Water System Reliability Study

City of Grand Ledge

Project No. 220695
February 19, 2025

fishbeck
Engineers | Architects | Scientists | Constructors

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Prepared For:

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List of Abbreviations/Acronyms

ADD	average daily demands
AWWA	American Water Works Association
City	City of Grand Ledge, Michigan
CIP	Capital Improvements Plan
EGLE	Michigan Department of Environment, Great Lakes, and Energy
gpd	gallons per day
gpm	gallons per minute
HMO	hydrous manganese oxide
ISO	Insurance Services Office
LEAP	Lansing Economic Area Partnership
LSL	long service life
MDD	maximum daily demands
MG	million gallons
mgd	million gallons per day
MOR	monthly operating report
PHD	peak hourly demand
psi	pounds per square inch
REU	residential equivalent unit
SSL	short service life
State	State of Michigan
WTP	water treatment plant

1.0 Executive Summary

The City of Grand Ledge (City) retained Fishbeck in 2022 to complete a Reliability Study and General Plan for the City's water system. This study included a review of the City's water supply, treatment, storage, and distribution systems. Water demands for the City water system were projected to 2027 and 2042. A calibrated hydraulic model of the system was used to evaluate its performance and develop recommendations for short-term and long-term capital improvements to the system.

The City provided water supply data from 2010 through 2021 that was used to determine the average daily demand (ADD), maximum daily demand (MDD), and MDD/ADD peaking factor for each year. A statistical analysis was performed on this data set to identify ADD, MDD, and MDD/ADD peaking factor representative of the 2022 system. This resulted in an ADD of 0.72 million gallons per day (mgd) and a MDD of 1.66 mgd. Projected ADD and MDD were estimated by considering expected growth within the City water system service area, resulting in a 2042 ADD and MDD of 1.17 mgd and 2.71 mgd, respectively.

The City's water system is supplied by four wells. Wells 6, 7, and 8 pump to the City's existing water treatment plant (WTP). Well 2 pumps directly to the distribution system and is currently only used for emergencies. The City's firm raw water supply capacity without Well 2 is 1.30 mgd, which is below the City's projected 2042 MDD. The City is currently exploring potential locations for additional wells and a transmission main from Well 2 to the WTP to accommodate increasing demands.

Groundwater is currently treated at the City's WTP with aeration and filtration for iron removal. Fluoride, phosphate, and sodium hypochlorite are also added for dental benefits, corrosion control, and disinfection, respectively. The WTP has a firm treatment capacity of 2.16 mgd. Although the City's MDD is projected to exceed the treatment capacity prior to 2042, a project to construct a new Iron Removal Plant is currently underway. The new Iron Removal Plant will also use aeration and filtration for iron removal with a firm treatment capacity of 2.85 mgd, and a full build-out firm capacity of 4.0 mgd.

The City has a clear well at the WTP for treated water storage, as well as two elevated tanks and one ground storage tank in the distribution system. The current storage capacity is 1.45 million gallons (MG). However, the WTP clear well will be abandoned as part of the new Iron Removal Plant project resulting in a future storage capacity of 1.35 MG. Fishbeck recommends the City consider additional elevated storage to accommodate increasing demands as those demand increases dictate.

The performance of the City's distribution system was evaluated using a calibrated hydraulic model to run an available fire flow and pressure analysis. Pressures throughout the system ranged from 50 pounds per square inch (psi) to 90 psi, a sufficient range for the distribution system. Areas of deficient fire flow, or available fire flow less than 1,500 gpm, included the following: the northeast corner of the system, the southwest corner of the system, and dead-end mains. Fishbeck targeted these areas of deficient fire flow in the 5-year Capital Improvement Plan (CIP), at a replacement rate of 1% of the total system per year. The 5-year CIP also included routine maintenance of the WTP Elevated Tank. The 20-year CIP included the remaining areas of deficient fire flow, as well as a water main that has surpassed its useful life, or a cast iron main greater than 100 years old and a ductile iron main greater than 80 years old. A new 0.50 MG elevated tank was also included in the 20-year CIP based on a recommended storage analysis. The estimated costs of the 5-year and 20-year CIP are $3,623,000 and $10,559,000, respectively.

2.0 Introduction

The City operates a municipal water distribution system that supplies water to the City and portions of Oneida Township. The distribution system is currently suppling ground water from four supply wells, three of which supply water to the City's WTP; the fourth well supplies the distribution system directly. The groundwater from the three wells is treated at the City's WTP, with a firm capacity of 1.73 mgd, prior to distribution.

In 2022, the City retained Fishbeck to complete a Water System Reliability Study and General Plan update. A Reliability Study is required to comply with the Part 12 and Part 16 rules of the State of Michigan (State) Safe Drinking Water Act, P.A. 399. A Reliability Study is required every 5 years, focusing primarily on comparing firm water supply capacity with present and projected future water demands. An update to the General Plan is also required every five years, focusing primarily on the hydraulic performance of the distribution system and the development of 5-year and 20-year CIP. This report fulfills these regulatory requirements.

This report is an update to the previous City of Grand Ledge Water System Reliability Study (Fishbeck, 2016). This report also references the most recent EGLE Sanitary Survey for the WTP and for the distribution system. These reports include detailed descriptions of the existing plant and equipment.

Since the previous Reliability Study, the City made plans to improve treatment capacity. Fishbeck is currently designing a new Iron Removal Plant with plans for construction to begin in 2023 with construction being completed in 2025. The increased capacity of this Iron Removal Plant will be discussed when evaluating the City's ability to meet future demands.

3.0 Historical Water Use

3.1 Water Demands

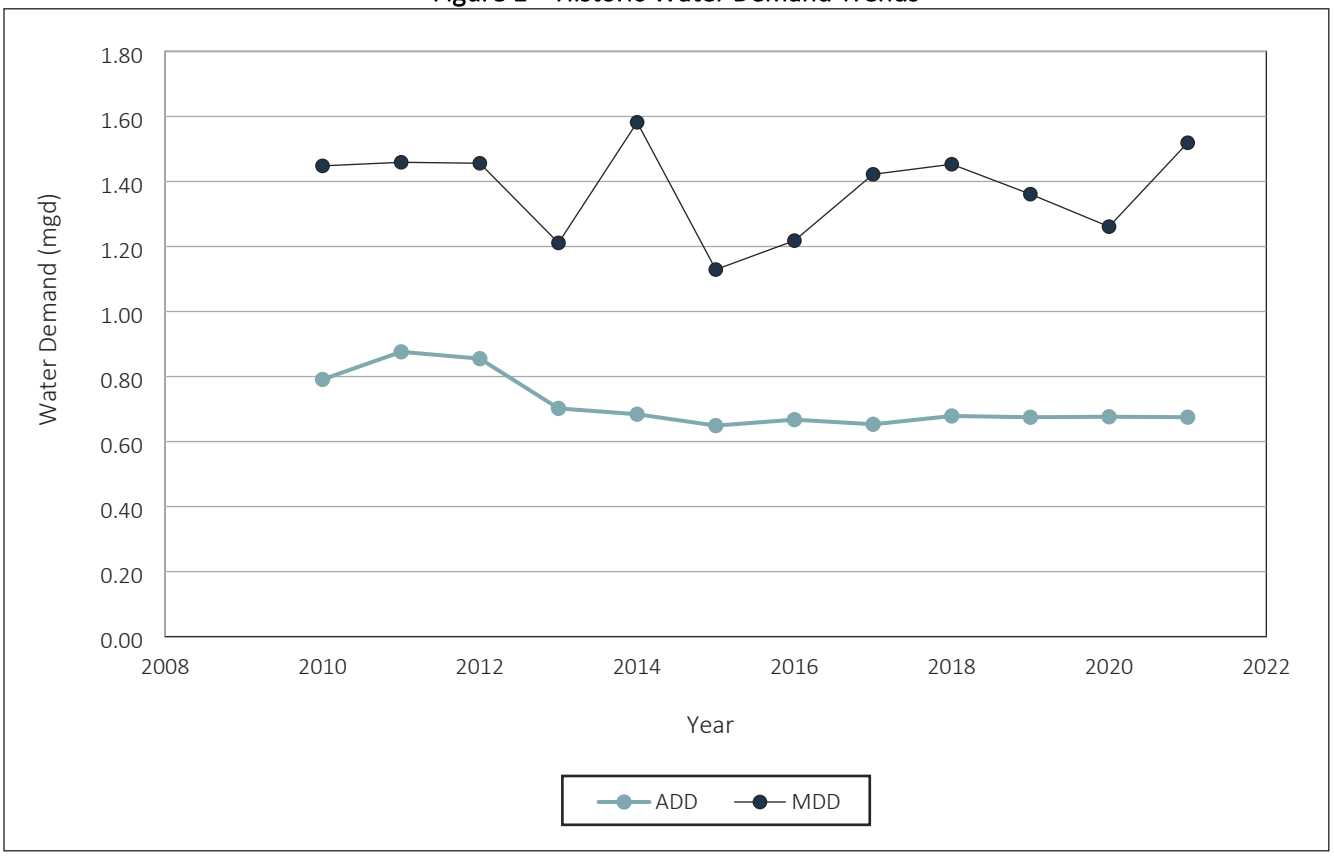
The City records the daily volume of water pumped from each supply well and treated at the WTP. This treatment data was gathered from Monthly Operating Reports (MORs) from 2010 to 2021. The daily volume of water treated at the WTP was assumed to be equivalent to the water demand in the system. The ADD was calculated for each year by taking the average of the daily treatment data for each year. The MDD was calculated for each year by taking the average of the daily maximum treatment volume from each year's data set. The MDD represents peak usage in the system and results in a MDD:ADD peaking factor calculated by dividing the MDD by the ADD for each year. These values are displayed in Table 1 from 2010 to 2021.

