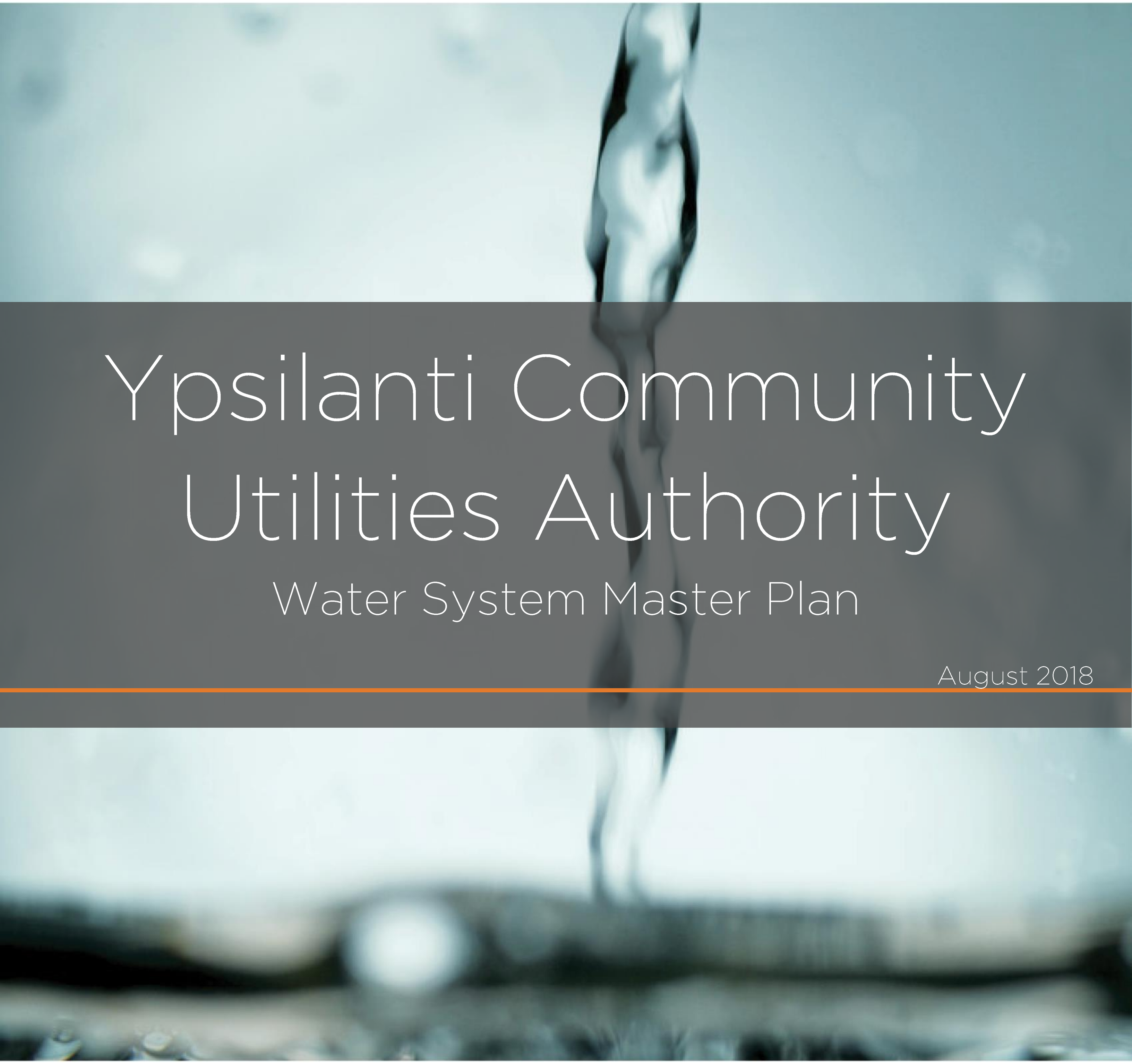

Ypsilanti Community Utilities Authority

Water System Master Plan

August 2018

Water Reliability Study

General Plan

Asset Management Plan

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The Ypsilanti Community Utilities Authority (the Authority) was formed in 1974 when the Charter Township of Ypsilanti (the Township) and the City of Ypsilanti (the City) combined their respective water departments. The Authority administers water services and/or wastewater services to the City of Ypsilanti, Charter Township of Ypsilanti, Pittsfield Township, Augusta Township, Superior Township, Sumpter Township, and the Western Townships Utilities Authority (wastewater only). The Authority purchases water from the Great Lakes Water Authority (GLWA) and delivers to approximately 112,000 people and 22,000 businesses.

The Authority is responsible for operation and maintenance of the public water supply facilities within the Charter Township of Ypsilanti and the City of Ypsilanti. The assets are tracking in the Authority's Geographic Information System (GIS) databases and work order management system, Lucity. Assets include:

- Approximately 330 miles of distribution main (16-inch diameter and smaller) and 24 miles of transmission main (larger than 16-inch diameter)
- Approximately 6,157 system valves
- Approximately 3,146 hydrants
- Four pressure reducing valve (PRV) vaults
- Four ground storage tanks and two elevated storage tanks with a capacity of 16.25 million gallons
- Six booster pumping stations with over 180 separately inventoried assets

The Michigan Department of Environmental Quality (MDEQ) requires that a Water Reliability Study and General Plan be prepared for municipal systems and updated every five years. New requirements in 2017 also include an Asset Management Plan (AMP). OHM Advisors was retained by the Authority to prepare a Water System Reliability Study, General Plan, and AMP. The required elements of the Water Reliability Study include population and water demand projections for existing, 5-year and 20-year planning periods along with a capacity and needs assessment of the water supply and storage components. The General Plan requirements include the creation of a comprehensive water system map, hydraulic analysis of the water system displaying system pressures and available fire protection, and a capital improvement plan for the 5-year and 20-year planning periods. The AMP requires an asset inventory and evaluation of probability and consequence of failure on a per asset basis.

Water Pressure and Available Fire Protection

A hydraulic water model was developed to perform the hydraulic analysis within the City and Township. GLWA connection settings and booster station operating data were input into the model to simulate actual operating conditions. Existing water demand was calculated and peaking factors for maximum day and peak hour were determined from the Authority's water records and SCADA (Supervisory Control and Data Acquisition) data from 2011 to 2017. SEMCOG (Southeast Michigan Council of Governments) future population projections were used to forecast the 5-year and 20-year population and resulting water demand projections. The model was then used to predict anticipated system pressures and available fire protection for these future planning periods.

Generally speaking, both the City and Township have good working pressure and adequate fire protection for the three planning periods. Desired fire protection rates vary depending on the land use. The following desired rates, based on training material published by the International Fire Service Training Association, were used:

- Single Family Residential = 1,000 gpm
- Multi-Family Residential = 1,500 gpm
- Commercial = 2,500 gpm
- Industrial = 3,500 gpm

Nearly all areas meet or exceed the desired fire protection rates. There are several areas within the City that have less than the desired flow rate due to being serviced by small, dead end mains.

Risk Assessment

The Authority used a methodical risk based approach to prioritizing projects. This approach considered both the Probability of Failure (PoF) or condition and Consequence of Failure (CoF) or criticality as shown in Figure A. Horizontal assets like water main were assigned a condition score, based on the asset's estimated remaining useful life and known break history. The following factors were combined to determine the Authority's CoF for horizontal assets:

- Diameter/Size – the relative size of the asset with respect to the rest of the system.
- Huron River Crossings
- Within the Right-of-Way of major roads – M-12, M-23, 1-94, Wiard Road (Between M-12 and I-94), and Washtenaw Avenue
- Dead Ends
- Top Water Users
- Critical Water Users

Vertical assets within the pumping stations were physically inspected by experienced process design engineers with input from Authority operators. Each vertical asset was assigned an expected failure year, PoF, and CoF.

