Aumsville Water Master Plan

Final

April 2015

KELLER associates

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April 2015

City of Aumsville

Water Master Plan

KELLER associates

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Water Master Plan

City of Aumsville, Oregon

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ACRONYMS, ABBREVIATIONS, AND SELECTED DEFINITIONS

AC	asbestos cement
cfs	cubic feet per second
CI	cast iron
CIP	Capital Improvement Plan
DHS	Department of Human Services
DI	ductile iron
EDU	equivalent dwelling unit
ft	feet (or) foot
FY	fiscal year
Gal	gallon
gpcd	gallons per capita per day
gpm	gallons per minute
HGL	hydraulic grade line
hp	horsepower
in	inch
ISO	Insurance Services Office
KW	Kilowatt
MG	million gallons
MGM	million gallons per month
mgd	million gallons per day
mg/L	milligrams per liter
OAR	Oregon Administrative Rules
OWRD	Oregon Water Resources Department
psi	pounds per square inch
PLC	programmable logic controller
PSU	Portland State University
PVC	polyvinyl chloride plastic
SCADA	supervisory control and data acquisition
SDC	system development charge
SEC	U.S. Securities and Exchange Commission
UGB	urban growth boundary
VFD	variable frequency drive
WMP	water master plan or water management plan
WMCP	water management and conservation plan
WWTP	wastewater treatment plant

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1.0 INTRODUCTION

1.1 EXISTING SYSTEM OVERVIEW

The City of Aumsville owns and operates a water system that serves approximately 3,815 residents, located primarily within the city limits. The study area is shown in Figures 01 and 02. Water is conveyed from five wells to the City's main 1.0 million gallon (MG) reservoir. Currently, each well discharges directly into the main reservoir where it is chlorinated, but a new centralized filter system is under construction to improve the taste and water quality prior to entering the reservoir. From the reservoir, water is delivered by a booster pump station to City residents through a network of pipelines during the day and an elevated reservoir at night. Figures 03 and 04 illustrate the existing system.

1.2 PURPOSE AND NEED

This report presents findings and recommendations relating to the Aumsville Water Master Plan. This master plan was commissioned by the City to determine the current state of the water system, plan for future needs, and update the Water Management and Conservation Plan (WMCP). The planning study builds upon previous planning efforts. Many changes have been made to the system since the last master plan was complete, including changing the point of connection for the wells into the system, installation of the Church well, changes in the urban growth boundary (UGB) and City limits, management changes such as improved tracking system of system demands, and improvements to the supervisory control and data acquisition (SCADA) system.

A review of the fundamental planning elements such as population, water supply and demand, development areas, and fire flow requirements is presented, as well as an analysis of the system, followed by a summary of recommendations and a capital improvement plan. Figures and supporting data for the information presented in this report have been included in the appendices for reference.

1.3 ACKNOWLEDGEMENTS

Keller Associates gratefully recognizes all those who have provided their support and assistance in the completion of this study. Keller Associates has worked as part of a technical advisory committee (involving key City staff, City Council members, and stakeholders) to understand the challenges currently facing the system and develop practical, cost-effective solutions. Members of the technical review committee include the following:

- Maryann Hills, City of Aumsville
- Steve Oslie, City of Aumsville
- Matt Etzel, City of Aumsville
- Robert Baugh, City Council
- Terrill Issak, Aumsville Rural Fire District
- Jim Schuette, Aumsville City Engineer

1.4 AFFECTED LOCAL GOVERNMENTS FOR WMCP

Comments provided by the following affected local governments are located in Appendix B: City of Aumsville, Marion County, Oregon Water Resource Department and the Oregon Health Authority.

1.5 PROPOSED SCHEDULE FOR UPDATES

This water master plan (WMP) should be updated at least every 5-10 years, or when major changes occur in the system. A WMCP progress report should be filed with Oregon Water Resources Department (OWRD) after 5 years and after 15 years, with a WMCP update completed at years 10 and 20.

1.6 CHECKLISTS

The elements of water master plans specified in Oregon Administrative Rules (OAR) Chapter 333, Division 61 are addressed in this document as noted in Table 1.1 below.

TABLE 1.1: Cross-references between WMP Sections and Division 61 Requirements

	Item	OAR Reference	Section
Part a			
✓	Current Master Plan	333-061-0060(5)a	all
✓	Master Plan prepared by a registered Oregon professional engineer	333-061-0060(5)a	all
Part b			
✓	Evaluate system for 20 year period	333-061-0060(5)b	all
✓	Water quality and service goals	333-061-0060(5)b (A)&(C)	2&3
✓	System deficiencies	333-061-0060(5)b (A)&(E)	3 &App.A
✓	Recommended alternatives	333-061-0060(5)b (A)&(F)	4.2
✓	Implementation schedule, costs, and financing	333-061-0060(5)b (A),(F),(G)	4.2&4.3
✓	Service area	333-061-0060(5)b (B)	2 &App. A
✓	Supply	333-061-0060(5)b (B)&(D)	3.2
✓	Status of water rights	333-061-0060(5)b (B)	3.8
✓	Drinking water quality	333-061-0060(5)b (B)	3.2&4.2
✓	Maps	333-061-0060(5)b (B)	App.A
✓	Water use	333-061-0060(5)b (B)&(D)	2.4
✓	O&M requirements	333-061-0060(5)b (B)	4.1
✓	Projected growth	333-061-0060(5)b (D)	2.3&2.4
✓	Regionalization	333-061-0060(5)b (F)	3.2&3.8
✓	Recommended water system improvement program	333-061-0060(5)b (H)	4
✓	WMCP requirements	333-061-0060(5)b (I)	all
Part c			
✓	Consistent with OAR 333-061	333-061-0060(5)c	all
✓	Consistent with OAR 660-011	660-011	all
✓	Consistent with OAR 690-086	690-086	all

The elements of water management and conservation plans specified in Oregon Administrative Rules (OAR) Chapter 690, Division 86 are addressed in this document as noted in Table 1.2.

TABLE 1.2: Cross-references between WMCP Sections and Division 86 Requirements

	Item	OAR Reference	Section
Water Supplier Description			
✓	Description of supplier's source(s)	690-086-140(1)	3.2
✓	Delineation of current service area	690-086-140(2)	2.1&2.2
✓	Assessment of adequacy and reliability of existing supplies	690-086-140(3)	3.2
✓	Quantification of present and historic use	690-086-140(4)	2.4
✓	Summary of water rights held	690-086-140(5)	3.8
✓	Description of customers served and water use summary	690-086-140(6)	2.4
✓	Identification of interconnnections with other suppliers	690-086-140(7)	2.4
✓	System schematic	690-086-140(8)	Figures
✓	Quantification of system leakage	690-086-140(9)	2.4
Water Conservation Element			
✓	Full metering of systems	690-086-150(4)(b)	5.2
✓	Meter testing and maintenance program	690-086-150(4)(c)	5.2
✓	Annual water audit	690-086-150(4)(a)	5.2
✓	Leak detection program	690-086-150(4)(e)	5.2
✓	Leak repair or line replacement program	690-086-150(6)(a)	
✓	Rate structure base on quantity of water metered	690-086-150(4)(d)	5.2
✓	Rate structure and billing practices that encourage conservation	690-086-150(6)(d)	5.2
✓	Public education program	690-086-150(4)(f)	5.2
N/A	Technical and financial assistance programs	690-086-150(6)(b)	N/A
N/A	Retrofit/replacement of inefficient fixtures	690-086-150(6)(c)	N/A
N/A	Other measures, if identified by supplier	690-086-150(6)(f)	N/A
✓	Reuse, recycling, non-potable opportunities	690-086-150(6)(e)	5.3
✓	Progress report on previous WMCP	690-086-150(1)	5.5
✓	Documentation of water use measurement and reporting	690-086-150(2)	5.4
✓	List of measures already implemented or required under contract	690-086-150(3)	5.5
Water Curtailment Element			
✓	Assessing your water supply	690-086-160(1)	6.2
✓	Stages of alert	690-086-160(2)	6.3
✓	Triggers for each stage of alert	690-086-160(3)	6.4
✓	Curtailment actions	690-086-160(4)	6.5
Water Supply Element			
✓	Delineation of current and future service areas	690-086-170(1)	2.2
✓	Population projections for service area	690-086-170(1)	2.1
✓	Prepare schedule to fully exercise each permit	690-086-170(2)	3.8
✓	Prepare demand forecast	690-086-170(3)	2.4
✓	Comparison of projected need and available sources	690-086-170(4)	2.4
✓	Analysis of alternative sources	690-086-170(5) and (8)	3.2
N/A	Quantification of maximum rate and monthly volume	690-086-170(6)	N/A*
N/A	Mitigation actions under state and federal laws	690-086-170(7)	N/A*
Other Items			
N/A	List of affected local governments and their comments	690-086-125(5)	1.4
✓	Date for submittal of next update	690-086-125(6)	1.5
N/A	Documentation, where additional time is requested to meet previous benchmarks or metering	690-086-125(7)	N/A

*To be provided in a predesign study for proposed wells; information is not available at this time.

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2.0 PLANNING CRITERIA

This chapter details the planning criteria used to establish standards by which the system is evaluated and serve as the basis for identifying needed improvements. These criteria include population, development areas, potable water demands, land use, and other factors affecting the water system.

2.1 STUDY AREA

The study area encompasses the area inside the urban growth boundary (UGB), which includes everything within the existing Aumsville city limits plus developed areas outside of the city limits that are currently served by the city water system. The future (2034) service area is not expected to change geographically within the planning period, with infill as the most likely growth situation.

2.2 LAND USE AND DEVELOPMENT AREAS

Land use assumptions for current and future development are illustrated in Figure 01. The City provided input to determine where likely residential & industrial growth would occur during the 20-year planning horizon. Residential growth is anticipated to occur in the interchange area on the northeast side of town, and a previously approved subdivision on the east side. Further development could occur on the west side of the city within the western limits of the UGB, most likely with an industrial facility.

2.3 POPULATION PROJECTIONS

The population values presented in Table 2.1 summarize existing and future populations used for this planning effort. Growth rates were obtained from the "Population Forecasts for Marion County, its Cities and Unincorporated Areas 2010-2030" which was completed by Portland State University (PSU) Population Research Center. PSU's study provided population projections for Aumsville. The growth rates provided in PSU's study were used in conjunction with PSU's certified population for 2011-2013 and the US census in 2010 to determine the population projections shown in Table 2.1. UGB expansion is not anticipated in the planning period, and all growth is assumed to occur within the existing UGB.

TABLE 2.1: Existing and Future Populations

Year	Population
2010	3584
2011	3680
2012	3700
2013	3815
2014	3895
2019	4318
2024	4733
2029	5173
2034	5673

2.4 EXISTING AND FUTURE WATER DEMANDS

2.4.1 Existing Demands

Table 2.2 shows the historical per capita demand data for 2010 through 2013, along with the design demands that were used for evaluating the existing system. Supporting data can be found in Appendix C.

Historical data from the well records was used to determine the annual average, minimum month, and peak month water systems demands. Water demands include residential, commercial, industrial and institutional users. The demands also include unaccounted for water (e.g. water loss, flushing, unmetered usage, etc.).

The annual average was calculated as an average of all of the monthly average flows for a given year. The minimum and maximum months were selected as the month with the least and greatest metered average, respectively. The peak day was taken from a two-day running average of data from the reservoir meter, and adjusted to include the flow of the Reservoir well that is not connected to the meter. The peak hour was estimated using a peaking factor typical of similar cities in the area.

TABLE 2.2: Existing Water Demand (gallons per capita per day)

Demand Scenario	2010	2011	2012	2013	Average 2010-2013	2013 Design Values
Population	3584	3680	3700	3815	varies	3815
Annual Average (gpcd)	79	69	76	78	76	73
Min Month (gpcd)	46	47	43	55	48	42
Max Month (gpcd)	150	136	114	130	133	141
Maximum Day (gpcd)	224	180	186	145	184	210
Peak Hour (gpcd)*	380	307	316	246	312	357

Peak hour is estimated to be 1.7 maximum day demand.

Table 2.3 and Chart 2.1 show a comparison of the typical water use in Aumsville to that in neighboring communities. Overall, Aumsville's water use is less than comparable communities. This is likely due to its lack of large industrial facilities.

TABLE 2.3: Comparison of Per Capita Water Consumption

Demand (gpcd)	Aumsville	Amity[1]	Silverton[2]	Stayton[3]	Wilsonville[4]	Willamina[5]	Gates[6]	Wood Village[7]
Average Day (gpcd)	73	114	142	309	163	118	149	100
Max Month (gpcd)	141	162	239		286	171	262	140
Max Day (gpcd)	210	257	304	752	405	219	459	190
Peaking Factor	1.7	1.7	2.1		1.7	1.7	1.7	1.5

1. From 2013 Amity Water Master Plan
2. From August 2011 Silverton Water Master Plan.
3. From May 2012 Stayton Water Model Distribution Systsem CIP update tech memo
4. From 2011 Demand Analysis
5. From 2014 Willamina Demand Analysis
6 From January 2012 Demand Analysis
7 From June 2014 Water Master Plan

CHART 2.1: Comparison of Per Capita Water Consumption

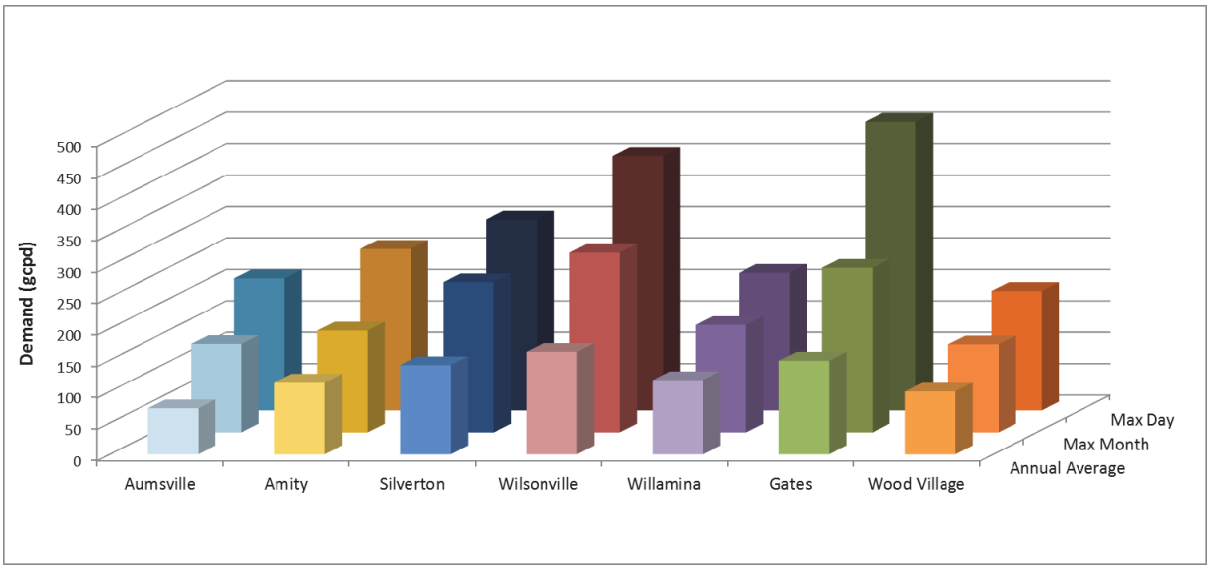


Chart 2.2 shows monthly water consumption for 2010-2013. Peaks correspond to summer demands, when demands are a little more than double what they are in the winter. Increases during the summer periods correspond to irrigation usage.

An estimate of irrigation usage is found in Table 2.4, which compares wet season (November-April) usage with dry season usage (May - October). The average wet season usage in million gallons per month (MGM) is considered as the base water used without irrigation. The wet season average was subtracted from the monthly usage in the dry season to estimate how much is used for irrigation in each month.

CHART 2.2: Monthly Metered Water Consumption (gallons)

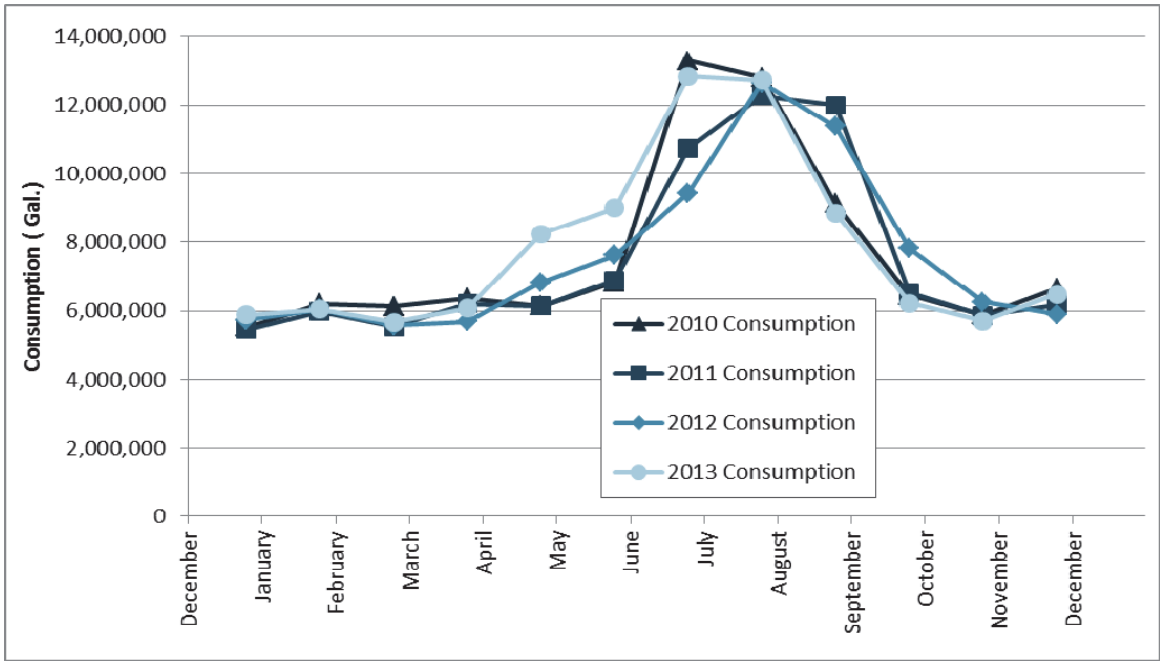


TABLE 2.4: Estimated Irrigation Usage

Period	2004-2014 Distribution Average (MGM)	Estimated Irrigation Usage (MGM)	% Irrigation Usage
January	145.9	0.0	0%
February	155.0	0.0	0%
March	150.7	0.0	0%
April	148.8	0.0	0%
May	174.5	11.9	7%
June	199.2	36.6	18%
July	244.6	82.0	34%
August	348.9	186.3	53%
September	310.2	147.6	48%
October	205.6	42.9	21%
November	169.0	0.0	0%
December	151.6	0.0	0%
Wet Season*	162.6	0.0	0%
Total	2403.8	507.2	21%

* The wet season consists of the water November-April and assumes no irrigation use during that time.

Chart 2.3 shows the breakdown of water consumption by user category for the study period of 2007 – 2013. On average, approximately 91% of all water metered can be attributed to single family and multifamily residential usage. Commercial and industrial uses account for approximately 6% of the total annual consumption.

CHART 2.3: Year-round Water Usage by User Category

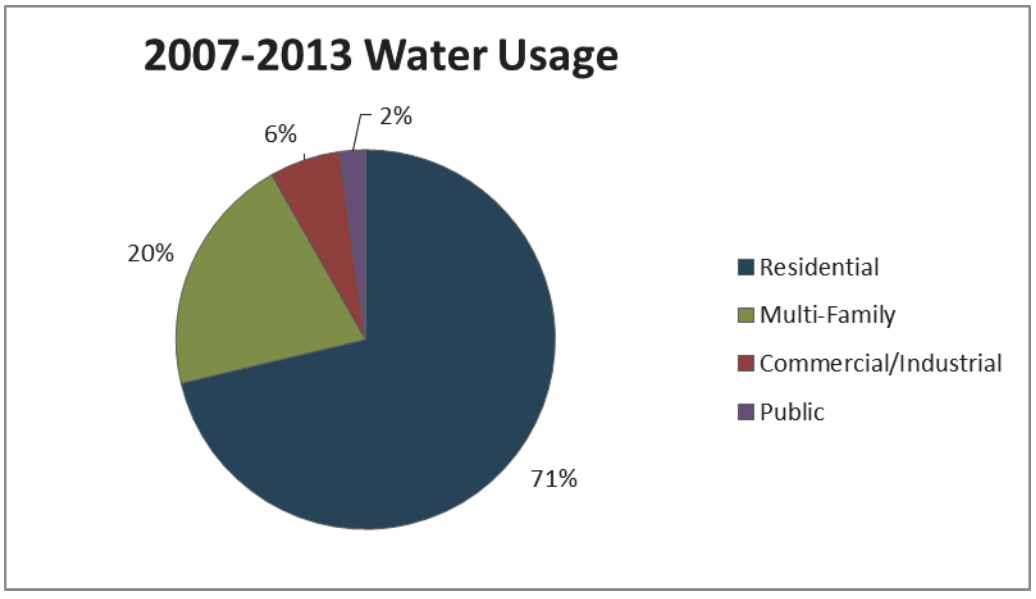
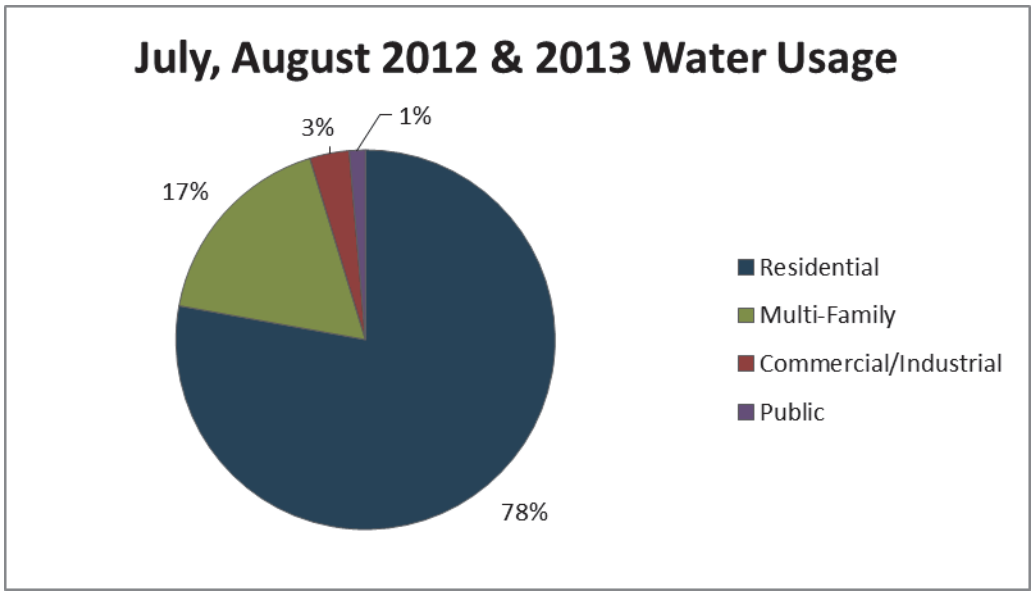


Chart 2.4 shows a breakdown of water consumption during July and August 2012 and 2013 to illustrate summer use. As expected, there is more residential use during this time resulting from residential irrigation, and commercial and industrial uses only account for 3 percent of the water usage.

CHART 2.4: Summer Water Usage by User Category



2.4.2 Water Loss

Unaccounted-for-water refers to the difference in water being produced and the water being metered at places of use. Sometimes this is referred to as water loss, and it can include uses such as hydrant flushing, firefighting, street cleaning, and/or inaccurate meters, leaking pipes, etc. If water loss exceeds 10%, then Oregon Administrative Rules (OAR Division 86) require that the water supplier implement a leak detection program. These rules require that the program be regularly scheduled and systematic, address distribution and transmission facilities, and utilize methods and technologies appropriate to the supplier's size and capabilities.

Table 2.5 compares annual water production and water consumption (individual meter data from 2010 to 2013) This comparison accounts for the estimated unmetered usage from parks, wastewater treatment plant, line flushing, street sweeping, vactor trucks, bulk water sales, hydrant flushing and fire fighting. The difference between production and consumption accounts for approximately 10% water loss on average. Tracking water loss and developing a leak detection and repair program is further discussed in Section 5 of this report. The City reports that previous leak detection efforts were not effective at finding leaks, but better technology is available now which may be more effective.

TABLE 2.5: Annual Water Loss

Year	Produced (Gal.)	Accounted for (Gal.)	Water Loss %
2010	103,533,000	91,334,400	12%
2011	92,951,200	89,822,500	3%
2012	102,873,800	90,877,600	12%
2013	108,959,400	93,697,000	14%
Average	102,079,350	91,432,875	10%

2.4.3 Possible Causes of Unaccounted-for-water

Possible causes of unaccounted-for-water in the Aumsville system and their potential for occurrence include the following:

Cause	Potential
• Unmetered water users	Low
• Water theft	Low
• Meter inaccuracies	Moderate
• Leaky pipes, valves, hydrants, services	Low

Unmetered Water Users

Only one location (Mill Creek Park) is unmetered in the City. The City has acquired a meter, and will soon install it.

Water Theft

Water theft could result from contractors or other water users illegally taking water from the City's system. This could occur at fire hydrants or from illicit connections to the City's mainlines. Water theft from hydrants would likely be observed by City staff if it amounted to significant amounts of water. Illicit connections could potentially be located during a leak detection study, provided that water was being drawn during the study. The probability that water theft accounts for a significant portion of the water loss is believed to be low.

Meter Inaccuracies

Meter inaccuracy, particularly for large meters, is often responsible for large portions of unaccounted-for-water by underreporting the actual water consumed. It is recommended that the City periodically test, calibrate, and repair meters. The majority of the meters in the system were replaced approximately 15 years ago. The service life of a residential meter is typically around 20 years, so the City should be preparing for a large scale testing, calibration, and repair or replacement.

Leaky Pipes, Valves, Hydrants, Services

Water loss is often attributed to older, leaky pipes. In a small water system these leaks could account for a significant percentage of the demand within the City, and should be fixed as budget is available.

2.4.4 Future Demands

Existing and projected future water system demands are presented in Table 2.6. These demands conservatively assume that future demands per capita will be similar to existing demands per capita. If users implement additional water conservation measures, these demands will decrease. These demands, plus an industrial reserve of 100 gpm starting in 2019, were used as a basis to develop future improvements in the City's water system.

The water supply needs to be capable of supplying the maximum day demand; systems are typically designed with redundancy so that *firm* capacity (capacity with the largest well offline) is sufficient for the max day demand.

TABLE 2.6: Existing and Future Water System Demands

Future Demand Scenario	2013 Design	2019	2024	2034
Population	3815	4318	4733	5673
Annual Average (gpm)	194	320	341	389
Min Month (gpm)	112	226	239	266
Max Month (gpm)	373	522	563	654
Maximum Day (gpm)*	557	730	791	928
Peak Hour (gpm)**	947	1172	1275	1508

*Maximum Day based on two-day running average to account for changes in storage volume
**Peak hour is estimated to be 1.7* maximum day demand.
***Starting in 2019, an industrial reserve of 100 gpm was added to all demands.

2.4.5 Distribution System Planning Criteria

In addition to design standards for the delivery of flow rates, standards for system pressures are necessary for the normal daily operation of the water system. The aim of standards for pressure is to provide safe and reliable service to water users under a variety of system conditions. If pressures are too high, damage can occur within the distribution system and at points of use. If pressures are too low, a variety of issues arise - including potential for backflow contamination, limited water availability, and a lower level of service. The recommended distribution pressure standards for new connections are listed in Table 2.7.

For the City of Aumsville, the highest flow requirements correspond to a fire flow event during maximum day demands.

In evaluating existing residential areas for fire flows, Keller Associates assumed a minimum fire flow requirement of 1,000 gpm for 2 hours while maintaining at least 20 psi in the distribution system. The local fire authority requested that a fire flow capacity of 1,500 gpm be provided for commercial areas, schools, and large churches. Structures with Insurance Services Office (ISO) ratings above 1,500 gpm were also modeled with their required demand. A cap of 3,000 gpm was agreed upon by the City and the local fire authority as a reasonable limit for fire flow to existing buildings. The system should be capable of providing these fire flows while also satisfying maximum day demands.

In addition, the booster facilities should be capable of delivering peak hour demands with the largest pump off-line.

Table 2.7: Distribution System Pressure Standards

System Scenario	Pressure
Minimum Pressures (peak hour)	40 psi
Minimum Pressure (fire+max day)	20 psi
Maximum Pressure (w/o regluators)	80 psi
Maximum Pressure (mainline)	100 psi

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3.0 EXISTING FACILITIES EVALUATION AND RECOMMENDATIONS

3.1 GENERAL

This section summarizes the condition of the City's existing facilities and provides recommendations for improvements. Associated costs for the recommended facility improvements are presented in the capital improvement plan found in Section 4.

3.2 EXISTING WELLS AND SOURCE EVALUATION

The City obtains its water from five active wells. Historically, these wells pumped directly to the distribution system. To improve the taste of the water, the City completed a network of dedicated transmission pipelines that would allow all of the water supply to be delivered to a single reservoir where it could be treated prior to distribution to the system. On-site chlorination provisions and yard piping have been retained at each of the well sites to allow for distribution from each well (except the Reservoir well) in the event of an emergency.

This section documents known issues and recommended improvements of the well facilities based on input from City staff and a facility tour. The scope of this study does not include a detailed independent evaluation of the City's well facilities, water quality/treatment, and structural conditions, or an evaluation of the proposed water treatment facility upgrades currently underway. The recommended improvements presented in this section should be evaluated in more detail as part of future pre-design efforts.

3.2.1 Source Water

There are no sensitive fish species affected because the system is supplied solely by groundwater. The City is located in a groundwater limited area, which is an area where OWRD restricts new water rights permits to specific beneficial uses. Because Aumsville's supply comes entirely from groundwater, many treatment and regulatory/environmental concerns commonly encountered in systems that utilize surface water do not apply.

3.2.2 Boone #2 Well

The Boone #2 well, constructed in 1983, is 320 feet deep. It reportedly has a relatively high production capacity when compared to other City wells, but is currently used sparingly due to water quality issues (hydrogen sulfide, ammonia, and salinity). Its capacity has been reduced from its original 650 gpm to 250 gpm. (If the aesthetic water quality concerns are disregarded, the well facility can currently deliver up to 350 gpm.) Boone #2 shares a water right with Church Well. If production at Boone #2 increases, additional water rights will need to be acquired or transferred. Currently, a development limitation has been placed on its water right limiting the total flow from Church well and Boone #2 to 202 gpm. A Cla-Val valve is used to throttle back the flow from this well pump to increase detention time in aeration tanks. This valve could potentially be

opened more after the implementation of the filtering project to allow for more flow from this well.

Two aeration tanks provide hydrogen sulfide removal at the well site. The well pumps directly into the aeration tanks, and the water is then pumped from the aeration tanks to the system. A new filter treatment system located at the 1 MG reservoir will reportedly improve water quality and remove hydrogen sulfide and ammonia, eliminating the need for the aeration tanks. The City reports that it is difficult to maintain a seal for the existing aeration tanks, and would like to abandon them if possible.

A propeller type flow meter controls flow through tanks and the well, and a magnetic meter adjacent to Boone #1 well measures production data for this well. There is no air release in the well discharge piping. The SCADA system for the well reads on/off, but no pressure or flows. The well pumps can be switched on and off remotely through the SCADA system. When a power bump occurs (often as a result of a soft start), the well has to be manually reset. The well is not equipped with a standby generator or generator hook-up. The only security equipment is barbed wire and a lock, and more security (including intrusion alarms) is desired.

Recommended Improvements

- The proposed filtration project at the main reservoir is anticipated to effectively remove hydrogen sulfide and ammonia. Unless additional treatment is desired, the aeration system could be abandoned when the project is completed. Abandonment would involve new yard piping, well pump replacement (requires higher head to pump directly into system), and filling in the aeration tanks with soil or concrete. If further improvements to water quality are desired, the aeration tanks could be retained and rehabilitated including sealing the tanks.
- Install an air release valve.
- Provide new electrical controls so the well controls will reset automatically after a power bump.
- Install an on-site backup generator.
- Install intrusion alarms tied to the SCADA system, and video surveillance. Upgrade the SCADA system to include pressure and flow monitoring.
- After the filtration project is installed to address the water quality issues, the supply capacity of the well should be re-evaluated.

