VILLAGE OF SHELBY

OCEANA COUNTY, MICHIGAN

WATER SYSTEM RELIABILITY STUDY

October 2020
Project No. 837770

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

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I. EXECUTIVE SUMMARY

This report reviews the Village of Shelby water system facilities, capacities and needs through the year 2038. In addition, it provides a master plan for water system improvements to be implemented as the need arises and funding permits.

The system was evaluated in three categories: water supply, water storage and water distribution. In general, the system was found to meet the current daily demands and projected future demands with certain upgrades for reliability.

A. WATER SUPPLY

The Village's water system is supplied by four (4) ground water wells. In 1995 The Village voluntarily began a Wellhead Protection Program, which identifies where the water supply recharge area is located, educates the public about the water source and water system and identifies possible contaminant sources. The Village of Shelby completed and received program approval in 2001.

Well #1 is located along the east side of Industrial Park Drive, just north of Sixth Street and has a well capacity of 603 gpm. Wells #2 and #4 are located just north of Deming St with a well capacity of 302 gpm and 750 gpm respectively. Well #3 is located on the west side of Valley Avenue and has a well capacity of 500 gpm. Well #2 is currently not being used due to issues with the well screen.

The firm capacity is defined as the capacity delivered with the largest component out of service. Firm pump capacity for the Village is 1,405 gpm. The existing maximum day demand for the Village is approximately 169 gpm, and the 2023 and 2038 projected maximum day demands are 175 gpm and 186 gpm, respectively. The MDEQ recommends that a community plan for additional supply capacity when the maximum day demand reaches 80% of firm capacity.

The Village's water quality is good. The Village adds chlorine to water for disinfection at all its wells.

B. WATER STORAGE

The Village has two high-pressure districts in its water system located in the northeast and southeast corners of the Village limits. The northeast high-pressure district has a booster station on the corner of Cherry St and Lesada St. The southeast high-pressure district has a booster station on the west side of Valley St next to Well #3. These booster stations help regulate pressures in the higher elevations of the Village.

The Village has one elevated storage tank. The tank is located north of 6th St and east of Industrial Park Dr. Constructed in 1980, it has a capacity of 200,000 gallons. The tank is in good condition.

The Village's existing storage capacity of 200,000 gallons exceeds the average daily consumption on water per the State's requirements. The tank also has the capacity, combined with the firm well capacity, to meet commercial fire flow of 2,000 gpm for two hours. However, it is not sufficient to provide the industrial fire flow of 3,000 gpm for the recommended duration of three hours under existing and projected maximum day demands. If the Village desires to meet industrial fire flow requirements, additional storage or well capacity is recommended. An additional 150,000 gallons of storage (total of 350,000 gallons) would meet industrial requirements for a 3-hour duration with current well capacity.

C. WATER DISTRIBUTION

The Village currently has over 18 miles of watermain. One-third of the Village's distribution is composed of 4-inch or smaller water main and another one-third is composed of 8-inch watermain. It is recommended the Village replace all 4-inch or smaller watermains with 8-inch watermain.

D. RECOMMENDED IMPROVEMENTS

Short term and long term water distribution improvements are recommended with a total estimated cost of $5,300,000. Implementation of these projects should coincide with the Village's street improvements plan or master plan.

Each recommended improvement has an estimated cost associated with it. These costs are rough estimates to be used for budgeting purposes.

II. BACKGROUND AND PURPOSE

The Village of Shelby is centrally located in Oceana County, approximately 7 miles south of Hart off US-31. The Village has a type 1 (public) water supply and distribution system with four water production wells and one elevated storage tank.

The purpose of this report is to provide the Village with a comprehensive analysis of their current water system in order to comply with MDEQ and Act 399. The report evaluates the existing water supply, treatment, storage and distribution, and provides recommendations for improvements to improve overall system reliability and to serve the existing and future needs of the Village. This report is also intended to be a master plan for guiding the community on the overall future water system capital improvement needs to meet future daily water and fire flow demands.

III. EXISTING WATER SYSTEM

A. WATER SUPPLY

1. Ground Water Wells

The Village of Shelby obtains water from four (4) ground water wells all of which draw water from an aquifer located in glacial material.

Well #1 is located along the east side of Industrial Park Drive, just north of Sixth Street and has a well capacity of 603 gpm. Wells #2 and #4 are located just north of Deming St with a well capacity of 302 gpm and 750 gpm respectively. Well #3 is located on the west side of Valley Avenue and has a well capacity of 500 gpm. Table 1 summarizes the wells that supply the Village's system. Well #2 is currently not being used due to issues with the well screen.

The firm capacity is defined as the capacity delivered with the largest component out of service. Firm pump capacity for the Village is 1,405 gpm (Well 4 out of service). The existing maximum day demand for the Village is approximately 169 gpm, and the 2023 and 2038 projected maximum day demands are 175 gpm and 186 gpm, respectively. The MDEQ/EGLE recommends that a community plan for additional supply capacity when the maximum day demand reaches 80% of firm capacity.

TABLE 1
WELL SUMMARY

Well No.	Year Drilled	Diameter	Depth	Current Capacity	TDH
1	1957	12 inch	220 feet	603 gpm	252 feet
2 (Not Used)	1957	10 inch	144 feet	302 gpm	230 feet
3	1968	10 inch	333 feet	500 gpm	310 feet
4	2002	10 inch	275 feet	750 gpm	310 feet

Table 2 shows the amount of water that was pumped from each supply source in 2018.

TABLE 2
2018 WELL PRODUCTION LEVELS

Month	Well No. 1 (gallons)	Well No. 2 (gallons)	Well No. 3 (gallons)	Well No. 4 (gallons)	Total (gallons)
January	167,800	220,000	185,000	3,331,000	3,903,800
February	150,700	215,900	74,600	2,645,000	3,086,200
March	138,000	198,300	129,500	2,954,000	3,419,800
April	100,500	190,000	144,500	2,844,000	3,279,000
May	191,600	101,200	230,700	3,537,000	4,060,500
June	175,300	200,600	250,000	3,656,000	4,281,900
July	214,500	256,700	405,000	4,051,000	4,927,200
August	214,500	256,700	213,900	3,727,000	4,412,100
September	198,900	-	237,800	3,330,000	3,766,700
October	192,300	-	204,000	3,136,000	3,532,300
November	189,900	-	179,600	2,751,000	3,120,500
December	163,700	-	225,400	2,787,000	3,176,100
Totals	2,097,700	1,639,400	2,480,000	38,749,000	44,966,100

2. Water Treatment & Quality

   The Village of Shelby does not currently utilize any supplemental treatment. Well #4 is the only well/reservoir being treated with chlorine due to a bacti issue and is being recorded via Monthly Operating Reports.

   The most recent testing conducted reports that the contaminant levels were well below the state requirements. The metals and radiological testing performed in 2018 indicate that the water met the State drinking water standards.

   The Village tests for lead and copper every three years. Lead/copper levels met the MDEQ/EGLE action levels in the most recent testing in 2018 at 10 locations in the network. The Village is in compliance and the next round of testing is due in 2020.

3. Wellhead Protection

   The Village's wellhead protection plan was approved in 2001.

4. Auxiliary Power

   The Village has a 120 kW diesel generator located at Wells #2 and #4. The Village uses a mobile, trailer mounted diesel generator for auxiliary power at Wells #1 and #3 that is normally at Well #1 but can be moved to Well #3 as needed.

