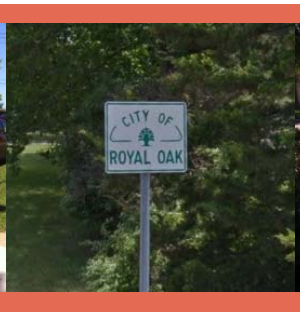
City of Royal Oak, Michigan
Community Development
Engineering Division

Water Distribution System Reliability Study and General Plan

October 2015

Royal Oak
Life Now Playing

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Introduction and Purpose

Introduction

The City of Royal Oak (city) is comprised of 11.79 square miles of land area. It is located in the northeast portion of the greater Detroit metropolitan area and the Southeast Michigan Council of Governments (SEMCOG) planning area. The city is in the southeastern portion of Oakland County and bordered by the cities of Birmingham, Troy, and Clawson on the north, the cities of Berkley, Huntington Woods, and Southfield and the Village of Beverly Hills on the west, the cities of Ferndale and Pleasant Ridge on the south, and the City of Madison Heights on the east. The 2000 Census reported the city's population at 60,062 persons and the 2010 Census reported the population at 57,236 persons. Figure 1, on page 6, is a vicinity map of the city and surrounding communities. SEMCOG population figures are presented on the SEMCOG Community Profile for the city in Appendix A.

The Southeastern Oakland County Water Authority (SOCWA) currently supplies the city with potable water that it purchases from the Detroit Water and Sewerage Department (DWSD). The city is currently supplied water at 11 metered source locations along the city's border and throughout the western side of the city. Note that there are 12 metered source locations for the city, but one source valve is maintained in the closed position. DWSD's system treats surface water from the Detroit River and lower Lake Huron and delivers it to the SOCWA distribution system through its regional distribution system. The 12 source locations and the city's distribution system are illustrated on Figure 2, on page 7, the Existing Water Distribution System General Plan. A 24" x 36" General Plan is also included for reference in Appendix B. The city's current contract with SOCWA is included in Appendix C.

Purpose

The purpose of the Water System Reliability Study is to meet the requirements of the State of Michigan *Safe Drinking Water Act 1976 PA 399, Part 12. Reliability* and *Part 16. General Plans*, as amended and to evaluate the city's existing water distribution system to determine where deficiencies exist and provide recommendations, with costs, for improvements required to meet existing and future service needs. The Water System Reliability Study also addresses unserved areas of the city and proposes ways of serving those areas with water in the future and presents a capital improvement and maintenance plan for the city's water system over the next 20 years.

The Study is intended to guide the city in providing water service to existing as well as potential future customers over the next 20 years. More specifically, the following items are included in the Study:

- Present and projected average daily demand (2020 and 2035);
- Present and projected maximum daily demand (2020 and 2035);
- Present and projected maximum hourly demand (2020 and 2035);
- Present and projected fire flow demand;

- Basis of projected demands;
- Annual supply totals for each source;
- Capacity during interruption of power service;
- Hydraulic analyses and evaluation of the existing water distribution system;
- Water shortage response plan for emergencies;
- Recommendations for distribution system improvements based on deficiencies and estimated costs of improvements.

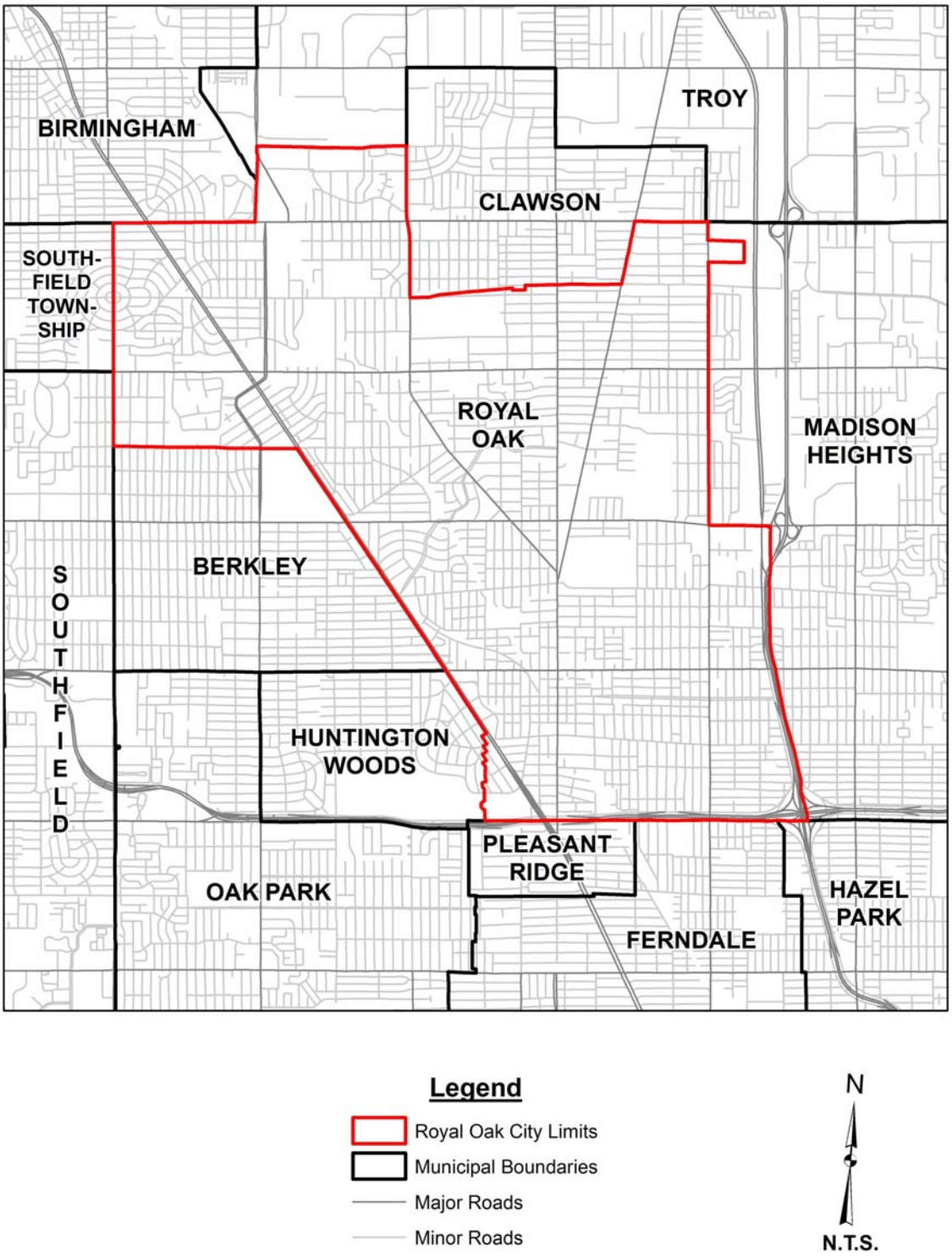


Figure 1 – Vicinity Map

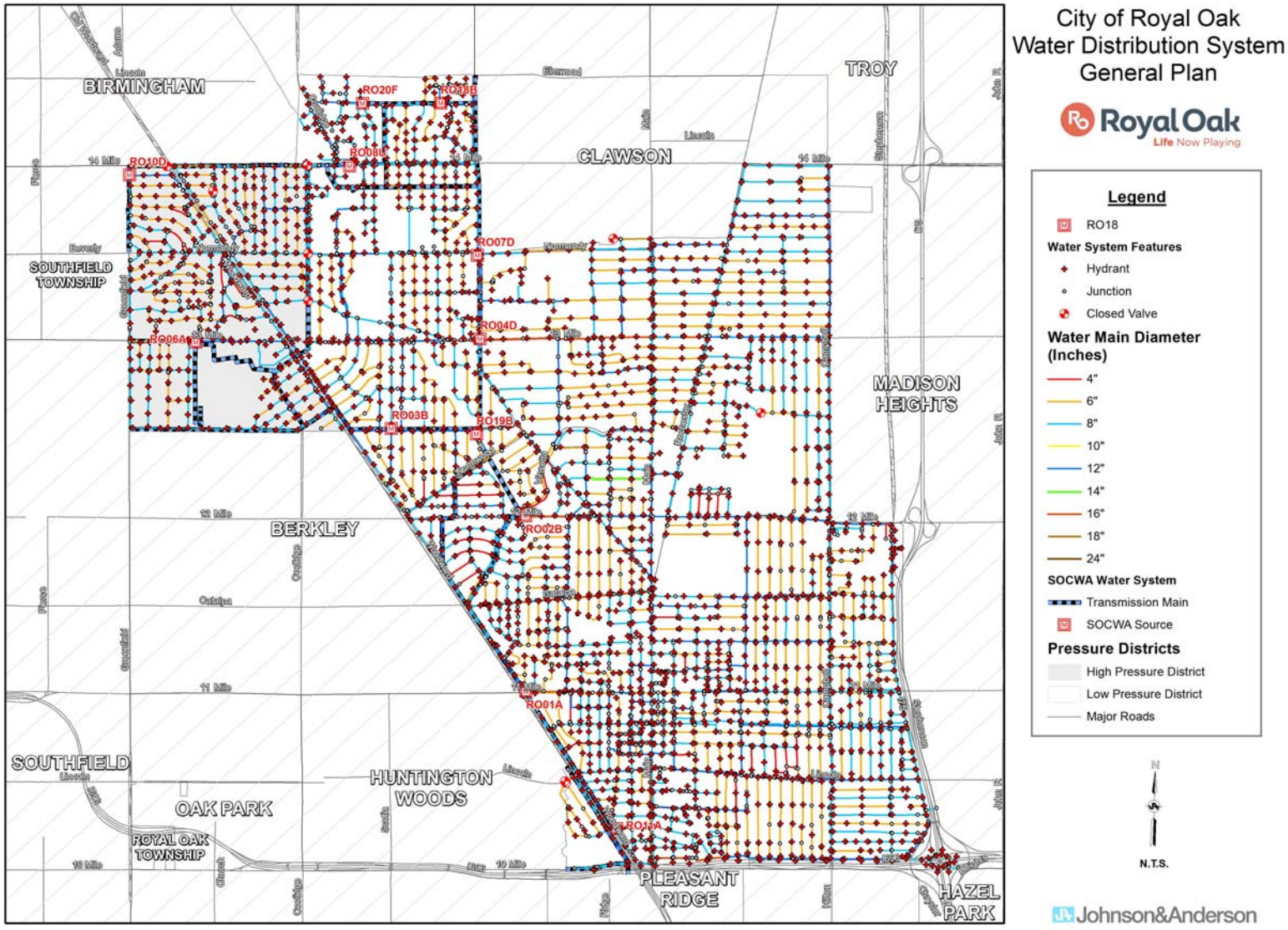


Figure 2 – Existing Water Distribution System General Plan
(Refer to Appendix B for a 24" x 36" Plan)

Background

Population

Information provided by the SEMCOG[1] was used to forecast the future population of the city. Figures provided from the U.S. Census Bureau were used to show historical population records. According to the U.S. Census Bureau, the population of the city was 70,893 in 1980, 65,410 in 1990, 60,062 in 2000, and 57,236 in 2010. The historical and forecasted population to year 2040 is shown in Table 1. The SEMCOG Community Profile for the city is presented in Appendix A.

Table 1. SEMCOG and U.S. Census Historical and Future Population Statistics for the City of Royal Oak

Year	Population	Source
1970	85,499	Census
1980	70,893	Census
1990	65,410	Census
2000	60,062	Census
2010	57,236	Census
2015	56,700	SEMCOG Forecast
2020	57,794	SEMCOG Forecast
2025	57,743	SEMCOG Forecast
2030	58,000	SEMCOG Forecast
2035	58,348	SEMCOG Forecast
2040	59,105	SEMCOG Forecast

City Land Use/Zoning

According to the 2008 SEMCOG's Land Use/Land Cover data[2] (presented in Appendix A), approximately 49.2% of the city is comprised of single-family residential areas, 25.6% of the city is classified as Transportation, Communication and Utility and 5.1% of the city is classified as commercial usage. Commercial corridors are mainly located along main roads including Woodward Avenue, Eleven Mile Road, and Main Street, and approximately three to four blocks east and west of Main Street between Eleven and Ten Mile Roads. Beaumont Hospital is located within the city but is supplied directly from SOCWA and is not a customer of the city. Land use for the city is presented by category in Table 2, on page 9. Figures 3 and 4, on pages 10 and 11, present the city's 2014 zoning for the north half and south half of the city, respectively. City zoning maps can also be found on the city's website at the following address: http://www.romi.gov/departments/planning/zoning-district-maps.

Table 2. City of Royal Oak Land Use Data from SEMCOG

Land Use Category	2008 Acres	2008 Land Use Percentage
Agricultural	0	0.00%
Single-Family Residential	3,725	49.25%
Multi-Family Residential	218	2.88%
Commercial	385	5.09%
Governmental/Institutional	549	7.26%
Industrial	160	2.12%
Transportation, Communication and Utility	1,938	25.62%
Park. Recreation and Open Space	584	7.72%
Water	5	0.07%
Totals:	7,564	100.00%

Topography

Elevation contours from the Oakland County's Geographic Information System (GIS) illustrate that the terrain generally slopes from the northwest corner of the city to the southeast corner of the city, decreasing in elevation. There are a few significant hills and depressions and other variations on a minor scale existing throughout the city. Elevations are between 746 and 604.6 feet above sea level (National Geodetic Vertical Datum). The lowest elevation (604.6) is located in the southeast corner of the city at the I-696 and I-75 Interchange. The highest elevation (746) is located in the northwest corner of the city at the intersection of East 14 Mile Road and Greenfield Road. The difference between the highest and lowest elevations within the city is 141.4 feet, which equates to a pressure difference of 61.3 pounds per square inch (psi).

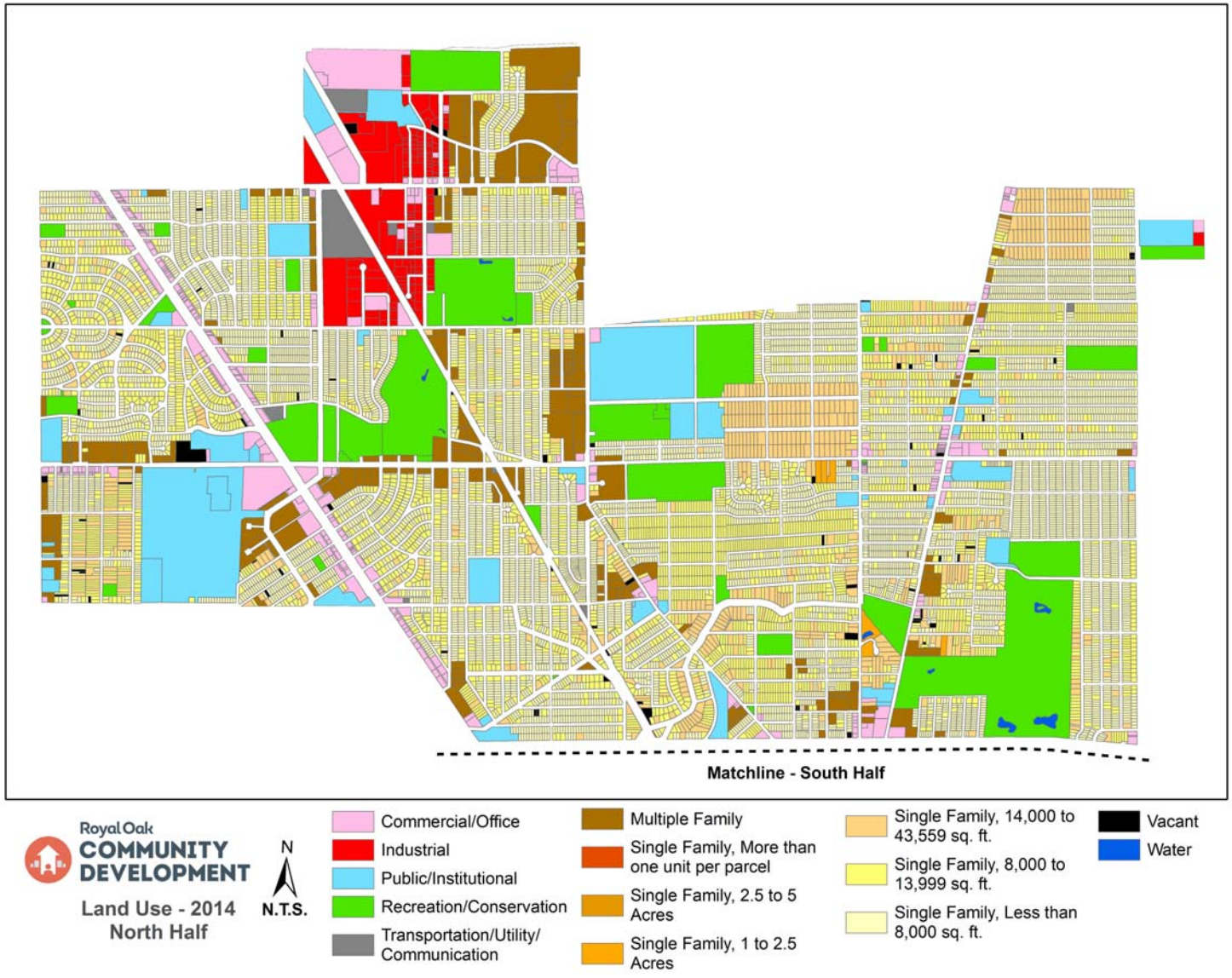


Figure 3 – Royal Oak Future Land Use Map – North Half of City

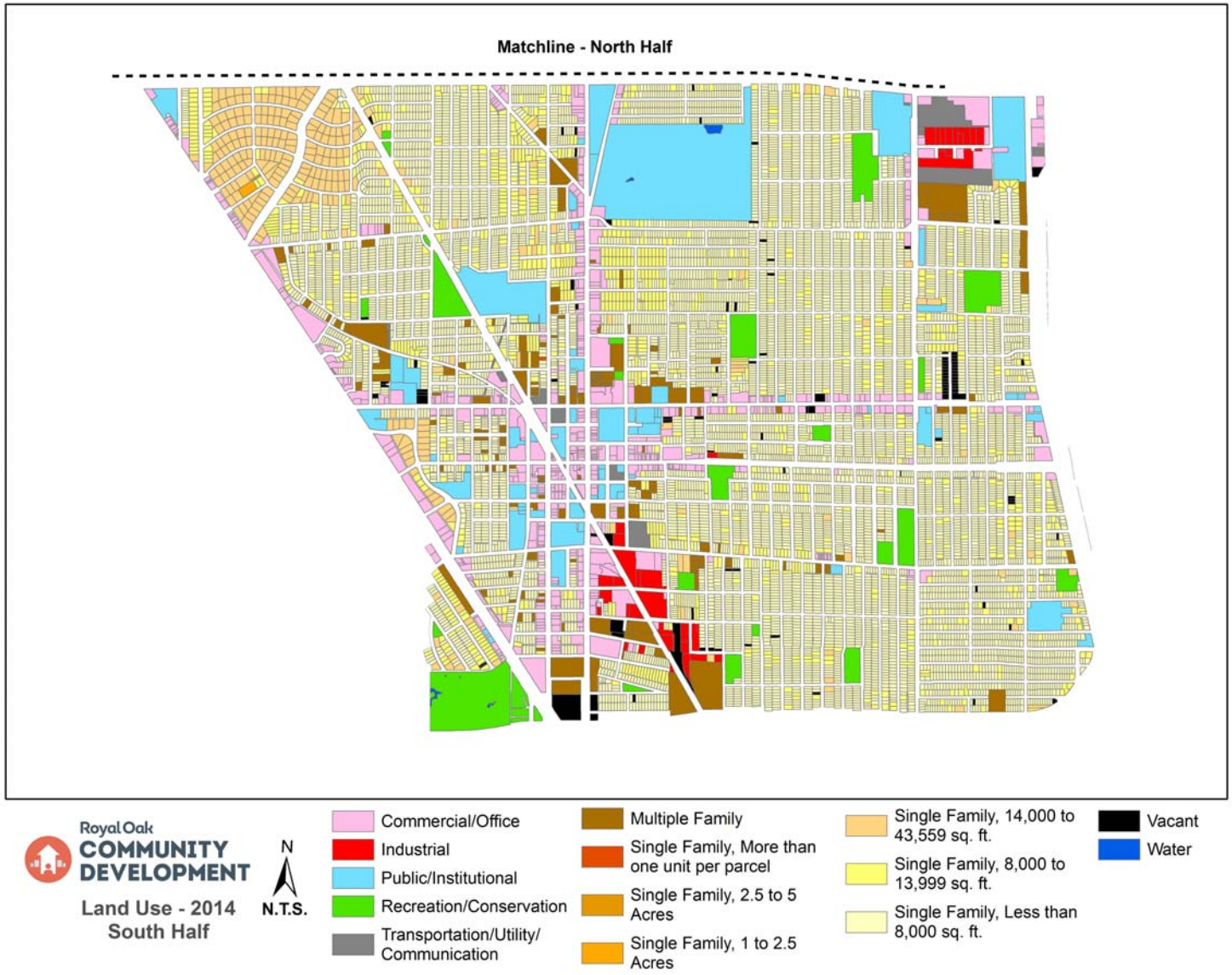


Figure 4 – Royal Oak Future Land Use Map – South Half of City

Existing Water Distribution System

Water System Service Area – Existing Customers

The Oakland County Geographic Information System (GIS) Tax Parcel feature class reports that in 2015 there were a total of 22,894 parcels in the city covering 5,700 acres with an additional 1,856 acres being right-of-way. The public water system currently supplies water to 22,492 residential customer connections, 1,366 commercial customer connections and 74 governmental customer connections. Six customers outside of the city located on Greenfield (2), 14 Mile (2), Crooks (1), and Campbell (1) Roads are also served by the city's water system. Table 3 presents the usage for customer classes, developed by the city for 2014.

Table 3. 2014 Water Usage by Customer Class

Usage Class	Number of Units	2014 Usage (cubic feet)	2014 Usage (gallons)
Residential	22,492	166,417,200	1,244,967,073
Commercial	1,366	49,900,000	373,301,900
Governmental	74	3,223,500	24,115,004
Fire Line	122	1,000	7,481
Other	91	2,738,100	20,483,726
Outside City	6	78,800	589,503
Total	24,151	222,358,600	1,663,464,687

Water Supply

The city currently has a total of 11 active metered connection/supply points from the SOCWA water system at separate locations throughout the city. It must be noted that the connection located at Torquay Avenue and Crooks Road has been closed for several years, although SOCWA still provides a line item for that location in billing data provided to the city. The city Water Billing Department maintains billing records from SOCWA for each of the supply meters. These records were analyzed from August 2013 through July 2015 to determine the total water delivered to the city's water system from SOCWA. The summary of water supplied to the city's water system for each of the two years studied is summarized by month in Tables 4 and 5, on pages 13 and 14. The meter locations are shown on Figure 2, on page 7, and on the map in Appendix B.

Table 4. Water Supplied to the City of Royal Oak from SOCWA in Cubic Feet (August 2013 - July 2014)

Meter ID	Location	Aug-2013	Sept-2013	Oct-2013	Nov-2013	Dec-2013	Jan-2014	Feb-2014	Mar-2014	Apr-2014	May-2014	June-2014	July-2014
RO01A	11 Mile & Woodward	2,753,700	2,443,200	2,263,200	2,040,600	2,075,700	2,160,500	2,082,700	2,234,400	1,956,500	2,154,100	2,415,600	2,575,600
RO02B	12 Mile & Vinsettta	2,202,200	1,681,300	1,576,400	1,444,400	1,511,500	1,777,200	1,757,600	1,944,600	1,703,500	1,748,300	1,887,700	2,007,700
RO03B	Webster & Benjamin	2,911,000	1,992,300	1,680,400	1,345,700	1,476,900	1,818,000	1,773,000	1,910,700	1,581,400	1,722,000	1,996,900	2,238,000
RO04D	13 Mile & Crooks	2,405,000	1,951,100	1,774,100	1,617,200	1,696,400	1,868,300	1,721,100	1,860,800	1,681,300	1,726,500	1,897,400	2,094,300
RO06A	13 Mile & Harvard	1,773,100	1,511,400	1,389,500	1,235,000	1,347,700	1,462,300	1,516,500	1,587,200	1,500,500	1,591,700	1,715,000	1,908,500
RO07D	Normandy & Crooks	647,800	346,400	321,200	248,400	269,100	385,000	363,100	414,000	343,700	309,100	361,700	417,400
RO08U	14 Mile & Edgeland	1,576,300	3,414,000	3,147,300	3,501,100	3,542,600	3,907,700	3,676,400	4,062,100	3,848,200	3,678,500	3,722,300	3,577,500
RO10D	Greenfield & Berkshire	1,242,500	1,022,500	787,300	774,100	849,000	961,600	1,022,100	1,088,000	1,023,200	1,123,100	1,236,000	1,358,800
RO11A	Woodward & Kenilworth	4,417,800	3,536,600	3,086,600	2,745,600	2,893,300	3,286,600	3,256,600	3,538,100	2,913,600	3,236,400	3,685,400	4,174,900
RO18B*	Torquay & Crooks	0	0	0	0	0	0	0	0	0	0	0	0
RO19B	Oliver Station	2,101,100	1,607,300	1,466,500	1,350,000	1,398,100	1,577,800	1,525,600	1,608,000	1,368,600	1,457,700	1,621,500	1,710,700
RO20F	Delemere & Meijer Dr	143,900	22,700	38,500	4,900	3,800	5,700	6,000	8,600	8,400	5,300	5,600	12,300
	Monthly Total	22,174,400	19,528,800	17,531,000	16,307,000	17,064,100	19,210,700	19,858,100	20,256,500	17,928,900	18,752,700	20,545,100	22,075,700

Total Water Purchased = 231,233,000 Cubic Feet = 1,729,854,073 Gallons
*A valve at Meter RO18B is currently closed and is expected to remain closed.

Table 5. Water Supplied to the City of Royal Oak from SOCWA in Cubic Feet (August 2014 – July 2015)

Meter ID	Location	Aug-2014	Sept-2014	Oct-2014	Nov-2014	Dec-2014	Jan-2015	Feb-2015	Mar-2015	Apr-2015	May-2015	June-2015	July-2015
RO01A	11 Mile & Woodward	2,524,300	2,497,100	2,481,900	2,255,500	2,216,100	2,285,700	2,124,400	2,700,300	2,378,100	2,263,900	2,321,200	2,637,900
RO02B	12 Mile & Vinsettta	2,126,500	1,715,400	1,649,200	1,621,400	1,670,400	1,848,800	1,763,700	2,076,900	1,949,100	1,761,700	1,845,600	2,022,600
RO03B	Webster & Benjamin	2,373,200	2,201,300	1,406,400	1,355,700	1,295,200	1,613,000	1,681,400	2,326,100	1,756,100	1,910,900	1,927,600	1,991,500
RO04D	13 Mile & Crooks	2,317,700	2,149,900	1,741,100	1,600,800	1,545,400	1,648,900	1,519,900	1,958,000	1,577,500	1,743,300	1,764,400	1,814,600
RO06A	13 Mile & Harvard	1,760,300	1,577,100	1,529,500	1,534,300	1,662,100	1,537,100	1,265,000	1,355,800	1,188,800	1,348,600	1,433,500	1,800,000
RO07D	Normandy & Crooks	357,400	326,700	269,000	260,900	318,300	365,000	309,600	357,800	311,700	354,800	354,900	420,200
RO08U	14 Mile & Edgeland	2,378,000	2,224,700	3,564,800	3,471,500	3,863,800	4,072,600	3,632,200	3,025,600	3,961,200	4,325,100	4,242,200	5,207,900
RO10D	Greenfield & Berkshire	1,400,000	1,117,000	1,056,200	1,061,500	1,160,600	1,035,100	768,700	819,200	731,200	1,000,000	923,100	1,074,700
RO11A	Woodward & Kenilworth	3,938,600	3,278,800	2,886,700	2,748,300	2,752,600	3,014,900	2,902,400	3,752,200	3,234,600	3,400,000	3,038,900	3,504,900
RO18B*	Torquay & Crooks	0	0	0	0	0	0	0	0	0	0	0	0
RO19B	Oliver Station	1,706,000	1,576,100	1,271,100	1,208,100	1,191,600	1,336,700	1,325,200	1,629,300	1,417,200	1,462,800	1,458,100	1,500,000
RO20F	Delemere & Meijer Dr	43,900	55,400	23,100	10,000	4,600	3,800	3,200	20,000	2,900	2,600	3,300	1,900
	Monthly Total	20,925,900	18,719,500	17,879,000	17,128,000	17,680,700	18,761,600	17,295,700	20,021,200	18,508,400	19,573,700	19,312,800	21,976,200

Total Water Purchased - 227,787,700 Cubic Feet = 1,704,042,379 Gallons
*A valve at Meter RO18B is currently closed and is expected to remain closed.

Non-revenue Water Determination

Non-revenue water is the difference between water produced or purchased and water metered to customers (i.e. consumed or billed). Non-revenue water is known as water loss that produces no revenue for the city, while still incurring a cost because it was delivered by SOCWA into the system and is billed to the city. Leaks, water used for firefighting, hydrant flushing, water lost during main breaks, water theft, un-calibrated meters, and inaccurate meters all contribute for the discrepancy between water purchased and consumed. The city's non-revenue water, for January 2014 through December 2014 based on water supplied from SOCWA (1,719,159,235 gallons) and water billed to customers (1,662,875,184 gallons, as determined from billing records provided by the city's Water Billing Clerk), was 3.27 percent. "The American Water Works Association has recommended that the loss occurring after treatment be maintained at 10% or less."[3]

Average Daily Demand Determination

Average daily demand is defined as the annual consumption for a given year divided by the number of days in the year. Based on water supplied to the city for the calendar year 2014 the calculated average daily demand is 4,710,025 gallons per day (gpd) which is equivalent to 3,271 gallons per minute (gpm). This demand also includes system non-revenue water and is used for system modeling purposes.

Maximum Daily Demand Determination

Maximum daily demand is defined as the water consumption that occurs on the largest demand day in a year. Based on supply records provided by SOCWA, from 2012 through 2014, a city maximum daily demand of 10.04 million gallons per day (6,972 gpm) occurred on June 28, 2012. Based on the average daily supply over a year and the maximum daily supply on this date in 2012, the reported maximum daily demand would be 2.13 times the average daily demand.

Maximum Hourly Demand

Maximum hourly demand is the demand that occurs during the hour of largest water use in a given year. Based on supply records provided by SOCWA, a maximum hourly supply of 541,466 gallons per hour (9,024 gpm) occurred on July 2, 2012 at 8:00 pm. Therefore, the city's maximum hourly demand is approximately 2.76 times the average daily demand.

Fire Flow Demand

The city has results from an Insurance Services Office (ISO), Inc. *Public Protection Classification Study* that was performed in 2005. According to the study's Hydrant Flow Data Summary, the highest needed fire flow is 6,000 gpm on Main Street at the first hydrant north of Crooks Road. The ISO Study including the Hydrant Flow Data Summary is presented in Appendix D.

Capacity During Power Outages

Because the city's water is supplied from SOCWA through the DWSD system, a power outage will not affect delivery of water unless it is a large scale regional power loss that affects DWSD and SOCWA storage, pumping and/or treatment facilities. DWSD has been adding generators to its system and would be able to supply water to the city, through SOCWA, during regional power outages once the generators were brought online. It is not known how much water could be supplied by DWSD during a power outage. Water supply from SOCWA is expected during power outages allowing the city to provide water service to customers at a minimum of 20 psi.

Emergency Connections

Royal Oak has five emergency interconnections to other water distribution systems. There is an eight-inch diameter interconnection with the SOCWA system at the southwest corner of Woodward Avenue and 14 Mile Road and a second eight-inch diameter interconnection with the SOCWA system at the southeast corner of Woodward Avenue and 14 Mile Road. There are two emergency connections to the Madison Heights distribution system at Campbell Road and 14 Mile Road, and along Stephenson Highway between Hudson Avenue and Brockton Avenue. An emergency connection to the Clawson distribution system is located on Chippewa Street west of Washington Avenue.

All of the connections described above are in a closed position and would need to be opened manually in order for water to be supplied through the valve to either system. No meters are installed at any of the locations to monitor the quantity of water that would be supplied through the connections. The valves could be opened during emergency conditions but the water supplied through the valves would only maintain flow and pressure in the immediate area/location of the connection. Water would not be supplied to the entire city or to the adjacent city through any or all of these interconnections. City personnel check the connections regularly to ensure they are in the closed position.

All of the emergency connection locations are shown on Figure 5, on page 17.

Figure 5 – City of Royal Oak Emergency Connections

Emergency Response Plan for Water Shortages

From the city's Water System Security Emergency Response Plan: "During power outages, City personnel will have hand radios and cell phones available for communications. The means available for communicating the emergency to the public include newspapers, radio stations, television stations, City public television station (WROK), and the City's website (www.ci.royal-oak.mi.us)."

The city can open emergency connections with neighboring communities (refer to Figure 5 on page 17), if they are able to supply water. The emergency connections would only supply localized areas of the city, not the entire city.

The Emergency Response Plan lists available water haulers that the city would contact, as necessary. They include Northwest Energy, Weir's Water & Pool, Inc., Blue Water Transport Inc., and Michigan Milk Producers Association.

Distribution System

The city's water distribution system is comprised of approximately 232 miles of water main ranging in age from new to approximately 94 years old. The mains are assumed to be primarily cast iron and ductile iron with a small percentage of asbestos cement water mains. Table 6 provides a tabulation of the total length of water main in the system by diameter. The table does not include SOCWA transmission mains located within the city. The system also contains approximately 2,148 hydrants, 3,547 valves, and 24,151 service connections. Figure 6, on page 19, shows the existing water distribution system with water mains color coded by diameter. A 24" x 36" General Plan presenting this information is included in Appendix B. Figure 7, on page 20, presents the existing water distribution system with water mains color coded by their approximate year of installation. The year of installation was determined based on the years stamped on the hydrants installed on the water main. A 24" x 36" map presenting the year of installation is included in Appendix E.

Table 6. Length of Distribution System Water Mains by Diameter

Diameter (inches)	Length (feet)	Length (miles)
4	32,427	6.14
6	462,946	87.68
8	499,698	94.64
10	452	0.09
12	202,153	38.29
14	1,943	0.37
16	24,425	4.63
18	285	0.05
24	1,052	0.20
Total	1,225,379	232

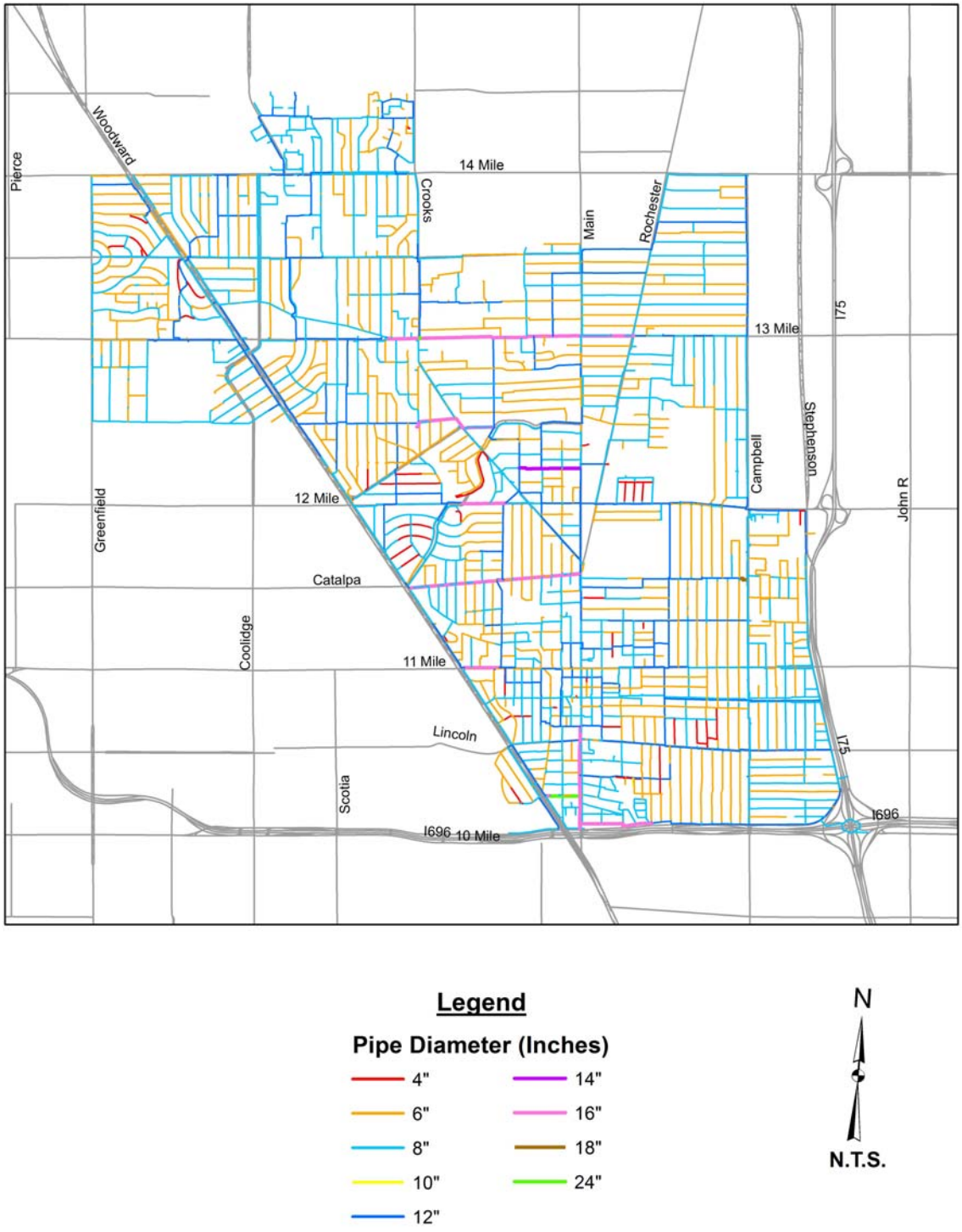


Figure 6 – Water Distribution System Schematic – Water Main Diameters
(Refer to Appendix B for 24" x 36" map of existing water main diameters)

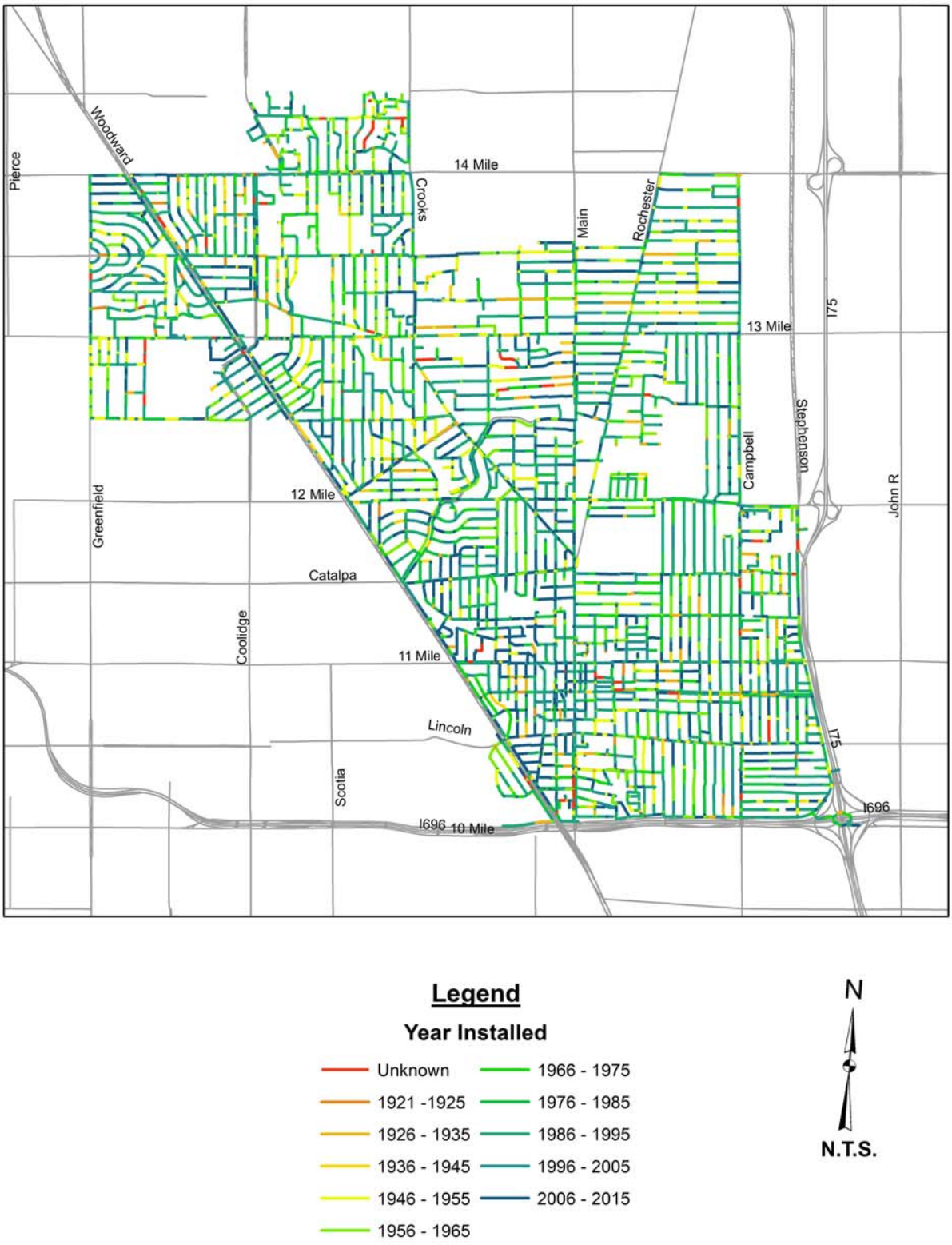


Figure 7 – Water Distribution System Plan – Year of Installation
(Refer to Appendix D for 24" x 36" map of installation year of water mains)

Distribution System Operation

The city's water distribution system receives treated surface water from DWSD Water Filtration Plants, delivered through SOCWA's system to 11 metered connections throughout the city. It should be noted, that currently, the connection at Torquay and Crooks, RO18B, is closed. The connection locations are shown on the General Plan on page 7 and in Appendix B. SOCWA source pressure ranges are presented in Table 7 along with hydraulic grade lines.

Table 7. SOCWA Supply Pressures and Hydraulic Grades Lines (HGL)

Meter ID	Location	Ground Elevation (ft.)	PSI Range	Lowest Pressure (ft.)	Highest Pressure (ft.)	Lowest HGL (ft.)	Highest HGL (ft.)
RO01A	11 Mile & Woodward	660.00	55 - 60	126.92	134.58	786.92	794.58
RO02B	12 Mile & Vinsettta	656.80	50 - 55	112.15	126.92	768.95	783.72
RO03B	Webster & Benjamin	672.94	50 - 55	112.15	126.92	785.09	799.86
RO04D	13 Mile & Crooks	677.29	45 - 50	103.85	115.38	781.14	792.67
RO06A	13 Mile & Harvard	708.00	70 - 75	161.54	173.08	869.54	881.08
RO07D	Normandy & Crooks	680.01	45 - 50	103.85	115.38	783.86	795.39
RO08U	14 Mile & Edgeland	703.18	45 - 50	103.85	115.38	807.03	818.56
RO10D	Greenfield & Berkshire	744.00	70 - 75	161.54	173.08	905.54	917.08
RO11A	Woodward & Kenilworth	666.00	55 - 60	126.92	138.46	792.92	804.46
RO18B*	Torquay & Crooks	N/A	N/A	N/A	N/A	N/A	N/A
RO19B	Oliver Station	667.00	50 – 55	115.38	126.92	782.38	793.92
RO20F	Delemere & Meijer Dr	704.00	45 – 50	103.85	115.38	807.85	819.38

*The connection at Meter RO18B is closed.

Water Quality

Each year, the city produces a Water Quality Report for distribution to its water customers, as required by the United States Environmental Protection Agency (USEPA) and the Michigan Department of Environmental Quality (MDEQ). The report is also referred to as the Consumer Confidence Report (CCR). The 2014 Water Quality Report, as well as previous years' reports, can be found on the city's website at http://www.romi.gov/departments/engineering/water-quality-reports.

The 2014 Water Quality Report shows the Maximum Contaminant Levels (MCL) and Maximum Contaminant Level Goals (MCLG) for certain compounds tested and detected in the city's water system. A MCL is the highest level of a contaminant that is allowed in drinking water under the *Safe Drinking Water Act*. The MCLG is the level of a contaminant in drinking water below which there is no known or expected risk to health. Drinking water samples are taken throughout the distribution system and are tested for total trihalomethanes, haloacetic acids, total coliform bacteria, E.coli bacteria, lead, and copper. Contaminants that are tested for at the DWSD Water Treatment Plants include fluoride, nitrate, xylene, total chlorine residual, turbidity, total organic carbon, combined radium (Radium 226 and 228) and sodium.

The data included in the city's 2014 Consumers Annual Report on Water Quality indicates that the concentration of tested compounds in the water supply is significantly below the required MCL and is considered safe for consumption.

Model Development and Calibration

Computer water system network analyses are used to effectively assist in planning, design, and operation of a water distribution system. Computer analyses are also used to identify system deficiencies and other necessary system upgrades. Johnson & Anderson (J&A) has developed a computer model of the city's water distribution system using data compiled from the city and field Global Positioning System (GPS) data obtained by J&A's survey department. This GPS data was then used to develop a city water network in the *ArcMap* program (i.e. a Geographic Information System (GIS) program). The GIS information was imported into *InfoWater* pressure pipe modeling software developed by MWH Soft, Inc. (currently Innovyze). The model contains all 4-inch diameter and larger water main in the city's system. A current water system model schematic is included in Appendix F.

The specialized computer modeling software allows the model to be constructed graphically using *ArcGIS* data. Utilizing drawings of the water system layout and computerized base map information the model is constructed to scale. This results in a reproducible *ArcMap* drawing of the entire system. Also included as inputs to the model are ground elevations at hydrants, pipe intersections, and other key locations in the model, water demands, and the length, diameter, and roughness coefficients (friction factors) of the water mains which are based on the type of material (i.e. ductile iron, cast iron, HDPE, etc.), the diameter, and the relative age of the main.

The city's model demands were allocated based on 2014 billing records obtained from the city's Treasurer. Demands were proportionately adjusted based on water supply records as presented in Tables 4 and 5, on pages 13 and 14. Ground elevations were determined from GPS and 2 foot elevation contours obtained from Oakland County's GIS department. Source node locations (i.e. SOCWA connections), elevations, and pressures are also included in the model.

Model calibration is the process of adjusting input data so that output data accurately reflects field values. It is very important that the network model be compared and calibrated to actual field conditions. Average daily demands are used for model calibration since hydrant flow tests, conducted for model calibration/validation, are not usually performed during periods of peak water usage. In order to calibrate the computer model to accurately predict field conditions, it is necessary to make systematic adjustments to the computer model inputs. Model inputs were checked and main diameters and connections adjusted as necessary, based on water system drawings from the city's engineering division. Roughness coefficients are adjusted in an iterative process to produce a model that accurately predicts field conditions.

Hydrant flow tests were performed by Department of Public Service (DPS) personnel and J&A staff in July 2015. The *InfoWater* model was calibrated to source pressures at the master meter locations based on pressures supplied by SOCWA. Once hydrant pressures and flows were calibrated using roughness coefficient adjustments the coefficients were assigned to water mains of the same diameter and relative age throughout the distribution system model. Model pressure and flow calibration results based on flow tests are shown in Table 8, on page 24. Hydrant test locations are presented on the map in Appendix G. Model calibration to within 15% of actual field conditions is generally considered an acceptable calibration.

Table 8. Model Calibration Results

Hydrant Test Location No.	Location Description	Size (inches)	Measured Static Pressure (psi)	Model Static Pressure (psi)	% Difference	Measured Residual Pressure (psi)	Pressure Drop	Model Residual Pressure (psi)	Flow Hydrant Junction Model No.	Metered Flow (gpm)	Metered Residual vs. Model Residual % difference
	Normal Pressure District										
1	Hudson, 1st west of Knowles	8.00	63.0	61.7	2.1	60.0	3.0	58.95	H-1-FLOW	1200	1.8
2	Main and Kenilworth, NE corner	8.00	61.0	62.0	-1.6	58.0	3.0	60.78	H-2-FLOW	1130	-4.8
5	Washington and Ninth	8.00	57.0	55.8	2.2	54.0	3.0	54.91	H-5-FLOW	1130	-1.7
6	W/S Woodward, 1st north of Sixth	8.00	58.0	59.4	-2.4	55.0	3.0	56.35	H-6-FLOW	1130	-2.5
7	Woodward and Catalpa, SE corner	8.00	56.0	57.6	-2.8	52.0	4.0	56.21	H-7-FLOW	1130	-8.1
8	E/S Woodward, 2nd north of Northwood	8.00	54.0	54.8	-1.4	52.0	2.0	50.77	H-8-FLOW	1050	2.4
13	W/S Woodward, 4th south of Lincoln	8.00	55.0	54.9	0.1	51.0	4.0	51.42	H-13-FLOW	1095	-0.8
14	Irving and Parent	6.00	66.0	64.8	1.8	56.0	10.0	61.11	H-14-FLOW	750	-9.1
15	Lincoln and Wilson, NE corner	8.00	69.0	67.3	2.5	66.0	3.0	65.37	H-15-FLOW	1250	1.0
16	Brockton and Helene	8.00	70.0	68.5	2.2	60.0	10.0	64.62	H-16-FLOW	1060	-7.7
17	11 Mile and Kenwood	8.00	68.0	67.1	1.4	62.0	6.0	59.76	H-17-FLOW	950	3.6
19	Stephenson, 1st north of Gardenia	8.00	68.0	67.4	1.0	62.0	6.0	59.57	H-19-FLOW	1140	3.9
22	Girard, 2nd east of Ardmore	8.00	63.0	62.9	0.1	53.0	10.0	58.34	H-22-FLOW	550	-10.1
23	Rochester and Woodland, NE corner	8.00	64.0	63.2	1.2	54.0	10.0	55.31	H-23-FLOW	880	-2.4
24	Campbell and Ottawa	8.00	64.0	63.1	1.4	54.0	10.0	55.02	H-24-FLOW	920	-1.9
26	Washington and Willis	8.00	59.0	57.8	2.1	54.0	5.0	56.36	H-26-FLOW	1060	-4.4
28	McDonald, 1st north of 12 Mile	8.00	61.0	60.0	1.6	59.0	2.0	58.26	H-28-FLOW	1160	1.3
29	Crooks and Webster	8.00	59.0	56.1	4.9	54.0	5.0	54.80	H-29-FLOW	1160	-1.5
30	Lexington, 1st west of Morris	12.00	58.0	57.5	0.8	54.0	4.0	51.62	H-30-FLOW	1100	4.4
32	Parmenter and Coventry, SW corner	8.00	48.0	48.4	-0.7	44.0	4.0	43.12	H-32-FLOW	1000	2.0
34	Delemere, 1st south of Samoset	8.00	42.0	43.2	-2.8	33.0	9.0	35.62	H-34-FLOW	840	-7.9
43	Alexander and Farnum	12.00	66.0	63.5	3.8	62.0	4.0	62.17	H-43-FLOW	1190	-0.3
	High Pressure District										
9	Starr and Hampton	8.00	72.0	73.8	-2.5	62.0	10.0	68.28	H-9-FLOW	700	-10.1
10	Woodward and Samoset, NE corner	6.00	60.0	60.6	-1.1	50.0	10.0	54.51	H-10-FLOW	750	-9.0
11	Woodward and Normandy, NW corner	8.00	66.0	66.2	-0.3	62.0	4.0	62.82	H-11-FLOW	970	-1.3
37	Dukeshire, 1st north of Yorba Linda	12.00	68.0	67.5	0.7	59.0	9.0	61.17	H-37-FLOW	1200	-3.7
38	Greenfield and Springer	8.00	58.0	58.6	-1.1	48.0	10.0	54.35	H-38-FLOW	600	-13.2
39	Greenfield and Judson	8.00	64.0	63.7	0.4	54.0	10.0	56.61	H-39-FLOW	650	-4.8

Existing System Deficiencies

Introduction

Computer model analyses provide water system performance data to facilitate operational and capital improvements to help the city maintain a safe, reliable, and cost-effective water supply to its existing and future water customers. The computer model has been used to analyze potential deficiencies and predict available fire flows at hydrants in the water distribution system. It is important to remember that the model utilizes a limited number of data points to extrapolate the results and is not capable of predicting exact field pressures and fire flows. The actual pressures and fire flows are a function of many complex factors that are simplified for the purposes of constructing the computer model. Manual hydrant flow tests performed in the field are the best means of determining available pressure and flow at a given location and specific time.

According to *Recommended Standards for Water Works*[4]: "The system shall be designed to maintain a minimum pressure of 20 psi (140 kPa) at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system shall be at least 35 psi (240 kPA) and should be approximately 60 to 80 psi (410 – 550 kPa) and not less than 35 psi (240 kPa)." This is also a Michigan Department of Environmental Quality (MDEQ) requirement.

Model Results

The *InfoWater* model of the existing water distribution system was used to evaluate the pressure and flow characteristics of the system. Average daily demand, maximum daily demand and maximum hourly demand scenarios were developed and run using the water distribution system model.

The computer model of the existing system with a 2015 average daily demand allocation calculated system pressures ranging from approximately 35.01 psi to 83.83 psi. The lowest pressure was reported on the dead-end hydrant lead on Coolidge Highway north of Meijer Drive in the northwest corner of the city. The highest pressure was reported on a hydrant lead on the northwest side of the I-75/I-696 interchange at lowest elevation in the city.

The existing system modeled with a 2015 maximum daily demand allocation calculated pressures ranging from 34.84 psi to 82.69 psi at the same locations as described above.

The existing system modeled with a 2015 maximum hourly demand allocation calculated pressures ranging from 34.75 psi to 81.77 psi at the same locations where low and high pressures were reported for average daily and maximum daily demand allocations.

Pressure contour maps for the 2015 average daily, maximum daily, and maximum hourly demand allocations are presented in Figures 8, 9, 10 on pages 26, 27, and 28. Two foot pressure contour maps for these demand allocations are provided in Appendix H.

