

VILLAGE OF PEWAUKEE WATER SYSTEM MASTER PLAN

August 3, 2022

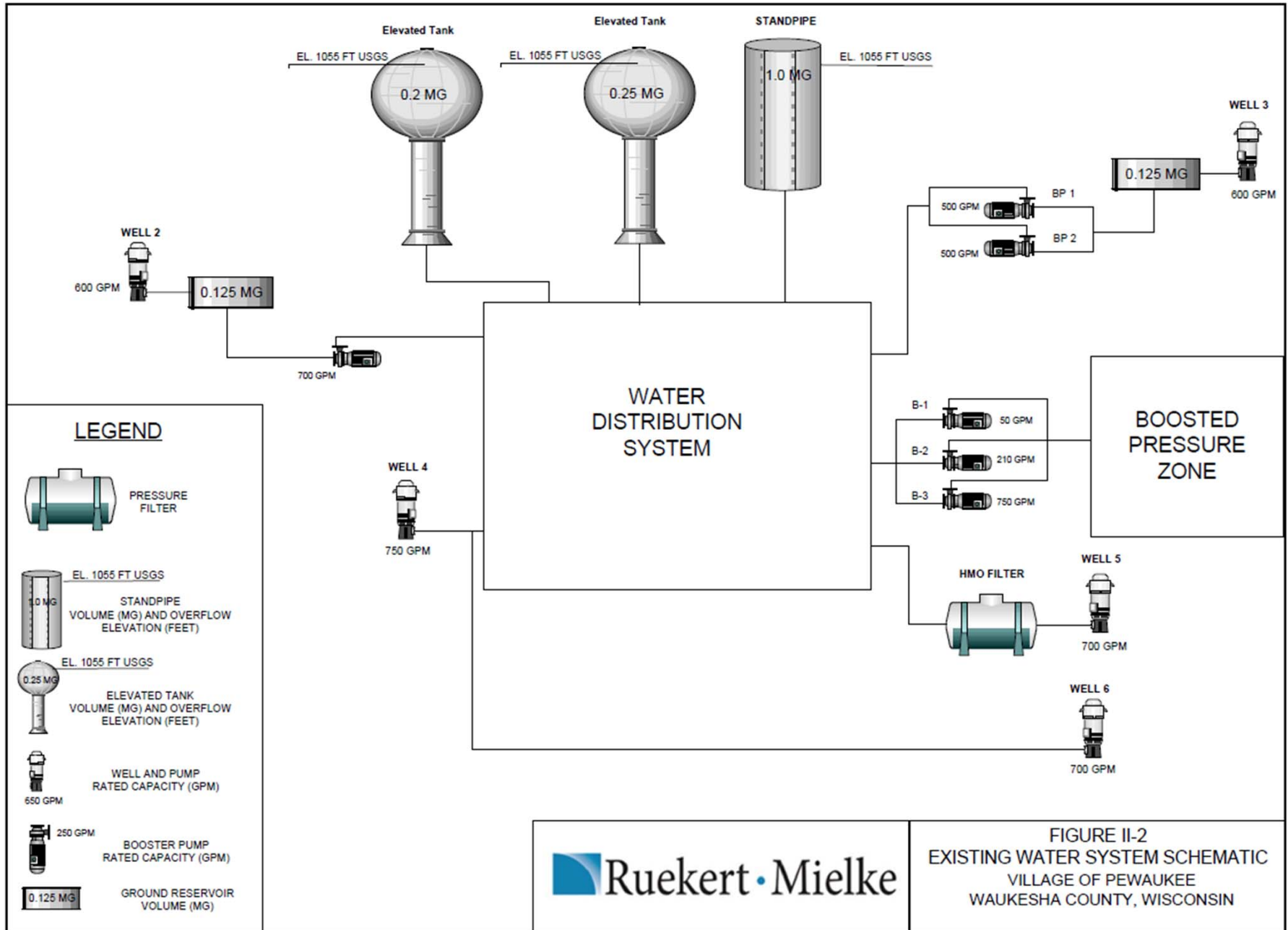
Village of Pewaukee Water System Master Plan

- Existing Water System Facilities
- Population and Community Growth
- Water Requirements
- Supply and Storage Analysis
- Water System Deficiency Analysis
- Recommendations
- Capital Improvements Plan

Existing Water System Facilities

- Supply and Storage Facilities
 - Five groundwater wells
 - Two elevated water storage tanks
 - One Standpipe
 - Two supply pumping stations
 - One booster pump station
- Pressure Zones
 - Main Service Zone
 - Hawthorne Boosted Zone

