Water System Asset Management Plan
Wolfeboro, New Hampshire

DRAFT

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2112.00

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Appendices

Executive Summary

Asset Management (AM) is an approach to maintaining aging infrastructure through informed decision making. AM Plans have many benefits and are crucial to utilities for cost effectively maintaining their aging infrastructure. The framework of this AM plan is the five core steps of Asset Management (EPA, 2008).

- **Asset Inventory -** What does the system own and what is its condition?
- **Level of Service -** What level is needed and how does the system actually perform?
- **Critical Assets -** What are the most important risks to manage?
- **Life Cycle Costing -** What will it cost and when?
- **Long-Term Funding Strategy -** How does the system pay the costs?

This Asset Management Plan is intended to establish an initial Water System AM Program for Wolfeboro to make more informed decisions for sustainable operation. The scope of this initial effort includes the horizontal water assets (i.e. water mains) and vertical assets (i.e. South Main Street Tank, PRV Station, and the Middleton Road BPS) within the Town's water distribution system. The Town's water treatment plant was previously evaluated, and the evaluation is attached.

<u>Asset Inventory</u>

The Asset Inventory and Assessment is the necessary first step of AM. The inventory collects and organizes data in a useful way to make better management decisions. The Town has inventoried its water distribution assets in Excel as well as in DOForms. Underwood Engineers and Town staff, visited the vertical assets (i.e. South Main Street Tank, PRV Station, and the Middleton Road BPS) and inventoried their assets (January 11, 2017).

<u>Level of Service</u>

The Level of Service (LOS) statement for the water system defines the way in which the utility managers and operators want the system to perform over the long term under normal circumstances (NMEFC, 2006). The LOS includes standards for regulatory compliance. The suggested LOS is summarized in Table ES-1.

Table ES-1. Suggested Level of Service Statement

Area of Service	Service Performance	Target Performance Level
Quality	Maintain clean and safe drinking water in compliance with State and Federal Regulations	100% of the time
	Maintain aesthetically high quality water within Secondary Standards as much as possible	100% of the time
Availability	Make water available to as many residents in Wolfeboro as economically feasible Fire flows will be maintained in accordance with ISO requirements except in extreme instances where cost is prohibitive.	100% of the time
Supply Capacity /Conservation	Minimize complete watering bans Minimize non-revenue water and manage bleeders Meet 10 State Standards as referenced by State Regulations • Meet average day demands with 1 treatment train out of service Meet maximum day demands with all wells in service	Except for extreme shortages
Water Pressure	The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 15 feet The minimum working pressure in the distribution system should be 30 psi and the normal working pressure preferably 60 to 100 psi Max pressure 150 psi Min pressure 20 psi during fire flows	95% of time
Reliability	Notification of 48 hours prior to planned shutdowns Respond to supply or quality issues affecting a significant level of customers within 1 to 2 hours Repair unplanned shutdowns and breaks within 24 hours where feasible	95% of time

Critical Assets

The purpose of defining critical assets is to determine where limited resources should be allocated to meet the required LOS. A common approach to determining risk is by the combination of probability of failure and consequence of failure. The most critical assets, with the highest risk score, are those that are more likely to fail and have major consequences for failure. Replacing these assets over others may provide the greatest benefit (reduction in overall system risk).

Using the methodology described in Section 4.1 and Grading Matrices, the water main assets were scored for Probability of Failure and Consequence of Failure and given a Risk Score. Results were incorporated into the Asset Management Inventory spreadsheet (**Appendix A**).

The highest risk assets and recommended replacement years are summarized in Table ES-2.

Table ES-2. Critical Assets (Risk Score > 20)

Asset	Recommended Action	Priority	Year of Action
Dockside	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe	1	2018
Estabrook Road	Possible 4" pipe exceeding expected life to be replaced with 6" DI pipe.	1	2018
Green Street	6" main installed in 1900 to be replaced with 6" DI pipe	1	2019
Central Ave	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe (from Depot Street to S. Main Street)	1	2020
Pine Street	Replace 4" CI pipe installed in 1890 with new 8" DI Pipe.	1	2018
N. Main Street*	Downtown Bridge to Forest Rd. (replace 8" CI pipe installed in 1889 with 12" DI pipe)	1	2021

*Recommended action based on "Water Model Update and Extended Time Calibration" (UE, 2013) recommendations. It should be noted that increasing the size of the Main Street pipe will cause lower residual pressures at higher elevations until a 12" loop is constructed north of Downtown.

Life Cycle Costing

Life Cycle costing was performed for the water system assets in the Town of Wolfeboro. The methodology is described in Section 5. The life cycle costing step evaluates long term capital needs based on material, age, and general standards. Life cycle costing provides a defensible basis to support requested funding levels for sustainability of the system. Total water system replacement costs are summarized in Table ES-3.

Table ES-3. Horizontal Asset Replacement Costs by Decade

Replacement Decade	Length (ft)	Cost
2010	13,012	$4,357,000
2020	1,250	$406,000
2030	1,250	$406,000
2040	6,420	$2,150,000
2050	1,250	$406,000
2060	1,690	$547,000
2070	20,886	$6,728,000
2080	42,798	$14,423,000
2090	43,330	$15,881,000
2100	41,417	$15,368,000
2110	32,310	$11,685,000
2120	6,000	$1,963,000
TOTAL	211,609	$74,287,000
Average cost per year (120 years)		**$619,000**

Table Es-3 above summarizes the total cost per decade to replace horizontal assets (i.e. water mains, valves, hydrants, etc.). Vertical assets (i.e. booster pumping stations, PRV's, water tanks, etc.) are summarized in Table Es-4 below:

Table ES-4. Vertical Asset Replacement Costs by Decade

Replacement Decade	PRV Station	Middleton Road BPS	South Main Street Tank	WTF
2010	$24,000	$33,000	$36,000	$506,000
2020	$18,000	$10,000	$480,000	$1,091,000
2030	$112,000	$50,000	$216,000	$1,329,000
2040	$16,000	$280,000	$353,000	$1,977,000
2050	$144,000	$35,000	$2,216,000	$1,527,000
2060	$50,000	$12,000	$180,000	$741,000
2070	$9,000	$35,000	$0	$4,112,000
2080	$400	$48,000	$458,000	$1,019,000
2090	$24,000	$35,000	$37,000	$2,533,000
2100	$50,000	$299,000	$471,000	$627,000
2110	$144,000	$37,000	$97,000	$1,534,000
2120	$6,000	$0	$180,000	$949,000
TOTAL	$597,000	$866,000	$4,722,000	$17,945,000
Average cost per year (120 years)	**$5,000**	**$7,000**	**$39,000**	**$150,000**

10-Year Water System CIP

Table ES-5 shows the water system assets that should be included in a 10-year Capital Improvements Plan (CIP).

Table ES-5. Water System 10 Year CIP

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Water Mains (Pipes Exceeding Typical Useful Life and Risk Score > 20)												
Dockside	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe. (55 LF)	1	$18,000									
Estabrook Road	Possible 4" pipe exceeding expected life to be replaced with 6" DI pipe. (280 LF)	1	$90,000									
Green Street	6" main installed in 1900 to be replaced with 6" DI pipe. (710 LF)	1	$100,000	$130,000								
Central Ave	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 8" DI pipe (from Depot Street to S. Main Street) (300 LF)	1			$110,000							
Pine Street	Replace 4" CI pipe installed in 1890 with new 8" DI Pipe. (820 LF)	1	$290,000									
N. Main Street	Downtown Bridge to Forest Rd. (replace 8" CI pipe installed in 1889 with 12" DI pipe) (4,370 LF)	1			$550,000	$402,000	700,000					
Mains with Risk Score > 15												
Willow Street	Replace 4" Steel Pipe installed in 1940 with new 6" DI Pipe from Center St intersection (1,280 LF)	2								$142,000		
Center Street	Replace 4" Steel Pipe installed in 1891 with new 6" DI Pipe from Elm Street to Birch (7,600 LF)	2								$495,000		
Depot Street	Replace 6" CI pipe installed in 1890 with 6" DI pipe (180 LF)	2						$58,000				
Oak Street	Replace 6" CI pipe installed in 1900 with new 6" DI pipe (330 LF)	2						$110,000				
Pleasant Street	Replace 6" CI pipe installed in 1900 with new 6" DI pipe (Northwest of Oak St., 1,000 LF)	2						$322,000				
River Street	Replace 6" CI pipe installed in 1900 with new 6" DI Pipe (from Center St to Hydrant, 260 LF)	2						$84,000				
South Main Street	Replace 8" CI pipe installed 1900 with new 8" DI pipe (Bridge to Pickering Corner 1,500 LF)	2							$525,000			
Seasonal Service Lines	Allowance to repair or replace seasonal service lines	3			$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
	HORIZONTAL ASSET SUBTOTAL		**$498,000**	**$130,000**	**$740,000**	**$482,860**	**$780,000**	**$654,000**	**$605,500**	**$717,000**	**$80,000**	**$80,000**

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Vertical Assets												
PRV Station	Minor replacements including unit heater, exhaust fan and louvre, dehumidifier, water meter.	3				$41,300						
Middleton Road BPS	Perform Pump Station Improvements described in UE letter dated 8/28/14	3		$550,000								
South Main Street Tank	Minor equipment replacements as they exceed expected life (Tablet Chlorinator, analyzer, exhaust fan, etc.)	3			$45,500							
	VERTICAL ASSET SUBTOTAL		**$0**	**$550,000**	**$45,000**	**$41,300**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Water Treatment Facility												
Miscellaneous Process Components	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043
Standard Chemical Feed Systems	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750
Bulk Chemical Storage	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.									$15,000		
Process Equipment	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831
Instrumentation Except Analytical	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323
Control Panels	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$142,500									
Polymer Feed System	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$15,000						
Clarifiers	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.											$130,000
Filters	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$50,000	
Treatment Unit Underdrains	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$100,000						
SCADA Computers	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$15,000							
Standby Generator	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$142,500	
Electrical (Filter Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$60,000	

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
HVAC (Filter Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$112,500	
Doors and Windows	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$70,350	
Mower/Blower	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$2,700							
ATV	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.								$9,000			
Pickup Truck	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$20,000	
HVAC (Pump Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$20,000	
Roof (Pump Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$5,700	
Fence and Gate	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$43,000	
Water Tank	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$150,000						
Laboratory Equipment	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Paving	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$31,800							
	WATER TREATMENT FACILITY SUBTOTAL		**$174,447**	**$31,947**	**$81,447**	**$296,947**	**$31,947**	**$31,947**	**$40,947**	**$61,947**	**$555,997**	**$161,947**
Water Department Equipment and Vehicles												
Vehicle Replacements	Replacement cost for Vehicles		$75,000			$21,000	$30,000			$25,000		$125,000
Water Department Equipment	Replacement cost for Equipment									$5,000		
	VEHICLE AND EQUIPMENT SUBTOTAL		**$75,000**			**$21,000**	**$30,000**			**$30,000**		**$125,000**
	TOTAL		**$747,447**	**$711,947**	**$866,447**	**$842,107**	**$841,947**	**$685,947**	**$646,447**	**$808,947**	**$635,997**	**$366,947**

1. Costs based on complete replacement.
***Costs are in 2017 dollars**

Long-Term Funding

Since a majority of the replacement costs will occur after 2070, the average annual cost to be set aside for future water main projects can be divided into two planning periods (2010s-2060s and 2070s-2120s). Planning Period 1 (2010s-2060s) will require a total of $30,615,000 worth of complete asset replacement while Planning Period 2 (2070s-2120s) will require $89,965,000.

The above cost estimates are based on complete water main replacement, which include trenching, road reconstruction, new piping, valves, and hydrants and replacement of complete systems of vertical assets. The long term funding would be as follows:

- **Planning Period 1**
  - 0-60 years
  - Approximate total cost for rehabilitation and replacement = $30,615,000
  - Approximately $510,000 needed per year
- **Planning Period 2**
  - 60-120 years
  - Approximate total cost for rehabilitation and replacement = $89,965,000
  - Approximately $1,499,000 needed per year

Alternatively, the Town could save and/or invest $1,005,000 per year (total planning cost spread evenly over 120 years).

All costs are presented in 2017 dollars.

Implementation and Communication

An AM Plan is a working, living document, constantly being updated. Both the staff and customers provide important information that can help to keep AM effective. A communication plan lays out how to get this information, and make sure that both staff and customers understand the importance of AM. A suggested communication plan is shown below (Table ES-6):

Table ES-6. Communication Plan

Audience	Outreach Strategies
Internal - Staff	• Conduct team meetings on strategic goals, record keeping, and importance of asset management. • Develop record keeping protocols within DOForms of repairs – make it easy to record important information.
External - Customers	• Create system to map location of complaints in order to suggest future improvement needs. • Notify customers of system updates (projects, issues, construction location/time) through the following medias: ○ System water bills ○ Brochures ○ Local newspapers

Recommendations

AM Plan Implementation and Future Tasks

- Continue to collect and update asset data and condition assessment in GIS
  - Record service and failure history for assets to refine the estimated useful life. These records can be used to update asset data.
- Apply AM principles (criticality, risk assessment, remaining useful life, etc.) to lower-tier assets (i.e. valves, hydrants, services).
- Monitor performance data, complaints, etc. to ensure LOS is being met, and refine LOS Statement as needed.
- Update critical assets as renewals are made and information is collected.
  - As assets are replaced and refurbished, update the "Probability of Failure" ranking to identify which assets are most critical.
- Update life cycle costs and budgeting as needed.
- Submit plan to DES for Asset Management Grant Reimbursement.
- Apply for future rounds for AM Grant funding as appropriate.

AM Communication

- Establish a Communication Program for customers, demonstrating the value of service and justifying the funding to sustain needs. Program elements may include:
  - Distribute AM brochure to customers.
  - AM content on website.
  - Public information meetings for major projects.
  - Customer surveys.
- Educate and inform all staff on AM principles and process.
- Conduct team meetings on strategic goals, record keeping, and asset management decisions.
- Allow asset information to be accessible and shared by staff.

Administrative Tasks

- Closely monitor assets that have exceeded their life expectancy, and service a critical part of the Town.
- Perform a water rate evaluation to assess the potential impact of the recommendations of this report.

CIP – Near Term Projects

- Program the recommended projects for the system (Section 6.1) into the CIP.
- Evaluate cost effective alternatives for proposed projects.
- Refine the scope, cost, and schedule for projects.
- Update CIP funding needs in future rate evaluations.
- Implement recommended capital improvements.

Long Term Funding

- Increase annual capital reserve contributions to $510,000 per year for Planning Period 1 and $1,499,000 per year for Planning Period 2 to support long term asset renewals unless current CIP expenditures meet recommended asset replacement/rehabilitation levels.
- Alternatively, the Town could save and/or invest $1,005,000 per year (total planning cost spread evenly over 120 years).
- The required capital reserve depends on the level of future risk that is accepted.

1. INTRODUCTION

Safe and reliable drinking water is critical to public health, economic prosperity, and quality of life in our communities. Significant investments have been made to build and expand water infrastructure, but these systems are aging. Many of these investments are not being sustained with long-term capital planning for replacement. There is growing recognition that utilities will be faced with excessive costs to maintain service.

Asset Management (AM) is an approach to mitigating the infrastructure challenge and making informed decisions. Asset Management programs are increasingly being developed by utilities to cost effectively maintain their aging infrastructure.

1.1. What is Asset Management?

Asset Management is a way of doing business intended to ensure the long-term sustainability of the water system. The goal of AM is to maintain a desired level of service for what you want your assets to provide at the lowest life cycle cost (EPA, 2008).

Successful Asset Management planning brings together the key elements to managing a water system sustainably:

- Stakeholders - from staff to customers
- Budgeting and Funding
- Sustainable Practices
- Information and Data Control

AM is a way of doing business to provide the required level of service in the most cost effective way.

1.2. Benefits

Benefits that Wolfeboro intends to achieve by implementing an AM Plan include:

- Improving system knowledge and data.
- Meeting service expectations and regulatory requirements.
- More efficient allocation of capital funds to critical assets.
- Prolonging asset life and aiding in rehabilitate/repair/replacement decisions through efficient and focused maintenance and replacements.
- Establishing defensible budgets for long-term system maintenance.

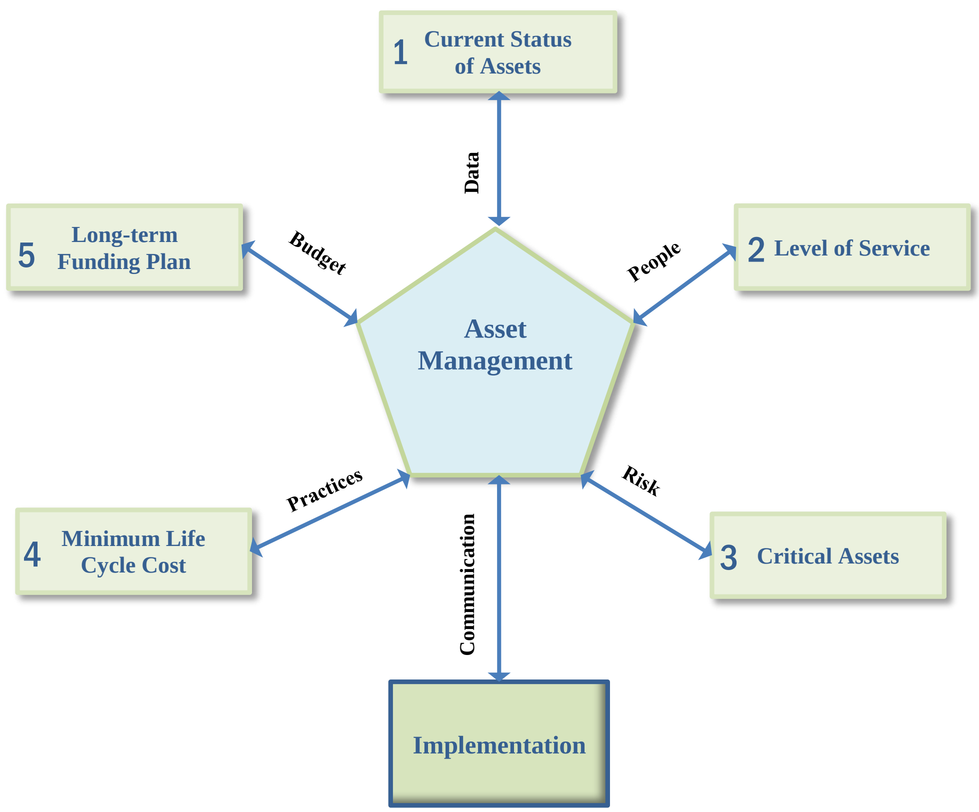
1.3. Core Components

The framework of this AM plan is the five core steps of Asset Management (EPA, 2008).

- **Asset Inventory -** What does the system own and what is its condition?
- **Level of Service -** What level is needed and how does the system actually perform?
- **Critical Assets -** What are the most important risks to manage?
- **Life Cycle Costing -** What will it cost and when?
- **Long-Term Funding Strategy -** How does the system pay the costs?

The development of the plan is followed by Implementation, an ongoing process of action, evaluation, and revision (Figure 1).

Figure 1. Flow Chart for the Core Steps of Asset Management



1.4. Goals

This Asset Management Plan is intended to establish an initial AM Program for Wolfeboro to make more informed decisions for sustainable operation. The Town will be able to build off this guide and expand the AM Plan to the entire system including lower tier assets (i.e. valves, hydrants, etc.). Goals for the AM Plan as outlined in the scope of work include:

- Establish scoring matrices and criteria for probability of failure and consequence of failure. Apply the matrices to the Town's major water system assets to determine the critical assets. Matrices can be used as an example for the rest of the system.
- Identify criteria for the level of service to be maintained.
- Identify critical assets and priority projects for replacement/rehabilitation.
- Evaluate life cycle costs for all water system assets.
- Identify long term planning and funding strategies for improvements of water system assets that are in line with the fiscal capacity of Wolfeboro.
- Identify a communication plan to inform customers of the asset management plan
- Identify a training plan for Town staff.

Keys to Successful AM

Keep it simple
Form a living document
Bring everyone on board

1.5. Related Asset Management Work

The Town has an existing asset inventory in GIS and Excel.

This Asset Management plan complements and builds on other previously completed or ongoing work including:

- Previous work by Woodard and Curran, 2013
- "Water Treatment Facility (WTF) Capital Improvements Plan (CIP)" by Underwood Engineers, 2017
- "Middleton Road Booster Pumping Station (BPS) Evaluation" by Underwood Engineers, 2014
- "Water Model Update and Alternatives Evaluation" by Underwood Engineers, 2013

2. ASSET INVENTORY

The Asset Inventory and Assessment is the necessary first step of AM. The inventory collects and organizes data in a useful way to make better management decisions.

The following sources of information were used to develop a detailed inventory of Wolfeboro's assets (**Appendix A**):

- Water main data provided by Wolfeboro including, location, age, size, and material.
- Seasonal service line data provided by Wolfeboro including location, age, size and material.
- Vertical asset inventory developed by UE and Town Staff during site visits (January 11, 2017)
- Additional assets attributed to the Town's Water Department.
- Asset criticality built off of previous reports (Woodard and Curran, 2013) as well as by Underwood Engineers.
- Discussions with Town Staff
- Previous engineering reports by UE and others

Information collected includes:

- List of assets
- Location
- Condition
- Age
- Remaining useful life
- Service history
- Replacement cost
- Noteworthy issues

2.1. Horizontal Water Asset Overview

The Town of Wolfeboro's horizontal assets are made up of water mains, hydrants, and valves. The scope of this project focused primarily on the Town's water distribution mains for the horizontal assets. Based off of water main inventories provided by the Town, Wolfeboro currently owns and operates approximately 211,609 LF (40 miles) of water mains of various materials, ages, and sizes. Some of the water mains have exceeded their life expectancy, and are in need of replacement.

Tables 1 and 2 below summarize the entire distribution system data by material and size. Although material and age often correlate poorly with failure, this information may help to locate older more critical pipes in the future as pipe break data is documented.

Table 1. Water Main Length by Material

Material	Length (Feet)	Percent of system
CI	70,328	33%
DI	122,868	58%
HDPE	2,470	1%
Wrought Iron	280	0%
Steel	1,540	1%
Galvanized	190	0%
Steel OD	520	0%
Unknown	13,413	6%
Total	**211,609**	**100%**

Table 2. Water Main Length by Size

Size	Length (Feet)	Percent of System
4	4,537	2%
6	75,122	36%
8	44,280	21%
10	22,240	11%
12	65,430	31%
Total	**211,609**	**100%**

2.1.1.Seasonal Water Services

In addition to the approximately 40 miles of water mains owned by the Town, there are approximately 8 miles of seasonal service lines. Due to the seasonal nature of the Town's population, several areas of the Town are served by these lines. The service lines vary between 1 to 2 inches in diameter and are primarily plastic in material. During the winter months when the seasonal residents leave Wolfeboro, the Town shuts down theses services. The installation of the seasonal lines vary between being buried below ground as well as installed above ground.

2.1.2.Privately Owned Water Mains

In addition to the approximately 40 miles of water mains owned and maintained by the Town of Wolfeboro, there are approximately 10 miles of water mains that are privately owned. The Town provides treated water to these private mains but does not maintain them. The private mains were not evaluated as part of this asset management plan.

2.2. Vertical Assets Overview

The Town's water system includes the following facilities:

- South Main Street Water Storage Tank
- PRV Station
- Middleton Road Booster Pumping Station
- Water Treatment Facility

- Upper Beech Pond Reservoir

2.2.1. ***<u>South Main Street Water Storage Tank</u>***

The 0.5 MG stand pipe water storage tank on South Main Street appears to be in good condition. The Tank, manufactured by Chicago Bridge and Iron, was installed in 1955. In 2008 several modifications were made to the site including the addition of a Solarbee mixer installed within the Tank which is used to improve the water quality within the tank and water system. A control building was built on the site in 2008 as well containing disinfection equipment for the tank, chlorine analyzers, electrical controls, and piping. A list of the assets attributed to the South Main Street Tank can be found in Appendix A.

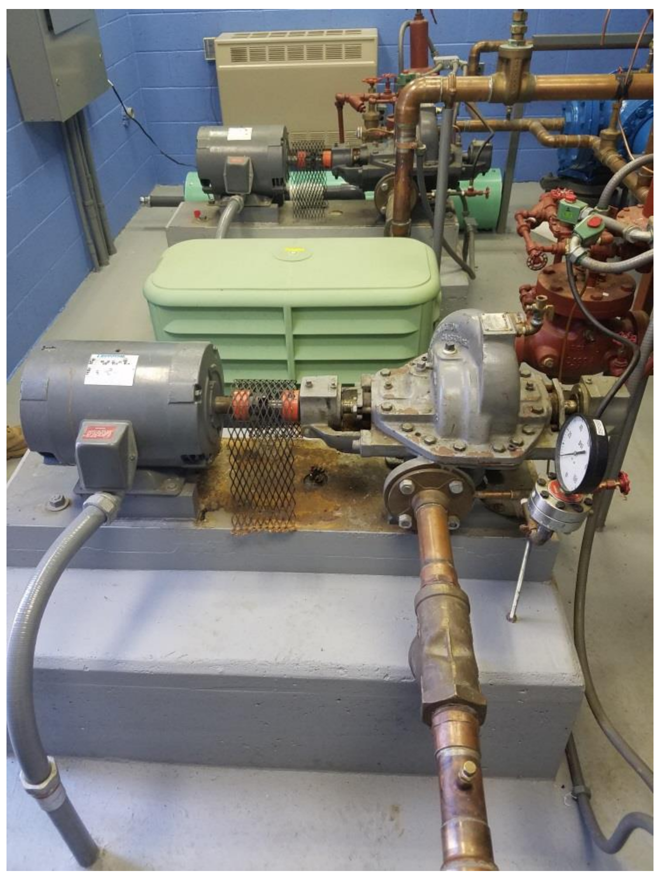


2.2.2. ***<u>Pressure Reducing Valve (PRV) Station</u>***

The Town of Wolfeboro maintains a PRV Station on Pine Hill Road. The station was built in 1995 and is used to reduce the system pressure from the elevation of the Water Treatment Facility before it enters the water distribution system within the Town. The station itself is in good condition and does not appear to require any major replacements within the next 5 years. The list of assets associated with the PRV Station is located in Appendix A.

2.2.3. Middleton Road Booster Pumping Station

The Middleton Road Booster Pumping Station (BPS) was built in 1989 and is currently used to increase the system pressure for the services at the end of Middleton road with two (2) 3hp jockey pumps (replaced in 2010 and 2016). In addition to the jockey pumps two Worthington booster pumps were installed with the station. The Worthington pumps and their controls are currently inactive. A list of the existing BPS assets and their conditions are provided in Appendix A.



In August 2014, Underwood Engineers evaluated increasing the fire flows of the Middleton Road area at the request of the Town. The evaluation concluded that the existing Worthington Pumps and jockey pumps were unable to provide the 1,000 gpm design fire flow while maintaining a minimum residual pressure of 20 psi within the system as requested by the Town. Underwood Engineers recommended replacing the Worthington Pumps with fire pumps capable of providing the requested fire flow in addition to other modifications to the BPS. For the purposes of this Asset Management Plan, the improvements recommended to increase fire flow and associated costs are used within the near term CIP. A copy of the Middleton Road Booster Pumping Station (BPS) Evaluation is provided in Appendix D.

2.2.4. Water Treatment Facility (WTF)

The Town's Water Treatment Facility (WTF), is located on Northline Road. The WTF consists of three (3) separate buildings.

- Water Treatment Filter Building
- Meter/Chlorination Building
- Pump Building

The WTF treats the Town's water supply from Upper Beech Pond and provides storage in a 1.0 MG concrete storage tank prior to being delivered to the Town's distribution system. In January 2017 Underwood Engineers provided an evaluation of the WTF to the Town and defined a Capital Improvements Program (CIP) for the WTF. The recommended WTF CIP from the 2017 memo has been incorporated into the overall 10-year CIP in this Asset Management Plan.

2.2.5.Upper Beech Pond

The Town's water supply is the Upper Beach Pond Reservoir. The Reservoir site contains yard piping (including valves and blowoff structures) and supplies raw water to the Town's WTF by two (2) 12" mains to be treated prior to being delivered by the Town. The two (2) 12" mains expected life cycle costs are included in the Water Main inventory provided in Appendix A.

2.2.6.Water Service Meters

The Town maintains approximately 2,605 meters within distribution system. The typical lifespan for a service meter is approximately 20 years. It should be noted that the Town maintains an inventory of their service meters. For the purpose of this report service meter costs were estimated at $500 each (Engineering and Contingency not included) and include installation of the meter as well as MIU.

2.2.7.Other Water System Assets

In addition to the other assets described, the Town's Water Department maintains additional equipment necessary to provide its standard level of service. The following assets are included in this asset management plan:

- Vehicles
- Backhoe
- Repair Equipment
- Leak Detection Equipment

2.2.8.AM Inventory Worksheet

The assets initially managed under this plan are summarized in the Asset Inventory worksheets (**Appendix A**). Data collection and revision should continue as part of Wolfeboro's operating routine.

2.2.9.Condition

As an asset's condition deteriorates it is more likely to fail. Condition scores were assigned based on previous assessments done by the operators and discussions with operators. See Section 4 for condition scoring of assets.

2.2.10. Remaining Useful Life

Remaining useful life for each asset was initially determined by subtracting the Number of Years in Service from the typical useful life assuming routine maintenance (Table 4). The estimated lifetimes should be refined as Wolfeboro builds experience and collects data.