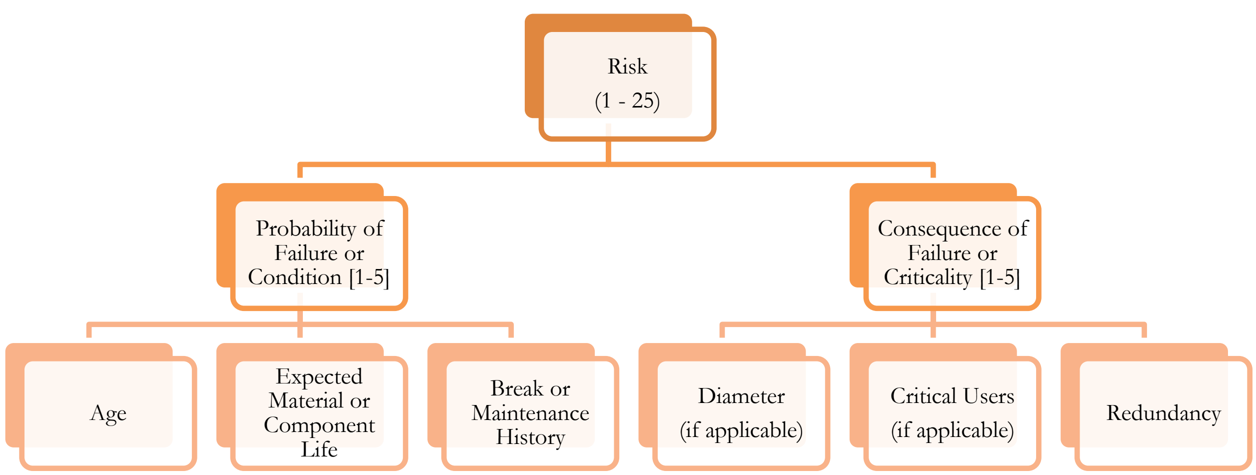

Figure A: Risk Assessment

Most of the Authority's assets are categorized as low or medium risk assets. These assets will continue to degrade over time and their condition will worsen, if no preservation measures are taken, which in turn will shift the distribution of the risk categories.

Level of Service

The Authority, in line with its mission statement outlined below, adopted level of service criteria, which it plans to use as a guideline to manage the water system. These level of service criteria are summarized in Table A.

YCUA is committed to enhancing the safety, health, and quality of life for the people serviced by the water system through effective management and maintenance of its infrastructure. YCUA's overall goal is to have appropriate capital reserves to ensure service to all of their customers.

Table A: Level of Service Criteria

Key Service Criteria	Target Level of Service
Regulatory Compliance	On-going compliance with all state and federal water quality regulations
Customer Rates	Rates will be reviewed on an annual basis and raised as needed.
Valve Maintenance	Continue advancements in valve exercising program
Hydrant Maintenance	Continue advancements in existing hydrant flushing program

Tracking and assessing of the level of service criteria will be completed as part of routine AMP reviews, and updated as necessary. As new level of service criteria are created, they will be incorporated into future versions of the AMP. With this document serving as the Authority's first iteration in the AMP process, targets and tracking are expected to develop as the Authority implements new digital tracking tools through GIS and Lucity.

Capital Improvements and Rate Sufficiency

A Capital Improvement Plan (CIP) has been completed for the Authority, and it includes recommended improvements based on the analysis of the water system.

The pump station inspections identified remaining useful life, anticipated replacement year, and anticipated replacement years for all assets. Table B summarizes the expected asset replacement costs for each station.

Table B: Pumping Station Asset Replacement Costs

Pumping Station	5-Year (2018-2022)	20-Year (2023-2037)
Bridge Road	$34,800	$1,162,300
Clark Road	$186,700	$66,900
Ellsworth	$28,400	$191,300
Holmes Road	$33,000	$343,000
Merritt Road	$198,300	$751,500
Textile Road	$204,900	$155,700
Total	**$686,100**	**$2,670,700**

Due to the large number of asset replacements needed at the Clark and Textile Road Stations, larger capital projects to replace or upgrade those stations are listed below. Additional larger improvements to the Merritt and Bridge Road Stations are also included below.

- Clark Road Pumping Station Replacement – $672,000
- Textile Road Pumping Station Upgrade – $1,070,000
- Merritt Road Pumping Station Improvements – $376,000
- Bridge Road Pumping Station Improvements – $430,000

A majority of the water main improvements shown in Table C are made due to water main breaks. Projects will be prioritized based on anticipated road projects and coordination with the City of Ypsilanti, Ypsilanti Township, and the Washtenaw County Road Commission.

Table C: CIP Projects

CIP Project	Total Estimated Cost	
Fairway Hills	$	993,600
Washtenaw, Cornell, N Huron River Dr.	$	3,824,700
North of Washtenaw Golf Club	$	5,359,500
S Clubview Dr.	$	414,800
West Willow Neighborhood (North)	$	1,447,200
5-Year Total =	**$**	**12,039,800**
Apple Ridge Park, Bud and Blossom Park neighborhoods	$	2,207,600
West Willow Neighborhood (West)	$	1,226,900
Gault Village	$	9,777,400
S Grove St.	$	4,946,400
West Willow Neighborhood (South)	$	2,198,900
E Cross St.	$	1,634,400
Taft and Jones	$	423,400
Faithway Baptist Church	$	1,939,700
West of S Ford Rd.	$	4,130,500
East of S Ford Rd.	$	2,652,500
E Michigan Ave	$	697,700
E Clark Rd.	$	3,590,600
N Prospect Rd	$	885,300
20-Year Total =	**$**	**36,311,300**

The Authority reviews and updates its financial position annually. The Authority's Board (Board) of Commissioners approves the annual budget and rate increases. The 5-year and 20-year cost considerations will be reviewed and incorporated, as appropriate, in future budgets. Funding gaps that may exist will be addressed at that time. A rate study will be recommended on a routine basis or when significant gaps in funding are realized.

I. PURPOSE AND SCOPE

The purpose of this Water Master Plan is to evaluate the existing municipal water supply, storage, and transmission and distribution systems serving the City of Ypsilanti, Ypsilanti Township, and portions of six other communities served by the Ypsilanti Community Utilities Authority (Authority). Results will include recommendations for improvements to the system necessary to meet the present and future needs of the community.

The Authority purchases drinking water from the Great Lakes Water Authority (GLWA) and distributes it to the City of Ypsilanti and Ypsilanti Township, as well as to Augusta Township, Superior Township, and portions of Pittsfield Township, York Township, Canton Township, and Van Buren Township. The Authority owns and maintains the distribution and transmission system within the City of Ypsilanti and Ypsilanti Township. The Authority also owns and maintains the transmission main from the Township to the prison, forensic center, and the York Township connection which are outside the City and Township.

This report considers the ability of the distribution system to provide the required operating pressure and desired fire protection throughout the City and Township. Planning periods for present day, 5-year, and 20-year projections are included.

The report is intended to satisfy the MDEQ Michigan Safe Drinking Water Act Part 12 Water Reliability Study, Part 16 General Plan Requirements, and Rule 1606 which outlines the requirements for the Asset Management Plan as a part of the General Plan. Sections II through V of this report address the Water Reliability Study, Section VI addresses the General Plan, and Section VII addresses the Asset Management Plan.

