FEASIBILITY REPORT

NORTHEAST & NORTHWEST URBAN SERVICE AREA EXPANSION STUDY

FOR THE
CITY OF ELK RIVER, MINNESOTA

January 19, 2023

Prepared By:

January 19, 2023

Mr. Justin Femrite, PE
Public Works Director/Chief Engineer
City of Elk River
13065 Orono Parkway
Elk River, MN 55330

Re: Feasibility Report
Northeast & Northwest Urban Service Area Expansion Study
City of Elk River, MN
WSB Project No. 020010-000

Dear Mr. Femrite:

Transmitted herewith is the feasibility report for the above-referenced project. The report summarizes the recommendations to expand the existing water distribution and sanitary sewer systems to serve the northeast service area. A financial analysis with an opinion of probable cost is also presented for the recommended expansion alternatives.

We would be happy to discuss this report with you at your convenience. If you have any questions, please do not hesitate to call me at (651) 286-8466.

Sincerely,

WSB

Greg Johnson, PE
Director of Water/Wastewater

cc. Brandon Wisner, Engineering Project Manager, City of Elk River

178 E 9TH STREET | SUITE 200 | SAINT PAUL, MN | 55101 | 651.286.8450 | WSBENG.COM

CERTIFICATION

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.

Greg Johnson, PE

Date: January 19, 2023 License No. 26430

Report Preparation Assistance and QA/QC:

Ursinio Puga, PE

Date: January 19, 2023 License No. 59303

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1. EXECUTIVE SUMMARY

The City of Elk River retained WSB to complete a serviceability analysis of the proposed Northeast and Northwest Urban Expansion Areas in response to the projected growth. The City authorized WSB to proceed with the study in February 2022. As part of this study, WSB evaluated the infrastructure needed to annex the northeast and northwest study areas to the existing sanitary sewer and water distribution systems. In addition, WSB evaluated the adequacy of the existing systems to serve the study areas as well as prepared a financial analysis for the recommended improvements. A map illustrating the project locations is shown in ***Figure A1*** in ***Appendix A***.

An analysis of the projected development densities and topographies within the study areas indicates that trunk gravity sewermain ranging in diameter from 10-inch to 18-inch will be needed to collect and convey the wastewater generated within the study areas. At least six (6) trunk lift stations with firm design capacities ranging from 185 gpm to 4,000 gpm will also be needed. Water service to the northeast areas can be provided by installing a new 12-inch trunk watermain loop through Twin Lakes Road NW, 209th Avenue NW, Quincy Street NW, Smith Street NW, and Tyler Street NW. The 12-inch watermain loop will ensure that the water pressures and available fire flows will be adequate for the projected growth. The northeast areas can be annexed to the system's main pressure zone without the need of installing pressure regulating infrastructure. Water service to the northwest areas will require pressure regulating stations to maintain the water pressures between 40 and 80 pounds per square inch (psi). A combination of 12-inch and 16-inch trunk watermain will be needed to serve the northwest areas. Water storage, supply, and treatment infrastructure is also recommended for both study areas. The recommended infrastructure layouts for the water distribution and sanitary sewer systems are shown in ***Figures A9***, ***A13***, ***A19***, ***A21*** and ***A22*** in ***Appendix A***.

The total estimated infrastructure cost needed to serve the study areas over the next twenty years and beyond is **$28,478,000** for the sanitary sewer system and **$75,612,000** for the water distribution system. Detailed cost breakdowns are shown in ***Appendix B***. A detailed phasing plan to extend public utilities to the study areas cannot be prepared at this time as the construction schedule of individual developments is unknown. However, a preliminary analysis was completed to identify which infrastructure would need to be constructed prior to any developments to provide utility service. This analysis is shown in ***Section 6*** of this report. Overall, it appears that extending water and sewer services to the expansion areas could be feasible as long as leapfrog development is avoided, the areas are not served simultaneously, and the cost is divided over various funding avenues. Promoting leapfrog development will require a considerable amount of infrastructure to be installed initially which could place the City and the ERMU at financial risk if subsequent development is slower than anticipated. Additionally, it is recommended to extend water and sewer service concurrently as this can reduce capital costs.

2. INTRODUCTION

2.1 Authorization

The City of Elk River retained WSB to complete a serviceability analysis of the proposed Northeast and Northwest Urban Expansion Areas in response to the short-term and long-term growth projected in this part of the city. City staff authorized WSB to proceed with the study in February 2022.

2.2 Scope

This report evaluates the infrastructure needed to annex the northeast and northwest study areas to the sanitary sewer and water distribution systems. The northwest site includes a portion of the gravel mining area. In addition, WSB evaluated the adequacy of the existing utility systems to serve the study areas and prepared a financial analysis for the recommended improvements. The northeast, northwest, and mining study areas are shown in ***Figure A1*** in ***Appendix A*** along with the City's existing municipal service area.

2.3 Data Available

Information and materials used in the preparation of this report included the following:

- City of Elk River Water Supply Plan (approved by the DNR in 2017);
- City of Elk River Comprehensive Plan Update (adopted in 2021);
- Pumping Records, As-Builts, and Design Data for the Trunk Highway 169 Sanitary Lift Station;
- Pumping Records, As-Builts, and Design Data for the Windsor Lift Station;
- Pumping Records, As-Builts, and Design Data for the Leachate Lift Station;
- Pumping Records and Design Data for the Evans Lift Station;
- Design Data for the Jackson Lift Station;
- Flow and Design Data for the Wastewater Treatment Plant;
- City of Elk River Water Pumping Records from 2017 to 2021;
- City of Elk River's 2015 Gravel Mining Area Land Use, Transportation, and Utility Plan; and
- City of Elk River GIS Data.

2.4 Description of Study Areas

The northeast and northwest study areas span approximately 2,200 acres and 2,800 acres, respectively; and both areas are projected to be annexed to the City's utility systems over the next 20 years per the City's 2040 Comprehensive Plan. Annexing both study areas would increase the City's municipal service area significantly considering that the City's existing municipal service area spans approximately 8,000 acres. The ground elevations in both study areas vary considerably, ranging from 900-ft above mean sea level (MSL) to 1,000-ft above MSL in the northeast areas and from 940-ft above MSL to 1,100-ft above MSL in the northwest areas. The vast change in elevations presents a challenge to extend water service as separate pressure zones may be needed to provide adequate water pressures. Contrastingly, wastewater may be able to drain by gravity from the higher elevations to the lower elevations without the need of a significant number of intermediate lift stations. The ground elevations of the northeast study areas are shown in ***Figure A2*** in ***Appendix A*** and the ground elevations of the northwest study areas are shown in ***Figure A3*** in ***Appendix A***. The ground elevations shown for the mining areas in ***Figure A3*** were obtained from the final proposed grading plan of the Gravel Mining Area Land Use, Transportation, and Utility Plan completed in 2015.

A significant portion of both study areas consists of wetlands which, for the purpose of this study, were considered nondevelopable land. ***Figures A4*** and ***A5*** in ***Appendix A*** show the extents of the wetlands for the study areas covering a total of 1,209 acres. Developable acreages for each study area were calculated by subtracting wetland areas and existing roads from the gross acreage. Additionally, an extra 10-percent was also subtracted to account for future roads within the future developed land resulting in a final total net developable area of approximately 3,260 acres for both study areas combined.

The projected land uses for each study area, as depicted in the City's Comprehensive Plan, are shown in ***Figures A6*** and ***A7*** in ***Appendix A***. As shown in the figures, the majority of the study areas will be traditional single family residential land use followed by mixed residential, commercial, and open space/public land uses. ***Tables 2.1*** and ***2.2*** below summarize the gross and net developable acreage of each land use type.

Table 2.1 – Projected Land Uses – Northeast Study Area

Land Use Type	Gross Acreage	Net Developable Acreage
Single Family Residential	1,659	1,012
Mixed Residential	523	307
Neighborhood Commercial	11	9
Total	**2,193**	**1,328**

Table 2.2 – Projected Land Uses – Northwest Study Areas

Land Use Type	Gross Acreage	Net Developable Acreage
Single Family Residential	2,212	1,393
Mixed Residential	318	266
Highway Business	48	41
Public/Semi Public	33	29
Open Space/Parks	214	202
Total	**2,825**	**1,931**

Development in the northeast areas is projected to start at the intersection of Twin Lakes Rd NW and Cleveland St NW. Development in the northwest areas is planned to begin in the northwestern portion of the study area and extend southeast towards the gravel mining site.

3. WATER DISTRIBUTION SYSTEM ANALYSIS

The City of Elk River uses a single water distribution system to serve the entire municipal service area. Due to the differences in ground elevation, the system is operated in two pressure zones, a low zone and a high zone, to maintain adequate water pressure throughout the system. Both pressure zones are interconnected only for emergency purposes and the use of booster stations and pressure reducing stations does not occur on a regular basis as the two zones remain isolated through valving. The existing water distribution system is depicted in ***Figure A8*** in ***Appendix A***. For the purpose of this study, the high zone is referred to as the main zone since new high pressure zones are being proposed to serve the development areas. Since the northeast and the northwest study areas have the potential of being annexed to the system's main pressure zone but not to the low pressure zone, only the main pressure zone was evaluated in this study. The water serviceability analysis completed for the study areas is summarized in the following sections.

3.1 Existing System Description

The City of Elk River utilizes five (5) production wells to supply water to the system's main pressure zone. The zone's firm pumping capacity, which is the total pumping capacity with the largest well out of service, is 3,400 gallons per minute (gpm). ***Table 3.1*** bellow summarizes the main zone's existing well pumping capacities.

Table 3.1 – Main Pressure Zone Existing Water Supply Capacity

Well Name	Well ID	Year Installed	Depth (feet)	Status	Capacity (gpm)	Capacity (gpd)
Well 5	537682	1994	406	Active	850	1,224,000
Well 6	580320	1999	300	Active	850	1,224,000
Well 7	664852	2001	341	Active	850	1,224,000
Well 8	694499	2004	390	Active	850	1,224,000
Well 9	757624	2008	454	Active	850	1,224,000
				Firm Pumping Capacity	**3,400**	**4,896,000**
				Total Pumping Capacity	**4,250**	**6,120,000**

GPM – Gallons per Minute; GPD – Gallons per Day

Elk River's main pressure zone has three (3) satellite direct filtration water treatment plants to remove iron, manganese, and other impurities from the groundwater. ***Table 3.2*** bellow summarizes the main zone's existing treatment facilities. Currently, Well 8 is routed to Well House 9 where it receives chemical conditioning. This well is does not need physical treatment (filtration) as its water quality meets existing drinking water standards. The main zone's firm treatment capacity was considered to be 80-percent of the zone's total treatment capacity to account for filter downtime for backwashes and plant maintenance.

Table 3.2 – Main Pressure Zone Existing Water Treatment Capacity

Plant Name	Wells Treated	Treatment Type	Total Capacity		Firm Capacity	
			(gpm)	(gpd)	(gpm)	(gpd)
5	5	Pressure Filtration	850	1,224,000	680	979,200
6	6	Pressure Filtration	850	1,224,000	680	979,200
7	7	Pressure Filtration	1,700	2,448,000	1,360	1,958,400
N/A	8	Chemical Only	850	1,224,000	850	1,224,000
		Treatment Capacity	**4,250**	**6,120,000**	**3,570**	**5,140,800**

GPM – Gallons per Minute; GPD – Gallons per Day

The system's main pressure zone has two (2) water towers. Water towers stabilize water pressure during average day and peak water demands and provide water storage for fire protection and power outages. At a minimum, a system's water storage volume should exceed the system's average day demand according to the Minnesota Department of Health (MDH). The main zone's storage facilities are summarized in ***Table 3.3***.

Table 3.3 – Main Pressure Zone Existing Water Storage Capacity

Facility Name	Facility Type	Year Installed	Primary Material	Capacity (gallons)
Auburn Street	Elevated Storage	1993	Steel	500,000
Johnson Street	Elevated Storage	2002	Steel	1,500,000
		Total Storage Capacity		**2,000,000**

3.2 Existing Water Demand

The system's main pressure zone historical water demands were analyzed using data provided by ERMU staff for the years 2017 through 2021 and are shown in ***Table 3.4*** and ***Figure 3.1***. The main zone's water demands have experienced a mild increasing trend over the past five (5) years likely due to population growth.