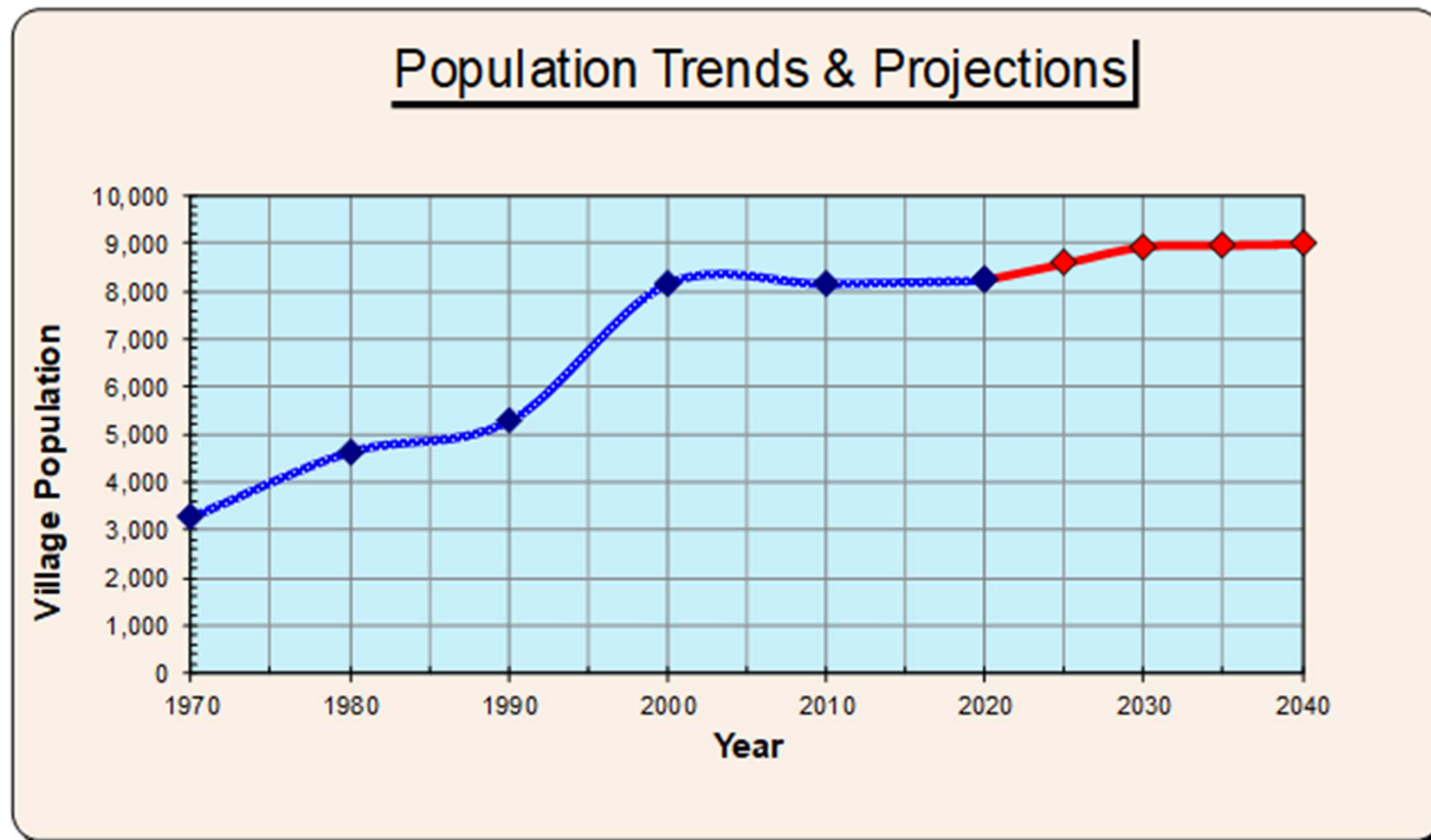
Existing Water System Schematic



Population and Community Growth

□ Population

- Total Population – Census 2020, with WDOA projection

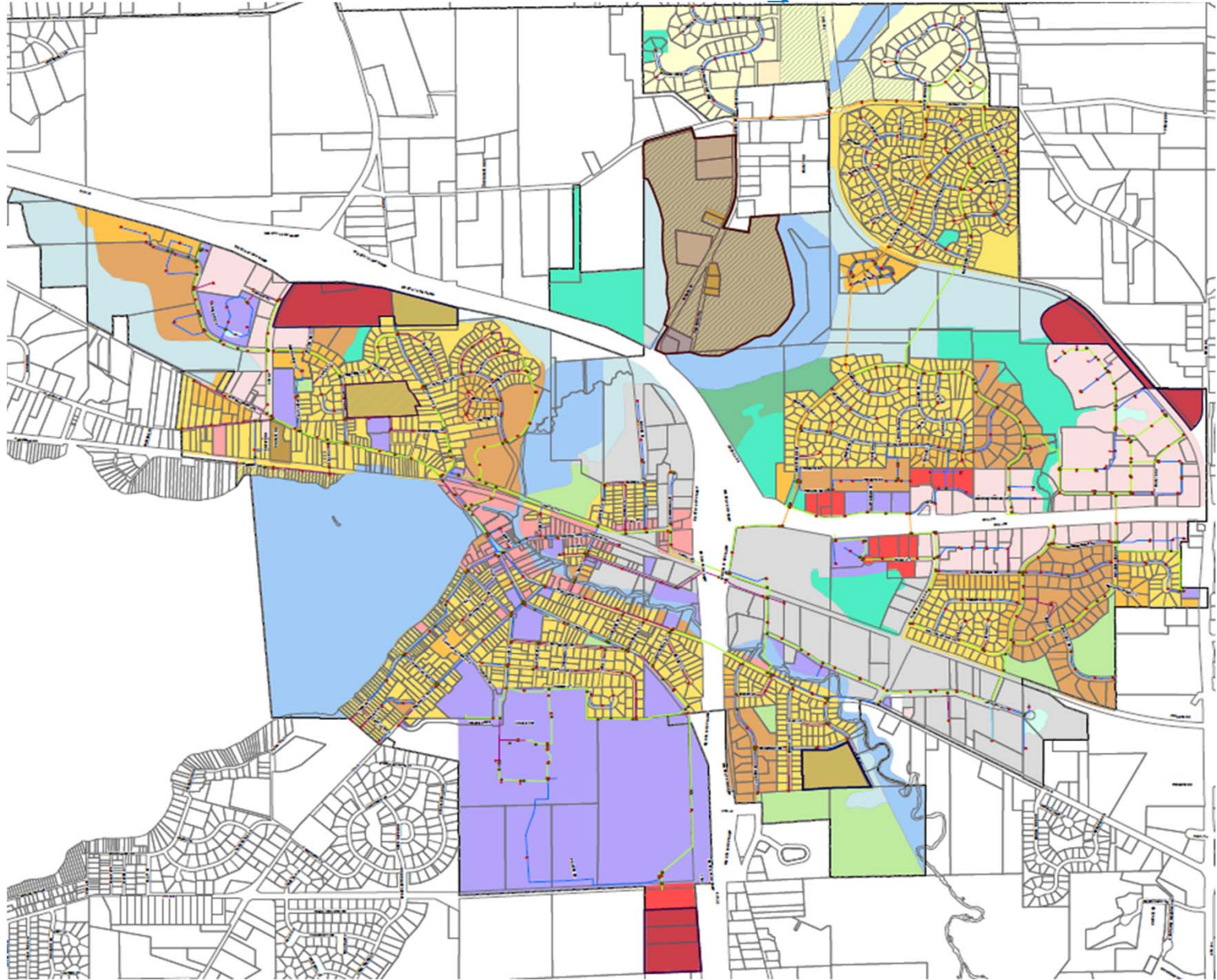


Population and Community Growth

□ Land Use

- Categorized existing and future land use (from 2021 Village Zoning Map)
- Estimated land use for existing service area by pressure zone
- Developed projections based on undeveloped land within Village for:
 - 2030
 - 2035
- Developed potential 2040 projection for service to a portion of the City of Pewaukee (City notified us during study that Village service not required)