5. Emergency Response Plan

   The Village Emergency Response Plan (ERP) was updated in 2018.

B. DISTRIBUTION SYSTEM

1. Pipe Condition

The existing water distribution system was originally constructed in the 1930's and has been expanded throughout the years. The watermain ranges from 4 to 12 inches in diameter for primary distribution mains. Table 3 provides a breakdown of the water distribution system's watermain inventory by size.

TABLE 3
WATERMAIN INVENTORY

Watermain Size (inches)	Length (feet)	Percent of Total (%)
4	29,421	30.8%
6	21,796	22.8%
8	28,791	30.2%
10	15,036	15.8%
12	400	0.4%
Total:	**95,444**	**100.0%**

Service lines are 100% copper.

2. Booster Stations

The topography of the Village of Shelby has higher elevations to the east and lower elevations in the center of the Village running along State St.

The southeastern high-pressure district receives its water primarily from Well #3 located adjacent to the booster station on Valley St. It services Easter, Plum, Sessions, the eastside of Bennet, Rankin, east of Valley, and Ferry St east of Sessions Rd. This station was constructed in 2002 and contains two 30-HP pumps, each with a capacity of 700 gpm.

The northeastern high-pressure district receives its water primarily from Wells #2 and #4. The booster station for this district is located on the corner of Cherry St and Lesada St, servicing Orchard View, Sunset Terrace, Hillcrest, and Runner St. This station was constructed in 2002 and contains two 30-HP pumps, each with a capacity of 700 gpm.

Both stations have a bypass to maintain pressure in the event of a power outage. There are no flow meters at the stations, demands are measured through customer meters.

TABLE 4
BOOSTER STATION SUMMARY

Location	Pump #	Installation Year	Pump Capacity (gpm)	TDH	Storage (gal)	Range of Operation (psi)
Valley Ave	1	2002	700	115	7000	90 – 95
	2	2002	700	115		
Cherry St	1	2002	700	115	7000	90 – 95
	2	2002	700	115		

3. Cross Connection Control

The Village has an accepted cross-connection control program.

D. WATER STORAGE

1. Specifications

The Village of Shelby's water storage is provided by one elevated storage tank. The tank is a 200,000-gallon, single-pedestal spheroid type with a low water level at an elevation of 936.00 and maximum elevation of 965.30. The elevated tank is located north of 6th St and east of Industrial Park Dr and was installed in 1980. The tank is equipped with an altitude valve; however, it is currently not used. The original 165,000-gallon ground storage tank was located in the eastern part of the system at the end of Orchard View Dr but has recently been decommissioned due to cracks in the concrete structure.

2. Tank Maintenance

The 200,000-gallon tank was most recently inspected in May of 2019. The tank is inspected every five years with a visual inspection occurring twice a week. The tank is in good structural condition.

E. CONTROLS

1. Telemetry

Shelby's system uses a radio telemetry for communication between the tanks and booster stations to regulate tank levels and system pressures. The system is monitored by a SCADA system and operates automatically through the use of level sensors, level transmitters and station control panels. The pumps are in rotation so that the 1st pump is on at 22' and off at 27', the 2nd pump is on at 21' and off at 28', the 3rd pump is on at 20' and off at 26',and the 4th pump is on at 19' and off at 25'.

2. Alarms

When an alarm is tripped, the SCADA system is used to call the programmed phone numbers to notify system operators. The SCADA system is programmed to call, text, and email the on-call operator until the alarm is acknowledged and reset.

F. SYSTEM OPERATIONS

1. Operators

The Village currently has one operator with a S-3 certification for distribution and a D-3 certification for treatment. It is recommended that the Village maintain at least two fully certified operators on staff.

2. Meters

Meter reading and billing is performed by Village employees on a monthly basis. The Village uses radio read meters. There are currently approximately 708 meters in use.

3. Maintenance

The Village flushes hydrants in the Spring and Fall and turns valves in the Summer. The Village keeps records of maintenance activities performed.

4. Parts

The Village maintains spare parts for the system including pipes and valves, ¾-inch and 1-inch services (corp & curb stops, clamps and lines), and meters.

IV. WATER USE AND FIRE PROTECTION

A. WATER USE

1. Customers

The Village of Shelby water system currently serves 708 customers, consisting of roughly 91% residential and 9% commercial/industrial. Past water usage data is presented in Table 5 below. Peak hour demands are estimated based on a peaking factor of 5 times the average demand.

For the purposes of projecting water consumption, only water consumption data from 2018 & 2019 was considered. The in-ground storage tank was recently (2017) decommissioned due to cracks in the structure. It is believed that these cracks leaked a significant amount of water over time and once decommissioned, water usage decreased in 2017 and 2018 to what may be normal usage as presented in table 5 below.

TABLE 5
WATER USAGE

Year	Total Water Pumped (gal)	Average Day Demand (gpd)	Maximum Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Maximum Day Peaking Factor	Peak Hour Demand* (gpm)
2015	98,791,768	270,662	496,724	188	345	1.8	940
2016	92,670,320	253,891	506,700	176	352	2.0	880
2017	84,314,008	230,997	496,672	160	345	2.2	800
2018	44,966,000	123,195	243,000	86	169	2.0	430
2019	40,851,300	111,921	264,200	78	183	2.3	390

*Peak hour demand is calculated at 5 times the average day demand

2. Historical Water Loss

Water losses were observed to be between 28% and 4% between January 2017 and December 2018 as calculated by dividing the unbilled water by annual pumpage. The significant change in water loss for their system may be attributed to the change in water storage systems, but eh Village should continue to monitor the water billed vs. water pumped to determine the issue. Losses of 10-15% are common in drinking water systems which accounts for acceptable system leakage and routine hydrant flushing.

TABLE 6
WATER LOSS CALCULATIONS*

Year	Total Water Pumped (gal)	Total Water Billed (gal)	Water Used by Village (gal)	Total Unbilled Water (gal)	Unbilled Percentage
2018	44,966,000	31,919,400	303,800	12,742,800	28.3%
2017	84,314,000	80,303,900	114,300	3,895,800	4.6%

*Information based on Village billing records

3. Large Water Users

Table 7 shows the average monthly use for the system's largest water users. Using this data, the average daily use and average demand were derived. These water users represent approximately 14% of the Village's daily water use in 2019.

TABLE 7
LARGEST WATER USERS

Customer	Average Monthly Use (Gallons)	Average Daily Use (Gallons)	Average Demand (gpm)
Shelby Schools	317,027	10,423	7.24
Hospital – Mercy Health	237,053	7,900	5.5
Barnett Apts	63,393	2,084	1.45
367 6th St	46,999	1,545	1.07
NJ Fox and Sons	46,688	1,535	1.07

B. POPULATION PROJECTIONS

In many communities, projections for future water demands are based on population projections and historic per capita usage figures. Table 8 below shows the past, present and projected population. Historic population figures were obtained from the U.S. Census Bureau. The population growth has been steady over the last 50 years, averaging at a growth rate of over 0.41% per year. The Census populations from the past 50 years were used to project and estimate future growth.

TABLE 8
POPULATION PROJECTIONS

Year	Total Village Population	Basis
1960	1,603	Census
1970	1,703	Census
1980	1,624	Census
1990	1,871	Census
2000	1,914	Census
2010	2,065	Census
2018	2,023	Projection
2023	2,065	Projection
2028	2,109	Projection
2038	2,198	Projection

The customer type distribution and water usage data are listed below in Table 9 for planning purposes.