Table 1 – Historical Water Demands

Year	ADD (mgd)	MDD (mgd)	MDD:ADD Peaking Factor
2010	0.79	1.45	1.83
2011	0.88	1.46	1.67
2012	0.86	1.46	1.70
2013	0.70	1.21	1.73
2014	0.68	1.58	2.31
2015	0.65	1.13	1.72
2016	0.67	1.22	1.83
2017	0.65	1.42	2.20
2018	0.68	1.45	2.14
2019	0.67	1.36	2.02
2020	0.68	1.26	1.86
2021	0.67	1.52	2.25
Average	0.72	1.38	1.94
Maximum	0.88	1.58	2.31
Minimum	0.65	1.13	1.67

The historical trends of ADD and MDD are displayed in Figure 1.

Figure 1 – Historic Water Demand Trends



Following 2013, the ADD in the City has remained relatively constant. Despite a consistent ADD, MDD has varied significantly. Similarly, the MDD:ADD peaking factor has varied significantly since 2010.

3.2 Non-Revenue Water

Water distribution systems typically "lose" water due to unmetered usage, leaks, meter errors, firefighting, or other reasons. This "lost" water is commonly referred to as non-revenue water, as it is not billed. One metric that can help to indicate the health of a water system is the percentage of water supplied to the system that is non-revenue. A non-revenue water percentage of 10 to 15% is considered typical; it can often be 20% or more in older systems. The City's non-revenue water was estimated by comparing the City's volume of water treated, from MORs, to the volume of water paid consumed, from customer billing data. This is summarized in Table 2.

Table 2 – Non-Revenue Water

Fiscal Year	Total Treated (MG)	Total Consumed (MG)	Non-Revenue (MG)	Non-Revenue (%)
FY-17	245	237	8.0	3.3%
FY-18	234	180	53.7	23.0%
FY-19	252	209	43.3	17.2%
FY-20	244	226	17.2	7.1%
FY-21	255	212	43.0	16.8%
		Average	33.0	13.5%

The City's non-revenue water accounts for approximately 13.5% of the total water treated. Some potential means to reduce non-revenue water include regular calibration of meters, reduction of unmetered water use, and replacement of aging water main.

3.3 Top Ten Users

Customer meter data was evaluated from 2011 through 2021. The average usage over the indicated time period was used to determine the top 10 users in the system. As summarized in Table 3, the top 10 users in the system account for 15.3% of the City's 2022 ADD.

Table 3 – Top 10 Water Users

Customer	Address	Average Demand (gpm)	% of 2022 ADD
City of Grand Ledge WWTP	109 Fitzgerald Park	13.07	2.6%
Ledgeway Investment	855 West Jefferson Street	11.72	2.4%
Independence Village	11525 Hartel Road	10.69	2.2%
Grand Oaks Village LLC	817 North Clinton Street	10.58	2.1%
Grand Ledge Auto Wash	940 East Saginaw Highway	9.21	1.9%
Grand Ledge High School	820 Spring Street	7.14	1.4%
Meijer, Inc.	730 East Saginaw Highway	4.76	1.0%
Serenity Place	216 South Clinton Street	3.34	0.7%
Quality Dairy Laundromat	804 Willow Highway	3.32	0.7%
WDS Ventures LLC	1004 East Saginaw Highway	2.09	0.4%
	Total Top 10 Users	75.91	15.3%

The demands of the top 10 users were input at their respective locations in the hydraulic model.

4.0 Demand Projections

While historical demands have stayed relatively static, the City and regional development organizations in the area expect this trend to change in the near future. In addition to typical growth within the City, the City expects to gain additional customers from an agreement with Oneida Township, development in the Willis Industrial Park, and an influx of customers who will utilize the City's infrastructure or who live within the City as a result of the development of several large industrial users near the City.

To project future water demands, the starting point (or initial value in 2022) for both the ADD and MDD were calculated based on the historical trend data.

The 2022 ADD starting point, 0.72 mgd, was the average ADD of the data set (water demands from 2010-2021). For the 2022 MDD starting point, the average of the MDD:ADD peaking factor over the data set was added to 1.65 times the standard deviation of the same dataset, which resulted in a peaking factor of value of 2.32. Statistically, this value is predicted to be greater than 95% of the potential values of the peaking factor within the dataset and assuming normal distribution of the data. The calculated peaking factor was then multiplied by the ADD starting point to get the 2022 MDD starting point which resulted in a value of 1.66 mgd.

Between the City and the Township, the City's water system currently serves approximately 3,292 accounts. Using the aforementioned starting points, the City's current ADD and MDD per account are 219 gallons per day (gpd) per account and 504 gpd per account.

4.1 Typical City Growth

The calculated ADD and MDD starting water demands for the existing City system were projected out for the next 20 years accounting for a number of anticipated growth factors, including typical anticipated growth within the City. An annual demand growth of 0.25% was assumed for regular growth within the City. This would result in an ADD of 0.75 mgd and a MDD of 1.74 mgd for the year 2042.

4.2 Lansing Economic Area Partnership

There are several major investment projects that are occurring within a short distance of the City. The Lansing Economic Area Partnership (LEAP), a regional economic development organization, indicated that they expect increased growth for the City over the next five years. This expected growth is partly due to the major investments nearby and partly due to the City being well located to see further development if water and sewer is available for investors. The major investments near the City are expected to bring in a total 3,580 jobs with an additional 1,149 indirect jobs created as part of the support of these major projects.

To establish expected demands, 10% of those 4,729 new workers were assumed to move into Grand Ledge's service area within 5 years. This would account for an additional 480 service connections to the City's water system. Using the City's current demands per account, the City's ADD would increase by 0.10 mgd by 2027.

4.3 Cooperative Development Agreement

The City and Township have joined in an agreement, the Cooperative Development Agreement, with the purpose of promoting economic growth and development in the City and in the Township. As part of this agreement, the City will expand the existing water and sewer systems to provide services to select areas of the Township, identified as the Cooperative Development Area, upon request. The Cooperative Development Area currently consists of approximately 550 occupied parcels. Within the next 20 years, 50% of these occupants are assumed to request water services from the City, accounting for an additional 275 service connections. Any new development that occurs within the Cooperative Development Area will also be provided City water and sewer services. The Tri-County Regional Planning Commission projected a 0.78% annual growth for this area. This would account for an additional 85 new service connections within the Cooperative Development Area receiving City water and sewer services by 2042.

The Township currently consists of approximately 740 occupied parcels located outside of the Cooperative Development Area. This is projected to increase to 855 by 2042 with a projected 0.78% annual growth within the Township. These occupants can also receive City water and sewer services through the Cooperative Development Agreement following a written mutual agreement between the involved parties. Within the next 20 years, 25% of these occupants were assumed to be provided with City water service under this mutual agreement, resulting in an additional 214 service connections.

Assuming the customers currently served by the Township request City services linearly over the next 20 years, the Cooperative Development Agreement will result in an additional 144 service connections by 2027 and 574 service connections by 2042. Using the City's current demands per account, this will increase City ADD by 0.03 mgd by 2027 and 0.12 mgd by 2042.

4.4 Willis Industrial Park

In addition to residential growth, the expansion of the City's water system could facilitate industrial growth within the City's industrial park, Willis Industrial Park. Willis Industrial Park currently consists of 116 acres of undeveloped land suitable for industrial customers. However, light industrial zoning in the City allows for a maximum building coverage of 50%, accounting for 58 acres of available building space. Typical average day industrial water demands account for approximately 150 gallons per day (gpd) per 1,000 square feet of building space.