Table 3.4 – Main Pressure Zone Historical Water Demands

Year	Average Day Demand (gpd)	Maximum Day Demand (gpd)	Peaking Factor
2017	1,277,079	2,965,000	2.32
2018	1,231,567	2,890,000	2.35
2019	1,098,255	2,856,000	2.60
2020	1,318,686	3,697,000	2.80
2021	1,509,232	4,286,000	2.84
Average	**1,287,000**	**3,339,000**	**2.59**

GPD – Gallons per Day

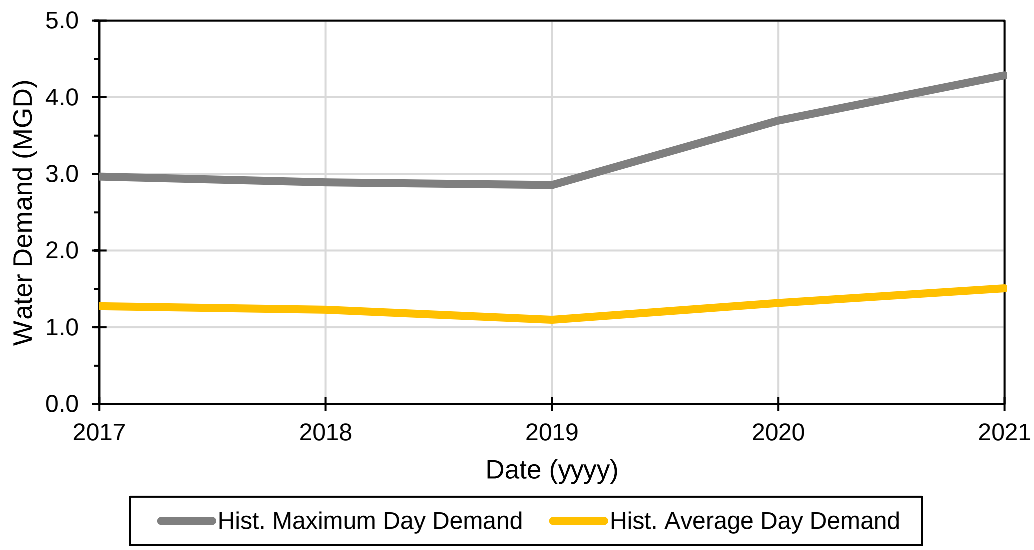

Figure 3.1 – Main Pressure Zone Historical Water Demands

3.3 Water Demand Projections

A water distribution system's average water demand can be 50 to 75 percent higher than the same system's average sanitary sewer flow. This difference in flow is typically associated to higher summer water usage (e.g., irrigation demands) that is not reflected in the wastewater flow. In the case of Elk River, the system-wide average water demand is approximately 61 percent higher than the City-wide average sanitary sewer flow. Due to this stablished relationship between flows, water demands for the study areas were projected using a demand per dwelling assumption that was calculated using lift station run time data provided by City staff. To be conservative, a 75 percent factor, instead of Elk River's 61 percent difference, was applied to the lift station run time data to calculate residential water demands. A detailed lift station run time data analysis is provided in ***Section 4.3*** of this report. Industry-standard water demand rates were used for non-residential land uses. Average water demands for the study areas were projected using the unit water demand flows summarized in ***Table 3.5***.

Table 3.5 – Water Demand per Land Use Assumptions

Land Use Type	Density (units/acre)	Residential Unit Flow (gpd/unit)	Average Unit Flow (gpd/acre)
Single Family Residential – Northeast Areas	2	145	290
Single Family Residential – Northwest Areas	3	145	435
Mixed Residential	5	145	725
Neighborhood Commercial	-	-	900
Highway Business	-	-	900
Public/Semi Public	-	-	0
Open Space/Parks	-	-	0

Unit – residential dwelling; gpd/acre – Gallons per Day per Acre

The projected water demands calculated for the study areas are summarized in the tables below. The maximum day peaking factor used corresponds to the main zone's average peaking factor from ***Table 3.4***.

Table 3.6 – Projected Water Demand for Northeast Areas

Land Use Type	Net Developable Acres	Average Unit Water Demand (gpd/acre)	Water Demand (gpd)
Single Family Residential	1,012	290	293,480
Mixed Residential	307	725	222,503
Neighborhood Commercial	9	900	8,100
		Average Daily Flow (gpd)	**524,083**
		Maximum Daily Flow (gpd)	**1,357,375**

Table 3.7 – Projected Water Demand for Northwest Areas (2040 Development Timeframe)

Land Use Type	Net Developable Acres	Average Unit Water Demand (gpd/acre)	Water Demand (gpd)
Single Family Residential	1,393	Varies(1)	282,599
Mixed Residential	266	725	192,850
Highway Business	41	900	36,900
Public/Semi Public	29	0	0
Open Space/Parks	202	0	0
		Average Daily Flow (gpd)	**512,349**
		Maximum Daily Flow (gpd)	**1,326,984**

(1) A large portion of the area is already developed with densities significantly lower than 3 units/acre. Therefore, densities vary throughout which affect average unit water demands.

Investigating the serviceability of the ultimate northwest areas beyond the year 2040 was not included in the scope of this study. However, a high level preliminary analysis was completed to assess the water demands expected beyond 2040 as this could affect trunk watermain sizing recommendations. The planned land uses for the ultimate northwest areas include single family residential, industrial, rural industrial, and highway business, which are projected to require a significant volume of water. A summary of the projected water demands for these land uses is shown in ***Table 3.8***. The northeast study area is not projected to develop beyond the boundary shown in ***Figure A1*** and therefore the 2040 water demand projections summarized in ***Table 3.6*** can also be a representation of ultimate development conditions.

Table 3.8 – Projected Water Demand for Northwest Areas (Beyond 2040 Development Timeframe)

Land Use Type	Net Developable Acres	Average Unit Water Demand (gpd/acre)	Water Demand (gpd)(1)
Single Family Residential	196	435	85,260
Industrial	478	1,000	478,000
Rural Industrial	231	800	184,800
Highway Business	428	900	385,200
		Average Daily Flow (gpd)	**1,133,260**
		Maximum Daily Flow (gpd)	**2,935,144**

(1) Water demand in addition to the 2040 projections from Table 3.7.

3.4 System Evaluation and Capacity Analysis for Northeast Areas

Computer modeling indicated that the northeast study areas can be annexed to the system's existing main pressure zone without creating a separate pressure zone. Therefore, the water supply, treatment, and storage infrastructure of the existing main pressure zone was evaluated to assess if it is adequately sized to supply water to the northeast areas. Since the rate of development for the northeast areas is unknown, the water demands summarized in ***Table 3.6*** were distributed linearly between now and the end of the planning period.

The water supply capacity evaluation for the main pressure zone is depicted in ***Figure 3.2***. As shown in the figure, a new 850 gpm (1,224,000 gpd) well is being proposed within a five (5) to ten (10) year timeframe in 2028 to ensure the zone's firm pumping capacity exceeds its maximum day demand. The timeline to drill this new well could vary depending on the rate of development of the northeast zone. ERMU should continue to monitor maximum day demands closely and begin discussions to drill a new well if the main zone's maximum day demands are consistently maintained between 4.0 and 4.4 MGD.

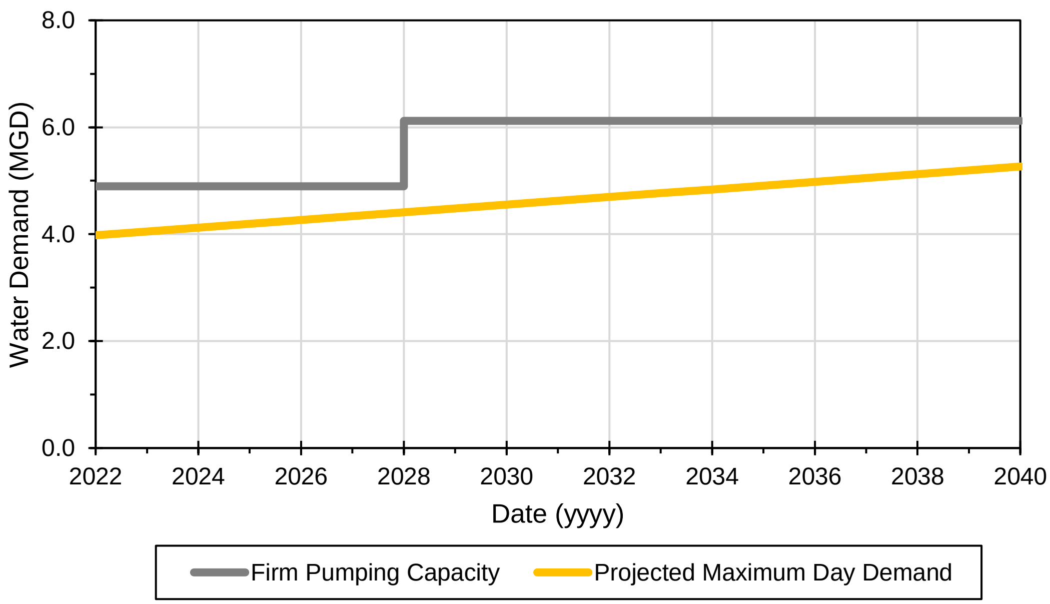

Figure 3.2 – Main Pressure Zone Water Supply Capacity Evaluation

The water treatment capacity evaluation for the main pressure zone is depicted in ***Figure 3.3***. The zone's existing firm water treatment capacity is 5,140,800 gpd (3,570 gpm) and it is anticipated that water treatment be provided at the new 850 gpm well proposed for 2028 if needed to meet drinking water standards. As shown in the figure below, increasing the zone's treatment capacity by providing treatment at the new well will be sufficient to meet the projected maximum day demands for the northeast service areas.

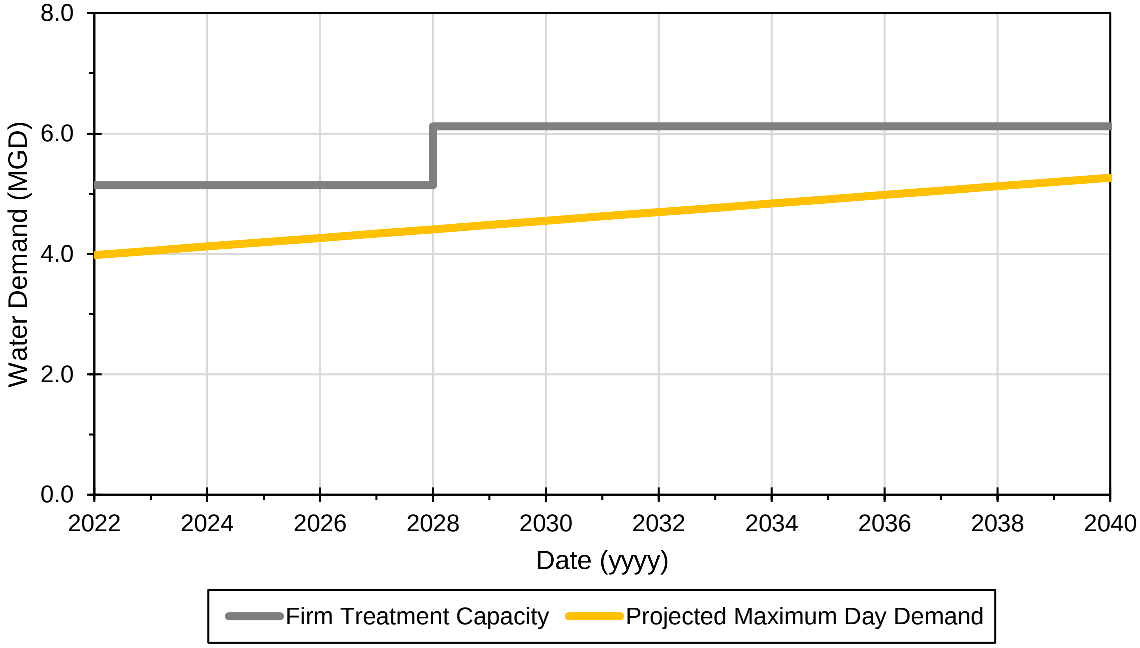

Figure 3.3 – Main Pressure Zone Water Treatment Capacity Evaluation

At a minimum, a municipal water distribution system should have enough water storage capacity to exceed the system's average day demand. However, water systems should also have enough storage capacity to meet the maximum day demand as well as additional volume for fire protection and equalization storage. Calculating storage requirements this way often results in a lower storage requirement volume if a system has excess supply capacity that can augment the system's storage capacity. The overall equation to determine recommended storage capacity based on maximum day demand, fire projection, and pressure equalization is as follows:

Equation 3.1 – Water Storage Calculation

Required Water Storage Volume = Adjusted Fire Storage (AFS) + Equalization Storage

where

AFS = (Maximum Day Demand + Fire Requirements – Firm Capacity) x Design Fire Duration (Hours)

Firefighting volume requirements vary based on land uses and specific commercial, industrial, and institutional uses. Firefighting requirements are based on guiding documents, including Ten States Standards, AWWA, and the Insurance Services Office (ISO); but fire flow requirements are usually at the discretion of each community. For system-wide water storage calculations, such as the ones completed for this study, a conservative available fire flow of 3,500 gpm for three (3) hours is often used as recommended by the AWWA and ISO.