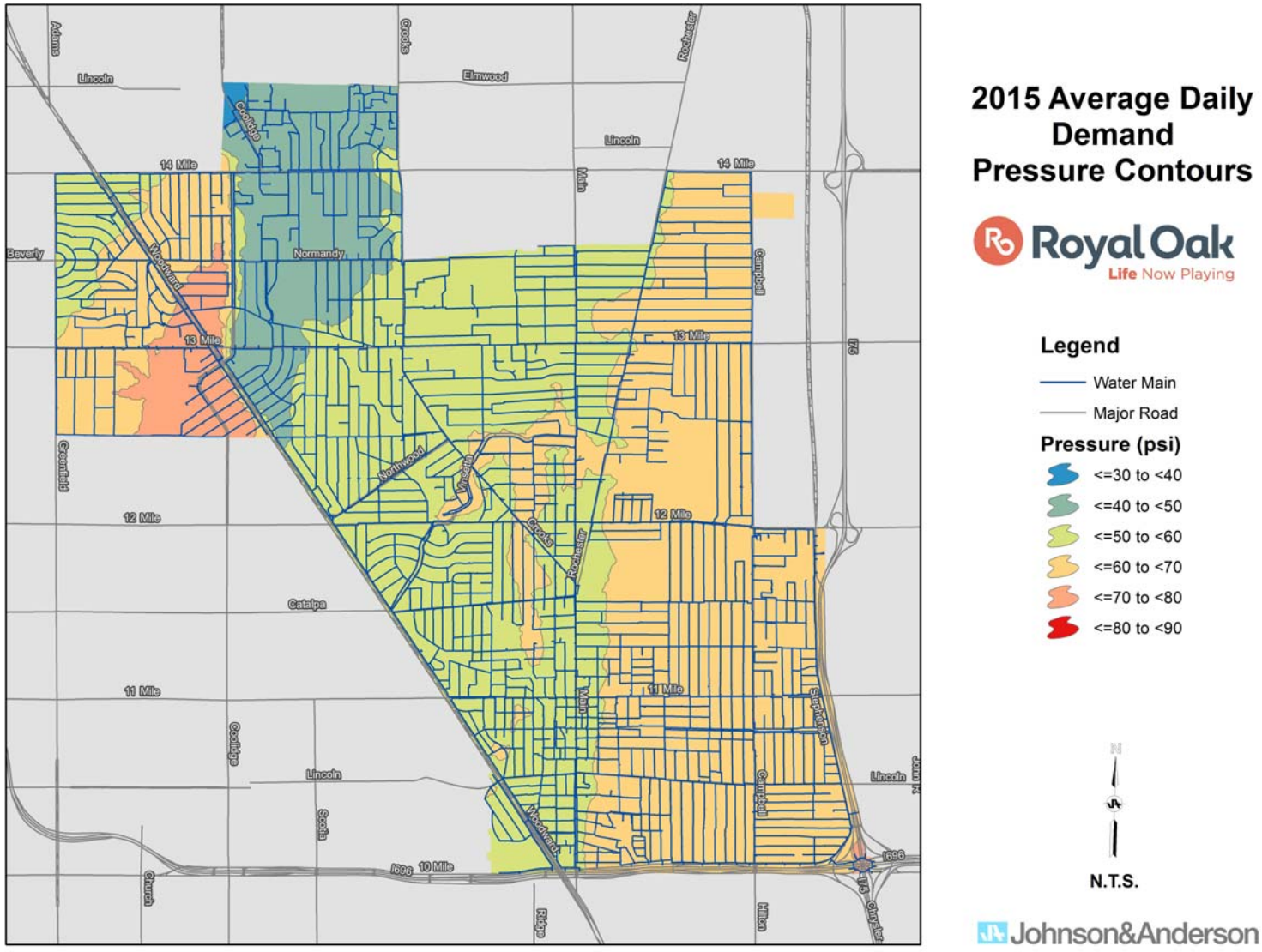


Figure 8 – 2015 Average Daily Demand Pressure Contours
(Refer to Appendix H for a 24” x 36” 2 foot pressure contour map)

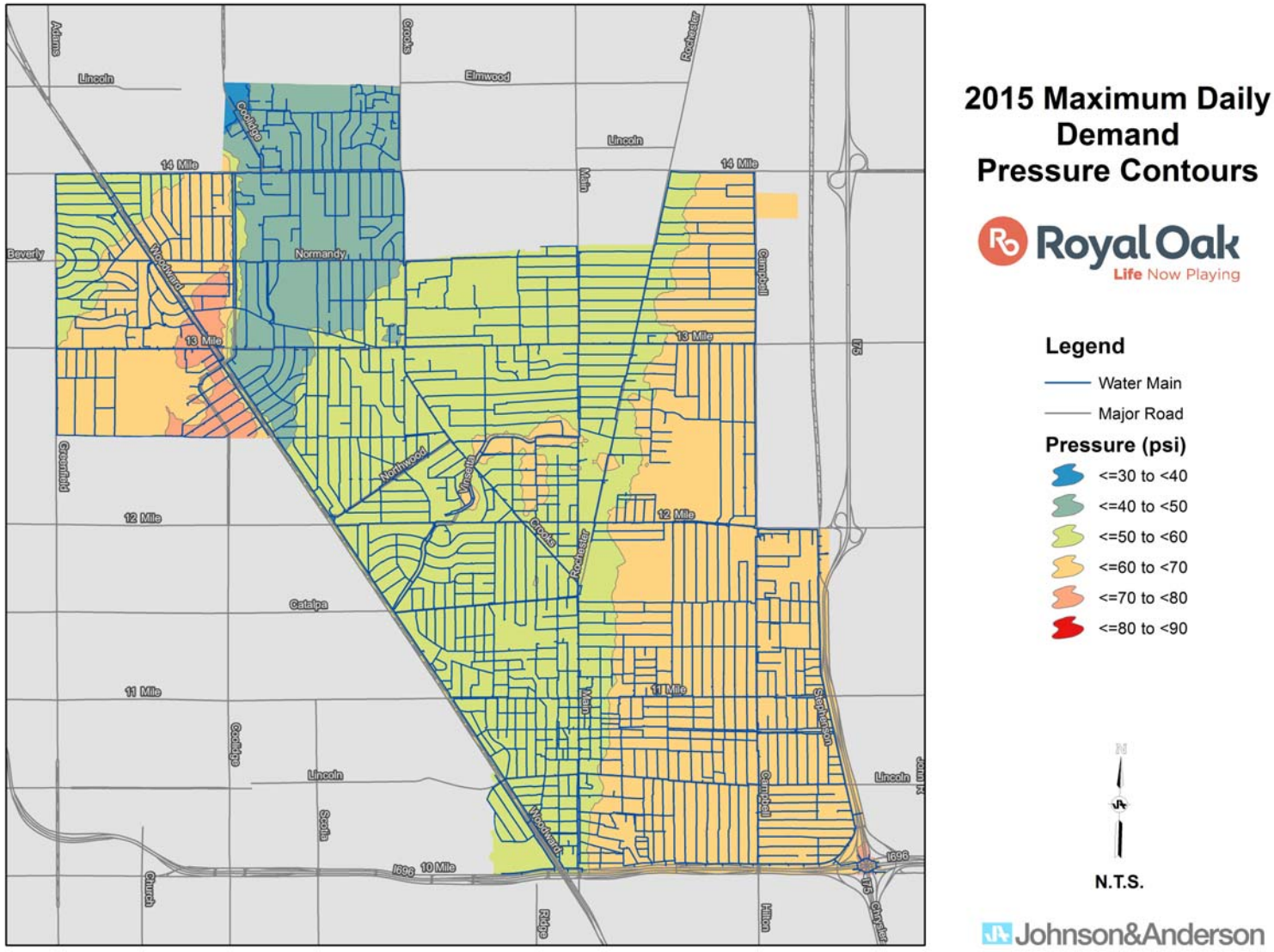


Figure 9 – 2015 Maximum Daily Demand Pressure Contours
(Refer to Appendix H for a 24" x 36" 2 foot pressure contour map)

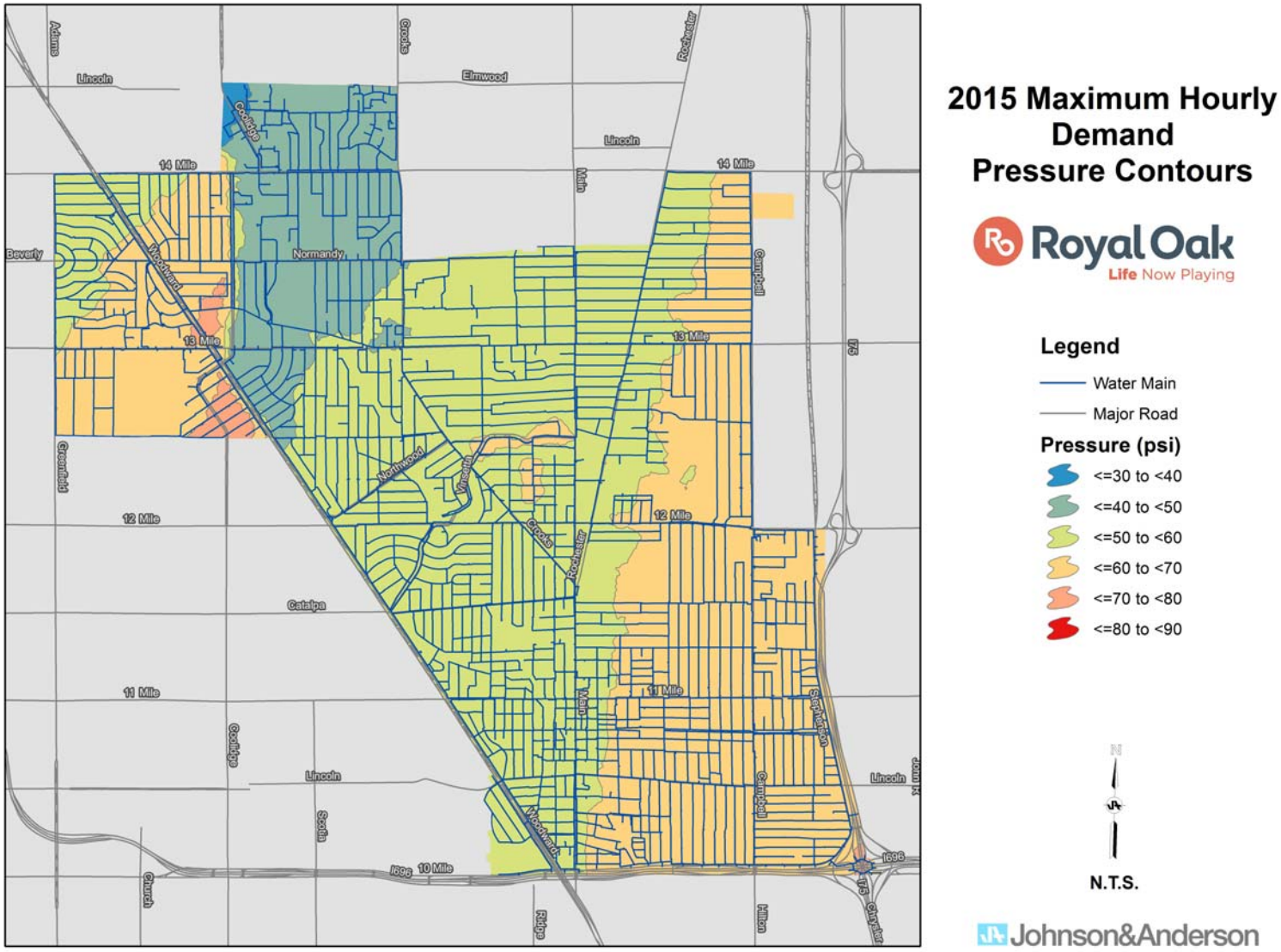


Figure 10 – 2015 Maximum Houry Demand Pressure Contours
(Refer to Appendix H for a 24” x 36” 2 foot pressure contour map)

The hydraulic grade lines presented in Table 9 are the model calibrated hydraulic grade lines based on supply pressure ranges provided by SOCWA. The water supplied at each source location for each demand scenario is also presented in Table 9. It must be noted that the steady-state water model is a specific system condition at a single point in time based on model settings and assumptions. The results presented are for specific outlined pressure settings and demand allocations. System demands fluctuate throughout the day based on a diurnal demand curve and also throughout the week based on the day of the week.

Table 9. Model Supply Results – 2015 Model

SOCWA Source	Location	Hydraulic Grade Line* (feet)	Average Daily Demand (gpm)	Percent of Total Supply	Maximum Daily Demand (gpm)	Percent of Total Supply	Maximum Hourly Demand (gpm)	Percent of Total Supply
RO01A	11 Mile & Woodward	794.58	829.5	25.35	1,429.5	20.50	1,748.0	19.37
RO02B	12 Mile & Vinsettta	772.18	0.0	0.00	0.0	0.00	0.0	0.00
RO03B	Webster & Benjamin	799.86	820.3	25.07	1,200.7	17.22	1,339.4	14.84
RO04D	13 Mile & Crooks	792.67	0.0	0.00	0.0	0.00	228.2	2.53
RO06A	13 Mile & Harvard	869.54	339.1	10.36	669.6	9.60	858.5	9.51
RO07D	Normandy & Crooks	783.86	0.0	0.00	0.0	0.00	0.0	0.00
RO08U	14 Mile & Edgeland	807.03	632.8	19.34	830.1	11.91	922.0	10.22
RO10D	Greenfield & Berkshire	869.05	130.7	4.00	331.5	4.75	437.4	4.85
RO11A	Woodward & Kenilworth	792.92	0.0	0.00	1,391.8	19.96	1,981.9	21.96
RO19B	Oliver Station	807.85	0.0	0.00	487.2	6.99	824.3	9.13
RO20F	Delemere & Meijer Dr	704.00	519.8	15.89	632.5	9.07	685.5	7.60
		Totals	3,272.3	100.00	6,972.9	100.0	9,025.1	100.0

*Hydraulic Grade Line as calibrated.

Fire Flows

The ISO currently governs residential fire flow requirements. The requirements are presented in Table 10 below, taken from the American Water Works Association (AWWA) Manual of Water Supply Practices M31[5].

Table 10. Required Fire Flow for One and Two Family Dwellings

Distance Between Houses	Needed Fire Flow
Less than 11.0 feet	1,500 gpm
11.0 feet to 30.0 feet	1,000 gpm
31.0 feet to 100.0 feet	750 gpm
Greater than 100.0 feet	500 gpm

Fire flow analyses were performed at each modeled system hydrant with the fire flow demand added to the maximum daily demand requirements. A residual pressure of 20.0 psi is required at

all system junctions when a fire flow demand is placed on the system. As seen in Table 10, the fire flow requirement for houses spaced 11.0 to 30.0 feet apart is 1,000 gpm. Less than 16% percent (334 of 2,148) of the hydrants in the existing system model (as identified with the GIS mapping) predicted available fire flows of less than 1,000 gpm at a residual pressure of 20.0 psi and less that 1% (19 of 2,148) of the hydrants in the existing system model predicted available fire flow of less than 500 gpm.

Table 11 lists modeled hydrants and describes the locations, where predicted available fire flow is below 500 gpm. As presented in Table 11 the locations where predicted available fire flow was calculated to be below 500 gpm are on dead end water mains as well as 4-inch and 6-inch diameter runs. Based on the pressure drop chart presented in Figure 14, on page 36, and discussed in the following section, the available fire flows could be improved by upgrading the 4-inch and 6-inch diameter mains to 8-inch or larger diameter mains. Looping mains would also improve available fire flows.

Table 11. Hydrants with Predicted Available Fire Flow < 500 gpm

Model Junction Number	Location Description	Water Main Description	Available Fire Flow @ 20 psi (gpm)
H-1159	Samoset between Greenfield and Woodward	Dead end 6" Dia.	217
H-456	Lakeside Drive east of North Main	Dead end 4" Dia.	232
H-1160	Samoset between Greenfield and Woodward	Dead end 6" Dia.	261
H-1467	West Houstonia between Evergreen & Maplewood	4" Dia. Main	310
H-1294	Virginia south of East University	Dead end 4" Dia.	342
H-1161	Samoset between Greenfield and Woodward	Dead end 6" Dia.	368
H-878	Albert west of Coolidge Hihgway	Dead end 6" Dia.	429
H-932	Simon Court south of East Farnum	Dead end 4" Dia.	431
H-1508	Thorncroft Court north of Torquay	Dead end 6" Dia.	447
H-1328	Fairway Drive east of Ardmore	Dead end 6" Dia.	448
H-720	Quickstad Park	Dead end 6" Dia.	465
H-86	North Lafayette north of West Derby	Dead end 6" Dia.	472
H-650	Alicia Court east of Alicia Lane	Dead end 6" Dia.	474
H-1327	Parkdale Ave east of Ardmore	Dead end 6" Dia.	481
H-474	Webster east of Marais	Long 6" Dia. Main	484
H-1465	Sycamore between Evergreen and Maplewood	4" and 6" Dia. Main	484
H-1220	Taylor east of N. Campbell	Dead end 6" Dia.	489
H-1565	Kent south of Chester	Dead end 6" Dia.	498
H-671	Evergreen Dr. north of Poplar	Dead end 6" Dia.	500

Figure 11, on page 32, presents predicted available fire flow locations below 500 gpm and between 500 gpm and 1,000 gpm. Figure 12, on page 33, is a pressure contour map showing pressure contours with a 2015 maximum daily demand allocation and a 6,000 gpm fire flow at

the hydrant on North Main Street just north of Crooks Road. This scenario represents the peak system demand and meets the modeling/mapping requirement of the *Safe Drinking Water Act, Part 16. General Plans, R 325.11605*. With the demand scenario described the residual pressure at that hydrant on North Main Street is 13.31 psi. The model predicts the hydrant will flow 5,440 gpm at a residual pressure of 20.0 psi.

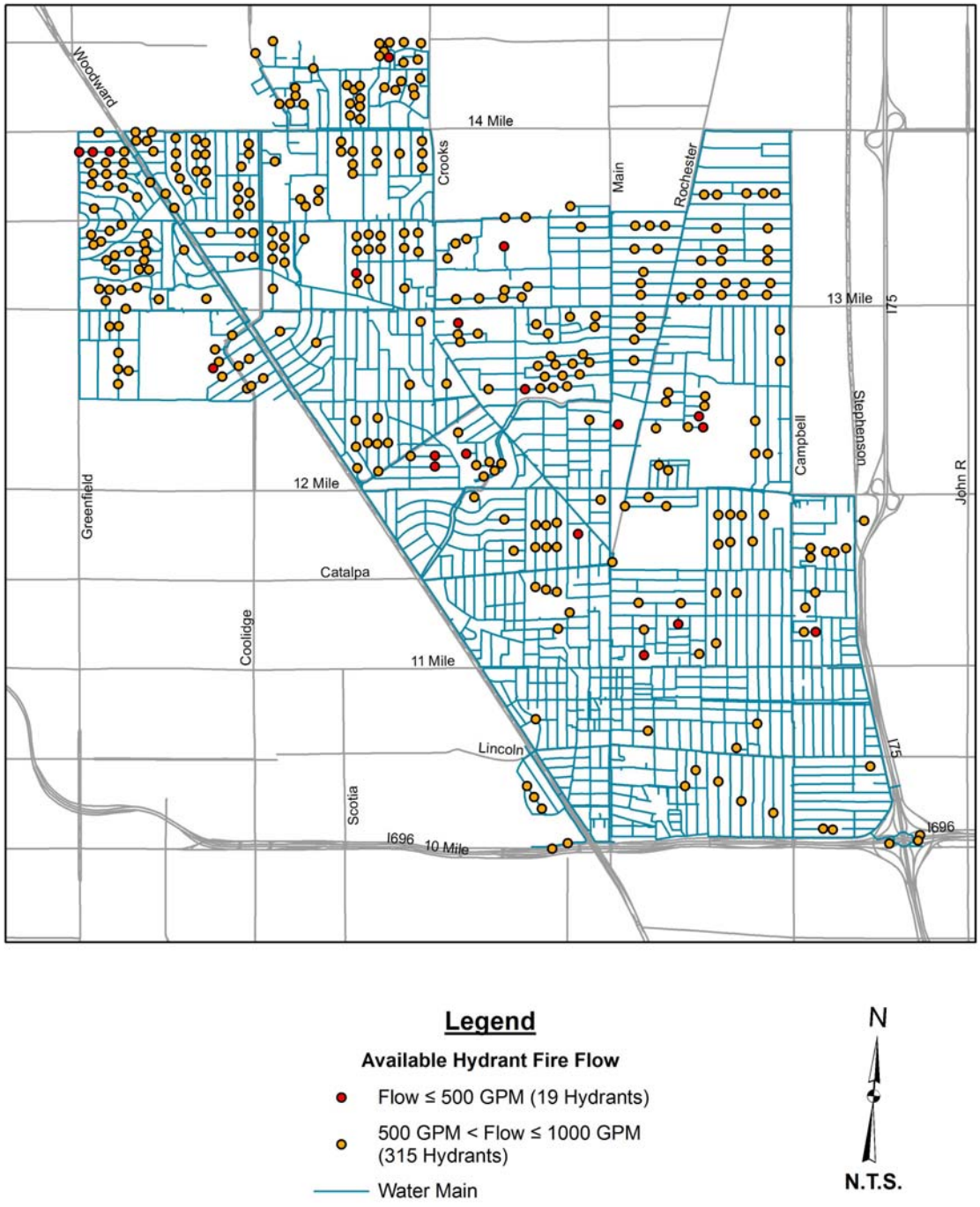


Figure 11 – Hydrants Where Predicted Available Fire Flow is < 1,000 gpm with 2015 Maximum Daily Demand plus Fire Flow

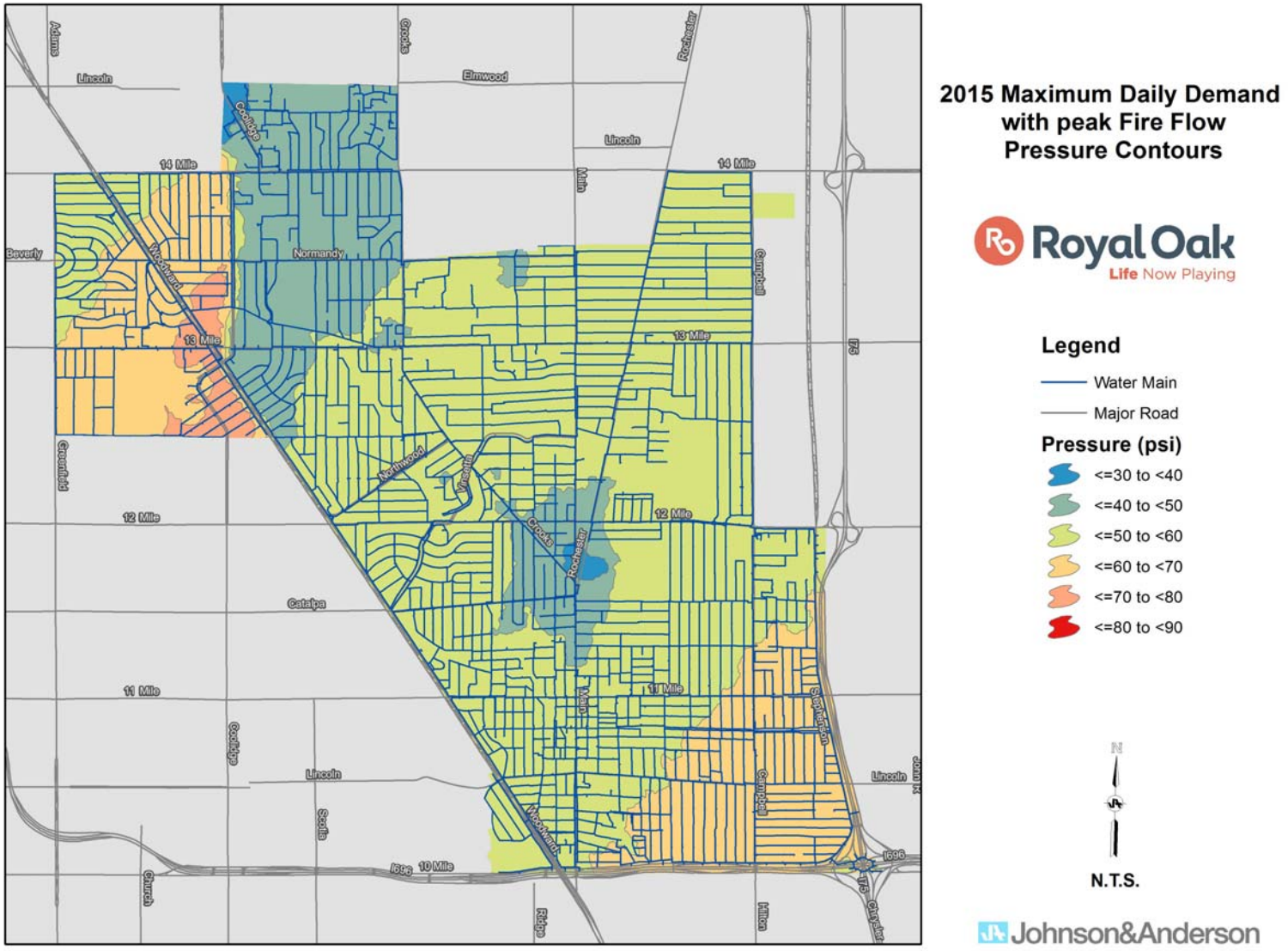


Figure 12 – 2015 Maximum Daily Demand with peak Fire Flow Pressure Contours

Pipe Head Loss

Head loss is the loss in pressure due to friction of the moving water along the pipe walls and through valves and fittings. Head loss is an important concern in water systems because as it increases, the water system becomes less efficient leading to increased pumping costs. Head loss is measured in feet of head loss per 1,000 lineal feet of pipe. One foot of head loss is equivalent to a 0.43 psi drop in pressure, and 2.31 feet of head loss is equal to 1 psi of head. The generally accepted values for head loss in transmission mains 24-inches and larger is 1 to 2 feet (0.43 psi to 0.87 psi) per 1,000 lineal feet of length, and 2 to 5 feet (0.87 psi to 2.17 psi) per 1,000 lineal feet of length for smaller diameter mains[6]. The water distribution model calculated that several water mains in the city water system are undersized based on the above criteria. The mains where high head loss occurs are predominately where a large volume of water is fed from SOCWA transmission mains into the city's system. However, for the most part, these mains are short in length and do not contribute excessively to overall head loss. The 8-inch diameter mains on the north and south side of 14 Mile Road between Leafdale Avenue and Elmhurst Avenue have somewhat high head loss during maximum hourly demand as shown on Figure 13, on page 35. This demand scenario happens infrequently and the high head loss for the short period of time does not raise concerns.

Figure 14, on page 36, illustrates the effects of undersized water mains by showing the pressure drop that will occur at 1,000 gpm for a 1,000 lineal feet length of various pipe diameters. As shown in the figure, there is a large improvement in reducing pressure drops due to friction, when a water main is increased in diameter from 6 inches to 8 inches.

Pipe Velocity

Velocity in water mains is a dependent factor related to head loss and can also be of concern. Maximum allowable velocity is used as a design criterion more frequently than head loss. The maximum allowable velocity is most commonly 5 feet per second (ft/s) for water mains[6]. Excessive pipe velocity can stir up sediment in the system causing a reduction in water quality. The water distribution model calculated that one water main in the system had a velocity greater than 5 feet per second during maximum hourly demand and two mains were just under 5.0 ft/s. These mains are located at SOCWA source meter connections RO08U and RO01A where a large volume of water is being transported through the main. High velocities also create excessive head loss. However, the mains where the high velocity occurs are less than 100 feet in length and therefore the total head loss is not substantial.

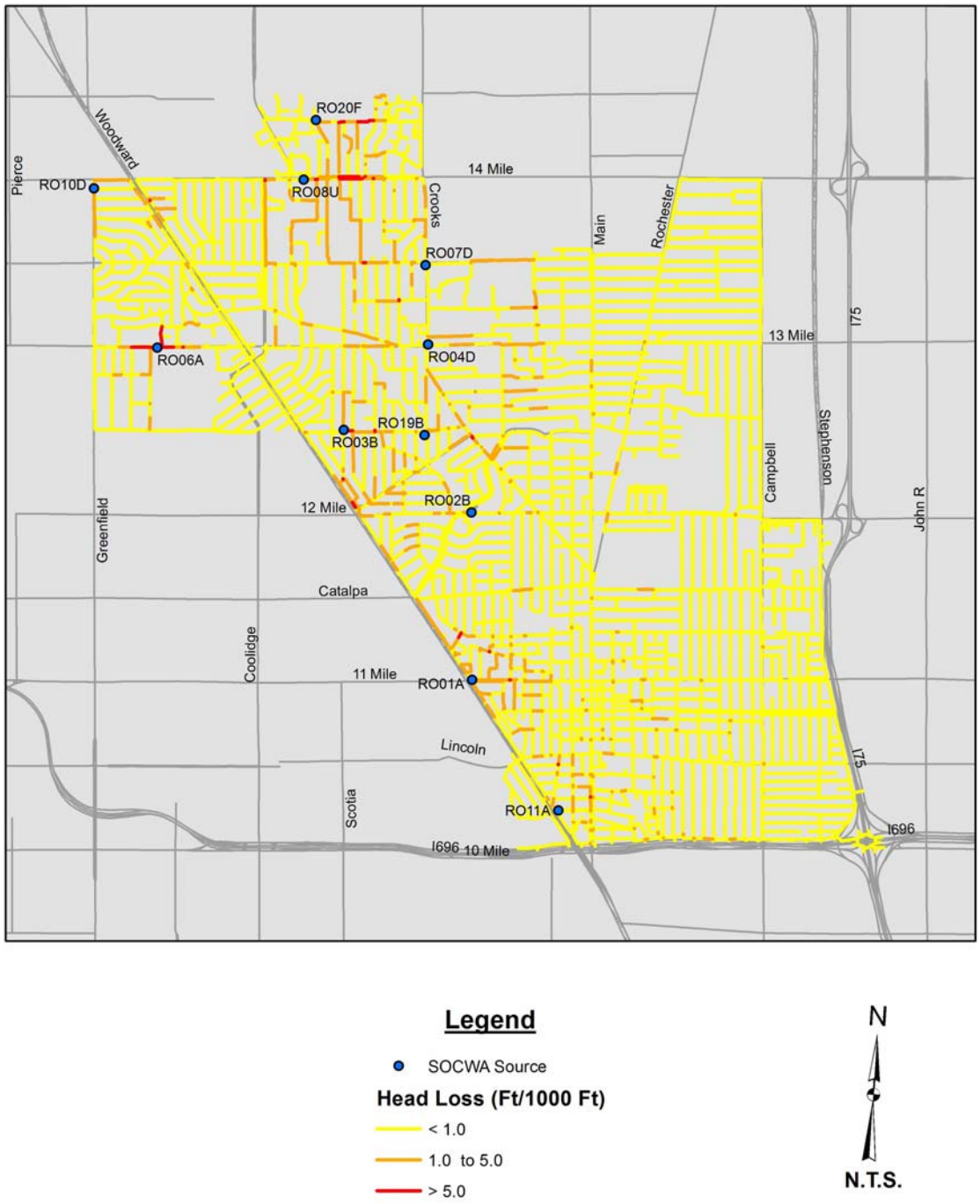


Figure 13 – Head Loss in Water Main with 2015 Maximum Hourly Demand Allocation

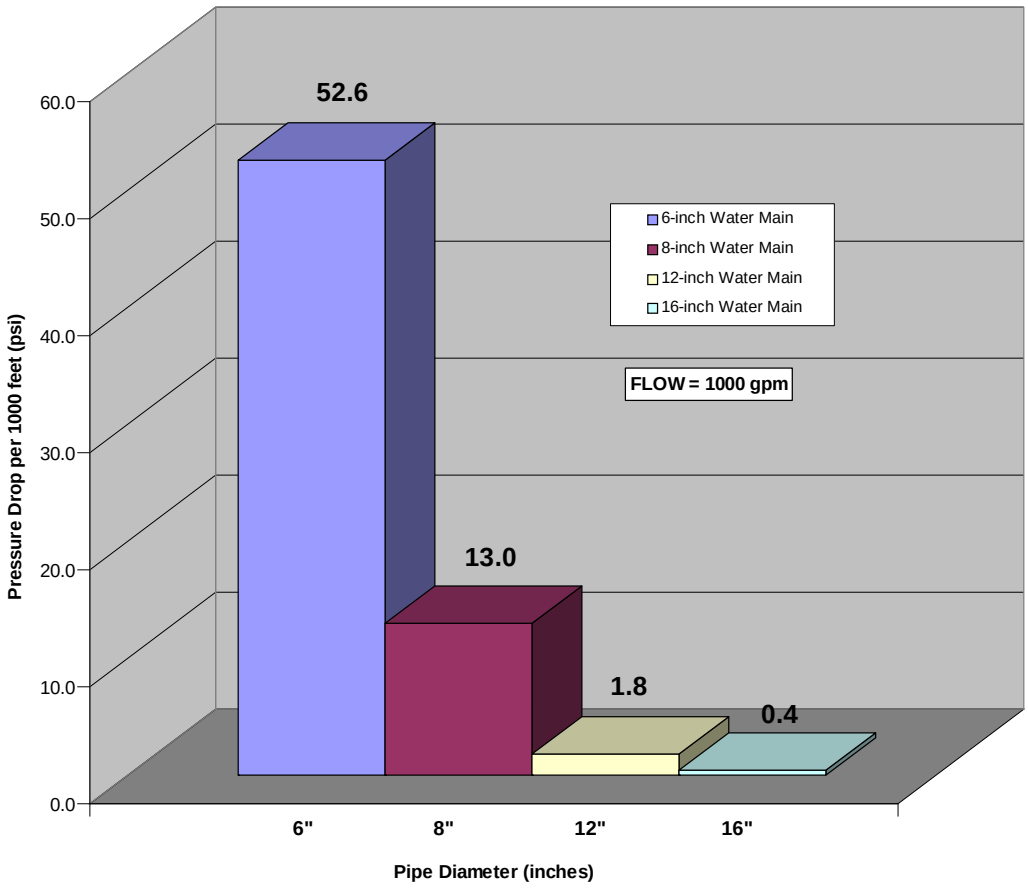
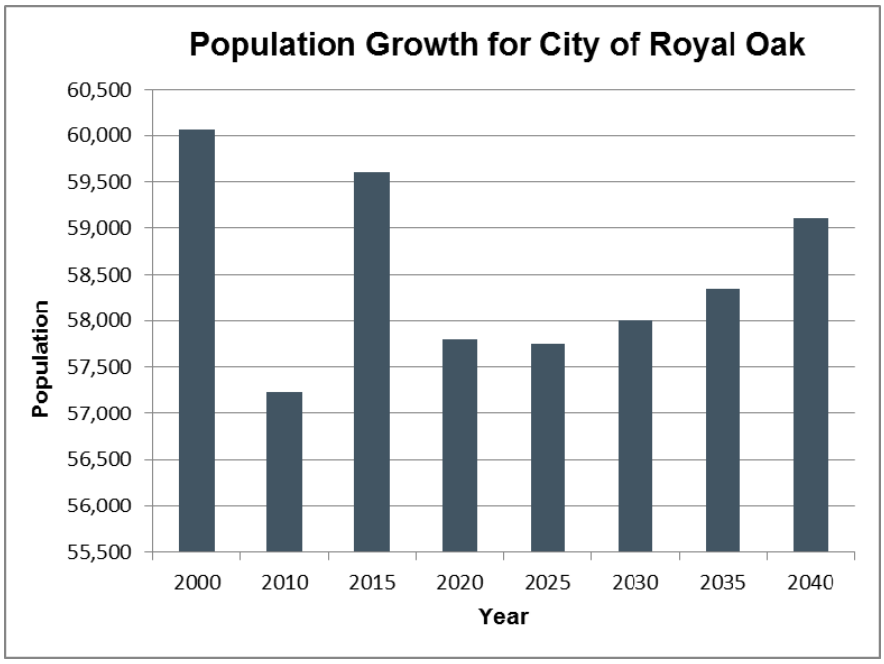


Figure 14 – Pressure Drops in Various Diameter Water Main

Future Water System Customers

The city is a community that has experienced substantial amounts of growth in past decades and is considered to be nearly built-out. The Southeast Michigan Council of Governments (SEMCOG) predicts a somewhat steady increase in population for the city from 2015 to 2040, as shown in Figure 15. The population in 2015, 2020, and 2035 is estimated to be 56,700, 57,794 and 58,347, respective1y. (Refer to Table 1, on page 8.)



Note: Population taken from City of Royal Oak's Community Profile on SEMCOG's website.

Figure 15 - Recent and Projected Population for Royal Oak

Based on water supply records from SOCWA, the city's average daily demand for calendar year 2014 was 3,271 gallons per minute (gpm). Assuming water usage remains constant for the next 20 years estimated future demands are presented in Table 12 below.

Table 12. Existing and Future System Demands

Demand Scenario	Year 2015*	Year 2020	Year 2035
Average Daily Demand (gpm)	3,270	3,330	3,370
Maximum Daily Demand (gpm)	6,970	7,110	7,180
Maximum Hourly Demand (gpm)	9,020	9,200	9,290
Fire Demand** (gpm)	6,000	6,000	6,000

*2015 Demands Estimated based on calendar year 2014 SOCWA supply and Royal Oak billing data.
** As reported in the Insurance Services Office, Inc. - Hydrant Flow Data Summary.

Future Water System Demands – Modeling Results

The computer model of the water distribution system was configured with a 2035 average daily demand allocation to simulate a worst case source condition (i.e. all SOCWA sources supplying water to the city at the lowest pressure). The city's planned system upgrades through the year fiscal year 2021 as presented on Table 14 (pages 45 – 48) and on the map in Appendix J were included in the model. Model results calculated system pressures ranging from 34.85 psi to 90.77 psi. The lowest pressure was reported on the dead-end hydrant lead on Coolidge Highway north of Meijer Drive in the northeast corner of the city. The highest pressure was reported on the dead end main on the west side of Woodward at Burnham Road in the high pressure district.

The water system modeled with upgrades and a 2035 maximum daily demand allocation calculated pressures ranging from 34.49 psi to 82.19 psi, at the same locations described above for the average daily demand scenario. The water system modeled with upgrades and a 2035 maximum hourly demand allocation calculated pressures ranging from 34.36 psi and 79.50 psi. The lowest pressure was reported on the dead-end hydrant lead on Coolidge Highway north of Meijer Drive in the northeast corner of the city. The highest pressure was reported on a hydrant lead on the northwest side of the I-75/I-696 interchange at lowest elevation in the city.

Pressure contour maps for 2035 demand allocations described above are presented in Figures 16, 17, and 18 on pages 39, 40, and 41. Two foot pressure contour maps for each demand allocation are included in Appendix I. Table 13 presents the hydraulic grade line and supply at each SOCWA source for the 2035 demand scenarios. Figure 19, on page 42 depicts the hydrant locations within the water system where predicted available fire flow was calculated to be below 1,000 gpm at a residual pressure of 20.0 psi for the 2035 maximum daily demand scenario plus fire flow and system upgrades through fiscal year 2021.

Table 13. Model Source Supply – Future Demands

SOCWA Source	Location	Hydraulic Grade Line* (feet)	Average Daily Demand (gpm)	Percent of Total Supply	Maximum Daily Demand (gpm)	Percent of Total Supply	Maximum Hourly Demand (gpm)	Percent of Total Supply
RO01A	11 Mile & Woodward	786.92	0.0	0.00	748.1	10.42	1,266.2	13.63
RO02B	12 Mile & Vinsettta	768.95	0.0	0.00	0.0	0.00	0.0	0.00
RO03B	Webster & Benfamin	785.09	0.0	0.00	262.6	3.66	640.4	6.90
RO04D	13 Mile & Crooks	781.14	0.0	0.00	0.0	0.00	0.0	0.00
RO06A	13 Mile & Harvard	869.54	0.0	0.00	0.0	0.00	94.6	1.02
RO07D	Normandy & Crooks	783.86	0.0	0.00	0.0	0.00	61.7	0.66
RO08U	14 Mile & Edgeland	807.03	850.0	25.25	1,186.5	16.53	1,280.7	13.79
RO10D	Greenfield & Berkshire	905.54	483.3	14.36	1,030.3	14.36	1,238.7	13.34
RO11A	Woodward & Kenilworth	792.92	1,400.3	41.59	3,120.0	43.48	3,488.7	37.57
RO19B	Oliver Station	782.38	0.0	0.00	0.0	0.00	328.9	3.54
RO20F	Delemere & Meijer Dr	807.85	633.1	18.06	828.9	11.55	886.6	9.55
		Totals	3,366.7	100.00	7,176.4	100.0	9,286.5	100.0

*Minimum Hydraulic Grade Line as provide by SOCWA. Note: Rounding differences occur in the model.

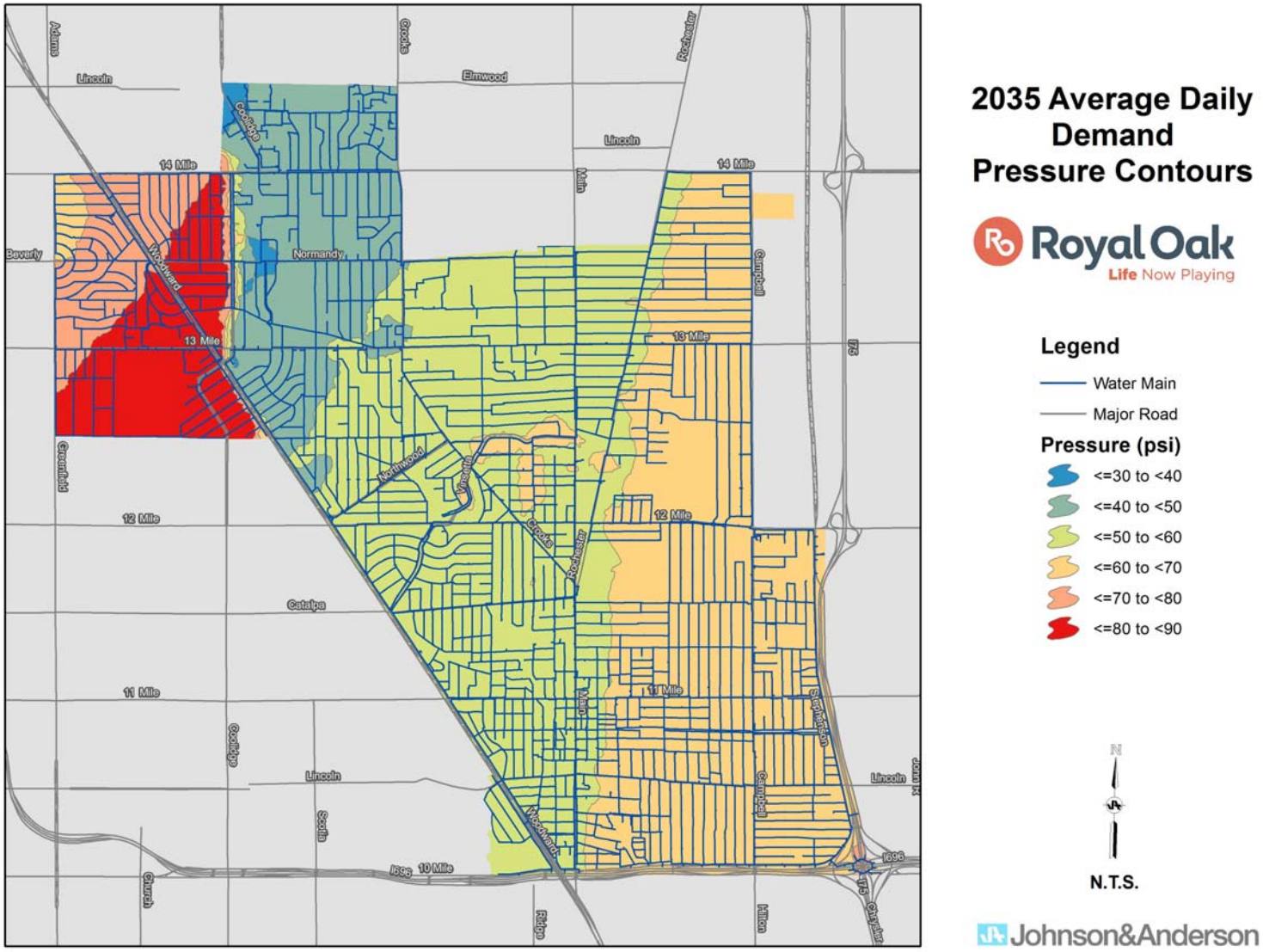


Figure 16 – 2035 Average Daily Demand Pressure Contours
(Refer to Appendix I for a 24" x 36" 2 foot pressure contour map)

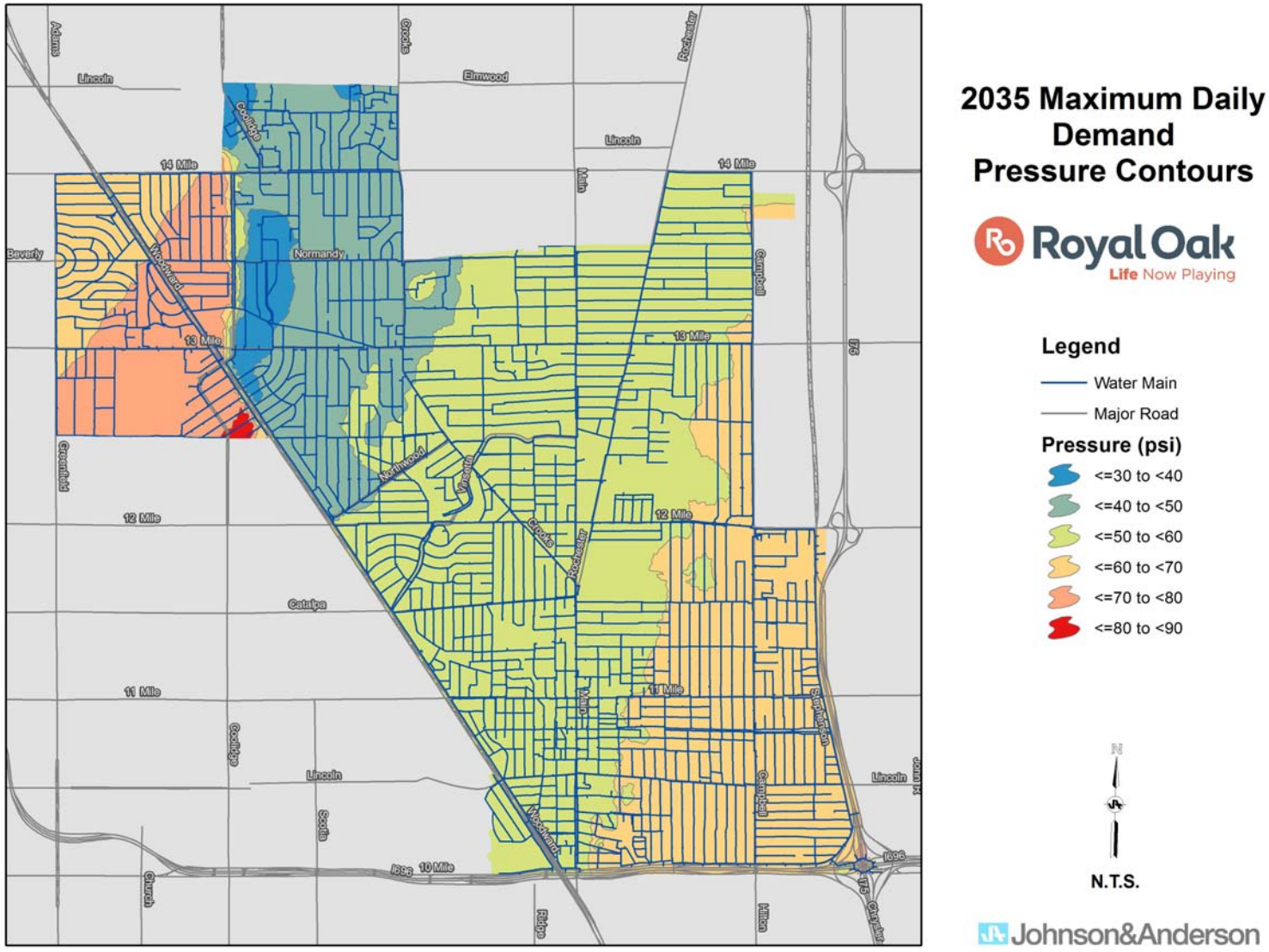


Figure 17 – 2035 Maximum Daily Demand Pressure Contours
(Refer to Appendix I for a 24" x 36" 2 foot pressure contour map)

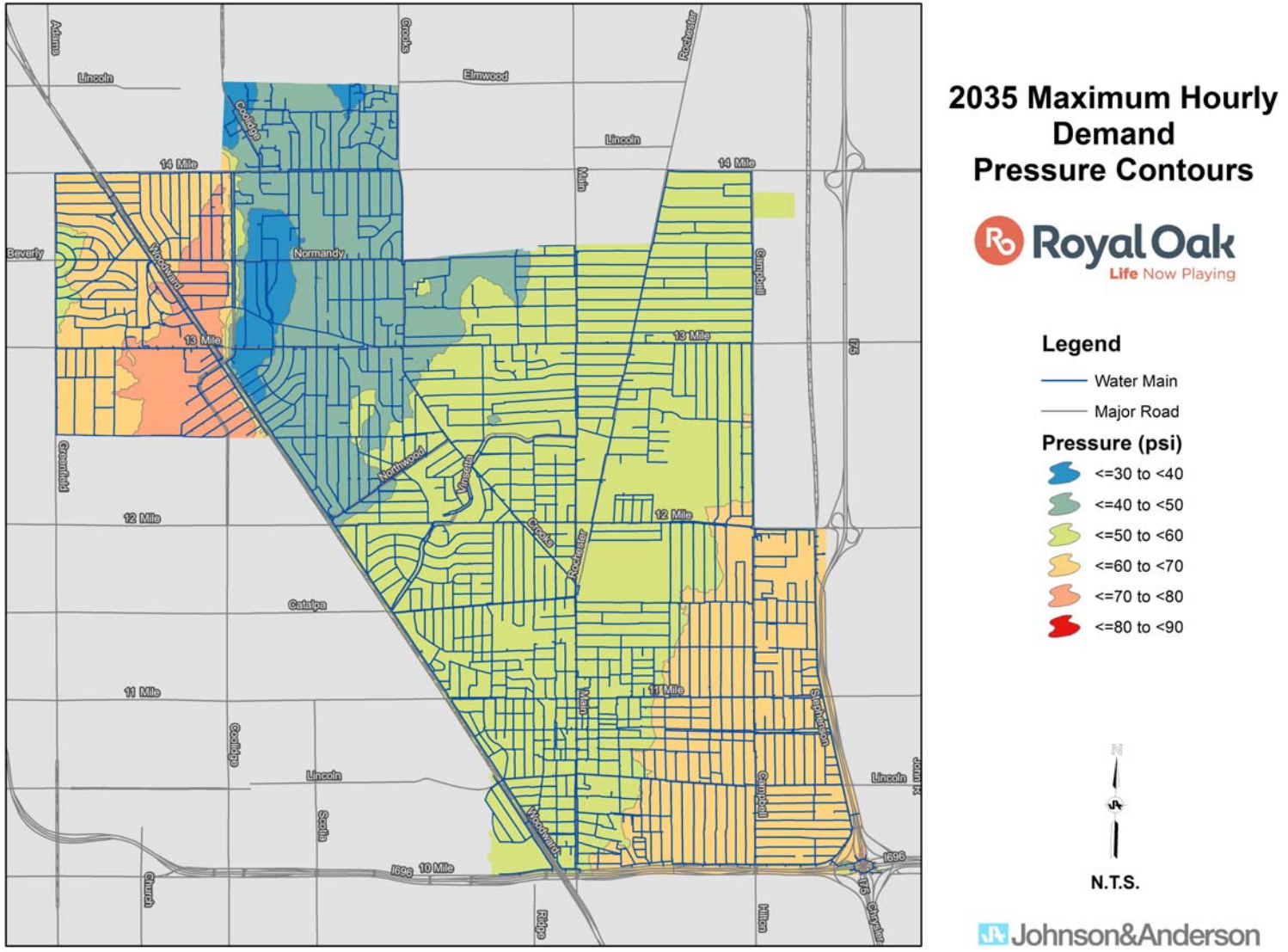


Figure 18 – 2035 Maximum Hourly Demand Pressure Contours
(Refer to Appendix I for a 24" x 36" 2 foot pressure contour map)

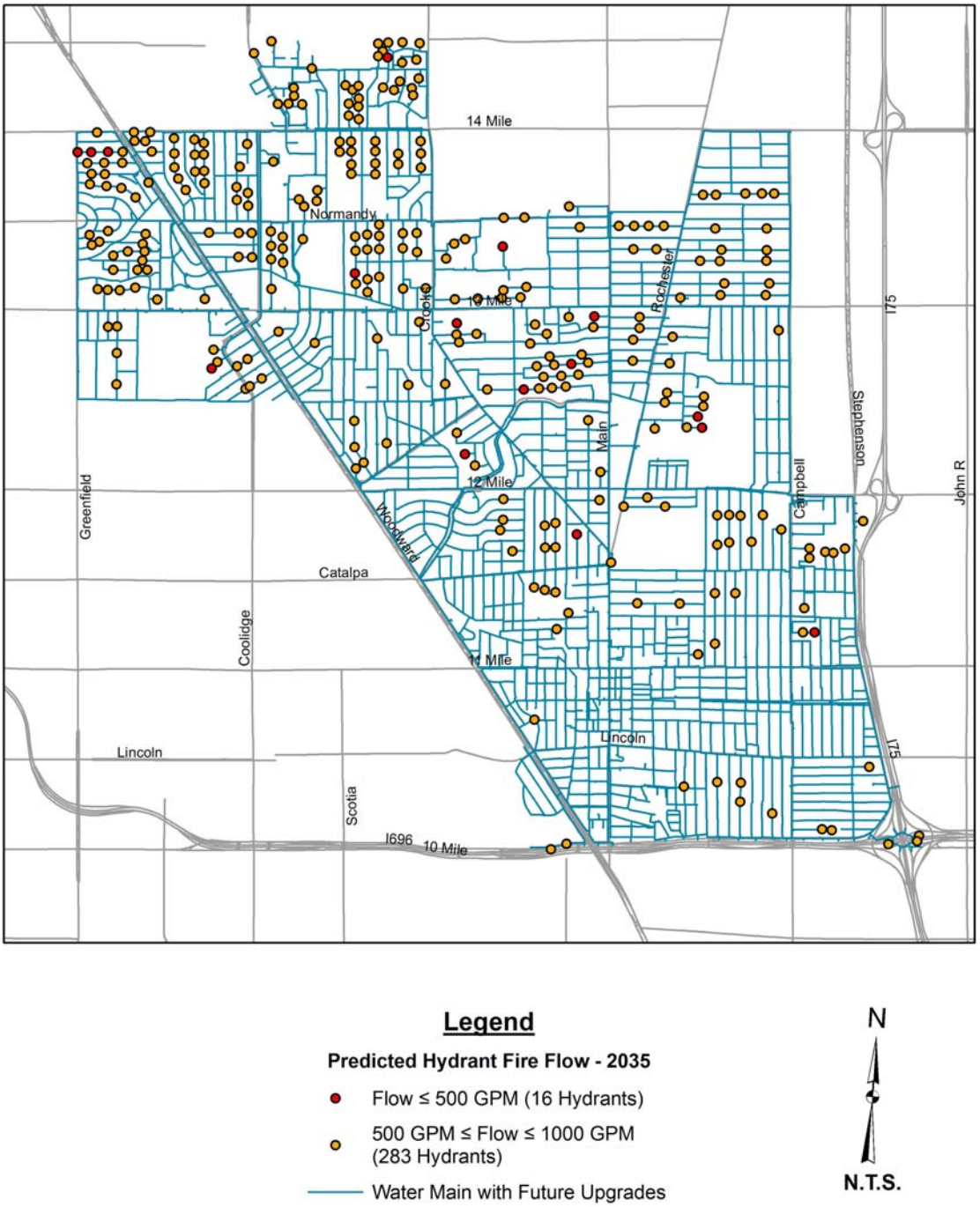


Figure 19 – Hydrants Where Predicted Available Fire Flow is < 1,000 gpm with 2035 Maximum Daily Demand plus Fire Flow

Capital Improvement Plan

Introduction

A Capital Improvement Plan (CIP) for the water distribution system identifies projects that will improve water system reliability and operational performance. The CIP provides a schedule for water main improvements and estimated costs. The city engineering division had previously developed a water main improvement CIP through the fiscal year 2021. Additional improvements were added based on water system modeling as part of the Reliability Study.

Water Main Upgrades

Proposed CIP water main upgrades are presented by fiscal years 2016 through 2021 in Table 14, on pages 44 – 47, and shown on the map in Appendix J and are based on water main size, age, condition, and joint type. It is anticipated that all 4-inch diameter water main will be replaced by the year 2020. Water distribution system upgrades improve pressures, flows within the system, and improve system reliability as older water mains are replaced.

As funds are made available beyond 2021, the city should analyze the water system using the hydraulic water model and upgrade all 6-inch diameter water main to a minimum of 8-inch diameter water main. Water mains, where frequent breaks occur, should be given first priority. The DPS has been tracking water main break locations for the past 19 years. A table of water main breaks from 1995 through 2014 is presented in Appendix K along with a 24” x 36” break location map. Figure 20, on page 48 also presents the water main break locations for years 1995 through 2014. It should be noted that all water main breaks are shown even on water mains that were subsequently replaced. Water main located in the right-of-way of main roads may need to be upgraded to larger than 8-inch diameter depending on future development and hydraulic water model predictions. Construction cost estimates for alternative improvement comparison purposes should be developed as projects are identified and/or become necessary.

