Aldrich + Elliott
WATER RESOURCE ENGINEERS

TOWN OF WILMINGTON, VERMONT

Water System

Asset Management Plan

October 2024

6 Market Place, Suite 2 | Essex Junction, Vermont 05452 | tel (802) 879.7733 | aeengineers.com

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1. Executive Summary

1.1 Introduction

The Town of Wilmington retained A+E to prepare an asset management plan for the water system. This project included the evaluation of the existing facilities, including but not limited to; source(s), transmission, treatment, storage, and the distribution system. The objective is to document existing conditions, identify deficiencies, and outline needed improvements and a schedule which the Town can utilize as a guidance document moving forward.

1.2 Asset Management Plan

A+E worked with the Town of Wilmington to document existing information for the water system and develop an asset management plan. This will be a useful tool which the Town and Water Department can utilize moving forward to update existing information and prepare operating budgets and capital improvement plans. The asset management plan included the following components:

- Level of Service Agreement
- Asset Management Team
- Water Map Updates
- Asset Inventory
- Condition Assessment
- Risk Assessment
- Hydraulic Water Model
- Life Cycle Cost Reduction Measures
- Capital Improvements Plan
- Funding Strategies

1.3 Hydraulic Analysis

A WaterCAD model of the Town of Wilmington's Water System was constructed by A+E to assess the water distribution system. The model was constructed based on the physical layout of the system, calibrated using hydrant flow data, and run through a variety of demand situations to identify hydraulic deficiencies. Hydraulic deficiencies considered include; available system pressures, ability to supply average and maximum daily demands, and the ability for the system to provide fire protection.

1.4 Implementation Schedule and Recommendations

As a result of the asset management plan, an implementation schedule and improvements were developed and outlined. The schedule is broken into phases and funding strategies as described below:

- <u>Capital Improvements</u> – Repairs, replacements or upgrades that are completed through funds in the capital reserve fund.

- Short Term Improvements – Improvements that address the most significant system deficiencies in the next 0-5 years.
- Long Term Improvements – Improvements that offer additional hydraulic benefits to the distribution system beyond significant system deficiencies in the next 5-10 years.
- Future Planning – Improvements that have been noted for the Owner to monitor and consider over the next 10+ years.

The Town water rates are high, making it difficult for the Town to cover the current debt retirement and also contribute adequate funds to the capital account unless rates are increased further. In FY 24, the Town was able to contribute about $50,000 to the capital account, so some funds are available to implement the recommended improvements.

A brief list of these recommended improvements by funding source will be listed below:

Operating Budget/Capital Improvements:
Several improvements were recommended in Section 7.3 for the distribution system and Control Building. The improvements over the next 0 to 5 years total about $28,500, and next 5 to 10 years total about $122,000, so can be prioritized and funded through the operating budget and capital account.

Short-Term Improvements:
The Route 9 waterline and sewer extension project is in permitting, with construction planned in 2025. This project is a short-term priority for the Town as it will add new water customers and create new residential and commercial growth. Water quality concerns have been identified in the early years due to the low demands and increased water age, so operational modifications were recommended and may need to be implemented to address these concerns. Additional information on these operational and structural measures considered is provided in the Memo included in Appendix S.

The Town continues to closely monitor the source capacity as utilizing the Haystack surface source will not be cost effective. By extending the new waterline east along Route 9 and 100, opportunities will become available for a new groundwater supply. The Town initiated a Groundwater Availability Study by Hoffer Consulting and continues to identify properties which could be used for a new water supply. Monitoring the source capacity and exploring possible sites to acquire for a new groundwater source will continue as a short-term priority for the Town.

Long-Term Improvements:
Waterlines were identified at five (5) locations that are original cast iron (1902) and are undersized, so should be considered as priorities for replacement over the next 5 to 10 years. The cost of these improvements can not be implemented through the capital account, so will require the use of State and other funding sources.

2. Introduction

2.1 Purpose

The Town of Wilmington retained Aldrich + Elliott, PC to prepare an asset management plan for their existing water system. The purpose of this project is to assess the water system and develop a list of needed improvements. Improvements will be characterized as capital, short term (0-5 years), long term (5-10 years), or future (10-20 years) system improvements.

2.2 Background

The Town of Wilmington is located in Windham County, Vermont, and the Water System (WSID #5310) serves a residential population of approximately 700 year-round residents and 700 seasonal residents through 263 service connections serving residential dwellings and businesses. The extents of the overall water system are shown in **Figure 1** of **Appendix A,** maps of the water system are provided in Appendix A. The Water System utilizes a number permitted supply sources to provide their users with drinking water.

All Vermont community water systems are required to operate under permit from the Agency of Natural Resources, Drinking Water and Groundwater Protection Division. The Permit to Operate (PTO) was issued on July 1, 2021 and does not have an expiration date, although it will be amended as deemed necessary over time. The system's permit to operate has been included in **Appendix B** of this report.

Systems are routinely inspected to ensure that they are operating in compliance with the Vermont Water Supply Rule (WSR) and the Federal Groundwater Rule. From the survey on November 7, 2019 there were no detected deficiencies identified and the Water System was determined to be in compliance with the rule and does not constitute a public health hazard or a significant public health risk. A copy of the system's sanitary survey can be found in **Appendix C.**

In 2020, the Town of Wilmington and the Wilmington Water District merged together and the Town of Wilmington took over the ownership and operations of the Wilmington Water System. A copy of the Wilmington Water District to Town of Wilmington Water System Plan of Merger Agreement can be found in **Appendix D**.

2.3 Scope of Asset Management Plan

The scope of this study is an asset management plan for the Town's water system, including the following tasks:

- Develop Level of Service Agreement
- Asset Inventory and Condition Assessment
- Prepare Water System Maps
- Risk and Life Cycle Cost Reduction Measures
- Develop and Evaluate Needed Improvements
- Develop and Asses Hydraulic Model
- Complete Life Cycle Cost Analysis
- Conduct Risk Assessment
- Develop Capital Plan
- Evaluate Funding Strategies
- Prepare an Asset Management Plan

2.4 Existing Ownership of System

Mailing Address:
2 East Main Street
PO Box 217
Wilmington, VT 05363

Physical Address:
2 East Main Street
PO Box 217
Wilmington, VT 05363

Contact Numbers:

Town Manager
Scott Tucker
(802) 464-8591 ext. 123
stucker@wilmingtonvt.us

Utility Manager
Christine Richter
(802) 464-8591
crichter@wilmingtonvt.us

Chief Water Operator
Chris Lavoy
(802) 258-7445
gmbinvt@yahoo.com

3. Description of Existing Facilities

3.1 Introduction

The Wilmington Water System serves a residential population of approximately 700 year-round residents and 700 seasonal residents through 263 service connections. The water system is supplied by groundwater under the influence of surface water (GWUDISW), and combines into a single raw water transmission main fed by gravity. This system has an 810,000-gallon concrete storage tank locate off of Ray Hill Reservoir (ST001). The water system is serviced by the storage tank, which maintain the hydraulic grade line for the majority of the water system. The permitted maximum day demand of the Town of Wilmington's Water System is 203,040 gallons per day (gpd) or 141 gallons per minute (gpd). A copy of the Permit-to-Operate can be found in **Appendix B**.