The scope of this study included the following:

- Compilation and reporting of current population and number of service connections.
- Compilation and reporting of water production and consumption data for present, 5-year, and 20-year planning periods consisting of average daily demand, maximum daily demand, peak hour demand, and fire demand. Basis for demand projections and annual usage totals are also provided.
- Data collection and system mapping.
- Development of a hydraulic water model using water demand allocation, GLWA pressure reducing valve (PRV) settings, and booster station settings to reflect the actual system operation.
- Water model analysis for average day, maximum day, peak hour, and fire protection demand scenarios under existing, 5-year, and 20-year planning periods.
- Probability of Failure, Consequence of Failure, and Business Risk Exposure calculations.
- Revenue structure, budgeting, and rate sufficiency information.
- Identification of recommended system improvements and cost opinions.

II. EXISTING WATER SYSTEM

A. SERVICE AREA

The City of Ypsilanti and Ypsilanti Township are the founding member communities of the Authority and comprise the main service area. This service area is primarily residential and commercial with some agricultural areas in the southern part of the Township. The City is 4.5 square miles and the Township is 31.8 square miles for a total service area spanning 36.3 square miles. The overall layout of the water main distribution and transmission system is shown in the General Plan Map Figure A-1, Appendix A.

B. WATER SUPPLY OVERVIEW

The primary water service feeds to the City and Township are through two GLWA connections. These connections are located near Willow Run Airport on Ecorse Dr. and Wiard Rd. One connection services the City while the other services the Township.

The GLWA connection servicing the Township (YT-01) has a flow meter and a pressure-reducing valve. The connection servicing the City (YT-02) has a flow meter and a pressure reducing valve (PRV) which is located farther downstream on Tyler Rd. A third connection (YT-03) serves Superior Township. YT-01 is located at Old Ecorse Road and Rawsonville Road/County Line, YT-02 is located at Old Ecorse Road and Thoroughbred Way, and YT-03 is located at Geddes Road and Ridge Road. Flows through these GLWA connections are contractually limited to 24.1 MGD (maximum day) except during cases of an emergency such as fires and/or other natural disasters.

The six pump stations operate such that:

- They will provide appropriate flows and pressures in the water system for the various demand scenarios along with the GLWA connection pressures and flow rates.
- They will ensure that flows through the GLWA connections will not exceed 24.1 MGD except in cases of emergencies.

A listing of the PRVs is shown in Table 1.

Table 1: Pressure Reducing Valves

Location	Size (in)	Existing Setting (psi)	Elevation (ft)	Existing Hydraulic Grade (ft)
Old Ecorse Road (YT-01)	30	85	728	924
Tyler Road	24	76	728	904
Wiard Road	20	81	726	913

The Authority also maintains three connections with Superior to the north, three connections with Augusta to the south, 13 connections with Pittsfield to the West, and one connection each with York, Van Buren, and Canton as illustrated in Figure A-1.

C. STORAGE OVERVIEW

The City of Ypsilanti has two elevated storage tanks and Ypsilanti Township has four ground storage tanks. Their capacities and locations are listed in Table 2 below. There is a total of 16.25 MG (million gallons) of storage within the Authority's system.

Table 2: Storage Tanks

Name	Location	Jurisdiction	Type	Capacity (gallons)	Year Constructed
Holmes	2615 Holmes Rd.	Township	Ground	2,000,000	1966
Bridge North	2365 Bridge Rd.	Township	Ground	5,000,000	1991
Bridge South	2365 Bridge Rd.	Township	Ground	5,000,000	1969
Ellsworth	2960 Ellsworth Rd.	Township	Ground	3,000,000	1970
Stone Tower	303 N. Summit	City	Elevated	250,000	1890
Shadford Tower	1861 Cross St.	City	Elevated	1,000,000	1957

D. TRANSMISSION AND DISTRIBUTION MAINS

The Authority's water system is comprised of 4-inch through 36-inch water mains with a total of 1,870,231 feet or 354 miles of water main. The Authority's water system was installed from the 1880s to the present, with the majority of these mains constructed in the last 40 years. A variety of pipe materials have been used including asbestos cement (AC), cast iron (CI), concrete (Conc), ductile iron (DI), galvanized iron (GI), high-density polyethylene (HDPE), polyvinyl chloride (PVC), steel, and traces of unknown (UNK) material. Water main installed in the 1880s is composed primarily of steel material while the more recently installed main is constructed of ductile iron.

It should be noted that limited gaps or erroneous data exist within the GIS pipe data as it relates to material of construction, and installation date. These will be updated if new information becomes available.

Table 3: Water System Piping Summary

Pipe Diameter (inches)	Total Length	Pipe Material								
	(feet)	AC	CI	Conc	DI	GI	HDPE	PVC	Steel	UNK
4	72,585	-	58,960	-	1,787	1,132	-	4,684	-	6,023
6	292,174	5,991	234,167	-	42,451	-	8	2,838	44	6,673
8	815,094	23,209	99,607	-	634,898	-	3,890	22,450	-	31,041
10	33,066	-	14,993	-	2,090	-	-	5,856	-	10,127
12	362,845	23,227	81,256	-	199,567	-	-	12,407	5,983	40,405
16	171,620	-	76,343	-	60,091	-	-	2,670	-	32,515
18	137	-	137	-	-	-	-	-	-	-
20	3,425	-	-	-	3,425	-	-	-	-	-
24	72,792	-	28,431	16,963	27,398	-	-	-	-	-
30	22,808	-	-	19,149	3,659	-	-	-	-	-
36	23,686	-	-	18,292	5,394	-	-	-	-	-
Percent	-	2.8%	31.8%	2.9%	52.4%	.06%	.21%	2.7%	.32%	6.8%
Total	**1,870,231**	**52,427**	**593,894**	**54,404**	**980,760**	**1,132**	**3,898**	**50,905**	**6,027**	**126,784**

II. POPULATION AND WATER USE

A. POPULATION

The Southeast Michigan Coalition of Governments (SEMCOG) population projections estimate that the City and Township will experience a combined 9% growth in population in the next 20 years. Appendix B contains the SEMCOG profiles for each of the communities served by the Authority. Table 4 summarizes the population projections for the City and Township. Since the Authority only provides water to a portion of the contract customers through a master meter, the total populations of those customers are not included in the population projection.

Table 4: Population Data

Year	City Population	Township Population	Total Population
Current	19,137	53,688	72,825
5-Year	19,187	54,602	73,789
20-Year	20,000	59,584	79,584

B. SERVICE CONNECTIONS and USER CLASS

A summary of the breakdown between residential and industrial/commercial users is shown in Table 5. The Township's users account for a little over 77% of the meters in the system. The contract customers were not considered in this meter count because the Authority uses a master meter at the community boundaries. The Authority does not own or operate the water distribution systems of its customer communities.

Table 5: Meter Count

Meter Size (inch)	City	Township	Allowed Usage (cubic feet)
⅝	4,560	16,305	600
1	231	391	1000
1 ½	131	398	2100
2	205	249	4000
3	16	20	9000
4	23	15	16,200
6	4	10	36,000
8	0	23	66,000
10	1	8	102,000
12	0	1	150,000
30	0	1	
TOTAL	5,171	17,421	

C. EXISTING WATER USAGE

Historical hourly demand data was provided by the Authority from the GLWA's Wholesale Automated Meter Reading (WAMR) portal. System demand is based on data from YT-01, YT-02, and YT-03. Average day, maximum day, and peak hour demand rates for the City and Township (including contract customers) are shown in Tables 6 and 7 in Million Gallons per Day (MGD).

