CITY OF BELDING
IONIA COUNTY, MICHIGAN

Water System Reliability Study

JULY 2007

Project No. 14893

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I. EXECUTIVE SUMMARY

This report reviews the City of Belding water system facilities, capacities, and needs through year 2017. 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, but has deficiencies with respect to fire flow demands in some areas served by dead-end or 4-inch watermains.

A. WATER SUPPLY & TREATMENT

The City is currently supplied by four wells, labeled No. 1, 2, 4, and 5. All wells are in regular service. The firm capacity is defined as the capacity delivered with the largest well out of service. The City has a firm capacity of 2,703 gpm with Well No. 4 out of service. The MDEQ requires the firm capacity of any water supply system meet or exceed the maximum day demands placed on the system. The existing maximum day demand is 2,028 gpm, which is 75% of the system's firm capacity. It is recommended that the City begin planning for additional source water capacity when the maximum day demand meets or exceeds 80% of the system's firm capacity. Further planning should also include the replacement of Well No. 2, which is near the end of its service life at 66 years old.

B. WATER STORAGE

Two elevated storage tanks currently supply water pressure and emergency storage for the City water customers with a total capacity of 1,000,000 gallons. The north tank is located in the northeast area of the City at Martha Street, and the south tank is located in the southeast area of the City on Hall Street, as shown in Figure 1. The north and south tanks were last inspected in 2005 and 2002, and the interiors repainted of both tanks have recently been repainted. The inspection report recommended that the exterior of the north tank should be repainted and the exterior of the south tank be pressure washed and recoated. The addition of a cathodic protection system is also recommended for the south tank in addition to other improvements.

The current tank capacity is capable of meeting the fire flow demands of a 3,000gpm fire flow for the recommended duration of 3 hours during the 2017 maximum day demands and firm well capacity flows. The need for additional storage capacity is not anticipated within the planning period.

C. WATER DISTRIBUTION

The water distribution system contains approximately 15% of 4-inch or smaller waterlines. It is recommended that the City plan on replacing these lines as road improvements are conducted on these streets. This is mainly due to problems associated with providing adequate fire flows through 6-inch or smaller lines.

D. RECOMMENDED IMPROVEMENTS

This report recommends improvements to the City's water system broken into short, medium and long-range projects for planning purposes. The improvements are primarily upgrades and replacements in the distribution system, maintenance of the storage tanks, and two new wells.

II. BACKGROUND AND PURPOSE

The City of Belding is located in the northwest corner of Ionia County in Southwest Michigan. Belding has a type 1 (public) water supply and distribution system with four water production wells and two elevated storage tanks.

The purpose of this report is to provide the City with a comprehensive analysis of their 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 serve the existing and future needs of the City. This report is intended to be the master plan for guiding the community on the overall future water system capital improvement needs to meet future daily water and fire flow demands.

The study and service area includes the City of Belding and a section of Otisco Township along M-91, southwest of the City limits. The service area is located in part of sections 2, 3, 4, 9, 10, 11, 12, 14, 15 and 16 of Otisco Township.

The Contingency Plan for the system was last updated in January of 2005 and should be revised with any changes in key personnel.

III. EXISTING WATER SYSTEM

A. WATER SUPPLY

1. Wells

The City of Belding water supply system currently consists of four wells. The wells are designated as Wells No. 1, 2, 4, and 5. Wells No. 1, 2, and 4 are located on the west side of the City. Well No. 2 is located near N. State Street and Kenwood Avenue, Well No. 4 is near Elm Street and Garfield, and Well No. 1 is near High Street and N. State Street. Well No. 5 is located on the east side of the City, near the corner of York Street and Reed Street. Table 1 summarizes selected data of each well and pump.

TABLE 1
WELL SUMMARY

Well Number	Year Drilled	Diameter (inch)	Depth (feet)	Rated Capacity @ TDH	Current Capacity @ TDH
1	2003	16	126	900gpm @ 280 ft.	910gpm @ 277 ft.
2	1941	18	105.5	1000gpm @ 242 ft.	948gpm @ 255 ft.
4	1989	16	121	1000gpm @ 238 ft.	1090gpm @ 228 ft.
5	1976	12	181	845gpm @ 357 ft.	845gpm @ 340 ft.

The wells were last inspected March 13, 2006 by Peerless-Midwest, Inc. The firm capacity is calculated by removing the capacity of the largest pump from the system. The pumping capacity that remains is the firm capacity. The City of Belding has a rated firm capacity of 2,745 gpm. The current firm pumping capacity is slightly less at 2,703 gpm (Well No. 4 out of service).

2. Well Houses

Well House No. 1 is located near High Ave. and N. State St. on the west side of the City. The well house was constructed in 2003 out of masonry block and is in good condition.

Well House No. 2 is located near N. State St. and Belhaven Ave. on the west side of the City. The well house was constructed with a vinyl siding exterior and is in good condition.

Well House No. 4 is located near Elm St. and Garfield St. on the west side of the City. The well house was constructed out of masonry block and is in good condition.

Well House No. 5 is located near Reed St. and York St. on the east side of the City. The well house was constructed out of masonry block and is in fair condition.

3. Water Treatment & Quality

The City utilizes a few different methods of treatment. Raw water is disinfected with chlorine gas at each well, and phosphate and fluoride are also added at all of the wells.

The City regularly tests the water quality of its wells and throughout the system per MDEQ requirements. There is testing done monthly for bacteria, yearly for partial chemical and every 9 years for metals analysis. The tests taken at the wells in 2004 reported that the contaminant levels were generally well below the state requirements. The water quality test taken in 2004 reported that the water met the State drinking water standards with arsenic levels of .002 mg/L or lower at each well, well below the new MCL of 0.010 mg/L. The City's water iron content is as high as 0.6 mg/L at the wells, and the City sequesters the iron with the addition of a polyphosphate.

The City tests for lead and copper on a triennial basis. Lead/copper levels met the MDEQ action levels in 2004. The City is in compliance, with the next round of testing due in 2007.

4. Wellhead Protection

The City has an approved wellhead protection plan based on delineated wellhead areas that was approved in 2000, and Belding has completed a substantial amount of work on the wellhead protection plan. Progress includes the delineation of Well 1 and the identification and abandonment of residential wells within the City. Revisions were also made to the City's master plan to limit developmental impacts on the water supply.

5. Auxiliary Power

Wells No. 2 and 4 are powered during emergencies by a common 180 kW diesel portable generator. A Detroit Diesel Allison diesel auxiliary motor powers Well No. 5, and a 200 kW diesel generator powers Well No. 1. Both the generator and auxiliary motor for Wells 5 and 1 are permanent and exclusive to the water system.

B. DISTRIBUTION SYSTEM

1. Pipe Condition

A majority of the City of Belding water distribution system is composed of cast iron watermain (80%). The remainder of the distribution system is ductile iron (20%). Table 2 provides a breakdown of the water distribution system's watermain inventory by size. Services lines are approximately 50% copper and 50% galvanized. It is recommended that the City replace galvanized services as they are identified, since they are less reliable than newer copper services.

TABLE 2
WATERMAIN INVENTORY

Watermain Size (inches)	Length (feet)	Percent of Total (%)
4	30,480	15.2
6	68,740	34.2
8	49,120	24.5
10	2,640	1.3
12	48,450	24.1
16	1,500	0.7
Total:	**200,930**	**100.0**

2. Low Flow Areas

As shown in Table 2 a portion of the existing system is composed of 4-inch watermain. As seen in Figure 1, there are very few areas fed by dead-end watermains. For these reasons, the City does not appear to have many serious low flow areas. The low flow areas are primarily limited areas served by dead-end or 4-inch watermains.

C. WATER STORAGE

1. Specifications

The City of Belding currently has two 500,000-gallon single-pedestal elevated tanks that supply water storage for the system. The north tank is located in the northeast area of the City at Martha Street, and the south tank is located on the southeast area of the City on Hall Street, as shown in Figure 1. The north tank is 154 feet tall with a head range of 37.5 feet, and the south tank is 115 feet tall with a head range of 37.5 feet.