The water supply source consists of the following groundwater/surface sources:

- Nine (9) spring sources constructed in the fall of 2017. The sources have so far been determined to not be under the influence of surface water (non-GWUDISW), but as yet, no permitted yield has been established. The nine (9) permitted groundwater sources (non-GWUDISW) spring sources have a combined safe yield of 63 gallons per minute (gpm)
- Three (3) spring sources under the direct influence of surface water (GWUDI Springs 1, 2, 16) have a combined safe yield of 42 gpm
- Haystack Pond is currently connected to the system at a low-rate use of approximately 5 gpm for regulatory purposes. Previously, the water supply from Haystack Pond has not been required since a new storage tank was built and source improvements made in the early 1990's. Haystack Pond was previously approved with a safe yield of 70 gpm, however, this number is expected to be reduced after a yield for the additional spring sources is established.

During operation, water flows via gravity from the springs though a 4-inch cast iron and 6" PVC water transmission main a distance of approximately 3.4 miles to an 810,000-gallon concrete storage tank located off of Wilmington Heights Road. When the reservoir is full, excess flow from the sources is diverted via overflow piping to bypass the tank and avoid additional treatment costs.

At the storage tank, chlorine is added, the water passes through cartridge type pre-filters and 1 micron absolute (LT2 approved) final filters, soda ash is added, and the treated water enters the two bay 810,000-gallon storage tank.

From the storage reservoir, water flows via gravity into a distribution system that consists of 8-inch & 12-inch ductile iron pipes, and 4-inch and 6-inch cast iron pipes. The static pressure in the center of Town is approximately 100 psi.

3.2 Level of Service and Asset Management Team

A level of service agreement was developed for the Town of Wilmington's Water System which outlines external and internal goals for the following categories:

- Public Health & Safety
- System Maintenance
- Customer Service

Each goal and performance measure includes; target level, measurement period, and needed data. It is recommended that the Town review, assess, and update the level of service agreement on an annual basis. A copy of the level of service agreement is provided in **Appendix E,** and aspreadsheet detailing the Asset Management Team is provided in **Appendix F**. The Asset Management Team includes a list of the Town staff that will be involved in the continuation of the Asset Management Program, what their roles are, and what qualifications they possess.

3.3 Water System Maps

A+E created updated water system maps for the Town of Wilmington's Water System. Isolation valves and hydrants were located with a Trimble R10 GNSS GPS receiver. Where cellular service was available, the VT CORS system was used to provide real-time corrections during data collection, which provide an estimated precision of +/- 1 vertical foot. Where cellular service was lacking, satellite-based augmentation system (SBAS) signals were used for calibration, which provide an estimated precision of +/- 3 vertical feet.

Information gathered during field survey aided in developing updated water system maps, which spatially locate critical infrastructure including waterlines, valves and hydrants. Waterline sizes are noted on the maps, along with labels for hydrants, valves, springs, and overflows.

Town staff have access to PDF and paper copies of the water system maps. Data generated by the GPS survey is available to the Town and may be used to enter collected asset information into a Geographic Information System (GIS). The Town should regularly update system maps, or at a minimum every five (5) years. Copies of the water system maps are provided in **Appendix A**.

3.4 Asset Inventory & Condition Assessment

The objective of this asset management plan is to develop the inventory in a simple Excel spreadsheet format that can continue to be used and updated by the Town staff. The asset inventory includes all major components of the water system including; water supply, transmission main, treatment system, storage reservoir, distribution piping, valves, and hydrants. Any asset that costs less than $1,000 to replace will be considered non-critical and is not included in the asset inventory. Inventory and assessment of curb stops are not included in this phase of asset management.

Asset inventory and condition assessment spreadsheets for the following assets can be found in separate appendices:

- Equipment (**Appendix G**)
- Waterlines (**Appendix H**)
- Valves (**Appendix I**)
- Hydrants (**Appendix J**)
- Springs **(Appendix K)**

The typical format for the inventory of each type of asset by location includes; ID #, asset category, asset type, location, model, manufacturer, year of installation, expected useful life, replacement cost, condition (1-5), probability of failure (1-5), consequence of failure (1-5), redundancy (0-1), remaining useful life, estimated replacement cost, repair costs and notes. Numerical values are typically assigned with 1 (poor) and 5 (excellent). Notes reference recent repairs or maintenance performed. Photos are also used as supplemental information to represent the condition of an asset where needed.

A description of each water system component for the Town of Wilmington is provided in the following sections.

3.5 Water Source

Table 3.1 provides a summary of the Water Sources characteristics. As mentioned in the Section 3.1, the water system is supplied by twelve (12) springs, with nine (9) of the springs from groundwater and three (3) springs from groundwater under the direct influence of surface water. The water system for emergencies can be supplied by additional contributions from Haystack Pond, which is surface water. Haystack pond has not been regularly used since the 1990's after the construction of the storage tank.

Table 3.1
Source Summary

Source ID	Name	Type	Date of Install	Source Yield (gpm)	Authorized MDD Rate (gpd)
WL001	9 Springs (5,7,8,9,10,11,12,4/13,14/15)	Groundwater	2017	63	90,720
WL003	Spring 1	GWUDISW	1992	42	60,480
WL004	Spring 2	GWUDISW	1992		
WL005	Spring 16	GWUDISW	1992		
IN002	Haystack Pond	Surface Water	1990	100,800	100,800

Below in Table 3.2 is the water production during the past four years from 2019-2022. The Town divides the production into three categories of the water delivered to the Town, the water used to keep the storage tank full, and the treated water overflow that is produced but not needed to supply the Town.

Table 3.2
Water Production (2019-2022)

Year	Water to Town (gal)	Water to Reservoir (gal)	Water Overflow (gal)	Total Water Production (gal)
2019	28,693,750[1]	27,639,000	45,685,850	102,018,600
2020	28,346,700	28,516,500	36,189,600	93,052,800
2021	33,304,200	31,995,580	40,471,070	105,770,850
2022	30,216,925	29,155,600	25,089,460	84,461,985
Average	**30,140,394**	**29,326,670**	**36,858,955**	**96,326,059**

Note:
1. The meter for water going to the Town wasn't operational during July 2019 and December 2019.

In 2023, A+E completed a Water System Capacity Analysis as requested by the Town. Based upon the 2013 water system evaluation report prepared by SVE Associates, the Town doesn't currently utilize surface water (IN002) from Haystack Pond, other than bleeding roughly 5 gallons per minute (gpm) to ensure conveyance from Haystack Pond is functioning properly and to keep the source on the Town's permit-to-operate. Not utilizing Haystack Pond lowers the permitted Average Daily Demand (ADD) of the system to 75,600 gallons. This is below the average demand of 81,952 gpd reported for the last four calendar years. The current permitted Maximum Day Demand (MDD) of the springs is 151,200 gallons, so the 90% percentile for reporting purposes would be 136,000 gallons. The Town has not reached this capacity during the reported observed data period.

As indicated in the permit to operate, the Town utilizes nine additional groundwater spring sources TA1-TA9 that connect to the collection system for WL001. These groundwater sources supplement the yield of this source and increase the capacity of the system. As noted in the Permit to Operate, it is recommended that the Town determine the safe yield of these sources and apply for an amended Permit to operate.

At the design year, the current utilized and approved sources would not be able to meet the demands of the water system. As indicated in the study, the Town may need to consider utilizing Haystack Pond as a treatment source to meet these future demands or explore other sources which may require additional treatment. The initial recommendation is to determine a permitted yield for springs TA1-TA9 if not already completed, and determine what the available source yields are.