Assuming 50% of available building space in Willis Industrial Park is developed linearly over the next 20 years, City ADD would increase by 0.05 mgd by 2027 and 0.19 mgd by 2042.

4.5 Projected Water System Demands

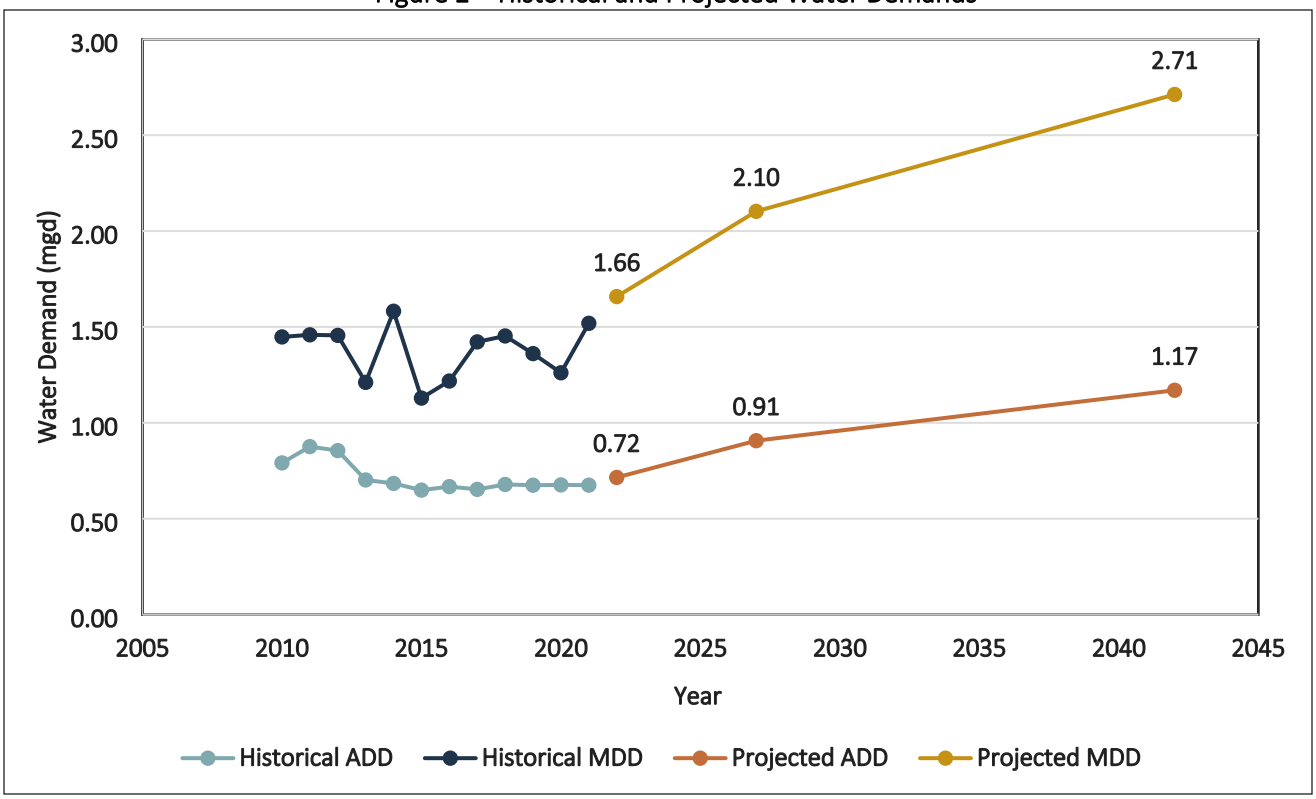
The City water system demands are expected to increase due to typical growth within the City, growth anticipated by LEAP, additional service connections from the Cooperative Development Agreement, and development of the Willis Industrial Park. The projected ADD of the water system was estimated using the

assumptions for each type of growth described above. The projected MDD of the water system was calculated by multiplying the ADD by the MDD:ADD peaking factor or 2.32. Additionally, peak hour demands (PHD) were calculated by using an assumed PHD:MDD peaking factor of 1.5. These projected water demands for the system are summarized in Table 4.

Table 4 – Projected Water Demands

Year	ADD (mgd)	MDD (mgd)	PHD (mgd)
2022	0.72	1.66	2.49
2027	0.91	2.10	3.15
2042	1.17	2.71	4.07

Figure 2 – Historical and Projected Water Demands



5.0 Existing Facilities

5.1 Raw Water System

The City's existing raw water system consists of four supply wells, summarized in Table 5: Well 2, Well 6, Well 7, and Well 8. Wells 6 through 8 all pump directly to the WTP; Well 2 pumps directly to the distribution system. Chlorine and phosphate are added directly at Well 2; it operates as a standby or emergency source. Additionally, the operation of Well 8 has been limited to 8 hours per day due to recommendation from Michigan Department of Environment, Great Lakes, and Energy (EGLE) based on an aquifer test completed in 1996. In addition to the four wells currently supplying the City's water system, the City also developed Well 9 in 1998. However, the City is awaiting approval from EGLE to outfit this well with a pump and begin operating.

Table 5 – Existing Well Capacity

Well Number	Installation Year	Rated Capacity (gpm)	Rated Capacity (mgd)
2	1941	400	0.58
6	1971	1,100	1.58
7	1988	500	0.72
8	1995	400	0.58
Raw Water System Total Capacity		2,400	3.46
Raw Water System Firm Capacity		1,300	1.88

The firm capacity of the raw water system, with the largest well out of service, is 1,300 or 1.88 mgd. However, Well 2 pumps directly to the distribution system. Therefore, the firm capacity of raw water currently supplied to the WTP for treatment is 900 gpm, or 1.30 mgd.

The historical yearly supply and daily average supply of each well is summarized in Table 6, from 2010-2021.

Table 6 – Historical Raw Water Supply Data

	Yearly Total (MG)				Daily Average (gpm)			
Year	Well 2	Well 6	Well 7	Well 8	Well 2	Well 6	Well 7	Well 8
2010	4.13	84.6	146.6	96.9	7.86	279.0	161.0	184.3
2011	1.01	133.1	119.5	93.6	1.92	227.3	253.2	178.0
2012	1.75	157.8	73.7	91.2	3.32	139.8	299.4	173.0
2013	1.11	141.2	63.9	95.2	2.11	121.5	268.6	181.2
2014	1.59	137.8	64.3	96.9	3.03	122.3	262.3	184.3
2015	1.66	106.1	80.3	84.6	3.16	153.5	201.4	160.5
2016	5.40	109.3	88.2	72.7	10.42	167.6	207.4	144.8
2017	0.97	81.1	118.2	46.4	1.82	224.1	154.5	88.6
2018	1.73	87.9	132.6	30.4	3.23	252.2	166.0	57.7
2019	1.19	81.0	150.5	24.1	2.24	286.0	153.9	46.0
2020	2.93	98.4	149.3	17.0	5.79	282.9	186.1	32.6
2021	2.12	115.2	160.2	5.0	4.00	304.6	219.3	9.6
Average	2.13	111.1	112.3	62.8	4.08	213.4	211.1	120.1

As noted, before, Well 2 is used as an emergency source, therefore the raw water supply from this well is much lower than Wells 6, 7, and 8. Monthly sampling accounts for a majority of Well 2's usage. Additionally, the raw water supply from Well 8 has decreased significantly since 2016.

5.2 Water Treatment

The WTP was constructed in 1988 and utilizes an Aerelater Type II-IQ by General Filter to remove iron from the raw water. The Aerelator system has a total treatment capacity of 2.3 mgd and a firm treatment capacity, with one filter cell out of service, of 1.73 mgd. The Aerelater system combines aeration, detention, and filtration in a single treatment unit to remove iron from the raw water. Raw water is pumped by the wells to the top of the unit and flows by gravity through a distribution tray. The iron in the water is oxidized by air drawn upward through the top of the unit using an induced draft blower. A detention tank sits just below the aeration portion of the unit, which allows time for the formation of filterable iron precipitate. The water then passes through the anthracite and sand filters at the bottom of the unit, which filter the iron precipitate out of the water.

Chemical treatment is also added to the finished water prior to flowing by gravity to the 0.1 MG clear well on the WTP site. Chlorine is added for disinfection, phosphate is added for corrosion control, and fluoride is added for dental benefits. These chemicals are stored at the WTP. Chlorine gas is delivered and stored in 100-lb cylinders; phosphate and fluoride are delivered and stored in 55-gallon drums.

