TM-3: Evaluation of Wholesale Meter Data

1.0 Introduction

Most of DWSD's wholesale customers are supplied through connections that are metered under the Wholesale Automated Meter Reading (WAMR) system. The WAMR system was put in place beginning in 2008, and it provides extensive time series data on water use and pressure that was used for hydraulic modeling.

Hydraulic models were used in conjunction with WAMR data to analyze the current and future needs of the DWSD system. To determine the system water use, nodal demands were applied in the model to simulate the customer requirements at their master meters. These nodal demands were represented by a base demand representing the average day demand and hourly demand factors that were applied to the base demand. The hourly demand factors simulate the diurnal variation of each customer's water use through the simulated period.

Historical diurnal customer demands are good indicators of how an individual community uses water throughout the day. This technical memorandum (TM) presents an evaluation of the WAMR data and describes how the information is used to establish wholesale customer hourly demand factors for the model. Other technical memoranda present water demand projections (TM-5) and the approach to hydraulic modeling (TM-11).

There are three communities that are not supplied by DWSD through master meters. They are the City of Detroit, the City of Dearborn, and the City of Highland Park. Their diurnal patterns are developed with a different methodology as WAMR data is not available for these communities.

2.0 Terminology

Table 2-1 highlights the terminology is used for water demands in hydraulic modeling. This is based on terminology used in DWSD's model contracts for wholesale water service.

Table 2-1: Hydraulic Modeling Terminology

Contract Term	Definition	Related Modeling Terms	Definitions and Application in the Master Plan Update
Annual Volume	Annual volume used by a customer for the period July 1 to June 30.	Annual Volume --and-- Customer Average Day Demand (CADD)	Same as Contract definition. Used in modeling expressed a flow rate MGD to estimate average day demand; used as a volume in other analyses to characterize annual volume of water use, making economic calculations, and comparisons to other customers or utilities.
Customer Maximum Day Demand	Customer's recorded water usage on the DWSD maximum day.	Customer Maximum Day Demand (CMDD)	Same as Contract definition, but not tied to the DWSD maximum day. This value is important for analysis and design of pump stations, and meters.
Customer Peak Hour	Customer's recorded water usage during the DWSD peak hour.	Customer Peak Hour Demand (CPHD)	Same as Contract definition, but not tied to the DWSD peak hour. This value is important for analysis and design of pump stations, transmission mains and meters.
DWSD Maximum Day	Maximum reported water production day for the system during any 24-hour period as measured from 12:00 AM Eastern Standard Time.	DWSD System Maximum Day Demand (SMDD)	Same as Contract definition. For DWSD, this is typically in the month of July or August. This value is important for analysis and design of pump stations, reservoirs, water treatment facilities, transmission mains and meters.
DWSD Peak Hour	The hour during the Maximum Day in which the most water is delivered to the system, measured from top of the hour. (There are further stipulations relative to customer billing.)	DWSD System Peak Hour (SPH)	Same as Contract definition. For DWSD, this is typically a day in the month of July or August. This value is important for analysis and design of pump stations, reservoirs, water treatment facilities, transmission mains and meters.

Table 2-1: Hydraulic Modeling Terminology

Contract Term	Definition	Related Modeling Terms	Definitions and Application in the Master Plan Update
Minimum Annual Volume	Fifty percent of the Customer's Projected Annual Volume.		Not applicable in modeling and analysis.
		Base Demand on Maximum Day	The volume of water used during the 24 hour period of the Customer Maximum Date; expressed as million gallons per day.
		Minimum Month Demand	Average daily demand during non-outdoor irrigation months, typically October to March. This value is important for water age analysis and other operational practice for during periods of low water demands.
		Maximum Month Demand	Average daily demand during the peak outdoor irrigation month, typically July or August. This is a measure of maximum sustained water use for outdoor irrigation. This value is important for sizing water treatment plants, reservoirs, and pumping stations, and for managing electrical energy use during peak water demand periods.
		Outdoor Irrigation Demand	Water demand associated with seasonal outdoor water use by commercial, residential, and major industrial customers.

3.0 Basis of Analysis

To analyze the diurnal patterns of the existing customers, hourly demand data was collected from the Wholesale Automated Meter Reading (WAMR) program. The WAMR program collects water use readings from 85 DWSD customers through the 290 wholesale meters at five minute intervals. For the purpose of the master planning analysis, the reads were collected in an hourly format.

Additionally, contract information was also collected that indicates the pressure and flow ranges at the master meter supply points as well as the flow split between master meters if more than one meter is supplying a customer. This information is provided in **Appendix A**.

To analyze the water system hydraulically, it is important to assess the needs of the system when it is the most stressed. This occurs during a maximum day condition, which for DWSD occurs within the summer months of the year.

Table 3-1 shows the recent maximum day demands of the system. Recognizing that a significant economic downtown occurred at the end of 2008, it was decided to select the highest recent demand day prior to the downturn for comparison to the maximum day demands that occurred after 2008. For this reason the years 2007, 2011, and 2012 were selected.

It is also recognized that not all customers' peak demands occur on the same day as the system. Therefore, the entire summer demands of 2012 were collected so that "non-coincidental" peak demands could be identified for customers, if applicable.

Table 3-1: DWSD System Maximum Day and Peak Hour Demands 2005 through 2013

Year	Date	Demand (MGD)	Time	Peak Hour (MGD)
2005	June 27	1,104	7:00 p.m.	1,347
2006	June 17	1,080	7:00 a.m.	1,337
2007	August 3	1,128	6:00 a.m.	1,388
2008	August 18	961	5:00 a.m.	1,184
2009	August 5	804	6:00 a.m.	989
2010	July 7	957	7:00 p.m.	1,130
2011	July 21	1,000	7:00 p.m.	1,205
2012	July 2	969	5:00 a.m.	1,171
2013	August 26	761	5:00 a.m.	914

4.0 Diurnal Comparative Analysis

4.1 Maximum Day Demand Patterns

To evaluate the diurnal patterns, the top 13 customers, those with maximum day demands of 15 mgd or higher, were analyzed. At the time of the analysis the City of Flint was included as it was the second

largest DWSD customer. However, effective May 2014, the City left the DWSD system and will join another supplier in the future.

The diurnal patterns for the top 13 users are shown in **Figures 4-1 to 4-13**.

The largest wholesale water users are shown in **Table 4-1**. The 13 largest wholesale customers comprised almost two-thirds of the total system maximum day demand in 2012. The 12 largest customers, excluding Flint, comprise 56% of the total wholesale maximum demand in 2012. The diurnal demands for each of these customers for the selected years are provided after the table. Note that if a non-coincidental curve is not shown it is because the community's maximum day in 2012 occurred on the same day as the system maximum day. Also, if a community has storage within its system, it is noted on the curve as well.

Table 4-1: DWSD Largest Wholesale Customers

Community	2012 MDD (MGD)	Portion of Total Wholesale Demand (%)
SEOCWA	66	10.7
Flint	37	6.0
Sterling Heights	36	5.8
Warren	29	4.6
Troy	26	4.2
Livonia	25	4.1
Farmington Hills	22	3.5
Shelby Twp	21	3.4
Macomb Twp	21	3.4
YCUA	21	3.3
Clinton Twp	20	3.2
Rochester Hills	19	3.0
West Bloomfield	15	2.4

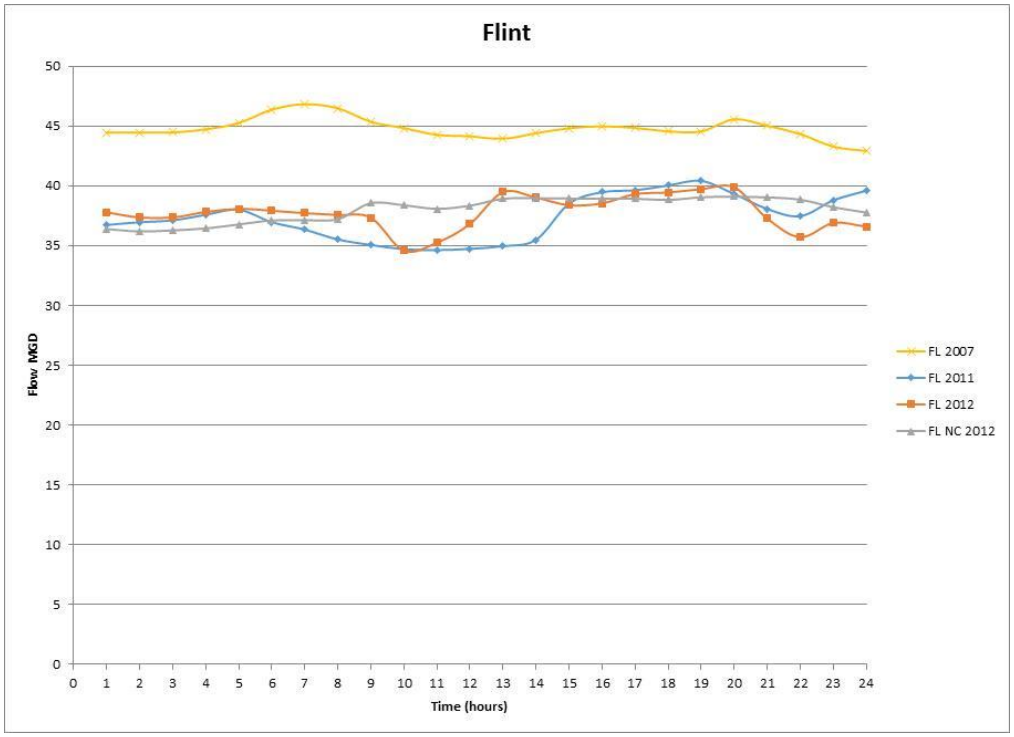
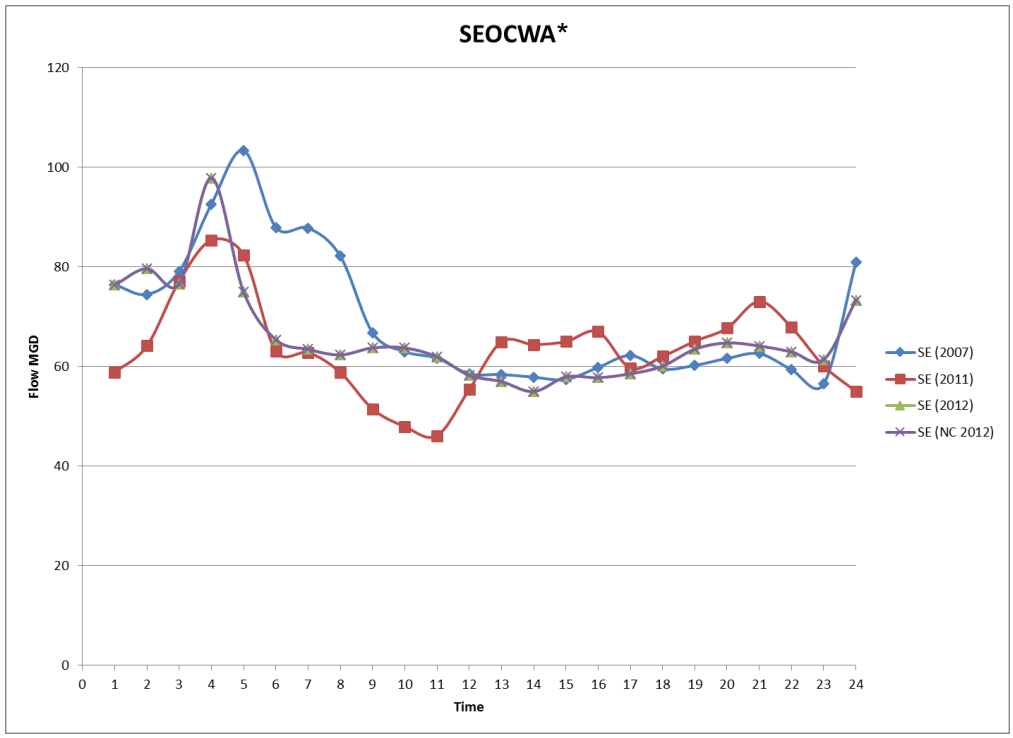