TABLE 9
CUSTOMER PLANNING DATA

Customer Type	Number of Connections	2017 Water Usage (Gallons)
Commercial	63	4,844,000
Residential	645	79,470,000
Totals	**708**	**84,314,000**

C. PROJECTED WATER DEMANDS

Projected water demands are calculated from the 2019 annual pumpage/usage report. For the purposes of this analysis, the amount of water used on a per capita basis is expected to remain consistent at 61 gpcd. This is taking the total Village water consumption and dividing it equally

on a per person per day basis. Table 10 shows the historical and projected average day demands. The maximum day peaking factor has an average around 2.0 over the last three years.

TABLE 10
PROJECTED WATER DEMANDS

	2023	2028	2038
Population	2,065	2,109	2,198
Average Usage (gpcd)	61	61	61
Average Day Demand (gallons)	125,965	128,649	134,078
Average Day Demands (gpm)	87.5	89.3	93.1
Max Day Peaking Factor	2.0	2.0	2.0
Maximum Day Demand (gallons)	251,930	257,298	268,156
Maximum Day Demand (gpm)	175	179	186
Peak Hour Peaking Factor	5.0	5.0	5.0
Peak Hour Demand (gpm)	437	447	466

D. FIRE PROTECTION

1. ISO Rating System

The Insurance Services Office (ISO) establishes suggested fire flow protection standards based on various factors including building construction type, area, height, type of development and density. These factors and others such as fire fighting capabilities, when combined, result in an ISO rating of between 1 and 10, 1 being the best and 10 being the worst. Insurance companies use this rating to determine appropriate insurance rates for their customers that live within the water service area. The Village of Shelby currently has an ISO rating of 5, which is based on an evaluation done by the ISO in 2017.

2. Recommended Fire Flows

The ISO establishes suggested fire flows at various locations throughout a community during its survey. It is not always cost-effective for a community to build a water system that meets all the suggested ISO fire flows. In such a situation, the community can choose to adopt target fire flow values. Table 11 below presents the suggested ISO fire flows and recommended target fire flow values. These recommended target fire flows were obtained from tabular values presented in the *"Fire Protection Handbook'*, the *"2000 International Fire Code"*, and the AWWA's Manual of Water Supply Practices – *"Distribution System Requirements for Fire Protection"*. It will be necessary for the Village to decide as to whether these recommended target fire flows provide the desired level of protection.

TABLE 11
ISO SUGGESTED AND RECOMMENDED TARGET FIRE FLOW VALUES AND DURATIONS

Classification	ISO Suggested Fire Flows @ 20 psi	Recommended Target Fire Flows @ 20 psi	Duration (Hours)
Residential	1,000 - 1,500	1,000	2
Commercial	2,000 - 2,500	2,000	2
Industrial	3,000	3,000	3
Institutional	3,500	3,500	3

3. Hydrant Flow Testing

Village staff, along with Fleis & Vandenbrink staff, performed fire hydrant flow tests throughout the system on November 7, 2018 to calibrate the model. See Figure 1 for a map of the system along with hydrant test locations. Table 12 provides the results of the fire hydrant tests used on model calibration.

The hydrant testing included 10 different testing locations. Two locations were measured to not have the desired 10 psi pressure difference between the Static and Residual pressures and were not included for calibration. Two other locations could not be calibrated within a +/- 10% tolerance of the measured flow.

The available fire flow amount at the minimum residual pressure of 20 psi was calculated using the following formula:

$$\text{AVAILABLE FIRE FLOW @ 20 psi} = \frac{\text{Hydrant Flow} * (\text{Static Pressure} - 20)^{0.54}}{(\text{Static Pressure} - \text{Residual Pressure})^{0.54}}$$

TABLE 12
AVAILABLE FIRE FLOW @ 20 PSI FOR SELECT LOCATIONS

Test Number	Test Location	Actual Hydrant Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Calculated Fire Flow @20psi (gpm)
1	Hydrant at corner of 72nd and Industrial Park	1,033	77	61	2,051
2	Hydrant at northern Village limits on State St	1,033	52	38	1,614
3	Hydrant at western Village limits on 6th St	1,124	79	67	2,656
4	SW corner of Lesada St and Cherry St	731	42	32	1,119
5	Just past western Village limits on 1st St.	992	48	32	1,342
6	Eastern Village limits on Ferry St	821	77	19	813

The results of the fire hydrant flow tests indicate that the Village's system provides adequate static pressures and fire flows over much of the system. All testing was completed with the pumps turned off.

V. EVALUATION OF SYSTEM CAPACITY

A. HYDRAULIC MODEL ANALYSIS

1. Model Description

In order to evaluate the water distribution system, a computer model was developed to simulate the existing system. The software used was WaterCAD version 8i developed by Bentley. The watermain sizes, configuration, friction factors, pump curves, topographic information, flow demands and storage tank data were input into the model to simulate the existing and proposed water distribution systems. Watermain friction factors were estimated based on values required to achieve model calibration to within ±10% of the calculated available fire flow at 20 psi residual for the test locations. Table 13 presents the comparison of the calculated available fire flow at 20 psi to the values obtained in the calibrated WaterCAD model for the test locations listed.

TABLE 13
COMPARISON OF CALCULATED FIRE FLOWS FROM FIELD MEASUREMENTS TO WATERCAD FIRE FLOWS

Test Number	Location	Available Fire Flow @ 20 psi (Calculated) (gpm)	Available Fire Flow @ 20 psi (WaterCAD) (gpm)	Difference Between Calculated & WaterCAD (%)
1	Hydrant at corner of 72nd and Industrial Park	2,051	1,849	9.9%
2	Hydrant at northern Village limits on State St	1,614	1,603	0.7%
3	Hydrant at western Village limits on 6th St	2,656	2,654	0.1%
4	SW corner of Lesada St and Cherry St	1,119	1,067	4.6%
5	Just past western Village limits on 1st St.	1,342	1,436	-7.0%
6	Eastern Village limits on Ferry St	813	835	-2.7%

2. Test Results

As the results of Table 13 show, the difference between the calculated available fire flow at 20 psi from hydrant testing and that predicted by the calibrated WaterCAD model is within a +/- 10% tolerance. Therefore, the model is an accurate approximation of the system.

3. Fire Flow Results

Fire flows were simulated throughout the existing system. The simulations were completed under existing firm capacity conditions. The elevated tank water levels were set at average operating depth. MDEQ/EGLE recommends a minimum of 20 psi residual pressure in the system at all times. This is to ensure that positive water pressure remains in the distribution system for customer use and to ensure safe water quality. All available fire flows reported are with a 20 psi residual. Table 14 below presents available fire flow at 20 psi under max day conditions for the existing water distribution system. These values were obtained by running the WaterCAD model under firm capacity conditions and target fire flow demands.

Figure 3 shows the system existing static pressure, and Figure 4 shows the existing available fire flow, expressed as contours, throughout the Village system for the 2019 maximum day demand.