Peaking factors (PF) for maximum day and peak hour usage were calculated for the past three years for both the City and Township. Based on these calculated peaking factors, appropriate peaking factors to use for the City water system were determined to be 1.72 for maximum day and 2.18 for peak hour. Appropriate peaking factors to use for the Township and wholesale customers were determined to be 1.7 for maximum day and 2.56 for peak hour. Pittsfield Township peak hour demands were limited to their contractual maximum demand of 4,450 gpm regardless of system peaking factor.

Table 6: City of Ypsilanti Historic Water Demand Summary

Year	Water Demand				
	Average Day	Maximum Day	Maximum Day PF	Peak Hour	Peak Hour PF
	MGD	MGD		MGD	
2015	2.07	3.25	1.57	4.26	2.06
2016	2.31	3.26	1.41	4.92	2.13
2017	2.06	3.54	1.72	4.50	2.18
PEAKING FACTORS			**1.72**		**2.18**

Table 7: Ypsilanti Township and Wholesale Customers Historic Water Demand Summary

Year	Water Demand				
	Average Day	Maximum Day	Maximum Day PF	Peak Hour	Peak Hour PF
	MGD	MGD		MGD	
2015	7.35	12.48	1.70	18.84	2.56
2016	8.26	13.93	1.69	19.48	2.36
2017	8.16	13.09	1.60	19.55	2.40
PEAKING FACTORS			**1.70**		**2.56**

The Authority has primarily residential water users with some commercial and several large industrial water users in the main water system. The largest water users within the City include Eastern Michigan University and Marsh Plating as well as some apartment complexes. The largest water users within the Township are the Ford Motor plant and an apartment complex. The wholesale customers are also major users within the system. The largest users and their demands are listed in Table 8.

Table 8: Top System Users

User	Location	Average Day Demand (gpm)
Eastern Michigan University	City	233
Marsh Plating	City	77
Forest Knoll	City	33
River Drive Apartments	City	19
Peninsular Place Apartments	City	15
Hewitt Land	City	10
Ypsilanti Housing	City	6
Ypsilanti Schools	City	7
Ford Motor	Township	51
Sun Communities	Township	39
Lake in the Woods	Township	79
St. Joseph Mercy Hospital	Township	112
Superior	Wholesale	320
Augusta	Wholesale	330
Pittsfield	Wholesale	2,430

D. FUTURE WATER DEMANDS

Projections of 5-year and 20-year water demands were made based on per capita flow and population projections within the City and Township. The existing average day demand is about 89 gallons per capita per day (gpcd) in the City and about 75 gpcd in the Township. The demands for the whole system include the contract customer communities which are expected to grow at a rate similar to that of the Township. The resulting 5-year and 20-year projected demands for the City, Township, and total system are shown in Tables 9, 10, and 11.

Table 9: City of Ypsilanti Projected Water Demand

Year	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
2018	1.70	2.92	3.71
5-Year	1.71	2.94	3.73
20-Year	1.78	3.06	3.88

Table 10: Ypsilanti Township Projected Water Demand

Year	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
2018	4.03	6.85	10.32
5-Year	4.10	6.97	10.50
20-Year	4.47	7.60	11.44

Table 11: Total System Projected Water Demand

Year	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
2018	9.90	16.83	22.36
5-Year	10.09	17.17	22.60
20-Year	10.91	18.47	23.81

E. FIRE PROTECTION

In addition to providing water at adequate pressure to the system users, a secondary purpose of a water system is to provide available water for fire protection. Although this is a secondary purpose of a water system, frequently the considerations for available fire protection can control the design of a water system. For this reason, it is important to define the fire protection that a system should achieve, and evaluate the ability of the system to provide the recommended available fire protection.

The required fire protection used for this study was determined based on our experience with other communities and the fire protection rating system used by the Insurance Services Office (ISO).

While it is important to provide adequate fire protection to protect the community and reduce home-owners insurance rates, a balance must be maintained between providing fire protection and not constructing oversized facilities to attain fire protection goals. There is an increase in cost to construct and maintain a water system with oversized facilities. A water system designed to provide high fire protection rates can cause long residence times in the system, which can contribute to deterioration in water quality. It is also important to note that providing fire protection is not a state or federal requirement of a water system. Therefore, the fire protection recommendations used in this study were selected to represent a balance between providing fire protection and not constructing oversized facilities to attain fire protection goals.

Based on the above discussion, the recommended fire protection used in this study ranges from 1,000 gpm for residential areas to 3,500 gpm for industrial areas based on training manuals published by the International Fire Service Training Association. Table 12 summarizes the recommended fire protection rates for each land use district. It should be noted that the recommended fire protection for various land use districts is based on fire protection for structures without a sprinkler system for fire suppression. For structures with a sprinkler system the fire protection desired to extinguish a fire may be much lower.

Table 112: Recommended Fire Protection per Zoning District

Recommended Fire Protection (gpm)	Zoning District
1,000	Single Family Residential
1,500	Multi-Family Residential
2,500	Commercial
3,500	Industrial

III. ANALYSIS OF EXISTING CONDITIONS

A. STORAGE CAPACITY

The Authority has 16.25 million gallons (MG) of total storage in the system. The Township has four ground storage tanks which have a total capacity of 15 MG, and the City has two elevated storage tanks that hold a total of 1.25 MG. The Ten States Standards recommends that a system have a minimum storage capacity equal to the average daily consumption. Systems should also have additional storage to provide the largest desired fire demand for three hours.

As shown in Tables 9 and 10, the combined average day demand of the City and Township is about 5.73 MG. With a desired fire protection of 3,500 gpm for industrial areas, a total of 630,000 gallons are required to meet the largest fire demand for three hours. The average day demands combined with the three hours of fire protection equals 6.36 MG. The Authority's current storage volume of 16.25 MG is sufficient to meet the system's average day and fire demands. The current storage capacity will be sufficient for at least the next 20 years.

B. PUMP STATIONS

The Authority operates and maintains six booster pumping stations throughout the service area. Table 13, below, provides detailed information on each of these stations. Firm capacity refers to the maximum capacity available when the largest pump is out of service. The presence of a variable frequency drive (VFD) is noted under Pump Horsepower (hp). Available pump curves are provided in Appendix K.

Table 123: Pump Station Details

Name	Location	Jurisdiction	Firm Capacity (MGD)	Pump Horsepower	Year Constructed
Holmes Road	2615 Holmes Rd.	Township	4	2 @ 100 hp	1966
Bridge Road	2365 Bridge Rd.	Township	23	2 @ 150 hp, 4 @ 300 hp (1 w/ VFD)	1991
Ellsworth Road	2960 Ellsworth Rd.	Township	3	2 @ 75 hp w/ VFD	1970
Textile Road	7527 Textile Rd.	Township	5	1 @ 30 hp, 1 @ 75 hp, 1 @ 100 hp	1961
Merritt Road	6929 Merritt Rd.	Township	11	3 @ 150 hp, 1 @ 200 hp	1986
Clark Road	2445 Huron River Dr.	Township	1	1 @ 30 hp, 1 @ 50 hp	1975

C. WATER QUALITY

YCUA receives its water from the GLWA. This water is treated at the Southwest Water Treatment Plant in Allen Park and the Springwells Treatment Plant in Dearborn. The Authority's drinking water is safe for consumption and meets federal and state requirements. A copy of the 2016 Drinking Water Quality Report is included in Appendix C.

D. POTENTIAL WATER SOURCES

The GLWA connections serving the City (YT-02) and Township (YT-01) are redundant in that either connection can feed the entire system in the event of an emergency. Should one connection fail, the other connection can serve the system by opening appropriate valves.