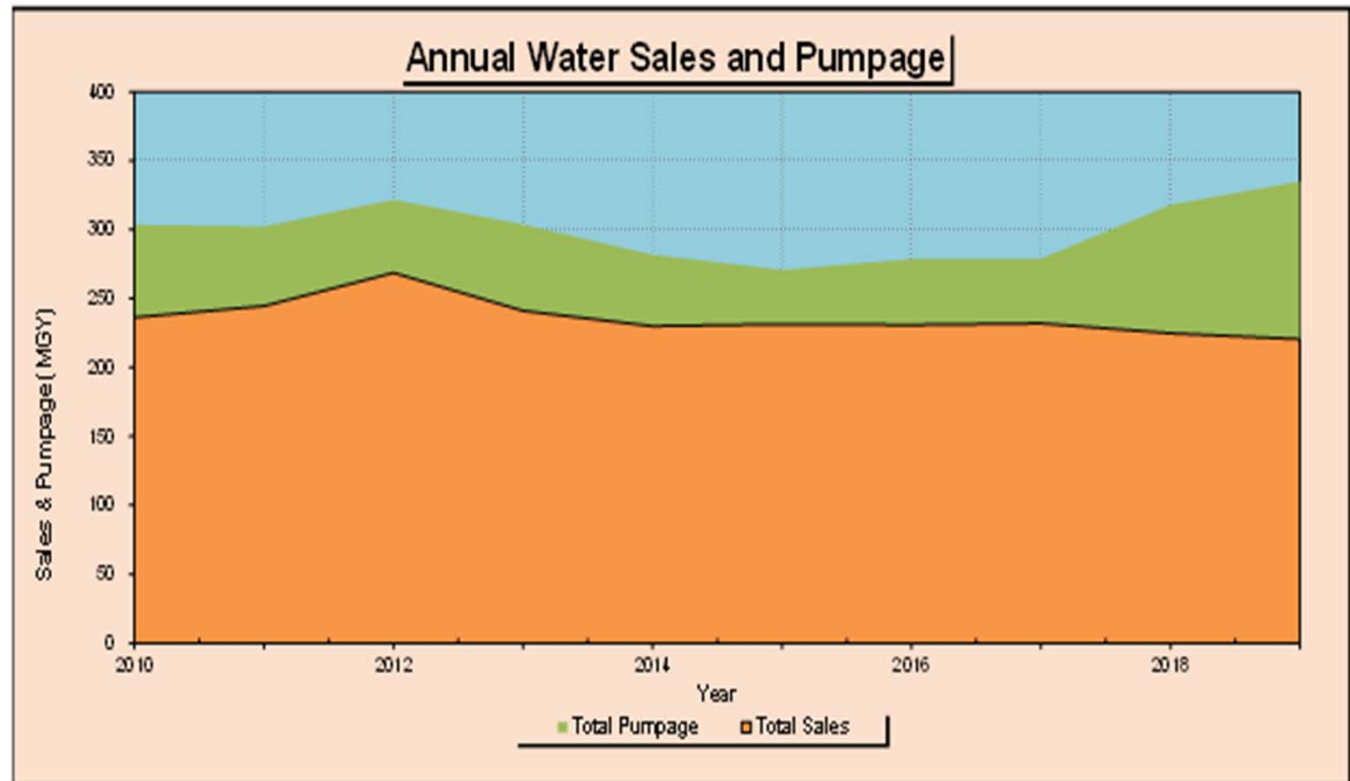
Population and Community Growth



Water Requirements

Summarized existing consumption from 2010 through 2020

Year	Estimated Population	Total Pumpage (MG)	Total Sales (MG)	Pumpage Sold (%)	Non-Revenue Water (%)	Water Losses (%)	Average Day		Maximum Day		Ratio of Maximum to Average Day Pumpage
							MGD	GPCD	MGD	Date	
2010	8,166	304	236	78%	22%	21%	0.832	101.8	1.961	Sept. 16	2.36
2011	8,159	302	245	81%	19%	18%	0.828	101.5	1.271	July 10	1.53
2012	8,165	322	289	83%	17%	16%	0.882	108.0	1.445	July 1	1.64
2013	8,170	304	241	79%	21%	20%	0.832	101.8	1.650	Sept. 12	1.98
2014	8,176	282	230	82%	18%	17%	0.772	94.4	1.077	Sept. 9	1.39
2015	8,182	271	231	85%	15%	13%	0.742	90.7	1.230	March 11	1.66
2016	8,187	279	231	83%	17%	16%	0.783	93.2	1.140	July 19	1.49