Equalization storage is the volume required to satisfy water demands that exceed the well pumping capacity throughout the day. During any given day, hourly demands vary as a diurnal demand pattern with the maximum hour demand designated as the peak hour demand. Equalization storage is determined by calculating the volume necessary to meet the peak hour demand beyond what the firm supply capacity can provide. The AWWA recommends the required equalization volume to equal 70 to 100 percent of the average day demand, or 20 to 25 percent of the maximum day demand.

The water storage capacity analysis completed for the northeast areas annexing to the main pressure zone is summarized in ***Table 3.9*** and depicted in ***Figure 3.4***. Given the requirements shown below, it is recommended to construct a 1.0 MG water tower within a ten (10) to fifteen (15) year timeframe in 2033.

Table 3.9 – Main Pressure Zone Storage Requirements

		Year 2020	**Year 2040**
A	Average Day Water Use in gpd	1,318,686	2,033,315
B	Maximum Day Water Use in gpd	3,697,000	5,266,286
C	Maximum Day Water Use in gpm (20-hrs to supply per AWWA)	3,081	4,389
D	Firm Pumping Capacity in gpm	3,400	4,250
E	AWWA Recommended Firefighting Rate in gpm	3,500	3,500
F	Firefighting Duration in hours	3	3
G	Design Firefighting Volume in Gal (E x F x 60 min/hour)	630,000	630,000
H	Total Coincident Demand in gpm (C + E)	6,581	7,889
I	Required Draft from Storage in gpm (H - D)	3,181	3,639
J	Adjusted Firefighting Storage in gal (F x 60 min/hr x I)	572,580	655,020
K	Equalization Storage in gpd (B x 25%)	924,250	1,316,572
L	Total Storage Needed in gal (J + K)	1,496,830	1,971,592
M	Existing Storage Capacity in gallons	2,000,000	2,000,000
N	**Storage Surplus/Deficit in gallons – Average Demand Method (M – A)**	**+681,314**	**-33,315**
O	**Storage Surplus/Deficit in gallons – Equation 1 Method (M – L)**	**+503,170**	**+28,408**

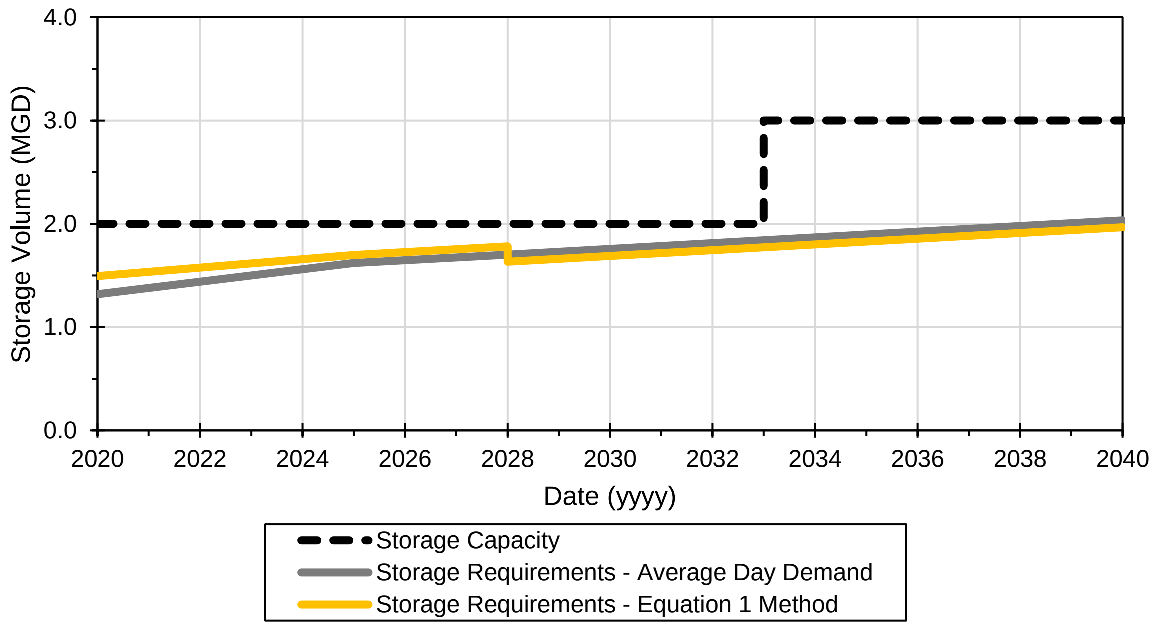

Figure 3.4. Main Pressure Zone Water Storage Capacity Evaluation

3.5 Recommended Water System Infrastructure for the Northeast Areas

The proposed water distribution system to serve the northeast study areas is shown in ***Figure A9*** in ***Appendix A***. A summary of the recommended infrastructure is described below:

> **Trunk Watermain**: Prior to extending water service to the northeast study areas, it is recommended to connect the existing 16-inch watermain along Cleveland Street NW with the 12-inch watermain stubbed at the intersection of Twin Lakes Road NW with 193rd Avenue NW using a 12-inch watermain. A 12-inch watermain can then be extended north along Twin Lakes Road NW until reaching the intersection with 209th Avenue NW. From this location, the 12-inch trunk can be directed west along 209th Avenue NW and south along Quincy Street NW. From there, the 12-inch trunk can be extended south along Smith Street NW and Tyler Street NW to connect to the existing trunk watermain along 193rd Avenue NW. Additionally, a 12-inch trunk watermain should be extended along 201st Avenue NW to create a smaller trunk loop. The trunk watermain for this study area can be extended in phases. Eight-inch watermain can be extended from the proposed 12-inch trunk loop to provide water service to the northeast study area via smaller watermain loops. The smaller 8-inch watermain loops shown in ***Figure A9*** are not definitive and their final location will change based on future development layouts.
>
> **Wells:** Additional wells beyond the future 850 gpm production well that is proposed for 2028 are not needed to serve the northeast study areas. This new well does not need to be drilled in the northeast area itself as long as it provides water to the main pressure zone since both areas will be interconnected.
>
> **Water Towers:** A new 1.0 MG water tower is needed to serve the northeast areas.
>
> **Water Treatment Plants**: The pressure zone's water treatment capacity must be increased to serve the northeast study area. This can be done by providing direct filtration treatment at the future 850 gpm well planned for 2028 if its water does not meet drinking water standards.
>
> **Pressure Zones:** The entire northeast area can be served off of the system's existing main pressure zone without the need of pressure regulating infrastructure. The average day and peak hourly water pressures for the northeast study area are shown in ***Figures A10*** and ***A11***. Water pressures were modeled using Bentley OpenFlows WaterGEMS CONNECT (WateGEMS) software based on the proposed watermain layout shown in ***Figure A9***. Water pressures were modeled using a conservative scenario where all the City's wells were turned off and the water level in the City's water towers were 10-ft below the overflow elevations. The modeled water pressures were compared against the Ten-States Standards which recommend that working distribution pressures be 50 to 80 psi, and not lower than 35 psi. Modeling indicated that water pressures can be maintained between 50 psi and 81 psi for average day demand conditions and between 47 psi and 81 psi for peak hourly demand conditions.
>
> **Booster Stations**: Larger distribution system booster stations will not be required to serve the study area. However, private internal booster stations may be needed at dwellings with a ground elevation of 990-ft or higher to maintain water pressure above 35 psi in second stories of single family homes. Less than 5-percent of the study area has ground elevations at or above 990-ft.
>
> **PRVs**: Pressure reducing valves (PRVs) will be needed in the southwest corner of the study area at individual dwellings with a ground elevation below 915-feet in order to maintain the water pressure below 80 psi per the Minnesota Plumbing Code. However, this area is mainly nondevelopable, so it is likely that not many services will require PRVs.

Fire flow recommendations provided by the AWWA for residential land uses were used to assess the fire flow requirements for the majority of the northeast study areas. According to the AWWA, the minimum fire flow available at any given point in a water distribution system should not be less than 500 gpm with a residual pressure of 20 psi. This represents the amount of water required to be provided by two standard hose streams on a fire in a typical residential area for dwellings with spacing greater than 30 feet. Minimum fire flow recommendations increase as the distance between dwellings is reduced. The recommended AWWA fire flows for residential land uses are shown in ***Table 3.10***.

Table 3.10 – Recommended Fire Flows for Residential Land Uses

Distance Between Buildings (ft)	Fire Flow Needed at 20 psi (gpm)
More than 30	500
21-30	750
11-20	1,000
Less than 10	1,500

Ft – Feet; GPM – Gallons per Minute

Fire protection needs can vary widely based on the physical characteristics of each building and municipal fire insurance ratings are partially based on the water distribution system's ability to provide needed fire flows up to 3,500 gpm. Knowing this, ***Table 3.11*** summarizes the fire flow requirements projected for the northeast study areas based on the anticipated land uses. These requirements are only intended to be used as a general planning guideline at this time.

Table 3.11 – Projected Fire Flow Requirements – Northeast Study Area

Land Use Type	Approximate Needed Fire Protection (gpm)
Single Family Residential	500 – 1,500
Mixed Residential	2,000 – 3,000
Neighborhood Commercial	1,500 – 2,500

GPM – Gallons per Minute

The available fire flows modeled for the northeast study area are shown in ***Figure A12*** in ***Appendix A***. The lowest available fire flow modeled for the study area is 2,400 gpm, which is located within single family residential land use. Mixed residential and commercial land uses in the northeast study area are projected to have an available fire flow of 3,500 gpm or higher. Modeling indicated that the majority of the study area will have an available fire flow greater than 3,000 gpm.

3.6 System Evaluation and Capacity Analysis for Northwest Areas

Computer modeling indicated that the northwest study areas cannot be annexed to the existing water distribution system without the use of a separate pressure zone as the ground elevations are significantly higher than the rest of the system. Upon consulting with ERMU staff, a hybrid approach was taken to serve these areas through the use of new production wells and booster stations. Although booster stations are not needed if multiple new wells are drilled in the northwest areas, it is strongly recommended to use booster stations to reduce capital expenses since fewer wells will be needed initially to supply drinking water. Because the northwest areas will be mostly isolated from the existing system, the supply, treatment, and storage infrastructure evaluation was completed for the future northwest areas alone without taking into account the system's main pressure zone like for the northeast areas. Since the rate of development for the northwest areas is unknown, the water demands summarized in ***Table 3.7*** were distributed linearly between now and the end of the planning period.

The water supply capacity evaluation for the northwest study areas is depicted in ***Figure 3.5***. This study proposes supplying the study areas with a hybrid approach of two (2) booster stations and a single well for a total initial combined firm pumping capacity of 800 gpm (1.15 MGD). As development increases, a new 850 gpm well could be drilled within five (5) to ten (10) years to increase the northwest area's firm pumping capacity to 1,650 gpm (2.38 MGD). Additional wells can be drilled beyond 2040 to serve the ultimate development boundary.

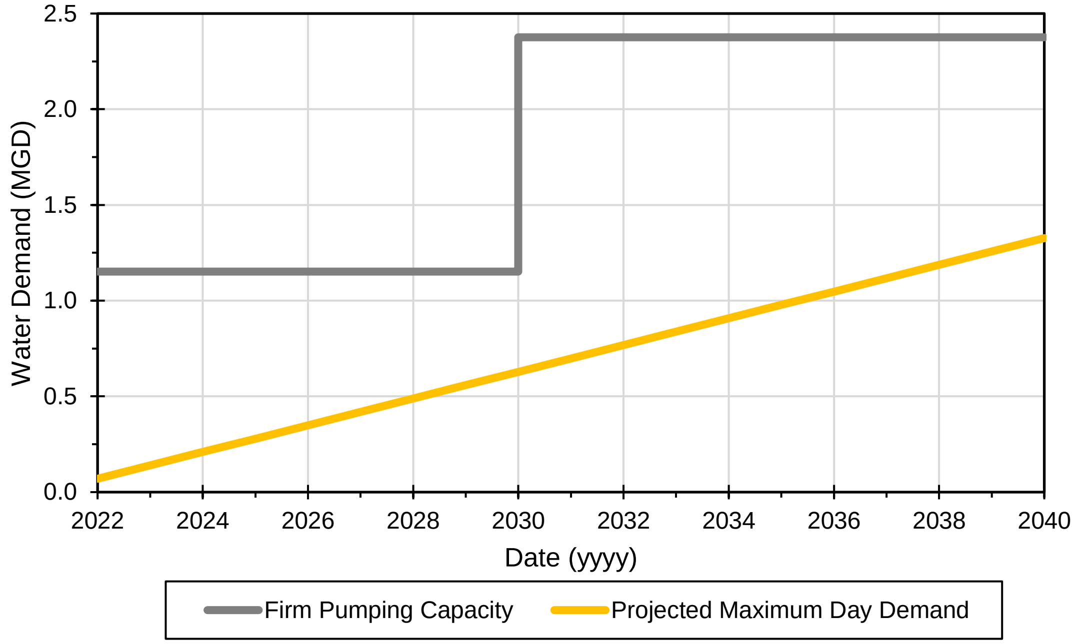

Figure 3.5 – Northwest Study Areas Water Supply Capacity Evaluation

The water treatment capacity evaluation for the northwest study areas is depicted in ***Figure 3.6***. The northwest areas will immediately have treated water available through the booster stations. It is strongly recommended that groundwater pumped by future wells in the northwest study areas is treated on-site with pressure filtration facilities.