Figure 4-1: 2011 Diurnal Demand for Flint (has storage within the customer system)



* Has storage within its system

Figure 4-2: 2011 Diurnal Demand for SEOCWA (has storage within the customer system)

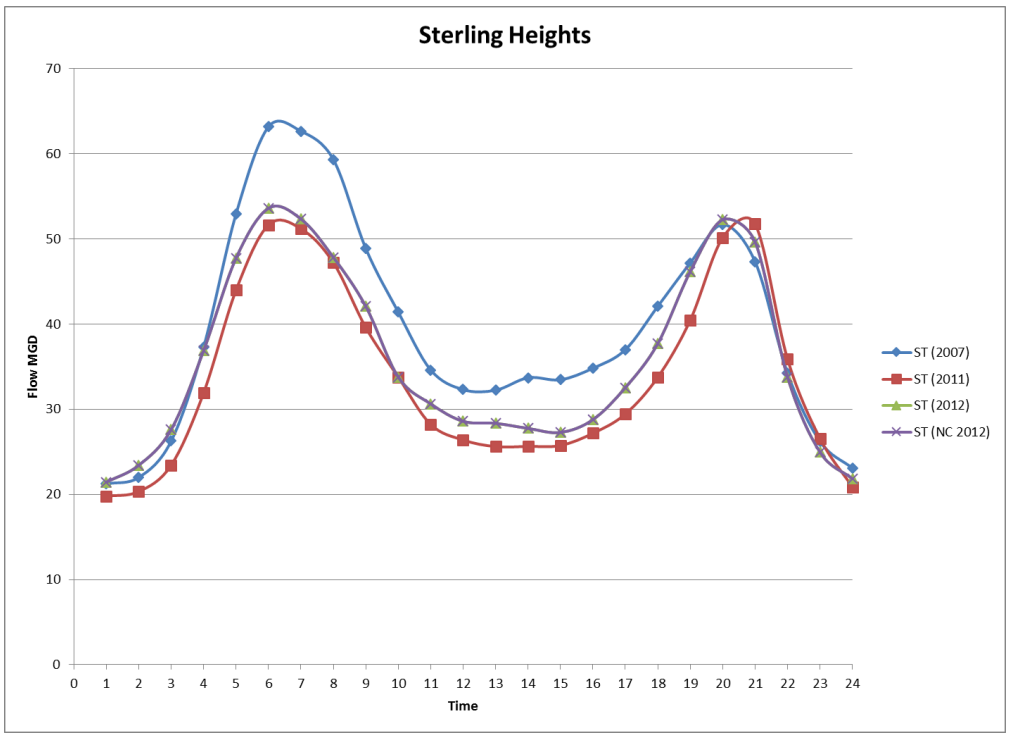


Figure 4-3: 2011 Diurnal Demand for Sterling Heights

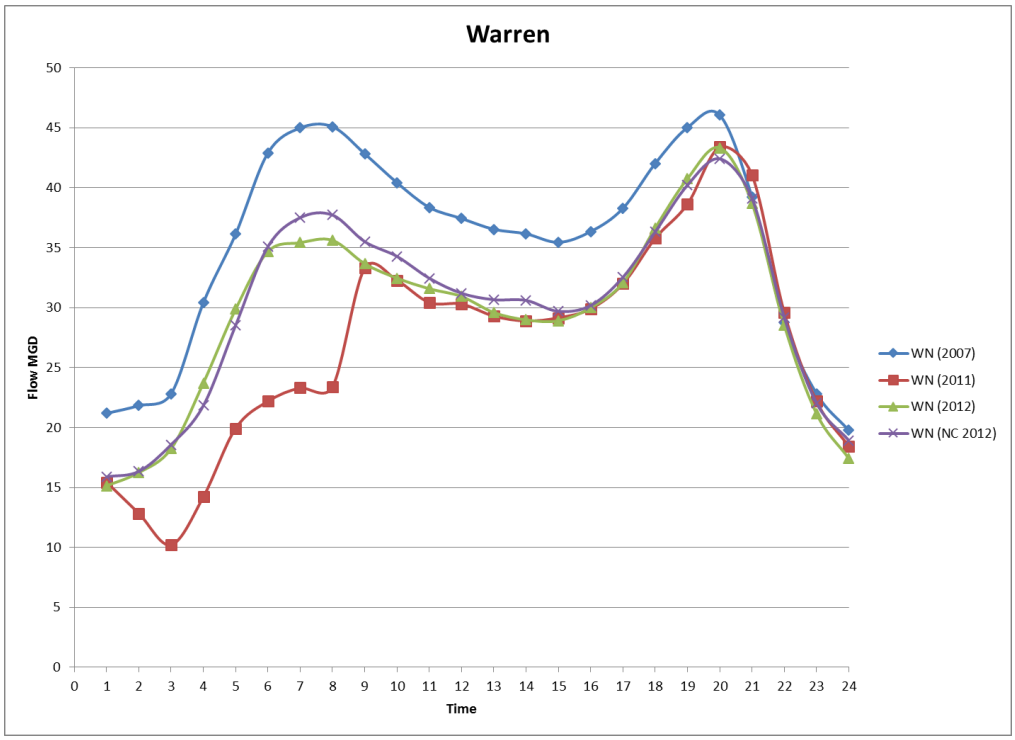


Figure 4-4: 2011 Diurnal Demand for Warren

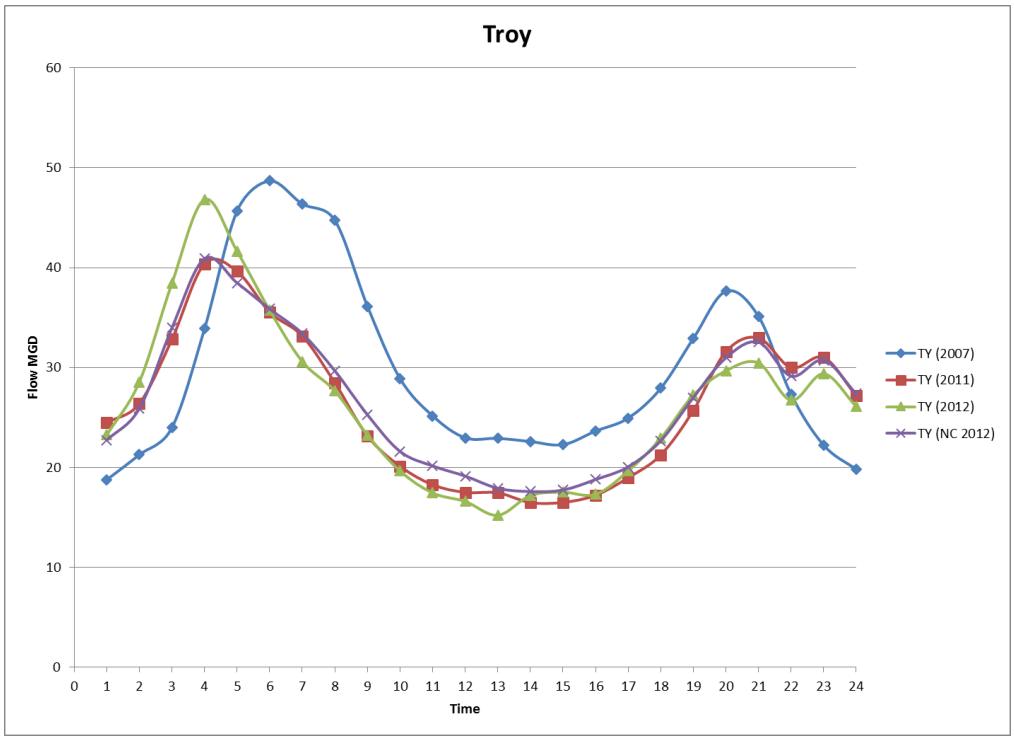