2017	8,193	279	232	83%	17%	14%	0.785	93.3	1.230	Sept 12	1.61
2018	8,199	318	225	71%	29%	25%	0.871	106.2	1.180	Sept. 28	1.36
2019	8,204	322	213	66%	34%	29%	0.882	107.6	1.119	June 6	1.27
2020	8,210	335	220	66%	34%	30%	0.918	111.8	1.438	July 6	1.57



Water Requirements

□ Established Unit Consumption Values based on Land Use and Population

Year	GALLONS PER ACRE PER DAY				
	Residential	Commercial	Industrial	Public	Multi-Family
2010	312	1161	130	113	
2011	324	1192	138	122	
2012	336	1237	142	254	
2013	310	1173	187	109	
2014	310	1112	123	110	
2015	316	450	120	110	991
2016	308	485	98	119	975
2017	299	526	116	114	956
2018	292	506	96	112	940
2019	284	452	84	106	907
2020	317	441	86	88	918
Average	310	477	120	123	948

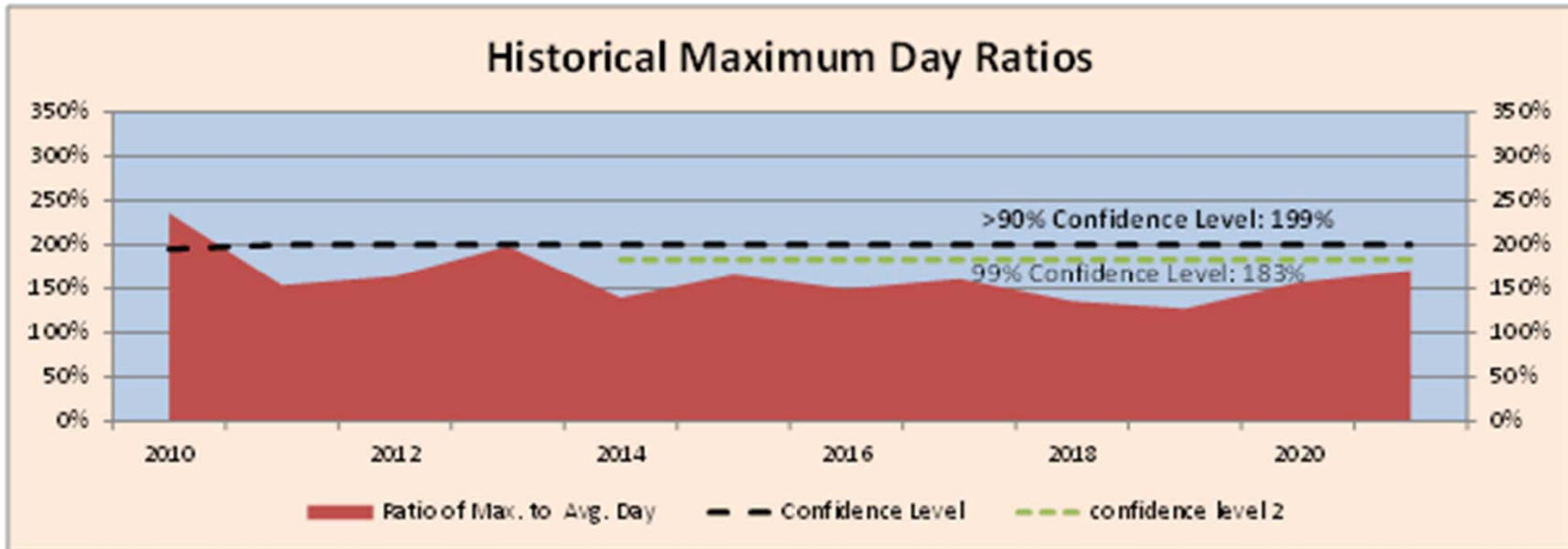
Notes
1. Commercial average from 2015 through 2020