3.2.3 Boone #1 Well

The Boone #1 well was constructed in 1969, is 447 feet deep, and has a capacity of 100 gpm. The City reports that the facility is in need of repairs, and its capacity has been reduced from 130 gpm to 100 gpm. The well draws from two water-bearing zones, alluvial and basalt. The City understands that if the well were to be redrilled, it is unlikely the state would allow a single well hole to pull water from two water-bearing layers again.

This well has had some water quality issues, including iron bacteria and hydrogen sulfide. It was treated for iron bacteria in 2012. City staff report that there were cave-ins in the well hole prior to 1992 (which resulted in a period of muddy water), and there is concern that it might occur again. A turbidity monitor and associated controls could be installed to turn off the well pump if this occurs again.

The SCADA and flow meter readouts for Boone #1 and Boone #2 are both located inside Boone #1. The flow meter for Boone #1 is connected to the SCADA system, but is not used for control or data acquisition. The SCADA system currently only reads pump on/off status. There are no reported issues or concerns with the electrical system. There is a 30 hp back-up generator on site; however, the generator is not exercised regularly.

The well house is in relatively good condition. However, the roof leaks a little, and the doorway to the generator slab is not adequately sealed. The well piping shows signs of deterioration. The waste line should be screened and turned down outside the building. An abandoned fuel tank from a previous generator is still on-site. The City would also like to improve security at the well house.

Recommended Improvements

- Repair roof.
- Seal doorway to generator pad.
- Coat well discharge piping.
- Remove abandoned fuel tank.
- Provide piping to neck down waste line, and provide screening.
- Replace control system with a new PLC and program.
- Install a turbidity meter.
- Install intrusion alarms tied to the SCADA system, and video surveillance. Update the SCADA system to include pressure monitoring, flow monitoring, and turbidity readings.
- Begin exercising the standby generator on a monthly basis.

3.2.4 Tower Well

The Tower well, constructed in 1958, is 100 feet deep. It has an original reported capacity of 130 gpm, but it is only capable of producing 70 gpm without pulling air. A recent video inspection suggested that the perforations are plugged, and attempts to clear them were not successful. There are no reported issues or concerns with the electrical system or SCADA controls to the well. There is a 125 KW backup generator on site that is exercised once a month.

Flow is metered via a propeller type device that is not connected to the SCADA system. The well is equipped with only a manual air release valve, there is no discharge pressure gauge, and the well piping is showing signs of deterioration. The building needs reflective coating on the roof. City staff has expressed a desire to improve security at the site.

Recommended Improvements

- Improvements to the well that are already planned are expected could increase the capacity up to 100 gpm. If the capacity ends up greater than the permitted 135 gpm, water right transfers must be requested and approved by OWRD. The evaluation and recommendation for this refurbishment was provided by others.
- Add an air release valve.
- Coat well piping.
- Add a reflective coating to roof.
- Confirm that irrigation for site is on a metered connection.
- Install intrusion alarms tied to the SCADA system, and video surveillance.
- Replace flow meter.
- Complete SCADA improvements, including pressure and flow monitoring.

3.2.5 Baker Well

The Baker well was constructed in 1948, and has not been used in several years. The power was disconnected before 1990, and the well is no longer connected to the distribution system. The well casing is relatively shallow (75 ft), and the City engineer reports that there is a possible surface water intrusion that would preclude use of water unless it were fully treated.

3.2.6 Reservoir Well

The Reservoir well, constructed in 1990, is 230 feet deep. It is currently producing only 30 gpm out of the theoretical reported capacity of 175 gpm. The City throttles a butterfly valve to control the pumping rate. The pump is pulling up black sand. In an attempt to correct the problem, the City had drilled three holes and packed pea gravel around the well. However, problems with the water quality persist. Water must be purged for the first 10 minutes prior to allowing flow into the distribution system. This well has also experienced issues with iron bacteria.

The City would like to see upgrades to the SCADA and security systems. There is no flow or pressure measurement recorded in the SCADA system, only

pump on/off status. Additionally, the flow meter is buried and inaccessible. Drawdown in the well cannot be measured with the existing setup.

There is a generator hook-up on the site that may be able to supply power if a generator is connected. However, the City reports that one pump in the booster station is able to run at a time (and not the well) with their generator because of a 100 amp breaker limitation.

Recommended Improvements

- Improvements to the well, consisting of drilling a new well on site and abandoning the existing well hole, are already planned. These improvements are expected to increase the capacity by 100 gpm. The evaluation and recommendation for this refurbishment was provided by others.
- Install a backup generator on-site.
- Perform regular maintenance for iron bacteria.
- Install intrusion alarms tied to the SCADA system, and video surveillance. Complete SCADA improvements, including pressure and flow monitoring.

3.2.7 Church Well

The Church well, constructed in 2005, is the City's newest and largest well. It pulls water primarily from an underlying basalt layer with a total depth of 183 feet. The City reports that the well has issues with salinity and hydrogen sulfide. The proposed filter project and the existing mixing of well water sources are intended to address water quality concerns. Boone #2 shares a water right with the Church Well. If production at Boone #2 increases, additional water rights will need to be acquired or transferred. Currently, a development limitation has been placed on its water right limiting the total flow from Church well and Boone #2 to 202 gpm. A

There is a chlorine disinfection system on site that was used for discharge directly to the distribution system when it was originally installed. This system, along with curtailment of water usage, could be used if the chlorination facility at the reservoir was not functioning.

There is no generator hook-up. Similar to the other wells in the system, the SCADA system at the Reservoir well does not monitor pressure and flow, only the on/off status of the well. There are times when this well has produced as high as 450 gpm, but it typically produces 350 gpm.

Recommended Improvements:

- The proposed filtration project at the 1 MG reservoir is reportedly going to effectively address the water quality issues related to this well, such that no additional action is needed. If increased water quality is still desired or needed

after the improvements, further investigations will be needed to determine how to address water quality concerns.

- Install intrusion alarms tied to the SCADA system, and video surveillance. Complete SCADA improvements, including pressure and flow monitoring.
- Install an on-site backup generator.

3.2.8 Supply and Demand

The capacities of Aumsville's wells are summarized in Table 3.1.

TABLE 3.1: Supply and Demand

Well	Theoretic Capacity (gpm)	Currently Producing (gpm)	Firm Capacity (gpm)	Water Rights (gpm)	Back-up Power
Baker Well	N/A	0	0	76	Well not in use
Tower Well	130	70	70	135	On-site
Reservoir Well	175	30	30	180	Not sufficient
Church Well	450	**350**	**0**	628	No hook-up
Boone #1 Well	130	100	100	130	On-site
Boone #2 Well	650	250	250	426	No hook-up
Unassigned Water Right	N/A	N/A	N/A	200	N/A
Total	1535	800	450	1349	-
Total with backup power	260	170	170	265	On-site
2014 Max day demand	557	557	557	557	-
Supply Minus Demand	978	243	-107	792	-

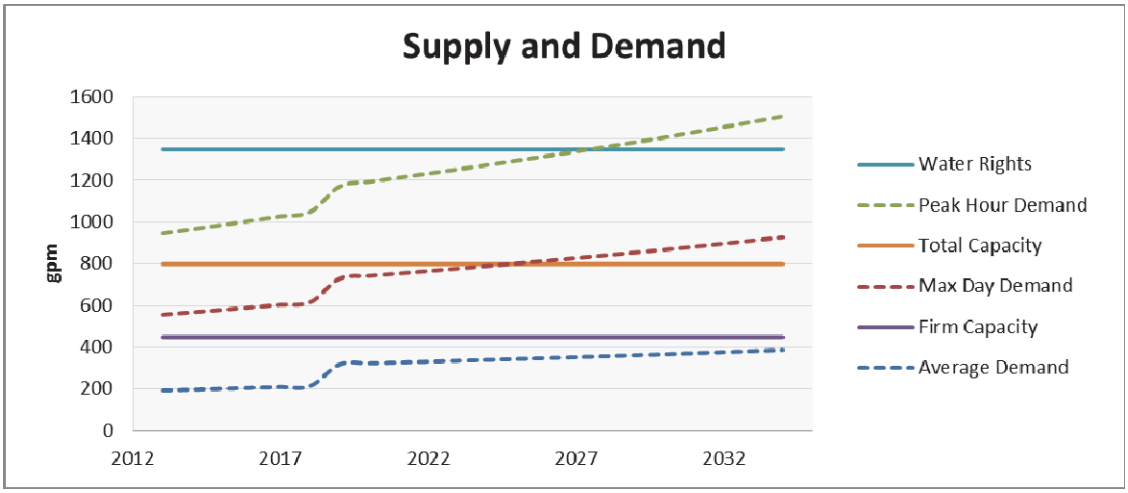
a) Boone #2 and Church Wells share a water right, so the total cannot exceed 628 gpm.

The capacities of the wells shown in Table 3.1 are the physical capacities, and do not account for limitations imposed by water rights or associated development limitations. This avoids unnecessary capital improvements. With all normally producing wells running, the total capacity is 800 gpm. However, the firm capacity with the largest well (Church well) off-line is 450 gpm, which is not sufficient to meet the current maximum day demand of 557 gpm. An additional 107 gpm of supply capacity is needed now based on the firm capacity. Due to development limitations on the water rights and capacity limitations with some of the smaller wells, a total flow of 402 gpm can be produced, providing a shortfall of 155 gpm for the max day, and 545 gpm for the peak hour.

As the maximum day demand grows in the future, this deficit will only grow, and the shortfall is anticipated to be 526 gpm by 2034. The City currently has plans to rehabilitate two existing wells (Tower well and Reservoir well) with the goal of obtaining 100 gpm additional from each well. The City anticipates that these improvements could add a total of 200 gpm to the City's firm supply, satisfying the immediate supply shortfall. After the filtration project is installed, the capacity of Boone #2 could potentially increase up to 100 gpm by opening the valve that currently limits flow through the well. This should be evaluated further with onsite testing to determine if this is possible and safe. Additional water rights will need to be acquired or transferred to this well.

Chart 3.1 compares the demands with the supply available over time. The jump in demands in 2019 assumes that a large industrial facility will enter the system in the next 5 years. The budgeted amount for this industrial reserve is 100 gpm. If this facility is constructed earlier or later than 2019, the graph for demands can be adjusted by 100 gpm in a given year to account for this change.

CHART 3.1: Supply and Demand



In addition to the rehabilitation projects, and conservation measures presented in section 5, the City will need to secure additional supply to meet the 2034 maximum day demands. For budgeting purposes, we have assumed one 300 gpm additional well will be completed by 2034. The capacity and ideal location of these well(s) will depend on a number of factors. Keller Associates recommends that the City begin soon to find the optimal location(s) for new wells by completing a hydrogeological and well siting study. This study could also evaluate the potential for additional upgrades to existing wells to maximize the delivery capacity from existing assets. Modifications and transfers of existing water rights will need to be evaluated as part of this process. Another option to consider as a similarly priced alternative is regionalization.

3.2.9 Regionalization and Interconnections

The City does not currently have any interconnections with other utilities, intergovernmental cooperation agreements, or water supply delivery contracts.

However, Aumsville is approximately 1.4 miles from the City of Salem's potable water transmission mains. The City of Salem has two gravity water mains running from its water treatment facility on Geren Island to its bulk water storage reservoir in Turner. The mains are 36-inch and 54-inch with carrying capacities of 16 mgd and 50 mgd respectively. The 36-inch is aged and is progressively being replaced by the City of Salem with a 69-inch main. The City of Salem's peak day water demand is currently about 45 mgd, leaving a surplus of about 20 mgd in the mains. This surplus is estimated to be consumed by the City of Salem in about 25-30 years, but with the replacement of the 36-inch line to a 69-inch line, there would be surplus water for a considerable period of time. If an interagency agreement for supply were to be completed with the City of Salem, the supply could be indefinite.

The hydraulics of Salem's transmission system is such that there is currently positive pressure in the mains adjacent to Aumsville, but as the demand in Salem increases,

the available head decreases. For budgetary purposes, this master plan assumes the available head at Aumsville will be at ground elevation, and therefore a booster pump station is required to elevate the water pressure into the Aumsville distribution system.

The estimated cost to utilize this water source includes construction of an interconnecting pipeline and a booster pump station, plus City of Salem fees for connection, installation, and system development charges. The interconnecting pipeline would consist of 8,000 feet of 12-inch diameter ductile iron pipe, vaults, flow meter(s), and control valves for an approximate cost of $1,150,000. The booster pump station would include VFD-driven pumps, a pump building, vaults, electrical and controls for an approximate cost of $750,000. Connection fees, meter supply and installation fees would need to be confirmed with the City of Salem. System Development Charges for the City of Salem are estimated at around $400,000. The total cost is estimated at approximately $2,500,000. Ongoing operating cost estimates are shown in Table 3.2.

TABLE 3.2: Operational Costs of Regionalization

Operations Items	Annual Cost
Pipeline maintenance cost	$5,000-$6,000
Booster Pump Station maintenance cost	$4,000-$5,000
Booster Pump Station operating cost	$3,000-$4,000
Replacement fund	~$35,000
City of Salem water rates fixed fee	$5,000
City of Salem water rates use charge*	$100,000-$150,000

*needs to be confirmed with the City of Salem

This option is comparable in cost to the installation of a new well, pipeline, and booster pump station. In a phased program, the booster pump station could be the same for the wells and a regional connection. The cost for construction of the well and associated pipeline is comparable to the interagency intertie pipeline, but there are other items to be considered. The City of Aumsville currently uses ground water, and the City of Salem intertie would be diverted from surface waters. These sources may have significantly different water chemistry that may cause water quality issues upon mixing. Further investigation is required to confirm to what extent this might apply. It is also possible the Aumsville ground water is under the influence of surface water, and that the two water sources are similar enough.

3.3 DISTRIBUTION SYSTEM DESCRIPTION, PLANNING CRITERIA, AND MODEL DEVELOPMENT

3.3.1 Existing Conditions

The existing distribution system is comprised of 17 miles of pipelines, fire hydrants, and one pressure zone. Table 3.3 summarizes the lengths of pipes categorized by material and size in the system. The most prominent pipe material in the system is PVC, followed by asbestos cement, with a small portion of wrapped steel on Church Street. Figures 03 and 04 in Appendix A show the existing system layout, pipe sizes, and pipe materials.

TABLE 3.3: Distribution System Pipe Material

Pipe Diameter (in)	Pipe Length by Material (ft)			*Total by Diameter (ft)*	*% of Total*
	PVC	Asbestos Cement	Steel		
<4"	3833	172	0	*4005*	*4.52%*
4"	1533	388	779	*2700*	*3.05%*
6"	19095	15064	0	*34159*	*38.54%*
8"	21064	2763	0	*23827*	*26.88%*
10"	23951	0	0	*23951*	*27.02%*
Total by Material (ft)	*69,477*	*18,387*	*779*	*88,643*	*100.00%*
% of Total	*78.38%*	*20.74%*	*0.88%*	*16.79*	*Miles*

The elevation within the existing service area varies from 340 feet to 406 feet above mean sea level. This range in elevations allows the system to be supplied with one pressure zone.

The hydraulic grade line (HGL) is a measurement that reflects energy in the system, and accounts for both the elevation and pressure energy. The daytime HGL is 514 feet, and the nighttime HGL drops to approximately 473 feet to conserve power and circulate water in the elevated tank.

3.3.2 Meters

The City has approximately 1095 water meters in their distribution system. All water meters currently installed were upgraded when the City switched to radio reading technology about 15 years ago. Since then, meters have been replaced on an as-needed basis, but are generally in working condition. When individual water meters age, inaccuracies can be a chronic problem. The City may undercharge customers with defective meters and lose potential revenue. Keller Associates recommends that the City adopt annual meter testing and replacement programs. The typical life of a residential meter is 20 years, so the City should begin preparing to replace the meters in approximately 5 years by evaluating the condition of existing meters and setting aside replacement budget funds.

3.3.3 Model Development and Calibration

A hydraulic model of the existing distribution system was created in conjunction with this study, using distribution system data provided by the City and elevation and mapping data from GoogleEARTH. The hydraulic modeling software used for the analysis was Bentley's WaterCAD v8i.

Elevation information was added to the model through an automated terrain modeling process, and manually checked for accuracy. Additional model input data from pump curves, operational controls, record drawings, and data gathered by City staff was incorporated into the hydraulic model. Water consumption records from the City's billing database were utilized to assign relative demands throughout the system in the hydraulic model, based on land use type and location. This allowed for a more accurate allocation of the existing system water demands.

Keller Associates collaborated with City staff in calibrating the hydraulic model to field conditions. Two rounds of hydrant flow tests were completed in the field to evaluate static conditions and measure flows and associated pressure drops in the system. The field measurements were compared with model results to determine whether the model simulated field conditions. The field test data correlated well to model results, giving confidence in the analysis and recommendations presented in this report. Refer to Appendix D for calibration details.

The only test location that did not closely simulate field conditions was near the elementary school. At this location, the modeled results were conservative, resulting in predicted pressures a little lower than observed under stressed conditions. Additional field investigative work may be needed to determine the source of the discrepancy, which could include conditions such as additional looping or a larger pipe along Olney Street. The model discrepancy is not significant enough to change the recommended capital improvements.

3.4 DISTRIBUTION SYSTEM ANALYSIS RESULTS AND RECOMMENDATIONS

With the calibrated model, the distribution system was evaluated against the planning criteria presented in Section 2. The following sections summarize the analysis results.

3.4.1 Hydrant Coverage

There are reportedly 124 fire hydrants distributed throughout the water system. In general, there should be less than 600 feet between hydrants in order to provide adequate fire protection.

Figure 05 in Appendix A illustrates existing and future hydrant coverage based on a 300-foot radius for each hydrant. The future hydrants were added to eliminate the most critical coverage gaps. The phasing of these future hydrants is addressed in the capital improvement plan. Priorities were assigned based on the distance to the nearest existing hydrant, land use (commercial areas and schools had higher priority), and density of uncovered structures.

3.4.2 Minimum Month Demand

Figure 06 in Appendix A highlights the system locations with various pressures under minimum month demand conditions. When pressures range from 45 psi to 80 psi, the standards for a minimum month are met. All locations within the study area are within this range.

3.4.3 Peak Hour Demand

Figure 07 in Appendix A highlights the system locations with various pressures under peak hour demand conditions. When pressures range from 45 psi to 80 psi, the standards for a peak hour event are met. All locations within the study area are within this range.

3.4.4 Maximum Day Demand plus Fire Demands

The model was populated with fire flow demands for areas with specific requirements identified with input from the local fire authority. Under maximum day and the fire flow requirements stated, the system was tested with the criterion of system pressures at or above 20 psi. The water model evaluates each pipe junction individually under

maximum day demands with the specific fire flow requirement for that node, while considering pressures at other nodes in the system. The analysis is steady state (pump, tanks and wells conditions do not change with time) and assumes adequate fire storage is provided to support the design durations. For the purposes of this analysis, the model assumed that all of the pumps were operational for delivering fire flows to the pressure zones serviced directly by the booster station. The booster station capacity evaluation criteria assume that the largest pump is off-line.

Figure 08 in Appendix A highlights the modeled nodes in the water system that do not meet maximum day demand plus fire requirements, and Figure 09 shows existing available fire flows. Appendix D contains the model results report for this and other pertinent model evaluations. Existing structures with ISO fire flow requirements above 3,000 gpm would need to have fire sprinklers to meet these criteria. Future structures may need sprinklers for fire flow demands as low as 1,500 gpm, depending on location. See Appendix A figures for existing and proposed fire flows with capital improvements.

Areas of inadequate fire protection are primarily a result of undersized lines, inadequate transmission, and lack of system looping.

3.4.5 Pipe Material Considerations

Asbestos cement (AC) and steel pipe make up 22% of the distribution system. These pipe materials are problematic, tending to cause operation and maintenance problems (low pressures, leaky pipes, poor fire protection, and poor water quality). The City should target AC and steel pipe for replacement before other pipeline materials.

3.4.6 Distribution System Recommendations

Upon completing the evaluation of the existing distribution system, several improvements were identified to correct existing deficiencies. Identified priority improvements as well as an overview of system expansion are presented in Figure 10 in Appendix A. Planning level cost estimates for each improvement can be found in Appendix E and are summarized in Section 4.

The following paragraphs describe the recommended distribution system improvements included in the capital improvement plan. These improvements are in addition to well, pumping and storage facility improvements described later. Details of the each priority improvement can be found in Appendix E.

Priority 1 Improvements

Priority 1 improvements are intended to correct immediate concerns including fire flow deficiencies over large portions of the city. The City hopes to implement these improvements within the next 6 years.

Priority 1 Improvements include:

- Construct a new 10-inch pipeline along Aumsville Highway, adding looping to the portion of the City with the worst fire flows
- Construct a new 8-inch pipeline loop near school
- Install additional fire hydrants

Priority 2 Improvements

Priority 2 improvements include less urgent pipeline improvements that are located in areas with local fire flow deficiencies, replacing wrapped steel pipe with modern materials, providing sufficient supply, and creating redundant storage and booster station capabilities. The City hopes to implement these improvements by 2024.

Priority 2 Improvements include:

- Replace existing 4-inch pipeline on Church Street with 8-inch line
- Create an 8-inch pipeline loop along Michael Way
- Construct an 8-inch pipeline on Maple Court
- Construct an 8-inch pipeline on Locust Court
- Install additional hydrants

Priority 3 Improvements

Priority 3 improvements are located in areas that would benefit from improved transmission for water quality and looping reasons. These improvements should be completed by 2034.

Priority 3 Improvements include:

- Construct additional pipelines for looping
- Install additional fire hydrants

Replacement Budgets

As system components reach the end of their useful life, they need to be replaced. Improvements addressing problems stemming from materials and age may have a minimal effect on available fire flows and system pressures, but are part of an ongoing replacement program intended to keep the system functioning properly over the long term. The replacement budget should include allocations for pipes, fire hydrants, and water meters. Money should also be budgeted for leak detection and reservoir cleaning.

The goal for this planning period should be to replace all AC and steel pipe in the system with PVC or ductile iron (DI). This accounts to an average of 1182 feet, at an estimated cost of $142,000 per year. It will take approximately 17 years to replace the AC and steel pipe, after which the existing PVC pipe will be reaching the end of its useful life and should need replacement. All items with recommended replacement budgets are shown in Table 3.4. The annual replacement budget totals $174,000.

TABLE 3.4: Replacement Budgets

Item	Complete Every	Cost / Year
Pipelines	75 years	$ 142,000
Fire Hydrants	50 years	$ 11,000
Water Meters	20 years	$ 14,000
Tank Cleaning and Inspection	3 years	$ 2,000
Leak Detection	8 years	$ 5,000
TOTAL	N/A	**$ 174,000**

3.5 FUTURE DEMANDS ANALYSIS AND RESULTS

Future demands were distributed in areas where the City expects growth to occur. Growth is anticipated to occur in the interchange area on the northeast side of town, and a previously approved subdivision on the east side. Further development could occur on the west side of the city within the western limits of the UGB most likely by an industrial facility. The City has requested that a reserve of 100 gpm be accounted for in the analysis to account for this potential industrial user.

A combination of all of the recommended priority improvements will provide sufficient pressures and flows to handle the increase in demands. Representative future loops included on Figure 10 in Appendix A were used in the model to check pressures and flow for the future development. The pipeline locations for the future loops are approximate, and should be evaluated further and refined when the layout of the development is defined in the predesign process for future sub-divisions and industrial facilities. Figures 11-13 in Appendix A show pressures and available fire flow with priority improvements completed.

3.6 EXISTING STORAGE EVALUATION

3.6.1 Existing Reservoir Conditions

The City has two storage reservoirs. The main storage tank is a 1.0 million gallon (MG) tank constructed in 1982 adjacent to the booster station and reservoir well, and the 0.1 million gallon elevated tank was constructed in 1965. Under normal operations, all well water is pumped directly to 1.0 million gallon tank, where it is mixed and treated before being delivered to the distribution system via a booster station.

The booster station provides pressures to the system and fills the elevated tank during the day from 5 a.m. to 11 p.m. To conserve energy and allow circulation in the elevated tank, pressures are reduced at night (11 p.m. to 5 a.m.).

The system has two operating modes. In the first mode, which is used in the daytime (5 a.m.-11 p.m.), the water travels through the booster station and into the system. During this operational mode, water fills the smaller, 0.1 MG elevated reservoir to prepare for the night (11 p.m.-5 a.m.). In the night hours, the operating mode changes to conserve energy and allow circulation in the elevated tank. In nighttime mode, the system floats on the elevated tank at a lower pressure than in the daytime. If the pressure drops too low (below 13 feet in the elevated tank), the system will return to daytime mode, turning on the booster station regardless of the time of day.

1982 Welded Steel Tank (1.0 Million Gallon Reservoir)

This reservoir is a welded steel tank with a nominal storage capacity of 1.0 million gallons. Water from all the City's wells feeds directly into the reservoir. All wells except the Reservoir well are metered by an influent flow meter. In the current operating scenario, the reservoir calls on the wells when the level drops to 28 feet, and stops filling at 38.5 feet, providing 1.5 feet of freeboard below the overflow.

The tank outlet is located in the bottom of the tank. City staff report that the tank has cathodic protection, and the drain valve is exercised annually. The tank was last inspected 5 years ago, and is due for an interior inspection to further define tank interior conditions.

Based on observations made by Keller Associates and input from City staff, the following deficiencies were identified:

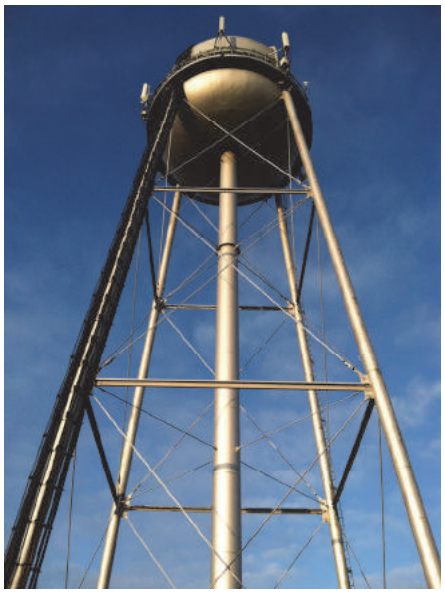
- The SCADA panel needs to be reset periodically, when it experiences a glitch and does not appropriately reflect the tank level.
- The manual level reading on the tank has frozen and the transducer has malfunctioned. City staff report that on one occasion the tank ran completely empty, and the system was running off the 100,000-gallon tank
- Original coal tar interior coating failing and does not meet current industry standards.
- The exterior of the tank was re-coated 5 years ago, but the tank needs to be washed periodically.
- The Reservoir well discharges directly to the tank, bypassing the influent flow meter.
- The reservoir loses close to 25% of the existing storage before calling on the wells. This is more than needed and reduces the available peaking and emergency storage that may be required for the system.

Recommended Improvements

- Repair outside manual level reading and level transducer.
- Replace SCADA PLC with new PLC unit with battery backup.
- Remove existing interior tar coating and recoat the interior of the tank.
- Recoat the exterior of the tank at the end of the 20-year planning period.
- Reroute the Reservoir well yard piping to discharge upstream of the influent flow meter.
- Consider reducing the operating storage to approximately 10% of total volume, particularly during the summer periods when peaking storage requirements are the highest.

1965 Elevated Tank (100,000 Gallon Reservoir)

This welded steel reservoir has a nominal size of 100,000 gallons. The base of the tank is elevated 96 feet off the ground, and it is 25 feet deep from the drain to the overflow. The tank levels range from full at 25 feet, to low level at 13 feet signaling the booster station to turn on. The City's goal is to prevent the levels in the tank from rising above 23.5 feet, but it appears that operational levels are much closer to the overflow elevation. The City should periodically check and change the settings of the altitude valve as necessary to achieve a freeboard distance of at least 1 foot.



The interior of the tank was recoated with epoxy 10 years ago, and an interior inspection of the tank was completed the following year. The tank is due for another interior inspection to determine existing conditions. The outside was inspected by Pittsburg Tank & Tower for structural issues after the City was hit by a tornado in December 2010, and a structural report was subsequently prepared in 2011. Based on observations made in this report and input from City staff, the following deficiencies and observations were identified:

- Concrete around the foundation needs to be sealed.
- Foundation anchor bolts need welding.
- To properly support the structure, windage rods need to be adjusted and welded.
- The exterior of the tank has not been recoated since its original construction.
- There is a single line in and out of the tank, so obtaining sufficient mixing may be an issue.
- Field data suggests that the water level may reach or exceed the overflow elevation before automatically shutting off the booster station.
- The ladder does not meet current safety standards.
- There is no safety railing around the top access hatch.
- The overflow pipe does not extend all the way to the ground.
- The reservoir provides minimal system operational benefits. Its size is relatively small, and the elevation is lower than the normal target pressure allows.

Recommendations

Additional storage needs (discussed in Section 3.7) support the construction of a new reservoir facility. The elevated reservoir may be abandoned when and if an additional reservoir is constructed. Because of this, repair or recoating of the elevated reservoir is not recommended, unless a structural deficiency is identified that presents a public safety or health hazard (in which case the City may prefer to dismantle the tank rather than incur the costs of a retrofit).

Addressing a few minor issues – especially those related to operations and structural problems – will reduce some immediate concerns and improve operations until a new tank can be constructed at a later date. These include:

- Check transducer settings against field measurements to verify it is working properly. Adjust the level set-point to allow for 1 foot of freeboard below the overflow.
- Repair items previously listed as deficiencies in the Pittsburg Tank & Tower Co. Inc. Structural Report dated May 20, 2011.

3.6.2 Available vs. Needed Storage

Existing and future storage capacity needs are presented in Table 3.5. The total storage required is anticipated to increase from 1,030,000 gallons to 1,434,000 gallons by 2034, assuming that emergency storage is in addition to (not nested in) the fire storage.

TABLE 3.5: Existing and Future Storage Needs

Storage Component	Year 2014	Year 2034
Operational & Peaking Storage[1,2] (GAL)	204,679	334,130
Fire Storage[3] (GAL)	540,000	540,000
Emergency Storage[4] (GAL)	285,522	559,884
Total Storage Required (GAL)	*1,030,000*	*1,434,000*
Storage Available (GAL)	*1,072,000*	*1,072,000*
Storage Surplus (GAL)	**42,000**	**-362,000**

1. Operating storage is currently 29% of effective volume (305,905 GAL). Keller Associates recomends (as show n above) reducing this to 10% to increase storage available for emergencies
2. Assumes operating plus peaking storage is 25% of max day
3. Assumes 3000 gpm for 3 hours
4. Assumes emergency storage volume equals one day at average daily demand, for both existing and future storage.

The analysis performed indicates that there is currently a surplus of 42,000 gallons; but by the end of the 20-year planning period, the City will have a deficit of 362,000 gallons if the emergency storage is not nested in the fire storage. Using the un-nested criteria established by the City, new storage would be needed before 2019, and should classify as a Priority 1 improvement. Additional storage would also necessitate an additional well and booster station, and the associated costs are substantial. Therefore, the City has elected to temporarily nest emergency and fire storage, and delay construction of the new reservoir until additional funds are available.

Should a large industrial facility with a demand greater than the largest existing facility move in prior to construction of the new reservoir, the need for storage will be accelerated. Similarly, if a large industry or commercial facility that requires more than 3000 gpm fire protection connects to the system, the need for additional storage could change. An alternative to providing additional storage is to require buildings to have sprinkler systems that will limit outside fire demands to 3000 gpm or less.

3.7 PUMP STATION EVALUATION

The booster pump station is located adjacent to the 1.0 MG reservoir. The pump station was upgraded in 2008, and serves the entire city during the day (5 a.m. to 11 p.m.), as well as filling the elevated tank for use between 11 p.m. and 5 a.m. The pump station also kicks on at night if the water level in the elevated reservoir drops below 13 feet.

The pump station draws water from the 1.0 MG tank and consists of two 30 hp, 600 gpm pumps, one 50 hp, 1,500 gpm fire pump, and a pressure relief valve. All pumps are on VFD control.