A copy of the 2023 Water System Capacity Analysis is provided in **Appendix L**.

3.6 Water Treatment

Prior to entering the water distribution system, raw water is treated with the following processes at the Control Building (TP001) a follows:

- Prior to filtration, the water system utilizes a sodium hypochlorite solution and positive displacement pump for disinfection.
- Filtration treatment via three (3) banks of membrane filter elements with progressively smaller pore sizes, including a bank of filter elements that contain membranes with a maximum pore size of 1 micron (absolute).
- Soda ash solution and positive displacement pump for pH adjustment for corrosion control treatment.
- Disinfection contact time is provided by the Water System's finished water storage tank (ST001).

3.7 Storage Tanks

Finished water is stored in one 810,100-gallon storage tank (ST001) with 2 cells, located off Ray Hill Road that was constructed in 1991.

Table 3.3
Storage Tank Characteristics

Tank	Installation Year	Total Storage Volume (gallons)	Tank Dimensions	Operating Level (1)	
				Minimum (ft)	Maximum (ft)
Storage Tank	1991	810,000	104' X 104'	1744.35	1758

Notes:
1. Vertical elevation datum NAVD88.

The concrete water storage tank was last inspected on November 9, 2020, by Liquid Engineering Corporation. The tank is divided into four different quadrants for its inspection report, which can be found in **Appendix M**. Some of the main observations from the inspection report are:

- The interior reservoir roof's general appearance is in good condition with some stains, efferences, settling creaking, exposed aggregate, and spalling.
- The interior reservoir walls general appearance is in good condition with no observed leaking and there are some with some stains, efferences, and settling creaking.
- The interior reservoir floor's general appearance is in good condition with no observed leaking and there are some stains and bug holes present.
- For the interior reservoir plumbing components there is a range of isolated rust (<0.01% of surface is rusted) to extensive rusting (<1% of surface is rusted).

Overall, the storage tank is in good condition with the settling cracks being the most visible discrepancy.

3.8 Booster Pump Stations

The Water System does not currently include any booster pump stations. All water flows by gravity from the permitted supply sources, through treatment, into the storage tank, and into the distribution system. Distribution system pressure is regulated and maintained by the water level in ST001.

3.9 Distribution

The water distribution network for the Town of Wilmington's water system is comprised of a combination of ductile iron, and cast-iron pipes, which range in size from 4" to 12" totaling approximately 47,480 feet/9.0 miles. In Table 3.4 below is the waterline inventory summarizing the approximate length for each pipe diameter size. The full waterline and valve inventory are included in **Appendix H and I**, respectively.

Table 3.4
Waterline Inventory

Pipe Diameter (in)	Approximate Length (ft)
4	14,770
6	16,105
8	7,515
12	9,390
Total	**47,780**

An updated water system map was developed by A+E for the Town of Wilmington's water system. A+E worked with the Town staff to GPS locate all critical infrastructure within the distribution system including; valve, springs, shut-off valves, overflow valves, hydrants, hydrant valves, wells, storage tank, and treatment building. Curb stops were not located with the GPS unit. The GPS information was utilized to develop the maps and inventory spreadsheets. A copy of the overall water system maps are provided in **Appendix A**.

3.10 Hydrants

There are 37 fire hydrants in the Wilmington Water System for fire protection. The Town has adopted both Kennedy and American Darlings as the standard fire hydrant manufacturer for the water distribution system. A detailed list of hydrants is provided in **Appendix J**.

3.11 Water Usage & Unaccounted Water

The Maximum Day Demand (MDD), according to the 2021 Permit-to-Operate (PTO), is approximately 203,040 gpd, which originates from the approved yield from a combination of ground water wells, groundwater under the direct influence of surface water (GWUDISW), and surface water and assumes the source is operated for 24 hours to meet the MDD.

Generally, there are two (2) types of unaccounted water:

1. Apparent water losses due to meter inaccuracy and water that is not properly accounted for such as hydrant flows.
2. Real losses, which are physical losses from the system such as leaks.

The American Water Works Association (AWWA) has set a goal of not more than 10% unaccounted for water within a system, but it is common for municipalities to be as high as 30%. Based upon provided billed water use and meter data at the reservoir for 2022, the Town has a total of 34.5% unaccounted water. Given the limited customers, age of the piping, and the length of piping in the distribution system, this number is expected. Recommendations to decrease this percentage include the replacement of aging watermains, leak detection, and replacement of meters for larger users.

3.12 Water Budget

The Town's Water Department budget is presented in Tables 3.5 and summarizes FY23 budget, and the FY22 proposed budget. A summary of the expenses and revenues is provided. The operating budget for the water system is included as **Appendix N**.

Table 3.5
Water Department Income

Income Type	Proposed Budget Income (FY23)	Actual Income (FY23)	Actual Percentage of Budget (FY23)
Operating Revenue	$353,045.00	$126,779.96	35.91%
Total Income	**$353,045.00**	**$126,779.96**	**35.91%**

Table 3.6
Water Department Expenses

Expense Type	Proposed Budget (FY23)	Actual Income (FY23)	Actual Percentage of Budget (FY23)
Labor	$(107,865.00)	$(44,378.63)	41.15%
Benefits	$(56,000.00)	$(21,298.56)	38.03%
Utilities	$(7,555.00)	$(3,129.27)	41.42%
Contract Services	$(7,200.00)	$(1,019.40)	14.16%
Operation & Maintenance	$(37,285.00	$(21,030.55)	56.40%
Advertising	$(100.00)	$(68.00)	68.00%
Bond Payment	$(87,040.00)	$(76,934.60)	88.39%
Capital Account	$(50,000.00)	$(0.00)	0.00%
Total Expenses	**$(266,005.00)**	**$(146,837.46)**	**55.20%**

Table 3.7
Water Department Financial Summary

Summary	Proposed Budget (FY23)	Actual Income (FY23)	Actual Percentage of Budget (FY23)
Total Income	$354,045.00	$126,779.96	35.91%
Total Expenses	$266,005.00	$(146,837.46)	55.20%
Profit	**$87,040.00**	**$(20,057.50)**	-

Table 3.7 summarizes income and expenses through nearly the first half of the 2023 fiscal year. With the information only covering a limited portion of the fiscal year, the Town had not received the second and third payments from its rate payers. The Water Department currently has $53,576 saved as capital reserve funds and is on track to have a balanced budget for FY23. A+E recommends the Town to continue to bolster its capital reserve fund to help with future maintenance and projects, and hold adequate capital required to fix watermain breaks, hydrant, valve, and equipment replacements on an as needed basis.

3.13 Water Rates

The Town of Wilmington has approximately 263 service connections. Residential customers are charged flat fees for the use of the Water System in addition to a usage fee. Residents are charged a flat fee $130 three times a year in September, January, and May, for a total of $390 for access and use of the Water System. There are separate flat fees for small non-profits, small commercial, large commercial, and sprinklers. Users are also charged $8.65 per 1,000 gallons of usage. Based on a typical residential family home using about 60,225 gallons per year, the home will be billed roughly $910 a year for water. A copy of the Town's water rates can be found in **Appendix O**. Compared to other comparable municipal water systems, utilizing the VT water and wastewater rates dashboard, the Town of Wilmington's rates are on the higher end of the State average. The dashboard consists of information tabulated by UNC and was last updated in 2021.