2. Tank Maintenance

The north tank was constructed in 1997, painted in 1998 and has a cathodic protection system installed. The tank was last inspected in 2005 by Dixon Engineering, Inc. The inspection report recommended that safety grabs be installed on the interior roof for fall protection of workers during wet interior painting. The report also indicated that the interior and exterior coating systems is are good condition, but that the City should begin budgeting for a repainting the exterior project in 4-6 years with a cost of roughly $78,000.

The south tank was constructed in 1969, painted on the exterior in August 1993, and the interior was painted in 2004. The tank was last inspected in 2002 with an interior warranty inspection in 2005 by Dixon Engineering, Inc. The inspection report recommended that the exterior of the tank be pressure washed and recoated within three to five years at a $57,500 cost for both operations. The report also indicated the need for a floating ring cathodic protection system with an approximate cost of $14,000. Further recommendations included the installation of cathodic clips and couplings, a new condensate drain line, a frost-free vent, and a screened flap valve on the overflow pipe, which the City has completed. Maintenance recommendations included cleaning and

painting the pit piping, maintaining the expansion joint, and welding platelets over the cathodic lift holes.

D. CONTROLS

1. Telemetry

The City uses a radio telemetry system. This provides communication from the wells to the tanks to turn the wells on and maintain the water level in the tanks.

E. SYSTEM OPERATIONS

1. Operators

The Belding water system is classified as S-2/D-2. The City has one operator with an S-2/D-2 license and one with a D-1 License. MDEQ recommends that public water systems have a minimum of two certified people on staff to operate the system. The City should make an effort to maintain two fully certified operators on staff.

2. Meters

Water Department employees perform meter reading on a quarterly basis. The City uses Sensus meters with touch pads. The meters throughout the City have all been updated in the last 12-15 years. The system currently serves 1,788 customers.

3. Maintenance

The City does not have a formal valve-turning program in place, but usually turns the primary valves during flushing and the others every 4-5 years. It is recommended that all mainline valves be exercised annually and detailed records be kept. Hydrants are flushed biannually with records maintained.

4. Parts

The City stocks spare parts for the major items in the system. Some of the parts include: extra main sections, repair clamps, hydrants, valves, fittings and services. The City utilizes several reliable local suppliers for any parts not in the inventory.

IV. WATER USE AND FIRE PROTECTION

A. WATER USE

1. Customers

The City of Belding water system currently serves 1,788 customers, consisting of roughly 8% commercial/industrial and 92% residential. Past water usage data is presented in Table 3 below.

TABLE 3
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
2000	596,550,000	1,630,000	3,369,000	1,132	2,340	2.1
2001	654,150,000	1,788,000	3,314,000	1,242	2,301	1.9
2002	614,300,000	1,681,000	3,196,000	1,167	2,219	1.9
2003	602,530,000	1,647,000	3,049,000	1,144	2,117	1.9
2004	605,960,000	1,655,000	4,180,000	1,149	2,903	2.5
2005	659,950,000	1,805,000	3,953,000	1,254	2,745	2.2
2006	491,850,000	1,346,000	2,920,000	935	2,028	2.2

* Includes high usage days caused by hydrant flushing, tower outages, etc.

2. Historical Water Loss

Unbilled water pumpage amounted to approximately 8% in 2005. When the estimated volume of water used for flushing and other routine maintenance uses is subtracted, the water loss due to leakage is estimated to be approximately 3%.

3. Large Water Users

Table 4 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 9.8% of the City's daily water use between 2000 and 2006.

TABLE 4
LARGEST WATER USERS

Customer	Average Monthly Use (Gallons)	Average Daily Use (Gallons)	Average Demand (gpm)
Indian Summer	1,745,433	57,384	39.9
Extruded Metal	1,480,151	48,662	33.8
Wonderland Ice	1,190,074	39,126	27.2
Belding Schools	114,825	3,775	2.6
Wellington Trailer Park	107,900	3,547	2.5
Spectrum Industries	75,600	2,485	1.7
Jacklyn Apartments	61,083	2,008	1.4
Metron Nursing Home	56,592	1,861	1.3
Richardson Mill Apt.	28,825	948	0.7
Car Lovers Car Wash	22,725	747	0.5
Hillside Finishing	15,533	511	0.4

B. POPULATION PROJECTIONS

The projected 10-year water demand for the City was estimated using the past and present population numbers obtained from the U.S. Census Bureau. The population of Belding has increased at a rate of approximately 0.67% per year between 1900 and 2000. Since the population decreased slightly between 1990 and 2000, a lower rate of 0.5% per year is used for projections. This results in a 2010 population of 6,178 and a 2017 population of 6,397. Table 5 below shows the past, present and projected population.

TABLE 5
POPULATION PROJECTIONS

Year	Population
1900	3,283
1910	4,119
1920	3,911
1940	4,089
1950	4,436
1960	4,887
1970	5,121
1980	5,699
1990	5,969
2000	5,877
2010	6,178
2017	6,397

C. PROJECTED WATER DEMANDS

The projected water demands for the 10-year study period were calculated using projected population and the current average usage per capita. Table 6 shows the current per capita water usage.

TABLE 6
PER CAPITA WATER USAGE

Year	Average Day Demand (gpd)	Estimated Population	Average Day Demand (gpcd)
2000	1,630,000	5,877	277
2001	1,788,000	5,906	303
2002	1,681,000	5,936	283
2003	1,647,000	5,966	276
2004	1,655,000	5,995	276
2005	1,805,000	6,025	300
2006	1,346,000	6,056	222

The amount of water used on a per capita basis has averaged approximately 285 gpcd, but in 2006, two of Belding's largest water users chose to use private water supplies. A conservative estimate of 275 gpcd will be used for analysis to reflect the change in demand. Since 2000, the maximum peaking factor (maximum day demand divided by average day demand) was 2.5 in 2004 and has averaged approximately 2.1 over the last 7 years. A maximum day peaking factor of 2.5 is used in this report to estimate future maximum day demands to account for a moderate unnatural water requirement during maximum usage conditions. Table 7 shows the projected water demands.

TABLE 7
PROJECTED WATER DEMANDS

	2010 (Estimate)	2017 (Estimate)
Population	6,178	6,397
Average Usage (gpcd)	275	275
Average Day Demand (gallons)	1,698,950	1,759,175
Average Day Demand (gpm)	1,180	1,222
Peaking Factor	2.5	2.5
Maximum Day Demand (gallons)	4,247,375	4,397,938
Maximum Day Demand (gpm)	2,950	3,054

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. This rating is used by insurance companies to determine appropriate insurance rates for its customers that live within the water supply system. The City of Belding currently has an ISO rating of 4. The current rating is based on an evaluation done in August of 2006.

2. Recommended Fire Flows

The ISO establishes suggested fire flows at various locations throughout a community during a survey. It is not always cost-effective for a community to build a water system that meets all of the suggested ISO fire flows. In such a situation, the community can choose to adopt target fire flow values. Table 8 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 City to decide as to whether these recommended target fire flows provide the desired level of protection.

TABLE 8
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	1,500	1,000	2
Commercial	2,500	2,500	2
Industrial	3,000	3,000	3
Institutional	3,500	3,500	3

3. Hydrant Flow Tests

Fleis & VandenBrink Engineering and City staff performed fire hydrant flow tests at select locations throughout the system (See Figure 2) on September 14, 2006 in order to obtain information used in calibration of the WaterCAD hydraulic computer model. Table 9 provides the results of the fire hydrant tests. 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 9
AVAILABLE FIRE FLOW @ 20 PSI FOR SELECT LOCATIONS

Test Number	Location	Actual Hydrant Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Calculated Fire Flow @20psi (gpm)
1	South of Ellis Street on M-91	992	60	52	2,370
2	Deodara Drive near Balsa Drive	1,045	57	54	4,060
3	West of Orchard Street on M-44	826	60	56	2,870
4	Blaine Avenue at Irving Street	1,012	58	52	2,750
5	Liberty Street at Front Street	716	80	76	3,100
6	East end of Crooks Street	826	71	29	920
7	West of Howe Street on Merrick Avenue	640	70	59	1,450
8	Liberty Street at Pearl Street	506	73	70	2,390

The results of the fire hydrant flow tests indicate that the City's system provides adequate static pressures and fire flows over a majority of the system. Test Number 6 is located on one of the few dead-end mains in the system and on a 4-inch watermain with limited fire flow capability in the area. Figure 3 shows the static pressures for the City's water system.