E. BACKUP POWER

The Merritt Road pump station has a 1,800 RPM generator rated at 500 kW with a system voltage of 480 volts.

IV. ANALYSIS OF UNACCOUNTED WATER

The annual volume of water purchased by the City and Township was compared to the annual volume of water billed to customers from 2007 to 2017 to quantify unaccounted water. The maximum acceptable water loss threshold is typically considered to be 10-15%. The combined water loss for the City and Township is below this threshold.

Unaccounted water can be attributed to any of the following:

- Water loss from the system
- Hydrant flushing
- Water used for fighting fires
- Water used for construction
- Water used for maintenance
- Other unmetered uses

Table 14 summarizes the unaccounted for water in the Authority's service area.

Table 134: Unaccounted for Water Summary

Year	Purchased (MG)	Billed to Customers (MG)	Percent Loss
2007	4,819	4,649	3.53%
2008	4,646	4,433	4.60%
2009	4,216	4,144	1.70%
2010	4,110	3,852	6.28%
2011	3,831	3,801	0.78%
2012	4,077	4,011	1.63%
2013	3,801	3,677	3.26%
2014	3,808	3,596	5.57%
2015	3,530	3,484	1.33%
2016	4,015	3,766	6.20%
2017	3,898	3,591	7.89%

V. WATER SHORTAGE RESPONSE

The Authority has an existing Emergency Response Plan, reviewed and approved by the MDEQ, that provides guidance for staff to respond during events that disrupt service in the water supply system. Due to the sensitive nature of portions of the Emergency Response Plan, it is not public record. Inquiries regarding the Emergency Response Plan should be directed to the Authority Director.

VI. HYDRAULIC ANALYSIS

A hydraulic model was prepared to evaluate the ability of the water system to provide adequate pressures and fire protection for existing, 5-year, and 20-year conditions. The model was also used to identify and recommend improvements for hydraulic deficiencies, if any. The model results indicate which areas have pressure and fire protection values less than desired.

A. COMPUTER MODEL

The computer program used by OHM Advisors for the creation and analysis of the water system is InfoWater/MSX Suite 8.6 developed by Innovyze. This program is widely used in the study of municipal water systems and capable of performing analysis of fluid flow in a pipe network under steady state and extended period conditions.

The InfoWater program utilizes an enhanced version of the EPANet analysis engine as developed and distributed by the U.S. Environmental Protection Agency. The program uses the conservation of water volume equation for the junctions and energy loss equations for the pipes to form a non-linear set of equations that mathematically represent the system. For a given set of boundary conditions, these equations can be solved to determine flow rate and pressure at any point within the system. This step is called "hydraulic balancing" of the network, and is accomplished by using an iterative technique to solve the non-linear equation set involved. The iterations end when the relative change in flow rates between two successive iterates is less than the specified accuracy (tolerance), and a steady state network solution is reached.

The water supply system is represented in the model by pipes and junctions. Junctions represent where pipes are connected and can be used to represent the water demand within the system. The information necessary for the analysis includes pipe length, diameter, and roughness coefficient. Additionally, each junction is given a demand and elevation above sea level. The system pumps, check valves, storage tanks, and pressure reducing valves (PRVs) are represented in the model and operational settings are input in the model. The program simulates the water flows through the system to determine the flow rates and pressures throughout the system.

The Authority's water system model includes the storage tanks, pumps, PRVs, transmission, and distribution mains (Appendix A, Figure A-1). A GIS layer of distribution and transmission mains was provided by the Authority and imported into the InfoWater program. Junction elevations were determined using Washtenaw County GIS contour data. Pump information was provided by the Authority and is available in Appendix K.

The Hazen-Williams friction formula was used to calculate energy losses associated with pipe wall friction. The use of this equation is standard practice to compute pressure losses in a water distribution network. The boundary conditions utilized for the simulations consist of minimum hydro-pneumatic tank operational hydraulic grades, minimum storage tank operational levels, pump curves associated with well pumps and high service pumps, and ground water levels of aquifers during pumping. Additionally, flow control valves were used on the hydro-pneumatic tank discharge lines to ensure that the model did not allow more water to flow from the hydro-pneumatic tanks than their respective well or high service pumps were capable of pumping into the tank.

B. DEMAND DISTRIBUTION

The total system demands shown in Tables 6 and 7 were compiled from the Authority's SCADA data. The top ten users in each the City and Township were determined from billing data, and specific demands were assigned to each of these top users. The remaining flow not assigned to the top users was allocated evenly across the rest of the system junctions, for each the City and Township respectively. Contractual demand limits for Pittsfield Township of 4,550 gpm are reflected in the maximum day and peak hour scenarios.

C. CALIBRATION

The model was calibrated using hydrant flow tests performed in November of 2017. These tests measured the static pressure under existing conditions and the residual pressure with a flowing hydrant at each test location. The flow rates coming out of the hydrants were also measured and calculations were made of what the flow rate would be with a residual pressure of 20 psi.

The model was run with average day demand, and static test pressures were compared to modeled pressures at the given test locations. A fire protection analysis was also performed with the model which calculated the available fire protection at every model junction with a 20-psi residual pressure remaining. The modeled available fire protection rates were compared to rates calculated from the field test data. Much of the data is within the desired tolerance (10% for static pressures, 15% for residual pressures, and 25% for fire protection). Where the modeled and field calculated fire protection rates were not within the desired tolerance, an additional comparison was done. At these locations, the measured test flow was put into the model and a comparison was made between the residual pressure measured in the field and the residual pressure predicted by the model. This additional comparison was also done for field tests that had less than a 10-psi pressure drop from static pressure to residual pressure as a low pressure drop makes accurate calculations of available fire protection at 20 psi more difficult. All but two of these comparisons were within the desired tolerance of 25%. Table 15 shows the hydrant test results.

Table 15: Model Calibration

Location	Pressure (psi)			Flow Rate (gpm)	Flow Rate @ 20 psi (gpm)	Model Static Pressure (psi)	Model Residual Pressure (psi)	Model Fire Protection @ 20 psi (gpm)	Percent Change		
	Static	Residual	Drop						Static Pressure	Residual Pressure	Fire
Southlawn at Bergen	76	68	8	1074	3073	72	52	1800	-5.3%	-23.5%	-41.4%
Greenside	70	62	8	1222	3286	68	61	3576	-3.6%	-1.6%	8.8%
Kingwood @ Oxford	58	56	2	1150	5641	59	56	4596	1.7%	0.0%	-18.5%
Woods Dr.	49	46	3	1087	3702	49	45	3169	0.0%	-2.2%	-14.4%
Sweet Rd.	64	46	18	1021	1654	68	52	1847	6.3%	13.0%	11.7%
Oak Ct	56	55	1	1198	8298	59	57	5959	5.4%	3.6%	-28.2%
Brooktree Ct	82	64	18	1256	2449	87	73	2924	6.1%	14.1%	19.4%
Levona St	75	74	1	375	3266	80	78	2355	6.7%	5.4%	-27.9%
Faircrest @ Applewood	64	57	7	1163	3137	76	66	2947	18.8%	15.8%	-6.0%
Trillium and Lilly	81	69	12	1300	3127	88	77	3476	8.6%	11.6%	11.1%
Lochmoor & Andrews	80	74	6	1353	4691	79	74	5129	-1.3%	0.0%	9.3%
Rolling Hills Park	78	54	24	1186	1911	75	41	1538	-3.8%	-24.1%	-19.5%

D. EXISTING PRESSURES AND FIRE PROTECTION

Existing System Modeling

The existing pressure scenarios that were performed are for average day, maximum day, and peak hour. The existing pressure scenarios are based on the following assumptions:

1. Existing demands from Tables 6 and 7 of the report.
2. Existing system hydraulics including improvements constructed as of January 2018, but not including any proposed improvements.
3. PRV settings from Table 1 of the report.
4. GLWA supply pressures as shown in Table 16 below.