There is a back-up power connection, but no permanent back-up generator on-site. In the event of a power failure, the only source of water is the elevated tank which is not adequate to sustain the system for a long period of time or to fight fires. Ensuring the continuous operation of this booster station during a power outage should be one of the City's highest priorities.

This is the only location where chlorine (hypochlorite generated onsite) is added to the system under normal operating conditions. This is done via a 3 hp recirculation pump that pumps to the reservoir. This pump uses automatic controls to keep chlorine levels between 0.4 mg/L and 1.5 mg/L; a chart recorder continually tracks chlorine level.

The SCADA system records the pump on/off status. The SCADA system does not track the circulation pump, the suction and discharge pressures of the booster station, or the chlorine residual. As part of the on-going filter project, a new flow meter will be installed at the booster station discharge to track booster station flows.

Recommended Improvements

- Install permanent on-site back-up generator.
- Complete SCADA improvements to include pressure and flow monitoring, including flow monitoring of the new discharge flow meter.

3.7.1 Need for an Additional Booster Station

Table 3.6 summarizes the booster station capacity with the required demands. The total capacity assumes everything is working as originally designed (all pumps on). The firm capacity accounts for the largest pump off-line. The booster station is capable of producing peak hour flows until approximately 2019, but cannot support 2014 fire plus max day demands even with all pumps running. This nessecitates an additional booster station. This booster station should be incorporated with the new proposed well and reservoir.

TABLE 3.6: Limiting Capacities

System Component	Total Capacity	Firm Capacity
Current Booster Station Capacity (gpm)	**2,700***	**1,200**
2014 Max Day Demand + Fire Flow (gpm)	3,557	3,557
2014 Peak Hour Demand (gpm)	947	947
2034 Max Day Demand + Fire Flow (gpm)	3,928	3,928
2034 Peak Hour Demand (gpm)	1,508	1,508

*as reported by City

3.8 WATER RIGHTS

The City of Aumsville has a total of six groundwater water rights for municipal use. Three of the six water rights have been certificated by the Oregon Water Resources Department (OWRD) with priority dates of, 1958, 1975, and 1990. One of the City's water rights is a groundwater registration claim (GR-3543/GR-3258) and has a "tentative" priority date of 1948. The allowed flow rates for the three certificates and the GR claim total 1.16 cfs (521 gpm). The three certificated water rights are permanent and cumulative. The GR claim is a "claimed" water right and will be adjudicated by the courts at some time in the future. However, one of these water rights (GR-3543/GR-3258, which is the one tied to the Baker well) is no longer used, and its water right should be transferred (through a Ground Water Registration Modification application) to a location where water can be used. The City's two other water rights have permits issued by the OWRD with priority dates of 1983 and 1998. The allowed flow rates for these permits total 1.846 cfs (828 gpm), making a total permitted water right of 1349 gpm. Development limitations limit total available water rights to 1.61 cfs (722 gpm). The City's water rights may be utilized year-round for municipal use. All water rights are summarized in Table 3.7.

Well capacity limitations reduce the actual production at most wells, so some rights may need to be transferred or otherwise consolidated to be entirely used in future wells. The existing water rights could serve the City's max day demand well beyond the planning period to an approximate population of 9,250 if fully utilized and development limitations are lifted. The City should complete water rights transfers with OWRD in order to allow for multiple points of diversion for wells in the same aquifers. This will provide the City greater flexibility in perfecting the water rights.

3.9 REQUEST FOR GREENLIGHT WATER

The City of Aumsville formally requests from OWRD to increase the diversion of water under Aumsville's extended Permits G-10223 and G-13679 beyond current development limitations in order to meet its 20-year projected demands, including full Greenlight Water for the use of Permit G-10223 for a total of 1.4 cfs and Permit G-13679 for a total of 0.446 cfs. This will allow Boone #2 to produce up to 0.95 cfs and Church Well to produce up to 1.4 cfs if Boone #2 is not in service, or the remainder of the water right not produced by Boone #2. The proposed well in the CIP can utilize the G-13679 water right, or it can be transferred to an existing well. The approximate monthly maximum volume projected to 2034 is 11.2 million gallons for G-10223 and 7.2 million gallons for G-13679. It is anticipated that perfection of G-10223 will happen as soon as possible after the extension order is approved. The extension order is anticipated to be a 5-year term. G-13679 has an estimated completion date of 10/1/2024; it is anticipated that this water right will be perfected by then.

Perfection of G-10223 will be associated with the construction of a new well, reservoir, and booster station (see priority 2 Capital improvements in section 4). This system will provide redundancy to the existing system. Currently the City relies on one booster station and one major reservoir for supply. If something happened to either of these, the City would only have water until the 0.1 MG elevated tank ran out of water. To improve this, a new booster station, reservoir and associated well are outlined in the capital improvement plan, and new green light water is needed to maximize potential of this facility.

Increased diversion of water under extended Permits G-10223 and G-13679 is the most appropriate supply alternative due to major cost savings in the short-term, and necessity of a larger supply in the long-term. Boone #2 and Church Wells currently need no capital improvements and have no associated costs to produce at full capacity. It is most economical to meet the City's immediate supply with these wells until future capital improvements can take place. Many of the wells in the city have capacity issues (as described in section 2) and do not currently produce the full amount of water allowed in their water rights. While capital improvements have been proposed to increase capacity in under-producing wells, these improvements will not help the immediate shortage problem. Two other solutions were evaluated, but were not chosen as the selected alternative: additional conservation measures, and regionalization.

The City of Aumsville has historically been effective at minimizing water use and un-accounted-for water, thus conservation alone is not a viable option to increase supply. Table 2.3 and Chart 2.1 compare Aumsville's water use to surrounding communities; Aumsville uses far less water on average per capita than any other city evaluated indicating good conservation practices are already in place. Aumsville also boasts a low unaccounted-for water percentage, fully metered system, and a rate structure based on usage. Water conservation measures are explained in further detail in section 5, and should be continued to maintain the low water use in the city and eliminate the need for unnecessary water rights in the future, but are not anticipated to reduce water consumption. Costs of implementing any additional conservation measures would be more expensive than the no cost option to increase diversion under existing water rights.

Regionalization is discussed in section 3.2.9, it is possible, but very expensive when compared to increasing the diversion from existing water rights that have development limits. Many other factors including water quality differences, reliance on others, and politics come into play with arrangements like this. This alternative was not selected as the best option to address the city's supply shortage.

There are no known legal or mitigation requirements to increase diversion under extended Permits G-10223 and G-13679. The City is collaborating with OWRD to follow proper protocol.

TABLE 3.7: Water Rights

Well	Application #	Permit #	Priority Date	Certification #	Transfer #	Source	Use	Allowed Rate	Development Limitation[c]	Actual Diversion				Authorized Completion Date
										Max. Instantaneous Rate Diverted to Date (cfs)	Max. Annual Qantity Diverted to Date (MG)	Avg. Monthly Diversion (MG)	Avg. Daily Diversion (gal.)	
Baker	-	GR-3543	8/1948	GR-3258	-	Mill Creek Basin	Municipal	0.17cfs (76 gpm)	-	-	-	-	-	Completed
Boone Park	G-6861	G-6400	3/24/1975	65917	-	Mill Creek Basin	Municipal	0.29 cfs (130 gpm)	-	0.24 cfs (110 gpm)	42.5	3.1	103,333	Completed
Boone #2[a]	G-10926	G-10223	4/14/1983	-	T-11186	Mill Creek Basin	Municipal	1.40 cfs (628 gpm)	0.45 cfs	0.56 cfs (250 gpm)	24.1	2.0	67,000	10/1/2012
Church[b]	G-10926	G-10223	4/14/1983	-	T-11186	Mill Creek Basin	Municipal		0.45 cfs	0.78 cfs (350 gpm)	34.5	2.6	86,700	10/1/2012
Reservoir[d]	G-12352	G-11891	12/18/1990	89924	-	Mill Creek Basin	Municipal	0.40cfs (202 gpm)	-	0.07 cfs (30 gpm)	17.2	1.4	46,700	Completed
Tower	G-1143	G-1051	8/1/1958	32214	-	Mill Creek Basin	Municipal	0.30 cfs (135 gpm)	-	0.16 cfs (70 gpm)	37.9	2.6	86,700	Completed
-	G-14758	G-13679	5/26/1998	-	-	Beaver Creek Basin	Municipal	0.446 cfs (200 gpm)	0.00 cfs	-	-	-	-	10/1/2024

*Source: JMS Engineering and OWRD
a) Boone #2 is llimited to 0.45 cfs of the 1.4 cfs for the total permit.
b) Church well was added to the entire permit (1.4 cfs if development limits are lifted, and Boone#2 isn't producing anything)
c) The total flow rate from Church and Boone #2 is currently limited to 0.45 cfs through a development limit.
d) The permited rate was 0.45 cfs, but that was reduced to 0.40 cfs when the certificate was issued.

4.0 CAPITAL IMPROVEMENT PLAN AND RATE IMPACTS

4.1 GENERAL

This section provides a capital improvement plan (CIP) for the recommended improvements discussed in Section 3, and documents potential impacts to System Development Charges (SDCs) and user rates. The CIP summarizes the recommended system improvements that are anticipated to require capital beyond routine maintenance practices. This CIP includes opinions of probable costs for the recommendations, which are presented in order of priority.

The prioritization schedule in the CIP was established by consulting with City staff. Priority 1 improvements are intended to correct immediate concerns including reducing fire flow deficiencies in industrial/commercial portions of the city, correct existing conditions concerns, and improve reliability especially during power outages. The City hopes to implement these improvements within the next 6 years. Priority 2 improvements include less urgent pipeline improvements that are located in areas with local fire flow deficiencies; replacing older, wrapped steel pipe; completing major well and booster station repairs/upgrades; improving supply for growth; and creating redundant storage and booster station capabilities. The City hopes to implement these improvements by 2024. Priority 3 improvements include major repairs to reservoirs and well facilities as well as new pipelines that would benefit the system by providing improved transmission and looping. These improvements are anticipated to be completed by 2034.

Though major repairs/replacements have been identified for aboveground facilities (wells, booster station, and reservoirs), the capital improvement plan presented in this chapter is not intended to provide an itemized list of anticipated pipeline and water facility replacement needs. The City should recognize that every part of the water system has a useful life, and budgeting for ongoing replacement/rehabilitation needs should be considered (an estimated replacement budget is provided in Section 3). Improvements addressing problems stemming from pipe materials should be included as part of an ongoing pipeline replacement program. These improvements may have a minimal effect on available fire flows and system pressures, but are intended to address ongoing asset replacement needs. The goal for this 20-year planning period should be to replace all AC and steel pipe in the system with PVC or ductile iron pipe, and begin replacing some of the older, undersized PVC pipelines.

4.2 CAPITAL IMPROVEMENT PLAN

4.2.1 Proposed Capital Improvements

The priority projects are shown on Figure 10 in Appendix A, and are described in the following paragraphs. Each project has a unique project identifier that indicates the priority and the project within that priority (e.g. Project 1A is a Priority 1 project, with a unique identifier of 1A). The project identifier is included in the CIP table, master plan figure, and cost estimate breakdown in the appendix for your convenience.

Project 1A – 10-inch Loop along Aumsville Highway, 8-inch Connection to Olney Street

This improvement includes construction of a 10-inch pipeline along Aumsville Highway, and connects dead end lines at Olney Street and Aumsville Highway. The 8-inch line along Olney Street is also extended to this intersection. This improvement increases fire flow to the school and a large commercial/industrial area within the city. It also provides improved water quality and redundancy through additional looping.

Project 1B – 8-inch Loop to School

This improvement adds pipelines and hydrants to increase fire flows near the school from approximately 1,100 gpm to approximately 2,500 gpm. (The school reportedly requires 5,500 gpm – an amount that far exceeds what most communities (including Aumsville) can practically provide. To further improve fire protection and meet current fire protection standards, the school may need to install a fire sprinkler system.) Even though full fire protection is not provided by the City to the school, this will provide a significant increase in fire protection for the school.

Project 1C – Additional Fire Hydrants

This improvement includes the addition of seven fire hydrants not associated with any previously described priority 1 projects. The purpose of these improvements is to improve fire coverage within the city.

Project 1D – Reservoir Improvements

This improvement includes interior painting, SCADA updates, and level reading improvements and associated equipment of 1MG reservoir, and structural recommendations previously determined by others for the 0.1MG reservoir.

Project 1E – Booster Station Improvements

This improvement includes the addition of a pressure transducer, intrusion system, generator, SCADA updates and associated equipment.

Project 1F – Well Improvements

This improvement includes all recommendations in section 3 for Boone#1, Reservoir, and Church Wells, as well as some of the recommendations for the other wells. Improvements at the Boone #2 Well consist of an air release valve, new pump and motor, surveillance system, SCADA updates, a pressure transducer and all associated equipment and piping changes. Improvements at the Tower Well consist of a surveillance system, SCADA updates, a pressure transducer, flow meter, and all associated equipment and piping changes.

Project 2A – 8-inch Main along Church Street

This improvement replaces a 4-inch wrapped steel pipe along Church Street between 8th Street and 5th Street with a new 8-inch PVC or ductile iron pipe.

Project 2B – 8-inch Loop along Michael Way

This improvement includes an additional line along Michael Way that connects the existing line (running north/south) connected to the hydrant with the existing line along Michael Way, and an additional fire hydrant.

Project 2C – 8-inch Main on Maple Court

This improvement consists of upsizing the existing 3-inch diameter pipeline on Maple Court with a new 8-inch diameter pipeline, and adding a fire hydrant.

Project 2D – 8-inch Main on Locust Court

This improvement consists of upsizing the existing 3-inch diameter pipeline on Locust Court with a new 8-inch diameter pipeline, and adding a fire hydrant.

Project 2E – Additional Fire Hydrants

This improvement includes the addition of five new fire hydrants not associated with any previously described priority 2 projects. The purpose of this project is to improve fire coverage.

Project 2F – 500,000 Gallon Reservoir

This improvement should be completed in conjunction with Projects 2G and 2H. It adds a redundant reservoir to the system and provides required storage for 2034 projected needs and beyond.

Project 2G – 250 gpm Well and Pipeline

This improvement should be completed in conjunction with Projects 2F and 2H. It adds an anticipated 300 gpm well to the system, providing needed supply for the projected 2024 maximum day demand. Completing a new well may take many years to site, permit, and develop. Because of this, the City should consider beginning the process of siting and permitting several years in advance of when the project will be needed.

It should be noted that the City is currently undertaking improvements to existing well facilities to expand their capacities. These improvements are required to correct existing supply deficiencies. In the event that these other projects are not successful in obtaining targeted increased capacity, this project (and potentially Projects 2F and 2H) should be completed as soon as financing will allow.

Project 2H – Additional Booster Station

This improvement should be completed in conjunction with Projects 2F and 2G. It adds a booster station to the system to distribute flows from the new well and reservoir, and provides redundant pumping capacity. This improvement also corrects an existing deficiency in the system by allowing the City to provide desired fire flows with the largest booster pump out of service.

Project 2I – Well Improvements

This improvement includes Boone #2 and Tower Wells. Improvements at the Boone #2 Well consist of a generator and all associated equipment. Improvements at the Tower Well consist of an air release valve, recoating the roof, and painting the interior piping.

Project 3A – 10-inch Loop along Aumsville Highway

This improvement includes construction of a 10-inch loop along Aumsville Highway, connecting the dead-end lines up to the wastewater treatment plant with Olney Street.

Project 3B – 8-inch Loop between 12th Street and Cedar Lane

This project improves system transmission and looping by constructing an 8-inch pipeline between 12th Street and Cedar Lane.

Project 3C – 8-inch Loop along Cleveland Street

This improvement connects the pipelines along Cleveland Street between 8th Street and 9th Street.

Project 3D – 8-inch Loop between Del Mar Drive and 1st Street

This improvement connects the waterline on Del Mar Drive with 1st Street to create an 8-inch loop, and adds a fire hydrant.

Project 3E – Additional Fire Hydrants

This improvement includes the addition of seven new fire hydrants not associated with any previously described priority 3 projects.

Project 3F – Reservoir Improvements

This improvement includes exterior painting of the 1MG reservoir.

Project 3G – Well Improvements

This improvement includes abandonment of aeration tanks and associated piping changes.

Table 4.1 outlines a prioritization schedule for the projects described above, and provides an opinion of probable cost for those improvements. Approximately $6 million in capital improvements have been identified for the 20-year planning horizon. Costs are shown in 2014 dollars and represent concept level costs that should be updated as part of project pre-design efforts in the future. A more detailed description of these improvements and a breakdown of the cost assumptions can be found in Appendix E of this report.

TABLE 4.1: Capital Improvement Plan

ID#	Item Description	Opinion of Probable Cost*	Percent SDC Eligible	SDC Amount	City Amount
Priority 1 Improvements (by 2020)					
1A	10-inch loop along Aumsville Highway, 8-inch connection to Olney Street	$255,000	50%	$127,500	$127,500
1B	8-inch Loop to School	$104,000	0%	$0	$104,000
1C	Additional Fire Hydrants	$50,000	14%	$7,200	$42,800
1D	Reservoir Improvements	$476,000	0%	$0	$476,000
1E	Booster Station Improvements	$263,000	0%	$0	$263,000
1F	Well Improvements	$620,360	13%	$81,600	$538,760
1G	WMCP Update	$4,800	50%	$2,400	$2,400
	Total Priority 1 Improvements	***$1,773,000***		***$218,700***	***$1,554,460***
Priority 2 Improvements (by 2024)					
2A	8-inch Main along Church Street	$136,000	0%	$0	$136,000
2B	8-inch loop along Michael Way	$77,000	0%	$0	$77,000
2C	8-inch main on Maple Court	$86,000	0%	$0	$86,000
2D	8-inch main on Locust Court	$89,000	0%	$0	$89,000
2E	Additional Fire Hydrants	$36,000	20%	$7,200	$28,800
2F	500,000 Gallon Reservoir	$1,123,000	100%	$1,123,000	$0
2G	300 gpm Well and Pipeline	$703,000	100%	$703,000	$0
2H	Additional Booster Station	$749,000	14%	$101,900	$647,100
2I	Well Improvements	$256,000	0%	$0	$256,000
2J	WMCP Progress Report	$6,300	50%	$3,200	$3,100
2K	10 Year WMP Update	$80,000	100%	$80,000	$0
	Total Priority 2 Improvements	***$3,341,000***		***$2,018,300***	***$1,323,000***
Priority 3 Improvements (by 2034)					
3A	10-inch loop along Aumsville Highway	$147,000	75%	$110,300	$36,700
3B	8-inch Loop between 12th Street and Cedar Lane	$32,000	25%	$8,000	$24,000
3C	8-inch Loop along Cleveland Street	$40,000	0%	$0	$40,000
3D	8-inch Loop between Del Mar Drive and 1st Street	$216,000	75%	$162,000	$54,000
3E	Additional Fire Hydrants	$57,000	13%	$7,200	$49,800
3F	Reservoir Improvements	$172,000	0%	$0	$172,000
3G	Well Improvements	$60,000	0%	$0	$60,000
3H	20 Year WMP	$80,000	100%	$80,000	$0
3I	WMCP Update	$6,300	50%	$3,200	$3,100
	Total Priority 3 Improvements	***$810,000***		***$260,400***	***$402,900***
	TOTAL (rounded)	**$5,924,000**		**$2,498,000**	**$3,281,000**
*** All costs in 2014 Dollars. Costs include engineering and contingencies.**					

4.2.2 Capital Improvements Already Underway by City

Prior to this master plan, the City had already identified capital improvements for fiscal year 2014/2015 which were designed and recommended by others. These improvements include expanding well capacity and recoating the interior of the 1 MG reservoir. These costs have been included in the 6-year CIP.

The City recognized the need for additional supply, and will be performing repair efforts on the Tower well and re-drilling the Reservoir well. According to City staff, each improvement is expected to increase the City's supply by 100 gpm.

The 1 MG gallon reservoir has a tar interior coating that needs to be replaced with a more modern coating. This is also anticipated to be completed in 2014/2015.

4.2.3 Additional Projects to Improve Water Quality

The Capital Improvement Plan presented above assumes that the filter project currently underway will address the water quality issues of the Boone #2 and Church wells. If water quality concerns persist following these improvements, the following changes may occur to the CIP.

- At Boone #2 well, instead of abandoning the aeration tanks and installing a new pump and bypass yard piping, repair the aeration tanks with a proper seal and maintain the existing piping scenario. This alternative will add approximately $5,000 to the CIP presented previously.
- At the Church well, a local treatment system would need to be installed to address hydrogen sulfide. All CIP items for the Church well previously presented should still be implemented. The cost impact could be significant, and would require further evaluation to determine.

4.3 FINANCIAL IMPACTS

Analyses of the impacts of recommended improvements on System Development Charges (SDC) and user rates was performed (supporting calculations can be found in Appendix F). This section summarizes the process and findings of the SDC and user rate analyses.

4.3.1 System Development Charges (SDCs)

There are two basic components of an SDC: reimbursement and growth. The reimbursement component of the SDC is intended to compensate the City for its previous investments, and is only applied to those investments that can benefit new growth. The reimbursement component of the SDC is calculated by dividing the value of a system component by the capacity, and is applied only to those elements of the system that have excess remaining capacity. For Aumsville, the value of the system component was estimated by depreciating the construction cost.

Because much of the water system is at or near capacity, only recent investments were included in estimating the replacement value. These included the filter project, chlorination project, and SCADA project that are intended to service both existing and future users. The construction cost (adjusted for inflation and depreciation), along with estimated capacities and reimbursement fee calculations, can be found in Appendix F.

The growth component of the SDC is calculated by allocating the SDC-eligible portion of the CIP costs to the associated capacity. The SDC eligible amount for each project is shown in Table 4.1, and includes the portion of the project benefiting growth. For Aumsville, the total SDC eligible portion of the projects intended to service the 2034 population is $2,498,000. Dividing this cost by the increase in number of equivalent dwelling units (EDUs) anticipated during the planning period yields the growth component of the SDC.

The total recommended SDC for a single family dwelling unit is shown in Table 4.2. For non-residential connections, an equivalent number of EDUs will need to be estimated for each new connection. The recommended SDC for a residential unit is slightly higher than the existing cost of $4,074 per EDU.

Table 4.2: SDC for Single Family Residential Unit

Component	Cost
Reimbursement	$ 266
Growth	$ 4,042
Total	$ 4,308

4.3.2 User Rate Impacts

Keller Associates prepared a user rate model to evaluate the impacts of recommended capital improvements and replacement budgets on the City's budget and associated water rates. Historical operating expenses and revenues (Appendix F) were reviewed with City staff, and provided a framework for forecasting future conditions.

In forecasting future conditions, the following assumptions were made:

- Budgeted operating revenues for FY 2014-15 were assumed to be the starting point for estimating future revenues.
- The recommended annual replacement budget would be 75% funded by FY 2019-20.
- Capital costs for future CIP items and replacement activities were assumed to increase 4% per year.
- Personnel services were assumed to increase 3% per year.
- Materials and services were assumed to increase 3% per year.
- A minimum reserve fund of $245,000 (including all accounts) should be maintained by the City, with a target reserve fund of approximately $440,000 established by FY 2019-20.

Two financing scenarios were evaluated. For the first scenario, the 6-year CIP would be cash financed (no additional debt financing). Under the second scenario, it was assumed that the Priority 1 improvements would be debt financed. Illustrations of both scenarios can be found in Appendix F. In generating this second scenario, it should be noted that the project terms, including interest period and amount of capital to be financed, are shown to generally illustrate the potential budget and user rate impacts. Actual impacts to the City will vary based on the source of funding and associated terms. Keller Associates recommends that the City utilize the professional services of an SEC-registered municipal advisor in conformance with the Dodd-Frank Wall Street Reform and Consumer Protection Act prior to selecting the appropriate financing source(s) and associated terms, seeking authority to indebt the City, or financially obligating the City in any way.

A copy of the user rate forecast can be found in Appendix F. Given the large number of capital projects in the 6-year period, user rates would have to be set much higher to cash finance the improvements. Based on the financing assumptions of the second scenario, the typical user rates would need to be increased approximately 15% for the next two years and 5% for each year thereafter. These rate increases are illustrated in Table 4.3.

Table 4.3: User Rate Impacts

	Budget 2013-14	Budget 2014-15	Forecast 2015-16	Forecast 2016-17	Forecast 2017-18	Forecast 2018-19	Forecast 2019-20
% Increase	0%	15%	15%	5%	5%	5%	5%
Monthly Bill	$31.82	$36.59	$42.08	$44.19	$46.40	$48.72	$51.15

It should be noted that the cost of Priority 2 improvements is double the estimated cost of the Priority 1 improvements. The Priority 2 improvements include a new well, reservoir and booster station. If the City chooses to pursue a debt financed scenario, the City will likely be facing additional rate increases (above the 3% annual increase) to fund or finance the projected Priority 2 improvements.

5.0 WATER CONSERVATION

5.1 GENERAL

Water conservation is a key element in maintaining an adequate water supply for Aumsville. This section presents existing and proposed water conservation program elements, and documents progress made since the previous Water Management and Conservation Plan (WMCP) update was completed in 2005.

5.2 CURRENT AND PROPOSED WATER CONSERVATION PROGRAM

5.2.1 Full Metering of Systems

A major tool in the City's conservation program is the ability to measure user consumption and well production. Aumsville can take these measurements due to a near fully metered water system. Almost all water customers, including public buildings, have meters to measure the quantity of water used. Each single family home and business has one water meter that monitors total water usage at each site.

The only location without metered water usage is the restroom and drinking fountain in the City park. It is recommended that a meter be added to these facilities, so the system is fully metered. The City plans to do this in the near future. A fully metered system allows for easier detection of illicit connections and leakages, enabling a more accurate water audit.

The City would also like to get real-time system-wide water usage by metering the City's booster station that services the community. The City is hoping to do this in the near future, and has added a bid alternative in the current filter project to install a flow meter.

The City's well and booster station meters should be tested every 1-3 years. When inaccuracies are found, the meter should be recalibrated or replaced. Data should be recorded on a continual basis using the SCADA system to improve methods of calculating maximum day and peak hour demands on the system.

TABLE 5.1: Meter Testing and Replacement Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Meter all water used by installing meter at park	Yes	Within 1 year
Test well and booster station flow meters	Yes	As required
Calibrate booster station flow meter	Yes	As required
Booster station flow meter continuously logged and trended on SCADA system	Yes	Ongoing

5.2.2 Meter Testing and Maintenance

The meter replacement goal calls for the City to test and/or replace active customer meters on a 20-year cycle, unless supporting data can demonstrate that a longer or shorter replacement life is warranted. With approximately 1095 active accounts as of December 2013, the City should replace over 55 meters a year on average to meet this goal. In general, meters are replaced based on age and condition. However, if a water customer or City finance staff notice an unexplained change in consumption, a

customer's meter may be tested and replaced. The majority of the meters were replaced about 15 years ago, and the City does not report many errors in recording, although the meters are not tested regularly.

As part of the Water Master Plan, an expanded meter testing and replacement program is recommended. This will include residential and larger (2-inch and above) customer meters. Suspicious meters will be tested and all meters will be replaced on a 20-year average cycle. Based on the results of this testing, the City may choose to accelerate or extend the meter replacement schedule.

Any new construction should include a water meter installed on every potable water service. This should include a meter bypass to facilitate future testing on large meters greater than 2 inches.

Only one well does not connect directly into the reservoir upstream of the meter, and it is a priority 1 improvement to rearrange the yard piping to allow this. All other wells flow directly into the reservoir, so well meters can be checked against the reservoir meter and tank levels to determine accuracy of both meters. If there is a discrepancy, further investigations are needed to determine which meter(s) are in error. Without removing the valves for offsite calibration, the well in error can be determined by process of elimination by turning off the wells one by one, and once again comparing meters and tank levels. When discrepancies are significantly reduced, the well that is off likely has the error. If discrepancies remain after all wells have been tested, it may be that multiple well meters or the reservoir meter is incorrect. After errors are found, inaccurate meters should be recalibrated or replaced.

TABLE 5.2: Meter Testing and Replacement Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Small customer meter testing	Yes	As required
Small customer meter replacement	Yes	20-year cycle / as required
Large customer meter testing/replacement	Yes	5-year cycle / as required
New construction includes water meter	No	On-Going
Well and reservoir meter calibration	Yes	Annual

5.2.3 Annual Water Audit

Unaccounted-for-water is discussed in Section 2 of this plan. The unaccounted-for-water is the difference between the amount of water produced from the City's wells and the amount of water sold and used for other purposes such as flushing. The City's water use is summarized in Appendix C. In the data analyzed for the last four years, the annual unaccounted-for-water averaged 10%, which is right at the 10% standard set forth in OAR690 Div. 86. Meters should be calibrated to confirm accuracy of actual water losses.

A water audit should be conducted each year. The annual metered usage and estimates of water used for line flushing and other unmetered uses should be compared with the amount of water produced. Using a flow measuring device such as a pitot tube and the time the hydrant is open during line flushing, provides a good estimate of flows. Firefighting can also use this method, but time and flow could be approximated after the fire is out. Water for bulk water sales, street sweeping, vactor trucks, and the wastewater treatment plant should be taken from metered connections

only. If no permanent meter is available, use of a portable meter should be used. Approximate water usage from each of these activities should be recorded the day they occur in a log for the entire year. When the year is over, all the data will be assessable in one place. The difference will represent the unaccounted-for-water in the system.

TABLE 5.3: Water Audit Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Conduct water audit	Yes	Annually

5.2.4 Leak Detection

In 2013, Aumsville exceeded OWRD's 10% benchmark for unaccounted-for-water with a water loss amounting to 14%. Even though the City's average unaccounted-for-water during the last four years is 10%, the percentage has been on the rise over the last three years. In an effort to reduce the amount of unaccounted-for-water, the City intends to complement their meter testing/replacement activities with ongoing leak detection efforts until the unaccounted-for-water is consistently below 10% each year.

Initially, this inspection program should cover approximately 20% of the system per year. Priority should be given to recently installed lines (i.e., within the one-year warranty period), and to older lines that have a history of leaking, have been damaged, experience high pressures, are under high traffic areas, have steep slopes, and/or are located in neighborhoods that have not had recent inspections. The goal is to cover the entire distribution system every five years until the unaccounted-for-water is consistently below the 10% target.

In addition to these scheduled inspections, members of the City's field crew identify leaks. Similarly, when citizens report wet conditions that may suggest a leak, a member of the field crew is dispatched to investigate. As leaks in the City's water distribution system are found, repairs should be made promptly.

Aumsville currently does not have a policy of leak forgiveness or a financial incentive to repair leaks quickly, although a large water bill provides some incentive for prompt repair. Other cities have policies that provide financial incentive to promptly fix leaks, rather than completely forgive the cost of water lost during the billing period. Due to the City's small size, the cost to implement and administer a program, and the small potential impact, the City has elected not to pursue this program at this time. Citizens with special hardships are encouraged to seek redress in a City council meeting.

The City currently offers assistance to residents in leak identification and repair. In this program, City staff contact the residents to arrange for site inspections to determine whether or not leaks exist. The site inspections are triggered by anomalies in the customer's monthly consumption pattern. Sometimes customers call in and ask for help, and the City responds to these requests as well.

TABLE 5.4: Leak Detection and Repair Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Leak detection studies	Yes	5-year cycle / as required
Leak repair and line replacement	No	As needed
Site inspections for unusually high water usage	No	Ongoing

5.2.5 Rate Structure Based on Usage

Customers are billed monthly according to the amount of water consumed beyond a base amount. A more detailed breakdown of the City's billing rate schedule (as of August 2014) is included in Appendix F. This rate structure rewards people all year long for conserving water, and more particularly during the summer peak demand periods. The water bill should include customer usage and a comparison to other similar water users in the system to promote conservation.

TABLE 5.5: Rate Structure Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Billing based on usage	No	On-going
Include customer usage history on bills	Yes	Every billing period
Compare usage to other users on bills	Yes	Every billing period

5.2.6 Technical and Financial Assistance

Since Aumsville has a population less than 7,500 and is not trying to initiate or expand a water right which has a known resource issue, it is not required by the Oregon Water Resources Department to provide financial and technical assistance to consumers with water conservation.

5.2.7 Public Education

Public education and involvement is critical to achieve a successful conservation program. Keller Associates recommends that the City continue and/or implement the following measures to keep the public informed of the status of the water system and how they can help.