5.3 High-Service Pumping

Three high-service vertical turbine pumps convey water from the clear well to the distribution system and are located in the existing WTP. The high service pumps operate at a total dynamic head of approximately 155 feet, corresponding to a system hydraulic grade of approximately 1,000 feet. The three pumps are characterized in Table 7.

Table 7 – High-Service Pumps

Pump	Installation Year	Replacement Year	Horsepower	Capacity (mgd)
HSP-1	1988	2017	75	2.16
HSP-2	1988	2018	50	1.44
HSP-3	1988	2017	25	0.72
			Total High-Service Pumping Capacity	4.32
			Firm High-Service Pumping Capacity	2.16

5.4 Storage

The City's water storage consists of two steel elevated storage tanks and two ground storage tanks. The characteristics of these tanks are described in Table 8.

Table 8 – Water Storage Tanks

Tank Location	Type	Installation Year	Capacity (gal)
WTP	Elevated Storage	1971	500,000
West Front Street	Elevated Storage	1909	100,000
Industrial Park	Above Grade Ground Storage	2006	390,000*
WTP	Below Grade Ground Storage (Clearwell)	1988	100,000
		Total Storage Capacity	1,090,000

* - The storage tank has a volume of 750,000 gallons, but 360,000 gallons are reserved for the National Guard Armory fire supply.

Although the City's total storage capacity is 1.09 MG, the WTP clear well will be abandoned as part of the new Iron Removal Plant Project. Therefore, total storage capacity will be 0.99 MG.

In an emergency where power is disrupted, water can be supplied to the system from the two elevated tanks. Additionally, standby power is currently available at the Industrial Park Ground Storage Tank to power the three booster pumps, and at the WTP to power the WTP and Well 7 pump.

5.5 Existing Capacity Evaluation

Ten States Standards recommends that the firm capacity of the raw water system and WTP exceed MDD of the water system. The firm capacity of the existing raw water system is 1.30 mgd, which does not meet the estimated current MDD of 1.66 mgd. Fishbeck recommends that the City expand its raw water system to meet the projected demands. Commissioning Well 9 or connecting Well 2 to the WTP could be the first step in increasing raw water capacity.

The firm capacity of the existing WTP is 1.73, exceeding the current MDD. The projected MDD of the system exceeds the treatment capacity prior to 2027. The planned Iron Removal Plant Project will address shortfalls in treatment capacity.

Ten States Standards also recommends that firm pumping capacity exceed MDD of the system. The firm capacity of the existing high-capacity pumps is 2.16 mgd, which is projected to be exceeded by 2042. However, these pumps will be abandoned as part of the planned Iron Removal Plant Project.

A system's water storage is recommended to accommodate fire flow volume as well as the maximum volume of the larger of the following: emergency storage or equalization storage. Fire flow volume for the City is the water needed to sufficiently extinguish a commercial fire, or 2,500 gpm for 2 hours as defined by Insurance Services Office. Emergency storage is defined by a 1-day supply of water at average daily use. Equalization storage is defined by 25% of a maximum use day. Although the City currently has a total of 1.09 MG of storage capacity, the clear well is not included due to the inability to run the high-service pumps on stand-by power. Additionally, the clear well will be abandoned as part of the new Iron Removal Plant Project. Therefore, the total storage capacity for the purposes of this evaluation is 0.99 MG. The recommended storage capacity of the system is summarized in Table 9.

Table 9 – Recommended Storage Evaluation

Recommended Storage Volume	2022	2027	2042
Fire Fighting Volume (MG)	0.30	0.30	0.30
Emergency Storage (MG)	0.72	0.91	1.17
Equalization Storage (MG)	0.41	0.53	0.68
Total Recommended Storage (MG)	1.02	1.21	1.47

The City's existing storage capacity only marginally meets the recommended volume; however, this is projected to be exceeded prior to 2042. Additionally, the West Front Street Elevated Tank is nearing the end of its useful life and will be abandoned prior to 2042. Therefore, Fishbeck recommends an additional 0.50 MG of storage, as further discussed in the CIP.

6.0 Planned Facility Improvements

The City plans to abandon the existing WTP and build a new Iron Removal Plant south of the existing building. Construction of the Iron Removal Plant is planned to begin in 2023. With this project, some existing facilities will also be taken out of service.

The new Iron Removal Plant will consist of aeration, filtration, and chemical addition. Iron oxidation will occur within two detention basins, each with an individual aerator. Water will be diverted from the basins to two wet wells for pumping to filtration. The aeration capacity of the new Iron Removal Plant will be 2.85 mgd.

Prior to filtration, hydrous manganese oxide (HMO) will be added to adsorb radium in the raw water. Following filtration, phosphate will be added for corrosion control, chlorine will be added for disinfection, and fluoride will be added for dental benefits. All chemicals fed during the treatment process will be stored within the Iron Removal Plant. Fluoride and phosphate will be delivered and stored in 55-gallon drums. Chlorine gas will be

delivered and stored in 150-lb cylinders. HMO will be generated on-site by mixing sodium permanganate and manganese sulfate, which will be delivered in 275-gallon totes.

Horizontal pressure filters containing anthracite, sand, and garnet sand will be used to remove oxidized iron and absorbed radium from the water. The design of the filters is summarized in Table 10. Three filters will be installed initially. However, excess space will be provided for installation of a fourth filter as water demands in the system increase. The firm capacity of the pressure filters, with one filter cell out of service, will be 2.85 mgd initially, and 4.00 mgd at full build-out.

Table 10 – Horizontal Pressure Filter Design

Design Parameter	Value
Filter Type	Horizontal Pressure Filter
Number of Filters	3 (+ 1 in future)
Number of Cells per Filter	2
Maximum Filtration Rate	3 gpm/ft^2
Filter Diameter	10 feet
Filter Length	28 feet
Maximum Flow per Cell	397 gpm
Maximum Flow per Filter	794 gpm

The existing clear well and high-service pumps will also be abandoned as part of the new Iron Removal Plant Project. Low-service pumps will be installed at the new Iron Removal Plant to convey water from the aeration basins through filtration and to distribution. Three pumps, each with a capacity of 1.43 mgd, will be installed initially, with additional space provided for future installation of a fourth pump. The firm pumping capacity will be 2.86 mgd initially, and 4.28 mgd at full build-out. The existing clear well will not be replaced, however an elevated tank on the WTP site, along with the existing elevated tanks will provide sufficient capacity for equalization.

7.0 Water Distribution System Summary

The City's water system currently supplies water to 2,909 accounts within the City and 383 accounts in Oneida Township. The distribution system consists of approximately 48 miles of water main. The City water system is displayed in Figure 3.

7.1 Service Connections

The City supplies water to its customers through a total of 3,006 service connections. The Residential Equivalent Units (REUs) associated with these service connections are summarized by meter size in Table 11.

Table 11 – Service Connections and REUs by Meter Size

Meter Size	REUs per Connection	Number of Connections	Total REUs
5/8-inch	1.0	80	80
3/4-inch	1.1	2,732	3,005
1-inch	1.4	96	134
1 1/2-inch	1.8	33	59
2-inch	2.9	54	157
3-inch	11.0	7	77
4-inch	14.0	3	42
6-inch	21.0	1	21
	Total	3,006	3,575

The service connections are characterized by customer type in Table 12.

Table 12 – Service Connections and REUs by Customer Type

Customer Type	Number of Connections	% of Total
Apartments	31	1.0%
Commercial	294	9.8%
Multi-Units	161	5.4%
Residential	2,520	83.8%
Total	3,006	100.0%

The City's water system is currently composed of primarily residential water users.

7.2 Water Mains

The water system map is displayed in Figure 4, characterized by water main diameter. Table 13 summarizes the distribution of water main diameter in the system.

Table 13 – Water Main Diameter

Diameter (in)	Water Main Length (ft)	% of Total Length
4	23,088	9.14%
6	34,561	13.7%
8	109,214	43.2%
10	9,271	3.67%
12	73,066	28.9%
16	3,364	1.33%
24	36	0.01%
Total System	252,600	100.0%

The distribution system is composed of cast iron and ductile iron water main, as displayed in Figure 5 and summarized in Table 14.

Table 14 – Water Main Material

Material	Water Main Length (ft)	% of Total Length
Cast Iron	55,086	21.8%
Ductile Iron	197,514	78.2%
Total System	252,600	100.0%

The age of distribution system is displayed in Figure 6 and summarized in Table 15, with water main categorized by installation year.

Table 15 – Water Main Installation Year

Installation Year	Water Main Length (ft)	% of Total Length
1900-1909	863	0.34%
1910-1919	6,530	2.59%
1920-1929	719	0.28%
1930-1939	10,447	4.14%
1940-1949	1,125	0.45%
1950-1959	11,454	4.53%
1960-1969	13,834	5.48%
1970-1979	27,966	11.1%
1980-1989	29,754	11.8%
1990-1999	63,704	25.2%
2000-2009	64,051	25.4%
2010-2020	22,153	8.77%
Total System	252,600	100.0%

The distribution system is healthy in terms of age, with a majority of the water main installed since 1990.