Table 146: Existing Model Boundary HGL Settings

YT-01 Connection		
YT-01 Supply Pressure	126	psi
PRV Setting	85	psi
HGL	924	ft
YT-02 Connection		
YT-02 Supply Pressure	130	psi
PRV Setting at Tyler Rd.	76	psi
HGL	903	ft

Figures E-1 through E-3 in Appendix E show existing pressures for the average day, maximum day, and peak hour demand scenarios.

Existing Pressure Results

Under normal demand conditions (average day, maximum day and peak hour), water systems are required to provide a minimum of 35 psi throughout their distribution system. For emergency conditions, the minimum pressure requirement is 20 psi. The range of modeled pressures for the existing system exceed regulatory minimums and are shown in Table 17.

Table 17: Range of Operating Pressures in the Existing System Model

Location	Average Day	Maximum Day	Peak Hour
City	37 – 94 psi	37 – 93 psi	37 – 93 psi
Township	48 – 130 psi	47 – 130 psi	47 – 130 psi

The average day results have pressures ranging from 37 psi to 94 psi within the City (see Figure E-1). Similarly, the maximum day and peak hour results have pressures ranging from 37 psi to 93 psi in the City's water system (see Figures E-2 and E-3). In the Township, pressures range from 48 psi to 130 psi during average day demands, and between 47 psi and 130 psi during maximum day and peak hour demands. These pressures are within normal operating conditions for both the City and Township. The boundary conditions are controlled by pressure reducing valves and pump stations; therefore, there is little variance in pressure. The lowest pressures are seen in the City near the intersection of Washtenaw and N. Hewitt Rd.

Existing Fire Protection Modeling

The existing fire protection analysis was performed based on the following assumptions:

1. Existing maximum day demands from Tables 6 and 7 of the report.
2. Existing system hydraulics, but not including any proposed improvements.
3. PRV settings from Table 1 of the report.
4. GLWA supply pressures as shown in Table 15.
5. Residual pressure of 20 psi at each node individually.

Each node in the system was assigned a desired fire protection value based on existing zoning of the parcels at the location of that given node. The desired fire protection for the different zoning classifications are shown in Table 12 of this report. A fire flow analysis was run for the system hydrant nodes to determine the available fire protection at each hydrant without dropping system pressures below 20 psi.

Percent of desired fire protection was taken by dividing available fire protection at each hydrant node by that node's determined desired fire protection. Figure E-4 shows the results of the fire protection analysis of the existing water system.

Existing Fire Protection Results

The system was found to have adequate fire protection for the most part. Nearly all areas meet or exceed the desired fire protection rates. There are some small areas scattered throughout the City that have less than 50% of the desired fire protection due to being located on 4-inch dead end mains. Although some individual hydrants have less than desired fire flow, hydrants within the City are located in fairly close proximity to each other which will aid in fire protection.

There is also an area in the Northeast part of the Township that has less than desired fire protection. This area is located on the Green Oaks Golf Course, and the small, 4-inch mains in this area are used for irrigation of the course.

E. ANALYSIS OF FUTURE CONDITIONS

Future Proposed System Analysis

In order to determine available pressure for the future conditions, 5-year and 20-year pressure analyses were performed. The 5-year and 20-year models were created from the existing model, with the following modifications adopted:

- Demands increased to 5-year and 20-year for average day, maximum day, and peak hour scenarios according to the projections in Tables 9, 10, and 11 of the report.
- Demand distribution was kept the same in the model by scaling demands up linearly according to increased population.
- Demands for the Pittsfield meters were not increased past the maximum day demands due to contractual limitations.
- System PRVs and booster station settings remained the same.
- Pipe replacements and upgrades were not included in the future model analyses, as they would have negligible impact on the system's pressures and fire protection.

Future Pressure Results

Figures F-1 through F-3 show 5-year pressures for the average day, maximum day, and peak hour scenarios. Ranges of modeled pressure results for the 5-year system are shown in Table 18. Figures G-1 through G-3 show 20-year pressures for the average day, maximum day, and peak hour scenarios. Ranges of modeled pressure results for the 20-year system are shown in Table 19.

Table 18: Range of Operating Pressures in the 5-Year System Model

Location	Average Day	Maximum Day	Peak Hour
City	37 – 94 psi	37 – 93 psi	37 – 93 psi
Township	48 – 130 psi	47 – 130 psi	47 – 130 psi

Table 159: Range of Operating Pressures in the 20-Year System Model

Location	Average Day	Maximum Day	Peak Hour
City	37 – 94 psi	37 – 93 psi	36 – 93 psi
Township	48 – 130 psi	47 – 130 psi	47 – 130 psi

The average and maximum day results for the 5-year and 20-year model scenarios do not show any areas with pressures below 35 psi. The peak hour results also do not show any areas with pressure beneath the required 35 psi. The lowest pressures are seen in the City near the intersection of Washtenaw and N. Hewitt Rd., which is at the highest elevation.

Future Proposed Fire Protection Modeling

In order to determine available fire protection in the future, 5-year and 20-year fire protection analyses were performed using the previously discussed 5-year and 20-year models.

The same desired fire protection values assigned to each node for the existing fire protection analysis were used for the future fire protection analyses. Figures F-4 and G-4 show the results of the 5-year and 20-year fire protection analyses, respectively.

VII. ASSET MANAGEMENT PLAN

A. OVERVIEW AND MISSION STATEMENT

The intent of this Asset Management Plan (AMP) is for the Authority to address high-priority asset needs that are critical to their infrastructure's performance, identify costs of operating the infrastructure, and plan for future capital improvements.

To assist with the MDEQ review of the AMP portion of this report, we have prepared a completed Water AMP checklist for consideraiton. The checklist is provided in Appendix L. This AMP is considered a living document that the Authority will review and update on a routine basis.

The purpose of the Authority's AMP is summarized by the following mission statement:

> ***YCUA is committed to enhancing the safety, health, and quality of life for the people serviced by the water system through effective management and maintenance of its infrastructure. YCUA's overall goal is to have appropriate capital reserves to ensure service to all of their customers.***

B. ASSET INVENTORY

An asset inventory is a list of the Authority's assets and their attributes. The Authority maintains digital records of their water distribution system using GIS. The Authority also uses a software program called Lucity to manage and maintain its assets as well as to coordinate maintenance and work order management. The current GIS data includes water main age, material, length, and size. For the AMP, assets were grouped based on type or function; the groupings include horizontal (water main, hydrants, and valves) and vertical assets (storage tank, storage tank components, booster stations, valve vaults, etc).

Table 20: Horizontal Asset Inventory Example

Asset ID	Asset Type	Install Year	Diameter (in)*	Material*	Condition	Remaining Useful Life
Example1	Distribution Main	1952	6	DI	3	50%
***if applicable**						

C. LIST OF MAJOR ASSETS

The major assets are simplified in the text below:

- Approximately 330 miles of distribution main (16-inch diameter and smaller) and 24 miles of transmission main (larger than 16-inch diameter)
- 6,157 system valves
- 3,146 hydrants
- Four pressure reducing valve (PRV) vaults
- Four ground storage tanks and two elevated storage tanks
- Six booster pumping stations - A comprehensive inventory of the assets within the booster pumping stations is provided in Appendix I.

