7 Transmission

The evaluation of the transmission system was performed in two phases. The first phase focused on priorities for the first five years of the planning period and examined three locations where needs for transmission improvements have been previously identified between DWSD and the respective wholesale customers. These locations are Adams Branch in Oakland County, 24-Mile Road in Macomb County, and the Downriver area of Wayne County.

The second phase of evaluation of the transmission system involved extensive hydraulic modeling and was a comprehensive examination of pipeline, booster pump station, reservoir needs to the year 2035. Phase 1 findings are presented below. Phase 2 findings begin in Section 7.9.

7.1 Adams Branch

The Adams Branch is the area north of South Boulevard fed from the Adams Pump Station. This branch is a single 42-inch water main that supplies Auburn Hills and Orion and parts of Pontiac and Rochester Hills. This area experienced periods of low pressure during summer months prior to 2008. Since 2008, peak water demands have been reduced or mitigated with new storage facilities, resulting in fewer pressure concerns.

The Analytical Work Group held a series of discussions with customers and DWSD from December 2011 to September 2013 on water service for the Adams Branch area. A summary of those discussions is presented in **Table 7-1**.

Table 7-1: Summary of AWG Discussion of Adams Branch

Date	Discussion and Findings
December 2011	The Technical Advisory Committee (TAC) Analytical Workgroup (AWG) identified the Adams Branch as the number one topic of discussion for 2012.
January 2012	A table of options was developed with long-term and short-term options and then reviewed by DWSD.
February 2012	Based on input from the DWSD Director, the options were revised with a new midterm option. The decision was made for the Adams Branch issue to continue to be assessed during break-out discussions that would follow the regular AWG Meetings.
March to May 2012	Adams Branch break-out meetings were held in March, April and May. Short term options for addressing the issue, including modifying the Auburn Hill tank filling schedule, were implemented.
July 2012	DWSD issued a report on July 16 presenting a hydraulic analysis of options for improving the pressure along the Adams Branch. The DWSD report concluded that the most cost effective method to improve pressure in the Adams Branch is to install an additional 17.5 mgd pump at the Orion Pump Station. The AWG recommended that additional options be considered as part of the Master Plan Update.

Table 7-1: Summary of AWG Discussion of Adams Branch

Date	Discussion and Findings
August 2012	Orion Township placed a new storage tank in service during August 2012 with the expectation to ease the pressure on the Adams Branch.
September 2013	OCWRC representatives presented a proposal for a North Oakland County Water Authority (NOCWA) representing a potential agreement among the Adams Branch customers to form a water authority similar to SOCWA. This proposal would allow for the customers to complete interconnections among their respective systems and maximize the use of existing customer and DWSD storage and transmission facilities.

Storage facilities have been installed along the Adams Branch area since 1963. In addition to the Orion Township storage tank noted in **Table 7.1**, Auburn Hills placed 1.5 million gallon storage tank in service in 2005. The DWSD Adams Road pump station includes a 10 million gallon tank that was placed in service in 1998. The one other reservoir on the Adams Branch is the 2 million gallon elevated tank for Pontiac that “floats” on the hydraulic grade and has been in service since approximately 1963.

Regarding low pressures prior to 2008, the daily, concurrent, outdoor irrigation water demands in the early morning and evening appeared to be the root of this area’s previous pressure problems.

In April 2013, the AWG offered the following guidance for the statement of work for the Master Plan Update:

1. DWSD was able to provide adequate pressure and flow during the 2012 summer season. This was done by utilizing the full capacity of the Orion Pump station.

2. Upgrades to the Orion Pump Station should be further evaluated by the Master Plan Update to assure that it can reliably supply water at its firm capacity.

3. Master Plan Team’s evaluation, including discussion with Oakland Township, should determine the desired parameters for DWSD water supply.

4. DWSD customers supplied from the Adams Branch should continue to work to develop a long term plan to supply DWSD water to the Adams Branch area.

5. Any additional studies of the North Adams Branch should be conducted on both peak hour demand and middle-of-the-night conditions using data acquired after the Orion Township tank was placed into service on August 24, 2012.

6. The issue of system redundancy should be addressed by the Water Master Plan update project.

Water demands for the Adams Branch area were reviewed based on results received to date from customers responding to the Technical Data Request. These customers have provided estimates of growth similar to those projected by SEMCOG. At the same time, demand management initiatives are under way, most importantly the more efficient use of 12 million gallons of storage in the City of Pontiac. See Section 7.4 for conclusions and recommendations.

Figure 7-1 shows the proposed NOCWA system.

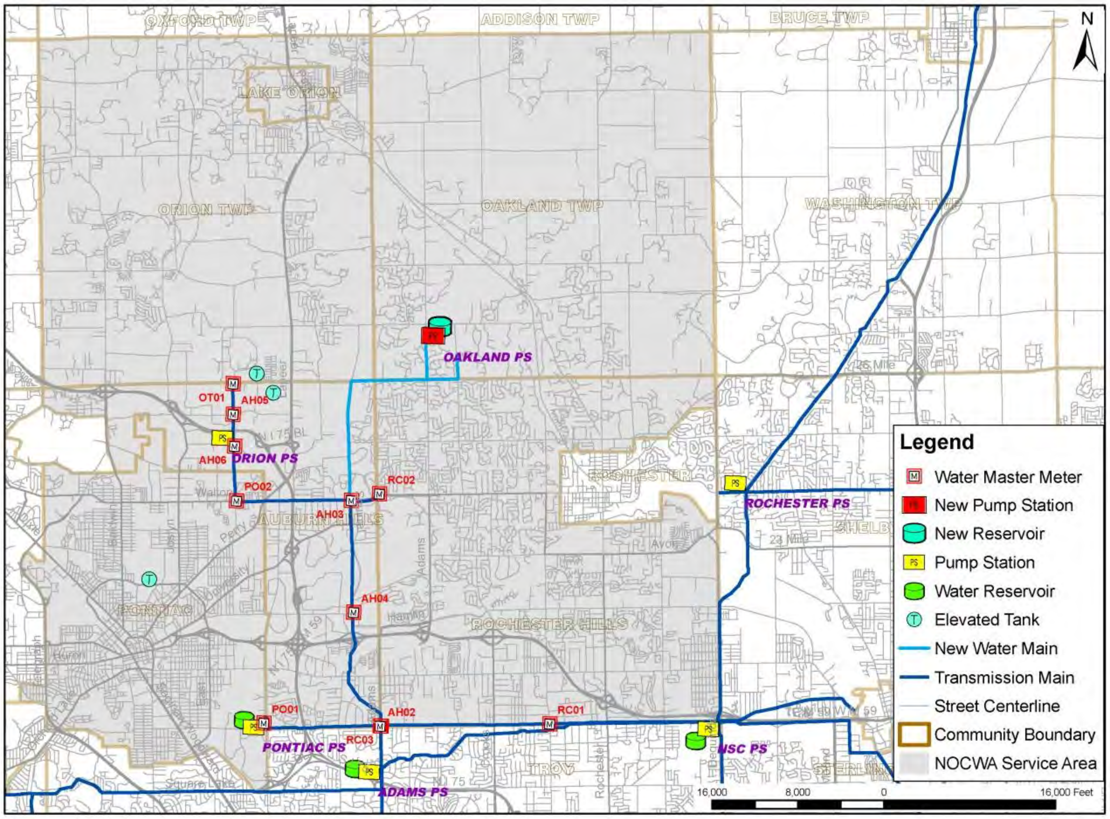


Figure 7-1: CS 1258 - DWSD Water Master Plan Update, Service Area and Water Supply for North Oakland County Water Authority (NOCWA)

7.2 24-Mile Road

Several customers in the vicinity of 24-Mile Road in Macomb County have observed low water pressure during summer months. This area of Macomb County had experienced substantial growth from the 1990's to 2007, and significant new housing and retail development has started again since 2011. **Figure 7-2** shows this portion of the service area.

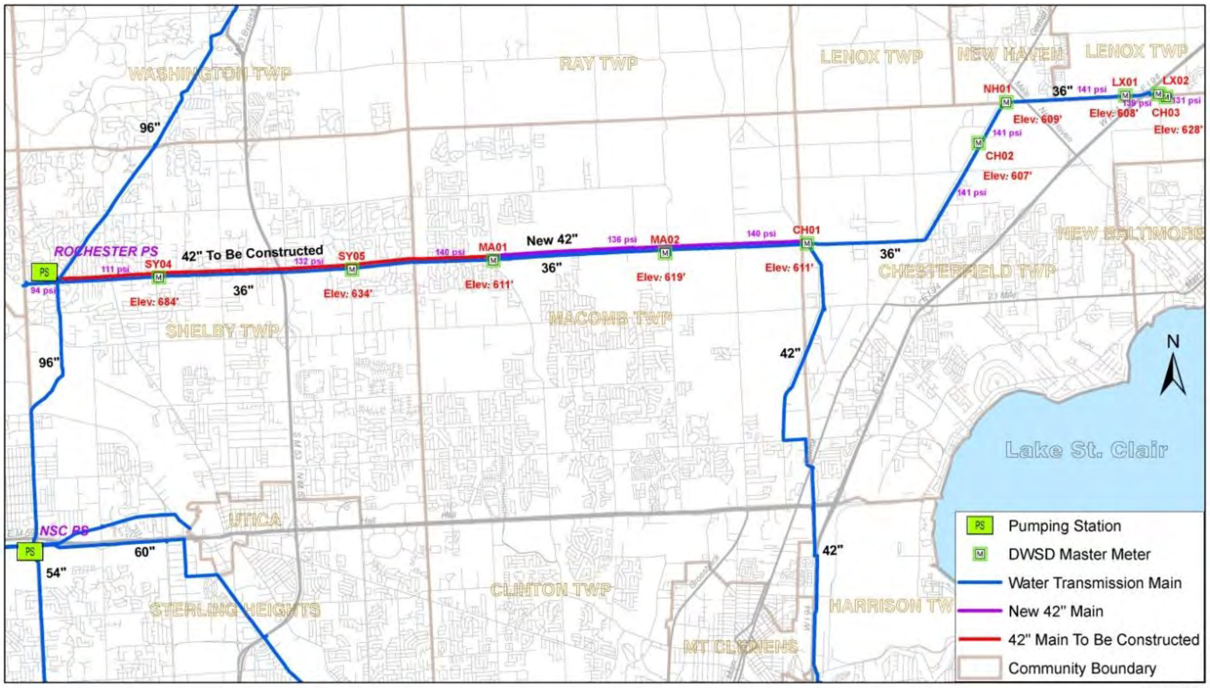


Figure 7-2: DWSD 36" & 42" Water Mains under Construction in 24 Mile Road

A history of the pressure issues identified by customers is summarized in **Table 7-2**.

Table 7-2: History of Pressure Issues Along 24-Mile Road

Date	Pressure Issue
2010	DWSD WS-674 24 Mile Road parallel main project—Fairchild to Foss Road put out for bid.
2010	Macomb reported low pressure issues at MA-03 during peak summer season. Calls to SCC result in increase 10 psi within 20-30 minutes.
2010	Macomb Township voiced frustration with the low pressures in the late evening and early morning hours. More discussion about staggering the start of the irrigation systems was concluded to be a way to mitigate the low pressure,
	Chesterfield experiences lower pressures in the summer months. In summer, the DWSD Snover valve just south of 24 Mile Rd is closed and CH-01, CH-02 and CH-03 are fed by the Lake Huron WTP through the 24 Mile main and CH-04 and CH-05 are fed by the Northeast WTP.
2011	Design complete for the 24 Mile Road pipeline between Rochester Station to Romeo Plank Rd. This project was bid in January 2011

In 2010, DWSD began construction of a new parallel transmission main on 24-Mile Road to improve water delivery to these customers. This new transmission main will be 36-inch to 42-inch diameter, and it will be parallel to an existing main in 24-Mile Road. Construction was advertised in three contracts due to an easement issue at the eastern end of the construction. As of November 2013, two contracts had been completed. A construction contract for the final segment of 42-inch parallel main

CDM Smith

on 24-Mile Road from the Rochester Pump Station to Romeo Plank Road (Project WS-681) is anticipated to be finished by 2017.

The hydraulic model of the transmission system was run to simulate future conditions in the vicinity of 24-Mile Road, after the current construction projects are completed. The modeling was performed with year 2011 maximum day water demands. A meeting was held with representatives of Shelby, Macomb, Chesterfield, and Lenox townships and the Village of New Haven in November 2013. A follow-up meeting with Macomb Township was held in February 2014 to review their projections for population and employment growth over the next twenty years. Substantial new development and expansion of the water service area further north in the township is planned.

Section 7.10 presents recommendations for transmission redundancy, which include a new connection to the 24-Mile Road main from the east end and a new booster pumping station near Chesterfield.

7.3 Downriver

Background information on previous analysis and assessment of the needs of the Downriver transmission system are presented in **Table 7-3**.

Table 7-3: Background on Downriver Transmission System Needs Assessment

Date	Discussion and Findings
Summer 2005	Brownstown Township (BR), City of Flat Rock (FK), Grosse Ile Township (GI), Huron Township (HN) and Ash Township (AS) met with DWSD to discuss low and high pressures issues.
December 2005	A hydraulic analysis performed and a report issued by DWSD.
2006 to 2012	DWSD added the Ready Road Pump Station and Reservoir to its Water Capital Improvement Plan and engaged a consultant to prepare a preliminary and final design. After 2012, the project was suspended pending the completion of the Water Master Plan Update.
December 2011	Technical Advisory Committee (TAC) Analytical Workgroup (AWG) identified the Downriver pressures as an issue to be addressed by the group.
March 2011 AWG	Short-term, mid-term, long-term recommendations and extents of the pressure issues evaluated and discussed.
May 2012 AWG	DWSD's historical flow and pressure data from the Wholesale Automated Meter Reading (WAMR) system was reviewed and shared with the communities.

Table 7-3: Background on Downriver Transmission System Needs Assessment

Date	Discussion and Findings
July 2012 AWG	Background on the Downriver area of the system, improvements made to the Downriver portion of the system, and drivers for selection of Downriver pressure issues were discussed. It was noted that a shutdown of the Allen Road main just north of Pennsylvania would affect 18 meters and cut-off service to Brownstown Twp., Berlin Twp., Flat Rock, Gibraltar, Rockwood, S. Rockwood and Woodhaven. These communities are connected together through emergency connections (ECs) with the exception of South Rockwood and Berlin Township, which only have ECs with each other. This would allow limited water service to transfer across communities, but would only provide minimal and temporary service.
August 2012	The current status of Downriver system including an overview of the map of the system and historical flow and pressure data was reviewed.
September to November 2012	DWSD provided feedback as a follow up to questions from the August AWG meeting. Overall, it was determined that the pressure issues that had existed in 2005 were no longer a problem for that portion of the system. However, emphasis was shifted to a concern regarding redundancy in the portion of the system south of Pennsylvania Avenue. Additionally, the ability of the Ready Road Pump Station and Reservoir to mitigate the redundancy issue was questioned. In case of an interruption of supply from DWSD south of Pennsylvania Avenue, the proposed Ready Road Reservoir would supply the affected system for only about 9 hours. Even a proposed water main along Will Carleton would be an extension from the proposed Ready Road pump station. It would not connect back into the system to loop the Downriver system. A complete loop would require the construction of approximately 6 additional miles of main on the proposed Will Carleton extension.

In April 2013, the AWG offered the following guidance for the statement of work for the Master Plan Update:

1. The proposed Ready Road Reservoir and Pump Station should not be constructed at this time. The timing of this project should be addressed by the Water Master Plan Update project.

2. The issue of system redundancy should be addressed by the Water Master Plan project.

3. DWSD should quickly develop a contingency plan to address a supply disruption south of Pennsylvania Avenue. At a minimum, this plan should address:

   a. What type of disaster recovery type actions DWSD will perform in case of an emergency or long-term supply disruption?

   b. How should the DWSD main in Allen Road be protected from third party damage?

   c. How will DWSD repair damage to the Allen Road main, including a time estimate for making repair?

d. What actions can the Downriver communities take to obtain emergency water supply through interconnections with their neighboring communities? Included in this should be a study of how much water can be delivered through existing customer mains that serve as loops between TN-1 and TN-3 and GI-1 and GI-3.

This Master Plan Update included additional assessment of future water demands, demand management, emergency response planning, and evaluation of flows and pressures at wholesale meters as documented elsewhere in this report. The Master Plan Update team also met with representatives of the Downriver Community Conference in January 2014 to discuss alternatives.

A total of seven alternatives are examined based on initial position of the AWG and discussion with stakeholders. Hydraulic modeling was performed to develop estimates of pipe diameter and pump station and reservoir capacity. The consideration of emergency supply from the City of Monroe was based on preliminary information regarding the City's water plant capacity. Due to the limited supply available from Monroe, and due to the cost of connecting to Monroe, this alternative is not cost-effective compared to other alternatives.

Table 7-4 presents the seven alternatives and their cost estimates. **Figures 7-3 to 7-9** present preliminary route layouts for the alternatives. All options provide the needed redundancy to the single transmission main. However, Alternative Number 7 is significantly less expensive than the other options, and it is recommended for immediate implementation in Section 7.10.