Table 14. Future Water Main Upgrade Cost Estimate

Street Name	Fiscal Year for Proposed Replacement	Location	Length (feet)	Existing Diameter (inches)	Proposed Diameter (inches)	Estimated Unit Cost (Lineal Foot)	Total Estimated Cost for Street
Vinsetta Blvd	15-16/16-17	Between Western Railroad and Crooks Rd	2,330	4	8	$ 210.00	$ 489,300.00
Forestdale Court	15-16/16-17	North of Cedarhill Dr	497	4	8	$ 210.00	$ 104,370.00
Bassett Rd	15-16/16-17	Between Woodward Ave and Fairlawn Rd	706	4	8	$ 210.00	$ 148,260.00
Vinton Rd	15-16/16-17	Between Woodward Ave and Fairlawn Rd	815	4	8	$ 210.00	$ 171,150.00
Linwood Ave	15-16/16-17	Between Lloyd Ave and Northwood Blvd	750	4	8	$ 210.00	$ 157,500.00
Sycamore Ave	15-16/16-17	Between Northwood Blvd and Evergreen Dr	817	4	8	$ 210.00	$ 171,570.00
Greenleaf Dr	15-16/16-17	Between Woodward Ave and Vinsetta Blvd	1,151	4	8	$ 210.00	$ 241,710.00
Woodsboro Dr	15-16/16-17	Between Sunset Blvd and Vinsetta Blvd	1,176	4	8	$ 210.00	$ 246,960.00
Crooks	15-16/16-17	Between Royal and Webster	1,220	8	12	$ 250.00	$ 305,000.00
Northwood	15-16/16-17	Between Crooks and Maplewood	2,400	6	8	$ 210.00	$ 504,000.00
Oliver	15-16/16-17	Between W. Webster and Poplar Ave	1,850	6 & 8	12	$ 250.00	$ 462,500.00
Glenwood	15-16/16-17	Between Oliver Rd and Glenview Ave	330	6	8	$ 210.00	$ 69,300.00
						2015 - 2016	$ 1,535,810.00
						2016 - 2017	$ 1,535,810.00
Ravena Ave	16-17/17-18	Between Woodward Ave and Chester Rd	816	4	8	$ 210.00	$ 171,360.00
Yorba Linda Blvd	16-17/17-18	Between Dukeshire Hwy and Kensington Dr	492	4	8	$ 210.00	$ 103,320.00
Rockingham Road	16-17/17-18	Between Woodward and Kensington Drive	670	6	8	$ 211.00	$ 141,370.00
Dukeshire Hwy	16-17/17-18	Between Woodward Ave and Chester Rd	1,101	4	8	$ 210.00	$ 231,210.00
						2016 - 2017	$ 323,630.00
						2017 - 2018	$ 323,630.00
Beaver Ave	17-18/18-19	Between Westgate Ave and Brookwood Ave	1,131	4	8	$ 210.00	$ 237,510.00
Virginia Ave	17-18/18-19	Between Pingree Blvd to north of E 11 Mile Road	792	4	8	$ 210.00	$ 166,320.00
Forest Ave	17-18/18-19	Between N Main St and Rosedale Ave	715	4	8	$ 210.00	$ 150,150.00
Clifton Ave	17-18/18-19	Between E 12 Mile Rd and Beaver Ave	633	4	8	$ 210.00	$ 132,930.00
Fern St	17-18/18-19	Between E 12 Mile Rd and Beaver Ave	623	4	8	$ 210.00	$ 130,830.00
Ardmore Ave	17-18/18-19	Between E 12 Mile Rd and Beaver Ave	615	4	8	$ 210.00	$ 129,150.00
Rochester Road	17-18/18-19	Between Donald to 14 Mile Road	1,560	8	12	$ 250.00	$ 390,000.00
Refer to Appendix J for map presenting upgrade locations.							

Street Name	Fiscal Year for Proposed Replacement	Location	Length (feet)	Existing Diameter (inches)	Proposed Diameter (inches)	Estimated Construction Cost (Lineal Foot)	Total Estimated Cost for Street
Vermont	17-18/18-19	Between Donald to 14 Mile Road	1,500	N/A	8	$ 210.00	$ 315,000.00
Ferris	17-18/18-19	Between Donald to 14 Mile Road	1,500	N/A	8	$ 210.00	$ 315,000.00
Normandy Road	17-18/18-19	Between Woodward Ave to Normandy Court	3,170	8	12	$ 250.00	$ 792,500.00
Woodward	17-18/18-19	Between Normandy Road to Buckingham	2,060	6	12	$ 250.00	$ 515,000.00
Judson	17-18/18-19	Between Ellwood Ave to Cummings Ave	600	6	8	$ 210.00	$ 126,000.00
Nakota	17-18/18-19	Between S Crooks Rd and Massoit Road	280	6	8	$ 210.00	$ 58,800.00
Rosewold	17-18/18-19	Between Normandy and Massoit Road	670	6	8	$ 210.00	$ 140,700.00
Dallas (universal joint)	17-18/18-19	Between S. Stephenson Hwy and Helene Ave	1,135	6	8	$ 210.00	$ 238,350.00
Chester Road	17-18/18-19	Between Dukeshire Hwy and Hillside Dr	410	N/A	12	$ 250.00	$ 102,500.00
						2017 - 2018	$ 1,970,370.00
						2018 - 2019	$ 1,970,370.00
Houstonia Ave	18-19/19-20	Between Beechwood and Main	1,980	14	12	$ 250.00	$ 495,000.00
Lexington	18-19/19-20	Between N Main and Quickstad Park	2,580	6	12	$ 250.00	$ 645,000.00
Glendale	18-19/19-20	Between E 13 Mile Road and Englewood Ave	1,325	N/A	8	$ 210.00	$ 278,250.00
Alexander	18-19/19-20	Between E 13 Mile Road and Woodlawn Ave	1,000	N/A	8	$ 210.00	$ 210,000.00
N Blair Ave	18-19/19-20	Between E 13 Mile Road and Woodlawn Ave	1,000	N/A	8	$ 210.00	$ 210,000.00
De Villen Ave	18-19/19-20	Between N Campbell Rd and N Ferris Ave	1,725	N/A	8	$ 210.00	$ 362,250.00
Girard Ave	18-19/19-20	Between N Vermont Ave and Altadena Ave	975	6	8	$ 210.00	$ 204,750.00
Parkdale Ave	18-19/19-20	Between N Wilson Ave and N Vermont Ave	725	N/A	8	$ 210.00	$ 152,250.00
E Houstonia Ave	18-19/19-20	Between N Campbell Rd and N Vermont Ave	1,090	N/A	8	$ 210.00	$ 228,900.00
N Vermont Ave	18-19/19-20	W 12 Mile Road and Girard Ave	3,180	6	8	$ 210.00	$ 667,800.00
						2018 - 2019	$ 1,727,100.00
						2019 - 2020	$ 1,727,100.00
Refer to Appendix J for map presenting upgrade locations.							

Street Name	Fiscal Year for Proposed Replacement	Location	Length (feet)	Existing Diameter (inches)	Proposed Diameter (inches)	Estimated Construction Cost (Lineal Foot)	Total Estimated Cost for Street
Oakdale St	18-19	Between W 4th St and W 11 Mile Road	876	4	8	$ 210.00	$ 183,960.00
E Harrison Ave	18-19	Between S Main St and Easement	702	4	8	$ 210.00	$ 147,420.00
Longfellow Ave	18-19	Between Lawson Park and E Lincoln Ave	1,528	4	8	$ 210.00	$ 320,880.00
E Harrison Ave	18-19	Between Railroad Easement and Batavia	842	4	8	$ 210.00	$ 176,820.00
W 6th St	18-19	Between S Laurel St and Woodward Ave	934	4	8	$ 210.00	$ 196,140.00
S Vermont Ave	18-19	Between E 7th St and E 5th St	1,010	4	8	$ 210.00	$ 212,100.00
E 7th St	18-19	Between S Vermont Ave and S Blair Ave	320	4	8	$ 210.00	$ 67,200.00
S Blair Ave	18-19	Between E Lincoln Ave and E 6th St	898	4	8	$ 210.00	$ 188,580.00
S Rembrandt Ave	18-19	Between S Lincoln Ave and E 6th St	749	4	8	$ 210.00	$ 157,290.00
W Houstonia Ave	18-19	Between Northwood Blvd and Evergreen Dr	1,952	4	8	$ 210.00	$ 409,920.00
ROW north of E Lincoln Ave	18-19	Between S Rembrandt Ave and S Blair Ave	354	4	8	$ 210.00	$ 74,340.00
E 7th St	18-19	Between S Troy St and Knowles St	647	4	8	$ 210.00	$ 135,870.00
S Altadena Ave	18-19	Between E Lincoln Ave and E 6th St	857	4	8	$ 210.00	$ 179,970.00
Dundee Road	18-19	Between Harrison Rd and Huntington Rd	655	4	8	$ 210.00	$ 137,550.00
Crooks Rd	18-19	Between Vinsetta Blvd and Lloyd Ave	395	4	8	$ 210.00	$ 82,950.00
						2018 - 2019	$ 2,670,990.00
Stephenson	19-20/20-21	Between E 4th Street and W Gardenia Ave	3,980	8	12	$ 250.00	$ 995,000.00
Forest Ave	19-20/20-21	Between Symes Ave and Stephenson	280	N/A	8	$ 210.00	$ 58,800.00
E 11 Mile Road	19-20/20-21	Between S Dorchester Ave and S Kenwood Ave	265	N/A	8	$ 210.00	$ 55,650.00
Helene Ave	19-20/20-21	Between Brockton Ave and Barrett Ave	805	N/A	8	$ 210.00	$ 169,050.00
E Farnum Ave	19-20/20-21	Between N Campbell and N Edison Ave	465	N/A	8	$ 210.00	$ 97,650.00
E 5th Street	19-20/20-21	Between Knowles and Alexander	1,425	6	12	$ 250.00	$ 356,250.00
E 6th Street	19-20/20-21	Between Knowles and Alexander	1,425	6	8	$ 210.00	$ 299,250.00
E 7th Street	19-20/20-21	Between Knowles and S Troy Street	655	6	8	$ 210.00	$ 137,550.00
E Harrison Ave	19-20/20-21	Between S Main Street and Batavia Ave	1,940	?	12	$ 250.00	$ 485,000.00
						2019 - 2020	$ 1,327,100.00
						2020 - 2021	$ 1,327,100.00
Refer to Appendix J for map presenting upgrade locations.							

Street Name	Fiscal Year for Proposed Replacement	Location	Length (feet)	Existing Diameter (inches)	Proposed Diameter (inches)	Estimated Construction Cost (Lineal Foot)	Total Estimated Cost for Street
Universal Joints							
St. Charles Court	20-21/21-22	Between Potter Ave and Curry Ave	695	6	8	$ 210.00	$ 145,950.00
Frederick Street	20-21/21-22	Between Potter Ave and Curry Ave	675	6	8	$ 210.00	$ 141,750.00
S Dorchester Ave	20-21/21-22	Between E 4th Street and E Lincoln Ave	1,600	8	8	$ 210.00	$ 336,000.00
S Kenwood Ave	20-21/21-22	Between E 4th Street and E Lincoln Ave	1,600	6	8	$ 210.00	$ 336,000.00
S Edgeworth Ave	20-21/21-22	Between E Lincoln Ave and E 11 Mile Road	2,700	8	8	$ 210.00	$ 567,000.00
S Minerva Ave	20-21/21-22	Between E Lincoln Ave and E 11 Mile Road	2,610	6& 8	8	$ 210.00	$ 548,100.00
Helene Ave	20-21/21-22	Between E Lincoln Ave and E 11 Mile Road	2,715	8	8	$ 210.00	$ 570,150.00
Yale Ave	20-21/21-22	Between S Stephenson Hwy and Wellesley Ave	395	8	8	$ 210.00	$ 82,950.00
E Hudson Ave	20-21/21-22	West of S Stephenson Hwy	455	6	8	$ 210.00	$ 95,550.00
Brockton Ave	20-21/21-22	Between S Stephenson Hwy and Helene Ave	1,125	6	8	$ 210.00	$ 236,250.00
						2020 - 2021	$ 1,529,850.00
						2021 - 2022	$ 1,529,850.00
N Minerva	21-22	Between E Farnum Ave and E 11 Mile Road	1,400	6	8	$ 210.00	$ 294,000.00
Mace Ave	21-22	Between S Stephenson Hwy and N Minerva Ave	555	6	8	$ 210.00	$ 116,550.00
S Edison Ave	21-22	Between E 4th Street and E Lincoln Ave	1,600	6	8	$ 210.00	$ 336,000.00
Tuffs Ave	21-22	Between S Stephenson Hwy and Wellesley Ave	465	8	8	$ 210.00	$ 97,650.00
N Maple Ave	21-22	Between W 12 Mile Road and W Derby Ave	1,690	6	8	$ 210.00	$ 354,900.00
Huntington Road	21-22	Between Hereford Drive and Woodward Ave	1,050	6 & 8	8	$ 210.00	$ 220,500.00
						2021 - 2022	$ 1,419,600.00
Total CIP 2016 - 2022							
Total Construction Length/Cost			95,384				$ 20,918,310.00
Contingencies @ 7%							$ 1,464,281.70
TOTAL							$ 22,382,591.70
Refer to Appendix J for map presenting upgrade locations.							

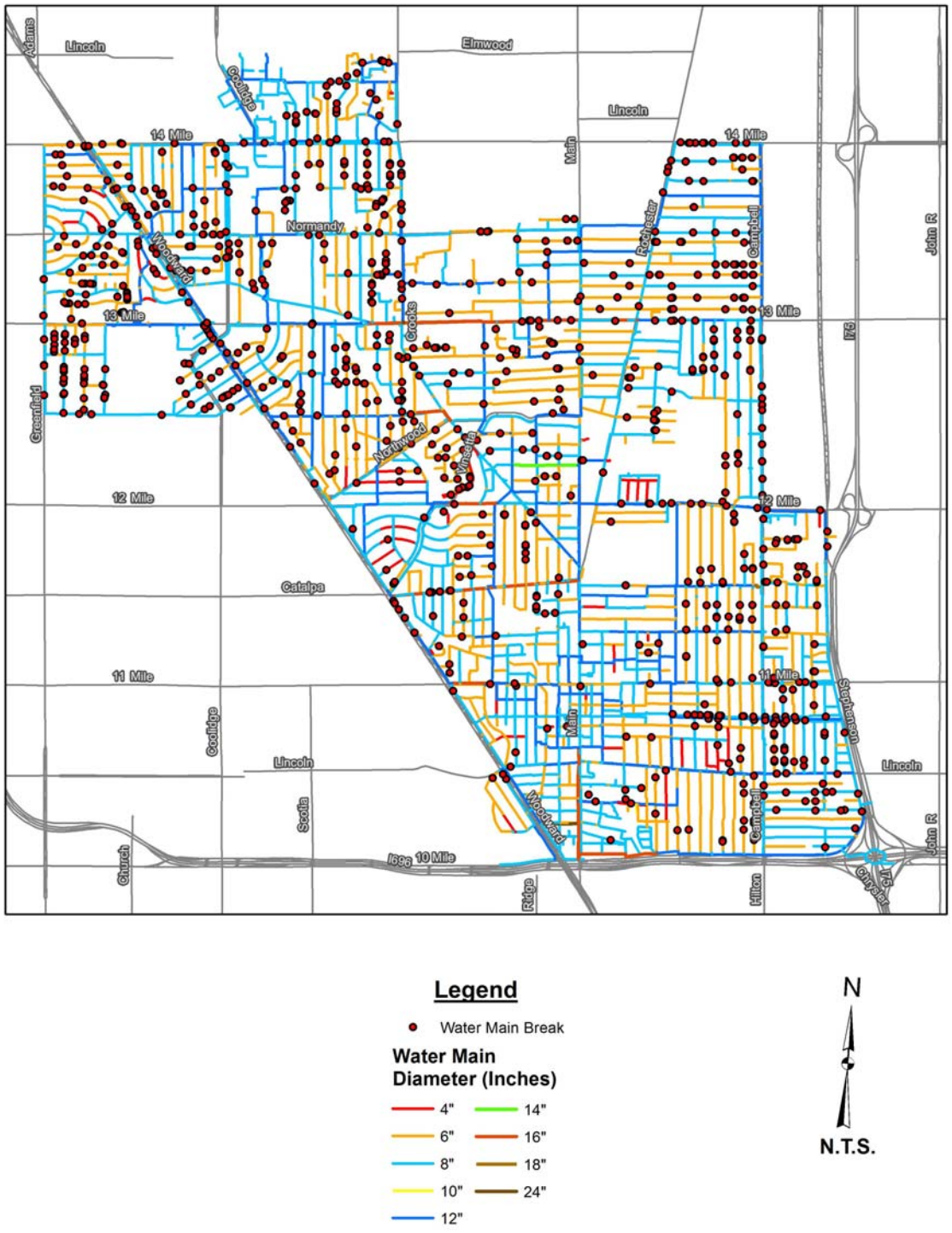


Figure 20 – Water Main Break Locations 1995 – 2014
(Refer to Appendix K for a 24" x 36" map of the water main break locations)

Geographic Information System

The city currently has *ArcGIS*, a GIS mapping program that allows communities to map utility system assets such as valves, hydrants, and water main with real world coordinates and information attributes including size, age and condition. *ArcGIS* allows the city to inventory, catalog, integrate, store, edit, analyze, share, and display all of their utility system assets in an easy to use electronic mapping interface.

The city has developed a water system network in GIS that includes all city water system valves and fire hydrants with GPS (Global Positioning System) latitude and longitude coordinates. This will allow city staff to locate valves and hydrants more precisely and quickly during normal operations and emergency situations. It also provides for very accurate infrastructure information such as water main length and valve elevations. It will also help the DPS and the engineering division review, organize, and analyze their utility information/data.

Leveraging the *ArcGIS* program investment is recommended to further ensure consistent, efficient and accountable water system operations and planning. As part of this program the city should consider purchasing GIS-Centric Work Order Management and CIP planning Software. This software would allow the city to leverage the existing GIS database to schedule and track labor, equipment and material for work tasks, hydraulically model the water system, perform condition assessment scenarios, plan risk and cost based improvement and rehabilitation to facilitate a proactive planning and operational enterprise.

The implementation of GIS-Centric Computerized Maintenance Management Software (CMMS) and CIP planning software packages would allow the DPS to more efficiently manage a substantial number of work orders and scheduling as well as infrastructure assets while minimizing costs of owning, operating, and maintaining the assets at acceptable levels of service. The application would beneficially enable users to create and schedule work orders to capture labor, equipment, and material used for various work activities on water system assets seamlessly within the GIS environment. Automated scheduling of work orders could also be developed in the GIS database to aid staff and ensure work tasks and preventative, warranty and scheduled maintenance for all water system assets including mains, valves, and hydrants are completed in a timely manner.

The costs for typical asset management, CMMS, and CIP software packages including training and annual maintenance are presented in Table 15 on page 53.

Document Management System

It is recommended that the city consider the purchase and implementation of a document management program. Within the engineering division, all of the system drawings, engineering files, and account files could be scanned, managed and incorporated into the GIS program for easy access and management. Other departments in the city would also benefit from a document management system. The cost for a typical document management program is included in Table 15 on page 53.

Fire Hydrant Maintenance

The city has approximately 2,148 fire hydrants within the water distribution system. System hydrants are in need of painting. The National Fire Protection Association color code should be followed for hydrant painting. The DPS may want to schedule hydrant painting over a number of years based on costs presented in Table 15, on page 53.

For system reliability it is recommended that hydrants 30 years old and older be replaced. The city currently installs EJ 5BR-250 hydrants with Storz connectors. Cost estimates to replace such hydrants have been included in Table 15, on page 53.

Note that the ISO study reported that all hydrants should be inspected twice a year and the inspection should include operation and a test at domestic pressure. Records should be kept of the inspections.

Based on conditions observed during hydrant flow tests it is recommended that the city implement a more aggressive hydrant flushing program. A flushing program would ensure hydrants are operating properly and could improve water quality within the distribution system.

Valve Maintenance and Replacement

Based on survey information gathered for developing the GIS water system database, the city's water distribution system contains approximately 3,547 valves (not including hydrant assembly valves). To ensure proper system functionality, valves should be exercised and maintained to remain in working order so they can be opened and closed in all situations. The city should develop a valve exercising program to ensure all valves are functioning properly.

Best Management Practice (BMP) includes repairing valves in the system as soon as possible to ensure proper isolation of the water system, as needed, for events including water main breaks, to assure the fewest number of customers are without water and fire protection during the repair.

The city should include an annual cost in the operating budget for valve repairs and replacements for valves that are beyond their useful life and unable to be repaired to function properly. Estimates for valve repair and replacement are included in Table 15, on page 53.

Curb-Stop Box Locating

The city should plan to GPS locate curb-stop box and valve locations within the system. A brief condition assessment could be done at the same time and issues noted where repairs were needed. GPS coordinates would then be available in the GIS system for quicker retrieval/location in the event of emergencies. Work orders could also be written using GPS referenced locations. The cost for locating curb boxes is included in Table 15, on page 53.

Automated Meter Infrastructure (AMI)

During general system maintenance, the DPS replaces approximately 800 meters a year. The city last completed a meter replacement program in the 1980s. It is generally recognized that the useful life of a water meter is approximately 20 years. It is recommended that the city consider initiating a meter replacement program in the near future.

A meter replacement program should consider implementation of a fixed network Automated Meter Infrastructure (AMI) system that would use Meter Interface Units (MIU) to transmit meter readings to fixed-based collectors that would then automatically transmit the information to the DPS for immediate processing and alerts for such conditions as reverse flows, tampering and leak detection.

One meter reading migration strategy would be to replace meters as they fail or reach end of life with new MIU units that would communicate with fixed based collectors providing a clear upgrade path and greater return on investment of the meter reading system. The new reading system could potentially provide additional cost savings to the city through reduced staff resources dedicated to meter reading and the liability associated with having them driving and walking around the city to collect the data.

A fixed network AMI system could also enhance customer service and system safety by allowing the DPS to perform data logging, final readings, leak detection notification on the customer side of the meter and receive real-time alarms such as meter tampering, reverse flow and high-low consumption automatically. The DPS could also have access to much more comprehensive data (daily, hourly, and time interval data) to use for water efficiency analyses and distribution main leak detection with the help of additional system leak detection equipment that also integrates directly with the MIUs as outlined in the next section.

Additionally, fixed network AMI systems set the stage for more advanced customer experiences that permit real time alerts and notices via automated voice messaging, e-mail, or cell phone text messaging. This information is valued by customers that want to monitor their usage for conservation and preventative maintenance. Residents could also be alerted to water leaks within their homes or businesses in real-time as opposed to finding out several months later when they receive very large water bills.

The number of fixed network collectors needed in the city based on the geographical extent and density of city customers would need to be determined through a radio frequency propagation study by the unit's manufacturer. The city is in the process of analyzing this type of system and has obtained detailed cost estimates.

Automated Leak Detection

As the city's water distribution system ages, it may be cost effective to develop an acoustic based distribution system leak detection program because it is more cost effective to repair leaks before catastrophic failures occur and to be able to realize as much revenue on the water purchased from the SOCWA as possible.

Leak detection monitoring devices can be mounted on valve stems and water mains and acoustic data loggers can listen for leaks within the system. Implementation of a distribution system leak detection program can be performed in phases such as installing monitors in areas with the oldest water main that is most susceptible for water main breaks and optimized through the use of the developed water system hydraulic model. As the program grows, the city would benefit from a monitoring system that provides real-time alerts of potential water main leaks continuously. Because a distribution system leak detection program can be implemented in phases, the costs could be included in the annual operating budget.

The fixed network AMI reading system, outlined above, can also be used with strategically placed distribution system leak detection monitoring devices to help pinpoint leaks within the distribution system. Distribution system leak detection notifications could be transmitted in real-time directly through the fixed network AMI reading system providing instant notification of potential problems to DPS staff. This type of monitoring and information system would aid staff to quickly and accurately resolve leaks prior to catastrophic water main breaks and reduce water loss increasing system water efficiency and potentially lowering city water costs.

Leak detection monitoring devices are approximately $800.00 each and it is estimated that the city's system would need approximately 100 to adequately develop a detection program for a program cost of $80,000.00. Installation could be completed by DPS staff reducing the cost of implementation. If a contractor were hired to install the units an additional estimated cost of $200.00 per unit would be added for budget purposes.

Table 15. Water Distribution System Best Management Practices Recommended Capital Improvement Program Cost Estimates

Water System Facilities/Services	Qty.	Unit	Unit Cost	Cost	Comments
GPS Curb Boxes	24,151	Each	$ 10.00	$ 241,510.00	Can be completed in multiple years
Fire Hydrant Painting	1,396	Each	$ 100.00	$ 139,600.00	Can be completed in multiple years
Fire Hydrant Replacement	863	Each	$ 2,005.00	$ 1,730,315.00	Can be completed in multiple years
Valve Maintenance	50	Each	$ 200.00	$ 10,000.00	Assuming 50 valves need maintenance annually
Valve Replacement	10	Each	$ 6,500.00	$ 65,000.00	Assuming 10 valves need replacing annually
Leak Detection Monitors	100	Each	$ 800.00	$ 80,000.00	
Leak Detection Monitors Annual Maintenance	1	Lump Sum	$ 16,000.00	$ 16,000.00	
GIS Asset Management Software/Training	1	Lump Sum	$ 40,000.00	$ 40,000.00	
GIS Asset Management Software Annual Maintenance	1	Lump Sum	$ 7,200.00	$ 7,200.00	
Capital Improvement Planning Software/Training	1	Lump Sum	$ 25,000.00	$ 25,000.00	
Capital Improvement Planning Software Annual Maintenance	1	Lump Sum	$ 4,500.00	$ 4,500.00	
CMMS Software, Installation, Configuration, Training	1	Lump Sum	$ 75,000.00	$ 75,000.00	
CMMS Software Annual Maintenance	1	Lump Sum	$ 13,500.00	$ 13,500.00	
Document Management System (10 seats)	1	Each	$ 50,000.00	$ 50,000.00	
Document Management System Annual Maintenance	1	Each	$ 9,000.00	$ 9,000.00	
TOTAL				**$ 2,506,625.00**	

Funding Sources – Capital Improvement Plan

Historically, the city has funded capital improvements and extensions to the water supply system through water billing rates. To continue funding of the water supply system improvements and/or extensions, the city has several possible funding sources as follows:

- Capital Improvement, Replacement and Financing Funds
- Operating Fund Revenue Balances (Depreciation Component of Rate Revenue)
- Bonds
- Low Interest Rate Loans from the State of Michigan Drinking Water Revolving Fund (DWRF)

Capital Improvement, Replacement and Financing Funds (CIRFF)

Simply stated, rates (CIRFF or operational enterprise funds) are typically used to cover operating costs, accumulate reserves for maintenance, and offset debt service. Rates alone can cover major capital improvements.

A lump-sum surcharge could be dedicated to collect necessary funds for a project. This type of charge would not be built into water rates, but rather collected equally from all users. The charge could be levied at any convenient interval for collection or payment in monthly, quarterly, or annual installments.

Reserves represent a water system savings account for future expenses. These restricted funds typically cover major replacements of capital equipment that may include pumps, motors, building roofs, and painting of water storage facilities. They may also be used to offset costs for capital infrastructure improvements. How the reserve fund was established may affect how the funds can be used. The allowable uses of reserves should be determined by the city's appropriate legal and financial advisors prior to approval for use of the CIRFF.

Bonds

Bonds are sold to fund non-operational expenses. They may be sold to cover major repairs and established capital improvement projects with useful lives exceeding the term of the loan. Bonds may be either general obligation, assessed against all residents; or revenue, assessed against users generating the income. Revenue bonds are typically used to fund capital improvements to public utilities because they may carry a lower interest rate owing debt service against the available revenue stream, and because they equitably allocate the cost of the improvement to those who specifically benefit from system improvements.

The construction of new water main is likely to result in a water rate increase because additional debt service would be required to be recouped over the period of the debt instrument (typically a municipal capital improvement bond).

Drinking Water Revolving Fund

The MDEQ provides a source of funding available for water system improvements known as the Drinking Water Revolving Fund (DWRF). Improvements made with these funds cannot support growth. Normal system operation, maintenance, and replacement items do not qualify for funding. The MDEQ criteria for award require that the project addresses compliance with the *Safe Drinking Water Act*, drinking water quality issues, or system reliability.

Projects submitted for funding are evaluated and ranked for need according to MDEQ guidelines. Strict guidelines for application have been established, and are tied to fixed-date time schedules. A Project Plan must be submitted no later than May 1st of the year in which funds are sought. The Project Plan must include the following items:

- Project Background;
- Need for the Project;
- Analysis of Alternatives;
- Selected Alternatives;
- Evaluation of Environmental Impacts;
- Mitigation of Environmental Impacts;
- Public Participation.

Rates for these funds are below market rate. For this reason, they are attractive. DWRF loans do, however, carry an administrative burden to apply for and qualify for the loan. The cost effectiveness of this option must be weighed against the cost for bonding, either through the local unit of government or the county.

References

1. Southeast Michigan Council of Governments (SEMCOG); *Community Profile for City of Royal Oak*, People.
2. SEMCOG *Community Profile for City of Royal Oak*, Land Use / Land Cover.
3. *Water Loss Determination: For What it's Worth*, Joan Kenny, Kansas Water Office and U.S. Geological Survey
4. *Recommended Standards for Water Works* – 2012 Edition, page 116 at http://10statesstandards.com/waterrev2012.pdf (which is also known as Ten States Standards).
5. AWWA Manual of Water Supply Practices M31, Third Edition, *Distribution System Requirements for Fire Protection*, Table 1-5, page 9.
6. Cesario, AWWA, *Model Analysis and Design of Water Distribution Systems*; 1995, page 138.

Appendix A
SEMCOG Community Profile

SEMCOG | Southeast Michigan Council of Governments

Community Profiles

YOU ARE VIEWING DATA FOR:

Royal Oak

CREATE CUSTOM PROFILE Print

211 S Williams St
Royal Oak, MI 48067-2634
http://www.romi.gov

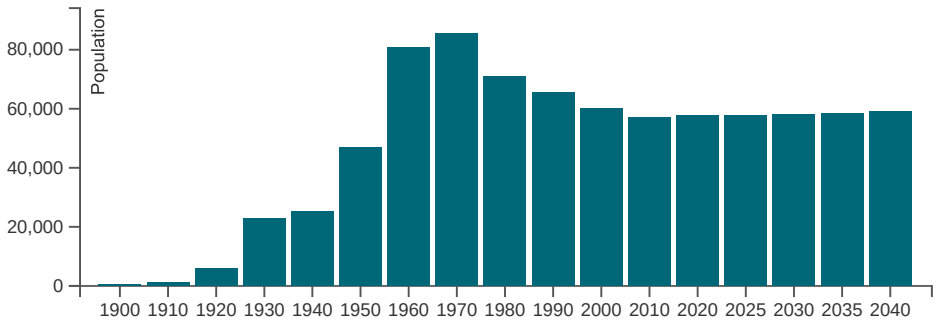
SEMCOG MEMBER

Census 2010 Population:
57,236
Area: 11.8 square miles

Population and Households

Link to American Community Survey (ACS) Profiles: 2011-2013 **Social** | **Demographic**

Population Forecast



Source: **U.S. Census Bureau** and **SEMCOG 2040 Forecast** produced in 2012.

Age Group	2010	2015	2020	2025	2030	2035	2040	Change 2010 - 2040
75+	4,083	4,197	4,734	5,684	6,971	8,321	9,199	5,116
65-74	3,387	4,468	5,741	6,240	7,099	6,689	6,095	2,708
60-64	2,936	3,596	4,421	4,469	4,056	3,667	3,359	423
35-59	20,714	19,404	18,160	17,223	16,524	16,767	17,597	-3,117
25-34	12,248	10,161	9,705	9,545	9,150	8,596	8,604	-3,644
18-24	4,313	5,115	5,289	4,918	4,488	4,604	4,476	163
5-17	6,263	6,363	6,396	6,420	6,471	6,515	6,544	281
Under 5	3,292	3,396	3,348	3,244	3,241	3,188	3,231	-61
Total	57,236	56,700	57,794	57,743	58,000	58,347	59,105	1,869

Source: **U.S. Census Bureau** and **SEMCOG 2040 Forecast** produced in 2010.

Note for Royal Oak: Incorporated in 1927 from Village of Royal Oak. Population numbers prior to 1927 are of the village.

Population and Households

Population and Households	Census 2010	Change 2000-2010	Pct Change 2000-2010	SEMCOG Dec 2014	SEMCOG 2040
Total Population	57,236	-2,826	-4.7%	59,016	59,105
Group Quarters Population	404	-102	-20.2%	404	497
Household Population	56,832	-2,724	-4.6%	58,612	58,608
Housing Units	30,207	265	0.9%	30,400	-
Households (Occupied Units)	28,063	-817	-2.8%	29,192	28,480
Residential Vacancy Rate	7.1%	3.6%	-	4.1%	-
Average Household Size	2.03	-0.04	-	2.01	2.06

Source: **U.S. Census Bureau** and **SEMCOG 2040 Forecast** produced in 2012.

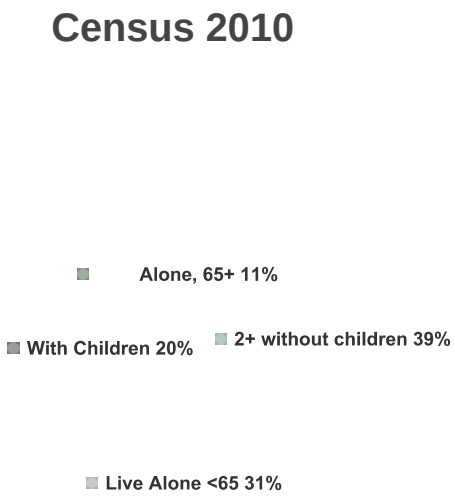
Components of Population Change

Components of Population Change	2000-2005 Avg.	2006-2010 Avg.
Natural Increase (Births - Deaths)	222	292
Births	764	940
Deaths	542	648
Net Migration (Movement In - Movement Out)	-1,029	10
Population Change (Natural Increase + Net Migration)	-807	302

Source: **Michigan Department of Community Health** Vital Statistics **U.S. Census Bureau,** and **SEMCOG.**

Demographics

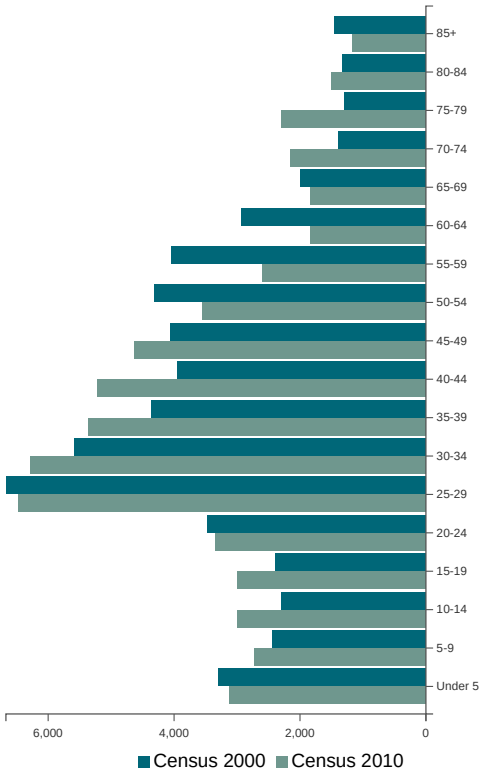
Household Types



Household Types	Census 2000	Census 2010	Pct Change 2000-2010
With Seniors 65+	6,609	5,732	-13.3%
Without Seniors	22,271	22,331	0.3%
Two or more persons without children	10,856	10,824	-0.3%
Live alone, 65+	3,337	2,999	-10.1%
Live alone, under 65	8,456	8,620	1.9%
With children	6,231	5,620	-9.8%
Total Households	**28,880**	**28,063**	**-2.8%**

Source: **U.S. Census Bureau** and **Decennial Census**.

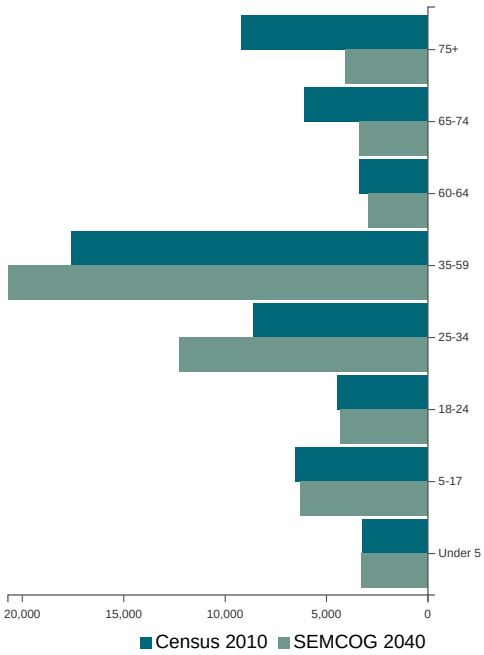
Population Change by Age, 2000-2010



Age Group	Census 2000	Census 2010	Change 2000-2010
85+	1,160	1,460	300
80-84	1,507	1,334	-173
75-79	2,292	1,289	-1,003
70-74	2,158	1,394	-764
65-69	1,841	1,993	152
60-64	1,830	2,936	1,106
55-59	2,591	4,042	1,451
50-54	3,549	4,310	761
45-49	4,633	4,057	-576
40-44	5,212	3,949	-1,263
35-39	5,357	4,356	-1,001
30-34	6,289	5,578	-711
25-29	6,469	6,670	201
20-24	3,342	3,462	120
15-19	2,989	2,387	-602
10-14	2,996	2,294	-702
5-9	2,719	2,433	-286
Under 5	3,128	3,292	164
Total	60,062	57,236	-2,826
Median Age	36.9	37.8	0.9

Source: **U.S. Census Bureau** and **Decennial Census**.

Forecasted Population Change 2010-2040



Source: **SEMCOG 2040 Forecast** produced in 2012.

Senior and Youth Populations

Senior and Youth Population	Census 2000	Census 2010	Pct Change 2000-2010	SEMCOG 2040	Pct Change 2010-2040
65 and over	8,958	7,470	-16.61%	15,294	104.74%
Under 18	10,695	9,555	-10.66%	9,775	2.30%
5 to 17	7,567	6,263	-17.23%	6,544	4.49%
Under 5	3,128	3,292	5.24%	3,231	-1.85%

Note: Population by age changes over time because of the aging of people into older age groups, the movement of people, and the occurrence of births and deaths.

Source: **U.S. Census Bureau**, **Decennial Census** and **SEMCOG 2040 Forecast** produced in 2012.

Race and Hispanic Origin

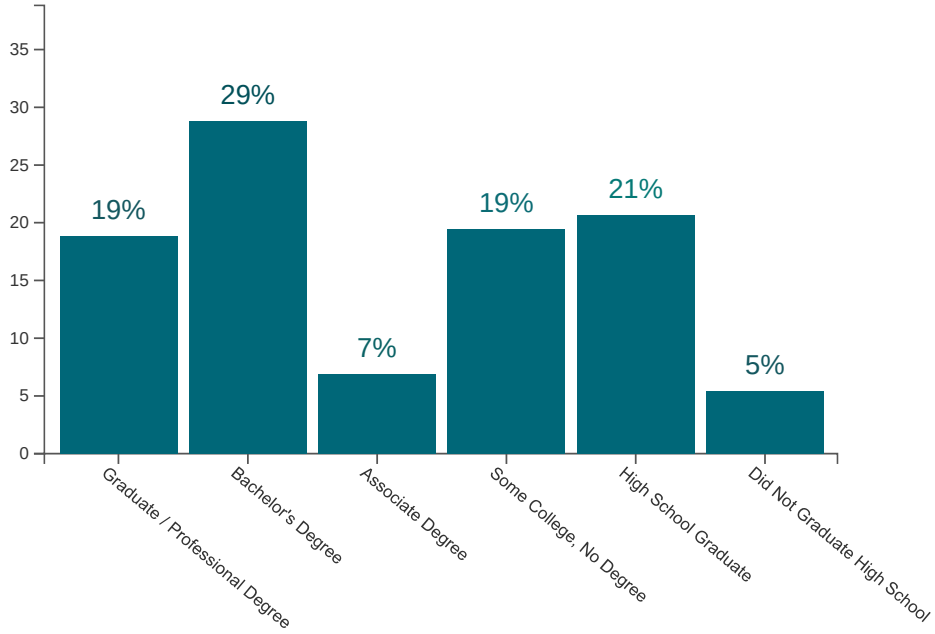
Race and Hispanic Origin	Census 2000	Percent of Population (2000)	Census 2010	Percent of Population (2010)	Percentage Point Change 2000-2010
Non-Hispanic	59,281	98.7%	55,896	97.7%	-1.0%
White	56,421	93.9%	50,975	89.1%	-4.9%
Black	910	1.5%	2,399	4.2%	2.7%
Asian	935	1.6%	1,339	2.3%	0.8%
Multi-Racial	756	1.3%	969	1.7%	0.4%
Other	259	0.4%	214	0.4%	-0.1%
Hispanic	781	1.3%	1,340	2.3%	1.0%
Total	60,062	100.0%	57,236	100.0%	0.0%

Source: **U.S. Census Bureau** and **Decennial Census**.

Highest Level of Education

Highest Level of Education*	5-Yr ACS 2010	Percentage Point Chg 2000-2010
Graduate / Professional Degree	18.9%	4.9%
Bachelor's Degree	28.8%	2.9%
Associate Degree	6.9%	0.6%
Some College, No Degree	19.4%	-3.0%
High School Graduate	20.6%	-2.3%
Did Not Graduate High School	5.4%	-3.1%

* Population age 25 and over

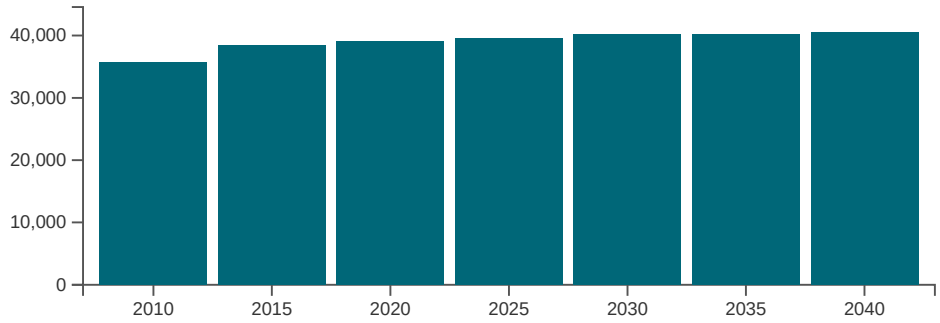


Source: **U.S. Census Bureau**, **Census 2000** and **2010 American Community Survey 5-Year Estimates**.

Economy & Jobs

Link to American Community Survey (ACS) Profiles: 2011-2013 **Economic**

Forecasted Jobs



Source: **SEMCOG 2040 Forecast** produced in 2012.

Forecasted Jobs by Industry

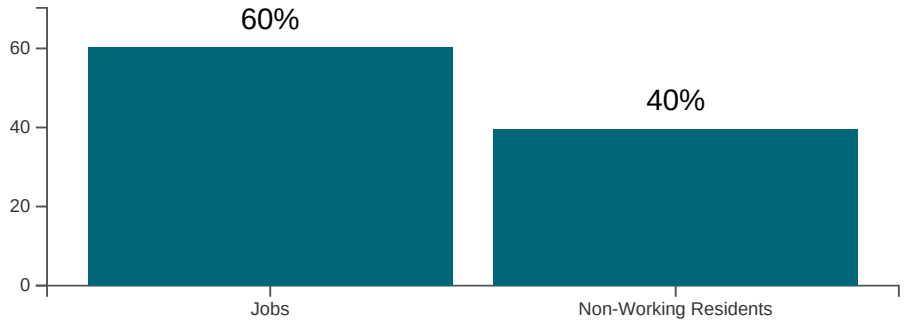
Forecasted Jobs By Industry	2010	2015	2020	2025	2030	2035	2040	Change 2010 - 2040
Natural Resources, Mining, & Construction	1,064	1,255	1,315	1,459	1,507	1,494	1,475	411
Manufacturing	1,166	1,264	1,260	1,191	1,184	1,118	1,113	-53
Wholesale Trade, Transportation, Warehousing, & Utilities	1,232	1,250	1,210	1,202	1,238	1,226	1,195	-37
Retail Trade	2,890	2,868	2,683	2,681	2,651	2,623	2,583	-307
Knowledge-based Services	4,995	5,414	5,505	5,506	5,573	5,567	5,593	598
Services to Households & Firms	4,235	4,791	4,971	4,971	5,124	5,103	5,240	1,005
Private Education & Healthcare	15,062	16,413	17,073	17,356	17,521	17,751	17,895	2,833
Leisure & Hospitality	3,321	3,373	3,303	3,296	3,417	3,458	3,492	171
Government	1,790	1,785	1,843	1,879	1,907	1,930	1,937	147
Total	35,755	38,413	39,163	39,541	40,122	40,270	40,523	4,768

Source: **SEMCOG 2040 Forecast** produced in 2012.

Note: "C" indicates data blocked due to confidentiality concerns of ES-202 files.

Daytime Population

Daytime Population	SEMCOG and ACS 2010
Jobs	35,755
Non-Working Residents	23,554
Age 15 and under	7,541
Not in labor force	13,547
Unemployed	2,466
Daytime Population	59,309



Source: **SEMCOG 2040 Forecast** produced in 2012, **U.S Census Bureau**, and **2010 American Community Survey 5-Year Estimates**.

Note: The number of residents attending school outside Southeast Michigan is not available. Likewise, the number of students commuting into Southeast Michigan to attend school is also not known.

Where Workers Commute From 5-Yr ACS 2010

Rank	Where Workers Commute From *	Workers	Percent
1	**Royal Oak**	6,005	19.8%
* Workers, age 16 and over employed in Royal Oak		30,282	

Rank	Where Workers Commute From *	Workers	Percent
2	**Detroit**	2,040	6.7%
3	**Troy**	1,425	4.7%
4	**Sterling Heights**	1,330	4.4%
5	**Madison Heights**	1,285	4.2%
6	**Southfield**	1,105	3.6%
7	**Warren**	1,000	3.3%
8	**Berkley**	910	3.0%
9	**Rochester Hills**	845	2.8%
10	**Ferndale**	825	2.7%
-	**Elsewhere**	13,512	44.6%
* Workers, age 16 and over employed in Royal Oak		30,282	

Source: **U.S. Census Bureau** - CTTP/ACS Commuting Data.
Commuting Patterns in Southeast Michigan

Resident Population

Where Residents Work 5-Yr ACS 2010

Rank	Where Residents Work *	Workers	Percent
1	**Royal Oak**	6,005	18.3%
2	**Detroit**	3,895	11.9%
3	**Troy**	3,285	10.0%
4	**Southfield**	2,660	8.1%
5	**Madison Heights**	1,285	3.9%
6	**Warren**	1,250	3.8%
7	**Birmingham**	1,230	3.8%
* Workers, age 16 and over residing in Royal Oak		**32,767**	

Rank	Where Residents Work *	Workers	Percent
8	**Farmington Hills**	960	2.9%
9	**Auburn Hills**	955	2.9%
10	**Dearborn**	835	2.5%
-	**Elsewhere**	10,407	31.8%
* Workers, age 16 and over residing in Royal Oak		**32,767**	

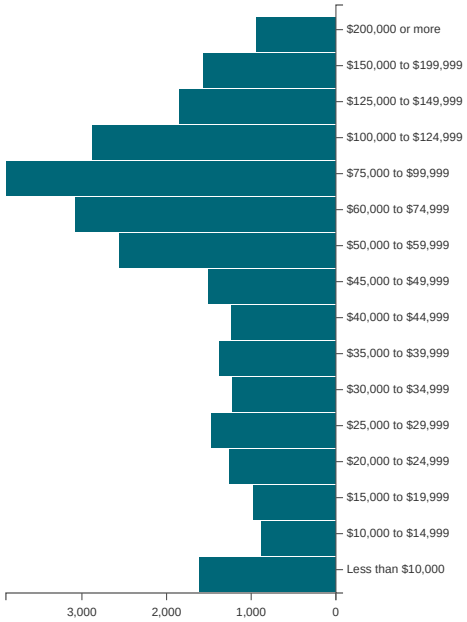
Source: **U.S. Census Bureau - CTTP/ACS Commuting Data**.

Household Incomes

Income	5-Yr ACS 2010	Change 2000-2010	Percent Change 2000-2010
Median Household Income (in 2010 dollars)	$ 60,184	$ -8,759	-12.7%
Per Capita Income (in 2010 dollars)	$ 37,095	$ -3,794	-9.3%

Source: **U.S. Census Bureau**, **Census 2000**, and **2010 American Community Survey 5-Year Estimates**.

Annual Household Incomes



Annual Household Income	5-Yr ACS 2010
$200,000 or more	942
$150,000 to $199,999	1,568
$125,000 to $149,999	1,849
$100,000 to $124,999	2,882
$75,000 to $99,999	3,898
$60,000 to $74,999	3,074
$50,000 to $59,999	2,557
$45,000 to $49,999	1,509
$40,000 to $44,999	1,239
$35,000 to $39,999	1,380
$30,000 to $34,999	1,230
Total	**28,329**

Annual Household Income	5-Yr ACS 2010
$25,000 to $29,999	1,473
$20,000 to $24,999	1,258
$15,000 to $19,999	977
$10,000 to $14,999	880
Less than $10,000	1,613
Total	**28,329**

Source: **U.S. Census Bureau** and **2010 American Community Survey 5-Year Estimates**.

Poverty

Poverty	Census 2000	% of Total (2000)	5-Yr ACS 2010	% of Total (2010)	% Point Chg 2000-2010
Persons in Poverty	2,550	4.3%	3,893	6.8%	2.6
Households in Poverty	1,331	4.6%	2,156	7.6%	3.0

Source: **U.S. Census Bureau** and **2010 American Community Survey 5-Year Estimates**.

Housing

Link to American Community Survey (ACS) Profiles: 2011-2013 **Housing**

Building Permits 2000 - 2015

Year	Single Family	Two Family	Attach Condo	Multi Family	Total Units	Total Demos	Net Total
2000 to 2015 totals	692	4	126	169	991	398	593

Year	Single Family	Two Family	Attach Condo	Multi Family	Total Units	Total Demos	Net Total
2000	12	0	0	0	12	15	-3
2001	17	0	6	0	23	8	15
2002	18	0	7	0	25	14	11
2003	37	0	5	8	50	20	30
2004	43	0	89	88	220	31	189
2005	97	0	0	0	97	38	59
2006	26	4	19	0	49	30	19
2007	22	0	0	0	22	11	11
2008	20	0	0	0	20	15	5
2009	4	0	0	0	4	10	-6
2010	11	0	0	37	48	5	43
2011	29	0	0	36	65	14	51
2012	88	0	0	0	88	40	48
2013	132	0	0	0	132	56	76
2014	129	0	0	0	129	82	47
2015	7	0	0	0	7	9	-2
2000 to 2015 totals	692	4	126	169	991	398	593

Source: **SEMCOG Development**.

Note: Permit data for most recent years may be incomplete and is updated monthly.

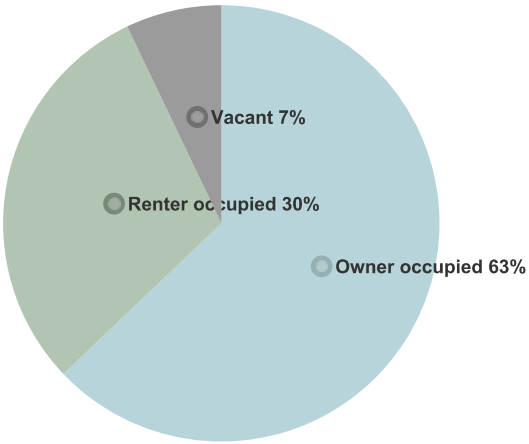
Housing Types

Housing Type	Census 2000	5-Yr ACS 2010	Change 2000-2010	New Units Permitted 2010-2014
Single Family Detached	20,179	20,701	522	396
Duplex	902	653	-249	0
Townhouse / Attached Condo	1,216	1,600	384	0
Multi-Unit Apartment	7,597	7,447	-150	73
Mobile Home / Manufactured Housing	43	162	119	0
Other	5	0	-5	
Total	29,942	30,563	621	469
Units Demolished				-206
Net (Total Permitted Units - Units Demolished)				263

Source: **U.S. Census Bureau**, **Census 2000**, and **2010 American Community Survey 5-Year Estimates**.

Housing Tenure

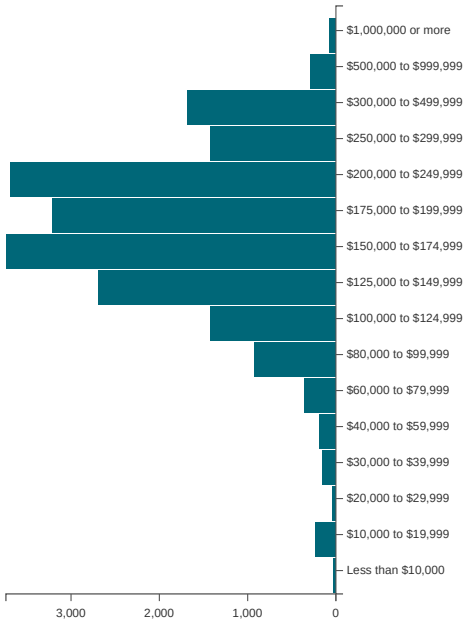
Housing Tenure	Census 2000	Census 2010	Change 2000-2010
Owner occupied	20,246	18,995	-1,251
Renter occupied	8,634	9,068	434
Vacant	1,062	2,144	1,082
Seasonal/migrant	202	126	-76
Other vacant units	860	2,018	1,158
Total Housing Units	29,942	30,207	265



Source: **U.S. Census Bureau**, **Census 2000**, **2010 American Community Survey 5-Year Estimates**.

Housing Value (in 2010 dollars)

Housing Value (in 2010 dollars)	5-Yr ACS 2010	Change 2000-2010	Percent Change 2000-2010
Median housing value	$177,300	$-19,824	-10.1%
Median gross rent	$792	$-51	-6.1%



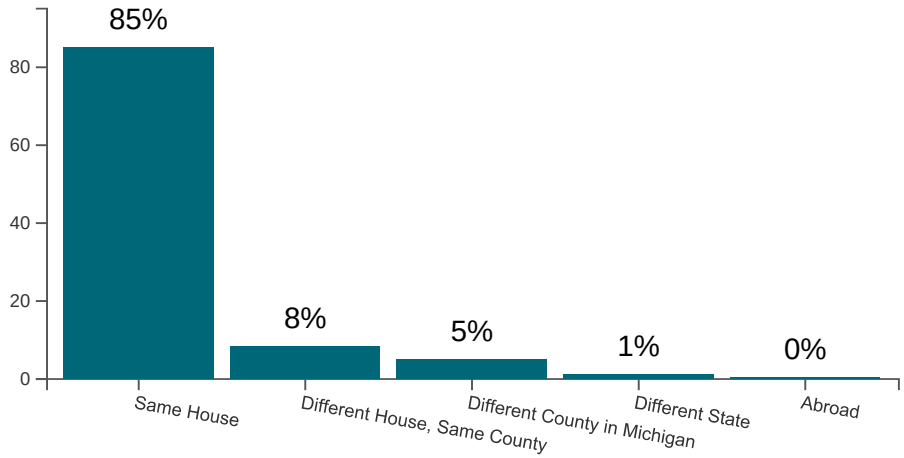
Housing Value	5-Yr ACS 2010
$1,000,000 or more	70
$500,000 to $999,999	291
$300,000 to $499,999	1,679
$250,000 to $299,999	1,420
$200,000 to $249,999	3,687
$175,000 to $199,999	3,207
$150,000 to $174,999	3,737
$125,000 to $149,999	2,686
$100,000 to $124,999	1,423
$80,000 to $99,999	927
$60,000 to $79,999	354
$40,000 to $59,999	191

Owner-Occupied Units	20,119

Housing Value	5-Yr ACS 2010
$30,000 to $39,999	151
$20,000 to $29,999	38
$10,000 to $19,999	232
Less than $10,000	26
Owner-Occupied Units	20,119

Source: **U.S. Census Bureau** and **2010 American Community Survey 5-Year Estimates**.

Residence One Year Ago *



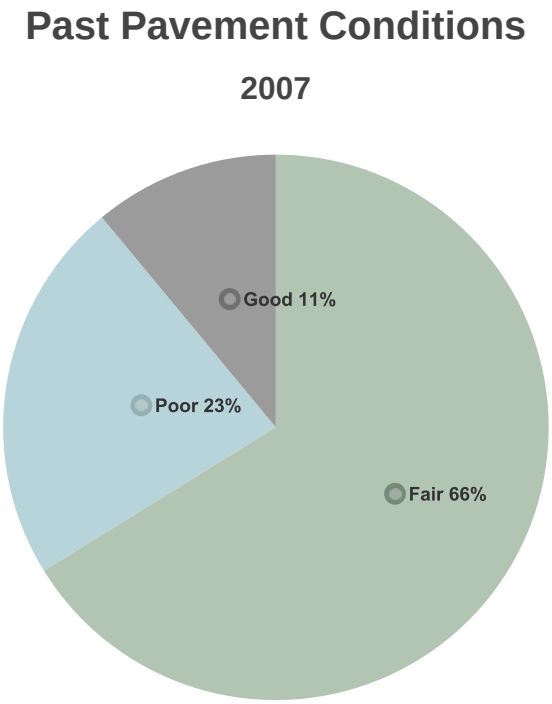
* This table represents persons, age 1 and over, living in Royal Oak from 2009-2013. The table does not represent person who moved out of Royal Oak from 2009-2013.