4. Basis of Design

4.1 General

Standards for the design of distribution systems are provided by the Vermont Water Supply Rule, latest addition. Specific guidance on the design, operation, and maintenance of water distribution systems, as they relate to fire protection and fire suppression activities, are provided in the American Water Works Association Manual M31, Distribution System Requirements for Fire Protection.

Criteria considered for this evaluation of the water system are discussed in Section 4.

4.2 Water Demands

Average Daily Demands

Average Daily Demand (ADD) is calculated by water systems to determine if system source and storage capacity are adequate to meet expected demands. Section 7 of the Water Supply Rule requires that, at a minimum, water systems have adequate storage volume for their ADD. However, for the Town of Wilmington, the storage volume must be sufficient to meet ADD and fire flow demands.

The meter data of water flowed from the storage tank to the Town from 2019 - 2022 indicate that the system's ADD is 82,577 gpd.

Table 4.1
Water Production (2019-2022)

Year	Water to Town (gal)	Water to Town (average gallons per day)
2019	28,693,750[1]	78,613
2020	28,346,700	77,662
2021	33,304,200	91,244
2022	30,216,925	82,786
Average	**30,140,394**	**82,577**

Note:
1. The meter for water going to the Town wasn't operational during July, 2019 and December, 2019.

Maximum Daily Demand

Maximum Day Demands (MDD) are calculated by water systems to determine the system's maximum capacity under stressed conditions. Water Supply Rule section 2.2 states "Source yields will be compared against the maximum demands of the system to determine the adequacy of the source(s) to meet the demand." The Town of Wilmington Water System's MDD according to the 2021 PTO is approximately 203,040 gpd.

4.3 Source Capacity

While the water sources are capable of producing the MDD rate of 252,000 gpd, the permitted capacity of the system is limited to 203,040 gpd, or 141 gpm, when operated for 24 hours to meet MDD, by the Water System's permitted treatment facility.

4.4 Distribution Design Requirements

Static System Pressure

To comply with the Water Supply Rule, "The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi."

Needed Fire Flow

In accordance with the WSR, "When fire protection is provided, the minimum requirement shall be 500 gpm at 20 psi residual pressure for a 2-hour duration for residential structures. If the Insurance Service Office (ISO) or other responsible agency (e.g., local fire department) recommends a higher flow rate than this minimum, the higher flow rate should be considered." ISO provides recommended Needed Fire Flows (NFF) for insurance rating purposes and bases these estimates on the amount of water needed to fight a fire in an individual, non-sprinklered building. ISO uses the needed fire flow to determine the adequacy of water supply and delivery systems.

Pipe Diameter and Material

For any new distribution system improvements, the minimum size of water mains shall be 8" diameter for waterlines that provide fire protection. The pressure pipe material shall depend on its application, and either be Polyvinyl Chloride (PVC) meeting AWWA C900, DR18 class 235, or cement-lined ductile iron, meeting all applicable ANSI/AWWA specifications, pressure class 350.

Valve Spacing

A sufficient number of valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves should be located at not more than 500-foot intervals in commercial districts and not more than one block or 800-foot intervals in other districts.

Hydrant Spacing

Fire hydrants should be provided at each street intersection and at intermediate points between intersections. Generally, hydrant spacing should range from 350 to 600 feet depending on the area being served.

4.5 Storage Volume Requirements

In accordance with the Water Supply Rule, water storage facilities shall have sufficient storage capacity to meet average daily domestic demands, and where fire protection is provided, fire flow demands. Further, Water Supply Rule Section 2.1 states that when a water system, expecting future growth reaches 90% of its current treatment or pumping capacity, it shall begin planning for the required additional capacity.

The needed minimum fire flow volume for the Town of Wilmington is assumed to be 180,000 gallons, which is equivalent to 1,500 gpm for a 2-hour duration. The Town of Wilmington's water system's ADD from 2019 - 2022 is 82,577 gpd. Storage for the ADD and the Available Fire Flow (1,500 gpm for 2 hours) is needed within the system. Provided below in Table 4.1 is an evaluation of the storage volume within the Town of Wilmington's water system, which is sufficient to meet existing needs.

Table 4.1
Storage Volume Evaluation

	Gallons
2019 - 2022 ADD	82,577
Minimum Fire Flow Storage (1,500 gpm @ 2 hours)	180,000
Required Storage	262,577
Available Storage	810,000
Minimum Necessary Storage to Meet WRS Required Pressures in the System	220,000
Excess Storage	547,423

The Minimum Necessary Storage to Meet WRS Required Pressures in the System was calculated using the hydraulic water model created in WaterCAD, which is discussed in further greater detail in Section 5.2.

4.6 Stand-by Power

The Water Supply Rule states, "Standby power may be required so that water may be treated and/or pumped to the distribution system during power outages. If not proposed as part of the project, the engineer shall provide reasons for not including standby power" (WSR 2.7). The only water process that requires standby power is at the Water Treatment Facility for properly treating the water to meet drinking water standards. The Town has a generator on-site for standby if the Water Treatment Facility loses power.

5. Water System Evaluation

5.1 General

The water system evaluation utilizes the asset management condition and risk assessment to consider deficiencies or needed improvements.

5.2 Hydraulic Model

A hydraulic model of the Wilmington Water distribution system was developed to aid in the evaluation, and this model was developed using Bentley, Inc. WaterCAD software.

A water system map using **Figure 1** of **Appendix A,** was created as part of this project and was used to develop a node map of the pipe network. Pipe materials and sizes were determined based on available record drawings of the system and institutional knowledge of the system. Elevations for the system were uploaded from GPS data collected in the field during the development of the water mapping.

Water usage data, provided by the Town was utilized in the water model. The WaterCAD model can be found in **Appendix P**. The water usage data was distributed around the system appropriately where there is more density versus less density within the system. Future growth or buildout conditions were not developed for the hydraulic model. If a new development occurs that requires significant water demands, the Town should evaluate the proposed development through the hydraulic model. As a minimum, the Town should update the hydraulic model within the next five (5) years to evaluate recent upgrades and changes in the water system infrastructure and operating conditions.

After developing a node map and inputting assumed water demands, the model was calibrated with hydrant flow data from the field using the Darwin Calibrator tool. The hydrant testing data taken in the field is presented in **Appendix Q**. The Darwin Calibrator tool uses iterative algorithms to adjust Hazen-William's roughness coefficients to find abest fit scenario. The computed best fit scenario was adjusted manually based on knowledge of the pipe network. The results of the Darwin Calibrator tool can be found in **Appendix P**.

The hydraulic model simulates a typical day within the distribution system, when the water storage tank is full and the springs and water sources are not operating. In other words, the hydraulic model computes a steady-state simulation. A steady-state simulation computes the state of the system (flows, pressures, operating conditions, etc.) assuming demands and conditions do not change with respect to time. The model results are theoretical and may vary from the real world. The model was not designed to model water quality or dynamic hydraulic conditions.

Simulations of the hydraulic model were run for the 2022 ADD of 82,786 gpd, 2022 MDD 203,040 gpd, and fire flow scenarios to assess if the system experienced low pressures under these scenarios.

5.3 Static System Pressure

Static system pressures were checked in the field by A+E during hydrant flow testing and verified in the hydraulic model. The static pressures collected in the field compared reasonably well with those calculated by the hydraulic model as seen in Table 5.1. Field measurements and all computed static pressures were all greater than the Water Supply Rules standards discussed in section 4.4. In Table 5.2 is the observed hydraulic grade of the hydrants that were flow tested compared to the simulated hydraulic grade from WaterCAD.