Table 7-4: Cost Estimate for Downriver Alternatives

Pressure Improvement and Redundancy Supply Alternative		Capitol Improvement Item	Unit	Quantity	Estimated Cost
1	Current Design of Ready Road Pump Station & Will Carleton Extension Pipeline	1-1 Ready Road Pumping Station with a Reservoir of 5 MG	LS	1	$15,000,000
		1-2 Will Carleton Extension 30" Pipeline	LF	42,540	$24,247,800
		1-3 Will Carleton Extension 30"Rail or Highway Crossing	LF	150	$213,750
		1-4 Will Carleton Extension 30" Stream Crossing	LF	50	$42,750
		1-5 Will Carleton Extension 24" Pipeline	LF	15970	$7,234,410
		1-6 Will Carleton Extension 24"Rail or Highway Crossing	LF	200	$226,500
		1-7 Will Carleton Extension 24" Stream Crossing	LF	250	$169,875
		Total			***$47,135,085***
2	Parallel Pipeline along Allen Rd./Dixie Hwy	2-1 Parallel 24" Pipeline along Allen Rd.	LF	26,700	$12,901,440
		2-2 Rail or Highway Crossing for 24" Pipeline along Allen Rd.	LF	50	$60,400
		2-3 Stream Crossing for 24" Pipeline along Allen Rd	LF	200	$144,960
		2-4 Parallel 16" Pipeline along Allen Rd.—Fort St.	LF	32,100	$11,812,800
		2-5 Rail or Highway Crossing for 16" Pipeline along Allen Rd.—Fort St.	LF	200	$184,000
		2-6 Stream Crossing for 16" Pipeline along Allen Rd—Fort St.	LF	450	$248,400
		Total			***$25,352,000***

Table 7-4: Cost Estimate for Downriver Alternatives

Pressure Improvement and Redundancy Supply Alternative		Capitol Improvement Item	Unit	Quantity	Estimated Cost
3	New Reservoir with Pumps to Supply	3-1 Ready Road Pumping Station with 3 Reservoirs (10MG Each)	LS	1	$30,675,000
		Total			***$30,675,000***
4	Supply from Electric Ave. PS and Parallel Pipeline along Allen Rd./Dixie Hwy	4-1 Parallel 16" Pipeline along Allen Rd.—Fort St.	LF	32,100	$11,812,800
		4-2 Rail or Highway Crossing for 16" Pipeline along Allen Rd.—Fort St.	LF	200	$184,000
		4-3 Stream Crossing for 16" Pipeline along Allen Rd—Fort St.	LF	450	$248,400
		Total			***$12,245,200***
5	Emergency Water Supply from Monroe System	5-1 New 24" Pipeline connected to Monroe along I-75	LF	63,500	$30,683,200
		5-2 Rail or Highway Crossing for 24" Pipeline along I-75	LF	250	$302,000
		5-3 Stream Crossing for 24" Pipeline along I-75	LF	1,200	$1,449,600
		5-4 Crossing of River Raisin (24" in Diameter)	LF	800	$724,800
		Total			***$33,159,600***
6	Alternative #1 Extension Pipeline Looped to Wick Rd.	6-1 New 30" Will Carleton Extension Pipeline	LF	42,540	$24,247,800
		6-2 Will Carleton Extension 30"Rail or Highway Crossing	LF	150	$213,750
		6-3 Will Carleton Extension 30" Stream Crossing	LF	50	$42,750
		6-4 New 24" Will Carleton-Clark Rd. Pipeline	LF	46,770	$21,186,810
		6-5 Rail or Highway Crossing for 24" Will Carlton-Clark Rd. Pipeline	LF	200	$226,500
		6-6 Stream Crossing for 24" Will Carlton-Clark Rd. Pipeline	LF	500	$339,750
		Total			***$46,257,360***
7	Use Community Distribution Pipes for Emergency Water Supply	7.1 New 12" Pipe	LF	2,000	$736,000
		7-2 Crossing of Huron River (12" in Diameter)	LF	600	$331,200
		7-3 Tapping Sleeve for Connecting Distribution Pipe to Transmission	EA	5	$150,000
		7-4 Magnetic Flow Meter and Vault	EA	6	$690,000
		7-5 Cone Valve and Vault	EA	6	$3,000,000
		Total			***$4,907,200s***

7.4 Phase 1 Conclusions

Based on the investigations of the Adams Road, Macomb County and Downriver pressure and redundancy problems, the following conclusions were reached and next steps proposed.

- Adams Branch originated as a pressure issue and is now primarily of concern due to lack of transmission redundancy. Wholesale customers in this area have investigated solutions for interconnections and transmission improvements between their communities, and these interconnections and improvements would resolve most of the pressure and redundancy problems. These customers have formed a new local water authority called the Northern Oakland County Water Authority.

- NOCWA was formed in October 2014, and it is in the process of optimizing its inter-community operations. The NOCWA communities include the highest elevations of the service area of the DWSD system. NOCWA reports that there are no interconnections among its member communities that will be used as part of regular non-emergency connections. The DWSD Orion pump station upgrade is scheduled for the year 2020, but could be implemented sooner. NOCWA believes that greater utilization of resources within its member communities should result in improvement in pressures. Modeling for this Water Master Plan shows the ability to meet projected 2035 maximum day demands when all booster stations and reservoirs are at design capacity. Collaborative modeling of the DWSD transmission system and NOCWA system, would provide an approach to optimize NOCWA's connection to DWSD.

- 24-Mile Road in Macomb County has experienced pressures below contract limits of some of the wholesale customers. DWSD is constructing improvements to the Rochester Pump Station and constructing a parallel main in 24-Mile Road. When those improvements are complete in 2016, then current pressure problems are expected to be resolved.

- The downriver communities identified a pressure issue approximately 9 years ago. In response, DWSD developed a plan for a new pumping station and transmission main extension for the area. The pressure issues have been largely eliminated since 2007. Redundancy of transmission remains a concern. In the current forecast of flat future water demand in this area, the most cost-effective initial improvement to improve redundancy is to establish agreements and new interconnections between existing water distribution mains owned by the communities in the area. Later in the planning period, depending on growth in the area, then additional DWSD transmission improvements may be justified.

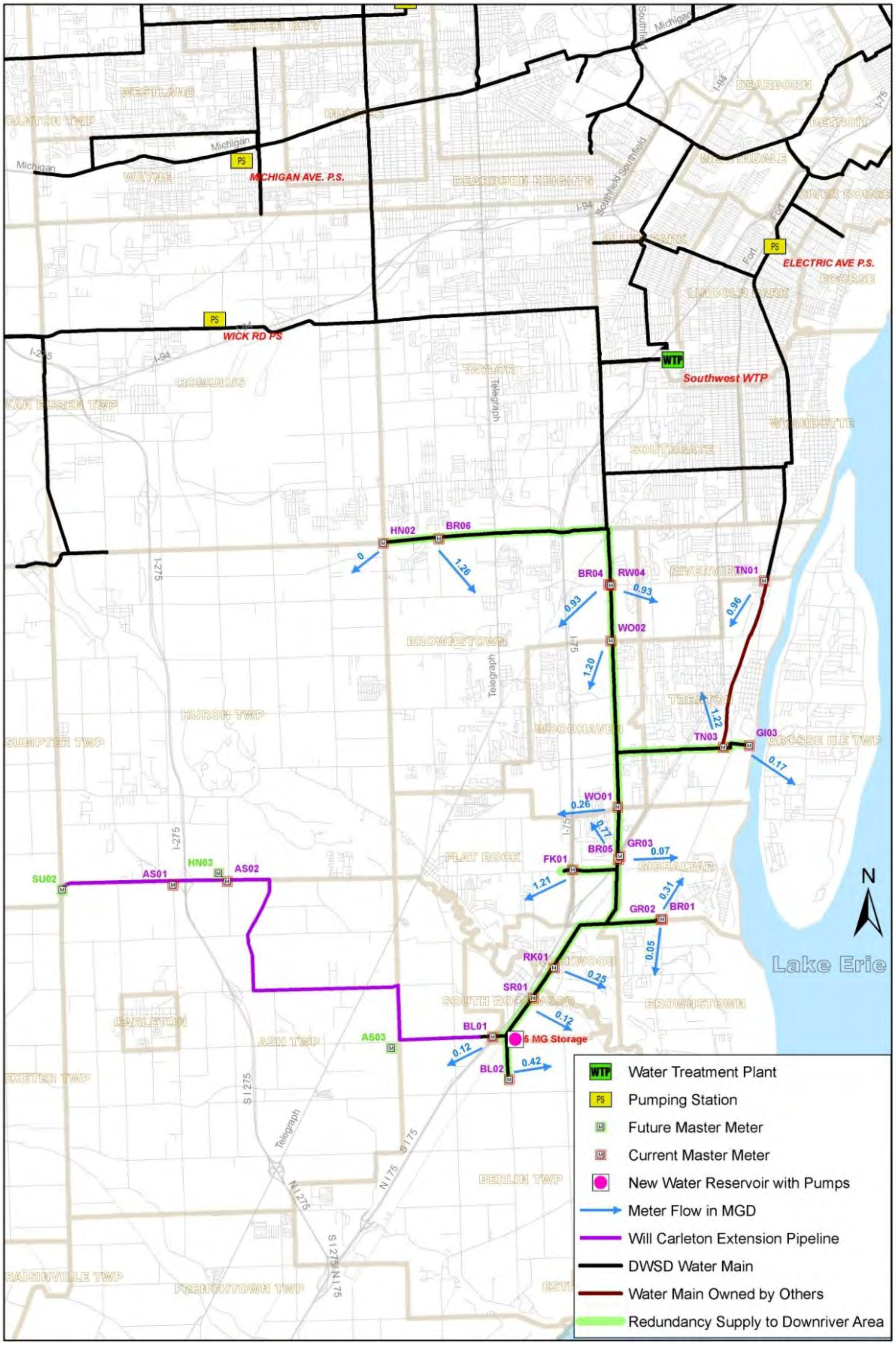


Figure 7-3: Supply Alternative 1 – Current Design of Ready Road Pump Station & Will Carleton Extension Pipeline

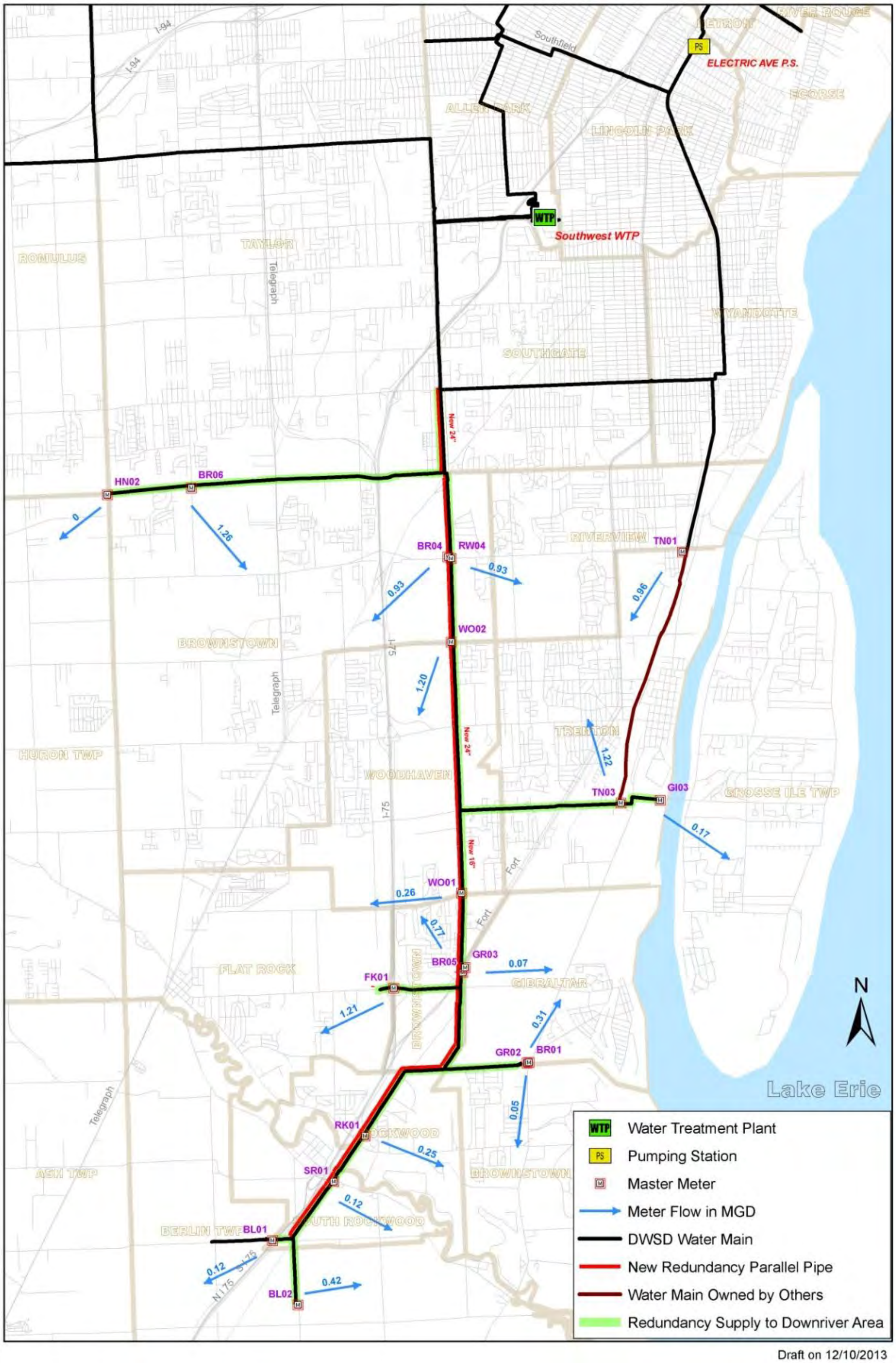


Figure 7-4: Alternative 2 – Parallel Pipeline along Allen Road/Dixie Hwy

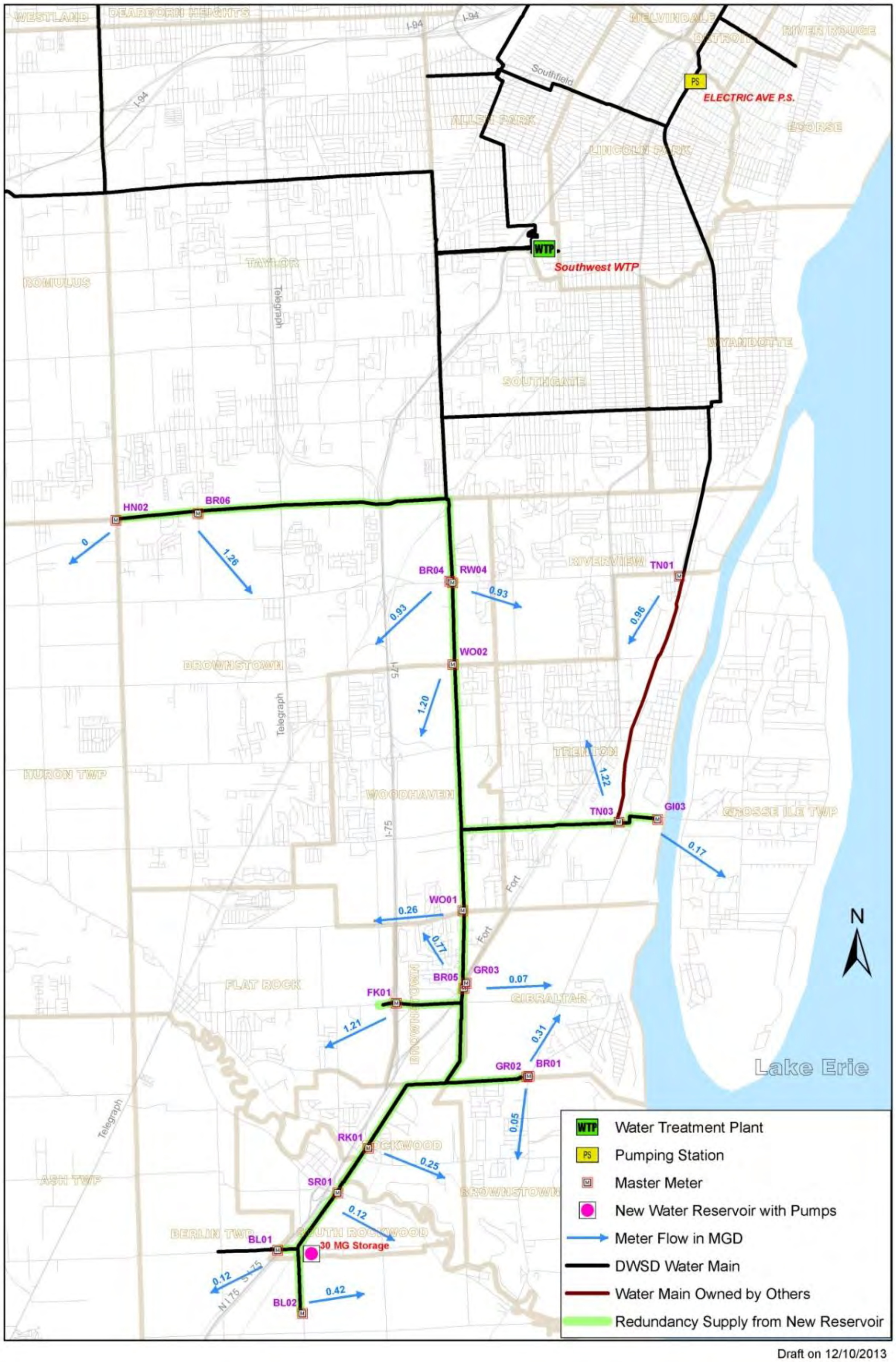


Figure 7-5: Alternative 3 – New Reservoir with Pumps to Supply Average Day Demand up to 3 Days