8.0 Hydraulic Model Development

A hydraulic model of the City's distribution system was developed and calibrated as part of the 2016 Reliability Study completed by Fishbeck. This hydraulic model was updated with water main replacements and improvements since that study and was then used to evaluate the performance of the current system and the proposed improvements. The hydraulic model contains a pipe network of the distribution system, the two elevated tanks, and the high service pumps. The operation of the high service pumps is based on the water level in the elevated tank at the WTP. The pumps remain off while the tank is draining and turn on to fill the tank. The system was modeled during draining conditions; the high service pumps were off and the WTP elevated tank was set at a hydraulic grade of 990 feet. Additionally, the West Front Street Elevated Tank was set at a hydraulic grade of 992 feet. The new low-service pumps that will be installed with the new Iron Removal Plant will also operate based on the WTP elevated tank levels, similar to the existing high-service pumps. Therefore, the future hydraulic conditions are assumed to be similar to the existing conditions and these tanks settings remained constant for 2022, 2027, and 2042 modeling scenarios.

The Industrial Park Booster Station, consisting of a ground storage tank and three booster pumps, is also represented in the hydraulic model. The booster station is operated daily to turn over the Industrial Park ground storage tank, and to supplement flow in the event of a fire. The booster pump station was not drawing from or supplying the system during evaluations of normal system operating conditions. However, one booster pump was pumping from the ground storage tank to the system during evaluations of fire flow conditions.

Demands were also added to the model for the evaluations completed herein. The ADD associated with the top 10 water users, as described in Table 3, were initialized at junctions corresponding to the geographic location of the users. MDD:ADD and PHD:MDD peaking factors were applied to these ADD to determine MDD and PHD for the top 10 users. The demands of the top 10 users remained constant for 2022, 2027, and 2042 demand scenarios. Demands were initialized at the remaining junctions in the system for 2022, 2027, and 2042 demand scenarios by taking the balance of the total projected demands described in Table 4.

9.0 Water Distribution System Evaluation

9.1 2022 Demand and Current System

9.1.1 Pressure Analysis

To evaluate the hydraulic performance of the current distribution system and its ability to meet 2022 demand conditions, a pressure analysis was performed. Using the hydraulic model, pressures throughout the system were evaluated at 2022 PHD of 2.49 mgd and with normal operating conditions of the Industrial Park Booster Station.

The pressure contours from this evaluation are displayed in Figure 7. Pressures range from 51 to 91 psi in the City's distribution system. Pressures below 35 psi are considered deficient; therefore, the pressures predicted by the model are sufficient.

9.1.2 Fire Flow Analysis

Available fire flow analyses can be used to evaluate the hydraulic performance of a system. With this analysis, available fire flow is determined by modeling the maximum flow rate that can be withdrawn from the system at any given node while maintaining a pressure of 20 psi at all other nodes in the model. This was completed at 2022 MDD conditions of 1.66 mgd and with fire flow conditions of the Industrial Park Booster Station.

The available fire flow contours from this evaluation are displayed in Figure 8. For this study, an available fire flow of 1,500 gpm was chosen as the minimum criteria, corresponding the Insurance Services Office (ISO) recommendation for the minimum recommended residential fire flow. A list of deficient areas in the system is provided in Table 16.

Table 16 – Areas of Deficient Fire Flow

Location	Available Fire Flow (gpm)
4-inch dead-end main along Schoolcraft Street	213
4-inch main along Union Street and Burch Street	298
4-inch main along High Street	404
4-inch main along Elm Street	408
4-inch and 6-inch dead-end mains at Fitzgerald Park	409
4-inch main along Oakwood Street, west of Morley Street	483
8-inch main along Spring Street between Jones Street and Seminary Street	510
4-inch main along North Clinton Street between High Street and Fleming Street	534
4-inch main along East Washington between M-100 and North Clinton Street	601
6-inch main along West Colonial Park Drive	710
4-inch main along Spring Street between Walnut Street and West Kent Street	717
6-inch dead-end main along Grand Manor Drive	806
4-inch main along main along Park Court	853
6-inch main along Old Mill Pond Road	913
8-inch main along Arrowhead Drive	1,054
6-inch dead-end main along Pinehurst Drive	1,079
8-inch main along Stone Bluff Drive	1,127
4-inch main along Jenne Street between East Kent Street and Marsh Drive	1,144
8-inch dead-end main along Fieldview Drive	1,157
6-inch main along Timber Creek Drive	1,237
6-inch dead-end main along Loch Circle	1,238
6-inch main along Ledge Lane, south of East Colonial Park	1,242
4-inch and 6-inch mains along Bates Avenue	1,253
8-inch main along Millstone Drive	1,352
4-inch dead-end main along River Bend Circle	1,369
6-inch dead-end main along Carlisle Circle	1,392

Many areas of deficient fire flow in the system are located along 4-inch mains and dead-ends.

9.2 2027 Demand and Current System

9.2.1 Pressure Analysis

To evaluate the hydraulic performance of the current system and its ability to meet 2027 demand conditions, a pressure analysis was performed. Using the hydraulic model, pressures throughout the system were evaluated at 2027 PHD conditions of 3.15 mgd and with normal operating conditions of the Industrial Park Booster Station.

The pressure contours from this evaluation are displayed in Figure 9. Pressures range from 51 to 91 psi in the City's distribution system. The pressures predicted by the model are sufficient, compared to the minimum criteria of 35 psi.

9.2.2 Fire Flow Analysis

An available fire flow analysis was also completed to evaluate the hydraulic performance of the current system at 2027 demand conditions. This was completed at 2027 MDD of 2.10 mgd and with fire flow conditions of the Industrial Park Booster Station.

The available fire flow contours from this evaluation are displayed in Figure 10. The deficient areas in the system, compared to the 1,500 gpm criteria, match that of the current system with 2022 demands, as described in Table 16.

9.3 2042 Demand and Current System

9.3.1 Pressure Analysis

To evaluate the hydraulic performance of the current system and its ability to meet 2042 demand conditions, a pressure analysis was performed. Using the hydraulic model, pressures throughout the system were evaluated at 2042 PHD conditions of 4.07 mgd and with normal operating conditions of the Industrial Park Booster Station.

The pressure contours from this evaluation are displayed in Figure 11. Pressures range from 50 to 90 psi in the City's distribution system. The pressures predicted by the model are sufficient, compared to the criteria of 35 psi.

9.3.2 Fire Flow Analysis

An available fire flow analysis was also completed to evaluate the hydraulic performance of the current system at 2042 demand conditions. This was completed at 2042 MDD of 2.71 mgd and with fire flow conditions of the Industrial Park Booster Station.

The available fire flow contours from this evaluation are displayed in Figure 12. The deficient areas in the system, compared to the 1,500 gpm criteria, match that of the current system with 2022 demands, as described in Table 16.

10.0 Recommended Improvements

A CIP was developed to improve the performance and reliability of the City's water distribution system. The CIP consists primarily of water main improvements and storage improvements. The storage capacity analysis was used to determine the needed storage improvements. Additionally, previous tank inspection reports were evaluated to determine recommended tank maintenance projects to be included in the CIP.

The proposed water main improvements plan was developed by assessing the material, age, and hydraulic performance of water mains in the system. The replacement of critical water mains in areas of deficient fire flow were prioritized in the development of the CIP.

Once water main improvements addressed all critical areas of deficient fire flow, replacement of aged water main was prioritized. The expected service life of each water main was estimated based on standards established in the

American Water Works Association (AWWA) report, "Buried No Longer". In the AWWA report, the typical estimated service life of water main was investigated using utilities' experiences, extensive research, and professionals' experiences. A Long Service Life (LSL) and a Short Service Life (SSL) were estimated for different regions around the United States and for different sizes of systems. For the purposes of this report, the estimated service lives for the Midwestern region with a medium to small size system were used. The average of the LSL and the SSL was used as the expected useful life. The service life of a cast iron main was estimated at 100 years, the service life of a ductile iron main was estimated at 80 years, and the service life of an asbestos cement or a concrete main was estimated at 70 years. The percentage of water mains in the City system that have already or will exceed their design life in the planning period are provided in Table 17.