The City will encourage activities such as planting landscaping that requires minimal water use, watering during non-peak hours, personal water use reduction practices (such as shorter showers, turning off the water while brushing teeth, etc.), and the use of water efficient fixtures.

Consumer Confidence Report

In accordance with federal requirements, the City prepares an annual report describing the municipal water supply and providing data regarding drinking water quality. This report is included in the monthly newsletter which is hand-delivered to all users within the service area, and will be posted on the City's website in the future.

Annual Children's Presentation

The City periodically implements a presentation on water reducing practices at the summer children's program in the park in order to teach the students at an early age to be enthusiastic about water conservation, and encourage their parents to conserve water. An outside entity has presented the water wise program to schools in the past.

City's Website

The City's website currently has a description of what to do if a leak is found. The website is a simple way to expand public education. The website will be expanded to include information regarding water rates, the consumer confidence reports for the last couple of years, common water-saving practices and procedures, steps on how to check for leaks, and a water efficient planting guide.

Articles in Newsletters

Water supply has been, and continues to be, a topic of interest in this community and the region. The City newsletter will frequently cover water system related topics relative to the City. The City will provide water-related articles in the newsletters on an annual basis.

Large User Agreements

The City periodically reaches out to industrial facilities and the school district to receive pledges of water conservation amounts.

Outdoor postings

In times of drought or high demand, the City posts information requesting voluntary conservation on the fire department's reader board and barricades in the street.

TABLE 5.6: Public Education Benchmarks

5- Year Benchmark	New Program?	Target Frequency
Consumer Confidence reports	No	Annually
Presentation to children	No	Periodically
Update website with conservation info	Yes	On-going
Articles in the Newsletter	No	On-going
Large user agreements	No	As required

5.3 IMPROVEMENTS SINCE PREVIOUS WMCP

In 2005, the City completed a Water Management and Conservation Plan (WMCP) update to the original 1998 Water management plan (WMP). That WMP and WMCP update included the water saving activities shown in Table 5.7. The current status of these activities is also listed in the table.

TABLE 5.7: Water Saving Procedures from Previous WMCPs

Activity	Current Status
Posting on fire department's reader board asking for voluntary water conservation during high demand periods	Ongoing
Odd/even watering	Only used once during curtailment
Annual Water Audits	Started with this master plan
Leak Detection and Repair Program	Not required because of low water loss
Rate structure that encourages conservation	In use
WWTP uses non-potable water for landscaping	Ongoing
Full metering of system	Ongoing, Only 1 meter missing, to be installed soon
Test & calibrate well and booster station flow meters	As required
Large customer meter replacement	Ongoing
New construction required to have a water meter	Ongoing
Site inspection for unusually high water use	Ongoing
Monthly billing cycle	Ongoing
Billing partially based on amount used	Ongoing
Consumer confidence report	Ongoing
School presentations	Periodically
Present at annual outreach event	No, other public education practices are in use
Water use reporting in compliance with OAR 069-085	Ongoing
Request water conservation commitments from industries and schools	Periodically
Investigate potential intertie with Salem	Ongoing
Media advertisements	No, other public education practices are in use
Maximum day measurement & recording at wells	Recommended in master plan
Identify and purchase land for future wells	Ongoing
Construct new well	Yes, Church well
Determine if Boone #2 and Reservoir well are maxed out on productivity	They are limited due to quality issues, not pumping capacity
Tracking of Recommendations in previous Water Management and Conservation Plans	Yes
Adopt a curtailment plan	Done
Adopt the 2005 WMCP	Done
Update Water Management Plan after 5 years	Currently occurring
WWTP uses non-potable water for landscaping	Yes
Articles in City Newsletter	Yes

5.4 DOCUMENTATION OF WATER USE MEASUREMENT AND REPORTING

Source meters are located on each well. Aumsville's water use reporting is done in compliance with OAR 690-085, and the report is submitted annually by December 31st to the OWRD.

TABLE 5.8: Water Use Measuring and Reporting

5- Year Benchmark	New Program?	Target Frequency
Report in Compliance with OAR 690-085	No	Annually

5.5 LIST OF MEASURES ALREADY IMPLEMENTED OR REQUIRED UNDER CONTRACT

The previous WMCP suggested conservation measures which are listed in Table 5.9. It is recommended to continue or add the water conservation measures summarized in Table 5.9. The City does not currently have any contracts requiring water conservation measures. These current measures in combination with the other proposed measures in this WMCP, if implemented properly, will create an effective program to conserve water.

TABLE 5.9: Comparison of Measures from Previous and Current WMCPs

	Recommended and/or Required		Recommended	State Requirement	Frequency
	1998	2005	2014	2014	2014
Full Metering of System	-	yes	yes	yes	Ongoing
Test well and booster station flow meters	yes	yes	yes	yes	As required
Calibrate booster station flow meter	yes	yes	yes	yes	As required
Booster station flow meter recording constantly to SCADA	-	-	yes	-	Ongoing
Small customer meter testing	yes	-	yes	yes	As required
Small customer meter replacement	yes	-	yes	yes	20-year cycle
Large customer testing/replacement	yes	yes	yes	yes	20-year cycle
New construction is required to have a water meter for all locations, and a meter bypass for large meters	yes	yes	yes	-	5 years, or as needed
Water audit	yes	yes	yes	yes	Annually
Leak detection studies	yes	yes	yes	yes if >10% water loss	5 years
Leak repair and line replacement	yes	yes	yes	yes if >15% water loss	Ongoing
Site inspections for unusually high water	-	yes	yes	-	Ongoing
Monthly water billing cycle	yes	yes	yes	-	monthly
Billing partially based on amount used	yes	yes	yes	yes	monthly
Include customer usage on utility bills*	yes	-	yes	-	monthly
Compare customers to other similar users on bills	-	-	yes	-	monthly
Consumer confidence report	?	yes	yes	yes	Annually
School presentation on water conservation	yes	yes	yes	-	Periodically
Update City website with conservation information*	-	-	yes	-	Ongoing
Water conservation articles in the newsletter*	-	-	yes	-	Periodically
Present water conservation info at an annual outreach event or landscape workshop*	yes	yes	yes	-	Annually
Post on fire department's reader board asking for voluntary water conservation during high demand periods	yes	-	yes	-	As required
Odd/even watering	yes	yes	yes	-	As required
WWTP uses non-potable water for landscaping	-		yes	-	Ongoing
Water use reporting in compliance with OAR 069-085	?	yes	yes	yes	Annually
Request water conservation commitments from industries and school district	yes	yes	yes	-	Periodically
Investigate potential of Salem interconnection	yes	no	yes	-	Ongoing
Media advertisements	yes	yes	-	-	Ongoing

*The State requires public education in general, but does not require specific programs.

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6.0 CURTAILMENT PLAN

6.1 GENERAL

A policy for curtailment of water usage gives a city a defined course of action to take in case of an emergency. The City of Aumsville outlines its curtailment plan in the City's 1998 Water Management Plan. This plan explains how the City would discontinue or curtail water usage during times of water shortage, emergency, and catastrophe. Keller Associates recommends a few changes to the plan, as outlined in this section. This section also provides some summary information about the water supply's potential vulnerabilities, identifies benchmarks for determining when curtailment measures should be taken, and provides specific curtailment activities that should be taken.

6.2 ASSESSING THE WATER SUPPLY

Aumsville's water system has two major limitations to maintaining a sufficient water supply in case of emergency – lack of backup power, and lack of redundancy in the well supply. Other events that may be less probable than a power outage or well pump failure, but that could require curtailment activities, may include reduction of water rights (possibly as a long-term response to correct a declining aquifer), declines in well production, possible source contamination, and intentional acts to disrupt the City's water supply.

The firm capacity of the wells (or the capacity with the largest well off-line) is 450 gpm. This represents 80% of the current maximum day demand. If only wells with backup power are included in the firm capacity, just 170 gpm or 30% of the current maximum day demands is available. Either a well failure during a peak summer day or an extended power outage could cause a water shortage for Aumsville. Three items can mitigate these risks: 1) more wells or additional water supply, 2) installing backup power at the wells, and 3) additional storage capacity. As discussed in previous sections of this report, the capital improvement plan includes projects in all three areas.

The last major water shortage occurred in 1996. It was caused by an error in programming that did not allow the wells to run when the booster station was pumping. This issue has since been resolved. Though there has not been a significant deficiency in water supply in the previous 10 years, if legal restrictions or a natural disaster occurred, the City would have limited or no water supply. If drought or a contamination event occurred in the aquifer, the City would have no water supply source.

The City desires to protect their facilities. All wells are enclosed in buildings, and the 1 MG tank and booster station are fenced. In an effort to further protect the City's ability to supply water, the City staff has expressed a desire to improve system security, including installation of video surveillance.

Regardless of the cause of the water shortage, the City needs to be prepared to handle shortfall situations. In the event of a shortfall, the following curtailment measures should be implemented.

6.3 STAGES OF ALERT

The City's curtailment program stages largely follow those outlined in the previous WMCP, as summarized below:

- Stage 1: Supply Limitations. This refers to a period when the demands have the potential to exceed the City's supply.
- Stage 2: Reservoir Not Fully Recovering. This is a manifestation that the demands are slightly exceeding the supply capacity.
- Stage 3: Reservoir Levels Not Recovering to 50% Full. This is an indication that the system is being stressed beyond capacity, and needs some immediate attention to avoid a further emergency.

6.4 TRIGGERS FOR ALERT

The following pre-determined levels are used as triggers for the City's actions:

- Stage 1 Trigger: If supply is limited due to any number of wells off-line, potentially resulting in less available flow than that day's demand, the first level of curtailment is triggered.
- Stage 2 Trigger: If reservoir levels do not recover to 90% full at least once during the day when all operating wells are running, the second level of curtailment is triggered. (89% of existing storage is required for fire protection and emergency storage.)
- Stage 3 Trigger: If reservoir levels return to less than 50% of capacity overnight, the third level of curtailment is triggered.

It should be noted that because of the nature of Aumsville's water supply, it is possible that a single event could take the City from a Stage 1 Trigger Alert to a Stage 3 Trigger Alert. Under the current system vulnerabilities, this is particularly true in the event of an extended power outage or the loss of the City's largest well during a peak summer demand period.

6.5 CURTAILMENT ACTIONS

Circumstances dictate what types of curtailment are most appropriate on a case-by-case basis. The following list displays the implementation actions associated with each stage of curtailment. The City's Public Works Director (in consultation with the City Engineer and City Administrator) has primary responsibility for coordinating water curtailment activities.

Stage 1

- Post curtailment notices on doors and online.
- Establish mandatory restrictions on irrigation by creating watering groups with specific times of the day each can water. Offset these times so not many people are watering at any given time.
- Implement odd/even watering.
- Stop irrigation at the City park.
- Prohibit irrigation during peak usage hours of 9:00 a.m. – 6:00 p.m.
- Stop all flushing of water lines.

Stage 2 (additional curtailment activities)

- Prohibit all non-essential washing such as vehicles, buildings, pavement, and equipment.
- Encourage customers to avoid using water for non-essential uses.
- Prohibit flow in fountains.
- Prohibit water use in construction.
- Prohibit the use of water in swimming pools and hot tubs.
- Limit duration of outdoor sprinklers to 15 minutes per zone.
- Implement other measures the City anticipates will help maintain adequate fire and emergency storage.

Stage 3 (additional curtailment activities)

- Declare an emergency, and post notices on doors and online.
- Prohibit all water use except human and animal consumption, and emergency use.
- Limit the amount of water allowed to each customer each day, imposing strict fines for exceeding limits.

Appendix A

Figures

KELLER associates

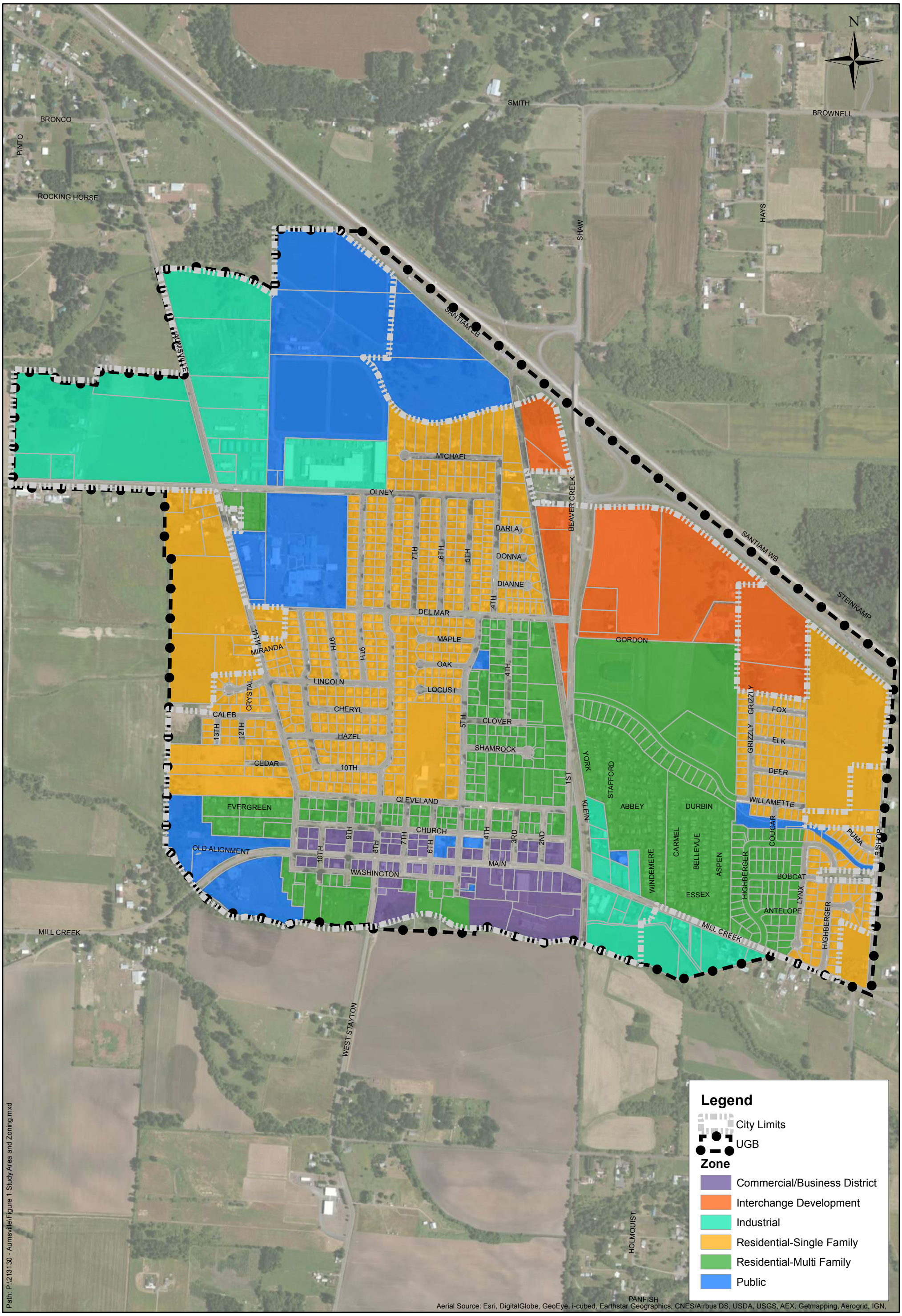


Figure:	Title:	Project:	Prepared for:	
01	STUDY AREA AND ZONING	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

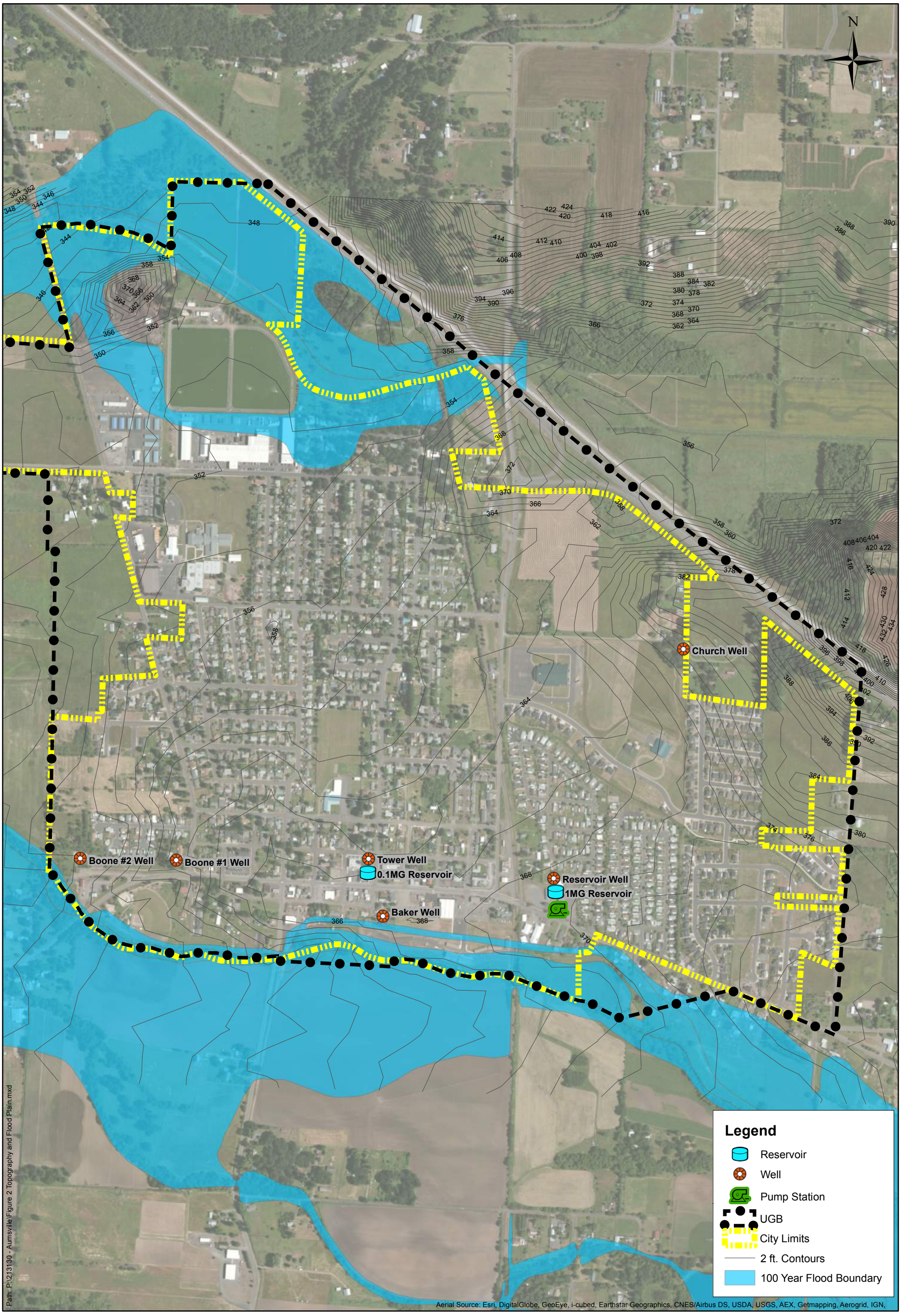


Figure:	Title:	Project:	Prepared for:	
02	TOPOGRAPHY AND FLOODPLAIN	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

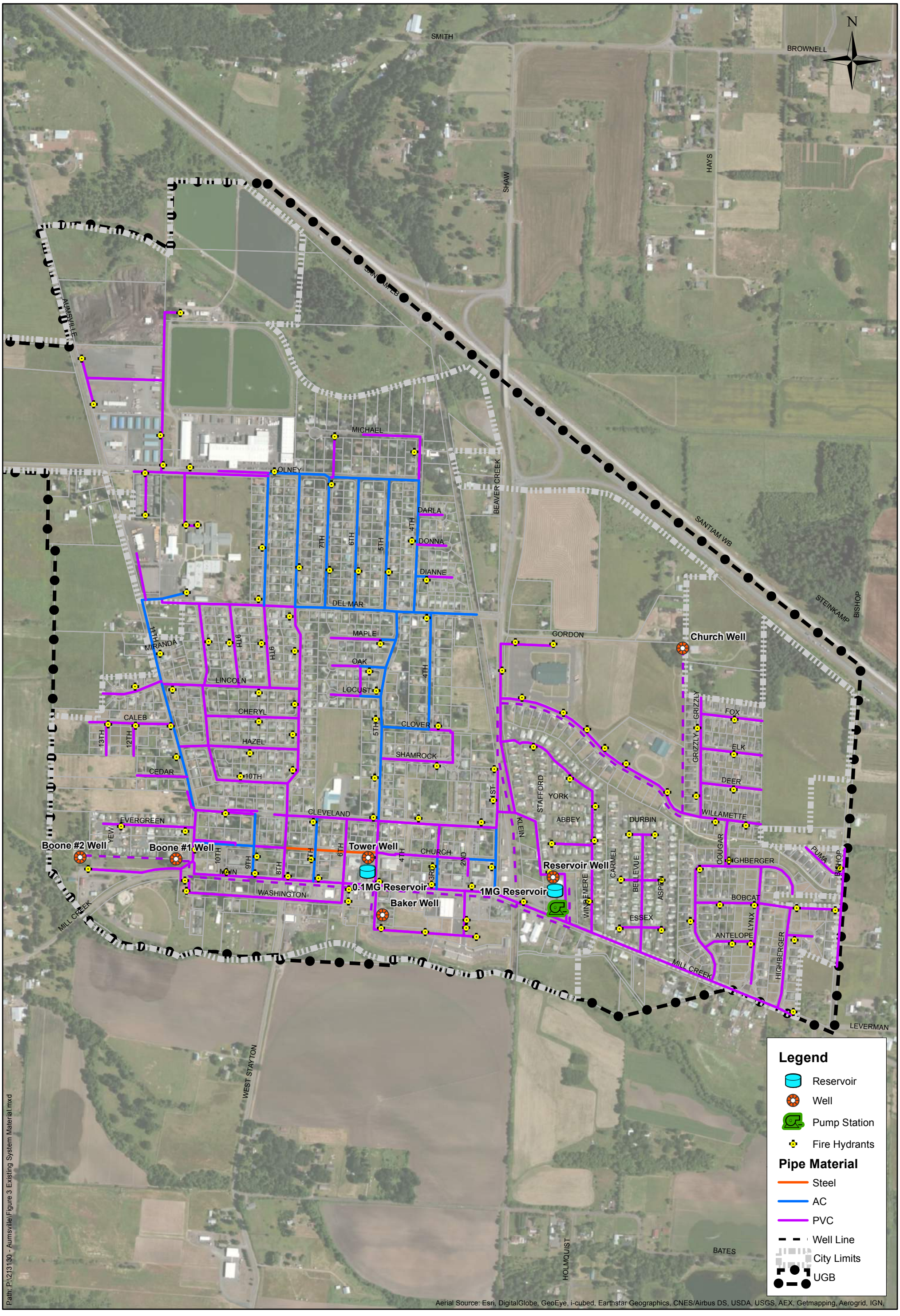


Figure:	Title:	Project:	Prepared for:	
03	EXISTING SYSTEM MATERIAL	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

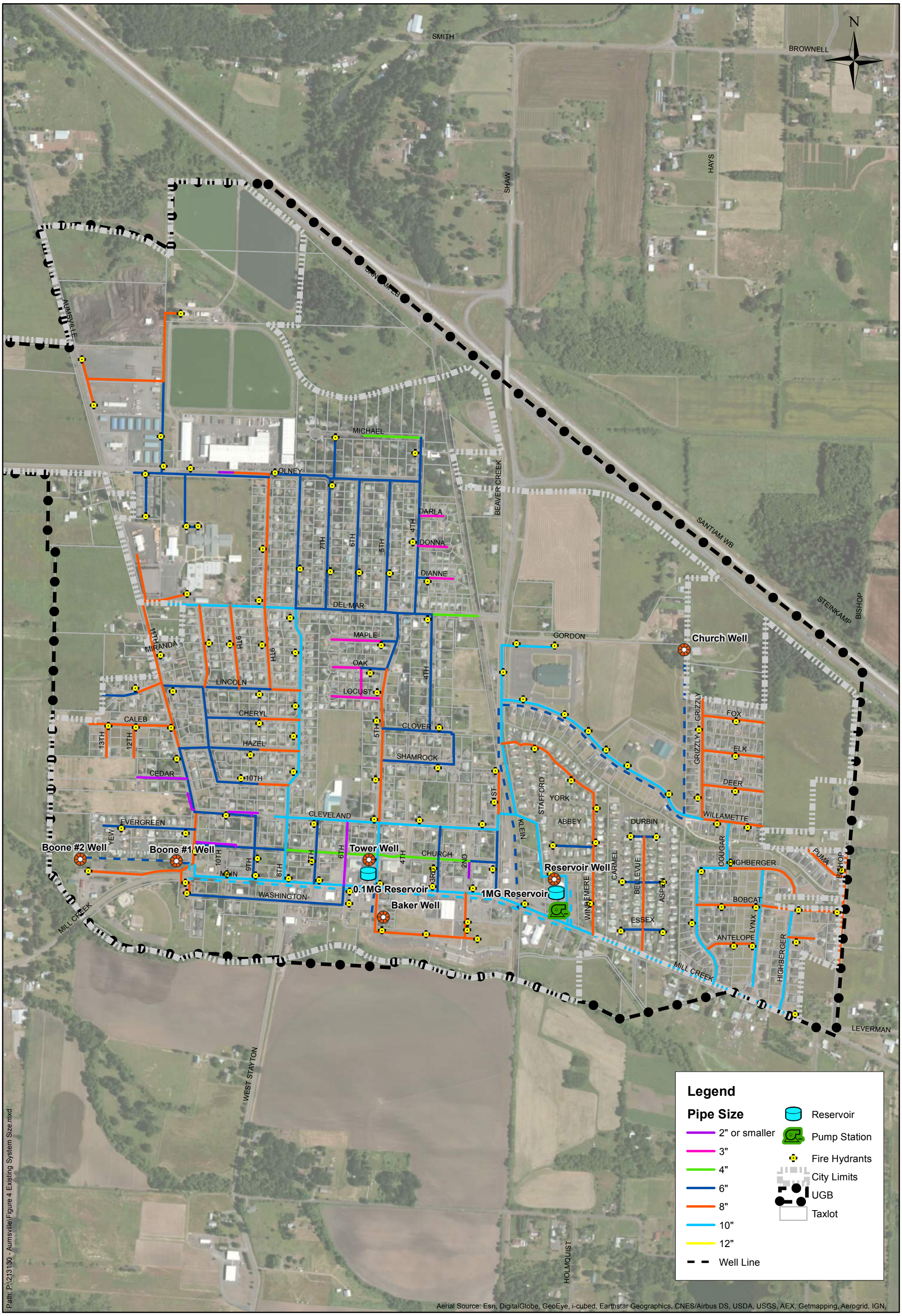


Figure:	Title:	Project:	Prepared for:	
04	EXISTING SYSTEM SIZE	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

N

SHAW
HAYS
SANTIAM EB
SANTIAM WB
STEINKAMP
BISHOP
BEAVER CREEK
MILL CREEK
WEST STAYTON
HOLMQUIST
LEVERMAN
AUMSVILLE
MICHAEL
OLNEY
DARLA
DONNA
DIANNE
DEL MAR
MAPLE
OAK
LOCUST
LINCOLN
CHERYL
HAZEL
CEDAR
CLOVER
SHAMROCK
CLEVELAND
CHURCH
MAIN
WASHINGTON
OLD ALIGNMENT
EVERGREEN
YEW
CRYSTAL
CALEB
MIRANDA
GORDON
YORK
STAFFORD
KLEIN
ABBEY
DURBIN
CARMEL
BELLEVUE
ASPEN
WINDEMERE
HIGHBERGER
GRIZZLY
FOX
ELK
DEER
WILLAMETTE
COUGAR
PUMA
BOBCAT
LYNX
ANTELOPE
ESSEX
1ST
2ND
3RD
4TH
5TH
6TH
7TH
8TH
9TH
10TH
11TH
12TH
13TH

Legend

- Future Fire Hydrants
- Existing Fire Hydrants
- Water Mains
- Hydrant buffer
- Hydrant buffer Future
- UGB
- City Limits

Path: P:\213130 - Aumsville\Figure 5 Fire Hydrant Coverage.mxd

Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure:	Title:	Project:	Prepared for:	
05	FIRE HYDRANT COVERAGE	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

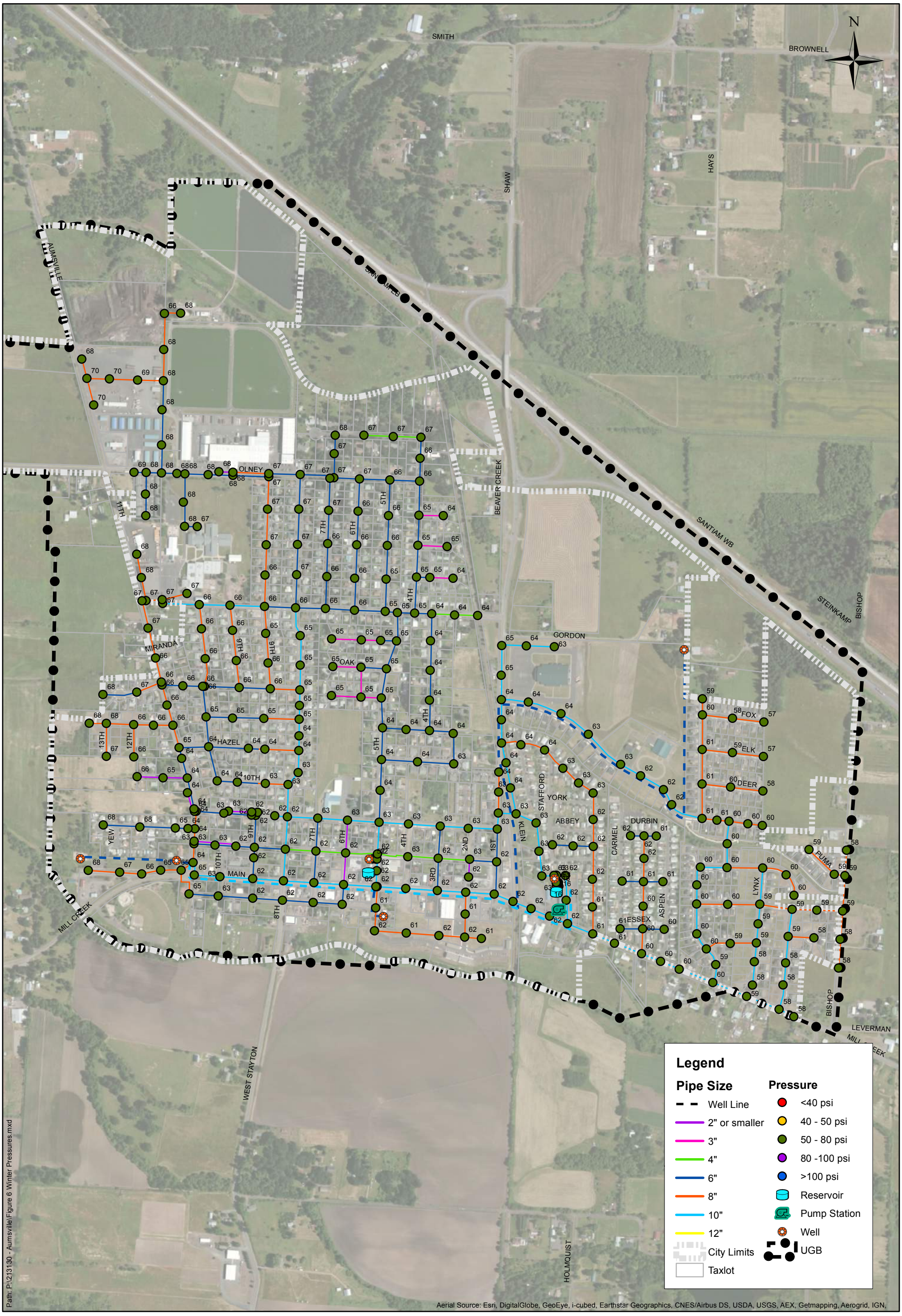


Figure:	Title:	Project:	Prepared for:	
06	EXISTING WINTER PRESSURES	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

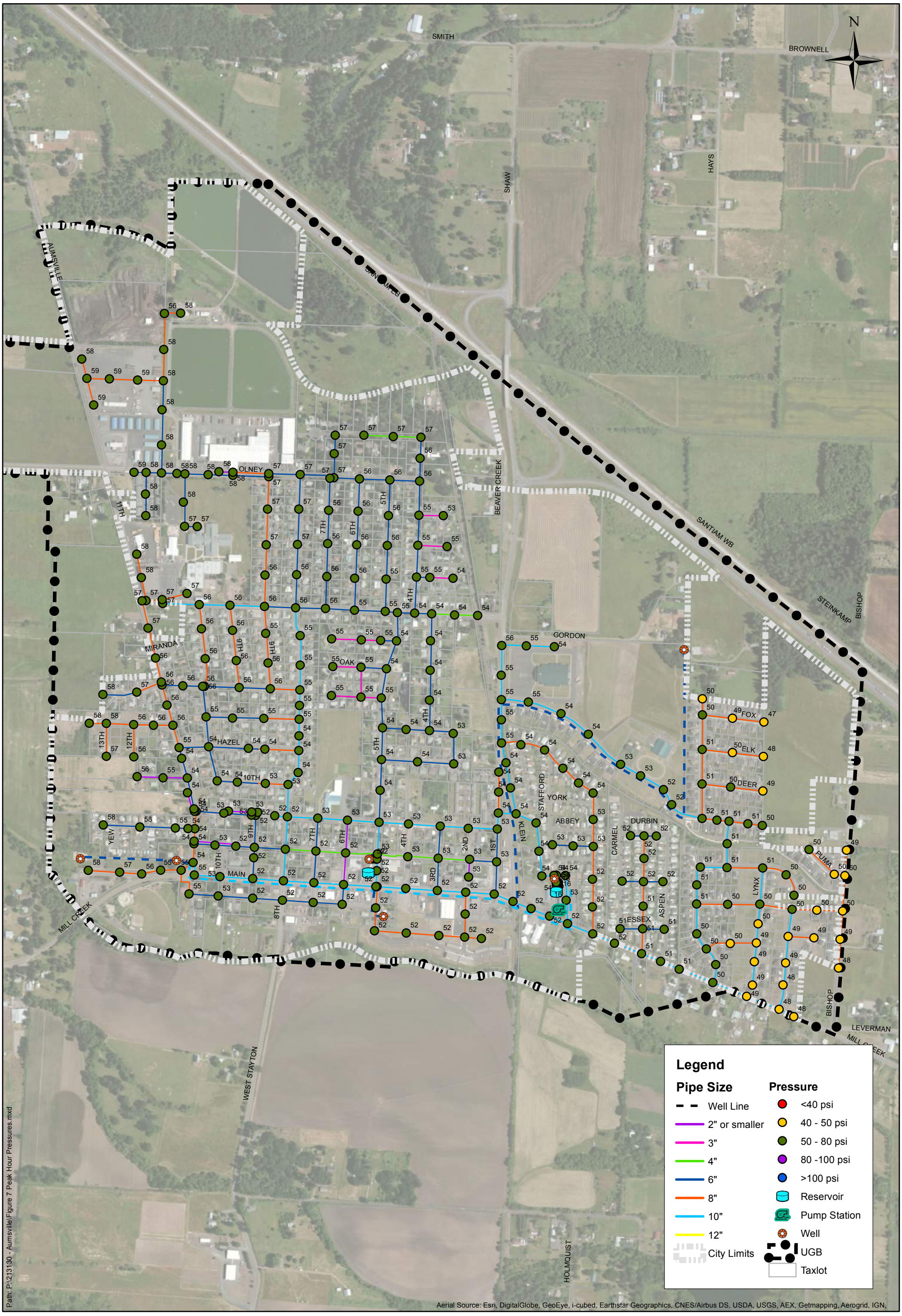


Figure:	Title:	Project:	Prepared for:	
07	EXISTING PEAK HOUR PRESSURES	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

N

Legend

Pipe Size

- Well Line
- 2" or smaller
- 3"
- 4"
- 6"
- 8"
- 10"
- 12"

- Failed Fire Flow Node
- Fire Flow Node
- Reservoir
- Pump Station
- Well
- Taxlot
- City Limits
- UGB

Labels indicate required fire flow at each location.