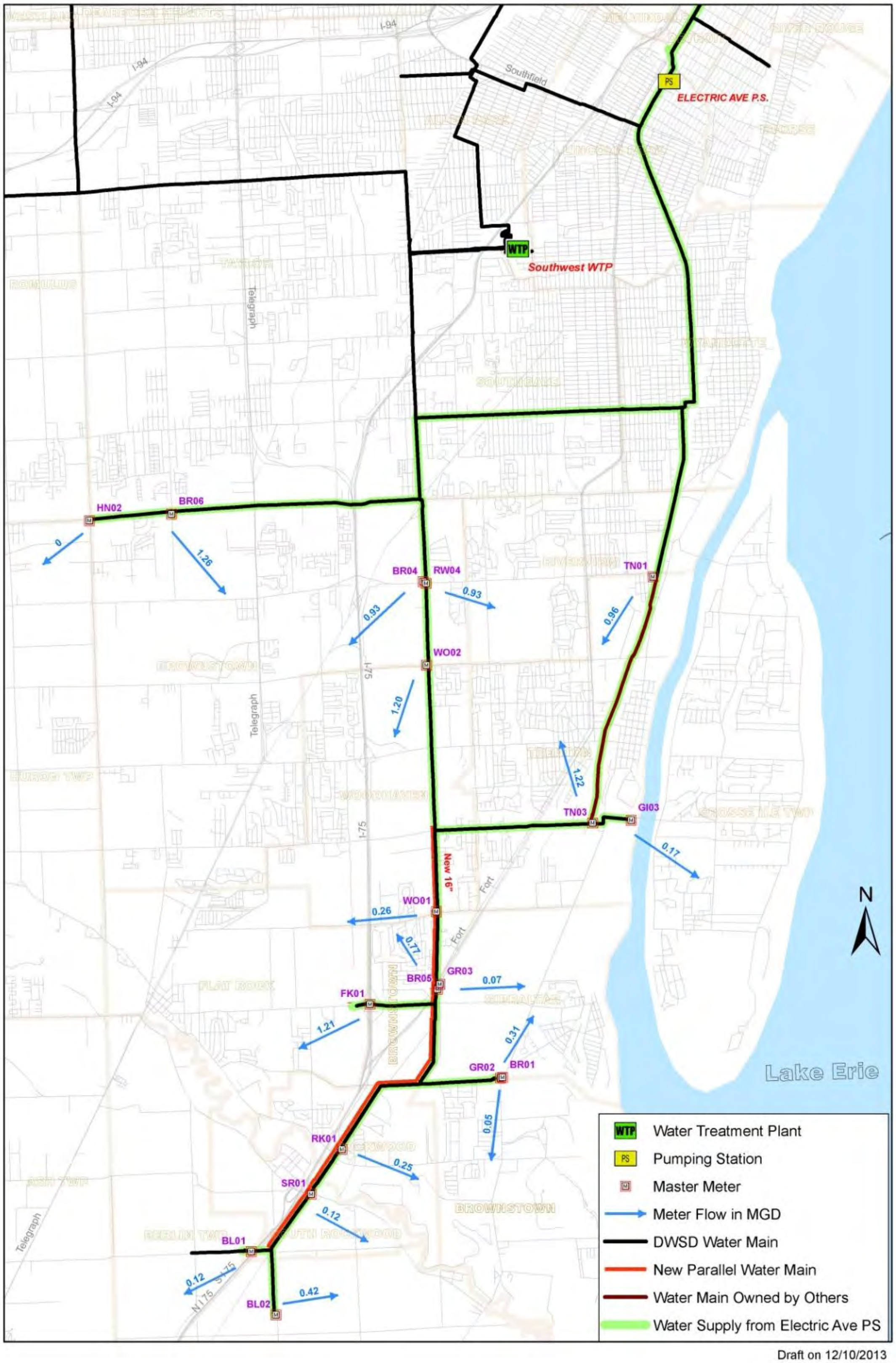


Figure 7-6: Alternative 4 – Supply from Electric Ave PS and Parallel Pipeline along Allen Rd./Dixie Hwy

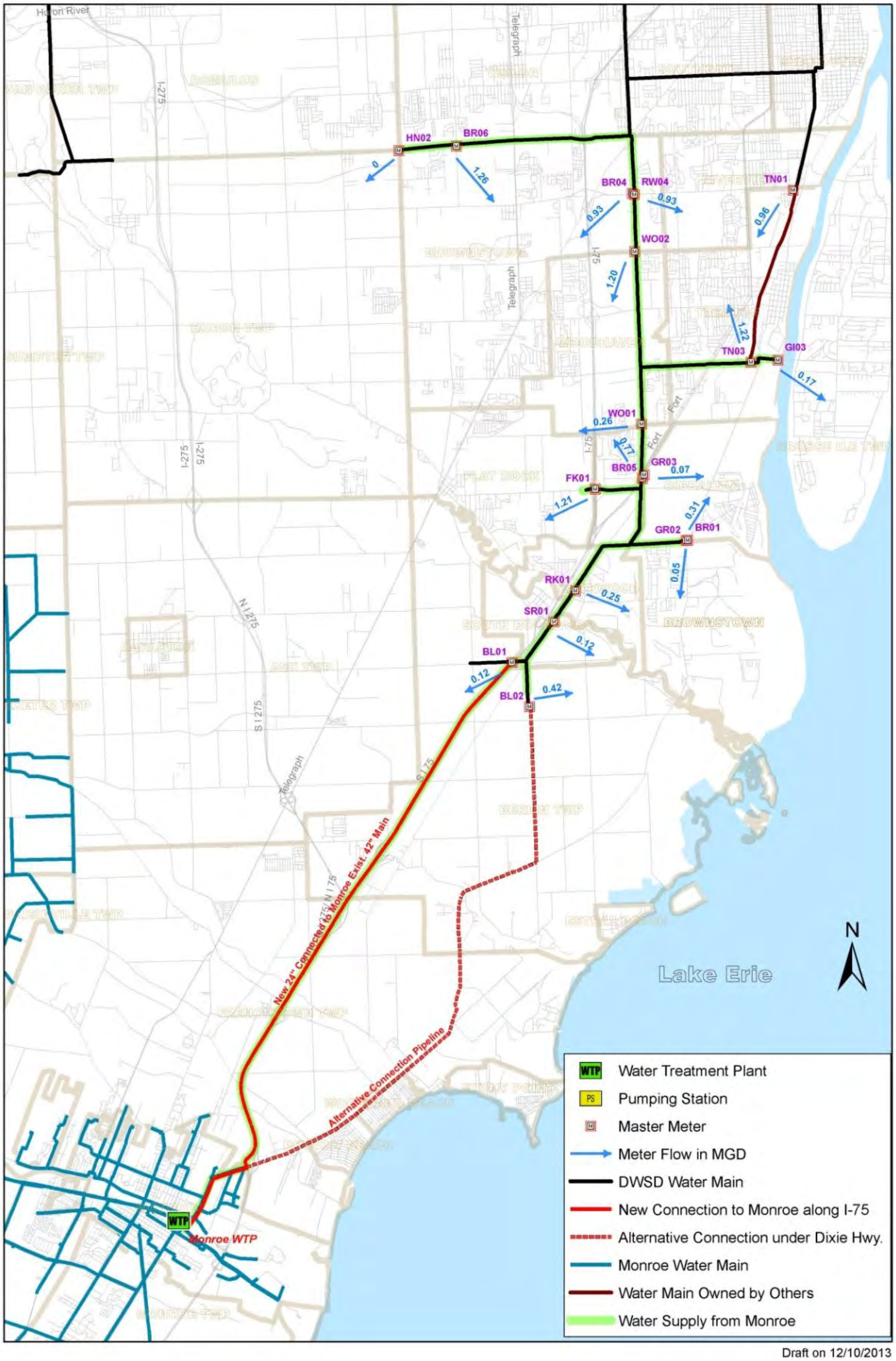


Figure 7-7: Alternative 5 – Emergency Water Supply from Monroe System

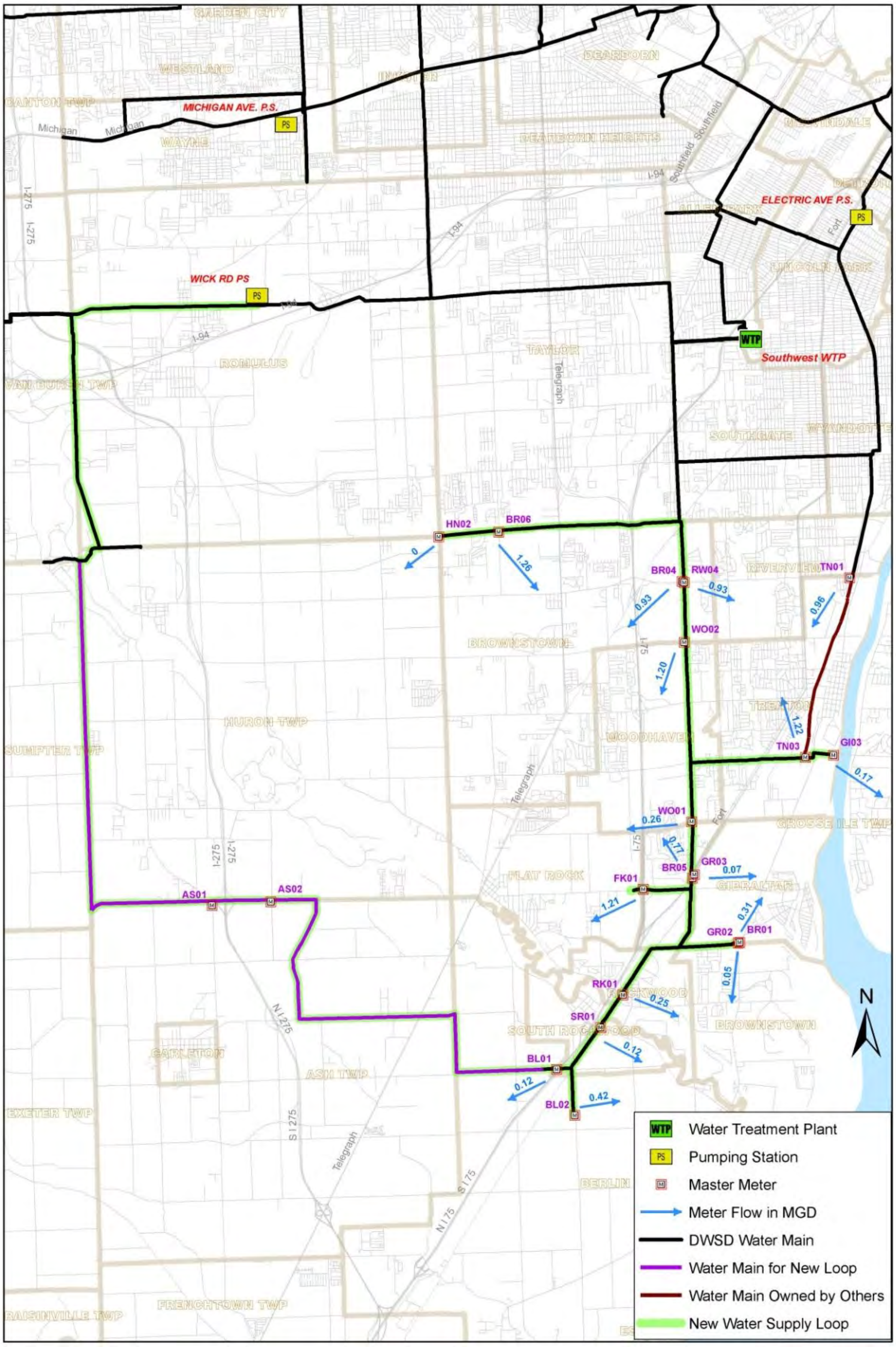


Figure 7-8: Alternative 6 – Alternative #1 Extension Pipeline Looped to Wick Road

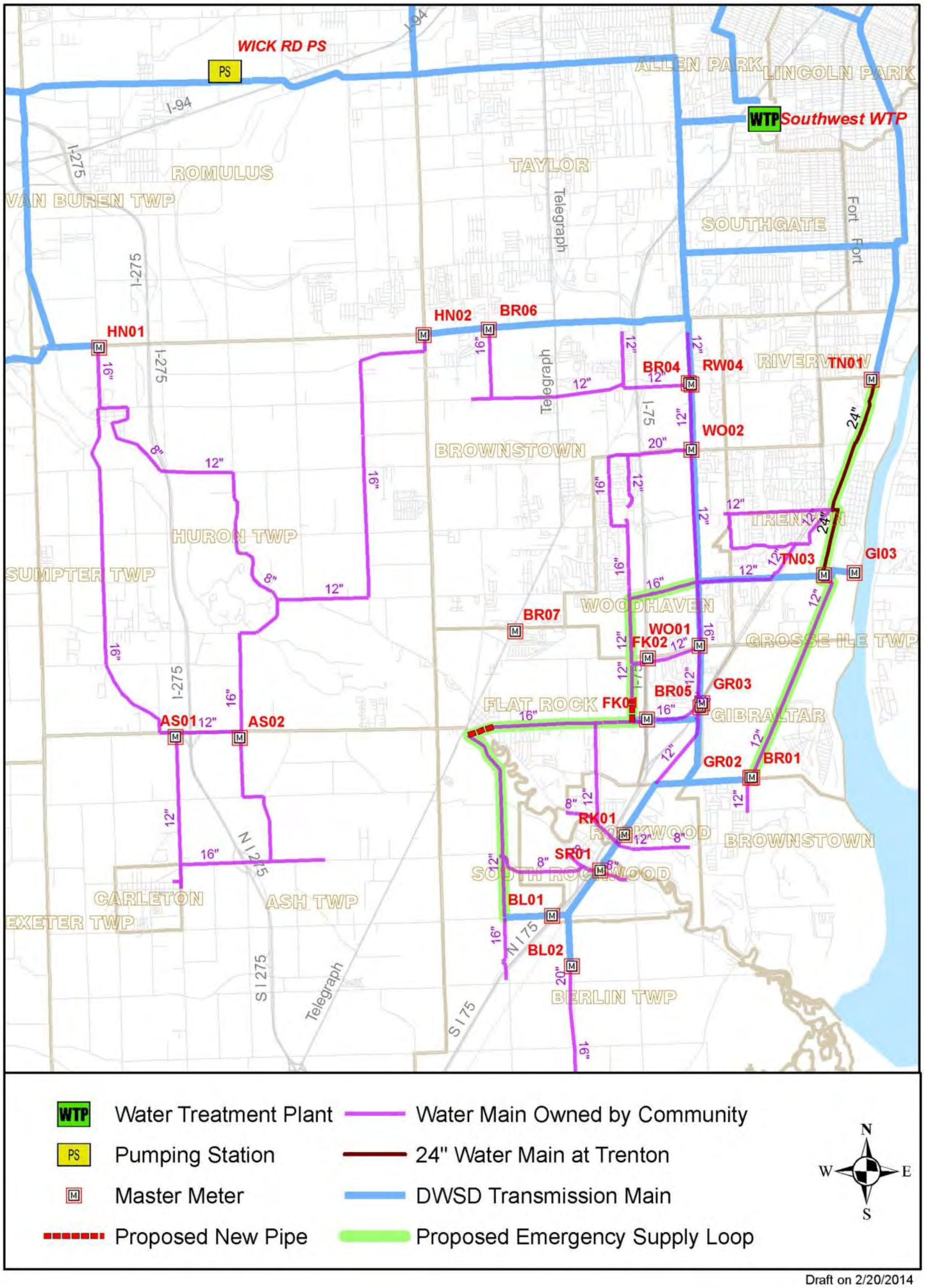


Figure 7-9: Alternative 7 – Use Community Distribution Pipes for Emergency Service

7.5 Energy Management

7.5.1 Introduction

DWSD's transmission system was originally designed to provide peak hour demand to most wholesale customers. The new Model Contract for wholesale water service introduced in 2007 was designed to incentivize wholesale customers to manage peak hour demand on the transmission system and promote regional planning. In the years since 2007, several customers have completed peak hour storage projects, and others are planning to add storage in the near future.

The trend started in 2007 is beginning to change demand patterns in the transmission system. This change in demand patterns provides an opportunity for additional review and optimization of energy management practice at DWSD. Reducing energy use within the transmission system is an important element of long term cost control. Electric energy costs comprise over 40 percent of DWSD's costs for treatment, high lift pumping and booster pumping in the transmission system. Changes in energy management practice early in the planning period will yield long term annual savings in operating cost.

Concurrent with the development of this Master Plan Update, DWSD was moving forward to implement a number of energy management initiatives. DWSD hired a Certified Energy Manager to lead efforts for evaluating a new proposed DTE rate schedule (D11), which could provide significant savings for DWSD. In the two previous years, DWSD consolidated all of its individual DTE accounts under one master agreement which makes it eligible for the new D11 rate schedule.

To provide current data for DWSD's efforts, the master planning team has focused on three aspects of electrical energy cost reduction:

- Peak Electrical Demand and Power Factor
- Optimization of Delivery Points to Wholesale Customers
- Energy Recovery through Hydraulic Turbines

7.5.2 Peak Electrical Demand and Power Factor

Copies of DWSD electrical bills were obtained from DTE for the summer 2013 months. The time period varied for each facility, but generally covered the time period between early December 2013 and January 2014. A summary of the information is provided in Table 7-5.

These data are the basis for the preliminary analysis for this Master Plan Update. DWSD has subsequently began to develop more extensive data and analysis of energy management opportunities.

Table 7-5: Summary of Recent Electrical Energy Bills for Major DWSD Facilities

Facility	DTW Rate Schedule	Dec 2013 Power Factor	Maximum Demand (KW)	Maximum Demand Charge (65%) (KW)	Data Date
Lake Huron	D6	99%	18,155	11,801	8/23/2013
Northeast	D6	99%	11,169	7,260	7/15/2013
Springwells	D6	99%	10,252	6,664	6/24/2013
Southwest	D6	98%	3,878	2,521	6/18/2013
Water Works Park	D6	98%	4,495	2,922	6/24/2013
Adams Road	D6	99%	1,848	1,201	7/15/2013
Eastside	D3	85%			N.A.
Electric Avenue	D3	88%			N.A.
Ford Road	D6	84%	1,037	674	8/23/2013
Franklin	D6	97%	2,217	1,441	7/16/2013
Haggerty	D3	80%			N.A.
Imlay	D6	87%	8,555	5,561	5/30/2013
Joy	D6	98%	1,940	1,261	5/20/2013
Michigan	D6	80%	209	136	7/17/2013
Newburgh	D6	91%	998	649	6/24/2013
North Service Center	D6	98%	5,472	3,557	7/15/2013
Northwest	D6	*Not available*			
Orion	D6	*Not available*			
Rochester	D3	49%			N.A.
Schoolcraft	D6	82%	1,015	660	8/19/2013
West Chicago	D3	54%			N.A.
West Service Center	D6	98%	1,858	1,208	8/26/2013
Wick	D6	85%	1,346	875	8/8/2013
Ypsilanti	D3	100%			N.A.

All of DWSD's facilities are either billed under the DTE Rate Schedule D3 or D6. The D3 rates are secondary service where DTE owns the transformer and DWSD receives voltage from the secondary side of the transformer at 120/240 Volts, 208/120 Volts, or 480/277 Volts. DTE will provide D3 service up to 1,000KW (or 1,176 KVA). The D6 and D6.1 rates are primary service where DTE brings the primary feed to the transformer. The transformer is owned by DWSD and they agree to a minimum load of not less than 50 KW for D6 or 10,000 KW for D6.1.

Both D6 rates have maximum demand charges equal to 65% of the highest KW use over the previous 11 months. Peak electrical demand is measured as the highest kilowatt use over a 30 minute period during the peak demand hours of the day (7:00 a.m. to 7:00 p.m.).