Figure 4-5: 2011 Diurnal Demand for Troy

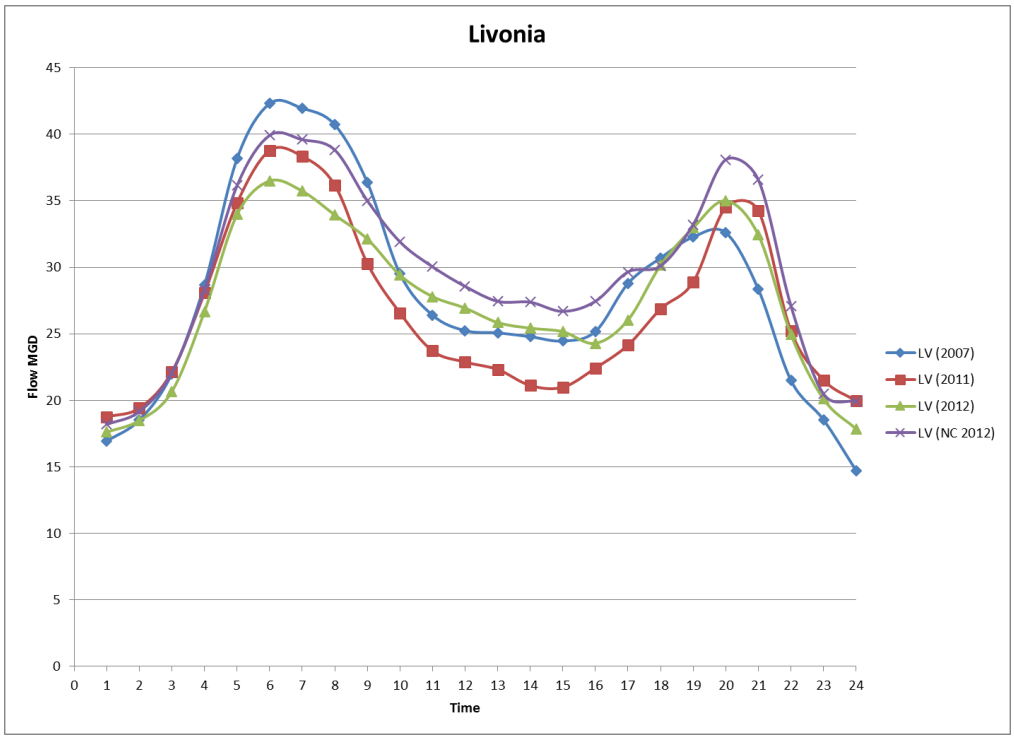


Figure 4-6: 2011 Diurnal Demand for Livonia

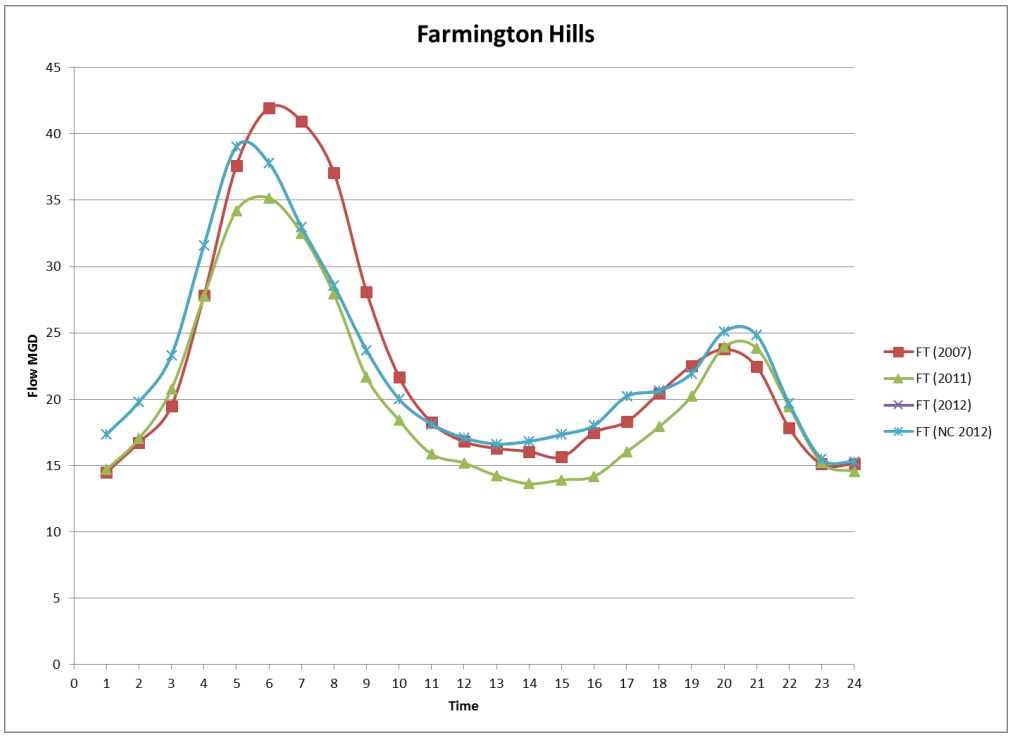


Figure 4-7: 2011 Diurnal Demand for Farmington Hills

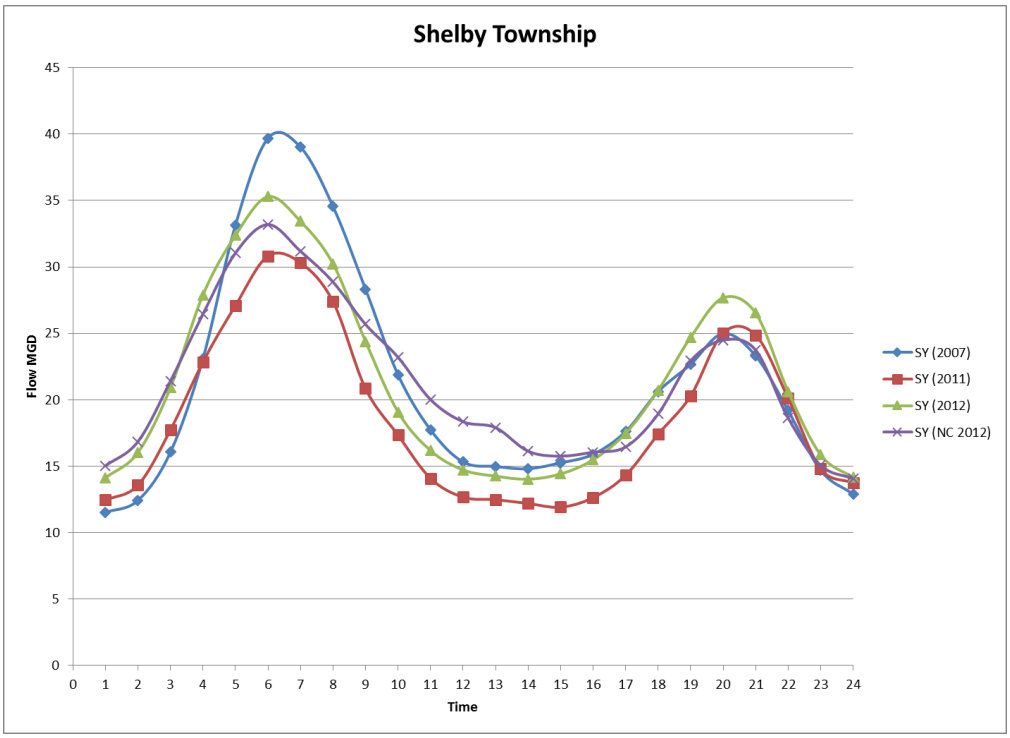


Figure 4-8: 2011 Diurnal Demand for Shelby Township

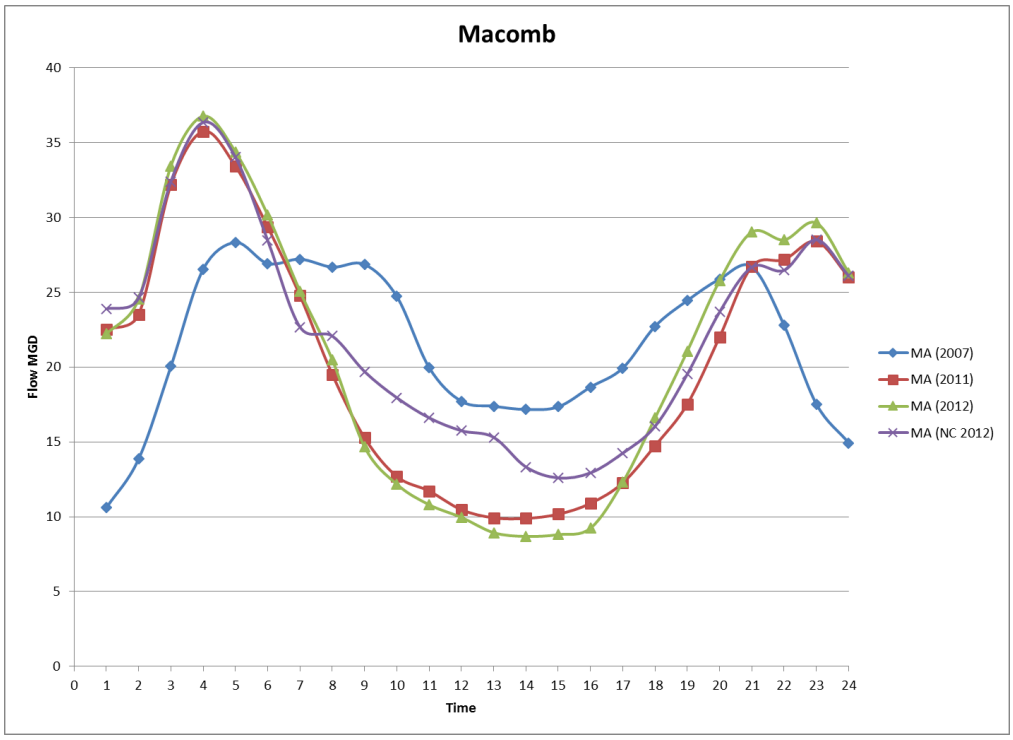
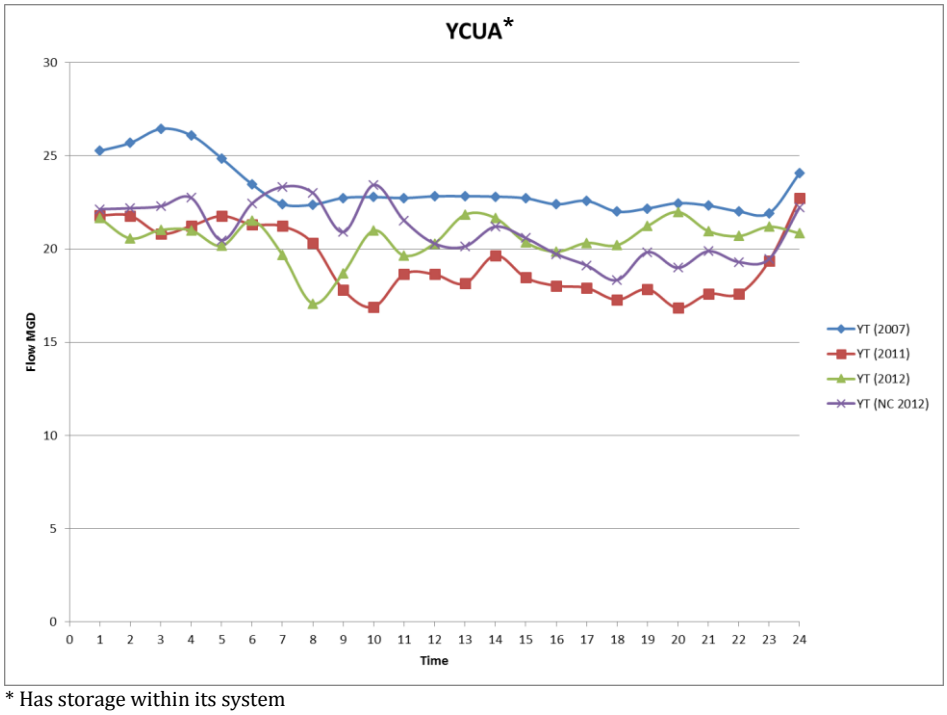
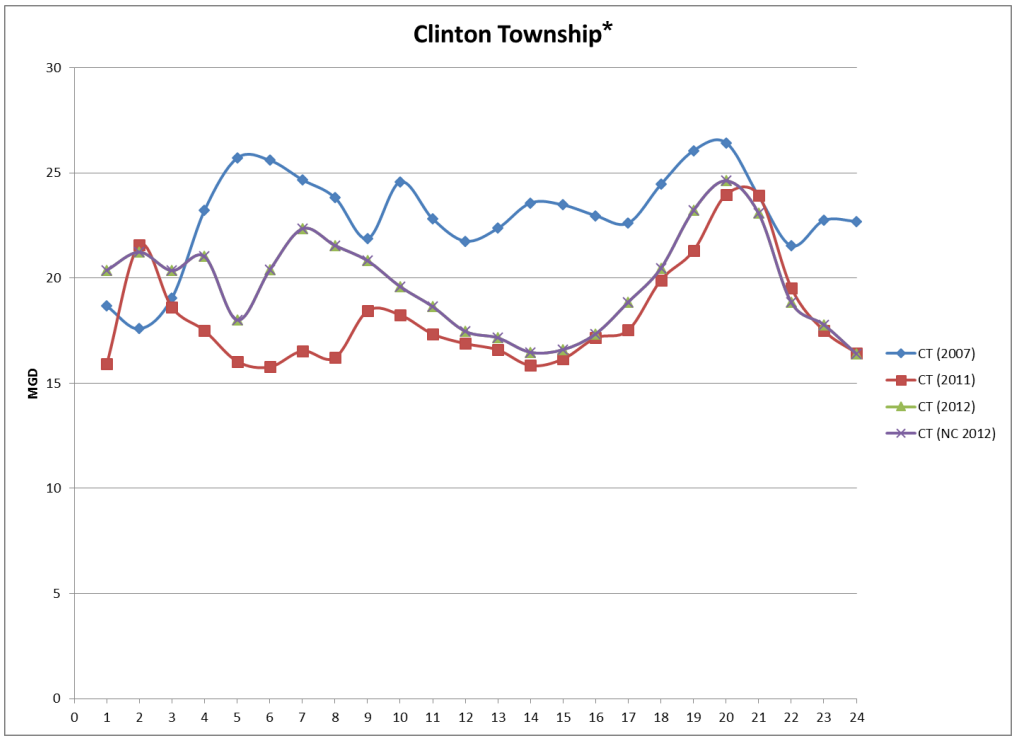


