watermain installed to route the raw water to Water Treatment Plant No. 1 or No. 3, or the well may be sealed and abandoned. This report assumes that Well No. 4 and the ground storage tank near Water Treatment Plant No. 2 are not used. Well No. 4 is a Mt. Simon well, in 2021 the DNR limited the construction of new Mt. Simon wells; therefore, it is recommended this well be maintained.

By evaluating topographic maps and the proposed growth areas, it was determined that the two small pressure zones may be joined, along with the southern growth area, to make a two-pressure zone system. Therefore, the future system consists of the main north pressure zone and a south pressure zone. A topographic map showing the proposed break-line between the pressure zones is provided in Figure 4.1.

B. WATER SUPPLY

Recall that it is desirable to maintain a firm well capacity (capacity with the largest well out of service) greater than the projected maximum daily demand. The utility's recommended firm capacity for the future system is 2.818 MGD or approximately 1,957 gpm.

As stated above, the status of well no. 4 needs further consideration. Since the city has multiple wells and multiple treatment plants it is important to look at the capacities of each treatment plant along with the capacity of the associated wells. Water Treatment Plant No. 1 has a capacity of 1,000 gpm, the associated wells have a total capacity of 1,410 gpm and a firm capacity of 900 gpm. Water Treatment Plant No. 3 has a capacity of 1,000 gpm, the associated wells have a total capacity of 1,500 gpm and a firm capacity of 500 gpm. The capacity of the treatment plants combined exceeds the future maximum daily demand. However, if the largest well is out of service the capacity of Treatment Plant No. 3 drops to 500 gpm. This results in the treatment plants having a firm pumping capacity of 1,500 gpm, which is less than the maximum daily demand. Therefore, it is recommended that an additional well be installed near Water Treatment Plant No. 3 with a minimum capacity of 500 gpm.

Alternatively, Treatment Plant No. 1 and No. 2 may be decommissioned and Treatment Plant No. 3 expanded to meet future maximum daily demands. In this case, Wells No. 1, No. 2, and No. 3 are decommissioned and the status of Well No. 4 needs further consideration. Wells No. 5 and No. 6 have a firm capacity of 500 gpm, therefore, additional supply wells with a combined capacity of 1,500 gpm are recommended to be added to the future system. This would give the future system a firm capacity of 2,000 gpm and a total capacity of 3,000 gpm at Treatment Plant No. 3.

While Water Treatment Plant No. 1 may be maintained, it is prudent to keep land north of Water Treatment Plant No. 3 for expansion purposes when Treatment Plant No. 1 is eventually decommissioned.

C. WATER STORAGE FACILITIES

Water storage requirements for the proposed future system using the approach described in Section II are summarized in Table 4.1. This analysis shows that New Prague's proposed future system requires an additional 1.0 MG to be distributed between both pressure zones. Factors to consider when identifying locations for a water tower are higher elevation points, nearby large-diameter watermain, and city-owned land.

Table 4.1 – Current System Storage Evaluation		
		Current System
Fire Demand (gpm)		3,500
Maximum Daily Demand (gpm)	+	1,957
Total Coincident Demand (gpm)	=	5,457
Firm Supply (gpm)(1)	-	2,000
Withdrawal from Storage (gpm)	=	3,457
Fire Flow Duration (minutes)	x	180
Firefighting Storage (MG)	=	0.62
Equalizing Storage (average daily demand)	+	1.34
Total Storage Required (MG)	=	**1.96**
Available Storage (MG)	-	1.00
Storage Deficit (MG)	=	**0.96**
(1) Assumes a future firm capacity of 2,000 gpm with new wells and excludes the highest capacity well.		

D. WATER TREATMENT FACILITIES

The future system assumes that Water Treatment Plant No. 2 is decommissioned. As stated above in Section IV. B. Water Treatment Plant No. 3 needs an additional supply well in order to meet firm pumping capacity recommendations while maintaining Treatment Plant No. 1. However, if Treatment Plant No. 1 is decommissioned Treatment Plant No. 3 not only needs additional wells, but an expansion to increase the capacity of the treatment plant itself. The capacity should be increased by an additional 1,000 gpm, to a total of 2,000 gpm, to meet future maximum daily demands if Treatment Plant No. 1 is decommissioned.