Path: P:\213130 - Aumsville\Figure 8 Failed Fire Flow nodes.mxd

Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure:	Title:	Project:	Prepared for:	
08	EXISTING FAILED FIRE FLOW NODES	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

N

Legend

Pipe Size	Existing AFF
Well Line	<500 gpm
2" or smaller	500 to1000 gpm
3"	1000 to 1500 gpm
4"	1500 to 2500 gpm
6"	>2500gpm
8"	Reservoir
10"	Pump Station
12"	Well
City Limits	UGB
Taxlot	

Path: P:\213130 - Aumsville\Figure 9b Existing Available Fire Flow empty elevated tank.mxd

Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure:	Title:	Project:	Prepared for:	
09	EXISTING AVAILABLE FIRE FLOW	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

Figure:	Title:	Project:	Prepared for:	
10	MASTER PLAN	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

N

Legend

Pipe Size

- Well Line
- 2" or smaller
- 3"
- 4"
- 6"
- 8"
- 10"
- 12"
- Priority 1 Pipes
- City Limits

Available Fire Flow

- <500 gpm
- 500 to1000 gpm
- 1000 to 1500 gpm
- 1500 to 2500 gpm
- >2500gpm
- Reservoir
- Pump Station
- Well
- UGB
- Taxlot

Path: P:\213130 - Aumsville\Figure 11 P1 Available Fire Flow.mxd

Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure:	Title:	Project:	Prepared for:	
11	PRIORITY 1 IMPROVEMENTS AVAILABLE FIRE FLOW	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

N

Legend

Pipe Size	Available Fire Flow
Well Line	<500 gpm
2" or smaller	500 to1000 gpm
3"	1000 to 1500 gpm
4"	1500 to 2500 gpm
6"	>2500gpm
8"	Priority 1 Improvements
10"	Priority 2 Improvements
12"	Priority 3 Improvements
Reservoir	Taxlot
Well	City Limits
Pump Station	UGB

Path: P:\213130 - Aumsville\Figure 12 P3 Available Fire Flow.mxd

Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure:	Title:	Project:	Prepared for:	
12	PRIORITY 3 IMPROVEMENTS AVAILABLE FIRE FLOW	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates

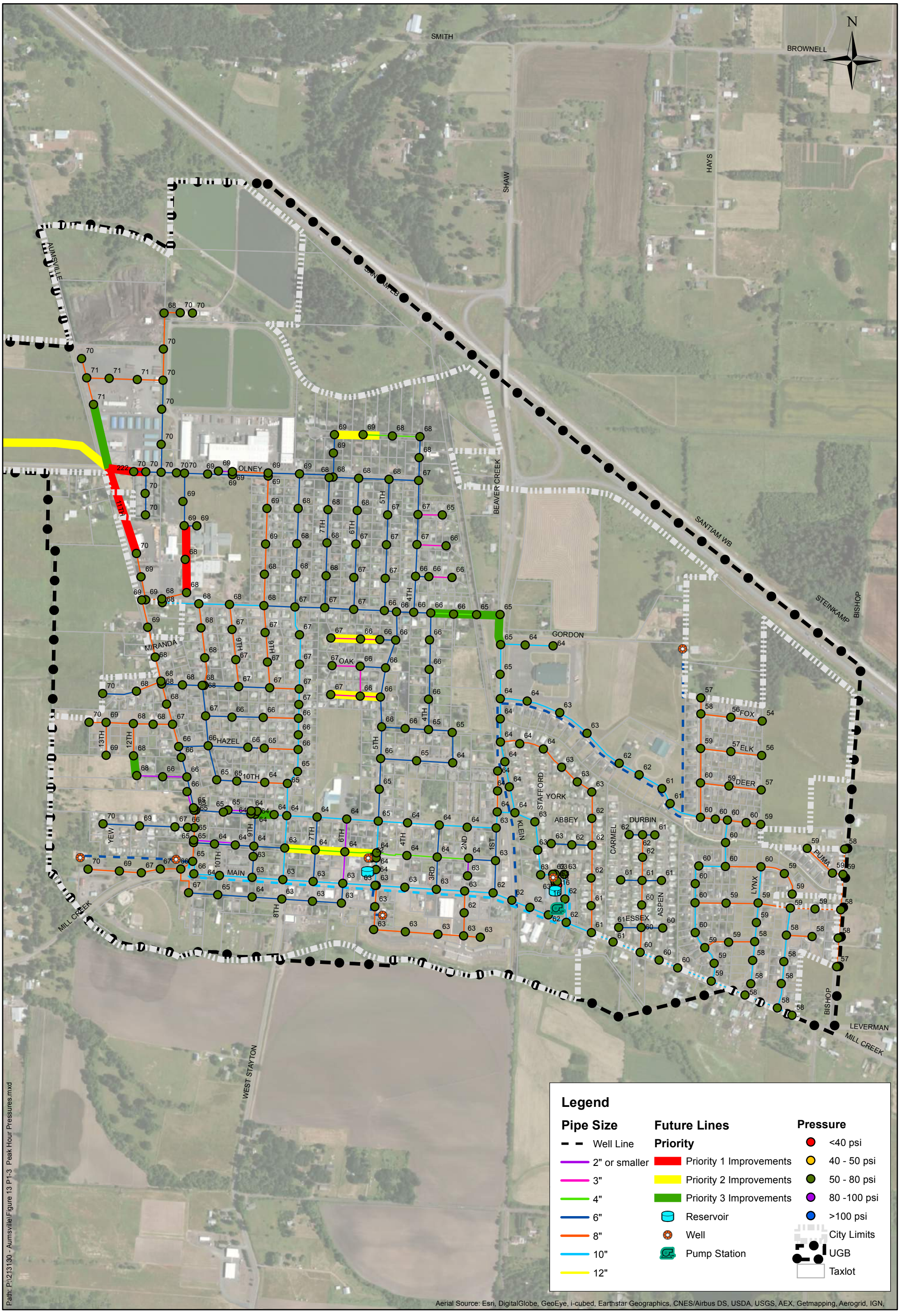
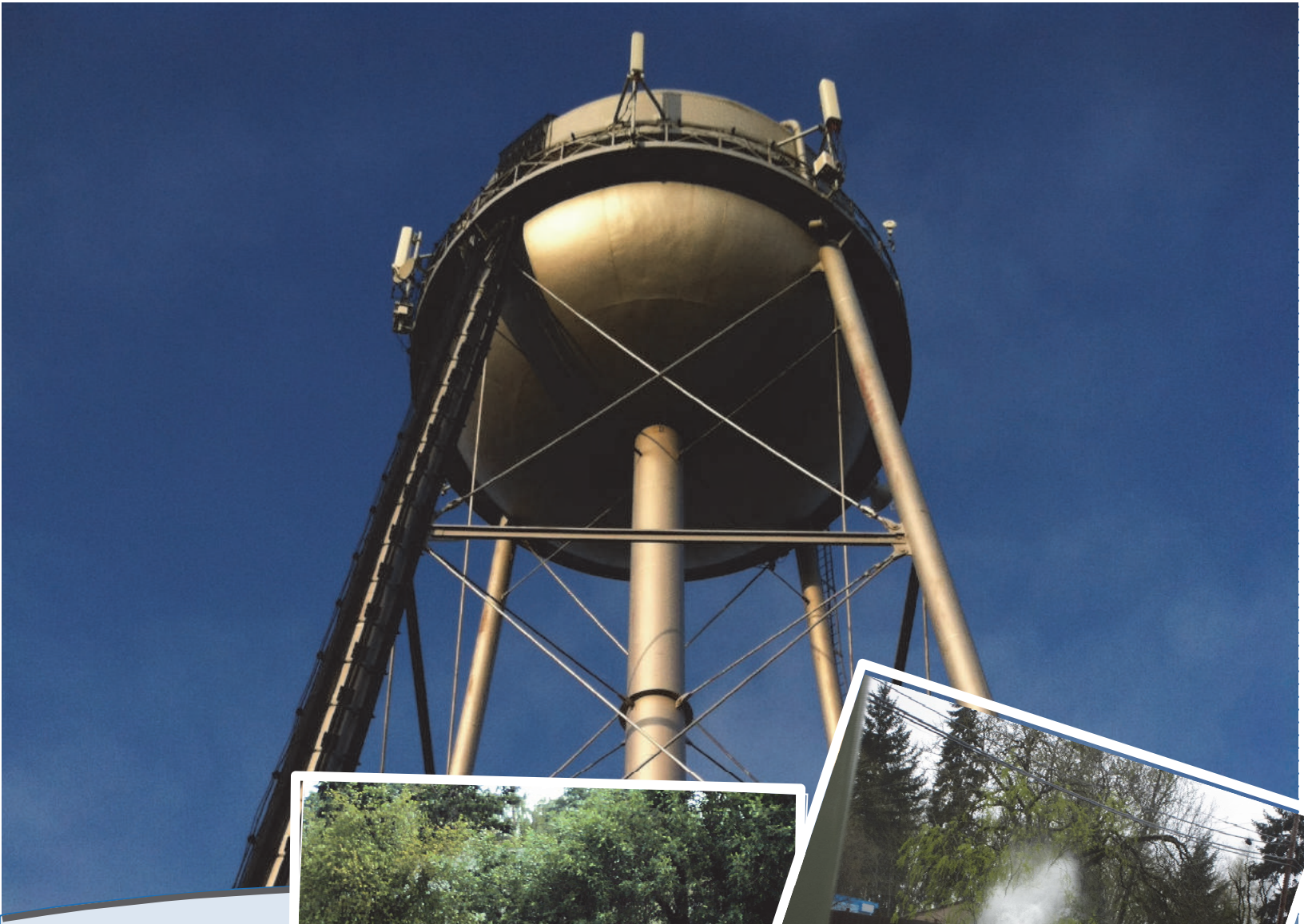


Figure:	Title:	Project:	Prepared for:	
13	PEAK HOUR PRESSURES WITH P1-P3 IMPROVEMENTS	AUMSVILLE WATER MASTER PLAN	City of Aumsville	KELLER associates



Appendix B

Comments From Local Governments

KELLER associates

Marion County
OREGON

PUBLIC WORKS

BOARD OF COMMISSIONERS
Sam Brentano
Janet Carlson
Kevin Cameron

DIRECTOR
Alan Haley

ADMINISTRATION

BUILDING INSPECTION

EMERGENCY MANAGEMENT

ENGINEERING

ENVIRONMENTAL SERVICES

OPERATIONS

PARKS

PLANNING

SURVEY

November 20, 2014

Peter A. Olsen, P.E.
Project Manager | Keller Associates, Inc.
707 13th Street SE, #280
Salem, Oregon 97301

Via email to: polsen@kellerassociates.com

Dear Mr. Olsen:

Thank you for providing the June 2014 draft copy of the Water Management and Conservation Plan for the City of Aumsville. As you point out, Oregon Administrative Rule Chapter 690, Division 86 requires that affected local governments be provided an opportunity to review the plan for consistency with their local comprehensive land use plan prior to the city submitting a draft plan to the Oregon Water Resources Department for review.

The Marion County Comprehensive Plan (MCCP) Urbanization Element, Environmental Goals encourage planning that does not exceed the capacity of water, energy, air and other resources. In addition, the MCCP Environmental Quality and Natural Resources Element, Goal C strives for the provision of an adequate quantity of water for beneficial uses within the county, including water for domestic, municipal, industrial, commercial and recreation uses. Goal D emphasizes the significance of educating property owners about the importance of the use of their property for water quality and quantity and encourages water conservation practices to hold water demand to a minimum through a public information program. This is especially important for local governments located within Groundwater Limited Areas, such as the City of Aumsville.

The Water Management and Conservation Plan for the City of Aumsville is consistent with the Marion County Comprehensive Plan, as both plans recognize water to be a significant and limited resource, encourage the provision of adequate water for residents' use, and support conservation practices when necessary. Further, the plan appears to have all of the elements required by state law.

Please do not hesitate to contact me if you have any questions.

Sincerely,

Lisa Milliman

Lisa Milliman
Associate Planner

cc: Matt Knudsen, Marion County, Environmental Specialist, mknudsen@co.marion.or.us

Appendix C
Demand Data

KELLER associates

C-1:
Monthly
Consumption Data

Monthly Total Consumption (Gallons)

month	year	Residential use	Multifamily	Comm/ind	Public	Total
		R (1)	M (2)	C/I (3)	P (4)	
1	2007	4001000	1316000	459000	118000	5894000
2	2007	3694000	1248000	500000	109000	5551000
3	2007	3790000	1248000	587000	111000	5736000
4	2007	4014000	1274000	591000	107000	5986000
5	2007	5513000	1378000	627000	64000	7582000
6	2007	7352000	1955000	657000	112000	10076000
7	2007	8926000	2748000	673000	162000	12509000
8	2007	8672000	2658000	757000	195000	12282000
9	2007	6636000	1850000	698000	223000	9407000
10	2007	4166500	1358000	643000	200000	6367500
11	2007	3967000	1371000	756000	202000	6296000
12	2007	4321000	1158000	634000	123000	6236000
1	2008	4029000	1335000	719000	121000	6204000
2	2008	3910000	1302000	790000	127000	6129000
3	2008	3769000	1243000	629000	135000	5776000
4	2008	3743000	1223000	600000	136000	5702000
5	2008	5397000	1648000	702000	149000	7896000
6	2008	6334000	1672000	677000	154000	8837000
7	2008	10507000	2948000	681000	228000	14364000
8	2008	9548000	2646000	681000	337000	13212000
9	2008	6888000	1823000	655000	259000	9625000
10	2008	4273000	1278000	558000	166000	6275000
11	2008	4288000	1414000	612000	127000	6441000
12	2008	3956000	1347000	741000	136000	6180000
1	2009	4010000	1365000	709000	139000	6223000
2	2009	10634000	1331000	634000	204000	12803000
3	2009	3907000	1250000	696000	329000	6182000
4	2009	4049000	1289000	764000	237000	6339000
5	2009	5264000	1589000	980000	105000	7938000
6	2009	6984000	1898000	678000	129000	9689000
7	2009	9909000	2943000	772000	122000	13746000
8	2009	10537000	3133000	915000	235000	14820000
9	2009	6650000	1986000	386000	328000	9350000
10	2009	5038000	1520000	410000	117000	7085000
11	2009	4030100	1606000	372000	187000	6195100
12	2009	4817000	1932000	393000	166000	7308000
1	2010	3774000	1252000	319000	180000	5525000
2	2010	4370000	1250000	350000	227000	6197000
3	2010	4126000	1333000	362000	307000	6128000
4	2010	4457000	1361000	324000	223000	6365000
5	2010	4343000	1328000	325000	148000	6144000
6	2010	4907000	1448000	287000	185000	6827000

7	2010	10099000	2740000	352000	84000	13275000
8	2010	9631000	2582000	436000	144000	12793000
9	2010	6697600	1739000	414000	269000	9119600
10	2010	4581800	1367000	388000	103000	6439800
11	2010	4018000	1340000	334000	183000	5875000
12	2010	4521000	1556000	313000	256000	6646000
1	2011	3748000	1255000	271000	196000	5470000
2	2011	4115000	1350000	287000	229000	5981000
3	2011	3816000	1256000	281000	198000	5551000
4	2011	4318000	1379000	298000	202000	6197000
5	2011	4277000	1425000	267000	168000	6137000
6	2011	4978000	1494000	319000	99000	6890000
7	2011	8071000	2149000	394000	139000	10753000
8	2011	9121000	2602000	340000	208000	12271000
9	2011	8660000	2543000	541000	257000	12001000
10	2011	4520500	1523000	358000	128000	6529500
11	2011	4027000	1407000	248000	184000	5866000
12	2011	4251000	1461000	251000	213000	6176000
1	2012	4058000	1284000	247000	153000	5742000
2	2012	4208000	1336000	316000	183000	6043000
3	2012	3834000	1173000	422000	147000	5576000
4	2012	3995600	1241000	276000	168000	5680600
5	2012	4977000	1370000	327000	158000	6832000
6	2012	5787000	1426000	294000	102000	7609000
7	2012	7272000	1773000	293000	87000	9425000
8	2012	9796000	2273000	432000	137000	12638000
9	2012	8607000	2053000	490000	219000	11369000
10	2012	5737000	1495000	391000	180000	7803000
11	2012	4411000	1358000	333000	153000	6255000
12	2012	4120000	1261000	348000	176000	5905000
1	2013	4103000	1235000	383000	165000	5886000
2	2013	4174000	1316000	377000	171000	6038000
3	2013	3896000	1275000	318000	187000	5676000
4	2013	4226000	1306000	342000	198000	6072000
5	2013	6229000	1456000	395000	157000	8237000
6	2013	6757000	1645000	414000	180000	8996000
7	2013	10091000	2112000	440000	189000	12832000
8	2013	9912000	2125000	442000	238000	12717000
9	2013	6750000	1421000	446000	235000	8852000
10	2013	4569000	1185000	386000	83000	6223000
11	2013	4161000	1118000	301000	119000	5699000
12	2013	4703000	1279000	342000	145000	6469000
	total	473325100	135939000	40150000	14559000	663973100

C-2:
Monthly Well Readings

MONTHLY WELL READINGS

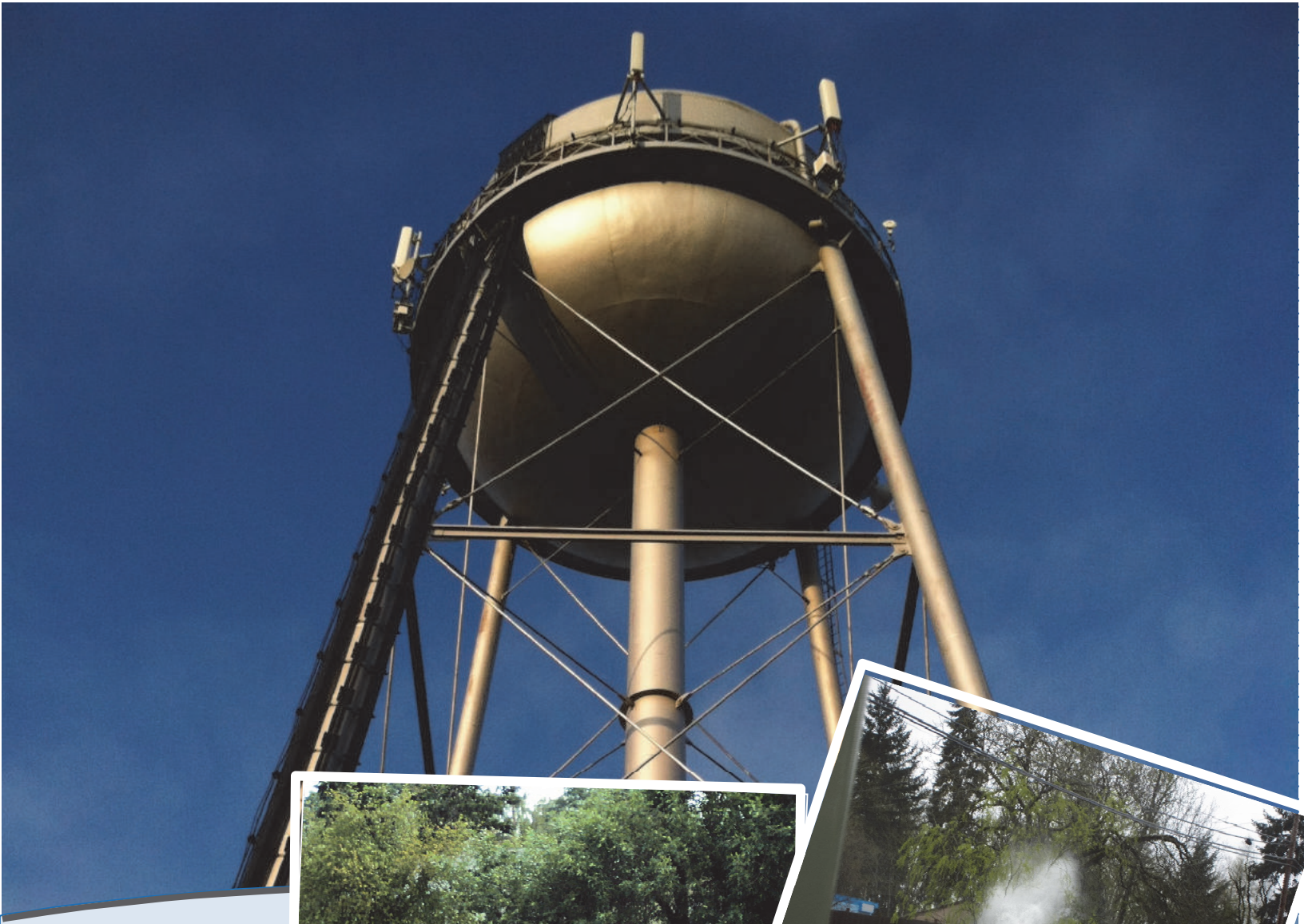
		BOONE WELL #1		BOONE WELL #2		TOWER WELL		RESERVOIR WELL		CHURCH WELL				
DATE	# of days	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading		TOTAL GALLONS PUMPED	% CAPACITY	Total gallons pumped (GPM)
11/5/02		48,924,600		128,310,000		72,721,500		15,617,900						
12/4/02		53,183,900	4,259,300	128,368,000	58,000	74,205,500	1,484,000	16,165,900	548,000			6,349,300	18%	
1/8/03		58,151,800	4,967,900	128,368,000	0	76,426,200	2,220,700	16,976,500	810,600			7,999,200	22%	
2/5/03		62,504,200	4,352,400	128,368,000	0	78,454,000	2,027,800	18,065,200	1,088,700			7,468,900	21%	
3/4/03		66,456,600	3,952,400	128,368,000	0	80,388,800	1,934,800	18,065,200	0			5,887,200	16%	
4/2/03		70,548,100	4,091,500	128,368,000	0	82,945,900	2,557,100	18,065,200	0			6,648,600	18%	
5/8/03		75,438,700	4,890,600	128,368,000	0	86,861,100	3,915,200	18,065,200	0			8,805,800	24%	
6/4/03		78,946,400	3,507,700	128,368,000	0	90,382,500	3,521,400	19,758,200	1,693,000			8,722,100	24%	
7/9/03		83,319,500	4,373,100	129,521,000	1,153,000	95,011,200	4,628,700	22,609,600	2,851,400			13,006,200	36%	
8/7/03		86,737,800	3,418,300	134,203,000	4,682,000	99,172,800	4,161,600	24,832,800	2,223,200			14,485,100	40%	
9/4/03		89,907,900	3,170,100	137,154,000	2,951,000	100,688,900	1,516,100	26,752,100	1,919,300			9,556,500	27%	
10/7/03		93,770,700	3,862,800	137,163,000	9,000	104,826,800	4,137,900	27,356,700	604,600			8,614,300	24%	
11/4/03		95,937,800	2,167,100	137,163,000	0	108,524,000	3,697,200	27,356,700	0			5,864,300	16%	
						new meter								
12/3/03		98,462,700	2,524,900	137,163,000	0	2,414,300	2,414,300	27,356,700	0			4,939,200	14%	
1/8/04	36.00	102,746,700	4,284,000	137,163,000	0	5,147,900	2,733,600	27,356,700	0			7,017,600	19%	135.37
2/3/04	26.00	106,114,200	3,367,500	137,163,000	0	6,774,000	1,626,100	27,356,700	0			4,993,600	14%	133.38
3/3/04	29.00	109,989,400	3,875,200	137,163,000	0	8,576,500	1,802,500	27,356,700	0			5,677,700	16%	135.96
4/6/04	34.00	114,149,700	4,160,300	137,163,000	0	10,712,600	2,136,100	27,356,700	0			6,296,400	17%	128.60
5/4/04	28.00	116,251,700	2,102,000	138,504,000	1,341,000	14,000,000	3,287,400	27,356,700	0			6,730,400	19%	166.92
6/8/04	35.00	116,268,100	16,400	141,448,000	2,944,000	19,656,800	5,656,800	27,356,700	0			8,617,200	24%	170.98
7/1/04	23.00	117,361,100	1,093,000	143,579,000	2,131,000	23,096,300	3,439,500	1,724,300	1,724,300			8,387,800	23%	253.25
8/4/04	34.00	120,395,600	3,034,500	149,109,000	5,530,000	28,339,800	5,243,500	3,918,300	2,194,000			16,002,000	44%	326.84
9/5/04	32.00	123,052,900	2,657,300	152,899,000	3,790,000	33,119,300	4,779,500	5,756,600	1,838,300			13,065,100	36%	283.53
10/6/04	31.00	123,918,200	865,300	153,812,000	913,000	37,160,500	4,041,200	7,245,400	1,488,800			7,308,300	20%	163.72
11/1/04	26.00	125,905,200	1,987,000	153,812,000	0	38,948,300	1,787,800	8,573,100	1,327,700			5,102,500	14%	136.28
12/8/04	37.00	129,715,700	3,810,500	153,812,000	0	41,888,800	2,940,500	9,088,800	515,700			7,266,700	20%	136.39
1/5/05	28.00	132,468,800	2,753,100	153,812,000	0	44,453,000	2,564,200	9,088,800	0			5,317,300	15%	131.88
2/3/05	29.00	135,412,500	2,943,700	153,812,000	0	47,697,700	3,244,700	9,088,800	0			6,188,400	17%	148.19
3/7/05	32.00	138,270,700	2,858,200	153,812,000	0	51,467,800	3,770,100	9,088,800	0			6,628,300	18%	143.84
4/6/05	30.00	141,309,300	3,038,600	153,812,000	0	55,081,600	3,613,800	9,088,800	0			6,652,400	18%	153.99
5/4/05	28.00	144,383,700	3,074,400	153,812,000	0	58,041,600	2,960,000	9,088,800	0			6,034,400	17%	149.66
6/1/05	28.00	147,662,800	3,279,100	153,812,000	0	61,355,900	3,314,300	9,088,800	0			6,593,400	18%	163.53
7/6/05	35.00	151,843,600	4,180,800	153,812,000	0	66,177,800	4,821,900	9,088,800	0			9,002,700	25%	178.63
8/1/05	26.00	155,943,600	4,100,000	156,233,000	2,421,000	70,121,200	3,943,400	10,388,300	1,299,500			11,763,900	33%	314.21
9/7/05	37.00	159,843,600	3,900,000	159,938,000	3,705,000	75,560,000	5,438,800	12,652,000	2,263,700			15,307,500	43%	287.30
10/4/05	27.00	162,843,600	3,000,000	161,734,000	1,796,000	77,840,600	2,280,600	14,007,500	1,355,500			8,432,100	23%	216.88
11/3/05	30.00	165,843,600	3,000,000	161,734,000	0	81,246,900	3,406,300	15,237,500	1,230,000			7,636,300	21%	176.77
12/1/05	28.00	173,000	2,000,000	161,734,000	0	84,743,500	3,496,600	15,473,900	236,400			5,733,000	16%	142.19
1/5/06	35.00	1,928,300	1,755,300	161,734,000	0	90,008,200	5,264,700	15,473,900	0			7,020,000	20%	139.29
2/6/06	32.00	4,764,200	2,835,900	161,734,000	0	94,786,400	4,778,200	15,473,900	0			7,614,100	21%	165.24
3/8/06	30.00	7,061,800	2,297,600	161,734,000	0	98,892,500	4,106,100	15,473,900	0			6,403,700	18%	148.23
4/8/06	31.00	8,750,900	1,689,100	161,734,000	0	102,871,900	3,979,400	15,473,900	0			5,668,500	16%	126.98
5/2/06	24.00	10,876,800	2,125,900	161,734,000	0	106,799,700	3,927,800	15,473,900	0			8,382,600	23%	242.55
6/6/06	35.00	14,122,300	3,245,500	162,194,000	460,000	112,078,600	5,278,900	17,342,800	1,868,900			12,791,800	36%	253.81
7/6/06	30.00	16,690,500	2,568,200	164,474,000	2,280,000	116,438,100	4,359,500	19,330,200	1,987,400			11,195,100	31%	259.15
8/9/06	34.00	20,066,000	3,375,500	172,043,000	7,569,000	121,186,100	4,748,000	21,264,300	1,934,100			17,626,600	49%	360.02
9/7/06	29.00	22,575,700	2,509,700	179,041,000	6,998,000	124,998,500	3,812,400	22,743,900	1,479,600			14,799,700	41%	354.40
10/3/06	26.00	24,440,200	1,864,500	181,766,000	2,725,000	128,242,400	3,243,900	23,996,900	1,253,000			9,086,400	25%	242.69
11/2/06	30.00	26,045,700	1,605,500	183,802,000	2,036,000	131,750,000	3,507,600	25,350,300	1,353,400			8,502,500	24%	196.82
12/3/06	31.00	28,151,900	2,106,200	184,724,000	922,000	135,461,500	3,711,500	25,350,300	0			6,739,700	19%	150.98
1/3/07	31.00	30,274,900	2,123,000	185,890,000	1,166,000	138,247,700	2,786,200	25,350,300	0			6,075,200	17%	136.09
2/5/07	33.00	33,219,200	2,944,300	185,890,000	0	142,245,600	3,997,900	25,350,300	0			6,942,200	19%	146.09