The Power Factor (PF) at the facilities is also monitored. The Power Factor is an indicator of how well the voltage and current is used at the facility. When electric motors are less efficient, the shift between the voltage and current use can become large. If this shift becomes too large then other customers on the DTE line are negatively impacted with their power feeds. DTE assesses a penalty for its D6 Schedule customers if the power factor falls below 85%. Customers with PFs less than 70% must install corrective equipment such as VFDs or PF correction capacitors.

7.5.3 Findings on Demand Charges and Power Factors

Electrical service costs represent over 25 percent of the Water Operations annual budget. Electrical service peak demand charges are typically about 25 percent, or more, of an individual facility's monthly electrical energy costs. Therefore, reducing demand charges is a means of reducing electrical service costs.

Reviewing Table 7.5, it would be expected that the maximum demand charge for the facilities would typically occur in the summer months. However, the maximum demand charge for two of these facilities (Imlay and Joy Road) occurred in May. It could have been due to an operational need within the transmission system, related to ongoing construction at one of these facilities or an adjacent facility. The cause that triggered the peak electrical demand charge could be useful to guide operating practice in the future.

The Maximum Demand Charge is a constant monthly charge for each month that follows the event that triggers the maximum demand. The Maximum Demand Charge can account for 20 to 30 percent of the total bill at times. DTE currently sets this charge at a rate of $14.34/kilowatt for 65% of the peak usage in the preceding 12 months. A recent evaluation by the Financial Advisor to the DWSD Board of Water Commissioners showed that the Imlay Station that is bypassed during the off season paid over $500,000 in fees associated with the difference between the peak demand charge and the actual peak use for each month.

Under the D6 schedule, three of the facilities have Power Factors less than 85%. They are Ford Road, Michigan Avenue, and Schoolcraft. DWSD can avoid cost penalties by improving the power factor at these facilities. Rochester and West Chicago have power factors below the 70% limit where DTE requires corrective actions.

DTE will perform an analysis for all of DWSD facilities to ensure that each station is on the most cost-effective rate schedule. The last known time this was done was in 2010. Based on the identified booster pumping stations to remain in operation, it will be beneficial for the Department to have another DTE analysis performed.

7.5.4 Delivery Point Optimization

Several wholesale customers are served by multiple supply meters over a range of pressures. The multiple supply points evolved over a period of time. Changes in population served, customer installed storage, and recent improvements and operation of the transmission system are reasons to review delivery points, and change past operating practice to reduce energy costs.

A case study of Redford Township's delivery points illustrates the potential for optimizing delivery to maintain pressures required by wholesale customers, but reduce the transmission system energy to meet those pressure requirements.

Figure 7-10 shows the existing delivery of water to Redford Township. The Township has 10 supply meters but currently takes the majority of its water from Meter RD09 at the northern end of the City.

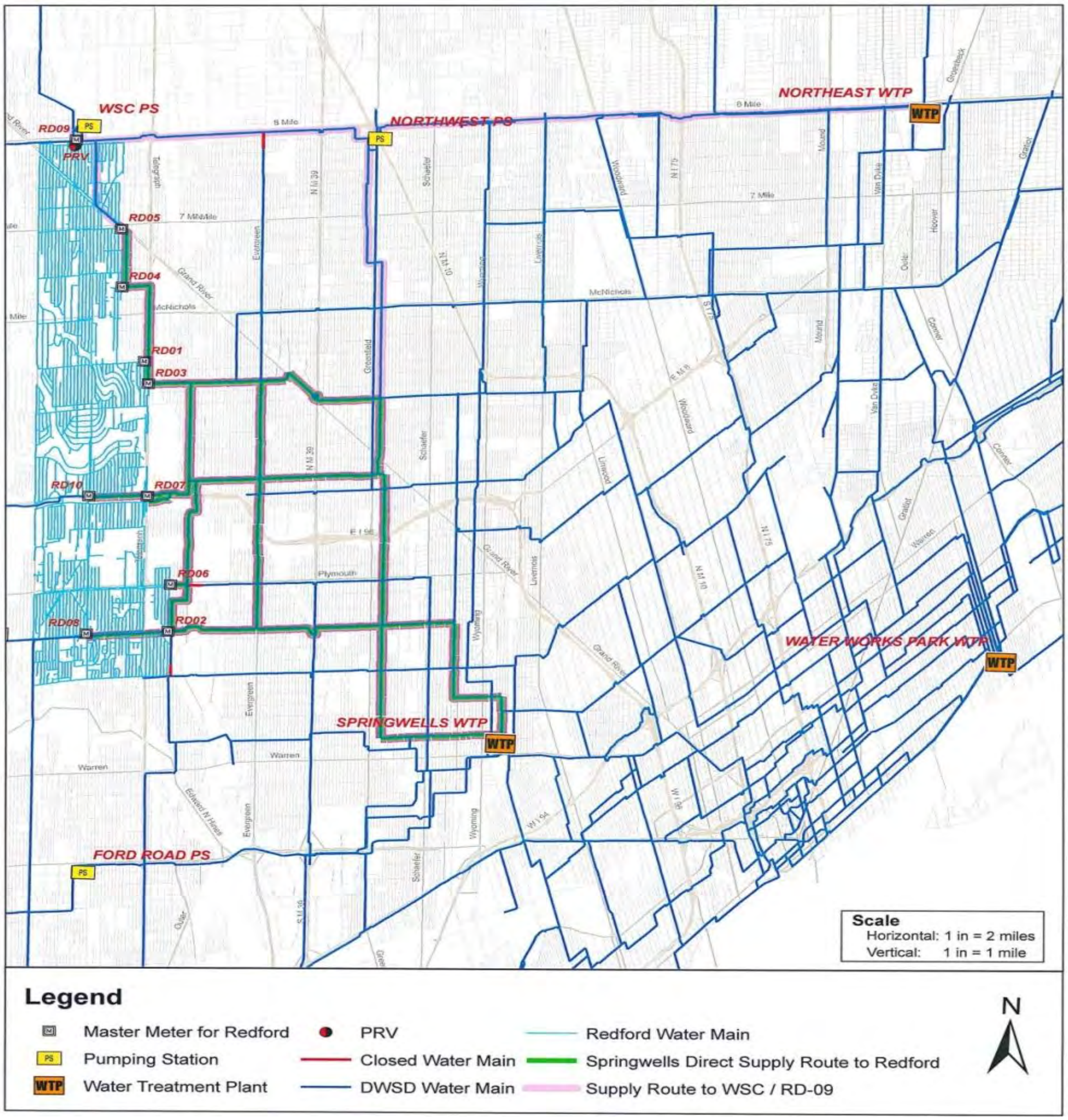
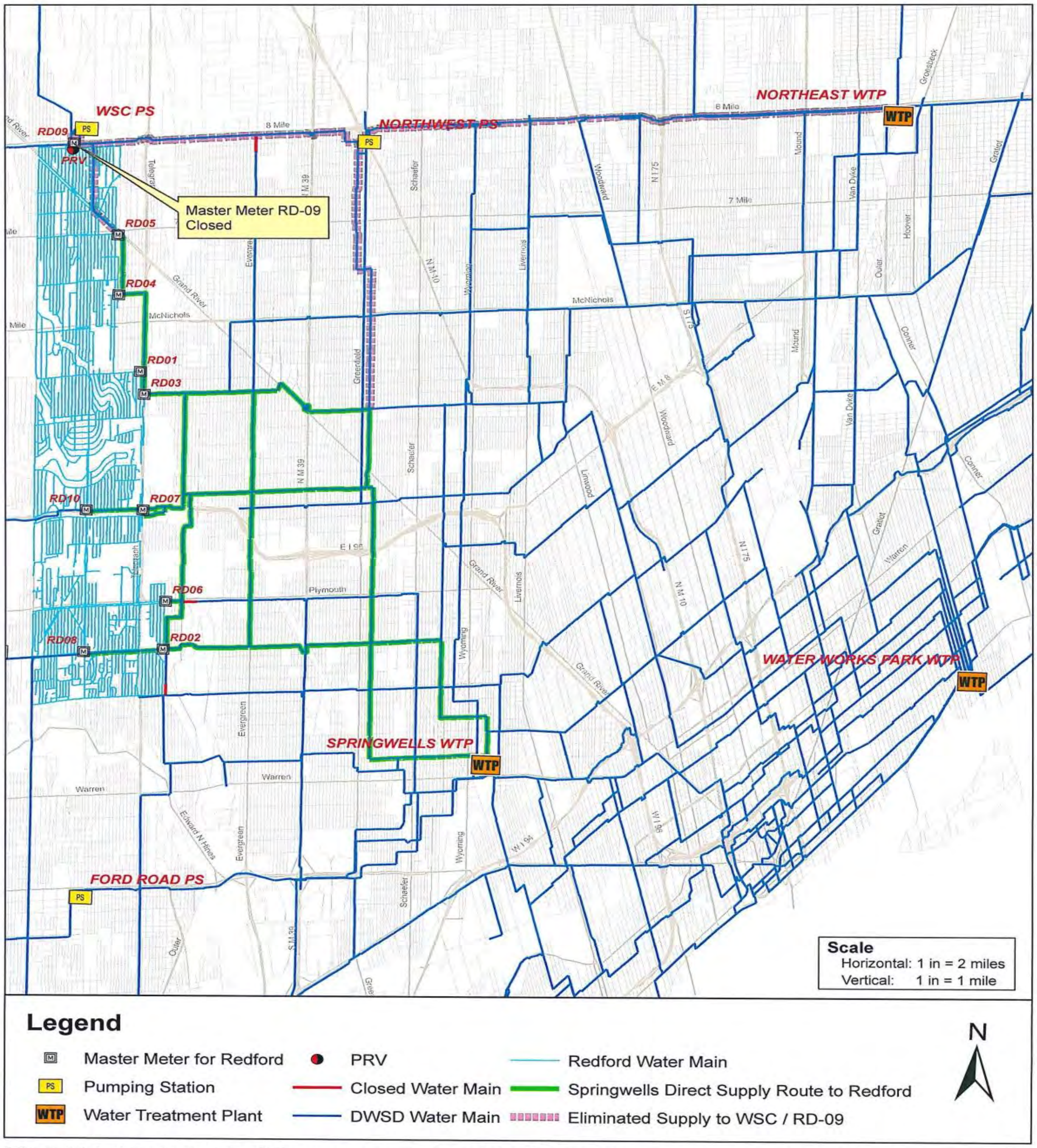


Figure 7-10: DWSD Water Transmission Energy Optimization Study, Water Supply to Redford Township - Existing Operations

This meter has the highest contract pressure requirement of all of Redford's meters. An evaluation was performed of the feasibility of delivering water only through Redford's other nine meters, as shown in **Figure 7-11**.



* The model simulation was based on 2011 system average day demand (471.1 MGD), Redford average day demand (4.76 MGD) and minimum pressure of 35 PSI maintained throughout the Redford distribution network.

Figure 7-11: DWSD Water Transmission Energy Optimization Study, Water Supply to Redford Township - Modified Operations

Tables 7-6 and 7-7 present a preliminary evaluation of cost savings for DWSD.

Table 7-6: Comparison of Master Meter Pressure and Flowrate between Existing and Modified Operations

Master Meter ID	Location	Existing Transmission Operations					Modified Operations (Changed Supply from WSC to RD-09)				
		Pressure from Model (PSI)			Flow from Model		Pressure from Model (PSI)			Flow from Model	
		Min	Max	Avg	Flow (MGD)	Percent	Min	Max	Avg	Flow (MGD)	Percent
RD-01	PURITAN/TELEGRAPH	49	76	64	0.00	0.03%	54	75	64	0.00	0.04%
RD-02	CHICAGO/W PARKWAY	62	85	75	0.31	6.54%	60	77	69	1.69	35.61%
RD-03	TELEGRAPH/MIDLAND	50	76	64	0.00	0.07%	55	72	64	0.02	0.52%
RD-04	BENETT/FIVE POINTS	43	71	59	0.03	0.55%	53	70	62	0.00	0.00%
RD-05	GRAND RIVER/7 MILE	40	68	56	0.03	0.54%	53	70	62	0.00	0.00%
RD-06	PLYMOUTH/W PARKWAY	56	81	56	0.06	1.17%	57	74	66	0.18	3.82%
RD-07	SCHOOLCRAFT/TELEGRAPH	53	79	67	0.01	0.18%	62	79	71	0.19	4.04%
RD-08	BEECH-DALY/W CHICAGO	60	80	72	0.79	16.49%	58	75	68	2.23	46.86%
RD-09	8 MILE/MACARTHUR (PRV)	70	109	94	3.39	71.18%	86	109	98	0.00	0.00%
RD-10	SCHOOLCRAFT/BEECH-DALY	54	83	70	0.15	3.25%	58	75	67	0.43	9.10%

Table 7-7: Comparison of Energy Consumption and Annual Energy Savings

Pumping Facility	Flow (MGD)	Avg. Press. (PSI)	Avg. Power (kW)	Daily Energy Use (kW)	Flow (MGD)	Avg. Press. (PSI)	Avg. Power (kW)	Daily Energy Use (kW)	Price (¢/KWh)	Energy Saving (KWh)	Percent Saving	Cost Saving
Northeast WTP	87.36	75.36	2649	63,570	87.19	75.34	2,643	63,434	8.411	49,732	0.21%	$4,183
Springwells WTP High	102.65	80.45	3323	79,743	102.92	80.18	3,320	79,684	8.411	21,314	0.07%	$1,793
West Service Center Int.	24.22	45.99	448	10,753	21.19	50.08	427	10,250	8.411	183,770	4.91%	$15,457
Northwest Pump Station	No Pumping	N.A.	0	0	No Pumping	N.A.	0	0	11.150	0.00	0.00%	$0

CDM Smith

7.5.5 Energy Recovery

The DWSD water transmission system has 19 locations where water is delivered to reservoirs and then re-pumped. Every delivery to a reservoir is an opportunity to recover energy. Also, there are 76 locations where either DWSD or one of its wholesale customers operates a pressure reducing valve (PRV). Each pressure reducing valve is also an opportunity to recover energy.

A pilot study was performed to investigate the economic and engineering feasibility for retrofitting hydraulic turbines in DWSD booster pumping station facilities. Technical Memo 16 demonstrates a potential installation for a 30 kilowatt hydraulic turbine generator at the West Service Center.

An analysis of energy savings possible at Imlay Station is shown in **Table 7.8**. Imlay Station draws suction from the reservoirs, rather than the 120-inch main.

Drawing suction from the 120-inch main would save $1.9 million per year.

Table 7-8. Energy Use Assessment at Imlay Pumping Station

Energy Loss Evaluation by Pumping Water from Reservoirs	
ADD Average Suction Pressure (PSI)	62
ADD Average Pressure in Reservoirs (PSI)	5
ADD Average Flow (MGD)	108
ADD Energy Loss (kWh)	59,514
MDD Average Suction Pressure (PSI)	55
MDD Average Pressure in Reservoirs (PSI)	5
MDD Average Flow (MGD)	300
MDD Energy Loss (kWh)	145,015
Annual Energy Loss* (kWh)	23,679,227
Energy Rate ($/kWh)	0.08
Annual Energy Cost	$1,895,000

* Annual energy loss is computed based on the monthly factors of average day and maximum day demand

7.5.6 Recommended Next Steps

Given the magnitude of energy costs in the annual O&M budget, GLWA should develop an energy management policy and procedures, as discussed in more detail in Chapter 11. Development of new policy and procedures should be based on established practice and case studies for the water industry. For example, the Water Environment Federation's *Energy Roadmap* provides a strategic approach to energy management and several case studies and methodologies.

Key features of energy management strategy should include:

- Strategic Management - policies, practices, measurable goals
- Organizational Culture – a shared vision within the organization regarding energy goals, and cross-functional teams empowered to achieve the goals

- Communication and Outreach – tools for two-way communication with operating staff and wholesale customers
- Demand-Side Management – methods to assess and reduce energy use and cost, bill, analysis, audits and real time monitoring
- Energy Generation – tools to evaluate feasibility, investment, and return on investment
- Continuing Innovation – assess results annually, refining goals, risk management, and further optimization study such as recommended in Section 7.9.1.8

7.6 Phase 2 Evaluations

The second phase of the planning effort included a needs assessment of booster pumping stations and reservoirs and hydraulic modeling of the transmission system projected average day demands and maximum day demands in 2035. Using the hydraulic model, a review was performed for needs for storage, transmission capacity improvements, and opportunities to reduce electrical energy costs for pumping. This analysis presumed that the Northeast water treatment plant would be repurposed, and the total capacity of the remaining four plants would be reduced to 1,040 MGD.

7.6.1 Booster Pump and Reservoir Needs Assessment

A series of meetings were held with DWSD staff and engineering consultants relative to renewal and replacement needs at booster pump stations and reservoirs. To facilitate these meetings, a list of major booster pumping and reservoir assets was created, and then discussion and documentation of needs proceed based on specific assets.

Table 7-9 includes the list of existing major assets for high lift pumping, booster pumping and reservoirs.