Year	Estimated Total Retail Population	GALLONS PER CAPITA PER DAY						Total Metered	Total Pumpage
		Residential	Commercial	Industrial	Public	Multi-family			
2010	8,168	31.4	39.9	3.8	4.4		79.3	101.8	
2011	8,159	32.8	41.0	3.8	4.7		82.2	101.5	
2012	8,165	33.8	42.5	3.9	9.9		90.1	108.0	
2013	8,170	31.2	40.3	5.1	4.2		80.8	101.8	
2014	8,176	31.2	38.2	3.4	4.3		77.0	94.4	
2015	8,182	31.7	15.4	3.3	4.3	22.8	77.5	90.7	
2016	8,187	30.9	16.6	2.7	4.6	22.4	77.3	93.2	
2017	8,193	29.9	18.0	3.2	4.4	22.0	77.6	93.3	
2018	8,199	29.2	17.3	2.8	4.3	21.6	75.1	108.2	
2019	8,204	28.4	15.5	2.3	4.1	20.8	71.1	107.6	
2020	8,210	31.7	15.1	2.3	3.4	21.1	73.6	111.8	
Average		31.1	16.3	3.3	4.8	21.8	78.3	100.9	

Notes
1. Commercial average is from 2015 through 2020

Water Requirements

- Identified Daily Demand variations
 - Maximum Day Ratio 199% of Average Day



- Peak Hour ratio 160% of Maximum Day based on actual use in Village

Future Projections

	Actual 2020/2021	Projected 2030	Projected 2035	Projected 2040
Total Population	8,238			
Population Served	8,210			
Residential Per Acre Sales (gpad)	317.0	315	315	315
Public Per Acre Sales (gpad)	88.0	110	110	110
Commercial Per Acre Sales (gpad)	441.0	500	500	500
Multi-family Sales (gpad)	918.0	950	950	950
Industrial Per Acre Sales (gpad)	86.0	120	120	120
Main Service Zone				
Residential Sales	0.25	0.30	0.33	0.39
Public Sales	0.03	0.03	0.03	0.04
Commercial Sales	0.12	0.16	0.16	0.19
Multi-family	0.17	0.18	0.18	0.18
Industrial Sales	0.02	0.02	0.03	0.03
	-	-	-	-
Total Water Sales for Zone (MGD)	0.59	0.70	0.74	0.82
Hawthorne Boosted Zone				
Residential Sales	0.010	0.009	0.009	0.009
Total Water Sales for Zone (MGD)	0.010	0.010	0.010	0.010
Future Boosted Zone				
Residential Sales	-	-	-	0.016
Public Sales	-	-	-	0.001
Total Water Sales for Zone (MGD)	0.000	0.000	0.000	0.017
TOTAL METERED SALES (MGD)	0.60	0.71	0.747	0.85

	Actual 2020/2021	Projected 2030	Projected 2035	Projected 2040
Total Annual Retail Sales (MGY)	221	257	270	309
Total Annual Pumpage (MGY)	296	320	337	390
Average Day Pumpage (MGD)	0.812	0.877	0.923	1.088
Design Maximum Day Pumpage (MGD)	1.62	1.74	1.84	2.13
Design Peak Hour Demand (gpm)	1,800	1,940	2,040	2,360

Notes

1. Design maximum day pumpage projections were estimated using a ratio of maximum to average day pumpage of 199 percent.
2. Design peak hour demand projections were estimated using a ratio of peak hour demand to maximum day pumpage of 160 percent.

Supply and Storage Analysis

□ Existing Reliable Supply

SUPPLY REQUIREMENTS

Design Average Day Demand (gpm)

Design Maximum Day Demand (gpm)

Design Peak Hour Demand (gpm)

Present Reliable Supply Capacity (gpm)¹

Reliable Supply Capacity Excess or (Deficiency) (gpm)

Water System 2021	
Design Average Day Demand (gpm)	576
Design Maximum Day Demand (gpm)	1,146
Design Peak Hour Demand (gpm)	1,834
Present Reliable Supply Capacity (gpm) ¹	1,175
Reliable Supply Capacity Excess or (Deficiency) (gpm)	29

Notes

1. Reliable Supply Capacity is Water Distribution Capacity from Table V-1

Existing Supply and Storage Analysis

SUPPLY RECOMMENDATIONS

Design Average Day Demand (gpm)
 Design Maximum Day Demand (gpm)
 Design Peak Hour Demand (gpm)
 Present Reliable Supply Capacity (gpm)¹
 Reliable Supply Capacity Excess or (Deficiency) (gpm)

Water System 2021	
	576
	1,146
	1,845
	1,175
	29

STORAGE RECOMMENDATIONS

Peak Hour Equalizing Need (gallons)²
 Optimum Fire Protection Needs (gallons)³
 Reserve Storage (gallons: 15% of Total)⁴
Total Optimum Recommended Storage (gallons)
 Available Effective Storage Capacity (gallons):
 Tower (26,187 gallons peak hour, 223,813 gallons fire flow)
 Tower (12,704 gallons peak hour, 187,296 gallons fire flow)
 Standpipe (31,000 gallons peak hour, 530,000 gallons fire flow)
Total Effective Storage Capacity (gallons)⁵
 Less Excess Available Reliable System Supply Capacity for Peak Hour⁶
 Repump Capacity from reservoir at Well 3⁷
Total Additional Capacity Recommended (gallons)