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 6.0 developed by Haestad Methods. The watermain sizes, configuration, friction factors, well 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 10 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 10
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	South of Ellis Street on M-91	2,366	2,217	6.3%
2	Deodara Drive near Balsa Drive	4,058	3,681	9.3%
3	West of Orchard Street on M-44	2,864	2,632	8.1%
4	Blaine Avenue at Irving Street	2,742	2,697	1.6%
5	Liberty Street at Front Street	3,090	3,080	0.3%
6	East end of Crooks Street	917	923	-0.6%
7	West of Howe Street on Merrick Avenue	1,450	1,348	7.0%
8	Liberty Street at Pearl Street	2,386	2,269	4.9%

2. Test Results

As the results of Table 10 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 recommends a minimum of 20 psi residual pressure in the system at all times. This is to ensure the 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 pressure. Table 11 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 5 shows the existing available fire flow, expressed as contours, throughout the City for the existing maximum day demand.

TABLE 11
COMPARISON OF TARGET FIRE FLOWS TO WATERCAD FIRE FLOWS

Test Number	Location	Recommended Target Fire Flow @ 20 psi (gpm)	Available Fire Flow @ 20 psi (WaterCAD) (gpm)	Difference Between Target & Available (%)
1	South of Ellis Street on M-91	1,000	1,913	91%
2	Deodara Drive near Balsa Drive	1,000	3,270	227%
3	West of Orchard Street on M-44	2,500	2,252	-10%
4	Blaine Avenue at Irving Street	1,000	2,374	137%
5	Liberty Street at Front Street	1,000	2,875	188%
6	East end of Crooks Street	1,000	853	-15%
7	West of Howe Street on Merrick Avenue	1,000	1,242	24%
8	Liberty Street at Pearl Street	2,500	2,082	-17%

The available fire flows shown in Table 11 vary from the values shown in Table 10 for multiple reasons. In Table 10, the wells were turned off for calibration, and in Table 11, Wells 2, 5, and 6 were operating to model firm capacity conditions. Additionally, the water levels in the tanks were set at the average operating level for Table 11, which are lower than the levels used in Table 10. Finally, Table 11 shows the flows during the maximum day demands, while the calibration model portrays minimal flow conditions.

In five of the test locations, the recommended target fire flow can be met at 20psi residual pressure. The other three locations (#3, #6, and #8) show a deficit in available water supply under these conditions.

B. WATER SUPPLY

The MDEQ recommends the firm capacity of a community's water supply be greater than the maximum day demand. Currently, the firm capacity of City's water system is 2,703 gpm and the existing maximum day demand is 2,028 gpm. The projected maximum day demand in 2017 is 3,054 gpm. It is recommended that the City plan to add an additional well source within the next 5 years or before demand reaches 80% of the firm capacity of the system. Well No. 2 is also reaching the end of its service life, since it is 66 years old. We also recommend that the City plan for its replacement within 5 to 10 years.

C. WATER STORAGE

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 12 compares the volume of available water using current firm well 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 12
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)	Well Flow (system inflow) (gpm)	Net System Outflow (gpm)	Total Storage Required (gallons)	Existing Storage (gallons)	Addt'l Storage Required (gallons)
Residential	1,000	2	2,028	3,028	2,703	325	39,000	1,000,000	0
Commercial	2,500	2	2,028	4,528	2,703	1,825	219,000	1,000,000	0
Industrial	3,000	3	2,028	5,028	2,703	2,325	418,500	1,000,000	0
Institutional	3,500	3	2,028	5,528	2,703	2,825	508,500	1,000,000	0

As the data in Table 12 shows, the City does not currently need any additional storage to meet even the recommended institutional target fire flow requirement of 3,500gpm for a 3-hour duration.

Table 13 below shows the estimated storage needed for the future maximum day demand. The estimated change in storage needed over the next ten years is minimal.

TABLE 13
REQUIRED STORAGE CAPACITY FOR FIRE FIGHTING
(2017 PROJECTED MAXIMUM DAY DEMAND)

Classification	Desired Fire Flow @ 20 psi (gpm)	Duration (hr)	Maximum Day Demand (gpm)	Total Flow Required (system outflow) (gpm)	Well Flow (system inflow) (gpm)	Net System Outflow (gpm)	Total Storage Required (gallons)	Existing Storage (gallons)	Addt'l Storage Required (gallons)
Residential	1,000	2	3,054	4,054	2,703	1,351	162,120	1,000,000	0
Commercial	2,500	2	3,054	5,554	2,703	2,851	342,120	1,000,000	0
Industrial	3,000	3	3,054	6,054	2,703	3,351	603,180	1,000,000	0
Institutional	3,500	3	3,054	6,554	2,703	3,851	693,180	1,000,000	0

It is apparent from the analysis presented above that the City has ample storage to meet not only the existing needs but also the projected needs of the City in the future. Therefore, no additional storage is recommended at this time.

VI. RECOMMENDED IMPROVEMENTS

Figure 6 shows the location of the recommended improvements. Figure 7 shows the residual pressure contours under future maximum day demand after completion of the recommended improvements, and Figure 8 shows available fire flows as contour lines. Table 14 provides a comparison of the future available fire flows to the recommended target fire flows after completion of the recommended short-term improvements.

TABLE 14
COMPARISON OF AVAILABLE FIRE FLOW TO TARGET FIRE FLOWS AFTER COMPLETION OF SHORT TERM RECOMMENDED IMPROVEMENTS

Test Number	Location	Recommended Target Fire Flow @ 20 psi (gpm)	2017 Available Fire Flow @ 20 psi (WaterCAD) (gpm)	Difference Between Target & Available (%)
1	South of Ellis Street on M-91	1,000	3,765	277%
2	Deodara Drive near Balsa Drive	1,000	3,541	254%
3	West of Orchard Street on M-44	2,500	4,834	93%
4	Blaine Avenue at Irving Street	1,000	2,553	155%
5	Liberty Street at Front Street	1,000	3,029	203%
6	East end of Crooks Street	1,000	2,391	139%
7	West of Howe Street on Merrick Avenue	1,000	1,319	32%
8	Liberty Street at Pearl Street	2,500	3,541	42%

As seen in Table 14, the recommended short-term improvements increase the available fire flow at each location to exceed the target flows.

Recommended Improvements – Estimated Cost

Distribution system improvements are recommended to improve available fire flows and overall system reliability. These improvements should be considered and implemented by the City as deemed necessary and as funding allows. Distribution improvements are shown in Figure 6. The City should plan on replacing old 4-inch watermains as road improvements are conducted in the City. These 4-inch lines should be replaced with minimum 8-inch lines.

Estimated costs are included with the recommended improvements. They are meant to be rough estimates for budgeting purposes only. They include appurtenances such as valves, hydrants, fittings, water services, restoration, engineering and contingencies. A unit price of $80 per foot was used for 8-inch watermain and $90 per foot for 12-inch watermain. A unit price of $140 per foot was used for the river crossing with 12-inch watermain. It is assumed that the watermains could be placed outside of the paved roadway. The costs are estimated to increase by anywhere from $25 per foot to $60 per foot if watermain must be constructed within the paved roadway, depending on the amount and type of road construction

Short Range Improvements (0 to 5 Years)

- Replace 1250 feet of 6-inch with 12-inch watermain on Front St. between Beulah St. and Maple St.