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Adams Road	109 MGD			
		Nitrogen Tanks		(2) Nitrogen Tanks
		HVAC System		
		Motor Control Center		Motor Controllers for Power Distribution Center
		Transformer		Tie Breaker, 4800V
		Switch Gear		
		VFD Drive		4800V VFD for LP #1 (installed 1992, no longer supported)
		Chiller System		
		Generators		(2) 4800V Emergency Generators
	18.20 MGD	LP #1		(4) Line Pumps
	18.20 MGD	LP #2		
	18.20 MGD	LP #3		
	18.20 MGD	LP #4		
	18.00 MGD	RP #1		(2) Reservoir Pumps
	18.00 MGD	RP #2		
		Reservoir	10 MG	Prestressed Wire-Wound Concrete Reservoir
		Sump Pumps		(2) Sump Pumps
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
East Side (CANYON)	30 MGD			
		HVAC System		
		Switchgear		
		Generators		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
East Side (CANYON)	10 MGD	RP #1		(3) Reservoir Pumps
	10 MGD	RP #2		
	10 MGD	RP #3		
		Reservoir	10 MG	Underground Concrete Reservoir
		Sump Pumps		(2) Sump Pumps
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Electric Ave.	24.5 MGD			
		HVAC System		
		Transformer		Main T-1, Main T-2
		Switchgear		
	5.04 MGD	LP #1		(2) Line Pumps
	5.04 MGD	LP #2		
	5.76 MGD	RP #3		(2) Reservoir Pumps
	8.64 MGD	RP #4		
		Reservoir #1	6.6 MG	3.3 MG Above Grade PWW Reservoir
		Reservoir #2		3.3 MG Above Grade PWW Reservoir
		Sump Pumps		(2) Sump Pumps
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Ford Road	109 MGD			
		HVAC System		
		Motor Control Center		
		Switchgear		
		VFD Drive		
	18.14 MGD	LP #1		(5) Line Pumps
	10.08 MGD	LP #2		
	10.08 MGD	LP #3		
	10.08 MGD	LP #4		
	10.08 MGD	LP #5		
	10.08 MGD	RP #6		(5) Reservoir Pumps
	10.08 MGD	RP #7		
	10.08 MGD	RP #8		
	10.08 MGD	RP #9		
	10.08 MGD	RP #10		
		Reservoir	10 MG	Reservoir
		Sump Pumps		(2) Sump Pumps
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Franklin	164 MGD			
		HVAC System		
		Motor Control Center		
		Transformer		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Franklin		Switchgear		
		VFD Drive		4800V VFD for line pump 3
		VFD Drive		4800V VFD for line pump 4
		Soft Starters		(1) @ LP #1
		Generators		(2) 4800V Emergency Generators
	30 MGD	LP #1		(4) Line Pumps
	30 MGD	LP #2		
	30 MGD	LP #3		
	30 MGD	LP #4		*Acts as Line pump and Reservoir pump #3
	22 MGD	RP #1		(2) Reservoir Pumps
	22 MGD	RP #2		
		Reservoir	10 MG	Concrete semi-underground reservoir
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Haggerty Road	91 MGD			
		HVAC System		
		Motor Control Center		MCC No. 1 - 480V
		Transformer		
		Switchgear		
		VFD Drive		4160V VFD for Line pump 1
		VFD Drive		4160V VFD for Line pump 2
		VFD Drive		4160V VFD for Line pump 3 & Reservoir pump 3
	21 MGD	LP #1		(3) Line Pumps

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Haggerty Road	21 MGD	LP #2		
	21 MGD	LP #3		*Acts as Line pump and Reservoir pump #3
	14 MGD	RP #1		(2) Reservoir Pumps
	14 MGD	RP #2		
		Reservoir	10 MG	At Grade Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Imlay	575 MGD			
		HVAC System		
		Motor Control Center		
		Motor		P2 - 13,800V, P4 - 13,800V, P5 - 13,800V
		Transformer		
		Switchgear		
		VFD Drive		13,800V VFD for Pump 1
		VFD Drive		13,800V VFD for Pump 6
		VFD Drive		13,800V VFD for Pump 7
		VFD Drive		13,800V VFD for Pump 8
		VFD Drive		13,800V VFD for Pump 3
		Soft Starters		(3) @ LP #2, #4, #5
		Chiller System		
		Generator		Emergency Generator
	75 MGD	LP #3		(6) Line Pumps

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Imlay	70 MGD	LP #4		
	70 MGD	LP #5		
	70 MGD	LP #6		
	70 MGD	LP #7		
	70 MGD	LP #8		
	75 MGD	RP #1		(2) Reservoir Pumps
	75 MGD	RP #2		
		Fill System		8 electric motor operated cone valves with associated isolation BFVs, 4 manually-operated gates, with the system being on Ovation for control
		South Bypass		2 - 54" check valves in parallel and associated isolation BFVs with Ovation connected for remote monitoring
		West Bypass		24" pressure sustaining valve with associated isolation gates (2)
		Storm Lift Sta.		Storm drainage lift station
		Reservoir	20 MG	Reservoir (actual capacity is about 17 MG)
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Joy Road	94 MGD			
		HVAC System		
		Motor Control Center		
		Transformer		
		Switchgear		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Joy Road		VFD Drive		
		Soft Starters		(2) @ LP #2, #3
		Generators		(2) 4800V Emergency Generators
	15.84 MGD	LP #1		(3) Line Pumps
	15.84 MGD	LP #2		
	14.80 MGD	LP #3		
	16.13 MGD	RP #1		(3) Reservoir Pumps
	16.13 MGD	RP #2		
	14.80 MGD	RP #3		
		Reservoir #1	10 MG	5 MG Reservoir
		Reservoir #2		5 MG Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Lake Huron WTP	480 MGD	Capacity		Total Capacity is 480 MGD; Firm Capacity is 420 MGD.
		High Lift PS #1		Eight vertical 60 MGD pumps driven by synchronous electric motors. Station constructed for 20 pumps. Existing pumps are in opening positions for 2-9.
	60 MGD	High Lift PS #2		Pumps 2, 8 & 9 installed in 2000 and are three stage pumps rated at 415 ft TDH
	60 MGD	High Lift PS #3		Pumps 3-7 are original pumps (refurbished in 98-01), four stage pumps rated at 415 ft TDH
	60 MGD	High Lift PS #4		
	60 MGD	High Lift PS #5		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Lake Huron WTP	60 MGD	High Lift PS #6		
	60 MGD	High Lift PS #7		
	60 MGD	High Lift PS #8		
	60 MGD	High Lift PS #9		
		Reservoir #1	15 MG	Clearwells 1 and 2 below grade and are 15 MG each
		Reservoir #2	15 MG	
		Reservoir #3	14 MG	Clearwell 3 is above grade and is 14 MG
Michigan Ave	29 MGD			
		HVAC System		
		Motor Control Center		MCC No. 1 - 480V; MCC No. 2 - 480V
		Transformer		
		Switchgear		
	3.60 MGD	LP #1		(3) Line Pumps
	3.60 MGD	LP #2		
	4.32 MGD	LP #3		
	8.64 MGD	RP #4		(2) Reservoir Pumps
	8.64 MGD	RP #5		
		Reservoir	3.5 MG	Steel Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Newburgh	52 MGD			
		HVAC System	NA	

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Newburgh		Motor Control Center		
		Transformer		
		Switchgear		
	8 MGD	LP #1		(5) Line Pumps
	8 MGD	LP #2		
	12 MGD	LP #3		
	12 MGD	LP #4		
	12 MGD	LP #5		
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Northeast WTP	608 MGD			
		High Lift PS #1		Twelve single-stage, vertical centrifugal, double volute pumps
		High Lift PS #2		
		High Lift PS #3		
		High Lift PS #4		
		High Lift PS #5		
		High Lift PS #6		
		High Lift PS #7		
		High Lift PS #8		
	52 MGD	High Lift PS #9		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Northeast WTP	52 MGD	High Lift PS #10		
	50 MGD	High Lift PS #11		
	50 MGD	High Lift PS #12		
	50 MGD	High Lift PS #13		
	49 MGD	High Lift PS #14		
	52 MGD	High Lift PS #15		
	52 MGD	High Lift PS #16		
	52 MGD	High Lift PS #17		
	49 MGD	High Lift PS #18		
	50 MGD	High Lift PS #19		
N	50 MGD	High Lift PS #20		
		Reservoir #1	8 MG	One 8 MG reservoir under the filters
		Reservoir #2	15 MG	Two 15 MG each subsurface reinforced concrete reservoirs north of the HLPS
		Reservoir #3	15 MG	
North Service Center	271 MGD			
		HVAC System		
		Motor Control Center		MCC No. 1 - 5 480V
		Transformer		
		Switchgear		
		VFD Drive		4800V VFD Drive for Line pump 7
		VFD Drive		4800V VFD Drive for Line pump 8
		VFD Drive		4800V VFD Drive for Line pump 9
		VFD Drive		4800V VFD Drive for Line pump 10
		Generators		(4) 4800V Emergency Generators; (1) Portable
		LP #1		Out of Service
		LP #2		(9) Line Pumps are in service

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
North Service Center	19.30 MGD	LP #3		
	23 MGD	LP #4		
	19.30 MGD	LP #5		
	19.30 MGD	LP #6		
	30 MGD	LP #7		
	30 MGD	LP #8		
	30 MGD	LP #9		
	30 MGD	LP #10		
	15 MGD	RP #1		(4) Reservoir Pumps
	15 MGD	RP #2		
	20 MGD	RP #3		
	20 MGD	RP #4		
		Reservoir #1	20 MG	10 MG Reservoir
		Reservoir #2		10 MG Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Northwest	50 MGD			
		HVAC System		
		Switchgear		
	10 MGD	RP #1		(5) Reservoir Pumps
	10 MGD	RP #2		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Northwest	10 MGD	RP #3		
	10 MGD	RP #4		
	10 MGD	RP #5		
		Reservoir	10 MG	Underground Concrete Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Orion	14 MGD			
		HVAC System	NA	
		Motor Control Center		MCC No. 1 - 480V
		Transformer		
		Switchgear		
	2 MGD	LP #1		(4) Line Pumps
	4 MGD	LP #2		
	4 MGD	LP #3		
	4 MGD	LP #4		
		Main Building (Temporary)		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Rochester	72 MGD			
		HVAC System	NA	
		Motor Control Center		
		Transformer		
		Switchgear		
		VFD Drive		4160V VFD Drive for Line pump 1
		VFD Drive		4160V VFD Drive for Line pump 3
	14.40 MGD	LP #1		(5) Line Pumps
	14.40 MGD	LP #2		
	14.40 MGD	LP #3		
	14.40 MGD	LP #4		
	14.40 MGD	LP #5		
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Roseville	21 MGD			
		HVAC System	NA	
		Motor Control Center		MCC No. 1 - 480V
		Transformer		
		Switchgear		
	3 MGD	LP #1		(4) Line Pumps
	3 MGD	LP #2		
	5 MGD	LP #3		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Roseville	10 MGD	LP #4		
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Schoolcraft	80 MGD			
		HVAC System		
		Transformer		
		Switchgear		
		Generators		(2) 4800V Emergency Generators
	20 MGD	LP #1		(3) Line Pumps
	20 MGD	LP #2		
	20 MGD	LP #3		*Acts as Line pump and Reservoir pump #2
	20 MGD	RP #1		(1) Reservoir Pump
		Reservoir	10 MG	Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics, etc.
Southwest WTP	305 MGD			

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Southwest WTP	55 MGD	High Lift PS #1		Seven pumps driven by synchronous electric motors, cone-type discharge control valves with hydraulic oil valve operators
	55 MGD	High Lift PS #2		
	25 MGD	High Lift PS #3		
	30 MGD	High Lift PS #4		
	30 MGD	High Lift PS #5		
	55 MGD	High Lift PS #6		
	55 MGD	High Lift PS #7		
		Reservoir #1	10 MG	Diameter: 338' Depth: 15'
		Reservoir #2	10 MG	
		Reservoir #3	10 MG	
Springwells WTP	780 MGD			
	40 MGD	HLP#1		(4) High lift pumps located in the high pressure district
	40 MGD	HLP#2		
	40 MGD	HLP#3		
	40 MGD	HLP#4		
	50 MGD	HLP#5		(4) High lift pumps located in the intermediate pressure district
	50 MGD	HLP#6		
	50 MGD	HLP#7		
	50 MGD	HLP#8		
	60 MGD	HLP#9		(2) High lift pumps located in the intermediate pressure district
	60 MGD	HLP#10		
	60 MGD	HLP#11		High lift pumps located in the high pressure district

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Springwells WTP	60 MGD	HLP#12		
	60 MGD	HLP#13		
	60 MGD	HLP#14		
	60 MGD	HLP#15		
		Reservoir #1	21 MG	
		Reservoir #2	20 MG	
		Reservoir #3	22 MG	
Water Works WTP	640 MGD			
				DCS/Ovation
	80 MGD	HLP		High lift pumps installed in 1962
	80 MGD	HLP		
	80 MGD	HLP		
	60 MGD	HLP		
	60 MGD	HLP		
	60 MGD	HLP		
	60 MGD	HLP		
	40 MGD	HLP		
	40 MGD	HLP		
	40 MGD	HLP		
	40 MGD	HLP		
	2.4 MGD	RP #1		
	2.4 MGD	RP #2		
	2.4 MGD	RP #3		
		Reservoir #1	8 MG	

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Water Works WTP		Reservoir #2A	5.8 MG	
		Reservoir #2B	5.9 MG	
West Chicago	36.5 MGD			
		(Asset Data not listed)	NA (Res. has been removed)	(Asset Data not listed)
West Service Center PS	266 MGD			
		HVAC System		
		Motor Control Center		MCC No. 1 - 5 208V
		Transformer		
		Switchgear		
		Generators		(2) 4800V Emergency Generators
	30 MGD	LP #1		(6) Line Pumps
	30 MGD	LP #2		
	30 MGD	LP #3		
	28.80 MGD	LP #4		
	29.50 MGD	LP #5		
	29.50 MGD	LP #6		
		VFD		
		Discharge Division Valves		
	24 MGD	RP #1		(4) Reservoir Pumps
	24 MGD	RP #2		
	20 MGD	RP #3		

Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
West Service Center PS	20 MGD	RP #4		
		Reservoir #1	20 MG	Water Storage Reservoir
		Reservoir #2		Water Storage Reservoir
		Main Building		
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Wick Road	72 MGD			
		HVAC System		
		Motor Control Center		
		Nitrogen Tanks		(2) Nitrogen Tanks
		Transformer		
		Switchgear		
		Generators		(2) 4160V Emergency Generators
	18 MGD	LP #1		(3) Line Pumps
	18 MGD	LP #2		
	12 MGD	LP #3		*Acts as Line pump and Reservoir pump #3
	12 MGD	RP #1		(2) Reservoir Pumps
	12 MGD	RS #2		
		VFD		L1, L2, L3/R3
		Reservoir #1	10 MG	Buried concrete Reservoir
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas

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Table 7-9: Major Pumping and Reservoir Assets

Station/ Reservoir	Pumping Capacity	Asset (1)	Storage	Asset Description (1)
Wick Road		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics
Ypsilanti	54 MGD			
		HVAC System	NA	
		Transformer		
		Switchgear		
		Nitrogen Tanks		(2) Nitrogen Tanks
		VSDs		(3) VSDs on all three line pumps
		Soft Starters		(3) @ LP #1, #2, #3
		Generator		(1) Emergency Generator
	18 MGD	LP #1		(3) Line Pumps
	18 MGD	LP #2		
	18 MGD	LP #3		
		Temporary Building		Existing Temporary Building
		Main Building		
		Sump Pumps		(2) Sump Pumps
		Grounds/Fences/Gates		Perimeter fencing, gates, driveways & parking areas
		Primary Instruments		Magnetic flow meters, level transmitters, pressure transmitters, vibration transmitters, motor temp transmitters, power monitoring, motor protection electronics

(1) Major Assets are in BOLD as listed in DWSD Asset Management Data Base "BOOSTER STATIONS AND SEWAGE STATIONS -ALL ASSETS (EXCLUDING DELETED AND INACTIVE) as of November 2013

The needs assessment results are documented in TM-14 in the appendix. The results of the needs assessment have been incorporated in the preliminary 20-year CIP in TM-17.

7.6.2 Hydraulic Modeling

A system-wide master planning hydraulic model was developed to simulate Year 2035 demands. The model was created based on an operational model of the system developed by DWSD under a concurrent contract. The model was updated by the master planning team with new information on nonrevenue water and recent and proposed system improvements.

The hydraulic model uses WaterGEMs modeling software. There are approximately 25,000 pipes in the model network. Demands were developed for each wholesale meter and for districts of retail meters based on calculated domestic, commercial, institutional, and major industrial demands, plus allowances for nonrevenue water. Demand patterns for each meter were developed from a review of 3 years of demands and are documented in TM-3. All modeling demands are consistent with the wholesale customer projections documented in TM-15. Additional discussion of the hydraulic model is presented in TM-11.

The hydraulic model was used to examine a range of service delivery options. The results of the modeling are presented below through the description of proposed transmission improvement programs.

7.7 Proposed Transmission Programs

Four programs are identified for improvements to the transmission system:

- Program to Decommission Certain Booster Pumping Stations
- Program to Optimize Service Delivery
- Program to Improve Transmission Redundancy
- Program for Renewal and Reliability

Leak detection programs are discussed in Chapter 9.

Accompanying this master plan report is a 20-year Capital Improvement Plan (CIP) spreadsheet that lists approximately 350 CIP projects. These projects are organized by program, including the four programs listed above for transmission, plus other programs for transmission, distribution, and metering and non-revenue water.

7.8 Program to Decommission Certain Booster Pumping Stations

The requirements for booster pumping stations were examined using the 2035 MDD model. There are 20 booster pumping stations in the transmission system. 2035 modeling results show that potentially 4 stations could be bypassed. These are generally older stations where present day demand and projected future demand are lower than the demands when the original stations were built.

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1. The Electric Ave Station has been used infrequently in the last 5 years. It could be permanently decommissioned based on the MDD model simulation while still meeting wholesale customer contract pressures. The Southwest High Lift station would be used to meet wholesale customer pressure requirements.

2. The Michigan Ave Station is a single water transmission to supply the City of Wayne and some master meters for Westland, Romulus, Garden City and Inkster. The upcoming Glenwood transmission main project will not provide redundancy for the function of Michigan Ave Station. However, following the completion of the Glenwood project, an additional 24-inch transmission main on Newburgh Road from Cherry Hill to Glenwood would allow the decommissioning of the Michigan Avenue Station. This new transmission main would also provide redundant supply to this area. This $5,000,000 project is included in the proposed 20-year CIP.

3. The West Chicago Station could be decommissioned if both Livonia and Westland agree to change flow splits for the Meters LV-15 (approximately 15% of total water supply to Livonia) and WL-06 (approximately 10% of total water supply to Westland). Per the model simulations, the supplies from the two meters can compensated by the other master meters serving the two communities.

4. The Northwest Station and reservoir could be decommissioned with a change in flow split within the SOCWA system

5. The existing reservoirs at Northwest, Electric Avenue, and Michigan Avenue would also be decommissioned. The Electric Avenue and Michigan Avenue reservoirs are relatively small, and the Northwest reservoir is a below grade reservoir. There is sufficient storage and transmission redundancy in each of the operating zones where these reservoirs are located, particularly if reservoirs operated by SOCWA could be used in an emergency to supply water outside of SOCWA's service area.

6. **Table 7-10** shows current flow splits for customers served by these stations.

The following approach is proposed for DWSD to work with its customers to examine opportunities for changing flow splits to reduce future capital and annual operating costs:

1. Schedule meetings with the community to present DWSD's interest in reapportioning the community's supply during the 3rd quarter of 2015.

2. Present the need to close down the particular facility (condition of the facility, the cost to renovate, energy costs, etc.).