E. WATER DISTRIBUTION SYSTEM

The future distribution system consists of watermains varying from 6 to 16 inches in diameter. The system is split into two pressure zones. The static high-water level is 1,159.5 feet above mean sea level for the main north pressure zone, and 1,180.0 feet above mean sea level for the south pressure zone. The south zone is fed by the southwest 10th Ave. booster station. The pressure tank in the booster station is assumed to be removed since the south zone will have an elevated storage tank. Each pressure zone has at least one water tower. Multiple pressure reducing valves (PRV) allow water to flow back into the north pressure zone should pressure in the main zone drop below the pressure setting of the PRVs.

Figure 4.1 - Topographic Map

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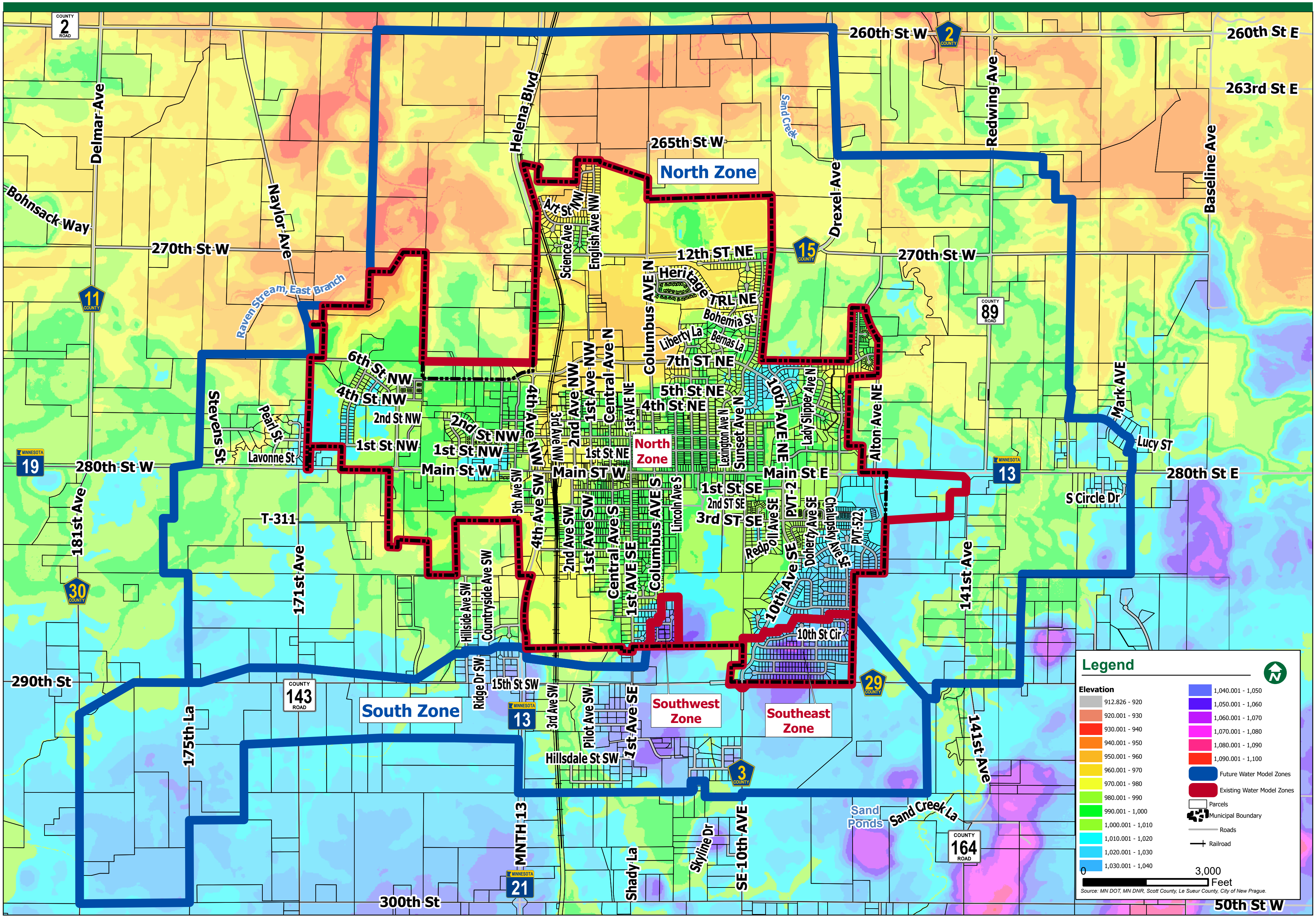

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F. FUTURE SYSTEM WATER MODEL

The future system water model was developed to simulate the anticipated average daily demands and maximum daily demands. Figure 4.2 shows a map of the future system's watermain sizes and major water system infrastructure.