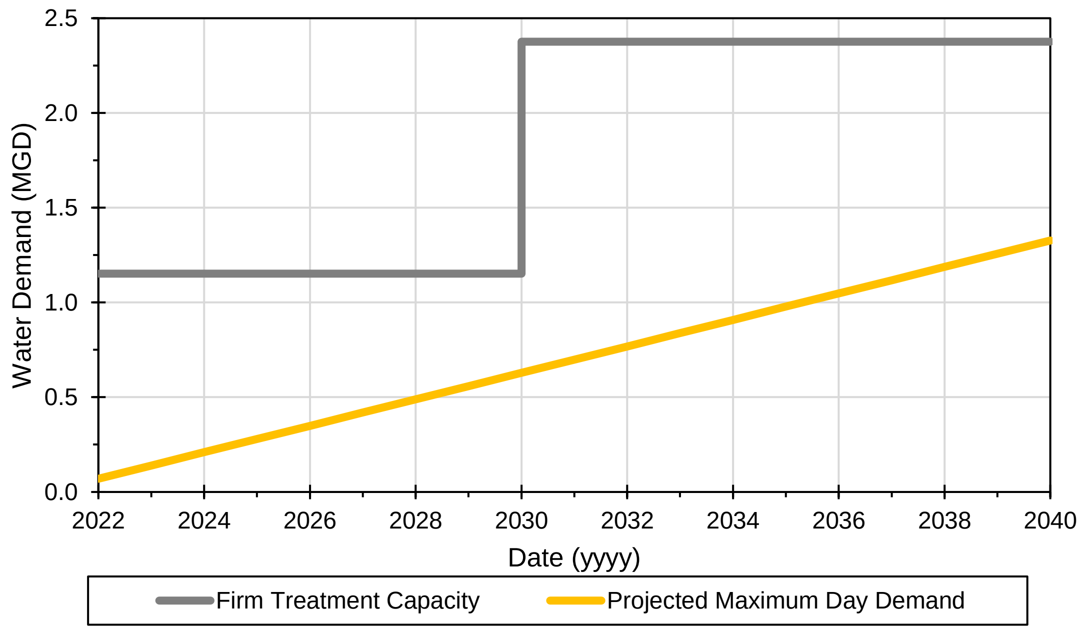

Figure 3.6 – Northwest Study Areas Water Treatment Capacity Evaluation

A water storage capacity analysis was completed for the northwest areas following the same method used in Section 3.4 of this report. A summary off this analysis for the northwest areas is shown in ***Table 3.12*** and depicted in ***Figure 3.7***. Given the requirements shown below, it is recommended to construct at least a 1.0 MG water tower within a five (5) year timeframe to serve the northwest study areas.

Table 3.12 – Northwest Study Areas Storage Requirements

		Year 2022	Year 2040
A	Average Day Water Use in gpd	26,966	512,349
B	Maximum Day Water Use in gpd	69,841	1,326,984
C	Maximum Day Water Use in gpm (20-hrs to supply per AWWA)	58	1,106
D	Firm Pumping Capacity in gpm	800	1,650
E	AWWA Recommended Firefighting Rate in gpm	3,500	3,500
F	Firefighting Duration in hours	3	3
G	Design Firefighting Volume in Gal (E x F x 60 min/hour)	630,000	630,000
H	Total Coincident Demand in gpm (C + E)	3,558	4,606
I	Required Draft from Storage in gpm (H - D)	2,758	2,956
J	Adjusted Firefighting Storage in gal (F x 60 min/hr x I)	496,440	532,080
K	Equalization Storage in gpd (B x 25%)	17,460	331,746
L	Total Storage Needed in gal (J + K)	513,900	863,826
M	Existing Storage Capacity in gallons	0	0
N	**Storage Surplus/Deficit in gallons – Average Demand Method (M – A)**	**-26,966**	**-512,349**
O	**Storage Surplus/Deficit in gallons – Equation 1 Method (M – L)**	**-513,900**	**-863,826**

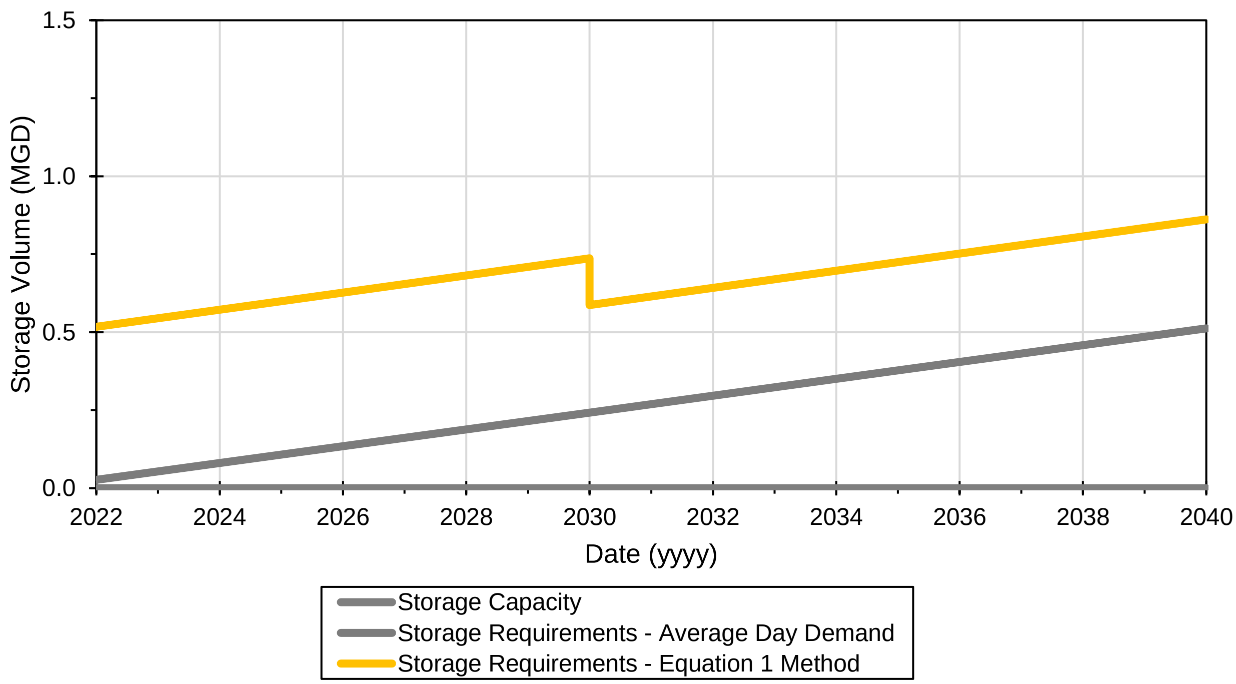

Figure 3.7. Northwest Study Areas Storage Capacity Evaluation

3.7 Recommended Water System Infrastructure for the Northwest Areas

The proposed water distribution system to serve the northwest study areas is shown in ***Figure A13*** in ***Appendix A***. A summary of the recommended infrastructure is described below:

Trunk Watermain: Modeling indicated that the existing 12-inch watermain can be extended north along Elk Lake Road NW starting at the intersection of Elk Lake Road NW and Meadowvale Road NW and then east along 205th Avenue NW and west along Ranch Road NW. Two (2) smaller loops are being proposed along future developments north of Ranch Road NW and along various existing streets such as Queen Street NW, 214th Avenue NW, Naples Street NW, 212th Avenue NW, Lander Street NW, and 209th Avenue NW. The 12-inch watermain along 205th Avenue NW can transition into a 16-inch watermain in the gravel mining areas and continue south along 205th Avenue NW and Proctor Road NW until connecting with the existing 16-inch watermain at the intersection of Proctor Road NW and 195th Lane NW. To serve the eastern areas, the existing 12-inch watermain on Holt Street NW should also be extended around the eastern and northern boundary of the study areas. Additionally, a smaller 12-inch loop can be created by extending 12-inch watermain along 197th Avenue NW, Lowell Street NW, 198th Avenue NW, Norfolk Street NW, and 199th Street NW. It is recommended that the 16-inch and eastern 12-inch watermains be extended north as development continues beyond 2040 to serve the ultimate boundary of the northwest service areas. Eight-inch watermain can be extended from the proposed 12-inch and 16-inch trunk loops to provide water service to the northwest study area via smaller watermain loops. The smaller 8-inch watermain loops shown in ***Figure A13*** are not definitive and their final location will change based on future development layouts.

Wells: The two (2) 850 gpm wells proposed for the northwest service areas should be drilled in the High Zone 2 shown in ***Figure A13***. These wells can be operated using the proposed water tower for the zone. Water from the High Zone 2 will flow to the other northwest areas (High Zone 1, Low Zone 1, and Low Zone 2) via pressure reducing stations.

Water Towers: A new 1.0 MG water tower is proposed for the northwest areas to be located in High Zone 2.

Water Treatment Plants: It is strongly recommended to provide water treatment via direct pressure filtration at the proposed wells in the northwest areas. A single plant could be used to treat water from both wells.

Pressure Zones: Modeling indicated that the northwest areas cannot be annexed to the system's main pressure zone without pressure regulating infrastructure. Given the ground elevations of the study area, it is recommended to serve the northwest areas with two (2) larger high pressure zones and two (2) smaller lower sub-zones. The hydraulic grade lines (HGLs) recommended for each of the zones varies from 1,120-ft to 1,181-ft and are shown in ***Figure A13***. Dividing the northwest study areas into the pressure zones shown in ***Figure A13*** would maintain the water pressures between 39 psi and 84 psi for average day demand conditions and between 37 psi and 84 psi for peak hourly demand conditions as shown in ***Figures A14*** and ***A15*** in ***Appendix A***. Although some areas are projected to experience water pressures lower than 50 psi, it is not recommended to serve the northwest study area with more than four (4) pressure zones as it would result in a significant increase in operation requirements for utility staff. Furthermore, the areas that are projected to have a water pressure below 50 psi are small in comparison to the size of the entire study area. The ultimate developments of the northwest areas can be served by the High Zone 2.

Booster Stations: As shown in ***Figure A13***, two (2) booster stations (BS-1 and BS-2) are recommended to supplement the well pumping capacity of the northwest study areas. Given the pumping capacity recommended for each booster station, each station should have at least two (2) pumps. Both booster stations can be built underground in a vault structure with an access hatch. The use of the booster stations can be slowly phased out as additional wells are drilled in the northwest areas. Once additional wells are drilled, the booster stations can be used for backup/emergency purposes or be completely eliminated.

PRVs: A total of five (5) PRVs are recommended to serve the study area. Two (2) PRVs (PRV-1 and PRV-3) will be used to serve the two smaller low pressure zones, two (2) PRVs will be used to recirculate water back to the system's main pressure zone, and a fifth one will be used to connect the High Zone 1 with the High Zone 2. Recirculating water from the high zones back to the main zone will allow for constant water movement within the northwest areas which should eliminate water stagnation in the water tower at the beginning when water demands are lower. The use of these PRVs is critical at first since the short-term water demands will not be large enough to turnover the water tower adequately. Individual PRVs may be needed at local dwellings where the water pressure is higher than 80 psi as shown in ***Figures A14*** and ***A15***.

Similar to the northeast area analysis, ***Table 3.13*** summarizes the fire flow requirements projected for the northwest study area based on the anticipated 2040 land uses. These requirements are only intended to be used as a general planning guideline at this time.