Figure 4-9: 2011 Diurnal Demand for Macomb



* Has storage within its system

Figure 4-10: 2011 Diurnal Demand for YCUA



* Has storage within its system

Figure 4-11: 2011 Diurnal Demand for Clinton Township

*

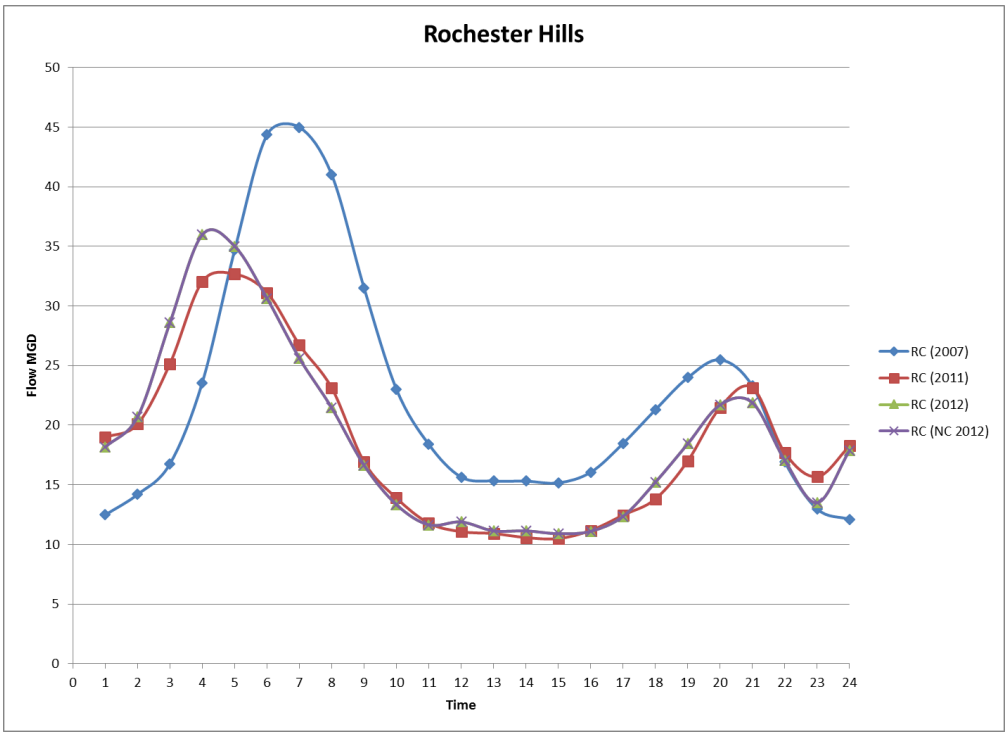
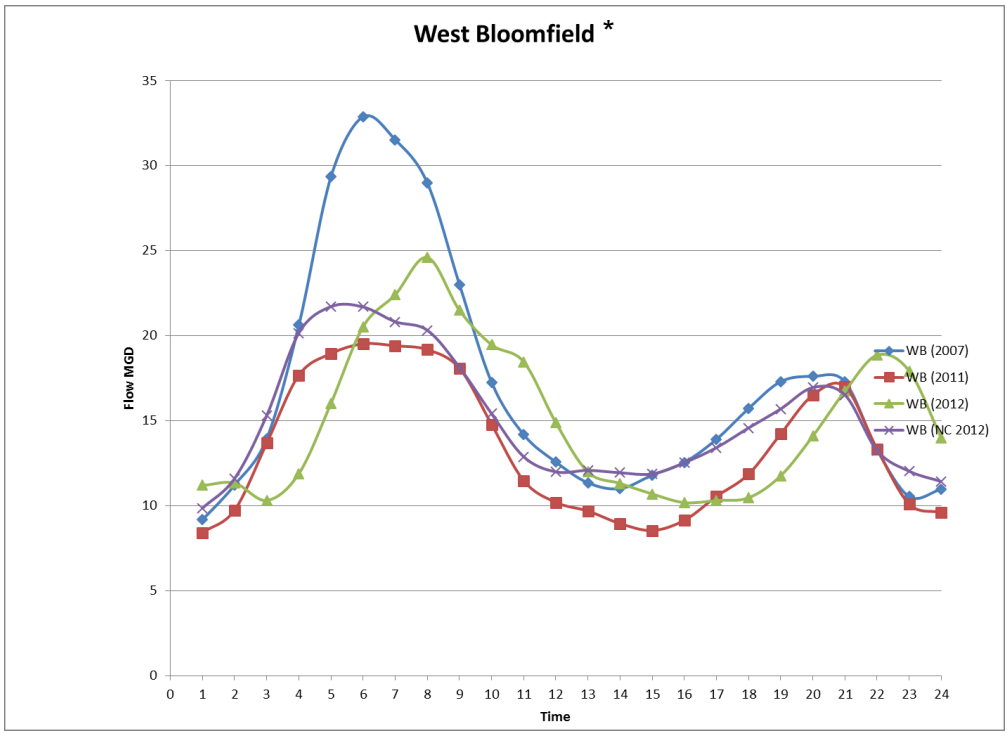


Figure 4-12: 2011 Diurnal Demand for Rochester Hills



* Has storage within its system

Figure 4-13: 2011 Diurnal Demand for West Bloomfield

4.2 Average Day Demand Patterns

An Average Day Demand (ADD) model is used to analyze the water quality (water age) within the transmission system and to evaluate energy use at the pumping stations. For the purpose of developing the diurnal model patterns for the ADD model, the planning team reviewed the ADD patterns developed by Metco/AECOM for the 2011 model and compared these to patterns from a selected number of customers in 2012. The 2012 patterns were developed by averaging the hourly demands in these communities over an entire month. The months selected were May and October because these months were close to the system average demand in 2012. A total of 13 communities were selected representing larger users throughout the transmission system.

Based on the comparison of the ADD 2011 patterns to the 2012 patterns it was determined that several of patterns were consistent using the two methodologies for 2011 and 2012, while some patterns had differences with the two methodologies. However, differences are site specific and would not affect the results for the intended use of the ADD models. It is worth noting that the ADD patterns will be applied to the 2025 and 2035 base demands in the model, so that total demand for each customer will not change, only the diurnal use of the water throughout the day. Therefore, the master planning team will use the 2011 ADD patterns in lieu of developing different patterns from the 2012 data.

5.0 Analysis & Findings

Based on a visual evaluation it is clear that for the most part the customer patterns exhibit similar peaking times and magnitude. Also, nearly all of the diurnal demands appear to be higher in 2007 than the other preceding years. This is attributable to three factors:

- the 2007 demands were prior to the economic downturn in late 2008;
- there was a loss in population throughout the region after 2008;
- the new model water service contract, instituted in 2008, provided rate incentives for wholesale customers to install or modify the use. This included voluntary programs within the community as well as installing or varying the operations of their water storage tanks.

Table 5-1 summarizes the findings from the communities with storage in their systems that have recently contracted with DWSD. The average day demand is the contracted amount and the maximum day and maximum hour demands are based on the 2012 system peak day.