1. Model Development

Future growth areas were added to the existing system. Infrastructure improvements were incorporated into the future system. The future system assumes a water tower to be installed near Water Treatment Plant No. 3 and a tower in the south pressure zone. Table 4.2 shows the anticipated demands of the north and south pressure zones. Based on the demand of the south zone, it is recommended that the tower for this zone be 0.50 MG to provide for average daily demands and some fire protection.

Table 4.2 – Future System Demand		
	Average Daily Demand (MGD)	**Maximum Daily Demand (MGD)**
Future North Zone	1.131	2.376
Future South Zone	0.211	0.442
TOTAL	**1.342**	**2.818**

The future system assumes the expansion of the southeast 10th Ave. booster station to manage future flows. Figure 4.2 shows an optional secondary booster location as a redundant supply source to the south pressure zone.

Watermain routes were added based on sanitary sewer routes shown in the 2024 Sanitary Sewer System Feasibility Study and parcel data. All small-diameter watermains of 4 inches and less were upsized to a minimum of 6 inches, and a new watermain was added at a minimum of 8 inches. The watermain near Water Treatment Plant No. 3 was increased to 16 inches to manage the flow for the entire system at peak flows and help provide fire flows to the north and south pressure zones. The 16-inch watermain was then extended until it tees with 12-inch trunk watermains along 3rd St SE, a 16-inch also branches off to the proposed water tower near Treatment Plant No. 3. A network of 12-inch trunk watermains extend to the existing water towers and 10th Ave. booster station. Several 10-inch watermains loop throughout the system.

2. Model Results

The model shows pressures within the desired pressure range throughout the system for both average daily demand and maximum daily demand. Pressure results are summarized in Table 4.3. Figures 4.3 and 4.4 show the average daily demand pressure and maximum daily demand pressures for the future system, respectively.

Table 4.3 – Future System – Pressure Results		
Pressure Zone	**Pressures (psi)**	
	Average Daily Demand	**Maximum Daily Demand**
North (Main) Zone	49 - 94, Avg. 70 ±7	42 - 86, Avg. 63 ±7
South Zone	51 - 80, Avg. 62 ±6	45 - 73, Avg. 55 ±6

Available fire flow in the main north zone is over 1,000 gpm for all hydrants, since small diameter watermains are increased. Fire flows in the south zone are also above 1,000 gpm with the addition of an elevated storage tank. The results for the north zone had the booster station off, as it was noted that fire flows upstream of the booster station, on the hydrants along Fairway Drive Southeast, were reduced with the booster station active. It is unlikely to have multiple fires simultaneously, so the available fire flow for the north zone is better represented with the booster station's fire pump off. Available fire flow results are summarized in Table 4.4. Figure 4.5 displays the maximum daily demand fire flow of the future system.

Table 4.4 – Future System – Fire Flow Results	
Pressure Zone	**Fire Flow**
	Maximum Daily Demand
North (Main) Zone	1,100 - 5,000+, Avg. 4,200 ±1,000
South Zone	1,000 - 5,000+, Avg. 3,800 ±1,300

Flow velocities are within acceptable ranges during maximum daily demands. Again, there is elevated head loss, above 10-ft/1,000-ft headloss, at the discharge line of Water Treatment Plant No. 3 during maximum daily demands with the pumps running. However, this is not the typical operation of the system and elevated headloss for short periods of time is not a concern.