Static pressures within the distribution system ranged from a low of 45 psi at Hydrant RHR HYD-1 (Ray Hill Road) to a high of 110.7 psi at Hydrant WMS HYD-6 (West Main Street) from the hydrants that were tested. A full report of calculated static pressures throughout the Wilmington Water System can be found in **Appendix P**.

Table 5.1
Observed Static Pressures

Hydrant ID	Field Measured Static Pressure (psi)	WaterCAD Simulated Static Pressure (psi)	Difference (psi)	Percent Difference (%)
LHR HYD-2	64	61.9	-2.1	3.4
FVA HYD-2	87	88.2	1.2	1.4
EMS HYD-6	105	103.0	-2.0	1.9
WMS HYD-5	109	107.7	-1.7	1.2
EMS HYD-3	100	97.3	-2.7	2.8
CHS HYD-1	104	106.0	2.0	1.8
WMS HYD-2	115	109.4	-5.6	5.1
NMS HYD-2	100	99.9	0.1	0.1
FVA HYD-4	87	86.1	-0.9	1.0
CHR HYD-2	91	88.2	-2.8	3.2
WHD HYD-3	53	49.7	-3.3	6.6
RHR HYD-2	48	48.9	0.9	1.8

5.4 Fire Flow Demands

The calibrated system model was used to determine if the system was capable of providing fire flow demands required by the Water Supply Rule and discussed in Section 4.3.2. Fire flow demands were considered as additional demands to the average day demand of the system. The fire flow constraints were set to a minimum of 500 gpm for pipes with hydrants connected and the minimum residual pressure constraint was set to 20 psi per zone for all nodes and hydrants within the system. There are seven (7) active fire hydrants within the Town's water distribution system that do not provide a minimum of 500 gpm while maintaining a 20-psi residual pressure throughout the distribution system. There are twenty-three (23) hydrants that provide marginal fire flow capabilities (<1,000 gpm), and there are 9 hydrants that provide flow capabilities between 1,000 gpm and 1,500 gpm. The zero (0) hydrants that have fire flow capabilities of greater than 1,500 gpm.

The following hydrants cannot supply a minimum of 500 gpm while maintaining a 20-PSI residual pressure:

- WHL HYD-1 (388 gpm)
- SHS HYD-1 (394 gpm)
- LHR HYD-3 (190 gpm)
- WHD HYD-2 (200 gpm)
- WHD HYD-3 (105 gpm)
- NMS HYD-4 (348 gpm)
- CHS HYD-1 (455 gpm)

The following hydrants provide between 500 gpm and 1,000 gpm while maintaining a 20-PSI residual pressure:

- FVA HYD-4 (549 gpm)
- FVA HYD-5 (545 gpm)
- RHR HYD-1 (885 gpm)
- RHR HYD-2 (738 gpm)
- RHR HYD-3 (967 gpm)

The following hydrants provide between 1,000 gpm and 1,500 gpm while maintaining a 20-PSI residual pressure:

- LHR HYD-2 (1,041 gpm)
- LHR HYD-1 (1,237 gpm)
- CHR HYD-3 (1,471 gpm)
- CHR HYD-2 (1,472 gpm)
- WMS HYD-6 (1,472 gpm)
- FVA HYD-2 (1,472 gpm)
- CHR HYD-1 (1,472 gpm)
- SMS HYD-1 (1,472 gpm)
- BES HYD-1 (1,472 gpm)
- FVA HYD-1 (1,472 gpm)
- NMS HYD-2 (1,472 gpm)
- NMS HYD-3 (1,472 gpm)
- NMS HYD-1 (1,472 gpm)
- WMS HYD-3 (1,473 gpm)
- WMS HYD-4 (1,473 gpm)
- WMS HYD-2 (1,474 gpm)
- EMS HYD-4 (1,474 gpm)
- EMS HYD-2 (1,474 gpm)
- EMS HYD-5 (1,474 gpm)
- EMS HYD-6 (1,474 gpm)
- EMS HYD-1 (1,474 gpm)
- EMS HYD-3 (1,474 gpm)

There are eleven (11) hydrants that are currently served by 6” water mains or smaller. These hydrants are grandfathered by the WSR; however, under the WSR new construction would require a minimum 8” water main be provided to supply adequate fire protection.

The hydrant flow tests completed in the field were selected in order to provide a representative sample of hydrants within the distribution system at various locations and various conditions (pipe sizes, loops, dead-ends, etc.). As discussed, and shown in Table 5.1, there are very few discrepancies between the field and hydraulic model static pressures. As the hydraulic model only displays a snapshot, real time events could be impacting the residual pressure that are not accounted for in the hydraulic model.

Figure 4A in **Appendix A** provides a hydrant color coding scheme based on the American Water Works Association (AWWA) standards. The AWWA provides a standard color code for bonnets and caps that indicate the hydrants available flow at 20 psi.

Standard color codes are as follows:

- Less than 500 gpm - Red
- 500 – 999 gpm - Orange
- 1,000 – 1,499 gpm - Green
- 1,500 gpm and greater - Light Blue

The Town should consider developing a fire flow capacity code for painting hydrants. The adoption of a code is optional; however, it could be helpful for the local Fire Department and Town Staff to know a hydrant's flow capabilities. This can assist that the distribution system is not overstressed while operating hydrants and to ensure that system pressures above 20 psi are maintained.

5.5 Hydraulically Limited Watermains

Hazen-Williams roughness coefficients (C-Factors) were determined for each pipe segment during model calibration. C-Factor is a quantitative representation of a pipe's resistance to flow. A high C-Factor (130 or above) represents a relatively new or clean pipe; a low C-Factor (<90) represents a resistance to flow in the pipe. A low C-Factor may be caused by a partially closed valve, or by tuberculation within the pipe. C- Factors are analyzed to determine if any pipeline segments are thought to be hydraulically limited.

Calculated C-Factors were analyzed to determine if any waterlines of the system were believed to be hydraulically limited. The mainlines within the distribution system were installed post-1990 and are primarily ductile iron, the results of the hydraulic calibration provided C-factors at or slightly below 130, which would indicate a new pipe. This appears to be accurate based on the age and looping within the distribution system. The lowest calculated C-Factor in the calibrated system was 65 and these were assumed values for dead-end lines which could not be flow tested. This indicates that the water mains within the distribution system are providing minimal resistance to flow. The waterlines with the lowest calculated C-Factors were the older cast iron pipes all with pipe diameter 6" or smaller that are on side streets and are original from the early 1900's. This metric is not indicative of the structural integrity of the pipelines, only the roughness of the pipe's interior wall.

The existing water distribution system generally meets needed fire flow demands, and the majority of the water system is currently looped. Based on a visual evaluation of the water distribution system additional looping for existing dead-end mains is recommended for Beaver Street and Church Street and is later discussed in more detail in Section 6.6.

5.6 Hydraulic Model Conclusions

There are a few waterlines that the model indicated are hydraulically limited and may be experiencing reduced diameters because of tuberculation such as:

- Winter Haven Drive
- Whiteny Lane
- Shafter Street
- Fairview Ave (4" Section)

- North Main Street (4” Section)
- Ray Hill Road
- Lisle Hill Road

The water mains above are all less than 8” in diameter and are among the older lines in the system. Because of the water mains ages, size, and material (many are cast iron), the waterlines are more susceptible to tuberculation and therefore are hydraulically limited. None of these water mains listed above are major distribution mains or service signification portions of the system.