Water System 2021	
	163,000
	630,000
	140,000
	933,000
	250,000
	200,000
	561,000
	1,011,000
	None
	30,000
	24,000
	None

2030 Supply and Storage Analysis

SUPPLY RECOMMENDATIONS

Design Average Day Demand (gpm)
Design Maximum Day Demand (gpm)
Design Peak Hour Demand (gpm)
Present Reliable Supply Capacity (gpm) ¹
Reliable Supply Capacity Excess or (Deficiency) (gpm)

Water System 2030
609
1,212
1,939
1,175
(37)

STORAGE RECOMMENDATIONS

Peak Hour Equalizing Need (gallons) ²
Optimum Fire Protection Needs (gallons) ³
Reserve Storage (gallons; 15% of Total) ⁴
Total Optimum Recommended Storage (gallons)
Available Effective Storage Capacity (gallons):
Tower (26,187 gallons peak hour, 223,813 gallons fire flow)
Tower (12,704 gallons peak hour, 187,296 gallons fire flow)
Standpipe (31,000 gallons peak hour, 530,000 gallons fire flow)
Total Effective Storage Capacity (gallons)⁵
Subtotal Capacity Recommended (gallons)
Less Excess Available Reliable System Supply Capacity for Peak Hour ⁶
Repump Capacity from reservoir at Well 3 ⁷
Total Additional Capacity Recommended (gallons)

Water System 2030
212,000
630,000
149,000
991,000
250,000
200,000
561,000
1,011,000
None
None
24,000
None

2035 Supply and Storage Analysis

SUPPLY RECOMMENDATIONS

Design Average Day Demand (gpm)

Design Maximum Day Demand (gpm)

Design Peak Hour Demand (gpm)

Present Reliable Supply Capacity (gpm)¹

Reliable Supply Capacity Excess or (Deficiency) (gpm)

Water System	
2035	
Design Average Day Demand (gpm)	640
Design Maximum Day Demand (gpm)	1,274
Design Peak Hour Demand (gpm)	2,038
Present Reliable Supply Capacity (gpm) ¹	1,175
Reliable Supply Capacity Excess or (Deficiency) (gpm)	(99)

STORAGE RECOMMENDATIONS

Peak Hour Equalizing Need (gallons)²

Optimum Fire Protection Needs (gallons)³

Reserve Storage (gallons; 15% of Total)⁴

Total Optimum Recommended Storage (gallons)

Available Effective Storage Capacity (gallons):

Tower (26,187 gallons peak hour, 223,813 gallons fire flow)

Tower (12,704 gallons peak hour, 187,296 gallons fire flow)

Standpipe (31,000 gallons peak hour, 530,000 gallons fire flow)

Total Effective Storage Capacity (gallons)⁵

Subtotal Capacity Recommended (gallons)

Less Excess Available Reliable System Supply Capacity for Peak Hour⁶

Repump Capacity from reservoir at Well 3⁷

Total Additional Capacity Recommended (gallons)

Water System	
2035	
Peak Hour Equalizing Need (gallons) ²	290,000
Optimum Fire Protection Needs (gallons) ³	630,000
Reserve Storage (gallons; 15% of Total) ⁴	163,000
Total Optimum Recommended Storage (gallons)	1,083,000
Available Effective Storage Capacity (gallons):	
Tower (26,187 gallons peak hour, 223,813 gallons fire flow)	250,000
Tower (12,704 gallons peak hour, 187,296 gallons fire flow)	200,000
Standpipe (31,000 gallons peak hour, 530,000 gallons fire flow)	561,000
Total Effective Storage Capacity (gallons)⁵	1,011,000
Subtotal Capacity Recommended (gallons)	72,000
Less Excess Available Reliable System Supply Capacity for Peak Hour ⁶	None
Repump Capacity from reservoir at Well 3 ⁷	24,000
Total Additional Capacity Recommended (gallons)	48,000

Water System Deficiency Analysis

- Isolated areas of potential fire flow inadequacy
- Isolated area of low pressures
 - Near School – School utilizes booster pumps to provide adequate pressure
 - Tower Court
- Well 2 and Well 4 exceed MCL for select radionuclides
- Hawthorne Boosted Zone served by a single water main
- Storage facilities require maintenance and repairs
- Current Utility staffing is low in comparison to median range for typical water utilities
- Existing storage facilities provide inadequate peak hour equalizing and operational storage

Recommendations

- Water Supply System Improvements
 - Develop a small boosted pressure zone to provide consistent adequate pressures for customers on Tower Court
 - Side benefit – increases available peak hour equalizing storage within the existing elevated storage tanks and standpipe
 - Construct treatment system for Well 4
 - Improves supply capacity to meet projected water demands for 2030 and 2035
 - Well 2 Retained for emergency use

Recommendations

- Distribution System Improvements
 - Address existing deficiencies
 - Replacement of water mains prone to failure.
 - Replacement of undersized water main to improve fire flow
 - Interconnection with Village of Sussex water system to provide back up source for Hawthorne Boosted Zone
 - Expansion to serve future development