Source: **2010 American Community Survey 5-Year Estimates**.

Transportation

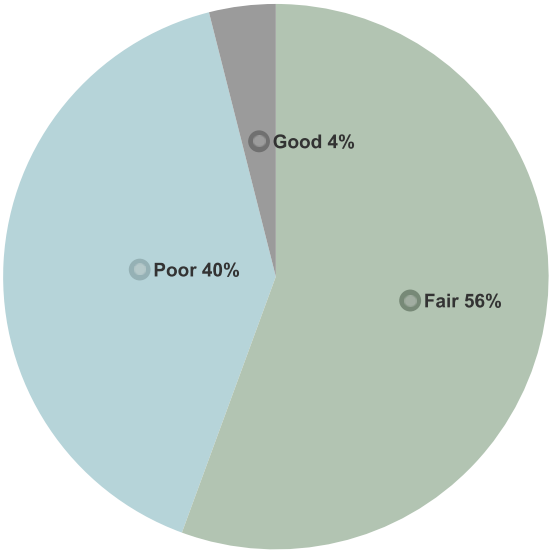
Miles of public road (including boundary roads): 245
Source: **Michigan Geographic Framework**

Pavement Condition (in Lane Miles)



Current Pavement Conditions

2014



Note: Poor pavements are generally in need of rehabilitation or full reconstruction to return to good condition. Fair pavements are in need of capital preventive maintenance to avoid deteriorating to the poor classification. Good pavements generally receive only routine maintenance, such as street sweeping and snow removal, until they deteriorate to the fair condition.
Source: **SEMCOG**

Bridge Status

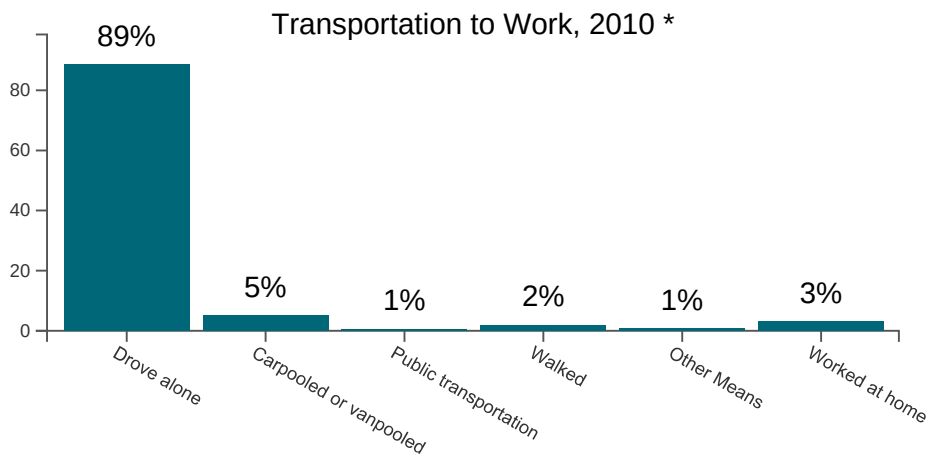
Bridge Status	2008	2008 (%)	2009	2009 (%)	2010	2010 (%)	Percent Point Chg 2008-2010
Open	23	100.0%	23	100.0%	42	100.0%	0.0%

Bridge Status	2008	2008 (%)	2009	2009 (%)	2010	2010 (%)	Percent Point Chg 2008-2010
Open with Restrictions	0	0.0%	0	0.0%	0	0.0%	0.0%
Closed*	0	0.0%	0	0.0%	0	0.0%	0.0%
Total Bridges	23	100.0%	23	100.0%	42	100.0%	0.0%
Deficient Bridges	7	30.4%	11	47.8%	12	28.6%	-1.9%

***** Bridges may be closed because of new construction or failed condition.
Note: A bridge is considered deficient if it is structurally deficient (in poor shape and unable to carry the load for which it was designed) or functionally obsolete (in good physical condition but unable to support current or future demands, for example, being too narrow to accommodate truck traffic).
Source: Michigan Structure Inventory and Appraisal Database

Detailed Intersection & Road Data

Travel



* Resident workers age 16 and over

Transportation to Work

Transportation to Work	Census 2000	Census 2000 (%)	Census 2010	Census 2010 (%)	% Point Chg 2000-2010
Drove alone	30,944	88.6%	29,047	88.6%	0.0%
Carpooled or vanpooled	1,821	5.2%	1,643	5.0%	-0.2%
Public transportation	354	1.0%	207	0.6%	-0.4%
Walked	644	1.8%	641	2.0%	0.1%
Other Means	190	0.5%	238	0.7%	0.2%
Worked at home	981	2.8%	1,025	3.1%	0.3%
Resident workers age 16 and over	34,934	100.0%	32,801	100.0%	0.0%

Source: **U.S. Census Bureau** | **Census 2000** | **2010 American Community Survey 5-Year Estimates**

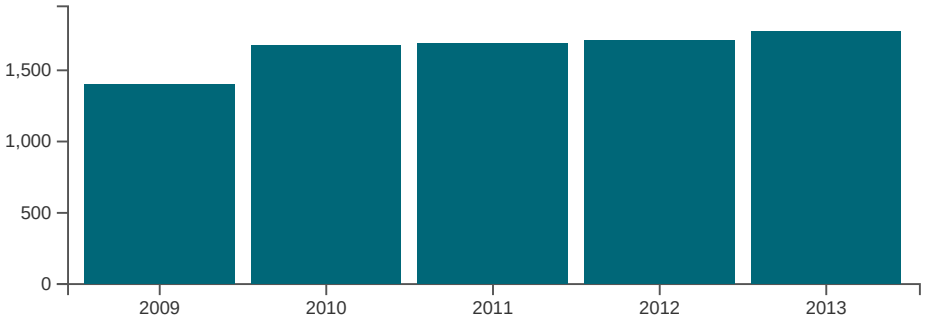
Mean Travel Time to Work

Mean Travel Time To Work	Census 2000	5-Yr ACS 2010	Change 2000-2010
For residents age 16 and over who worked outside the home	22.5 minutes	22.5 minutes	0.0 minutes

Source: **U.S. Census Bureau Census 2000 2010 American Community Survey 5-Year Estimates**

Safety

Crashes, 2009-2013



Source: **Michigan Department of State Police with the Criminal Justice Information Center**, and **SEMCOG.**

Crash Severity

Crash Severity	2009	2010	2011	2012	2013	Percent of Crashes 2009 - 2013
Fatal	4	1	0	1	0	0.1%
Incapacitating Injury	21	20	17	16	21	1.2%
Other Injury	298	416	403	400	386	23.1%
Property Damage Only	1,080	1,239	1,269	1,293	1,365	75.7%
Total Crashes	1,403	1,676	1,689	1,710	1,772	100.0%

Crashes by Involvement

Crashes by Involvement	2009	2010	2011	2012	2013	Percent of Crashes 2009 - 2013
Red-light Running	55	59	65	77	56	3.8%
Lane Departure	149	144	148	125	143	8.6%
Alcohol	72	68	67	59	71	4.1%
Drugs	16	15	22	18	17	1.1%

Crashes by Involvement	2009	2010	2011	2012	2013	Percent of Crashes 2009 - 2013
Deer	0	5	1	3	1	0.1%
Train	0	0	0	0	0	0.0%
Commercial Truck/Bus	54	71	60	65	63	3.8%
School Bus	4	7	2	2	2	0.2%
Emergency Vehicle	10	6	13	10	9	0.6%
Motorcycle	13	13	13	17	10	0.8%
Intersection	580	610	614	608	566	36.1%
Work Zone	19	12	29	23	21	1.3%
Pedestrian	18	23	14	16	20	1.1%
Bicyclist	30	23	23	31	18	1.5%
Older Driver (65 and older)	215	286	293	282	439	18.4%
Young Driver (16 to 24)	215	286	293	282	668	21.1%

High Frequency Intersection Crash Rankings

Local Rank	County Rank	Region Rank	Intersection	Annual Avg 2009-2013
1	58	141	Woodward Ave @ 11 Mile Rd	26.8
2	64	160	14 Mile Rd W @ Crooks Rd	25.6
3	115	311	13 Mile Rd W @ 13 Mile Rd W	20.2
4	123	341	Bermuda Mohawk/E I 696 Ramp @ E I 696	19.6
5	178	501	12 Mile Rd W @ Woodward Ave	16.6
6	205	577	11 Mile Rd E @ I 75 Service Drive	15.2
7	213	608	13 Mile Rd W @ Coolidge Rd	14.8
8	220	627	14 Mile Rd E @ Rochester Rd N	14.6
9	227	645	13 Mile Rd W @ Woodward Ave	14.4
10	244	706	12 Mile Rd W @ Stephenson Hwy	13.8

Note: Intersections are ranked by the number of reported crashes, which does not take into account traffic volume. Crashes reported occurred within 150 feet of the intersection.
Source: **Michigan Department of State Police with the Criminal Justice Information Center SEMCOG**

High Frequency Road Segment Crash Rankings

Local Rank	County Rank	Region Rank	Segment	From Road - To Road	Annual Avg 2009-2013
1	36	67	13 Mile Rd W	Woodward Ave - Greenfield Rd	53.2
2	58	122	E I 696	Campbell Rd S - E I 696/I 75 Ramp	45.6
3	76	164	E I 696	Stephenson/10 Mile Turnaround - Bermuda Mohawk/E I 696 Ramp	41.8
4	114	258	Coolidge Rd	Meijer Dr - Maple Rd E	35.0
5	223	567	E I 696	S Chrysler/S Stephenson Ramp - E I 696/N I 75 Ramp	25.2
6	241	626	Woodward Ave	Coolidge Hwy - N Woodward/12 Mile Turnaround	24.2
7	247	636	11 Mile Rd E	Troy N - Campbell Rd N	24.0
8	266	674	N I 75	11 Mile/N I 75 Ramp - Gardenia	23.2
9	293	743	S I 75	11 Mile/S I 75 Ramp - 11 Mile Rd E	22.0
10	305	787	14 Mile Rd W	Coolidge Rd - Woodward Ave	21.4

Note: Segments are ranked by the number of reported crashes, which does not take into account traffic volume.

Environment

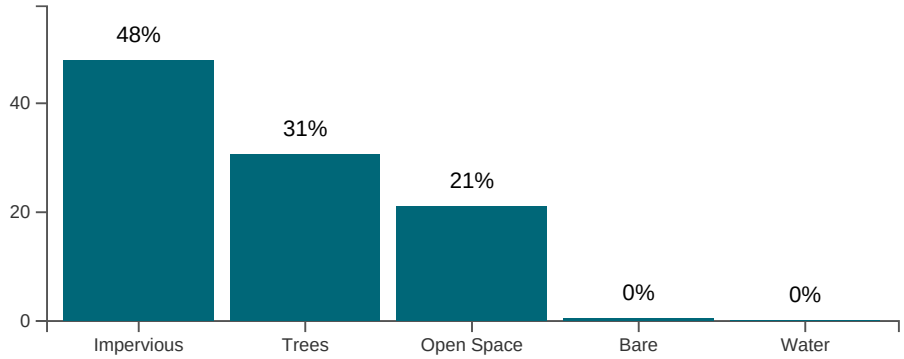
SEMCOG 2008 Land Use

SEMCOG 2008 Land Use	Acres	Percent
Agricultural	0	0.0%
Single-family residential	3,725	49.2%
Multiple-family residential	218	2.9%
Total	7,563	

SEMCOG 2008 Land Use	Acres	Percent
Commercial	385	5.1%
Industrial	160	2.1%
Governmental/Institutional	549	7.3%
Park, recreation, and open space	584	7.7%
Airport	0	0.0%
Transportation, Communication, and Utility	1,938	25.6%
Water	5	0.1%
Total	7,563	

Note: Land Cover was derived from SEMCOG's 2010 Leaf off Imagery.
Source: **SEMCOG**

SEMCOG Land Cover in 2010



Type	Description	Acres	Percent
Impervious	buildings, roads, driveways, parking lots	3,621	47.8%
Trees	woody vegetation, trees	2,310	30.5%
Open Space	agricultural fields, grasslands, turfgrass	1,596	21.1%
Bare	soil, aggregate piles, unplanted fields	33	0.4%
Water	rivers, lakes, drains, ponds	9	0.1%
Total Acres		7,569	

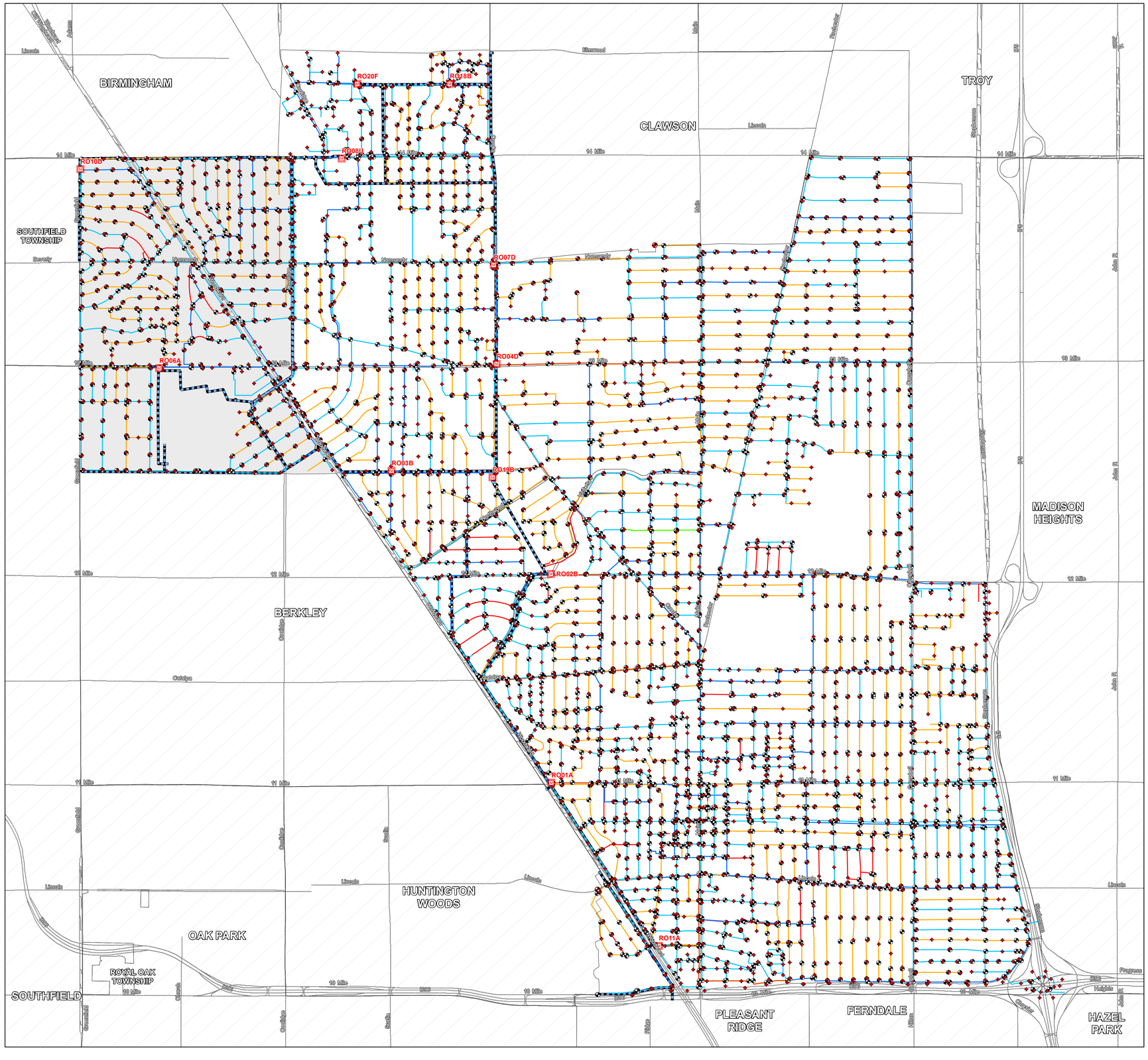
Source Data

SEMCOG - Detailed Data

Appendix B
Water Distribution System General Plan

City of Royal Oak
Water Distribution System
General Plan

Royal Oak
Life Now Playing



Legend

Water System Features

- Hydrant
- System Valve
- Closed Valve

Water Main Diameter (Inches)

- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 24"

SOCWA Water System

- Transmission Main
- SOCWA Source

Pressure Districts

- High Pressure District
- Low Pressure District
- Major Roads

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,200 Feet

Johnson&Anderson

Appendix C
SOCWA Membership Agreement and Second Amendment

Commission Letter #118-08
Commission Meeting: 5-5-08
Subject: SOCWA Membership

May 2, 2008

THE HONORABLE MAYOR
And
MEMBERS OF CITY COMMISSION

Attached is a new membership agreement for the city of Royal Oak to continue its membership in SOCWA. A copy of the new DWSD/ SOCWA contract is attached along with a summary of the significant changes in the new agreement between SOCWA and DWSD. Royal Oak's Current contract as member of SOCWA runs through 2015. The new agreement will extend the contract through 2038. This will align the membership agreement with the DWSD contract.

The Oakland County Drain Commissioner's Office has reviewed alternative sources for water for the county and determined DWSD provides best source for water in south Oakland County for the term of this contract.

The following resolution is appropriate for approval

> BE IT RESOLVED that the membership agreement between SOCWA and the city of Royal Oak be approved.

Respectfully Submitted,

Greg Rassel, Director
Recreation and Public Service

Approved,

Thomas Hoover
City Manager

THIS AGREEMENT, made this 14th day of April, 1960, by and between the SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY, a Michigan Public Corporation (hereinafter sometimes referred to as the "Authority"), party of the first part, and the CITY OF ROYAL OAK, A Michigan Municipal Corporation (hereinafter sometimes referred to as the "City"), party of the second part,

WITNESSETH:

WHEREAS, the Southeastern Oakland County Water Authority has been duly created under the provisions of Act No. 196 of the Michigan Public Acts of 1952, of which Authority the said City is a constituent member; and

WHEREAS, the said Authority has entered into a contract with the City of Detroit, a Michigan Municipal Corporation, for the purchase of water in sufficient quantities to meet all reasonable requirements of the Authority's customers as provided in said contract, the said water to be delivered to the Authority at designated locations, a copy of which contract is marked "Exhibit A" and is attached hereto for the purpose of reference; and

WHEREAS, the Authority has acquired a water supply system for the purpose of transporting, pumping and storing the water so received from the City of Detroit and distributing the same to its several constituent members; and

WHEREAS, the said Authority intends to issue revenue bonds under the provisions of Act No. 94 of the Michigan Public Acts of 1933, as amended, for the purpose of defraying the cost of additions to said water supply system; and

WHEREAS, the future Maximum Daily Demand for water as estimated by each constituent municipality for the territory within its present boundaries, is as follows:

Municipality	Allocated Capacity July 1, 1959 (Million Gallons Daily)	Estimated Maximum Day M.G.D
City of Berkley	5.53	5.53
Village of Beverly Hills	5.50	6.50
*Village of Bingham Farms	0.00	1.50
City of Birmingham	8.49	9.75
City of Clawson	4.40	4.80
*Village of Franklin	0.00	2.70
City of Huntington Woods (exclusive of the Rackham Golf Course and Detroit Zoological properties)	3.22	3.95
City of Huntington Woods (portion within Rackham Golf Course and Detroit Zoological properties)	2.09	2.09
City of Lathrup Village	3.20	3.80
City of Pleasant Ridge	1.96	1.96
City of Royal Oak	21.42	23.00
City of Southfield	14.19	40.00
Township of Southfield	0.00	0.00
Total	70.00	105.58

*If they become constituent municipalities, and

WHEREAS, in order to issue and sell said revenue bonds it is necessary that the Authority and each of its constituent members enter into a contract for the sale and purchase, respectively, of water during the term of such bonds;

THEREFORE, IT IS AGREED BY AND BETWEEN THE PARTIES HERETO, as follows:

1. The said Authority to the best of its ability and consistent with its obligations to its several constituent members and subject to the terms of this agreement, agrees to deliver to said City, water in sufficient quantities to meet the reasonable requirements of the City and its customers within the present city limits, and also of such customers outside said city limits, so long as they shall remain customers of the city, as are listed on "Exhibit B" hereto attached and made a part hereof; and the City agrees to purchase from the Authority its said entire water requirements in accordance with the terms of this agreement; Provided that the Cities of Berkley, Birmingham, Clawson, and Royal Oak, may furnish to their own water systems, a portion of their water supply from their own wells as is provided for in Section 13 of each of the contracts of the Authority with these constituent members.

It is understood that the City's allocated capacity, as above set forth, includes the aforementioned outside customers.

In the event that the City should annex territory or combine with other territories now lying within the limits of the Authority, then this contract shall cover such territory unless such inclusion is prevented by law, and in event such territory is included, the allocated capacity of the City shall be increased and the allocated capacity of the municipality from which such territory was detached, shall be decreased, in such an amount as may be agreed to by the two municipalities, or in event of their disagreement, then in an amount which shall be fixed by the Board of Trustees.

2. Water shall be delivered by the Authority to the City at the following locations:

RO-1	Judson & Tyler
RO-2	13 Mile & Harvard
RO-3	Greenfield & Berkshire
RO-4	14 Mile & Hampton
RO-5	13 Mile & Crooks
RO-6	11 Mile & Woodward
RO-7	12 Mile & Vinsetta
RO-8	Webster & Benjamin
RO-9	Crooks & Normandy
RO-10	14 Mile & Edgeland
RO-11	10 Mile & Woodward
RO-12	Vinsetta & Woodward
RO-13	Oliver Station
RO-14	Lincoln & Woodward

Water may be delivered to the City at such other points as may, from time to time, be mutually agreed upon by the parties hereto.

3. The Authority shall supply and sell water from the Authority's water system to the City, and the City shall receive and purchase such water in accordance with the terms of this agreement for an indefinite period, but at least to July 1, 1995. This agreement may be terminated by either party after July 1, 1995, upon two years written notice served upon the other party by delivering the same to the Secretary of the Board of Trustees of the Authority or to the Clerk of the City, as the case may be, or at any time upon the mutual consent of both parties. The execution and final approval of this agreement shall terminate the prior contract dated the 13th day of September, 1954, between the Authority and the City.

4. The charges for water to be furnished pursuant to the terms of this contract shall be as follows:

a. Demand Charge:

The City shall pay in each of the Authority's fiscal years, a demand charge, which shall be in the amount of $64,649.45, which shall entitle the City to an allocated capacity in the amount of 21.42 million gallons per day. The demand charge shall be as provided for in the Articles of Incorporation of the Authority; shall be payable monthly in advance, and the payments shall extend to July 1, 1981. Should the City require capacity in excess of 21.42 million gallons in any two days as the result of actual usage of water, then the City shall pay to the Authority an additional demand charge at the rate of $3,018.18 per million gallons per day for such additional allocated capacity as is provided for in Article XIV of the Articles of Incorporation.

b. Consumption Charge:

The City shall pay to the Authority a consumption charge based upon the amount of water delivered by the Authority to the City, as measured by the meters installed and maintained by the Authority, at such rate or rates as shall be fixed from time to time by the Authority. The said consumption charge shall be payable monthly.

All charges, including demand charge and consumption charge, shall be subject to such penalties for non-payment as shall be provided from time to time by the Board of Trustees of the Authority.

5. The charges for water shall be such that the gross income shall be sufficient to conform with all of the requirements of Act No. 94 of the Michigan Public Acts of 1933 as amended, with such surplus as shall be necessary to make any bonds salable which shall be issued under the terms of said Act No. 94. If for any reason the total income of the Authority during any fiscal year shall not be sufficient to satisfy its obligations accruing during such year, including payments to be made to the Bond and Interest Redemption Fund, if revenue bonds are outstanding, then the amount of any deficiency shall be pro-rated among the constituent municipalities, in accordance with the amount of water delivered by the Authority to said respective municipalities during such fiscal year, which amount shall be considered as an additional charge for water.

6. The City shall raise the amount of the water charges to be paid to the Authority by the City, by imposing charges upon its own water users sufficient to promptly meet the obligations of the City to the Authority, but in event the receipts therefrom are not sufficient to pay all sums when due then said City shall be responsible for any deficit. If the City shall be required hereunder to pay any such deficit it may reimburse itself from future surplus receipts from its water users. The City shall at all times have in force a sufficient ordinance to enforce the collection of its water charges, which ordinance shall provide that such charges shall be a lien upon the premises served and that such charges remaining unpaid or delinquent for a period of six (6) months or more, shall be certified by the proper

officer of the City to the tax assessing officer thereof, to be entered upon the next succeeding tax roll against the premises to which water services shall have been rendered.

7. The Authority shall have any and all remedies provided by law for the enforcement of the payment of any amount due it from the City.

8. All meters measuring water delivered by the Authority to the City, as provided in paragraph 2 hereof, shall be furnished and maintained by the Authority at its own expense. The Authority agrees to maintain all said meters so that they will correctly measure all water which passes through them. The City agrees to accept the Authority's estimate of quantities of water supplied during all periods in which the meters fail to measure correctly, provided there is a reasonable basis for such estimates. The judgment of the Authority as to the condition and accuracy of all meters shall be binding upon the City.

9. The City hereby approves the terms of said contract with the City of Detroit (Exhibit A), and agrees that it will do all things necessary to be done and will refrain from the doing of all things which are necessary not to be done, in order that the Authority may comply with the terms of said contract; and further, that the City will do all things required in said contract to be done by it as a constituent member of the Authority and will refrain from doing such things as are prohibited in said contract to be done by it as a constituent member of the Authority, all to the same extent as though such requirements and prohibitions were reincorporated herein at length.

10. The Authority shall have power to enforce the various provisions of said contract with the City of Detroit insofar as it applies to the City.

11. Whenever the City desires to make any extensions or additions to its water mains or pipes or to install pumping, regulating or storage facilities it shall file with the Authority clear and complete plans and specifications for such work and receive the approval of the Authority therefor. All such work shall be subject to inspection by the Authority in order that the latter may ascertain if it conforms to the requirements specified in said contract with the City of Detroit and with any reasonable regulations of the Authority. The expense of such approval and inspection shall be paid by the City.

12. The Board of Water Commissioners of the City of Detroit by the terms of said contract between the Authority and the City of Detroit, has reserved to itself the right to temporarily discontinue the supply of water to any of the water mains or pipe lines of the Authority, and the Authority does hereby expressly reserve to itself the right to temporarily discontinue the supply of water to the City, whenever either the Board of Water Commissioners of the City of Detroit or the Authority shall upon its own determination find it necessary for health reasons and/or for purposes of testing, repairing or replacing water mains, meters or other of its facilities serving the Authority or the City, or other similar or necessary reasons, as the case may be. No claim for damages for any such temporary discontinuance or for any discontinuance caused by Acts of God or other causes

beyond its control, shall ever be made against the City of Detroit, the Detroit Board of Water Commissioners, or the Authority.

13. The City reserves the right to furnish to itself from its own wells an amount of water not exceeding one million (1, 000, 000) gallons in any day from March 15 to October 15 in any year; provided, however, that prior to intermingling of water from the well supply of the City with water furnished by the Authority, the schedule of operation of the wells shall be furnished to the Authority and the approval of the Authority secured as to the schedule and quality of the water; or the City shall furnish copies of the results of tests of said water conducted by the properly constituted Governmental health agency having jurisdiction.

IN WITNESS WHEREOF, the parties hereto have caused this contract to be executed by their respective duly authorized officers, as of the day and year first above written.

WITNESSES:

John Lamerato

Helen Bierly

SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY

By Fred L. Yockey
Its Chairman, Fred L. Yockey

By Charles D. Kelley
Its Secretary, Charles D. Kelley

Gladys Forga

Jane M. Williams

CITY OF ROYAL OAK

By William Hayward
Its Mayor, William Hayward

By Gladys Holmes
Its Clerk, Gladys Holmes

AMENDMENT TO AGREEMENT

THIS AGREEMENT made this 6th day of May, 1991, by and between the SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY, a municipal authority and public body corporate of the State of Michigan (hereinafter referred to as the "Authority"), and the City of Royal Oak, a Michigan municipal corporation (hereinafter referred to as the "Municipality"):

W I T N E S S E T H:

WHEREAS, the Municipality has previously entered into a certain agreement dated as of April 14, 1960, (the "Agreement") between the Municipality and the Authority, providing for the sale and delivery of water by the Authority to the Municipality;

AND WHEREAS, the Agreement is to continue in full force and effect until July 1, 1995;

AND WHEREAS, the Authority proposes to authorize issuance and sale of additional revenue bonds which will be payable, in part, from the proceeds of the payments made by the Municipality pursuant to the Agreement which bonds will have a last maturity falling due after July 1, 1995;

AND WHEREAS, in order to market said bonds, it will be necessary to extend the period of the Agreement until July 1, 2015, in order to assure adequate revenues to market said bonds.

THEREFORE, IT IS HEREBY AGREED by and between the parties hereto as follows:

EXHIBIT A

1. Paragraph 3 of the Agreement is hereby amended to read as follows:

3. The Authority shall supply and sell water from the Authority's water system to the Municipality, and the Municipality shall receive and purchase such water in accordance with the terms of this agreement for an indefinite period of time but at least to July 1, 2015. This agreement may be terminated by either party after July 1, 2015, upon two years written notice served upon the other party by delivering the same to the Secretary of the Board of Trustees of the Authority or to the Clerk of the Municipality, as the case may be, or at any time upon mutual consent of both parties.

2. Except for the foregoing changes, the Agreement and all of the terms and provisions hereof are hereby ratified and confirmed and shall remain as set forth in the Agreement.

IN WITNESS WHEREOF, the parties hereto have, by action of their respective governing bodies, caused this Agreement to be executed by their duly authorized officers, the day and year first above written.

WITNESSES:

SOUTHEASTERN OAKLAND COUNTY
WATER AUTHORITY

By _____
Chairman of the
Board of Trustees

By _____
Secretary of the
Board of Trustees

CITY OF ROYAL OAK

WITNESSES:

By _____
Patricia Paruch
Its Mayor

By _____
Mary C. Richards
Its City Clerk

DE\P040049537.I\85181-00 00001

Approved as to Form:

Lawrence M. Doyle
City Attorney

SECOND AMENDMENT TO MEMBERSHIP AGREEMENT

This binding Second Amendment, made this ___ day of May, 2008, between the Southeastern Oakland County Water Authority, a duly authorized and legally enabled municipal authority and public body corporate of the State of Michigan ("Authority") and the City of Royal Oak, a duly authorized municipal corporation ("Municipality"):

WITNESSETH:

WHEREAS, the Authority and the Municipality are parties to a certain agreement dated April 14, 1960 and a first Amendment dated May 6, 1991, ("Agreement") providing for and otherwise governing the delivery of water by the Authority to the Municipality;

WHEREAS, the Authority has now negotiated and entered into a contract with City of Detroit, Board of Water Commissioners ("Detroit"), for the long-term purchase of water under terms and conditions sufficient to meet the requirements of the Authority and the Municipality, a copy of which is attached hereto for the purpose of reference; and

WHEREAS, the Authority has acquired and maintained a water supply system acceptable to Municipality for the purpose of transporting, pumping and storing the water received under the Authority's contract with Detroit in accordance with the attached contract and thereafter distributing the water to the Municipality and all members of the Authority.

NOW, THEREFORE, it is agreed between the Authority and the Municipality as follows:

1. The Agreement between the Authority and the Municipality is hereby amended to be effective upon the approval and execution of this Amendment.

2. The Agreement between the Authority and the Municipality is extended to termination dates in contract between the Authority and Detroit, attached hereto for immediate reference.

3. Municipality may terminate this Agreement with written notice to the Authority (six) 6 months before the termination notice provisions between the Authority and Detroit as set forth at Article 2 of the attached contract.

4. The Municipality reserves the right to furnish to itself from its own wells an amount of water not exceeding one million (1,000,000) gallons in any day between May 1 and October 1 in any year. However, prior to accepting water from its own wells, the Municipality must provide the results of tests of said water conducted by the properly constituted Governmental health agency having jurisdiction and obtain the approval of the Authority. In addition, the use of said water must be otherwise consistent with the current agreement between the Authority and Detroit.

5. Water shall be delivered by the Authority to the City at the following locations:

a.	11 Mile & Woodward	RO-01
b.	12 Mile & Vinsetta	RO-02
c.	Webster & Benjamin	RO-03
d.	13 Mile & Crooks	RO-04
e.	Beaumont East	RO-05
f.	Beaumont West	RO-05
g.	13 Mile & Harvard	RO-06
h.	Normandy & Crooks	RO-07
i.	14 Mile & Edgeland	RO-08
j.	14 Mile & Hampton	RO-09
k.	Berkshire & Greenfield	RO-10
l.	Lincoln & Woodward	RO-15
m.	Kenilworth & Woodward	RO-11
n.	Torquay & Crooks	RO-18
o.	Oliver Station	RO-19
p.	Delemere & Meijer	RO-20
q.	Woodward & Vinsetta	RO-21

6. Except for the modifications specifically set forth in this Second Amendment, the Agreement and all of the terms and provisions of the Agreement, including its prior amendment, are hereby ratified and confirmed and shall remain binding and controlling as set forth in the Agreement.

WITNESSES:

SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY

_____

By:_____
Chairman of the Board of Trustees

_____

By:_____
Secretary of the Board of Trustees

WITNESSES:

_____ OF _____

_____

By:_____

Its: Mayor

_____

By:_____

Its: _____ Clerk

WATER SERVICE CONTRACT

BETWEEN

CITY OF DETROIT

AND

SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY

TABLE OF CONTENTS

WATER SERVICE CONTRACT
BETWEEN
CITY OF DETROIT
AND
SOUTHEASTERN OAKLAND COUNTY WATER AUTHORITY

This Water Service Contract ("Contract") is made between the City of Detroit, a municipal corporation, by its Water and Sewerage Department and Board of Water Commissioners (the "Board"), and the Southeastern Oakland County Water Authority, a municipal authority ("Customer"). The Board and Customer may be referred to individually as "Party" or collectively as the "Parties."

Whereas, the City of Detroit owns a public water supply system ("System") operated by the Board; and

Whereas, the Board supplies water service to numerous governmental entities in the Board's water service area; and

Whereas, Customer desires to obtain water service from the Board; and

Whereas, the purpose of this Contract is to provide for the long-term service of potable water to Customer; and

Whereas, the Board implemented a voluntary partnering effort with its wholesale water customers, of which the Technical Advisory Committee is a central part, and which is intended to assist the Board in data gathering, alternative evaluations and recommendations, achieving full disclosure of rates, identifying true cost of service principles to guide revenue collection, and to provide assistance with a cohesive planning effort for the Board's water service area;

ACCORDINGLY, THE PARTIES AGREE AS FOLLOWS:

Article 1.
Definitions

1.01 The following words and expressions, or pronouns used in their stead, shall be construed as follows:

"**Adjusted Prevailing Water Rate**" shall have the meaning ascribed in Article 3 herein.

"**Annual Volume**" shall mean the actual volume of water used by Customer for the period of July 1st to June 30th as measured on bills issued from August 1st through July 31st.

"**Board**" shall mean the City of Detroit Board of Water Commissioners.

"**City**" shall mean the City of Detroit, a municipal corporation, acting through its Board of Water Commissioners.

"**Contract**" shall mean each of the various provisions and parts of this document, including all attached Exhibits and any amendments thereto, as may be executed and approved by Customer's governing body, the Board of Water Commissioners, and the Detroit City Council.

"**Contract Term**" shall have the meaning ascribed in Article 2 herein.

"**Customer**" shall mean the Party that enters into a contract with the City of Detroit by way of this Contract, whether an authority, city, township, village or other municipal corporation recognized by the State of Michigan.

"**Customer Maximum Day Demand**" shall mean the Customer's recorded water usage on the DWSD Maximum Day. Customer Maximum Day Demand shall, in conjunction with Customer Peak Hour Demand, be a component of its Maximum Flow Rate.

"**Customer Peak Hour Demand**" shall mean the Customer's recorded water usage during the DWSD Peak Hour. Customer Peak Hour Demand, in conjunction with Customer Maximum Day Demand, shall be a component of its Maximum Flow Rate.

"**DWSD**" shall mean the City of Detroit Water and Sewerage Department.

"**DWSD Maximum Day**" shall mean the maximum reported water production day for the System during any twenty-four hour period as measured from 12:00 a.m. Eastern Standard Time in any given calendar year, as determined by DWSD in reviewing water production and storage reports.

"**DWSD Peak Hour**" shall mean the hour during the DWSD Maximum Day in which the most water is delivered to the System, measured from top-of-the-hour to top-of-the-hour (e.g. 7:00 a.m. to 8:00 a.m.), and as determined by DWSD in reviewing water production and pumping reports. In calculating the DWSD Peak Hour, the time period from 11:00 PM to 5:00 AM Eastern Standard Time (EST) shall not be considered provided, however, that if Customer has an approved Filling Schedule, the time period specified in the Filling Schedule shall supersede the time period of 11:00 PM to 5:00 AM EST.

"**Early Termination Costs**" shall have the meaning ascribed in Article 3 herein.

"**Filling Schedule**" shall have the meaning ascribed in Article 22 herein.

"**Maximum Flow Rate**" shall mean the aggregate amount of water usage that Customer commits not to exceed, as determined by the Customer Maximum Day Demand and the Customer Peak Hour Demand, collectively.

"**Meter Facilities**" shall mean a location in which a water meter is housed including, without limitation, meter pits and meter vaults.

"**Minimum Annual Volume**" shall mean fifty percent of Customer's Projected Annual Volume.

"**Notices**" shall mean all notices, consents, approvals, requests and other communications required to be given under the terms of this Contract.

"**Pressure Problem**" shall have the meaning ascribed in Article 5 herein.

"**Pressure Range**" shall have the meaning ascribed in Article 5 herein.

"**Projected Annual Volume**" shall mean the projected annual water sales to Customer as set forth in Exhibit B.

"**Service Area**" shall mean the mutually agreed upon area where Customer is permitted to distribute water received from the Board under the terms of this Contract which (a) may be entirely within the corporate limits of Customer or may exceed the corporate limits of Customer and (b) which may or may not include the entire geographical area within the Customer's corporate limits.

"**System**" shall mean the public water works system owned and operated by the City of Detroit, acting through its Board of Water Commissioners and its Water and Sewerage Department.

"**Technical Advisory Committee**" shall mean the committee consisting of representatives of the Detroit Water and Sewerage Department, wholesale water customers of the Detroit Water and Sewerage Department and their respective representatives, and shall include its successor or replacement if altered or discontinued. The Technical Advisory Committee or its successor shall remain in existence for a minimum term of January 1, 2008 until December 31, 2038 unless the committee determines otherwise.

"**Water Distribution Points**" shall have the meaning ascribed in Article 4 herein.

Article 2.
Contract Term

2.01 Term. The Board shall sell and supply water to Customer from the System in accordance with the terms of this Contract for a period of thirty years from the effective date of this Contract and any ten-year renewal terms (collectively the "Contract Term"), subject to Article 3 herein. The effective date of this Contract shall be the date that this Contract is approved by the Detroit City Council or Customer's governing body whichever is later. This Contract replaces and supersedes any prior water service contracts between the Parties.

2.02 Renewal. This Contract shall automatically renew at the conclusion of the thirty-year term for an additional ten-year term, unless a Party provides written notification to the other Party in accordance with Article 16 on or before the conclusion of the twenty-fifth year of the thirty-year term stating its intent not to renew this Contract. Thereafter, this Contract shall automatically renew every ten years for an additional ten-year term, unless a Party provides written notification to the other Party in accordance with Article 16 on or before the conclusion of the fifth year of the then current ten-year term stating its intent not to renew this Contract. The automatic renewals of this Contract shall not preclude a review of its terms and the Parties are encouraged to reaffirm or amend its terms as necessary. The Parties may, in writing, mutually agree upon a longer renewal term.

2.03 Notification of Renewal. The Board shall notify Customer of its first Contract renewal option during the twenty-fifth year of the thirty-year term; provided, however, that the Board's failure to so notify Customer shall not obviate Customer's obligations as set forth in Section 2.02.

Article 3.
Early Termination Costs

3.01 Early Termination Costs. In addition to any other remedies provided for by law or by the terms of this Contract, Customer shall be liable to the Board for the payment of any costs incurred by the Board related to providing water to Customer in the event Customer terminates this Contract before the conclusion of a Contract Term ("Early Termination Costs"); provided, however, that payment of such Early Termination Costs by Customer shall not entitle Customer to receive water service from the Board.

3.02 Calculation of Costs. Payment of Early Termination Costs will be calculated by applying the Adjusted Prevailing Water Rate to the Minimum Annual Volume requirements for the remainder of the Contract Term. The Adjusted Prevailing Water Rate shall be the rate charged by the Board to Customer as of Customer's effective termination date, adjusted annually to reflect projected inflationary increases utilizing a locally based wholesale price index. The Parties may agree upon another standardized price index. The Board may seek a recommendation from the Technical Advisory Committee on the amount of the Early Termination Costs.

3.03 Specifically Constructed Facilities. If the Board has constructed facilities specifically for the benefit of Customer, additional costs may be included in the calculation of the Early Termination Costs, provided that any such facilities shall be identified in a written agreement between the Board and Customer at or near the time of construction.

3.04 Formation of Water Authority. Customer may join with another authority, city, township, village or other municipal corporation recognized by the State of Michigan to form a water authority for the sole purpose of collectively contracting for water service from the Board. The exercise of this right shall not be construed as an early termination of this Contract and this Contract shall be voided upon the approval of a new water service contract by Customer's governing body, the Board and the Detroit City Council.

Article 4.
Service Area

4.01 Delivery Location. Water shall be delivered by the Board to Customer at the location(s) identified in Exhibit A (collectively, the "Water Distribution Points"), and at other locations as may be mutually agreed upon in writing by the Board and Customer.

4.02 Limit of Responsibility. The Board shall have no responsibility for distributing, operating, repairing, replacing and maintaining any portions of the Customer's water supply system downstream of the Water Distribution Points shown in Exhibit A, provided, however, that this Section 4.02 does not prevent the application of the provisions of Section 11.02 herein.

4.03 Board Responsibility. The Board owns and is responsible for operating and maintaining all parts of its System upstream from Customer's Water Distribution Points. Should the Board fail to maintain its Meter Facilities and/or any Board owned and maintained equipment within the Meter Facilities, Customer shall provide written notice to the Board which describes the objectionable condition of the Meter Facility and/or the equipment within, and its intent to take reasonable steps to maintain the condition and charge the reasonable cost of doing so to the Board. Upon receipt of the notice and subject to Section 11.01, the Board shall have thirty calendar days to repair the condition specified in the notice, unless a force majeure event prevents the repair within the thirty-day period. If the Board has not repaired the condition at the conclusion of the thirty-day period and has not provided a written explanation to Customer explaining the reason for the delay (e.g. necessary parts are on order or occurrence of a force majeure event specified in Section 11.01), then Customer may take reasonable steps to maintain the specified condition and charge the reasonable cost of doing so to the Board.

4.04 Extension of Service Area. Customer's distribution of water supplied by the Board shall be limited to the Service Area stated in Exhibit A. The Parties agree that situations may arise in which Customer desires to extend its Service Area, either temporarily or permanently, beyond its corporate limits. Should such a situation arise, Customer shall provide written notice to the Board explaining the nature, duration and extent of the requested Service Area extension. The Board shall have the option, which it may exercise at any time, of requiring a written amendment to this Contract to accommodate the change in Service Area. Should the Board determine that an immediate amendment is required, the Parties shall, within thirty calendar days of Customer's request, meet to negotiate mutually agreeable terms for the extension of the Service Area. The Board shall not unreasonably deny a request to extend the Service Area.

4.05 Change or Addition of Water Distribution Points. Water Distribution Points may be added or changed only by the express written agreement of the Board and Customer and shall be embodied in a written amendment to this Contract.

4.06 Sole Supplier. Except as provided in Article 17 herein, the Board shall be the sole supplier of public potable water to Customer's Service Area.

Article 5.
Pressure; Maximum Flow Rate; Minimum Annual Volume

5.01 Pressure Range. The Board shall use its best efforts to deliver water at the Water Distribution Points at a pressure range ("Pressure Range") adequate to meet the reasonable requirements of Customer. For purposes of evaluating this effort, water pressure shall be determined by reviewing the average hourly pressure measured from top-of-the-hour to top-of-the-hour (e.g. 7:00 a.m. to 8:00 a.m.). The Pressure Range to be provided by the Board to Customer's Water Distribution Points is specified in Exhibit B. The location at which the water pressure will be measured shall be specified in Exhibit A and identified as point "P". A Pressure Range will not be established for water meters that are not located on a DWSD transmission main.

5.02 Remedy for Non-Compliance with Pressure Range. If the water pressure at Customer's Water Distribution Points is above or below the Pressure Range, the Parties shall meet to discuss the reasons for the non-compliance and, if agreed, develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the pressure event, or as otherwise agreed. The corrective action plan shall include a timetable for resolution of the non-compliance issue(s).

A. If it is determined that another customer's exceedence of the rates of flow established by that customer's Maximum Flow Rate caused or contributed to the Board's inability to meet its Pressure Range agreement with Customer, then the corrective action plan shall provide for the resolution of the issue.

B. If Customer is exceeding the rates of flow established by its Maximum Flow Rate on a day other than the DWSD Maximum Day at the time Customer experiences a variation from the Pressure Range, then the Board shall be relieved from its obligation to provide water to Customer within the Pressure Range for that period of time during which Customer is exceeding the rates of flow established by its Maximum Flow Rate.

5.03 Maximum Flow Rate. Customer's Maximum Flow Rate is specified in Exhibit B. Customer shall not exceed the Maximum Flow Rate specified in Exhibit B, as measured in million gallons on the DWSD Maximum Day and during the DWSD Peak Hour.

5.04 Remedy for Non-Compliance with Maximum Flow Rate. The Board has no obligation to supply to Customer more than the Maximum Flow Rate. If Customer exceeds its Maximum Flow Rate on the DWSD Maximum Day or during the DWSD Peak Hour, the Board and Customer may, as needed, take one or more of the following steps:

A. The Board may require that Customer take all reasonable steps to reduce its consumption to the Maximum Flow Rate. Such steps may include water conservation measures, outdoor water use restrictions, water loss studies and remediation, and an internal system operation evaluation.

B. The Parties may meet to negotiate a new Maximum Flow Rate. If so negotiated, Customer shall pay the rate associated with the new Maximum Flow Rate in the subsequent rate year.

C. The Board may recalculate Customer's rate for the Board's current fiscal year utilizing a revised cost allocation formula as follows:

i. For cost allocation purposes only, a new Maximum Flow Rate will be established from the first exceedence date forward. The new Maximum Flow Rate will be at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day, and may be higher than the actual flow rate demonstrated by Customer. Pursuant to subsection (ii) below, the Board will seek a recommendation from the Technical Advisory Committee's Analytical Work Group (as defined in Section 6.07 herein) on the establishment of the new Maximum Flow Rate. If the Board receives a recommendation and the recommendation is higher than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate, then the Board shall be limited to establishing a new Maximum Flow Rate that is at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day and no higher than the recommendation provided by the Analytical Work Group. If no recommendation is received by the Board, or if the Board receives a recommendation and the recommendation is less than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate, then the Board shall be limited to establishing a new Maximum Flow Rate that is at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day and no higher than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate. In any event, Customer's exceedence of its Maximum Flow Rate will continue to affect each subsequent year's rate calculation until renegotiated. If a rate has been approved for the next fiscal year (July 1st to June 30th) but the rate has not yet been applied, the Board may modify Customer's rate to account for an exceedence of its Maximum Flow Rate. If the Board has built capital facilities based upon Customer's negotiated Maximum Flow Rate and Customer consistently exceeds its Maximum Flow Rate, then the Board may re-calculate the amount of Customer's percentage of the capital cost of such facilities.

ii. The Board will seek a recommendation from the Technical Advisory Committee's Analytical Work Group, or its successor, whenever it intends to invoke subsection 5.04(C)(i). Any recommendation from the Analytical Work Group shall be received by the Board within sixty calendar days after the Board's request for a recommendation.

5.05 Procedure for Non-Compliance with Maximum Flow Rate. If Customer has failed in its obligations under Section 5.03, the Parties shall meet to discuss the reasons for the non-compliance and develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the non-compliance event, or as otherwise agreed. If the Parties determine that a corrective action plan is not required and a subsequent incident of non-compliance occurs, the Parties shall meet to develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the subsequent incident of non-compliance, or as otherwise agreed. Any corrective action plan required under this Section 5.05 shall include a timetable for resolution of the non-compliance issue(s). In the event the reason for Customer's non-compliance under Section 5.03 is due to a Customer water main break, fire or meter calibration performed by DWSD, these events will be taken into consideration in determining (1) whether a corrective action plan is warranted and (2) the extent to which, if any, the steps specified in Section 5.04 should apply.

5.06 Minimum Annual Volume. Customer shall purchase from the Board not less than the Minimum Annual Volume of water specified in Exhibit B. If Customer's Annual Volume is less than the Minimum Annual Volume, Customer shall pay to the Board an amount computed by applying the current rate to the Minimum Annual Volume less any amounts already billed to the Customer by the Board.

5.07 Periodic Review. For Customer and System planning purposes and, with regard to the Minimum Annual Volume, enforcement of the provisions of Article 3, a Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume shall be established by mutual agreement for the Contract Term. A contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume shall be established by mutual agreement for first two years of the Contract Term. Not later than the second year of the Contract Term, the Board and Customer shall negotiate a contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume for the succeeding three years of the Contract Term. Not later than the fifth year of the Contract Term, and every five years thereafter, the Board and Customer shall negotiate a contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume for the succeeding five years of the Contract Term. If the Parties do not negotiate new or revised Maximum Flow Rates, Pressure Ranges, Projected Annual Volumes and Minimum Annual Volumes according to the aforementioned schedule, then the figures established for planning purposes (as shown in italicized type in Exhibit B) shall become contractually binding for the then-current three or five year term.

5.08 Remedy for Excessive Rate(s) of Flow Causing Pressure Problem(s). Customer acknowledges that Customer's rates of flow may cause and/or contribute to the Board's inability to meet its Pressure Range agreements with Customer and/or the Board's other customers (hereinafter, "Pressure Problem"). The Board may review or monitor Customer's daily rates of flow if a Pressure Problem occurs and the Board's Pressure Range agreement with Customer and/or another customer of the Board is alleged to have been breached. The approximate rate of flow by individual meter location used to establish the Pressure Range and Maximum Flow Rate is specified in Exhibit B. If a Pressure Problem occurs, the Parties shall meet to discuss the reasons for the Pressure

Problem and develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the Pressure Problem, or as otherwise agreed. The corrective action plan may require one or both of the following steps:

A. The Board may require that Customer take all reasonable steps to reduce its consumption to the rate of flow established by the Maximum Flow Rate. Such steps may include water conservation measures, outdoor water use restrictions, water loss studies and remediation, and an internal system operation evaluation. In addition, the Board may require that Customer adjust its rate of flow at individual meters, including the establishment of a not-to-exceed flow rate for individual meters.

B. The Parties may meet to negotiate a new Maximum Flow Rate. If so negotiated, Customer shall pay the rate associated with the new Maximum Flow Rate in the subsequent rate year.

If the Parties determine that a corrective action plan is not required and a subsequent Pressure Problem occurs, the Parties shall meet to develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the subsequent Pressure Problem, or as otherwise agreed. Any corrective action plan required under this Section 5.08 shall include a timetable for resolution of the Pressure Problem. In the event the reason for the Pressure Problem is due to a Customer water main break, fire or meter calibration performed by DWSD, these events will be taken into consideration in determining (1) whether a corrective action plan is warranted and (2) the extent to which, if any, the steps specified above in this Section 5.08 should apply.

5.09 Board Costs for Corrective Action Plan. If at any time the Board is required under the terms of this Article 5 to develop and implement a corrective action plan and the plan involves incurring capital costs, the Board will determine whether the costs will be charged as a System cost or whether the cost will be borne by a specific customer or customers. If the Board determines that all or part of the costs should be borne by a specific customer or customers, the Board will seek a recommendation from the Technical Advisory Committee on the assessment of the costs.

5.10 Customer Costs for Corrective Action Plan. If at any time Customer is required under the terms of this Article 5 to develop and implement a corrective action plan, Customer will pay all costs related thereto.

Article 6.
Technical Advisory Committee

6.01 Establishment. The Technical Advisory Committee is formed to facilitate a cooperative working partnership between the Board and its wholesale water customers by facilitating the development of recommendations regarding System planning and supply to DWSD management and the Board. The Technical Advisory Committee shall maintain bylaws that govern the way it conducts its business. In the event of a conflict between the terms of the bylaws adopted by the Technical Advisory Committee and the terms of this Contract, the terms of this Contract shall control.

6.02 General Responsibilities. The Technical Advisory Committee shall periodically review and evaluate the rates, rate methodology, and performance of the System. The Technical Advisory Committee shall review and evaluate flow rates, pressures and Annual Volumes for the System at a minimum of every five years to assist the Board in its System planning effort. The Technical Advisory Committee shall have the opportunity each year to review the Capital Improvement Program as prepared by DWSD, prior to its adoption by the Board. The Technical Advisory Committee may consider Customer proposals for improving the operation of Customer's water system and/or the System. The Board will supply the Technical Advisory Committee with information the Board deems reasonably necessary to accomplish the general responsibilities defined in this Section 6.02.

6.03 Annual Report by Board. The Board will present an annual report to the Technical Advisory Committee which shall consist of (1) all instances of non-compliance with the Parties' obligations contained in Article 5 herein, including Customer and Board responses thereto; (2) a general report on System operation and maintenance; and (3) a report that lists those contracts, if any, that have been entered into by the Board and another customer(s) where the terms of the contract(s) invoke the application of Article 14 herein.

6.04 Notification of Rates. The Board shall provide Customer and the Technical Advisory Committee with notice of the proposed rates for each fiscal year as early as possible before the implementation of the rates.

6.05 Disclosure of Rate Information by Board. Each year, the Board will disclose to Customer and the Technical Advisory Committee information related to wholesale rates.

6.06 Disclosure of Rate Information by Customer. Each year, Customer will disclose to its customers information related to its retail rates and other charges, and information regarding what portion of those costs is related to charges from DWSD and/or other major service providers.

6.07 Work Groups. The Technical Advisory Committee may create work groups to address specific issues facing the System. The work groups in existence as of January 1, 2008 are the Analytical Work Group, the Best Practices Work Group, the Contract Work Group, the Customer Service Work Group, the Emergency Preparedness Work Group, and the Rates Work Group. Any reference to a particular work group in this Contract shall include its successor or replacement if altered or discontinued.

Article 7.
Rates

7.01 Rates. Customer agrees to pay for all water supplied by the Board at such rates as the Board may establish. Rates shall be reasonable in relation to the costs incurred by the Board for the supply of water and shall conform to Public Act 34 of 1917, Michigan Compiled Laws, Sec. 123.141, et seq., as amended. The Board shall give written notice of any changes in the rates. Notice shall be made in accordance with Section 5e of Public Act 279 of 1909, Michigan Compiled Laws, Sec. 117.5e, as amended, ("Act 279").

7.02 Notification of Rates. As soon as possible in the ratemaking process, the Board shall provide information on proposed rates and the draft data and information used in the calculation of proposed rates in a format that will enable Customer to assist in the ratemaking process. Not less than thirty calendar days prior to the hearing required by Act 279, the Board shall provide Customer with written notice of a proposed rate and the underlying data used to calculate the rate. The Board shall meet with Customer to review the rate and the data.

7.03 Estimate of Usage. In the event meters fail to correctly measure the quantity of water supplied to Customer for any period of time, the Board shall provide a reasonable estimate of the quantity of water supplied to Customer for such period provided that there is a reasonable basis for the estimate. Customer and the Board shall, either through their respective technical representatives and/or the Technical Advisory Committee, seek agreement upon a method to estimate such quantities. In the event the Parties are unable to agree upon a method to estimate such quantities, the Board's determination of a method shall be conclusive and the Customer agrees to accept the estimate established by the Board.

7.04 Rate Methodology. The Board agrees to provide to Customer a description of the current methodology for rate making in the form of the "Rates 101" document produced by the Technical Advisory Committee, as may be periodically updated. The "Rates 101" document, entitled *DWSD Rates: Understanding DWSD Wholesale Water Rates*, and any updates thereto shall be provided to Customer via posting on the DWSD website.