MONTHLY WELL READINGS

		BOONE WELL #1		BOONE WELL #2		TOWER WELL		RESERVOIR WELL		CHURCH WELL				
DATE	# of days	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading		TOTAL GALLONS PUMPED	% CAPACITY	Total gallons pumped (GPM)
3/7/07	30.00	35,676,000	2,456,800	185,890,000	0	145,773,000	3,527,400	25,350,300	0			5,984,200	17%	138.52
4/2/07	26.00	37,929,700	2,253,700	185,890,000	0	149,203,000	3,430,000	25,350,300	0			5,683,700	16%	151.81
4/24/07	22.00	39,466,000	1,536,300	186,085,000	195,000	152,169,500	2,966,500	25,350,300	0	182,900		4,697,800	13%	148.29
6/4/07	41.00	42,212,900	2,746,900	189,518,000	3,433,000	157,271,300	5,101,800	25,913,400	563,100	1,632,700	1,449,800	13,294,600	37%	225.18
7/2/07	28.00	44,545,500	2,332,600	193,426,000	3,908,000	161,034,900	3,763,600	25,913,400	0	2,376,200	743,500	10,747,700	30%	266.56
8/4/07	33.00	45,673,100	1,127,600	194,199,000	773,000	163,070,400	2,035,500	26,203,700	290,300	16,555,800	14,179,600	18,406,000	51%	387.33
9/6/07	33.00	49,742,800	4,069,700	195,655,000	1,456,000	166,426,300	3,355,900	27,941,300	1,737,600	18,507,300	1,951,500	12,570,700	35%	264.53
10/3/07	27.00	53,928,100	4,185,300	195,655,000	0	169,908,600	3,482,300	28,652,100	710,800	18,507,300	0	8,378,400	23%	215.49
10/30/07	27.00	57,333,800	3,405,700	195,655,000	0	172,709,200	2,800,600	28,856,500	204,400	18,507,300	0	6,410,700	18%	164.88
12/4/07	35.00	61,155,800	3,822,000	195,656,000	1,000	175,962,400	3,253,200	30,298,400	1,441,900	18,507,300	0	8,518,100	24%	169.01
1/7/08	34.00	64,882,200	3,726,400	195,656,000	0	179,206,100	3,243,700	30,646,300	347,900	18,507,300	0	7,318,000	20%	149.47
2/5/08	29.00	67,814,300	2,932,100	195,656,000	0	181,770,300	2,564,200	30,996,300	350,000	18,507,300	0	5,846,300	16%	140.00
3/5/08	29.00	70,860,600	3,046,300	195,656,000	0	184,398,700	2,628,400	32,246,300	1,250,000	18,507,300	0	6,924,700	19%	165.82
4/7/08	33.00	74,183,900	3,323,300	195,656,000	0	187,297,800	2,899,100	1,382,600		18,507,300	0	6,222,400	17%	130.94
5/7/08	30.00	77,923,600	3,739,700	195,661,000	5,000	190,549,600	3,251,800	1,383,000	400	18,937,600	430,300	7,427,200	21%	171.93
6/3/08	27.00	81,514,900	3,591,300	195,661,000	0	193,689,500	3,139,900	1,547,000	164,000	20,011,800	1,074,200	7,969,400	22%	204.97
7/7/08	34.00	85,054,200	3,539,300	195,661,000	0	197,345,400	3,655,900	1,547,000	0	27,868,400	7,856,600	15,051,800	42%	307.43
8/1/08	25.00	85,867,300	813,100	195,661,000	0	198,052,000	706,600	2,748,300	1,201,300	38,680,000	10,811,600	13,532,600	38%	375.91
9/3/08	33.00	89,195,800	3,328,500	195,661,000	0	201,029,500	2,977,500	5,009,900	2,261,600	44,735,200	6,055,200	14,622,800	41%	307.72
10/8/08	35.00	93,544,100	4,348,300	195,661,000	0	204,754,500	3,725,000	5,013,200	3,300	44,735,200	0	8,076,600		160.25
11/4/08	27.00	96,892,800	3,348,700	195,661,000	0	207,553,800	2,799,300	5,013,200	0	48,573,100	3,837,900	9,985,900		256.84
12/4/08	30.00	100,841,700	3,948,900	195,661,000	0	210,908,900	3,355,100	5,013,200	0	48,601,800	28,700	7,332,700		169.74
1/7/09	34.00	103,799,400	2,957,700	195,661,000	0	214,203,800	3,294,900	7,230,800	2,217,600	48,601,800	0	8,470,200		173.00
2/3/09	27.00	106,073,800	2,274,400	195,661,000	0	216,511,000	2,307,200	9,346,900	2,116,100	48,601,800	0	6,697,700		172.27
3/2/09	27.00	108,600,300	2,526,500	195,661,000	0	218,675,400	2,164,400	11,482,100	2,135,200	48,601,800	0	6,826,100		175.57
4/2/09	31.00	111,379,700	2,779,400	195,661,000	0	221,108,000	2,432,600	13,637,400	2,155,300	48,601,800	0	7,367,300		165.04
5/4/09	32.00	115,211,700	3,832,000	195,661,000	0	224,526,200	3,418,200	16,088,300	2,450,900	48,601,800	0	9,701,100		210.53
6/4/09	31.00	118,686,900	3,475,200	195,661,000	0	227,800,200	3,274,000	17,999,800	1,911,500	50,396,700	1,794,900	10,455,600		234.22
7/7/09	33.00	122,093,700	3,406,800	195,661,000	0	231,088,400	3,288,200	20,308,900	2,309,100	55,788,900	5,392,200	14,396,300		302.95
8/6/09	30.00	123,314,100	1,220,400	195,661,000	0	231,880,100	791,700	22,227,300	1,918,400	70,852,200	15,063,300	18,993,800		439.67
9/10/09	35.00	126,915,400	3,601,300	195,661,000	0	234,095,600	2,215,500	22,227,600	300	80,173,600	9,321,400	15,138,500		300.37
10/5/09	25.00	130,885,100	3,969,700	195,661,000	0	236,926,800	2,831,200	22,227,600	0	81,312,600	1,139,000	7,939,900		220.55
11/5/09	31.00	135,579,400	4,694,300	195,661,000	0	239,945,700	3,018,900	22,227,600	0	81,312,600	0	7,713,200		172.79
12/10/09	35.00	140,849,100	5,269,700	195,661,000	0	243,874,200	3,928,500	22,227,600	0	81,312,600	0	9,198,200		182.50
1/6/10	27.00	144,779,700	3,930,600	195,661,000	0	246,947,300	3,073,100	22,227,600	0	81,493,500	180,900	7,184,600		184.79
2/2/10	27.00	147,184,200	2,404,500	195,661,000	0	250,319,900	3,372,600	22,227,600	0	82,390,800	897,300	6,674,400		171.67
3/4/10	30.00	150,707,200	3,523,000	195,661,000	0	252,706,100	2,386,200	22,227,600	0	82,390,800	0	5,909,200		136.79
4/8/10	35.00	156,185,500	5,478,300	195,661,000	0	254,168,400	1,462,300	22,227,600	0	83,962,400	1,571,600	8,512,200		168.89
5/5/10	27.00	160,243,800	4,058,300	195,661,000	0	256,651,900	2,483,500	22,227,600	0	84,134,500	172,100	6,713,900		172.68
6/8/10	34.00	165,756,100	5,512,300	195,661,000	0	260,229,500	3,577,600	22,227,600	0	84,134,500	0	9,089,900		185.66
7/7/10	29.00	170,364,900	4,608,800	195,661,000	0	264,546,200	4,316,700	22,227,600	0	84,324,500	190,000	9,115,500		218.28
8/4/10	28.00	171,851,000	1,486,100	195,661,000	0	265,068,300	522,100	22,227,600	0	97,351,600	13,027,100	15,035,300		372.90
9/8/10	35.00	174,317,000	2,466,000	195,661,000	0	265,324,100	255,800	22,227,600	0	113,145,300	15,793,700	18,515,500		367.37
10/5/10	27.00	177,052,200	2,735,200	195,661,000	0	265,968,300	644,200	22,227,600	0	115,992,700	2,847,400	6,226,800		160.15
11/3/10	29.00	180,312,800	3,260,600	195,661,000	0	267,540,100	1,571,800	22,227,600	0	115,992,700	0	4,832,400		115.72
12/7/10	34.00	184,058,800	3,746,000	195,661,000	0	269,517,400	1,977,300	22,227,600	0	115,992,700	0	5,723,300		116.90
1/5/11	29.00	187,282,800	3,224,000	195,661,000	0	271,464,800	1,947,400	22,227,600	0	115,992,700	0	5,171,400		123.84
2/8/11	34.00	191,105,700	3,822,900	195,661,000	0	273,643,800	2,179,000	22,227,600	0	115,992,700	0	6,001,900		122.59
3/9/11	29.00	194,387,500	3,281,800	195,661,000	0	275,522,700	1,878,900	22,227,600	0	115,992,700	0	5,160,700		123.58
4/5/11	27.00	197,384,700	2,997,200	195,661,000	0	277,233,600	1,710,900	22,227,600	0	115,992,700	0	4,708,100		121.09
5/3/11	28.00	200,583,000	3,198,300	195,661,000	0	279,029,200	1,795,600	22,227,600	0	115,992,700	0	4,993,900		123.86
6/8/11	36.00	204,838,700	4,255,700	195,661,000	0	282,473,500	3,444,300	22,227,600	0	115,992,700	0	7,700,000		148.53
7/6/11	28.00	207,764,900	2,926,200	195,661,000	0	285,087,500	2,614,000	22,227,600	0	119,307,600	3,314,900	8,855,100		219.62
8/2/11	27.00	209,899,000	2,134,100	195,661,000	0	287,084,000	1,996,500	22,227,600	0	125,818,700	6,511,100	10,641,700		273.71

MONTHLY WELL READINGS

		BOONE WELL #1		BOONE WELL #2		TOWER WELL		RESERVOIR WELL		CHURCH WELL				
DATE	# of days	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading	Gallons Pumped	Meter Reading		TOTAL GALLONS PUMPED	% CAPACITY	Total gallons pumped (GPM)
9/5/11	34.00	213,244,100	3,345,100	195,661,000	0	290,264,000	3,180,000	22,227,600	0	136,315,000	10,496,300	17,021,400		347.66
10/5/11	30.00	215,233,800	1,989,700	195,661,000	0	292,092,000	1,828,000	22,227,600	0	142,385,600	6,070,600	9,888,300		228.90
11/7/11	33.00	218,694,600	3,460,800	195,661,000	0	295,327,800	3,235,800	22,227,600	0	142,604,500	218,900	6,915,500		145.53
12/7/11	30.00	220,914,200	2,219,600	195,661,000	0	299,001,400	3,673,600	22,227,600	0	142,604,500	0	5,893,200		136.42
1/4/12	28.00	220,914,200	0	195,661,000	0	303,503,200	4,501,800	22,227,600	0	142,604,500	0	4,501,800		111.65
2/7/12	34.00	220,914,200	0	195,661,000	0	308,885,900	5,382,700	22,227,600	0	146,308,700	3,704,200	9,086,900		185.60
3/8/12	30.00	220,914,200	0	195,661,000	0	312,111,900	3,226,000	22,227,600	0	150,440,800	4,132,100	7,358,100		170.33
4/1/12	24.00	224,445,700	3,531,500	195,661,000	0	313,326,500	1,214,600	22,227,600	0	151,469,500	1,028,700	5,774,800		167.09
5/1/12	30.00	226,911,500	2,465,800	195,661,000	0	316,023,400	2,696,900	22,227,600	0	153,397,000	1,927,500	7,090,200		164.13
6/6/12	36.00	232,292,300	5,380,800	195,661,000	0	320,253,600	4,230,200	22,227,600	0	153,482,700	85,700	9,696,700		187.05
7/5/12	29.00	236,403,800	4,111,500	195,661,000	0	323,842,300	3,588,700	22,227,600	0	153,482,700	0	7,700,200		184.39
8/6/12	32.00	240,727,600	4,323,800	195,853,000	192,000	327,577,000	3,734,700	22,227,600	0	158,729,000	5,246,300	13,496,800		292.90
9/6/12	31.00	244,455,800	3,728,200	195,944,000	91,000	330,779,600	3,202,600	22,227,600	0	164,805,200	6,076,200	13,098,000		293.41
10/2/12	26.00	246,812,700	2,356,900	196,112,000	168,000	332,703,400	1,923,800	22,227,600	0	170,408,200	5,603,000	10,051,700		268.47
11/6/12	35.00	250,126,500	3,313,800	196,339,000	227,000	335,332,500	2,629,100	22,227,600	0	173,174,400	2,766,200	8,936,100		177.30
12/4/12	28.00	253,075,300	2,948,800	196,339,000	0	337,863,500	2,531,000	22,227,600	0	173,777,100	602,700	6,082,500		150.86
1/7/13	34.00	257,184,500	4,109,200	196,527,000	188,000	341,406,000	3,542,500	22,227,600	0	174,453,500	676,400	8,516,100		173.94
2/5/13	29.00	260,505,900	3,321,400	196,606,000	79,000	344,231,100	2,825,100	22,227,600	0	175,105,300	651,800	6,877,300		164.69
3/6/13	29.00	263,864,700	3,358,800	196,726,000	120,000	347,044,000	2,812,900	22,227,600	0	175,830,600	725,300	7,017,000		168.03
4/3/13	28.00	267,168,600	3,303,900	196,726,000	0	349,815,100	2,771,100	22,249,400	21,800	176,716,300	885,700	6,982,500		173.18
5/7/13	34.00	271,747,300	4,578,700	196,726,000	0	351,907,200	2,092,100	22,492,200	242,800	179,320,100	2,603,800	9,517,400		194.39
6/5/13	29.00	275,617,700	3,870,400	197,122,000	396,000	355,279,800	3,372,600	22,636,400	144,200	180,636,300	1,316,200	9,099,400		217.90
7/1/13	26.00	279,614,900	3,997,200	197,122,000	0	359,373,600	4,093,800	22,791,400	155,000	181,969,100	1,332,800	9,578,800		255.84
8/1/13	31.00	284,198,200	4,583,300	197,128,000	6,000	363,708,400	4,334,800	23,435,200	643,800	187,833,300	5,864,200	15,432,100		345.70
9/5/13	35.00	289,070,900	4,872,700	197,130,000	2,000	368,066,900	4,358,500	23,887,000	451,800	193,039,600	5,206,300	14,891,300		295.46
10/7/13	32.00	291,829,900	2,759,000	197,130,000	0	369,892,400	1,825,500	24,157,500	270,500	196,405,900	3,366,300	8,221,300		178.41
11/6/13	30.00	293,716,300	1,886,400	197,130,000	0	371,037,400	1,145,000	24,375,000	217,500	199,497,900	3,092,000	6,340,900		146.78
12/4/13	28.00	295,652,000	1,935,700	197,130,000	0	372,140,200	1,102,800	24,612,300	237,300	202,707,400	3,209,500	6,485,300		160.85
1/2/14	29.00	297,531,800	1,879,800	197,130,000	0	373,191,500	1,051,300	24,630,000	17,700	206,357,500	3,650,100	6,598,900		158.02
2/4/14	33.00	300,053,600	2,521,800	197,130,000	0	374,548,900	1,357,400	24,749,200	119,200	210,508,800	4,151,300	8,149,700		171.50



Appendix D

Calibration Details & Model Results

KELLER associates

D-1:
Calibration Details

Flow Data			Time	Static Tank levels		Comments
Flow Test	Junction	Flow	Static Time	1MG Tank Level	0.1MG Tank Level	
#	in model	(gpm)		(ft)	(ft)	
1	J-115	2542	11:12	30.7	24.3	hydrants as planned
2.1	J-91	1126	11:30	30.1	24.4	hydrants as planned
2.2	J-91	1101-1126	11:37	29.8	24.4	hydrants as planned, fire pump off
3	J-13	1233	9:39	33	24.2	hydrants as planned
4	J-360	1007-1021	9:17	33.4	24.1	hydrants as planned (option 4.1 on map)
4 repeat	J-360	1014	9:17	not measured	valve closed	hydrants as planned (option 4.1 on map)
4 moved	J-360	1014	9:39	not measured	valve closed	hydrants moved to the two closest ones on Olney
5.1	J-57	1101	10:45	31.5	24.9	hydrants as planned
5.2	J-57	2152	10:55	31	24.9	hydrants as planned
5.2 repeat	J-391	2230	10:45	not measured	valve closed	hydrants as planned
6.1	J-250	1222-1233	10:00	32.5	24.6	P6B.1 moved because P6B doesn't exist
6.2	J-250	1861	10:25	32	24.6	P6.2B moved to get a larger flow drop
7	J-202	1577	10:55	not measured	valve closed	P7A was on 11th and Main, P7B was the same as F5, F7 was at the end of the line in the county public works department

Flow Test	Site A														
	Field						Modeled						Difference		
	Elevation	Static	Static Head	Residual	Residual	Drop	Junction	Static	Static Head	Residual	Residual	Drop	Static	Residual	drop
#	(ft)	(psi)	(ft)	(psi)	(ft)	(psi)		(psi)	(ft)	(psi)	(ft)	(psi)	difference	difference	difference
1	365.08	68	522.16	53	487.51	15	J-534	67.5	521	53.7	489.127	14	1	-1	1
2.1	367.17	66	519.63	64	515.01	2	J-268	63.4	514	64	515.01	-1	3	0	3
2.2	367.17	66	519.63	65	517.32	1	J-268	63.4	514	64.1	515.241	-1	3	1	2
3	352.57	74	523.51	67	507.34	7	J-170	72.9	521	63.7	499.717	9	1	3	-2
4	353.05	72	519.37	41	447.76	31	J-186	72.7	521	28.5	418.885	44	-1	13	-13
4 repeat	353.05	72	519.37	41	447.76	31	J-200	72.8	521	34	431.59	39	-1	7	-8
4 moved	351.05	0	0	55	478.1	0	J-186	0	351	49.5	465.395	0	0	6	0
5.1	360.57	69	519.96	66	513.03	3	J-134	69.5	521	65.9	360.57	4	-1	0	-1
5.2	360.57	69	519.96	46	466.83	23	J-134	69.5	521	52.9	482.769	17	-1	-7	6
5.2 repeat	360.57	68	517.65	46	466.83	22	J-134	69.2	520	48.8	473.298	20	-1	-3	2
6.1	362.02	70	523.72	66	514.48	4	J-38	68.8	521	65.5	513.325	3	1	1	1
6.2	362.02	70	523.72	60	500.62	10	J-38	66.1	515	56	491.38	10	4	4	0
7	358.34	69	517.73	54	483.08	15	J-390	70.2	521	55.7	487.007	15	-1	-2	1

Flow Test	Site B														
	Field						Modeled						Difference		
	Elevation	Static	Static Head	Residual	Residual	Drop	Junction	Static	Static Head	Residual	Residual	Drop	Static	Residual	drop
#	(ft)	(psi)	(ft)	(psi)	(ft)	(psi)		(psi)	(ft)	(psi)	(ft)	(psi)	difference	difference	difference
1	366.86	68	523.94	51	484.67	17	J-99	66.7	521	53.3	489.983	13	1	-2	4
2.1	372.98	65	523.13	62	516.2	3	J-380	60.9	514	60.8	513.428	0	4	1	3
2.2	372.98	65	523.13	61	513.89	4	J-380	60.9	514	60.9	513.659	0	4	0	4
3	359.86	69	519.25	65	510.01	4	J-151	69.8	521	64.1	507.931	6	-1	1	-2
4	353.06	71	517.07	69	512.45	2	J-135	72.7	521	66.6	506.906	6	-2	2	-4
4 repeat	353.06	74.5	525.155	68	510.14	6.5	J-135	72.8	521	66.5	506.675	6	2	2	0
4 moved	351.74	0	0	55	478.79	0	J-19	0	352	49.2	465.392	0	0	6	0
5.1	365.6	69	524.99	66	518.06	3	J-401	67.3	521	64	513.44	3	2	2	0
5.2	365.6	68	522.68	47	474.17	21	J-401	67.3	521	51.8	485.258	16	1	-5	6
5.2 repeat	365.6	68	522.68	49	478.79	19	J-401	67	520	48.7	478.097	18	1	0	1
6.1	359.49	69	518.88	67	514.26	2	J-378	69.9	521	66.5	513.105	3	-1	1	-1
6.2	359.68	71	523.69	59	495.97	12	J-379	67.1	515	56.5	490.195	11	4	3	1
7	361.74	70	523.44	61.5	503.805	8.5	J-391	68.7	520	56	491.1	13	1	6	-4

Booster Pump Station																		
Flow Test	Field						Model						Difference					
	Pump 1		Pump 2		Pump 3		Pump 1		Pump 2		Pump 3		Pump 1		Pump 2		Pump 3	
#	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)	Pressure (psi)	Frequency (Hz)
1	58	60	59	60	59	55	59.6	60	59.6	60	60	reservoir	-2	0	-1	0	-1	reservoir
2.1	66	58	66	58	62	40	66	58	66	58	66	reservoir	0	0	0	0	-4	reservoir
2.2	66	57	66	57	0	off	66	57	66	57	0	off	0	0	0	0	0	off
3	66	55	67	55	65	40	66.6	55	66.6	55	67	reservoir	-1	0	0	0	-2	reservoir
4	66	56	67	56	0	off	66.5	56	66.5	56	0	off	-1	0	1	0	0	off
4 repeat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	off
4 moved	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	reservoir
5.1	66	57	65	57	0	off	65.8	57	65.8	57	0	off	0	0	-1	0	0	off
5.2	60	60	61	60	60	54	60.7	60	60.7	60	61	reservoir	-1	0	0	0	-1	reservoir
5.2 repeat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	off
6.1	66	56	67	56	65	42	66.5	56	66.5	56	67	reservoir	-1	0	1	0	-2	reservoir
6.2	65	60	64	60	63	47	61.4	60	61.4	60	61	reservoir	4	0	3	0	2	reservoir
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	reservoir

D-2:
Model Results
(Existing System)

Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-1	364	Fire Flow	0	0	1	64	55	3500
J-100	367	Fire Flow	0	1	2	62	52	3500
J-101	368	Fire Flow	0	0	0	62	52	3500
J-102	356	Fire Flow	1	3	4	66	56	2839
J-103	357	Fire Flow	1	3	4	66	55	2655
J-104	358	Fire Flow	1	4	7	65	55	1948
J-105	359	Fire Flow	1	3	5	65	55	403
J-106	359	Fire Flow	1	3	4	65	55	3436
J-107	357	Fire Flow	0	2	4	65	55	3403
J-108	358	Fire Flow	1	3	4	65	55	363
J-109	360	Fire Flow	0	2	4	64	54	3221
J-11	354	Fire Flow	0	0	0	67	57	3214
J-110	357	Fire Flow	0	2	4	66	56	3273
J-111	364	Fire Flow	0	2	3	63	53	3500
J-112	363	Fire Flow	0	2	3	63	53	3500
J-113	355	Fire Flow	1	3	5	66	56	2407
J-114	356	Fire Flow	0	2	3	66	56	2100
J-115	366	Fire Flow	0	0	0	62	52	3500
J-116	366	Fire Flow	0	1	2	62	52	3500
J-117	365	Fire Flow	0	2	4	62	53	1671
J-118	365	Fire Flow	1	3	4	62	52	3292
J-119	353	Fire Flow	1	3	5	67	57	2813
J-12	354	Fire Flow	0	0	0	67	57	3205
J-120	358	Fire Flow	0	2	4	65	55	3100
J-121	357	Fire Flow	0	2	3	66	56	3285
J-122	359	Fire Flow	0	2	4	65	54	2378
J-123	366	Fire Flow	0	2	3	62	52	3500
J-124	366	Fire Flow	0	1	1	62	52	3500
J-125	356	Fire Flow	0	1	1	66	56	3319
J-126	355	Fire Flow	0	1	1	66	56	3294
J-127	364	Fire Flow	0	2	4	63	53	3241
J-129	366	Fire Flow	0	0	1	62	52	3500
J-13	354	Fire Flow	0	2	3	67	57	2697
J-130	356	Fire Flow	0	0	1	66	56	3223
J-131	365	Fire Flow	0	1	2	62	52	3324
J-132	357	Fire Flow	1	3	4	66	56	3128
J-133	356	Fire Flow	0	2	3	66	56	3316
J-134	361	Fire Flow	0	0	0	64	54	2909
J-135	353	Fire Flow	0	1	2	67	57	2735
J-136	361	Fire Flow	0	1	2	64	54	2859
J-137	367	Fire Flow	0	1	2	62	52	3500
J-138	363	Fire Flow	0	2	4	63	53	3500
J-139	360	Fire Flow	1	3	5	64	54	2479
J-14	354	Fire Flow	0	1	2	67	57	2740
J-140	358	Fire Flow	1	3	5	65	55	2038
J-142	364	Fire Flow	0	0	1	62	53	2710
J-143	364	Fire Flow	1	3	6	63	53	3500
J-144	355	Fire Flow	0	1	2	66	56	2351
J-145	375	Fire Flow	0	1	2	59	50	3379
J-146	353	Fire Flow	0	2	3	67	57	2181
J-147	374	Fire Flow	0	2	3	60	50	2805
J-148	351	Fire Flow	0	2	4	68	58	1848
J-149	374	Fire Flow	0	1	2	60	50	3444
J-15	364	Fire Flow	0	0	1	62	53	2689
J-150	374	Fire Flow	0	0	1	60	50	3454
J-151	360	Fire Flow	0	1	2	64	54	2180
J-152	372	Fire Flow	1	4	7	61	51	2286

Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-153	372	Fire Flow	1	3	6	61	51	2672
J-154	361	Fire Flow	1	3	4	64	54	2722
J-155	373	Fire Flow	0	1	1	60	51	3330
J-156	373	Fire Flow	1	3	4	60	51	3428
J-157	376	Fire Flow	0	1	2	59	49	3275
J-158	359	Fire Flow	0	1	2	65	54	2402
J-159	359	Fire Flow	1	3	6	65	55	3097
J-16	364	Non-Fire Flow	0		1	62	53	N/A
J-160	362	Fire Flow	1	3	6	64	54	3125
J-161	368	Fire Flow	1	3	5	62	53	3387
J-162	367	Fire Flow	1	3	4	63	53	1810
J-163	364	Fire Flow	0	2	3	64	54	3222
J-166	363	Fire Flow	1	4	7	63	53	1948
J-167	361	Fire Flow	0	2	3	64	54	2220
J-168	374	Fire Flow	0	1	1	60	50	2587
J-169	365	Fire Flow	0	1	2	62	52	2951
J-17	368	Fire Flow	0	0	0	63	54	3500
J-170	353	Fire Flow	0	2	4	68	57	1669
J-171	377	Fire Flow	0	1	2	59	49	3014
J-172	351	Fire Flow	0	0	1	68	58	1024
J-173	363	Fire Flow	0	0	0	64	55	3500
J-174	354	Fire Flow	0	2	4	67	57	1448
J-175	361	Fire Flow	0	1	1	64	54	645
J-176	376	Fire Flow	0	0	0	59	50	2151
J-177	375	Fire Flow	0	2	3	59	50	1884
J-178	353	Fire Flow	0	0	0	67	57	3150
J-179	351	Fire Flow	0	0	1	68	58	2588
J-180	357	Fire Flow	1	3	4	65	55	308
J-181	370	Fire Flow	0	1	1	62	52	3500
J-184	356	Fire Flow	0	1	1	66	56	50
J-185	376	Fire Flow	0	0	1	59	50	2455
J-186	353	Fire Flow	0	1	1	67	57	1072
J-187	353	Fire Flow	0	2	4	67	57	570
J-188	379	Fire Flow	0	0	1	58	48	1986
J-189	377	Fire Flow	0	0	1	58	49	1976
J-19	352	Fire Flow	0	0	0	68	58	1426
J-190	378	Fire Flow	0	2	3	58	49	2111
J-191	380	Fire Flow	0	2	3	57	48	1859
J-192	381	Fire Flow	1	3	4	57	47	1669
J-193	350	Fire Flow	0	1	1	68	58	911
J-194	352	Fire Flow	0	1	2	68	58	873
J-195	365	Fire Flow	0	1	1	63	54	3089
J-196	356	Fire Flow	0	1	1	66	56	3226
J-197	353	Fire Flow	0	2	3	67	57	2726
J-198	370	Fire Flow	0	1	1	61	52	3500
J-199	352	Fire Flow	1	5	8	68	58	1334
J-2	365	Fire Flow	1	3	5	64	54	3500
J-20	352	Fire Flow	0	0	0	68	58	1361
J-200	351	Fire Flow	0	0	0	68	58	1257
J-201	367	Fire Flow	0	0	1	62	52	3500
J-202	351	Fire Flow	0	1	2	68	58	2329
J-208	352	Fire Flow	0	0	0	68	58	1610
J-209	352	Fire Flow	0	0	0	68	58	1904
J-21	367	Fire Flow	0	0	0	62	52	3465
J-210	351	Fire Flow	0	0	1	68	58	1099
J-211	352	Fire Flow	0	0	0	68	58	1240
J-212	353	Fire Flow	1	3	6	67	57	2804

Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-213	354	Fire Flow	1	3	6	67	57	2422
J-214	355	Fire Flow	1	4	7	67	57	2342
J-215	355	Fire Flow	1	4	7	66	56	2240
J-216	356	Fire Flow	1	3	6	66	56	2122
J-217	357	Fire Flow	1	3	6	66	56	2073
J-218	356	Fire Flow	1	3	6	66	56	2152
J-219	355	Fire Flow	1	3	6	66	56	2250
J-220	354	Fire Flow	1	3	6	67	57	2370
J-221	354	Fire Flow	1	3	4	67	57	2912
J-222	355	Fire Flow	1	3	6	67	56	3054
J-223	355	Fire Flow	1	3	6	67	57	2532
J-224	356	Fire Flow	1	4	7	66	56	2361
J-225	357	Fire Flow	1	3	6	66	56	2247
J-226	357	Fire Flow	1	3	6	65	55	2171
J-227	354	Fire Flow	0	2	4	67	57	763
J-228	356	Fire Flow	0	1	1	66	56	1669
J-229	353	Fire Flow	0	1	2	67	57	1976
J-23	350	Fire Flow	0	0	0	69	58	1196
J-230	355	Fire Flow	1	3	4	66	56	3173
J-231	356	Fire Flow	1	3	4	66	56	3140
J-232	356	Fire Flow	1	3	4	66	56	3151
J-233	357	Fire Flow	1	3	4	66	56	3089
J-235	357	Fire Flow	1	3	4	66	56	3168
J-236	358	Fire Flow	1	3	4	65	55	3164
J-237	353	Fire Flow	0	0	0	67	57	3095
J-238	355	Fire Flow	0	2	4	67	57	3098
J-239	360	Fire Flow	1	3	4	64	54	2029
J-24	350	Fire Flow	0	1	2	69	59	1146
J-240	360	Fire Flow	1	3	4	64	54	1984
J-241	360	Fire Flow	1	3	4	64	54	2039
J-242	362	Fire Flow	1	3	6	64	54	2731
J-243	363	Fire Flow	1	3	4	63	53	3500
J-244	364	Fire Flow	0	1	2	63	53	1586
J-245	365	Fire Flow	1	5	9	63	53	3500
J-246	358	Fire Flow	1	5	9	65	55	2382
J-247	352	Fire Flow	1	4	7	68	58	1676
J-248	359	Fire Flow	0	1	2	65	55	73
J-249	359	Fire Flow	1	3	4	65	55	2808
J-25	369	Fire Flow	0	2	3	62	52	2150
J-250	361	Fire Flow	1	3	4	64	54	2888
J-251	362	Fire Flow	0	2	4	64	54	2753
J-252	357	Fire Flow	1	3	5	65	55	3338
J-253	358	Fire Flow	1	3	4	65	55	3286
J-256	362	Fire Flow	0	0	0	65	56	3408
J-257	362	Fire Flow	0	0	1	65	55	3620
J-258	363	Fire Flow	0	0	0	64	55	3249
J-26	370	Fire Flow	1	4	7	61	52	1850
J-265	364	Fire Flow	0	1	1	64	55	3500
J-266	365	Fire Flow	0	2	3	64	54	3500
J-267	366	Fire Flow	0	1	2	63	54	3500
J-268	367	Fire Flow	0	2	3	63	53	3446
J-269	368	Fire Flow	0	2	3	62	53	3400
J-27	358	Fire Flow	0	2	3	65	55	2576
J-270	369	Fire Flow	0	0	1	62	52	3348
J-271	361	Fire Flow	1	3	4	64	54	2047
J-272	366	Fire Flow	1	4	7	63	54	3500
J-273	367	Fire Flow	0	1	2	63	54	3500

Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-274	365	Fire Flow	1	4	7	64	54	3500
J-275	366	Fire Flow	1	4	7	63	54	3500
J-276	366	Fire Flow	1	3	5	63	54	3435
J-277	367	Fire Flow	0	2	3	63	54	3389
J-278	368	Fire Flow	1	5	8	62	53	3364
J-279	370	Fire Flow	1	4	7	62	52	2327
J-28	359	Fire Flow	0	1	2	65	55	2544
J-280	372	Fire Flow	1	4	7	61	51	2837
J-281	370	Fire Flow	1	4	7	62	52	3491
J-282	371	Fire Flow	1	4	7	61	52	3500
J-283	374	Fire Flow	1	3	4	60	50	3273
J-284	375	Fire Flow	0	1	2	59	50	3272
J-285	378	Fire Flow	1	3	4	58	49	3194
J-286	378	Fire Flow	0	1	2	58	49	3205
J-287	378	Fire Flow	0	1	2	58	49	2190
J-288	374	Fire Flow	1	3	6	60	50	2386
J-289	376	Fire Flow	1	3	6	59	50	2058
J-29	362	Fire Flow	0	2	3	64	54	3344
J-290	378	Fire Flow	1	3	6	58	49	1822
J-291	350	Fire Flow	0	0	0	69	58	1115
J-292	352	Fire Flow	0	0	0	68	58	989
J-293	351	Fire Flow	0	0	1	68	58	892
J-294	355	Fire Flow	0	1	1	67	56	873
J-295	348	Fire Flow	0	0	0	69	59	910
J-296	348	Fire Flow	0	0	0	70	59	895
J-297	366	Fire Flow	0	1	1	62	52	3473
J-298	367	Fire Flow	0	0	0	61	52	3370
J-299	367	Fire Flow	0	0	0	62	52	3382
J-3	361	Fire Flow	0	0	0	64	54	3238
J-30	365	Fire Flow	0	2	3	62	52	3500
J-300	368	Fire Flow	0	1	1	61	52	3500
J-301	367	Fire Flow	0	2	3	61	52	3500
J-302	364	Fire Flow	0	1	1	63	53	3496
J-303	363	Fire Flow	0	2	3	63	53	2499
J-304	365	Fire Flow	0	2	3	62	52	2287
J-305	366	Fire Flow	0	1	2	62	52	2273
J-306	366	Fire Flow	0	1	2	62	52	2425
J-307	366	Fire Flow	0	2	4	62	52	2844
J-308	358	Fire Flow	0	1	1	65	55	3012
J-309	357	Fire Flow	0	2	3	66	56	2769
J-31	364	Fire Flow	0	1	2	62	53	3500
J-310	354	Fire Flow	1	3	5	67	57	2573
J-311	363	Non-Fire Flow	0		2	63	53	N/A
J-312	363	Fire Flow	0	2	3	63	53	2745
J-313	373	Fire Flow	0	1	1	60	51	3500
J-314	369	Fire Flow	0	1	1	62	52	3500
J-316	364	Fire Flow	0	1	2	64	54	3500
J-317	365	Fire Flow	1	3	4	64	54	3500
J-318	369	Fire Flow	0	1	1	63	54	3500
J-319	370	Fire Flow	0	1	1	62	53	3500
J-32	369	Fire Flow	1	5	8	62	53	1834
J-320	376	Fire Flow	0	0	1	59	49	3326
J-323	362	Fire Flow	0	2	4	64	53	2026
J-324	371	Fire Flow	0	0	0	61	52	3500
J-325	370	Fire Flow	0	1	2	62	52	3314
J-326	376	Fire Flow	0	1	1	59	50	2771
J-329	358	Fire Flow	1	3	4	65	55	493

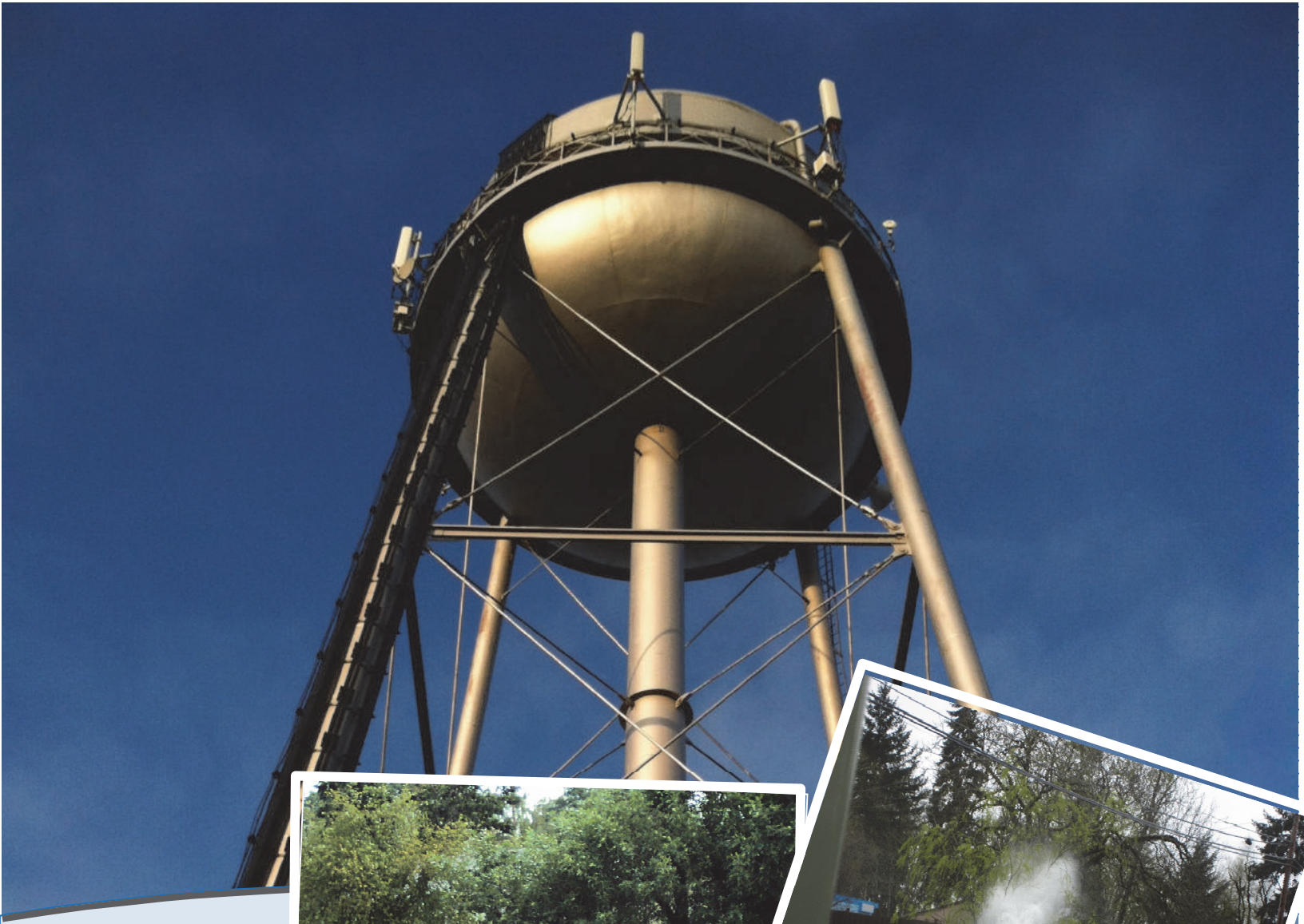
Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-33	352	Fire Flow	0	0	0	68	58	1781
J-330	374	Fire Flow	0	1	2	60	50	2888
J-331	374	Fire Flow	1	3	4	60	51	3422
J-332	376	Fire Flow	0	2	4	59	50	2095
J-333	352	Fire Flow	0	0	0	68	58	2842
J-334	360	Fire Flow	0	2	3	64	54	2218
J-335	372	Fire Flow	0	0	0	61	51	3419
J-336	360	Fire Flow	1	3	5	64	54	888
J-338	364	Fire Flow	0	1	1	64	55	3500
J-339	377	Fire Flow	0	1	1	59	49	3153
J-34	352	Fire Flow	0		1	68	58	small line *
J-340	364	Fire Flow	0	1	1	63	53	2947
J-341	356	Fire Flow	0	2	3	66	56	3154
J-342	365	Fire Flow	0	2	4	63	54	3500
J-343	368	Fire Flow	1	3	4	62	53	2326
J-344	355	Fire Flow	1	3	4	66	56	2971
J-345	369	Fire Flow	0	1	1	62	52	4000
J-346	369	Fire Flow	0	0	0	62	52	3500
J-347	356	Fire Flow	0	2	3	66	56	2880
J-348	372	Fire Flow	0	1	2	60	51	3500
J-349	359	Fire Flow	0	0	1	65	55	3500
J-350	375	Fire Flow	0	1	1	59	50	3324
J-351	375	Fire Flow	0	2	3	59	50	3453
J-352	372	Fire Flow	1	3	4	60	51	3414
J-358	368	Fire Flow	0	1	1	63	54	3500
J-360	353	Fire Flow	0	0	1	68	57	1121
J-361	364	Fire Flow	0	0	0	62	53	3500
J-362	369	Fire Flow	0	0	0	63	55	3500
J-363	369	Fire Flow	0	0	0	63	55	3500
J-364	369	Fire Flow	0	0	0	63	55	3500
J-365	369	Non-Fire Flow	0		0	16	16	N/A
J-367	369	Non-Fire Flow	0		0	16	16	N/A
J-368	369	Non-Fire Flow	0		0	16	16	N/A
J-37	363	Fire Flow	0	1	2	63	53	3500
J-371	364	Non-Fire Flow	0		0	52	52	N/A
J-373	364	Fire Flow	0		0	62	53	N/A
J-377	358	Fire Flow	0	0	0	65	55	3416
J-378	359	Fire Flow	0	0	0	65	55	2980
J-379	360	Fire Flow	0	0	0	64	55	3456
J-38	362	Fire Flow	0	2	3	63	54	3500
J-380	373	Fire Flow	0	0	0	60	51	3026
J-381	371	Fire Flow	0	0	0	61	51	3331
J-39	359	Fire Flow	0	1	2	65	55	2210
J-395	368	Fire Flow	0	0	0	61	52	3464
J-4	361	Fire Flow	0	0	0	64	54	3291
J-40	359	Fire Flow	0	2	3	65	55	1846
J-401	366	Fire Flow	0	0	0	62	52	3187
J-41	367	Fire Flow	0	0	0	62	52	3500
J-42	366	Fire Flow	0	1	1	62	52	3500
J-43	366	Fire Flow	0	0	0	63	53	3500
J-44	365	Fire Flow	0	1	1	63	54	3500
J-45	375	Fire Flow	1	3	5	59	50	1978
J-46	374	Fire Flow	0	2	4	60	51	2012
J-47	378	Fire Flow	0	0	0	58	49	3232
J-48	378	Fire Flow	0	0	0	58	48	3126
J-49	364	Fire Flow	0	2	3	62	53	3500
J-5	362	Fire Flow	0	0	1	63	54	3415

Existing Model Results

Label	Elavation	Zone	Min. Month Demand	Max Day Demand	Peak Hour Demand	Min. Month Pressure	Peak Hour Pressure	Available Fire Flow
J-50	366	Fire Flow	0	2	3	63	53	2613
J-51	366	Fire Flow	0		2	62	53	small line *
J-52	352	Fire Flow	0	0	1	68	58	2420
J-53	350	Fire Flow	0	0	1	69	59	2312
J-534	365	Fire Flow	0	2	4	63	53	3479
J-54	361	Fire Flow	0	0	1	64	54	3174
J-55	361	Non-Fire Flow	0		1	64	54	N/A
J-56	366	Fire Flow	0	0	1	63	54	3500
J-57	361	Fire Flow	0	1	1	64	54	3494
J-58	371	Fire Flow	1	3	6	61	52	2544
J-59	371	Fire Flow	1	6	10	61	52	1933
J-6	362	Fire Flow	0	0	1	63	54	3411
J-60	348	Fire Flow	0	0	0	70	59	883
J-61	351	Fire Flow	0	1	2	68	58	874
J-62	353	Fire Flow	0	0	0	67	57	3142
J-63	359	Fire Flow	1	3	4	65	55	825
J-64	359	Fire Flow	1	3	4	65	55	2165
J-65	370	Fire Flow	1	6	10	61	52	1893
J-66	372	Fire Flow	1	3	4	60	51	3200
J-67	373	Fire Flow	1	4	7	60	51	2169
J-68	360	Fire Flow	0	2	4	64	54	3473
J-69	372	Fire Flow	1	3	6	61	51	2153
J-7	355	Fire Flow	0	0	0	67	57	3187
J-70	364	Fire Flow	0		1	63	53	small line *
J-72	359	Fire Flow	1	3	4	65	55	1766
J-73	359	Fire Flow	1	5	8	65	54	445
J-74	357	Fire Flow	0	2	4	66	56	3148
J-75	359	Fire Flow	0	2	3	65	55	3175
J-76	358	Fire Flow	1	3	5	65	55	1923
J-77	361	Fire Flow	1	5	8	64	53	432
J-78	372	Fire Flow	0	0	1	61	51	3500
J-79	358	Fire Flow	0	0	1	65	55	3348
J-8	355	Fire Flow	0	1	1	67	57	3175
J-80	358	Fire Flow	0	2	4	65	55	3059
J-81	359	Fire Flow	1	3	5	65	55	1724
J-82	359	Fire Flow	0	1	2	65	55	2123
J-83	355	Fire Flow	0	0	1	67	57	2837
J-84	355	Fire Flow	0	2	4	67	57	2600
J-85	376	Fire Flow	0	0	0	59	49	3200
J-86	377	Fire Flow	0	2	3	58	49	2780
J-87	354	Fire Flow	1	3	6	67	57	2807
J-88	373	Fire Flow	0	2	4	60	51	3432
J-89	372	Fire Flow	1	3	4	60	51	3413
J-9	368	Fire Flow	0	0	1	63	54	3500
J-90	371	Fire Flow	1	3	4	61	52	3248
J-91	372	Fire Flow	1	3	5	61	51	3377
J-94	367	Fire Flow	0	1	1	62	53	3438
J-95	355	Fire Flow	0	0	1	67	57	2648
J-96	375	Fire Flow	0	0	0	59	50	3180
J-97	348	Fire Flow	0	1	2	70	59	883
J-98	358	Fire Flow	1		4	65	55	small line *
J-99	367	Fire Flow	0	0	0	62	52	3500

*small line in the vicinity of a larger line and excluded from fireflow analysis



Appendix E

Capital Improvement Plan

KELLER associates

CITY OF AUMSVILLE
Water Master Plan
Capital Improvement Plan

ID#	Item Description	Opinion of Probable Cost*	Percent SDC Eligible	SDC Amount	City Amount
Priority 1 Improvements (by 2020)					
1A	10-inch loop along Aumsville Highway, 8-inch connection to Olney Street	$255,000	50%	$127,500	$127,500
1B	8-inch Loop to School	$104,000	0%	$0	$104,000
1C	Additional Fire Hydrants	$50,000	14%	$7,200	$42,800
1D	Reservoir Improvements	$476,000	0%	$0	$476,000
1E	Booster Station Improvements	$263,000	0%	$0	$263,000
1F	Well Improvements	$620,360	13%	$81,600	$538,760
1G	WMCP Update	$4,800	50%	$2,400	$2,400
	Total Priority 1 Improvements	***$1,773,000***		***$218,700***	***$1,554,460***
Priority 2 Improvements (by 2024)					
2A	8-inch Main along Church Street	$136,000	0%	$0	$136,000
2B	8-inch loop along Michael Way	$77,000	0%	$0	$77,000
2C	8-inch main on Maple Court	$86,000	0%	$0	$86,000
2D	8-inch main on Locust Court	$89,000	0%	$0	$89,000
2E	Additional Fire Hydrants	$36,000	20%	$7,200	$28,800
2F	500,000 Gallon Reservoir	$1,123,000	100%	$1,123,000	$0
2G	300 gpm Well and Pipeline	$703,000	100%	$703,000	$0
2H	Additional Booster Station	$749,000	14%	$101,900	$647,100
2I	Well Improvements	$256,000	0%	$0	$256,000
2J	WMCP Progress Report	$6,300	50%	$3,200	$3,100
2K	10 Year WMP Update	$80,000	100%	$80,000	$0
	Total Priority 2 Improvements	***$3,341,000***		***$2,018,300***	***$1,323,000***
Priority 3 Improvements (by 2034)					
3A	10-inch loop along Aumsville Highway	$147,000	75%	$110,300	$36,700
3B	8-inch Loop between 12th Street and Cedar Lane	$32,000	25%	$8,000	$24,000
3C	8-inch Loop along Cleveland Street	$40,000	0%	$0	$40,000
3D	8-inch Loop between Del Mar Drive and 1st Street	$216,000	75%	$162,000	$54,000
3E	Additional Fire Hydrants	$57,000	13%	$7,200	$49,800
3F	Reservoir Improvements	$172,000	0%	$0	$172,000
3G	Well Improvements	$60,000	0%	$0	$60,000
3H	20 Year WMP	$80,000	100%	$80,000	$0
3I	WMCP Update	$6,300	50%	$3,200	$3,100
	Total Priority 3 Improvements	***$810,000***		***$260,400***	***$402,900***
	TOTAL (rounded)	**$5,924,000**		**$2,498,000**	**$3,281,000**
*** All costs in 2014 Dollars. Costs include engineering and contingencies.**					

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Unit Price Summary Table

ITEM	UNIT	UNIT PRICE
All pipe material is PVC -		
4" Pipe - Includes Fittings, Trenching and Backfill	LF	$40
6" Pipe - Includes Fittings, Trenching and Backfill	LF	$45
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55
10" Pipe - Includes Fittings, Trenching and Backfill	LF	$63
12" Pipe - Includes Fittings, Trenching and Backfill	LF	$70
Connect to existing Water Main	EA	$3,800
New Fire Hydrant Assembly	EA	$4,500
Service Line Replacement	EA	$800
Control Density Backfill - Additional Cost	LF	$45
Gravel Road Repair	LF	$8
6ft Width Pavement Repair (3-inches thick)	LF	$25
6ft Width Pavement Repair (5-inches thick)	LF	$40
Bore 18" Steel Casing	LF	$760
Traffic Control	LF	$2
Traffic Control (with flaggers)	LF	$5
Micellaneous Surface Restoration	LF	$5
Easement Acquisition	LF	$20
Mobilization, Overhead, and Profit	%	35%
Mobilization - % of Item Cost Sum	%	5%
Contingency - % of Construction Subtotal	%	25%
Contingency - % of Construction Subtotal	%	30%
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%
Permitting, Engineering and CMS* - % of Total Construction Costs (Misc.)	%	15%
Legal, Administration - % of Total Construction Cost	%	2%

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 1 Distribution System					
1A: 10-inch loop along Aumsville Highway, 8-inch connection to Olney Street					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	320	$17,600	
10" Pipe - Includes Fittings, Trenching and Backfill	LF	$63	760	$47,880	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	2	$9,000	
Control Density Backfill - Additional Cost	LF	$45	760	$34,200	
6ft Width Pavement Repair (3-inches thick)	LF	$25	320	$8,000	
6ft Width Pavement Repair (5-inches thick)	LF	$40	760	$30,400	
Traffic Control	LF	$2	320	$640	
Traffic Control (with flaggers)	LF	$5	760	$3,800	
					$159,000
Mobilization - % of Item Cost Sum	%	5%		$8,000	
Construction Subtotal					$167,000
Contingency - % of Construction Subtotal	%	25%		$42,000	
Total Construction Cost					$209,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$42,000	
Legal, Administration - % of Total Construction Cost	%	2%		$4,000	
Total Project Cost (rounded)					***$255,000***
1B: 8-inch Loop to School					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	570	$31,350	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
6ft Width Pavement Repair (3-inches thick)	LF	$25	570	$14,250	
					$58,000
Mobilization - % of Item Cost Sum	%	5%		$3,000	
Construction Subtotal					$61,000
Contingency - % of Construction Subtotal	%	25%		$15,000	
Total Construction Cost					$76,000
Easement Acquisition	LF	$20	570	$11,400	
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$15,000	
Legal, Administration - % of Total Construction Cost	%	2%		$2,000	
Total Project Cost (rounded)					***$104,000***
1C: Additional Fire Hydrants					
New Fire Hydrant Assembly	EA	$4,500	7	$31,500	
					$32,000
Mobilization - % of Item Cost Sum	%	5%		$2,000	
Construction Subtotal					$33,000
Contingency - % of Construction Subtotal	%	25%		$8,000	
Total Construction Cost					$41,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$8,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$50,000***
				Total Priority 1 Cost (rounded)	**$409,000**

*CMS: Construction Management Services

**All estimates are based on 2014 dollars

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 2 Distribution System					
2A: 8-inch Main along Church Street					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	780	$42,900	
Connect to existing Water Main	EA	$3,800	4	$15,200	
Service Line Replacement	EA	$800	7	$5,600	
6ft Width Pavement Repair (3-inches thick)	LF	$25	780	$19,500	
Traffic Control	LF	$2	780	$1,560	
					$85,000
Mobilization - % of Item Cost Sum	%	5%		$4,000	
Construction Subtotal					$89,000
Contingency - % of Construction Subtotal	%	25%		$22,000	
Total Construction Cost					$111,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$22,000	
Legal, Administration - % of Total Construction Cost	%	2%		$2,000	
Total Project Cost (rounded)					***$136,000***
2B: 8-inch loop along Michael Way					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	380	$20,900	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
Service Line Replacement	EA	$800	6	$4,800	
6ft Width Pavement Repair (3-inches thick)	LF	$25	380	$9,500	
Traffic Control	LF	$2	380	$760	
					$48,000
Mobilization - % of Item Cost Sum	%	5%		$2,000	
Construction Subtotal					$50,000
Contingency - % of Construction Subtotal	%	25%		$13,000	
Total Construction Cost					$63,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$13,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$77,000***
2C: 8-inch main on Maple Court					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	415	$22,825	
Connect to existing Water Main	EA	$3,800	1	$3,800	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
Service Line Replacement	EA	$800	14	$11,200	
6ft Width Pavement Repair (3-inches thick)	LF	$25	415	$10,375	
Traffic Control	LF	$2	415	$830	
					$54,000
Mobilization - % of Item Cost Sum	%	5%		$3,000	
Construction Subtotal					$56,000
Contingency - % of Construction Subtotal	%	25%		$14,000	
Total Construction Cost					$70,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$14,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$86,000***

Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 2 Distribution System					
2D: 8-inch main on Locust Court					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	410	$22,550	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
Service Line Replacement	EA	$800	12	$9,600	
6ft Width Pavement Repair (3-inches thick)	LF	$25	410	$10,250	
Traffic Control	LF	$2	410	$820	
					$55,000
Mobilization - % of Item Cost Sum	%	5%		$3,000	
Construction Subtotal					$58,000
Contingency - % of Construction Subtotal	%	25%		$15,000	
Total Construction Cost					$73,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$15,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$89,000***
2E: Additional Fire Hydrants					
New Fire Hydrant Assembly	EA	$4,500	5	$22,500	
					$23,000
Mobilization - % of Item Cost Sum	%	5%		$1,000	
Construction Subtotal					$24,000
Contingency - % of Construction Subtotal	%	25%		$6,000	
Total Construction Cost					$30,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$6,000	
Legal, Administration - % of Total Construction Cost	%	2%		$200	
Total Project Cost (rounded)					**$36,000**
2F: 500,000 Gallon Reservoir					
Construct 500,000 Welded Steel Reservoir	EA	$400,000	1	$400,000	
12" Pipe - Includes Fittings, Trenching and Backfill	LF	$70	100	$7,000	
Intrusion Detection System	EA	$4,000	1	$4,000	
Level sensor	EA	$8,000	1	$8,000	
New SCADA Remote Terminal Unit	LS	$18,000	1	$18,000	
					$437,000
Mobilization - % of Item Cost Sum	%	5%		$22,000	
Filter Project	LS	$275,000	1	$275,000	
Construction Subtotal					$734,000
Contingency - % of Construction Subtotal	%	25%		$183,000	
Total Construction Cost					$917,000
Land Acquisition	LS	$50,000	1	$50,000	
Permitting, Engineering and CMS* - % of Total Construction Costs (Misc.)	%	15%		$138,000	
Legal, Administration - % of Total Construction Cost	%	2%		$18,000	
Total Project Cost (rounded)					***$1,123,000***
2G: 300 gpm Well and Pipeline					
New Well Construction - Includes yard piping and mechanical	LS	$250,000	1	$250,000	
Standby Power Generator	LS	$50,000	1	$50,000	
12" Pipe - Includes Fittings, Trenching and Backfill	LF	$70	1,500	$105,000	
Micellaneous Surface Restoration	LF	$5	1,500	$7,500	
					$413,000
Mobilization - % of Item Cost Sum	%	5%		$21,000	
Construction Subtotal					$433,000
Contingency - % of Construction Subtotal	%	25%		$108,000	
Total Construction Cost					$541,000
Easement Acquisition	LF	$20	500	$10,000	
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$108,000	
Hydrogeologic Consulting Services	LS	$32,000		$32,000	
Legal, Administration - % of Total Construction Cost	%	2%		$11,000	
Total Project Cost (rounded)					***$703,000***

Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 2 Distribution System					
2H: Additional Booster Station					
Construct New Equipment Slab	SF	$50	200	$10,000	
Construct New Enclosure Building	SF	$120	225	$27,000	
Building HVAC	LS	$6,000	1	$6,000	
Building Electrical	LS	$5,000	1	$5,000	
Connection Piping	LS	$19,000	1	$19,000	
Install New Skid Mounted 3 Pump Water Booster System	LS	$150,000	1	$150,000	
Install Flow Meter in Discharge	EA	$8,500	1	$8,500	
Install Pressure Transducer	EA	$7,500	1	$7,500	
400 Amp Automatic Transfer Switch (Service Type)	EA	$12,000	1	$12,000	
Install New Service Conductors	FT	$15	180	$2,700	
125 kw Diesel Generator	EA	$72,000	1	$72,000	
Generator Enclosure	EA	$12,000	1	$12,000	
New SCADA Remote Terminal Unit	LS	$18,000	1	$18,000	
					$350,000
Mobilization, Overhead, and Profit	%	35%		$122,000	
Construction Subtotal					$472,000
Contingency - % of Construction Subtotal	%	30%		$142,000	
Total Construction Cost					$614,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$123,000	
Legal, Administration - % of Total Construction Cost	%	2%		$12,000	
Total Project Cost (rounded)					***$749,000***
				Total Priority 2 Cost (rounded)	**$2,999,000**

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 3 Distribution System					
3A: 10-inch loop along Aumsville Highway					
10" Pipe - Includes Fittings, Trenching and Backfill	LF	$63	550	$34,650	
Connect to existing Water Main	EA	$3,800	2	$7,600	
Control Density Backfill - Additional Cost	LF	$45	550	$24,750	
6ft Width Pavement Repair (5-inches thick)	LF	$40	550	$22,000	
Traffic Control (with flaggers)	LF	$5	550	$2,750	
					$92,000
Mobilization - % of Item Cost Sum	%	5%		$5,000	
Construction Subtotal					$96,000
Contingency - % of Construction Subtotal	%	25%		$24,000	
Total Construction Cost					$120,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$24,000	
Legal, Administration - % of Total Construction Cost	%	2%		$2,000	
Total Project Cost (rounded)					***$147,000***
3B: 8-inch Loop between 12th Street and Cedar Lane					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	170	$9,350	
Connect to existing Water Main	EA	$3,800	2	$7,600	
6ft Width Pavement Repair (3-inches thick)	LF	$25	10	$250	
Micellaneous Surface Restoration	LF	$5	170	$850	
					$18,000
Mobilization - % of Item Cost Sum	%	5%		$1,000	
Construction Subtotal					$19,000
Contingency - % of Construction Subtotal	%	25%		$5,000	
Total Construction Cost					$24,000
Easement Acquisition	LF	$20	170	$3,400	
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$5,000	
Legal, Administration - % of Total Construction Cost	%	2%		$0	
Total Project Cost (rounded)					***$32,000***
3C: 8-inch Loop along Cleveland Street					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	160	$8,800	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
6ft Width Pavement Repair (3-inches thick)	LF	$25	160	$4,000	
Traffic Control	LF	$2	160	$320	
					$25,000
Mobilization - % of Item Cost Sum	%	5%		$1,000	
Construction Subtotal					$26,000
Contingency - % of Construction Subtotal	%	25%		$7,000	
Total Construction Cost					$33,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$7,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$40,000***
3D: 8-inch Loop between Del Mar Drive and 1st Street					
8" Pipe - Includes Fittings, Trenching and Backfill	LF	$55	825	$45,375	
Connect to existing Water Main	EA	$3,800	2	$7,600	
New Fire Hydrant Assembly	EA	$4,500	1	$4,500	
6ft Width Pavement Repair (3-inches thick)	LF	$25	755	$18,875	
Bore 18" Steel Casing	LF	$760	70	$53,200	
Traffic Control (with flaggers)	LF	$5	825	$4,125	
					$134,000
Mobilization - % of Item Cost Sum	%	5%		$7,000	
Construction Subtotal					$140,000
Contingency - % of Construction Subtotal	%	25%		$35,000	
Total Construction Cost					$175,000
Easement Acquisition	LF	$20	70	$1,400	
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$35,000	
Legal, Administration - % of Total Construction Cost	LS	$4,000		$4,000	
Total Project Cost (rounded)					***$216,000***

Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Priority 3 Distribution System					
3E: Additional Fire Hydrants					
New Fire Hydrant Assembly	EA	$4,500	8	$36,000	
					$36,000
Mobilization - % of Item Cost Sum	%	5%		$2,000	
Construction Subtotal					$38,000
Contingency - % of Construction Subtotal	%	25%		$9,000	
Total Construction Cost					$47,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$9,000	
Legal, Administration - % of Total Construction Cost	%	2%		$200	
Total Project Cost (rounded)					**$57,000**
				Total Priority 3 Cost (rounded)	**$492,000**

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
1 MG Reservoir Improvements					
Priority 1 Improvements (Portion of 1D Improvements)					
Shot Blast Interior	SF	$3	23,000	$69,000	
Provide Interior Blasting Hazardous Material Containment	Day	$250	45	$11,250	
Repaint Interior	SF	$4	23,000	$92,000	
Replace SCADA PLC with New unit with Battery Backup	LS	$2,500	1	$2,500	
Install Pressure Transducer Level Monitor System	LS	$10,500	1	$10,500	
Repair Manual Level Reading	LS	$250	1	$250	
Install Flow Meter Piping	FT	$90	60	$5,400	
					$191,000
Mobilization, Overhead, and Profit	%	35%		$66,815.00	
Construction Subtotal					$258,000
Contingency - % of Construction Subtotal	%	30%		$77,000	
Total Construction Cost					$335,000
Permitting, Engineering and CMS* - % of Total Construction Costs (Misc.)	%	15%		$50,000	
Legal, Administration - % of Total Construction Cost	%	2%		$7,000	
Total Project Cost (rounded)					***$392,000***
Priority 3F Improvements					
Shot Blast Exterior	SF	$2	13,000	$26,000	
Repaint Exterior	SF	$3	13,000	$39,000	
Provide Blasting Hazardous Material Containment	Day	$650	35	$22,750	
					$88,000
Mobilization, Overhead, and Profit	%	35%		$31,000	
Construction Subtotal					$118,000
Contingency - % of Construction Subtotal	%	30%		$36,000	
Total Construction Cost					$154,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	10%		$15,000	
Legal, Administration - % of Total Construction Cost	%	2%		$3,000	
Total Project Cost (rounded)					***$172,000***
				Total Reservoir Cost (rounded)	**$564,000**