Table 4. Estimated Useful Lives of Water Mains

Material	Years
ACP	100
CIP	115
DI	110
PVC	100
HDPE	75
Wrought Iron	100
Steel	100
Galvanized	100
Steel OD	100
Unknown	100
Services	30

Table 5. Estimated Useful Lives of Vertical Assets

Material	Years
Buildings	50
Pumps	20
Yard Piping	100
Electrical	25
Storage Tanks	100
Valves	50
Treatment Equipment.	15-20

References: AWWA Buried No Longer, UE experience, Manufacturer's specs

3. LEVEL OF SERVICE

3.1. Introduction

The Level of Service (LOS) Statement defines the way in which the utility managers and operators want the system to perform over the long term and under normal circumstances (NMEFC, 2006). The LOS includes standards for regulatory compliance. Specific service items should provide criteria for measuring performance. Standards included in the LOS should also be relevant, achievable, and in line with customers' expectations. These standards can grow as Asset Management continues to be implemented.

Important functions of the Level of Service include:

- Determining critical assets
- Assessing utility performance
- Linking costs and services
- Communicating the system’s operation to customers

3.2. Level of Service Statement

To build the initial LOS Statement, key areas of service are suggested in Table 6.

Table 6. Suggested Level of Service Statement

Area of Service	Service Performance	Target Performance Level
Quality	Maintain clean and safe drinking water in compliance with State and Federal Regulations	100% of the time
	Maintain aesthetically high quality water within Secondary Standards as much as possible	100% of the time
Availability	Make water available to as many residents in Wolfeboro as economically feasible Fire flows will be maintained in accordance with ISO requirements except in extreme instances where cost is prohibitive.	100% of the time
Supply Capacity /Conservation	Minimize complete watering bans Minimize non-revenue water and manage bleeders Meet 10 State Standards as referenced by State Regulations • Meet average day demands with 1 treatment train out of service Meet maximum day demands with all wells in service	Except for extreme shortages
Water Pressure	The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 15 feet The minimum working pressure in the distribution system should be 30 psi and the normal working pressure preferably 60 to 100 psi Max pressure 150 psi Min pressure 20 psi during fire flows	95% of time
Reliability	Notification of 48 hours prior to planned shutdowns Respond to supply or quality issues affecting a significant level of customers within 1 to 2 hours Repair unplanned shutdowns and breaks within 24 hours where feasible	95% of time

4. CRITICAL ASSETS AND PRIORITY PROJECTS

Often there are not financial and physical resources to address the needs of all the infrastructure at the same time. Some assets are very important to system operation while others are not. The purpose of defining critical assets is to determine where limited resources should be allocated to meet the required LOS. Wolfeboro recognizes that its critical infrastructure includes the supply, storage, and transmission mains. The assets among these with the highest criticality or risk should be prioritized for improvements.

4.1. Procedure for Ranking/Criteria

A common approach to determining risk is by the combination of probability of failure and consequence of failure (NMEFC, 2006). These measures are defined in the sections that follow. Risk scoring provides a defensible prioritization for replacement, rehabilitation, or maintenance and is graphically represented in Figure 2. "Risk" is short for "Business Risk Exposure".

Risk = Probability of Failure X Consequence of Failure

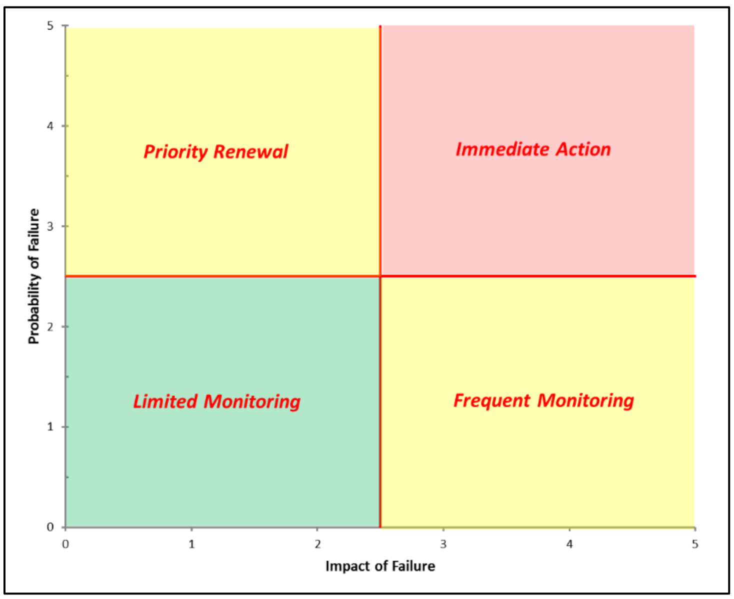


Figure 2. General Criticality Matrix

The most critical assets, with the highest risk score, are those that are more likely to fail and have major consequences of failure. Replacing these assets over others may provide the greatest benefit (reduction in overall system risk).

Management of each asset depends on how its risk is rated (Figure 2):

- Low probability of failure and low consequence of failure: Only limited monitoring is needed and "run to failure" may be appropriate.
- High probability of failure and low consequence of failure: Capital improvements should be prioritized.
- Low probability of failure and high consequence of failure: More frequent or direct assessment should be done.
- High probability of failure and high consequence of failure: Immediate attention is needed to prevent a catastrophic failure.

4.1.1. Grading Assets

Assets should be graded for Probability of Failure and Consequence of Failure using the Grading Matrices provided in Appendix A. Both Probability of Failure and Consequence of Failure have categories for guidance on how to score each asset (Sections 4.3 and 4.4). Each category should be scored individually and an overall score assigned.

The Town's water mains were previously inventoried and scored by Woodard and Curran (W&C). At the Town's request, Underwood Engineers simplified the water main scores from W&C's evaluation by basing the probability of failure on pipe age and adjusting the consequence of failure to a 5 point scale.

4.1.2. Probability of Failure

The Probability of Failure for each asset should be ranked from 1 to 5 with 5 being the highest probability. The Town has developed the following criteria to rank the water main assets by averaging the scores from each of the following categories:

Failure History: Tracking an assets failure history is an important tool in determining its condition and expected level of service. An asset that has been installed for a considerable time without required maintenance would be expected to continue to operate normally during its expected useful lifetime. Whereas an asset that has repeatedly failed in the past can be expected to fail in the future.

Age: Over time, assets will deteriorate and cause them to be more likely to fail. Each asset will have a different expected useful lifespan, when it can be expected to fail. This expected useful lifespan can be determined either from the manufacturer or from experience. The useful lifespan should be adjusted based on the conditions of use and the amount of maintenance. For example, if a 100 year old pipe was recently relined, it should receive a lower Probability of Failure score when compared to a 60 year old pipe (all other factors being equal). It is important to note that the age of an asset should be used as a supplemental factor to other criteria for Probability of Failure.

General Knowledge of Asset: This can include both historical knowledge and experiences with an asset. Knowing how the asset was installed and methods of construction should be included in determining Probability of Failure. Experiences with certain manufacturers can also be helpful in predicting failure. If a certain pump or pipe manufacturer is known to produce a lower quality product, it might be worth assigning a higher Probability of Failure score. An asset's location can also provide insight to probability of failure. If a well house is in a remote location, its probability of failure can be higher due to risk of a power outage from fallen trees, and wouldn't be accessible to a generator immediately.

4.1.3.<u>Consequence of Failure</u>

The Consequence of Failure for each asset should be ranked from 1 to 5 with 5 being the highest level of consequence. Scores are achieved by averaging the scores from each of the following categories:

<u>Regulatory Compliance</u>: Meeting State and Federal regulations is a must for any water system. If the system is not able to meet regulations, they can not only face fines, but put the customers at risk to health and safety issues. Assets that directly affect the ability for the water system to meet regulations should be ranked with a higher Consequence of Failure score.

<u>Cost of Repair:</u> When an asset fails, it will need to be repaired/replaced. The cost of that repair will vary depending on the asset. Small repairs or already owned replacements would not hinder the Town's maintenance budget and be but larger asset replacement costs would be higher and not readily available. Factoring in these type of consequences should be tracked for each asset.

<u>Social Cost/Inconvenience to Customers:</u> Social costs and impacts to customers relate to who is affected by a failure. Water mains in a small residential area will only affect a small number of customers. But the failure of a main providing water to a factory, hospital, or school will have a much higher Consequence of Failure. Another consideration of social costs is the repair/replacement of the assets. If two similar water mains break, but one is located on a road with heavy traffic, the repair work required will be more obstructive to residents.

<u>Collateral Damage:</u> The impact the failure of an asset has on other assets should also be taken into account. An asset may fail and cause other assets within the distribution system to fail as well by placing too much strain on the system. Other collateral damages that may occur may be outside the water distribution system. A water main leak that creates a sinkhole in a road will not only include repair of main, but repairs to the roads as well. The more collateral damage caused by an asset's failure, the higher the Consequence of Failure Score.

<u>Environmental Costs:</u> Asset failure can also lead to environmental impacts in some cases. If an old well house has a leaking chemical storage tank, and the chemical leaks outside the foundation into a nearby wetland, the environmental impact can be significant. Asset failures that lead to higher environmental impacts will have a higher Consequence of Failure Score.

4.2. Criticality – Ranking Water System Assets

Using the methodology described in Section 4.1, the water main assets were scored for Probability of Failure and Consequence of Failure and given a Risk Score. Results were incorporated into the Asset Management Inventory spreadsheet (**Appendix A**).

4.3. Highest Risk Mains

The highest risk mains and recommended replacement years are summarized in **Table 7.**

Table 7. Critical Mains (Risk Score > 20)

Asset	Recommended Action	Priority	Year of Action
Dockside	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe	1	2018
Estabrook Road	Possible 4" pipe exceeding expected life to be replaced with 6" DI pipe.	1	2018
Green Street	6" main installed in 1900 to be replaced with 6" DI pipe	1	2018/2019
Central Ave	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe (from Depot Street to S. Main Street)	1	2020
Pine Street	Replace 4" CI pipe installed in 1890 with new 8" DI Pipe.	1	2018
N. Main Street*	Downtown Bridge to Forest Rd. (replace 8" CI pipe installed in 1889 with 12" DI pipe)	1	2020/2021/2023

*Recommended action based on "Water Model Update and Extended Time Calibration" (UE, 2013) recommendations. It should be noted that increasing the size of the Main Street pipe will cause lower residual pressures at higher elevations until a 12" loop is constructed north of Downtown.

Priority for these mains was determined based on their age and consequence of failure. Each of these pipe segments have exceeded their estimated life expectancy and should be replaced prior to failure.

5. LIFE CYCLE COSTING

The life cycle costing step evaluates long term capital needs for major refurbishment and replacement of assets. Life cycle costing is a defensible tool to help support necessary funding levels for sustainability of the system.

5.1. Water Main Life Cycle Costs

For the purposes of initial planning, the following assumptions were used to evaluate life cycle costs of the water mains for the Town as a whole:

- Costs are conceptual (order of magnitude), including engineering and contingency.
- Costs are in today's dollars (2017).
- Mains are replaced per their estimated life expectancy determined in the Inventory and Assessment step.
- Mains are replaced with current industry standard materials/technology.
- Minor maintenance and repairs are assumed to be in the annual operating budget and are not included.
- All water mains 6" and under were assumed to be replaced with 6" ductile iron pipe. 8" mains and above are to be replaced with ductile iron pipe of like size. Service lines were assumed to be replaced in kind. Replacement costs include the following:
    - Ductile Iron Water Main
    - Roadway repairs
    - Traffic control (signs)
    - Service connections (domestic)
    - Service connections (fire)
    - Service restoration
    - Ledge removal and erosion control

Water main replacement costs for the entire water system are summarized in Table 8. Cost includes Engineering and Contingency.

Table 8. Water Main Complete Replacement Costs

Replacement Decade	Length (ft)	Cost
2010	13,012	$4,357,000
2020	1,250	$406,000
2030	1,250	$406,000
2040	6,420	$2,150,000
2050	1,250	$406,000
2060	1,690	$547,000
2070	20,886	$6,728,000
2080	42,798	$14,423,000
2090	43,330	$15,881,000
2100	41,417	$15,368,000
2110	32,310	$11,685,000
2120	6,000	$1,963,000
TOTAL	211,609	$74,287,000
Average cost per year (120 years)		**$619,000**

Note: Costs are in 2017 dollars.

Table 9 below demonstrates the costs per decade of each vertical asset. Costs include Engineering and Contingency.

Table 9. Vertical Asset Costs per Decade

Replacement Decade	PRV Station	Middleton Road BPS	South Main Street Tank	WTF
2010	$24,000	$33,000	$36,000	$506,000
2020	$18,000	$10,000	$480,000	$1,091,000
2030	$112,000	$50,000	$216,000	$1,329,000
2040	$16,000	$280,000	$353,000	$1,977,000
2050	$144,000	$35,000	$2,216,000	$1,527,000
2060	$50,000	$12,000	$180,000	$741,000
2070	$9,000	$35,000	$0	$4,112,000
2080	$400	$48,000	$458,000	$1,019,000
2090	$24,000	$35,000	$37,000	$2,533,000
2100	$50,000	$299,000	$471,000	$627,000
2110	$144,000	$37,000	$97,000	$1,534,000
2120	$6,000	$0	$180,000	$949,000
TOTAL	$597,000	$866,000	$4,722,000	$17,945,000
Average cost per year (120 years)	**$5,000**	**$7,000**	**$39,000**	**$150,000**

Note: Middleton Road BPS costs shown in Table 9 represent maintaining existing assets and does not include upgrades recommended in the 10-year CIP.

5.2. Life Cycle Planning

There are four basic options for dealing with assets over time (NMEFC, 2006). Asset Management is intended to optimize spending between these options while meeting the required level of service:

- Repair the assets as they fail
- Operate and maintain the existing assets
- Rehabilitate the assets
- Replace the assets

Provided the level of service is met, it is generally appropriate to replace certain assets when the LOS goals are not met or risk exceeds the community's tolerance. Annual costs of ownership include risk costs, repairs, and maintenance. Risk costs are the cost impacts of a failure and associated emergency repairs. The Criticality step helps to prioritize projects by risk, but the costs of renewal must also be considered for a complete benefit/cost analysis.

An asset should be renewed when it no longer meets LOS goals and/or when risk exceeds the community's tolerance.

The primary tool for life-cycle planning of major assets is the Business Case Evaluation (BCE). It is a defendable way to determine if a project is needed and how best to address it. The BCE supports rational decisions to select the lowest lifecycle cost alternative and minimize risk, thus providing the greatest value to the customer.

The Business Case Evaluation is recommended for major assets that do not meet the current LOS or are nearing the end of useful life. The basic BCE Steps are:

- Define the problem and drivers.
- Identify and screen alternatives, including "no action".
- Develop life cycle costs including capital, operational, and maintenance costs, for each alternative.
- Define risk costs (financial, environmental, and social = "triple bottom line").
- Recommend the alternative with the lowest net present value that meets the LOS.

Benefit/Cost analysis using the BCE process should be applied to Wolfeboro's major assets as they approach the end of useful life.

5.3. Optimizing Pipe Renewals

Life cycle costs have been identified for budget planning but does not say with certainty when and where water mains should be replaced. Unknown factors and insufficient information make accurate predictions for work that is far in the future impossible. Future tactical modeling is required to optimize the replacement year for each pipe segment.

An approach used in models such as the AWWA BNL Modeling Tool is to define the service life based on the tolerance for risk. The risk of failure or break rate for pipe generally increases with age. Pipes identified as more critical or higher risk have a shorter service life and are cost effective to replace sooner. Conversely, pipes with low consequences of failure allow a higher break rate to be tolerated and a longer time for replacement. As more data is collected in the future, defensible criteria for replacement can be developed to prioritize and optimize pipe renewals.

In summary, the specific locations for future water main replacements should be based on factors such as:

- Break rate and tolerance for risk of failure.
- Coordination with Town road or sewer improvements.
- System deficiencies and/or hydraulic constraints, if any.
- Future development and expansion.

6. FUNDING PLAN

6.1. Short Term – Capital Improvement Plan

Table 10 shows the assets that should be included in a 10-year Capital Improvements Plan (CIP). It is assumed that each project will be a complete asset replacement project.

Table 10. Water System 10 Year CIP

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Water Mains (Pipes Exceeding Typical Useful Life and Risk Score > 20)												
Dockside	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe. (55 LF)	1	$18,000									
Estabrook Road	Possible 4" pipe exceeding expected life to be replaced with 6" DI pipe. (280 LF)	1	$90,000									
Green Street	6" main installed in 1900 to be replaced with 6" DI pipe. (710 LF)	1	$100,000	$130,000								
Central Ave	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 8" DI pipe (from Depot Street to S. Main Street) (300 LF)	1			$110,000							
Pine Street	Replace 4" CI pipe installed in 1890 with new 8" DI Pipe. (820 LF)	1	$290,000									
N. Main Street	Downtown Bridge to Forest Rd. (replace 8" CI pipe installed in 1889 with 12" DI pipe) (4,370 LF)	1			$550,000	$402,000	700,000					
Mains with Risk Score > 15												
Willow Street	Replace 4" Steel Pipe installed in 1940 with new 6" DI Pipe from Center St intersection (1,280 LF)	2								$142,000		
Center Street	Replace 4" Steel Pipe installed in 1891 with new 6" DI Pipe from Elm Street to Birch (7,600 LF)	2								$495,000		
Depot Street	Replace 6" CI pipe installed in 1890 with 6" DI pipe (180 LF)	2						$58,000				
Oak Street	Replace 6" CI pipe installed in 1900 with new 6" DI pipe (330 LF)	2						$110,000				
Pleasant Street	Replace 6" CI pipe installed in 1900 with new 6" DI pipe (Northwest of Oak St., 1,000 LF)	2						$322,000				
River Street	Replace 6" CI pipe installed in 1900 with new 6" DI Pipe (from Center St to Hydrant, 260 LF)	2						$84,000				
South Main Street	Replace 8" CI pipe installed 1900 with new 8" DI pipe (Bridge to Pickering Corner 1,500 LF)	2							$525,000			
Seasonal Service Lines	Allowance to repair or replace seasonal service lines	3			$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
	HORIZONTAL ASSET SUBTOTAL		**$498,000**	**$130,000**	**$740,000**	**$482,860**	**$780,000**	**$654,000**	**$605,500**	**$717,000**	**$80,000**	**$80,000**

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Vertical Assets												
PRV Station	Minor replacements including unit heater, exhaust fan and louvre, dehumidifier, water meter.	3				$41,300						
Middleton Road BPS	Perform Pump Station Improvements described in UE letter dated 8/28/14	3		$550,000								
South Main Street Tank	Minor equipment replacements as they exceed expected life (Tablet Chlorinator, analyzer, exhaust fan, etc.)	3			$45,500							
	VERTICAL ASSET SUBTOTAL		**$0**	**$550,000**	**$45,000**	**$41,300**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Water Treatment Facility												
Miscellaneous Process Components	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043
Standard Chemical Feed Systems	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750
Bulk Chemical Storage	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.									$15,000		
Process Equipment	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831
Instrumentation Except Analytical	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323
Control Panels	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$142,500									
Polymer Feed System	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$15,000						
Clarifiers	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.											$130,000
Filters	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$50,000	
Treatment Unit Underdrains	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$100,000						
SCADA Computers	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$15,000							
Standby Generator	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$142,500	
Electrical (Filter Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$60,000	

Project	Notes/References	Priority	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
HVAC (Filter Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$112,500	
Doors and Windows	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$70,350	
Mower/Blower	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$2,700							
ATV	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.								$9,000			
Pickup Truck	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$20,000	
HVAC (Pump Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$20,000	
Roof (Pump Building)	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$5,700	
Fence and Gate	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.										$43,000	
Water Tank	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.					$150,000						
Laboratory Equipment	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.		$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Paving	See Water Treatment Facility (WTF) Capital Improvements Plan (CIP) date 2/10/17 for details.				$31,800							
	WATER TREATMENT FACILITY SUBTOTAL		**$174,447**	**$31,947**	**$81,447**	**$296,947**	**$31,947**	**$31,947**	**$40,947**	**$61,947**	**$555,997**	**$161,947**
Water Department Equipment and Vehicles												
Vehicle Replacements	Replacement cost for Vehicles		$75,000			$21,000	$30,000			$25,000		$125,000
Water Department Equipment	Replacement cost for Equipment									$5,000		
	VEHICLE AND EQUIPMENT SUBTOTAL		**$75,000**			**$21,000**	**$30,000**			**$30,000**		**$125,000**
	TOTAL		**$747,447**	**$711,947**	**$866,447**	**$842,107**	**$841,947**	**$685,947**	**$646,447**	**$808,947**	**$635,997**	**$366,947**

1. Costs based on complete replacement.
***Costs are in 2017 dollars**

These assets represent the near term projects based on the risk score described in Section 4. A majority of the water mains targeted for replacement within the next 10 years have exceeded their expected useful life. Replacing these aging mains prior to failure may prevent a critical crisis in the near future and improve the hydraulics of the system by removing tuberculated mains from the system. They should be addressed as soon as funding is available and coordinated with other infrastructure projects.

Costs are estimates for planning purposes and include construction, engineering and contingency as follows:

Horizontal Assets

- 4" and 6" Pipe = $322/LF
- 8" Pipe = $350/LF
- 10" and 12" Pipe = $378/LF
- 14" Pipe = $406/LF
- 16" Pipe = $434/LF
- 20" Pipe = $490/LF

Specific Vertical Assets Costs can be located within Appendix A.

6.2. Long Term Funding Strategy

The long term funding step evaluates how to best meet the costs of maintenance, repair, rehabilitation, and replacement of assets. Long term planning is required because the funding needs are significant and unsustainable if deferred until the future.

Wolfeboro's potential sources of funding include:

- Revenues
  - Water user charge
- Capital reserve funds
  - Set aside by budget or surpluses
- Debt
- Grants

Funding requirements for long term replacement costs are summarized in Table 11. Level funding is recommended to spread out the high cost of future projected projects. For example, a significant portion of the water mains are due to be replaced in the 2040's. It behooves the Town to begin proactively planning for their replacement now. A majority of the rehabilitation and replacement costs will occur after 2070, so the average annual cost to be set aside for future water main projects can be divided into two planning periods (2010s-2060s and 2070s-2120s).

Table 11. Total Water System Rehabilitation and Replacement Costs

Replacement Decade	Cost
Planning Period 1	
2010's	$5,410,000
2020's	$5,648,000
2030's	$3,004,000
2040's	$6,081,000
2050's	$7,555,000
2060's	$2,837,000
Planning Period 1 Total	**$30,615,000**
Cost per year	**$510,000**
Planning Period 2	
2070's	$11,876,000
2080's	$19,492,000
2090's	$19,492,000
2100's	$18,212,000
2110's	$16,619,000
2120's	$4,396,000
Planning Period 2 Total	**$89,965,000**
Cost per year	**$1,499,000**
TOTAL	**$120,580,000**

As shown in Table 11 above, the Town will need to invest approximately $510,000 per year for the next 60 years. The Town's 2017 combined budget for the Water Treatment Facility and Distribution is approximately $1.6M with $103,159 targeted towards asset repairs and replacement (approximately $33,924 for the WTF and $69,235 for the distribution system).

Alternatively, the Town could save and/or invest $1,005,000 per year (total planning cost spread evenly over 120 years).

It is recommended that the Town increase its annual asset replacement budget to meet the expected future costs.

High levels of saving would reduce future risk, but places a greater burden on current users through rate impacts. The target amount of capital reserves to set aside depends on the level of future risk that Wolfeboro accepts. As the system ages, future evaluations should better quantify risk and adjust the required capital reserves if necessary.

7. COMMUNICATION AND IMPLEMENTATION

An Asset Management Plan is a working, living document, constantly being updated. These updates come from the employees and customers. Both the staff and customers provide important information that can help to keep asset management effective. A communication plan lays out how to get this information, and make sure that both staff and customers understand the importance of Asset Management.

7.1. Training for Staff

Each employee's input and knowledge of the system is vital to a successful and accurate Asset Management Plan. The employees must understand their role, and how they can help to improve the overall functionality of the system. Developing an Asset Management Charter issued to employees can help get everyone on the same page, and work towards a common goal.

The staff who run the system know the most about it, and can help when deciding which assets are at the highest risk and need the most attention. An effective way for them to communicate this information to the decision makers is by keeping logs of maintenance and repairs done on the system. When something like a main break occurs, the following information should be recorded in the DOForm Asset Record as well as the Asset Management Plan:

- Cause of failure
- Location
- How it was fixed
- Downtime and impact to consumer
- Cost
- Any difficulties or unexpected obstacles in repairing

The same approach should be used for repairs done at the reservoir, treatment facilities, tanks and pumping stations. This will help identify the cost of maintaining each asset, and allow for a cost comparison to be made for replacement. This information can help identify if replacing an old asset is more cost effective than continuing with the routine maintenance.

Goals of Staff Training:

- Employees should understand the importance of asset management planning
- Documenting asset failures

7.2. Customer Outreach

Getting feedback from customers helps to keep the Level of Service up to date. Listening to customer complaints and comments can change the type of service provided, which can affect priority of assets, and how much risk a system is willing to accept.

Customers should also understand how and why money is being spent on system repairs and asset replacements. A more informed public will be more willing to approve rate increases to ensure they receive the type of service they want.

Objectives for customer outreach include:

- Communicate the benefits that new infrastructure will provide to customers in terms of improved water quality and availability.
- Provide the necessary communication support to allow for successful increases in water rates.

7.3. Suggested Communication Plan

Modes of delivery/communication:

Table 12. Communication Plan

Audience	Outreach Strategies
Internal - Staff	• Conduct team meetings on strategic goals, record keeping, and importance of asset management. • Develop record keeping protocols within DOForms of repairs – make it easy to record important information.
External - Customers	• Create system to map location of complaints in order to suggest future improvement needs. • Notify customers of system updates (projects, issues, construction location/time) through the following medias: ○ System water bills ○ Brochures ○ Local newspapers

8. CONCLUSIONS

8.1. Summary of Assets

The Town Wolfeboro currently owns and operates approximately 211,609 LF (40 miles) of water main of various materials, age, and sizes.

The Town's vertical water system assets include the following facilities:

- South Main Street Water Storage Tank
- PRV Station
- Middleton Road Booster Pumping Station
- Water Treatment Facility

The Water Treatment Facility was not evaluated as part of this Asset Management Plan. However, a previous evaluation (Wolfeboro WTF Capital Improvements Plan, UE 2017) was used and the recommendations were incorporated into the attached CIP.

8.2. Critical Assets

Using the methodology described in Section 4.1, the water main assets were scored for Probability of Failure and Consequence of Failure and given a Risk Score. Results were incorporated into the Asset Management Inventory spreadsheet (**Appendix A**).

The highest risk assets and recommended replacement years are summarized in **Table 13**.

Table 13. Critical Assets (Risk Score > 20)

Asset	Recommended Action	Priority	Year of Action
Dockside	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe	1	2018
Estabrook Road	Possible 4" pipe exceeding expected life to be replaced with 6" DI pipe.	1	2018
Green Street	6" main installed in 1900 to be replaced with 6" DI pipe	1	2018/2019
Central Ave	6" CI pipe installed in 1900 (exceeding expected life) to be replaced with new 6" DI pipe (from Depot Street to S. Main Street)	1	2020
Pine Street	Replace 4" CI pipe installed in 1890 with new 8" DI Pipe.	1	2018
N. Main Street*	Downtown Bridge to Forest Rd. (replace 8" CI pipe installed in 1889 with 12" DI pipe)	1	2020/2021/2023

*Recommended action based on "Water Model Update and Extended Time Calibration" (UE, 2013) recommendations. It should be noted that increasing the size of the Main Street pipe will cause lower residual pressures at higher elevations until a 12" loop is constructed north of Downtown.

8.3. 10-Year CIP

A 10-year CIP has been provided with projects that address the following:

- Most critical assets (Risk Score >20)
- Water Mains Assets that have exceeded their expected useful life (Risk Score >12)
- Vertical Assets (RPV Station, South Main Street Tank, and the Middleton Road Booster Pumping Station) to be replaced within the next 10 years.
- Water Treatment Facility Projects
- Water Department Vehicles and Equipment

For the purpose of planning, the costs associated with the proposed 10-year CIP is for complete replacement and in 2017 dollars.

8.4. Long Term Funding Needs

The average annual costs to be set aside for future water main projects are divided into two planning periods. Planning Period 1 (2010s-2060s) and Planning Period 2 (2070s-2120s) are described below:

- **Planning Period 1**
  - 0-60 years
  - Approximate total cost for rehabilitation and replacement = $30,615,000
  - Approximately $510,000 needed per year
- **Planning Period 2**
  - 60-120 years
  - Approximate total cost for rehabilitation and replacement = $89,965,000
  - Approximately $1,499,000 needed per year

Alternatively, the Town could save and/or invest $1,005,000 per year (total planning cost spread evenly over 120 years).

High levels of saving would reduce future risk, but places a greater burden on current users through rate impacts. The target amount of investment depends on the level of future risk that Wolfeboro accepts. As the system ages, future evaluations should better quantify risk and adjust the required investment if necessary.

9. RECOMMENDATIONS

9.1. AM Plan Implementation and Future Tasks

- Continue to collect and update asset data and condition assessment in GIS.
  - Record service and failure history for assets to refine the estimated useful life. These records can be used to update asset data.
- Apply AM principles (criticality, risk assessment, remaining useful life, etc.) to lower-tier assets (i.e. valves, hydrants, services).
- Review and adopt the Level of Service (LOS).
- Monitor performance data, complaints, etc. to ensure LOS is being met, and refine LOS Statement as needed.
- Update critical assets as renewals are made and information is collected.
  - As assets are replaced and refurbished, update the "Probability of Failure" ranking to identify which assets are most critical.
- Update life cycle costs and budgeting as needed.
- Submit plan to DES for Asset Management Grant Reimbursement.