Table 17 – Expected Useful Service Life of Water Main

		% of Mains Beyond Expected Useful Life		
Material	Expected Useful Life	Existing System	System in 5 Years	System in 20 Years
Cast Iron	100 Years	2.9%	3.2%	6.9%
Ductile Iron	80 Years	0.0%	0.0%	0.2%

To maintain a reliable and sustainable water system, water main should be replaced on a regular basis. The goal is to replace water main in the system before it reaches the end of its expected useful life. It is estimated that 2.9% of the City water system is currently beyond its expected useful life and 6.9% of the system will be beyond its expected useful life within 20 years. Replacement of these water main was targeting following areas of deficient fire flow.

10.1 5-Year Improvements

The 5-year water system improvements involve 11 water main projects and the periodic required maintenance of the WTP Elevated Tank. The total estimated cost of these projects is $3,623,000.

10.1.1 Storage Improvements

The WTP Elevated tank was last inspected in 2005. It is recommended that the interior and exterior of tank be sandblasted and painted prior to 2027. The estimated cost of this is $475,000.

10.1.2 Water Main Improvements

The 11 water main improvement projects were scheduled based on a replacement rate of approximately 1% per year. The projects included in the 5-year CIP address areas of deficient fire flow. These are prioritized based on the respective benefit to overall hydraulic performance.

The total estimated cost of these water main improvement projects is $3,148,000. Table 18 summarizes the water main projects included in the 5-Year improvements and the respective estimated costs. The location of each 5-Year Improvement project is displayed in Figure 13.

Table 18 – 5-Year Water Main Improvements

CIP No.	Year	Description	Diameter (in.)	Length (ft.)	Estimated Cost
1	2023	Replace 4-inch and 6-inch mains along Green Street between Jones Street and West South Street	8	1,140	$289,000
2	2023	Replace 4-inch main along Elm Street	8	1,060	$269,000
3	2023	New main along Elm Street connecting 4-inch and 12-inch mains along North Clinton Street	8	60	$16,000
4	2024	Replace 4-inch and 6-inch mains along Morley Street south of Halbert Street	8	1,150	$292,000
5	2024	Replace 4-inch and 6-inch mains along High Street	8	1,090	$277,000
6	2025	Replace 4-inch mains along Kennedy Street, Seminary Street, and Schoolcraft Street south of Jones Street	8	1,650	$419,000
7	2025	Replace 4-inch and 8-inch mains along Jenne Street between East Kent Street and Spring Street	12	1,460	$487,000
8	2026	Replace 4-inch main along Spring Street between West Lincoln Street and West Kent Street	8	930	$236,000
9	2026	New main crossing Grand River from Fitzgerald Park to West Main Street	12	700	$378,000
10	2026	Replace 6-inch main along West Main Street from Hawks Ridge to Ledge Street	8	1,430	$363,000
11	2027	Replace 4-inch main along Orchard Street east of Morley Street	8	480	$122,000
			Total	11,150	$3,148,000

Pressure and fire flow analyses were completed with the 5-year improvements and 2027 demand conditions. The results of these analyses are illustrated in Figures 14 and 15, respectively. With the 5-year improvements, pressures range from 51 to 91. Available fire flow is predicted to increase in the residential and commercial areas north of Kent Street between the Grand River and Sandstone Creek, as well as the neighborhoods between Halbert Street and High Street.

10.2 6- to 20-Year Improvements

The water system improvements for the remaining years of the 20-year planning period involve 34 water main projects and the construction of an additional elevated storage tank. The total estimated cost of these projects is $10,343,000 to $10,559,000, depending on tank location.

10.2.1 Storage Improvements

As discussed previously, the City's storage capacity is projected to be exceeded prior to 2042. Fishbeck recommends constructing an additional elevated tank following the completion of the 5-year capital improvements. A 0.50 MG tank is needed to meet the City's recommended storage requirements by 2042, assuming the West Front Street Elevated Tank will no longer be in service at this time. The tank would be sized to provide a maximum hydraulic grade of 995 feet, similar to that of the WTP Elevated Tank.

Fishbeck considered four potential locations on land owned by the City for the elevated tank based on ground elevation and water system connectivity. These locations are depicted in Figure 16. The overflow height needed to achieve a hydraulic grade of 995 for each location is provided below in Table 19. The estimated cost of each alternative is also provided.

Table 19 – Elevated Tank Locations

Location	Ground Elevation	Overflow Height	Estimated Cost
Whitney Street	830 feet	165 feet	$2,721,000
Fitzgerald Park	846 feet	149 feet	$2,522,000
West Washington Street	849 feet	146 feet	$2,487,000
Cudney Lane	860 feet	135 feet	$2,505,000

The costs provided above include construction of the tank as well as installation of a 12-inch water main to connect the tank to the existing water system. However, additional water main improvements and site work may be desired depending on the location of the elevated tank. The costs associated with this were not included above.

10.2.2 Water Main Improvements

The 34 proposed water main improvement projects were scheduled based on a replacement rate of approximately 1% per year following the completion of the elevated storage tank. The early projects included in the 20-year CIP, Project 12 to 15, address the remaining areas of deficient fire flow. The later projects address water main that has surpassed its expected useful life.

The total estimated cost of these projects is $7,838,000. Table 20 summarizes the water main projects included in the 20-Year improvements, and the respective estimated costs. The location of each 20-Year Improvement project is also displayed in Figure 13.

Table 20 – 20-Year Water Main Improvements

CIP No.	Year	Description	Diameter (in.)	Length (ft.)	Estimated Cost
12	2030	Replace 4-inch main along East Washington Street, connect to 12-inch main along North Clinton Street	8	300	$77,000
13	2030	Replace 6-inch mains along West Colonial Park Drive and East Colonial Park Drive	8	1,660	$421,000
14	2030	Replace 4-inch and 6-inch mains along Bates Street and Fergeson Street north of Fleming Street	8	850	$216,000
15	2031	Replace 4-inch along Sandstone Creek Drive	8	1,800	$457,000
16	2032	Replace 4-inch and 6-inch mains along Oakwood Street west of Morley Street	8	1,140	$289,000
17	2032	Replace 4-inch main along Greenwood from East Main Street to North Clinton Street	8	500	$127,000
18	2032	Replace 4-inch main along Taylor Street between Lamson Street and East Scott Street	8	830	$211,000
19	2033	Replace 10-inch main along Seymour Street	12	1,330	$444,000
20	2033	Replace 4-inch and 6-inch mains along Willow Street	8	1,300	$330,000
21	2034	Replace 4-inch main along Union Street west of Morley Street	12	1,110	$371,000
22	2034	Replace 4-inch main along Union Street east of Church Street	12	1,030	$344,000
23	2035	Replace 10-inch main along Maple Street south of Jones Street	12	1,870	$624,000
24	2036	Replace 4-inch and 8-inch mains along Walnut Street	8	1,140	$289,000
25	2036	Replace 4-inch and 8-inch mains along Jones Street east of Green Street	8	790	$201,000
26	2037	New main along Park Street from Lamson Street to East Scott Street	8	790	$201,000
27	2037	Replace 4-inch main along West South Street east of Green Street	8	1,150	$292,000
28	2038	Replace 4-inch main along Seminary Street	8	740	$188,000
29	2038	Replace 8-inch main along Kennedy Street north of Jones Street	8	750	$191,000
30	2038	Replace 4-inch dead-end along Valley Ridge Drive	8	400	$102,000
31	2038	Install new main along Valley Ridge Drive from dead-end to Jones Street	8	410	$104,000
32	2039	Replace 4-inch main along Liberty Street	8	440	$112,000
33	2038	Install new main along Liberty Street southwest of Lamson Street	8	290	$74,000
34	2038	Install new main along Liberty Street east of East Lincoln Street	8	410	$104,000
35	2033	Replace 6-inch main along Belknap Street	8	1,390	$353,000
36	2040	Replace 6-inch main along Willow Highway west of Ledge Mor Boulevard	8	1,340	$340,000
37	2040	Replace 4-inch main along Cedar Street	8	440	$112,000
38	2040	New main along Cedar Street from Tulip Street to Old Post Road	8	400	$102,000
39	2041	Replace 4-inch main along Mineral Street	8	430	$109,000
40	2041	New main along Mineral Street from West Main Street to West Front Street	8	410	$104,000
41	2041	Replace 4-inch main along Church Street south of Union Street	8	440	$112,000
42	2041	Replace 4-inch main along Burch Street and connect to 12-inch main along Union Street	8	400	$102,000
43	2041	Replace 6-inch mains along Park Court and Ledge Lane	8	440	$112,000

CIP No.	Year	Description	Diameter (in.)	Length (ft.)	Estimated Cost
44	2042	Replace 4-inch main along Jackson Street southwest of East Scott Street	8	410	$104,000
45	2042	Replace 6-inch main along Ledge Street	8	380	$97,000
46	2042	Replace 8-inch main crossing the Grand River at the West Front Street Tank	12	780	$422,000
			Total	28,290	$7,838,000

Pressure and fire flow analyses were completed with the 20-year improvements and 2042 demand conditions. The additional elevated storage tank was not included in these analyses. The results of these analyses are illustrated in Figures 17 and 18, respectively. With the 20-year improvements, pressures range from 51 to 92 and available fire flow is predicted to increase in the remaining critical areas of the distribution system.