TABLE 14
COMPARISON OF TARGET FIRE FLOWS TO WATERCAD FIRE FLOWS

Test #	Location	Recommended Target Fire Flow at 20 psi (gpm)	Available Fire Flow at 20 psi (WaterCAD) (gpm)	Difference between Target & Available (%)
1	Hydrant at corner of 72nd and Industrial Park	2,000	1,910	-5
2	Hydrant at northern village limits on State St	1,000	1,720	72
3	Hydrant at western village limits on 6th St	1,000	2,791	176
4	SW corner of Lesada St and Cherry St	1,000	2,936	194
5	Just past western Village limits on 1st St.	1,000	1,587	59
6	Eastern Village limits on Ferry St	1,000	921	-8

The available fire flows shown in Table 14 vary from the values shown in Table 13 for multiple reasons. In Table 13, the pumps were turned off for calibration, and in Table 14, only Well No.4 was turned off to model firm capacity conditions. Also, Table 14 shows the flows during the maximum day demands, while the calibration model portrays minimal flow conditions.

The recommended target fire flow can be met at 20 psi residual pressure for four of the tested locations. The other two locations (#1 and #6) show a deficit in available water supply under these conditions.

B. WATER SUPPLY

The MDEQ/EGLE recommends that the firm capacity of a community's water supply be greater than its maximum day demand. Currently, the firm capacity of the Village's water supply is 1,405 gpm and the 2019 maximum day demand was 183 gpm. Therefore, the existing firm capacity is sufficient for the current demands of the system. The MDEQ/EGLE recommends that communities plan to increase supply when maximum day demand reaches 80% of firm capacity. The projected maximum day demand of 186 gpm for 2038 is approximately 13% of firm capacity. The Village's water system would not require any additional supply source to cover daily water demands.

C. WATER STORAGE

Water storage requirements are dependent on both average use and emergency demands. For example, the recommended target fire flow for commercial areas is 2,500 gpm for two hours. To provide the required volume of water to combat a fire of this duration, 300,000 gallons of water would be used. Table 15 compares the volume of available water using firm pump capacity and the existing storage volume for each of the classifications of recommended target fire flows and fire flow durations for the existing maximum day demand.

TABLE 15
REQUIRED STORAGE CAPACITY FOR FIRE FIGHTING
(EXISTING MAXIMUM DAY DEMAND)

Classification	Desired Fire Flow @ 20 psi (gpm)	Duration (hr)	Existing Maximum Day Demand (gpm)	Total Flow Required (system outflow) (gpm)	Pump Flow (system inflow) (gpm)*	Net System Outflow (gpm)	Total Storage Required (gallons)	Existing Storage (gallons)	Addt'l Storage Required (gallons)
Residential	1,000	2	183	1,183	1,405	0		200,000	0
Commercial	2,000	2	183	2,183	1,405	778	93,360	200,000	0
Industrial	3,000	3	183	3,183	1,405	1,778	320,000	200,000	120,000
Institutional	3,500	3	183	3,683	1,405	2,278	410,000	200,000	210,000

* Firm pump capacity assumes Well #4 is out of service.

As the data in Table 15 shows, the Village does not have sufficient storage to meet the target fire flow requirements for fires classified above the commercial level. An industrial fire could be met for 2 hours and 30 minutes.

Although these tables show that the existing storage is low in terms of meeting desired fire flow, the storage capacity of the tank exceeds existing and future maximum day demands of the system. Increasing storage capacity excessively can result in low water turnover and ice control issues in a storage tank. We do not recommend additional storage at this time.

Table 16 shows the estimated storage needed for the future maximum day demand. The estimated change in storage needed over the next twenty years is minimal.

TABLE 16
REQUIRED STORAGE CAPACITY FOR FIRE FIGHTING
(2038 PROJECTED MAXIMUM DAY DEMAND)

Classification	Desired Fire Flow @ 20 psi (gpm)	Duration (hr)	Maximum Day Demand (gpm)	Total Flow Required (system outflow) (gpm)	Pump Flow (system inflow) (gpm)*	Net System Outflow (gpm)	Total Storage Required (gallons)	Existing Storage (gallons)	Addt'l Storage Required (gallons)
Residential	1,000	2	186	1,186	1,405	0	0	200,000	0
Commercial	2,000	2	186	2,186	1,405	781	93,720	200,000	0
Industrial	3,000	3	186	3,186	1,405	1,781	320,580	200,000	120,580
Institutional	3,500	3	186	3,686	1,405	2,281	410,580	200,000	210,580

* Firm pump capacity assumes Well #4 is out of service.

VI. RECOMMENDED IMPROVEMENTS

Table 17 provides a comparison of the future available fire flows to the recommended target fire flows after completion of the recommended improvements under the projected 2038 maximum day system demands. See Figure 4 for a map of recommended improvements projects.

TABLE 17
COMPARISON OF AVAILABLE FIRE FLOW TO TARGET FIRE FLOWS
AFTER COMPLETION OF RECOMMENDED IMPROVEMENTS

Test Number	Location	Recommended Target Fire Flow @ 20 psi (gpm)	2038 Available Fire Flow @ 20 psi (WaterCAD) (gpm)	Difference Between Target & Available (%)
1	Hydrant at corner of 72nd and Industrial Park	2,000	1,908	-5
2	Hydrant at northern Village limits on State St	1,000	2,208	121
3	Hydrant at western Village limits on 6th St	1,000	2,931	193
4	SW corner of Lesada St and Cherry St	1,000	2,768	177
5	Just past western Village limits on 1st St.	1,000	1,861	86
6	Eastern Village limits on Ferry St	1,000	1,511	51

Figures 5 and 6 show available fire flow under maximum day demand in 2023 and 2038, respectively. Individual recommendations with estimated costs associated in year 2020 dollars are as follows:

Short Term Improvements

1. Place 440 feet of 8-inch watermain connecting the south side of Northland Crossing to Sessions Road. $110,000

2. Place 430 feet of 8-inch watermain looping Sunset Terrace with 6th St and replace the 620 feet of 2-inch watermain with 8-inch watermain on Sunset Terrace to 6th St. $131,000

3. Drill new Well #2 at same location. $70,000

Short Term Improvements Total Cost: $311,000

Long Term Improvements

4. Replace all pipes from 1930's and 1940's with 8-inch watermain. $2,850,000

5. Replace the remaining 10,120 feet of 4-inch or smaller watermain with 8-inch watermain. $1,265,000

6. Install 200,000 gallon elevated storage tank to achieve desired Fire Flows $900,000

Long Term Improvements Total Cost: $5,015,000

TOTAL ESTIMATED COST OF ALL RECOMMENDED IMPROVEMENTS: $5,326,000

Costs are meant to be rough estimates for budgeting purposes only. They include appurtenances such as valves, hydrants, fittings, water services, restoration, engineering and contingencies. Approximate unit price estimates of $125 per foot for 8-inch watermain, assuming that the watermain can be placed outside the paved roadway and within the road right-of-way.

General Recommendations

Distribution system improvements are recommended to improve available fire flows and overall system reliability. These improvements should be considered and implemented by Village officials as deemed necessary and funding allows. Distribution improvements are shown in Figure 4.

- Continue to utilize a minimum of 8" watermain with looping whenever possible for interior networks to ensure that fire flow is not constricted within developments or along non-major mile roadways. Looping also improves reliability and water quality.

- Continue to document maintenance performed on the distribution system, both routine and emergency situations.