9.2. AM Communication

- Establish a Communication Program for customers, demonstrating the value of service and justifying the funding to sustain needs. Program elements may include:
  - Distribute AM brochure to customers.
  - AM content on website.
  - Public information meetings for major projects.
  - Customer surveys.
- Educate and inform all staff on AM principles and process.
- Conduct team meetings on strategic goals, record keeping, and asset management decisions.
- Allow asset information to be accessible and shared by staff.

9.3. Administrative Tasks

- Perform a water rate evaluation to assess the potential impact of the recommendations of this report.

9.4. CIP – Near Term Projects

- Program the recommended projects (Section 6.1) into the CIP.
- Evaluate cost effective alternatives for proposed projects.
- Refine the scope, cost, and schedule for projects.
- Update CIP funding needs in future rate evaluations.
- Implement recommended capital improvements.

9.5. Long Term Funding

- Increase annual capital reserve contributions to $343,000 per year for Planning Period 1 and 1,283,000 per year for Planning Period 2 to support long term asset renewals unless current CIP expenditures meet asset replacement/rehabilitation.
- Alternatively, the Town could save and/or invest $813,000 per year (total planning cost spread evenly over 120 years).
- The required capital reserve depends on the level of future risk that is accepted.

10.REFERENCES

AWWA (2013) *Buried No Longer: Confronting America's Water Infrastructure Challenge*. Available at: (Accessed March 17 2014)

AWWA (2014) *Sample Utility Communications Plan.* Available at: http://www.awwa.org/resources-tools/public-affairs/communications-tools/public-communications-toolkit/sample-utility-communications-plan.aspx (Accessed April 2 2014)

EPA (2008) *Asset Management: A Best Practices Guide*. Available at http://water.epa.gov/infrastructure/sustain/am_resources.cfm (Accessed March 17 2014)

New Mexico Environmental Finance Center (2006) *Asset Management: A Guide For Water and Wastewater Systems*. Available at: http://water.epa.gov/infrastructure/sustain/am_resources.cfm (Accessed 17 March 2014)

Appendix A:

Water Distribution Asset Inventory

WATER SYSTEM
ASSET MANAGEMENT MODEL

for

Wolfeboro, NH

Town Water System

PREPARED BY:

UNDERWOOD ENGINEERS, INC.
25 Vaughan Mall
Portsmouth, NH 03801
603-436-6192

DRAFT
26-Apr-17

Asset Management Plan - Worksheet Instructions

Wolfeboro

Date Worksheet Updated	4/26/2017

General

Cell color coding:

Input data

Calculated data

1. Asset Inventory Worksheet

The Inventory is formed with a "top down" approach.

List major water system assets for which asset management is appropriate.

Minor assets that are not worth asset management and are covered under the operating budget should not be included.

2. Asset Condition Assessment

Identify the state of each asset including capacity, age, condition, remaining life, etc.

Qualitative remarks may be more important than numbered ratings.

Assign a condition based on suggested scale below, with additional notes if applicable.

Condition Rating	Description
1-Excellent	New or like new, in full working order with no issues
2-Good	Fully functional, minor maintenance may be needed only, few known issues
3-Fair	Functional, needs some refurbishment, known issues may impact functionality in next few years
4-Poor	Not fully functional, needs repair or replacement to restore performance
5-Very Poor	Non functional, at or beyond useful life, needs repair or replacement

Above is suggested categories by UE, based on ranking scale examples at Iowa Rural Water and elsewhere

Useful Life: Enter the Typical Useful Life based on the suggested ranges below.

Expected Useful Lives of Assets	
Asset	Years
Wells	40 to 60
Treatment Equipment	10 to 20
Storage Tanks	60 to 100
Pumps	10 to 20
Electrical equipment	15 to 25
Buildings/Structure	60 to 70
Distribution Mains	75 to 115
Meters	10 to 20
Service Lines	30 to 50
Hydrants	40 to 60

Above table based on NMEFC Asset Management Guide, EPA Asset Management: Handbook for Small Water Systems, and other sources.

Assets are assumed to be reasonably maintained.

Remaining Life: This is calculated by subtracting age from typical useful life

Enter an Adjusted Useful life based on experience and condition for the particular asset at this time.

3. Asset Prioritization and Criticality Assessment Worksheet

Rate the Probability of Failure Score (1 to 5) based on age, condition, failure history, experience, etc.

Rate the Consequence of Failure Score (1 to 5) based on cost of repair, impacts to customers, collateral damage, environmental costs, reduced level of service, etc.

Risk Score or Criticality Factor = Probability of Failure x Consequence of Failure

For a more robust analysis, calculate the Risk Cost = the probability of failure in a year multiplied by the cost of failure

Probability or Consequence of Failure Rating
1 - Very Low
2 - Low
3 - Moderate
4 - High
5 - Very High

4. Asset Life Cycle Costs

Enter estimated replacement cost based on technology that would be used for replacement.

Based on remaining useful life, determine estimated decade of replacement.

Enter cost in appropriate column for the decade of replacement.

Costs for each decade are totalled and illustrated in Chart for Replacement Costs.

Copy near-term projects (within 5 to 10 years) into CIP Table for more definitive scheduling.

5. Long Term Funding and Planning

Summary of long term funding needs.

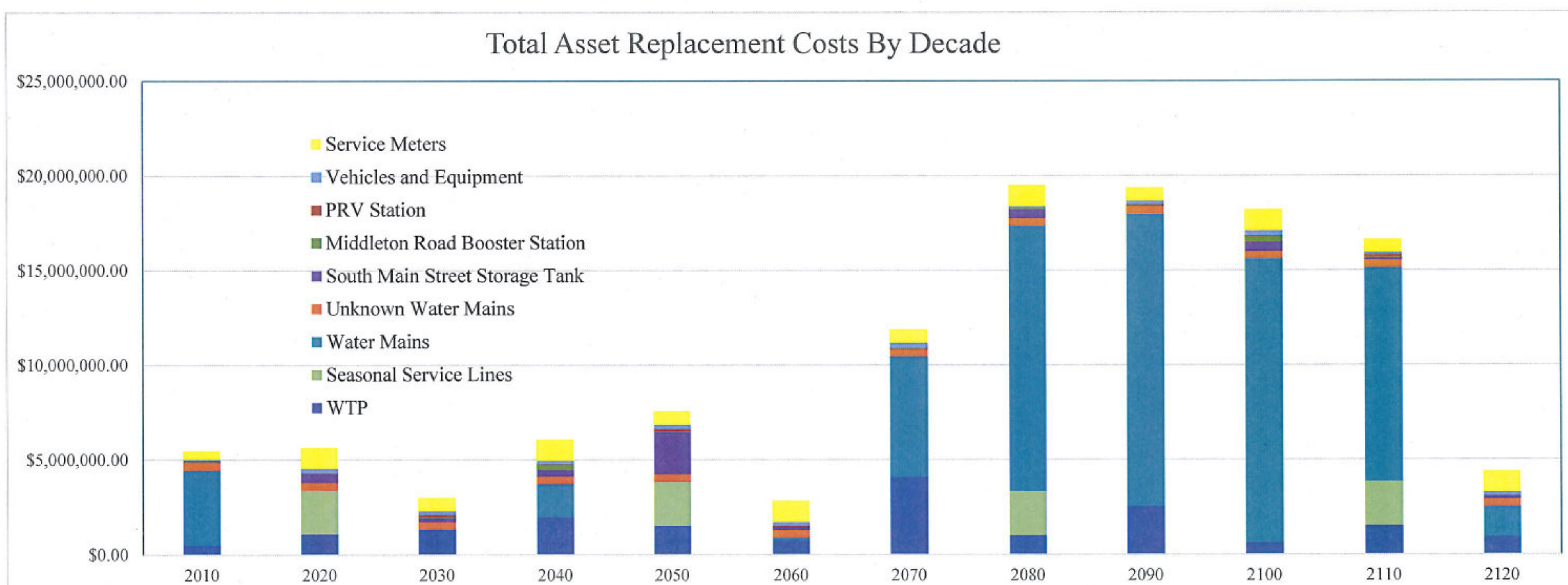
Enter years to save reserves and % allocated from capital reserves.

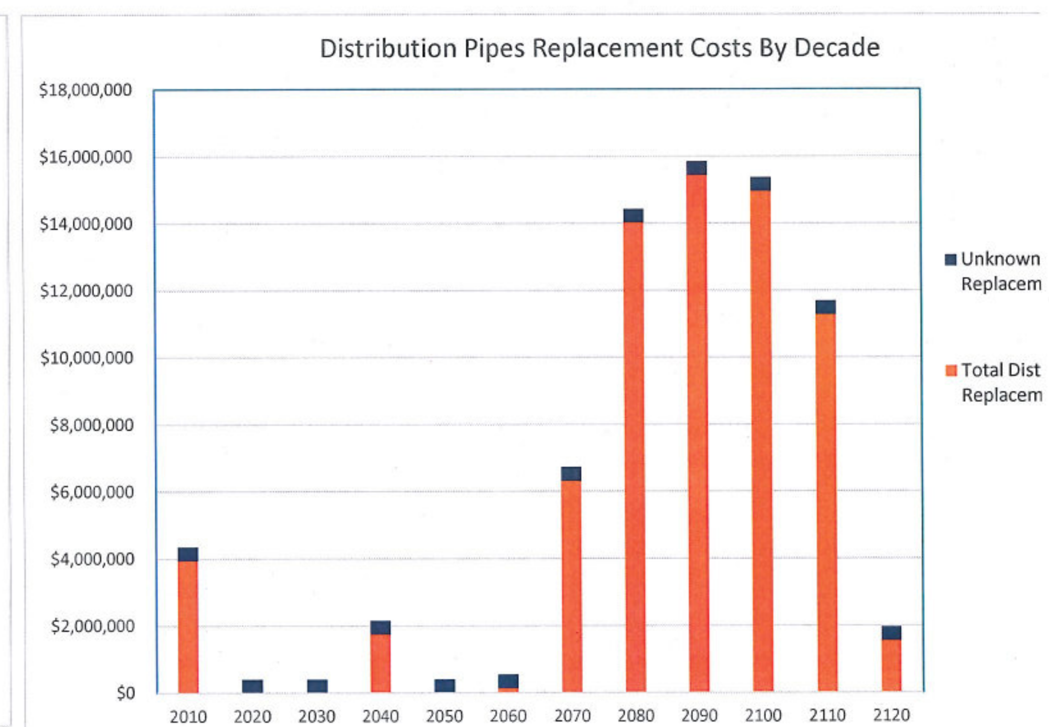
Calculates reserve contributions needed per year assuming level funding.

Replacement cost charts are linked to this sheet

	Summary of Long Term Replacement/Renewal Costs - by Decade												
	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100	2110	2120	TOTAL ASSET COST
PRV Station	$23,660	$18,040	$111,700	$15,500	$143,900	$50,400	$9,000	$400	$24,000	$50,400	$143,900	$5,500	$596,400
Middleton Rd. BPS	$33,150	$9,800	$49,950	$280,000	$35,250	$11,900	$35,250	$48,300	$35,250	$289,800	$37,350	$0	$866,000
S. Main Street Tank	$35,700	$480,200	$215,500	$353,000	$2,215,840	$180,000	$0	$457,500	$37,000	$470,600	$97,000	$180,000	$4,722,340
Known Water Pipes	$3,951,724	$0	$0	$1,743,980	$0	$141,680	$6,322,792	$14,017,556	$15,443,120	$14,962,794	$11,279,520	$1,557,780	$69,420,946
Assumed Unknown Pipe cost per decade	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$405,542.67	$4,866,512
Seasonal Service Lines	$0.00	$2,311,680.00	$0.00	$0.00	$2,311,680.00	$0.00	$0.00	$2,311,680.00	$0.00	$0.00	$2,311,680.00	$0.00	$9,246,720
WTF	$505,750.50	$1,091,450.00	$1,329,463.50	$1,976,600.00	$1,526,713.50	$740,800.00	$4,111,763.50	$1,019,350.00	$2,533,163.50	$626,500.00	$1,534,213.50	$948,800.00	$17,944,568
Service Meters	$459,200.00	$1,118,600.00	$704,900.00	$1,118,600.00	$704,900.00	$1,118,600.00	$704,900.00	$1,118,600.00	$704,900.00	$1,118,600.00	$704,900.00	$1,118,600.00	$10,695,300
Vehicles and Equipment	$75,000.00	$213,000.00	$186,500.00	$188,000.00	$211,500.00	$188,000.00	$286,500.00	$113,000.00	$186,500.00	$288,000.00	$105,000.00	$180,000.00	$2,221,000
TOTAL COST PER DECADE	$5,489,727	$5,648,313	$3,003,556	$6,081,223	$7,555,326	$2,836,923	$11,875,748	$19,491,929	$19,369,476	$18,212,237	$16,619,106	$4,396,223	$120,579,786

	Planning Period		
	0 to 60 years	60 to 120 years	Total
	$30,615,068	$89,964,719	$120,579,786
Years to Build Reserve	60	60	120
Total reserves needed per year	$510,251.13	$1,499,411.98	$1,004,831.55
Capital Reserves Funding %	50%	50%	50%
Capital Reserves Contibution per Year	$255,125.56	$749,705.99	$502,415.78





Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

Inventory of Water Mains														Criticality Assessment and Asset Prioritization			Life Cycle Costs and Planning	5. Long Term Replacement/Renewal Costs - by Decade												
ID#	Category	Street Name	From	To	Size (inches)	Length (Feet)	Material	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's	UNK
WM-41	Distribution	Dockside			6	55	CI	1900	115	117	-2	2015		5	5	25	$17,710	$17,710												
WM-48	Distribution	Estabrook Road			4	280	WI	UNK	0	UNK	UNK	UNK	From Ints. So. Main need to confirm size	5	5	25	$90,160													$90,160
WM-57	Distribution	Green Street			6	710	CI	1900	115	117	-2	2015		5	5	25	$228,620	$228,620												
WM-28	Distribution	Central Avenue			6	300	CI	1900	115	117	-2	2015	Depot St. to South Main St.	4	5	20	$96,600	$96,600												
WM-83	Distribution	No. Main St. (Rte. 109)			8	4370	CI	1889	115	128	-13	2004	Downtown bridge to just before Forest Rd	4	5	20	$1,529,500	$1,529,500												
WM-100	Distribution	Pine Street			4	820	CI	1890	115	127	-12	2005	8 inch main to 6 in. main (Two different size mains on Pine St. - see following Pine St. listing.)	4	5	20	$264,040	$264,040												
WM-136	Distribution	Willow St.			4	440	Steel OD	1940	100	77	23	2040	From Ints. Center St. mainline is 6" (installed 2006) across Center street and reduces to existing 4"	4	4	16	$141,680				$141,680									
WM-24	Distribution	Center St.			4	1540	B.S.	1891	100	126	-26	1991	Parallel to 6" line starting at 1180' from Elm St. ints. to end on Birch Rd.	3	5	15	$495,880	$495,880												
WM-39	Distribution	Depot Street			6	180	CI	1890	115	127	-12	2005		3	5	15	$57,960	$57,960												
WM-89	Distribution	Oak Street			6	330	CI	1900	115	117	-2	2015	To intersection of Pleasant St.	3	5	15	$106,260	$106,260												
WM-104	Distribution	Pleasant Street			6	1000	CI	1900	115	117	-2	2015	Northwest of Oak Street	3	5	15	$322,000	$322,000												
WM-111	Distribution	River Street			6	260	CI	1900	115	117	-2	2015	From Center St. to hydrant	3	5	15	$83,720	$83,720												
WM-119	Distribution	So. Main St. (Rte. 109)			8	1500	CI	1900	115	117	-2	2015	Bridge in center of town to Pickering Corner. Transitions to 12" DI just before bridge	3	5	15	$525,000	$525,000												
WM-7	Distribution	Bay Street			8	2830	CI	1930	115	87	28	2045		3	4	12	$990,500				$990,500									
WM-25	Distribution	Center Street			6	7600	CI	1962	115	55	60	2077	From ints.Elm St north to end. Length includes section on Birch Road (Confirm Date)	4	3	12	$2,447,200							$2,447,200						
WM-30	Distribution	Christian Ridge Road			6	900	CI	1970	115	47	68	2085	Inventory says 360' in 1970 with hydrant in 1971	4	3	12	$289,800								$289,800.0					
WM-35	Distribution	Crescent Lake Avenue			6	1,000	CI	1970	115	47	68	2085	From 6 So. Main Street to Pine Street	4	3	12	$322,000								$322,000.0					
WM-62	Distribution	High Street			4	530	UNK	UNK	100	UNK	UNK	UNK		4	3	12	$170,660													$170,660
WM-77	Distribution	Lucas Street			6	250	CI	1949	115	68	47	2064		3	4	12	$80,500						$80,500							
WM-92	Distribution	Old Mill Drive			6	1,280	CI	1969	115	48	67	2084		4	3	12	$412,160								$412,160.0					
WM-101	Distribution	Pine Street			6	700	CI	1971	115	46	69	2086	4 in. main to Crescent Lake Ave.	4	3	12	$225,400								$225,400.0					
WM-117	Distribution	Sewell Road			6	566	DI	1962	110	55	55	2072	may not exist	4	3	12	$182,252							$182,252						
WM-26	Distribution	Center Street			12	800	DI	2005	110	12	98	2115	NHDOT project limits smith river bridge crossing with preinsulated restrained DI pipe	5	2	10	$302,400											$302,400		
WM-27	Distribution	Center Street			12	1800	DI	2005	110	12	98	2115	From ints. Main St. to NHDOT limits and to elm street intersection.	5	2	10	$680,400											$680,400		
WM-88	Distribution	No. Main St. (Rte. 109)			12	80	Steel OD	2006	100	11	89	2106	Bridge crossing preinsulated pipe (DI outside bridge limits)	5	2	10	$30,240										$30,240			
WM-108	Distribution	Railroad Avenue			6	540	CI	1900	115	117	-2	2015	From Central Ave. to terminal private hydrant	2	5	10	$173,880	$173,880												
WM-120	Distribution	So. Main St. (Rte. 28)			10	4330	DI	1983	110	34	76	2093	From Pickering Corner/Center St. South to Treadwell Ln on East side of Road	5	2	10	$1,636,740									$1,636,740				
WM-2	Distribution	Anagance Lane			6	580	CI	1962	115	55	60	2077		3	3	9	$186,760							$186,760						
WM-6	Distribution	Bassett Road			6	1,290	CI	1960	115	57	58	2075		3	3	9	$415,380							$415,380						
WM-19	Distribution	Bernard Drive			6	240	CI	1960	115	57	58	2075	From Ints. Winterhaven Rd.	3	3	9	$77,280							$77,280						
WM-22	Distribution	Brewster Heights			6	2100	UNK	UNK	100	UNK	UNK	UNK		3	3	9	$676,200													$676,200
WM-23	Distribution	Canopache Road			6	890	CI	1962	115	55	60	2077	S. Main to Anagance	3	3	9	$286,580							$286,580						
WM-42	Distribution	Eagle Terrace			8	1350	UNK	UNK	100	UNK	UNK	UNK	Need as-builts	3	3	9	$472,500													$472,500
WM-44	Distribution	Edgewood Terrace			6	470	CI	1968	115	49	66	2083		3	3	9	$151,340								$151,340.0					
WM-49	Distribution	Fairway Drive			8	715	DI	1974	110	43	67	2084		3	3	9	$250,250								$250,250.0					
WM-52	Distribution	Forest Road			6	8500	CI	1965	115	52	63	2080		3	3	9	$2,737,000								$2,737,000.0					
WM-68	Distribution	King Street (No. branch from Bay St.)			6	400	CI	1966	115	51	64	2081	North Side	3	3	9	$128,800								$128,800.0					
WM-71	Distribution	Lake View Drive			6	1760	CI	1974	115	43	72	2089	No. Main to end of Lake View Dr.	3	3	9	$566,720								$566,720.0					
WM-90	Distribution	Old Lakeview Terrace			6	283	CI	1965	115	52	63	2080	X-country to Lucas St.	3	3	9	$91,126								$91,126.0					
WM-91	Distribution	Old Lakeview Terrace			6	1,920	CI	1965	115	52	63	2080	Alond Rd.	3	3	9	$618,240								$618,240.0					
WM-99	Distribution	Pine Hill to N. Main (cross country)			10	7800	CI	1970	115	47	68	2085	Pike Hill Cemetery to Jennifer Circle to Main St. (mid 70's, cross country line)	3	3	9	$2,948,400								$2,948,400.0					
WM-105	Distribution	Pleasant Valley Road			6	1730	DI	1970	110	47	63	2080	Ints. w/So. Main to capped end and start of 2" size	3	3	9	$557,060								$557,060.0					
WM-107	Distribution	Port Welden Road			6	3540	CI	1960	115	57	58	2075		3	3	9	$1,139,880							$1,139,880						
WM-125	Distribution	Treadwell Lane			10	200	CI	1971	115	46	69	2086	From Inventory (part of line going to High School)	3	3	9	$75,600								$75,600.0					
WM-126	Distribution	Treadwell Lane			6	670	CI	1971	115	46	69	2086	End of Lane	3	3	9	$215,740								$215,740.0					
WM-138	Distribution	Winterhaven Rd.			6	3020	CI	1960	115	57	58	2075	From Port Welden Rd. to So. end Port Welden Rd.	3	3	9	$972,440							$972,440						
WM-46	Distribution	Elm Street			12	300	DI	2005	110	12	98	2115	Elm Street Pumping Station to intersection w/ Center Street	4	2	8	$113,400											$113,400		
WM-47	Distribution	Endicott Street			8	300	DI	2008	110	9	101	2118	New 8 inch Ductile iron to last Hydrant	4	2	8	$105,000											$105,000		
WM-63	Distribution	Highland Terrace			6	842	DI	1992	110	25	85	2102		4	2	8	$271,124										$271,124			
WM-84	Distribution	No. Main St. (Rte. 109)			12	1,260	DI	1991	110	26	84	2101	Abandoned W.S.T. to Forest Road	4	2	8	$476,280										$476,280			
WM-85	Distribution	No. Main St. (Rte. 109)			12	760	DI	1996	110	21	89	2106	Forest Road to 8" on North Main Street	4	2	8	$287,280										$287,280			
WM-86	Distribution	No. Main St. (Rte. 109)			12	4100	DI	1996	110	21	89	2106	Waumbeck Rd. to Abandoned W.S.T	4	2	8	$1,549,800										$1,549,800			
WM-95	Distribution	Partridge Drive			6	1540	CI	1970	115	47	68	2085	East from Ints. Maplewood Dr. to Forest Rd.	4	2	8	$495,880								$495,880.0					
WM-96	Distribution	Pine Hill Road			12	400	DI	1995	110	22	88	2105	Beach Pond Road to PRV	4	2	8	$151,200										$151,200			
WM-97	Distribution	Pine Hill Road			12	400	DI	1995	110	22	88	2105	2nd Line - Beach Pond Road to PRV	4	2	8	$151,200										$151,200			
WM-98	Distribution	Pine Hill Road			12	5,000	DI	1995	110	22	88	2105	Connection of Elm Street up into Press. Red. Vault	4	2	8	$1,890,000										$1,890,000			
WM-102	Distribution	Pine Street			8	150	DI	2008	110	9	101	2118	8 in. main to Center St.	4	2	8	$52,500											$52,500		
WM-110	Distribution	Railroad Avenue			8	190	DI	2006	110	11	99	2116	main connection to new condos	4	2	8	$66,500											$66,500		
WM-112	Distribution	River Street			8	2400	DI	1980	110	37	73	2090	(mid 1980's)	4	2	8	$840,000									$840,000				
WM-121	Distribution	So. Main St. (Rte. 28)			10	400	DI	1998	110	19	91	2108	Middleton to 8-inch	4	2	8	$151,200										$151,200			
WM-122	Distribution	So. Main St. (Rte. 28)			12	6000	DI	1998	110	19	91	2108	McManus to intersection with Middleton Road	4	2	8	$2,268,000										$2,268,000			
WM-127	Distribution	Treadwell to McManus (cross country)			10	1850	DI	1983	110	34	76	2093	X-country across golf course	4	2	8	$699,300									$699,300				
WM-128	Distribution	Union			8	660	DI	2011	110	6	104	2121	New 8 inch Ductile Iron Main to Lehner	4	2	8	$231,000												$231,000	
WM-129	Distribution	Varney Road			6	1,900	CI	1934	115	83	32	2049		2	4	8	$611,800				$611,800									
WM-1	Distribution	Abenaukee Estates Drive			6	3450	UNK	UNK	100	UNK	UNK	UNK	From Ints. So. Main (Rte. 28)	2	3	6	$1,110,900													$1,110,900
WM-3	Distribution	Anagance Lane			8	485	DI	1992	110	25	85	2102		3	2	6	$169,750										$169,750			
WM-5	Distribution	Baas Drive			6	1,410	CI	1960	115	57	58	2075		2	3	6	$454,020							$454,020						
WM-8	Distribution	Bay Street			8	700	DI	2009	110	8	102	2119	Mill St. to King St. in conjuction w/ Bridge project. Note: repaired major leak at intersection with king	3	2	6	$245,000											$245,000		
WM-10	Distribution	Beech Pond Rd (cross country)			12	1860	DI	1988	110	29	81	2098	Line #2 from the Intake to WTP connection (parallel)	3	2	6	$703,080									$703,080				
WM-11	Distribution	Beech Pond Rd (cross country)			12	3600	DI	1988	110	29	81	2098	Line #1 WTP to intersection w/Beech Pond Rd. (parallel)	3	2	6	$1,360,800									$1,360,800				
WM-12	Distribution	Beech Pond Rd (cross country)			12	3600	DI	1988	110	29	81	2098	Line #2 WTP to intersection w/Beech Pond Rd.(parallel)	3	2	6	$1,360,800									$1,360,800				
WM-9	Distribution	Beech Pond Rd (cross country)			12	1860	DI	1988	110	29	81	2098	Line #1 from the Intake to WTP connection (parallel)	3	2	6	$703,080									$703,080				
WM-13	Distribution	Beech Pond Road			12	3000	DI	1988	110	29	81	2098	Line #1 Beech Pond Rd. from ints. w/ cross country line to York Rd. (parallel)	3	2	6	$1,134,000									$1,134,000				
WM-14	Distribution	Beech Pond Road			12	3000	DI	1988	110	29	81	2098	Line #2 -Beech Pond Rd. from ints. w/ cross country line to York Rd. (parallel)	3	2	6	$1,134,000									$1,134,000				
WM-15	Distribution	Beech Pond Road			12	6,500	DI	1996	110	21	89	2106	Line #1 Ints. with York Rd to Pine Hill Road	3	2	6	$2,457,000										$2,457,000			
WM-16	Distribution	Beech Pond Road			12	6,500	DI	1996	110	21	89	2106	Line #2 - Ints. with York Rd to Pine Hill Road (parallel)	3	2	6	$2,457,000										$2,457,000			
WM-18	Distribution	Beech Pond Road Spur			8	680	DI	1992	110	25	85	2102	From ints w/ intake cross-country line toward north to hydrant to Solid Waste	3	2	6	$238,000										$238,000			
WM-20	Distribution	Berrywood Drive			6	1660	CI	1970	115	47	68	2085		2	3	6	$534,520								$534,520.0					
WM-21	Distribution	Blackberry Lane			8	700	DI	1980	110	37	73	2090		3	2	6	$245,000									$245,000				
WM-29	Distribution	Chipmunk Lane			6	320	CI	1970	115	47	68	2085	From Ints. Partridge Drive	2	3	6	$103,040								$103,040.0					
WM-31	Distribution	Clark Road			8	2,000	DI	2006	110	11	99	2116		3	2	6	$700,000											$700,000		
WM-32	Distribution	Clark Road			12	2,200	DI	2006	110	11	99	2116		3	2	6	$831,600											$831,600		
WM-33	Distribution	Clipper Drive			6	1,180	DI	1980	110	37	73	2090		3	2	6	$379,960									$379,960				
WM-38	Distribution	Deer Run Road			6	400	CI	1970	115	47	68	2085		2	3	6	$128,800								$128,800.0					
WM-45	Distribution	Elm Street			12	1,560	DI	1991	110	26	84	2101	Bay Street to Elm Street Pumping Station	3	2	6	$589,680										$589,680			
WM-50	Distribution	Filter Bed Road			12	1200	DI	1974	110	43	67	2084	From Int. with Varney Rd	2	3	6	$453,600								$453,600.0					
WM-53	Distribution	Forest Road			10	200	DI	1996	110	21	89	2106	From North Main in 200 ft	3	2	6	$75,600										$75,600			
WM-54	Distribution	Friend Street			8	760	DI	2004	110	13	97	2114		3	2	6	$266,000											$266,000		
WM-58	Distribution	Greenleaf Drive			8	2,050	DI	1980	110	37	73	2090		3	2	6	$717,500									$717,500				
WM-61	Distribution	Hemlock Drive			6	840	DI	1992	110	25	85	2102		3	2	6	$270,480										$270,480			
WM-65	Distribution	Jiminy Drive			6	1280	CI	1970	115	47	68	2085	From Ints. Berrywood Drive	2	3	6	$412,160								$412,160.0					
WM-66	Distribution	Keewaydin Road			6	1,880	CI	1966	115	51	64	2081	Between N. Main St. & Hawkins Rd.	2	3	6	$605,360								$605,360.0					