Table 3.13 – Projected Fire Flow Requirements – 2040 Northwest Study Areas

Land Use Type	Approximate Needed Fire Protection (gpm)
Single Family Residential	500 – 1,500
Mixed Residential	2,000 – 3,000
Highway Business	1,500 – 2,500
Public/Semi Public	500 – 1,000
Open Space/Parks	N/A

GPM – Gallons per Minute

The available fire flows modeled for the northwest study areas vary from approximately 1,000 gpm to 4,000+ gpm and are shown in ***Figure A16*** in ***Appendix A***. All of the single family residential and public/semi public areas will have an available fire flow of equal or greater than 1,000 gpm, which will be adequate. The mixed residential and highway business areas are projected to have an available fire flow equal or greater than 3,000 gpm, which should also be adequate.

4. SANITARY SEWER SYSTEM ANALYSIS

The City's existing sanitary sewer collection system is shown in ***Figure A17*** in ***Appendix A***. The system uses a combination of gravity and pressurized flow to convey wastewater to the City's wastewater treatment plant located near the intersection of Trunk Highways 10 and 169. The sanitary sewer serviceability analysis completed for the study areas is summarized in the following sections.

4.1 Existing System Description

The City's sanitary sewer collection system includes approximately 81 miles of sewer mains and 23 lift stations. The gravity sewer pipes range in diameter from 8 inches to 24 inches and collect wastewater from approximately 8,000 acres. Prior to commencing this serviceability analysis, City staff identified several lift stations that could be used to convey all, or a portion, of the wastewater generated in the study areas. These lift stations are highlighted in ***Figure A17,*** and their design characteristics are summarized in ***Table 4.1***. The existing sanitary sewer system in the northwest study area is shown in ***Figure A18*** in ***Appendix A***. The northeast study area is not currently served by municipal sanitary sewer.

Table 4.1 – Existing Sanitary Sewer Lift Station Data

Parameter	TH 169 Lift Station(1)	Evans Lift Station(2)	Windsor Lift Station(2)
Lift Station Type	Submersible	Submersible	Submersible
Upstream Gravity Diameter (inch)	24	24 & 18	8
Number of Pumps	2 (space for 4)	3	2
Individual Pump Design Capacity (inch)	1,200	1,150	240
Firm Pumping Capacity (gpm)(3)	1,660	2,300	240
Pumping Head Conditions (feet)	110	53	108
Number of Forcemains	1	1	1
Forcemain Diameter (inch)	14 & 16	14	6
Length of Forcemain (feet)	1,470 (14-inch) 275 (16inch)	1,850	12,500

GPM – Gallons per Minute; ft- Feet
(1) Individual pump capacity based on drawdown test completed on April 6, 2022.
(2) Theoretical pump capacities. Drawdown test not completed.
(3) The firm capacity of a lift station is defined as the lift station's capacity with its largest pump out of service.

Both the TH 169 and the Evans Lift Stations pump wastewater from the sanitary sewer collection system directly to the City's wastewater treatment plant (WWTP) and could potentially be used to convey wastewater from the study areas. The wastewater plant was originally constructed in the late 1950s and has gone through multiple expansions and rehabilitations with the latest one occurring in 2017. Currently, the plant utilizes an activated sludge treatment train with extended aeration followed by a chemical phosphorus removal process, final clarification, sand filtration, and ultraviolet (UV) disinfection. The biosolids generated throughout the facility are aerobically digested, dewatered with screw presses, and hauled to the Elk River Waste Management Landfill located a few miles north of the wastewater plant. The plant's biological treatment capacity was doubled during the 2017 expansion from 2.2 MGD to 4.5 MGD. Although the plant's biological treatment units can treat up to 4.5 MGD of average flow, the existing headworks infrastructure is not capable of handling that high of volume of wastewater and will require expansion in the future to increase the overall treatment capacity to 4.5 MGD.

4.2 Existing Wastewater Flows

Residual capacities were calculated for the existing lift stations shown in ***Table 4.1*** based on wastewater flow data provided by the City to assess their remaining pumping capacity. This capacity study is summarized in ***Table 4.2***.

Table 4.2 – Existing Wastewater Flows

Parameter	TH 169 Lift Station	Evans Lift Station	Windsor Lift Station
Average Daily Flow (gpm)	335	370	11
Peak Hourly Flow (gpm)	700 – 800	800	44
Firm Pumping Capacity (gpm)	1,660	2,300	240
Residual Capacity (gpm)	860 – 960	1,500	196

City staff also reported that the City's wastewater treatment plant treated an average daily flow of 1.35 MGD in 2021. Based on a biological treatment capacity of 4.5 MGD, the wastewater treatment plant has 70-percent biological residual capacity. It is unclear how much capacity is remaining at the headworks portion of the plant. Both the lift stations shown in ***Table 4.2*** and the wastewater treatment plant are adequately sized to convey and treat the existing wastewater flows.

4.3 Wastewater Flow Projections

Wastewater flows for the study areas were projected using the unit wastewater flows shown in ***Table 4.3***. These unit wastewater flows were calculated based on city-provided lift station runtime data for the Windsor Lift Station, the proposed land use densities for new developments, and industry-standard wastewater generation rates. Lift station runtime data for the Windsor Lift Station indicated that, on average, residential dwellings in Elk River generate approximately 83 gallons per day (gpd) of wastewater. In order to conservatively estimate average wastewater flows for new residential dwellings in the study areas, a 50-percent safety factor was applied to the Windsor Lift Station data resulting in an average wastewater flow of 124.5 gpd per dwelling. This residential average wastewater flow is still below industry-standard rates.

Table 4.3 – Wastewater Generation Assumptions

Land Use Type	Density (units/acre)	Residential Unit Flow (gpd/unit)	Average Unit Flow (gpd/acre)
Single Family Residential – Northeast Areas	2	124.5	250
Single Family Residential – Windsor LS Homes	Varies	83	-
Single Family Residential – Northwest Areas	3	124.5	375
Mixed Residential	5	124.5	625
Neighborhood Commercial	-	-	800
Highway Business	-	-	800
Public/Semi Public	-	-	0
Open Space/Parks	-	-	0

Unit – residential dwelling; gpd/acre – Gallons per Day per Acre

The projected wastewater flows calculated for the study areas are summarized in the tables below.

Table 4.4 – Projected Wastewater Flow for Northeast Areas

Land Use Type	Net Developable Acres	Average Unit Wastewater Flow (gpd/acre)	Wastewater Flow (gpd)
Single Family Residential	1,012	250	253,000
Mixed Residential	307	625	191,875
Neighborhood Commercial	9	800	7,200
Total Average Wastewater Flow (gpd)			**452,075**
Peak Hourly Flow Peaking Factor(1)			**3.5**
Peak Hourly Flow (gpd)			**1,582,263**

(1) Source: Metropolitan Council Environmental Services Flow Variation Factors for Sewer Design.

Table 4.5 – Projected Wastewater Flow for Northwest Areas (2040 Development Timeframe)

Land Use Type	Net Developable Acres	Average Unit Wastewater Flow (gpd/acre)	Wastewater Flow (gpd)
Single Family Residential	1,393	Varies(1)	229,074
Mixed Residential	266	625	166,250
Highway Business	41	800	32,800
Public/Semi Public	29	0	0
Open Space/Parks	202	0	0
Total Average Wastewater Flow (gpd)			**428,124**
Peak Hourly Flow Peaking Factor(2)			**3.5**
Peak Hourly Flow (gpd)			**1,498,434**

(2) Average unit wastewater flow for existing Windsor Lift Station dwellings was calculated using 83 gpd/unit. A generation rate of 124.5 gpd/unit was used for all remaining single family residential areas.
(3) Source: Metropolitan Council Environmental Services Flow Variation Factors for Sewer Design.

Investigating the serviceability of the ultimate northwest areas is beyond the scope of this study. However, a high level preliminary analysis was completed to assess how the proposed northwest Regional Lift Station (discussed in ***Sections 4.6*** and ***4.7*** of this report) may change to serve the projected ultimate developments. The planned land uses for the ultimate northwest areas include single family residential, industrial, rural industrial, and highway business, which are projected to generate a significant volume of wastewater. A summary of the projected wastewater flows for these land uses is shown in ***Table 4.6***. The wastewater flows for the northwest study areas summarized in ***Table 4.6*** are only for the developments planned beyond the year 2040. The total projected flow (ultimate flow) of the entire northwest areas can be calculated by adding wastewater flows from ***Tables 4.5*** and ***4.6.*** The northeast study area is not projected to develop beyond the boundary shown in ***Figure A1*** and therefore the 2040 flow projections summarized in ***Table 4.4*** can also be a representation of ultimate development conditions.

Table 4.6 – Projected Wastewater Flow for Northwest Areas (Beyond 2040 Development Timeframe)

Land Use Type	Net Developable Acres	Average Unit Wastewater Flow (gpd/acre)	Wastewater Flow (gpd)
Single Family Residential	196	375	73,500
Industrial	478	800	382,400
Rural Industrial	231	600	138,600
Highway Business	428	800	342,400
Total Average Wastewater Flow (gpd)			**936,900**
Peak Hourly Flow Peaking Factor(1)			**3.2**
Peak Hourly Flow (gpd)			**2,998,080**

(1) Source: Metropolitan Council Environmental Services Flow Variation Factors for Sewer Design.

The Elk River wastewater treatment plant's facility plan completed in 2013 projected the city-wide wastewater flows through 2035. These projections were used to design the 2017 plant expansion. The projected city-wide wastewater flows obtained from the facility plan are shown in ***Table 4.7***.

Table 4.7 – 2035 City-Wide Projected Wastewater Flows

Parameter	Value
Average Dry Weather Flow	3.98 MGD
Average Wet Weather Flow	4.54 MGD
Peak Hourly Wet Weather Flow	7.27 MGD

MGD – Million Gallons per Day

4.4 System Evaluation and Capacity Analysis for Northeast Areas

A 20-year capacity analysis of the TH 169 Lift Station was completed to assess if this lift station can be used to pump wastewater generated in the northeast study area. If the TH 169 Lift Station is used to pump wastewater generated in the northeast study areas, its peak hourly flow is projected to increase to 2,200 and 2,300 gpm when the northeast study area is fully developed. This flow will exceed the lift station's existing firm pumping capacity by 540 to 640 gpm. Although this flow increase would trigger upsizing the TH 169 Lift Station to serve the study area, a capacity increase would not be required initially.

The TH 169 Lift Station was originally designed with space to install two (2) additional pumps. Therefore, additional pumps could be installed to increase the lift station's pumping capacity. Installing one (1) additional 1,200 gpm pump would increase the lift station's pumping capacity to 2,860 gpm, which would be sufficient to pump the wastewater generated in the lift station's existing service area and the northeast study area. Installing two (2) additional 1,200 gpm pumps would increase the lift station's firm pumping capacity to 4,060 gpm. Installing a second 1,200 gpm pump could be done if large developments beyond those planned for the study area are expected for the lift station's service area in the future.

The TH 169 Lift Station has a 1,745-ft long forcemain. Most of the forcemain (1,470-ft) is 14-inch in diameter and the remaining 275-ft is 16 inches in diameter. Forcemains are typically designed to maintain flow velocities between two (2) and five (5) feet per second (fps) to avoid particle settling. Depending on the application, velocities of up to eight (8) fps could be acceptable. Although higher velocities are sometimes acceptable, they also result in higher pipe friction headloss. Headloss in a forcemain is defined as the reduction in energy of the water as it moves through the pipe. High headloss and velocity indicates a forcemain is undersized for the flow that is conveyed. An undersized forcemain that generates high headlosses will also increase the energy cost to operate the pumps. In order to keep energy costs reasonable, forcemains are usually designed to maintain headlosses below 10-ft per 1,000-ft length of forcemain. The wastewater velocity and headloss through the TH 169 forcemain were evaluated under three different scenarios: existing pumping conditions, addition of one 1,200 pump, and addition of two additional 1,200 gpm pumps. The results of this analysis are summarized in ***Table 4.8***.

Table 4.8 – TH 169 Capacity Analysis for Existing 14-inch Forcemain

Scenario at TH 169 Lift Station	Total No. of Pumps	Firm Pumping Capacity (gpm)	Wastewater Velocity (fps)	Headloss (ft/1,000 ft)(1)
Existing Conditions	2	1,660	3.46	3.0
One Additional Pump	3	2,860	5.96	8.3
Two Additional Pumps	4	4,060	8.46	15.9

(1) The roughness condition of the existing forcemain is unknown and assumptions were made to calculate the headlosses.

As summarized in ***Table 4.8***, the existing 14-inch forcemain could potentially still be used if only one additional 1,200 gpm pump is added. However, serious consideration should be given to installing a parallel forcemain if a second 1,200 gpm pump is added in the future. A more detailed forcemain analysis should be completed in the future to identify if the existing forcemain can be used before installing additional pumps. Upon discussing the use of the TH 169 Lift Station with City staff, it was decided not to use this lift station to convey wastewater generated in the northeast study area.