Table 5-1: DWSD Customers with Storage in 2011

Community	Contract Average Day Demand (CADD) - MGD	2012 Maximum Day Demand (CMDD) – MGD	2012 Peak Hour Demand (CPHD) – MGD	Customer Storage – MG	% of ADD	CPHD/CADD	CPHD/CMDD
Auburn Hills	4.2	8.5	9.6	1.0	24%	2.3	1.1
Northville Twp.	3.5	9.1	14.6	1.0	28%	4.1	1.6
Grosse Pte. Woods	1.7	4.3	4.7	0.5	29%	2.7	1.1
New Haven	0.3	0.6	0.8	0.1	29%	2.2	1.2
Plymouth Twp.	4.0	9.7	14.4	1.4	35%	3.6	1.5
Clinton Twp.	9.7	19.7	20.4	3.5	36%	2.1	1.0
Harrison Twp.	2.0	4.1	6.4	0.8	37%	3.1	1.6
Northville	0.7	1.4	2.0	0.4	57%	2.9	1.4
Van Buren Twp.	3.1	6.0	9.7	2.0	65%	3.1	1.6
St. Claire Shores	5.2	8.3	5.7	4.0	77%	1.1	0.7
Orion Twp.	3.1	7.6	7.6	2.5	80%	2.4	1.0
Wixom	1.7	3.9	5.6	1.5	89%	3.3	1.5
Farmington	1.1	2.2	2.2	1.0	91%	2.0	1.0
SEOCWA	30.2	65.9	65.4	32.5	107%	2.2	1.0
YCUA	10.8	20.6	21.5	14.3	132%	2.0	1.0

Table 5-1: DWSD Customers with Storage in 2011

Community	Contract Average Day Demand (CADD) - MGD	2012 Maximum Day Demand (CMDD) – MGD	2012 Peak Hour Demand (CPHD) – MGD	Customer Storage – MG	% of ADD	CPHD/CADD	CPHD/CMDD
Pontiac	6.6	11.2	10.2	12.0	183%	1.5	0.9
Ferndale	1.6	2.3	2.6	3.0	185%	1.6	1.1
Oak Park	2.4	1.5	1.3	6.3	261%	0.5	0.9

The results indicate that the total storage volume to the average day demand varies between 24% and 261%. **Figure 5-1** shows a trend line demonstrating that as the storage increases in the system the peaking factors decrease; either maximum hour or maximum day to the average day demand.

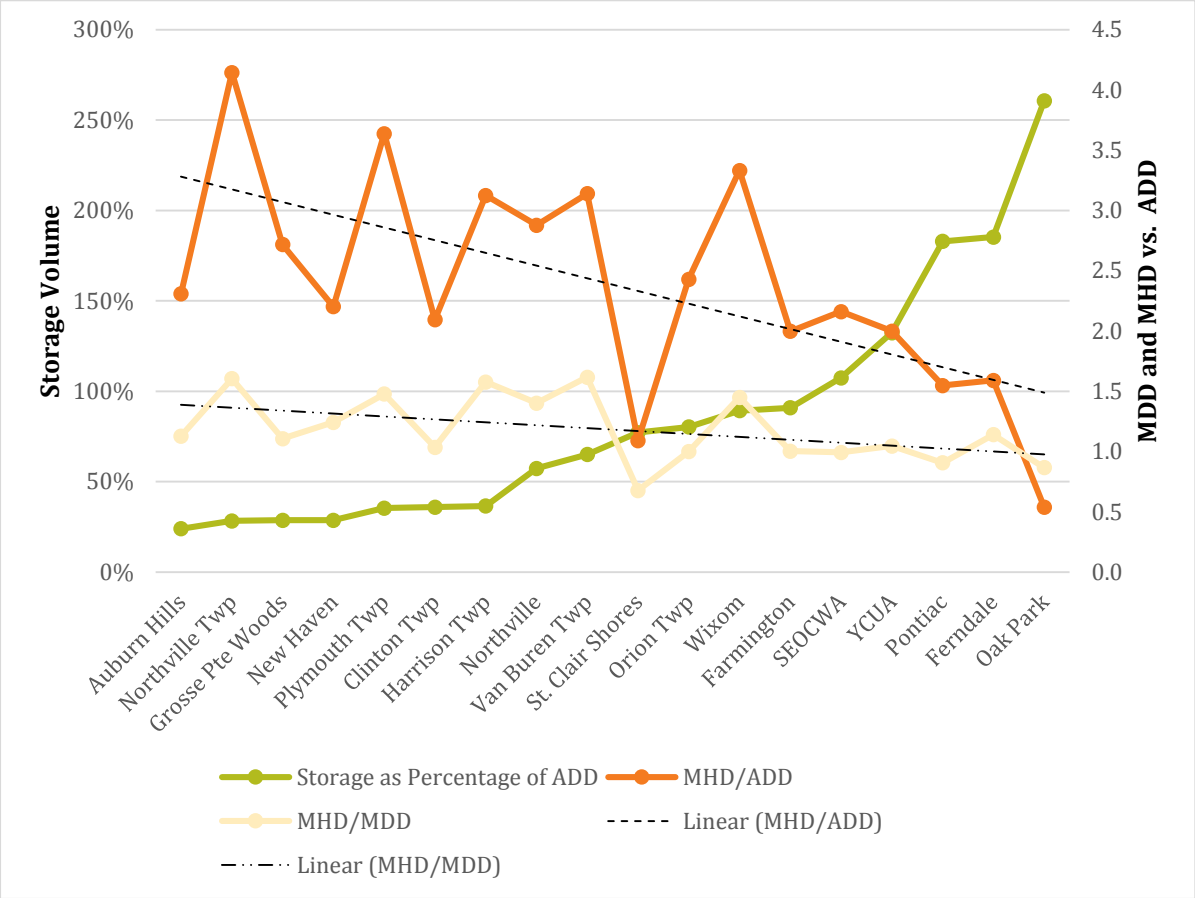


Figure 5-1: Volume of Customer Storage vs. Peaking Factors

6.0 Use of Diurnal Patterns for Model Demands

Since the analysis of the patterns indicates that the diurnal demands are fairly consistent from year to year, they would be used to simulate the future demand years. The patterns were applied on an hourly basis to the planning year base demand for each customer community.

Furthermore, due to the consistency in the diurnal patterns year-to-year for the system customers, the patterns established for Dearborn and Detroit were based on the 2011 maximum day model that was provided to the master planning team from DWSD.

Highland Park was not a DWSD customer prior to the State of Michigan's direction to DWSD to supply the community water. Therefore, there was no useful information available. Since the community that is surrounded by the City of Detroit has similar demographics and topography, it was decided to use the same patterns as Detroit for Highland Park.

The base demands, which are described in TM-11, Hydraulic Model, are the summation of the communities' residential demands, outdoor irrigation demands, large water users, and other industrial, commercial, and institutional users.

Figure 6-1 shows an example of the approach for planning year 2015. In this example the base demand is 8 MGD. Once the diurnal pattern is normalized, the hourly factors are then applied to the base demand to get the hourly demand for the modeling analysis.

As example, Hour 7 has a factor of 1.47. Therefore, the demand that would be analyzed for Hour 7 would equal 11.76 MGD.

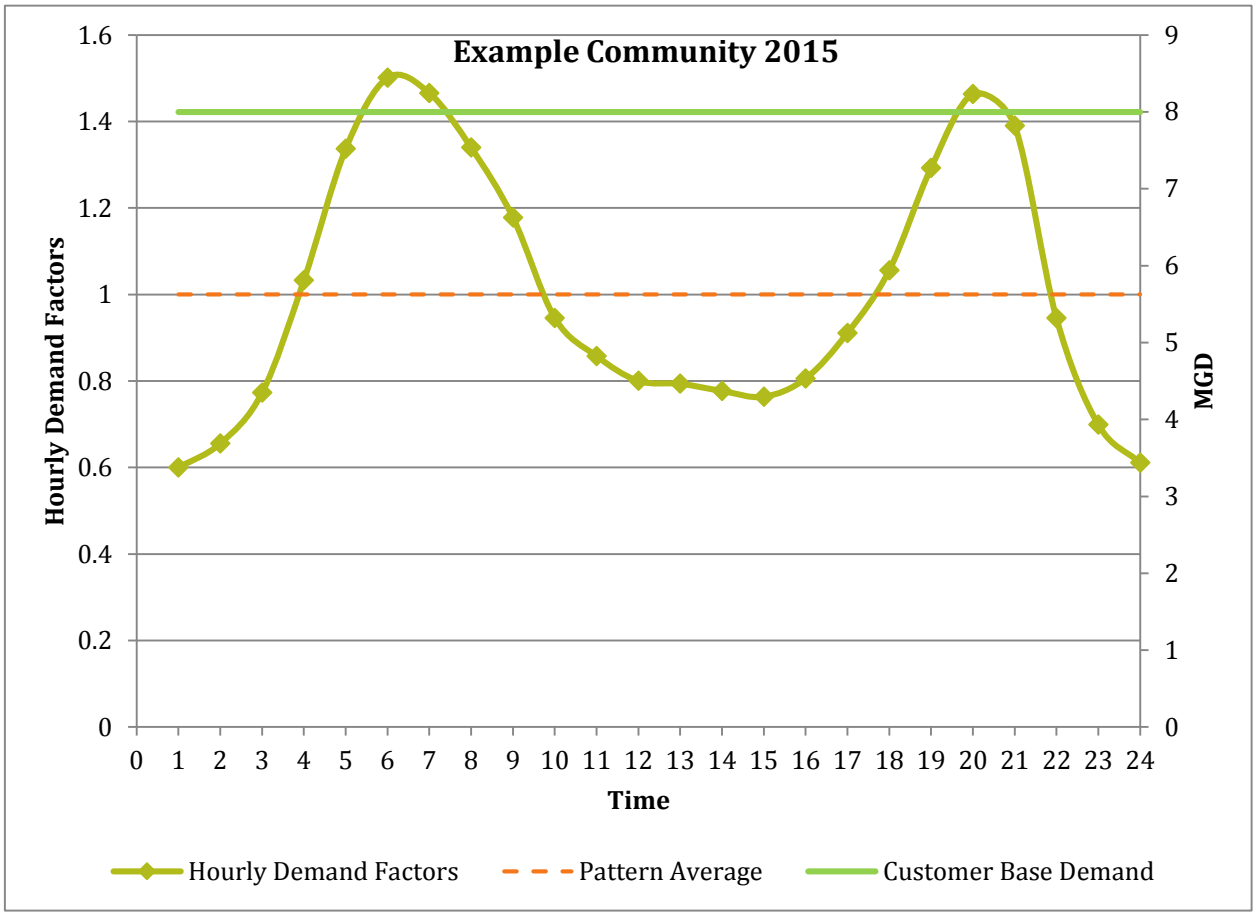


Figure 6-1: Example for Diurnal Demand Development

Once the total demand has been determined for each hour it is then distributed amongst the community's master meters. The distribution of the demand for simulating current and near future conditions was based on contract flow splits identified in Appendix A. For the master meters that show a percentage range, an average of the range will be used unless other available information can be provided by the customer.

The curves established from this analysis provide guidance in establishing estimated patterns for the customers currently without storage, but planning storage in the future.