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

Inventory of Water Mains

ID#	Category	Street Name	From	To	Size (inches)	Length (Feet)	Material	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks
WM-69	Distribution	King Street (So. branch from Bay St.)			8	800	DI	2000	110	17	93	2110	Ties into 6" north side section
WM-72	Distribution	Lang Pond Road			8	1,240	DI	1974	110	43	67	2084	
WM-73	Distribution	Larry Road			6	970	CI	1974	115	43	72	2089	
WM-78	Distribution	Maplewood Drive			6	1580	CI	UNK	115	UNK	UNK	UNK	
WM-80	Distribution	Middleton Road			10	6800	DI	1989	110	28	82	2099	From Ints. So. Main (Rte. 28) to include Booster Station in 1989
WM-81	Distribution	Mill Street			12	1,200	DI	2003	110	14	96	2113	Tapping sleeve connection to main street
WM-87	Distribution	No. Main St. (Rte. 109)			12	7,540	DI	2003	110	14	96	2113	From 200' North of Libby Museum to Waumbeck Rd.
WM-93	Distribution	Park Ave			4	300	UNK	UNK	100	UNK	UNK	UNK	needs confirmation
WM-94	Distribution	Partridge Drive			6	260	CI	1970	115	47	68	2085	West from Ints. Maplewood Drive
WM-103	Distribution	Pleasant Street			8	970	DI	2009	110	8	102	2119	Southwest of Oak Street installed with Town Crew
WM-106	Distribution	Pointe Sewall Road			6	1400	UNK	UNK	100	UNK	UNK	UNK	
WM-109	Distribution	Railroad Avenue			4	190	Galvanized	1967	100	50	50	2067	Starting from Main St. across from Dockside. (Confirm type) ?????
WM-114	Distribution	Sewall Road			6	500	CI	1962	115	55	60	2077	length needs confirmation
WM-115	Distribution	Sewall Road			8	2080	DI	1982	110	35	75	2092	From Ints. Forest Rd. to hydrant (check first 40' for size and material)
WM-123	Distribution	So. Main St. (Rte. 28)			8	1700	DI	1999	110	18	92	2109	10-inch to terminal end
WM-124	Distribution	So. Main St. (Rte. 28)			8	600	HDPE	2008	75	9	66	2083	From McManus North to hydrant
WM-130	Distribution	Varney Road			12	750	DI	2003	110	14	96	2113	Bay St to Friend St
WM-131	Distribution	Waumbeck Road			10	660	DI	1996	110	21	89	2106	From Rte. 109 (No. Main St.) to hydrant on corner.
WM-132	Distribution	Waumbeck Road			6	3726	UNK	UNK	100	UNK	UNK	UNK	From hydrant on corner to end.
WM-134	Distribution	Wickers Way			8	440	DI	1990	110	27	83	2100	Pine Hill Rd. to hydrant prior to Quarry
WM-135	Distribution	Wickers Way			6	120	UNK	1990	100	27	73	2090	
WM-4	Distribution	Applewood Drive			6	440	CI	1978	115	39	76	2093	West from Ints. Maplewood Drive
WM-36	Distribution	Cricket Hill Road			8	590	DI	1983	110	34	76	2093	
WM-51	Distribution	Filter Bed Road (north end)			6	580	DI	1980	110	37	73	2090	From ints. with Pine Hill Rd.
WM-74	Distribution	Lehner Street			8	1400	HDPE	2012	75	5	70	2087	New C-900 Plastic- part of DT project
WM-79	Distribution	McManus Road			12	160	DI	1998	110	19	91	2108	From tank to S. Main St.
WM-82	Distribution	Nary Shores Road			6	2040	DI	1980	110	37	73	2090	North Main to just past Hickory Road
WM-113	Distribution	School Street			8	350	DI	2011	110	6	104	2121	New 8 inch Ductile Iron Carpenter to Glendon
WM-116	Distribution	Sewall Road			8	10,600	DI	2003	110	14	96	2113	Tapping sleeve connection in N. Main St.
WM-40	Distribution	Diamond Cove Way			4	280	UNK	UNK	100	UNK	UNK	UNK	From Ints. Forest Rd.
WM-55	Distribution	Glendon Street			8	470	HDPE	2012	75	5	70	2087	Installed w/ DT project
WM-59	Distribution	Grove Street			6	200	DI	2015	110	2	108	2125	
WM-70	Distribution	Lake Street			6	460	DI	2015	110	2	108	2125	Installed with Town Crew
WM-118	Distribution	Silver Street			4	157	UNK		100	2017	-1917	100	
WM-133	Distribution	Whiten Neck Rd.			6	2720	DI	2016	110	1	109	2126	Bridge to the end
WM-67	Distribution	Keewaydin Road			8	1,200	DI	1995	110	22	88	2105	To intersection w/ Hawkins Rd.
WM-75	Distribution	Libby Street			6	360	DI	2013	110	4	106	2123	Installed with Town Crew from Mill St. to the end

ID#	Criticality Assessment and Asset Prioritization: Consequence of Failure	Probability of Failure	Risk Score	Life Cycle Costs and Planning: Replacement Cost	5. Long Term Replacement/Renewal Costs - by Decade: 2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's	UNK
WM-69	3	2	6	$280,000											$280,000		
WM-72	2	3	6	$434,000								$434,000.0					
WM-73	2	3	6	$312,340								$312,340.0					
WM-78	2	3	6	$508,760													$508,760
WM-80	3	2	6	$2,570,400									$2,570,400				
WM-81	3	2	6	$453,600											$453,600		
WM-87	3	2	6	$2,850,120											$2,850,120		
WM-93	2	3	6	$96,600													$96,600
WM-94	2	3	6	$83,720								$83,720.0					
WM-103	3	2	6	$339,500											$339,500		
WM-106	2	3	6	$450,800													$450,800
WM-109	2	3	6	$61,180						$61,180							
WM-114	2	3	6	$161,000							$161,000						
WM-115	3	2	6	$728,000									$728,000				
WM-123	3	2	6	$595,000										$595,000			
WM-124	3	2	6	$210,000								$210,000.0					
WM-130	3	2	6	$283,500											$283,500		
WM-131	3	2	6	$249,480										$249,480			
WM-132	2	3	6	$1,199,772													$1,199,772
WM-134	3	2	6	$154,000										$154,000			
WM-135	3	2	6	$38,640									$38,640				
WM-4	2	2	4	$141,680									$141,680				
WM-36	2	2	4	$206,500									$206,500				
WM-51	2	2	4	$186,760									$186,760				
WM-74	4	1	4	$490,000								$490,000.0					
WM-79	2	2	4	$60,480										$60,480			
WM-82	2	2	4	$656,880									$656,880				
WM-113	2	2	4	$122,500												$122,500	
WM-116	2	2	4	$3,710,000											$3,710,000		
WM-40	1	3	3	$90,160													$90,160
WM-55	3	1	3	$164,500								$164,500.0					
WM-59	3	1	3	$64,400												$64,400	
WM-70	3	1	3	$148,120												$148,120	
WM-118	1	3	3	$50,554	$50,554												
WM-133	3	1	3	$875,840												$875,840	
WM-67	1	2	2	$420,000										$420,000			
WM-75	2	1	2	$115,920												$115,920	

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

Inventory of Seasonal Service Lines

ID#	Category	Street Name	From	To	Size (inches)	Length (Feet)	Material	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks
SS-1	Distribution	#74 Keewaydin Point Rd.			1	1000	Plastic	1980	30	37	-7	2010	Keewaydin to #74
SS-2	Distribution	Herron Hollow			1 1/4	2640	Plastic	1980	30	37	-7	2010	From Pine St. to Crooked Pond Rd
SS-3	Distribution	Holden Shore Road			1 1/4	1920	Plastic	1980	30	37	-7	2010	Start at ints. Whiten Neck Rd/Kings Pine Rd. and Olsen Way and pass by No. side of unnamed traffic circle thence cross country to Holden Shore Rd. (come in 420' from intersection w/Olsen Lane)
SS-4	Distribution	Hopewell Point Road			1 1/4	400	Plastic	1980	30	37	-7	2010	Right Fork (Summer)
SS-5	Distribution	Hopewell Point Road			1 1/4	1140	Plastic	1980	30	37	-7	2010	Left Fork (Summer)
SS-6	Distribution	Hopewell Point Road			1 1/4	1910	Plastic	1980	30	37	-7	2010	From Ints. Forest Road to Fork
SS-7	Distribution	J Camps			1 1/2	2180	Plastic		30	UNK	UNK	UNK	S.E. branch off above line (starting at 1000') goes parallel to shore of Rust Pond
SS-8	Distribution	Kingswood Rd			2	3910	Plastic		30	UNK	UNK	UNK	
SS-9	Distribution	Lewando Lane			1 1/2	400	Plastic	1980	30	37	-7	2010	From the end of Clark Rd. to the end
SS-10	Distribution	Mandalay Rd.			1 1/2	1500	Plastic	1980	30	37	-7	2010	Small diameter distribution system maintained by camp owners. From Old Keewaydin to the end of Mandalay
SS-13	Distribution	McCarthy/Anna Rd. Area			1 1/2	2220	Plastic		30	UNK	UNK	UNK	Summer only, from end hydrant No. Main (Rte. 109)
SS-14	Distribution	Millwood Road			1 1/4	1500	Plastic	1980	30	37	-7	2010	From Heron Hollow to the end
SS-15	Distribution	Moose Point Road			1 1/2	1050	Plastic		30	UNK	UNK	UNK	Aka Allen A and Albee Beach House
SS-16	Distribution	Museum Shores Road			1 1/2	450	Plastic		30	UNK	UNK	UNK	needs confirmation
SS-17	Distribution	Oakwood Rd.			2	2640	Plastic	1980	30	37	-7	2010	From Ints. So. Main (Rte. 28) to Puffs Pt.
SS-18	Distribution	Oakwood Rd.			1 1/2	2640	Plastic	1980	30	37	-7	2010	From Puffs Pt. to the end of Oakwood
SS-19	Distribution	Old Keewaydin Point Rd.			1 1/4	3000	Plastic	1980	30	37	-7	2010	From Ints. Keewaydin Rd. to Mandalay Rd.
SS-20	Distribution	Piper Lane			1 1/4	1520	Plastic	1980	30	37	-7	2010	From Old Keewaydin to the end of Piper Lane

ID#	Criticality Assessment and Asset Prioritization			Life Cycle Costs and Planning	5. Long Term Replacement/Renewal Costs - by Decade											
	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
SS-1	2	4	8	$56,000		$56,000			$56,000			$56,000			$56,000	
SS-2	2	4	8	$147,840		$147,840			$147,840			$147,840			$147,840	
SS-3	2	4	8	$107,520		$107,520			$107,520			$107,520			$107,520	
SS-4	2	4	8	$22,400		$22,400			$22,400			$22,400			$22,400	
SS-5	2	4	8	$63,840		$63,840			$63,840			$63,840			$63,840	
SS-6	2	4	8	$106,960		$106,960			$106,960			$106,960			$106,960	
SS-7	2	4	8	$122,080		$122,080			$122,080			$122,080			$122,080	
SS-8	2	4	8	$218,960		$218,960			$218,960			$218,960			$218,960	
SS-9	2	4	8	$22,400		$22,400			$22,400			$22,400			$22,400	
SS-10	2	4	8	$84,000		$84,000			$84,000			$84,000			$84,000	
SS-13	2	4	8	$124,320		$124,320			$124,320			$124,320			$124,320	
SS-14	2	4	8	$84,000		$84,000			$84,000			$84,000			$84,000	
SS-15	2	4	8	$58,800		$58,800			$58,800			$58,800			$58,800	
SS-16	2	4	8	$25,200		$25,200			$25,200			$25,200			$25,200	
SS-17	2	4	8	$147,840		$147,840			$147,840			$147,840			$147,840	
SS-18	2	4	8	$147,840		$147,840			$147,840			$147,840			$147,840	
SS-19	2	4	8	$168,000		$168,000			$168,000			$168,000			$168,000	
SS-20	2	4	8	$85,120		$85,120			$85,120			$85,120			$85,120	

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017		Current Year	2017

PRV Station

ID#	Category	Group	Asset Name	Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost
	Condition of Assets											**Criticality Assessment and Asset Prioritization**			**Life Cycle Costs and Planning**
	Distribution	PRV Station	Building		2: Good	1995	60	22	38	2055		5	2	10	$140,000
	Distribution	PRV Station	(4) 12" Gate Valves		2: Good	1995	50	22	28	2045		4	2	8	$14,000
	Distribution	PRV Station	6" PRV		2: Good	1995	25	22	3	2020	Ross Model 40 Rebuilt with leather Cups 2 years ago	4	2	8	$7,000
	Distribution	PRV Station	10" PRV		2: Good	1995	25	22	3	2020	Ross Model 40 Rebuilt with leather Cups 2 years ago	4	2	8	$9,800
	Distribution	PRV Station	(4) Pressure Transducers		2: Good	1995	25	22	3	2020	KPSI	5	2	10	$840
	Distribution	PRV Station	Unit Heater		2: Good	1995	10	22	-12	2005		2	4	8	$420
	Distribution	PRV Station	Electrical Distribution Panel		2: Good	1995	35	22	13	2030		4	3	12	$28,000
	Distribution	PRV Station	SCADA RTU		2: Good	1995	35	22	13	2030		4	4	16	$70,000
	Distribution	PRV Station	Exhaust Fan & Louver		2: Good	1995	20	22	-2	2015		2	4	8	$21,000
	Distribution	PRV Station	Propane Tank (500 Gal)		2: Good	1995	40	22	18	2035		3	3	9	$9,800
	Distribution	PRV Station	Portable Dehumidifier		2: Good	1995	10	22	-12	2005		2	5	10	$140
	Distribution	PRV Station	Cemetary Water Meter		2: Good	1995	20	22	-2	2015		2	3	6	$2,100
	Distribution	PRV Station	Piping & Fittings		2: Good	1995	100	22	78	2095		5	2	10	$28,000

5. Long Term Replacement/Renewal Costs - by Decade

Asset Name	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
Building					$140,000						$140,000	
(4) 12" Gate Valves				$10,000					$10,000			
6" PRV		$7,000		$2,000			$2,000		$2,000			$2,000
10" PRV		$9,800		$2,500			$2,500		$2,500			$2,500
(4) Pressure Transducers		$840		$600			$600		$600			$600
Unit Heater	$420	$300	$300	$300	$300	$300	$300	$300	$300	$300	$300	$300
Electrical Distribution Panel			$28,000									
SCADA RTU			$70,000			$50,000				$50,000		
Exhaust Fan & Louver	$21,000		$2,000		$2,000		$2,000		$2,000		$2,000	
Propane Tank (500 Gal)			$9,800									
Portable Dehumidifier	$140	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Cemetary Water Meter	$2,100		$1,500		$1,500		$1,500		$1,500		$1,500	
Piping & Fittings									$5,000			

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

South Main Street Tank

ID#	Category	Group	Asset Name	Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost
	Condition of Assets											**Criticality Assessment and Asset Prioritization**			**Life Cycle Costs and Planning**
	Storage	Water Tank	S. Main Street Tank	500,000	2: Good	1955	100	62	38	2055	Chicago Bridge & Iron (welded steel)	5	3	15	$2,100,000
	Storage	Water Tank	Tank Recoating				25				Water Tank Maintenance recoating				$350,000
	Storage	Water Tank	Altitude Valve		2: Good	1955	50	62	-12	2005	Ross Model 40 RD Duel Acting	3	4	12	$21,000
	Storage	Water Tank	(2) 16" Gate valves		2: Good	1955	50	62	-12	2005		3	3	9	$9,800
	Storage	Water Tank	16" Check Valve		2: Good	1955	50	62	-12	2005		3	3	9	$4,900
	Storage	Water Tank	Valve Vault		2: Good	1955	75	62	13	2030	Precast Concrete Structure	3	3	9	$84,000
	Storage	Water Tank	Mixer		2: Good	2008	20	9	11	2028	Solarbee	2	2	4	$63,000
	Storage	Water Tank	Control Building		2: Good	2008	60	9	51	2068	12' x 12' Precast Concrete Structure	4	2	8	$140,000
	Storage	Water Tank	Piping & Fittings		2: Good	2008	100	9	91	2108		4	2	8	$42,000
	Storage	Water Tank	(2) 8" Butterfly Valves		2: Good	2008	50	9	41	2058		3	2	6	$4,200
	Storage	Water Tank	(2) 4" Gate Valves		2: Good	2008	50	9	41	2058		3	2	6	$3,360
	Storage	Water Tank	4" Check Valve		2: Good	2008	50	9	41	2058		3	2	6	$1,680
	Storage	Water Tank	8" Check Valve		2: Good	2008	50	9	41	2058		3	2	6	$2,100
	Storage	Water Tank	4" Motor Operated Butterfly Valve		2: Good	2008	25	9	16	2033		3	2	6	$9,800
	Storage	Water Tank	4" Magnetic Flow Meter		2: Good	2008	25	9	16	2033	Foxboro	3	2	6	$7,700
	Storage	Water Tank	Chlorine Analyzer		2: Good	2008	15	9	6	2023	Hach CL17	2	2	4	$9,800
	Storage	Water Tank	Tablet Chlorinator, PPG Accu-Tab		2: Good	2008	20	9	11	2028	Model 3075	2	2	4	$42,000
	Storage	Water Tank	Control Panel/RTU		2: Good	2008	25	9	16	2033	Electrical installation includes electical distribrution equipment	3	2	6	$70,000
	Storage	Water Tank	Exaust Fan		2: Good	2008	20	9	11	2028		2	3	6	$14,000
	Storage	Water Tank	Electrical Unit Heater		2: Good	2008	20	9	11	2028		2	3	6	$1,400
	Storage	Water Tank	Fire Alarm Panel		2: Good	2008	25	9	16	2033		2	2	4	$7,000

5. Long Term Replacement/Renewal Costs - by Decade

Asset Name	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
S. Main Street Tank					$2,100,000							
Tank Recoating		$350,000		$350,000				$350,000.0		$350,000		
Altitude Valve	$21,000											
(2) 16" Gate valves	$9,800											
16" Check Valve	$4,900											
Valve Vault			$84,000								$60,000	
Mixer		$63,000										
Control Building						$140,000						$140,000
Piping & Fittings										$42,000		
(2) 8" Butterfly Valves					$4,200					$3,000		
(2) 4" Gate Valves					$3,360					$2,400		
4" Check Valve					$1,680					$1,200		
8" Check Valve					$2,100					$1,500		
4" Motor Operated Butterfly Valve			$9,800		$7,000			$7,000.0		$7,000		
4" Magnetic Flow Meter			$7,700		$5,500			$5,500.0		$5,500		
Chlorine Analyzer		$9,800	$7,000		$7,000	$7,000		$7,000.0	$7,000		$7,000	$7,000
Tablet Chlorinator, PPG Accu-Tab		$42,000	$30,000		$30,000	$30,000		$30,000.0	$30,000		$30,000	$30,000
Control Panel/RTU			$70,000		$50,000			$50,000.0		$50,000		
Exaust Fan		$14,000		$2,000		$2,000		$2,000		$2,000		$2,000
Electrical Unit Heater		$1,400		$1,000		$1,000		$1,000		$1,000		$1,000
Fire Alarm Panel			$7,000		$5,000			$5,000.0		$5,000		

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017		Current Year	2017

Middleton Road BPS

ID#	Category	Group	Asset Name	Condition of Assets: Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Criticality Assessment and Asset Prioritizatio: Consequence of Failure	Probability of Failure	Risk Score	Life Cycle Costs and Planning: Replacement Cost
	Distribution	Pumping Station	Building		2:Good	1989	60	28	32	2049	20'x12' Split Face, shingle roof	4	3	12	$280,000
	Distribution	Pumping Station	Electrical Panels		4	1989	25	28	-3	2014	To be replaced to meet code	3	4	12	$28,000
	Distribution	Pumping Station	Flushing Station		2:Good	2017	20	0	20	2037	Kuferle: Eclipse	2	2	4	$4,200
	Distribution	Pumping Station	Pump Control Panel		Unused	1989	25	28	-3	2014	Not in use and not to be maintained	4	4	16	$4,200
	Distribution	Pumping Station	Jockey Pump #1	3 hp	2:Good	2010	20	7	13	2030	J-Class	4	3	12	$4,200
	Distribution	Pumping Station	Jockey Pump #2	3 hp	2:Good	2016	20	1	19	2036	Franklin Electric (1)	4	1	4	$4,200
	Distribution	Pumping Station	Worthington Pump #1	15 hp	Unused	1989	20	28	-8	2009	Not in use and not to be maintained	1	4	4	$7,000
	Distribution	Pumping Station	Worthington Pump #2	15 hp	Unused	1989	20	28	-8	2009	Not in use and not to be maintained	1	4	4	$7,000
	Distribution	Pumping Station	Pump Control Valves		2:Good	1989	50	28	22	2039		3	2	6	$4,200
	Distribution	Pumping Station	Hydropneumatic Tanks		2:Good	1989	25	28	-3	2014		3	4	12	$2,100
	Distribution	Pumping Station	Exhaust Fans		2:Good	1989	20	28	-8	2009		2	4	8	$2,000
	Distribution	Pumping Station	Unit Heater (Propane)		2:Good	1989	20	28	-8	2009		3	4	12	$1,050
	Distribution	Pumping Station	Propane Tank (500 gal)		2:Good	1989	40	28	12	2029		3	3	9	$9,800
	Distribution	Pumping Station	Piping and Fittings		2:Good	1989	100	28	72	2089		3	2	6	$42,000

5. Long Term Replacement/Renewal Costs - by Decade

Asset Name	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
Building				$280,000						$280,000		
Electrical Panels	$28,000		$28,000		$28,000		$28,000		$28,000		$28,000	
Flushing Station			$4,200		$4,200		$4,200		$4,200		$4,200	
Pump Control Panel												
Jockey Pump #1			$4,200									
Jockey Pump #2			$4,200									
Worthington Pump #1												
Worthington Pump #2												
Pump Control Valves			$4,200					$4,200.0				
Hydropneumatic Tanks	$2,100		$2,100			$2,100		$2,100.0			$2,100	
Exhaust Fans	$2,000		$2,000		$2,000		$2,000		$2,000		$2,000	
Unit Heater (Propane)	$1,050		$1,050		$1,050		$1,050		$1,050		$1,050	
Propane Tank (500 gal)		$9,800				$9,800				$9,800		
Piping and Fittings								$42,000.0				