D. CONDITION ASSESSMENT

Through a methodical analysis procedure, the Probability of Failure (PoF) or condition of assets in the Authority's water distribution system has been assessed. The remaining useful life of the Authority's horizontal water main assets (mains, hydrants, and valves) was estimated based on the asset's install year and estimated design life. The estimated design life for various asset classes were determined from sources published by the Environmental Protection Agency and the American Society of Civil Engineers and are presented in Table 21.

Table 21: Estimated Water Main Design Life

Water System Asset Component	Estimated Design Life (years)
Water Main - Asbestos Cement (AC)	80
Water Main – Concrete (Conc)	100
Water Main - Ductile Iron (DI)	100
Water Main - High Density Polyethylene (HDPE)	100
Water Main – Cast Iron	100
Water Main – Galvanized Iron (GI)	80
Water Main – Polyvinyl Chloride (PVC)	100
Water Main - Copper	70
Water Main – Steel	80
Hydrants	60
Valves	40

A condition assessment was completed on the Authority's horizontal and vertical assets. The PoF of the Authority's assets is based on a condition scoring system, which uses a scale of one (1) to five (5), with one (1) meaning the asset is new or in excellent condition and five (5) meaning the asset has reached the end of its useful life. Horizontal assets were assigned a condition score, based on the asset's estimated remaining useful life and known break history, the as shown in Table 22. If water main age or material was unknown and could not be assumed, the associated pipe segment was assigned the average condition rating identified for pipe segments where all data was known. Vertical assets within the pumping stations were physically inspected by experienced process design engineers with input from Authority operators. Each vertical asset was assigned an expected failure year and PoF. Appendix H and Appendix I provide reference to the Authority's condition scores for horizontal assets and vertical assets, respectively. The condition scores are also maintained digitally in GIS and Lucity.

Table 22: Water Main Condition Score Generator

Condition Score	Condition Description	Estimated Remaining Useful Life (%)
1	New or Excellent Condition	100% - 80%
2	Minor Deterioration	80% - 60%
3	Moderate Deterioration	60% - 40%
4	Significant Deterioration	40% - 20%
5	Unserviceable	20% - 0%

The following understanding was generated based on the condition analysis:

- The horizontal assets have an average condition score of 2.5, meaning the majority of the system is expected to have minor to moderate deterioration.
- Over 71% of the vertical assets (estimated based on asset replacement cost) have a score of 3 or less, which means the majority of the system components are in moderate or better condition.
- The infrastructure will continue to degrade over time, for example, even though the average condition of the horizontal infrastructure suggests that the system is in moderate condition, a small percent of the infrastructure has a score of 4 (17%) and 5 (14%); this percentage will grow over time. The same holds true for the vertical assets.

E. CRITICALITY AND RISK

The investigation leading to the identification of critical water distribution infrastructure involved the development of a Business Risk Exposure (BRE) score, which is defined as the product of the probability of the infrastructure failing and the consequence of its failure. While the likelihood of failure is related to the physical condition of an asset described in the previous section, the Consequence of Failure (CoF) focuses on the economic losses and impacts to society due to an asset's failure.

The CoF for the Authority's water distribution assets is based on a ranking system, which uses a scale of one (1) to five (5), with 1 meaning the asset would have insignificant disruption if it were to fail and 5 meaning the asset would have catastrophic disruption if it were to fail. See Table 23 for the Authority's CoF ranking system. The CoF for vertical assets were assigned based on the criticality of an individual asset to system operation and incorporated redundancy.

The following factors were combined to determine the Authority's CoF for horizontal assets:

- Diameter/Size – the relative size of the asset with respect to the rest of the system.
- Huron River Crossings
- Within the Right-of-Way of major roads – M-12, M-23, 1-94, Wiard Road (Between M-12 and I-94), and Washtenaw Avenue
- Dead Ends
- Top Water Users
- Critical Water Users

Table 23: Consequence of Failure

Consequence of Failure Score	Description
1	Insignificant Disruption
2	Minor Disruption
3	Moderate Disruption
4	Major Disruption
5	Catastrophic Disruption

The results of a system level analysis indicate that the Authority's horizontal assets have an average CoF score of 2.5.

BRE is reported on a one to twenty-five (1 – 25) rating scale. BRE incorporates both condition and criticality to provide a means of prioritizing future system expenditures. Figure 1 summarizes the information used to calculate the risk for each of the Authority's horizontal and vertical assets, as applicable.

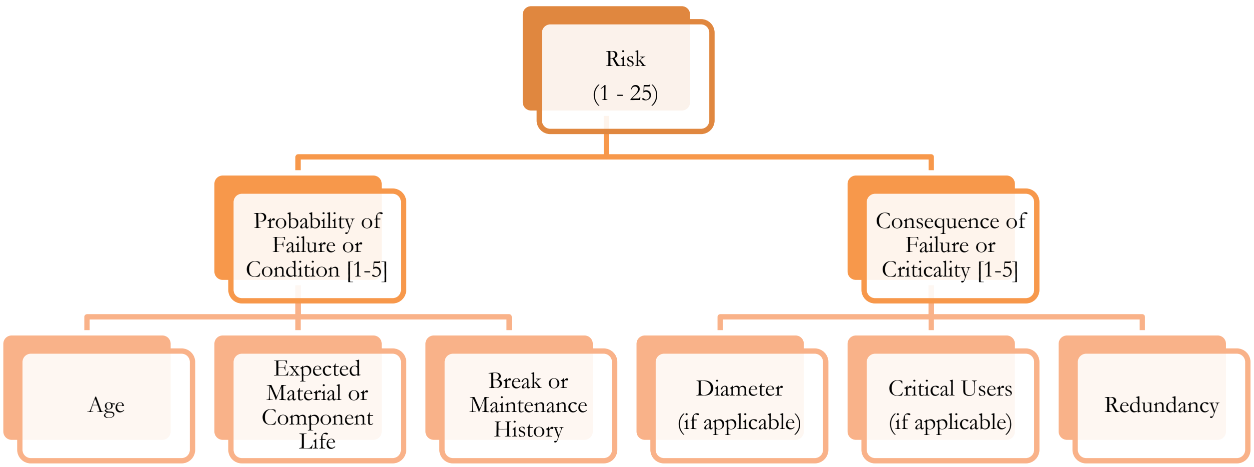

Figure 1: Risk/BRE Calculation

While most of the Authority's assets are categorized as low or medium risk assets as shown in Figures 2 and 3, these assets will continue to degrade over time and their condition will worsen, if no preservation measures are taken, which in turn will shift the distribution of the risk categories.

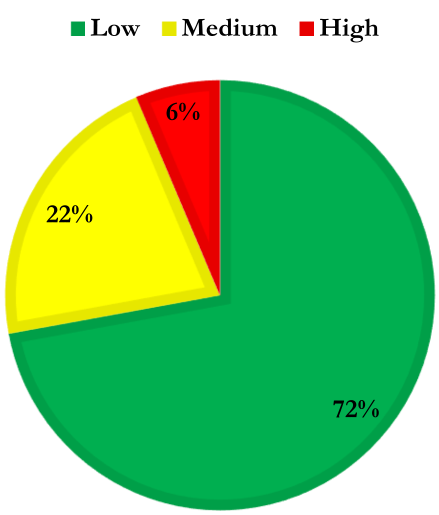

Figure 2: Horizontal Risk Distribution

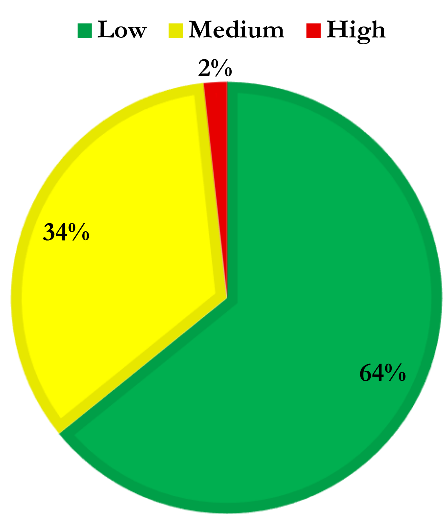

Figure 3: Vertical Risk Distribution

F. LEVEL OF SERVICE

The Authority, in line with its mission statement outlined earlier, adopted level of service criteria, which it plans to use as a guideline to manage the water system. These level of service criteria are summarized in Table 24.