Figure 4.2 - Future Water Distribution System

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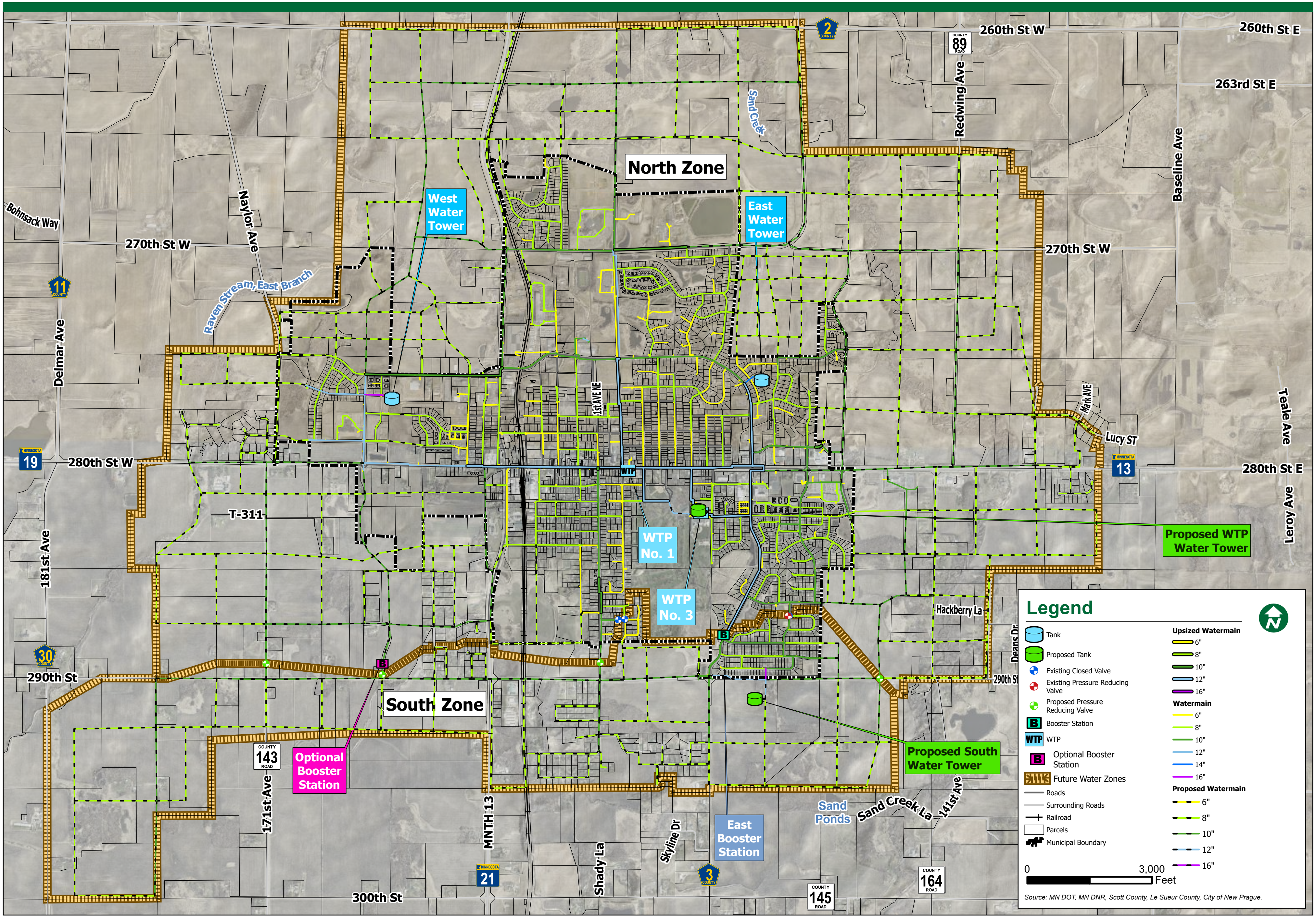

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Future Water Systems Model

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Figure 4.3 - Future System - Average Daily Demand - Pressure