  $113,000

- Replace 500 feet of 6-inch with 12-inch watermain on Broas St. between State Rd. and Beulah St.

  $45,000

- Construct 445 feet of 12-inch watermain to cross the river from York St. to Park St.

  $63,000

- Replace 1700 feet of 4-inch and 6-inch watermain with 12-inch watermain along York St. from Riverside Ave. to Reed St.

  $153,000

- Replace 3,270 feet of existing 8-inch with 12-inch watermain along M-44 from Water St. to Orchard St.

  $295,000

- Loop 4,570 feet of 12-inch watermain on M-44 and M-91 to Orchard Street (subject to agreement with Otisco Township).

  $412,000

- Add an additional well and wellhouse with a minimum capacity of 900 gpm.

  $250,000

- Tank maintenance for both elevated storage tanks.

  $167,000

TOTAL COST OF SHORT RANGE RECOMMENDED IMPROVEMENTS: $1,498,000

Medium Range Improvements (5 to 10 Years)

- Replace 2,700 feet of existing 4-inch watermain with 8-inch watermain on Morton Ave. from Gooding St. to Riverside Ave.

  $216,000

- Install 1,920 feet of 8-inch watermain from Park St. to M-44 along the east City Limits.

  $154,000

- Replace 1,910 feet of 6-inch watermain with 12-inch watermain along M-44 from Hall St. east to Hawley Hwy.

  $172,000

- Construct 325 feet of 8-inch watermain along May St. from N. State St. to Elizabeth St.

  $26,000

- Construct 620 feet of 8-inch watermain on Pleasant St. from Brown St. to M-44.

  $50,000

- Replace 1,610 feet of 4-inch watermain with 8-inch watermain along Pleasant St. from M-44 to Division St.

  $129,000

- Construct 400 feet of 8-inch watermain along Earle St. from Crawford St. to Root St.

  $32,000

- Replace 1000 feet of 4-inch with 8-inch watermain on Liberty St. between Broas St. and Bridge St.

  $80,000

- Replace Well No. 2 with an equal capacity well and new wellhouse.

  $250,000

- Replace 305 feet of 6-inch with 12-inch watermain on Front St. between Main St. and Congress St.

  $28,000

TOTAL COST OF MEDIUM RANGE RECOMMENDED IMPROVEMENTS: $1,137,000

Long Range Improvements (10 to 15+ Years)

- Replace the remaining 26,810 feet of 4-inch with minimum 8-inch watermain throughout the City.

  $2,145,000

- Loop dead-end mains where feasible.

  Variable Cost

TOTAL COST OF LONG RANGE RECOMMENDED IMPROVEMENTS: $2,145,000

TOTAL COST OF ALL RECOMMENDED IMPROVEMENTS: $4,780,000

VII. FUNDING SOURCES

Five possible sources of funding have been identified for the City of Belding to complete the recommended improvement projects. 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 Michigan Department of Environmental Quality. The current interest rate is 2-1/8 percent. The loan period is 20 years, and on a $1,000,000 project, the City would save approximately $400,000 in interest compared to conventional bonding.

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 (formerly FHA)

Rural Utility Service offers grants and loans for water improvements to communities with a low to moderate average household income. The City may qualify for a grant and loan. There are two types of loans available from RUS: direct loans and guaranteed loans.

Direct loans are only issued if the City is unable to obtain funding from other sources at reasonable rates. The current interest rate is approximately 4.5 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 City 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. The current bond rate is approximately 5.25 percent.

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 City's full faith and credit.

Revenue Bonds

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

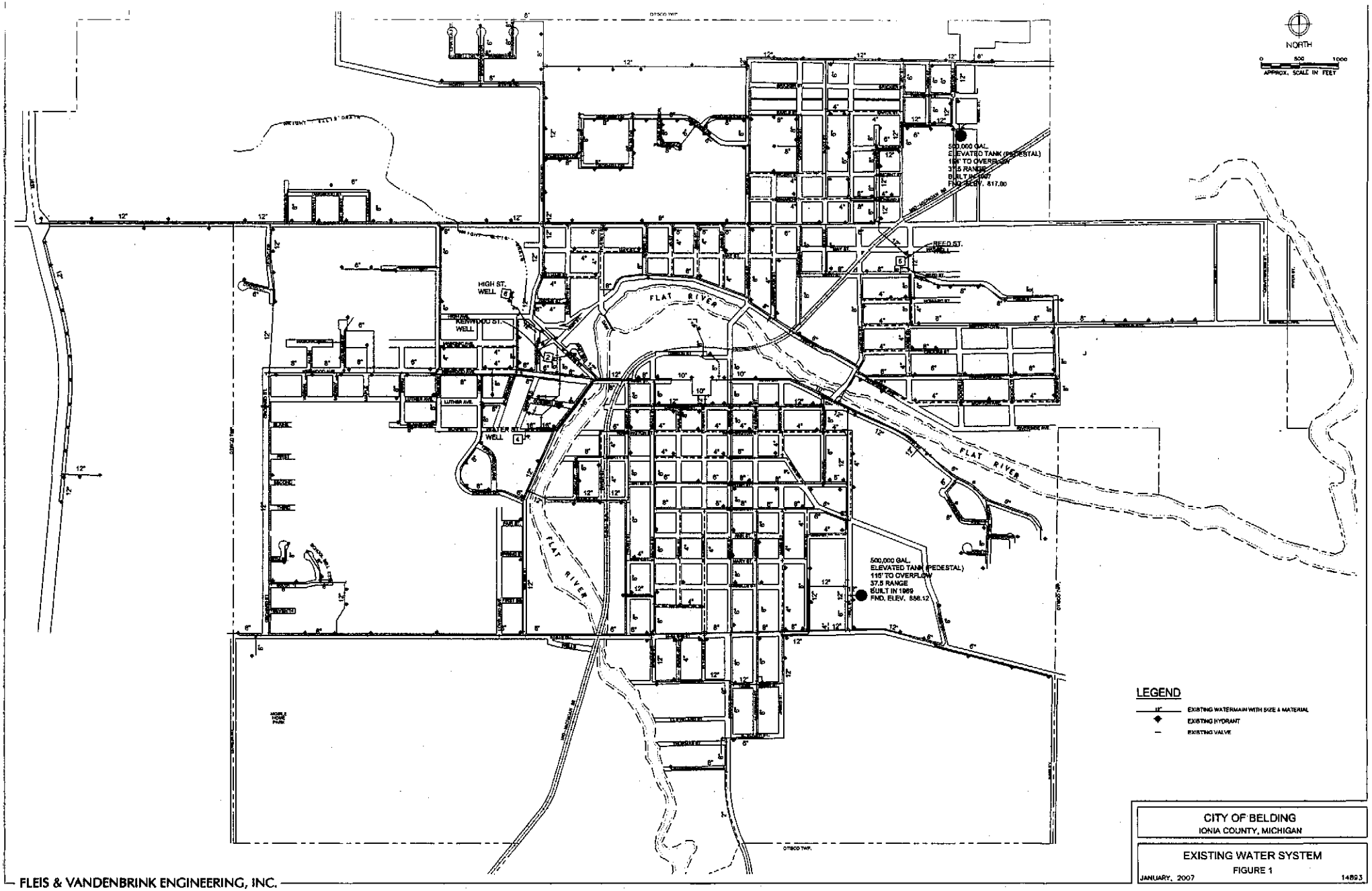
Revenue bonds are subject to the right of referendum. Petitions for a public vote can be filed by registered City voters during a 45-day referendum period. Voter approval is not

required if the referendum period expires without petitions being filed. The current bond rate is approximately 5.5 percent.

Contract Bonds

Contract bonds are authorized by several state laws. They authorize the City 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 City.