3. Ask their engineer to analyze the new distribution of flow in their local model and identify any improvements that may be needed (if any) within their community. Complete these analyses by the end of 2015.

4. Develop an approach that addresses the community's need for peak supply, non-peak supply, and redundancy. Complete this during the first quarter of 2016.

The current CIP includes $45,000,000 for upgrades to the Electric Avenue, Northwest, Michigan Avenue and West Chicago. After deducting the $5,000,000 for the new 24" main along Newburgh Road between Cherry Hill Road and Glenwood Avenue, the net savings would be approximately $40,000,000. Annual energy cost savings, including reduction in demand charges based on the current rate schedule, are estimated to be $300,000 to $500,000 annually.

Figure 7-12 shows alternative locations for proposed new transmission mains to replace the Michigan Avenue booster station. One alternative is a 24-inch main on Newburgh Road between Cherry Hill and Glenwood Avenue. A second alternative is a 30-inch main on Merriman Road. The Newburgh Road alternative allows for the bypass of the Michigan Avenue Pump Station and provides a redundant transmission supply to the City of Wayne, which is currently supplied only by single source. The Merriman Road alternative provides a more direct supply and improved pressure from the Ford Road booster station, but it does not provide the redundant loop at the west end of the Michigan Avenue main. Both alternatives should be examined during design, along with a third alternative to create a loop from a main in Hannan Road extending from the south and supplied from Wick Road booster station.

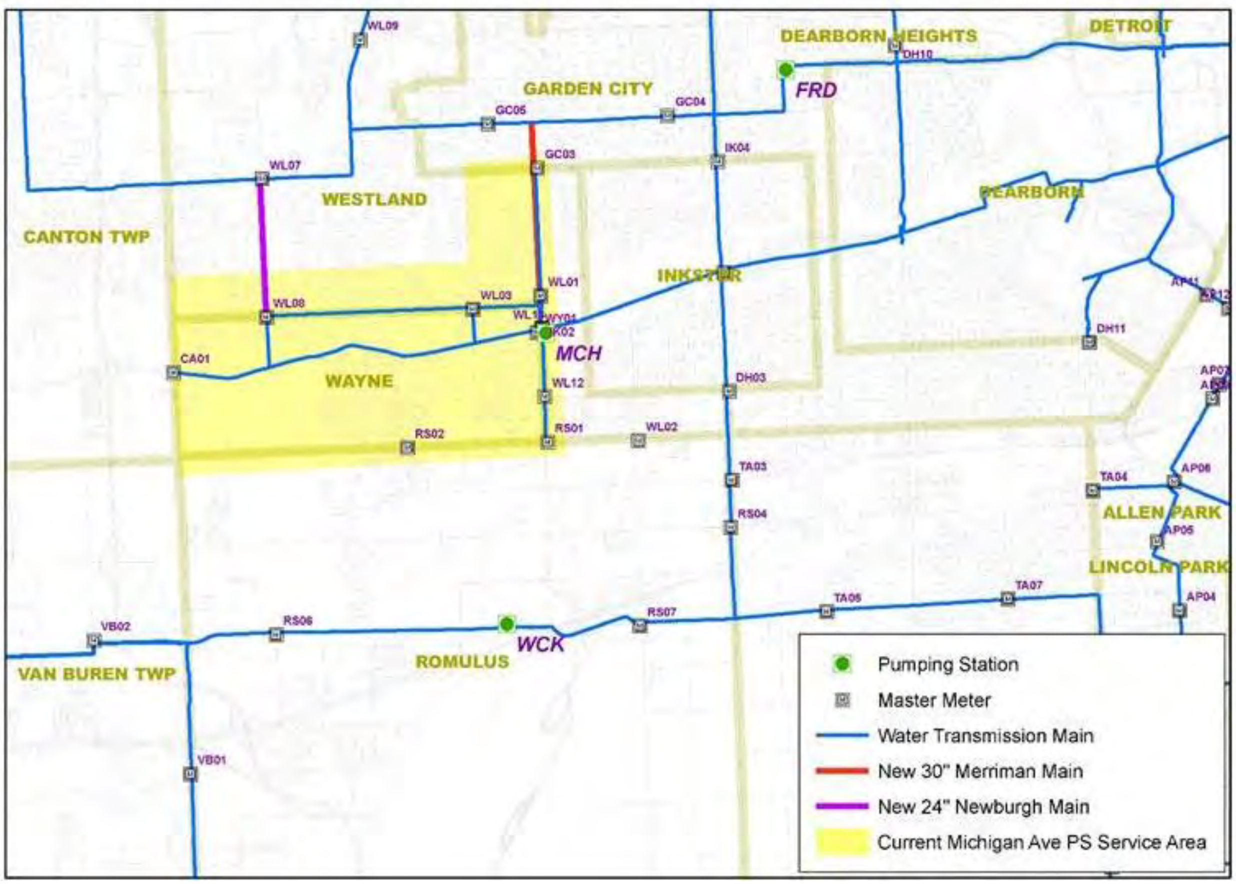

Figure 7-12: Proposed Alternative Mains on Newburgh Road or Merriman Road to Replace the Michigan Avenue Booster Station

7.9 Program to Optimize Delivery to Certain Customers

The program to optimize delivery is targeted at those customers who are supplied water at pressures greater than needed for the customer's service area. Some supply pressures are dictated by requirements of adjacent customers, and some supply pressures may be high due to the transmission main from which the customer is served.

Table 7-11 presents an analysis of opportunities to optimize service at lower pressure to certain customers. Changes to the customer supply point or to the transmission system are identified, capital costs are estimated, along with energy savings and payback period.

This program also includes projects required to maintain adequate chlorine residual for Lapeer City and Mayfield. These customers are located on the western end of the 72-inch main to Flint, and the water age will be in excess of 20 days when Genesee County discontinues its water purchases from DWSD in July 2016. DWSD is currently performing bench scale tests to determine the requirements for chlorine booster stations. If chlorine booster stations are required, then a design build project would be awarded later in 2015 to build the new facilities.

Figures 7-13 and 7-14 show the projected service areas of the four water treatment plants in 2035 for average daily demand and maximum day demand. The new service areas will increase the service area for the Lake Huron and Water Works Park plants. Finished water supply from Lake Huron will be at a higher pressure, and three customers – Madison Heights, Sterling Heights and Troy – have meters in critical locations relative to the new service areas. **Table 7-11** shows the analysis of meters and anticipated new pressures. All of the meters are within or very close to existing contract limits. Therefore, it is recommended that no new PRVs be installed, but instead monitor pressures as the new service areas are implemented and assess the need for PRVs or changes in contract limits in the future.

Table 7-10: Booster Pump Stations and Existing Flow Splits

Booster Station	Affected Community	Supply Percentage	Affected Master Meters
West Chicago	Livonia	15%	LV-15
West Chicago	Westland	10%	WL-06
Northwest	S.O.C.W.A.	25%	SE-05, 07
Michigan Avenue	City of Wayne	100%	WY-01
Michigan Avenue	Romulus	4%	RS-01, 02
Michigan Avenue	Westland	16%	WL-01, 03, 08, 12, 13
Michigan Avenue	Garden City	24%	GC-03
Michigan Avenue	Inkster	0%	Emergency Supply Meter, IK-02

Table 7-11: Analysis of Meters and Anticipated New Pressures for the New Lake Huron Service Area

Community	Meter	Model Simulation		Contract Limits	
		Min	Max	Lower	Upper
MADISON HEIGHTS	_MH01	55	62	51	78
	_MH02	57	67	53	80
STERLING HEIGHTS	_ST02	58	71	55	77
	_ST03	71	86	59	90
	_ST04	61	78	49	79
	_ST05	60	71	56	82
	_ST06	74	91	68	89
	_ST07	73	89	69	90
	_ST08	70	86	61	83
	_ST09	58	73	50	73
	_ST10	64	75	65	86
	_ST11	43	60	31	54
TROY	_TY01	60	75	50	75
	_TY03	56	68	51	77
	_TY04	125	136	114	149
	_TY06	98	102	87	111
	_TY07	86	89	72	96
	_TY08	119	131	104	134

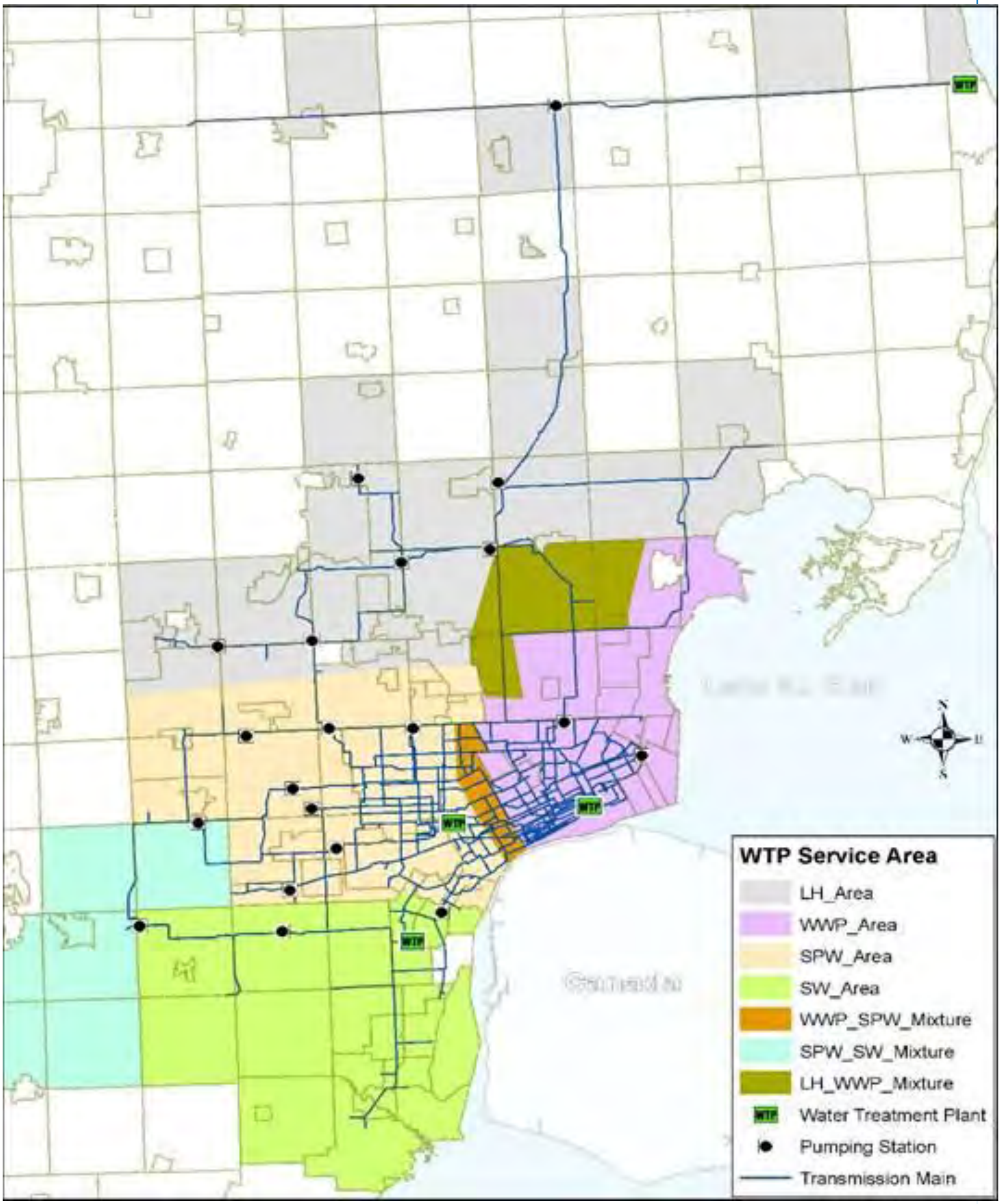

Figure 7-13: 2035 Service Areas for Average Daily Demand

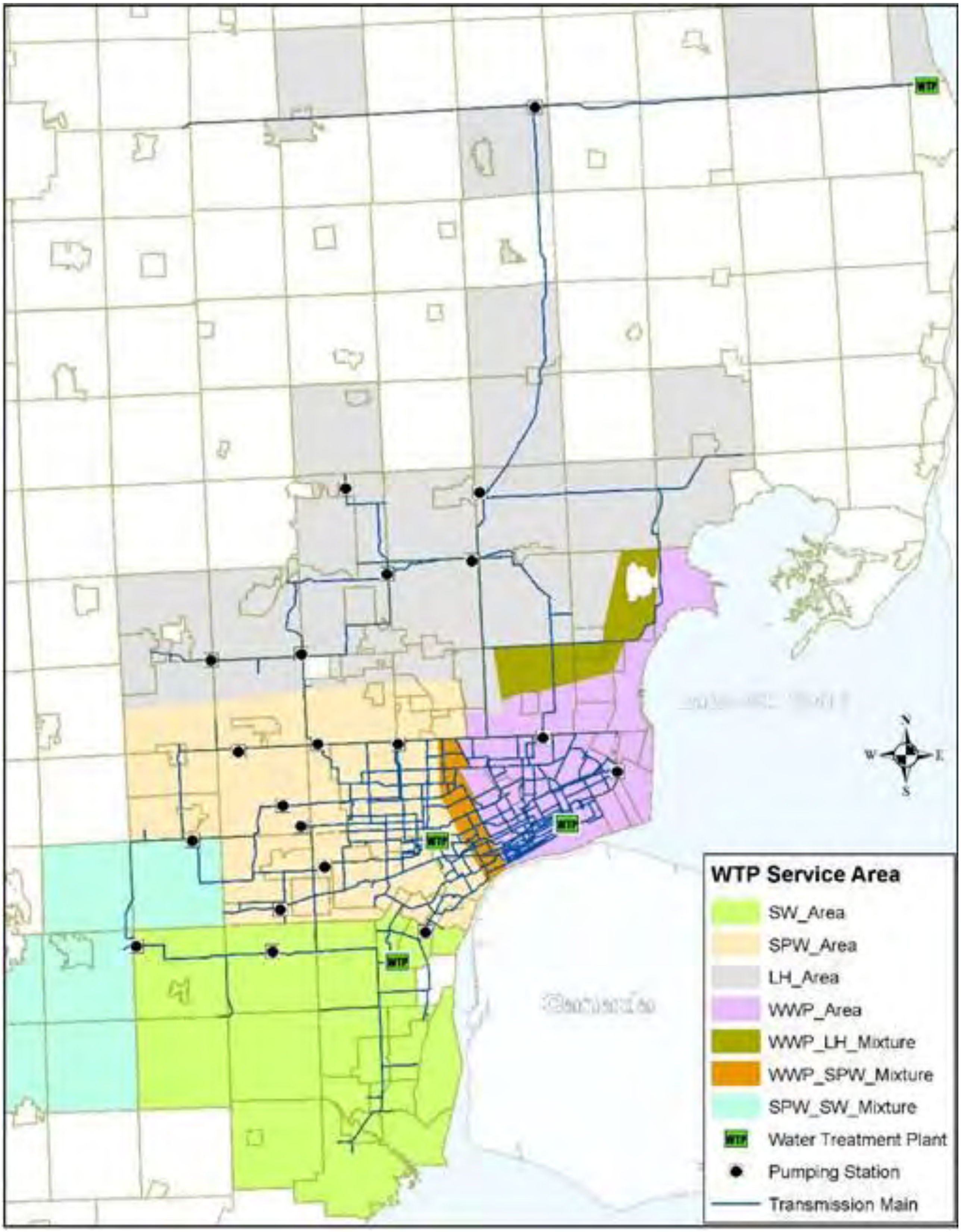

Figure 7-14: 2035 Service Areas for Maximum Daily Demand

7.9.1 Energy Evaluation Based on Seasonal Adjustment (Non-Peak Period)

An energy evaluation was conducted to identify communities that may have excess pressure within their system. This analysis is based on an assumed 35 psi minimum pressure at the highest point of service within the community and the associated headloss from the master meters to the high point.

If a community was found to have excess pressure then the lower contract pressure limit was adjusted by the excess amount and energy savings within the system was calculated. If capital improvements were required then the costs were identified and the associated payback period was computed.

Generally, the energy savings were based on supplying the lower contract pressures during the non-peak period (October through April) and then supplying pressures within the contract limits during the summertime when demands are highest.

The energy evaluation is considered preliminary since each individual system was not modeled as part of this analysis. It is recommended that savings that provide a payback period of less than 25 years should be investigated further with the communities.

The findings for each community with potential excess energy are summarized in **Table 7.11**. A description of each is provided below.

7.9.1.1 Macomb Township

24 Mile Road is the main supply to Macomb Township. By 2035 two parallel mains will supply the area. The lowest pressure supplied to this main is currently controlled by Rochester Hills and communities north of 24 Mile Road. The energy analysis for this area is based on splitting the discharge header at Rochester Station and additional piping so that the two mains along 24 Mile Road could be separated. The one main would supply Rochester Hills and the communities north of 24 Mile Road while the other main would supply Macomb Township.

7.9.1.2 Keego Harbor/Slyvan Lake

These communities are supplied by the 42-inch loop between the Adams Road and Franklin Pump Stations. The pressure for the area is controlled by West Bloomfield master meters. To supply a lower pressure to Keego Harbor and Slyvan Lake would require a pump station at West Bloomfield to boost its pressure. The estimated payback period exceeds 35 years, so it is not considered cost-effective.

7.9.1.3 Utica

Utica is supplied by the 24-inch main along Utica Road and Auburn Road. This main also supplies two of Shelby Township's meters which control the pressure along Utica Road. Savings could be achieved by constructing a main from Auburn south to M-59. **Figure 7-15** shows the proposed new supply main for Utica.