Article 8.
Meters and Meter Facilities

8.01 Metering Requirement. All water furnished by the Board to Customer shall be measured by water meters installed in Meter Facilities at Customer's Water Distribution Points unless, in the Board's determination, it is not feasible to install water meters due to the configuration of Customer's water system.

8.02 Existing Distribution Points. As of the effective date of this Contract, the Board shall own, operate and maintain all water meters and Meter Facilities for all existing Water Distribution Points, unless specifically indicated otherwise in Exhibit A.

8.03 Customer Maintenance Responsibilities. Customer shall be responsible for maintaining at its Water Distribution Points any and all appurtenances as may be designated as Customer's responsibility in Exhibit A. Should Customer fail to maintain the appurtenances shown in Exhibit A, the Board may take reasonable steps to maintain the appurtenances and charge the reasonable cost of doing so to Customer. Prior to the Board taking action to maintain the appurtenances, the Board shall give Customer thirty days written notice to complete the required maintenance. Notice to the Customer shall not be required if, in the Board's determination, there exists an emergency condition affecting the operation of the System or if the health, safety and welfare of the general public may be jeopardized.

8.04 New Distribution Points. For any new Water Distribution Points that may be constructed or installed after the effective date of this Contract, Customer shall furnish at Customer's expense, a water meter and Meter Facility that meets the Board's specifications. Thereafter, the Board shall furnish any replacement water meters for new Water Distribution Points and the expense shall be recovered through the Board's rates as a System cost. The Board shall own, operate and maintain all water meters and Meter Facilities after construction, installation or replacement, unless specifically indicated otherwise in Exhibit A.

8.05 Meter Repair and Replacement. If the Board initiates a meter repair or meter replacement, the cost shall be recovered through the Board's rates as a System cost. If Customer requests a meter replacement for reasons other than malfunction or disrepair, Customer shall pay the cost of the replacement.

8.06 Pressure Regulating Facilities. After the effective date of this Contract, all newly installed Customer-owned pressure regulating facilities shall be installed in a facility that is separate from the Board's Meter Facility.

Article 9.
Dispute Resolution

9.01 Any and all claims alleging a breach of this Contract may first be submitted to an alternative dispute resolution process. An alternative dispute resolution process may include, but is not limited to, facilitation, binding arbitration, or non-binding arbitration. Each Party shall be responsible for its own costs and fees (including expert witness fees and attorney fees), unless otherwise agreed to in writing. The Parties shall agree upon the form and procedures for the agreed upon alternative dispute resolution process. This Article 9 shall not prohibit a Party from seeking relief directly from a court of competent jurisdiction at any time.

Article 10.
Default Provisions

10.01 In the event either Party commits a material breach of this Contract, the Party alleging the breach shall give written notice of the breach to the other Party within a reasonable time of discovering the breach. The Party in breach shall be given a reasonable time to cure the breach. If the Party in breach fails to cure the breach, the non-breaching Party may declare this Contract in default and pursue all available legal remedies, including termination of this Contract for cause. In the event that the Party in breach is showing reasonable progress toward curing the breach, the Party alleging the breach may extend the time for curing the breach.

Article 11.
Force Majeure and Other Events

11.01 Force Majeure. No failure or delay in performance of this Contract, by either Party, shall be deemed to be a breach thereof when such failure or delay is caused by a force majeure event including, but not limited to, any Act of God, strikes, lockouts, wars, acts of terrorism, riots, epidemics, explosions, sabotage, breakage or accident to machinery or lines of pipe, the binding order of any court or governmental authority, or any other cause, whether of the kind herein enumerated or otherwise, not within the control of a Party, except that no cause or contingency shall relieve Customer of its obligation to make payment for water delivered by the Board.

11.02 Board Liability. Except to the extent that the Board is the proximate cause, the Board shall not be held liable or accountable for any bursting, leakage, breakage, damage or accident of any kind that may occur to Customer's water works system, or any damages of any kind or nature, including, but not limited to, injury to persons or damage to property, resulting from such bursting, leakage, breakage, damage or accident that may occur to water mains or pipes located downstream of the Water Distribution Points specified herein, or located within Customer's distribution system.

11.03 Discontinuance of Service. In the event the public health, safety and welfare requires the Board to discontinue temporarily all or part of the supply of water to Customer, no claims for damages of any kind or nature for such discontinuance shall be made by Customer against the Board. The Board will provide notice to Customer of any temporary discontinuance of the water supply.

Article 12.
Timely Payment

12.01 Bills for water service shall be rendered to Customer on a monthly basis. All such bills shall be due and payable within forty-five calendar days from the date shown on the bill. Any portion of the charges that are not paid by the due date shall be subject to a finance charge at a rate of 1.5% per month for each month that they remain unpaid. Any portion of the total bill, plus any finance charges applied to the bill which are not paid by the next billing date, shall be shown on the next bill as arrears. The Board may disconnect water service if bills are overdue ninety calendar days from the billing date. The Board shall not terminate water service if there is a good faith dispute concerning the accuracy of billings. If the accuracy of a bill is in dispute, Customer shall place the disputed amount in an escrow account pending resolution of the dispute. Accrued interest on the escrow account shall belong to the Party that prevails in the resolution of the dispute.

Article 13.
Assignment

13.01 This Contract shall not be assigned, in whole or in part, by either Party without the prior written consent of the other Party. Consent to an assignment by either Party shall not be unreasonably withheld.

Article 14.
Ensuring Equality of Contract Terms

14.01 If the Board enters into any contract, and any amendments thereto, with a water service customer other than Customer, and the material terms of such other contract are more favorable than the material terms of Customer's Contract, Customer may elect to adopt all of such other material terms. However, if Customer exercises the option provided for in this Article 14, Customer must accept all material terms of the other contract in their entirety and may not select among various terms contained in multiple other contracts by, for example, selecting the Contract Term from one contract and the Early Termination Costs provision of another contract. The terms and conditions of Exhibit B of this Contract are specifically excluded from the application of this Article 14.

Article 15.
Amendment

15.01 The Parties may periodically consider it in their best interests to change, modify or extend a term, condition or covenant of this Contract for reasons which may include, but are not limited to, the creation, expansion or closing of industry or other business. Any change, addition, deletion, extension or modification that is mutually agreed upon by the Board and Customer shall be incorporated in a written amendment to this Contract. Such amendments shall not invalidate this Contract nor relieve or release either Party of any of its respective obligations under this Contract unless so stated in the amendment.

15.02 No amendment to this Contract shall be effective and binding upon the Parties unless it expressly makes reference to this Contract, is in writing, is signed and acknowledged by duly authorized representatives of both Parties, is approved by Customer's governing body, and is approved by the Board and the Detroit City Council.

Article 16.
Notices

16.01 Except as otherwise specified herein, all notices, consents, approvals, requests and other communications (collectively, "Notices") required or permitted under this Contract shall be given in writing and mailed by first class mail to the Parties and at the addresses identified in Exhibit B.

16.02 All Notices shall be deemed given on the day of post-marked mailing. Any Notice given by a Party hereunder must be signed by an authorized representative of such Party.

16.03 Notwithstanding the requirement above as to the use of first-class mail, change of address notices, termination notices, and other Notices of a legal nature, shall be sent by certified first-class mail, postage prepaid, return receipt requested.

Article 17.
Water Quality

17.01 Contamination. For the protection of the health of all consumers supplied with water from the System, Customer agrees to guard carefully against all forms of contamination. Should contamination occur, the area or areas affected shall immediately be shut off and isolated, and shall remain so until such conditions shall have been abated, and the water declared safe and fit for human consumption by the properly constituted governmental health agencies having jurisdiction of the area affected. Customer shall immediately notify the Board, and the Board shall immediately notify Customer, of any emergency or condition that may affect the quality of water in either Party's system.

17.02 Co-mingling of Water Sources. Except in cases of emergency, Customer will not permit water from any other source of supply to be mixed or mingled with water from the System without prior written approval from the Board. In cases of emergency, only such water from sources other than the Board shall be used as shall meet the requirements of the Michigan Department of Environmental Quality, and then only in such quantities as shall be necessary to relieve the emergency.

17.03 Emergency Connections. During emergencies, Customer's water facilities may be used and connected, at the discretion of the Board, to water facilities serving other communities for flow in either direction to provide an adequate water supply from the System to Customer and to other areas and other units of government. Customer shall be permitted to immediately make an emergency connection when the connection point to be used has been previously approved for emergency use by the Board in writing, provided that Customer shall, after making the connection, promptly notify the Board of such event. When the emergency has been abated, the emergency connection must be severed as soon as practicable. The Board, or its designee, must approve, in writing, the continuation of any emergency connection that is required for longer than seven calendar days. If an approved emergency connection continues for more than seven calendar days, Customer must provide the Board with weekly updates on the emergency and a schedule for abatement of the emergency that must be approved by the Board in writing.

17.04 Water Quality. The Board shall endeavor to remain in compliance with all applicable Michigan and Federal laws, rules and regulations regarding drinking water quality.

Article 18.
Rights-of-Way

18.01 Use of Rights-of-Way. The Customer shall assist the Board to obtain permission to use streets, highways, alleys, and/or easements in the local governmental units within the Customer's jurisdiction for the purpose of constructing, maintaining, and operating water facilities to adequately service the Customer's jurisdiction and other areas. This assistance shall include obtaining the consent of the local governmental units, as provided in Article 7, Section 29, Michigan Constitution of 1963. In the event of such construction, the Board shall request the Customer and local governmental units within the Customer's jurisdiction to execute such separate instruments granting rights-of-way in its streets, highways, and alleys as may be reasonably required by the Board. The

Board shall give the Customer notice of any construction work in the Customer's jurisdiction. The Board shall comply with any of Customer's ordinances that apply to the construction. Customer shall inform the Board of the applicable ordinances. The Board and Customer shall meet to review the construction and its impact on their respective operations. The Board shall restore all existing structures and/or improvements laying in the right-of-way of construction to as good a condition as before the construction took place. Any such facilities constructed, maintained and operated under this section shall remain the property of the Board and shall not be operated or maintained by any entity other than the Board or its authorized representatives.

18.02 Relocation of Facilities. Should future construction by any federal, state or county agency require relocation of a water transmission main, Meter Facility or other Board facility, the cost incurred by the Board for such relocation, if not reimbursed by the agency requiring the relocation, will be charged in future rates as a common-to-all cost to all System users. Otherwise, the cost incurred by the Board for construction requiring the relocation of a water transmission main, Meter Facility or other Board facility that is proposed, required, undertaken, conducted or facilitated by Customer will be charged to Customer.

18.03 Easements. Subject to the provisions of Section 18.01 herein and to the extent that Customer has jurisdiction, the Board shall be granted temporary and permanent easements, and shall be permitted to use the streets, alleys and highways within Customer's legal jurisdiction for the purpose of constructing, operating and maintaining the System. This consent by Customer is given in compliance with Article 7, Sec. 29 of the Michigan Constitution of 1963, provided that the Board shall provide Customer with a written explanation of the type of easement required and the duration thereof.

Article 19.
Access to Towers and Antennas

19.01 Where possible, each Party shall give to the other Party access to towers and antennas under its respective jurisdiction for the purpose of transmitting information recorded in the Meter Facilities. Access shall not be unreasonably denied by either Party.

Article 20.
Relationship to Wastewater Services

20.01 Customer and the Board acknowledge that future growth in the System may place additional burdens on their respective wastewater systems. Customer, if it is also a wastewater disposal services customer of the Board, understands that any increase in the volume of water it receives from the System is not a guarantee of increased capacity in the Board's wastewater disposal system.

Article 21.
Construction Standards

21.01 The Board shall have the right to review and approve Customer's construction plans for Meter Facilities at new Water Distribution Points, water mains sized twenty-four inches and larger, pump stations, reservoirs and water towers. The Board's approval of construction plans shall be timely and shall not be unreasonably withheld.

Article 22.
Operation of Storage

22.01 Prior to Customer's operation of any new or existing water storage facility, Customer shall seek the Board's written approval of the filling schedule ("Filling Schedule") of the storage facility. The Board may periodically require Customer to change or adjust a previously approved Filling Schedule. The Parties shall collaborate on devising a mutually beneficial Filling Schedule. If the Parties are unable to agree upon a Filling Schedule, the Board's determination of a Filling Schedule shall be final. All Filling Schedules shall be for a period of six consecutive hours. Customer shall at all times abide by the then-current Board approved Filling Schedule. The Board shall act promptly in approving Filling Schedule requests. Nothing in this Article 22 shall prevent Customer from operating its storage facility at any time, provided that any storage operation that falls outside of the approved Filling Schedule shall not be exempt from the terms of Sections 5.03 and 5.04 herein.

Article 23.
Miscellaneous

23.01 If any provision of this Contract or its application to any person or circumstance shall to any extent be invalid or unenforceable, the remainder of this Contract shall not be affected and shall remain valid and enforceable to the fullest extent permitted by law.

23.02 This Contract contains the entire agreement between the Parties and all prior negotiations and agreements are merged into this Contract. Neither Party has made any representations except those expressly set forth in this Contract, and no rights or remedies are, or shall be, acquired by either Party by implication or otherwise unless expressly set forth in this Contract.

23.03 Unless the context otherwise expressly requires, the words "herein," "hereof," and "hereunder," and other words of similar import, refer to this Contract as a whole and not to any particular section or subdivision.

23.04 The headings of the sections of this Contract are for convenience only and shall not be used to construe or interpret the scope or intent of this Contract or in any way affect the same.

23.05 The rights and remedies set forth in this Contract are not exclusive and are in addition to any of the rights or remedies provided by law or equity. This Contract and all actions arising under it shall be governed by, subject to, and construed according to the law of the State of Michigan. Each Party agrees, consents and submits to the exclusive personal jurisdiction of any state or federal court of competent jurisdiction in Wayne County, Michigan, for any action arising out of this Contract. Each Party also agrees that it shall not commence any action against the other Party because of any matter whatsoever arising out of or relating to the validity, construction, interpretation and enforcement of this Contract in any state or federal court of competent jurisdiction other than one in Wayne County, Michigan.

23.06 There are no third party beneficiaries to this Contract and this Contract shall not be construed to benefit any persons other than the Board and Customer.

23.07 This Contract may be executed in any number of originals, any one of which shall be deemed an accurate representation of this Contract. Promptly after the execution of this Contract, the Board shall provide a copy to the Customer.

23.08 The rights and benefits under this Contract shall inure to the benefit of and be binding upon the respective Parties hereto, their agents, successors, and assigns.

23.09 Any and all documents, memoranda, reports, exhibits or other written material referred to in this Contract are and shall be incorporated by reference herein.

23.10 This Contract shall be deemed to be mutually drafted.

(Signatures appear on next page)

In Witness Whereof, the City and Customer, by and through their duly authorized officers and representatives, have executed this Contract.

Witnesses:

1. _____
(signature)

2. _____
(signature)

Southeastern Oakland County Water Authority:

By: _____
Jeffrey A. McKeen

Its: General Manager

Witnesses:

1. _____
(signature)

2. _____
(signature)

City of Detroit:

By: _____
Kwame M. Kilpatrick

Its: Mayor

APPROVED BY
SOUTHEASTERN OAKLAND COUNTY
WATER AUTHORITY BOARD ON:

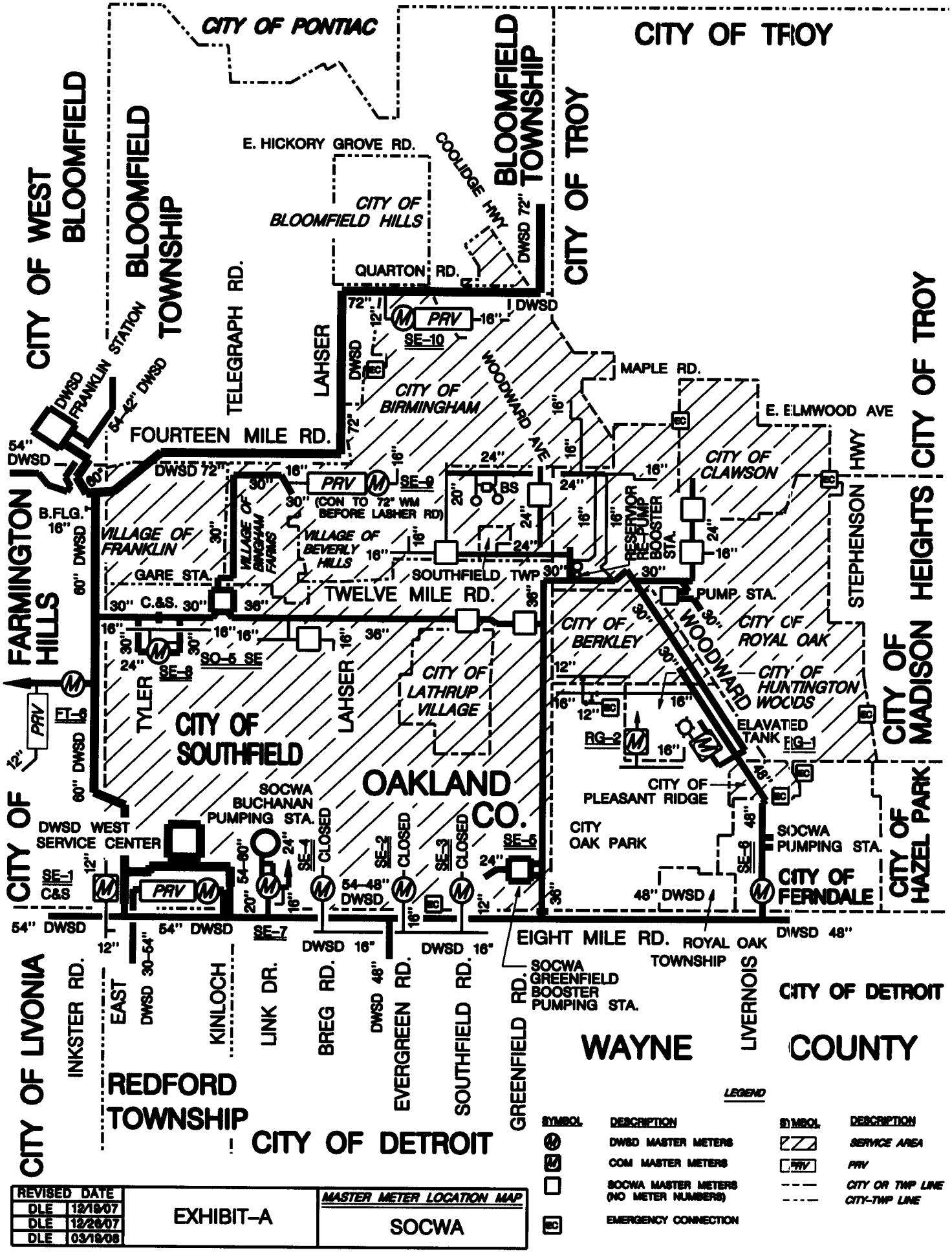
_____
Date

APPROVED BY
BOARD OF WATER COMMISSIONERS ON:

_____
Date

APPROVED BY
DETROIT CITY COUNCIL ON:

_____
Date



REVISED DATE		EXHIBIT-A	MASTER METER LOCATION MAP
DLE	12/18/07		SOCWA
DLE	12/26/07		
DLE	03/19/08		

EXHIBIT A

Customers Located Outside of Service Area:

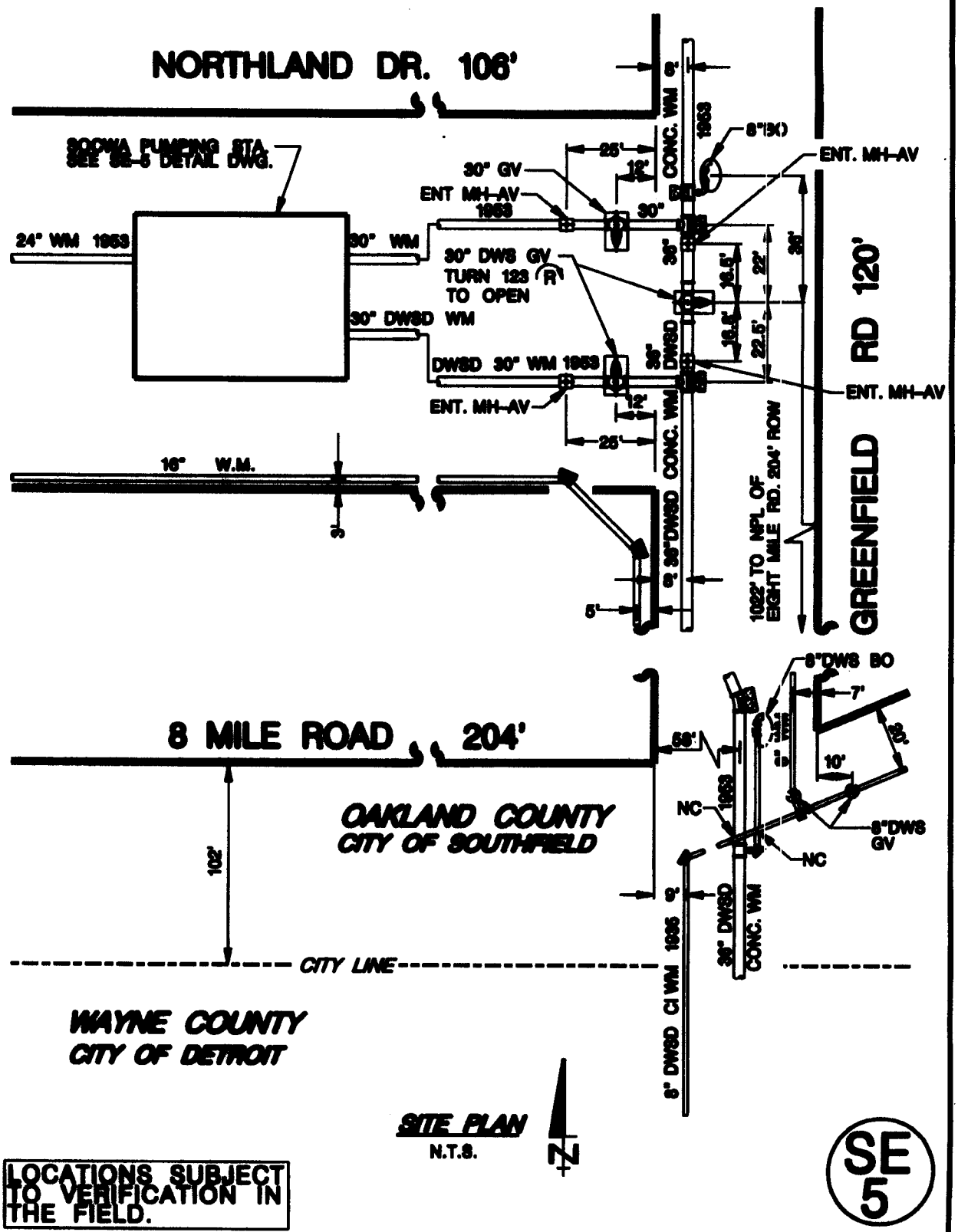
1. 32380 N. Campbell, Madison Heights
2. 20743 Inkster, Farmington Hills
3. 20753 Inkster, Farmington Hills
4. 20757 Inkster, Farmington Hills
5. 20761 Inkster, Farmington Hills
6. 20765 Inkster, Farmington Hills
7. 20773 Inkster, Farmington Hills
8. 20781 Inkster, Farmington Hills
9. 20911 Inkster, Farmington Hills
10. 20919 Inkster, Farmington Hills
11. 20925 Inkster, Farmington Hills
12. 20929 Inkster, Farmington Hills
13. 20937 Inkster, Farmington Hills
14. 20989 Inkster, Farmington Hills
15. 20999 Inkster, Farmington Hills
16. 21033 Inkster, Farmington Hills
17. 21103 Inkster, Farmington Hills
18. 21107 Inkster, Farmington Hills
19. 21127 Inkster, Farmington Hills
20. 21137 Inkster, Farmington Hills
21. 21185 Inkster, Farmington Hills
22. 21195 Inkster, Farmington Hills
23. 21205 Inkster, Farmington Hills
24. 21207 Inkster, Farmington Hills
25. 21305 Inkster, Farmington Hills
26. 21313 Inkster, Farmington Hills
27. 21329 Inkster, Farmington Hills
28. 21337 Inkster, Farmington Hills
29. 21345 Inkster, Farmington Hills
30. 21355 Inkster, Farmington Hills
31. 21503 Inkster, Farmington Hills
32. 21505 Inkster, Farmington Hills
33. 22899 Inkster, Farmington Hills
34. 22955 Inkster, Farmington Hills
35. 25575 Inkster, Farmington Hills
36. 27400 W. 9 Mile, Farmington Hills
37. 27500 W. 9 Mile, Farmington Hills
38. 27680 Spring Valley Dr., Farmington Hills

EXHIBIT A

Emergency Connections:

1. Oakridge and Woodward, between Pleasant Ridge and Ferndale
2. Bermuda and 10 Mile, between Pleasant Ridge and Ferndale
3. 11 Mile and Tulare, between SOCWA and Oak Park
4. Main and Elmwood, between Clawson and Troy
5. I-75 south of Hudson, between Royal Oak and Madison Heights
6. 14 Mile and Campbell, between Royal Oak and Madison Heights
7. 15 Mile west of Argyle, between Birmingham and Bloomfield Twp.
8. 8 Mile, west of Southfield, east of Greenview, Southfield to DWSD

EXHIBIT–A SE–05
NORTHLAND DR AND GREENFIELD RD
SOCWA

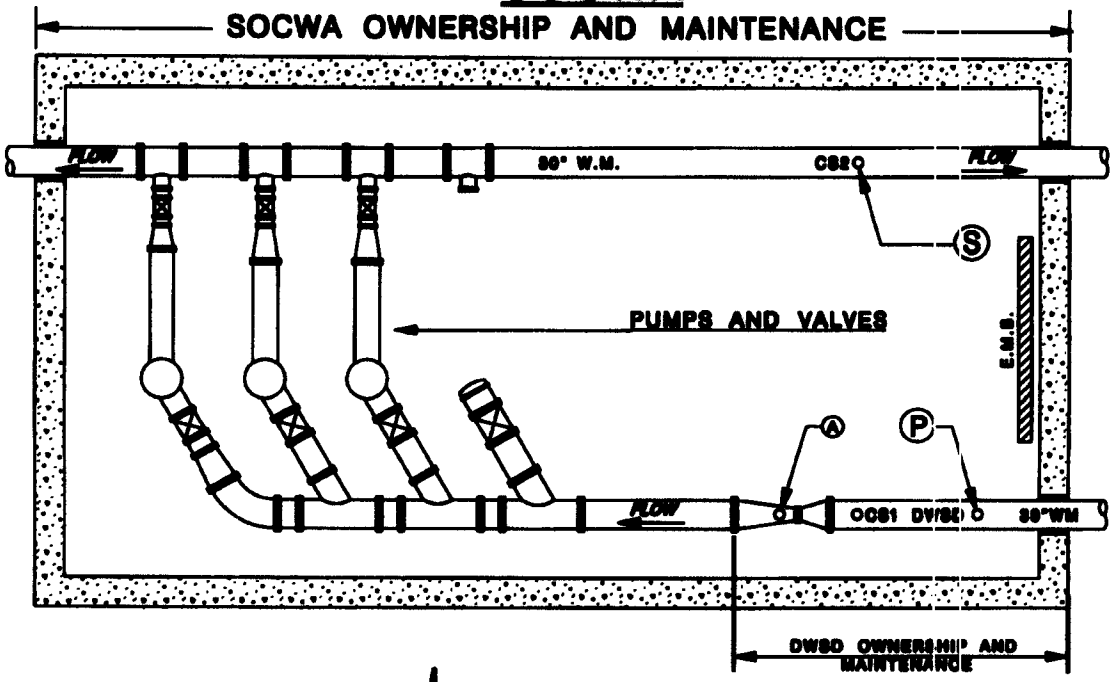


SITE PLAN
N.T.S.

LOCATIONS SUBJECT TO VERIFICATION IN THE FIELD.

SE 5

EXHIBIT-A SE-05
NORTHLAND DR AND GREENFIELD RD
SOCWA



N

METER PIT DETAIL
NO SCALE

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 - 6

LEGEND		
TAG	QTY.	DESCRIPTION OF MAJOR NEW EQUIPMENT
A	2	PRESSURE TRANSMITTER
B	2	FLOW TRANSMITTER
C	1	TEMPERATURE TRANSMITTER
D	1	PROGRAMMABLE LOGIC CONTROLLER
E	1	RADIO - METRICOM
F	1	ANTIENNA

(P) - UP STREAM PRESSURE TRANSMITTER

(S) - OTHER PRESSURE TRANSMITTER

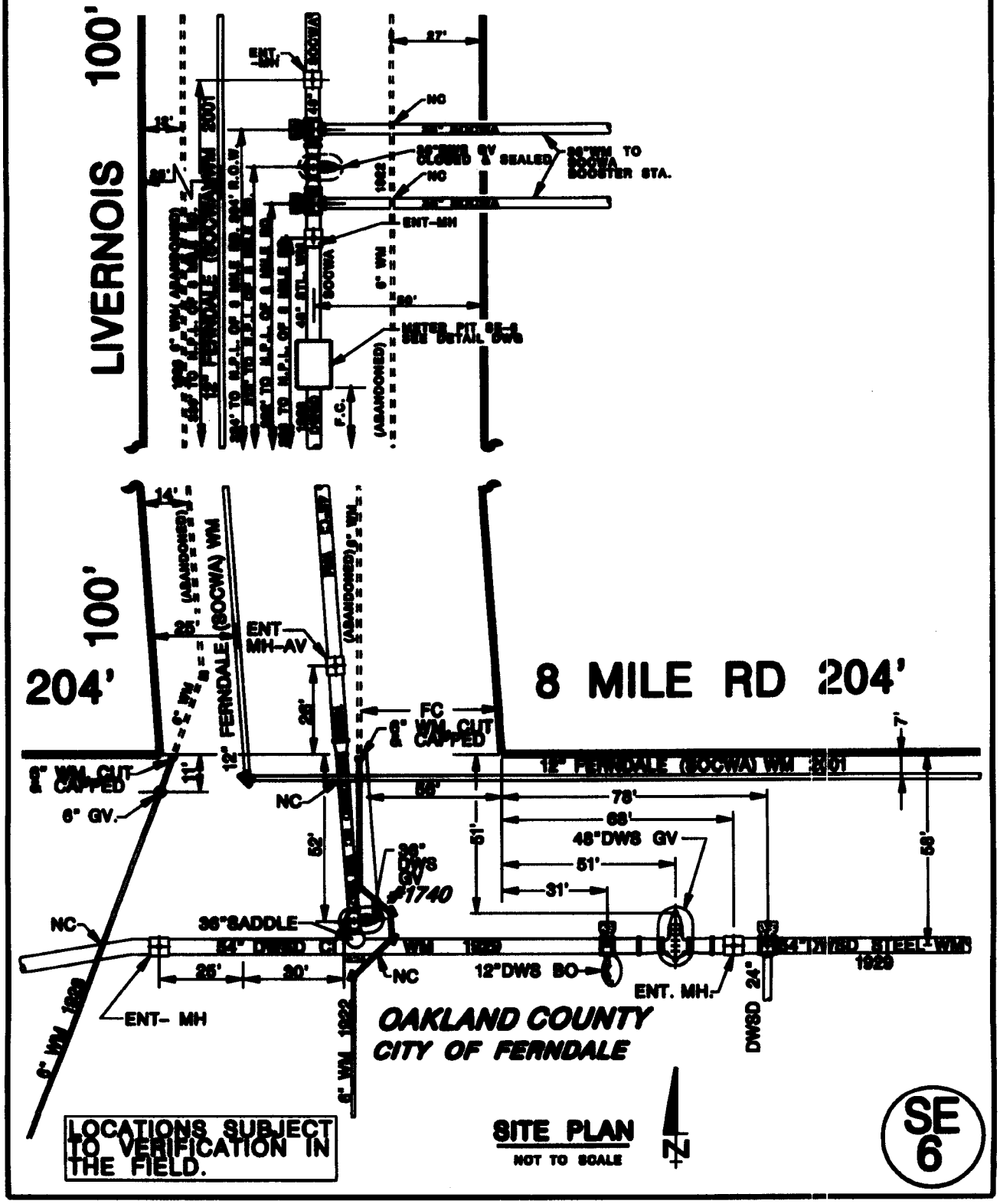
ADDRESS..... 21101 GREENFIELD
FEED TO..... SOCWA
FEED FROM..... 54"DWSD TRANS. MAIN (8 MILE RD)
TYPE OF METER..... VENTURI
SIZE OF METER..... 30" x 18.013
METER NUMBER..... 811901
DATE METER SET..... 11-05-58
METER PIT CONST & SIZE.. NONE
SECTION MAP..... 12-S
REMARKS..... C-1507
GATE BOOK..... N-2045
FIELD BOOK..... NONE
DRAWN BY..... J.M.T 9-26-07

SE 5

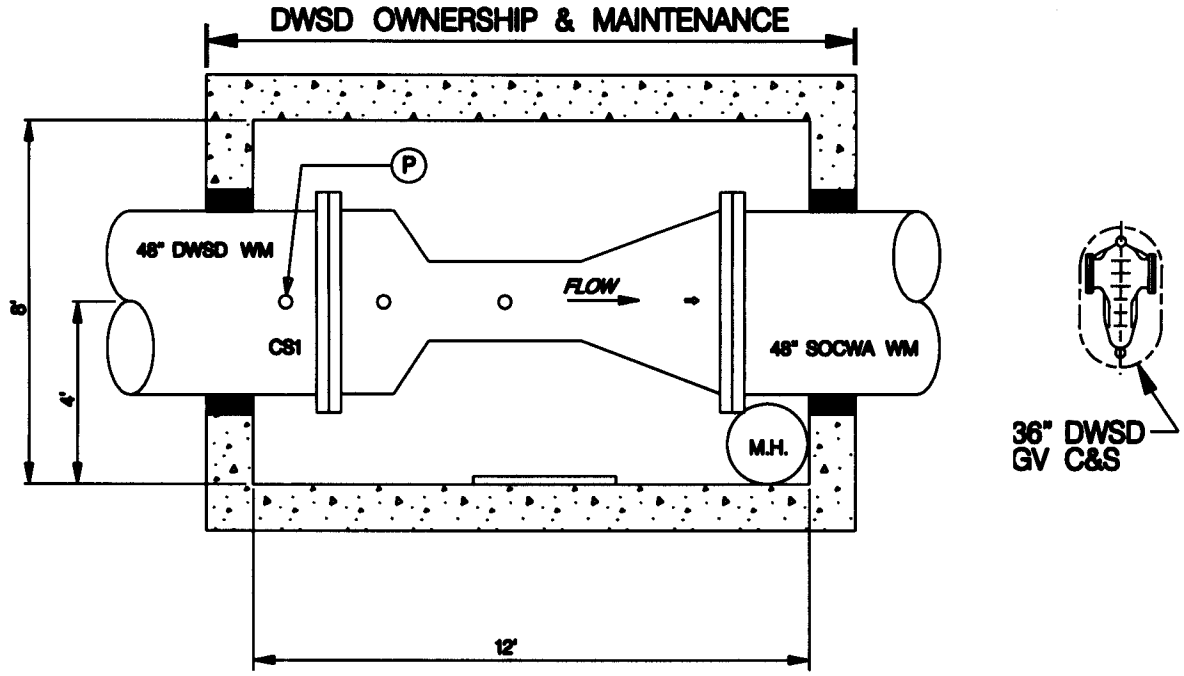
EXHIBIT-A SE-06

EIGHT MILE RD. & LIVERNOIS

SOCWA



EXHIBIT–A SE–06
EIGHT MILE RD. & LIVERNOIS
SOCWA



METER PIT DETAIL
NO SCALE

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 – 6

Ⓟ UPSTREAM PRESS. TRANSMITTER

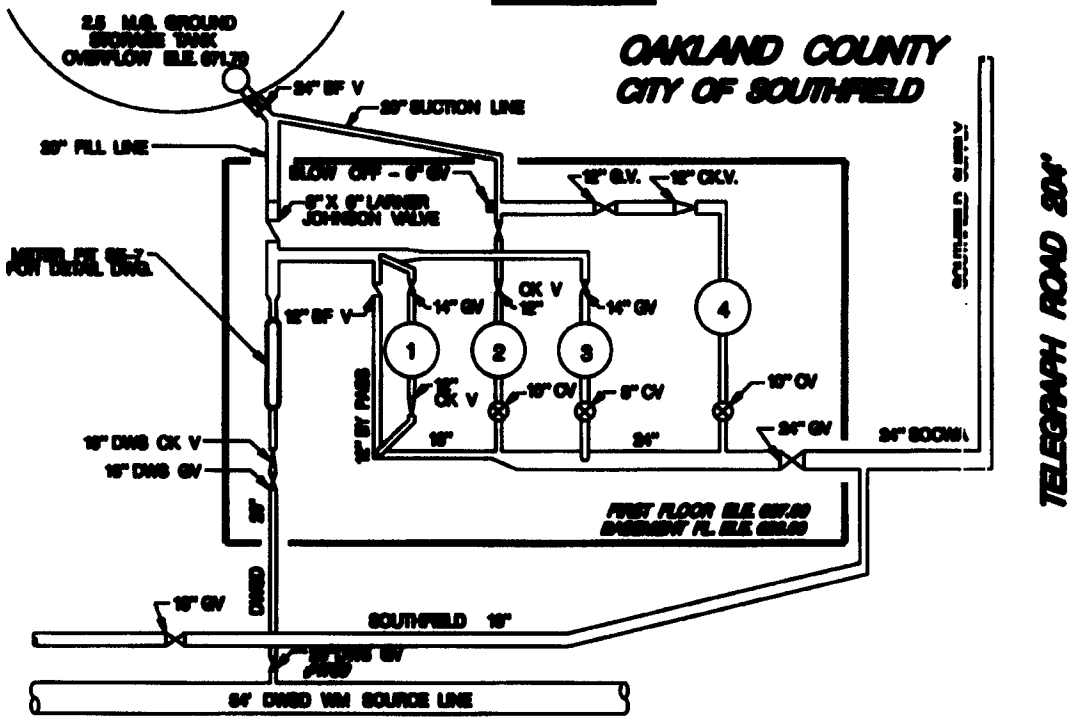
ADDRESS	230 LIVERNOIS
FEED TO	SOCWA
FEED FROM	48" DWSD TRANS. MAIN
TYPE OF METER	SIMPLEX VENTURI TUBE
SIZE OF METER	47" X 21.654"
METER NUMBER	95041821-01-01
DATE METER SET	11–5–58
METER PIT CONST & SIZE	12'–0"X8'–0" I.D. REINF. CONC.
SECTION MAP	18–S
REMARKS	UPDATE 9/20/07
GATE SHEET	N–570
REFERENCE	DWS–805
DRAWN BY	M. SCOTT 9–20–07

SE 6

EXHIBIT–A SE–07

EIGHT MILE RD. & TELEGRAPH RD

SOCWA



SITE PLAN
NO SCALE

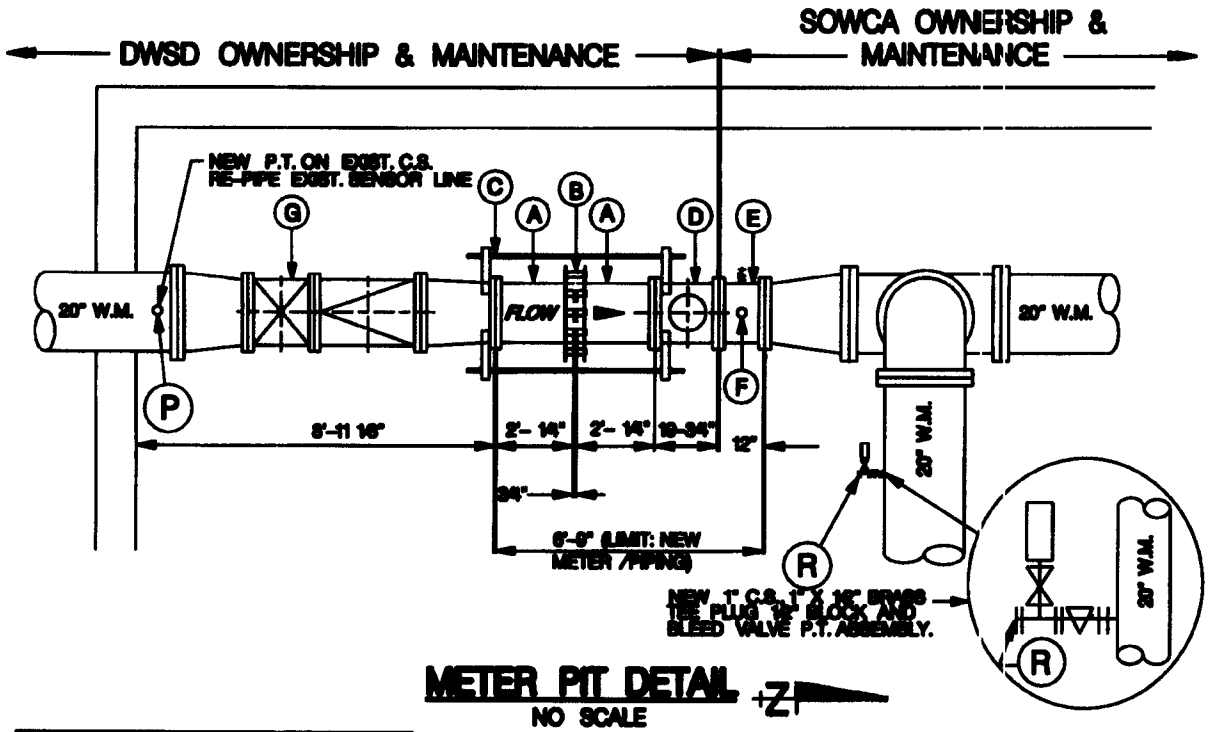
N

PUMPING UNITS					
PUMP NO.	CAPACITY G.P.M.	CAPACITY M.G.D.	HEAD F.T.	DISM. MOTOR H.P.	DATE INSTALLED
1	[illegible]		[illegible]	75	
2	[illegible]		[illegible]	125	
3	[illegible]		160	150	
4	[illegible]		170	200	

LOCATIONS SUBJECT TO VERIFICATION IN THE FIELD.

SE 7

EXHIBIT–A SE–07
EIGHT MILE RD & TELEGRAPH RD
SOCWA



METER PIT DETAIL +Z
NO SCALE

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 – 6

(P) UPSTREAM PRESSURE P.T.

(R) OTHER PRESSURE P.T.

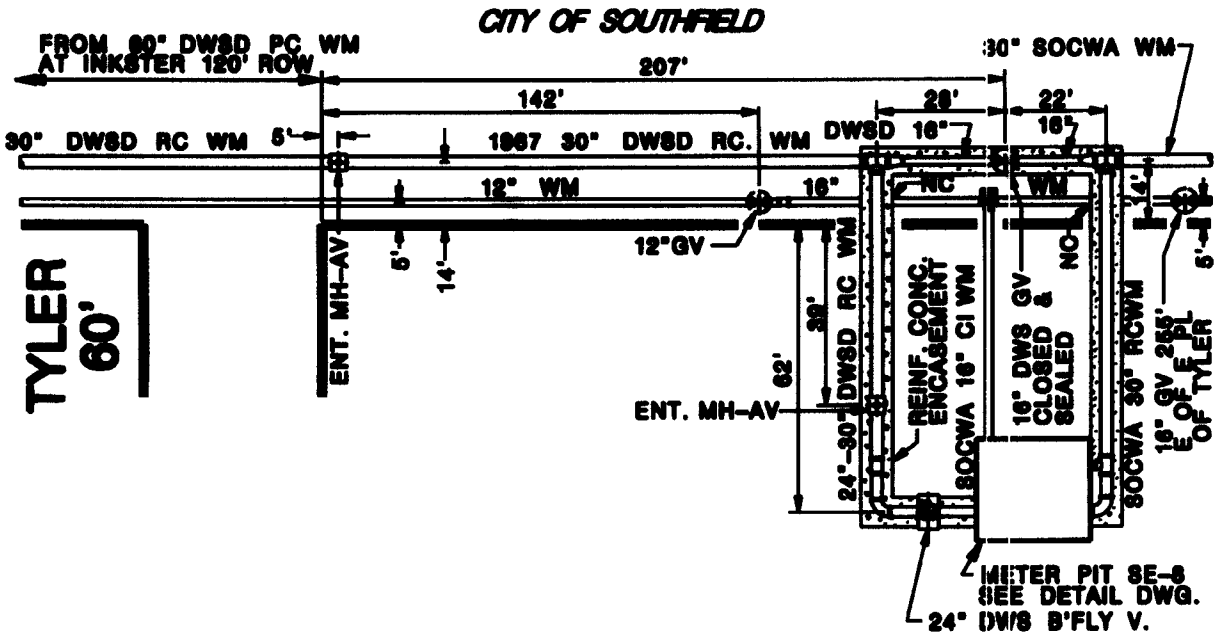
LEGEND			
TAG	QTY.	DESCRIPTION	SIZE
A	2	12" X 2'-0 1/4" F-PE PIPE, GADR, D.I.	12"
B	1	12" 'DRESSER STYLE' COUPLING	12"
C	LOT	COUPLING RESTRAINT: [4] 48" LONG THRD.RODS, [8] BAR PLATES	1" DIA.
D	1	12" FLGD. MAGNETIC FLOWMETER, 19.75" F-F	12"
E	1	12" X 1" F-F PIPE W/6" TAPPED BOSS ON TOP @ 1 1/2" C.C. TAP ON SIDE @ D.I.	12"
F	1	TEST TEE ASSEMBLY W/6" COMPANION FLANGE	
G	1	GATE VALVE	12"

ADDRESS_____ 24250 W. 8 MILE RD.
FEED TO_____ SOCWA
FEED FROM_____ 54" DWSD TRANS. MAIN
TYPE OF METER_____ ABB MAG
SIZE OF METER_____ 12", 19.75" F–F
METER NUMBER_____ V/40670/1
DATE METER SET_____ 3/27/2003
METER PIT CONST & SIZE__
SECTION MAP_____ 8–S
REMARKS_____ NONE
GATE SHEET_____ NONE
REFERENCE _____ DWS–805
DRAWN BY_____ M. SCOTT 10–10–07

SE 7

EXHIBIT–A SE–08
TWELVE MILE RD. EAST OF TYLER
SOCWA

12 MILE RD. 66'

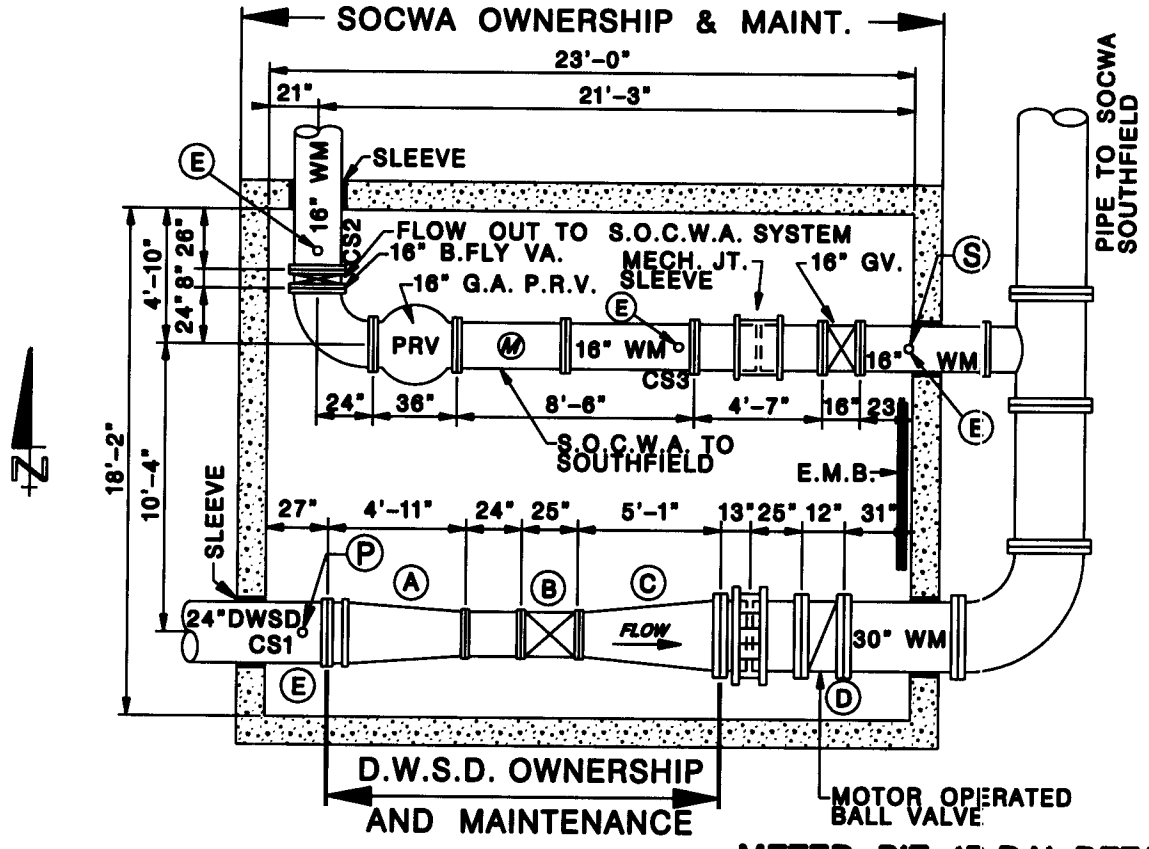


SITE PLAN
NOT TO SCALE

LOCATIONS SUBJECT TO VERIFICATION IN THE FIELD.

SE 8

EXHIBIT-A SE-08
TWELVE MILE RD. EAST OF TYLER
SOCWA



METER PIT / P.R.V. DETAIL

NOT TO SCALE

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 - 6

LEGEND		
TAG	QTY.	DESCRIPTION OF MAJOR NEW EQUIPMENT
A	1	23.9375"x13.534" B.I.F. VENTURI TUBE
B	1	16" WILLIAMETTE BALL VALVE
C	1	30" DRESSER COUPLING
D	1	30" BUTTERFLY VALVE
E	1	CORP. STOP

(P) - UPSTREAM PRESSURE TRANSMITTER

(S) - OTHER PRESSURE TRANSMITTER

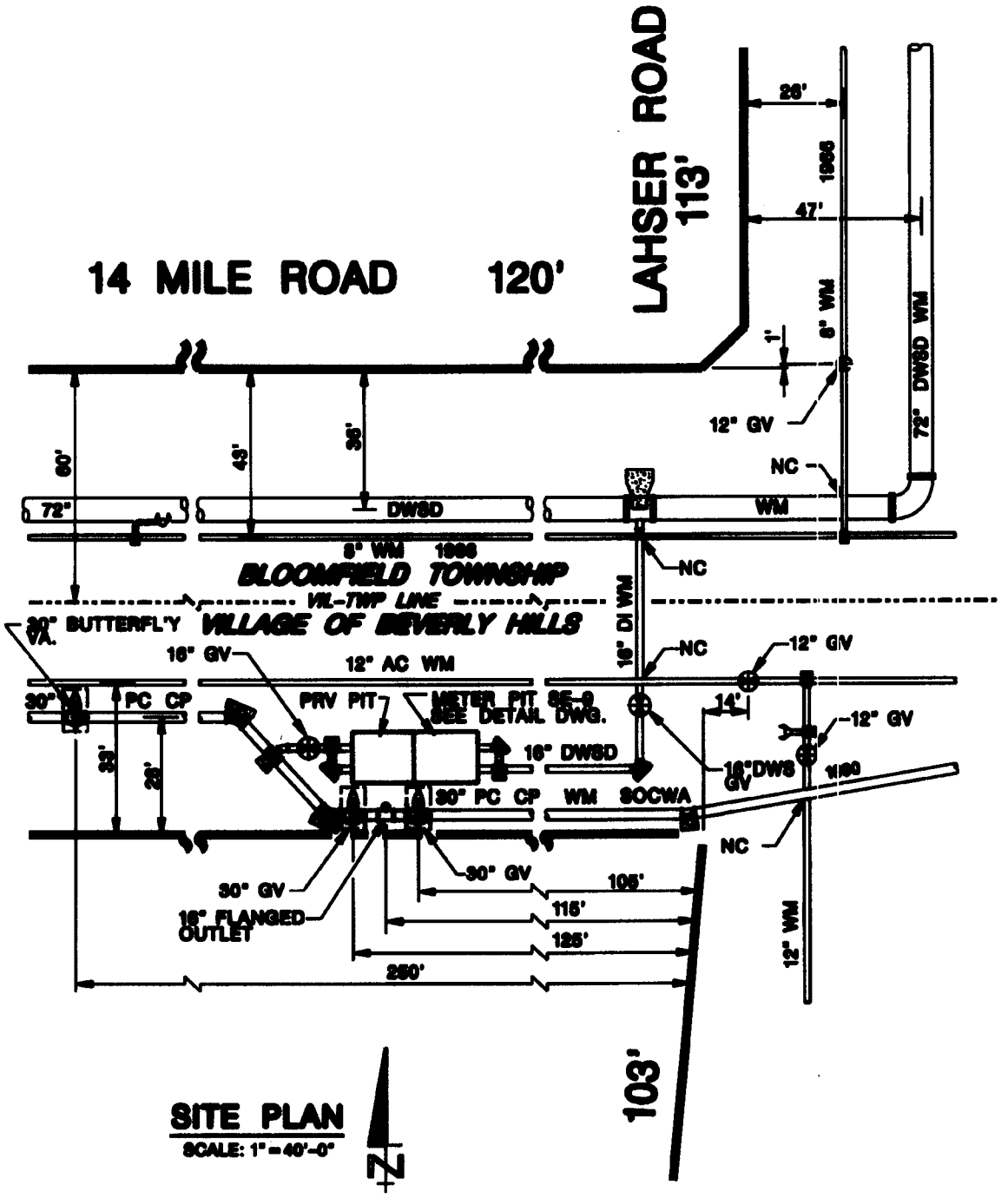
ADDRESS _____ 26755 W. 12 MILE RD.
FEED TO _____ SOCWA
FEED FROM _____ 30" DWSD TRAN MAIN
TYPE OF METER _____ B.I.F. VENTURI TUBE
TYPE SIZE OF P.R.V. _____ 16 G.A.
SIZE OF METER _____ 23.9375" x 13.534"
P.R.V. MODEL _____ 49 D
METER NUMBER _____ 57863-1
DATE METER SET _____
METER PIT CONST.& SIZE _____ 23'-0" x 18'-1.5" I.D. REINF. CONC.
SECTION MAP _____ 7-V & W
REMARKS _____
GATE BOOK _____ W-1941
FIELD BOOK _____
DRAWN BY _____ J.M.T 10-05-07

SE 8

EXHIBIT-A SE-09

FOURTEEN MILE RD & LASHER RD

SOCWA



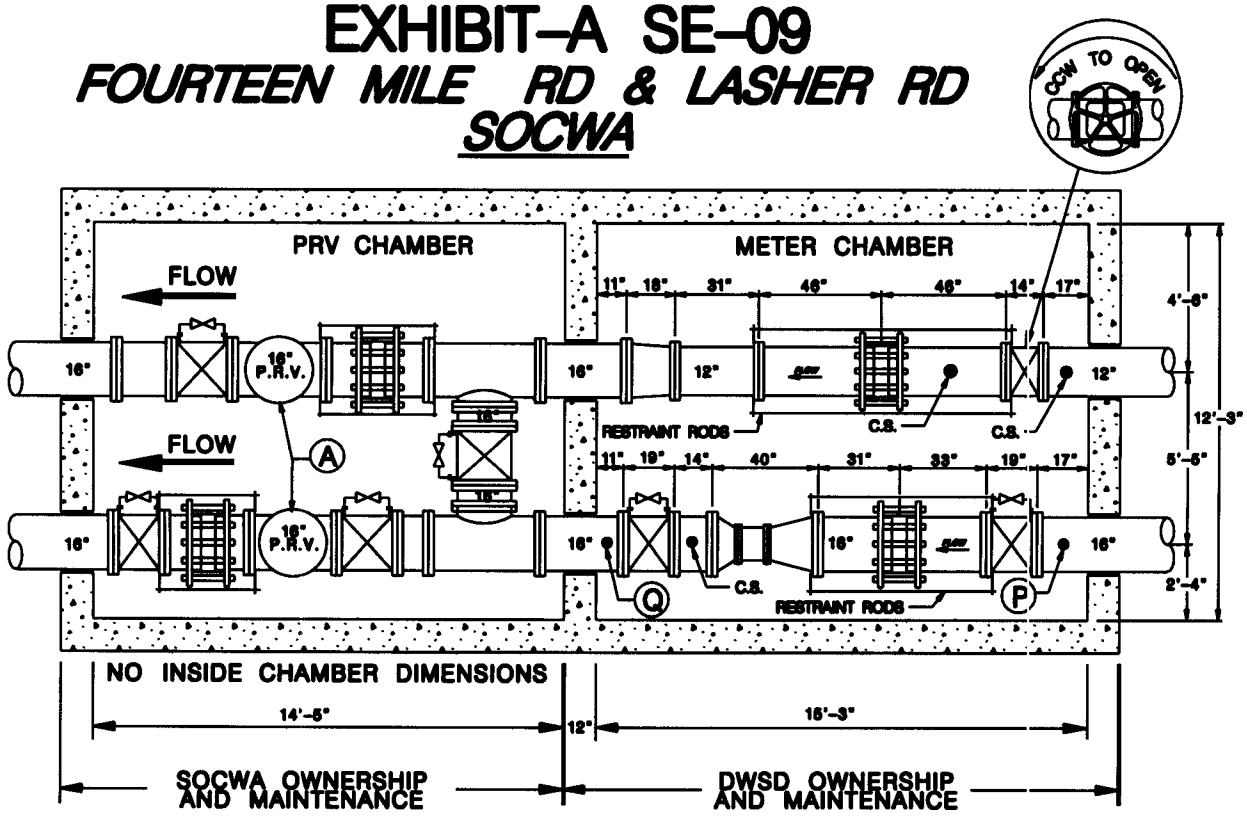
LOCATIONS SUBJECT TO VERIFICATION IN THE FIELD.