Table 24: Level of Service Criteria

Key Service Criteria	Target Level of Service
Regulatory Compliance	On-going compliance with all state and federal water quality regulations
Customer Rates	Rates will be reviewed on an annual basis and raised as needed.
Valve Maintenance	Continue advancements in valve exercising program
Hydrant Maintenance	Continue advancements in existing hydrant flushing program

Tracking and assessing of the level of service criteria will be completed as part of routine AMP reviews, and updated as necessary. As new level of service criteria are created, they will be incorporated into future versions of the AMP. With this document serving as the Authority's first iteration in the AMP process, targets and tracking are expected to develop as the Authority implements new digital tracking tools through GIS and Lucity.

VIII. REVENUE STRUCTURE

The Authority reviews and updates its financial position annually. The Authority's Board (Board) of Commissioners approves the annual budget and rate increases. The budget and rate increase for fiscal year 2018-2019 were approved at the Board meeting on August 23, 2017. The meeting minutes indicating the Board's approval of the budget and 3.2% increase to water rate are included in Appendix J. Also included in Appendix J is the Authority's proposed budget, which indicates that annual revenue will cover expenditures with no gap in funding. The basis for water rates in the City and Township including allowed usage and surcharges are also available.

Please note that the revenue structure elements provided will be updated on an annual basis. The elements provided in Appendix J are based on Fiscal Year 2017-2018 budget and revenue considerations. This AMP's 5-year and 20-year CIP cost considerations will be reviewed and incorporated, as appropriate, in future budgets. Funding gaps that may exist will be addressed at that time. A rate study will be recommended on a routine basis or when significant gaps in funding are realized.

IX. CAPITAL IMPROVEMENT PLAN

A capital improvement plan (CIP) is a core component of this study and an essential planning tool that allows the Authority to properly plan for high cost, non-recurring projects. A CIP should detail capital needs related to future and upcoming regulations, major asset replacements, system expansions, system consolidation or regionalization and improved technology.

The CIP, which is outlined below, aides the Authority in identifying, prioritizing, and implementing water distribution system capital projects over a five (5) year and twenty (20) year planning period. Where applicable, this CIP pulls forward the 2005 Water Master Plan Recommendations and the 2014 Drinking Water Revolving Fund application projects. Based on the findings of this study and consultation with the Authority, the following improvements are recommended for the Authority's water system. Maps showing these projects and details are included in Appendix D.

The five and 20-year CIP recommendations are summarized below and are based on 2018 dollars.

A. PUMPING STATION IMPROVEMENTS

The pump station inspections identified remaining useful life, anticipated replacement year, and anticipated replacement years for all assets. Table 25 summarizes the expected asset replacement costs for each station.

Table 25: Pumping Station Asset Replacement Costs

Pumping Station	5-Year (2018-2022)	20-Year (2023-2037)
Bridge Road	$34,800	$1,162,300
Clark Road	$186,700	$66,900
Ellsworth	$28,400	$191,300
Holmes Road	$33,000	$343,000
Merritt Road	$198,300	$751,500
Textile Road	$204,900	$155,700
Total	**$686,100**	**$2,670,700**

Due to the large number of asset replacements needed at the Clark and Textile Road Stations, larger capital projects to replace or upgrade those stations are listed below. More detailed cost estimates for those projects are available in Appendix I. Additional larger improvements to the Merritt and Bridge Road Stations are also included below.

Several pumping station upgrades are included in the 5-year planning horizon.

- Clark Road Pumping Station Replacement – $672,000
- Textile Road Pumping Station Upgrade – $1,070,000
- Merritt Road Pumping Station Improvements – $376,000
  - Addition of 1 VFD ($108,000)
    - This cost assumes the existing motor is constant speed and needs to be re-wound to accept the new VFD with a NEMA4X enclosure.
  - Replacement of 3 VFDs ($36,000 each)
    - This cost assumes the existing motors are constant speed and need to be re-wound to accept the new VFDs. The existing enclosures can be used to house the replacement VFDs.
  - Replacement of Generator ($160,000)
- Bridge Road Pumping Station Improvements – $430,000
  - Addition of 4 VFDs ($107,500 each)
  - This cost assumes the existing motors are constant speed and need to be re-wound to accept the new VFDs with a NEMA4X enclosure. If VFDs are installed as separate projects, costs will increase 10-15% or approximately $120,000 per VFD due to increased mobilization costs.

Due to the known volatility in the skilled trade labor market and recognizing the Davis-Bacon Act regarding prevailing wages, these prices should be validated prior to commencing design phase efforts. Please note these figures do not account for costs of sewer repair.

B. WATER MAIN IMPROVEMENTS

For this analysis, a majority of the horizontal asset recommendations are made due to water main breaks. For budgetary purposes, replacement piping is assumed to be ductile iron PC 350 (e.g., open cut construction). Pipe costs are based on construction costs of $160/foot for 8-inch, $185/foot for 12-inch, and $215/foot for 16-inch, plus 10% for contingency and 25% for professional services which includes restoration and associated appurtenances. Due to the known volatility of the construction labor, material marketplace, and specific conflicts that may exist within corridors, these prices should be validated prior to commencing design phase efforts. Pipe replacement costs may be increased or decreased if pipe replacement techniques such as directional drilling or pipe bursting are employed. Projects will be prioritized based on anticipated road projects and coordination with the City of Ypsilanti, Ypsilanti Township, and the Washtenaw County Road Commission. A map of the 2017 PASER ratings is available in Appendix D. Table 26 below provides the estimated costs for each of the proposed CIP projects. The first 5 projects listed are in the 5-year planning period, while the remaining projects are in the 20-year planning period. A map of the proposed CIP locations is shown in Appendix D.

Table 26: CIP Projects

CIP Project	Total Estimated Cost	
Fairway Hills	$	993,600
Washtenaw, Cornell, N Huron River Dr.	$	3,824,700
North of Washtenaw Golf Club	$	5,359,500
S Clubview Dr.	$	414,800
West Willow Neighborhood (North)	$	1,447,200
5-Year Total =	**$**	**12,039,800**
Apple Ridge Park, Bud and Blossom Park neighborhoods	$	2,207,600
West Willow Neighborhood (West)	$	1,226,900
Gault Village	$	9,777,400
S Grove St.	$	4,946,400
West Willow Neighborhood (South)	$	2,198,900
E Cross St.	$	1,634,400
Taft and Jones	$	423,400
Faithway Baptist Church	$	1,939,700
West of S Ford Rd.	$	4,130,500
East of S Ford Rd.	$	2,652,500
E Michigan Ave	$	697,700
E Clark Rd.	$	3,590,600
N Prospect Rd	$	885,300
20-Year Total =	**$**	**36,311,300**