As observed in Figure 18, available fire flow in the southwest corner of the distribution system remains deficient. However, this area is within the Township. The City is encouraged to share the results of the available fire flow analysis with the Township, however Water main improvements in this area are dictated by the Township.

10.3 Summary of Cost Estimation

Estimates of cost for distribution system improvements represent construction costs for replacement of the Water main and restoration of the driving surface directly above the main. These estimates do not include engineering or contingency costs. Additional costs for replacement of adjacent utilities and road reconstruction are not included in the unit costs. Improvements should be coordinated with other utility and road replacement projects wherever feasible to maximize the benefit of the investment. City budgetary constraints will dictate the actual priorities and timing of construction for projects.

The construction cost estimates presented in this report reflect January 2023 costs. These opinions of cost were prepared to determine approximate construction costs. There are several factors that could cause the actual project costs to deviate from these estimates, including the competitive bidding climate at the time the construction bids are received, inflation, and additions to or changes in the scope of the project that may occur during the design process. The City should update estimated costs prior to proceeding with any future work and make necessary adjustments to determine the bidding climate in the year the work is proposed to be completed.

Figures

PLOT INFO: Z:\2022\220695\CAD\GIS\ProProj\GrandLedgeWaterReliabilityStudy.aprx Layout: FIG03_Existing Water System Date: 1/2/2025 8:17 AM User: awade

LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Water Hydrant
- Water System Valve
- Water Main
- City of Grand Ledge
- Oneida Township Service Area

Industrial Park Ground Storage Tank

Industrial Park Booster Station

Front St. Elevated Tank

Well No. 2

WTP Elevated Tank

Well No. 7

Well No. 6

Well No. 8

Lincoln Brick Park

Fitzgerald Park

Island Park

Grand Ledge

Abrams Municipal Airport

Wright Rd

Harteau Rd

Nelson St

Willow Hwy

E Saginaw Hwy

Upright

Grand River

43

100

WTP

EXISTING WATER SYSTEM

NORTH

FEET

0 700 1,400

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 3

PROJECT NO. 220695

City of Grand Ledge

Eaton County, Michigan

Water System Reliability Study

Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

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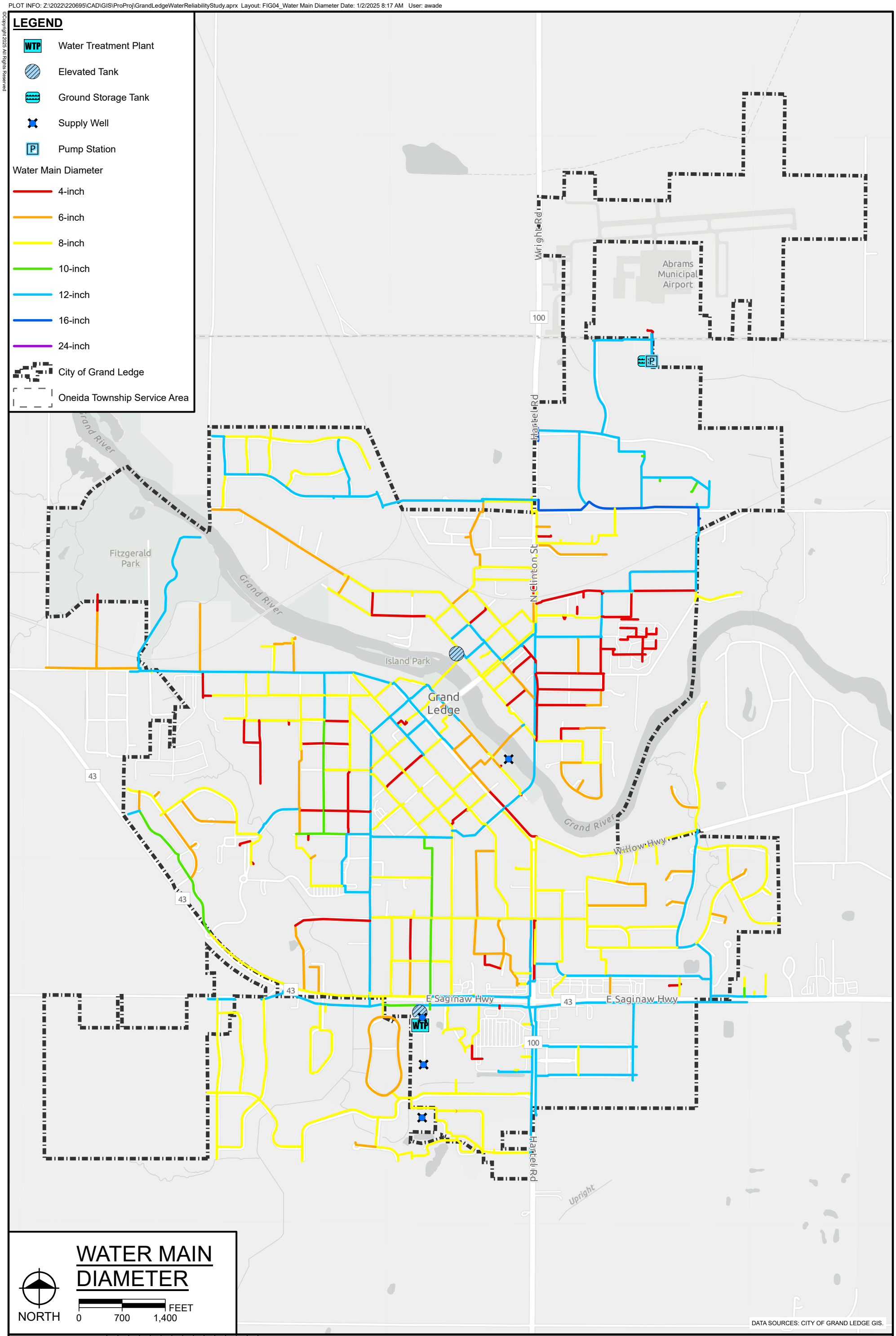
PLOT INFO: Z:\2022\220695\CAD\GIS\ProProj\GrandLedgeWaterReliabilityStudy.aprx Layout: FIG04_Water Main Diameter Date: 1/2/2025 8:17 AM User: awade

LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main Diameter

- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch
- 24-inch
- City of Grand Ledge
- Oneida Township Service Area