SE 9

EXHIBIT–A SE–09

FOURTEEN MILE RD & LASHER RD

SOCWA



METER PIT DETAIL

NOT TO SCALE

N

TAG	QTY	LEGEND	SIZE
–	–	ALL WORK DONE BY OTHERS	–
A	2	P.R.V.	16"

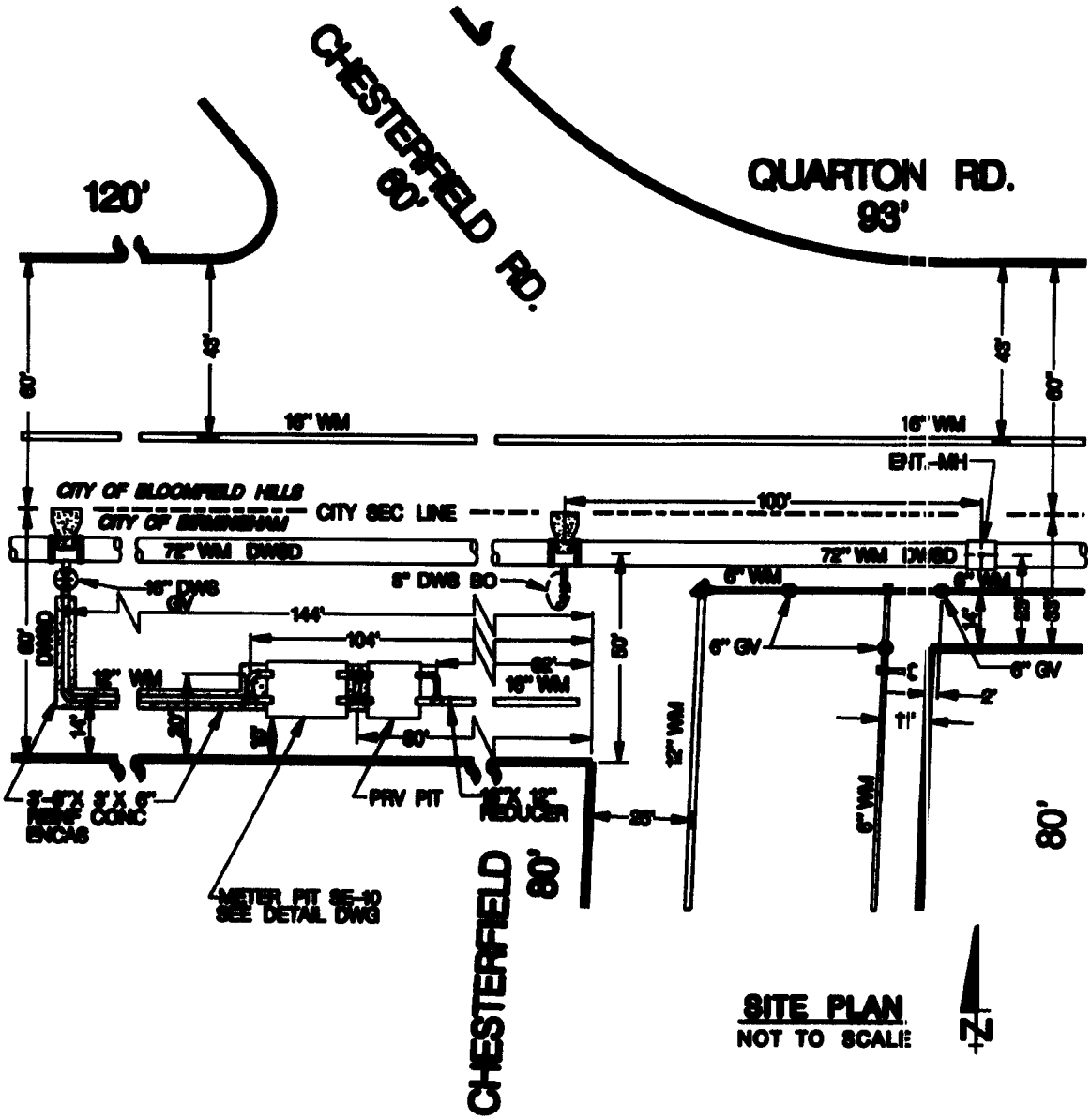
Ⓟ = UPSTREAM PRESSURE TRANSMITTER
Ⓠ = OTHER PRESSURE TRANSMITTER

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 – 6

ADDRESS ..... 22035 14 MILE ROAD
FEED TO ..... SOCWA
FEED FROM ..... 72" DWSD TRANS MAIN
TYPE OF METER ..... VENTURI
TYPE OF P.R.V. .....
SIZE OF METER ..... 16" x 11.6"
SIZE OF P.R.V. ..... 16"
METER NUMBER 97501500101
DATE METER SET .....
METER PIT CONST & SIZE ..... 30'–9" x 12'–3" REINF. CONC.
SECTION MAP 9–Z
REMARKS DWS–805 01/01/03
GATE BOOK N–403
DRAWN BY ..... R. NICHOLS 10/05/07

SE 9

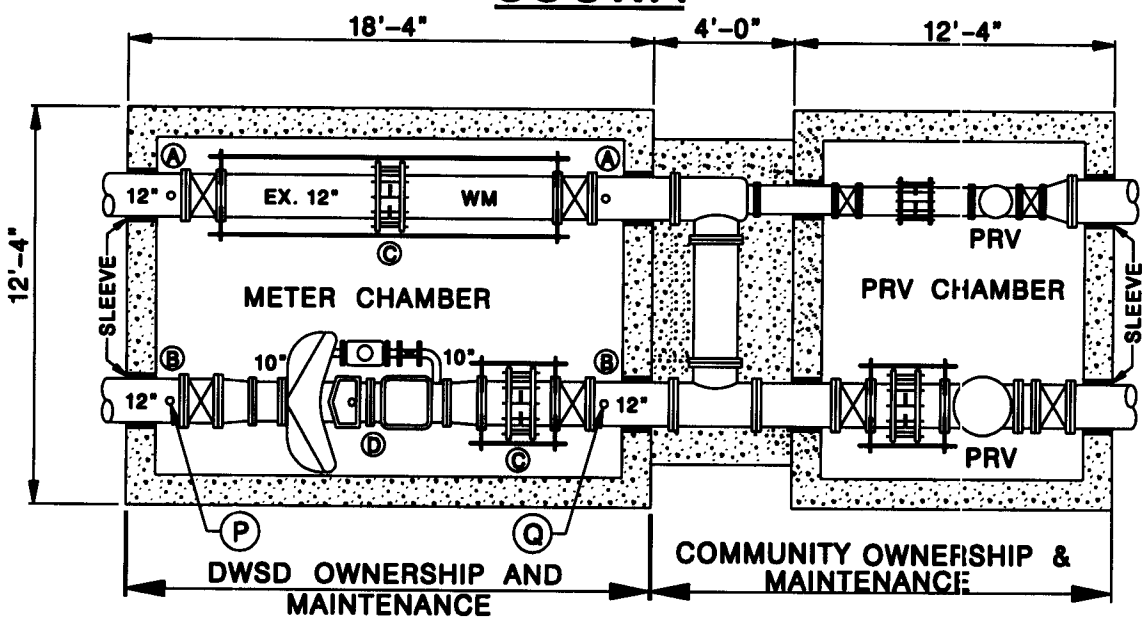
EXHIBIT–A SE–10
QUARTON AND CHESTERFIELD
SOCWA



LOCATIONS SUBJECT TO VERIFICATION IN THE FIELD.

SE 10

EXHIBIT-A SE-10
QUARTON AND CHESTERFIELD
SOCWA



METER PIT DETAIL
NOT TO SCALE

Ⓐ- CORP. STOP
Ⓑ- CORP. STOP W/P.T.
Ⓒ- RSTR. RODS
Ⓓ- 10" x 2" FLGD. SENSUS FIRELINE METER, W5500

TYPICAL PRESSURE LOSS THRU METER	
METER TYPE	P.S.I. LOSS
VENTURI	1 TO 2
MAG	0
TURBINE	4 - 6

LEGEND			
TAG	QTY.	DESCRIPTION OF MAJOR NEW EQUIPMENT	
-	-	ALL WORK DONE BY OTHERS	

Ⓟ - UP STREAM PRESSURE TRANSMITTER

Ⓠ - OTHER PRESSURE TRANSMITTER

ADDRESS	1775 QUARTON
FEED TO	SOCWA
FEED FROM	72" DWSD TRANS. MAIN
TYPE OF METER	SENSUS TURBO
SIZE OF METER	10" x 2"
TYPE OF P.R.V.	
SIZE OF P.R.V.	12" & 6"
METER NUMBER	10") 1557840 & 2") 1557693
DATE METER SET	
METER PIT CONST & SIZE	16'-0" x 10'-0" REINF. CONC.
SECTION MAP	11-Z
REMARKS	NONE
FIELD BOOK	
GATE BOOK	
DRAWN BY	J.M.T 10-05-07

SE 10

EXHIBIT B
Projected Annual Volume and Minimum Annual Volume (Table 1)
Pressure Range and Maximum Flow Rate (Table 2)
Flow Split Assumptions (Table 3)
Addresses for Notice (Table 4)

Table 1 and Table 2 set forth the agreed upon Projected Annual Volumes, Minimum Annual Volumes, Pressure Ranges and Maximum Flow Rates for the term of this Contract provided that figures in bold type face are immediately enforceable pursuant to the terms of Section 5.07 and italicized figures are contained for planning purposes only but will become effective absent the negotiated replacements anticipated in Section 5.07.

The approximate rate of flow by individual meter set forth in Table 3 is the assumption upon which the Pressure Range commitments established in Table 2 have been devised. Should Customer deviate from these assumptions at any meter(s), the Board may be unable to meet the stated Pressure Range commitments in this Contract or in the contract of another customer of the Board and Section 5.08 of this Contract may be invoked.

EXHIBIT B

Table 1
Projected Annual Volume and Minimum Annual Volume

Fiscal Year Ending June 30	Projected Annual Volume (mcf)	Minimum Annual Volume (mcf)
2009	**1,398,800**	**699,400**
2010	**1,379,000**	**689,500**
2011	*1,360,000*	*680,000*
2012	*1,341,000*	*670,500*
2013	*1,322,000*	*661,000*
2014	*1,304,000*	*652,000*
2015	*1,285,000*	*642,500*
2016	*1,267,000*	*633,500*
2017	*1,250,000*	*625,000*
2018	*1,232,000*	*616,000*
2019	*1,232,000*	*616,000*
2020	*1,232,000*	*616,000*
2021	*1,232,000*	*616,000*
2022	*1,232,000*	*616,000*
2023	*1,232,000*	*616,000*
2024	*1,232,000*	*616,000*
2025	*1,232,000*	*616,000*
2026	*1,232,000*	*616,000*
2027	*1,232,000*	*616,000*
2028	*1,232,000*	*616,000*
2029	*1,232,000*	*616,000*
2030	*1,232,000*	*616,000*
2031	*1,232,000*	*616,000*
2032	*1,232,000*	*616,000*
2033	*1,232,000*	*616,000*
2034	*1,232,000*	*616,000*
2035	*1,232,000*	*616,000*
2036	*1,232,000*	*616,000*
2037	*1,232,000*	*616,000*
2038	*1,232,000*	*616,000*

EXHIBIT B

Table 2
Pressure Range and Maximum Flow Rate

Calendar Year	Pressure Range (psi) Meter SE-05		Pressure Range (psi) Meter SE-06		Pressure Range (psi) Meter SE-07		Maximum Flow Rate (mgd)	
	Min	Max	Min	Max	Min	Max	Max Day	Peak Hour
2008	**31**	**55**	**40**	**63**	**40**	**62**	**62.88**	**62.88**
2009	**31**	**55**	**40**	**63**	**40**	**62**	**62.00**	**62.00**
2010	*31*	*55*	*40*	*63*	*40*	*62*	*61.40*	*61.40*
2011	*31*	*55*	*40*	*63*	*40*	*62*	*60.80*	*60.80*
2012	*31*	*55*	*40*	*63*	*40*	*62*	*60.20*	*60.20*
2013	*50*	*75*	*50*	*75*	*50*	*75*	*59.60*	*59.60*
2014	*50*	*75*	*50*	*75*	*50*	*75*	*59.00*	*59.00*
2015	*50*	*75*	*50*	*75*	*50*	*75*	*58.40*	*58.40*
2016	*50*	*75*	*50*	*75*	*50*	*75*	*57.80*	*57.80*
2017	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2018	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2019	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2020	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2021	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2022	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2023	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2024	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2025	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2026	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2027	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2028	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2029	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2030	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2031	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2032	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2033	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2034	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2035	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2036	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*
2037	*50*	*75*	*50*	*75*	*50*	*75*	*57.20*	*57.20*

EXHIBIT B

Table 2 (Cont'd)
Pressure Range and Maximum Flow Rate

Calendar Year	Pressure Range (psi) Meter SE-08		Pressure Range (psi) Meter SE-09		Pressure Range (psi) Meter SE-10		Maximum Flow Rate (mgd)	
	Min	Max	Min	Max	Min	Max	Max Day	Peak Hour
2008	**71**	**103**	**90**	**120**	**88**	**115**	**62.88**	**62.88**
2009	**71**	**103**	**90**	**120**	**88**	**115**	**62.00**	**62.00**
2010	*71*	*103*	*90*	*120*	*88*	*115*	*61.40*	*61.40*
2011	*71*	*103*	*90*	*120*	*88*	*115*	*60.80*	*60.80*
2012	*71*	*103*	*90*	*120*	*88*	*115*	*60.20*	*60.20*
2013	*80*	*103*	*90*	*120*	*88*	*115*	*59.60*	*59.60*
2014	*80*	*103*	*90*	*120*	*88*	*115*	*59.00*	*59.00*
2015	*80*	*103*	*90*	*120*	*88*	*115*	*58.40*	*58.40*
2016	*80*	*103*	*90*	*120*	*88*	*115*	*57.80*	*57.80*
2017	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2018	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2019	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2020	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2021	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2022	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2023	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2024	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2025	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2026	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2027	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2028	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2029	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2030	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2031	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2032	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2033	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2034	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2035	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2036	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*
2037	*80*	*103*	*90*	*120*	*88*	*115*	*57.20*	*57.20*

EXHIBIT B

Table 3
Flow Split Assumptions

Meter	**Assumed Flow Split (2008-2009)**
SE-05	0% to 32 %
SE-06	0% to 32 %
SE-07	0% to 10%
SE-08	0% to 40 %
SE-09	0% to 32 %
SE-10	0% to 13 %

Table 4
Addresses for Notice

If to the Board:	**If to Customer:**
Director Detroit Water and Sewerage Department 735 Randolph Detroit, Michigan 48226	General Manager SOCWA 3910 W. Webster Royal Oak, Michigan 48073

SUMMARY OF SIGNIFICANT CHANGES TO 9/10/2007 VERSION OF DWSD MODEL CONTRACT

1. General: Replaced "Board of Water Commissioners" with "City of Detroit" throughout the contract as the contract is between the City of Detroit and SOCWA; titles added to all subsections.
2. Table of Contents: added sections on "Water Quality" and "Operation of Storage".
3. Definitions: added definitions for "Adjusted Prevailing Water Rate", "Filling Schedule" and "Pressure Problem".
4. Definition of "DWSD Peak Hour" clarifies that approved storage filling hours are not included in "DWSD Peak Hour" calculation.
5. Definition of "DWSD Peak Hour" clarifies that all times are Eastern Standard Time.
6. Definition of Technical Advisory Committee includes a minimum term of the Technical Advisory Committee from January 1, 2008 until December 31, 2038.
7. Section 4.04, clarifies how "Service Area" will be extended in the future.
8. Section 4.06, clarifies that DWSD will be the sole provider of water except in emergencies.
9. Section 5.01, clarifies how and when pressures are measured.
10. Section 5.05, was old section 5.07.
11. Section 5.06, was old section 5.05.
12. Section 5.07, was old section 5.06.
13. Section 5.09, adds TAC as a review body for advising DWSD on allocation of costs for Corrective Action Plans.
14. Section 8.03, adds 30 day written notice before DWSD performs required maintenance on customer's facilities at water distribution points that customer refuses to perform.
15. Section 8.05, new section partially removed from old section 8.04, clarifies which party pays for replacement water meter.
16. Section 9.01, clarifies Dispute Resolution as an optional process.
17. Section 14.01, clarifies that contract Exhibit B is excluded from equality of contract terms; clarifies that only material terms will be changed.
18. Section 17.04, new section on Water Quality.
19. Section 18.03, clarifies that easements have to be within customer's jurisdiction. Since SOCWA does not have any jurisdiction over public rights-of-way, this section does not apply to SOCWA.
20. Section 22.01, new section on Storage Filling, establishes storage filling schedule.
21. Section 23.10, new section deems contract to be mutually drafted.

Appendix D
Insurance Services Office, Inc. Study

111 NORTH CANAL STREET SUITE 950 CHICAGO, IL 60606-7270
TEL: (312) 930-0070 (800) 444-4554 FAX: (312) 930-0017

February 15, 2006

Thomas R. Hoover, City Manager
City of Royal Oak
211 Williams St., PO Box 64
Royal Oak, MI 48068-0064

RE: Public Protection Classification Results
Royal Oak, Oakland County, MI

Dear Mr. Hoover:

We wish to thank you and the other community officials for your cooperation during our recent Public Protection Classification (PPC) survey. ISO is the leading supplier of statistical, underwriting, and actuarial information for the property/casualty insurance industry. Most insurers use the PPC classifications for underwriting and calculating premiums for residential, commercial and industrial properties.

ISO has completed its analysis of the structure fire suppression delivery system provided in your community. We would like to report that the resulting classification is a Class 3. This classification number applies to all properties in the classified area with a needed fire flow of 3,500 gpm or less. The private and public protection at properties in the jurisdiction with larger fire flows is individually evaluated and may vary from the jurisdiction classification. Congratulations on your commitment to serve the needs of your community's property owners and residents.

ISO will advise its subscribing insurers of this classification change within the next 30-days and assign an effective date of May 1, 2006. This date allows insurers the necessary lead time to incorporate the Public Protection Classification change into their policy rating systems.

Enclosed is a summary of the ISO analysis of your fire suppression services. If you would like to know how your community's classification could improve, or if you would like to learn about the potential effect of proposed changes to your fire suppression delivery system, please call us at the phone number listed below.

The PPC program is not intended to analyze all aspects of a comprehensive structure fire suppression delivery system program. It is not for purposes of determining compliance with any state or local law, nor is it for making recommendations about loss prevention or life safety.

If you have any questions about your classification, please let us know.

Sincerely,

Public Protection Department

(800) 930-1677 Ext. 6209

Encl.

cc: Wilbur G. White, Fire Chief
Richard D. Lang, Water Supt.

Grading Sheet For: Royal Oak, MI
Oakland County

Public Protection Class: 3 Surveyed: October, 2005

Feature	Credit Assigned	Maximum Credit
Receiving and Handling Fire Alarms	7.70%	10.00%
Fire Department	32.18%	50.00%
Water Supply	36.54%	40.00%
*Divergence	-5.40%	
Total Credit	71.02%	100.00%

The Public Protection Class is based on the total percentage credit as follows:

Class	%
1	90.00 or more
2	80.00 to 89.99
3	70.00 to 79.99
4	60.00 to 69.99
5	50.00 to 59.99
6	40.00 to 49.99
7	30.00 to 39.99
8	20.00 to 29.99
9	10.00 to 19.99
10	0 to 9.99

*Divergence is a reduction in credit to reflect a difference in the relative credits for Fire Department and Water Supply.

The above classification has been developed for use in property insurance premium calculations.

INSURANCE SERVICES OFFICE, INC.

CLASSIFICATION DETAILS

Graded Area: Royal Oak
County: Oakland State: MI
Date Surveyed: October, 2005 Total Credit: 71.02 Class: 3 Pop.: 60062

RECEIVING AND HANDLING FIRE ALARMS

This section of the Fire Suppression Rating Schedule reviews the facilities provided for the general public to report fires, and for the operator on duty at the communication center to dispatch fire department companies to the fires.

	Credit	
	Actual	Maximum
1. Credit for Telephone Service (Item 414)		
This item reviews the facilities provided for the public to report fires, including the listing of fire and business numbers in the telephone directory.	1.70	2.00
2. Credit for Operators (Item 422)		
This item reviews the number of operators on-duty at the communication center to handle fire calls.	3.00	3.00
3. Credit for Dispatch Circuits (Item 432)		
This item reviews the dispatch circuit facilities used to transmit alarms to fire department members.	3.00	5.00
4. Total Credit for Receiving and Handling Fire Alarms:	7.70	10.00
Relative Classification for Receiving and Handling Fire Alarms:	3	

Graded Area: Royal Oak
County: Oakland State: MI
Date Surveyed: October, 2005 Total Credit: 71.02 Class: 3 Pop.: 60062

FIRE DEPARTMENT

This section of the Fire Suppression Rating Schedule reviews the engine and ladder-service companies, equipment carried, response to fires, training and available fire fighters.

	Credit	
	Actual	Maximum
1. Credit for Engine Companies (Item 513) This item reviews the number of engine companies and the hose equipment carried.	8.91	10.00
2. Credit for Reserve Pumpers (Item 523) This item reviews the number of reserve pumpers, their pump capacity and the hose equipment carried on each.	0.88	1.00
3. Credit for Pump Capacity (Item 532) This item reviews the total available pump capacity.	5.00	5.00
4. Credit for Ladder-Service Companies (Item 549) This item reviews the number of ladder and service companies and the equipment carried.	2.97	5.00
5. Credit for Reserve Ladder-Service Companies (Item 553) This item reviews the number of reserve ladder and service trucks, and the equipment carried.	0.31	1.00

Graded Area: Royal Oak
County: Oakland State: MI
Date Surveyed: October, 2005 Total Credit: 71.02 Class: 3 Pop.: 60062

FIRE DEPARTMENT
(continued

	Credit	
	Actual	Maximum
6. Credit for Distribution (Item 561)		
This item reviews the percent of the built-upon area of the city which has an adequately-equipped, responding first-due engine company within 1.5 miles and an adequately-equipped, responding ladder-service company within 2.5 miles.	2.64	4.00
7. Credit for Company Personnel (Item 571)		
This item reviews the average number of equivalent fire fighters and company officers on duty with existing companies.	8.59	15.00+
8. Credit for Training (Item 581)		
This item reviews the training facilities and their use.	2.88	9.00
9. Total Credit for Fire Department:	32.18	50.00+
Relative Classification for Fire Department:	4	

+ This indicates that credit for company personnel is open-ended, with no maximum credit for this item.

Graded Area: Royal Oak
County: Oakland State: MI
Date Surveyed: October, 2005 Total Credit: 71.02 Class: 3 Pop.: 60062

WATER SUPPLY

This section of the Fire Suppression Rating Schedule reviews the water supply system that is available for fire suppression in the city.

	Credit	
	Actual	Maximum
1. Credit for the Water System (Item 616)		
This item reviews the supply works, the main capacity and hydrant distribution.	32.24	35.00
2. Credit for Hydrants (Item 621)		
This item reviews the type of hydrants, and method of installation.	1.96	2.00
3. Credit for Inspection and Condition of Hydrants (Item 631)		
This item reviews the frequency of inspections of hydrants and their condition	2.34	3.00
4. Total Credit for Water Supply:	36.54	40.00
Relative Classification for Water Supply:	1	

INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Royal Oak

County Oakland State MI Witnessed by Insurance Services Office, Inc. Date October 28, 2005

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83C(d^2)p^{0.5})$ INDIVIDUAL HYDRANTS			TOTAL	PRESSURE PSI STATIC	PRESSURE PSI RESID.	FLOW -AT 20 PSI $Q_R=Q_F(h_R^{0.54}/h_F^{0.54})$ NEEDED **	FLOW -AT 20 PSI AVAIL.	REMARKS***
1	Comm	Main St. & Kenilworth Ave.	Main (Low)	1440	1740		3180	65	42	3500	4600	
2	Comm	Troy St. & Fourth Ave.	Main (Low)	1420	2030		3450	65	52	3500	6700	
3	Comm	Washington Ave. & Ninth St.	Main (Low)	1570	1600		3170	60	42	3000	4900	
4	Comm	E/S Woodward Ave., 1st hyd. N. of Sixth St.	Main (Low)	1400	780		2180	64	39	3000	3000	
5	Comm	Woodward Ave. & Catalpa Dr., S/E corner	Main (Low)	780	1600		2380	60	52	2500	5700	
6	Comm	Starr Rd. & Hampton Blvd.	High	940	1290		2230	75	25	2000	2300	
7	Comm	Lincoln Ave. & Wilson Ave., N/E corner	Main (Low)	1880	580		2460	72	57	2250	4800	
8a	Comm	Brockton Ave. & Helene Ave.	Main (Low)	1040	1170		2210	72	35	1750	2700	
8b	Res	Brockton Ave. & Helene Ave.	Main (Low)	1040	1170		2210	72	35	1000	2700	
9a	Comm	Harrison Ave. & Knowles St.	Main (Low)	1770			1770	62	55	2500	4700	
9b	Res	Harrison Ave. & Knowles St.	Main (Low)	1770			1770	62	55	1000	4700	
10	Comm	Stephenson Hwy., 1st hyd. N. of Gardenia Ave.	Main (Low)	1690			1690	72	53	3000	2900	
11	Comm	Troy St. & University Ave.	Main (Low)	1630	1500		3130	63	45	2500	5000	
12	Comm	Rochester Rd. & Woodland Ave., N/E corner	Main (Low)	1170			1170	65	58	3000	3200	
13a	Comm	Campbell Rd. & Ottawa Ave.	Main (Low)	990	1210		2200	70	38	2500	2800	
13b	Res	Campbell Rd. & Ottawa Ave.	Main (Low)	990	1210		2200	70	38	1000	2800	

THE ABOVE LISTED NEEDED FIRE FLOWS ARE FOR PROPERTY INSURANCE PREMIUM CALCULATIONS ONLY AND ARE *NOT* INTENDED TO PREDICT THE MAXIMUM AMOUNT OF WATER REQUIRED FOR A LARGE SCALE FIRE CONDITION. THE AVAILABLE FLOWS ONLY INDICATE THE CONDITIONS THAT EXISTED AT THE TIME AND AT THE LOCATION WHERE TESTS WERE WITNESSED.

***Comm = Commercial; Res = Residential.**

****Needed is the rate of flow for a specific duration for a full credit condition. Needed Fire Flows greater than 3,500 gpm are not considered in determining the classification of the city when using the Fire Suppression Rating Schedule.**

INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Royal Oak

County Oakland State MI Witnessed by Insurance Services Office, Inc. Date October 28, 2005

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83C(d^2)p^{0.5})$ INDIVIDUAL HYDRANTS			TOTAL	PRESSURE PSI STATIC	PRESSURE PSI RESID.	FLOW - AT 20 PSI $Q_R=Q_F(h_R^{0.54}/h_F^{0.54})$ NEEDED **	FLOW - AT 20 PSI AVAIL.	REMARKS***
14	Comm	Baker St. & Sherman Dr., S/E corner	Main (Low)	1170	1470		2640	64	34	3000	3200	
15a	Comm	McDonald Ave., 1st hyd. N. of 12 Mile Rd.	Main (Low)	1630			1630	65	55	2500	3700	
15b	Res	McDonald Ave., 1st hyd. N. of 12 Mile Rd.	Main (Low)	1630			1630	65	55	1000	3700	
16	Comm	Crooks Rd. & Webster Rd.	Main (Low)	1800	1210		3010	61	55	2500	8500	
17a	Comm	Chester Rd. & Devon Rd.	Main (Low)	830	1400		2230	56	35	2000	3000	
17b	Res	Chester Rd. & Devon Rd.	Main (Low)	830	1400		2230	56	35	1000	3000	
18	Comm	Parmenter Blvd. & Coventry, S/W corner	Main (Low)	1720	1370		3090	50	41	3500	5900	
19	Comm	Torquay Ave., 1st hyd. W. of Leafdale Blvd.	Main (Low)	1600	1800		3400	44	37	3000	6600	
20	Comm	Delemere Blvd., 1st hyd. S. of Samoset Rd.	Main (Low)	1210	1090		2300	43	20	2250	2300	
21	Comm	Dukeshire Hwy., 1st hyd. N. of Yorba Linda Blvd.	High	1400	1440		2840	72	34	3000	3400	
22	Res	Greenfield Rd. & Springer Ave.	High	1090	1090		2180	61	17	1000	2100	
23a	Comm	Beaumont Hospital - Medical Office Bldg., West, S/W corner	Beaumont	1660	1540		3200	67	41	5000	4400	
23b	Comm	Beaumont Hospital - Medical Office Bldg., West, S/W corner	Beaumont	1660	1540		3200	67	41	3500	4400	
24	Comm	N/S 13 Mile Rd., 1st hyd. E. of Benjamin Ave.	Main (Low)	1770	1720		3490	55	45	3000	6900	
25a	Comm	Clawson Ave., 1st hyd. S. of Glenwood Rd.	Main (Low)	1470	1250		2720	57	36	2500	3700	
25b	Res	Clawson Ave., 1st hyd. S. of Glenwood Rd.	Main (Low)	1470	1250		2720	57	36	1000	3700	

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INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Royal Oak

County Oakland State MI Witnessed by Insurance Services Office, Inc. Date October 28, 2005

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83(C(d^2)p^{0.5}))$ INDIVIDUAL HYDRANTS			TOTAL	PRESSURE PSI STATIC	PRESSURE PSI RESID.	FLOW -AT 20 PSI $Q_R=Q_F(h_R^{0.54}/h_F^{0.54})$ NEEDED **	FLOW -AT 20 PSI AVAIL.	REMARKS***
26a	Comm	Alexander Ave. & Farnum Ave.	Main (Low)	1980	1720		3700	70	54	3000	6800	
26b	Res	Alexander Ave. & Farnum Ave.	Main (Low)	1980	1720		3700	70	54	1000	6800	
27	Comm	Washington Ave. & 5th St., N/E corner	Main (Low)	1660			1660	56	48	3500	3700	
28a	Comm	11 Mile Rd. & Campbell Rd., S/E corner	Main (Low)	1170			1170	69	62	2250	3300	
28b	Res	11 Mile Rd. & Campbell Rd., S/E corner	Main (Low)	1170			1170	69	62	1500	3300	
29	Comm	Edgeworth Ave., 1st hyd. S. of 12 Mile Rd.	Main (Low)	1330			1330	69	56	3500	2700	
30a	Comm	Main St., 1st hyd. N. of Crooks Rd.	Main (Low)	1710			1710	59	46	6000	3100	
30b	Comm	Main St., 1st hyd. N. of Crooks Rd.	Main (Low)	1710			1710	59	46	3500	3100	
31	Comm	Rochester Rd., 1st hyd. N. of Detroit Ave.	Main (Low)	1250			1250	62	48	3500	2300	
32a	Comm	Girard Ave., 1st hyd. E. of Ardmore Ave.	Main (Low)	1090			1090	62	26	3500	1200	
32b	Res	Girard Ave., 1st hyd. E. of Ardmore Ave.	Main (Low)	1090			1090	62	26	1000	1200	
33a	Comm	Nakota Rd. & Hampton Blvd.	High	670	670		1340	67	36	2500	1700	
33b	Res	Nakota Rd. & Hampton Blvd.	High	670	670		1340	67	36	1000	1700	
34	Comm	E/S Woodward Ave. & Buckingham Rd.	High	1040			1040	55	38	2000	1500	
35a	Comm	Woodward Ave & Normandy Rd., N/W corner	High	940	1250		2190	62	39	4500	3000	
35b	Comm	Woodward Ave. & Normandy Rd., N/W corner	High	940	1250		2190	62	39	2000	3000	

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INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Royal Oak

County Oakland State MI Witnessed by Insurance Services Office, Inc. Date October 28, 2005

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83(C(d^2)p^{0.5}))$ INDIVIDUAL HYDRANTS			TOTAL	PRESSURE PSI STATIC	PRESSURE PSI RESID.	FLOW - AT 20 PSI $Q_R=Q_T(h_R^{0.54}/h_T^{0.54})$ NEEDED **	FLOW - AT 20 PSI AVAIL.	REMARKS***
36	Comm	Woodward Ave. & Coolidge Hwy., S/W corner	High	990	990		1980	70	29	3500	2200	
37	Comm	W/S Woodward Ave. & Warick Rd.	High	990			990	74	36	1750	1200	
38	Res	Prairie Ave., 1st hyd. S. of Judson Ave.	High	890			890	67	27	1000	950	
39	Comm	W/S Woodward Ave., 3rd hyd. S. of Lincoln Rd.	Main (Low)	940			940	59	38	3000	1300	
40	Comm	W/S Coolidge Hwy., 1st hyd. N. of Nakota Rd.	High	1120			1120	68	36	3000	1400	
40(a)	Comm	E/S Coolidge Hwy. & Samoset Rd.	Main (Low)	940			940	42	20	3000	950	
41	Comm	E/S Coolidge Hwy. & Samoset Rd.	Main (Low)	940			940	42	20	4500	950	
41(a)	Comm	W/S Coolidge Hwy., 1st hyd. N. of Nakota Rd.	High	1120			1120	68	36	4500	1400	
42	Comm	E/S Woodward Ave., 1st hyd. N/W of Benjamin Ave.	Main (Low)	1660			1660	52	47	3500	4500	
43	Comm	Main St. & 7th St.	Main (Low)	1650			1650	57	52	3500	4900	
44a	Comm	Lexington Blvd., 1st hyd. W. of Marais Ave.	Main (Low)	1570			1570	59	48	4500	3100	
44b	Comm	Lexington Blvd., 1st hyd. W. of Marais Ave.	Main (Low)	1570			1570	59	48	3500	3100	
45a	Comm	14 Mile Rd. & Fernlee Ave., S/E corner	Main (Low)	1540			1540	45	41	4500	4100	
45b	Comm	14 Mile Rd. & Fernlee Ave., S/E corner	Main (Low)	1540			1540	45	41	3500	4100	
46	Comm	Washington Ave. & Willis Ave.	Main (Low)	1440			1440	57	50	3500	3500	
Tests witnessed as follows: Nos. 1-8 & 10-26 (3/24/98), Nos. 9, 32 & 42-46 (7/20/05) and Nos. 27-31 & 33-41 (10/28/05). Nos. 40 & 40(a) and 41 & 41(a) have combined 2 water services credited for a single NFF.												

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PUBLIC PROTECTION CLASSIFICATION

IMPROVEMENT STATEMENTS
FOR
Royal Oak
Oakland County, MI

Prepared by
INSURANCE SERVICES OFFICE, INC.
111 North Canal St., Ste 950, Chicago, IL 60606
312-930-0070 FAX 800-711-6431

The following statements are based upon the criteria contained in our Fire Suppression Rating Schedule and upon conditions in Royal Oak, MI during October, 2005. They indicate the performance needed to receive full credit for the specific item in the Schedule, and the quantity you have provided. Partial improvement will result in receiving a partial increase in the credit. These statements relate only to the fire insurance classification of your city. They are not for property loss prevention or life safety purposes and no life safety or property loss prevention recommendations are made.

RECEIVING AND HANDLING FIRE ALARMS

Credit For Telephone Service (Item 414).

Actual = 1.70%; Maximum = 2.00%

For maximum credit in the Schedule, emergency calls should progress to the business number.

For maximum credit in the Schedule, both the number to report a fire and the fire department business number should be listed under "Fire Department" in the white pages directory (or government section of the white pages). Your fire number is not listed and your business number is not listed under "Fire Department".

Credit For Dispatch Circuits (Item 432).

Actual = 3.00%; Maximum = 5.00%

For maximum credit in the Schedule, the primary alarm dispatch circuit should be monitored for integrity in accordance with National Fire Protection Association Standard, 1221.

Total credit for Receiving and Handling Fire Alarms (Item 440)

Actual = 7.70%; Maximum = 10.00%

FIRE DEPARTMENT

Credit For Engine Companies (Item 513).

Actual = 8.91%; Maximum = 10.00%

For maximum credit in the Schedule, 3 engine companies are needed in your city.
These are calculated as follows:

3 for the Basic Fire Flow of 3500 gpm.

You have 3 engine companies in service.
These are calculated as follows:

88 percent for Engine E9-10 because of insufficient equipment.
Additionally Engine E9-10 is lacking: an adequate pump testing program.

89 percent for Engine E9-30 because of insufficient equipment.
Additionally Engine E9-30 is lacking: an adequate pump testing program.

89 percent for Engine E9-40 because of insufficient equipment.
Additionally Engine E9-40 is lacking: an adequate pump testing program.

Credit For Reserve Pumpers (Item 523).

Actual = 0.88%; Maximum = 1.00%

For maximum credit in the Schedule, 1 fully-equipped reserve pumper is needed. You have 1 reserve pumper.
This is calculated as follows:

84 percent for Engine E9-31 because of insufficient equipment.
Additionally Engine E9-31 is lacking: an adequate pump testing program.

Credit For Pump Capacity (Item 532).

Actual = 5.00%; Maximum = 5.00%

For maximum credit in the Schedule, at least 3500 gpm in fire department pump capacity is needed.
You have 8250 gpm in creditable pump capacity.
This is calculated as follows:

5500 gpm in service and reserve	= 5500 gpm
5500 gpm X 50% for other apparatus	= 2750 gpm
Total	= 8250 gpm

Credit For Ladder And Service Companies (Item 549).

Actual = 2.97%; Maximum = 5.00%

For maximum credit in the Schedule, 2 ladder companies are needed in your city.

These are calculated as follows:

2 ladder companies due to method of operation.

You have 2 ladder companies
These are calculated as follows:

85 percent for Ladder E9-12 because of insufficient equipment.

32 percent for Ladder Composite 4 because of insufficient equipment and insufficient aerial device length.

Credit For Reserve Ladder And Service Companies (Item 553).

Actual = 0.31%; Maximum = 1.00%

For maximum credit in the Schedule, 1 fully-equipped reserve ladder truck is needed.
You have 1 reserve ladder truck.
This is calculated as follows:

29 percent for Ladder E9-11 because of insufficient equipment, insufficient aerial device testing and insufficient aerial device length.

Credit For Distribution (Item 561).

Actual = 2.64%; Maximum = 4.00%

For maximum credit in the Schedule, all sections of the city with hydrant protection should be within 1½ miles of a fully-equipped engine company and 2½ miles of a fully-equipped ladder, service, engine-ladder or engine-service company. The distance to be measured along all-weather roads.

Credit For Company Personnel (Item 571).

Actual = 8.59%; Maximum = 15.00%

An increase in the on-duty company personnel by one person will increase the fire department credit by 0.5.

Credit For Training (Item 581).

Actual = 2.88%; Maximum = 9.00%

For maximum credit in the Schedule, the training program should be improved. You received 32 percent credit for the current training program and the use of facilities.

For maximum credit in the Schedule, pre-fire planning inspections of each commercial, industrial, institutional and other similar-type building should be made twice a year by company members. Records of the inspections should include complete and up-to-date notes and sketches.

Total credit for Fire Department (Item 590)

Actual = 32.18%; Maximum = 50.00%

WATER SUPPLY

Credit For Supply System (Item 616).

Actual = 32.24%; Maximum = 35.00%

For maximum credit in the Schedule, the needed fire flows should be available at each location in the city. Needed fire flows of 2500 gpm and less should be available for 2 hours, 3000 and 3500 gpm for 3 hours and all others for 4 hours. See the attached table for an evaluation of fire flow tests made at representative locations in your city.

All AWWA standard hydrants within 1000 feet of a building, measured as hose can be laid by apparatus, are credited; 1000 gpm for hydrants within 300 feet; 670 gpm for 301 to 600 feet; and 250 gpm for 601 to 1000 feet. Credit is reduced when hydrants lack a pumper outlet, and is further reduced when they have only a single 2½-inch outlet.

Credit For Hydrants (Item 621).

Actual = 1.96%; Maximum = 2.00%

For maximum credit in the Schedule, all hydrants should: have a 6-inch or larger branch connection.

Credit For Inspection and Condition of Hydrants (Item 631).

Actual = 2.34%; Maximum = 3.00%

For maximum credit in the Schedule, all hydrants should be inspected twice a year, the inspection should include operation and a test at domestic pressure. Records should be kept of the inspections. Hydrants should be conspicuous, well located for use by a pumper, and in good condition.

Total credit for Water Supply (Item 640)

Actual = 36.54%; Maximum = 40.00%

FIRE FLOW TESTS

Royal Oak, MI

Tests witnessed on October 28, 2005

Test No.	Needed Fire Flow† gpm	Limited By Supply Works, gpm	Limited by Distribution Mains (flow tests), gpm	Limited By Hydrant Spacing, gpm
1	3500			
2	3500			
3	3000			
4	3000			
5	2500			
6	2000			
7	2250			
8a	1750			
8b	1000			
9a	2500			
9b	1000			
10	3000		2900	
11	2500			
12	3000			
13a	2500			
13b	1000			
14	3000			
15a	2500			
15b	1000			
16	2500			
17a	2000			
17b	1000			
18	3500			
19	3000			
20	2250			

21	3000			
22	1000			
23a†	5000		4400	
23b	3500			
24	3000			
25a	2500			
25b	1000			
26a	3000			
26b	1000			
27	3500			
28a	2250			
28b	1500			
29	3500		2700	
30a†	6000		3100	
30b	3500		3100	
31	3500		2300	
32a	3500		1200	
32b	1000			
33a	2500		1700	
33b	1000			
34	2000		1500	
35a†	4500		3000	
35b	2000			
36	3500		2200	
37	1750		1200	
38	1000		950	
39	3000		1300	
40	3000		1400	
40(a)				
41†	4500		950	
41(a)				
42	3500			
43	3500			
44a†	4500		3100	
44b	3500		3100	

†Needed fire flows exceeding 3500 gpm are not considered in Item 616 (CSS) Credit for System Supply

Appendix E
Water Main Year of Installation Map

City of Royal Oak Water System Year Installed

Royal Oak
Life Now Playing

Legend

Year Installed

- Unknown
- 1921 -1925
- 1926 - 1935
- 1936 - 1945
- 1946 - 1955
- 1956 - 1965
- 1966 - 1975
- 1976 - 1985
- 1986 - 1995
- 1996 - 2005
- 2006 - 2015

Reference

- Major Roads

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,200 Feet

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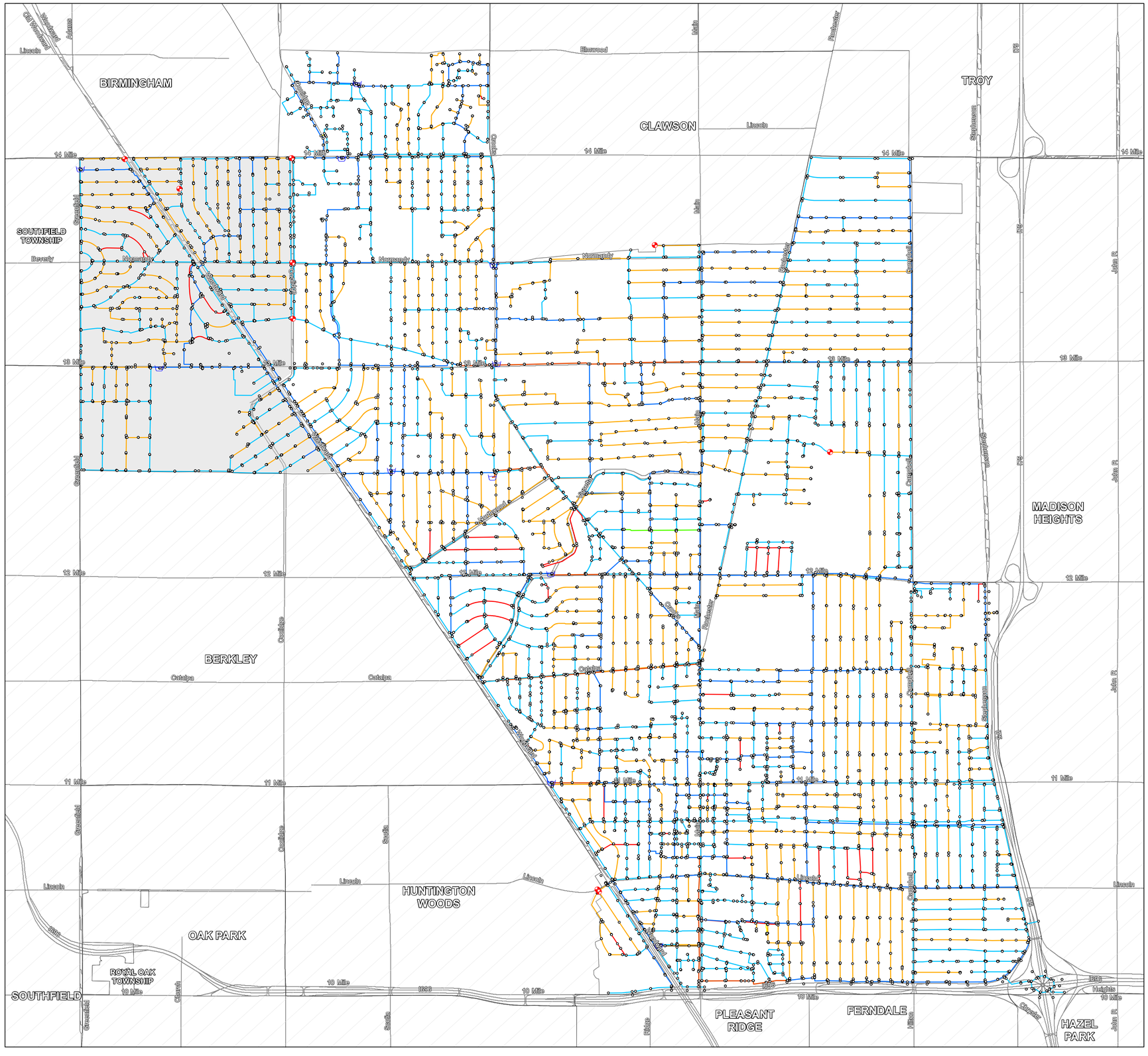
Appendix F
Water Model Schematic

City of Royal Oak
Water Model Schematic

Royal Oak
Life Now Playing



Legend

- SOCWA Source
- Water Model Junctions
- Closed Valve

Water Main Diameter (Inches)

- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 24"

Pressure Districts

- High Pressure District
- Low Pressure District
- Major Roads

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,200 Feet

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Appendix G
Hydrant Flow Test Locations Map

City of Royal Oak
Fire Hydrant
Flow Test Locations

Royal Oak
Life Now Playing

BIRMINGHAM
TROY
CLAWSON
SOUTHFIELD TOWNSHIP
MADISON HEIGHTS
BERKLEY
SOUTHFIELD
OAK PARK
HUNTINGTON WOODS
ROYAL OAK TOWNSHIP
PLEASANT RIDGE
FERNDALE
HAZEL PARK

10 Flow 10
34 Flow 34
32 32 Flow
24 24 Flow
11 Flow 11
37 37 Flow
9 Flow 9
38 Flow 38
39 39 Flow
30 Flow 30
23 Flow 23
29 29 Flow
22 22 Flow
8 Flow 8
28 28 Flow
7 Flow 7
19 19 Flow
43 43 Flow
26 Flow 26
17 Flow 17
6 Flow 6
15 Flow 15
5 Flow 5
1 1 Flow
13 Flow 13
2 Flow 2
14 Flow 14
16 16 Flow

Legend

- Flow Hydrants
- Residual Hydrants

Water Main Diameter (Inches)

- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 24"

SOCWA Water System

- Transmission Main

Pressure Districts

- High Pressure District
- Low Pressure District

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,235 Feet

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Appendix H
2015 Demand Scenarios - 2 Foot Pressure Contour Maps

2015 Average Daily Demand Pressure Contours

Royal Oak
Life Now Playing

Legend

Pressure (psi)

36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80

40
50
60
70
80

Pressure Districts

High Pressure District

Low Pressure District

N

N.T.S.

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BIRMINGHAM
TROY
CLAWSON
SOUTHFIELD TOWNSHIP
MADISON HEIGHTS
BERKLEY
SOUTHFIELD
OAK PARK
HUNTINGTON WOODS
ROYAL OAK TOWNSHIP
PLEASANT RIDGE
FERNDALE
HAZEL PARK

2015 Maximum Daily Demand Pressure Contours

Royal Oak
Life Now Playing

Legend

Pressure (psi)

36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80

40
50
60
70
80

Pressure Districts

High Pressure District

Low Pressure District

N

N.T.S.

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2015 Maximum Hourly Demand Pressure Contours

Royal Oak
Life Now Playing

Legend

Pressure (psi)

36	40
38	50
40	60
42	70
44	80
46	
48	
50	
52	
54	
56	
58	
60	
62	
64	
66	
68	
70	
72	
74	
76	
78	
80	

Pressure Districts

- High Pressure District
- Low Pressure District

N

N.T.S.

Johnson&Anderson

Appendix I
2035 Demand Scenarios - 2 Foot Pressure Contour Maps

2035 Average Daily Demand Pressure Contours

Royal Oak
Life Now Playing

Legend

Pressure (psi)

36	40
38	50
40	60
42	70
44	80
46	90
48	
50	
52	
54	
56	
58	
60	
62	
64	
66	
68	
70	
72	
74	
76	
78	
80	
82	
84	
86	
88	
90	

Pressure Districts

- High Pressure District
- Low Pressure District

N

N.T.S.

Johnson&Anderson

2035 Maximum Daily Demand Pressure Contours

BIRMINGHAM
CLAWSON
TROY
SOUTHFIELD TOWNSHIP
MADISON HEIGHTS
BERKLEY
SOUTHFIELD
OAK PARK
HUNTINGTON WOODS
ROYAL OAK TOWNSHIP
PLEASANT RIDGE
FERNDALE
HAZEL PARK

Royal Oak
Life Now Playing

Legend

Pressure (psi)

36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80

40
50
60
70
80

Pressure Districts

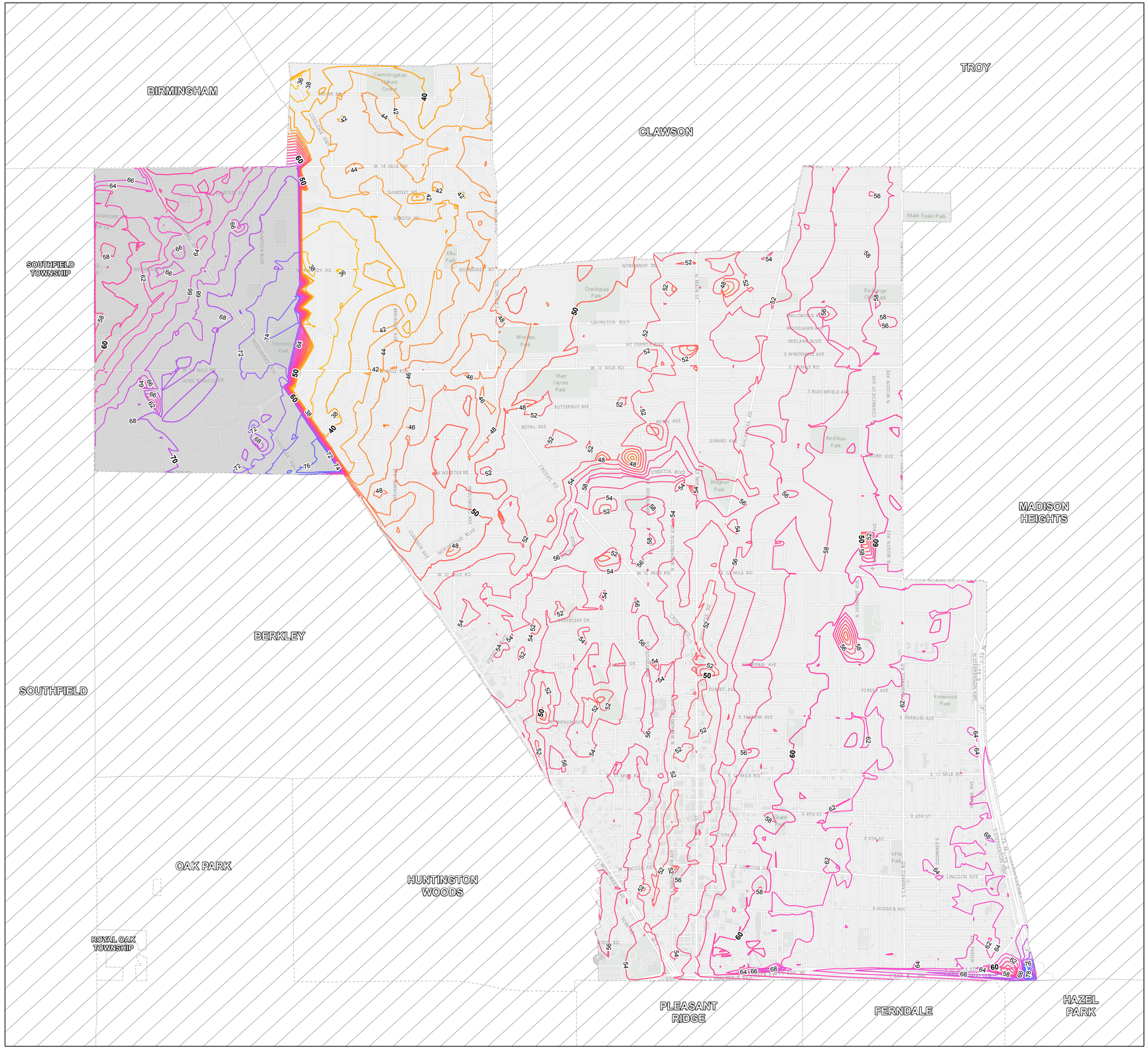
High Pressure District
Low Pressure District

N

N.T.S.

Johnson&Anderson

2035 Maximum Hourly Demand Pressure Contours



Royal Oak
Life Now Playing

Legend

Pressure (psi)

36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80

40
50
60
70
80

Pressure Districts

High Pressure District

Low Pressure District

N

N.T.S.