*CMS: Construction Management Services

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
0.1 MG Reservoir Improvements (Tower)					
Priority 1 Improvements (Portion of 1D Improvements)					
Recommendations from Structural Report by Others	EA	$55,000	1	$55,000	
Construction Subtotal					$55,000
Contingency - % of Construction Subtotal	%	25%		$13,750.00	
Total Construction Cost					$68,750
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$13,750.00	
Legal, Administration - % of Total Construction Cost	%	2%		$1,375.00	
Total Project Cost (rounded)					***$84,000***
				Total Reservoir Cost (rounded)	**$84,000**

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Booster Station					
Priority 1E Improvements					
Install Pressure Transducer	EA	$7,500	1	$7,500	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
400 Amp Automatic Transfer Switch (Service Type)	EA	$12,000	1	$12,000	
Install New Service Conductors	FT	$15	180	$2,700	
200 KW Diesel Generator	EA	$84,000	1	$84,000	
Generator Enclosure	EA	$12,000	1	$12,000	
					$123,000
Mobilization, Overhead, and Profit	%	35%		$43,000	
Construction Subtotal					$166,000
Contingency - % of Construction Subtotal	%	30%		$50,000	
Total Construction Cost					$216,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$43,000	
Legal, Administration - % of Total Construction Cost	%	2%		$4,000	
Total Project Cost (rounded)					***$263,000***
	Total Booster Station Cost (rounded)				**$263,000**
*CMS: Construction Management Services					

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Boone #1 Well					
Priority 1 Improvements (Portion of 1F Improvements)					
Paint Interior Piping	LS	$3,500	1	$3,500	
Install Drain Line and Screen	EA	$6,500	1	$6,500	
Install On-site Video Surveillance System	EA	$300	1	$300	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Install Turbidity Meter	EA	$8,000	1	$8,000	
Install Pressure Transducer	EA	$2,500	1	$2,500	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
Replace Roof and Roof Deck	EA	$9,500	1	$9,500	
Masonry in Opening	EA	$11,500	1	$11,500	
Wasteline Pipe Extension and Screening	EA	$150	1	$150	
Remove Old Fuel Tank	EA	$2,200	1	$2,200	
					$49,000
Mobilization, Overhead, and Profit	%	35%		$17,000	
Construction Subtotal					$66,000
Contingency - % of Construction Subtotal	%	30%		$20,000	
Total Construction Cost					$86,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$17,000	
Legal, Administration - % of Total Construction Cost	%	2%		$2,000	
Total Project Cost (rounded)					***$105,000***
				Total Well Cost (rounded)	**$105,000**
*CMS: Construction Management Services					

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Boone #2 Well (with Filter Project)					
Priority 1 Improvements (Portion of 1F Improvements)					
Install Air Release Valve	EA	$9,500	1	$9,500	
Install New 350 gpm Well Pump	EA	$5,503	1	$5,503	
Install New 350 gpm Well Pump Motor	EA	$10,017	1	$10,017	
Install New Well Pump wiring	LF	$9	320	$2,864	
Modify Yard Piping	EA	$9,600	1	$9,600	
Install On-site Video Surveillance System	EA	$300	1	$300	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
Install Pressure Transducer	EA	$2,500	1	$2,500	
					$45,000
Mobilization, Overhead, and Profit	%	35%		$16,000	
Construction Subtotal					$61,000
Contingency - % of Construction Subtotal	%	30%		$18,000	
Total Construction Cost					$79,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$16,000	
Legal, Administration - % of Total Construction Cost	%	2%		$2,000	
Total Project Cost (rounded)					***$96,000***
Priority 2 Improvements (Portion of 1F Improvements)					
Add New Tap Gutter	EA	$2,200	1	$2,200	
Add New Disconnects	EA	$6,500	2	$13,000	
400 Amp Automatic Transfer Switch	EA	$12,000	1	$12,000	
100 kw Diesel Generator	EA	$58,000	1	$58,000	
Generator Enclosure and Pad	EA	$9,000	1	$9,000	
					$94,000
Mobilization, Overhead, and Profit	%	35%		$33,000	
Construction Subtotal					$127,000
Contingency - % of Construction Subtotal	%	30%		$38,000	
Total Construction Cost					$165,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$33,000	
Legal, Administration - % of Total Construction Cost	%	2%		$3,000	
Total Project Cost (rounded)					***$202,000***
Priority 3G Improvements					
Abandon Aeration Tanks	LS	$18,500	1	$18,500	
Modify Yard Piping	FT	$80	120	$9,600	
					$28,000
Mobilization, Overhead, and Profit	%	35%		$10,000	
Construction Subtotal					$38,000
Contingency - % of Construction Subtotal	%	30%		$11,000	
Total Construction Cost					$49,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$10,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$60,000***
				Total Well Cost (rounded)	**$358,000**
*CMS: Construction Management Services					

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Tower Well					
Priority 1 Improvements (Portion of 1F Improvements)					
Install On-site Video Surveillance System	EA	$300	1	$300	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
Install Flow Meter	EA	$8,500	1	$8,500	
Install Pressure Transducer	EA	$2,500	1	$2,500	
					$16,000
Mobilization, Overhead, and Profit	%	35%		$6,000	
Construction Subtotal					$22,000
Contingency - % of Construction Subtotal	%	30%		$6,000	
Total Construction Cost					$28,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	15%		$4,000	
Legal, Administration - % of Total Construction Cost	%	2%		$600	
Total Project Cost (rounded)					***$33,000***
Priority 2 Improvements (Portion of 1F Improvements)					
Install Air Release Valve	EA	$9,500	1	$9,500	
Recoat Roof	EA	$11,500	1	$11,500	
Paint Interior Well Piping	LS	$7,500	1	$7,500	
					$29,000
Mobilization, Overhead, and Profit	%	35%		$10,000	
Construction Subtotal					$38,000
Contingency - % of Construction Subtotal	%	30%		$12,000	
Total Construction Cost					$50,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	5%		$3,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$54,000***
				Total Well Cost (rounded)	**$87,000**
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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Reservoir Well					
Priority 1 Improvements (Portion of 1F Improvements)					
Install On-site Video Surveillance System	EA	$300	1	$300	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
Install Flow Meter	EA	$8,500	1	$8,500	
Install Pressure Transducer	EA	$2,500	1	$2,500	
Modify Piping	FT	$110	28	$3,080	
					$19,000
Mobilization, Overhead, and Profit	%	35%		$7,000	
Construction Subtotal					$26,000
Contingency - % of Construction Subtotal	%	30%		$8,000	
Total Construction Cost					$33,000
Permitting, Engineering and CMS* - % of Total Construction Costs	%	20%		$7,000	
Legal, Administration - % of Total Construction Cost	%	2%		$1,000	
Total Project Cost (rounded)					***$41,000***
				Total Well Cost (rounded)	**$41,000**
*CMS: Construction Management Services					

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Item	Unit	Unit Price	Estimated Quantity	Item Cost (Rounded)	Total Cost (Rounded)
Church Well					
Priority 1 Improvements (Portion of 1F Improvements)					
Install On-site Video Surveillance System	EA	$300	1	$300	
Install Intrusion Detection System	EA	$1,200	1	$1,200	
Add New Disconnects	EA	$6,500	2	$13,000	
400 Amp Automatic Transfer Switch	EA	$12,000	1	$12,000	
75 kw Diesel Generator	EA	$38,000	1	$38,000	
Generator Enclosure and Pad	EA	$9,000	1	$9,000	
Install Flow Meter	EA	$3,500	1	$3,500	
Install Pressure Transducer	EA	$2,500	1	$2,500	
Programming PLC for SCADA Upgrades	LS	$3,500	1	$3,500	
					$83,000
Mobilization, Overhead, and Profit	%	35%		$29,000	
Construction Subtotal					$112,000
Contingency - % of Construction Subtotal	%	30%		$34,000	
Total Construction Cost					$146,000
Permitting, Engineering and CMS* - % of Total Construction Costs (Misc.)	%	15%		$22,000	
Legal, Administration - % of Total Construction Cost	%	2%		$3,000	
Total Project Cost (rounded)					***$170,000***
				Total Well Cost (rounded)	**$170,000**
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Replacement Budget

Pipeline Replacement Costs		**Feet/year**
# feet of PVC, CI and DI pipeline		69,477
# feet of AC and Steel pipeline		19,166
Replacement Cycle (yrs)		75
# feet /year Total		1,182
Cost per Foot to Replace	$	120.00
Annual Pipeline Replacement Budget	$	141,829
Required Annual Budget Rounded		**142,000**

*valves and fittings are incidental to this replacement budget
**AC & Steel Pipe should be replaced at a faster rate

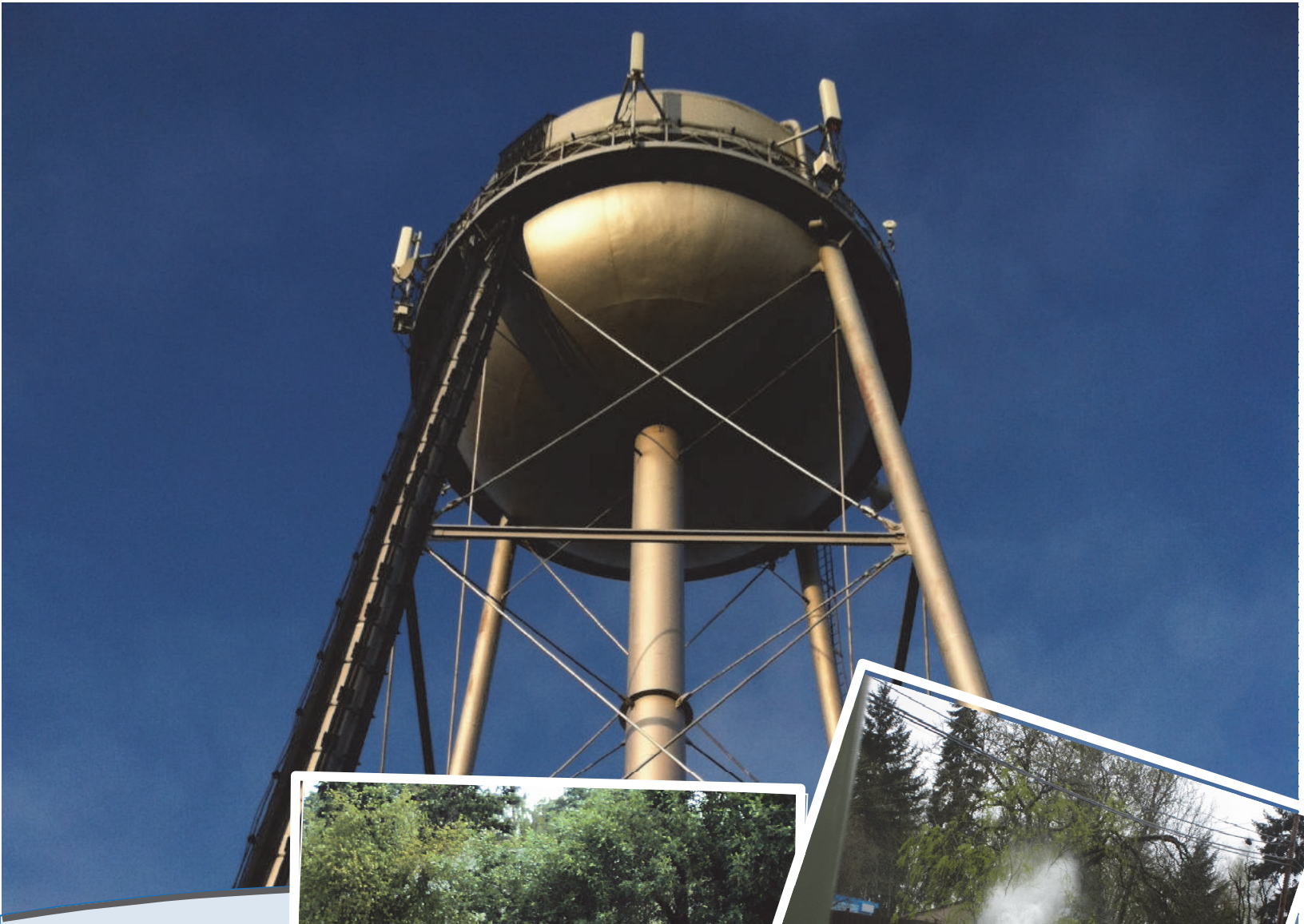
Fire Hydrant Replacement		
# Hydrants (2014)		124
Typical Life (yrs)		50
# Hydrants per year		2.48
Cost /Hydrant	$	4,500
Annual Budget (rounded)	**$**	**11,000**

Meter Replacement		
# Meters		1095
Typical life (years)		20
# replace/year		54.75
Typical cost/meter	$	250
Annual budget (rounded)	**$**	**14,000**

Tank Inspection and Cleaning		
Cleaning	$	3,000
Inspection	$	2,000
Frequency (yrs)		3
Typical cost/year	$	1,667
Annual budget (rounded)	**$**	**2,000**

Leak Detection		
Leak Detection Cycle (yrs)		8
% of system/year		13%
Typical cost/year (rounded)	$	5,000

174,000



Appendix F

Rates & SDCs

KELLER associates

F-1:
Existing Rate Structure

WATER STEPPED CHARGE CODE DEFINITIONS -- 02/05/2014

CODE	DESCRIPTION	USAGE	AMOUNT RATE	TAX MULTIPLIER
1	SF		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
2	DPLX		63.64	0.00000
	STEP 1	0	63.64000	
	STEP 2	14000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
3	SR RATE-SF		23.87	0.00000
	STEP 1	0	23.87000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
4	.75"SM N-R		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
5	16PLEX APRTMNTS		509.12	0.00000
	STEP 1	0	09.12000	
	STEP 2	112000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
6	1"SM N-R		53.14	0.00000
	STEP 1	0	53.14000	
	STEP 2	11690	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
7	1.5"SM N-R		76.38	0.00000
	STEP 1	0	76.38000	
	STEP 2	16800	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
8	2SM N-R ON ANY SIZE MTR		63.64	0.00000
	STEP 1	0	63.64000	
	STEP 2	14000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
9	12PLEX/12REG&0VAC		381.84	0.00000
	STEP 1	0	81.84000	
	STEP 2	84000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	

	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
10	MLL CRK EST-71SF&38SR=109		3166.28	0.00000
	STEP 1	0	66.28000	
	STEP 2	763000	0.00000	
	STEP 3	99999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
11	2"LRG N-R		169.64	0.00000
	STEP 1	0	69.64000	
	STEP 2	37310	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
12	SEWER ONLY-SF SR RATE		0.00	0.00000
	STEP 1	0	0.00000	
	STEP 2	0	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
13	SEWER ONLY-SF		0.00	0.00000
	STEP 1	0	0.00000	
	STEP 2	0	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
14	WTR ONLY-(SF/.75"N-R)		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
15	1.5"LRG N-R		76.38	0.00000
	STEP 1	0	76.38000	
	STEP 2	16800	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
16	SEWER ONLY-COUNTY SF		0.00	0.00000
	STEP 1	0	0.00000	
	STEP 2	0	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
17	DUPLEX-SF/SR		55.69	0.00000
	STEP 1	0	55.69000	
	STEP 2	14000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
18	.75"SM N-R+DPLX		95.46	0.00000
	STEP 1	0	95.46000	
	STEP 2	21000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
19	WNDMR MDWS-75SF&28SR=103		3054.86	0.00000

	STEP 1	0	54.86000	
	STEP 2	721000	0.00000	
	STEP 3	99999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
20	EVERGREEN EST-29SF&10SR=3		1161.48	0.00000
	STEP 1	0	61.48000	
	STEP 2	273000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
21	.75"SM N-R+SF		63.64	0.00000
	STEP 1	0	63.64000	
	STEP 2	14000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
22	8-PLEX		254.56	0.00000
	STEP 1	0	54.56000	
	STEP 2	56000	0.00000	
	STEP 3	99999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
23	WTRONLY-COUNTY SF/.75"N-R		63.64	0.00000
	STEP 1	0	63.64000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00600	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
24	SF ON SM N-R.75"MTR		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	99999999	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
25	.75"LRG N-R		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
26	1"LRG N-R		53.14	0.00000
	STEP 1	0	53.14000	
	STEP 2	11690	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
27	3-SM N-R ON.75"MTR		95.46	0.00000
	STEP 1	0	95.46000	
	STEP 2	21000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
28	.75"SM CHURCH		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	7000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	

	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
29	1"SM CHURCH		53.14	0.00000
	STEP 1	0	53.14000	
	STEP 2	11690	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
30	CLSD/TMP-OFF ON PRMS		0.00	0.00000
	STEP 1	0	0.00000	
	STEP 2	0	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
31	1.5"LRG CHURCH		76.38	0.00000
	STEP 1	0	76.38000	
	STEP 2	16800	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
32	6-SM N-R ON 1"MTR(0 VAC)		190.92	0.00000
	STEP 1	0	90.92000	
	STEP 2	42000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
33	2"LRG N-R(WTR ONLY)		169.64	0.00000
	STEP 1	0	69.64000	
	STEP 2	37310	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
34	.75"N-R+SF(BS)		31.82	0.00000
	STEP 1	0	31.82000	
	STEP 2	14000	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
35	1"LRG NR(WTR ONLY)		53.14	0.00000
	STEP 1	0	53.14000	
	STEP 2	11690	0.00000	
	STEP 3	9999999	0.00300	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
36			0.00	0.00000
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	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
37			0.00	0.00000
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	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
38	.75-2"PBLC AGNCY-NO CHRG		0.00	0.00000

	STEP 1	0	0.00000	
	STEP 2	0	0.00000	
	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
39			0.00	0.00000
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	STEP 4	0	0.00000	
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	STEP 6	0	0.00000	
40			0.00	0.00000
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	STEP 3	0	0.00000	
	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
41			0.00	0.00000
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	STEP 6	0	0.00000	
42			0.00	0.00000
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	STEP 4	0	0.00000	
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	STEP 6	0	0.00000	
43			0.00	0.00000
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	STEP 6	0	0.00000	
44			0.00	0.00000
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45			0.00	0.00000
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46			0.00	0.00000
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47			0.00	0.00000
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48			0.00	0.00000
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49			0.00	0.00000
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50			0.00	0.00000
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51			0.00	0.00000
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52			0.00	0.00000
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54			0.00	0.00000
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55			0.00	0.00000
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56			0.00	0.00000
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57			0.00	0.00000

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62			0.00	0.00000
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63			0.00	0.00000
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66			0.00	0.00000
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70			0.00	0.00000
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71			0.00	0.00000
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72			0.00	0.00000
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73			0.00	0.00000
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74			0.00	0.00000
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75			0.00	0.00000
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76			0.00	0.00000

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79			0.00	0.00000
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80			0.00	0.00000
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81			0.00	0.00000
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82			0.00	0.00000
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83			0.00	0.00000
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84			0.00	0.00000
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85			0.00	0.00000
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86			0.00	0.00000
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87			0.00	0.00000
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88			0.00	0.00000
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89			0.00	0.00000
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90			0.00	0.00000
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	STEP 6	0	0.00000	
91			0.00	0.00000
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92			0.00	0.00000
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93			0.00	0.00000
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94			0.00	0.00000
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95			0.00	0.00000

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	STEP 6	0	0.00000	
96			0.00	0.00000
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	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
97			0.00	0.00000
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	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
98	TMP-OFF W/O PREMISE		0.00	0.00000
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	STEP 4	0	0.00000	
	STEP 5	0	0.00000	
	STEP 6	0	0.00000	
99	CLSD W/O PREMISE		0.00	0.00000
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	STEP 6	0	0.00000	

F-2:
Existing SDC

2014 Annual Indexed Adjustment of Water, Sewer & Transportation SDC's

1/9/2014

ENR Construction Cost Index:	1/1/2014	9664.45
	1/1/2013	9437.27
	Change:	**227.18**

Percent Change: (227.18/9437.27)	**0.0241**

Previous Water SDC	Percent Change	Change Dollar Amount	New Water SDC	Imposed
$3,978.61	0.0241	$95.78	$4,074.39	$4,074.39

Previous Sewer SDC	Percent Change	Change Dollar Amount	New Sewer SDC	Imposed
$5,290.65	0.0241	$127.36	$5,418.01	$5,418.01

Previous Transportation SDC	Percent Change	Change Dollar Amount	New Transportation SDC	Imposed
$3,613.82	0.0241	$86.99	$3,700.81	$3,700.81

F-3:
Rate Analysis

City of Aumsville
Water System
Historical Revenues and Expenses

	Actual 2010-11	Actual 2011-12	Actual 2012-13	Budget 2013-14	Budget 2014-15
Revenues					
User charges	$ 515,694	$ 514,453	$ 552,346	$ 535,000	$ 585,000
Miscellaneous	$ 11,511	$ 13,115	$ 3,198	$ 11,750	$ 14,220
Water SDCs	52,186	38,368	$ 112,708	171,530	69,715
Earnings from Water Improvement Fund	1,185	1,463	$ 1,245	455	500
Total Revenues	580,576	567,399	669,497	718,735	669,435
Expenditures					
Personnel Services	268,050	285,211	298,397	334,069	370,435
Materials and Services	101,651	84,939	112,921	133,183	143,470
Capital Outlay (water fund)	18,779	2,501	52,006	17,000	18,500
Debt Service	30,045	30,045	30,045	30,045	30,505
Transfer to Vehicle/PW/OE/Administrative Fee to GF	5,000	15,478	17,554	24,390	24,966
Transfer to Water Improvements Fund	150,000	110,000	45,000	55,000	100,000
Adjustment to Account for Internal Nature of Trans	*(150,000)*	*(110,000)*	*(45,000)*	*(55,000)*	*(100,000)*
Contingency	-	-	-	15,611	45,849
Adjusted for what is actually anticipated to be spent					*(45,849)*
SDC (materials and services, Capital outlay)	27,314	6,374	4,610	351,533	246,166
Adjusted for what is actually anticipated to be spent					*(137,156)*
Materials and Services (water improvement fund)	12,219	21,017	10,249	100,238	201,390
Adjustment to Account for Internal Nature of Trans					-
Capital Outlay (water improvement fund)	17,122	4,261	136,149	153,000	49,822
Adjusted for what is actually anticipated to be spent					*(11,000)*
Total Expenditures	480,180	449,826	661,931	1,159,069	937,098
Net Change in Fund Balance	**$ 100,396**	**$ 117,573**	**$ 7,566**	**$ (440,334)**	**$ (267,663)**
Ending Fund Bal (water fund)	78,226	77,620	77,242	-	-
Reserved for Future Expenditure	208,558	294,743	194,590	-	-
Restricted Fund Balance (SDCs)	68,541	100,403	208,365	-	-
	355,325	472,766	480,197	-	-

City of Aumsville
Forecast of Revenues and Expenses
Cash Financing

	Budget 2013-14	Budget 2014-15	Forecast 2015-16	Forecast 2016-17	Forecast 2017-18	Forecast 2018-19	Forecast 2019-20
User Rate % Annual Increase		30.0%	20.0%	15.0%	3.0%	3.0%	3.0%
	31.82	**41.37**	**49.64**	**57.09**	**58.80**	**60.56**	**62.38**
Revenues							
User charges[1]	$ 535,000	$ 760,500	$ 912,600	$ 1,049,490	$ 1,080,975	$ 1,113,404	$ 1,146,806
Miscellaneous	11,450	14,220	14,220	14,220	14,220	14,220	14,220
Operating Revenue	546,450	774,720	926,820	1,063,710	1,095,195	1,127,624	1,161,026
Water SDCs	171,530	69,715	0	0	0	0	0
Water Improvement Fund	455	500	500	500	500	500	500
Total Revenues	718,435	844,935	927,320	1,064,210	1,095,695	1,128,124	1,161,526
Expenditures							
Personnel Services[2]	334,069	370,435	381,548	392,994	404,784	416,928	429,436
Materials and Services + Minor Capital Outlay[3]	150,183	161,970	166,829	171,834	176,989	182,299	187,768
Existing Debt Service	30,045	30,505	30,505	30,505	30,505	30,505	30,505
Transfer to GF (Vehicle/PW/OE/Admin)	24,390	24,966	25,715	26,486	27,281	28,099	28,942
Operating Expense	538,687	587,876	604,597	621,820	639,559	657,831	676,651
Capital Improvement Projects[4]	451,771	349,222	359,323	475,131	199,323	339,128	331,557
Replacement Program	0	0	20,000	20,000	100,000	125,000	149,648
Total Expenditures	990,458	937,098	983,920	1,116,951	938,883	1,121,959	1,157,855
Net Change in Fund Balance	**0**	**(92,163)**	**(56,600)**	**(52,741)**	**156,812**	**6,165**	**3,671**
Ending Fund Balance (water, reserve, and SDC funds)	494,668	402,505	345,905	293,164	449,976	456,141	459,812
Ending Fund Balance (if no add'l SDCs)	494,668	332,790	276,190	223,449	380,261	386,426	390,097

Notes:

1. Assumes increase in revenue comes soley from existing accounts; conservatively excludes minor additional revenue from new growth
2. 3 % annual increase in personnel services assumed
3. 3 % annual increase in materials and services assumed
4. Capital outlay based on 6-year CIP; includes 4% annual inflation of capital projects
5. Replacement Budget adjusted from recommended $169,000 to account for existing budget line items totaling $10,000. Also inflated cost 4% per year.

Capital Improvement Plan (Inflated Costs)

		2015	2016	2017	2018	2019	2020
Total CIP Improvements		***$184,000***	***$359,323***	***$475,131***	***$199,323***	***$339,128***	***$331,557***
Replacement Budget		*$0*	*$20,000*	*$20,000*	*$100,000*	125,000	149,648
Total Yearly Costs		**$184,000**	**$379,323**	**$495,131**	**$299,323**	**$464,128**	**$481,204**

City of Aumsville
Forecast of Revenues of Expenses
Debt Financing

	Budget 2013-14	Budget 2014-15	Forecast 2015-16	Forecast 2016-17	Forecast 2017-18	Forecast 2018-19	Forecast 2019-20
User Rate % Annual Increase		15.0%	15.0%	5.0%	5.0%	5.0%	5.0%
	31.82	**36.59**	**42.08**	**44.19**	**46.40**	**48.72**	**51.15**
Revenues							
User charges[1]	$ 535,000	$ 672,750	$ 773,663	$ 812,346	$ 852,963	$ 895,611	$ 940,392
Miscellaneous	11,450	14,220	14,220	14,220	14,220	14,220	14,220
Operating Revenue	546,450	686,970	787,883	826,566	867,183	909,831	954,612
Water SDCs	171,530	69,715	0	0	0	0	0
Water Improvement Fund	455	500	500	500	500	500	500
Total Revenues	718,435	757,185	788,383	827,066	867,683	910,331	955,112
Expenditures							
Personnel Services[2]	334,069	370,435	381,548	392,994	404,784	416,928	429,436
Materials and Services + Minor Capital Outlay[3]	150,183	161,970	166,829	171,834	176,989	182,299	187,768
Existing Debt Service	30,045	30,505	30,505	30,505	30,505	30,505	30,505
Transfer to GF (Vehicle/PW/OE/Admin)	24,390	24,966	25,715	26,486	27,281	28,099	28,942
Operating Expense	538,687	587,876	604,597	621,820	639,559	657,831	676,651
Capital Improvement Projects[4]	451,771	349,222	*111,089*	*111,089*	*111,089*	*111,089*	*111,089*
Replacement Program[5]	0	0	20,000	20,000	100,000	125,000	149,648
Total Expenditures	990,458	937,098	735,686	752,909	850,649	893,920	937,387
Net Change in Fund Balance	**0**	**(179,913)**	**52,696**	**74,157**	**17,034**	**16,411**	**17,724**
Ending Fund Balance (water, reserve, and SDC funds)	494,668	314,755	367,451	441,608	458,642	475,053	492,777
Ending Fund Balance (if no add'l SDCs)	494,668	245,040	297,736	371,893	388,927	405,338	423,062

Notes:

1. Assumes increase in revenue comes soley from existing accounts; conservatively excludes minor additional revenue from new growth
2. 3 % annual increase in personnel services assumed
3. 3 % annual increase in materials and services assumed
4. Assumes cash financing of FY 2014-15 improvements, and debt financing (20 year, 3% interest) the balance of the FY improvements in FY 2015-16. The project terms, including interest period and amount of capital to be financed, are shown here to generally illustrate the potential budget and user rate impacts. Actual impacts to the City will vary based on the source of funding and associated terms. Keller Associates recommends that the City utilize the professional services of a SEC registered municipal advisor in conformance with the Dodd-Frank Wall Street Reform and Consumer Protection Act prior to selecting the appropriate financing source(s) and associated terms, seeking authority to indebt the City, or financially obligating the City in any way.
5. Assumes target replacement budget ($174k in 2014 dollars) is 75% funded by FY 2019-20.

Capital Improvement Plan (Inflated Costs)

		2015	2016	2017	2018	2019	2020
Total CIP Improvements		***$184,000***	***$359,323***	***$475,131***	***$199,323***	***$339,128***	***$331,557***
Replacement Budget		*$0*	*$20,000*	*$20,000*	*$100,000*	125,000	149,648
Total Yearly Costs		**$184,000**	**$379,323**	**$495,131**	**$299,323**	**$464,128**	**$481,204**

F-4:
SDC Analysis

City of Aumsville
Water Master Plan

System Development Charge = Growth Component + Reimbursement Component

Existing & Future EDUs*	
Estimated 2014 Population	3895
People per Household (2010 Census)	3.03
Residential Households	1285
Existing System EDUs (Residential is 95% of Peak Demand)	**1353**
2034 Population	5673
2034 Additional EDUs (Assumes residential is 95% of new EDUs)	618
2034 EDUs	**1971**

SDC - Growth Component		
Total SDC Eligible Projects (Priority 1, 2, and 3)	$2,498,000	
EDU Increase from Existing to 2034	618	
Total Growth Component ($/EDU)		**$4,042**

SDC - Reimbursement Component

Filter Project	
Construction Cost	$275,100
Present Value without Depreciation, Tank Construction Cost (0 years at 3%	$275,100
Depreciation (0 years of 30 year Design Life)	$0
Present Value	$275,100
Existing System Demand (gpm) (max day)	557
Existing System Demand per EDU (gpm)	0.41
Total Filter Capacity (gpm)	1,000
Total EDUs Served by Filter Capacity	2,429
Remaining Filter Capacity (EDUs)	1,076
Cost per EDU	**$113**

Chlorination Project	
Construction Cost	$337,300
Present Value without Depreciation, Tank Construction Cost (7 years at 3%	$414,836
Depreciation (7 years of 30 year Design Life)	($96,795)
Present Value	$318,041
Existing System Demand (gpm) (max day)	557
Existing System Demand per EDU (gpm)	0.41
Total Capacity (Limited by Filter) (gpm)	1,000
Total EDUs Served	2,429
Remaining Capacity Available based on Capacity (Limited by Filter) (EDUs)	1,076
Cost per EDU	**$131**

SCADA Project	
Construction Cost	$44,657
Present Value without Depreciation, Tank Construction Cost (1 years at 3%	$45,997
Depreciation (1 years of 20 year Design Life)	($2,300)
Present Value	$43,697
Existing EDUs	1,353
2034 EDUs	1,971
Remaining Booster Station Capacity (EDUs)	618
Cost per EDU	**$22**

Total Reimbursement Component ($/EDU)	**$266**

Total SDC (Growth + Reimbursement)	
Recommended SDC Amount ($/EDU)	**$4,308**

*EDU: Equivalent Dwelling Unit

Compare to Existing SDC ($/EDU) **$4,074**