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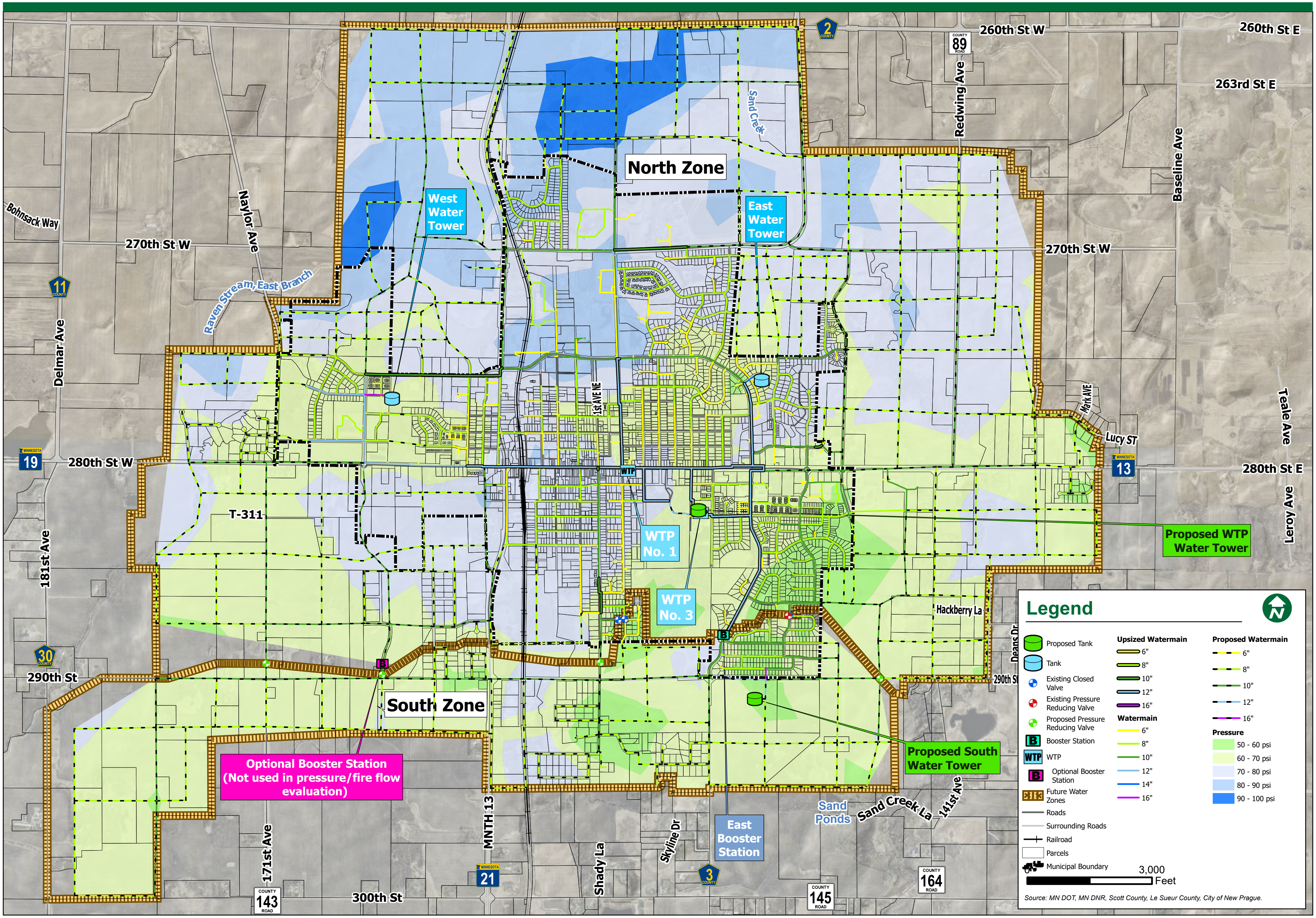

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Figure 4.4 - Future System - Maximum Daily Demand - Pressure