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017		Current Year	2017

Water Treatment Facility				Condition of Assets								Criticality Assessment and Asset Prioritization			Life Cycle Costs and Planning	5. Long Term Replacement/Renewal Costs - by Decade											
ID#	Category	Group	Asset Name	Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
WTP 1	Treatment	Water Treatment Plant	Air & Vacuum Valve - Raw Water	N/A	2: good	1996	20	21	-1	2016	1" Valmatic, rebuilt in 2008	3	5	15	$551	$551		$551		$551		$551		$551		$551	
WTP 2	Treatment	Water Treatment Plant	Air & Vacuum Valve - Backwash	N/A	1: new	2016	20	1	19	2036	1" Replaced entire assembly in 2016	3	1	3	$551			$551		$551		$551		$551		$551	
WTP 3	Treatment	Water Treatment Plant	Air Compressor	N/A	1: new	2016	20	1	19	2036	ANEST- IWATA Air supply for all pneumatics	2	1	2	$17,250			$17,250		$17,250		$17,250		$17,250		$17,250	
WTP 4	Treatment	Water Treatment Plant	Alum Feed System	N/A	2: good	2013	20	4	16	2033	day tank, chemical feed pumps, tubing, valves, etc.; flow paced 4-20 mA; (2) LMI B721-49031; 55 gal day tank	3	1	3	$15,000			$15,000		$15,000		$15,000		$15,000		$15,000	
WTP 5	Treatment	Water Treatment Plant	Alum Storage System	N/A	2: good	2012	15	5	10	2027	(2) 1,000 gal bulk tanks, valves and piping	2	2	4	$7,500		$7,500		$7,500	$7,500		$7,500	$7,500.0		$7,500	$7,500	
WTP 6	Treatment	Water Treatment Plant	Backwash Control Valve	N/A	2: good	1996	20	21	-1	2016	8" Open/closed, manual wheel with indicator	3	5	15	$2,025	$2,025		$2,025		$2,025		$2,025		$2,025		$2,025	
WTP 7	Treatment	Water Treatment Plant	Blower #1	N/A	2: good	1996	20	21	-1	2016	EG&G Rotron Blower; 20 hp; DR39BM72 Part 037032	2	5	10	$18,000	$18,000		$18,000		$18,000		$18,000		$18,000		$18,000	
WTP 8	Treatment	Water Treatment Plant	Blower #2	N/A	2: good	1996	20	21	-1	2016	EG&G Rotron Blower; 20 hp; DR39BM72 Part 037032	2	5	10	$18,000	$18,000		$18,000		$18,000		$18,000		$18,000		$18,000	
WTP 9	Treatment	Water Treatment Plant	FE-100 flow meter - Raw Water	N/A	3: fair/good	1996	20	21	-1	2016	Venturi; 12" BHUT-CI 12 x 7; serial #3008; primary flow signal	2	5	10	$8,250	$8,250		$8,250		$8,250		$8,250		$8,250		$8,250	
WTP 10	Treatment	Water Treatment Plant	Filter to Waste Control Valves #1	N/A	2: good	1996	20	21	-1	2016	8" Pneumatic modulated from the level controller signal	2	5	10	$8,700	$8,700		$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 11	Treatment	Water Treatment Plant	Filter to Waste Control Valves #2	N/A	2: good	1996	20	21	-1	2016	8" Pneumatic modulated from the level controller signal	2	5	10	$8,700	$8,700		$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 12	Treatment	Water Treatment Plant	Filtered Water Control Valve #1	N/A	2: good	1996	20	21	-1	2016	8" Pneumatic modulated from the level controller signal	2	5	10	$8,700	$8,700		$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 13	Treatment	Water Treatment Plant	Filtered Water Control Valve #2	N/A	2: good	2014	20	3	17	2034	8" Pneumatic modulated from the level controller signal	2	1	2	$8,700			$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 14	Treatment	Water Treatment Plant	Influent Rate Control Valve #1	N/A	2: good	2013	20	4	16	2033	only positioners are original, pneumatic modulating from	2	1	2	$8,700			$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 15	Treatment	Water Treatment Plant	Influent Rate Control Valve #2	N/A	2: good	2010	20	7	13	2030	8" Pratt, pneumatic, Bailey positioner w/ Pratt actuators; only positioners are original, pneumatic modulating from SCADA	2	2	4	$8,700			$8,700		$8,700		$8,700		$8,700		$8,700	
WTP 16	Treatment	Water Treatment Plant	Backwash Control Valves (2)	N/A	2: good	1996	20	21	-1	2016	8" butterfly	2	5	10	$2,025	$2,025		$2,025		$2,025		$2,025		$2,025		$2,025	
WTP 17	Treatment	Water Treatment Plant	Surface Wash Control Valves (2)	N/A	2: good	1996	20	21	-1	2016	6" Solenoid activated Cla-Valve	2	5	10	$3,450	$3,450		$3,450		$3,450		$3,450		$3,450		$3,450	
WTP 18	Treatment	Water Treatment Plant	Polymer Blending Unit	N/A	2: good	1996	25	21	4	2021	Stranco Poly-Blend model # 100-UP with a 1.0 gph feed pump	2	4	8	$15,000		$15,000		$15,000			$15,000		$15,000			$15,000
WTP 19	Treatment	Water Treatment Plant	Potassium Permanganate Feed System	N/A	2: good	1996	20	21	-1	2016	not in use; 150 gal tank; 1/4 hp mixer; pump removed	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 20	Treatment	Water Treatment Plant	Air Dryer	N/A	2: good	2010	20	7	13	2030	Ingersoll Rand	2	3	6	$1,313			$1,313		$1,313		$1,313		$1,313		$1,313	
WTP 21	Treatment	Water Treatment Plant	Soda Ash Feed System - Pumps (2)	N/A	2: good	2013	15	4	11	2028	Milroy pumps w/ drives	2	2	4	$15,000		$15,000		$15,000	$15,000		$15,000	$15,000.0		$15,000	$15,000	
WTP 22	Treatment	Water Treatment Plant	Soda Ash Feed System - Dry Feeder	N/A	2: good	1996	15	21	-6	2011	Dry feeder w/ auger; solution tank w/ mixer; level probe controller original. Gear Box replaced in 2013	2	5	10	$45,000	$45,000	$45,000		$45,000	$45,000		$45,000	$45,000.0		$45,000	$45,000	
WTP 23	Treatment	Water Treatment Plant	Soda Ash Feed System - Misc.	N/A	2: good	1996	20	21	-1	2016	Valves and piping	2	5	10	$4,500	$4,500		$4,500		$4,500		$4,500		$4,500		$4,500	
WTP 24	Treatment	Water Treatment Plant	Sodium Hypochlorite Feed System	N/A	2: good	2013	20	4	16	2033	Day tank, chemical feed pumps, tubing, valves, etc.; flow paced 4-20 mA; (2) LMI B711-D90H1; 55 gal day tank	2	2	4	$15,000			$15,000		$15,000		$15,000		$15,000		$15,000	
WTP 25	Treatment	Water Treatment Plant	Sodium Hypochlorite Storage System	N/A	2: good	2010	15	7	8	2025	(2) 1,000 gal bulk tanks, valves and piping	2	3	6	$7,500		$7,500		$7,500	$7,500		$7,500	$7,500.0		$7,500	$7,500	
WTP 26	Treatment	Water Treatment Plant	Static Mixer	N/A	2: good	1996	20	21	-1	2016	12"	2	5	10	$22,500	$22,500		$22,500		$22,500		$22,500		$22,500		$22,500	
WTP 27	Treatment	Water Treatment Plant	Treatment Unit #1 - Clarifier (screens and media)	N/A	2: good	2017	10	0	10	2027	Screens to be replaced spring 2017; beads good per operator	3	3	9	$65,000		$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000.0	$65,000	$65,000	$65,000	$65,000
WTP 28	Treatment	Water Treatment Plant	Treatment Unit #1 - Filter (media)	N/A	1: new	2016	10	1	9	2026	Media replaced 2016; sand & anthracite; 2007 rebuilt wash arms	3	1	3	$25,000		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WTP 29	Treatment	Water Treatment Plant	Treatment Unit #1 - Underdrain and Pipe	N/A	2: good	1996	25	21	4	2021		3	4	12	$50,000		$50,000		$50,000			$50,000		$50,000			$50,000
WTP 30	Treatment	Water Treatment Plant	Treatment Unit #1 - Vessel	N/A	2: good	1996	50	21	29	2046		3	3	9	$375,000				$375,000					$375,000			
WTP 31	Treatment	Water Treatment Plant	Treatment Unit #2 - Clarifier (screens and media)	N/A	2: good	2017	10	0	10	2027	Screens to be replaced spring 2017; beads good per operator	3	3	9	$65,000		$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000
WTP 32	Treatment	Water Treatment Plant	Treatment Unit #2 - Filter (media)	N/A	1: new	2016	10	1	9	2026	Media replaced 2016; sand & anthracite; 2007 rebuilt wash arms	3	1	3	$25,000		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WTP 33	Treatment	Water Treatment Plant	Treatment Unit #2 - Underdrain and Pipe	N/A	2: good	1996	25	21	4	2021		3	4	12	$50,000		$50,000		$50,000			$50,000		$50,000			$50,000
WTP 34	Treatment	Water Treatment Plant	Treatment Unit #2 - Vessel	N/A	2: good	1996	50	21	29	2046		2	3	6	$375,000				$375,000					$375,000			
WTP 35	Treatment	Water Treatment Plant	Blended Polyphosphate Feed System	N/A	2: good	2012	20	5	15	2032	50 gal tank; LMI pump AA971-45851	2	2	4	$3,000			$3,000									
WTP 36	Treatment	Water Treatment Plant	Backwash Recycle System	N/A	2: good	1996	20	21	-1	2016	Not in use; manual; 2 submersible pumps in sump chamber fed by weirs	3	5	15	$22,500	$22,500		$22,500		$22,500		$22,500		$22,500		$22,500	
WTP 37	Treatment	Water Treatment Plant	Strainer	N/A	2: good	1996	20	21	-1	2016	(1) 12"Haywood, (2) 12" Dezurik Butterfly valves	2	5	10	$28,500	$28,500		$28,500		$28,500		$28,500		$28,500		$28,500	
WTP 38	Treatment	Water Treatment Plant	Filter influent flow meters (2)	N/A	2: good	1996	20	21	-1	2016	8" venturi; Honeywell flow controllers at PLC	2	5	10	$5,550	$5,550		$5,550		$5,550		$5,550		$5,550		$5,550	
WTP 39	Treatment	Water Treatment Plant	Filter level controller #1	N/A	2: good	1996	20	21	-1	2016	Magnetrol	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 40	Treatment	Water Treatment Plant	Filter level controller #2	N/A	2: good	2016	20	1	19	2036	Magnetrol	2	1	2	$7,500			$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 41	Treatment	Water Treatment Plant	DP cells (all)	N/A	2: good	2009	20	8	12	2029	Foxboro	2	3	6	$9,000		$9,000		$9,000		$9,000		$9,000.0		$9,000		$9,000
WTP 42	Treatment	Water Treatment Plant	Backwash flow meter (1)	N/A	2: good	1996	20	21	-1	2016	PFS 10"Venturi	2	5	10	$6,300	$6,300		$6,300		$6,300		$6,300		$6,300		$6,300	
WTP 43	Treatment	Water Treatment Plant	Sample Pumps (2)	N/A	2: good	1996	20	21	-1	2016	Oberdoffer Gear Pumps, original motors, heads replaced every 4 years	2	5	10	$1,500	$1,500		$1,500		$1,500		$1,500		$1,500		$1,500	
WTP 44	Treatment	Water Treatment Plant	Alum High Level Alarm Panel	N/A	2: good	1996	20	21	-1	2016	audible alarm	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 45	Treatment	Water Treatment Plant	Blower Control Panel #1	N/A	2: good	1996	20	21	-1	2016	Omnitrol MCC	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 46	Treatment	Water Treatment Plant	Blower Control Panel #2	N/A	2: good	1996	20	21	-1	2016	Omnitrol MCC	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 47	Treatment	Water Treatment Plant	Holding Tank High level Alarm Panel	N/A	2: good	1996	20	21	-1	2016	3 IT-115	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 48	Treatment	Water Treatment Plant	Process Instruments - Online Analyzers	N/A	2: good	2016	20	1	19	2036	to be replaced 2016	2	1	2	$18,000			$18,000		$18,000		$18,000		$18,000		$18,000	
WTP 49	Treatment	Water Treatment Plant	Sample Pump Control Panel	N/A	2: good	1996	20	21	-1	2016	Omni-Trol MCC	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 50	Treatment	Water Treatment Plant	Disinfection Tank Level Monitor	N/A	2: good	2008	20	9	11	2028	Hydroranger 200	2	3	6	$3,000		$3,000		$3,000		$3,000		$3,000.0		$3,000		$3,000
WTP 51	Treatment	Water Treatment Plant	WTP Control Panel (PLC)	N/A	2: good	1996	20	21	-1	2016	incl. (17) I/O cards; (2) Honeywell flow controllers ($1500/ea)	2	5	10	$45,000	$45,000		$45,000		$45,000		$45,000		$45,000		$45,000	
WTP 52	Treatment	Water Treatment Plant	SCADA Computer	N/A	2: good	2010	5	7	-2	2015	Optiplex 380 with SCADA Software	2	5	10	$7,500	$7,500	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
WTP 53	Treatment	Water Treatment Plant	SCADA Backup Computer	N/A	2: good	2005	5	12	-7	2010	Optiplex GX150 with SCADA Software	1	5	5	$7,500	$7,500	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
WTP 54	Treatment	Water Treatment Plant	Standby Power System	N/A	2: good	1996	30	21	9	2026	CAT 3306; 250kW; added block heater	3	4	12	$142,500		$142,500			$142,500			$142,500.0			$142,500	
WTP 55	Treatment	Water Treatment Plant	Individual electrical panels	N/A	2: good	1996	30	21	9	2026	Breaker Panels for lighting, outlets and general Plant use	2	4	8	$60,000		$60,000			$60,000			$60,000.0			$60,000	
WTP 56	Treatment	Water Treatment Plant	Pellet boilers (2)	N/A	2: good	2013	15	4	11	2028	MESYSTEMS Okofen PES36 Pellet Boilers	2	2	4	$60,000		$60,000		$60,000	$60,000		$60,000	$60,000.0		$60,000	$60,000	
WTP 57	Treatment	Water Treatment Plant	Heat Pump	N/A	2: good	2013	15	4	11	2028	Daiken (3) Ton VRV with (2) 18,000 kbtu Ceiling Cassettes	2	2	4	$7,500		$7,500		$7,500	$7,500		$7,500	$7,500.0		$7,500	$7,500	
WTP 58	Treatment	Water Treatment Plant	Laboratory Equipment	N/A	2: good	varies	20	#VALUE!	#VALUE!	#VALUE!		2		0	$100,000		$100,000		$100,000		$100,000		$100,000.0		$100,000		$100,000
WTP 59	Treatment	Water Treatment Plant	Doors & Windows	N/A	2: good	1996	30	21	9	2026		1	4	4	$55,500		$55,500			$55,500			$55,500.0			$55,500	
WTP 60	Treatment	Water Treatment Plant	Equipment Pads & Containment Curbs	N/A	2: good	1996	50	21	29	2046		2	3	6	--				–								
WTP 61	Treatment	Water Treatment Plant	Floors	N/A	2: good	1996	50	21	29	2046		2	3	6	$19,500				$19,500					$19,500			
WTP 62	Treatment	Water Treatment Plant	Loading Dock - Exterior	N/A	2: good	1996	50	21	29	2046		1	3	3	$54,000				$54,000					$54,000			

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

Water Treatment Facility				Condition of Assets								Criticality Assessment and Asset Prioritization			Life Cycle Costs and Planning	5. Long Term Replacement/Renewal Costs - by Decade											
ID#	Category	Group	Asset Name	Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score	Replacement Cost	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
WTP 63	Treatment	Water Treatment Plant	Roof	N/A	2: good	2012	30	5	25	2042	Insulated underside of the Roof and installed Metal roofing system	4	2	8	$61,500				$61,500					$61,500			
WTP 64	Treatment	Water Treatment Plant	Stairs & Handrails	N/A	2: good	1996	50	21	29	2046		1	3	3	$66,600				$66,600					$66,600			
WTP 65	Treatment	Water Treatment Plant	Walls - Exterior	N/A	2: good	1996	50	21	29	2046	Enclosed Gable ends and Soffit with Vinyl 2013-2016	4	3	12	$109,500				$109,500					$109,500			
WTP 66	Treatment	Water Treatment Plant	Walls - Interior	N/A	2: good	1996	50	21	29	2046		4	3	12	$37,500				$37,500					$37,500			
WTP 67	Treatment	Water Treatment Plant	Storage Shed	N/A	2: good	2012	50	5	45	2062	16' x 12'	1	1	1	$7,500						$7,500					$7,500	
WTP 68	Treatment	Water Treatment Plant	Mower/Blower	N/A	2: good	2006	15	11	4	2021	John Deere	2	4	8	$2,700		$2,700	$2,700		$2,700	$2,700		$2,700.0	$2,700		$2,700	$2,700
WTP 69	Treatment	Water Treatment Plant	ATV	N/A	2: good	2012	10	5	5	2022	Polaris Ranger 400 I&O	1	3	3	$9,000		$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000
WTP 71	Treatment	Water Treatment Plant	Chart Recorders	N/A	2: good	1996	20	21	-1	2016	(1) Chessel; (2) Foxboro. Replace with data loggers.	1	5	5	$3,150	$3,150		$3,150		$3,150		$3,150		$3,150		$3,150	
WTP 72	Treatment	Water Treatment Plant	Soda Ash System	N/A	2: good	2012	20	5	15	2032	(2) Milroy pumps 36 gph, 100 psi (G61P8PM4N-1); Dry feeder w/ auger; solution tank w/ mixer; level probe controller; rotameter 2 gpm to solution tank; piping; valves; etc.	3	2	6	$75,000			$75,000		$75,000		$75,000		$75,000		$75,000	
WTP 73	Treatment	Water Treatment Plant	Sodium Hypochlorite System	N/A	2: good	2012	20	5	15	2032	500 gal bulk tank; 55 gal day tank; LMI C721-DGG141 pump; flow paced off mag meter	3	2	6	$30,000			$30,000	$30,000		$30,000	$30,000		$30,000	$30,000		$30,000
WTP 74	Treatment	Water Treatment Plant	Turbine Meter	N/A	2: good	1996	20	21	-1	2016	Rockwell W-8500; redundant 12" water main to PRV station; currently not in use. To be replaced by 12" mag meter	2	5	10	$8,100	$8,100		$8,100		$8,100		$8,100		$8,100		$8,100	
WTP 75	Treatment	Water Treatment Plant	Mag Meter	N/A	2: good	1996	20	21	-1	2016	8300 Series (8308-SABA-TSJ-GFG2); active 12" water main to PRV station	2	5	10	$8,100	$8,100		$8,100		$8,100		$8,100		$8,100		$8,100	
WTP 76	Treatment	Water Treatment Plant	SCR Drives for Soda Ash Pumps	N/A	2: good	2012	20	5	15	2032		2	2	4	$1,500			$1,500		$1,500		$1,500		$1,500		$1,500	
WTP 77	Treatment	Water Treatment Plant	Water Meter and Chemical Feed Control Panel (PLC)	N/A	2: good	2012	20	5	15	2032	wireless to WTP SCADA	2	2	4	$30,000			$30,000		$30,000		$30,000		$30,000		$30,000	
WTP 78	Treatment	Water Treatment Plant	Online Analyzers	N/A	2: good	2012	20	5	15	2032	lime chip tank for CL17 reagent goes to dry well	2	2	4	$12,000			$12,000		$12,000		$12,000		$12,000		$12,000	
WTP 79	Treatment	Water Treatment Plant	Gas Heaters	N/A	2: good	2012	20	5	15	2032		2	2	4	$4,500			$4,500		$4,500		$4,500		$4,500		$4,500	
WTP 80	Treatment	Water Treatment Plant	Exhaust Fan and ductwork	N/A	2: good	2012	20	5	15	2032		2	2	4	$12,000			$12,000		$12,000		$12,000		$12,000		$12,000	
WTP 81	Treatment	Water Treatment Plant	Soda Ash Water Heater	N/A	2: good	2012	20	5	15	2032	Rinnai RL75	2	2	4	$1,500			$1,500		$1,500		$1,500		$1,500		$1,500	
WTP 82	Treatment	Water Treatment Plant	Propane Tank	N/A	2: good	2012	20	5	15	2032		2	2	4	$0			$0		$0		$0		$0		$0	
WTP 83	Treatment	Water Treatment Plant	Containment Curbs	N/A	2: good	2012	50	5	45	2062		2	1	2	–						–						
WTP 84	Treatment	Water Treatment Plant	Doors	N/A	2: good	1989	30	28	2	2019	2 double & 1 single	1	4	4	$8,400	$8,400			$8,400			$8,400			$8,400		
WTP 85	Treatment	Water Treatment Plant	Floors	N/A	2: good	1989	50	28	22	2039		4	3	12	$2,250			$2,250					$2,250.0				
WTP 86	Treatment	Water Treatment Plant	Roof	N/A	2: good	1989	50	28	22	2039	Metal	3	3	9	$4,650			$4,650					$4,650.0				
WTP 87	Treatment	Water Treatment Plant	Walls - Exterior	N/A	2: good	1989	50	28	22	2039		3	3	9	$36,000			$36,000					$36,000.0				
WTP 88	Treatment	Water Treatment Plant	Walls - Interior	N/A	2: good	1989	50	28	22	2039		4	3	12	–			–					–				
WTP 89	Treatment	Water Treatment Plant	Hydro-pneumatic Tanks	N/A	2: good	2009	20	8	12	2029	(2) Well Xtrol WX-3CS; 125 psi	3	3	9	$1,800		$1,800		$1,800		$1,800		$1,800.0		$1,800		$1,800
WTP 90	Treatment	Water Treatment Plant	Pump BW-1 (Backwash)	N/A	2: good	1996	20	21	-1	2016	Horz. Split-Case; 60 hp; Peerless 8AE15	2	5	10	$33,000	$33,000		$33,000		$33,000		$33,000		$33,000		$33,000	
WTP 91	Treatment	Water Treatment Plant	Pump BW-2 (Backwash)	N/A	2: good	1996	20	21	-1	2016	Horz. Split-Case; 60 hp; Peerless 8AE15	2	5	10	$33,000	$33,000		$33,000		$33,000		$33,000		$33,000		$33,000	
WTP 92	Treatment	Water Treatment Plant	Pump PW-1 (Plant Water)	N/A	2: good	1996	20	21	-1	2016	2 hp; 21 ft. H2O suction; 45 psi discharge	2	5	10	$4,500	$4,500		$4,500		$4,500		$4,500		$4,500		$4,500	
WTP 93	Treatment	Water Treatment Plant	Pump PW-2 (Plant Water)	N/A	2: good	1996	20	21	-1	2016	2 hp; 21 ft. H2O suction; 45 psi discharge	2	5	10	$4,500	$4,500		$4,500		$4,500		$4,500		$4,500		$4,500	
WTP 94	Treatment	Water Treatment Plant	Pump S-1 (Sample)	N/A	2: good	1996	20	21	-1	2016		2	5	10	$750	$750		$750		$750		$750		$750		$750	
WTP 95	Treatment	Water Treatment Plant	Pump SW-1 (Surface Wash)	N/A	2: good	1996	20	21	-1	2016	15 hp; Peerless series C; type 815G; style M	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 96	Treatment	Water Treatment Plant	Pump SW-2 (Surface Wash)	N/A	2: good	1996	20	21	-1	2016	15 hp; Peerless series C; type 815G; style M	2	5	10	$7,500	$7,500		$7,500		$7,500		$7,500		$7,500		$7,500	
WTP 97	Treatment	Water Treatment Plant	Backwash Check Valves (2)	N/A	2: good	2008	20	9	11	2028	14"	3	3	9	$36,000		$36,000		$36,000		$36,000		$36,000.0		$36,000		$36,000
WTP 98	Treatment	Water Treatment Plant	Main Pump House Control Panel	N/A	2: good	1996	20	21	-1	2016		3	5	15	$37,500	$37,500		$37,500		$37,500		$37,500		$37,500		$37,500	
WTP 99	Treatment	Water Treatment Plant	Backwash Pump VFDs 60 hp (2)	N/A	2: good	2016	20	1	19	2036	Added in 2016 to eliminate pumping against throttled valve for control	3	1	3	$25,500			$25,500		$25,500		$25,500		$25,500		$25,500	
WTP 100	Treatment	Water Treatment Plant	Secondary Control Panel	N/A	2: good	1996	20	21	-1	2016		3	5	15	$22,500	$22,500		$22,500		$22,500		$22,500		$22,500		$22,500	
WTP 101	Treatment	Water Treatment Plant	Heaters, Exhaust Fan, Ductwork, Louvers/Dampers	N/A	2: good	1996	30	21	9	2026		2	4	8	$20,000		$20,000			$20,000			$20,000.0			$20,000	
WTP 102	Treatment	Water Treatment Plant	Propane Tank	N/A	2: good	1996	30	21	9	2026		2	4	8	$0		$0										
WTP 103	Treatment	Water Treatment Plant	Doors & Windows	N/A	2: good	1996	30	21	9	2026		1	4	4	$6,450		$6,450			$6,450			$6,450.0			$6,450	
WTP 104	Treatment	Water Treatment Plant	Equipment Pads	N/A	2: good	1996	30	21	9	2026		1	4	4	–		–										
WTP 105	Treatment	Water Treatment Plant	Floors	N/A	2: good	1996	50	21	29	2046		4	3	12	$3,000				$3,000					$3,000			
WTP 106	Treatment	Water Treatment Plant	Roof	N/A	2: good	1996	30	21	9	2026	asphalt shingles	4	4	16	$5,700		$5,700			$5,700			$5,700.0			$5,700	
WTP 107	Treatment	Water Treatment Plant	Walls - Exterior	N/A	2: good	1996	50	21	29	2046		4	3	12	$33,000				$33,000					$33,000			
WTP 108	Treatment	Water Treatment Plant	Walls - Interior	N/A	2: good	1996	50	21	29	2046		4	3	12	–				–					–			
WTP 109	Treatment	Water Treatment Plant	Land	N/A	2: good	1996	N/A	21	#VALUE!	#VALUE!	305 ac.	4		0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
WTP 110	Treatment	Water Treatment Plant	Pavement	N/A	2: good	2010	10	7	3	2020		2	4	8	$31,800		$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
WTP 111	Treatment	Water Treatment Plant	Security Fence and Gates	N/A	2: good	1996	30	21	9	2026		2	4	8	$43,000		$43,000			$43,000			$43,000.0			$43,000	
WTP 112	Treatment	Water Treatment Plant	Yard Piping	N/A	2: good	1996	75	21	54	2071	including from Pond to WTP, chemical feed sleeves not aligned (not in use)	3	2	6	$1,170,000							$1,170,000					
WTP 113	Treatment	Water Treatment Plant	Water Tank - FW Clearwell	N/A	2: good	1996	75	21	54	2071	(1) Million gallon Pre-stressed Concrete Tank	4	2	8	$1,650,000							$1,650,000					
WTP 114	Treatment	Water Treatment Plant	Lagoons (2)	N/A	2: good	1996	50	21	29	2046	Cleaned once in 10 years	3	3	9	$100,500				$100,500								$100,500

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017	Current Year	2017

Water Treatment Facility

ID#	Category	Group	Asset Name	Condition of Assets: Capacity	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Criticality Assessment and Asset Prioritization: Consequence of Failure	Probability of Failure	Risk Score	Life Cycle Costs and Planning: Replacement Cost
WTP 115	Treatment	Water Treatment Plant	100,000 Gallon Disinfection Tank (baffled)	N/A	2: good	2008	30	9	21	2038		4	2	8	$300,000
WTP 116	Treatment	Water Treatment Plant	2,000 gal Holding Tank	N/A	2: good	1996	30	21	9	2026		4	4	16	$7,500
WTP 117	Treatment	Water Treatment Plant	2,000 gal double-walled fuel tank	N/A	2: good	1996	30	21	9	2026		3	4	12	--
WTP 118	Treatment	Water Treatment Plant	Septic, holding and pipe chase manholes	N/A	2: good	1996	30	21	9	2026	(10)?	4	4	16	$45,000
WTP 119	Treatment	Water Treatment Plant	Heating Pellet storage	N/A	2: good	2012	15	5	10	2027	(20) Ton capacity	2	3	6	$45,000
														TOTAL	$6,223,414

5. Long Term Replacement/Renewal Costs - by Decade

ID#	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
WTP 115			$300,000			$300,000			$300,000			$300,000
WTP 116		$7,500			$7,500			$7,500.0			$7,500	
WTP 117		–			–			–			–	
WTP 118		$45,000			$45,000			$45,000.0			$45,000	
WTP 119		$45,000		$45,000	$45,000		$45,000	$45,000.0		$45,000	$45,000	
TOTAL	$505,751	$1,091,450	$1,329,464	$1,976,600	$1,526,714	$740,800	$4,111,764	$1,019,350	$2,533,164	$626,500	$1,534,214	$948,800

Asset Management Worksheet

Wolfeboro, New Hampshire

Date Worksheet Updated	4/26/2017

Current Year	2017

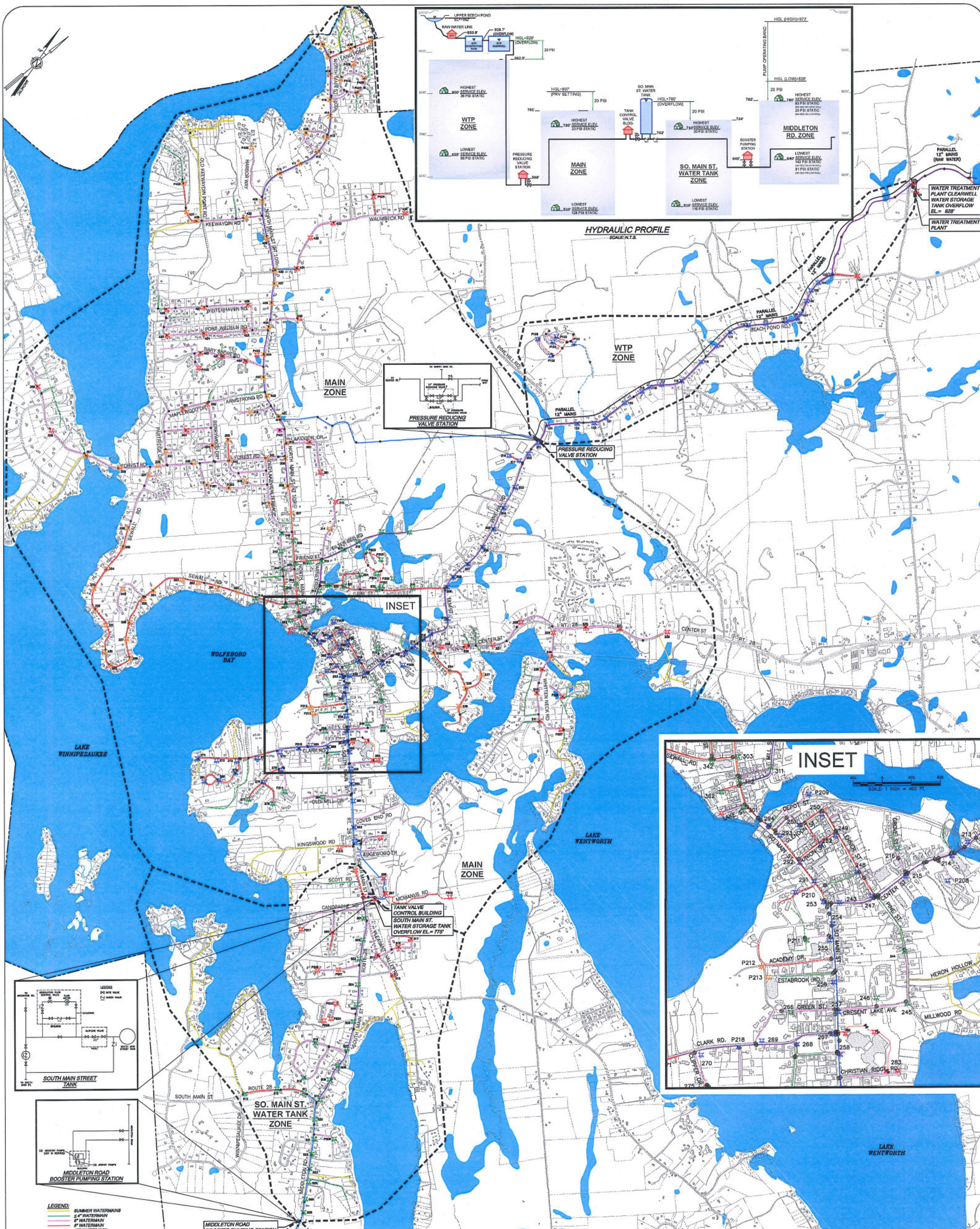
Vehicles and Maintenance Equipment

Vehicles and Maintenance Equipment				Condition of Assets									Criticality Assessment and Asset Prioritization		
ID#	Category	Group	Asset Name	Make	Model	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	End Service Year	Remarks	Consequence of Failure	Probability of Failure	Risk Score
WS-7	Maintenance	Vehicle	COMPACT PICK-UP	CHEVEROLET	COLORADO	2: Good	2017	10	0	10	2027	Meter truck	1	1	1
WS-3	Maintenance	Vehicle	1/2 TON REG CAB	GMC	SIERRA	2: Good	2015	10	2	8	2025	W&S Foreman	1	1	1
WS-4	Maintenance	Vehicle	3/4 TON W/PLOW	CHEVROLET	SILVERADO	2: Good	2012	10	5	5	2022	Purchased in 2012	1	2	2
WS-1	Maintenance	Vehicle	1/2 TON EXT CAB	CHEVROLET	SILVERADO	2: Good	2011	10	6	4	2021	Assistant director truck good condition	1	2	2
WS-5	Maintenance	Vehicle	1 1/2 TON DUMP	FORD	F-550 SUPERDUTY	2: Good	2003	15	14	1	2018	Newer Engine good condition	1	3	3
WS-6	Maintenance	Vehicle	BACKHOE	JOHN DEERE	310G	2: Good	2002	25	15	10	2027	Re-pinning in 2017 +5 extended life	3	3	9
Equip.	Maintenance	Equipment	DIRECT TAP MACH.	REED	TM-1100	2: Good	2008	20	9	11	2028	Replacable bits	2	3	6
Equip.	Maintenance	Equipment	SADDLE TAP MACH.	TAP MATE	T-2	2: Good	2013	20	4	16	2033	Replacable bits	2	4	8
Equip.	Maintenance	Equipment	ACOUSTIC LEAK DET.	FCS	XMIC	2: Good	2015	10	2	8	2025	Purchased in 2015	1	1	1

ID#	Life Cycle Costs and Planning	5. Long Term Replacement/Renewal Costs - by Decade											
	Replacement Cost	2010's	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's	2100's	2110's	2120's
WS-7	$25,000.00		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WS-3	$25,000.00		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WS-4	$30,000.00		$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000
WS-1	$25,000.00		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WS-5	$75,000.00	$75,000		$75,000	$75,000		$75,000	$75,000		$75,000	$75,000		$75,000
WS-6	$100,000.00		$100,000			$100,000		$100,000			$100,000		
Equip.	$3,000.00		$3,000		$3,000		$3,000		$3,000.0		$3,000		
Equip.	$1,500.00			$1,500		$1,500		$1,500		$1,500			
Equip.	$5,000.00		$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000		

Appendix B:

Water Distribution Map



DATE	UNDERWOOD engineers	WATER DISTRIBUTION MAP	FIG.
4/17	25 Vaughan Mall, Portsmouth, N.H. 03801	TOWN OF WOLFEBORO	1
PROJECT 1945	Tel. 603-436-6192 Fax. 603-431-4733	WOLFEBORO, NEW HAMPSHIRE	

Appendix C:

Water Treatment Facility (WTF) Capital Improvements Plan (CIP)

UNDERWOOD engineers

25 Vaughan Mall, Unit 1
Portsmouth, NH, 03801-4012
Tel: 603-436-6192 Fax: 603-431-4733

Memo

To: David Ford, P.E., DPW Director, Town of Wolfeboro, NH

Cc: Janine Gillum, Superintendent; Scott Pike, Chief Operator; Town of Wolfeboro, NH

From: Michael B. Metcalf, P.E. and Michael C. Unger, P.E. MCU

Date: February 10, 2017

Subject: Water Treatment Facility (WTF) Capital Improvements Plan (CIP)

Background

The Town of Wolfeboro owns and operates a Water Treatment Facility (WTF) located on Northline Road. The facility treats surface water from Upper Beech Pond. The campus includes three buildings:

- Water Treatment Filter Building which houses pre-treatment chemical feeds, package upflow clarifier units with dual media (sand/anthracite) filters, laboratory, main control room, and standby generator.
- Meter / Chlorination Building which houses post-treatment chemical feeds and flow meters measuring water delivered to the distribution system.
- Pump Building which houses backwash, surface wash, plant water, and sample pumping systems.