Lisle Hill Road has limited static pressure that can be provided by the storage tank. This area formerly had a booster pump station to increase pressures for users in this area. This booster pump station has been abandoned, and residents now increase pressures from within their homes. The static pressure at the top of Lisle Hill Road is able to provide 48 psi to the users, therefore, there aren’t any necessary changes for domestic flow to the residents that live on Lisle Hill Road.

Aldrich + Elliott will keep a copy of the Town of Wilmington’s Water System’s hydraulic model on private servers until, at least, 2028. If the Town would like access to the model, it will be provided at no additional charge. If the Town would like Aldrich + Elliott to modify the model to assess possible alternatives, a fee may be incurred.

5.7 Valve and Hydrant Spacing

The water system was evaluated to determine if valves and hydrants are sufficiently provided to meet Water Supply Rule recommendations. Based on our analysis, there are eight (8) areas where the valves are over the recommended 800 feet spacing. Improvements at these locations would be recommended if the Town were to replace these waterlines in the future. Existing valving has been adequate for Town needs, so cutting in new valves is not recommended at this time.

The locations of where additional valves could be considered include between:

- There are no valves on the transmission main from the wells to until the storage tank, which is roughly 11,875 feet long. Additional valving could be utilized in the event of a break requiring repair.
- There is no valve along the 12” transmission main between the Ray Hill Reservoir and the intersection with Ray Hill Road between TM WMH-1 and TM GV-1, which is roughly 1,715 feet long.
- There is no valve on the 12” transmission main before Main Street between TM GV-1 and WMS GV-9, which is roughly 1,605 feet long.
- There is no mainline valve along the 6-inch water main on Ray Rill Road between RHR GV-1 and RHR GV-5, which is roughly 1,740 feet long.
- There is no mainline valve along the 4-inch water main along Winter Haven Drive, which is roughly 1,600 feet long.
- There is no mainline valve along the water main along North Main Street after NMS GV-4, which is approximately 1,915 feet long.
- There is no mainline valve along the 8-inch water main on West Main Street between WMS GV-14 and WMS GV-11, which is approximately 1,255 feet long.

- There is no mainline valve along the dead-end section of Fairview Avenue after FVA GV-6, which is approximately 915 feet.

Out of the eight (8) areas where the mainline valves are over the recommended 800 feet spacing, there is only one (1) area of concern where the Town should review and possibly add mainline gate valves. The 11,875 feet long distance along the transmission is an extremely long distance without any gate valves. If a break occurred along the transmission main, additional valving would allow an area to be isolated for repair. When the older sections (early 1900's) of the transmission main are replaced that mainline gate valves should be installed at regular intervals.

The existing hydrants are well spaced and provide adequate coverage for the water distribution system. There are twelve (12) hydrants that are served off of water mains that are smaller than 8-inches in diameter. The recommendation would be to maintain these hydrants to ensure operation, and consider replacement when the waterline can be concurrently upgraded.

5.8 Age Related Deficiencies

As discussed previously in Section 3, supply, treatment, and storage assets were evaluated based on their condition, age and remaining useful life. In most cases asset conditions were rated on a scale of 1 (Excellent) to 5 (Deficient), with the exception of hydrants which were rated on a scale of 1 (Good) to 3 (Needs Replacement). A complete asset condition rating can be found in the **Appendix G**.

Generally the supply, treatment and storage assets are in good conditions for continued use. The entirety of the treatment equipment was replaced in the last large upgrade project during 2016. The reservoir and associated storage piping was constructed in 1992. There are limited needs for the treatment and storage assets.

Presented below are assets which are recommended to be replaced within the next five year period. Replacement of this process and distribution equipment will allow for better operation and improved reliability of the system.

<u>Control Building Equipment</u>

- Automated Influent Control Valve
- Tank Level Sensor (1)
- Influent Turbidity Sensor

<u>Distribution Equipment</u>

- Metal Detector
- Water Line Tracer
- Operator Computer

Presented below are assets which are deemed to be in fair condition, but given their expected useful life, replacement should be considered as a possibility within the next 5-10 years.

Control Building Equipment

- Circuit Breaker
- Chlorine Pumps and Meters
- Soda Ash Pump and Meter
- Soda Ash Mixer
- Unit Heater and Exhaust
- Flow Meters
- Chlorine and pH Analyzer
- Filters

Distribution Equipment

- Water System Storage Garage (Structure)

The remainder of the treatment equipment will likely last 10+ years. However, given that the age of the remainder of this equipment is

The equipment that is considered in poor condition (<5 years) should be included in the capital improvements budget or could use other funding sources for the next 5 years. The equipment that deemed in fair condition is included as part of short-term planning (5 to 10 years). The equipment that is deemed in good condition with expected replacement needed is included as long-term planning (10 to 20 years).

5.9 Risk Related Assets

Assets were also evaluated based on their risk which is a function of the probability of failure, consequence of failure and redundancy factor. Risk ratings vary on a scale of 0 (Low) to 25 (High). A complete asset risk rating can be found in the appendices. Presented below are assets which are deemed to be high risk (a score greater than 10 points). It is these items that should be given priority for repairs as these components are critical for the continued operation of the distribution system. A failure of these components can be prevented by replacing or repairing these components before the end of their expected life spans.

Equipment (Control Building)

There were no risk ratings that exceeded a score of 10 points. The majority of equipment allows for process control, with many treatment elements including redundant elements or available spare parts. Furthermore, equipment is generally in good condition having been replaced in 2016. As equipment ages the expected risk rating will continue to increase. The filter and disinfection equipment as well as process control equipment (tank level sensors, meters, and turbidity sensors) will likely be the first assets to receive “high risk” ratings.

Exposed Stream Crossings:

There are three (3) elevated stream crossings along the transmission main, of which two were rebuilt in the 1990’s and the third was reconstructed in November of 2012. In general, the stream crossings have performed well, but the exposed line has a greater chance of future damage due to the steam washouts, damage from the falling trees, or freezing if the water flow is ever blocked and allowed to back up into the crossings in the winter.

6.0 Development of Improvements

6.1 General

This section will evaluate operational improvements that the Town are currently utilizing and recommend improvements to improve the reliability and life expectancy of assets. Assets that require replacement or improvements are summarized by location.

6.2 Operational Improvements & Recommendations

Normal Operation

Certain tasks are completed on a routine basis in order to ensure adequate operation of the Town of Wilmington Water System. These tasks can be defined as follows:

- Daily
- Routine
- Quarterly
- Semi-Annually
- Annually
- Less than Annual Frequency

A copy and description of the normal operation can be found in the Section IV of the "Operations & Maintenance Manual – Town of Wilmington Water System", which was approved by the Secretary on March 14, 2019. A copy of the O&M manual can be found in **Appendix R**.

Maintenance Schedules

In addition to the information presented in the O&M Manual, the following items are recommended:

- Asset Management Program – Update (Annually)
- Capital Improvements Plan – Update (Annually)
- Water System Maps – Update (Every 5 years or following significant upgrades)
- Water Audit Spreadsheet – Update (Quarterly)

Records & Documentation

In order to document repairs to assets and accurately track expenditures, it is recommended that the Town utilize the following forms to document and track assets repairs and costs:

- Water Break Form
- Life Cycle Cost Spreadsheet
- Equipment Repair Sheets

The Town should implement a filing process to ensure that information recorded is accurate, useful and accessible. This information will aide in future planning and budget preparation. A customer compliant form is also included with the asset documentation forms.