Appendix A
Wholesale Customer Contract Parameters

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
AH-02	AUBURN HILLS	ADAMS / SOUTH BLVD	127/149	3-11		
AH-03	AUBURN HILLS	WALTON / SQUIRREL	83/107	25-65		
AH-04	AUBURN HILLS	FEATHERSTONE / SQUIRREL	104/126	15-40		
AH-05	AUBURN HILLS	HARMONS / GIDDINGS	55/87	30-60		
AH-06	AUBURN HILLS	GIDDING / TAYLOR	69/100	15-45		
AP-04	ALLEN PARK	PARK / MOORE	55/79	14	5.700	8.400
AP-05	ALLEN PARK	ALLEN / BELMONT	56/78	17		
AP-06	ALLEN PARK	PHILOMENE / ARNOLD	56/76	30		
AP-07	ALLEN PARK	OUTER DR / GAS HWY	51/74	17		
AP-08	ALLEN PARK	GAS HWY / ENTERPRISE DR	49/71	2		
AP-09	ALLEN PARK	GAS HWY / (S) OUTER DR	54/74	7		
AP-11	ALLEN PARK	OAKWOOD / SOUTHFIELD	53/73	7		
AP-12	ALLEN PARK	FAIRLANE / OAKWOOD	54/73	6		
AS-01	ASH TOWNSHIP	GRAFTON / WILL CARLETON	**N/A** (observed: 58.7/102.4)	47	1.570	2.100
AS-02	ASH TOWNSHIP	ROMINE / WILL CARLETON	**N/A** (observed: 58.4/102.7)	53		
BC-01	BURTCHVILLE TWP	STATE / METCALF	137/194	100	0.478	0.680
BL-01	BERLIN TWP	READY RD / I-75 FWY	56/79	34	1.360	2.180
BL-02	BERLIN TWP	PENN CENTRAL / DIXIE HWY	55/78	66		
BR-01	BROWNSTOWN TWP	WOODRUFF / RIVER RD	**N/A** (observed: 59.7/74.4)	0-8	7.200	11.300

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
BR-04	BROWNSTOWN TWP	SIBLEY / ALLEN RD	55/77 Incr. to 60/77 CY2015	20-60		
BR-05	BROWNSTOWN TWP	ALLEN / FORT	56/80 Incr. to 60/80 CY2015	20-40		
BR-06	BROWNSTOWN TWP	BEECH-DALY / PENNSYLVANIA	49/71 Incr. to 60/71 CY2015	27-48		
BR-07	BROWNSTOWN TWP	TELEGRAPH / VAN HORN	**N/A** (observed: 49.0/66.7)	0-3		
BU-01	BRUCE TWP	33 MILE / McKAY	67/129	100	CY 2010: 0.017; CY 2011: 0.025	CY 2010: 0.068: CY 2011: 0.010
BV-01	BELLEVILLE	SHELDON / SAVAGE	**N/A** (observed: 54.2/77.0)	100	0.548	0.813
CA-03	CANTON TWP	JOY / SHELDON	123/150	15-40	22.500	36.000
CA-04	CANTON TWP	JOY / MORTON TAYLOR	124/151	25-40		
CA-05	CANTON TWP	WARREN / NAPIER	72/99	10-25		
CA-06	CANTON TWP	JOY / BECK	102/128	20-25		
CA-07	CANTON TWP	RIDGE / PROCTOR	105/130	0-10		
CH-01	CHESTERFIELD TWP	24 MILE / FAIRCHILD	69.2/144.8		10.57	14.28
CH-02	CHESTERFIELD TWP	25 1/2 MILE / GRATIOT	69.1/144.7			
CH-03	CHESTERFIELD TWP	26 MILE / (NE) 1-94 FWY	55.7/132.2			
CH-04	CHESTERFIELD TWP	23 MILE / FAIRCHILD	41.1/129			
CH-05	CHESTERFIELD TWP	M-59 / SNOVER RD	56.5/140.8			
CL-01	CENTER LINE	VAN DYKE / WOOD	**N/A** (obs.: 53.2/74.2)	100	1.190	1.800
CM-01	COMMERCE TWP	14 MILE / (W) HAGGERTY	71/99	60-90	6.430	11.620
CM-02	COMMERCE TWP	HAGGERTY / 14 MILE	76/105	0-25		
CM-03	COMMERCE TWP	BENSTEIN / MAPLE	82/111	5-20		
CT-01	CLINTON TWP	KELLY / 14 MILE	62/85	15	21.400	24.900

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
CT-02	CLINTON TWP	METRO PKWY / UNION LK RD	71/95	3		
CT-03	CLINTON TWP	14 MILE / GRATIOT	65/86	6		
CT-04	CLINTON TWP	METRO PKWY / UTICA	69/90	54		
CT-05	CLINTON TWP	M-59 / SNOVER RD	55/88	22		
DH-01	DEARBORN HTS	WARREN / PIERSON	39/62	0-5	9.000	13.300
DH-02	DEARBORN HTS	JOY / TELEGRAPH	34/55	0-5		
DH-03	DEARBORN HTS	ANNAPOLIS / INKSTER	44/64	30-40		
DH-10	DEARBORN HTS	TELEGRAPH / MIDWAY	33/62	5-15		
DH-11	DEARBORN HTS	DARTMOUTH / PELHAM	45/68	0-5		
DH-12	DEARBORN HTS	WARREN / INKSTER	49/65	40-60		
EC-01	ECORSE	VISGER / BASSETT	51/73	100	4.000	4.500
ED-01	EASTPOINTE	8 MILE / GRATIOT	62/93	100	4.000	6.100
ED-02	EASTPOINTE	8 MILE / KELLY	41/52	0		
FA-01	FARMINGTON	FARMINGTON / North of 8 MILE	48/73	50-70	2.250	2.450
FA-02	FARMINGTON	GRAND RIVER / DRAKE	**N/A** (observed: 79.2/94.9)	0-25		
FA-03	FARMINGTON	GRAND RIVER / WHITTAKER	**N/A** (observed: 87.2/102.4)	0-20		
FE-02	FERNDALE	8 MILE / HILTON	50/75	100	3.000	3.100
FE-03	FERNDALE	8 MILE / WANDA	50/75	0		
FK-01	FLAT ROCK	GIBRALTAR / I-75 FWY	56/79	65	2.600	3.500
FK-02	FLAT ROCK	VREELAND / 1-75 FWY	**N/A** (obs.: 56.2/71.9)	35		
FL-01	FLINT	POTTER / BAXTER	39.8/59.7	100	47.65	49.83
FR-01	FRASER	14 MILE / GARFIELD	64/84 decr. to 55/65 CY2013	27-37	3.100	4.900
FR-02	FRASER	14 MILE / GROESBECK	64/86 decr. to 55/65 CY2013	7-17		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
FR-03	FRASER	14 MILE / HAYES	63/84 decr. to 55/65 CY2013	51-61		
FT-02	FARMINGTON HILLS	8 MILE / ORCHARD LAKE	61/87	0-10	21.000	38.000
FT-03	FARMINGTON HILLS	8 MILE / MIDDLEBELT	68/94	0-15		
FT-04	FARMINGTON HILLS	8 MILE / GILL	49/75	0-5		
FT-05	FARMINGTON HILLS	8 MILE / LUJON	81/109	0-5		
FT-06	FARMINGTON HILLS	ELEVEN MILE / INKSTER	86/117	0-40		
FT-07	FARMINGTON HILLS	10 MILE / HAGGERTY	55/83	0-30		
FT-08	FARMINGTON HILLS	14 MILE / MIDDLEBELT	123/143	0-15		
FT-09	FARMINGTON HILLS	14 MILE / FARMINGTON	93/122	15-40		
FT-10	FARMINGTON HILLS	14 MILE / HALSTED	101/131	0-50		
FT-11	FARMINGTON HILLS	8 MILE / HALSTED	100/131	5-20		
GC-02	GARDEN CITY	WARREN / MIDDLEBELT	**N/A** (observed: 64.1/79.9)	0-1	3.350	5.350
GC-03	GARDEN CITY	CHERRY HILL / MERRIMAN	**N/A** (observed: 58.5/75.4)	0-20		
GC-04	GARDEN CITY	HARRISON / MARQUETTE	66/86	5-15		
GC-05	GARDEN CITY	HUBBARD / MARQUETTE	61/82	65-95		
Greater Lapeer Community Utilities Authority (GLCUA)					3.21	5.47
AC-01	**CITY OF ALMONT**	ALMONT / GLOVER	68.9/137.3			
IC-01	**IMLAY CITY**	BOWERS / BLACKS CORNERS	31.8/54.6			
IT-01	**IMLAY TWP**	GRAHAM RD AND GT R.R.	55.4/121.7 Feb 2011-Dec2012			
MF-01	**MAYFIELD TWP**	BOWERS / ROODS LAKE	Q: 57.5/78.2			
LA-01	**CITY OF LAPEER**	CALHOUN / OREGON	56.0/76.1			
LA-02	**CITY OF LAPEER**	SAGINAW / OREGON	59.5/83.6			

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
LA-03	**CITY OF LAPEER**	OREGON / MILLVILLE	41.0/61.6			
GI-01	**GROSSE ILE TWP**	JEFFERSON / TOLL BRIDGE	56.1/76.2		3.21	5.43
GI-03	**GROSSE ILE TWP**	SOUTH BRIDGE / JEFFERSON	56.3/79.8			
GK-01	**GROSSE PTE PK**	KERCHEVAL / WAYBURN	58.5/77.3		3.55	5.65
GK-02	**GROSSE PTE PK**	JEFFERSON / WAYBURN	59.2/77.8			
GK-03	**GROSSE PTE PK**	ESSEX / BARRINGTON	60.4/82.0			
GR-02	**GIBRALTAR**	WOODRUFF / RIVER RD	60.8/102.5		0.94	1.41
GR-03	**GIBRALTAR**	FORT / ALLEN	56.5/79.1			
GS-01	***GROSSE PTE SHRS***	VERNIER / MORNINGSIDE	**N/A** (observed: 46.1/66.2)	5-20	1.430	CY 2012: 2.73
GS-02	***GROSSE PTE SHRS***	FAIRFORD / BALLANTYNE	**N/A** (observed: 45.9/64.1)	50-70		
GS-03	***GROSSE PTE SHRS***	MOORLAND / CITY LIMITS	**N/A** (observed: 45.2/67.0)	20-40		
GW-01	**GROSSE PTE WDS**	MACK / ALLARD	53/74	85	4.960	4.960
GW-02	**GROSSE PTE WDS**	VERNIER / EDSEL FORD	45/55	4		
GW-03	**GROSSE PTE WDS**	HARPER / 8 MILE	43/55	11		
HK-01	**HAMTRAMCK**	ST AUBIN / FABER	40/57	5	1.900	2.750
HK-02	**HAMTRAMCK**	BUFFALO / TROWBRIDGE	39/58	4		
HK-03	**HAMTRAMCK**	CANIFF / DEQUINDRE	31/65	8		
HK-04	**HAMTRAMCK**	VINCENT / MARCUS	37/55	3		
HK-05	**HAMTRAMCK**	JOS CAMPAU / TROWBRIDGE	34/55	4		
HK-06	**HAMTRAMCK**	DENTON / ST AUBIN	41/64	27		
HK-08	**HAMTRAMCK**	HAMTRAMCK DR / (S) CLAY	38/55	1		
HK-10	**HAMTRAMCK**	GALLAGHER / TROWBRIDGE	39/58	48		
HN-01	**HURON TWP**	PENNSYLVANIA / HURON RIVER	60/96	80-100	3.420	5.290