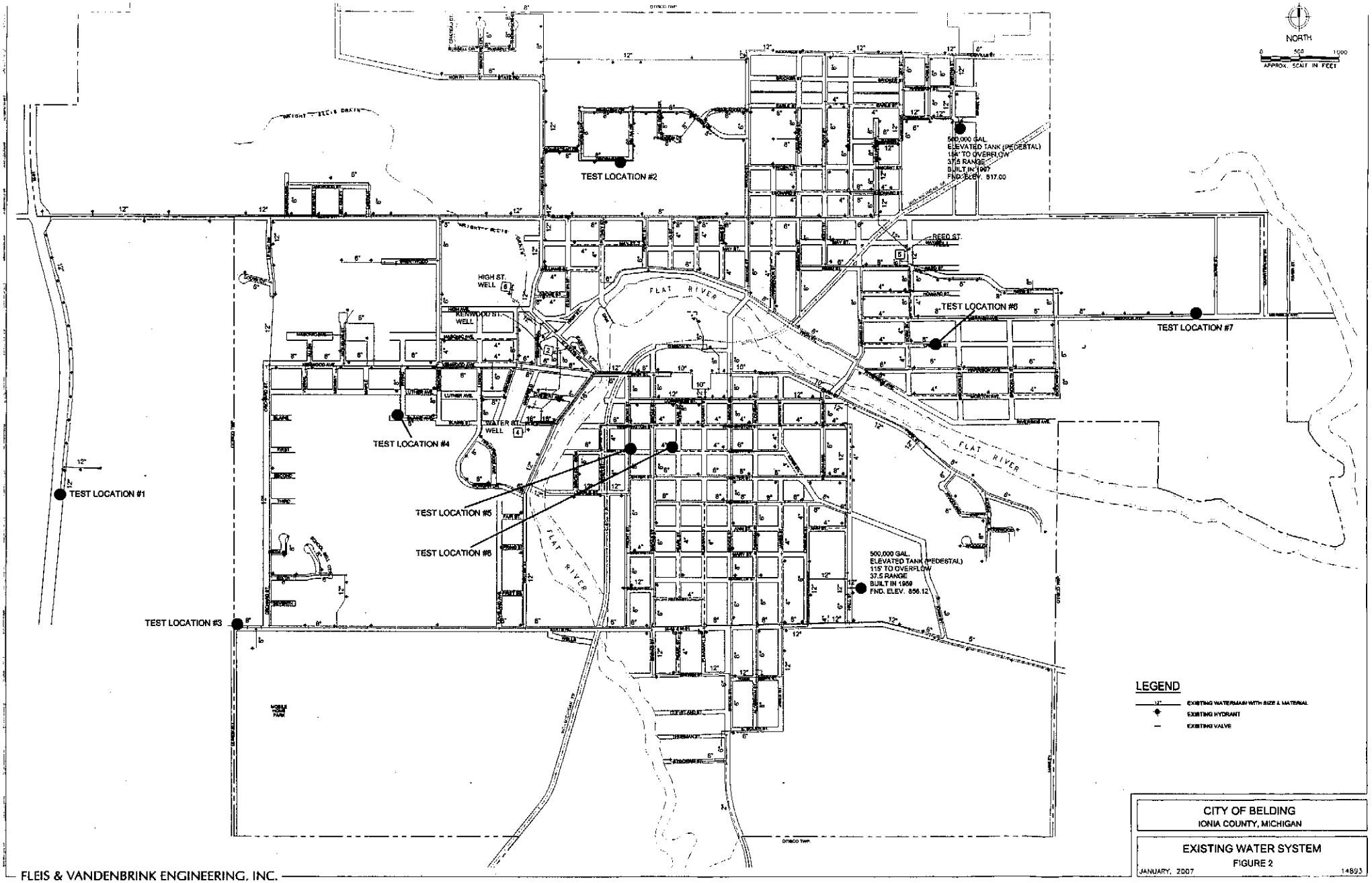
The City may want to consider a contract bond as the County may be able to borrow at a more favorable rate than the City if they are willing to pledge its taxing power as secondary security for repayment of the bonds. Also contract bonds may be paid back by a number of sources including: specials assessments, connection fees, and user fees. The current bond rate is approximately 5.25 percent.



CITY OF BELDING
IONIA COUNTY, MICHIGAN

EXISTING WATER SYSTEM
FIGURE 1
JANUARY, 2007 14893

FLEIS & VANDENBRINK ENGINEERING, INC.