Regardless of whether the existing TH 169 lift station will be used to pump northeast area flows, wastewater flow generated in the northeast study area will need to be treated at the City's WWTP. Given the plant's existing wastewater flow, it appears that the existing wastewater treatment plant has sufficient capacity to treat wastewater generated in the northeast study area.

4.5 Recommended Sanitary Sewer Infrastructure for the Northeast Areas

The recommended sanitary sewer collection system layout and sewershed distribution to serve the northeast study areas are shown in ***Figures A19*** and ***A20*** in ***Appendix A***, respectively. The sanitary sewer layout was preliminary designed based on the following criteria:

1. Prioritize gravity flow over pressurized flow;
2. Maintain a minimum cover depth of 7.5-feet;
3. Minimize gravity sewer depth installation deeper than 30-feet;
4. Design gravity trunk sewermains to flow 85-percent full under peak hourly flow conditions;
5. Install gravity sewer pipe per the minimum Ten-States Standards' recommended slopes;
6. Design forcemains to maintain flow velocities between 2.0 and 5.0 fps;
7. Design forcemains to maintain headloss gradients below 10 ft per 1,000 ft;
8. Recommend lift stations firm capacities that exceed by 25-percent the projected peak hourly flows;
9. Lift station design shall be submersible type with a wet well and a valve vault; and
10. Limit wet well depths to 35-feet when possible.

A summary of the recommended sanitary sewer infrastructure for the northeast study areas is listed below:

Trunk Sewermain (gravity flow): It is recommended to install trunk sewermains ranging from 10-inch to 18-inch diameter along Cleveland Street NW and Twin Lakes Road NW to minimize the need for lift stations. Eight-inch sewermains can be extended beyond the trunk mains to serve the remaining portions of the study area.

Lift Stations (pressurized flow): Although the ground elevations throughout the study area are conducive to maximizing gravity flow, trunk lift stations are still required to pump wastewater. At least three trunk lift stations will be needed to serve the study area. Additional smaller lift stations or small low pressure systems may be needed to serve minor portions of the study area as indicated in ***Figure A20***. The need for these lift stations will depend on the final grading within particular developments near the wetland areas. A summary of the recommended trunk lift stations is shown in ***Table 4.9***. Each lift station's wet well depth is the minimum recommended depth to serve the sewersheds identified in ***Figure A20***. Deeper wet wells can be installed if a more conservative design is desired.

Table 4.9 – Preliminary Northeast Lift Station Design(1)

Name	Ultimate Peak Hourly Flow (gpm)	Initial Firm Pumping Capacity (gpm)	Ultimate Firm Pumping Capacity (gpm)(2)	No. Pumps (Initial/ Ultimate)	Min. Wet Well Depth (ft)	Forcemain Quantity	Forcemain Diameter (inch)
Regional	1,100	500 – 750	1,500	2/3	41	Dual	8 & 12
West	140	185	185	2	35	Single	6
North	170	225	225	2	20	Single	6

(1) Ultimate firm pumping design capacities and forcemain diameters shall be revised during each lift station's design phase based on final development densities.
(2) Initially, two (2) 750 gpm pumps can be installed at the Regional Lift Station. As development increases, a third 750-gpm pump can be added to increase the lift station's firm pumping capacity to 1,500 gpm.

Wastewater pumped by the northeast Regional Lift Station will be conveyed via dual forcemain directly into the City's WWTP. Because of this, it is likely that a new receiving structure will be needed at the facility. Initially, the 8-inch forcemain alone can be used when the lift station's pumping capacity is lower and both forcemains can be used as the lift station's pumping capacity increases over time. It is recommended to install both forcemains at the same time to reduce installation costs. Air release valve manholes should be installed at the high points of the forcemains as shown in ***Figure A20***.

4.6 System Evaluation and Capacity Analysis for Northwest Areas

A portion of the wastewater generated in the northwest areas will be pumped by the existing Windsor Lift Station. As shown in ***Table 4.2***, the Windsor Lift Station has an existing residual capacity of 196 gpm (or 82-percent). Peak hourly flow in this lift station's sewershed is projected to increase to approximately 300 gpm for ultimate development conditions. Given that the existing lift station capacity is only 240 gpm, the pumping capacity of this lift station may require upsizing in the future. Ultimate peak hourly flows for this sewershed may never reach 300 gpm. Since the Windsor Lift Station has sufficient residual capacity for the existing and short-term development conditions, it is recommended not to upsize this lift station right away and to monitor the peak hourly flows as development increases. Consideration to increasing the lift station's pumping capacity by installing larger pumps should be given if the peak hourly flows reach approximately 200 gpm. The existing 6-inch HPDE forcemain can safely flow up to 360 gpm. Consequently, submersible pumps with individual pumping capacities of up to 360 gpm could be installed at the Windsor Lift Station in the future without having to upsize the lift station's wet well, internal piping, or forcemain.

As shown in ***Table 4.5***, the peak hourly flow for the entire northwest area under the 2040 development timeframe is projected to be 1,498,434 gpd (or 1,041 gpm). Given that the entire area will require a regional lift station in the future, the actual peak hourly flow leaving the northwest areas will equal the regional lift station's firm pumping capacity (proposed to be 1,500 gpm). The way the City's sanitary sewer system is currently operated, wastewater flow generated in the existing northwest developments is pumped by the Jackson Lift Station and by the Evans Lift Station before arriving at the wastewater treatment plant. The Jackson and Evans Lift Stations have firm pumping capacities of 700 gpm and 2,300 gpm, respectively. Additionally, unlike with the TH 169 Lift Station, neither Jackson nor the Evans Lift Stations have space available to install additional pumps.

Given that both the Jackson and the Evans Lift Stations do not have space for additional pumps, increasing their capacity to serve the northwest areas long term would require a significant capital expense. Larger pumps could be installed (similar to the Windsor Lift Station). However, this would only be a temporary solution as there isn't space available to install additional pumps. Therefore, it is recommended that the proposed northwest Regional Lift Station pumps directly to the City's WWTP.

Given the City's estimate of the current wastewater flow treated at the plant, it appears that the existing treatment plant will have sufficient residual capacity to treat the wastewater flow generated in the northwest areas alone. However, flows will need to be closely monitored at the wastewater plant as both study areas (northeast and northwest) approach the 2040 development projections, precisely given that the plant's existing headworks infrastructure is not sized for a wastewater flow of 4.5 MGD.

4.7 Recommended Sanitary Sewer Infrastructure for the Northwest Areas

The recommended sanitary sewer collection system layout to serve the northwest study areas is shown in ***Figure A21*** in ***Appendix A***. The sanitary sewer layout for the northwest areas was preliminary designed following the same criteria of the northeast areas – *see* ***Section 4.5***. A summary of the recommended sanitary sewer infrastructure is listed below:

Trunk Sewermain (gravity flow): It is recommended to install trunk sewermains ranging from 10-inch to 12-inch diameters along 205Th Avenue NW up until the intersection with Proctor Road NW as shown in ***Figure A21***. Eight-inch sewermains can be extended beyond the trunk mains to serve the remaining portions of the study area.

Lift Stations (pressurized flow): At least three (3) lift stations will be needed to serve the study area. Additional smaller lift stations or small low pressure systems may be needed to serve minor portions of the study area as indicated in ***Figure A21***. A summary of the recommended lift stations is shown in ***Table 4.10***. Each lift station's wet well depth is the minimum recommended depth to serve the lift station's service areas identified in ***Figure A21***. Deeper wet wells can be installed if a more conservative design is desired. Future developments located west of the proposal Regional Lift Station can be served by the existing Windsor Lift Station and 6-inch forcemain. These areas are highlighted in ***Figure A21*** as Windsor's LS proposed sewershed. Because the Windsor Lift Station can serve the majority of the northwest study areas, the northwest Regional Lift Station will not be needed until the mining areas begin developing.

Table 4.10 – Preliminary Northwest Lift Station Design[1]

Name	Ultimate Peak Hourly Flow (gpm)	Initial Firm Pumping Capacity (gpm)	Ultimate Firm Pumping Capacity (gpm)	No. Pumps (Initial/ Ultimate)	Min. Wet Well Depth (ft)	Forcemain Quantity	Forcemain Diameter (inch)
Regional	3,300	750	4,000	2 or 3/4	30	2	12 & 16
NW-LS-1	155	200	200	2/2	26	1	6
NW-LS-2	366	425	425	2/2	25	1	6

(1) 2040 firm pumping design capacities and forcemain diameters shall be revised during each lift station's design phase based on final development densities.

Wastewater pumped by the northwest Regional Lift Station will be sent directly to the City's WWTP which will require the facility to update its receiving structure. This lift station will need at least a single 12-inch forcemain to operate at the recommended initial firm pumping capacity of 750 gpm. Similar to the existing TH 169 Lift Station, the proposed northwest Regional Lift Station can be constructed with enough space to install future pumps. Initially, only two to three pumps will be needed and individual pumping capacities can be increased or new pumps can be added in the future as development progresses. Although parallel forcemains are strongly recommended with long runs of forcemains like this one, the proposed parallel 16-inch forcemain will not be needed until approximately the 2050-2060 timeframe. Therefore, the City could choose not to install the 16-inch forcemain until later. However, for the purpose of budgetary planning, the cost estimate for the northwest study areas includes the construction of the 16-inch forcemain at this time. A proposed layout for both forcemains along the railroad corridor is shown in ***Figure A22*** in ***Appendix A***. A high-level ultimate sanitary sewer layout for the northwest areas beyond 2040 is shown in ***Figure A23*** in ***Appendix A***.

5. FINANCING

5.1 Opinion of Probable Cost

A detailed engineer's opinion of probable costs for the proposed improvements is included in ***Appendix B*** of this report. The opinion of probable cost incorporates bid prices from the 2021 and 2022 construction seasons including a 10% construction contingency. Indirect costs were budgeted at 20% of the construction cost and include engineering, legal, financing, and administrative costs. The indirect costs do not include the funding required to purchase necessary easements. ***Table 5.1*** and ***5.2*** below provide a summary of the opinion of probable costs to extend water and sanitary sewer service to the study areas. The cost estimates are based on current market conditions and shall be used for preliminary planning purposes only. Market conditions are rapidly changing, and unit prices should be updated prior to proceeding with the projects recommended by this study.

Table 5.1 – Opinion of Probable Cost to Extend Water Service (2040 planning timeline)

Proposed Improvement	Northeast Areas	Northwest Areas
Bonds, Insurance, and General Conditions	$ 1,042,000	$ 1,448,500
Mobilization/Demobilization	$ 2,084,000	$ 2,897,100
Trunk Watermain	$ 4,543,000	$ 7,748,000
Pressure Regulating Infrastructure	$ -	$ 1,222,000
Wells and Treatment	$ 9,500,000	$ 12,000,000
Storage Infrastructure	$ 4,750,000	$ 4,750,000
Other (hydrants, valves, and fittings)	$ 2,046,500	$ 3,250,600
Construction Sub-Total	**$ 23,965,500**	**$ 33,316,200**
Construction Contingency (10%)	$ 2,396,550	$ 3,331,620
Construction Total	**$ 26,362,100**	**$ 36,647,800**
Indirect Costs (20%)	$ 5,272,420	$ 7,329,560
Total Cost	**$ 31,635,000**	**$ 43,977,000**

Table 5.2 – Opinion of Probable Cost to Extend Sanitary Sewer Service (2040 planning timeline)

Proposed Improvement	Northeast Areas	Northwest Areas
Bonds, Insurance, and General Conditions	$ 432,900	$ 505,100
Mobilization/Demobilization	$ 865,800	$ 1,010,200
Trunk Gravity Sewer and Manholes	$ 1,611,000	$ 674,000
Trunk Lift Stations	$ 2,865,000	$ 2,840,000
Air Release Valve Manholes	$ 80,000	$ 25,000
Pressurized Forcemains and Testing	$ 4,096,400	$ 6,557,000
Connecting to Existing System	$ 6,000	$ 6,000
Construction Sub-Total	**$ 9,957,100**	**$ 11,617,300**
Construction Contingency (10%)	**$ 995,710**	**$ 1,161,730**
Construction Total	**$ 10,952,800**	**$ 12,779,000**
Indirect Costs (20%)	**$ 2,190,560**	**$ 2,555,800**
Total Cost	**$ 13,143,000**	**$ 15,335,000**

In addition to the costs for the new infrastructure to be located in the two expansion areas, improvements will need to be made to the existing sanitary sewer infrastructure at the wastewater treatment plant to receive the new waste. These improvements include a receiving station estimated to cost $2,000,000 and a headworks (basin and receiving structure) estimated to cost $6,000,000.