VII. FUNDING SOURCES

Six possible sources of funding have been identified to complete the recommended improvement projects if desired. A brief description of each follows:

Drinking Water Revolving Fund

This is a preferred alternative. It is a low interest loan program sponsored by the MDEQ/EGLE. The current interest rate is 2.5 percent, and some communities may be eligible for principle forgiveness under the Green Project Reserve funding if the project reduces system energy use or provides water conservation.

The program is competitive, and projects are scored on a point system that ranks them on a priority list. Not all projects submitted are funded so it is important to maximize points on the application. Requirements include a fairly extensive project plan, but most expenses, including the project plan, are eligible activities that can be rolled into the loan. In order for a community to be competitive, they should have a completed wellhead protection program. Applications are submitted by May 1st of every year.

USDA - Rural Utilities Service Grants or Loans

Rural Utility Service offers grants and loans for water improvements to communities with a low to moderate average household income. Since the Village's median average household income is not in the low to moderate range, it may be difficult to obtain grant dollars for a project. There are two types of loans available from RUS: direct loans and guaranteed loans.

Direct loans are only issued if the Village is unable to obtain funding from other sources at reasonable rates. The current interest rate is approximately 2.375 percent.

Guaranteed loans are made and serviced by lenders such as banks and savings and loan associations. Guarantees will not exceed 80 percent on any loss of interest and principal on the loan.

Special Assessment Bonds

Special assessments levied under PA 188 of 1954 are one of the most common ways to finance infrastructure improvements. The Village may levy special assessments against properties that receive special benefits from a public improvement. Property owners have petition rights that must be satisfied before the special assessment can go forward.

Special assessments typically can be repaid in installments with interest. The bonds may not exceed the amount of the special assessment roll, and may be secured secondarily by a pledge of the Village's full faith and credit.

Revenue Bonds

Revenue bonds are authorized by PA 94 of 1933. They authorize the Village to borrow money and issue bonds. They are paid from user fees generated by the operation of the improvements.

Revenue bonds are subject to the right of referendum. Petitions for a public vote can be filed by registered Village voters during a 45-day referendum period. Voter approval is not required if the referendum period expires without petitions being filed.

Contract Bonds

Contract bonds are authorized by several state laws. They authorize the Village to enter into an agreement with the County or a public authority in order to have the County or authority issue bonds on behalf of the Village.

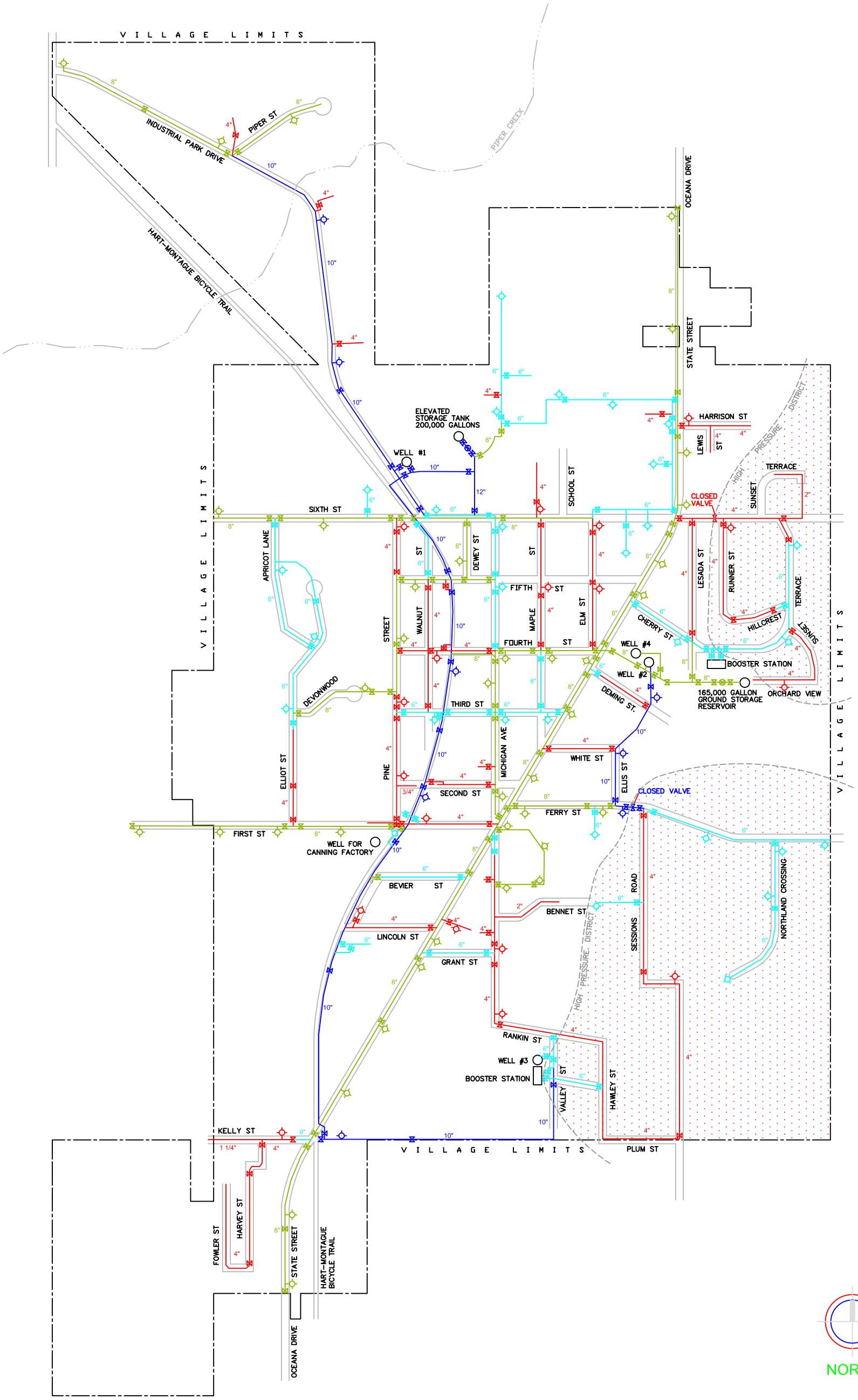
The Village may want to consider a contract bond as the County may be able to borrow at a more favorable rate than the Village if they are willing to pledge its taxing power as secondary security for repayment of the bonds. Also contract bonds may be paid back by a number of sources including: specials assessments, connection fees, and user fees.

Economic Development Administration (EDA) and Michigan Economic Development Commission (MEDC)

EDA and MEDC fund infrastructure improvements when a business or industry is interested in locating in a community that will need to provide infrastructure improvements to support the incoming industry.

As an example, if an industry wanted to locate in the Village where there is not currently watermain, or the watermain is undersized to serve the business, these organizations could assist in funding the improvements. Also, water supply and/or storage improvements could be funded with grant dollars if the improvements are necessary to support the new business.