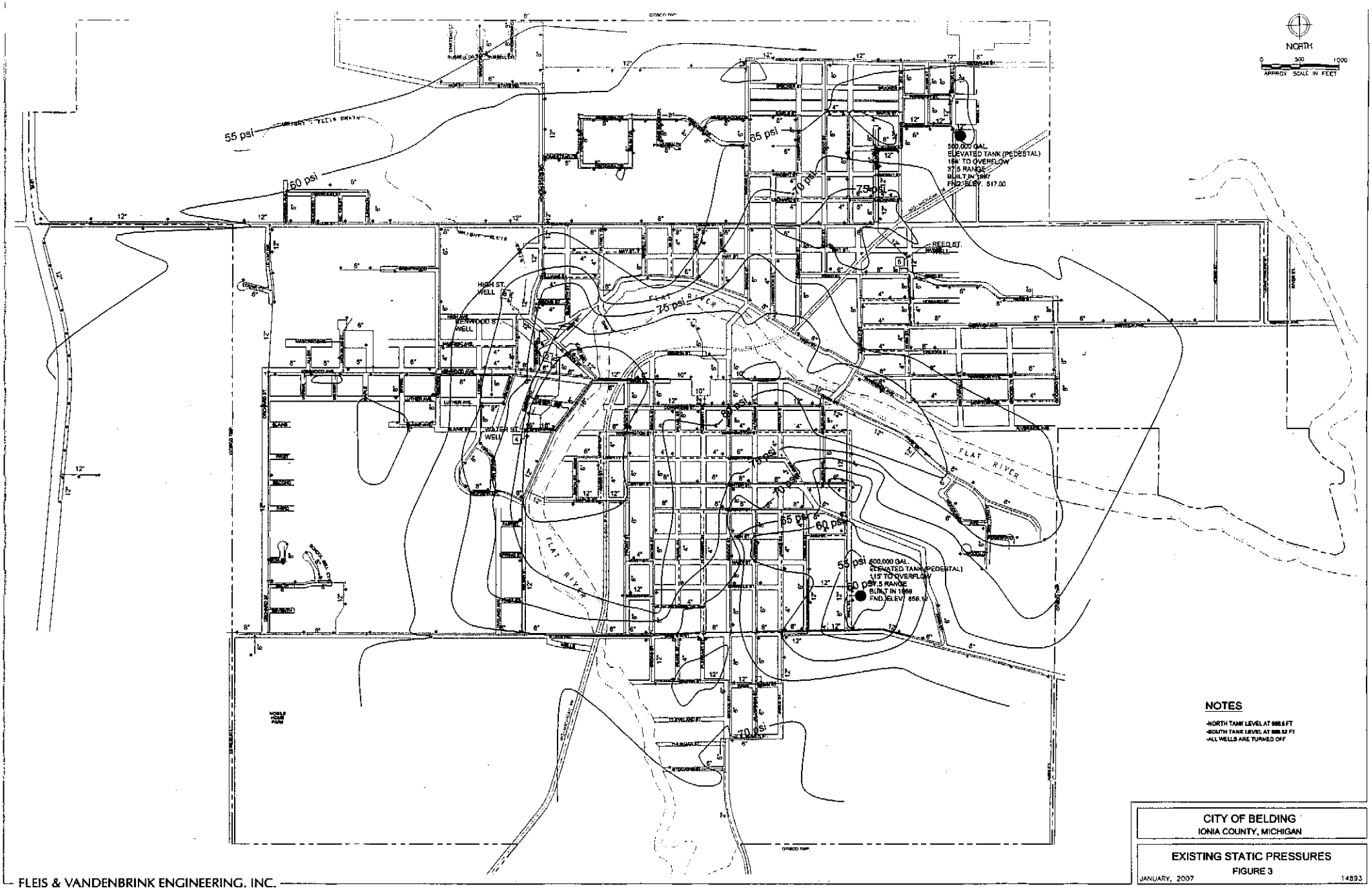


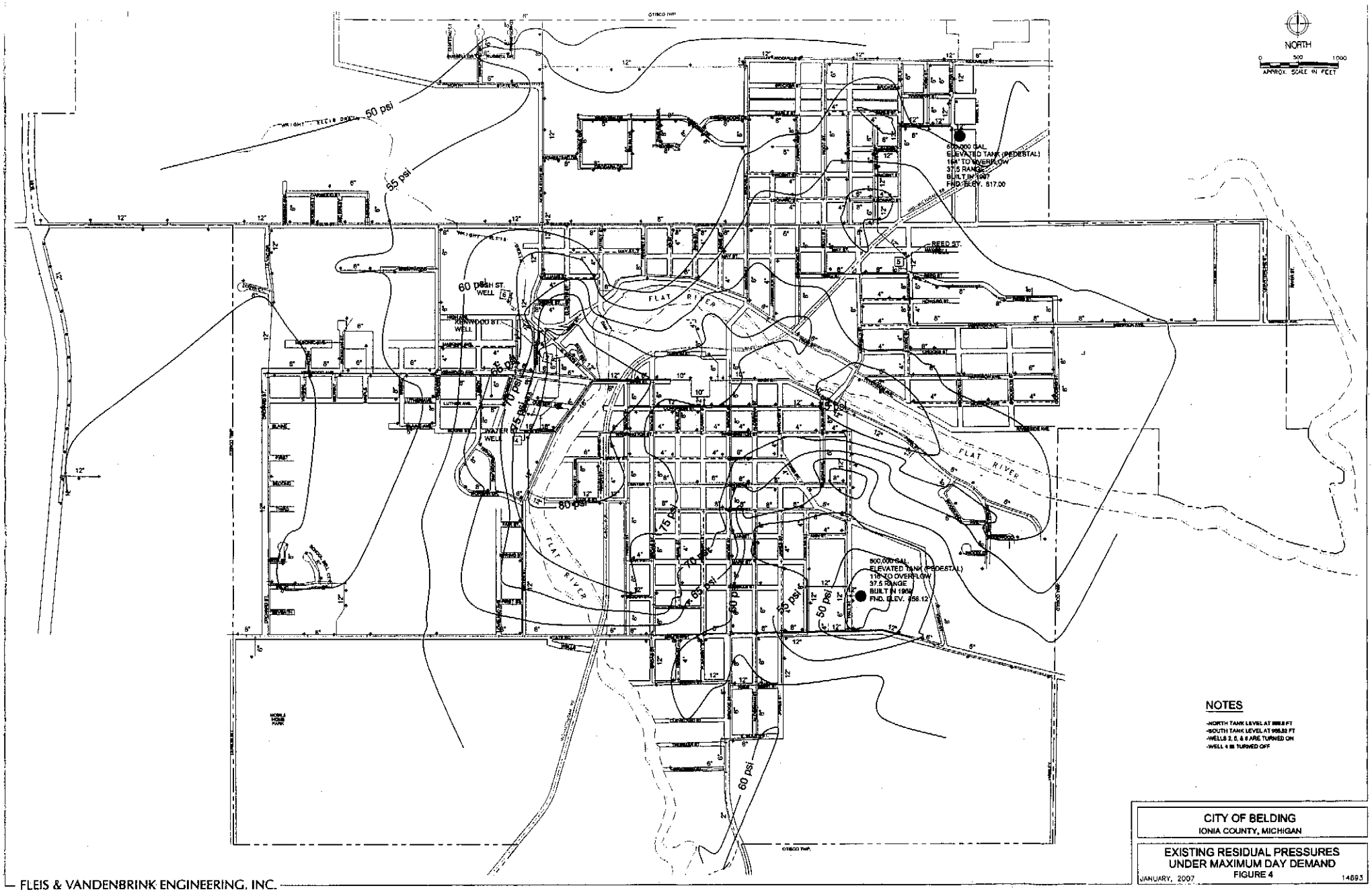
CITY OF BELDING
IONIA COUNTY, MICHIGAN

EXISTING WATER SYSTEM
FIGURE 2

JANUARY, 2007 14893

FLEIS & VANDENBRINK ENGINEERING, INC.


NORTH
0 500 1000
APPROX. SCALE IN FEET
55 psi
60 psi
65 psi
70 psi
75 psi
80 psi
500,000 GAL.
ELEVATED TANK (PEDESTAL)
156' TO OVERFLOW
371.5 RANGE
BUILT IN 1997
FND. ELEV. 917.00
HIGH ST. WELL
KENWOOD ST. WELL
WATER ST. WELL
REED ST. WELL
FLAT RIVER
600,000 GAL.
ELEVATED TANK (PEDESTAL)
115' TO OVERFLOW
371.5 RANGE
BUILT IN 1969
FND. ELEV. 858.12
NOTES
-NORTH TANK LEVEL AT 888.6 FT
-SOUTH TANK LEVEL AT 888.52 FT
-ALL WELLS ARE TURNED OFF
CITY OF BELDING
IONIA COUNTY, MICHIGAN
EXISTING STATIC PRESSURES
FIGURE 3
JANUARY, 2007
14893
FLEIS & VANDENBRINK ENGINEERING, INC.