5.2 Funding Options

The City has historically assessed property for trunk extensions and lift stations on a per acre basis as property develops. Because the northeast and northwest expansion areas create unique challenges for assessing property owners, we have explored alternative funding mechanisms to fully recover the cost of the projects from development as it occurs. These funding alternatives include special assessments, trunk area charges collected when land is platted, and SAC fees collected with building permits.

Special Assessments. The City may levy special assessments against benefitting properties for 100% of the cost of the improvements at the time the improvement is installed, as long as the City can establish benefit. The assessments are secured against the property and paid with property taxes, making them a very reliable revenue source for the City. They may be prepaid and are usually paid in full when land is sold. Because special assessments increase the holding cost of undeveloped property, the use of assessments can encourage properties to develop and connect to the water and sanitary sewer systems.

The difficulties in assessing the northeast and northwest expansion areas include:

1) There are a significant number of existing residential properties with well and septic in the area. Some of these are on very large lots and, if assessed on a per acre basis, these households will pay a significant amount to connect to utilities.

2) The areas have a decades-long development horizon. Infrastructure installed today to reach and serve these areas may not be fully utilized for another 10-20 years. In addition, since the infrastructure will be phased, some property may be assessed for a major lift station, for example, before the trunk line is extended to serve the property. Property will need to be assessed several years in advance of being able to hook-up to utilities. One potential solution to this is to defer the special assessments until a property develops.

Trunk Charges. Trunk charges are collected when land is platted and the development pattern is known. They can be charged based on net developable acreage or on the projected number of SAC units expected to be developed on the property. One advantage to trunk charges is that they can be tied to the actual density of development. Typically, there are higher trunk charges for commercial/industrial and multi-family uses than single family uses as these higher density land uses require larger trunks and lift stations. If the trunk charges are based on the expected SAC units instead of acreage, a large-lot existing home would just pay for one connection. If the homeowner later sold a portion of their lot for development, additional trunk charges would be collected.

The disadvantage of trunk charges is that the City will not be reimbursed for its capital investment until land is platted for development. The projects will be largely financed, so that repayment can be aligned with anticipated development. However, if development occurs more slowly than anticipated, the City will need to rely on other revenues. For the sewer utility, the City can look to sewer user charges. However, since the City does not operate its own water utility, it may need to negotiate higher water rates with the ERMU to help pay the debt service on the water revenue bonds if development gets delayed. Ultimately, the City may need to rely on property taxes if development is delayed significantly.

Trunk charges may be assessed if the landowner agrees to it.

Availability Charges (WAC and SAC). ERMU currently charges a WAC fee of $3,990 per plumbing unit when a building permit is pulled. The City of Elk River currently charges $5,769 per SAC unit when a building permit is pulled. This SAC fee pays for debt service on the wastewater treatment plant and other sewer improvements associated with expanding the system to serve growth. ERMU and the City could add a separate SAC fee for the Northeast and Northwest Areas, respectively, that would pay for the improvements that specifically serve those areas. Alternatively, the City could increase the existing SAC fee paid by all developing properties in the City.

The advantages and disadvantages of the SAC fees are similar to those for the Trunk Charges. The advantage is that the precise development is known, and the charge very accurately reflects the property use. Developers prefer SAC fees over trunk charges because they have their construction financing in place to pay for them.

The major disadvantage to SAC fees is that waiting for the building permit furthers extends the time between when the improvements are installed and when the fee is collected. Land can be platted and development may still be delayed due to the economy or developer performance.

Proposed Funding Method. Given the logistical difficulty of assessing the utility expansion, this study proposes recovering most of the City's capital costs from trunk charges. The improvements at the sewer treatment plant, estimated at $8 million, would be paid by the existing SAC fee. Our analysis of the current demands on the SAC fee revenue show capacity to pay for these improvements assuming continued modest 3% annual fee increases. The SAC Fee analysis is shown in ***Appendix C***.

5.3 Financial Risk and Project Phasing

To assess the potential financial risk of recovering costs with development fees rather than imposing up-front assessments, a preliminary infrastructure phasing plan was prepared for the expansion areas. The phasing is shown in ***Tables 5.3*** through ***5.6***.

Table 5.3 – Project Phasing for Water Infrastructure in the Northeast Expansion Area

Item No.	Description	Total	0-5 Years	6-10 years	11-15 Years	16-20 Years
1	Bonds, Insurance, General Conditions	1,042,000	574,276	98,665	303,282	65,777
2	Mobilization/Demobilization	2,084,000	1,148,553	197,330	606,565	131,553
3	12-inch Watermain	4,543,000	1,362,900	1,362,900	908,600	908,600
4	Hydrant and Valve	1,175,200	352,560	352,560	235,040	235,040
5	12-inch Gate Valve and Box	322,400	96,720	96,720	64,480	64,480
6	Ductile Iron Fittings	536,900	161,070	161,070	107,380	107,380
7	850 gpm Well with Treatment	9,500,000	9,500,000			
8	1 MG Composite Water Tower	4,750,000			4,750,000	
9	Connect to Existing System	12,000	12,000			
	SUBTOTALS	23,965,500	13,208,079	2,269,245	6,975,347	1,512,830
	Contingency (10%)	2,396,550	1,320,808	226,924	697,535	151,283
	Construction Subtotal	26,362,100	14,528,900	2,496,200	7,672,900	1,664,100
	Indirect Costs (20%)	5,272,420	2,905,780	499,240	1,534,580	332,820
	TOTAL PROJECT COSTS	**31,635,000**	**17,435,000**	**2,995,000**	**9,207,000**	**1,997,000**

While growth is expected to occur over 20 years or more in the northeast areas, over half of the water project costs must be incurred in the first five years. This is a similar situation in expanding water into the northwest areas as shown in ***Table 5.4***.

Table 5.4 – Project Phasing for Water Infrastructure in the Northwest Expansion Area

Item No.	Description	Total	0-5 Years	6-10 years	11-15 Years	16-20 Years
1	Bonds, Insurance, General Conditions	1,448,500	928,779	464,789	54,932	-
2	Mobilization/Demobilization	2,897,100	1,857,622	929,611	109,868	-
3	12-inch Watermain	6,380,000	3,828,000	1,914,000	638,000	
4	16-inch Watermain	1,368,000	820,800	410,400	136,800	
5	Hydrant and Valve	1,853,200	1,111,920	555,960	185,320	
6	12-inch Gate Valve and Box	452,600	271,560	135,780	45,260	
7	16-inch Gate Valve and Box	80,000	48,000	24,000	8,000	
8	Ductile Iron Fittings	852,800	511,680	255,840	85,280	
9	BS-1 Booster Station	575,000	575,000			
10	BS-2 Booster Station	575,000	575,000			
11	Pressure Reducing Manholes	72,000	72,000			
12	Two 850 gpm Wells with Treatment	12,000,000	6,000,000	6,000,000		
13	1 MG Composite Water Tower	4,750,000	4,750,000			
14	Connect to Existing System	12,000	12,000			
	SUBTOTALS	33,316,200	21,362,360	10,690,380	1,263,459	-
	Contingency (10%)	3,331,620	2,136,236	1,069,038	126,346	-
	Construction Subtotal	36,647,800	23,498,600	11,759,400	1,389,800	-
	Indirect Costs (20%)	7,329,560	4,699,720	2,351,880	277,960	-
	TOTAL PROJECT COSTS	**43,977,000**	**28,198,000**	**14,111,000**	**1,668,000**	**-**

Extension of water service into the northwest areas is expected to require a $28.2 million investment (in today's dollars) within the first five years. If the ERMU or the City issued $28.2 million in bonds to fund the initial project, the annual debt service would be approximately $2.2 million assuming an interest rate of 4.5% and a term of 20 years. If development does not occur at a pace to generate $2.2 million in annual fee revenue, the ERMU would need to increase water rates to make the annual debt payment.

Table 5.5 – Project Phasing for Sanitary Sewer Infrastructure in the Northeast Expansion Area

Item No.	Description	Total	0-5 Years	6-10 years	11-15 Years	16-20 Years
1	Bonds, Insurance, General Conditions	432,900	310,205	23,983	71,448	27,265
2	Mobilization/Demobilization	865,800	620,409	47,966	142,895	54,529
3	10-inch PVC Sanitary Sewer Pipe	464,000		232,000	232,000	
4	12-inch PVC Sanitary Sewer Pipe	234,000		117,000	117,000	
5	15-inch PVC Sanitary Sewer Pipe	270,000	270,000			
6	18-inch PVC Sanitary Sewer Pipe	247,000	247,000			
7	48-inch Sanitary Sewer Manhole	396,000	130,680	130,680	134,640	
8	6-inch PVC Forcemain	475,600			380,480	95,120
9	8--inch PVC Forcemain	1,432,500	1,432,500			
10	12-inch PVC Forcemain	2,158,300	2,158,300			
11	Forcemain Pressure Testing	30,000	9,900		9,900	10,200
12	Air Release Valve Manhole on Single Forcemain	30,000			15,000	15,000
13	Air Release Valve Manhole on Dual Forcemain	50,000	50,000			
14	North Lift Station	425,000				425,000
15	West Lift Station	540,000			540,000	
16	Regional Lift Station	1,900,000	1,900,000			
17	Connect to Existing System	6,000	6,000			
	SUBTOTALS	9,957,100	7,134,994	551,629	1,643,363	627,114
	Contingency (10%)	995,710	713,499	55,163	164,336	62,711
	Construction Subtotal	10,952,800	7,848,500	606,800	1,807,700	689,800
	Indirect Costs (20%)	2,190,560	1,569,700	121,360	361,540	137,960
	TOTAL PROJECT COSTS	**13,143,000**	**9,418,000**	**728,000**	**2,169,000**	**828,000**

Table 5.6 – Project Phasing for Sanitary Sewer Infrastructure in the Northwest Expansion Area

Item No.	Description	Total	0-5 Years	6-10 years	11-15 Years	16-20 Years
1	Bonds, Insurance, General Conditions	505,100	42,553	-	437,516	25,031
2	Mobilization/Demobilization	1,010,200	85,107	-	875,033	50,061
3	10-inch PVC Sanitary Sewer Pipe	224,000			224,000	
4	12-inch PVC Sanitary Sewer Pipe	270,000			270,000	
5	48-inch Sanitary Sewer Manhole	180,000			180,000	
6	6-inch PVC Forcemain	446,600	178,640			267,960
7	12-inch PVC Forcemain	2,519,900			2,519,900	
8	16-inch PVC Forcemain	3,568,000			3,568,000	
9	Forcemain Pressure Testing	22,500	7,425		7,425	7,650
10	Air Release Valve Manhole on Dual Forcemain	25,000			25,000	
11	NW-LS-1 Lift Station	440,000	440,000			
12	NW-LS-2 Lift Station	450,000	225,000			225,000
13	Regional Lift Station	1,950,000			1,950,000	
14	Connect to Existing System	6,000			6,000	
	SUBTOTALS	11,617,300	978,725	-	10,062,874	575,702
	Contingency (10%)	1,161,730	97,872	-	1,006,287	57,570
	Construction Subtotal	12,779,000	1,076,600	-	11,069,200	633,300
	Indirect Costs (20%)	2,555,800	215,320	-	2,213,840	126,660
	TOTAL PROJECT COSTS	**15,335,000**	**1,292,000**	**-**	**13,283,000**	**760,000**

5.4 Potential Development Fees

The City and ERMU's financial risks are also dependent on having competitive development fees. If the development fees are too high, they may push the sale price of a home above the Elk River market, making development less financially feasible and slowing the pace of development.

Ehlers calculated the cost per acre for installing the proposed water and sanitary sewer extensions into the northeast and northwest areas. Project costs were allocated by land use and development type and based on the estimated gallons used per net acre per day for each development type. This analysis is shown in ***Appendix C***.

Estimated fees were calculated on a per acre basis and are referred to as trunk fees. These could also be collected as WAC and SAC fees, shown on a per unit bases, or a combination of the two.

Table 5.7 – Estimated Development Fees for Water Infrastructure Expansion

Expansion Area	Land Use	Water Trunk Fee per Developable Acre	Fee per Square Foot	Fee per Unit
Northeast	Single Family Mixed Residential Neighborhood Commercial	$17,503 $43,757 $54,319	$0.40 $1.00 $1.25	$8,751 - -
Northwest	Single Family Mixed Residential Highway Business	$22,891 $38,151 $47,360	$0.53 $0.88 $1.09	$7,630 - -

The fee per dwelling unit is higher in the northeast area because land use estimates indicate there will be an average of 2 single family dwelling units per net developable acre in the while the northwest area is expected to develop with an average of 3 single family dwelling units per net developable acre. The majority of the land in both areas is slated for single family home development.