6.3 Water Sources and Distribution System

In the Wilmington Water System there are twelve springs wells and a surface water source that provide water to the Town. Nine (9) of the springs were recently built in 2017 and the other three (3) springs were built in 1990. Hatches and structures have been maintained and there are limited needs at these sources. Regular maintenance needs should be continued to be budgeted, but no significant assets are itemized for replacement.

The distribution system requires equipment and tools for continued operation and use. The majority of spare parts and tools are located at the water department building on Church Street. Generally, these parts and needed tools are purchased out of the yearly operational budget. A number of larger purchases are itemized below to allow for future planning.

Pressure deficiencies in the Ray Hill service area were identified by the hydraulic model. Further study of this area is recommended to establish existing conditions and make recommendations. A line item is carried for engineering assistance to develop this project.

The recommended distribution assets that should be purchased within the next five years are shown in Table 6.1.

Table 6.1
Distribution Improvements (0-5 Years)

Asset	Need	Remaining Useful Life (Years)	Estimated Replacement Cost (dollars)
Metal Detector	Aged equipment past service life.	<1	$2,000
Waterline Locator	Aged equipment past service life.	<1	$3,000
Operator Computer	Critical to access remote data and operate system.	2	$1,000
Ray Hill Evaluation	Deficient pressures indicated on model.	2	$10,000
		Total	**$16,000**

The water department building on Church Street is not currently insulated, and limited space is available at the control building (located at the reservoirs). This presents challenges for repairs and the space to work on projects during the winter months. Currently, operational staff relies on non-Town owned space when additional heated space is required. The garage will still require upkeep to maintain the space as is, but a line item is carried to insulate the space and allow for additional functionality.

Table 6.2
Distribution Improvements (5-10 Years)

Asset	Need	Remaining Useful Life (Years)	Estimated Replacement Cost (dollars)
Garage	Uninsulated.	5	$75,000
		Total	**$75,000**

6.4 Control Building

The Control Building was constructed in 1991 along with other water system improvements. In 2016, an upgrade project was completed that resulted in a building addition as well as the replacement of the majority of the treatment equipment. Provided in Table 6.3 is a summary of age related and risk related deficiencies, including estimated replacement costs. Replacement costs only include the cost of the asset and does not include labor or other materials for installation. For a detailed summary of the Control Building asset inventory, condition, risk and replacement costs refer to **Appendix G**.

Table 6.3
Control Building Improvements (0-5 Years)

Asset	Need	Remaining Useful Life (Years)	Estimated Replacement Cost (dollars)
Automated Control Valve	Not functioning.	0	$7,500
Influent Turbidity Sensor	Challenging to operate, can't interface with automated valve.	1	$2,500
Tank Level Sensor	Located to close to wall, relocation/replacement recommended.	1	$2,500
		Total	**$12,500**

A large portion of the treatment equipment was installed in 2016. Thus, within the 5–10-year window some of this equipment will exceed its expected useful life and require replacement. As the replacement of this equipment will be a significant cost to budget for, items expected to exceed their useful life are tabulated below in Table 6.4 to allow for planning purposes.

Table 6.4
Control Building Improvements (5-10 Years)

Asset	Need	Remaining Useful Life (Years)	Estimated Replacement Cost (dollars)
Circuit Breaker	Original, aged.	5	$5,000
Filters	Overall, of filters and process piping expected. (In addition to regular cartridge replacement).	8	$22,500
Chlorine Pumps and Meters	Expected end of useful life.	8	$4,000
Soda Ash Pumps and Meters	Expected end of useful life.	8	$4,000
Soda Ash Mixer and Tank	Expected end of useful life.	8	$3,500
Unit Heater and Exhaust	Corrosion expected given proximity to chemicals.	8	$3,000
Flow Meters	Expected end of useful life.	8	$3,000
Chlorine and pH Analyzer	Expected end of useful life.	8	$2,000
		Total	**$47,000**

6.5 Storage Tanks

The water system's storage tank (ST001) called the Ray Hill Reservoir is a concrete storage tank that was built in 1991. The storage tank was recently inspected in 2020, and appear to be in good condition. A copy of the inspection report can be found in **Appendix M**. As the inspection was completed in 2020, it is recommended that the Town complete an inspection in the fall of 2025 to maintain a five-year inspection cycle.

6.6 Waterlines

The majority of the distribution system was constructed original from the early 1900's or from the mid 1990's. Piping serving the town from the storage tanks is primarily ductile iron and some cast iron. The expected lifespan of piping of this material is 100 years. This means a vast section of system, which was replaced in the 1990's, will likely be able to serve the Town until 2090 with regular maintenance and repair.

Provided in Table 6.5 is a summary of distribution piping that was identified to carry a higher risk of failure. For a detailed summary of the waterline asset inventory, condition, risk and replacement costs refer to **Appendix H**. The waterlines below are not critical to system as a whole, but have surpassed their expected useful life. Waterlines assume replacement in-kind with size. These areas would likely be upsized if constructed. Specific identified projects are summarized in Section 7.

Table 6.5
Waterline Improvements

Waterline ID	Location	Reason	Existing Diameter (in.)	Material	Approx. Length (ft.)	Est. Replacement Cost
FVA-4-1902	Fairview Ave.	Age/ Undersized	4	CI	150	$41,250
CHR-4-1902	Castle Hill Rd.	Age/ Undersized	4	CI	530	$145,750
NMS-4-1902	North Main St.	Age/ Undersized	4	CI	720	$198,000
LHR-4-1902	Lisle Hill Rd.	Age/ Undersized	4	CI	710	$195,250
WHD-4-1902	Winter Haven Dr.	Age/ Undersized	4	CI	1600	$440,000

There have been five (5) water main breaks noted since the water main upgrade project in the mid 1990’s:

- Near the end of the waterline of the 4-inch cast-iron pipe on North Main Street.
- Along the 4-inch cast-iron pipe on Winer Haven Drive.
- Three (3) leaks on Fairview Avenue, but those area of water main breaks have all been replaced during the 2019 project on Fairview Avenue.

Provided in Table 6.6 is a list of waterlines that should be monitored by the Town. All of the waterlines are now more than 120 years old and are original to the distribution system. A large portion of these waterlines serve a few households and are not critical to the system’s functionality. However, it will be important to monitor these waterlines as eventually it will be more cost-effective to replace the waterlines than fixing breaks multiple times.

There are three (3) waterlines that are listed below in Table 6.6 that are more critical to monitor than the other nine (9) waterlines. The three (3) cross country transmission mains listed below are part of the over three (3) mile transmission main from the springs to the water storage tank. In 2012, some of the original transmission was examined while a stream abutment was being repaired. This allowed for a visual inspection of a section of the 4-inch cast iron watermain. The visual inspection of the 4-inch cast iron transmission main did show only some internal and external corrosion present. Overall, the watermain was in good condition, especially for being installed around 1902. If conditions of the transmission main have deteriorated more significantly over the past ten years, then it will become more critical to replace those sections of transmission main. In the past 10 years there have been no indications of further or accelerated deterioration of the transmission main, but the Town should continue to closely monitor this section of piping given its critical nature.