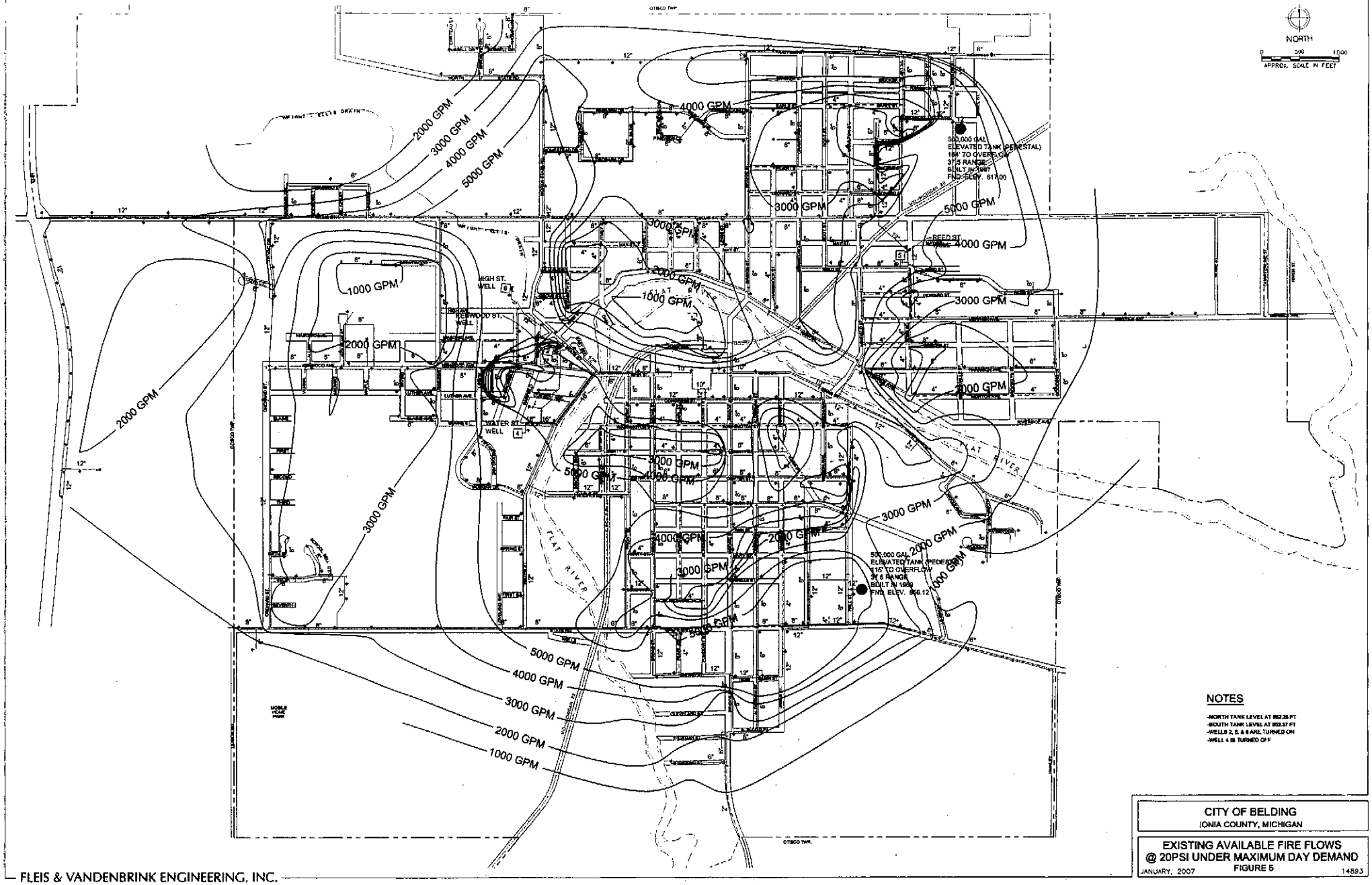


CITY OF BELDING
IONIA COUNTY, MICHIGAN

EXISTING RESIDUAL PRESSURES
UNDER MAXIMUM DAY DEMAND
FIGURE 4

JANUARY, 2007 14893

FLEIS & VANDENBRINK ENGINEERING, INC.

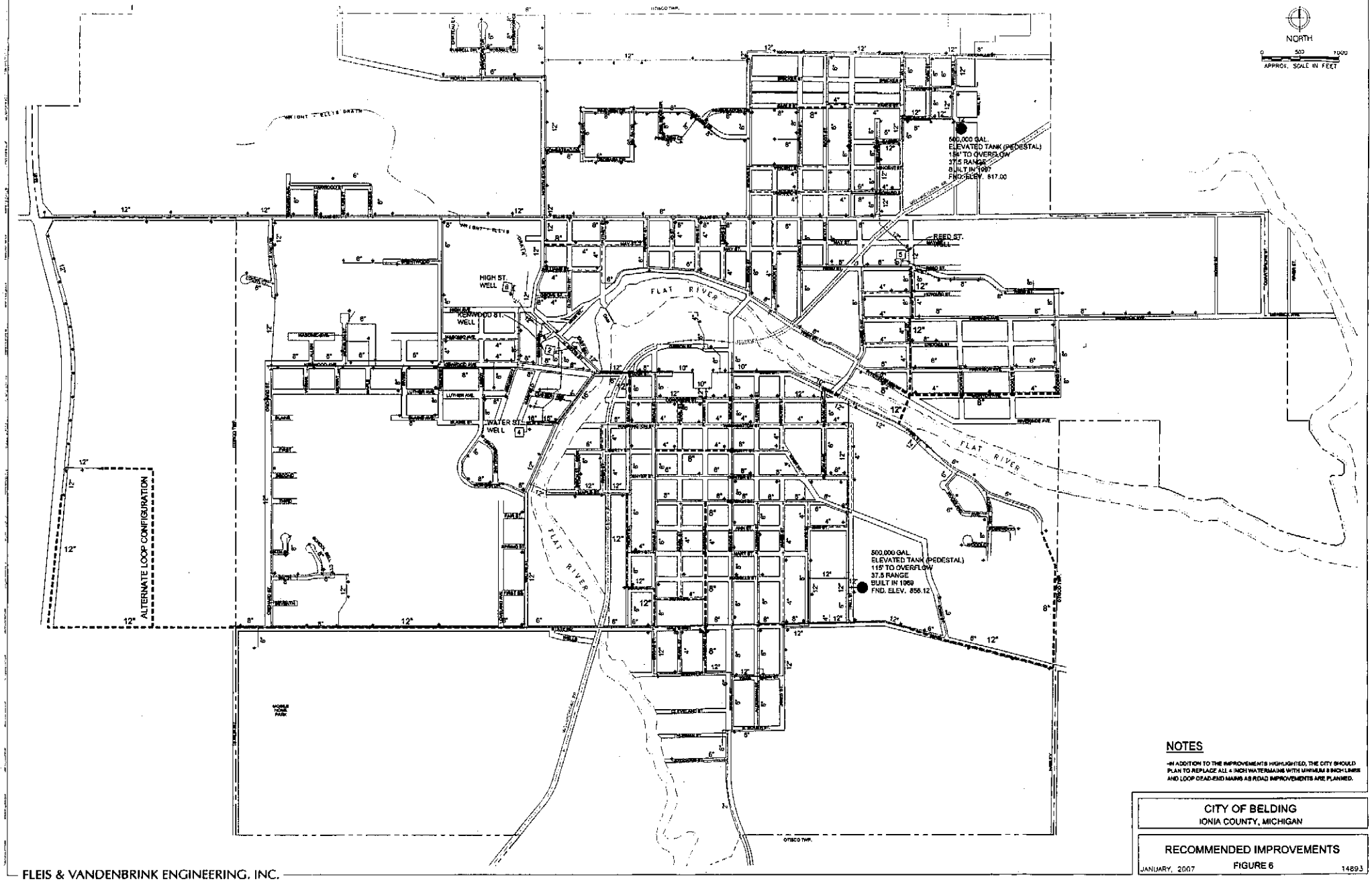


CITY OF BELDING
IONIA COUNTY, MICHIGAN

EXISTING AVAILABLE FIRE FLOWS
@ 20PSI UNDER MAXIMUM DAY DEMAND

JANUARY, 2007 FIGURE 5 14893

FLEIS & VANDENBRINK ENGINEERING, INC.



NOTES

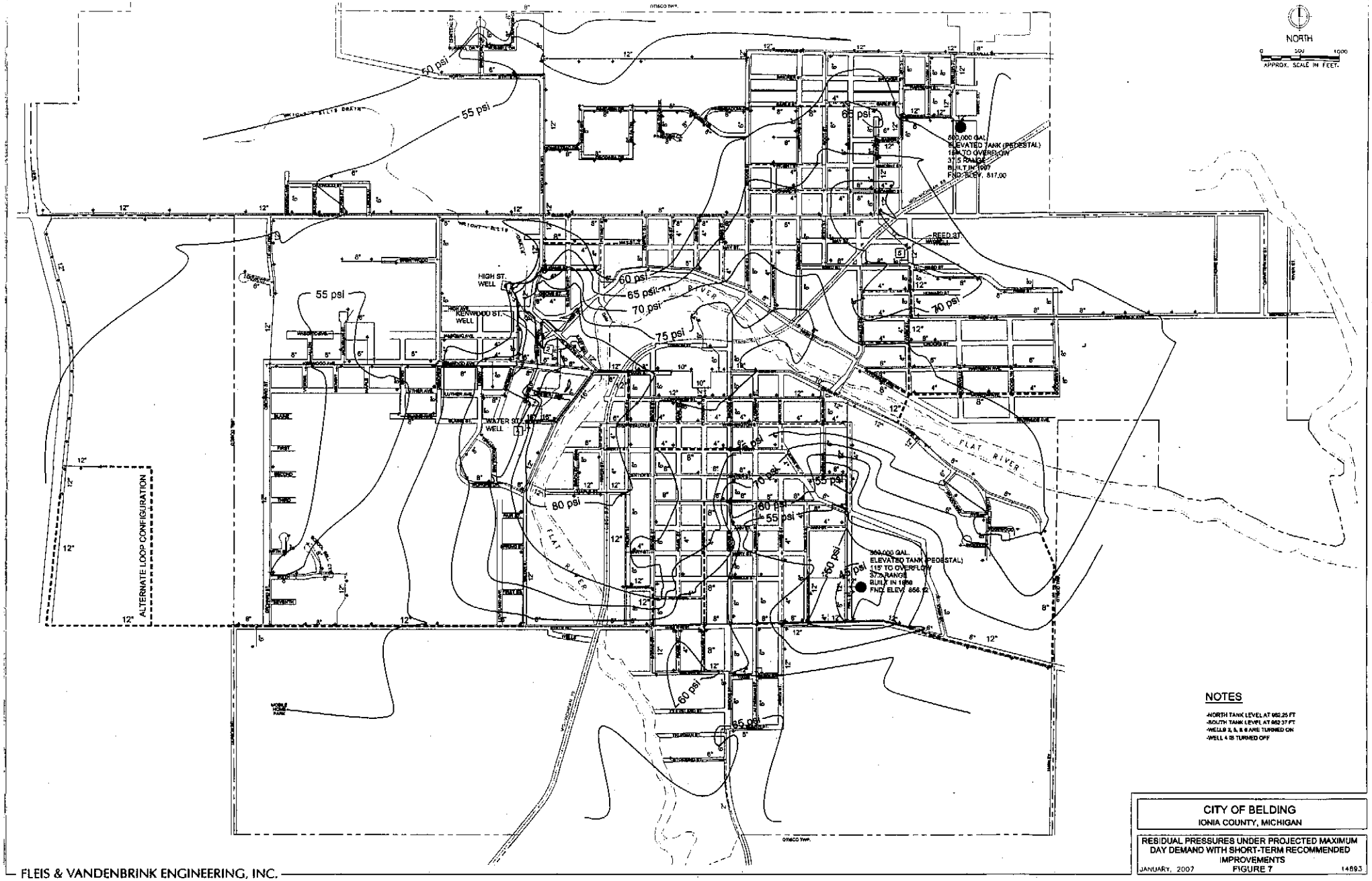
-IN ADDITION TO THE IMPROVEMENTS HIGHLIGHTED, THE CITY SHOULD PLAN TO REPLACE ALL 4 INCH WATERMAINS WITH MINIMUM 8 INCH LINES AND LOOP DEAD-END MAINS AS ROAD IMPROVEMENTS ARE PLANNED.