Water flows by gravity from Upper Beech Pond and enters the Filter Building where soda ash is added for pH adjustment and alum for coagulation. Water continues to flow by gravity through the package upflow clarifiers and dual media filters, removing turbidity and pathogens. Sodium hypochlorite is added prior to water entering a 100,000 gallon buried baffled disinfection tank outside the building, which provides chlorine contact time for CT credit required by the Surface Water Treatment Rule. Water finally enters a 1.0 MG baffled pre-stressed concrete storage tank (also referred to as a clearwell) prior to being delivered by gravity to the distribution system through the Meter Building.

Finished water is pumped back to the Filter Building for filter backwash and surface wash. Backwash waste is discharged to onsite lagoons, which are reportedly cleaned approximately every 10 years.

The Town has requested Underwood Engineers (UE) prepare a Water System Capital Improvements Plan (CIP) for the Water Treatment Facility to assist with planning and budgeting

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for the next 20 years. The CIP is based on the asset inventory that will be incorporated into the Town's Water System Asset Management Plan being completed separately.

The Water System Asset Management Plan will also include future inventory and CIP work for the distribution system, storage tank at South Main Street, PRV station, and Middleton Road Booster Pumping Station.

Inventory

Underwood Engineers updated the Town's existing WTF asset inventory, which was originally created by Woodard & Curran (W&C) in 2013, using visual observations conducted during a site visit and information provided by the Town. A condition ranking was assigned to each asset. It was outside the scope of this project to review or update the Likelihood of Failure and Consequence of Failure rankings assigned by W&C in 2013.

In general, the WTF is well-maintained in good to excellent condition.

Typical Useful Life

Typical useful lives were estimated using a combination of industry literature (i.e. AWWA's *Buried No Longer* report) and engineering judgment based on experience with similar systems. The remaining useful life and anticipated replacement year were then calculated from the installation year.

Replacement Costs

Opinions of probable replacement costs were developed using various sources including:

- Town records from original purchase
- Equipment vendors
- R.S. Means
- Contractors' schedule of values from previous construction projects
- Engineering judgment

In general, equipment costs were increased by 50% to account for installation and other associated costs (demolition, startup, etc.).

CIP

A 20-year capital improvements plan (CIP) was developed based on information in the Asset Inventory. All costs are presented in 2016 dollars.

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Programming Projects

Where practical, replacement of individual items are programmed in the CIP based on their anticipated remaining useful life.

Many assets (particularly process equipment) have reached the end of their anticipated useful lives based on values in the literature but are still in good to excellent condition. The actual year when replacement will be required cannot be projected with certainty. For the purpose of the CIP, these assets have been grouped, and their total replacement cost has been averaged over the next 20 years. We recommend the Town set aside funds in capital reserve to support replacement of these assets when required.

Near-Term Projects

We understand the Town replaced filter media in 2016. The Town has contracted to replace online analytical equipment at the Water Treatment Filter Building and expects the work to be complete in 2016. These projects are not included in the CIP.

We understand the Town has purchased replacement clarifier screens and intends to replace them in 2017. Per Town operators, the clarifier beads were examined and determined not to need replacement.

The first project recommended by Underwood Engineers is an upgrade of all control panels. A detailed engineering evaluation and design are recommended to identify obsolete components requiring replacement and design for plant-wide consistency and compatibility.

Wolfeboro Water Treatment Facility Asset Inventory

Asset Register and Hierarchy — Current Year 2016

Asset ID	Facility	System	CIP Project #	Asset Name	Notes	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life	Anticipated Replacement Year	Replacement Cost	Source
1	Water Treatment Filter Building	Process Equipment	1	Air & Vacuum Valve - Raw Water	1" Valmatic, rebuilt in 2008	good	1996	20	20	0	2016	$551	A&N Valves and Controls is local rep for Valmatic. Model #101-S
2	Water Treatment Filter Building	Process Equipment	1	Air & Vacuum Valve - Backwash	1" Replaced entire assembly in 2016	new	2016	20	0	20	2036	$551	A&N Valves and Controls is local rep for Valmatic. Model #101-S
3	Water Treatment Filter Building	Process Equipment	2	Air Compressor	ANEST- IWATA Air supply for all pneumatics	new	2016	20	0	20	2036	$17,250	From Town.
4	Water Treatment Filter Building	Process Equipment	3	Alum Feed System	day tank, chemical feed pumps, tubing, valves, etc.; flow paced 4-20 mA; (2) LMI B721-49031; 55 gal day tank	good	2013	20	3	17	2033	$15,000	Engineer's judgment
5	Water Treatment Filter Building	Process Equipment	4	Alum Storage System	(2) 1,000 gal bulk tanks, valves and piping	good	2012	15	4	11	2027	$7,500	Price for two 1000 gal Chem-tainer tanks (tank-depot.com) = $4300
6	Water Treatment Filter Building	Process Equipment	1	Backwash Control Valve	8" Open/closed, manual wheel with indicator	good	1996	20	20	0	2016	$2,025	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
7	Water Treatment Filter Building	Process Equipment	5	Blower #1	EG&G Rotron Blower; 20 hp; DR39BM72 Part 037032	good	1996	20	20	0	2016	$18,000	$12190/blower. Price from AMETEK.
8	Water Treatment Filter Building	Process Equipment	5	Blower #2	EG&G Rotron Blower; 20 hp; DR39BM72 Part 037032	good	1996	20	20	0	2016	$18,000	$12190/blower. Price from AMETEK.
9	Water Treatment Filter Building	Process Equipment	6	FE-100 flow meter - Raw Water	Venturi; 12" BHUT-CI 12 x 7; serial #3008; primary flow signal	fair/good	1996	20	20	0	2016	$8,250	Sullivan Associates
10	Water Treatment Filter Building	Process Equipment	1	Filter to Waste Control Valves #1	8" Pneumatic modulated from the level controller signal	good	1996	20	20	0	2016	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
11	Water Treatment Filter Building	Process Equipment	1	Filter to Waste Control Valves #2	8" Pneumatic modulated from the level controller signal	good	1996	20	20	0	2016	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
12	Water Treatment Filter Building	Process Equipment	1	Filtered Water Control Valve #1	8" Pneumatic modulated from the level controller signal	good	1996	20	20	0	2016	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
13	Water Treatment Filter Building	Process Equipment	1	Filtered Water Control Valve #2	8" Pneumatic modulated from the level controller signal	good	2014	20	2	18	2034	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
14	Water Treatment Filter Building	Process Equipment	1	Influent Rate Control Valve #1	8" Pratt, pneumatic, Bailey positioner w/ Pratt actuators; only positioners are original, pneumatic modulating from SCADA	good	2013	20	3	17	2033	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
15	Water Treatment Filter Building	Process Equipment	1	Influent Rate Control Valve #2	8" Pratt, pneumatic, Bailey positioner w/ Pratt actuators; only positioners are original, pneumatic modulating from SCADA	good	2010	20	6	14	2030	$8,700	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci)
16	Water Treatment Filter Building	Process Equipment	1	Backwash Control Valves (2)	8" butterfly	good	1996	20	20	0	2016	$2,025	Dezurik quote from Atlantic Fluid Tech. (Rick Ricci) (manual wheel with indicator)
17	Water Treatment Filter Building	Process Equipment	1	Surface Wash Control Valves (2)	6" Solenoid activated Cla-Valve	good	1996	20	20	0	2016	$3,450	Quote from Cla-Val Eastern HQ - $2355
18	Water Treatment Filter Building	Process Equipment	9	Polymer Blending Unit	Stranco Poly-Blend model # 100-UP with a 1.0 gph feed pump	good	1996	25	20	5	2021	$15,000	price from blue book
19	Water Treatment Filter Building	Process Equipment	3	Potassium Permanganate Feed System	not in use; 150 gal tank; 1/4 hp mixer; pump removed	good	1996	20	20	0	2016	$7,500	Engineer's judgment
20	Water Treatment Filter Building	Process Equipment	5	Air Dryer	Ingersoll Rand	good	2010	20	6	14	2030	$1,313	From Ingersoll Rand Boston Customer Center
21	Water Treatment Filter Building	Process Equipment	10	Soda Ash Feed System - Pumps (2)	Milroy pumps w/ drives	good	2013	15	3	12	2028	$15,000	Engineer's judgment
22	Water Treatment Filter Building	Process Equipment	10	Soda Ash Feed System - Dry Feeder	Dry feeder w/ auger; solution tank w/ mixer; level probe controller original. Gear Box replaced in 2013	good	1996	15	20	-5	2011	$45,000	Town
23	Water Treatment Filter Building	Process Equipment	3	Soda Ash Feed System - Misc.	Valves and piping	good	1996	20	20	0	2016	$4,500	Engineer's judgment
24	Water Treatment Filter Building	Process Equipment	3	Sodium Hypochlorite Feed System	Day tank, chemical feed pumps, tubing, valves, etc.; flow paced 4-20 mA; (2) LMI B711-D90H1; 55 gal day tank	good	2013	20	3	17	2033	$15,000	Engineer's judgment
25	Water Treatment Filter Building	Process Equipment	4	Sodium Hypochlorite Storage System	(2) 1,000 gal bulk tanks, valves and piping	good	2010	15	6	9	2025	$7,500	Price for two 1000 gal Chem-tainer tanks (tank-depot.com) = $4300
26	Water Treatment Filter Building	Process Equipment	1	Static Mixer	12"	good	1996	20	20	0	2016	$22,500	From BAU/Hopkins. 12" full length type
27	Water Treatment Filter Building	Process Equipment	11	Treatment Unit #1 - Clarifier (screens and media)	Screens to be replaced spring 2017; beads good per operator	good	2017	10	-1	11	2027	$65,000	budget price from David F Sullivan & Assoc. (Westech)
28	Water Treatment Filter Building	Process Equipment	12	Treatment Unit #1 - Filter (media)	Media replaced 2016; sand & anthracite; 2007 rebuilt wash arms	new	2016	10	0	10	2026	$25,000	budget price from David F Sullivan & Assoc. (Westech)
29	Water Treatment Filter Building	Process Equipment	13	Treatment Unit #1 - Underdrain and Pipe		good	1996	25	20	5	2021	$50,000	budget price from David F Sullivan & Assoc. (Westech) x2 for installation and concrete
30	Water Treatment Filter Building	Process Equipment	14	Treatment Unit #1 - Vessel		good	1996	50	20	30	2046	$375,000	David F Sullivan & Assoc. (Westech)
31	Water Treatment Filter Building	Process Equipment	11	Treatment Unit #2 - Clarifier (screens and media)	Screens to be replaced spring 2017; beads good per operator	good	2017	10	-1	11	2027	$65,000	budget price from David F Sullivan & Assoc. (Westech)
32	Water Treatment Filter Building	Process Equipment	12	Treatment Unit #2 - Filter (media)	Media replaced 2016; sand & anthracite; 2007 rebuilt wash arms	new	2016	10	0	10	2026	$25,000	budget price from David F Sullivan & Assoc. (Westech)
33	Water Treatment Filter Building	Process Equipment	13	Treatment Unit #2 - Underdrain and Pipe		good	1996	25	20	5	2021	$50,000	budget price from David F Sullivan & Assoc. (Westech) x2 for installation and concrete
34	Water Treatment Filter Building	Process Equipment	14	Treatment Unit #2 - Vessel		good	1996	50	20	30	2046	$375,000	David F Sullivan & Assoc. (Westech)
35	Water Treatment Filter Building	Process Equipment	3	Blended Polyphosphate Feed System	50 gal tank; LMI pump AA971-45851	good	2012	20	4	16	2032	$3,000	Engineer's judgment
36	Water Treatment Filter Building	Process Equipment	15	Backwash Recycle System	Not in use; manual; 2 submersible pumps in sump chamber fed by weirs	good	1996	20	20	0	2016	$22,500	UE project 1769 - MVD
37	Water Treatment Filter Building	Process Equipment	1	Strainer	(1) 12"Haywood, (2) 12" Dezurik Butterfly valves	good	1996	20	20	0	2016	$28,500	$2000/valve (Dezurik - Atlantic Fluid Tech). $15,000 for Koflo strainer (BAU Hopkins)
38	Water Treatment Filter Building	Process Equipment	6	Filter influent flow meters (2)	8" venturi; Honeywell flow controllers at PLC	good	1996	20	20	0	2016	$5,550	Sullivan Associates
39	Water Treatment Filter Building	Process Equipment	6	Filter level controller #1	Magnetrol	good	1996	20	20	0	2016	$7,500	Town
40	Water Treatment Filter Building	Process Equipment	6	Filter level controller #2	Magnetrol	good	2016	20	0	20	2036	$7,500	Town
41	Water Treatment Filter Building	Process Equipment	6	DP cells (all)	Foxboro	good	2009	20	7	13	2029	$9,000	From Town - $1500 per cell.
42	Water Treatment Filter Building	Process Equipment	6	Backwash flow meter (1)	PFS 10"Venturi	good	1996	20	20	0	2016	$6,300	Sullivan Associates
43	Water Treatment Filter Building	Process Equipment	1	Sample Pumps (2)	Oberdoffer Gear Pumps, original motors, heads replaced every 4 years	good	1996	20	20	0	2016	$1,500	Engineer's judgment
44	Water Treatment Filter Building	Control System	8	Alum High Level Alarm Panel	audible alarm	good	1996	20	20	0	2016	$7,500	Engineer's judgment
45	Water Treatment Filter Building	Control System	8	Blower Control Panel #1	Omnitrol MCC	good	1996	20	20	0	2016	$7,500	Engineer's judgment
46	Water Treatment Filter Building	Control System	8	Blower Control Panel #2	Omnitrol MCC	good	1996	20	20	0	2016	$7,500	Engineer's judgment
47	Water Treatment Filter Building	Control System	8	Holding Tank High level Alarm Panel	3 IT-115	good	1996	20	20	0	2016	$7,500	Engineer's judgment
48	Water Treatment Filter Building	Control System	7	Process Instruments - Online Analyzers	to be replaced 2016	good	2016	20	0	20	2036	$18,000	Town
49	Water Treatment Filter Building	Control System	8	Sample Pump Control Panel	Omni-Trol MCC	good	1996	20	20	0	2016	$7,500	Engineer's judgment
50	Water Treatment Filter Building	Control System	6	Disinfection Tank Level Monitor	Hydroranger 200	good	2008	20	8	12	2028	$3,000	Price found online
51	Water Treatment Filter Building	Control System	8	WTP Control Panel (PLC)	incl. (17) I/O cards; (2) Honeywell flow controllers ($1500/ea)	good	1996	20	20	0	2016	$45,000	SMR - $25k panel , $5k install
52	Water Treatment Filter Building	Control System	17	SCADA Computer	Optiplex 380 with SCADA Software	good	2010	5	6	-1	2015	$7,500	Engineer's judgment
53	Water Treatment Filter Building	Control System	17	SCADA Backup Computer	Optiplex GX150 with SCADA Software	good	2005	5	11	-6	2010	$7,500	Engineer's judgment
54	Water Treatment Filter Building	Electrical Service	18	Standby Power System	CAT 3306; 250kW; added block heater	good	1996	30	20	10	2026	$142,500	from Milton CAT. Includes 2000 gal fuel tank. No transfer switch. (Model C9)
55	Water Treatment Filter Building	Electrical Distribution	19	Individual electrical panels	Breaker Panels for lighting, outlets and general Plant use	good	1996	30	20	10	2026	$60,000	Engineer's judgment
56	Water Treatment Filter Building	HVAC/Mechanical Equipment	20	Pellet boilers (2)	MESYSTEMS Okofen PES36 Pellet Boilers	good	2013	15	3	12	2028	$60,000	Town
57	Water Treatment Filter Building	HVAC/Mechanical Equipment	20	Heat Pump	Daiken (3) Ton VRV with (2) 18,000 kbtu Ceiling Cassettes	good	2013	15	3	12	2028	$7,500	From Daiken Rep. for a "ductless mimi-split".
58	Water Treatment Filter Building	HVAC/Mechanical Equipment	39	Laboratory Equipment		good	varies					$100,000	Engineer's judgment (allowance)
59	Water Treatment Filter Building	Structural/Architectural	21	Doors & Windows		good	1996	30	20	10	2026	$55,500	Based on $10/SF (UE project #1769 MVD)
60	Water Treatment Filter Building	Structural/Architectural	22	Equipment Pads & Containment Curbs		good	1996	50	20	30	2046	--	Included in floor cost.
61	Water Treatment Filter Building	Structural/Architectural	22	Floors		good	1996	50	20	30	2046	$19,500	$2.12/SF - Goldenseal Unit Costs online
62	Water Treatment Filter Building	Structural/Architectural	22	Loading Dock - Exterior		good	1996	50	20	30	2046	$54,000	RS Means/engineer's opinion (PJP)

Wolfeboro Water Treatment Facility Asset Inventory

Asset Register and Hierarchy   Current Year   2016

Asset ID	Facility	System	CIP Project #	Asset Name	Notes	Condition	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life	Anticipated Replacement Year	Replacement Cost	Source
63	Water Treatment Filter Building	Structural/Architectural	22	Roof	Insulated underside of the Roof and installed Metal roofing system	good	2012	30	4	26	2042	$61,500	RS Means - around $4/SF; around $2/SF insulation
64	Water Treatment Filter Building	Structural/Architectural	22	Stairs & Handrails		good	1996	50	20	30	2046	$66,600	Based on $12/SF (UE project #1769 MVD)
65	Water Treatment Filter Building	Structural/Architectural	22	Walls - Exterior	Enclosed Gable ends and Soffit with Vinyl 2013-2016	good	1996	50	20	30	2046	$109,500	UE project #1769 - Tirey Cost Opinion Spreadsheet
66	Water Treatment Filter Building	Structural/Architectural	22	Walls - Interior		good	1996	50	20	30	2046	$37,500	UE project #1769 - Tirey Cost Opinion Spreadsheet
67	Water Treatment Filter Building	Structural/Architectural	22	Storage Shed	16' x 12'	good	2012	50	4	46	2062	$7,500	Town
68	Water Treatment Filter Building	Vehicles	23	Mower/Blower	John Deere	good	2006	15	10	5	2021	$2,700	Internet search for comparable items
69	Water Treatment Filter Building	Vehicles	24	ATV	Polaris Ranger 400 I&O	good	2012	10	4	6	2022	$9,000	Internet search for comparable items
70	Water Treatment Filter Building	Vehicles	25	Truck	Chevy Colorado	good	2016	10	0	10	2026	$20,000	Internet search for comparable items
71	Meter (Existing Chlorination) Building	Process Equipment	6	Chart Recorders	(1) Chessel; (2) Foxboro. Replace with data loggers.	good	1996	20	20	0	2016	$3,150	$700 each from Bluebook
72	Meter (Existing Chlorination) Building	Process Equipment	16	Soda Ash System	(2) Milroy pumps 36 gph, 100 psi (G61P8PM4N-1); Dry feeder w/ auger; solution tank w/ mixer; level probe controller; rotameter 2 gpm to solution tank; piping; valves; etc.	good	2012	20	4	16	2032	$75,000	Town
73	Meter (Existing Chlorination) Building	Process Equipment	3	Sodium Hypochlorite System	500 gal bulk tank; 55 gal day tank; LMI C721-DGG141 pump; flow paced off mag meter	good	2012	20	4	16	2032	$30,000	Engineer's judgment
74	Meter (Existing Chlorination) Building	Process Equipment	6	Turbine Meter	Rockwell W-8500; redundant 12" water main to PRV station; currently not in use. To be replaced by 12" mag meter	good	1996	20	20	0	2016	$8,100	Sullivan Associates
75	Meter (Existing Chlorination) Building	Process Equipment	6	Mag Meter	8300 Series (8308-SABA-TSJ-GFG2); active 12" water main to PRV station	good	1996	20	20	0	2016	$8,100	Sullivan Associates
76	Meter (Existing Chlorination) Building	Electrical Distribution	16	SCR Drives for Soda Ash Pumps		good	2012	20	4	16	2032	$1,500	Engineer's judgment
77	Meter (Existing Chlorination) Building	Control System	26	Water Meter and Chemical Feed Control Panel (PLC)	wireless to WTP SCADA	good	2012	20	4	16	2032	$30,000	Engineer's judgment
78	Meter (Existing Chlorination) Building	Control System	26	Online Analyzers	lime chip tank for CL17 reagent goes to dry well	good	2012	20	4	16	2032	$12,000	Engineer's judgment
79	Meter (Existing Chlorination) Building	HVAC/Mechanical Equipment	27	Gas Heaters		good	2012	20	4	16	2032	$4,500	UE job #1612 Manor Parkway Pressure Zone - Petersen Report
80	Meter (Existing Chlorination) Building	HVAC/Mechanical Equipment	27	Exhaust Fan and ductwork		good	2012	20	4	16	2032	$12,000	UE job #1612 Manor Parkway Pressure Zone - Petersen Report
81	Meter (Existing Chlorination) Building	HVAC/Mechanical Equipment	16	Soda Ash Water Heater	Rinnai RL75	good	2012	20	4	16	2032	$1,500	retail price from google (for Rinnai RL 75)
82	Meter (Existing Chlorination) Building	HVAC/Mechanical Equipment	27	Propane Tank		good	2012	20	4	16	2032	$0	Wolfeboro WTP does not own tank. Not responsible for replacing.
83	Meter (Existing Chlorination) Building	Structural/Architectural	28	Containment Curbs		good	2012	50	4	46	2062	--	Included in floor cost.
84	Meter (Existing Chlorination) Building	Structural/Architectural	21	Doors	2 double & 1 single	good	1989	30	27	3	2019	$8,400	Based on $10/SF (UE job #1769 MVD)
85	Meter (Existing Chlorination) Building	Structural/Architectural	28	Floors		good	1989	50	27	23	2039	$2,250	$2.12/SF - Goldenseal Unit Costs online
86	Meter (Existing Chlorination) Building	Structural/Architectural	28	Roof	Metal	good	1989	50	27	23	2039	$4,650	RS Means - around $4/SF
87	Meter (Existing Chlorination) Building	Structural/Architectural	28	Walls - Exterior		good	1989	50	27	23	2039	$36,000	UE job #1769 - Tirey Cost Opinion Spreadsheet
88	Meter (Existing Chlorination) Building	Structural/Architectural	28	Walls - Interior		good	1989	50	27	23	2039	--	
89	Pump Building	Process Equipment	1	Hydro-pneumatic Tanks	(2) Well Xtrol WX-3CS; 125 psi	good	2009	20	7	13	2029	$1,800	Model # does not exist. Price is for WX-302. Price for ASME certified = $4800 (AMTROL)
90	Pump Building	Process Equipment	5	Pump BW-1 (Backwash)	Horz. Split-Case; 60 hp; Peerless 8AE15	good	1996	20	20	0	2016	$33,000	Quote from Carlsen Systems (same pump)
91	Pump Building	Process Equipment	5	Pump BW-2 (Backwash)	Horz. Split-Case; 60 hp; Peerless 8AE15	good	1996	20	20	0	2016	$33,000	Quote from Carlsen Systems (same pump)
92	Pump Building	Process Equipment	1	Pump PW-1 (Plant Water)	2 hp; 21 ft. H2O suction; 45 psi discharge	good	1996	20	20	0	2016	$4,500	UE job #1695 - Bella Brook
93	Pump Building	Process Equipment	1	Pump PW-2 (Plant Water)	2 hp; 21 ft. H2O suction; 45 psi discharge	good	1996	20	20	0	2016	$4,500	UE job #1696 - Bella Brook
94	Pump Building	Process Equipment	1	Pump S-1 (Sample)		good	1996	20	20	0	2016	$750	Engineer's judgment
95	Pump Building	Process Equipment	5	Pump SW-1 (Surface Wash)	15 hp; Peerless series C; type 815G; style M	good	1996	20	20	0	2016	$7,500	Quote from Carlsen Systems (same pump)
96	Pump Building	Process Equipment	5	Pump SW-2 (Surface Wash)	15 hp; Peerless series C; type 815G; style M	good	1996	20	20	0	2016	$7,500	Quote from Carlsen Systems (same pump)
97	Pump Building	Process Equipment	1	Backwash Check Valves (2)	14"	good	2008	20	8	12	2028	$36,000	$12,000/valve - American Flow Company - Series 2100 14"
98	Pump Building	Control System	8	Main Pump House Control Panel		good	1996	20	20	0	2016	$37,500	Engineer's judgment
99	Pump Building	Electrical Distribution	29	Backwash Pump VFDs 60 hp (2)	Added in 2016 to eliminate pumping against throttled valve for control	good	2016	20	0	20	2036	$25,500	Horizon Solutions (Allen-Bradley)
100	Pump Building	Electrical Distribution	8	Secondary Control Panel		good	1996	20	20	0	2016	$22,500	Engineer's judgment
101	Pump Building	HVAC/Mechanical Equipment	30	Heaters, Exhaust Fan, Ductwork, Louvers/Dampers		good	1996	30	20	10	2026	$20,000	UE job #1612 - Salem
102	Pump Building	HVAC/Mechanical Equipment	30	Propane Tank		good	1996	30	20	10	2026	$0	Wolfeboro WTP does not own tank. Not responsible for replacing.
103	Pump Building	Structural/Architectural	21	Doors & Windows		good	1996	30	20	10	2026	$6,450	Based on $10/SF (1769 MVD)
104	Pump Building	Structural/Architectural	31	Equipment Pads		good	1996	30	20	10	2026	--	Included in floor cost.
105	Pump Building	Structural/Architectural	31	Floors		good	1996	50	20	30	2046	$3,000	$2.12/SF - Goldenseal Unit Costs online x2 for small project
106	Pump Building	Structural/Architectural	32	Roof	asphalt shingles	good	1996	30	20	10	2026	$5,700	RS Means - around $4/SF x2 for small project
107	Pump Building	Structural/Architectural	31	Walls - Exterior		good	1996	50	20	30	2046	$33,000	UE job #1769 - Tirey Cost Opinion Spreadsheet
108	Pump Building	Structural/Architectural	31	Walls - Interior		good	1996	50	20	30	2046	--	
109	Water Treatment Facility	Land	N/A	Land	305 ac.	good	1996	N/A	N/A	N/A	N/A	$0	
110	Water Treatment Facility	Land	40	Pavement		good	2010	10	6	4	2020	$31,800	Based on $100/ton - Engineer's judgment (PJP)
111	Water Treatment Facility	Land	33	Security Fence and Gates		good	1996	30	20	10	2026	$43,000	1260LF x $30/LF + gates
112	Water Treatment Facility	Yard Piping	34	Yard Piping	including from Pond to WTP, chemical feed sleeves not aligned (not in use)	good	1996	75	20	55	2071	$1,170,000	$200/ft (MBM)
113	Water Treatment Facility	Water Tank - FW Clearwell	35	Water Tank - FW Clearwell	(1) Million gallon Pre-stressed Concrete Tank	good	1996	75	20	55	2071	$1,650,000	From DN Tanks. Includes $250k for baffle walls
114	Water Treatment Facility	Lagoons (2)	36	Lagoons (2)	Cleaned once in 10 years	good	1996	50	20	30	2046	$100,500	NHDOT unit prices
115	Water Treatment Facility	100,000 Gallon Disinfection Tank (baffled)	37	100,000 Gallon Disinfection Tank (baffled)		good	2008	30	8	22	2038	$300,000	Engineer's judgment. $2/gal
116	Water Treatment Facility	2,000 gal Holding Tank	38	2,000 gal Holding Tank		good	1996	30	20	10	2026	$7,500	Engineer's judgment
117	Water Treatment Facility	2,000 gal double-walled fuel tank	18	2,000 gal double-walled fuel tank		good	1996	30	20	10	2026	--	Included in standby power system cost.
118	Water Treatment Facility	Manhole Structures	38	Septic, holding and pipe chase manholes	(10)?	good	1996	30	20	10	2026	$45,000	UE job #1783 - Keene Infra. $3000/MH
119	Water Treatment Facility	Silo - Pellets	20	Heating Pellet storage	(20) Ton capacity	good	2012	15	4	11	2027	$45,000	Town

WOLFEBORO, NEW HAMPSHIRE
DRAFT 20-YEAR CAPITAL IMPROVEMENTS PLAN FOR WATER TREATMENT FACILITY

Project #	Item to be Replaced (Unless Otherwise Noted)	Opinion of Probable Replacement Cost	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Future	Comments
1	Miscellaneous Process Components (process valves, strainer, static mixer, sample pumps, plant water system)	$160,851	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043		Note 2
2	Compressors	$17,250																				$17,250		
3	"Standard" Chemical Feed Systems (day tanks, tubing, piping, valves, fittings, chemical feed pumps, etc.)	$75,000	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750		Note 2
4	Bulk Chemical Storage	$15,000									$15,000													
5	Process Equipment (process pumps, blowers, air dryer)	$118,313	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831	$11,831											
6	Instrumentation Except Analytical (flow meters, level controllers, DP cells, chart recorders)	$66,450	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323	$3,323		Note 2
7	Online Analyzers (Filter Building)	$18,000																				$18,000		
8	Control Panels (Filter Building and Pump Building)	$142,500		$142,500																				
9	Polymer Feed System and Blending Unit	$15,000					$15,000																	
10	Soda Ash Feed System (Filter Building)	$60,000												$60,000										
11	Clarifiers (replace screens and media)	$130,000	$130,000										$130,000										$130,000	Note 3
12	Filters (replace media)	$50,000										$50,000										$50,000	$50,000	Note 3
13	Treatment Units Underdrain, Pipe, and Valves	$100,000					$100,000																	
14	Treatment Unit Vessels	$750,000																					$750,000	
15	Backwash Recycle System	$22,500																					$22,500	Not in use.
16	Soda Ash Feed System (Meter Building)	$78,000															$78,000							
17	SCADA Computers and Software	$15,000				$15,000					$15,000					$15,000					$15,000			Regular SCADA maintenance recommended every 5 years.
18	Standby Generator, incl. Fuel Tank	$142,500										$142,500												
19	Electrical (Filter Building)	$60,000										$60,000												
20	HVAC (Filter Building), including Silo	$112,500										$112,500												
21	Doors and Windows (All Buildings)	$70,350										$70,350												
22	Structural (Filter Building)	$356,100																					$356,100	
23	Mower/Blower	$2,700				$2,700																		
24	ATV	$9,000								$9,000														
25	Pickup Truck	$20,000										$20,000												
26	Control Panel and Online Analyzers (Meter Building)	$42,000															$42,000							
27	HVAC (Meter Building)	$16,500															$16,500							
28	Structural (Meter Building)	$42,900																					$42,900	
29	Backwash Pump VFDs	$25,500																				$25,500		
30	HVAC (Pump Building)	$20,000										$20,000												
31	Structural (Pump Building)	$36,000																					$36,000	
32	Roof (Pump Building)	$5,700										$5,700												
33	Fence and Gate	$43,000										$43,000												
34	Yard Piping	$1,170,000																					$1,170,000	
35	Water Tank - FW Clearwell Clean and Recoat	$1,650,000					$150,000															$150,000	$1,650,000	Budget to clean and recoat every 25 years.
36	Lagoons	$100,500																					$100,500	
37	100,000 Gallon Disinfection Tank	$300,000																					$300,000	
38	Holding Tank and Manhole Structures	$52,500																					$52,500	
39	Laboratory Equipment	$100,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000		Note 2
40	Paving	$31,800				$31,800										$31,800							$31,800	Budget to overlay every 10 years.
	Annual Total =	**$6,243,414**	**$161,946**	**$174,446**	**$31,946**	**$81,446**	**$296,946**	**$31,946**	**$31,946**	**$40,946**	**$61,946**	**$555,996**	**$161,946**	**$80,115**	**$20,115**	**$66,915**	**$156,615**	**$20,115**	**$20,115**	**$20,115**	**$35,115**	**$280,865**	**$4,692,300**	

Notes:
1 All costs in 2016 dollars.
2 For minor items or where a specific anticipated replacement year is not readily identifiable, a recommended annual budget is presented for repair and/or replacement as needed.
3 Budget to replace clarifier screens and beads and filter media every 10 years.
4
5
6

UNDERWOOD engineers

Appendix D:

Middleton Road Booster Pumping Station (BPS) Evaluation

1863.00

DRAFT

August 28, 2014

Mr. David Ford, P.E.
Public Works Director – Town of Wolfeboro
84 South Main Street
PO Box 629
Wolfeboro, NH 03894

Re: ***Middleton Road Booster Pumping Station (BPS) Evaluation***
Wolfeboro, NH

Dear Mr. Ford:

Underwood Engineers is pleased to provide the following letter report in fulfillment of ESR #15 dated July 25, 2014.