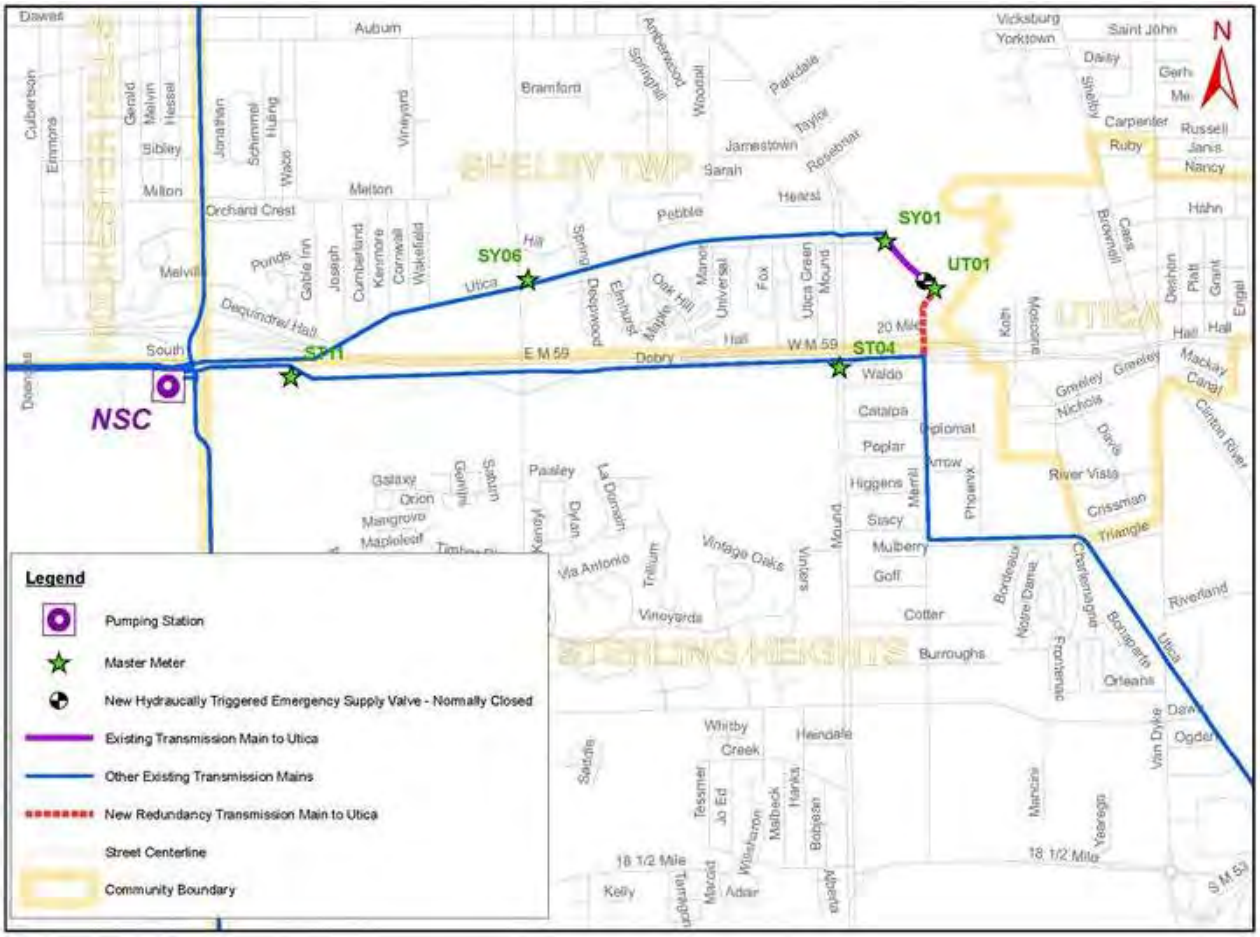

Figure 7-15: Proposed New Supply to Utica

In conjunction with the change to service for Utica, a hydraulic turbine should be evaluated for the North Service Center cone valves, which throttle pressure from Imlay Station. In the current operation, the energy dissipated through the cone valves has a value of $1,600,000 annually. Some of this energy loss will be reduced after the service area for the Lake Huron plant is extended to the south of the North Service Center. A new hydraulic turbine would take the place of one or more cone valves and recover approximately $400,000 in renewal energy annually.

7.9.1.4 Plymouth

This community is supplied from the Sheldon main. To realize the energy savings supplying the City of Plymouth, pump stations would be required to supply Plymouth and Northville Townships.

7.9.1.5 Gibraltar/South Rockwood

These communities are supplied via the Allen Road main. This main is controlled by the contract pressures to Brownstown. To realize the energy savings supplying Gibraltar and South Rockwood a pump station would be required to supply the Brownstown supply north of these communities.

7.9.1.6 River Rouge

River Rouge is supplied via the main along Jefferson. This main is controlled by the contract pressures to Melvindale. To realize the energy savings supplying River Rouge a pump station would be required to supply Melvindale at ME-03. However, since ME-03 only accounts for 10% of the supply to Melvindale, it should be investigated whether this meter could be closed. Closing the meter would realize the energy savings without additional capital improvements in the transmission system.

7.9.1.7 Grosse Pointe Park

Energy savings supplying Grosse Pointe Park may be achieved by creating a new district with lower pressures in the Detroit area that supplies the community. The estimated cost is based on an assumed rehabilitation cost associated with valves required to isolate the area.

7.9.1.8 Summary

The energy optimization analysis performed for this Water Master Plan Update is a first step to using new data available through the wholesale meter systems, the hydraulic model, and its energy analysis features. An additional study is recommended to be performed jointly by DWSD and respective customers in operating zones where further optimization is considered feasible.

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Table 7-12: Reducing Master Meter Supply Pressure for Communities with Excess Pressure

Region	Community	Master Meter ID	Existing Contract Lower Limit (psi)	Excess Pressure [1] (psi)	Contract Lower Limit Change (psi)	Off-Peak Season energy Saving [2] (kWh)	On-Peak Season energy Saving [2] (kWh)	Energy cost saving [3] ($)	CIP Cost ($1,000)	Payback (Years)	Notes
2	Keego Harbor	KH-01	92	45	92 / 47	198,952	0	15,916	1,452	>35	Local pumping is required to boost the pressure for the West Bloomfield master meters to obtain the energy savings in Keego Harbor and Sylvan Lake
2	Sylvan Lake	SL-01	93	38	93 / 55						
3	Utica	UT-01	107	56	107 / 51	84,946	0	6,796	220	32	Build a new isolation valve and a redundancy pipeline to serve Utica.
4	Plymouth	PT-02	65	31	65 / 34	233,000	0	18,640	577	31	Local pumping required to boost pressure for Northville and Plymouth Township to obtain the energy savings in City of Plymouth.
		PT-03	125	31	125 / 94						
		PT-04	75	31	75 / 44						
6	Gibraltar	GR-02	61	8	61 / 53	637,140	0	50,971	742	15	Local pumping is required to boost the pressure for Browntown Township.
		GR-03	57	8	57 / 49						
6	South Rockwood	SR-01	60	9	60 / 51						
6	River Rouge	RR-01	58	10	58 / 48	260,663	0	20,853	113	6	Local pumping is required to boost the pressure for Melvindale, ME-3. If ME-3 can be closed (10% of supply) then no capital improvements required.
		RR-02	54	10	54 / 44						
		RR-03	53	10	53 / 43						
7	Grosse Pointe Park	GK-01	59	12	59 / 47	302,301	92200	31,560	500	16	Annual energy savings obtained by isolating a portion of the WWP Intermediate Zone. Approximately 20 isolation valves are required to be closed to isolate the area.
		GK-02	59	12	59 / 47						
		GK-03	60	12	60 / 48						

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7.10 Program to Improve Transmission Redundancy

This program includes continuing work with NOCWA on the Adams Branch and with the Downriver customers to resolve their respective needs for redundancy for the single transmission mains that serve their areas. Capital improvement projects are included in the capital improvement plan in TM-17 to provide the recommended redundancy or pumping station upgrades.

Table 7-13 presents an analysis of customers served by single transmission mains and proposed means to create redundancy through inter-customer emergency connections.

7.10.1 Chesterfield Pump Station

This program includes the construction of a new pumping station and reservoir in Chesterfield near 23 Mile Road. This proposed pumping station provides an alternative route to supply water north of 24-Mile Road in the event of a break on the 96-inch main south of 24-Mile Road. A new reservoir in Chesterfield also provides storage in region of the system where there is relatively little regional storage compared to other parts of the service area. The design concept for this facility is based on the recommendations of the 2004 Water Master Plan.

7.10.2 Downriver

This program includes a short reach of new parallel 24-inch main on Allen Road between Pennsylvania and Van Horn. Also included is a hydraulic modeling study by DWSD to confirm the concept plan for interconnections between communities shown in **Figure 7-9**. Following the modeling study, it is anticipated that the respective wholesale customers would complete their interconnections as part of planned water main extensions and upgrades.

There is a question regarding the legal ownership of the existing 24-inch main between TN-01 and TN-03 in Trenton. This main was not listed on the inventory of facilities that were transferred to DWSD by Wayne County in 1960. This main is critical to the redundancy solution for Downriver, and from a system perspective, it would be operationally advantageous if this became a GLWA main after legal review of historic documents.

Table 7-13: Wholesale Customers Served by Single Transmission Mains

High Priority Master Meters*	All Master Meters on the Single line	Single Main	Whole 2035 Population Served	Whole Average Day Demand 2035 (MGD)	Master Plan Conclusion
WAMR_CM02, WAMR_CM01, WAMR_WA01, WAMR_NV04, WAMR_CM03, WAMR_NV05,WAMR_WX01	WAMR_FT08, WAMR_WB03, WAMR_FT09, WAMR_WB02, WAMR_FT10, WAMR_WB06, WAMR_WB07, WAMR_CM02, WAMR_CM01, WAMR_WA01, WAMR_NV04, WAMR_CM03, WAMR_NV05,WAMR_WX01	From Haggerty Station To Wixom	150,256	18.5	Investigate the use of adjacent community water systems during an emergency along 14 Mile Road west of the Franklin Station. The emergency plan should include the Haggerty and Franklin reservoir supplies.
WAMR_BR06, WAMR_BR04, WAMR_RW04, WAMR_WO02, WAMR_TN03, WAMR_WO01, WAMR_GR03, WAMR_BR05, WAMR_FK01, WAMR_GR02, WAMR_BR01, WAMR_RK01, WAMR_SR01, WAMR_BL02, WAMR_BL01	WAMR_BR06, WAMR_HN02, WAMR_BR04, WAMR_RW04, WAMR_WO02, WAMR_TN03, WAMR_GI03, WAMR_WO01, WAMR_GR03, WAMR_BR05, WAMR_FK01, WAMR_GR02, WAMR_BR01, WAMR_RK01, WAMR_SR01, WAMR_BL02, WAMR_BL01	From Southwest Plant To Berlin Township	98,247	9.7	Recommendations have been made for wholesale customer interconnections plus DWSD transmission project with total cost of $5 million.
WAMR_YT01	WAMR_YT01	From Ypsilanti Station To Ypsilanti	90,124	8.2	YCUA to determine if communities can be supplied by remaining master meters if YT-01 is out of service. Explore parallel feed to YCUA, YT-01.
WAMR_CT04	WAMR_CT04	To Clinton Township	54,396	5.5	Clinton to determine if community can be supplied by remaining master meters if CT-04 is out of service. Explore parallel feed to CT-04.
WAMR_AH05, WAMR_OT01	WAMR_AH05, WAMR_OT01	From Orion station To Orion	28,443	4.6	Inter community redundancy improved by NOCWA

Table 7-13: Wholesale Customers Served by Single Transmission Mains

High Priority Master Meters*	All Master Meters on the Single line	Single Main	Whole 2035 Population Served	Whole Average Day Demand 2035 (MGD)	Master Plan Conclusion
WAMR_WB08, WAMR_KH01, WAMR_SL01	WAMR_WB08, WAMR_KH01, WAMR_WB01, WAMR_SL01	To Keego Harbor	36,413	4.4	Investigate the use of adjacent community water systems to develop an emergency operations plan for the service to Keego Harbor.
WAMR_PO01	WAMR_PO01	To Pontiac	33,860	4.1	Inter community redundancy improved by NOCWA
WAMR_NH01, WAMR_LX01, WAMR_LX02	WAMR_CH02, WAMR_NH01, WAMR_LX01, WAMR_LX02, WAMR_CH03	To Lenox Township	57,729	4.7	Investigate Chesterfield's ability to serve Lenox and New Haven during an emergency. Investigate emergency interconnect with the New Baltimore water system.
WAMR_EC01	WAMR_EC01	To Ecorse	7,656	2.9	Investigate emergency supply from adjacent communities. Investigate emergency interconnect with the Wyandotte water system.
WAMR_SS04, WAMR_SS05, WAMR_SS03	WAMR_ED02, WAMR_SS04, WAMR_HW06, WAMR_SS05, WAMR_SS03, WAMR_GW02, WAMR_GW03	To Grosse Point Wood	32,952	2.9	Communities to investigate whether their systems can be supplied by their other master meters during an emergency. Investigate use of adjacent community water systems for supply during an emergency.
WAMR_AH04, WAMR_AH03, WAMR_AH06	WAMR_AH04, WAMR_AH03, WAMR_RC02, WAMR_PO02, WAMR_AH06	From Adam Station To Auburn Hills	52,060	7.5	Inter community redundancy improved by NOCWA
WAMR_WY01, WAMR_WL03	WAMR_WY01, WAMR_WL03, WAMR_WL08, WAMR_WL12, WAMR_RS01, WAMR_WL01, WAMR_WL06	To Michigan Avenue Station	37,221	4.1	Recommendation for new 24" D.I. Pipeline along Newburgh Road between Cherry Hill Road and Glenwood Avenue

Table 7-13: Wholesale Customers Served by Single Transmission Mains

High Priority Master Meters*	All Master Meters on the Single line	Single Main	Whole 2035 Population Served	Whole Average Day Demand 2035 (MGD)	Master Plan Conclusion
WAMR_LA02, WAMR_LA01, WAMR_LA03	WAMR_IC01, WAMR_LA02, WAMR_LA01, WAMR_LA03	From Imlay Station To Flint	23,152	2.4	Lapeer has wells for back up supply.
WAMR_SU01	WAMR_VB05, WAMR_VB04, WAMR_SU01	To Van Buren Township	14,180	1.1	Van Buren to investigate whether their system can be supplied by their other master meters during an emergency. Investigate use of adjacent community water systems for supply to Superior Township.
WAMR_GI01	WAMR_GI01	To Grosse Ile Township	6,773	0.7	Grosse Isle to investigate whether their system can be supplied by their other master meters during an emergency.
WAMR_UT01	WAMR_SY06, WAMR_SY01, WAMR_UT01	To Utica	12,273	1.3	Investigate emergency service from Shelby Township or Sterling Heights. Installation of 16" main for energy reduction would also provide needed redundancy.

7.10.3 New Isolation Gates for 96-inch Main

The installation of additional isolation gates on the 96-inch main will require that the main be depressurized to approximately 30 psi for safety to during the installation of line stops.

While the main is depressurized, it will be necessary to provide temporary booster pumping at each metered connection, and issue a boil water advisory. It is possible that interconnections between wholesale customer systems would minimize the number of temporary booster stations. This work should be scheduled for a non-winter month outside of the peak outdoor irrigation season, such as October through April, exclusive of the winter months.

There are two existing isolation gates: one is immediately north of the North Service Center, and one in north of Romeo in Bruce Township at McKay Road and 33-Mile Road.

New gates are proposed at five locations, as shown in **Figure 7-16**:

1. Almont Township, near 44-Mile Road, and south of the existing 16-inch blind tee at Graham Road and Rider Road

2. Bruce Township, near Bordman Road, and south of the existing 16-inch blind tee at Scotch Settlement Road and Bordman Road

3. Washington Township, near 30-Mile Road, and south of WC-01 at 31-Mile Road and GTWRR

4. Washington Township, near Brown Road, and north of the 16-inch tee serving SY-2, SY-7, and WC-2.

5. Shelby Township, near 24-Mile Road, north of the 24-inch tee serving the Rochester booster pump station.

If 60-inch isolation gates are installed, the estimated head loss is 0.5 psi per gate. This is negligible head loss for this transmission main.

The following is a preliminary sequence of work.

The work would be divided into two phases. Phase 1 would be for work north of the existing isolation gate at McKay Road and 33-Mile Road. Phase 2 would be for work south of that isolation gate. Phase 1 could be completed within approximately 7 working days with multiple shift operations. The boil water advisory would extend for a second week. Phase 2 could be completed within two weeks with a multiple shift operation. The boil water advisory would extend for a third week.

7.10.3.1 First Phase Isolation Gates

During the first phase, customers south of the isolation gate at McKay Road and 33-Mile Road would receive average day water supply from the North Service Center at or near contract pressures.

Prior to construction, perform detailed planning and scheduling with two customers -- Almont and Bruce Township -- regarding arrangements for temporary pumping and boil water advisories.

1. Establish temporary pumping at meter AC-1 and BU-1.

2. Establish work area for hot taps at approximately 1,000 feet north and south of the new isolation gate

3. Make provision for draining the 96-inch main at the temporary pumping locations.

4. Close the isolation gate at McKay Road and 33-Mile Road.

5. Continue to supply water from the NSC to points south of McKay Road and 33-Mile Road.

6. Cease pumping at Imlay Station. AC-1 and BU-1 will be supplied from the volume of water in the main.

7. Begin temporary pumping from AC-1 and BU-1. Drain water from the pipe as needed. Drop the pressure in the 96-inch main to a pressure acceptable for installation of hot taps.

8. Complete four hot tap installations.

9. Increase pressure to approximately 60 PSI in impacted area, continue temporary pumping.

10. Install line stops for new isolation gate for near Bordman Road.

11. Install new isolation gate near Bordman Road.

12. Remove line stops for Bordman Road.

13. Install line stops for new isolation gate for near 44-Mile Road.

14. Install new isolation gate near 44-Mile Road.

15. Remove line stops for 44-Mile Road.

16. Initiate pumping at Imlay Station.

17. Restore normal water service north of McKay and 33-Mile Road.

18. Perform water quality testing and inspections over required period, then lift boil water alert.

19. Total estimated time for temporary pumping is one week, for Boil Water Alert (BWA) is two weeks.

7.10.3.2 Second Phase Isolation Gates

During the second phase, customers north of the existing isolation gate at McKay Road and 33-Mile Road would receive average day water supply from Imlay Station at or near contract pressures.

Use an approach similar to Phase 1. Install the new isolation gates from north to south. As each new isolation gate is completed, move the boundary of supply from Imlay Station further south.

7.11 Program for Renewal and Reliability

This program includes continuing upgrades for transmission mains and booster pump stations and reservoirs to extend or renew service life. A series of projects for water transmission main condition assessment and rehabilitation are proposed, along with identified needs for transmission isolation valves, valve exercising projects, booster pump station upgrades and reservoir improvements and repairs. There are approximately 260 transmission system valves that are 20 inches in diameter or larger. DWSD should develop condition assessment protocols and best practices over the period 2016 to 2020 to guide this program over the planning period.