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
HN-02	**HURON TWP**	INKSTER / PENNSYLVANIA	Current: 34/68 CY 2014:55/75	0-20		
HR-01	**HARRISON TWP**	METRO PKWY / UNION LK RD	71/94	67	4.810	6.130
HR-02	**HARRISON TWP**	HENRY B.JOY BLVD. / EXECUTIVE DR.	73/97	33		
HW-03	**HARPER WOODS**	EDSEL FORD / KINGSVILLE	50/72	10-30	2.550	3.670
HW-05	**HARPER WOODS**	EDSEL FORD / KINGSVILLE	50/71	70-90		
HW-06	**HARPER WOODS**	8 MILE / BEACONSFIELD	45/55	0-5		
HZ-01	**HAZEL PARK**	JOHN R / 8 MILE	48/73	20-40	1.700	2.600
HZ-02	**HAZEL PARK**	8 MILE / JOHN R	48/73	0-5		
HZ-04	**HAZEL PARK**	WEST END / 8 MILE	47/71	20-40		
HZ-05	**HAZEL PARK**	DEQUINDRE / FELKER	57/94	40-60		
IK-01	**INKSTER**	MICHIGAN / INKSTER	43.3/62.9		4.64	6.08
IK-02	***INKSTER***	MICHIGAN / MERRIMAN	N/A (obs.: 66.3/91.8)			
IK-04	**INKSTER**	CHERRY HILL / INKSTER	47.8/65.3			
KH-01	**KEEGO HARBOR**	GTW RR / MADDY LANE	92/110	100	0.450	0.650
LP-02	**LINCOLN PARK**	FORT / OUTER DR	74.9/55.7		7.94	11.66
LP-03	**LINCOLN PARK**	OUTER DR / FORT ST	49.1/80.9			
LP-05	***LINCOLN PARK***	SOUTHFIELD / FRANK	N/A (obs.: 52.7/64.9)			
LV-02	**LIVONIA**	8 MILE / MIDDLEBELT	68/93	0-3	31.900	39.600
LV-03	**LIVONIA**	8 MILE / MERRIMAN	61/92	5-15		
LV-04	**LIVONIA**	8 MILE / DEERING	73/98	0-3		
LV-12	**LIVONIA**	8 MILE / NEWBURGH	102/131	25-33		
LV-13	**LIVONIA**	JOY / NEWBURGH	50/70	0-3		
LV-14	**LIVONIA**	SCHOOLCRAFT / STARK	56/79	16-26		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
LV-15	**LIVONIA**	W CHICAGO / HARTEL	59/86	7-25		
LV-16	**LIVONIA**	EIGHT MILE / HAGGERTY	88/117	15-30		
LX-01	**LENOX TWP**	26 MILE / BURDON (WEST)	70/143	90	0.530	0.850
LX-02	**LENOX TWP**	26 MILE / (E) I-94 FWY	70/142	10		
MA-01	**MACOMB TWP**	24 MILE / ROMEO PLANK	80/145 Increases to 100/150 in CY 2014	40	28.000	40.000
MA-02	**MACOMB TWP**	24 MILE / CARD	67/139 Increases to 100/150 in CY 2014	30-40		
MA-03	**MACOMB TWP**	21 MILE / FAIRCHILD	57/135 increases 10 100/150 in CY 2014	20-30		
ME-01	**MELVINDALE**	OAKWOOD / FLORA	52/74	0-4	1.700	2.300
ME-02	**MELVINDALE**	OAKWOOD / HARMON	47/74	20-80		
ME-03	**MELVINDALE**	SEAWAY DR / I-75 FWY	52/71	10-20	1.700	2.300
MH-01	**MADISON HTS**	11 MILE / DEQUINDRE	51/78	60	5.650	7.150
MH-02	**MADISON HTS**	WHITCOMB / DEQUINDRE	53/80	40		
NE-01	**NORTHVILLE TWP**	SHELDON / 7 MILE	68/100	0-20	CY2013: 10.2, CY2014: 10.3, CY2015: 10.4, CY2016: 10.5, CY2017: 10.7	CY2013: 16.5, CY2014: 16.7, CY2015: 16.9, CY2016: 17.1, CY2017: 17.2
NE-03	**NORTHVILLE TWP**	8 MILE /0.5 mi W.- MEADOWBROOK	52/76	0-10	0.700	1.200
NE-04	**NORTHVILLE TWP**	8 MILE / MEADOWBROOK	59/80	25-60		
NE-05	**NORTHVILLE TWP**	6 MILE / SHELDON	58/90	5-40		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
NE-08	**NORTHVILLE TWP**	5 MILE / SHELDON	71/94	5-45		
NH-01	**NEW HAVEN**	26 MILE / GRATIOT	69/144	100		
NL-01	**NORTHVILLE**	CENTER / BASE LINE	60/83	65-100	1.650	2.150
NL-02	**NORTHVILLE**	CADY / WING	80/94	0-35		
NV-01	**NOVI**	10 MILE / HAGGERTY	54/82	0-10	CY 2013: 17.5	CY 2013: 28.0
NV-02	**NOVI**	NORTH / CENTER	52/79	0-10		
NV-03	**NOVI**	8 MILE / MEADOWBROOK	52/82	0-15		
NV-04	**NOVI**	14 MILE / DECKER	81/109	45-65		
NV-05	**NOVI**	W PARKER DR / NORTH HAVEN	72/100	25-40		
OC-01	**OAKLAND COUNTY**	WHITCOMB / DEQUINDRE	58/80	100	0.250	0.250
OP-02	**OAK PARK**	8 MILE / COOLIDGE	35/60; 40/60 in CY 2014	100	4.100	4.100
OT-01	**ORION TWP**	BROWN / GIDDINGS	54/95 Increasing to 70/95 in CY 2018	100	8.500	9.500
PL-01	**PLYMOUTH**	ANN ARBOR RD / SHELDON	120/145	43	1.810	2.620
PL-02	**PLYMOUTH**	SHELDON / GOLDSMITH	93/121	57		
PO-01	**PONTIAC**	OPDYKE / 20 MILE	37/59	65-35	13.0 Decr. To 12.0 CY2014	13.0 Decr. To 12.5 CY2014
PO-02	**PONTIAC**	GIDDINGS / WALTON	83/107	35-65		
PT-02	**PLYMOUTH TWP**	5 MILE / SHELDON	65/94	49	10.000	12.400
PT-03	**PLYMOUTH TWP**	JOY / ROCKER	125/150	33		
PT-04	**PLYMOUTH TWP**	JOY / RIDGE	75/100	18		
RC-01	**ROCHESTER HILLS**	SOUTH BLVD / LIVERNOIS	87/109 Increase to 90/109 in CY 2014	32	23.800	37.400
RC-02	**ROCHESTER HILLS**	WALTON / SQUIRREL	95/120 Increase to 100/120 in CY 2014	45		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
RC-03	**ROCHESTER HILLS**	SOUTH BLVD / ADAMS	125/148	18		
RC-04	**ROCHESTER HILLS**	24 MILE / DEQUINDRE	55/135 increases to 70/135 in CY 2014 then 105/135 at CY 2016	5		
RD-01	**REDFORD TWP**	PURITAN / TELEGRAPH	41/64	0-5	7.900	11.500
RD-02	**REDFORD TWP**	CHICAGO / WEST PARKWAY	51/74	0-20		
RD-03	**REDFORD TWP**	TELEGRAPH / MIDLAND	42/64	0-2		
RD-04	**REDFORD TWP**	BENETT / FIVE POINTS	34/62	0-3		
RD-05	**REDFORD TWP**	GRAND RIVER / 7 MILE	31/60	0-3		
RD-06	**REDFORD TWP**	PLYMOUTH / WEST PARKWAY	48/68	0-3		
RD-07	**REDFORD TWP**	SCHOOLCRAFT / TELEGRAPH	45/68	0-5		
RD-08	**REDFORD TWP**	BEECH-DALY / W CHICAGO	50/71	5-60		
RD-09	**REDFORD TWP**	8 MILE / MACARTHUR	51/98	90		
RD-10	**REDFORD TWP**	SCHOOLCRAFT / BEECH-DALY	43/67	2-10		
RE-01	**ROSEVILLE**	8 MILE / GRATIOT	67/93	60-80	6.700	9.500
RE-03	**ROSEVILLE**	KELLY / 14 MILE	62/84	20-40		
RK-01	**ROCKWOOD**	FORT / GERMAN	54/81	100	0.560	0.900
RM-01	**ROMEO**	DICKENSON / DORSEY	51/113	100	0.51	0.72
RR-01	**RIVER ROUGE**	COOLIDGE / BASSETTE	58/77	5-30	2.000	2.400
RR-02	**RIVER ROUGE**	ANCHOR / JEFFERSON	54/76	70-95		
RR-03	**RIVER ROUGE**	PLEASANT / CITY LIMITS	53/74	0		
RS-01	**ROMULUS**	VAN BORN / MERRIMAN	**N/A** (observed: 60.5/81.7)	13	CY2012: 8.59	CY2012: 10.6
RS-02	**ROMULUS**	VAN BORN / FOURTH	**N/A** (observed: 56.7/78.1)	1		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
RS-04	**ROMULUS**	ECORSE / INKSTER	40/61	0.5		
RS-06	**ROMULUS**	WICK / OZGA	67/97	85		
RS-07	**ROMULUS**	WICK / MIDDLEBELT	41/62	0.5		
RT-01	**ROYAL OAK TWP**	8 MILE / MONTE VISTA	42/59 Increasing to 45/59 in CY 2015	60-70	0.510	0.780
RT-02	**ROYAL OAK TWP**	8 MILE / GARDEN LANE	42/55 Increasing to 45/55 in CY 2015	30-40		
RW-01	**RIVERVIEW**	PENNSYLVANIA / ELECTRIC	36.5/76.3		2.87	4.01
RW-04	**RIVERVIEW**	ALLEN / SIBLEY	55.9/77.5			
SE-05	**S.E.O.C.W.A.**	NORTH / GREENFIELD	31/55	0-40	70.000	70.000
SE-06	**S.E.O.C.W.A.**	8 MILE / LIVERNOIS	40/63	0-40		
SE-07	**S.E.O.C.W.A.**	8 MILE / TELEGRAPH	40/62	0-10		
SE-08	**S.E.O.C.W.A.**	12 MILE / TYLER	71/103	15-35		
SE-09	**S.E.O.C.W.A.**	14 MILE / LAHSER	90/120	30		
SE-10	**S.E.O.C.W.A.**	QUARTON LK / CHESTERFIELD	88/115	3-12		
SE-11	**S.E.O.C.W.A.**	LAHSER / SQUARE LAKE	92/113	7		
SE-12	**S.E.O.C.W.A.**	SQUARE LAKE / ADAMS S	110/131	6		
SE-13	**S.E.O.C.W.A.**	SQUARE LAKE / TELEGRAPH	81/102	11		
SE-14	**S.E.O.C.W.A.**	INKSTER / MAPLE	116/136	10		
SE-15	**S.E.O.C.W.A.**	LAHSER / BROADWAY	66/95	2		
SG-01	**SOUTHGATE**	ALLEN / BREST	52/77	0-5	6.100	8.100
SG-03	**SOUTHGATE**	FORT / EUREKA	57/79	0-5		
SG-04	**SOUTHGATE**	EUREKA / ALLEN	54/76	95-100		
SL-01	**SYLVAN LAKE**	WOODROW WILSON / LITTLETELL	93/111	100	0.380	0.530