EXISTING WATER SYSTEM



LEGEND

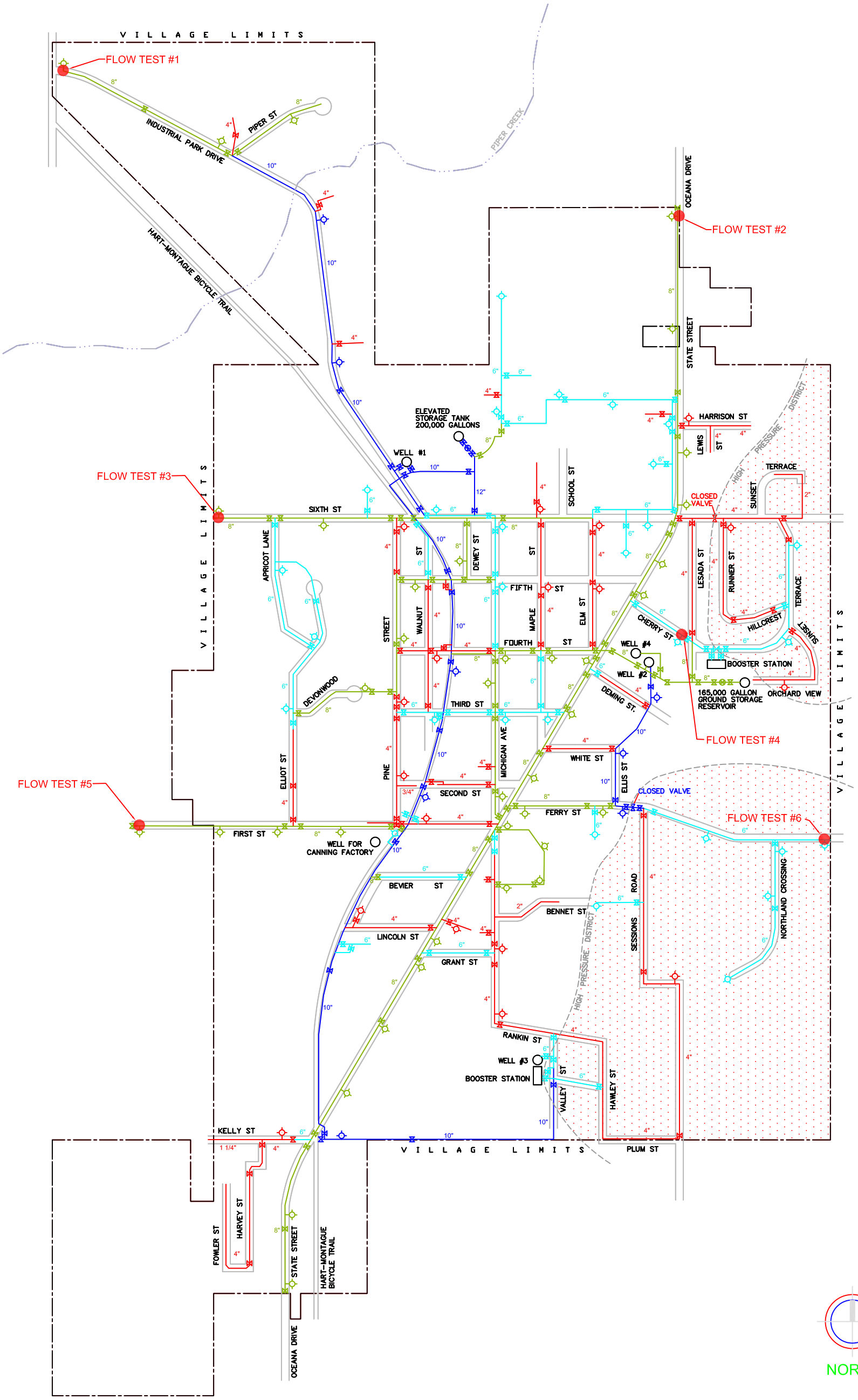
- 4" EXISTING 5" OR LESS WATER MAIN
- 6" EXISTING 6" WATER MAIN
- 8" EXISTING 8" WATER MAIN
- 10" EXISTING 10" OR LARGER WATER MAIN
- HYDRANT LOCATION
- ALTITUDE VALVE
- CLOSED VALVE
- CHECK VALVE
- GATE VALVE

VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 1

F&V PROJECT NO. 837770

HYDRANT FLOW TEST LOCATIONS



LEGEND

- EXISTING WATER MAIN
- HYDRANT LOCATION
- ALTITUDE VALVE
- CLOSED VALVE
- CHECK VALVE
- GATE VALVE

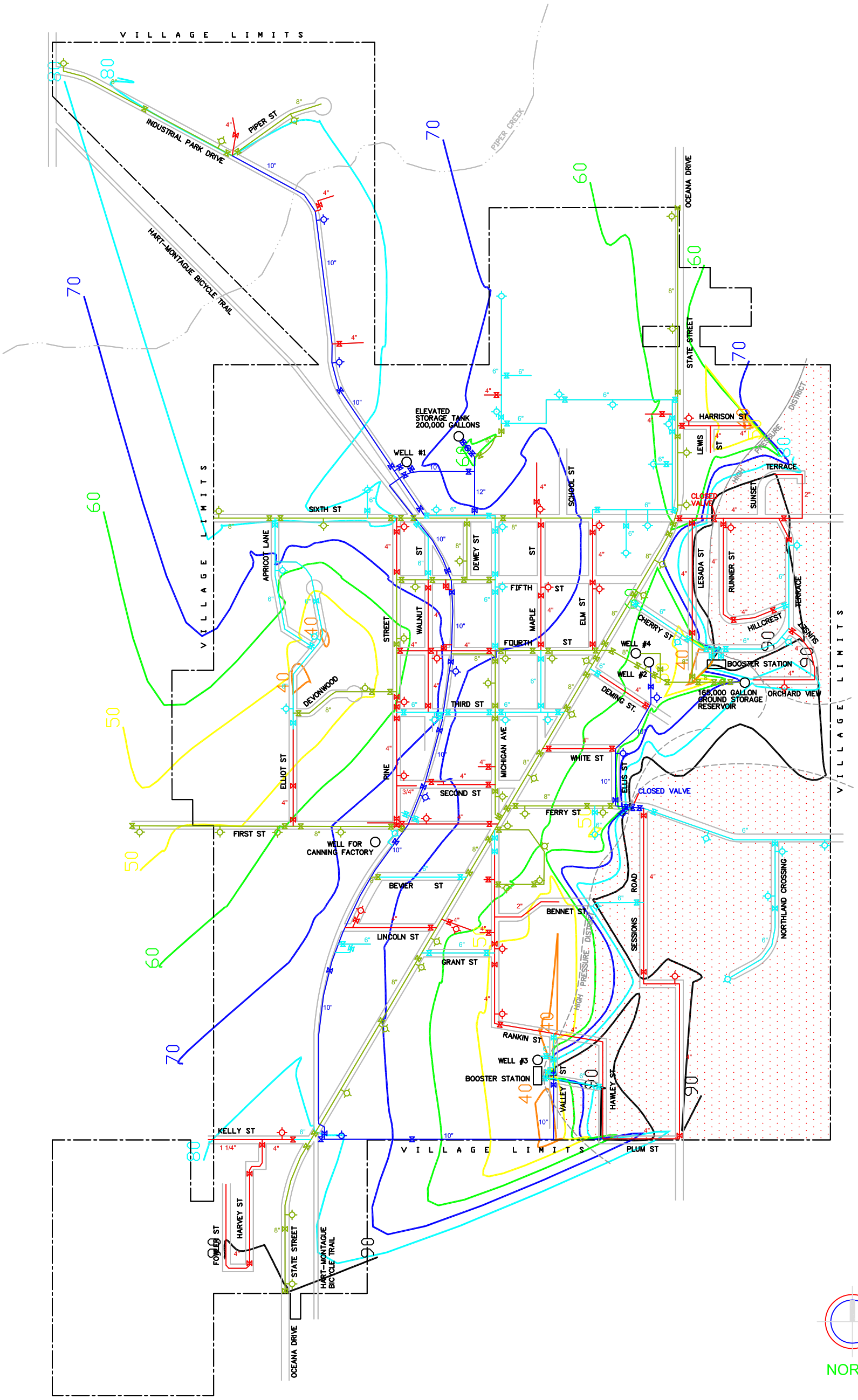
VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 2