Recommendations

SUPPLY SOURCE	Supply Capacity		Service Pump Capacity		Water To Distribution Capacity		Hawthorne Hill Booster Pump Capacity	
	(gpm)	(MGD)	(gpm)	(MGD)	(gpm)	(MGD)	(gpm)	(MGD)
Wells								
Well No. 2 ¹	600	0.88			0	0.00		
Well No. 3	600	0.88			600	0.88		
Well No. 4 ²	750	1.08			650	0.94		
Well No. 5	500	0.72			500	0.72		
Well No. 6 ³	700	1.01			400	0.58		
Booster Pumps								
Well No. 2 Booster			700	1.01	0	0.00		
Well No. 3 Booster Pump No. 1			500	0.72	500	0.72		
Well No. 3 Booster Pump No. 2			500	0.72	500	0.72		
Hawthorne Hill Booster Pump No. 1							50	0.07
Hawthorne Hill Booster Pump No. 2							210	0.30
Hawthorne Hill Booster Pump No. 3							750	1.08
Total Pumping Supply Capacity ⁴	2,650	3.82	1,700	2.45	2,150	3.10	1,010	1.45
Less: Largest Supply Unit ⁵	1,450	2.09	700	1.01	650	0.94	750	1.08
Reliable Supply⁽⁶⁾	1,200	1.73	1,000	1.44	1,250	2.23	260	0.37

Note

1. Well No. 2 pump capacity rated at 600 gpm. Assumes out of service for emergency use only.
2. Well No. 4 pump rated for 750 gpm. Assumes pumping capacity reduced to 650 gpm with treatment.
3. Well No. 6 pump rated at 700 gpm. Actual pumping capacity is reduced to 400 gpm average due to fouling.
4. For Pumping Capacity - Only well pumps are considered as booster pump capacities exceed well pump capacities.
5. For Supply Capacity - Assumes Well No. 4 is out of service.
6. Water to distribution capacity estimated with 20 hours of operation per day.

Recommendations

2035 Supply and Storage with improvements

SUPPLY RECOMMENDATIONS

Design Average Day Demand (gpm)
 Design Maximum Day Demand (gpm)
 Design Peak Hour Demand (gpm)

Present Reliable Supply Capacity (gpm)¹

Reliable Supply Capacity Excess or (Deficiency) (gpm)

Water System	
2035	
	640
	1,274
	2,038
	1,281
	8

STORAGE RECOMMENDATIONS

Peak Hour Equalizing Need (gallons)²
 Optimum Fire Protection Needs (gallons)³
 Reserve Storage (gallons; 15% of Total)⁴
Total Optimum Recommended Storage (gallons)

Available Effective Storage Capacity (gallons):
 Tower (72,450 gallons peak hour, 177,550 gallons fire flow)
 Tower (91,770 gallons peak hour, 108,230 gallons fire flow)
 Standpipe (138,000 gallons peak hour, 530,000 gallons fire flow)

Total Effective Storage Capacity (gallons)⁵

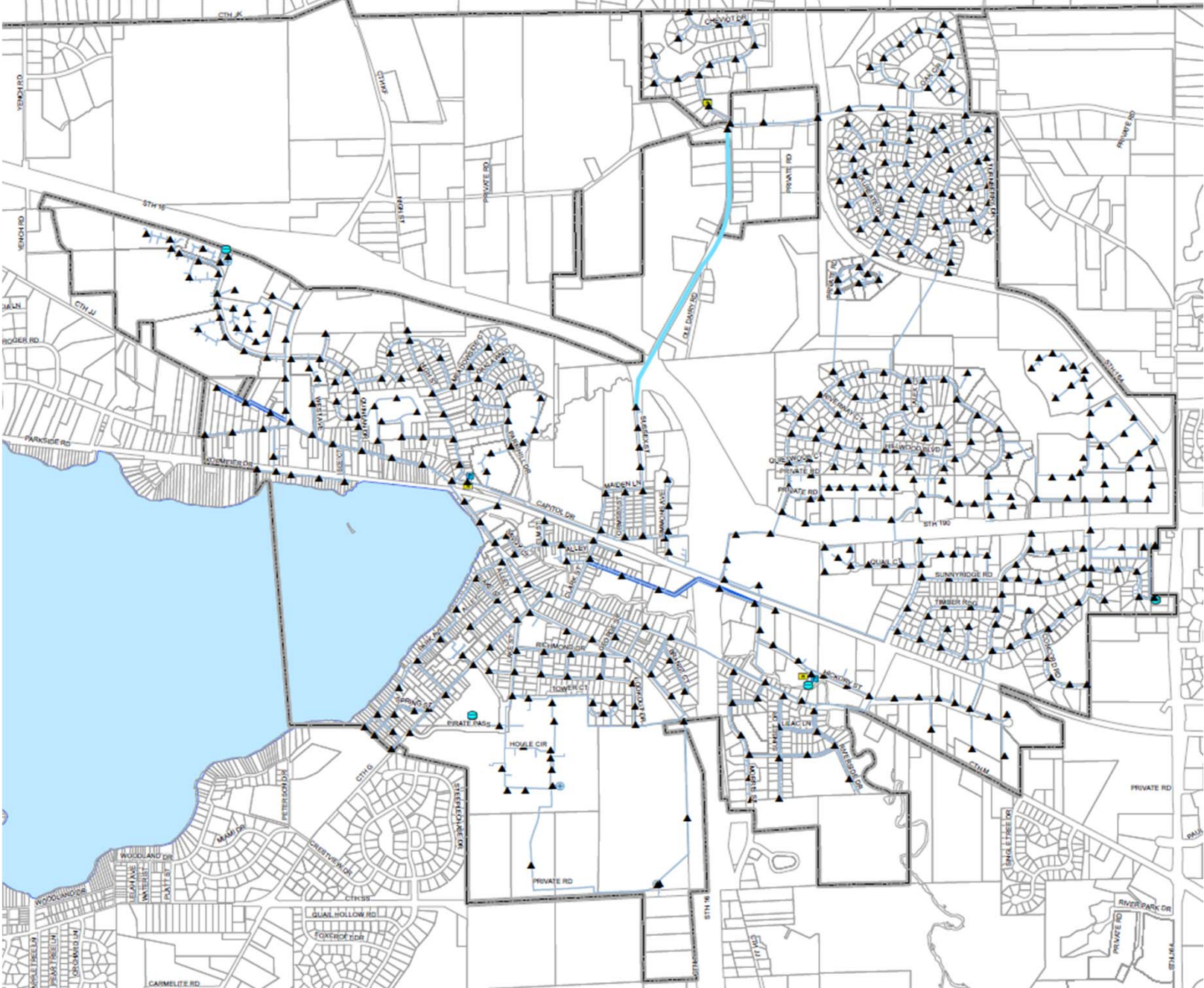
Subtotal Capacity Recommended (gallons)