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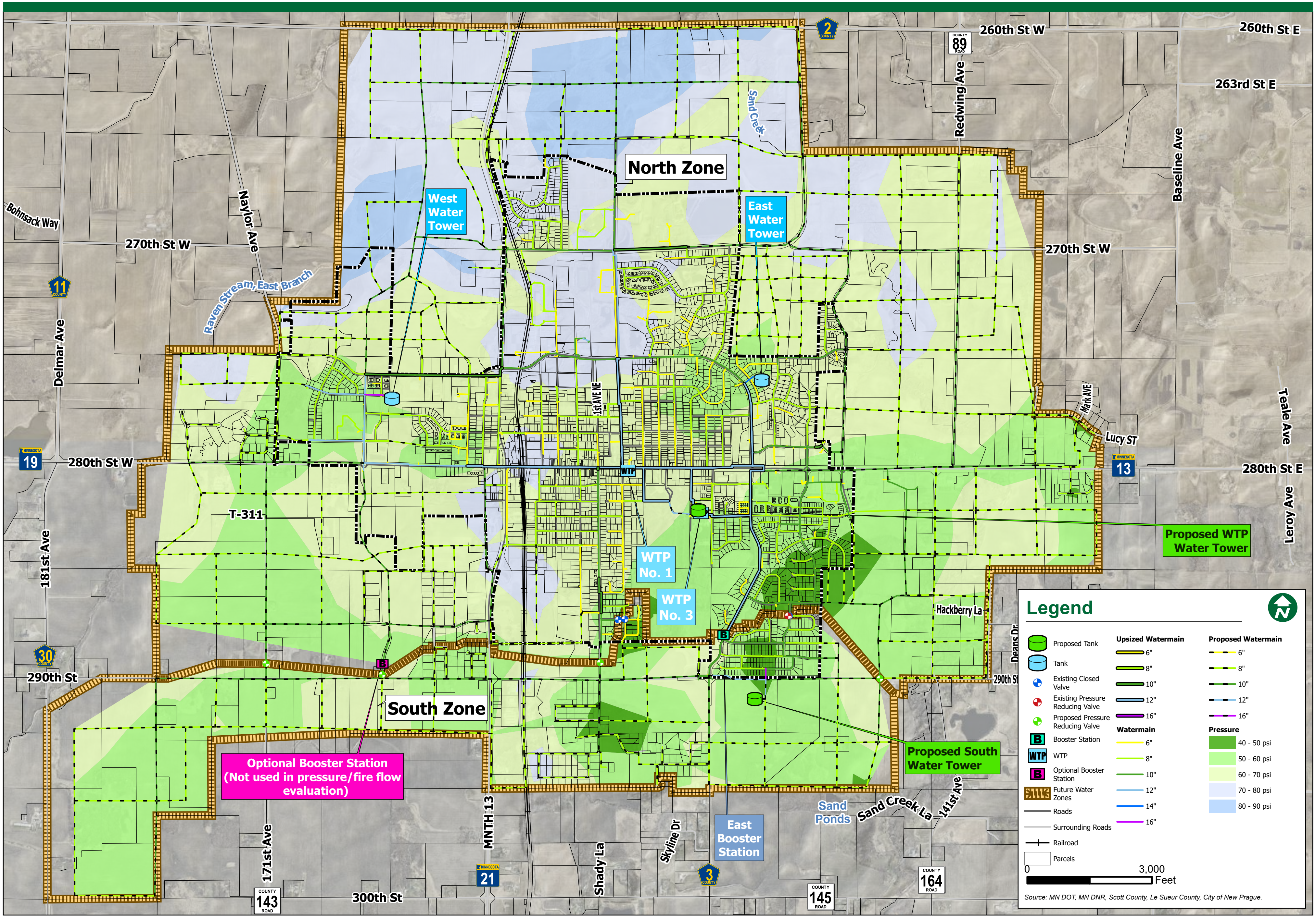

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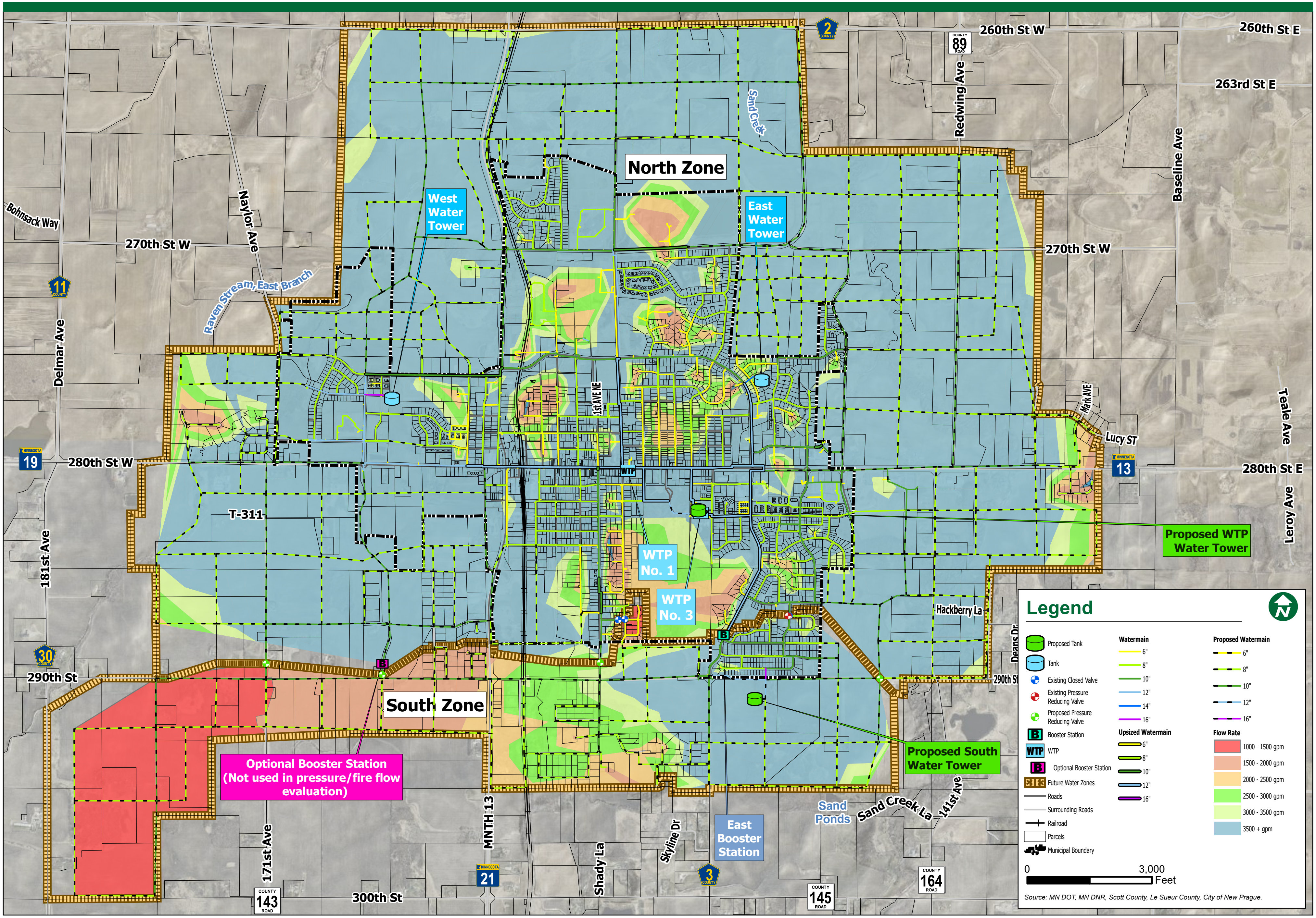
Figure 4.5 - Future System - Maximum Daily Demand - Available Fire Flow