NORTH

WATER MAIN DIAMETER

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 4

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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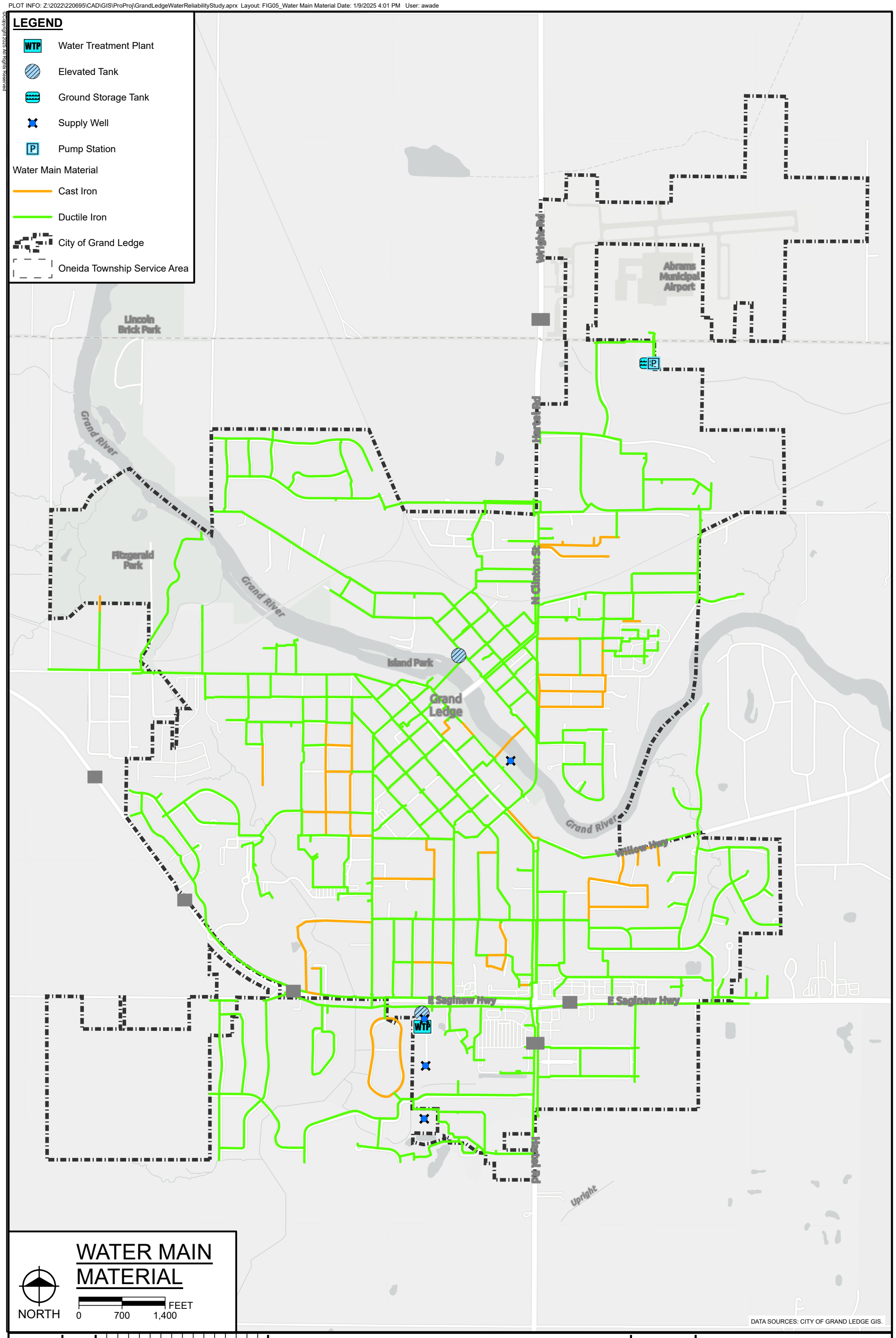
LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main Material

- Cast Iron
- Ductile Iron
- City of Grand Ledge
- Oneida Township Service Area



WATER MAIN MATERIAL

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 5

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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PLOT INFO: Z:\2022\220695\CAD\GIS\ProProj\GrandLedgeWaterReliabilityStudy.aprx Layout: FIG06_Water Main Installation Year Date: 1/9/2025 4:01 PM User: awade

LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main Installation Year

- <1910
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1979
- 1980-1989
- 1990-1999
- 2000-2009
- >2009
- Unknown
- City of Grand Ledge
- Oneida Township Service Area

Lincoln Brick Park
Grand River
Fitzgerald Park
Wright Rd
Abrams Municipal Airport
Herbert Rd
Island Park
Grand Ledge
Willow Hwy
E Saginaw Hwy
WTP
Upright

WATER MAIN INSTALLATION YEAR

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 6

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

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PLOT INFO: \\corp.ftch.com\AllProjects\2022\220695\CAD\GIS\ProProj\GrandLedgeWaterReliabilityStudy.aprx Layout: FIG07_Existing System - 2022 Pressure Date: 1/15/2025 7:42 AM User: prbaskins

LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Water Main

Pressure Contours - 2022

- 55 psi
- 65 psi
- 75 psi
- 85 psi
- City of Grand Ledge
- Oneida Township Service Area

EXISTING SYSTEM, 2022 DEMANDS: PRESSURE

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 7

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

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PLOT INFO: \\corp.ftch.com\AllProjects\2022\220695\CAD\GIS\ProProj\GrandLedgeWaterReliabilityStudy.aprx Layout: FIG08_Existing System - 2022 Fire Flow Date: 1/15/2025 7:42 AM User: prbaskins

LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station
- Water Main

Available Fire Flow Contours - 2022

- 1,500 gpm
- 2,500 gpm
- 3,500 gpm
- 4,500 gpm
- City of Grand Ledge
- Oneida Township Service Area

EXISTING SYSTEM, 2022 DEMANDS: FIRE FLOW

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 8

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Water Main

Pressure Contours - 2027

- 55 psi
- 65 psi
- 75 psi
- 85 psi
- City of Grand Ledge
- Oneida Township Service Area

EXISTING SYSTEM, 2027 DEMANDS: PRESSURE

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 9

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Water Main

Available Fire Flow Contours - 2027

- 1,500 gpm
- 2,500 gpm
- 3,500 gpm
- 4,500 gpm
- City of Grand Ledge
- Oneida Township Service Area

EXISTING SYSTEM, 2027 DEMANDS: FIRE FLOW

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 10

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station
- Water Main

Pressure Contours - 2042

- 55 psi
- 65 psi
- 75 psi
- 85 psi
- City of Grand Ledge
- Oneida Township Service Area

Wright Rd
Abrams Municipal Airport
100
Hartel Rd
N Clinton St
Grand River
Fitzgerald Park
Island Park
Grand Ledge
43
E Saginaw Hwy
Willow Hwy
WTP
Upright

EXISTING SYSTEM, 2042 DEMANDS: PRESSURE

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 11

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Water Main

Available Fire Flow Contours -2042

- 1,500 gpm
- 2,500 gpm
- 3,500 gpm
- 4,500 gpm
- City of Grand Ledge
- Oneida Township Service Area

EXISTING SYSTEM, 2042 DEMANDS: FIRE FLOW

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 12

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main

- 5-Year CIP
- 20-Year CIP
- Existing
- City of Grand Ledge
- Oneida Township Service Area

Lincoln Brick Park
Fitzgerald Park
Island Park
Grand River
Abrams Municipal Airport
Wright Rd
N Clinton St
Hartel Rd
Grand Ledge
E Saginaw Hwy
Willow Hwy
Upright
100
43

No.1 No.2 No.3 No.4 No.5 No.6 No.7 No.8 No.9 No.10 No.11 No.12 No.13 No.14 No.15 No.16 No.17 No.18 No.19 No.20 No.21 No.22 No.23 No.24 No.25 No.26 No.27 No.28 No.29 No.30 No.31 No.35 No.36 No.37 No.38 No.39 No.40 No.42 No.43 No.44 No.45 No.46

WTP

WATER MAIN IMPROVEMENTS

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 13

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station

Water Main

- 5-Year CIP
- Existing

Pressure Contours - 5 Year CIP

- 55 psi
- 65 psi
- 75 psi
- 85 psi
- City of Grand Ledge
- Oneida Township Service Area

5-YEAR IMPROVEMENTS, 2027 DEMANDS: PRESSURE

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 14

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main

- 5-Year CIP
- Existing

Available Fire Flow Contours - 5 Year CIP

- 1,500 gpm
- 2,500 gpm
- 3,500 gpm
- 4,500 gpm
- City of Grand Ledge
- Oneida Township Service Area

5-YEAR IMPROVEMENTS, 2027 DEMANDS: FIRE FLOW

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 15

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- Pump Station
- Proposed 0.50 MG Elevated Tank
- Water Main
- City of Grand Ledge
- Oneida Township Service Area

Cudney Lane

West Washington Street

Whitney Street

Fitzgerald Park

PROPOSED ELEVATED TANK LOCATIONS

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 16

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main

- 5-Year and 20-Year CIP
- Existing

Pressure Contours - 20 Year CIP

- 55 psi
- 65 psi
- 75 psi
- 85 psi
- City of Grand Ledge
- Oneida Township Service Area

Grand River
Fitzgerald Park
Island Park
Grand Ledge
Abrams Municipal Airport
Wright Rd
N Clinton St
Hartel Rd
E Saginaw Hwy
Willow Hwy
Upright
43
100
WTP

20-YEAR IMPROVEMENTS, 2042 DEMANDS: PRESSURE

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 17

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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LEGEND

- WTP — Water Treatment Plant
- Elevated Tank
- Ground Storage Tank
- Supply Well
- P — Pump Station

Water Main

- 5-Year and 20-Year CIP

Available Fire Flow Contours - 20 Year CIP

- 1,500 gpm
- 2,500 gpm
- 3,500 gpm
- 4,500 gpm
- City of Grand Ledge
- Oneida Township Service Area

Grand River
Fitzgerald Park
Island Park
Grand Ledge
Abrams Municipal Airport
Wright Rd
N Clinton Trail
Hartel Rd
E Saginaw Hwy
Upright
100
43

20-YEAR IMPROVEMENTS, 2042 DEMANDS: FIRE FLOW

NORTH

0 700 1,400 FEET

DATA SOURCES: CITY OF GRAND LEDGE GIS.

FIGURE NO. 18

PROJECT NO. 220695

City of Grand Ledge
Eaton County, Michigan

Water System Reliability Study

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