Less Excess Available Reliable System Supply Capacity for Peak Hour⁶
 Repump Capacity from reservoir at Well 3⁷

Total Additional Capacity Recommended (gallons)

Water System	
2035	
	181,000
	630,000
	144,000
	955,000
	250,000
	200,000
	668,000
	1,118,000
	None
	6,000
	24,000
	None

Recommendations



Capital Improvements Plan

Short-Term Improvements (2022 – 2025)	Estimated Cost ^{2,3}
Distribution System Improvements	
Water Main Replacement E. Wisconsin Prospect to Maryknoll ⁴	\$ 440,000
Water Main Replacement Stone Ct. Briar Ct. Lexington Ct, Timber Ridge ⁴	\$ 15,000
Water Main Replacement Evergreen ⁴	\$ 285,000
Water Main Replacement Concord Road, Meadow Creek Ct. ⁴	\$ 10,000
Water Main Replacement Orchard Ave ⁴	\$ 170,000
Water Main Replacement Park Hill Drive ⁴	\$ 170,000
Water Main Replacement Glacier/Wisconsin West of Ryan ⁵	\$ 500,000
Well Rehab – Well 4, and Well 6 ⁴ .	\$ 290,000
Storage Facility Rehab -Quinlan, Well 3 Standpipe, Lake Street and Sunnyridge ⁴	\$1,190,000
Well 4 HMO Treatment	\$1,675,900
Subtotal	\$4,745,900
Engineering and Contingencies ¹	\$1,423,800
Total	\$6,169,700
Intermediate-Term Improvements (2026 – 2030)	
Distribution System Improvements	
Water Main Replacement Richmond Drive from Main St. to Lake St. ⁴	\$ 300,000
Water Main Replacement Prospect Ave from Main St. to Maple ⁴	\$ 100,000
Water Main Loop Capital -Celia-Quail Ct. ⁴	\$ 150,000
Water Main Replacement Main Street from Prospect to Village Limit ⁴	\$ 80,000
Water Main Replacement Hickory Street from Clark to Village Hall ⁴	\$ 100,000
Water Main Replacement Kopmeier Drive from Kopmeier Rd to east end ⁴	\$ 285,000
Water Main Loop Glacier to Capitol ⁴	\$ 175,000
Water Main Replacement Sussex Street from Maiden to 300 feet North ⁴	\$ 75,000
Water Main Replacement – Hickory Street (2,950 Feet 8-inch)	\$ 467,800
Booster Pump Station for customers on Tower Road	\$ 305,300
Well Rehab -Well 5, Well 3 and Well 2 ⁴	\$ 475,000
Subtotal	\$2,513,100
Engineering and Contingencies ¹	\$ 753,900
Total	\$3,267,000

Capital Improvements Plan

Long-Term Improvements (2031 – 2035)	
Distribution System Improvements	
Provide 10-inch on Sussex Street, crossing STH 16 to Lindsay Road (Approximately 4,600 feet of 10-inch diameter pipe)	\$ 1,062,600
Subtotal	\$1,062,600
Engineering and Contingencies ¹	\$340,100
Total	\$1,402,700
Footnotes:	
¹ Assumes 30 percent for engineering, administrative, legal, and contingencies.	
² Estimates do not include land purchase, if necessary.	
³ All costs are presented in 2022 dollars.	
⁴ Costs obtained from Village CIP for 2021 through 2030.	
⁵ Recommended for correcting existing deficiency, cost obtained from Village CIP for 2021 through 2030.	