1. BACKGROUND

The Town of Wolfeboro owns and operates an existing water booster pumping station (BPS), which increases system pressure in order to serve a small number of services at the end of the system on Middleton Road. The BPS includes two active jockey pumps (3 hp), which meet normal daily demands. Two existing booster pumps, manufactured by Worthington, are currently inactive. This pressure zone does not currently have fire protection (no existing hydrants). The Town wants to install hydrants along the section of main served by the BPS. Fire flow would be provided either by reactivating the Worthington Pumps, if they have adequate capacity or by replacing them with larger booster pumps.

Scope of Work

As requested by the Town, Underwood Engineers provided the following professional engineering services to evaluate the ability of the existing Middleton Road BPS and existing Worthington pumps to provide fire protection to the boosted zone:

- Reviewed fire flow requirements with the Town.
- Conducted a site visit to the BPS to collect data on existing facilities, equipment, and controls and observe current operations.
- Conducted a hydrant flow test at a hydrant on the suction side of the BPS to evaluate the ability of the existing distribution system to provide fire flow while maintaining the minimum required 20 psi residual pressure.
- Using the Town's hydraulic model, estimated the headloss between the BPS and the end of the system at the design fire flow.

- Reviewed model number and pump curves provided by the manufacturer, to evaluate the nominal capacity of the existing Worthington pumps and their suitability for the proposed use.
- Evaluated the suitability of the existing electrical system and pump motors for the proposed use.
- Recommended a control sequence for operating either the Worthington pumps or replacement pumps in conjunction with the jockey pumps. Evaluated the suitability of the existing controls and telemetry.
- Provided comments on and consideration of water quality due to distance from water treatment facility and limited use.
- Developed recommended improvements to meet the Town's goals.
- Prepared an opinion of probable capital cost to construct the recommended improvements.
- Prepared this letter report summarizing findings, recommendations, and opinion of probable capital cost.

2. REVIEW OF EXISTING INFORMATION

Flow Testing and Water Modeling
On August 6, 2014, representatives of the Town and Underwood Engineers conducted a hydrant flow test at the last hydrant on Middleton Road, on the suction side of the BPS. Based on the results of this test and hydraulic modeling using the Town's existing water distribution system model, we estimate that the existing water distribution system can supply ***up to 1,100 gpm*** at the suction side of the Middleton Road BPS at the minimum allowable residual pressure of 20 psi.

Design Fire Flow
The Town identified a ***design fire flow of 1,000 gpm*** for the boosted pressure zone. This is within the 500 to 1,500 gpm range of fire flows recommended by the Insurance Services Office (ISO) for residential areas.

Review of Existing Station and Equipment
Per records provided by the Town, the station was originally constructed in 1989. The Worthington pumps appear to be original to the station at that time. The existing piping on Middleton Road (station suction and discharge) is reportedly 10-inch cement-lined ductile iron but had not been confirmed.

Pump curves for the existing Worthington model 1.5LLR-7 pumps were not available from the Town or the manufacturer, but Underwood Engineers obtained a copy (attached) from the Natural Resources Conservation Service online database. The original design point of the pumps is not known, but based on the curves provided, the maximum capacity of the existing pumps is 175 gpm, ***which is not sufficient to provide the design fire flow even with both pumps in operation.***

UE conducted a site visit to the BPS on August 6, 2014 and made the following observations. The station building is 18' x 10'-8" (interior dimensions) of concrete masonry unit (CMU) construction. An evaluation of the building construction is outside the scope of this report but based on a visual examination the building components (roof shingles, eaves, walls, floor slab, and exposed foundation walls) appear to be in acceptable condition. No evidence of insulation was observed but design drawings provided by the Town indicate insulated cores. The intake louver is covered in plastic. An exhaust fan is present but was not tested.

A 10-inch ductile iron manifold runs the length of the station. 2-inch copper piping is tapped off the 10-inch pipe to feed the two Worthington booster pumps (inactive) and two 3 hp jockey pumps. The jockey pumps and two (2) hydropneumatic tanks are installed on a wooden platform above the process piping.

The jockey pumps are controlled by a mercury pressure switch. When discharge pressure drops to 80 psi, the active jockey pump is called to start and runs until the hydropneumatic tanks are charged to 125 psi. The active jockey pump is selected by the position of a double throw switch. There is no automatic redundancy. If the active pump fails, an operator must manually throw the switch into the ON position for the other pump.

The original relay-based pump control panel for the Worthington pumps is being bypassed to operate the jockey pumps. It cannot be used without disconnecting controls to the jockey pumps. Wiring diagrams are not available for the control panel but it appears to be arranged to start and stop the pumps based on discharge pressure with automatic alternation of the lead pump.

Additional information on the electrical system is provided in the attached report by Lee F. Carroll Electrical Consultants, sub-consultant to Underwood Engineers.

Water Quality and Water Age

The pressure zone at the end of Middleton Road is the farthest point from the WTF and is fed from the South Main Street Tank, an intermediate, tank. Therefore it has the highest water age in the distribution system. High water age is commonly associated with degradation of water quality, particularly loss of chlorine residual, higher chance for bacteria regrowth and coliform detections, higher concentration of disinfection byproducts (DBPs), and increased taste and odor.

Per Town operations staff, the Town receives taste and odor complaints from customers at the end of Middleton Road. We are not aware of any water quality violations.

Adding fire protection (hydrants and high demand pumps) to the pressure zone will not, by itself, affect water quality. However, it will allow the Town to flush the water main on the discharge side of the BPS during seasonal flushing, which should improve water quality. The flushing velocity that would be provided by the proposed pumps would help remove sediment and may help control biofilm. In addition, if demands increase due to expansion of service to more customers, water age will decrease, and water quality is expected to improve (maintain higher chlorine residual, lower chance for bacteria regrowth or coliform detections, lower disinfection byproducts, less taste and odor). Many factors besides just water age affect water quality, so the potential for water quality to improve with greater use cannot be fully known in advance.

Summary of Deficiencies:

- Existing Worthington pumps would not be able to meet design fire flow if reactivated.
- 2-inch copper pump suction and discharge piping would be inadequate to accommodate design fire flow.
- Original relay-based pump control panel is outdated and is being bypassed to operate jockey pumps.
- Selecting active jockey pump via manual transfer switch does not provide automatic redundancy.
- Several electrical panels do not have adequate clearance as required by code.
- Service conduits do not have expansion fittings (code requirement).
- Feeding jockey pumps power from original 15 hp motor starters presents multiple code violations.
- No standby power.
- No alarm telemetry.
- Existing electrical service is not adequate for proposed pump loads that would be required to provide design fire flow (see below).
- Some exterior lighting fixtures are damaged.
- Interior lighting fixtures use older, less efficient ballasts.
- Intake louver is covered in plastic.

3. RECOMMENDED PUMP ARRANGEMENT AND CONTROLS

The Worthington pumps should be replaced with a booster pump or pumps capable of delivering the 1,000 gpm design fire flow controlled by VFDs to maintain constant discharge pressure. The existing control panel should be replaced with an industry standard PLC-based control panel.

The existing jockey pumps could be reused, but the capital cost savings are probably outweighed by the benefits of having all pumps supplied by a single supplier and controlled by a single control panel (unitary responsibility). In addition, the motors should be replaced with inverter duty motors for use with VFDs anyway. Information provided by the Town does not provide the exact design point for the existing jockey pumps, but a pump curve identifies them as 50 gpm nominal. It is outside the scope of this project to project domestic demands, and we assume 50 gpm is appropriate. We observed the existing jockey pumps operate for 3 cycles each lasting 1 to 2 minutes during the 2 hours we were onsite, which indicates these pumps have significant excess capacity to meet domestic (non-fire) demands.

Therefore, for the purpose of this report, we assume all pumps will be replaced by a skid-mounted package pumping system including pumps, motors, VFDs, control panel, suction and discharge manifolds and valves and appurtenances. We propose two (2) jockey pumps each rated for 50 gpm and two (2) booster pumps each rated at 500 gpm. The jockey pumps will have redundancy and can alternate to prevent a single pump from running constantly. The booster pumps will be able to supply the design fire flow with both pumps in operation. DES rules require that systems without storage be able to meet peak hour flows with the largest pump out of service. Providing two booster pumps will allow peak flows of up to 600 gpm to be met with the largest pump out of service, which will accommodate significant expansion in the boosted zone.

As system demands increase, each pump would be called to start sequentially based on a drop in discharge pressure. Pump speed for all pumps would be controlled by VFDs to maintain constant discharge pressure.

For the purpose of estimating pump horsepower, electrical loads, and budgetary pricing, we calculate recommended total dynamic heads (TDHs) as follows.

<u>Jockey Pump TDH</u>

Discharge Head (to provide 35 psi at highest home in service area)	871’
Suction Head (S. Main Street Tank low water level)	-767’
Static Head Gain	104’
Distribution Losses (assumed)	+5’
Station Losses (assumed)	+15’
Jockey Pump TDH Required	**124’**

<u>Booster Pump TDH</u>

Static Discharge Head (to provide 20 psi at highest hydrant in service area)	806’
Static Suction Head (S. Main Street Tank low water level)	-767’
Static Head Gain	39’
Suction Distribution Losses at Design Flow (model predicted)	+75’
Discharge Distribution Losses at Design Flow (model predicted)	+25’
Safety Term	+10’
Station Losses (assumed)	+15’
Booster Pump TDH Required	**164’**

Per preliminary information provided by pump suppliers, jockey pumps rated for 50 gpm at 124 feet TDH and booster pumps rated for 500 gpm at 164 feet TDH would require 3 hp and 30 hp nominal motors, respectively.

4. CONCLUSIONS

Based on the above analysis and findings, Underwood Engineers concludes the following:

- Based on hydrant flow results and model predictions, the existing water distribution system can supply up to 1,100 gpm at the suction side of the Middleton Road BPS at the minimum allowable residual pressure of 20 psi.
- The existing Worthington pumps and motors are <u>not</u> capable of supplying the design fire flow of 1,000 gpm.
- The existing electrical system exhibits several code violations. In particular, the required clearance is not provided in front of several panels.
- The existing relay-based pump control panel is outdated and not operable in conjunction with the existing jockey pumps.

- The station has no existing telemetry.
- Based on preliminary layouts and information provided by pumping system manufacturers, no building expansion is needed to accommodate the recommended pumps, motors, and process piping and valves. However, some electrical equipment may need to be mounted to the building exterior in weatherproof enclosures.

5. RECOMMENDATIONS AND OPINION OF PROBABLE COST

Based on the above conclusions, Underwood Engineers recommends the Town take the following actions:

- Replace the existing jockey pumps, Worthington booster pumps, hydropneumatic tanks and controls with new pumps using VFDs to maintain constant discharge pressure and new PLC-based controls.
- Upgrade electrical service and replace electrical equipment as required to provide adequate service to the proposed pumps and correct code violations.
- Demolish the existing copper piping and concrete pump pads to make room for the replacement pumps and electrical equipment. Reconfigure 10-inch process piping as required to connect to replacement pumps' suctions and discharges.
- Perform a radio path study to confirm adequate radio transmission between the Middleton Road BPS and the MTU at the WTF.
- Install a new radio-based SCADA RTU and any antenna-related infrastructure indicated by the radio path study to transmit indications and alarms.
- Install a portable generator connection and manual transfer switch (MTS) to make provisions for standby power. Consider installing a permanent standby generator and automatic transfer switch (ATS) in the future.
- Remove plastic covering intake louver. Install a motor operated damper interlocked to open when the exhaust fan runs.
- Confirm floor slab has sufficient structural capacity to support larger pumps and motors.

The Engineer's opinion of probable cost for these improvements is $460,000 to $530,000 including construction, contingency, and engineering, assuming the work will be performed by a Contractor, not Town forces. Allowances are also included for charges by the electrical utility for service upgrade and a SCADA system radio path study. A cost breakdown is attached.

If the Town were to install the permanent standby generator and ATS at this time (instead of the portable generator connection and MTS), the opinion of probable cost would be $590,000 to $680,000 including construction, contingency, and engineering.

Please call if you have any questions.

Very truly yours,

UNDERWOOD ENGINEERS, INC.

Michael B. Metcalf, P.E.
Sr. Project Manager

Michael C. Unger, P.E.
Sr. Project Engineer

MCU/mcu

Encl.

- Hydrant Flow Test Results
- Initial Review of the Existing Electrical Installations
- Worthington Pump Curve
- Opinion of Probable Cost Breakdown

Wolfeboro, NH
Hydrant Flow Test
Underwood Engineers
Date/Time: August 6th, 2014 0900 hrs

Test 1: Middleton Road

Table 1. Test Results

	Field Observations				
Location	Static Pressure psi	Residual Pressure psi	Pitot Pressure psi	Flow gpm	Remarks
Flow Hydrant - Nearest to P.S.			25	785	
1 st hydrant on Middleton Rd	80	70			
Hydrant across from Jehovah's Witness Sign	56	43			
Hydrant across from #105 Middleton Rd	50	35			

Table 2. Compare Model Predictions and Calculated Available Fire Flow*

	Calculated**	Model***
Pressure Hydrant across from #105 Middleton Road	1,141	1,100

**Under conditions at time of flow test (see report).*
***Calculated fire flow based on observed field data. Neglects residual pressures at other locations in the system.*
****Predicted by model. 20 psi minimum residual pressure at all locations in system.*

Initial Review
of the
Existing Electrical Installations
and Proposed Electrical Upgrades
at the
Middleton Road Potable Water Booster Pump Station
Wolfeboro, NH

THE STATE OF NEW HAMPSHIRE
LEE
F.
CARROLL
No. 2828
REGISTERED
PROFESSIONAL ENGINEER

8/25/2014

as prepared for

Underwood Engineers
25 Vaughn Mall
Portsmouth, NH 03801

by:

Lee F. Carroll, PE; Electrical Consultants
1 Madison Avenue
PO Box 357
Gorham, NH 03581-0357
(603) 466-5065

Purpose:

This report is prepared at the request of Michael Unger, PE: Underwood Engineers, 25 Vaughn Mall, Portsmouth, NH 03801, to document information about the existing electrical system installations and equipment installed at the Middleton Road Booster Pumping Station in Wolfeboro, NH. The intent if the report being to evaluate existing conditions and indicate modifications needed to conform to applicable electrical codes.

Format:

This report has been prepared in two phases. The first phase is the documentation of the electrical installations as they presently exist for the equipment now in place. The second phase has been added to the fist phase after the proposed modifications to equipment and controls was adequately developed to permit the report to indicate suggested/recommended/required modifications to the electrical installations to accommodate the proposed equipment modifications.

Phase 1: Review of Existing Electrical Installations:

The existing booster pumping station is located at 133 Middleton Road. Utility services are provided underground from utility pole NETCO #27 and appear to consist of one 2 inch conduit for telephone service (no service is connected and the conduit ends approximately 2 feet above the floor inside the building). The electrical service conduit at the utility pole is 4 inch. At the building exterior it appears there is a PVC reducer that provides a 2 inch conduit riser to the utility meter. Neither service conduit at the building appears to have an expansion fitting provided (a code requirement). The Wolfeboro Electric Department has a cluster mount of 3 single phase transformers at the service pole. Ratings were not able to be determined. The power to the facility is 208/120 volts, 3 phase, 4 wire, 60 hertz and the utility meter has manufacturer's number 43 623 953 and a hand written number 4976 on it. The meter is a KwHr meter with a demand scale that has a maximum demand scale reading of 36. The demand pointer is off scale (above 36). It is not locked (as is standard utility practice to prevent non-authorized persons from resetting it). My assumption is that the demand is not being billed on the account and this is because there is not adequate electrical equipment presently installed and that is also operational to create a demand as high as was observed on the meter.

The existing conductor size from the utility pole to the meter is not accessible to confirm it is appropriate. The conductors from the meter to the interior main electrical panel also were not accessible.

The main electrical panel is a 225 Ampere, main breaker panel with 2-100 Ampere, 3 pole, feeder breakers (one to each of the original station 15 horsepower (HP) pump motor starters) and 6-20 Ampere, 1 pole breakers for lights, receptacles, exhaust fan, gas heater and controls). There are no spare breakers nor is there physical space to install any additional breakers. The mounting of the main electrical panel does not provide the code required minimum of 36 inches clear working space in front of its full width.

Adequacy of grounding could not be confirmed because the main panelboard covers need to be removed to determine the presently installed grounding electrode conductor.

Feeders from the main panelboard are generally routed under (or in) the concrete floor slab, as are conduits from the original motor starters to the original motors and/or from the original pump control panel to auxiliary devices (solenoids, limit switches, mercroid pressure controls) at the original pump locations.

The pump motor starters (Square D, combination fused disconnect, FVNR units) for the original pump motors (15 HP, 208 volt, 3 phase, 60 hertz, 40 ampere full load, code G - per nameplates) are in the "off" position and the motor couplings to the pumps have been positioned so that the motor and pump shafts are not connected together, One (apparent mercroid switch) on one pump has been removed and its control wires are not capped, but are left exposed and unused at the pump.

The location of the original pump motor starters do have code required working space in front of the units. Control wiring from these starters to the original pump control panel are installed in surface mounted conduit.

The original pump control panel does not have the required minimum 36 inches of clear working space in front of it. The panel contains run time meters for the original pumps, selector switches, alarm lights, etc. No wiring diagram for this was found at the site. It is an older, relay base control system. Wiring diagrams are required to evaluate any possible reuse of this panel, but a first opinion is to just replace it with a new programmable logic controller (PLC) based panel that would be set up to provide the final control interface for the proposed modified pumps.

There are 2 small "booster pumps" that have been installed and are now operational at this facility. These have 3 HP, 208 volt, 3 phase, 60 hertz, apparent 8.1 Ampere full load rated motors. Based on their installation appearance these must have been installed after the original pumps and possibly by "others". As now arranged the 3 phase power to a separate Square D, size 1 (7½ HP maximum at 208V) combination fused disconnect, FVNR starter that is mounted adjacent to the original pump control panel, is connected to the power feed conductors run from one of the original 15 HP pump starters. (These are then routed through the original pump control panel and through a conduit to the new starter). This presents multiple code violations as follows: (1) the connection to the original starter power feed places more than one conductor under the terminal (which is not permitted unless the manufacturer's installation information indicates it can be done). (2) The existing pump control panel is not listed as a wireway for circuits not associated with its use (the power feed to the new 3 HP pump starter).

The output wiring from the present 3 HP pump starter is routed to a wall mounted, 3 pole double throw (3PDT) manual transfer switch. This permits the operator to select which pump will run when controls activate the motor starter. The code violation with the starter and with the 3PDT switch is that neither has the code required 36 inch clear working space in front if it. One mercroid pressure switch mounted to the exterior of the original pump control panel has been re wired to the starter for the 3 HP pump motors. It appears to be set to start the pump (selected by the 3PDT manual switch position) when pressure decreases to 75 psi and to stop that pump when the pressure reaches 125 psi. The pump cycled several times during the site review.

The existing facility has no apparent alarm system and no method of sending alarms to a remote location to insure response.

The existing facility has no standby generator to allow operation during periods when utility power fails.

The first issues that will need to be addressed under Phase 2 of this report will be whether the existing service rating will be adequate for proposed loads and how the electrical equipment can be arranged to provide code required working space. The second issue will be how to transmit alarm/status data from this site to a remote monitoring location.

Phase 2 - Suggested/Recommended/Required Electrical System modifications to accommodate modified equipment power and control requirements:

The indicated scope/recommendation for the facility upgrade will include the removal of the existing 15 HP pumps (currently not in service), the existing 3 HP domestic booster pumps, existing pump controls, interface panel, motor starters, and main electric service and distribution panel.

The proposed new installation will consist of 2 - 3 HP domestic booster pumps with individual VFD controls and 2 - 30 HP fire flow booster pumps with individual VFD controls. A new programmable logic controller (PLC) based control panel will provide coordinated control of the four (4) proposed pumps and will interface with a new SCADA panel which will provide monitoring and alarm interface via a radio path to the Owner's existing SCADA system. A new fire and security panel is also proposed to provide any fire or security alarm activation to be transmitted via the new SCADA system. There will be no standby power included in the basic installations proposed, but this report will indicate the costs estimated to (1) provide the capability for connection of a portable standby power unit and to (2) provide a fixed standby generator with weather enclosed, sound attenuated, liquefied petroleum gas (LPG) fueled and an automatic transfer switch.

The existing 225 Ampere main utility service will not be adequate to permit the simultaneous operation of all four proposed new pumps. On that basis the main utility service conductors, metering, and power distribution panels will all require upgrades. It is also possible that the utility will need to upgrade their existing pole mounted service transformers. This service upgrade requirement is based on the existing facility loads on the present 225 Ampere service approximating 150 Amperes (2 motors @ 48.3 Amperes plus two motors @ 11 Amperes plus controls and ancillary power). The proposed new equipment loads will approximate 250 Amperes (2 motors @ 92 Amperes plus 2 motors @ 11 Amperes plus controls and ancillary power). A new 400 Ampere, 208/120 Volt, 3 phase, 4 wire, 60 Hertz service is being recommended on that basis.

Assuming we can maintain a minimum 3 foot Code required clear working space in front of the new electric service and distribution panel, new SCADA panel, and new fire and security panel, and also in front of the new, skid mounted pump control panel and variable frequency drives (VFDs), the panels should physically fit in the proposed ten (10) foot wall section where the present electrical service and distribution panel is located. It must be remembered that the 3 foot clear space is the space in front of the panels, and the SCADA panel is likely to be up to 10 inches deep (and IF an automatic transfer switch were to be included, that would likely be 13 inches deep), and mounting channels for the panels will add approximately another 2 inches in depth from the wall surface. The pre-design estimated width of the panels is: 20 inches for power service and distribution panel, 36 inches for the SCADA panel, and 18 inches for the fire and security panel. Allowing a minimum 4 inch clearance between the panels results in an overall estimated electrical space requirement of 90 inches. IF we want to include an automatic transfer switch we add an item that is 18 inches wide (based on ASCO, Series 300 without maintenance bypass built in), or we end up with a total space requirement of 9 feet 4 inches.

With a generator and automatic transfer switch the utility main service breaker and a readily accessible manual disconnect switch for the generator would be physically located on the building exterior. With provision for connection of a portable generator, the utility main service breaker and the manual transfer switch for the portable unit's connection to the system would be located on the building exterior (the manual transfer switch exceeding 2 feet in width).

It is recommended that any project include the replacement of the present exterior light fixtures, some of which are damaged. It is also suggested that the interior fluorescent lighting be converted to the more energy efficient "T-8" lamps with appropriate electronic ballasts. General purpose 120 volt receptacles would be changed to Ground Fault Circuit Interrupter style units to improve personnel safety.

If a standby generator is included for all four pumps plus ancillary facility loads, the unit that will be required appears to be at least 150 KW rated. This is due to motor starting loads, even with the pumps started sequentially.

Based on the foregoing the following electrical construction costs are noted. These do not include engineering design costs or any charges that the local utility may invoice for any upgrades to their installations. The estimates are based on the new service conductors from the utility service pole to the facility being 200 feet in length and the existing conduit being 4 inch (as it appeared to likely be from the field review).

Pre-design estimated electrical construction costs with no provisions for any standby power now or in the future are $45,500.00.

Pre-design estimated electrical construction costs with provisions included to permit connection of a portable standby generator, but not including the costs of such a generator, and including all the other facility electrical upgrade costs is $57,000.00.

Pre-design estimated electrical construction costs with inclusion of an on-site standby power unit and associated automatic transfer switch, and including all the other facility electrical upgrade costs is $129,500.00.

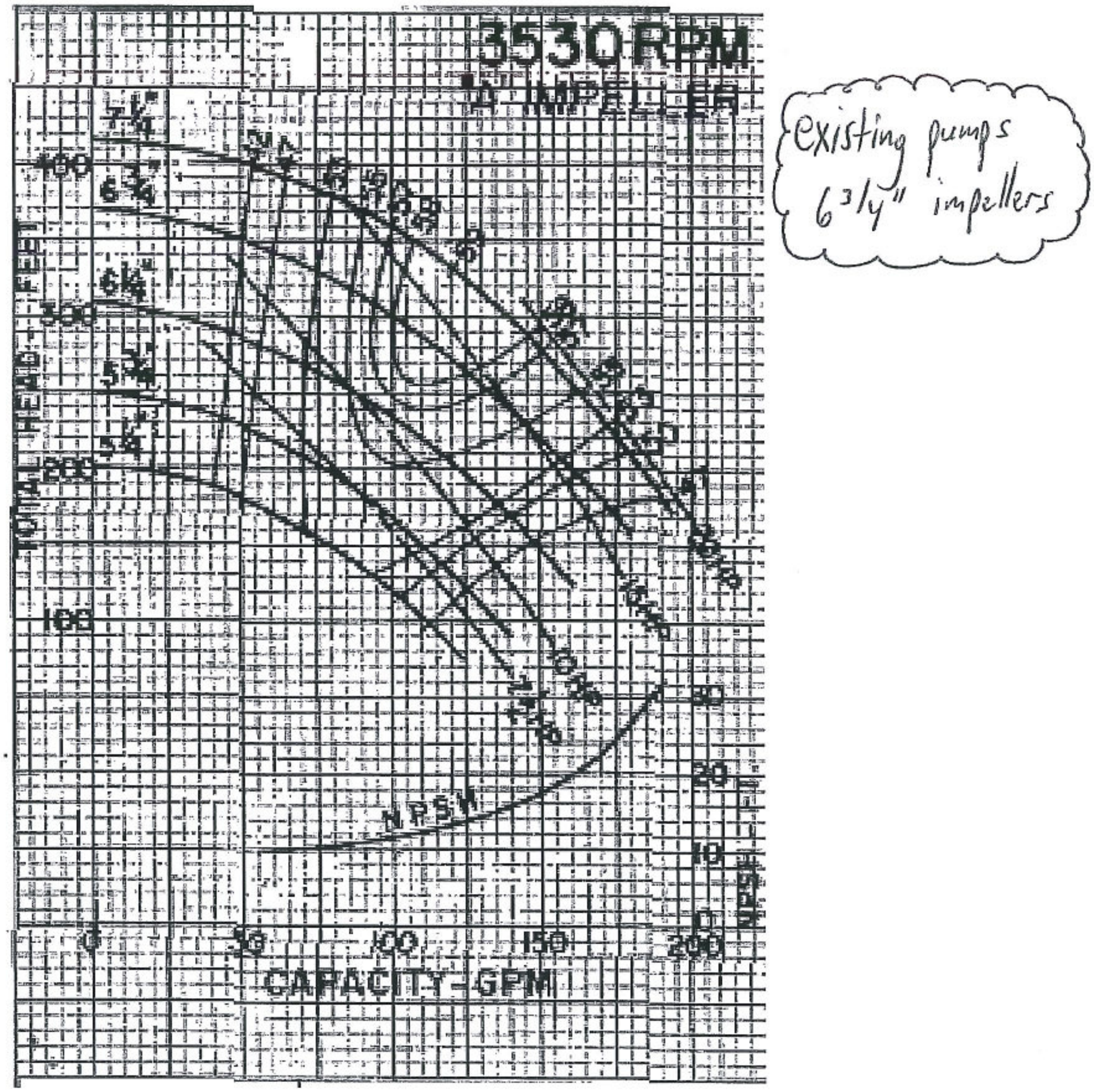
It is recommended that a contingency amount of not less than 10% or more than 20% be added to the foregoing estimates.