F&V PROJECT NO. 837770

F&V

EXISTING STATIC PRESSURES



LEGEND

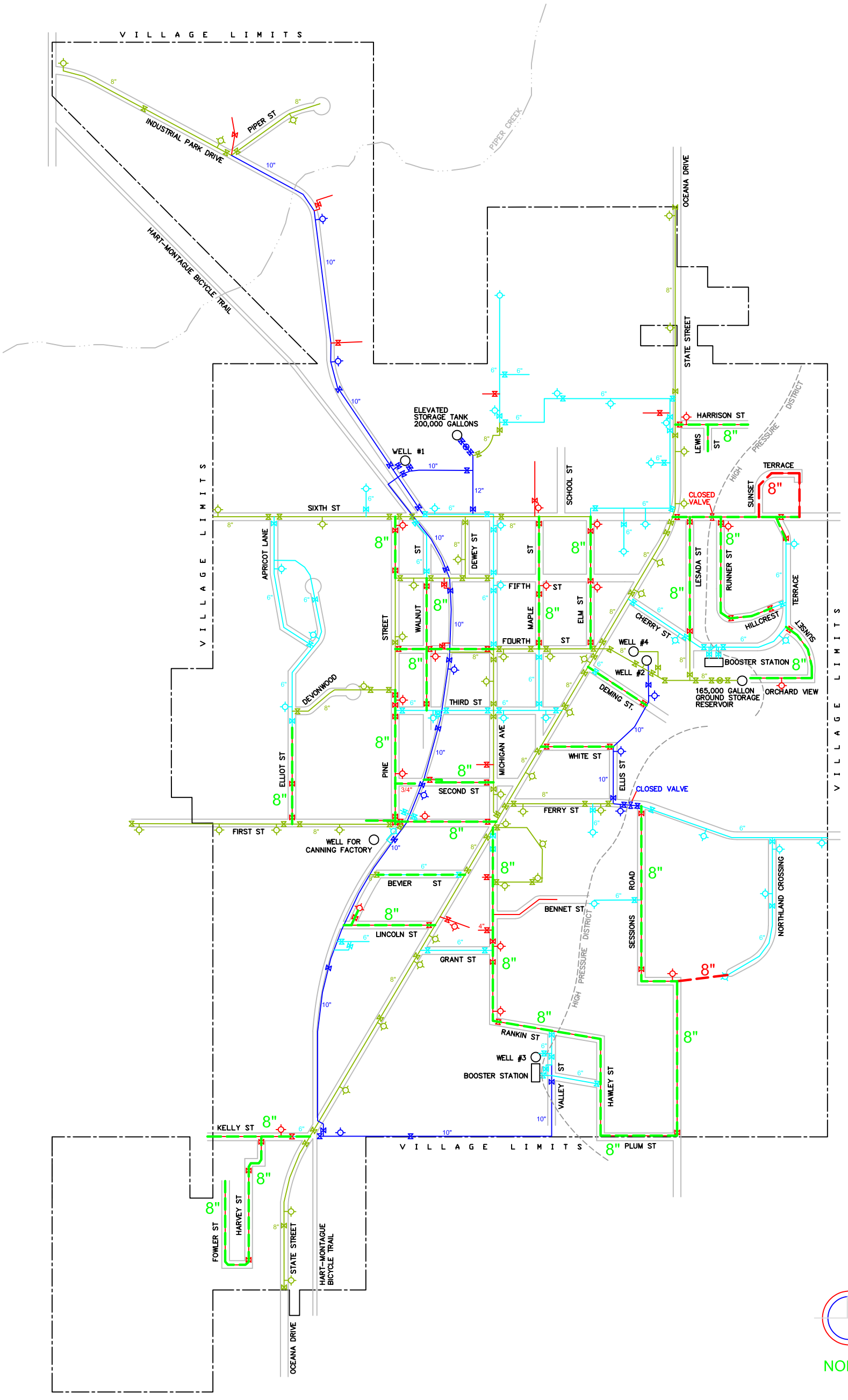
- 30 PSI
- 40 PSI
- 50 PSI
- 60 PSI
- 70 PSI
- 80 PSI
- 90 PSI

VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 3

F&V PROJECT NO. 837770

RECOMMENDED IMPROVEMENTS



LEGEND

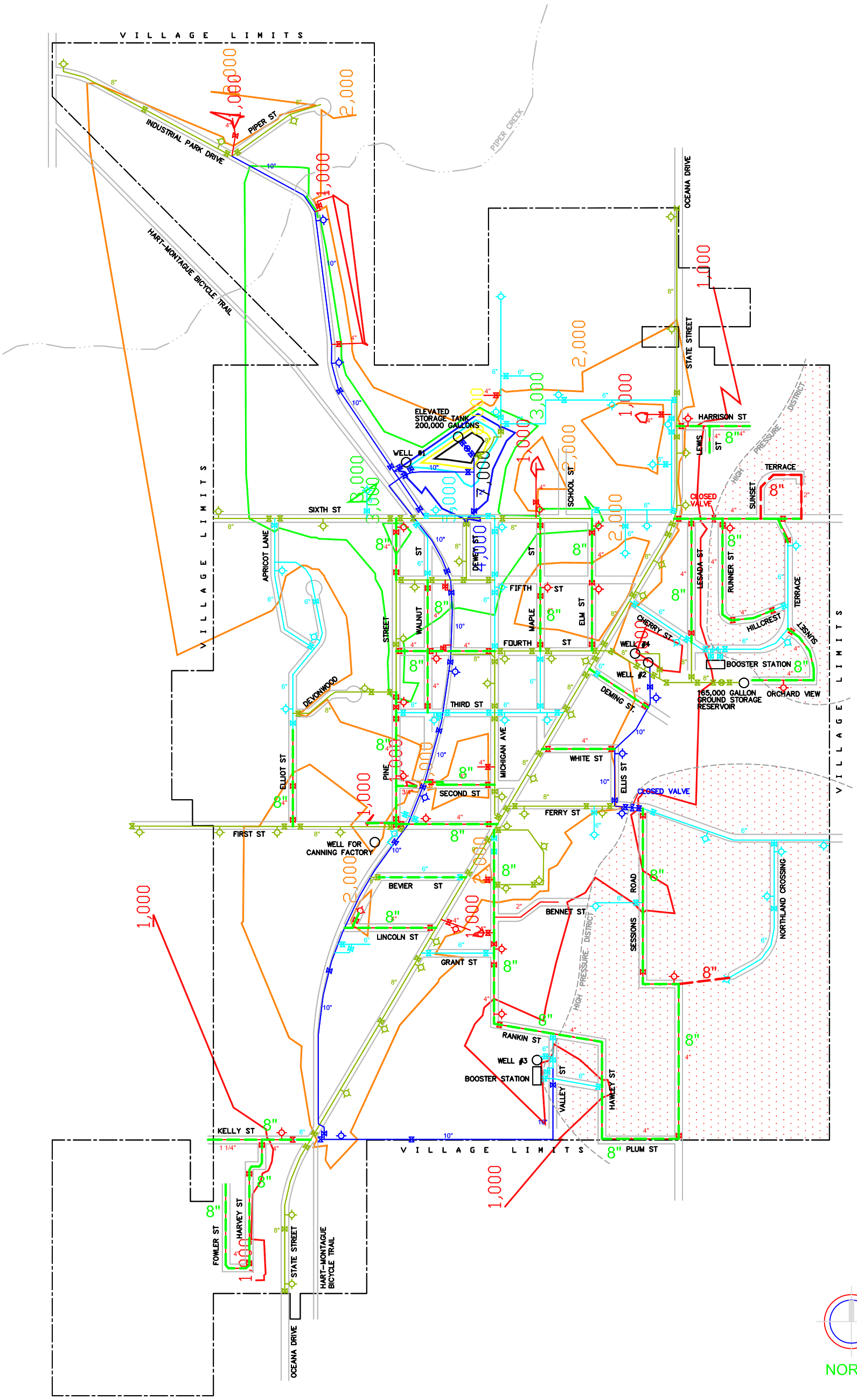
- EXISTING 5" OR LESS WATER MAIN
- EXISTING 6" WATER MAIN
- EXISTING 8" WATER MAIN
- EXISTING 10" OR LARGER WATER MAIN
- HYDRANT LOCATION
- ALTITUDE VALVE
- CLOSED VALVE
- CHECK VALVE
- GATE VALVE
- LONG TERM IMPROVEMENTS
- SHORT TERM IMPROVEMENTS

VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 4

F&V PROJECT NO. 837770

AVAILABLE FIRE FLOWS AT 20 PSI
MAX DAY DEMAND 2023
WITH SHORT TERM IMPROVEMENTS



LEGEND

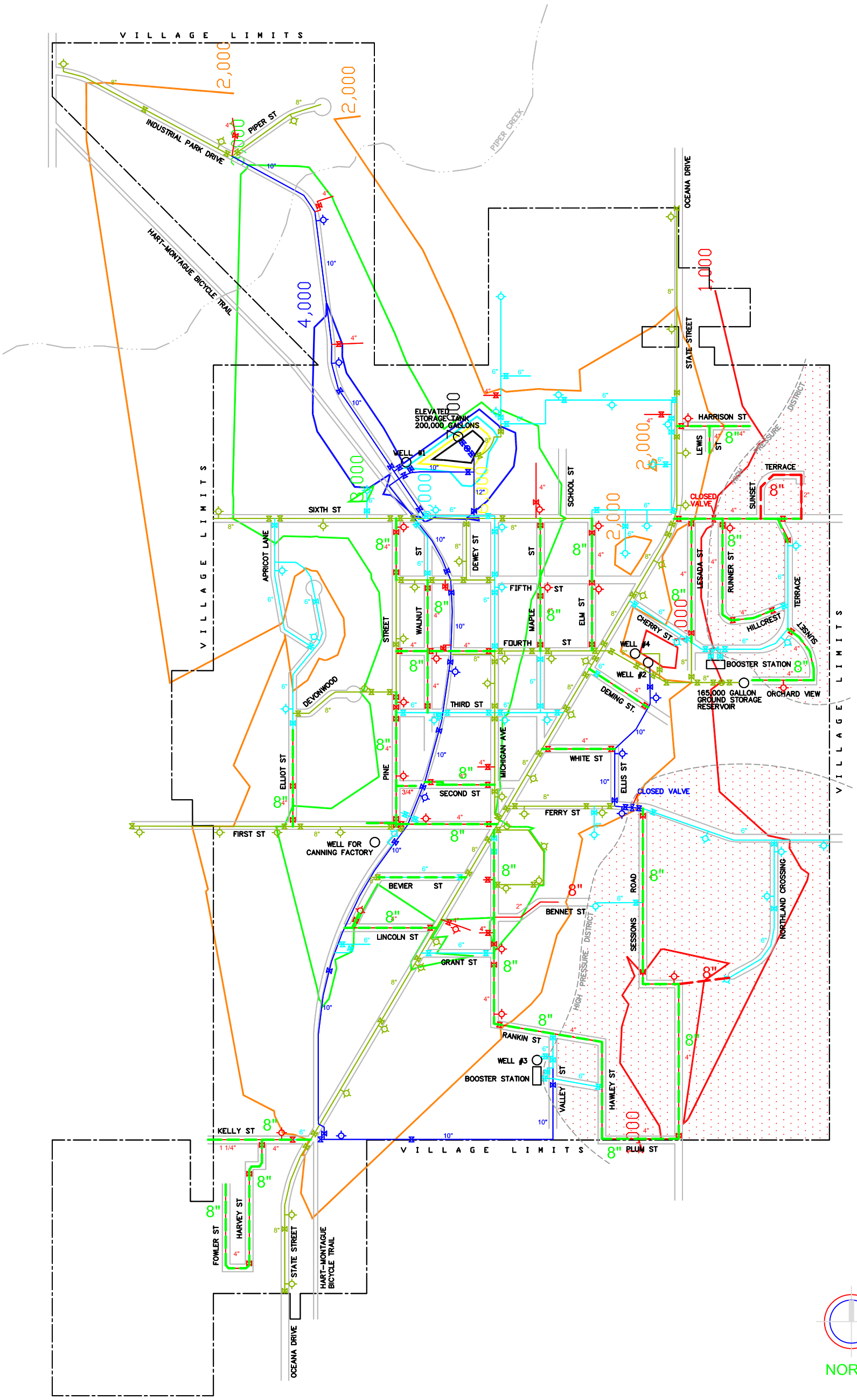
- EXISTING 5" OR LESS WATER MAIN
- EXISTING 6" WATER MAIN
- EXISTING 8" WATER MAIN
- EXISTING 10" OR LARGER WATER MAIN
- HYDRANT LOCATION
- ALTITUDE VALVE
- CLOSED VALVE
- CHECK VALVE
- GATE VALVE
- 1000 GPM
- 2000 GPM
- 3000 GPM
- LONG TERM IMPROVEMENTS
- SHORT TERM IMPROVEMENTS

VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 5

F&V PROJECT NO. 837770

AVAILABLE FIRE FLOWS AT 20 PSI
MAX DAY DEMAND 2038
WITH RECOMMENDED IMPROVEMENTS



LEGEND

- EXISTING 5" OR LESS WATER MAIN
- EXISTING 6" WATER MAIN
- EXISTING 8" WATER MAIN
- EXISTING 10" OR LARGER WATER MAIN
- LONG TERM IMPROVEMENTS
- SHORT TERM IMPROVEMENTS
- HYDRANT LOCATION
- ALTITUDE VALVE
- CLOSED VALVE
- CHECK VALVE
- GATE VALVE
- 1000 GPM
- 2000 GPM
- 3000 GPM
- 4000 GPM
- 5000 GPM
- 6000 GPM
- 7000 GPM

VILLAGE OF SHELBY
OCEANA COUNTY, MICHIGAN
WATER RELIABILITY STUDY

FIGURE 6

F&V PROJECT NO. 837770

316 Morris Avenue, Ste. 230
Muskegon, MI 49440
P: 231.726.1000
F: 231.726.2200
www.fveng.com