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
SN-01	**ST CLAIR COUNTY / Greenwood DTE supply**	METCALF / KILGORE	69.9/126.9		1.35	1.35
SR-01	**SOUTH ROCKWOOD**	DIXIE HWY / HURON RIVER DR	60/83	100	0.174	0.279
SS-02	**ST CLAIR SHORES**	14 MILE / LIPKE	74/96	57-67	9.500	10.000
SS-03	**ST CLAIR SHORES**	8 MILE / (N) HARPER	45/55	13-23		
SS-04	**ST CLAIR SHORES**	8 MILE / BEACONSFIELD	44/54	0-6		
SS-05	**ST CLAIR SHORES**	8 MILE / HARPER	46/56	14-24		
ST-02	**STERLING HTS**	16 MILE / DEQUINDRE	55/77 Increase to 60/75 in CY 2013	0-5	38.000	58.000
ST-03	**STERLING HTS**	14 MILE / SCHOENHERR	59/90 Increase to 65/80 in CY 2018	0-15		
ST-04	**STERLING HTS**	20 MILE / MOUND	49/79 Increase to 55/70 in CY 2018	0-10		
ST-05	**STERLING HTS**	14 MILE / MOUND	56/82 Increase to 65/80 in CY 2018	0-5		
ST-06	**STERLING HTS**	UTICA / KLIENO	68/89 Increase to 72/85 in CY 2018	20-30		
ST-07	**STERLING HTS**	16 MILE / EDISON	69/90 Increase to 72/85 in CY 2018	15-25		
ST-08	**STERLING HTS**	WALNUT LAKE / UTICA	61/83 Increase to 72/85 in CY 2018	15-25		
ST-09	**STERLING HTS**	18 MILE / DEQUINDRE	50/73 Increase to 55/80 in CY 2018	0-5		
ST-10	**STERLING HTS**	14 MILE / VAN DYKE	65/86 Increase to 70/85 in CY 2018	0-10		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
ST-11	**STERLING HTS**	DORBY / (E) DEQUINDRE	31/54 Increase to 60/80 in CY 2018	0-15		
SU-01	**SUMPTER TWP**	BEMIS / SAVAGE	58/93	100	1.120	1.810
SY-01	**SHELBY TWP**	AUBURN / VAN DYKE	95/126	0-1	25.000	47.500
SY-02	**SHELBY TWP**	26 MILE / MOUND	67/116	0-10		
SY-03	**SHELBY TWP**	24 MILE / DEQUINDRE	61/139	0-10		
SY-04	**SHELBY TWP**	24 MILE / MOUND	83/136	50-70		
SY-05	**SHELBY TWP**	24 MILE / SCHOENHERR	94/139	0-20		
SY-06	**SHELBY TWP**	UTICA / RYAN	96/121	0-10		
SY-08/ RH-01	**SHELBY TWP**	24 MILE / (W) DEQUINDRE	56/136	0-15		
TA-03	**TAYLOR**	BEVERLY / INKSTER	40/64	3-5	12.000	16.000
TA-04	***TAYLOR***	PELHAM / PHILOMENE	**N/A** (observed: 52.8/64.4)	1-3		
TA-05	**TAYLOR**	BEECH-DALY / WICK	45/67	30-35		
TA-06	**TAYLOR**	ALLEN / NORTHLINE	55/78	35-40		
TA-07	**TAYLOR**	WICK / MONROE	52/75	25-30		
TN-01	**TRENTON**	SIBLEY / ELECTRIC	50.8/72.5		4.91	6.70
TN-03	**TRENTON**	VAN HORN / M.C.R.R.	54.9/79.5			
TY-01	**TROY**	LONG LAKE / DEQUINDRE	50/75	0-3	CY2013: 28, CY2014: 28, CY2015: 29, CY2016: 29, CY2017: 29	CY2013: 39, CY2014: 39, CY2015: 39, CY2016: 40, CY2017: 40
TY-03	**TROY**	DEQUINDRE / MAPLE	51/77 Increase to 65/82 in CY 2023	0-25		
TY-04	**TROY**	ROCHESTER / SOUTH BLVD	114/149	30-75		
TY-06	**TROY**	ADAMS / WATTLES	87/111	0-25		
TY-07	**TROY**	SOUTH BLVD / CROOKS	72/96 Increase to 80/96 in CY 2023	20-30		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
TY-08	**TROY**	SQUARE LAKE RD / ADAMS	104/134	5-10		
UT-01	**UTICA**	AUBURN / MERRILL	107/135	100	1.200	2.000
VB-01	**VAN BUREN TWP**	HANNAN / HURON RIVER	61/95	25	6.900	7.200
VB-02	**VAN BUREN TWP**	TYLER / HAGGERTY	61/87	45		
VB-04	**VAN BUREN TWP**	BEMIS / SAVAGE	67/93	10		
VB-05	**VAN BUREN TWP**	BEMIS / HAGGARTY RD	67/93	0-2		
VB-06	**VAN BUREN TWP**	MICHIGAN / RAWSONVILLE	100/140	5		
VB-07	**VAN BUREN TWP**	TYLER / QUAINT	54/76	25-55		
WA-01	**WALLED LAKE**	14 MILE / DECKER	80/107	100	1.380	1.910
WB-02	**W BLOOMFIELD TWP**	14 MILE / FARMINGTON	94/118 Increase to 95/118 in CY 2014	10-20	CY2013: 16.5, CY2014: 16.1, CY2015: 15.8, CY2016: 15.4, CY2017: 15.0	CY2013: 25.8, CY2014: 25.2, CY2015: 24.6, CY2016: 24.1, CY2017: 23.5
WB-03	**W BLOOMFIELD TWP**	14 MILE / MIDDLEBELT	124/142 Increase to 124/145 in CY 2011	0-10		
WB-04	**W BLOOMFIELD TWP**	WALNUT LAKE / MIDDLEBELT	94/101 Increase to 95/102 in CY 2015	0-10		
WB-05	**W BLOOMFIELD TWP**	MIDDLEBELT / LONG LAKE	118/124 Increase to 119/126 in CY 2019	0-10		
WB-06	**W BLOOMFIELD TWP**	14 MILE / HALSTED	101/142 Increase to 102/145 in CY 2013	0-10		
WB-07	**W BLOOMFIELD TWP**	HAGGERTY / 14 MILE	79/107 Increase to 80/108 in CY 2016	0-10		
WB-08	**W BLOOMFIELD TWP**	WOODROW WILSON / LITTLETELL	96/114 Increase to 98/116 in CY 2019	55-65		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
WG-01	**WASHINGTON TWP**	30 1/2 MILE / VAN DYKE	52/111 Increase to 95/115 in CY 2023	45	CY2013: 5.0, CY2014:5.1, CY2015: 5.2, CY2016: 5.3, CY2017: 5.4	9.000
WG-02	**WASHINGTON TWP**	26 MILE / GTW RR	69/120 Increase to 100/120 in CY 2023	55		
WL-01	***WESTLAND***	MERRIMAN / GRAND TRAVERSE	**N/A** (observed: 60.7/79.7)	10	13.100	18.700
WL-02	***WESTLAND***	MIDDLEBELT / VAN BORN	**N/A** (observed: 65.6/89.9)	0		
WL-03	***WESTLAND***	GLENWOOD / VENOY	**N/A** (observed: 61.3/83.1)	1		
WL-06	***WESTLAND***	MIDDLEBELT / JOY	**N/A** (observed: 62.3/78.4)	14		
WL-07	**WESTLAND**	NEWBURGH / CHERRY HILL	53/73	26		
WL-08	***WESTLAND***	NEWBURGH / GLENWOOD	**N/A** (observed: 56.4/76.7)	11		
WL-09	**WESTLAND**	WAYNE / HUNTER	48/70	25		
WL-10	**WESTLAND**	JOY / NEWBURGH	49/68	9		
WL-12	***WESTLAND***	MERRIMAN / ANNAPOLIS	**N/A** (observed: 59.6/81.1)	4		
WL-13	***WESTLAND***	MICHIGAN / MERRIMAN	**N/A** (observed: 63.7/85.1)	0		
WN-03	**WARREN**	8 MILE / RYAN	63/91	0-10	31.900	41.900
WN-04	**WARREN**	8 MILE / MOUND	60/91	0-10		
WN-05	**WARREN**	8 MILE / VAN DYKE	64/92	0-40		
WN-07	**WARREN**	8 MILE / GROESBECK	63/92	5-40		
WN-10	**WARREN**	14 MILE / RYAN	55/80 Increases to 63/80 in CY 2016	0-10		
WN-11	**WARREN**	14 MILE / SCHOENHERR	64/88	5-15		

I.D. #	Community	Meter Location	Pressure min/max (psi)	Flow Spilt (%)	Max Day	Peak Hour
WN-12	**WARREN**	11 MILE / DEQUINDRE	58/79 Increase to 63/79 in CY 2016	5-15		
WN-13	**WARREN**	14 MILE / MOUND	67/89	5-20		
WO-01	**WOODHAVEN**	VREELAND / ALLEN	56/79	10-30	4.360	7.000
WO-02	**WOODHAVEN**	KING / ALLEN	54/76	70-90		
WX-01	**WIXOM**	MAPLE / BECK RD	80/120	100	5.100	5.100
YT-01	**YPSILANTI**	PENN CENTRAL R.R. & ECORSE	110/145 increase to 112/145 in CY 2018	60-85	24.100	24.100
YT-02	**YPSILANTI**	ECORSE / PENN CENT RR	115/145 Increase to 117/145 in CY 2018	10-20		
YT-03	**YPSILANTI**	10400 GEDDES RD	110/145 Increase to 112/145 in CY 2018	0-10		

THIS PAGE INTENTIONALLY LEFT BLANK.