END OF REPORT

horizontally split centrifugal pumps

LR-LLR

EYE AREA = 2.65 SQ.IN., MAX. DIA. SOLIDS = 1/8", MAX. SHAFT BHP AT 3530 RPM = 75, 1730 = 38



A-6529 R-1 | WORTHINGTON PUMP INC. – RATING CURVE | 1½LLR-7

Minimum recommended flow – Sustained operation to the left of the slanted broken line could possibly result in shaft breakage due to fatigue.

MIDDLETON ROAD BOOSTER PUMPING STATION IMPROVEMENTS
WOLFEBORO, NH
OPINION OF PROBABLE COST
8/28/2014

ITEM	QUANTITY	UNIT	UNIT PRICE	PROBABLE COST
General Requirements (11.5%)	1	LS	$ 29,000.00	$29,000
Demo: exist. pumps, pump pads, copper piping and valves	1	LS	$ 5,000.00	$5,000
Demo: electrical and control panels	1	LS	$ 10,000.00	$10,000
Furnish packaged booster pumping system (4 pumps and controls)	1	LS	$ 100,000.00	$100,000
Install packaged pumping system and controls	1	LS	$ 35,000.00	$35,000
F&I process piping and valves to connect pumping system	1	LS	$ 30,000.00	$30,000
F&I magnetic flowmeter	1	LS	$ 8,000.00	$8,000
F&I motor operated damper on intake louver	1	LS	$ 3,000.00	$3,000
F&I new electrical and SCADA equipment, lighting, portable generator connection, MTS	1	LS	$ 57,000.00	$57,000
SUBTOTAL				***$277,000***
Contractor OH&P - 15%				$42,000
Contingency - 20%				$55,000
TOTAL PROBABLE CONSTRUCTION COST				***$374,000***
Electrical Utility Fee Allowance				$10,000
Radio Path Study				$3,000
Design and Construction Phase Engineering (25%)				$94,000
TOTAL PROJECT COSTS				***$481,000***
Range (-5%/+10%)			***$460,000.00***	***$530,000***
Notes:				

Appendix E:

Water Model Update and Alternatives Evaluation

1778.00

November 1, 2013

Mr. David Ford, P.E.
Public Works Director – Town of Wolfeboro
84 South Main Street
PO Box 629
Wolfeboro, NH 03894

Re: ***Water Model Update and Extended Time Calibration***
Wolfeboro, NH

Dear Mr. Ford:

The following letter report summarizes updates to the Town of Wolfeboro's existing water model and extended time calibration performed by Underwood Engineers in accordance with ESR #8 and #13.

1. BACKGROUND

The Town of Wolfeboro has an existing water distribution system hydraulic model in the WaterGEMS software platform (Bentley). The model includes both steady-state and extended time period scenarios.

The Town has requested Underwood Engineers review and update of the model, including steady state and extended period calibration, to reflect distribution system improvements and operational changes made since the model's origination and/or last update.

2. REVIEW OF EXISTING INFORMATION

The Town provided the following information related to model input and calibration:

- Water model in WaterGEMS. Filename = "wolfeboroGEMS.wtg".
- Water system GIS (as of July 25, 2012).
- Distribution System Inventory
- Draft "Hydraulic Model Report Update" by Wright-Pierce, dated September 2008.
- Operational data:
    - Verbal explanation of WTF operations.
    - Continuous SCADA data for calibration period (see **Section 5** below).

Underwood met with Town personnel on two occasions (July 9 and July 17, 2013) to conduct site visits and review controls and setpoints for the tanks, PRV station and the water treatment facility (WTF). Field hydrant flow tests were performed on July 17, 2013, with assistance from

Town personnel at representative locations, throughout the distribution system and in specific areas of concern.

3. UPDATING MODEL EXISTING CONDITIONS

Based on our review of existing information, Underwood Engineers made the following updates to the model.

Water Mains

- Lehner Street – replaced 6" CI with 8" C900, C = 150, from School Street to Cropley Hill to reflect recent water main replacement.

Note: The Town's GIS shows an 8" main on South Main Street parallel to the 10" main; However, the 8" is not shown in the model. The Town has confirmed the 8" main is abandoned.

Demands

Underwood Engineers updated demands based on information provided by the Town as noted below. Global edits were applied to the existing base demands. Therefore, the relative distribution of demands was not changed.

- Average Day = 0.485 MGD (based on average production data from 2010 to 2012). Note: current or recent average day demands (as opposed to projected future demands) are typically used for extended period simulations because current demands are more appropriate for evaluating system operations and are likely to be conservative for water age analysis.
- Max Day = 0.75 MGD (provided by the Town). Note: projected future maximum day demands are typically used for pressure and fire flow evaluations because future demands are likely to be conservative compared to current demands.

Booster Pumping Stations

- Middleton Road
    - Added station at actual location along Middleton Road.
    - Set station elevation to 643 ft.
    - Added pump definitions to reflect the booster pumping system:
        - 2 jockey pumps (3 hp) each rated for 50 gpm. An assumed TDH of 155 ft. was used in order to provide a discharge pressure of 115 psi per Town staff. The TDH can be refined if the Town provides a pump curve.
    - Added pressure reducing valve (PRV) on pump discharge manifold to simulate the maximum discharge pressure of 115 psi.

Water Treatment Facility (WTF) and South Main Street Tank

The model as provided by the Town used flow control valves to simulate WTF and South Main Street Tank operations.

We retained the flow control valves in the model but revised controls as follows:

- Valve (FCV-1) upstream of Clearwell (T-1) setting = 900 gpm (average WTF discharge per SCADA data provided by the Town)
- Pipe downstream of FCV-1, upstream of T-1 initially set to Active
  - Set to Open when T-1 level is less than or equal to 18 feet
  - Set to Close when T-1 level is greater than or equal to 26 feet
  - Set to Open at 7:45am daily
- South Main Street Tank (T-2) valve (FCV-2) setting = 400 gpm (value in model as received from the Town)
  - Set to Open when T-2 level is less than or equal to 67 feet
  - Set to Close when T-2 level is greater than or equal to 75.5 feet

Modeling WTF and tank operations is challenging because flow rate and fill times are adjusted manually by operators often using intuition and experience, which cannot be pre-programmed into the model. Therefore, we recommend subsequent modelers consult with WTF operators and manually adjust model parameters as needed for a given operational scenario. For example, flow rates can be adjusted or time-based controls can be changed to replace tank level controls.

Scenarios

- Created the following five scenarios:
  - "Average Day 2013": steady state; current average day demands.
  - "Water Age on Average Day": extended time period simulation; water age analysis; current average day demands.
  - "Max Day 2013": steady state; current maximum day demands.
  - "Fire Flow on Max Day": steady state; maximum day demands; fire flow analysis.
  - "Calibration 2013": extended time calibration (see **Section 5** below).

4. STEADY-STATE CALIBRATION

Flow Tests

On July 17, 2013, Underwood Engineers and representatives from the Town conducted nine hydrant flow tests throughout Town (see Figures 1A-7B, attached).

Table A. Conditions during the tests were as follows:

Test	Time	Clearwell Level	South Main Street Level	Finished WTF Flow
Test 1A	8:59 AM	19.5 ft	75.0 ft	541 gpm
Test 1B	9:31 AM	19.5 ft	74.5 ft	582 gpm
Test 2	10:28 AM	20.4 ft	73.8 ft	513 gpm
Test 3	11:03 AM	20.9 ft	73.4 ft	444 gpm
Test 4	11:40 AM	21.3 ft	73.0 ft	402 gpm
Test 5	12:23 PM	21.5 ft	72.6 ft	525 gpm
Test 6	2:30 PM	22.5 ft	75.1 ft	414 gpm

Test 7A	1:07 PM	22.0 ft	72.3 ft	442 gpm
Test 7B	1:20 PM	22.2 ft	72.2 ft	397 gpm

Results are presented in Tests 1A through 7B on the attached Data Sheets. The following adjustments were made in response to discrepancies between field observations and model predictions:

- Lehner Street – Reduced C-Values for the remaining 6" CI section from 60 to 40.
- Junctions – Several junctions throughout the system had incorrect or zero elevations. Elevations were adjusted based on data from Google Earth.

Model predictions after calibration are also shown on Tests 1A through 7B Data Sheets.

Significant findings based on field results and steady-state calibration are summarized as follows:

- **Test 1A – Lehner St.**: Excessive headloss was observed and appears to be associated with the section of 6" CI main. Possible causes could be a partially closed valve and/or severe tuberculation. The model is over predicting in this area due to the unexplained headloss. Lowering the C-value in the model is not sufficient to reproduce the observed residual pressures. At this time, we reduced the C-value for this section from 60 to 40, consistent with the C-value for other old, unlined cast iron mains in the model. However, the Town should be aware that the model is not predicting observed pressures in this area. We recommend this section of main be replaced. Otherwise additional evaluations should be conducted to determine the cause of the excessive headloss.
- **Test 1B – Lehner St.**: The model is over predicting in this area due to the same unexplained headloss associated with the 6" CI main observed in Test 1A.
- **Test 2 – N. Main St.:** Observed residual pressures at all test hydrants were significantly lower than model predictions. However, the C-value for the test area calculated from the field data (C=112) compared well to the model C-value (C=120). This suggests calibration issues upstream of the test area. Attempts to calibrate the model to correspond to observed field data were not successful because C-values upstream of the test area would have to be reduced, which in turn would cause calibration to fail in other areas of the system. One possible explanation is a closed or partially closed valve that adjusted model C-values cannot accurately represent.
- **Test 3 – Waumbeck Rd.:** Observed residual pressures were lower than model predictions at all residual hydrants including the hydrant on the 12-inch trunk main on North Main Street. However, the C-value for the 6-inch section of the test area calculated from field data (C=102) compared well to the model C-value (C=110). Headloss in the 10-inch section was not significant enough to calculate a C-value from field data. These results suggest the calibration issue is upstream of the test area, consistent with Test 2.
- **Test 4 – Forest Rd.:** Observed field results generally compared well to model predictions.
- **Test 5 – Sewall Rd.:** Results of this test are similar to Test 2. Observed residual pressures were lower than model predictions. Attempts to calibrate the model to correspond to observed field data were not successful because C-values upstream of the test area would have to be reduced, which in turn would cause calibration to fail in other

areas of the system, specifically Forest Road and North Main Street. The results for Test 5 likely have the same cause as Tests 2 and 3, possibly a partially closed valve.

- **Test 6 – Center St.:** Flow from the flow hydrant was insufficient to register a reading on the pitot gauge. Since the observed flow was not known, residual pressures could not be predicted in the model. The model predicts an available fire flow of 187 gpm at the flow hydrant, which is too low to accurately register on a pitot gauge, consistent with field observations. Therefore, we consider model calibration on Center Street to be reliable.
- **Test 7A – Beach Pond Rd.:** Observed field results generally compared well to model predictions.
- **Test 7B – Beach Pond Rd.:** Observed field results generally compared well to model predictions.

5. EXTENDED TIME CALIBRATION

Calibration Period

The Town provided 15-minute SCADA output data for the period July 1 through July 7, 2013, including:

- Clearwell Level
- South Main Street Tank Level
- Raw water flow to WTF
- Finished WTF Flow

After reviewing the SCADA output data, Underwood selected the 5-day period of July 3 through July 7, 2013 to use for model calibration because tank level fluctuations/turnover and general operations were relatively consistent during the entire period.

Demands

Using SCADA output data provided by the Town, we made the following adjustments to model demands:

- Applied a global demand multiplier to adjust demands in the model to match the average system demand during the 5-day calibration period of 0.58 MGD. (Note: These demands are specific to the calibration period and therefore are only applied to the "Calibration 2013" scenario.)
- Revised the diurnal demand pattern applied to all nodes. System demand was estimated for each hourly time step by subtracting the volume of water stored from the volume produced. The hourly demands were then averaged for the 5-day calibration period for which SCADA data were provided.
    - Information on diurnal water use by the largest water users was not available, so all nodes have been assigned the same diurnal demand pattern.

Extended Period Calibration

An extended time period simulation was run using the updated model. Initial age of all elements in the model were set to "0" hours. Results for each tank level were compared to actual SCADA data for the 5-day calibration period (Exhibits T1 and T2). The calibration efforts clearly improved the model's ability to predict tank level fluctuations. Certain discrepancies are noted:

- Clearwell: model predictions compare well to SCADA data. The model predicts slightly shorter turnover period than was observed (Exhibit T1). This is likely due to demand fluctuations during the calibration period or a slight over-prediction of demands by the model.
- South Main Street Tank: model does not predict each individual fill and draw cycle but generally represents the behavior of the tank when considered over the full 5-day calibration period (Exhibit T2). This is likely due to day-to-day demand fluctuations and operator interaction. Discussions with Town personnel suggest manual fill operations sometimes occur in the summer when staff is at the tank site confirming operation of the tablet chlorinator. The Town could not confirm that operators filled the tank manually on all the days observed on SCADA but since they occurred at the same time of day, it is reasonable to assume so. In this case, the calibrated model predicted all automatic fills. Since the manual fills are irregular occurrences, the model cannot be programmed to simulate them.

Based on the results, the extended time calibration was considered successful.

We note that modeling of specific water quality constituents (i.e. chlorine residual), although possible, was not proposed or performed at this time due to cost and possible inaccuracies. USEPA guidance documents indicate that "proper calibration of the water quality component can be a difficult task and is typically done with much less accuracy than calibration of the hydraulic component". Water quality modeling requires additional model parameter inputs including bulk decay coefficients, wall demand coefficients, and formation coefficients, depending on the specific constituent being modeled. Although modeling software uses "default" values for these parameters, they may vary widely depending on pipe type and condition and local flow velocity. For these reasons, guidance documents recommend extensive field testing (i.e. water quality surveys and tracer studies) as part of water quality calibration.

In lieu of modeling specific water quality components, water age is commonly used as a surrogate for water quality because water age depends only on the type of extended time hydraulic calibration performed at this time. The Town can consider water quality calibration and modeling in the future depending on the Town's planning and design needs, but it may not be needed unless water quality issues become apparent.

6. WATER MAIN IMPROVEMENT ALTERNATIVES ANALYSIS

For specific areas (Center Street, Lehner Street, Main Street, Pine Street, see Figure 8), the Town requested that UE use the hydraulic model to evaluate the hydraulic benefit of replacement. The following replacement projects were evaluated:

1. Center Street (from Elm Street to end of main): replace existing 6" CI with new 6" or 8" main.
2. Lehner Street (from Cropley Hill Road to Center Street): replace existing 6" CI with new 8" main.

3. Main Street (from 12" DI on N. Main Street to Center Street): replace existing 8" CI with new 12" main.
4. Pine Street: replace existing 4" CI with new 6" main from end of 8" DI to beginning of 6" CI or replace entire length of 4" and 6" CI with either new 8" or 12" main from Center Street to Huggins Hospital.

Depending on the Town's preference, all new water main could be ductile iron or PVC.

Modeling results are summarized in **Table B** below and on Exhibits A1 through A8 attached. Exhibits A1 through A8 graphically illustrate the impacts on available fire flows and water age for the given model nodes for each alternative evaluated.

Table B. Model-predicted average available fire flow (gpm) with 20 psi residual throughout system. (see Exhibits A1 through A8)

Project	Model Evaluated At	Existing System	Replace With		
			6" DI	8" DI	12" DI
Center Street	End of Main	187 gpm	570 gpm	1,147 gpm	N/A
Lehner Street	Lehner & Glendon	2,094 gpm*	N/A	2,526 gpm	N/A
Main Street	Main & Center	2,816 gpm	N/A	N/A	1,260 gpm**
Pine Street	Huggins Hospital	1,209 gpm	1,863 gpm***	2,680 gpm	2,846 gpm

*Model over-predicts available fire flow in this area (see **Section 4**). Calculated available fire flow based on field results = 1,910 gpm
**See text (3rd bullet below)
***Only replacing existing 4" with new 6" DI, leaving remaining 6" CI in place

Based on the model results, we offer recommendations for these streets as follows:

- *Center Street*: Based on the age of pipes and hydraulic restrictions, we recommend replacement with new 8-inch main. New 8-inch main will provide a significant increase in hydraulic capacity and fire flow which is particularly important on dead ends and dense residential neighborhoods. Using 8" instead of 6" will increase water age somewhat, but other areas of Town have higher predicted water ages and the fire flow benefit of 8" vs. 6" is significant.
- *Lehner Street:* We recommend replacement with 8" main. The fire flow benefit is limited due to looping because hydrants at either end of the 6" section can be fed from different directions. However, replacement is justified by the age of the 6" section, the unexplained headloss observed during flow tests and for consistency with rest of the water main on Lehner Street.
- *Main Street*: Increasing the 8" section of water main on Main Street to 12" will increase available fire flow locally at hydrants downtown, but will effectively *reduce* available fire flow downtown *while maintaining 20 psi residual throughout the system*; the limiting location is the high point on North Main Street near Armstrong Road. This seems counterintuitive because increasing water main diameter should reduce headloss and *increase* fire flow. However, in this case, increasing the pipe diameter on Main Street

affects the distribution of flow coming from the PRV vault between the 10-inch cross country main and the 12-inch main on Pine Hill Road; that is, it induces a greater percentage of the flow in a fire flow situation in the downtown area to go through the 10-inch cross country main, increasing headloss in this main. This increased headloss contributes to decreased pressures on North Main Street, therefore limiting the system's ability to provide fire flow downtown **and** maintain 20 psi residual throughout the system. To be clear, increasing the main size **will** increase the available fire flow on Main Street but it will result in pressures below 20 psi elsewhere in the system. In order to achieve greater fire flows downtown, **and** maintain 20 psi residual throughout the system, a 12-inch loop appears necessary north of the downtown area in conjunction with increasing the 8-inch section on Main Street to 12-inch. In summary, replacing the 8-inch main on Main Street with 12-inch is recommended due to the age of the existing main and to strengthen the core of system. However, the Town should recognize that under high flow conditions the replacement will be at the expense of lower residual pressures at higher elevations until the Town completes a 12-inch loop north of downtown.

- *Pine Street*: Replace 4-inch and 6-inch cast iron with 8-inch ductile iron. Even though the majority of these pipes are less than 50 years old, replacement will improve fire flow on Pine Street and at Huggins Hospital.

7. CONCLUSIONS

Based on the above analysis and findings, Underwood Engineers concludes the following:

- Steady-state model calibration improved the model's ability to predict residual pressures with the following exceptions:
  - At Lehner Street, an extremely high headloss was observed in the 6-inch cast iron main and could not be replicated by model calibration.
  - At North Main Street, Waumbeck Road and Sewall Road, observed residual pressures were lower than model predictions at all residual hydrants. Calibration was not successful because C-values upstream of the test area would have to be reduced, which in turn would cause calibration to fail in other areas of the system. Based on the fact that similar results were observed for three tests, it is likely that a constriction exists upstream of the test areas. Possibilities include a partially closed or closed valve, debris caught in a main, or a section of small-diameter pipe. The exact location is not known but may be along the 10-inch cross country main or the 8-inch main on North Main Street.
- Extended time model calibration significantly improved the model's ability to predict tank level fluctuations.
- Operation of the Water Treatment Facility and South Main Street Tank are not fully automated and depend on operator judgment, which cannot always be directly programmed into the model.
- The Town is not currently running the Middleton Road Pump Station at full capacity. Pumps and controls are not fully defined in the model.
- Water main replacement projects described in **Section 6** would improve fire flows.

8. RECOMMENDATIONS

Based on the above conclusions, Underwood Engineers recommends the Town take the following actions:

- Conduct additional flow testing to diagnose the low residual pressures observed on North Main Street, Waumbeck Road and Sewall Road. At a minimum, flow testing should be conducted on the 10-inch cross country main and the 8-inch main on North Main Street.
- Replace the 6-inch main on Lehner Street or conduct additional testing to diagnose the excessive observed headloss.
- Review and confirm pump curves for Middleton Road booster pumps.
- Prior to running extended time period simulations, the modeler should consult with WTF operators and manually adjust model parameters as needed for a given operational scenario.
- Plan/Budget for water main replacement projects described in **Section 6** and summarized below;
    - *Center Street* – replace 6" CI from Elm St to end of main with new 8" DI.
    - *Lehner Street* – replace 6" CI with new 8".
    - *Main Street* – replace 8" with 12" while recognizing that under high flow conditions the replacement will be at the expense of lower residual pressures at higher elevations until the Town completes a 12" loop north of downtown.
    - *Pine Street* – Replace 4" and 6" CI with 8".

Please call if you have any questions.

Very truly yours,

UNDERWOOD ENGINEERS, INC.

Michael B. Metcalf, P.E.
Sr. Project Manager

Michael C. Unger, P.E.
Sr. Project Engineer

MBM/MCU/rla

Encl.

- Data Sheets 1A through 7B
- Figures 1A through 7B
- Exhibits T1 and T2
- Exhibits A1 through A8

Appendix F:

Asset Management Brochure

LEVEL OF SERVICE

The Level of Service (LOS) Statement defines the way in which the utility managers and operators want the system to perform over the long term.

The following highlight Wolfeboro's LOS statement.

Quality

- Maintain clean and safe drinking water in compliance with State and Federal Regulations.

Availability

- Make water available to as many Wolfeboro residents as economically feasible.

Supply

- Minimize watering bans.
- Minimize non-revenue water and manage bleeders.

Distribution

- Minimum water pressure should be 35 psi, with average pressure ranging from 60 to 80 psi.

Reliability

- Notify customers 48 hours prior to planned shutdowns.
- Respond to supply or quality issues affecting a significant level of customers within 1 to 2 hrs.

ASSET MANAGEMENT STRATEGIES

Keys to Successful AM

Keep it simple
Form a living document
Bring everyone on board

The following techniques are used to help keep Asset Management a successful on-going process.

- Continually updating the asset inventory and condition of assets over time.
- Update the Level of Service over time. Keep consistent with desired performance and customer expectations.
- Repair or replace assets that have a high probability of failure and high consequence of failure.
    - These will have the largest impacts on the system.

Brochure produced by:

UNDERWOOD engineers

April 2017

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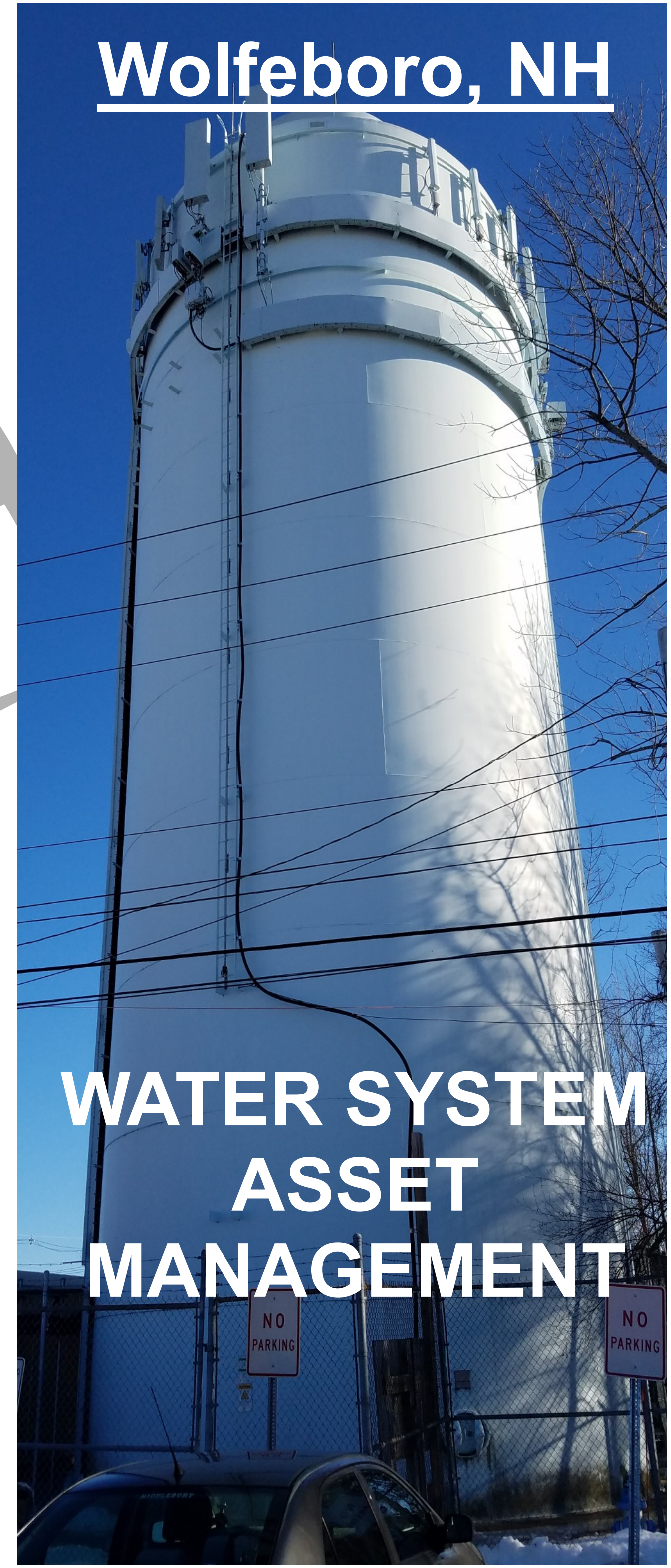
Wolfeboro, NH



WATER SYSTEM ASSET MANAGEMENT

INFO YOU SHOULD KNOW

What is Asset Management?

Asset Management (AM) planning is a decision-making tool that helps managers determine how to operate and maintain their systems at the lowest cost while maintaining the desired level of service. It consists of the following:

Asset Inventory - What the system owns.
Level of Service - How the system performs.
Critical Assets - Identifying the most important risks and assets.
Life Cycle Costing - Costs of maintaining the system.
Long-Term Funding Strategy - How the system will pay the costs.

How does it help?

Safe and reliable drinking water is critical to public health and quality of life in our communities. Significant investments have been made to build water infrastructure, but these systems are aging. Utilities will soon be faced with excessive costs to maintain service.

AM helps to better understand the condition of the water system, current and future deficiencies and needs, and the financial resources necessary to rehabilitate and replace assets when necessary.

THE WOLFEBORO WATER SYSTEM

Water Sources and Treatment

- Upper Beech Pond Reservoir
- Water from the Reservoir flows by gravity to the Water Treatment Facility on Northline Road.
- There the “raw” water is filtered and treated for pH adjustment and disinfection before entering the distribution system.

Water Distribution Stations

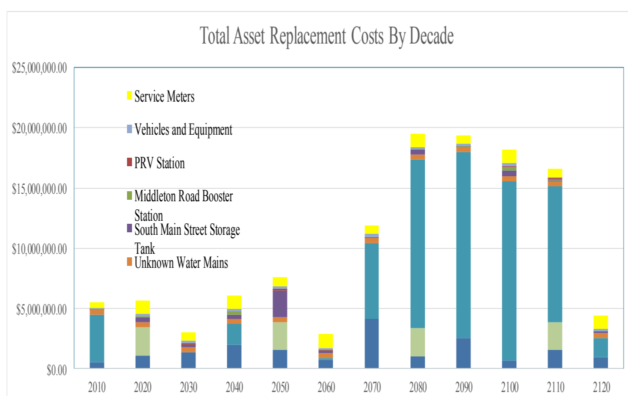
- The Town maintains a pressure reducing valve (PRV) station to drop the high service pressure (due to changes in elevation) to normal operating pressure within the Town.
- Middleton Road Booster Pumping Station (BPS). The BPS provides increased service pressures along Middleton Road, a low pressure area.

Water Storage

- Water Treatment Facility Clearwell (1.0 million gallons)
- South Main Street Water Storage Tank (0.5 million gallons)

Distribution Mains

- Wolfeboro owns and operates approximately 40 miles of water main of various materials, age, and sizes.
- In addition to the water mains, Wolfeboro owns and operates approximately 8 miles of 1-2 inch seasonal service lines.



LIFECYCLE COSTS

Cost Estimates

Underwood Engineers estimated costs over the next 120 years based on expected life span of assets. Costs included both major refurbishments and replacement of assets.

LONG TERM FUNDING PLAN

Life Cycle Costs

- The average annual cost to be set aside for future projects is approximately $800,000. This may be reduced by leveraging alternative sources of funding (i.e. grants, SRF loans, coordination with other Capital projects).