Johnson&Anderson

Appendix J
Water Main Upgrade Map 2016 - 2021

City of Royal Oak
Water Main Upgrade Map
2016-2021

Royal Oak
Life Now Playing

Legend

Water Main Replacement Schedule

- 2016
- 2017
- 2018
- 2019
- 2020
- 2021

Existing Lines

- Existing Lines

Pressure Districts

- High Pressure District
- Low Pressure District

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,200 Feet

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Appendix K
Water Main Breaks 1995 - 2014

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
73	CHIPPEWA	MAIN AND WASHINGTON	6"	CRACK AROUND	1/3/1995
2528	SHENANDOAH	WEBSTER & ABERDOVEY	6"	CRACK AROUND	1/6/1995
2224	HARWOOD	KENWOOD & HELENE	6"	CRACK AROUND	1/7/1995
1318	STEPHENSON S	DALLAS & BROCKTON	12"	SPLIT	1/10/1995
3327	WOODWARD N	WEST OF WOODWARD IN ALLEY	8"	CRACK AROUND	1/10/1995
1706	MAPLE N	12 MILE & WOODSBORO	6"	UNIVERSAL JOINT LEAK	1/13/1995
3650	BETSY ROSS	YORBA LINDA & AMHERST	6"	CRACK AROUND	1/13/1995
4307	VERONA CIRCLE S	GREENFIELD & FAIRMONT	6"	CRACK AROUND AT 4412	1/16/1995
2609	OLIVER	GLENWOOD & CROOKS	6"	CRACK AROUND	1/16/1995
810	REMBRANDT N	GARDENIA & FOREST	6"	BLOWOUT	1/23/1995
	FOURTH	WASHINGTON & LAFAYETTE	4"	CRACK AROUND	1/24/1995
112	JEFFREY	MAIN & WASHINGTON	6"	CRACK AROUND	1/28/1995
	CATALPA	OAKRIDGE	8"	BLOW-OUT	1/29/1995
	TWELVE MILE E	CONNECTICUT	8"	RUSTED BOLTS	1/31/1995
4331	WOODWARD N	NAKOTA & GRANDVIEW	6"	CRACK AROUND	2/4/1995
1107	KENWOOD	KENWOOD CT. & GARDENIA	6"	CRACK AROUND	2/5/1995
116	DORCHESTER S	11 MILE AND FOURTH	6"	CRACK AROUND	2/14/1995
1104	FOURTEEN MILE E	FERRIS AND VERMONT	8"	CRACK AROUND	2/15/1995
	BENJAMIN	AT 13 MILE	8"	CRACK AROUND	2/15/1995
1503	GENESEE	CAMPBELL AND VERMONT		RUSTED BOLTS	2/16/1995
4622	THORNCROFT	SAMOSET AND FOURTEEN	6"	CRACK AROUND	2/18/1995
505	LEXINGTON	CUSTER & WASHINGTON	6"	CRACK AROUND	2/21/1995
1913	CAMPBELL	REDRUN & HOUSTONIA		RUSTED BOLTS-LEAK	2/22/1995
	LINDEN	W OF EPL OF ROCHESTER RD	6"	BLOWOUT	3/13/1995
2416	FOURTEEN MILE E	LEAFDALE & BRIARWOOD	8"	CRACK AROUND	3/26/1995
3828	DEVON	CHESTER AND NORMANDY		RUSTED BOLTS - LEAKING	3/28/1995
721	EDGEWORTH S	SIXTH & LINCOLN	8"	U-JOINT LEAK	4/11/1995
	ELEVEN MI	WASHINGTON	6"	LEAK-INSTALLED NEW CROSS	4/23/1995
526	MAGNOLIA	BEECHWOOD & MARYWOOD	"	CRACK AROUND	6/7/1995
610	WOODWARD N	ELEVEN MILE & CATALPA	8"	BLOW-OUT	7/13/1995
818	WOODWARD N	11 MILE & CATALPA	8"	BLOW OUT	7/13/1995
3116	WARICK	WOODWARD & COOLIDGE	6"	SPLIT	8/9/1995
2224	CONNECTICUT N	HOUSTONIA & PARKDALE	6"	SPLIT	8/12/1995
1853	MASSOIT	CRESTHILL AND NAKOTA	6"	CRACK AROUND	9/18/1995
4136	SPRINGER	YORBA LINDA & PARKWAY	8"	CRACK AROUND	9/24/1995
3215	SYLVAN	13 MILE & POPLAR	6"	SERVICE BREAK FOR 3215	10/23/1995
4279	CROOKS	NORMANDY AND MANOR	8"	CRACK AROUND	11/12/1995
2908	MAPLEWOOD	ESSEX AND GLENWOOD	8"	CRACK AROUND	11/13/1995
	ELMHURST & NORM	BETWEEN KENT & LINWOOD	6"	CRACK AROUND	11/16/1995
410	CHARLOTTE	WASHINGTON & CUSTER	8"	CRACK AROUND	11/17/1995
1701	FOURTH E	CAMPBELL & EDISON	8"	U-JOINT LEAK	11/20/1995

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
3806	EDGELAND	GREENWAY AND NORMANDY	6"	RUSTED MJ BOLTS	11/21/1995
3111	HARVARD	WEBSTER AND ALBERT	8"	CRACK AROUND	11/28/1995
1014	KENWOOD N	GARDENIA & KENWOOD CT	6"	CRACK AROUND	12/4/1995
1031	KNOWLES	HARRISON & HUDSON	4"	CRACK AROUND	12/4/1995
1015	KNOWLES	HARRISON & HUDSON	4"	CRACK AROUND	12/4/1995
1613	AMELIA	CAMPBELL AND BLAIR	6"	CRACK AROUND	12/9/1995
4203	VERONA S	NORMANDY & FULTON PLACE	6"	CRACK AROUND	12/12/1995
3354	ELLWOOD	13 MILE AND JUDSON	6"	BLOWOUT (2 CLAMPS)	12/14/1995
4157	YORBA LINDA	ON FAIRMONT	6"	CRACK AROUND	12/15/1995
4460	SHERIDAN	ON GREENF.BET.SHER.&BUCK	8"	CRACK AROUND	12/19/1995
	MERRILL WEST OF	WOODWARD(WOOD.&COOLIDGE)	6"	CRACK AROUND	12/28/1995
	THIRTEEN MILE W	MAIN AND CROOKS	6"	CRACK AROUND	1/2/1996
1401	LINCOLN E	BETWEEN LINCOLN & 6TH	6"	CRACK AROUND	1/6/1996
615	THIRTEEN MI E	ACROSS FROM 615(MAIN&CROO	6"	CRACK AROUND	1/7/1996
4410	THIRTEEN MI E	ON GREENFIELD(13&SPRINGER	8"	CRACK AROUND	1/8/1996
508	BLAIR N	FARNUM & 11 MILE	6"	CRACK AROUND	1/8/1996
713	ST CHARLES	N OF 11 MI,W OF POTTER	6"	JOINT LEAK	1/9/1996
4519	DELEMERE	14 MILE & NORMANDY	8"	CRACK AROUND	1/13/1996
617	AMELIA	ROCHESTER & CAMPBELL	6"	CRACK AROUND	1/21/1996
3118	TRAFFORD	WOODARD & COOLIDGE	6"	CRACK AROUND	1/22/1996
904	WOODWARD N	CATALPA AND 11 MILE		JOINT LEAK	1/25/1996
720	ELEVEN MILE E	CAMPBELL & MAIN	8"	CRACK AROUND	1/29/1996
1820	VERMONT N	12 MILE AND HOUSTONIA	6"	BLOWOUT	1/31/1996
3330	ELLWOOD	THIRTEEN MILE & JUDSON	6"	CRACK AROUND	2/3/1996
1905	FOURTEEN MI E	ROSEWALD & SEDGEMOOR	8"	CRACK AROUND	2/8/1996
1105	OTTAWA	FERRIS AND VERMONT	8"	CRACK AROUND	2/10/1996
2120	WICKHAM	WEST OF CROOKS	6"	CRACK AROUND	2/23/1996
4119	FOURTEEN MILE W	COOPER AND WOODWARD	6"	CRACK AROUND	2/24/1996
4228	ROSEWOLD	NORMANDY & MASSOIT	8"	CRACK AROUND	2/24/1996
	AMELIA	NEC MAIN	6"	CRACK AROUND	2/28/1996
3506	HUNTER	WOODWARD & HAMPTON	6"	LEAK	5/16/1996
	WILLIAMS	BETWEEN 4TH AND FIFTH		LEAK	5/31/1996
3124	CONNECTICUT N	BLOOMFIELD & 13 MILE	8"	CRACK AROUND	7/30/1996
3002	LINWOOD		6"	CRACK AROUND	10/8/1996
3015	SYLVAN		6"	CRACK AROUND	10/15/1996
2008	KENWOOD COURT	KENWOOD & EDGEWORTH	6"	CRACK AROUND	10/18/1996
3203	PRAIRIE	WEBSTER & 13 MILE	8"	CRACK AROUND	10/23/1996
3205	PRAIRIE		8"	CRACK AROUND	10/23/1996
1427	POPLAR	EVERGREEN & CEDAR	6"	CRACK AROUND	10/27/1996
1427	POPLAR		6"	CRACK AROUND	10/28/1996
2210	CONNECTICUT N		6"	CRACK AROUND	10/29/1996

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
2224	CONNECTICUT N		6"	BLOWOUT	10/29/1996
2214	CONNECTICUT N		8"	CRACK AROUND	10/31/1996
818	BUTTERNUT		6"	BREAK AROUND	11/2/1996
4279	CROOKS		8"	CRACK AROUND	11/13/1996
5021	ELMHURST		8"	CRACK AROUND	11/13/1996
2303	WOODLAND		6"	CRACK AROUND	12/1/1996
4345	CROOKS		8"	CRACK AROUND	12/2/1996
3224	WILSON N		6"	CRACK AROUND	12/2/1996
4227	DELEMERE	60' N OF NORMANDY	8"	CRACK AROUND	12/10/1996
4104	COLONIAL		6"	CRACK AROUND	12/20/1996
2427	CAMPBELL N			JOINT LEAK	12/21/1996
2605	OLIVER		6"	CRACK AROUND	12/24/1996
2918	WILSON N		6"	CRACK AROUND	12/29/1996
1500	LEXINGTON	CROOKS	"	BLOWOUT (ON BOTTOM)	12/30/1996
1500	LEXINGTON	KIMBALL HIGH SCHOOL	6"	BLOWOUT	1/4/1997
1422	LINWOOD		6"	CRACK AROUND	1/15/1997
3362	PRAIRIE	100' NORTH OF ADDRESS	8"	CRACK AROUND AND BLOWOUT	1/18/1997
4353	DELEMERE		8"	CRACK ARUND	1/21/1997
1202	CLOVERDALE	FORESTDALE & HILLDALE	6"	CRACK AROUND	1/30/1997
2602	GLENVIEW		8"	CRACK AROUND	1/31/1997
1500	LEXINGTON	CROOKS	8"	JOINT LEAK & CRACK AROUND	2/1/1997
1500	LEXINGTON	CROOKS	6"	JOINT LEAK & CRACK AROUND	2/2/1997
3355	GARDEN	WEBSTER & 13 MILE	6"	CRACK AROUND	2/7/1997
3117	LINWOOD		6"	CRACK AROUND	2/8/1997
3921	PARKVIEW DRIVE	HILLSIDE & PARKWAY	6"	CRACK AROUND	2/17/1997
4609	CROOKS		8"	CRACK AROUND	2/21/1997
1214	HOUSTONIA W		6"	JOINT LEAK	3/1/1997
1710	CONNECTICUT N	GARDENIA & 12 MILE	6"	BLOWOUT	3/5/1997
709	THIRTEEN MI E		12"	CLAMP LEAKING	3/7/1997
1809	GARDENIA		6"	CRACK AROUND	3/10/1997
4049	NORMANDY	WOODWARD & GREENFIELD	8"	CRACK AROUND	3/12/1997
1500	LEXINGTON	KIMBALL HIGH SCHOOL	6"	BLOWOUT	4/18/1997
1513	FOURTH E	CAMPBELL & MAIN	8"	BLOWOUT	5/30/1997
	FOURTH	KNOWLES	8"	LATERAL CRACK	7/15/1997
2924	WOODWARD	BAMLET	6"	BLOWOUT	7/20/1997
2418	LINCOLN E		8"	BLOWOUT	7/21/1997
	WOODWARD	BEMBRIDGE	6"	BLOWOUT	7/21/1997
2922	TRAFFORD		6"	BLOWOUT	7/21/1997
2812	WOODWARD N		6"	CRACK AROUND	7/28/1997
719	MIDLAND		6"	CRACK AROUND	7/31/1997
908	MARYWOOD	CATALPA & AUSTIN	8"	CRACK AROUND	8/9/1997

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
908	MARYWOOD	CATALPA AND AUSTIN	8"	CRACK AROUND	8/9/1997
1302	FOURTH E	BLAIR	6"	CRACK AROUND	8/11/1997
1125	SHERMAN	BAKER & MAXWELL	6"	BLOWOUT	8/30/1997
415	SHERMAN	BAKER & JOSEPHINE	6"	BLOWOUT	8/31/1997
	SHERMAN	NE CORNER SHERMAN&BAKER	8"	BLOWOUT	8/31/1997
2122	WICKHAM		6"	CRACK AROUND	9/13/1997
4518	ROSEWOLD		6"	CRACK AROUND	9/14/1997
SWC	BEMBRIDGE	13 MILE ROAD	6"	CRACK AROUND	10/27/1997
2820	WOODSLEE	THIRTEEN MILE	8"	CRACK AROUND	10/30/1997
1222	FOURTH E	BLAIR	12"	CRACK AROUND	10/31/1997
	DEAD END OF	POPLAR (IN STARR PARK)	6"	BLOWOUT	10/31/1997
413	WOODLAWN		6"	BLOWOUT ON BOTTOM	11/1/1997
911	MCLEAN	LINCOLN/HUDSON	6"	THREE HOLE BLOW OUT	11/9/1997
1721	BONNIEVIEW		6"	BLOWOUT	11/12/1997
422	WALNUT		6"	BLOWOUT	11/12/1997
4605	COOLIDGE	NORMANDY & 14 MILE	6"	CRACK AROUND	11/13/1997
1318	STEPHENSON S		12"	CRACK AROUND	11/15/1997
1009	THIRTEEN MI E	ROCHESTER/CAMPBELL	12"	CRACK AROUND	11/18/1997
5015	ELMHURST	14 MI & MEIJER'S DRIVE	6"	CRACK AROUND	12/2/1997
3504	WEBSTER W	COOLIDGE & GREENFIELD	8"	CRACK AROUND	12/9/1997
3927	PARKVIEW		6"	CRACK AROUND	12/15/1997
3131	GUILFORD		6"	CRACK AROUND	12/20/1997
2201	MACE		6"	JOINT LEAK	12/22/1997
4208	FULTON PLACE S		6"	CRACK AROUND	12/25/1997
3826	DEVON	NORMANDY/CHESTER	6"	CRACK AROUND	12/29/1997
105	MAIN S	11 MILE & SECOND	4"	CRACK AROUND	12/30/1997
4219	SHERIDAN	GRANDVIEW & WRENFORD	4"	CRACK AROUND	1/4/1998
1217	FOURTH E	GAINSBOROUGH/REMBRANDT	8"	CRACK AROUND	1/18/1998
1128	GROVE	GARDENIA/12 MILE	6"	CRACK AROUND	1/20/1998
1307	ELEVEN MI E	CAMPBELL/MAIN	6"	CRACK AROUND	1/20/1998
1835	CHESTER	CROOKS/COOLIDGE	6"	CRACK AROUND	1/25/1998
609	ENGLEWOOD	ROCHESTER/ALEXANDER	6"	CRACK AROUND	1/26/1998
4600	COOLIDGE	NAKOTA & SAMOSET	8"	CRACK AROUND	1/27/1998
1423	MILLARD		8"	CRACK AROUND	2/2/1998
	MEMORIAL PARK		4"	HIT BY CONTRACTOR	2/5/1998
525	HELENE S		8"	JOINT LEAK	2/24/1998
3366	ELLWOOD	13 MILE & JUDSON	6"	CRACK AROUND	3/15/1998
500	STEPHENSON S	FOURTH & SIXTH	8"	CRACK AROUND	3/15/1998
314	THIRTEEN MI E	MAIN & WASHINGTON	6"	BLOW OUT	3/15/1998
4350	GROVELAND		6"	CRACK AROUND	5/8/1998
1519	THIRTEEN MI E		6"	JOINT LEAK	5/11/1998

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
30935	WOODWARD	COOLIDGE & GUILDFORD		CRACK AROUND	5/18/1998
2128	CONNECTICUT N		6"	JOINT LEAK	5/19/1998
719	VERMONT S		6"	CRACK AROUND	5/24/1998
32515	WOODWARD		6"	BLOWOUT	6/18/1998
523	EDISON S	4TH/LINCOLN	6"	CRACK AROUND	6/23/1998
1501	CATALPA		8"	BLOWOUT	6/26/1998
1500	CATALPA				6/27/1998
1139	FARNUM W		6"	CRACK AROUND	6/28/1998
32609	WOODWARD		6"	CRACK AROUND	7/2/1998
3234	ALBERT	DEAD END OF ALBERT	6"	CRACK AROUND	7/9/1998
1002	SYMES COURT		6"	CRACK AROUND	7/14/1998
1717	ELEVEN MI E	BETWEEN CAMPBELL & STEPH.	6"	CRACK AROUND	7/23/1998
623	GOLF	ARDMORE AND DEAD END	6"	CRACK AROUND	7/23/1998
633	DORCHESTER S	SIXTH AND LINCOLN	8"	JOINT LEAK	7/24/1998
423	EDISON S		6"	CRACK AROUND	7/29/1998
1725	GARDENIA	CAMPBELL AND STEPHENSON	6"	BLOW OUT	8/1/1998
3214	BELLE COURT	WEST OF COOLIDGE	6"	CRACK AROUND	8/3/1998
3220	NORMANDY	WOODWARD AND COOLIDGE	8"	CRACK AROUND	8/8/1998
1832	GREENLEAF		4"	CRACK AROUND	8/19/1998
1409	WYANDOTTE		6"	CRACK AROUND	8/19/1998
4605	COOLIDGE		8"	CRACK AROUND	8/28/1998
1617	TWELVE MI E			JOINT LEAK-REPLACED BOLTS	9/3/1998
	SB RAMP TO I-75	FROM WB 696	6"		9/12/1998
2220	CONNECTICUT N		6"	CRACK (LATERAL)	9/30/1998
2210	CONNECTICUT N		6"	BLOWOUT	9/30/1998
2214	CONNECTICUT N		6"	LATERAL CRACK	9/30/1998
1308	TWELVE MI E		6"	BLOWOUT	10/4/1998
1106	HILLDALE		6"	BLOWOUT	10/19/1998
3608	MARK ORR		6"	JOINT LEAK	10/21/1998
531	HARRISON E		4"	CRACK AROUND	10/25/1998
1305	E. FIFTH		6"	BROKE MAIN- BLOWOUT	10/28/1998
4158	HIGHFIELD		6"	BROKE MAIN- CRACK ARND	11/2/1998
121	EDMUND		6"	BROKE MAIN- CRACK ARND	11/8/1998
619	FAIRWAY		6"	BROKE MAIN- CRACK ARND	11/22/1998
4115	CROOKS		12"	JOINT LEAK	11/25/1998
1020	NORMANDY		6"	BROKE MAIN- LAT CRACK	12/1/1998
2307	W. 14 MILE		8"	BROKE MAIN- CRACK ARND	12/15/1998
402	W SUNNYBROOK			BROKE MAIN- CRACK ARND	12/23/1998
1509	ENGLEWOOD		6"	BROKE MAIN- CRACK ARND	12/24/1998
1419	GENESEE		6"	BROKE MAIN- CRACK ARND	12/25/1998
4404	BRIARWOOD		6"	BROKE MAIN- CRACK ARND	12/25/1998

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
3338	PRAIRIE			BROKE MAIN- CRACK ARND	12/27/1998
3502	MAIN N			WMB	12/27/1998
30903	WOODWARD			WMB	1/1/1999
3124	BLAIR N		8"	WMB	1/2/1999
3211	GWEN CT		6"	WMB	1/7/1999
1108	12 MILE E		6"	WMB	1/8/1999
3350	GREENFIELD		8"	WMB	1/9/1999
3644	BETSY ROSS		6"	WMB	1/9/1999
30776	WOODWARD		6"	WMB	1/9/1999
1002	WEBSTER W		6"	WMB	1/9/1999
4614	THORNCROFT		6"	WMB	1/14/1999
2210	CONNECTICUT N		6"	WMB	1/16/1999
2109	HUDSON E		6"	WMB	1/17/1999
4203	VERONA S		6"	WMB	1/17/1999
2605	14 MILE W		8"	WMB	1/18/1999
2829	14 MILE W		8"	WMB	1/19/1999
4279	CROOKS		8"	WMB	1/19/1999
30983	WOODWARD		6"	WMB	1/23/1999
1603	WINDEMERE E		6"	WMB	1/23/1999
3115	EVERGREEN		6"	WMB	1/24/1999
806	MAGNOLIA		6"	WMB	1/25/1999
1327	4TH E		8"	WMB	1/25/1999
26998	WOODWARD		6"	WMB	1/26/1999
26998	WOODWARD		6"	WMB	1/27/1999
30852	WOODWARD		6"	WMB	1/31/1999
728	VERMONT N		6"	WMB	2/10/1999
4403	ROBINWOOD		8"	WMB	2/19/1999
1920	BELLAIRE			WMB	2/22/1999
2230	ELMHURST		6"	WMB	2/25/1999
4350	GROVELAND		6"	WMB	2/25/1999
29582	WOODWARD		8"	WMB	3/12/1999
2051	ELMHURST		8"	WMB	4/1/1999
1009	BAUMAN		8"	WMB	4/16/1999
2119	CAMPBELL N		8"	WMB	4/19/1999
2119	CAMPBELL N		8"	WMB	4/21/1999
519	EDISON S		6"	WMB	5/5/1999
25901	WOODWARD		12"	WMB	5/7/1999
830	LOCKWOOD		6"	WMB	6/7/1999
	WELLESLEY	& YALE		JOINT LEAK	6/9/1999
302	12 MILE E			12" TEE HIT BY CONTRATOR	6/21/1999
1711	11 MILE E		6"	BROKEN MAIN	7/17/1999

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
611	DORCHESTER S			JOINT LEAK	7/19/1999
2027	CAMPBELL N			BROKEN MAIN	8/3/1999
25980	YORK		6"	BROKEN MAIN	8/4/1999
1608	CONNECTICUT N	12&GARDENIA		REPAIR BRKN MAIN	8/6/1999
1607	GENESEE	CAMPBELL & ROCHESTR		REPAIR BRKN MAIN	8/8/1999
2412	HAWKINS	CARMEN & WEBSTER		REPAIR BRKN MAIN	8/19/1999
1017	VINSETTA	WOODWD & LAWNDALE		BROKEN MAIN	9/23/1999
2012	GLENWOOD	GLENWOOD		BROKEN 6" WATERMAIN	9/26/1999
1870	CHESTER	DEVON & DURHAM		BROKEN 6" WATERMAIN	10/7/1999
422	WALNUT	WASHINGTON & MARYWD		BROKEN 6" MAIN	10/8/1999
3944	HIGHFIELD	PARKWY & HILLDSIDE		BROKEN 6" WATERMAIN	10/10/1999
917	AMELIA	ALEXANDER & BLAIR		REPAIR 6" BROKEN MAIN	10/14/1999
3611	CROOKS	13 MI & LEXINGTON		REPAIR 6" MAIN	10/26/1999
1805	11 MILE E	N CAMPBELL & STEPHENSON		REPAIR BROKEN MAIN	11/1/1999
3010	FERRIS	BLOOMFLD & DEVILLEN		REPAIR BROKEN MAIN	11/7/1999
1526	SYCAMORE	EVERGRN & NORHTWD		REPAIR BROKEN MAIN	11/8/1999
2309	VINSETTA	CROOKS & MARAIS		REPAIR BROKEN MAIN	11/15/1999
3531	DURHAM	ACROSS FROM		BLOW OUT REPAIR MAIN	11/23/1999
422	WALNUT	WDWD & WASHINGTON		BLOW OUT REPAIR MAIN	11/23/1999
422	WALNUT	MARYWD & WASH		BROKEN 6" MAIN	11/23/1999
3626	CHESTER	WDWD & COOLIDGE		CRACK AROUND MAIN	12/5/1999
4602	THORNCROFT	14 MI & NAKOTA		REPAIR BROKEN MAIN	12/6/1999
1205	GENESEE	ROCH & CAMPBELL		REPAIR BROKEN MAIN	12/6/1999
1120	14 MILE E	FERRIS&VERMONT		BROKEN MAIN	12/13/1999
1707	GARDENIA	CAMPBELL&EDISON		BROKEN MAIN	12/17/1999
3314	NORMANDY	WDWD&COOLIDGE		BROKEN MAIN	12/26/1999
4287	CROOKS	NORMANDY&14 MILE		BROKEN MAIN	12/26/1999
927	OTTAWA	ROCH&FERRIS		BROKEN MAIN	12/27/1999
1123	LEXINGTON	MARIAS&CROOKS		BROKEN MAIN	12/27/1999
818	MARYWOOD	11 MI & CATALPA		REPAIR BROKEN MAIN	12/30/1999
4127	EDGAR	COOLIDGE & CROOKS		REPAIR BROKEN MAIN	12/30/1999
818	MARYWOOD	11 MI & MAIN		BROKEN MAIN	12/31/1999
914	LLOYD	CROOKS & MAIN		BROKEN MAIN	12/31/1999
2715	WEBSTER W	WDWD & CROOKS		BROKEN MAIN	1/1/2000
2215	HUDSON E	CAMPBELL&STEPHENSON		BROKEN MAIN	1/1/2000
3722	DURHAM	CROOKS&DURHAM		BROKEN MAIN	1/2/2000
2212	BROCKTON	KENWOD&HELENE		BROKEN MAIN	1/5/2000
3903	COOLIDGE	CHESTER & NORMANDY		REPAIR BROKEN MAIN	1/6/2000
4450	BERKSHIRE	WDWD & GREENFIELD		REPAIR BROKEN MAIN	1/8/2000
3902	DEVON	NORMANDY&CHESTER		REPAIR BROKEN MAIN	1/11/2000
27844	WOODWARD	CATALPA&OAKRIDGE		BROKEN MAIN	1/17/2000

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
4009	PARKVIEW	PARKWAY & HILLSIDE		BROKEN MAIN	1/20/2000
4325	DELEMERE	NORMANDY&DELEMERE CT		BROKEN MAIN	1/21/2000
29	CHIPPEWA	MAIN& WASHINGTON		BROKEN MAIN	1/21/2000
3034	MARAIS	POPLAR&BUTTERNUT		BROKEN MAIN	1/22/2000
909	FOURTH E	CAMPBELL&MAIN		BROKEN MAIN	1/25/2000
2115	HARVARD	STEPHENSON&CAMPBELL		BROKEN MAIN	1/26/2000
3534	MARK ORR	13 MI & NORMANDY		JOINT LEAK	1/28/2000
432	13 MILE W	MAIN&CROOKS		BROKEN MAIN	1/28/2000
728	BLAIR N	11 MI & GARDENIA		BROKEN MAIN	1/29/2000
1011	WILSON S	HUDSON&LINCOLN		REPAIR 6" MAIN	1/31/2000
900	GAINSBRO N	11 MI & GARDENIA		WATER LEAK	2/2/2000
30852	WOODWARD	COOLIDGE & SAGAMORE		BROKEN MAIN 6"	2/5/2000
4130	ROCHESTER	WHITCOMB & MILLARD		BROKEN MAIN	2/6/2000
1607	ENGLEWOOD	CAMPBELL&BLAIR		BROKEN MAIN 6"	2/6/2000
3132	MERRILL	COOLIDGE&WOODWARD		BROKEN MAIN 5	2/7/2000
226	DORCHESTER S	11 MI & 4TH		BROKEN MAIN	2/12/2000
1824	FOURTEEN W	CROOKS&SEDGEMOOR		BROKEN MAIN	2/15/2000
816	SYMES	GARDENIA & FOREST		BROKEN MAIN	2/15/2000
1817	LINCOLN E			BROKEN MAIN	2/15/2000
4722	GROVELAND			BROKEN MAIN	2/16/2000
1410	EDGEWOOD			BROKEN MAIN	2/16/2000
3310	HUNTER	HAMPTON&MANDALAY		BROKEN 6" MAIN	3/24/2000
1713	LINCOLN			REPAIR MAIN BREAK	5/18/2000
2112	VERMONT N			BROKEN MAIN	6/19/2000
3006	CROOKS			BROKEN MAIN	7/25/2000
302	ENGLEWOOD	ROCH & GLENDALE		ROCH & GLENDALE	8/29/2000
	PLEASANT&4TH			REPAIR BROKEN MAIN	9/7/2000
	4TH&PLEASANT			REPAIR BROKEN MAIN	9/13/2000
		NORMANDY/PARKWAY		BROKEN 8" MAIN	9/25/2000
1421	11 MILE E			BROKEN 8" MAIN	10/7/2000
1600	CAMPBELL N			REPAIR FIRE LINE TO DPS	11/1/2000
5025	ELMHURST			REPAIR BROKEN MAIN	11/11/2000
		ENGLWD & ROCHESTER		REPR. BROKEN MAIN	11/19/2000
	ROCHESTER	& ENGLEWOOD		REPAIR BROKEN MAIN	11/20/2000
2427	14 MILE W	LEAFDALE & BRIARWOOD		REPAIR BROKEN MAIN	11/25/2000
641	AMELIA	ROCH & BLAIR		REPR. BROKEN MAIN	11/26/2000
1209	ENGLEWOOD	BLAIR & CAMPBELL		REPAIR BROKEN MAIN	11/30/2000
3216	MAPLEWOOD	13 MI & ESSEX		REPAIR BROKEN MAIN	12/10/2000
3025	14 MILE W	E OF RR TRACKS		REPAIR BROKEN MAIN	12/11/2000
4062	13 MI W	IN ALLEY	6"	BROKEN WATER MAIN	12/18/2000
3010	LINWOOD	LINWOOD CT & GLENWOOD		MAIN BREAK	1/1/2001

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	DELEMERE BLVD	N OF NORMANDY		BROKEN 8" MAIN	1/2/2001
3135	PRAIRIE	WEBSTER & ALBERT		BROKEN 8" MAIN	1/2/2001
503	AMELIA	ROCH & BELLEVUE		BROKEN 6" MAIN	1/7/2001
	COOLIDGE	ISLD BET E COOL/W WDWD		BROKEN MAIN	1/8/2001
	FOREST	NE CORNER CAMPBELL		BROKEN MAIN	1/9/2001
3306	ELLWOOD	13 MI & JUDSON		REPR. BROKEN MAIN	1/12/2001
5138	ARLINGTON	GRANDVW&PARKWAY		BROKEN 6" MAIN	1/15/2001
2926	BLAIR N	DEVILLEN/BLOOMFIELD		BROKEN 8" MAIN	1/22/2001
	CUMMINGS	13 MI & ALLEY S OF 13 MILE		REPAIR 6" MAIN	2/8/2001
	14/THORNCROFT	SEC		REPAIR MAIN 6X8 TEE	2/18/2001
	LEAFDALE	100' S OF 14 MILE	6"	MAIN JOINT LEAK	2/28/2001
	EDGEWORTH S	75' S OF 11 MILE	8"	MAIN JOINT LEAK	3/14/2001
1104	14 MILE E		8"	MAIN BREAK REPAIR	4/2/2001
2701	CAMPBELL N		8"	MAIN JOINT LEAK	4/19/2001
29862	WOODWARD	S. OF WEBSTER	8"	MAIN HORIZONTAL CRACK	5/1/2001
708	LINCOLN W	W. OF PLEASANT	8"	WMB	6/14/2001
1403	Poplar	E. of Evergreen	6"	WMB	7/10/2001
1009	13 Mile E	E. of Alexander	8"	Main Blow-out	7/30/2001
718	6th E	grant park	6"	WMB	8/24/2001
1421	Catalpa	at Maplegrove	8"	WMB	9/18/2001
3219	Garden	n of albert	6"	WMB	10/1/2001
511	Lafayette S	n of 6th	6"	WMB	10/9/2001
4116	Custer	s of Normandy	8"	WMB	10/14/2001
	Coolidge- w side	s of Samoset	8"	WMB	10/23/2001
1423	Poplar	e of Evergreen	6"	WMB	10/24/2001
618	Dorchester N	n of Farnum	8"	WMB	10/26/2001
	Bembridge	at Eton Cross	6"	WMB	10/26/2001
1842	Shire Ct.	e of Coventry	6"	WMB	10/29/2001
4115	Crooks	s of Normandy	12"	joint leak on main	10/31/2001
4636	Rochester	s of Genesee	8"	WMB	11/5/2001
3614	Betsy Ross	n of Yorba Linda	6"	WMB	11/16/2001
	Albert	w of alley- w of Woodward	8"	WMB	11/17/2001
306	13 mile W	e of washington	6"	WMB	11/20/2001
835	Farnum W	at Maxwell	4"	WMB	11/27/2001
3420	Fairmont	n of 13 mile	6"	WMB	12/1/2001
3156	Warick	e of Coolidge	6"	WMB	12/4/2001
2440	Parmenter	at Briarwood	6"	WMB	12/15/2001
	Wilson	75' n of Lincoln	6"	WMB	12/17/2001
2018	Kenwood Ct.	n of Gardenia	6"	WMB	12/19/2001
1503	Huron	e of Vermont	6"	WMB	12/30/2001
2311	Torquay	w of Elmhurst	8"	WMB	1/6/2002

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
25901	Woodward	s of Lincoln	8"	WMB	1/9/2002
	Maple	& Sherman	4"	WMB	1/9/2002
728	Blair N	s of Forest	8"	WMB	1/10/2002
4136	Colonial	w of Parkway	6"	WMB	1/12/2002
2530	Washington N	s of Webster	6"	WMB	1/16/2002
2902	Woodland	s of Woodland Ct.	6"	WMB	1/18/2002
1121	3rd E	w of Blair	6"	WMB	1/20/2002
nec	Shire Ct.	at Coventry	6"	WMB	1/23/2002
5116	Elmhurst	n of Torquay	6"	WMB	1/24/2002
	Laplaza	w of Main	8"	WMB	1/26/2002
3010	Sylvan	n of Butternut	6"	WMB	1/28/2002
705	St Charles	w of Potter	6"	WMB	1/28/2002
	Campbell	n of Ottawa	4"	WMB - Mark Twain service	2/5/2002
sec	Rochester	at Genesee	8"	WMB	2/12/2002
3112	Trafford	e of Coolidge	6"	WMB	2/23/2002
2307	4th E	e of Helene	8"	WMB	2/26/2002
	Garden	s of 13 Mile	6"	WMB	3/5/2002
4612	Rosewold	n of Samoset	6"	WMB	3/20/2002
30959	Woodward	behind nrthwd shop center	8"	WMB	3/26/2002
	Rochester	at Genesee	8"	WMB	3/28/2002
	Greenleaf	at Forestdale	6"	WMB	3/28/2002
	14 Mile W	e of Coolidge	8"	WMB	4/15/2002
929	11 Mile W	e of Oak	6"	WMB	5/13/2002
	Campbell	n of Gardenia- at Apts.	4"	WMB	6/21/2002
810	Rembrandt N	s of Gardenia	6"	WMB	6/24/2002
422	Austin	e of Marywood	6"	WMB	7/2/2002
410	Campbell N	n of Taylor	6"	WMB	7/2/2002
400	Campbell N	n of Taylor	6"	WMB	7/2/2002
410	Campbell N	n of Taylor	6"	WMB	7/3/2002
435	Girard	e of Rochester	8"	WMB	7/5/2002
4710	Rosewold	s of 14 Mile	6"	WMB	7/6/2002
nwc	Girard	at Rochester	6"	WMB	7/8/2002
335	Midland	w of Rochester	6"	WMB	7/10/2002
4733	Mandalay	at 14 mile	6"	WMB	7/18/2002
1711	11 mile E	e of Campbell	6"	WMB	7/19/2002
nwc	Laplaza	at Main	6"	WMB	7/24/2002
	Bembridge	e of Woodward	6"	WMB	7/26/2002
721	Dorchester S	n of Lincoln	8"	WMB	8/6/2002
520	13 Mile W	at Columbus	6"	WMB	8/14/2002
1619	Ottawa	w of Campbell	8"	WMB	8/26/2002
4628	Thorncroft	s of 14 Mile	6"	WMB	9/5/2002

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
621	Edison S	s of 6th	6"	WMB	9/9/2002
nwc	Main S	n of 5th	8"	WMB	9/10/2002
2210	Sprague	e of Minerva	6"	WMB	9/19/2002
3502	Main N	n of Midland	8"	WMB	9/19/2002
	Detroit	e of Ardmore	6"	WMB	9/20/2002
902	14 Mile E	e of Rochester	8"	WMB	9/23/2002
	Connecticut	at 13 mile	8"	WMB	9/30/2002
	Lloyd	at Lyons	6"	WMB	10/11/2002
1713	Maple N	s of 12 Mile	6"	WMB	10/11/2002
nec	Verona Circle N	Fulton Place N	8"	WMB	10/15/2002
sec	Marywood	at Walnut	8"	WMB	10/19/2002
1613	Poplar	e of Crooks	6"	WMB	10/19/2002
	Normandy	at Benjamin	8"	WMB	10/20/2002
	14 Mile	at Elmhurst	8"	WMB	10/22/2002
	Stephenson	at Middlesex	8"	WMB	10/23/2002
4903	Delemere	n of 14 Mile	8"	WMB	10/23/2002
2220	Cooper	n of Massoit	8"	WMB	10/24/2002
3214	Belle Ct	w of Coolidge	6"	WMB	10/24/2002
3216	Belle Ct	w of Coolidge	6"	WMB	10/24/2002
3224	Warick	w of Coolidge	8"	WMB	10/25/2002
swc	Vermont	at 6th	6"	WMB	10/27/2002
613	Detroit	e of Ardmore	6"	WMB	10/28/2002
	Detroit	80' e of Ardmore	6"	WMB	10/29/2002
4012	Devon	s of Normandy	6"	WMB	10/30/2002
216	Jeffrey	w of Main	6"	WMB	10/30/2002
	Blair	at 4th	6"	WMB	11/3/2002
4402	Buckingham	at Wrenford	6"	WMB	11/3/2002
3704	Durham	s of Chester	6"	WMB	11/5/2002
4204	Springer	e of Yorba Linda	8"	WMB	11/5/2002
2123	Campbell N	n of Houstonia	8"	WMB	11/6/2002
4408	Woodland	n of Nakota	8"	WMB	11/7/2002
nwc	Stephenson	at 11 Mile	8"	WMB	11/9/2002
1601	Millard	w of Campbell	8"	WMB	11/9/2002
2020	4th E	w of Edgeworth	12"	WMB	11/11/2002
2519	Campbell N	n of Girard	8"	WMB	11/12/2002
swc	Marywood	at Walnut	8"	WMB	11/14/2002
520	13 Mile W	at Columbus	8"	WMB	11/14/2002
2914	Ferris	n of DeVillen	6"	WMB	11/15/2002
	Hunter	alley e of Woodward	6"	WMB	11/24/2002
4820	Briarwood	n of 14 Mile	6"	WMB	11/30/2002
	4th	e of Minerva	12"	WMB	12/2/2002

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
4038	Webster W	e of Garden	8"	WMB	12/2/2002
1312	Montrose	e of Blair	6"	WMB	12/3/2002
	Campbell N	n of Gardenia	6"	WMB	12/3/2002
	Custer	at Lexington	8"	WMB	12/3/2002
4018	Edgar	s of Normandy	6"	WMB	12/4/2002
1121	4th E	w of Blair	8"	WMB	12/6/2002
3620	Betsy Ross	n of Yorba Linda	6"	WMB	12/7/2002
2332	Hawkins	s of Carmen	6"	WMB	12/7/2002
3860	Hillside Ct.	e of Hillside	6"	WMB	12/8/2002
nec	Ravena	at Chester	4"	WMB	12/9/2002
4234	Hampton	n of Normandy	8"	WMB	12/9/2002
824	Altadena N	s of Gardenia	6"	WMB	12/12/2002
1422	14 Mile E	w of Campbell	8"	WMB	12/15/2002
412	Jeffrey	w of Washington	6"	WMB	12/19/2002
1009	4th St E	w of Gainsborough	8"	WMB	12/19/2002
	Connecticut N	in Lockman Park	6"	WMB	12/21/2002
4240	Mankato	n of Normandy	6"	WMB	12/21/2002
3111	Garden	n of Webster	6"	WMB	12/23/2002
105	Mt Vernon	w of Main	6"	WMB	12/27/2002
1125	Sherman	w of Maxwell	6"	WMB	12/30/2002
722	12 Mile E	at Cody	12"	WMB	12/31/2002
	Lincoln	w of Woodward	8"	WMB	1/1/2003
721	Dorchester S	n of Lincoln	8"	WMB	1/2/2003
1616	4th E	w of Campbell	12"	WMB	1/4/2003
	Greenleaf	at Fairlawn	4"	WMB	1/5/2003
2015	Vinsetta	n of Houstonia	6"	WMB	1/7/2003
1909	4th E	w of Kenwood	8"	WMB	1/9/2003
4410	Rosewold	n of Nakota	6"	WMB	1/10/2003
614	Rembrandt N	n of Farnum	6"	WMB	1/10/2003
1012	Woodsboro	e of Hilldale	6"	WMB	1/12/2003
215	5th W	e of Washington	6"	Fireline WMB	1/12/2003
	Ravena	75' w of Woodward	4"	WMB	1/12/2003
820	Blair N	n of Forest	8"	WMB	1/13/2003
4108	Coolidge	s of Normandy	8"	joint leak- WMB	1/14/2003
1500	Lexington	n side of Kimball	6"	WMB	1/15/2003
1609	Woodlawn	w of Campbell	8"	WMB	1/16/2003
4819	Elmhurst	n of 14 Mile	8"	joint leak- WMB	1/16/2003
2610	Ferncliff	n of Webster	6"	joint leak- WMB	1/17/2003
1206	Edgewood	n of Derby	6"	WMB	1/18/2003
4600	Leafdale	n of Samoset	6"	joint leak- WMB	1/21/2003
3219	Prairie	n of Albert	8"	WMB	1/21/2003

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
1620	Northwood	w of R.R.	6"	WMB	1/22/2003
2517	Oliver	n of Webster	8"	WMB	1/25/2003
906	Mayfield	w of Maxwell	6"	WMB	1/25/2003
	Benjamin	n of R.R.	8"	WMB	1/26/2003
1819	Brockton	e of Campbell	8"	WMB	1/27/2003
4107	Auburn	w of Parkway	6"	WMB	1/27/2003
	Parkway	s of Amherst	8"	joint leak- WMB	1/28/2003
	Mandalay	s of Chester	6"	WMB	1/28/2003
2427	Linwood	s of Webster	6"	WMB	1/28/2003
nec	Northwood	at Galpin	6"	WMB	1/29/2003
nwc	Girard	at Vermont	6"	WMB	1/29/2003
1307	Poplar	e of Evergreen	6"	WMB	1/30/2003
1926	Vinsetta	n of 12 mile	4"	WMB	1/30/2003
3408	Ravena	e of Hampton	6"	WMB	1/31/2003
826	Marywood	n of Austin	8"	WMB	1/31/2003
1204	Montrose	at Blair	6"	WMB	1/31/2003
2461	Brockton	w of Stephenson	8"	WMB	2/4/2003
	Helene	n of Harwood	8"	replace bad clamp- WMB	2/5/2003
4714	Mandalay	s of 14 mile	6"	WMB	2/7/2003
520	13 Mile W	at Columbus	6"	WMB	2/8/2003
105	Houstonia E	e of Main	4"	WMB	2/10/2003
2906	Altadena N	n of Devillen	8"	WMB	2/10/2003
905	Genesee	e of Rochester	8"	WMB	2/12/2003
602	12 Mile E	at Ardmore	12"	WMB	2/13/2003
511	Amelia	w of Rochester	6"	WMB	2/13/2003
705	Edgeworth S	n of Lincoln	8"	joint leak- WMB	2/14/2003
	Chester	e of Durham	6"	WMB	2/14/2003
3130	Linwood	e of Elmhurst	6"	WMB	2/14/2003
227	Windemere E	w of Glendale	6"	WMB	2/15/2003
25901	Woodward	s of Lincoln	8"	WMB	2/17/2003
4041	Dukeshire	s of Normandy	4"	WMB	2/17/2003
1012	Vermont N	n of Gardenia	6"	WMB	2/18/2003
	Bembridge	s of 13 Mile	6"	WMB	2/18/2003
	Blair	s of Amelia	8"	WMB	2/18/2003
2818	Elmhurst	Glenwood	8"	WMB	2/19/2003
4115	Crooks	s of Normandy	12"	joint leak- WMB	2/20/2003
nec	Lockwood	at Crane	6"	WMB	2/24/2003
30402	Woodward	n of Bembridge	6"	WMB	2/25/2003
1216	Royal	e of Cedar	8"	WMB	2/28/2003
119	Houstonia E	e of Main	4"	WMB	3/2/2003
2303	Campbell N	s of Parkdale	8"	joint leak- WMB	3/3/2003

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
119	Pingree	w of Fairgrove	6"	WMB	3/4/2003
716	Blair N	s of Forest	8"	WMB	3/5/2003
	Minerva S	n of 4th	6"	joint leak- WMB	3/6/2003
1006	Symes Ct	n of Gardenia	6"	WMB	3/9/2003
30122	Woodward	n of Burnham	6"	WMB	3/10/2003
2603	Aberdovey	w of Shenandoah	6"	WMB	3/11/2003
603	Devillen	e of Ardmore	6"	WMB	3/14/2003
nec	Lincoln	at Pleasant	8"	WMB	3/16/2003
900	Irving	s of Lincoln	6"	WMB	3/20/2003
515	Edison S	s of 4th	6"	joint leak- WMB	3/21/2003
113	Minerva S	s of 11 Mile	6"	WMB	3/22/2003
402	Sunnybrook W	w of Washington	6"	WMB	3/27/2003
	Memorial Park	n of Starr	4"	WMB	3/27/2003
1718	Houstonia W	w of Evergreen	4"	WMB	4/3/2003
	6th E	at Irving	6"	WMB	4/15/2003
3266	Greenfield	s of Judson	8"	joint leak- WMB	4/16/2003
4710	Rosewold	s of 14 mile	6"	WMB	5/2/2003
512	13 Mile W	w of Washington	6"	WMB	6/25/2003
423	Dorchester S	s of 4th	8"	WMB	6/29/2003
501	Helene	s of 4th	8"	WMB	7/21/2003
nec	Englewood	at Blair	6"	WMB	7/29/2003
3616	Normandy	e of Olivia	8"	WMB	7/30/2003
3844	Ravena	w of Woodward	4"	WMB	8/14/2003
2009	Bellaire	w of Edgeworth	6"	WMB	8/18/2003
nec	Warick	e of Coolidge	6"	WMB	8/24/2003
1126	Murdock	e of Lloyd	6"	WMB	8/25/2003
2402	Crooks	n of Vinsetta	8"	WMB	8/27/2003
4905	Crooks	n of Parmenter	8"	WMB	9/10/2003
503	Lloyd	w of Marywood	6"	WMB	9/26/2003
4112	Seminole	n of Normandy	4"	WMB	10/10/2003
	Woodsboro	w of Hilldale	6"	WMB	10/11/2003
3218	Belle ct	w of Coolidge	6"	WMB	10/28/2003
623	Golf	e of Ardmore	6"	WMB	10/29/2003
2448	Ardmore	on Detroit	6"	WMB	11/6/2003
4035	Auburn	e of Parkway	6"	WMB	11/8/2003
swc	11 mile E	at Stephenson	8"	joint leak- WMB	11/10/2003
1870	Chester	e of Durham	6"	WMB	11/12/2003
1901	Wickham	w of Crooks	8"	WMB	11/17/2003
30991	Woodward	s of 13 mile	8"	WMB	11/18/2003
2008	Alicia	s of Lloyd	6"	WMB	11/18/2003
nec	Lincoln W	Pleasant S	8"	WMB	12/3/2003

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	13 Mile E	Altadena N	8"	WMB	12/6/2003
716	Blair N	s of Forest	8"	WMB	12/7/2003
sec	14 Mile W	Campbell N	8"	WMB	12/11/2003
	Custer	n of Mt Vernon	8"	WMB	12/12/2003
609	Englewood	e of Rochester	6"	WMB	12/13/2003
1229	4th E	w of Blair	8"	WMB	12/31/2003
812	Dorchester N	n of Forest	6"	small hole in top of pipe	1/1/2004
1201	Millard	at Blair	8"	crack around	1/5/2004
	Maple N	s of 12 Mile	6"	bad u-joint, replaced 8' of pipe	1/6/2004
	Manor	w of Crooks	6"	crack around	1/7/2004
nec	Lawndale	at Fernwood	6"	short lateral crack	1/8/2004
1800	14 Mile W	w of Crooks	8"	crack around	1/10/2004
1800	14 Mile W	e of Sedgemoor	8"	crack around	1/11/2004
1403	Lexington	e of Crooks	6"	crack around	1/13/2004
304	Royal	w of Main	6"	crack around	1/16/2004
3259	Prairie	n of Albert	8"	crack around	1/19/2004
2120	Wickham	w of Crooks	6"	blowout on side- 2" dia	1/20/2004
	Lonfellow	at Hudson	4"	crack around	1/20/2004
906	Campbell S	s of Lincoln	8"	blowout on top- 4 holes	1/21/2004
4103	Buckingham	w of Cooper	6"	crack around	1/22/2004
1821	Lincoln E	w of Dorchester	8"	short lateral crack	1/24/2004
612	Hudson E	e of Woodward	4"	pipe offset 2"- crack around	1/25/2004
nec	Robinwood	at Nakota	8"	crack around	1/27/2004
5025	Elmhurst	n of Parmenter	8"	crack around	2/3/2004
1134	Campbell N	n of Gardenia	4"	crack around	2/3/2004
515	Edison S	n of 6th	6"	blowout, 2 3" holes	2/6/2004
1104	14 Mile E	e of Ferris	8"	crack around	2/7/2004
512	13 Mile W	w of Washington	6"	blowout-2" hole, crack also	2/8/2004
nec	5th & Center	w side of RR	4"	crack around	2/10/2004
715	Edison S	n of Lincoln	6"	blowout- 3" hole	2/10/2004
1311	McLean	s of Hudson	6"	crack around	2/12/2004
4235	14 Mile W	e of Woodward	6"	crack around	2/12/2004
425	Linden	e of Rochester	6"	blowout- 3" hole	2/14/2004
2810	Linwood	n of Glenwood	6"	crack around	2/18/2004
515	E 6th	e of Knowles	6"	crack around	2/19/2004
1617	12 Mile E	w of Campbell	12"	joint leak	2/21/2004
526	Webster W	w of Marywood	6"	blowout- 2" hole	2/20/2004
1017	Millard	w of Blair	8"	crack around	2/23/2004
715	Edison S	n of Lincoln	6"	joint leak	2/26/2004
	Nakota	e of Briarwood	6"	crack around	2/27/2004
623	13 Mile W	at Custer	12"	lateral crack- 37 degree water	2/28/2004

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
2511	Barrett	w of Stephenson	8"	blowout & lateral crack	3/15/2004
1501	Helene	s of Guthrie	8"	5' long lateral crack	3/15/2004
	696	w of 75	6"	4' long lateral crack	3/15/2004
	696	w of 75	6"	5' long lateral crack	3/17/2004
	Woodward	at Lincoln	6"	old clamp bad- crack around	3/19/2004
1333	Wilson S	n of 696	6"	blowout- 3" hole on bottom	3/21/2004
510	Gardenia	w of Oakmount	8"	blowout- 2" hole on side	4/24/2004
1212	14 Mile E	e of Ferris	8"	old clamp bad	4/26/2004
1922	Wickham	w of Crooks	6"	crack around	6/5/2004
202	13 Mile W	w of Main	6"	6" long lateral crack	7/3/2004
613	Lloyd	w of Marywood	6"	blowout	7/9/2004
31157	Woodward	s of Yorba Linda	8"	joint leak- tap sleeve	7/12/2004
	Maple N	s of 12 Mile	6"	2 bad universal joints	7/20/2004
202	13 Mile W	w of Main	6"	16" long lateral crack	8/21/2004
31805	Woodward	s of Normandy	8"	mech joint leak	9/13/2004
707	Woodlawn	e of Alexander	8"	crack around	10/16/2004
3628	Greenway	s of Normandy	8"	crack around	10/22/2004
	Greenfield	s of Arlington	8"	joint leak - lead	11/6/2004
1311	Windemere E	e of Blair	6"	crack around	11/7/2004
1212	Royal	w of Cedar	8"	10 x 6 blowout on bottom	11/7/2004
3106	Blair N	n of Bloomfield	8"	crack around	11/11/2004
3814	Linwood	n of Chester	6"	crack around	11/14/2004
4422	Rosewold	n of Nakota	6"	crack around	11/14/2004
	Catalpa	at alley e of Woodward	8"	crack around	11/16/2004
32121	Woodward	n of Normandy	8"	crack around	11/29/2004
32302	Woodward	n of Nakota	6"	crack around	11/29/2004
3114	Wilson N	n of Bloomfield	6"	crack around	12/19/2004
3366	Prairie	s of 13 Mile	8"	crack around	12/20/2004
nwc	Cedar	at Butternut	6"	crack around	12/20/2004
2958	Woodslee	e of Eton Cross	6"	crack around	12/21/2004
4361	Robinwood	s of Nakota	8"	crack around	12/23/2004
1818	Massoit	s of Nakota	6"	crack around	12/25/2004
swc	Normandy	at Mark Orr	8"	crack around	12/26/2004
3018	Blair N	s of Bloomfield	8"	crack around	12/27/2004
1702	Sycamore	e of Maplewood	4"	crack around	12/28/2004
1508	Montrose	w of Campbell	6"	crack around	12/28/2004
4610	BRIARWOOD	n of Samoset	6"	crack around	1/1/2005
4422	HILLCREST	n of Nakota	6"	crack around	1/11/2005
32301	WOODWARD	n of Parkway	6"	crack around	1/25/2005
nec	ROCHESTER	at Millard	8"	crack around	1/26/2005
	MANDALAY	n of Chester	6"	hole on bottom	1/27/2005

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	LEXINGTON	at Washington	6"	3' long lateral crack on top	1/28/2005
1925	NAKOTA	e of Rosewold	8"	crack around	1/28/2005
	CUSTER	n of Mt Vernon	8"	crack around	1/29/2005
4420	SAMOSET	e of Greenfield	6"	crack around	2/1/2005
1300	CAMPBELL N	s of Bellaire	6"	crack around	2/4/2005
1972	RIDGE	w of Coventry	6"	crack around	2/5/2005
217	HARRISON E	e of Main	4"	2 cracks- replace pipe	2/9/2005
4949	DELEMERE	s of Parmenter	8"	old clamp bad- crack around	2/12/2005
	JOSEPHINE	at Hartrick	6"	crack around	2/13/2005
603	FAIRWAY	e of Ardmore	6"	crack around	2/16/2005
619	ENGLEWOOD	e of Rochester	6"	crack around	2/17/2005
2021	11 MILE E	w of Edgeworth	8"	4" long lateral crack on side	2/18/2005
2324	CROOKS	n of Vinsetta	8"	crack around	2/19/2005
2005	4th E	e of Kenwood	8"	bad U-Joint	2/23/2005
nec	LINDEN	at Main	6"	at gatewell- crack around	2/23/2005
	FAIRMONT	s of Amherst	6"	mech joint leak	2/28/2005
	CROOKS	s of Vinsetta	4"	crack around	3/15/2005
1405	MOHAWK	n of Dondero	6"	crack around	3/19/2005
217	HARRISON E	e of Main	4"	crack around	3/27/2005
	MEMORIAL PARK	e of Woodward		crack around	4/1/2005
	DEVILLEN	w of Rochester	8"	3" dia blowout	5/4/2005
423	CALIFORNIA	on dead end	4"	crack around	5/11/2005
119	PINGREE	e of Main	4"	crack around	5/16/2005
1904	CRESTHILL	n of Massoit	6"	crack around	5/22/2005
3118	TRAFFORD	w of Woodward	6"	4' lateral crack on bottom	5/27/2005
3243	PRAIRIE	s of Judson	8"	crack around	6/9/2005
3632	BETSY ROSS	n of Yorba Linda	6"	crack around	6/19/2005
sec	MAIN N	at Woodlawn	8"	1' lateral crack	6/30/2005
2008	KENWOOD CT	n of Gardenia	6"	12" blowout on bottom	7/3/2005
1027	4TH E	at Gainsborough	8"	5' long lateral crack / blowout	7/7/2005
926	LOCKWOOD	s of Catalpa	6"	crack around	7/11/2005
1418	SMITH	w of Crooks	6"	1' lateral crack	7/20/2005
423	DORCHESTER S	s of 4th	8"	3 holes on bottom	7/23/2005
504	13 MILE W	w of Washington	6"	crack around	7/27/2005
1017	VINSETTA	e of Woodward	6"	crack around	7/29/2005
926	LOCKWOOD	s of Catalpa	6"	1' lateral crack	8/4/2005
2900	CROOKS	n of Royal	8"	old coupling cracked	8/5/2005
419	EDISON S	s of 4th	6"	2 large holes on bottom	8/7/2005
	BLOOMFIELD W	at Rochester	6"	1' lateral crack	8/8/2005
	COOLIDGE	n of Normandy	8"	1' lateral crack	8/9/2005
3614	HILLSIDE	n of Yorba Linda	8"	crack around	8/12/2005