The implementation of the proposed transmission programs will allow DWSD to operate its system on an emergency basis with any one plant out of service. **Figures 7-17 to 7-20** show how average day demand could be supplied under different plant outage scenarios.

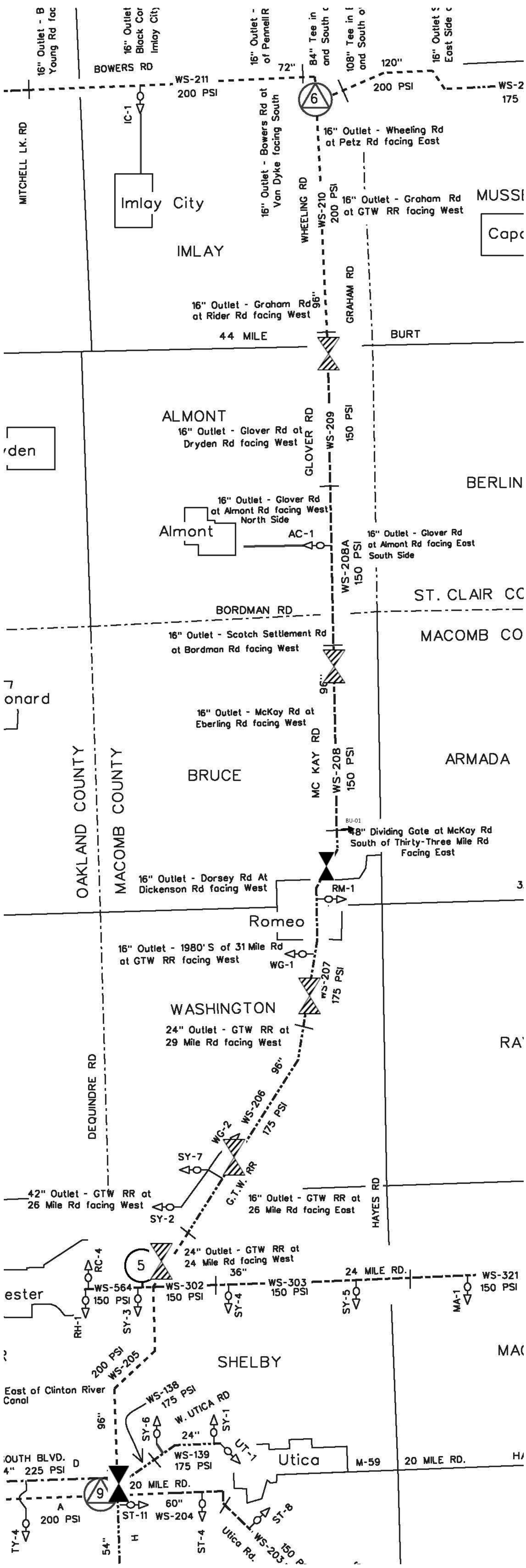

Figure 7-16: Proposed Isolation Valves for 96-Inch Transmission Main

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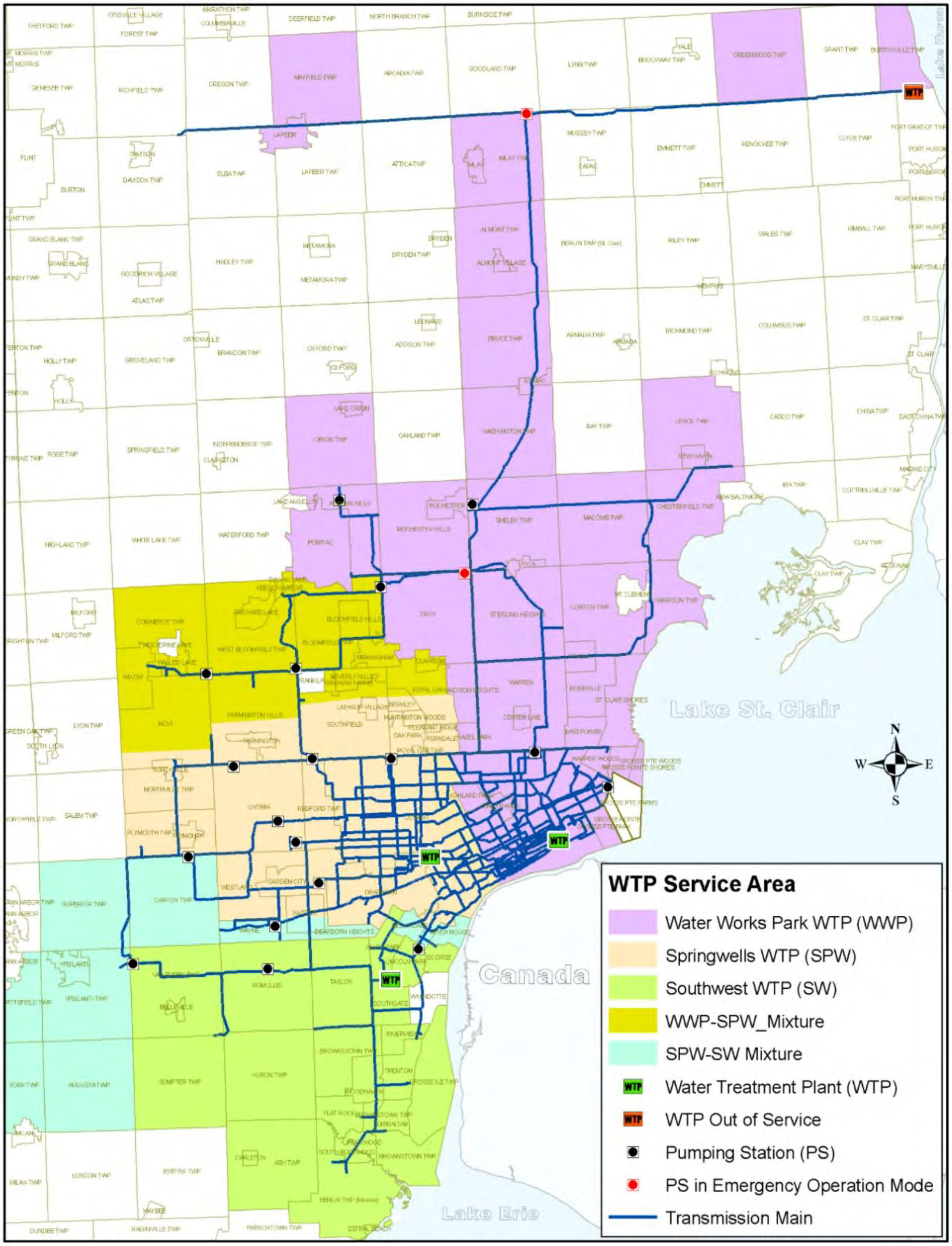

Figure 7-17: Average Day Demand with Lake Huron WTP Out of Service

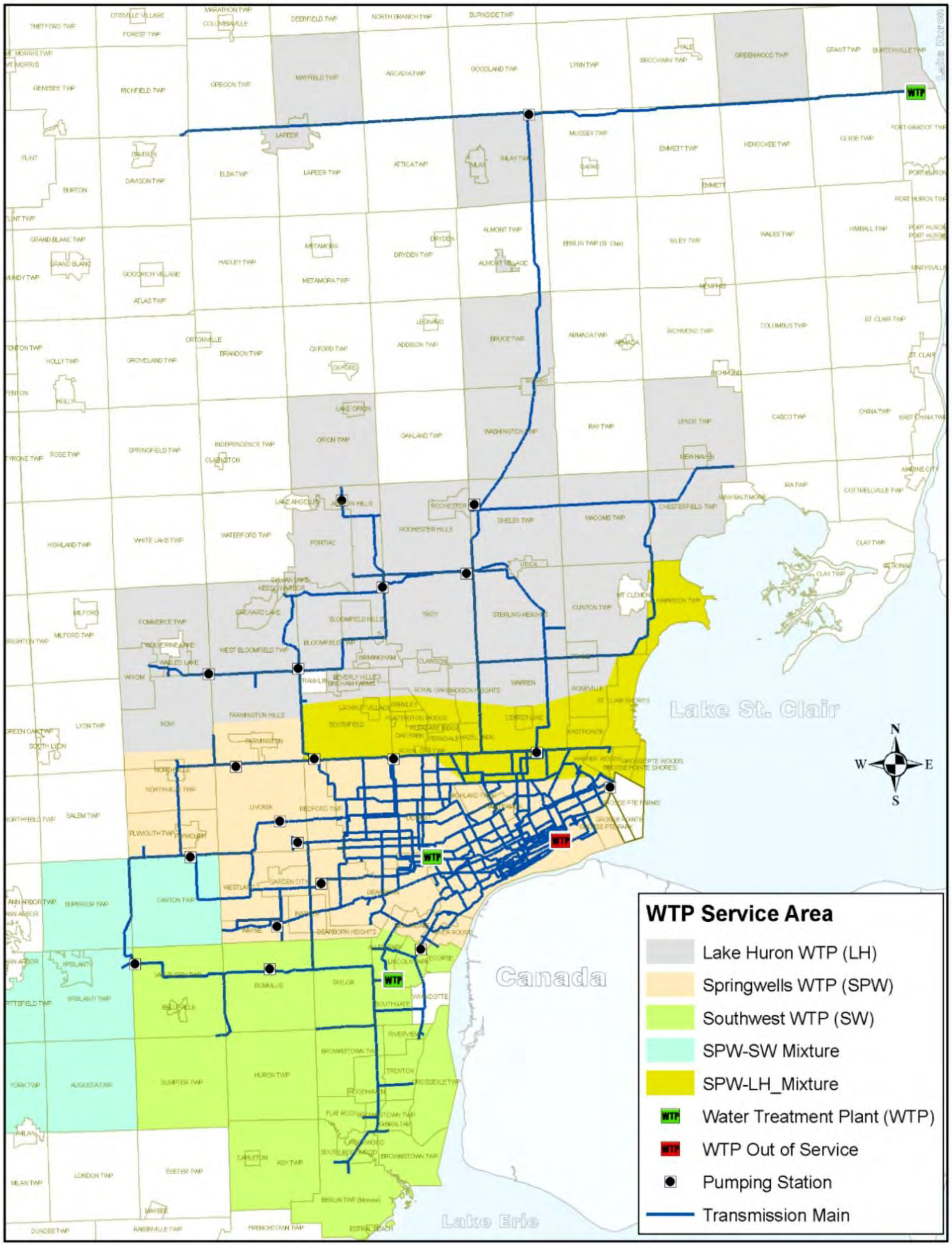

Figure 7-18: Average Day Demand with Water Works Park WTP Out of Service

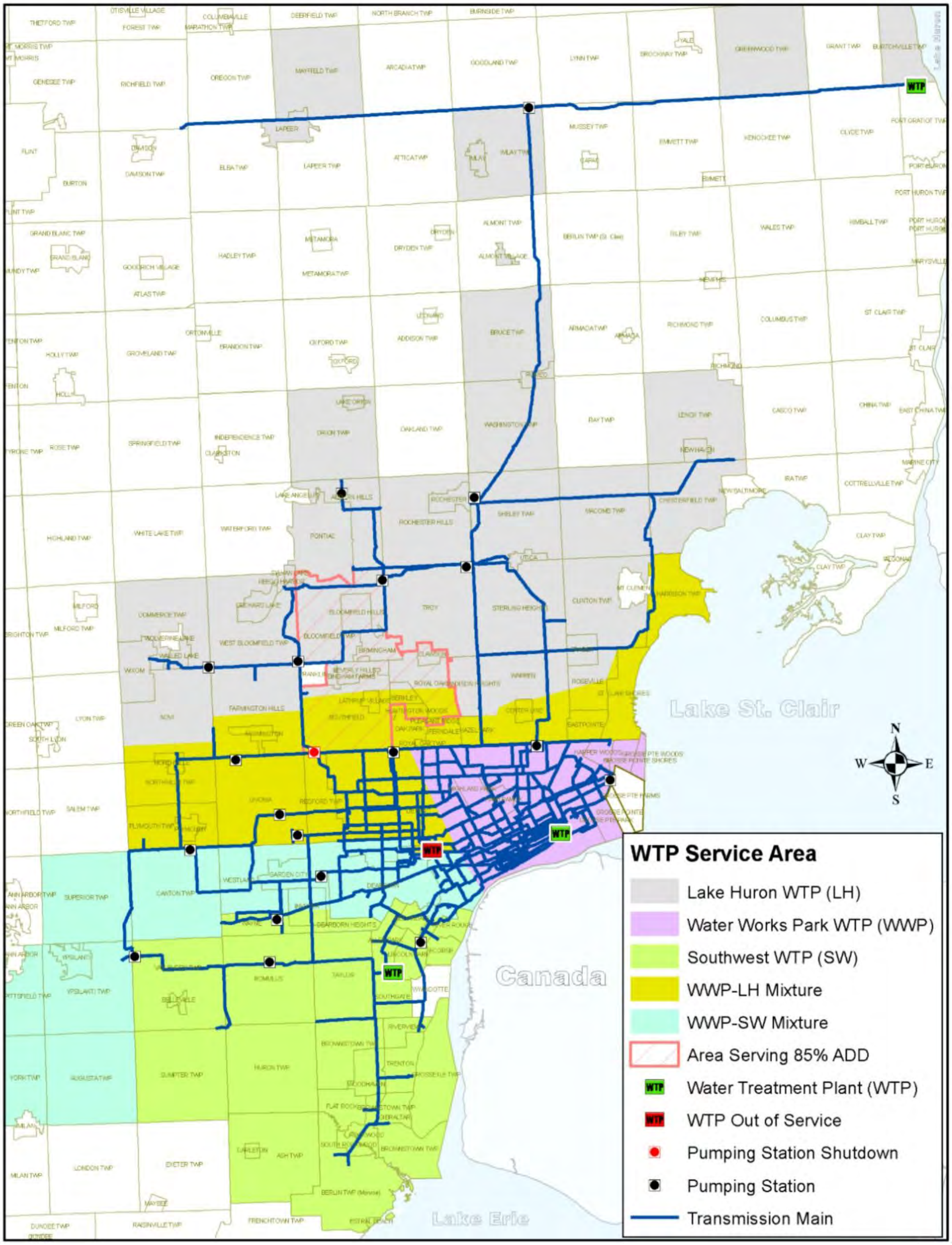

Figure 7-19: Average Day Demand with Springwells WTP Out of Service

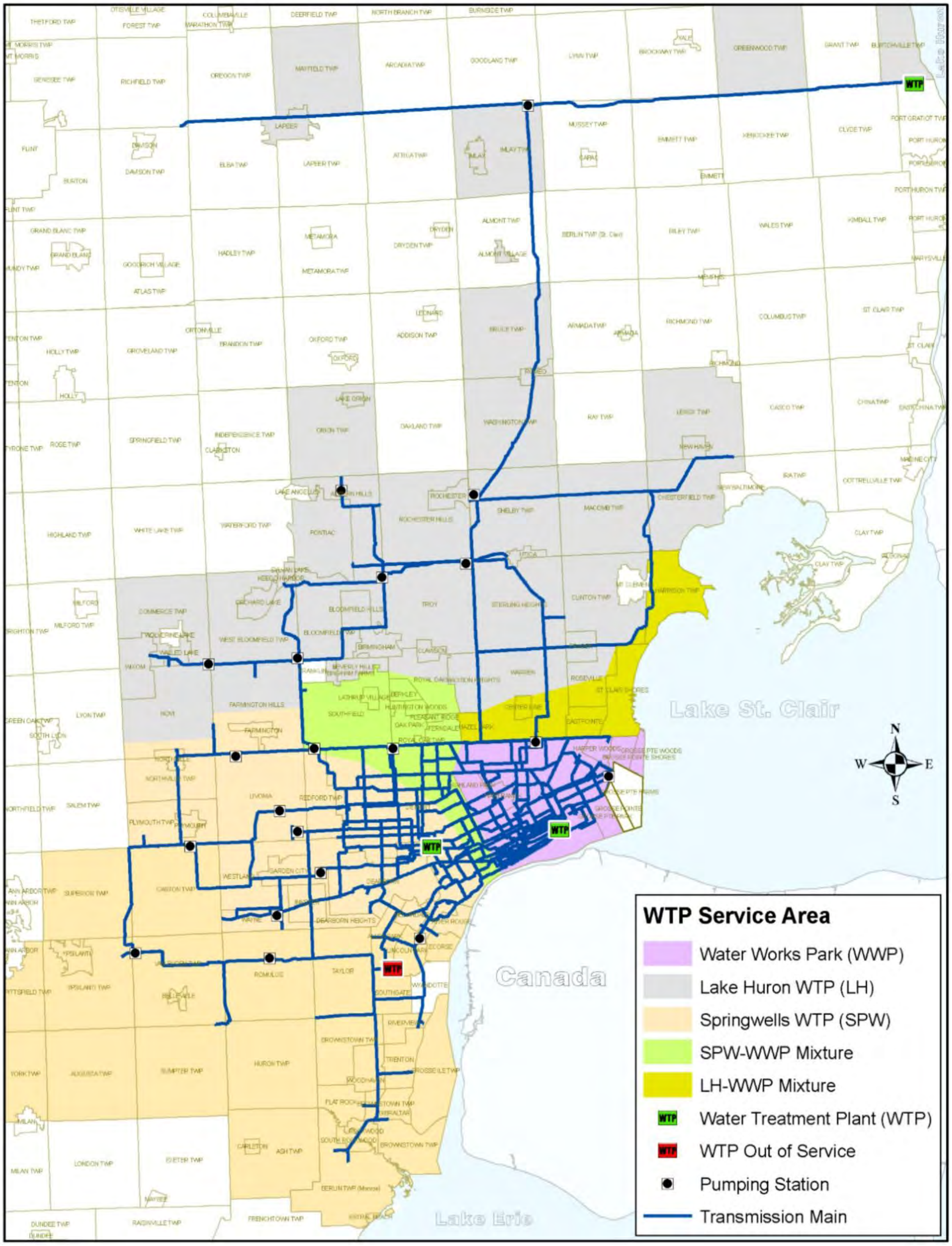

Figure 7-20: Average Day Demand with Southwest WTP Out of Service