Table 5.8 – Estimated Fees for Sanitary Sewer Infrastructure Expansion

Expansion Area	Land Use	Water Trunk Fee per Developable Acre	Fee per Square Foot	Fee per Unit
Northeast	Single Family Mixed Residential Neighborhood Commercial	$7,268 $18,170.38 $23,258.09	$0.17 $0.42 $0.53	$3,634
Northwest	Single Family Mixed Residential Highway Business	$7,005 $17,512.10 $22,415.49	$0.16 $0.40 $0.51	$2,335

The fees shown in ***Tables 5.7*** and ***5.8*** would need to be **in addition** to the existing EMRU WAC fee and City SAC fee. The total fees for the northeast and northwest areas are shown in ***Tables 5.9*** and ***5.10***.

Table 5.9 – Water and Sewer Development Fees for a Single-Family Home in the Extension Areas

Northeast Extension Areas

Development Fee/Assessment	Estimated Cost per Single Family Unit
Water Extension Costs	$8,751
WAC Fee	$3,990
Sewer Extension Costs	$3,634
SAC Fee	$5,769
Total	**$22,144**

Northwest Extension Areas

Development Fee/Assessment	Estimated Cost per Single Family Unit
Water Extension Costs	$7,630
WAC Fee	$3,990
Sewer Extension Costs	$2,335
SAC Fee	$5,769
Total	**$19,724**

The City and ERMU will take on more financial risk if their fees are substantially higher than other suburban and exurban communities. Special assessments are factored into land costs: the cost of the improvements is essentially netted out of the sale price that the seller receives. If, however, costs are recovered through connection fees then land sellers will attempt to sell their properties at full value for land served by public utilities, and the developers will then need to pay the fees "on top of" the land cost. If the fees are higher than surrounding communities, the developers will request fee reductions or seek land elsewhere, stifling development.

Figure 5.1 shows the anticipated SAC and Trunk charges for Elk River expansion areas compared with the 2022 fees for several other developing communities in the Twin Cities Metropolitan Area.

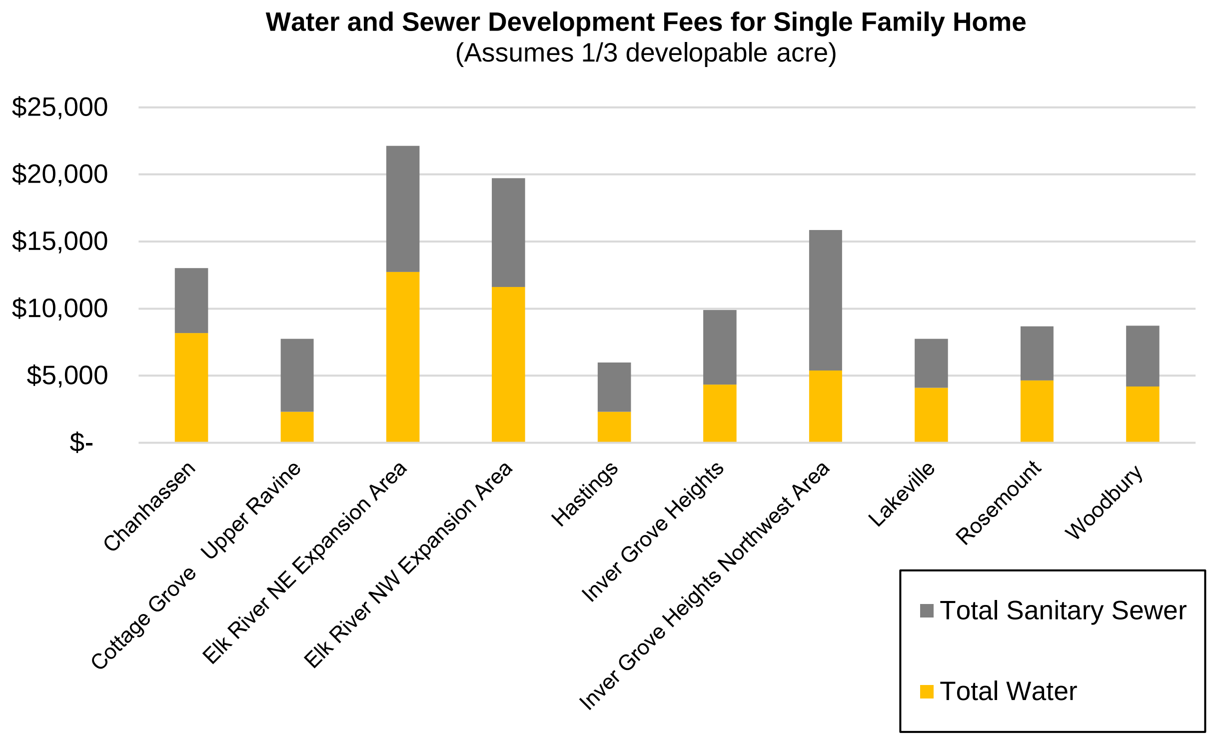

Figure 5.1 – Comparison of 2022 Water and Sewer Development Fees for a Single Family Home with Potential Development Fees in Elk River.

6. PROJECT SCHEDULE AND PHASING

A detailed phasing plan to extend public utilities to the study areas cannot be prepared at this time as the construction schedule of individual developments is unknown. However, a preliminary analysis was completed to identify which infrastructure would need to be constructed prior to any developments to provide utility service.

6.1 Northeast Study Area

In order to recommend which infrastructure would be needed in the short term, it was assumed that development would begin near the intersection between Cleveland Street NW and Twin Lakes Rd NW.

The following infrastructure is anticipated to begin water service:

- Trunk Watermain: Extend 12-inch watermain along Twin Lakes Rd NW between 193rd Avenue NW and Cleveland Street NW to finish connecting the existing loop. Continue extending the 12-inch watermain along Twin Lakes Rd NW and Tyler Street NW as development continues.

The following infrastructure is anticipated to begin sewer service:

- Lift Stations: The Regional Lift Station will be needed to begin sewer service. It is anticipated that an initial firm pumping capacity of 500 to 700 gpm will be needed during the first 5 to 10 years of operation. The lift station’s firm pumping capacity can be increased as development progresses.
- Forcemains: The 8-inch and 12-inch forcemains associated with the Regional Lift Station will also be needed to begin service along with the air release valve manholes identified for both forcemains.
- Trunk Sewermain: It is likely that the full section of 18-inch trunk sewermain will be needed to begin service. Additional trunk sewermain may be needed based on development phasing.
- Connection at WWTP: A new intake structure will be needed at the Elk River WWTP to receive the wastewater pumped by the Regional Lift Station. The cost of the receiving structure is not included in this report.

6.2 Northwest Study Area

In order to recommend which infrastructure would be needed in the short term, it was assumed that development would begin in the southeast portions of the Northwest study area and extend northwest along the gravel mining site avoiding leapfrog development.

The following infrastructure is anticipated to begin water service:

- Booster Stations: The BS-2 booster station will be needed to begin water service. A pumping capacity of 400 gpm is considered to be sufficient for this booster station as long as additional supply capacity through wells is provided in the future.
- PRVs: The PRV-2 will be needed to recirculate excess water pumped by BS-2 and avoid stagnation. PRV-1 and PRV-3 may also be needed if those existing residents also want water service.
- Trunk Watermain: Extend 16-inch watermain along Proctor Road NW and 12-inch watermain along Irving Street NW and 197th Avenue NW to serve development as needed.
- Wells: A well may be needed shortly after the initial development phasing to supplement BS-2. However, it is likely this will not be needed to begin water service. Water treatment will likely be needed at this well.
- Water Tower: A water tower is not needed if the initial plans are to only serve single family dwellings located throughout the southeast corner of the area. However, a water tower is recommended to begin service if utilities are being extended to serve mixed residential or highway business land uses.

The following infrastructure is anticipated to begin sewer service:

- Non-Trunk Sewermain: 8-inch pipe can be extended to connect the southern most areas to the existing sanitary sewer system by gravity. Portions of the southern areas may need a small lift station or a low pressure system due to ground elevations.
- Lift Stations: The Regional Lift Station and the NW-LS-2 will be needed if sewer service is extended initially beyond 198th Avenue NW. It is anticipated that an initial firm pumping capacity of 750 gpm be needed at the Regional Lift Station during the first 10 to 15 years of operation. The lift station's firm pumping capacity can be increased as development progresses. The anticipated firm pumping capacity for the NW-LS-2 is 425 gpm.
- Forcemains: The 12-inch, 16-inch, and 6-inch forcemains for the Regional and NS-LS-2 lift stations will be needed to begin service if development is extended beyond 198th Avenue NW. Air release valve manholes will also be needed.
- Trunk Sewermain: The proposed 12-inch and 10-inch trunk sewermains will be needed to connect the Regional Lift Station with the gravel mining areas if those areas develop initially.
- Connection at WWTP: A new intake structure will be needed at the Elk River WWTP to receive the wastewater pumped by the Regional Lift Station. The cost of the receiving structure is not included in this report.

7. CONCLUSIONS

The conclusions identified in this study are summarized as follows:

- **Water Serviceability of the Northeast Areas:** The northeast areas will be annexed to the system's existing main pressure zone for water service without the need to create a separate pressure zone. The following water system infrastructure is recommended to provide water service over the next 20 years: a new 850 gpm well with treatment, a new 1.0 MG water tower, and extending 12-inch trunk watermain.

- **Water Serviceability of the Northwest Areas:** The northwest areas cannot be annexed to the system's main pressure zone due to high ground elevations and separate pressure zones will be needed. Therefore, it is recommended to serve the northwest areas with a hybrid approach that includes new production wells drilled in the northwest areas and booster stations to supplement water supply. In addition, a new 1 MG water tower is also recommended. Pressure reducing stations (PRVs) are also recommended to recirculate excess water from the northwest areas back to the main pressure zone to avoid water stagnation in the new water tower. It is anticipated that water treatment will be needed at each well.

- **Sewer Serviceability of the Northeast Areas:** A new Regional Lift Station with an ultimate capacity of 1,500 gpm will be needed to pump wastewater generated in the study area directly into the City's WWTP. Trunk sewermains ranging in diameter from 10 to 18 inches can be installed upstream of the new Regional Lift Station to collect and convey wastewater. Two (2) additional lift stations with pumping capacities of 185 and 225 gpm will also be needed to serve this area.

- **Sewer Serviceability of the Northwest Areas:** Similar to the northeast areas, a new Regional Lift Station with an ultimate capacity of 4,000 gpm will be needed to pump wastewater generated from the study area directly into the City's WWTP. However, the Regional Lift Station will not be needed until development beings in the gravel mining areas. Until then, the existing Windsor Lift Station can pump the existing and short-term flows. Trunk sewermain ranging in diameter from 10 to 12 inches can be installed upstream of the new Regional Lift Station to collect and convey wastewater and a 24-inch trunk sewermain is recommended to collect wastewater from the northwest ultimate service boundary. Two (2) additional lift stations with pumping capacities of 200 and 425 gpm will also be needed to serve this area.

- **Wastewater Treatment Plant (WWTP) Assessment:** The plant's biological treatment capacity was doubled during the 2017 expansion from 2.2 MGD to 4.5 MGD. However, it is anticipated that the headworks portion of the plant will not have sufficient capacity for the future flow from the study areas and expansion will be required. Additional studies will be needed to determine the expansion needs at the City's WWTP.

- **Opinion of Probable Cost:** The total estimated infrastructure cost needed to serve the study areas over the next twenty years and beyond is **$28,478,000** for the sanitary sewer system and **$75,612,000** for the water distribution system. Detailed cost breakdowns are shown in ***Appendix B***.

8. FEASIBILITY AND RECOMMENDATION

This study evaluated the infrastructure needed to serve the study areas shown in ***Figure A1***. If sanitary sewer and water service is extended to these areas, it is recommended to follow the infrastructure layouts shown in ***Figures A9***, ***A13***, ***A19***, ***A21*** and ***A22*** in ***Appendix A***. Since the study area is mostly undeveloped, installation of water and sanitary sewer utilities will be driven by development. The total estimated infrastructure cost needed to serve the study areas over the next twenty years and beyond is **$28,478,000** for the sanitary sewer system and **$75,612,000** for the water distribution system. Detailed cost breakdowns are shown in ***Appendix B***. Overall, it appears that extending water and sewer services to the expansion areas could be feasible as long as leapfrog development is avoided, the areas are not served simultaneously, and the cost is divided over various funding avenues. Promoting leapfrog development will require a considerable amount of infrastructure to be installed initially which could place the City and the ERMU at financial risk if subsequent development is slower than anticipated. Additionally, it is recommended to extend water and sewer service concurrently as this can reduce capital costs.

APPENDIX A – FIGURES

APPENDIX B – DETAILED COST BREAKDOWN

APPENDIX C – FINANCIAL DATA