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	GIRARD	e of Ardmore	8"	3" hole on side	8/16/2005
2115	11 MILE E	w of Minerva	8"	solid sleeve split	8/17/2005
2108	4TH E	e of Edgeworth	8"	old coupling cracked	8/22/2005
	HARVARD	at Judson	8"	8" lateral crack on bottom of mech bel	8/23/2005
2709	CAMPBELL N	n of Girard	8"	2 cracks	8/27/2005
	COOLIDGE	e of Woodward	8"	slip joint bell blown out on bottom	9/2/2005
1809	GARDENIA	e of Edison	6"	crack around	9/11/2005
3852	RAVENA	s of Chester	4"	6" lateral crack at u-joint	9/14/2005
313	JOSEPHINE	s of Sherman	6"	bad service seal clamp	9/15/2005
1308	12 MILE E	e of Vermont	6"	2 holes on bottom	9/25/2005
1908	CRESTHILL	n of Massoit	6"	crack around	10/13/2005
nec	OWANA	at Dondero	6"	4 x 8 hole on bottom	10/28/2005
704	WILSON N	s of Forest	6"	crack around	11/17/2005
2420	PARMENTER	parking lot- Briarwood Condos	6"	crack around	11/23/2005
1600	MONTROSE	w of Campbell	6"	crack around	11/27/2005
3010	SYLVAN	n of Butternut	6"	crack around	11/27/2005
nwc	GREENLEAF	at Fairlawn	4"	crack around	11/28/2005
1031	VINSETTA	e of Woodward	6"	6" lateral crack on bottom	11/29/2005
1303	POPLAR	in starr park	6"	4 x 8 hole on bottom	12/4/2005
1308	12 MILE E	e of Vermont	6"	4" hole on side	12/9/2005
4038	HIGHFIELD	e of Parkway	6"	crack around	12/9/2005
1303	HICKORY	e of Crooks	8"	crack around	12/16/2005
4103	EDGELAND	s of Normandy	6"	crack around	12/17/2005
1609	OTTAWA	w of Campbell	8"	crack around	12/17/2005
swc	VINSETTA	at Crooks	4"	crack around	12/17/2005
4612	ROSEWOLD	n of Samoset	6"	crack around	12/20/2005
sec	GREENFIELD	at Samoset	8"	crack around	12/24/2005
124	KENWOOD S	s of 11 Mile	6"	4" hole on bottom	12/25/2005
1009	MIDLAND	e of Alexander	6"	crack around	12/26/2005
124	KENWOOD S	s of 11 Mile	6"	3" hole on bottom	12/27/2005
3003	PRAIRIE	n of Webster	8"	crack around	1/1/2006
4202	MANOR	n of Normandy	6"	crack around	1/16/2006
1405	MIDLAND	w of Campbell	6"	2x4 blowout & 6" lateral on bottom	1/19/2006
4815	ELMHURST	n of 14 Mile	8"	bolts- joint leak	1/27/2006
1313	4TH E	e of Blair	8"	2" hole on side	2/11/2006
	WILSON S	n of Lincoln	6"	crack around	2/12/2006
1426	CONNECTICUT N	s of Bellaire	4"	10" lateral split on bottom	2/13/2006
sec	MAPLE S	at 3rd	8"	crack around	2/15/2006
2712	BEMBRIDGE	at Essex	6"	crack around	2/28/2006
1027	4TH E	at Gainsborough	8"	2 small holes on side	2/28/2006
432	13 MILE W	w of Washington	6"	crack around	3/4/2006

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	TRAFFORD	w of Woodward	6"	crack around	3/5/2006
	KENT	at Normandy	6"	crack around	3/26/2006
	SHAW	w of Clawson	8"	crack around	3/26/2006
1817	LINCOLN E	w of Dorchester	8"	4 x 8 hole on bottom	5/10/2006
1817	LINCOLN E	w of Dorchester	8"	replaced pipe	5/12/2006
	FOREST	e of Edgeworth	6"	replaced pipe	5/22/2006
4220	COOPER	s of Nakota	8"	12" split on bootom	5/31/2006
903	AMELIA	e of Alexander	6"	blowout	6/8/2006
2009	BELLAIRE	e of Campbell	6"	blowout	6/12/2006
212	JOSEPHINE	s of Hartrick	6"	6" split on side	6/17/2006
1026	CAMPBELL S	n of Hudson	8"	4 x 4 hole on side	6/18/2006
sec	OLIVIA	at Nakota	6"	crack around	6/21/2006
1513	4TH E	e of Connecticut	8"	6" hole on side	7/24/2006
	VERMONT N	n of Gardenia	6"	lateral crack	8/4/2006
3940	DEVON	n of Chester	6"	lateral crack	8/15/2006
sec	FOREST	at Edison	6"	lateral crack	8/18/2006
3402	LINWOOD	n of Starr	6"	crack around	8/26/2006
503	WALNUT	w of Marywood	6"	6" lateral crack on bottom	9/7/2006
606	12 MILE E	e of Fern	12"	hole on top w/ lateral crack	10/3/2006
4934	FERNLEE	s of Parmenter	8"	crack around	10/24/2006
2507	CAMPBELL N	s of Girard	8"	joint leak	11/4/2006
4240	YORBA LINDA	s of Springer	6"	crack around	11/6/2006
2603	CAMPBELL N	n of Girard	8"	crack around	11/17/2006
swc	WOODWARD	at Harrison	8"	crack around	11/23/2006
swc	14 MILE W	at S.B. Coolidge	8"	crack around	11/24/2006
3402	BENJAMIN	n of 13 Mile	8"	crack around	11/24/2006
nec	WOODWARD	at Hunter	8"	crack around	11/24/2006
nec	YORBA LINDA	at Hillside	6"	crack around	11/26/2006
	GLENWOOD	w of Maplewood	6"	crack around	11/27/2006
	MEMORIAL PARK	n.s. of maint office	4"	crack around	11/20/2006
sec	EVERGREEN	at Smith	6"	crack around	12/8/2006
nwc	HARVARD	at Albert	8"	crack around	12/13/2006
1407	GENESEE	e of Vermont	6"	crack around	12/21/2006
31717	WOODWARD	n of Chester	8"	crack around	12/30/2006
	WEBSTER W	at Buckingham	8"	crack around	12/30/2006
1423	ENGLEWOOD	w of Campbell	6"	crack around	1/2/2007
1208	GROVE	n of Derby	6"	crack around	1/14/2007
4551	COOLIDGE	s of Samoset	8"	crack around	1/17/2007
	14 MILE W	w of Crooks	8"	2" hole on side	1/17/2007
2605	14 MILE W	w of Delemere	8"	crack around	1/20/2007
1613	ENGLEWOOD	w of Campbell	6"	crack around	1/21/2007

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
3126	GLENVIEW	n of Essex	6"	WMB	1/22/2007
1424	MONTROSE	w of Campbell	6"	crack around	1/23/2007
507	POTTER	n of Frederick	12"	1" hole in bell	1/24/2007
4426	BERKSHIRE	w of Woodward	6"	crack around	1/24/2007
3254	ALBERT	w of Coolidge	6"	crack around	1/26/2007
4610	HILLCREST	n of Samoset	6"	crack around	1/26/2007
	ROCHESTER	at Woodside	8"	4x10" hole on side	1/29/2007
3854	HILLSIDE CT	e of Hillside	6"	crack around	1/31/2007
1911	CAMPBELL N	n of Red Run	8"	crack around	2/1/2007
3602	RAVENA	e of Woodward	8"	joint leak	2/2/2007
31542	WOODWARD	n of Ravena	8"	crack around	2/3/2007
116	BLAIR N	n of 11 mile	6"	crack around	2/4/2007
1708	4th E	e of Campbell	8"	U-Joint	2/4/2007
3118	GREENFIELD	n of Webster	8"	joint leak	2/6/2007
	HUNTER	e of Woodward	6"	crack around	2/9/2007
3704	GREENWAY	s of Normandy	8"	joint leak	2/9/2007
1712	MAPLE N	s of 12 Mile	6"	U-Joint	2/10/2007
3912	DURHAM	n of Chester	6"	crack around	2/10/2007
sec	WOODWARD	at 13 Mile	8"	crack around	2/10/2007
27722	WOODWARD	s of Catalpa	8"	crack around	2/11/2007
2711	BEMBRIDGE	e of Eton Cross	6"	crack around	2/12/2007
120	DORCHESTER S	s of 11 Mile	8"	crack around	2/12/2007
	EDISON N	n of 11 Mile	6"	crack around	2/13/2007
4345	CROOKS	n of Manor	8"	crack around	2/15/2007
3512	HUNTER	w of Hampton	6"	crack around	2/16/2007
1305	4th E	e of Blair	8"	crack around	2/16/2007
708	GENESEE	e of Rochester	8"	crack around	2/18/2007
2702	SHENANDOAH	s of Eton Cross	6"	crack around	2/18/2007
nwc	ORCHARD VIEW	at Columbus	6"	crack around	2/19/2007
1725	FORESTDALE	n of Cedar Hill	4"	crack around	2/19/2007
1020	ALTADENA N	n of Gardenia	6"	crack around	2/21/2007
	DETROIT	at Main	6"	cut out bad joint	2/23/2007
1915	VINSETTA	w of Murdock	6"	3" hole in side	2/28/2007
900	NORMANDY	w of Custer	6"	crack around	2/12/2007
	ELMWOOD	n of Normandy	6"	crack around	2/28/2007
1503	MIDLAND	w of Campbell	6"	crack around	3/1/2007
1222	LAWNDALE	w of Hilldale	6"	WMB	3/2/2007
322	AUSTIN	w of Washington	4"	1" hole in side	3/5/2007
1318	STEPHENSON S	n of Dallas	8"	crack around	3/6/2007
31800	WOODWARD	n of Hunter	8"	crack around	3/8/2007
sec	HELENE	at 11 Mile	8"	U-Joint	3/9/2007

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
1316	LYONS	w of Crooks	6"	crack around	3/17/2007
321	POPLAR	n of Bloomfield	6"	crack around	3/18/2007
3816	RAVENA	w of Woodward	4"	bad U-Joint, installed 4" gate	4/30/2007
1710	12 MILE E	e of Campbell	8"	3" hole in side	5/10/2007
3250	WARICK	w of Coolidge	6"	2- 2" holes on bottom	6/2/2007
906	CAMPBELL S	s of Lincoln	8"	1"x4" hole on side	6/6/2007
	LINDEN	at Fern	6"	lateral crack	6/13/2007
1915	VINSETTA	w of Laurome	6"	3" hole in side	6/15/2007
	HUDSON E	w of Stephenson	6"	bad U-Joint	6/20/2007
nec	BLAIR N	at Farnum	8"	3" hole in side	6/24/2007
1900	VERMONT N	n of 12 Mile	6"	WMB	6/27/2007
816	WILSON N	n of Forest	6"	WMB	6/27/2007
725	HELENE	n of Lincoln	8"	u-Joint with crack around	7/2/2007
2200	VERMONT N	n of Houstonia	6"	hole in bottom w/lateral crack	7/6/2007
1714	CONNECTICUT N	s of 12 Mile	6"	lateral crack	7/9/2007
1009	BAUMAN	w of Ferris	6"	2 holes and lateral crack on bottom	7/16/2007
1513	4TH E	w of Wilson	8"	3" hole on bottom	7/31/2007
sec	ETOWAH	at Dondero	6"	2" hole on top with crack around	8/3/2007
nwc	LINDEN	at Fern	6"	3" hole on side & 2" hole on side	8/5/2007
30606	WOODWARD	n of Woodslee	6"	3x8" hole on bottom	8/10/2007
	WEBSTER W	e of Harvard	8"	12" long lateral crack on bottom	8/11/2007
439	LINDEN	w of Fern	6"	3" long lateral crack on side	8/11/2007
1842	CENTER N	s of Mary	6"	12" long lateral crack on bottom	8/15/2007
3402	NORMANDY	w of Mankato	8"	3" hole on side	8/13/2007
130	WILSON N	n of 11 mile	6"	main bad at corp	8/17/2007
1010	NORMANDY	e of Marais	6"	12" long lateral crack on bottom	8/25/2007
	12 MILE E	w of Ferris	6"	(2) lateral cracks	8/30/2007
1813	4th E	e of Edison	8"	6x12 hole on top w/ 10" long lateral cr	9/10/2007
301	MINERVA S	n of 4th	6"	36" long lateral crack on bottom	9/14/2007
	CONNECTICUT N	n of Gardenia	6"	6" long lateral crack on bottom	9/17/2007
2015	BELLAIRE	w of Edgeworth	6"	small hole w/ crack at joint	9/20/2007
716	CONNECTICUT S	n of Lincoln	6"	4" lateral crack on top	10/17/2007
	CENTER S	s of 4th	4"	crack around	10/19/2007
nec	HENDRIE	at 6th	6"	4" lateral crack on side of gradelok div	10/29/2007
	CROOKS	s of Normandy	12"	mech joint leak	11/7/2007
	MANOR	at Cresthill	6"	crack around	11/11/2007
3117	VINSETTA	w of Marywood	6"	3" hole in side	11/13/2007
1417	CATALPA	w of Forestdale	8"	6" hole on top & 2" hole at service	11/14/2007
sec	CATALPA	at Farnum	8"	6" long lateral crack on bottom	11/15/2007
3119	CAMPBELL N	n of Bloomfield	8"	crack around	11/20/2007
	DELEMERE	n of Normandy	8"	crack around	11/27/2007

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
	MAIN N	n of Vinsetta	6"	4" x 8" hole on top	11/28/2007
4600	ROSEWOLD	n of Samoset	6"	crack around	11/29/2007
	LEXINGTON	at Main	6"	crack around	11/29/2007
nec	BLAIR N	at Forest	8"	crack around	11/29/2007
nec	WOODWARD	at Chester	8"	crack around	12/1/2007
2422	OLIVER	s of Webster	6"	crack around	12/8/2007
1617	MILLARD	w of Campbell	8"	crack around	12/9/2007
	BONNIEVIEW	e of Woodland	6"	crack around	12/9/2007
1906	MASSOIT	w of Cresthill	6"	crack around	12/9/2007
3338	PRAIRIE	s of 13 Mile	8"	at service- crack around	12/12/2007
1313	4TH E	e of Blair	8"	3" hole on side	12/13/2007
3704	DURHAM	s of Chester	6"	2" hole on bottom	12/14/2007
2527	CAMPBELL N	s of Girard	8"	crack around	12/18/2007
nec	5th E	at Kayser	6"	crack around	12/18/2007
31253	WOODWARD	n of Yorba Linda	8"	crack around	12/21/2007
3015	MAIN N	s of Bloomfield	6"	crack around	12/27/2007
1303	WILSON S	s of Hudson	6"	crack around	12/27/2007
616	VERMONT N	n of Farnum	6"	crack around	12/28/2007
nec	MANADLAY	at Normandy	6"	old cast-iron clamp rusted away	12/28/2007
	DETROIT	on Main St	6"	4" x 8" hole on bottom	12/30/2007
1507	WINDEMERE E	w of Campbell	6"	mech joint leak	1/4/2008
304	ROYAL	w of Main	8"	6" hole in bottom, replaced 8'of pipe	1/6/2008
sec	MAPLE	at Park	4"	crack around	1/7/2008
613	LLOYD	w of Marywood	6"	crack around	1/7/2008
3124	BLAIR N	s of 13 Mile	8"	crack around	1/10/2008
	BENJAMIN	at R.R.	8"	crack around	1/10/2008
4108	COOLIDGE	s of Normandy	8"	crack around	1/24/2008
	WINDEMERE W	on 13 Mile	6"	10" lateral crack on bottom	1/30/2008
1128	BLAIR N	s of Derby	6"	crack around	1/31/2008
2317	VINSETTA	e of Crooks	6"	2" hole on side	2/3/2008
4107	AUBURN	w of Parkway	6"	crack around	2/4/2008
31253	WOODWARD	n of Yorba Linda	8"	crack around	2/11/2008
	4TH E	at Connecticut	8"	crack around	2/14/2008
5114	THORNCROFT	n of Torquay	6"	crack around	2/15/2008
NWC	12 MILE E	at Connecticut	12"	mech joint leak	2/20/2008
2924	CROOKS	n of Royal	8"	crack around	2/24/2008
	GENESEE	50' E of Rochester	8"	2" hole on side	3/3/2008
4504	ROCHESTER	n of Donald	8"	crack around	3/3/2008
718	14 MILE E	e of Rochester	8"	main cracked at tap	3/4/2008
nwc	MARY	at Washington	6"	crack around	3/9/2008
2435	NORMANDY	e of Benjamin	8"	crack around	3/10/2008

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
1503	ENGLEWOOD	w of Campbell	6"	crack around	3/13/2008
3208	GLENVIEW	n of Essex	6"	crack around	3/15/2008
4541	CROOKS	s of Samoset	6"	crack around	3/15/2008
3211	MERRILL	w of Coolidge	6"	4' long lateral crack on bottom	3/19/2008
sec	ALEXANDER S	at 6th	12"	crack around	3/20/2008
	ALBERT	e of Coolidge	6"	mech joint leak	3/12/2008
	CAMPBELL N	n of Bloomfield	8"	crack around	3/13/2008
	696 & 75	ramp NB75 to EB696	8"	16"x4" hole on bottom	4/23/2008
	969 & 75	ramp EB696 to NB75	6"	3" hole on bottom	5/6/2008
	MANDALAY	at Nakota	6"	3" hole on side	5/16/2008
	696 & 75	ramp NB75 to EB696	8"	3" hole on bottom	5/28/2008
	696 & 75	ramp NB75 to EB696	8"	3" hole on side	6/17/2008
1026	WASHINGTON N	n of Catalpa	6"	4" hole on side & 12" lateral crack	7/20/2008
	MAIN	n of Vinsetta	8"	3" lateral crack on bottom	7/29/2008
	DETROIT	at Main	6"	3' long lateral crack w/ 3 holes	7/29/2008
509	EDISON S	s of 4th	6"	2" hole on bottom	7/30/2008
2317	VINSETTA	e of Crooks	6"	3" hole on bottom	7/31/2008
900	MARYWOOD	s of Catalpa	8"	3" hole on bottom	8/9/2008
1804	11 MILE E	e of Edison	6"	3' long lateral crack w/ 3 holes	8/9/2008
1825	BASSETT	e of Woodward	4"	2"x8" hole on side	8/11/2008
3614	DURHAM	s of Chester	6"	4" long lateral crack	8/20/2008
3408	NORMANDY	w of Mankato	8"	2"x6" hole on top	8/29/2008
3231	GARDEN	s of Judson	6"	crack around	8/31/2008
nec	BLAIR N	at Farnum	8"	8' long lateral crack on bottom	9/2/2008
422	AUSTIN	e of Marywood	6"	8" long lateral crack on bottom	9/3/2008
3224	WARICK	w of Coolidge	6"	2' long crack on bottom with 3 holes	9/5/2008
1428	EDGEWOOD	s of Woodsboro	6"	hole in top from backhoe	9/9/2008
	12 MILE W	w of Main	8"	10" long lateral crack on top	10/11/2008
3516	RAVENA	e of Woodward	8"	crack around	10/20/2008
931	WASHINGTON N	s of Catalpa	8"	2" hole in side	10/27/2008
sec	THORNCROFT	at Samoset	6"	crack around	11/4/2008
27906	WOODWARD	s of Catalpa	8"	crack around	11/20/2008
1407	GENESEE	e of Vermont	6"	crack around	11/22/2008
719	VERMONT S	s of 7th	6"	3" hole in bottom	11/28/2008
5091	ELMHURST	s of Torquay	8"	crack around	11/30/2008
4138	SAMOSET	e of Woodward	6"	crack around	12/2/2008
2912	WILSON N	n of DeVillen	6"	crack around	12/4/2008
1725	GARDENIA	e of Campbell	6"	crack around	12/8/2008
1023	WILLIAMS CT	n of Harrison	1.5"	2' long crack on side	12/10/2008
nec	SEDGEMOOR	at Samoset	8"	crack around	12/10/2008
31109	GREENFIELD	n of 13 Mile	6"	crack around	12/10/2008

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#	Break Location	Cross Streets	Size	Break Description	Date
404	LAPLAZA	e of Marywood	8"	crack around	12/13/2008
1921	BELLAIRE	e of Campbell	6"	2' long crack on top with 3 holes	12/17/2008
1806	11 MILE E	e of Edison	6"	4" hole on bottom	12/18/2008
2612	SHENANDOAH	n of Aberdovey	6"	crack around	12/20/2008
3018	CONNECTICUT N	s of Bloomfield	8"	crack around	12/20/2008
	FOREST	e of Main	4"	2' long crack on top	12/24/2008
2301	14 MILE W	w of Elmhurst	8"	crack around	12/25/2008
1611	GENESEE	w of Campbell	6"	crack around	12/28/2008
nec	MANKATO	at Samoset	6"	crack around	12/31/2008
	MANDALAY	n of Chester	6"	crack around	12/31/2008
403	EDMUND	w of Rochester	6"	crack around	1/1/2009
4715	COOLIDGE	s of 14 (across from)	8"	crack around	1/5/2009
4924	CARA	n of Parmenter	6"	crack around	1/6/2009
3203	GARDEN	n of Albert	6"	crack around	1/17/2009
2401	KALAMA	e of Brinkey	8"	4" hole on top	1/21/2009
2207	KALAMA	w of Helene	8"	crack around	1/22/2009
4403	HAMPTON	n of Nakota	8"	crack around	1/24/2009
2210	CONNECTICUT N	s of Parkdale	6"	crack around	1/25/2009
	KNOWLES	s of Lincoln	4"	1' long lateral crack	1/27/2009
4114	KENT	s of Normandy	6"	crack around	1/31/2009
sec	ROSEWOLD	at Massoit	8"	crack around	1/31/2009
1618	EDGEWOOD	s of 12 mile	6"	crack around	1/31/2009
4909	DELEMERE	n of 14 Mile	8"	crack around	2/1/2009
3251	PRAIRIE	s of Judson	8"	crack around	2/1/2009
3206	BELLE CT	w of Coolidge	6"	crack around	2/1/2009
nec	LASALLE E	at Main	6"	crack around	2/2/2009
1607	AMELIA	w of Campbell	6"	crack around	2/4/2009
4233	CROOKS	n of Normandy	8"	crack around	2/6/2009
2717	OLIVER	n of Webster	6"	crack around	2/10/2009
1108	ROYAL	e of Cedar	8"	crack around	2/12/2009
1015	MCLEAN	n of Hudson	6"	crack around	2/12/2009
3116	WARICK	w of Woodward	6"	crack around	2/15/2009
	WEST N	n of Sherman	6"	crack around	2/18/2009
	WEST N	n of 11 Mile	6"	crack around	2/18/2009
4335	14 MILE W	w of Woodward	6"	crack around	2/20/2009
1820	4TH E	w of Dorchester	8"	bad u-joint	2/20/2009
5039	ELMHURST	n of Parmenter	6"	crack around	2/24/2009
2027	CLAWSON	in rear of property	6"	crack around	2/24/2009
4004	COOLIDGE	s of Normandy	8"	mech joint leak	2/26/2009
918	14 MILE E	e of Rochester	8"	crack around	2/27/2009
	COOLIDGE	at Samoset	8"	crack around	3/7/2009

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#	Break Location	Cross Streets	Size	Break Description	Date
nec	MANDALAY	at Nakota	6"	crack around	3/9/2009
329	DEWEY	e of Rochester	6"	crack around	3/28/2009
27942	WOODWARD	s of Catalpa	8"	old clamp deteriorated	4/1/2009
	AMELIA	on Main	6"	crack around	5/8/2009
1012	FERRIS	n of Gardenia	6"	4" hole on side	5/24/2009
30402	WOODWARD	n of Bembridge	6"	4 x 10 hole on bottom	6/30/2009
30402	WOODWARD	n of Bembridge	6"	4" hole on bottom	7/2/2009
30402	WOODWARD	n of Bembridge	6"	4 x 10 hole on bottom	7/7/2009
1501	OWANA	at Dondero	6"	4' long lateral crack on bottom	7/16/2009
nec	SMITH	at Evergreen	6"	12" long lateral w/3" hole on bottom	7/21/2009
705	EDISON S	s of 6th	6"	4" long lateral crack on bottom	7/24/2009
3134	HARVARD	s of Albert	8"	crack around	8/4/2009
	11 MILE W	e of Woodward	6"	18" long lateral crack on bottom	8/6/2009
1403	NORTHWOOD	w of Crooks	6"	6" long lateral crack on side	8/12/2009
3166	WARICK	e of Coolidge	6"	3" hole on bottom	8/12/2009
808	EDISON N	n of Forest	6"	crack around	9/24/2009
3500	LEXINGTON	w of football stadium	6"	a/c joint damaged by boring contracto	10/28/2009
2303	14 MILE W	w of Elmhurst	8"	4" hole in side	10/29/2009
4279	CROOKS	s of Manor	8"	crack around	10/30/2009
1824	14 MILE W	e of Sedgemoor	8"	4" hole in side	11/7/2009
2515	NORMANDY	e of Delemere	8"	crack around	11/23/2009
3224	BLAIR N	s of 13 Mile	8"	crack around	12/9/2009
2807	OLIVER	n of Glenwood	6"	crack around	12/9/2009
	10 MILE	w of Hoffman	6"	lat crack at joint on hyd lead	12/12/2009
4114	COLONIAL	w of Parkway	6"	crack around	12/12/2009
5089	MANSFIELD	s of Torquay	6"	crack around	12/14/2009
	4TH E	at Connecticut	8"	crack around	12/21/2009
2200	12 MILE E	w of Stephenson	4"	Service for 2200 - crack around	12/21/2009
1821	LINCOLN E	w of Dorchester	8"	4" hole in side	12/30/2009
1917	LINCOLN E	w of Kenwood	8"	2' long lateral crack through u-joint	12/30/2009
1920	4TH E	w of Kenwood	8"	4" hole on bottom	12/30/2009
	KENWOOD	s of 4th	6"	3' long lateral crack on side	12/31/2009
705	DORCHESTER S	n of Lincoln	8"	u-joint leak	12/31/2009
509	EDISON S	s of 4th	6"	6" long lateral crack on bottom	1/1/2010
423	EDISON S	s of 4th	6"	12" long lateral crack on bottom	1/2/2010
629	DORCHESTER S	s of 6th	8"	2" hole in side	1/5/2010
	KENWOOD S	s of 4th	6"	bad u-joint	1/6/2010
1427	POPLAR	e of Evergreen	6"	crack around	1/6/2010
4209	COOLIDGE	n of Normandy	8"	crack around	1/6/2010
sec	THORNCROFT	at Samoset	6"	crack around	1/7/2010
818	CONNECTICUT N	n of Forest	6"	crack around	1/10/2010

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#	Break Location	Cross Streets	Size	Break Description	Date
2207	MACE	e of Minerva	6"	4" hole in side	1/11/2010
4209	COOLIDGE	n of Normandy	8"	mech joint leak	1/12/2010
122	EDISON N	n of 11 Mile	6"	crack around	1/12/2010
3115	HARVARD	s of Albert	8"	crack around	1/12/2010
408	LAPLAZA	e of Marywood	8"	crack around	1/16/2010
115	PLEASANT S	s of 11 Mile	4"	crack around	1/21/2010
	GREENFIELD	n of 13 mile	8"	crack around	1/29/2010
1128	WILSON N	at Derby	6"	crack around	1/30/2010
	13 MILE W	e of Harvard	12"	crack around	2/3/2010
32121	WOODWARD	n of Normandy	8"	crack around	2/5/2010
	LINWOOD	at Linwood Ct	6"	2' hole in side, plus crack around	2/5/2010
1515	ENGLEWOOD	w of Campbell	6"	crack around	2/6/2010
3102	ELMHURST	n of Essex	8"	crack around	2/8/2010
1527	4th E	w of Wilson	8"	crack around	2/12/2010
610	ALTADENA N	n of Farnum	6"	crack around	2/12/2010
swc	5TH E	at Knowles	6"	2" hole in bottom	2/15/2010
1836	MASSOIT	s of Nakota	6"	crack around	2/18/2010
3132	WARICK	w of Woodward	6"	crack around	2/22/2010
	ST CHARLES	e of Curry	6"	bad u-joint	3/5/2010
1112	FERRIS	n of Gardenia	6"	4"x6" hole on top	3/20/2010
922	GREENLEAF	w of Maxwell	6"	crack around	4/27/2010
2507	CAMPBELL N	s of Girard	8"	mech joint leak	5/19/2010
1306	EDGEWOOD	s of Bellaire	6"	crack around	6/9/2010
	DEVON	n of 13 mile	6"	2' long lat crack on bot & 2x6" hole	8/3/2010
1303	POPLAR	e of Evergreen	6"	1' lateral crack on bottom w/2" hole	8/10/2010
810	REMBRANDT N	n of Forest	6"	6" long lateral crack on bottom	8/17/2010
3610	NORMANDY	e of Olivia	8"	2' long lat crack on bot & 2x6" hole	8/25/2010
	CONNECTICUT N	n of Gardenia	6"	2- 4" holes, 20' apart	8/25/2010
830	LOCKWOOD	s of Crane	6"	2" x 6" hole on top	8/31/2010
121	EDMUND	e of Main			9/5/2010
3176	WARICK	e of Coolidge	6"	3- 2" holes on top	9/13/2010
	MEMORIAL PARK	w of maint bldg	4"	crack around	9/30/2010
1617	VINSETTA	s of 12 mile	6"	crack around	10/22/2010
623	FAIRWAY	e of Ardmore	6"	split on top	11/8/2010
3313	MERRILL	w of Coolidge	6"	crack around	11/23/2010
swc	MANOR	at Crooks	6"	crack around	11/24/2010
swc	VINSETTA	at 12 Mile	8"	crack around	11/30/2010
3009	HELEN CT	n of Oliver	6"	crack around	12/7/2010
	MANKATO	s of Samoset	6"	crack around	12/7/2010
1800	BELLAIRE	e of Campbell	6"	crack around	12/14/2010
1211	ENGLEWOOD	e of Blair	6"	crack around	12/14/2010

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
3264	GREENFIELD	s of Judson	8"	crack around	12/16/2010
	TROY N	s of University	8"	crack around	12/24/2010
nec	VERMONT N	at Farnum	6"	crack around	12/24/2010
3122	MAPLEWOOD	n of Essex	8"	crack around	12/27/2010
112	JEFFREY	w of Main	6"	crack around	12/27/2010
nwc	WOODSBORO	at Maxwell	6"	crack around	12/28/2010
2929	WOODLAND	n of Woodland Ct	6"	crack around	1/2/2011
	HILLSIDE	at Betsy Ross	6"	mech joint leak	1/3/2011
2502	LINWOOD	n of Webster	8"	crack around	1/3/2011
3326	COOLIDGE	w of Woodward	6"	2" hole in side	1/4/2011
2336	VINSETTA	w of Magnolia	6"	crack around	1/4/2011
4819	ELMHURST	n of 14 Mile	8"	mech joint leak	1/11/2011
320	WEBSTER W	w of Washington	6"	crack around	1/13/2011
	HILLCREST	s of 14 Mile	6"	crack around	1/16/2011
	NAKOTA	at Hillcrest	6"	crack around	1/19/2011
918	14 MILE E	e of Rochester	8"	crack around	1/20/2011
801	MAPLEGROVE	n of Farnum	4"	crack around	1/20/2011
724	PLEASANT S	n of Lincoln	4"	crack around	1/22/2011
2000	14 MILE W	w of Sedgemoor	8"	crack around	1/23/2011
2448	GALPIN	s of Webster	6"	crack around	1/24/2011
3916	COOLIDGE	s of Normandy	8"	crack around	1/26/2011
4502	HILLCREST	s of Samoset	6"	crack around	1/26/2011
1102	ROYAL	e of Cedar	8"	crack around	1/29/2011
3314	ELLWOOD	n of Judson	6"	crack around	1/30/2011
2626	GLENVIEW	w of Oliver	8"	crack around	1/30/2011
4425	COOLIDGE	s of Nakota	8"	crack around	1/31/2011
25943	WOODWARD	s of Lincoln	8"	crack around	1/31/2011
1513	OWANA	s of Dondero	6"	old clamp bad - rotted bolts	1/31/2011
1893	VINSETTA	w of Laurome	6"	crack around	2/1/2011
5060	MANSFIELD	s of Torquay	6"	crack around	2/1/2011
1010	14 MILE E	w of Ferris	8"	2' long lateral crack on bottom	2/1/2011
3006	FERRIS	s of Bloomfield	6"	crack around	2/2/2011
702	CONNECTICUT N	s of Forest	6"	crack around	2/3/2011
2930	FERRIS	s of Bloomfield	6"	crack around	2/3/2011
sec	BLAIR N	at Bloomfield	8"	crack around	2/4/2011
2418	GLENVIEW	s of Webster	6"	crack around	2/5/2011
1623	AMELIA	w of Campbell	6"	crack around	2/6/2011
324	ROYAL	w of Main	8"	4" hole in side	2/8/2011
3306	PARKER	w of Coolidge	8"	main cracked around at service	2/9/2011
30963	WOODWARD	s of 13 Mile	8"	4" hole in side, plus bad serv saddle	2/10/2011
130	EDISON N	n of 11 Mile	6"	crack around	2/10/2011

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
sec	EVERGREEN	at Smith	6"	crack around	2/12/2011
	ELMWOOD	at Nakota	6"	crack around	2/13/2011
1946	VINSETTA	s of Houstonia	4"	crack around	2/15/2011
3824	EDGAR	s of Normandy	6"	crack around	2/16/2011
478	CAMBRIDGE	s of Forestdale	6"	crack around	2/16/2011
920	14 MILE E	e of Rochester	8"	crack around	2/23/2011
3361	GARDEN	s of 13 Mile	6"	crack around	2/24/2011
	FERNWOOD	at Mayfield	6"	2" hole on top	2/26/2011
2922	ALTADENA N	n of DeVillen	8"	crack around	2/28/2011
1103	WILSON S	s of Hudson	6"	crack around	3/17/2011
swc	4TH E	at Minerva	8"	crack around	4/1/2011
802	ROYAL	w of Columbus	6"	4"x18" hole on bottom	4/9/2011
	KENWOOD N	s of Bellaire	6"	mech joint leak	4/14/2011
	EDGEWORTH S	s of 11 Mile	8"	u-joint leak	4/20/2011
3115	LINWOOD	n of Essex	6"	3' long lateral crack on top	4/22/2011
sec	WOODWARD	at Vinton	6"	6" hole in side of hyd lead off 12"	4/26/2011
2005	BELLAIRE	w of Edgeworth	6"	6" hole in top of pipe	4/26/2011
2828	TRAFFORD	e of Woodward	6"	8" long lateral crack on bottom	5/14/2011
nec	LINCOLN W	at Hendrie	8"	18" long lateral crack on bottom	6/11/2011
1851	WICKHAM	w of Crooks	8"	crack around	6/19/2011
302	ALTADENA N	n of University	6"	4" hole in bottom	6/20/2011
1106	STEPHENSON S	n of Hudson	8"	8" long lateral crack on bottom	6/22/2011
2005	BELLAIRE	w of Edgeworth	6"	6" hole in top of pipe	6/26/2011
1520	14 MILE E	w of Campbell	8"	12" long lateral crack on bottom	6/26/2011
	NORMANDY	w of Coolidge	8"	8" long lateral crack on bottom	7/6/2011
1116	CLOVERDALE	w of Hilldale	6"	6" long lateral crack on bottom	7/20/2011
2928	CROOKS	n of Royal	8"	4" long lateral crack on side	7/23/2011
501	HELENE	s of 4th	8"	20" x 4" hole on bottom	7/27/2011
2311	KALAMA	w of Brinkey	8"	6" long lateral crack on side	7/27/2011
	HELENE	s of Lincoln	8"	4" hole, plus 6" hole w/ lateral crack	7/31/2011
1612	4TH E	w of Campbell	12"	6" long lateral crack on side	8/4/2011
817	WILSON S	s of Lincoln	6"		8/8/2011
2023	VINSETTA	n of Houstonia	6"	2" hole in side	8/22/2011
623	FAIRWAY	e of Ardmore	6"	3" hole in side	8/22/2011
922	NORMANDY	w of Custer	6"	4"x8" hole in bottom	9/13/2011
922	NORMANDY	w of Custer	6"	4"x8" hole in bottom	9/14/2011
3320	NORMANDY	e of Mankato	8"	6" long lateral crack on side	9/21/2011
nwc	NORMANDY	at Verona	8"	4" hole on bottom, plus 20" lateral	9/21/2011
1324	STEPHENSON N	s of 12 Mile	6"	2" hole in bottom of hyd lead	10/5/2011
2135	NORMANDY	w of Woodland	8"	12" long lateral crack on bottom	10/15/2011
647	CONNECTICUT S	s of 6th	6"	1/2" hole in side	10/17/2011

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
4150	COLONIAL	w of Parkway	6"	crack around	11/8/2011
2004	GLENWOOD	at Ferncliff	6"	4"x8" hole in bottom	11/26/2011
1509	GENESEE	w of Campbell	6"	crack around	11/26/2011
	14 MILE W	at Elmhurst	12"	crack around	12/3/2011
1925	KALAMA	at Kenwood	8"	4' long lateral on top	12/5/2011
1509	CATALPA	w of Maplegrove	8"	2"x24" hole on top	12/8/2011
nec	SYMES	at Farnum	6"	4" hole in bottom	12/12/2011
4514	THORNCROFT	s of Samoset	6"	crack around	12/13/2011
	HELENE	s of Lincoln	8"	crack around	12/28/2011
30975	WOODWARD	s of 13 Mile	8"	20" long lateral on bottom	1/7/2012
	LAWNDALE	at Iroquois	8"	crack around	1/9/2012
1316	EDISON N	s of Bellaire	6"	crack around	1/10/2012
525	ENGLEWOOD	e of Rochester	6"	crack around	1/11/2012
1844	SHIRE	e of Coventry	6"	crack around	1/18/2012
	FAIRMONT	n of 13 Mile	6"	crack around	1/24/2012
623	FAIRWAY	e of Ardmore	6"	crack around	1/29/2012
1603	MARYWOOD	s of Crooks	6"	crack around	2/20/2012
1500	STEPHENSON N	s of 12 Mile	8"	crack around	2/21/2012
sec	CONNECTICUT N	at Girard	8"	crack around	2/22/2012
230	ORCHARD VIEW	w of Washington	6"	crack around	2/23/2012
4579	COOLIDGE	s of Samoset	8"	crack around	3/3/2012
nec	EDGEWOOD	at Derby	6"	4" hole in bottom	3/24/2012
sec	FERNCLIFF	at Glenwood	6"	4" hole in bottom	4/6/2012
nec	EDGEWOOD	at Derby	6"	4" hole in bottom	4/20/2012
2009	BELLAIRE	w of Edgeworth	8"	2' long lateral on bottom/ w 4" hole	4/20/2012
sec	VERONA	at Normandy	6"	4" hole in side	5/14/2012
1313	CATALPA	e of Forestdale	8"	4' long lateral crack on bottom	6/17/2012
2105	NORTHWOOD	w of Woodland	8"	4" hole in side	6/17/2012
310	ALTADENA N	n of University	6"	4" hole in side	7/1/2012
	DEVON	at Normandy	6"	12" long lateral on side	7/10/2012
	GUILFORD	e of Woodward	6"	3" hole on top	7/14/2012
729	13 MILE E	e of Alexander	8"	2- 3" holes in side	7/17/2012
	ROCHESTER	at Woodside	8"	4' long lateral crack on side	7/18/2012
2007	VINSETTA	n of Houstonia	6"	6" long lateral crack on bottom	7/24/2012
1103	5th E	e of Gainsborough	6"	15" long lateral crack on bottom	7/26/2012
1321	CATALPA	e of Forestdale	8"	12" long lateral to u-joint	7/27/2012
	MAPLE	n of 4th	8"	4" hole in side	8/7/2012
725	HELENE	n of Lincoln	8"	4" long lateral crack on bottom	8/11/2012
	ARDMORE	at Parkdale	2"	crack around	8/15/2012
4334	GROVELAND	s of Nakota	6"	6" long lateral crack on bottom	8/21/2012
4004	DUKESHIRE	s of Normandy	4"	3" hole in side	8/28/2012

WATER MAIN BREAKS 1995 - 2014					
#	Break Location	Cross Streets	Size	Break Description	Date
3115	EVERGREEN	n of Poplar	6"	crack around	8/29/2012
	MANOR	s of Cresthill	6"	crack around	10/11/2012
2131	LAROME	s of Lloyd	6"	crack around	10/16/2012
sec	VERMONT S	at 11 mile	6"	crack around	10/25/2012
3206	CONNECTICUT N	s of 13 Mile	8"	crack around	11/4/2012
1811	FARNUM E	w of Dorchester	6"	crack around	11/6/2012
428	LASALLE W	e of Columbus	6"	crack around	11/11/2012
3626	BETSY ROSS	n of Yorba Linda	6"	crack around	11/13/2012
	GREENLEAF	at Maxwell	6"	crack around	11/14/2012
	FARNUM E	at Dorchester	6"	3" hole at joint	11/30/2012
4202	YORBA LINDA	w of Fairmont	6"	crack around	12/1/2012
	MAIN S	at Harrison	8"	crack around	12/1/2012
1218	4TH E	w of Blair	12"	3' long section blew off top of pipe	12/3/2012
	CHESTER	on Crooks	6"	crack around	12/4/2012
625	EDISON S	s of 6th	6"	old steel coupling rotted out	12/5/2012
4003	ALBERT	w of Harvard	6"	small holes on top	12/6/2012
1205	4TH E	w of Blair	8"	3"x10" hole in side	12/11/2012
1300	LLOYD	e of Lyons	6"	crack around	12/12/2012
1614	CONNECTICUT N	s of 12 Mile	6"	4" hole in bottom	12/24/2012
312	BLOOMFIELD W	e of Poplar	6"	crack around	12/25/2012
3206	WILSON N	s of 13 Mile	6"	crack around	12/28/2012
4934	FERNLEE	s of Parmenter	8"	crack around	12/29/2012
4222	YORBA LINDA	s of Springer	6"	crack around	12/31/2012
212	JEFFREY	w of Main	6"	crack around	1/3/2013
nec	MAIN N	at Englewood	8"	crack around	1/3/2013
	FARNUM W	at Forestdale	4"	crack around	1/4/2013
nec	ROCHESTER	at Ottawa	8"	crack around	1/6/2013
4522	HILLCREST	s of Samoset	6"	crack around	1/6/2013
3147	WARICK	w of Woodward	6"	2x6 & 2x8 holes on bottom, 10'apart	1/9/2013
3228	MANDALAY	n of Normandy	6"	crack around	1/10/2013
3142	PRAIRIE	s of Albert	8"	crack around	1/13/2013
nec	LINWOOD CT	at Linwood	2"	service saddle bad	1/15/2013
29350	WOODWARD	s of Benjamin	6"	crack around	1/16/2013
3351	GARDEN	s of 13 Mile	6"	crack around	1/21/2013
4100	GREENWAY	s of Normandy	8"	crack around	1/22/2013
4915	DELEMERE	n of 14 Mile	8"	6" long lateral on side	1/27/2013
3330	CHESTER	w of Mandalay	8"	crack around	1/27/2013
3030	SYLVAN	n of Butternut	6"	crack around	1/29/2013
30919	WOODWARD	s of 13 Mile	8"	1' long lateral on side	2/1/2013
2428	BROCKTON	e of Helene	8"	crack around	2/5/2013
nec	KENWOOD	at University	8"	lateral crack at joint	2/5/2013

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#	Break Location	Cross Streets	Size	Break Description	Date
1623	WEBSTER W	e of Oliver	8"	crack around	2/6/2013
3167	MERRILL	e of Coolidge	6"	crack around	2/10/2013
3346	CUMMINGS	s of 13 Mile	6"	old clamp rotted out	2/10/2013
1605	4TH E	e of Wilson	8"	crack around	2/11/2013
1114	EDGEWORTH N	s of Kenwood Ct	6"	crack around	2/11/2013
1015	ENGLEWOOD	e of Alexander	6"	crack around	2/11/2013
32172	WOODWARD	s of Nakota	6"	8" long lateral on side	2/12/2013
821	ELLEN	at Hickory	6"	crack around	2/17/2013
1515	ENGLEWOOD	w of Campbell	6"	crack around	2/18/2013
1309	CATALPA	w of Fernwood	8"	crack around	2/18/2013
1417	MCLEAN	n of 10 Mile	6"	crack around	2/24/2013
	AUBURN	at Parkway	6"	old clamp rotted out	3/2/2013
619	FREDERICK	e of Curry	6"	bad U-Joint	3/5/2013
	LLOYD	at Northwood	6"	crack around	3/7/2013
2628	MAPLEWOOD	s of Glenwood	6"	crack around	3/8/2013
2017	ROCHESTER	s of Houstonia	8"	crack around	3/18/2013
4049	NORMANDY	e of Parkway	8"	crack around	3/19/2013
1026	VERMONT N	n of gardenia	6"	crack around	3/27/2013
	WINDEMERE E	at Alexander	6"	(2)4" holes, 1' apart	3/28/2013
1519	MIDLAND	w of Campbell	6"	crack around	4/1/2013
1006	SYMES CT	n of gardenia	6"	crack around	4/15/2013
1013	BAUMAN	w of Ferris	6"	20" long lateral on bottom	5/14/2013
swc	CAMPBELL N	at Girard	8"	old clamp rotted out	6/26/2013
4326	ELMWOOD	n of Massoit	6"	2" long lateral crack	8/24/2013
4336	COOLIDGE	s of Nakota	8"	old coupling rotted out	8/30/2013
	GIRARD	w of Vermont	6"	4" long lateral crack on bottom	9/7/2013
4338	ELMWOOD	s of Nakota	6"	4" long lateral crack on bottom	10/24/2013
32172	WOODWARD	s of Nakota	6"	crack around	10/30/2013
4106	YORBA LINDA	e of Fairmont	6"	crack around	11/14/2013
31000	WOODWARD	on 13 Mile	6"	crack around	11/15/2013
724	CONNECTICUT N	s of Forest	6"	crack around	11/16/2013
swc	HARRISON E	at Morse	4"	crack around	11/18/2013
3251	PRAIRIE	s of Judson	8"	crack around	11/29/2013
4236	YORBA LINDA	s of Springer	6"	crack around	12/2/2013
3516	DURHAM	n of 13 Mile	6"	3" hole in bottom	12/5/2013
4608	ROSEWOLD	n of Samoset	6"	old clamp rotted out	12/16/2013
4715	COOLIDGE	s of 14 Mile	8"	crack around	12/17/2013
3848	HILLSIDE CT	e of Hillside	6"	crack around	12/18/2013
32268	WOODWARD	s of Nakota	6"	crack around	12/23/2013
4130	WEBSTER W	w of Garden	8"	crack around	12/27/2013
3022	BLAIR N	s of Bloomfield	8"	crack around	12/28/2013

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#	Break Location	Cross Streets	Size	Break Description	Date
4104	ARLINGTON	n of Parkway	6"	4" long lateral on side	12/30/2013
sec	WILSON N	at Derby	6"	crack around	1/4/2014
3920	DURHAM	s of Normandy	6"	crack around	1/4/2014
308	WALNUT	w of Washington	6"	4" hole in bottom	1/5/2014
426	WALNUT	e of Marywood	6"	crack around	1/6/2014
27958	WOODWARD	s of Catalpa	8"	crack around	1/7/2014
1715	CROOKS	s of 12 Mile	8"	crack around	1/7/2014
1722	CHESTER	w of Crooks	6"	crack around	1/8/2014
1018	12 MILE E	w of Ferris	6"	crack around	1/9/2014
818	LONGFELLOW	s of Lincoln	4"	2" hole in bottom	1/10/2014
	TORQUAY	at Elmhurst	8"	crack around	1/10/2014
1525	WILSON S	n of 10 Mile	6"	4" hole in bottom	1/11/2014
3027	GARDEN	n of Webster	6"	crack around	1/11/2014
1920	WICKHAM	w of Crooks	6"	crack around	1/13/2014
4422	SHERIDAN	e of Greenfield	6"	crack around	1/17/2014
705	DORCHESTER S	n of Lincoln	8"	bad U-Joint	1/18/2014
1002	CEDAR HILL	w of Maxwell	6"	crack around	1/20/2014
sec	WILSON N	at Derby	6"	crack around	1/25/2014
swc	OLIVER	at Glenview	6"	crack around	1/27/2014
2708	GLENWOOD	w of Eton Cross	8"	crack around	1/27/2014
729	13 MILE E	e of Alexander	12"	crack around	1/29/2014
1122	WILSON N	s of Derby	6"	crack around	1/30/2014
3310	PRAIRIE	n of Judson	8"	4" hole on top	2/1/2014
	LINWOOD	at Essex	6"	crack around	2/1/2014
2023	NAKOTA	e of Woodland	8"	crack around	2/2/2014
nwc	CAMPBELL N	at Bloomfield	8"	crack around	2/2/2014
210	JOSEPHINE	n of Alfred	6"	2" holes on top & bottom	2/3/2014
1318	STEPHENSON S	n of Dallas	8"	crack around	2/4/2014
1519	4th E	w of Wilson	8"	crack around	2/5/2014
	HAMPTON	s of Normandy	8"	crack around	2/5/2014
1840	VINSETTA	n of 12 Mile	4"	3" hole in side	2/5/2014
4511	CROOKS	s of Samoset	8"	crack around	2/8/2014
3118	GREENFIELD	n of Webster	8"	mech joint - bolts	2/9/2014
	WINDEMERE E	at Alexander	6"	3" hole in side	2/11/2014
	KNOWLES	at alley N of 4th	8"	crack around	2/11/2014
727	WINDEMERE E	e of Alexander	6"	(2) 3" holes on side - 6' apart	2/12/2014
1626	EDGEWOOD	s of 12 Mile	6"	crack around	2/13/2014
nec	CHESTER	at Woodward	8"	crack around	2/15/2014
swc	ELMHURST	at Parmenter	8"	crack around	2/15/2014
1218	IRVING	s of Harrison	6"	crack around	2/16/2014
3907	COOLIDGE	n of Chester	8"	old clamp rotted out	2/16/2014

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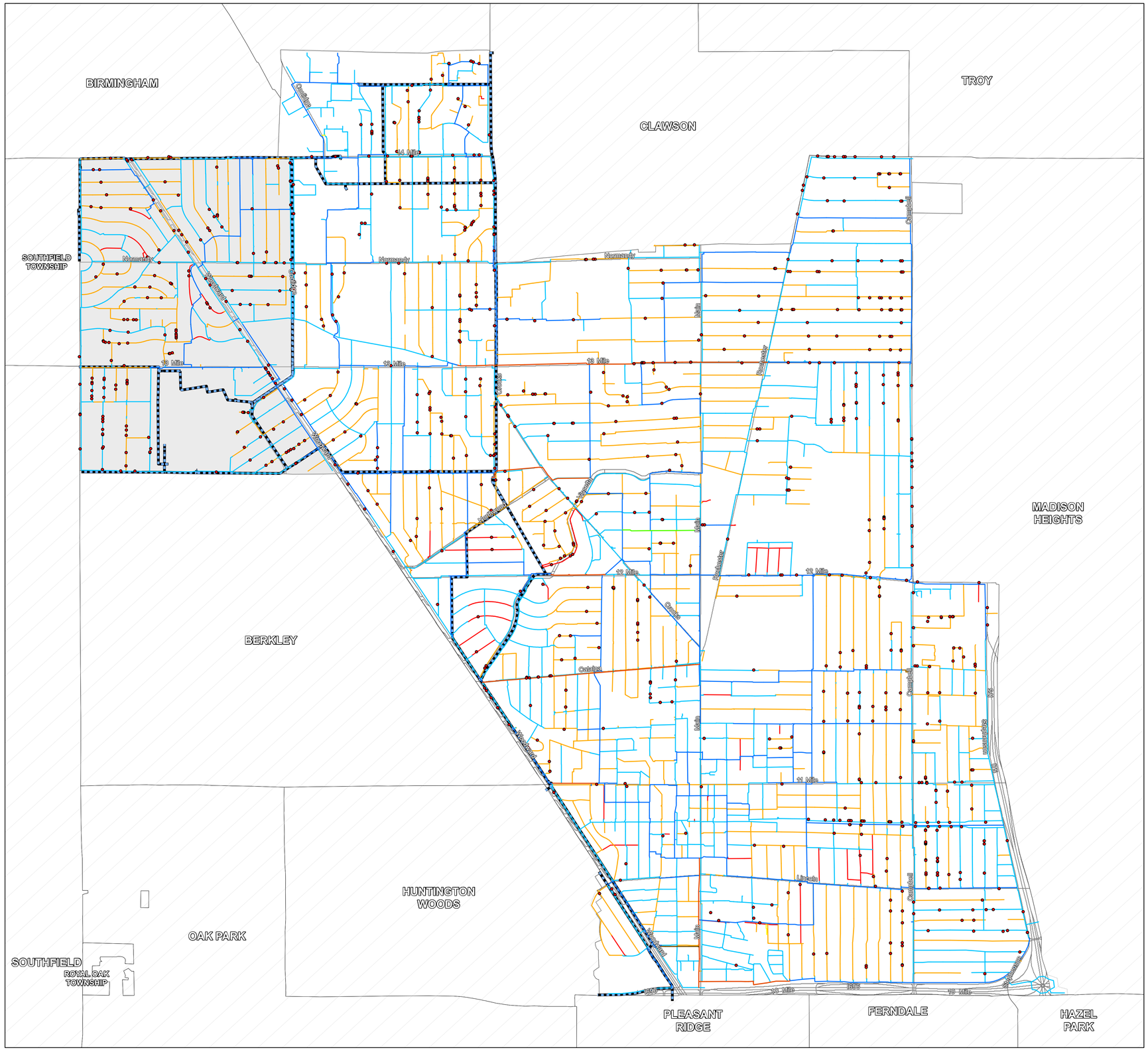
#	Break Location	Cross Streets	Size	Break Description	Date
	MIDLAND	at Blair	6"	3x6 hole on side	2/17/2014
4616	ROCHESTER	n of Ottawa	8"	crack around	2/18/2014
3350	ELLWOOD	s of 13 mile	6"	3x8 hole on bottom	2/18/2014
swc	FULTON S	at Normandy	6"	2x6 hole on bottom	2/18/2014
3334	CUMMINGS	s of 13 mile	6"		2/18/2014
3522	HUNTER	w of Hampton	6"	crack around	2/19/2014
	RAVENA	alley W of Woodward	4"	bad U-Joint	2/19/2014
717	KENWOOD S	n of Lincoln	6"	bad clamp	2/21/2014
	SYMES	at Gardenia	6"	3" hole in side and crack around	2/27/2014
	14 MILE W	at Cooper		crack around	3/1/2014
2902	ELMHURST	n of Glenwood	8"	crack around	3/3/2014
	EDGEWORTH	n of Lincoln	8"	bad U-Joint	3/6/2014
2708	GLENWOOD	w of Eton Cross	8"	4" hole on bottom	3/7/2014
120	BLAIR N	n of 11 Mile	6"	crack around	3/8/2014
27942	WOODWARD	s of Catalpa	8"	crack around	3/9/2014
	LOCKWOOD	at Crane	6"	2" hole on side	3/9/2014
1406	MONTROSE	w of Campbell	6"	crack around	3/10/2014
704	11 MILE W	at Plaesant	6"	3" hole on top	3/12/2014
631	BLAIR S	s of 6th	4"	crack around	3/12/2014
1901	WICKHAM	w of Crooks	8"	crack around	3/17/2014
nec	NORTHWOOD	at Galpin	6"	2" hole on top	3/27/2014
1531	WILSON S	s of Hudson	6"		3/30/2014
sec	WILSON S	at 3rd	6"		4/1/2014
2806	WOODLAND	n of Webster			4/9/2014
4316	ROBINWOOD	n of Massoit	8"	crack around	4/27/2014
nwc	DELEMERE	at Samoset	8"	crack around	5/3/2014
sec	KENWOOD S	at 4th	6"	old clamp rotted out	5/4/2014

City of Royal Oak
Water Main Breaks

Royal Oak
Life Now Playing



Legend

- Water Main Breaks (1,020)

Water Main Diameter (Inches)

- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 24"

SOCWA Water System

- Transmission Main

Pressure Districts

- High Pressure District
- Low Pressure District
- Major Roads

N

0 600 1,200 2,400 3,600 Feet

1 Inch = 1,200 Feet

Johnson&Anderson