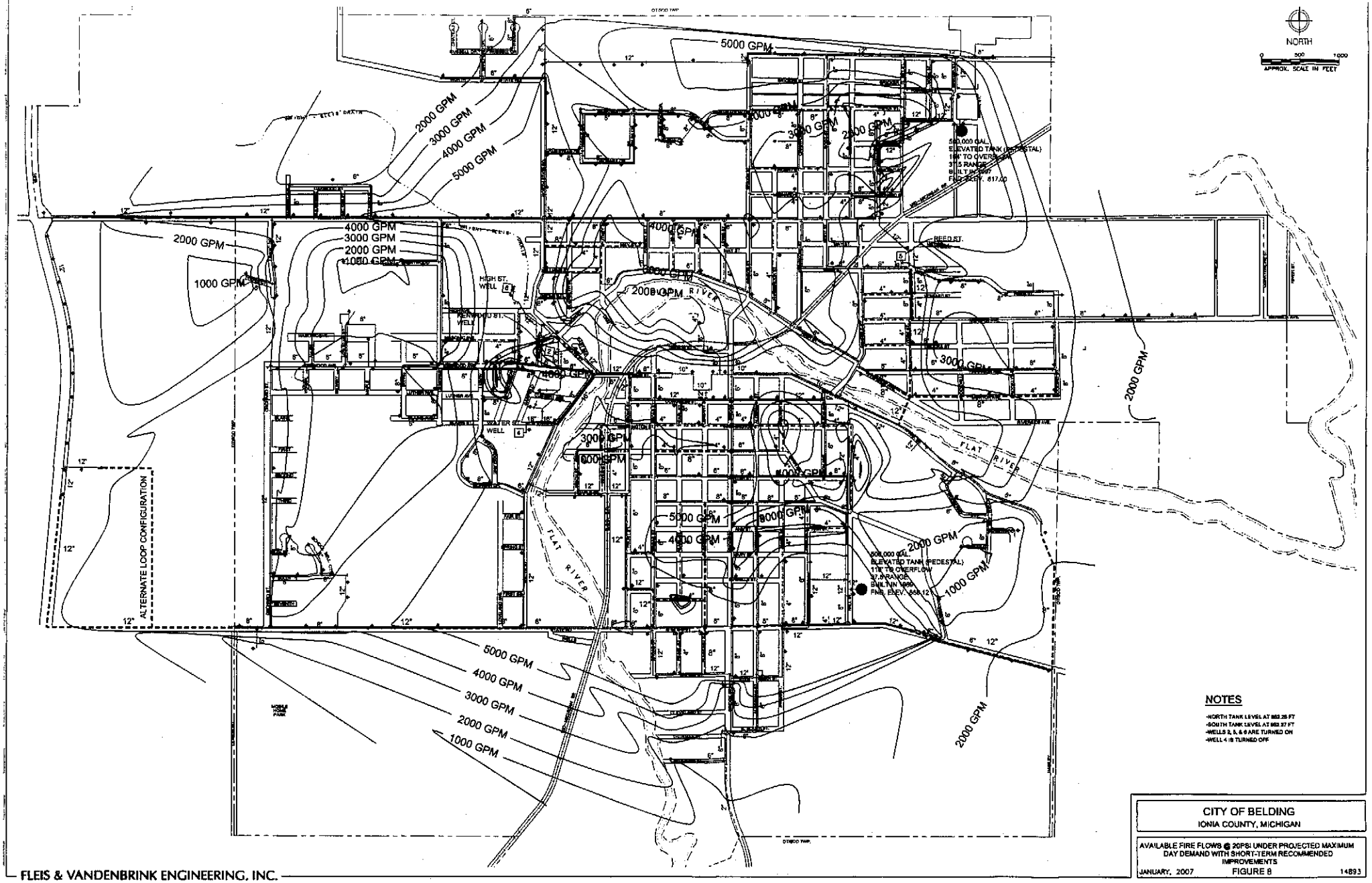
CITY OF BELDING
IONIA COUNTY, MICHIGAN

RECOMMENDED IMPROVEMENTS

JANUARY, 2007 FIGURE 6 14893

FLEIS & VANDENBRINK ENGINEERING, INC.


NORTH
0 500 1000
APPROX. SCALE IN FEET
50 psi
55 psi
60 psi
65 psi
70 psi
75 psi
80 psi
500,000 GAL. ELEVATED TANK (PEDESTAL) 115' TO OVERFLOW 375 RANGE BUILT IN 1997 FND ELEV. 817.00
HIGH ST. WELL
KENWOOD ST. WELL
WATER ST. WELL
REED ST. WELL
FLAT RIVER
ALTERNATE LOOP CONFIGURATION
500,000 GAL. ELEVATED TANK (PEDESTAL) 115' TO OVERFLOW 375 RANGE BUILT IN 1956 FND ELEV. 856.12
NOTES
-NORTH TANK LEVEL AT 982.25 FT
-SOUTH TANK LEVEL AT 982.37 FT
-WELLS 2, 5, & 6 ARE TURNED ON
-WELL 4 IS TURNED OFF
CITY OF BELDING
IONIA COUNTY, MICHIGAN
RESIDUAL PRESSURES UNDER PROJECTED MAXIMUM DAY DEMAND WITH SHORT-TERM RECOMMENDED IMPROVEMENTS
JANUARY, 2007
FIGURE 7
14693
FLEIS & VANDENBRINK ENGINEERING, INC.



NOTES

- NORTH TANK LEVEL AT 859.35 FT
- SOUTH TANK LEVEL AT 859.37 FT
- WELLS 2, 5, & 6 ARE TURNED ON
- WELL 4 IS TURNED OFF

CITY OF BELDING
IONIA COUNTY, MICHIGAN

AVAILABLE FIRE FLOWS @ 20PSI UNDER PROJECTED MAXIMUM DAY DEMAND WITH SHORT-TERM RECOMMENDED IMPROVEMENTS

JANUARY, 2007 FIGURE 8 14893

FLEIS & VANDENBRINK ENGINEERING, INC.