October 2024



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V. OPINION OF PROBABLE COST

A. GENERAL

This section presents the general cost estimates for the water system improvements. The cost estimates provided in this section are preliminary cost estimates using 2024 costs. Water supply, storage, and treatment improvement costs should be evaluated during the preliminary engineering of each item.

B. COST ESTIMATES

Below are the opinions of probable construction costs based on estimated construction costs for 2024. Table 5.1 provides probable cost opinions for water supply and water storage recommendations.

While maintaining Treatment Plant No. 1 would save capital costs overall, there is additional risk the utility would be taking when using a facility that is over 84 years old and supply wells that are over 76 to 99 years old. As improvements are made, the condition and capacity of Treatment Plant No. 1 and the associated wells should be evaluated to determine long term viability of the supply and treatment. The land north of Water Treatment Plant No. 3 should be kept for expansion purposes when Treatment Plant No. 1 is eventually decommissioned.

While constructing a ground storage tank in the form of a clearwell would save capital costs, there is additional operation and maintenance costs associated with pumps required to pump the water into the distribution system and associated power consumption. Additional pumps would be necessary to transfer the water from the clearwell to the distribution system. The clearwell could be the site of the future Treatment Plant No. 3 expansion for when Treatment Plant No. 1 is decommissioned. The storage tank costs utilized for this report should be re-evaluated at the time of design to ensure it is sized correctly and that the proper reservoir is constructed.

In the event Treatment Plant No. 1 is decommissioned, the cost to route the wells to Treatment Plant No. 3 is approximately $300,000 for 3,100 feet of 8-inch watermain for each well, rerouting the wells would have additional electrical costs for remote panels. The estimated cost to seal and abandon Well No. 1, No. 2, and No. 3 is $250,000 total. Based on rough cost estimates and the age of the wells, it is deemed more cost-effective to seal and abandon these wells and construct new wells.

The cost to install raw watermain from Well No. 4 near Water Treatment Plant No. 2 to Treatment Plant No. 3 is approximately $720,000 for 7,500 feet of 8-inch watermain. The cost to install raw watermain from Well No. 4 to Water Treatment Plant No. 1 is approximately $450,000 for 4,700 feet of 8-inch watermain

Table 5.1 – Opinion of Probable Cost – Water Supply and Storage		
Item	Cost Estimate – Clearwell	Cost Estimate – Water Tower
Construct 1,000 gpm Well	$1,200,000	$1,200,000
0.5 MG Tower – South Zone	$3,750,000	$3,750,000
Alternative: 0.5 MG Clearwell [1] – Water Treatment Plant No. 3	$2,000,000	-
Alternative: 0.5 MG Tower – Water Treatment Plant No. 3	-	$4,250,000
Subtotal	**$6,950,000**	**$9,200,000**
25% Contingency	$1,750,000	$2,300,000
20% Admin/Engineering/Legal	$1,750,000	$2,300,000
TOTAL	**$9.5M – $11.5M**	**$12.5M – $15M**
[1] Ground storage tanks and clearwells have additional O&M costs associated with pump maintenance and power consumption compared to elevated storage tanks.		

Table 5.2 provides probable cost opinions to install the future watermains as seen in Figure 4.2 - Future Water System Map. These cost opinions include mobilization, street restoration, and other associated costs for installing the watermains; however, they do not account for smaller diameter lateral watermains and service lines to homes and businesses associated with future developments.

Table 5.2 – Opinion of Probable Cost - Watermain		
Watermain Size	Linear Feet	Cost Estimate
6-inch	1,480	$140,000
8-inch	309,220	$29,380,000
10-inch	116,660	$11,670,000
12-inch	23,720	$2,500,000
16-inch	160	$30,000
	Subtotal	**$43,720,000**
25% Contingency		$10,000,000
20% Admin/Engineering/Legal		$10,000,000
	TOTAL	**$60M – $65M**

Table 5.3 provides cost opinions for the 10th Ave. booster station improvements and additional PRV stations. The 10th Ave. booster station improvements involve replacing the existing pumps with slightly larger pumps, removing the pressure tank, adding fire pumps, replacing pipe and valves, and electrical improvements. The PRV station costs include the structure, pressure reducing valve, piping, and isolation valves.

Table 5.3 – Opinion of Probable Cost – Booster Station, and PRV	
Item	**Cost Estimate**
10^{th} Ave. Booster Station Improvements	$500,000
PRV Structure and Valve (approx. $60,000 each)	$250,000
Subtotal	**$750,000**
25% Contingency	$200,000
20% Admin/Engineering/Legal	$200,000
TOTAL	**$1M – $1.5M**

If Water Treatment Plant No. 1 is decommissioned, then Treatment Plant No. 3 should be expanded to increase its capacity by 1,000 gpm. Table 5.4 provides cost opinions for the expansion of Water Treatment Plant No. 3. This includes additional building space, filter equipment, and electrical equipment.

Table 5.4 – Opinion of Probable Cost – Water Treatment Expansion	
Item	**Cost Estimate**
Water Treatment Plant No. 3 Expansion	$10,000,000
Subtotal	**$10,000,000**
25% Contingency	$2,500,000
20% Admin/Engineering/Legal	$2,500,000
TOTAL	**$13.5M – $16.5M**

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VI. IMPLEMENTATION

A. GENERAL

Planning for significant infrastructure requires a robust capital improvements plan (CIP) to couple proper timing of new and replacement system components with the ability to absorb associated costs. A three-phase approach is recommended to balance financial preparedness with the needs described in this report. Note an updated rate study is often necessary to align income with proposed system improvement expenditures.

B. PHASING OF IMPROVEMENTS

Phase I includes the construction of a supply well and clearwell at Water Treatment Plant No. 3 and the expansion of the water distribution system in the immediate five-year horizon. In the following ten years, the city should plan to address Phase II, which includes additional storage needs and further expansion of the distribution system. This sequencing allows the funding source time to build adequate funds. Phase III includes any improvements to the distribution system that remain after fifteen years. This phasing assumes Treatment Plant No. 1 is maintained and an expansion of Treatment Plant No. 3 is not required until after this phasing sequence.

Note that increasing pipe size in the network is a substantial part of the future need and is typically most efficiently accomplished by incorporating it into future street reconstruction projects to the extent possible. Pipe sizing in growth areas can simply incorporate recommended diameters as part of the initial street and municipal infrastructure construction. Storage and pressure boost components may need to be accelerated to permit growth in certain areas.

Table 6.1 – Recommended Phasing of Water System Improvements	
Phase I - Supply Well, Clearwell, and Water Distribution Expansion	$25M
Phase II - Additional Tower and Further Distribution Expansion	$25M
Phase III - Remaining Improvements to Distribution System	$25M
Total Anticipated Probable Costs Over Next 20+/- Years	**$75M**

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