Table 6.6
Waterlines To Be Monitored

Waterline ID	Location	Reason	Existing Diameter (in.)	Approx. Length (ft.)	Est. Replacement Cost
CCL-4-1902 (Wooded)	Cross Country - Wooded	Age/Risk	4	4,730	$1,064,250
CCL-4-1902 (Steep/Remote Sections)	Cross Country – Steep/Remote Sections	Age/Risk	4	3,350	$806,625
CCL-6-1902	Cross Country – Haystack Pond to Springs	Age/Risk	6	2,260	$565,000
CHR-4-1902	Castle Hill Road	Age	4	530	$145,750
CHS-4-1902	Church Street	Age	4	415	$114,125
FVA-4-1902	Fairview Avenue	Age	4	150	$41,250
LHR-4-1902	Lisle Hill Road	Age	4	710	$195,250
NMS-4-1902	North Main Street	Age	4	720	$198,000
RHR-4-1902	Ray Hill Road	Age	4	2,925	$809,875
SHS-4-1902	Shafter Street	Age	4	510	$140,250
WHD-4-1902	Winter Haven Drive	Age	4	1,600	$440,000
WHL-4-1950	Whiteny Lane	Age	4	750	$206,250

Provided in Table 6.7 is a list of waterlines that are currently undersized. When these waterlines do get eventually replaced it will be important to upsize the watermains to at least 8” to properly comply with WSR requirements for fire protection.

Table 6.7
Undersized Waterlines for Fire Protection

Waterline ID	Location	Existing Diameter (in.)	Approx. Length (ft.)	Est. Replacement Cost
CHR-4-1902	Castle Hill Road	4	530	$145,750
CHS-4-1902	Church Street	4	415	$114,125
FVA-4-1902	Fairview Avenue	4	150	$41,250
LHR-4-1902	Lisle Hill Road	4	710	$195,250
NMS-4-1902	North Main Street	4	720	$198,000
RHR-6-1902	Ray Hill Road	6	2,925	$809,875
SHS-4-1902	Shafter Street	4	510	$140,250
WHD-4-1902	Winter Haven Drive	4	1,600	$440,000
WHL-4-1950	Whiteny Lane	4	750	$206,250

Provided in Table 6.8 is a waterline installation that A+E suggests to be further investigated to improve hydraulic looping of the system. There currently isn’t a waterline connecting the waterlines down Church Street and Beaver Street, but making a connection would improve the hydraulic conditions of the system. Both Beaver Street and Church Street waterlines are dead ends and by making the connection to South Main Street would create a hydraulic loop that would significantly improve flow within the system and the risk associated if there is a break with dead-end lines.

Table 6.8
Waterlines Recommended to Increase Looping of System

Location	Reason	Approx. Length (ft.)	Est. Installation Cost
Connecting Beaver Street to Church Street and South Main Street	Hydraulic Improvement	900	$247,500

The majority of the distribution system is served by 8" DI piping. Thus, fire flow demands are able to be met via the supply from the storage tanks. However, as the water system is serviced from the single distribution pipe there is not much redundancy in the event of a pipe failure. Future projects considering expansion of the system should take this lack of redundancy into consideration during design.

It is recommended that the town take advantage of leak detection surveys conducted by either Vermont Rural Water Association or DWGWPD to identify leaks in the distribution system before they cause a significant loss of water.

6.7 Valves

Valves within the distribution system appear to be in adequate condition and present limited risk. As part of the water distribution system improvements beginning in the mid 1990's, valve clusters have been installed at major waterline junctions which allows for improved operation and functionality during repairs or outages. Per the Town of Wilmington O&M Manual, it is recommended that valves be operated at least once a year, and that notes be provided to document the operating condition.

Provided in Table 6.9 is a summary of age related and risk related deficiencies, including projected replacement costs. Replacement costs include the cost of the asset, labor and other materials. For a detailed summary of the valve asset inventory, condition, risk and replacement costs refer to **Appendix I**.

Table 6.8
Valve Improvements

Valve ID	Location	Reason	Estimated Replacement Cost
RHR GV-1	Ray Hill Road	Age	$5,500
RHR GV-5		Age	$5,500
RHR GV-6		Age	$5,500
RHR GV-7		Age	$5,500
RES GV-1	Reservoir (Haystack Pond)	Age	$5,000
RES GV-2		Age	$5,000
RES GV-3		Age	$5,000
WHL GV-1	Whitney Lane	Age	$5,000

There are not any mainline transmission or critical water distribution valves that need to be replaced due to a large effort to replace water mains in 1990's. The valves on Ray Hill Road and Whitney Lane are all past their expected useful life, but are not as critical for system functionality. Depending on the functionality of the valving on Ray Hill Road and Whitney Lane, the recommendation would be to wait until those waterlines are replaced to replace the valves. Valves are also expected to be original at Haystack Pond. Haystack Pond is currently not used a primary water source for the system, but is still allowed to be a source based off of the Town's PTO. If further utilized, improvements to valving should be considered.

As discussed in Section 5.7, the addition of valves to the transmission main between the springs and the storage tank is something the Town should investigate spending some capital to install. Installing new valves along the transmission main will allow the Town to isolate the transmission main into smaller sections if there is a break.

6.8 Hydrants

The vast majority of hydrants within the Town of Wilmington Water System have been installed in the mid-1990s or more recently as the Town slowly upgrades the system. At this time, there are fifteen (15) fire hydrants recommended for replacement within the next 5 to 10 years. Ten (10) of the fifteen (15) watermains are not located off of 8-inch water mains. The Town should monitor the hydrant operating conditions when completing their bi-annual flushing program and make repairs as needed.

There are five (5) hydrants within the water system that are now past their 40-year useful life expectancy or have known issues and should be planned to be replaced. These hydrants are:

- WMS HYD-2 (West Main St)
- LHR HYD-1 (Lisle Hill Rd)
- LHR HYD-2 (Lisle Hill Rd)
- EMS HYD-4 (East Main Street)

- EMS HYD-6 (East Main St)
- EMS HYD-7 (East Main St)

For a detailed summary of the hydrant asset inventory, condition, risk and replacement costs refer to **Appendix J.**

There are ten (10) hydrants within the water system that are now past their 40-year useful life expectancy. However, these hydrants are located on small diameter lines. These hydrants are:

- CHS HYD-1 (Church St)
- NMS HYD-4 (North Main St)
- RHR HYD-1 (Ray Hill Rd)
- RHR HYD-2 (Ray Hill Rd)
- RHR HYD-3 (Ray Hill Rd)
- SHS HYD-1 (Shafter St)
- WHD HYD-1 (Winter Haven Dr)
- WHD HYD-2 (Winter Haven Dr)
- WHD HYD-3 (Winter Haven Dr)
- WHL HYD-1 (Whitney Ln)

Also, for consideration for the Town would be to implement a bonnet or cap color coding for fire hydrants based on available fire flow as presented in **Figure 4A** in **Appendix A**. This information would be helpful to the fire department and the Wilmington Water System during flushing operations.

6.9 Water Meters

The Town has approximately a total of 263 water service connections. The water service connections are metered and each user pays a tri annual fee in addition to a usage fee. The water meters were installed in the mid-1990s and are reaching the end of their expected useful life. Replacement should be considered in addition to an upgrade to modernized units. Modern meters allow for readings to be conducted in an expediated manner, decreasing needed operator time. If the Town begins the process of meter replacement, it is recommended that the meters for the larger users be replaced first.

7.0 Implementation Schedule & Recommendations

7.1 General

Based on the needs identified through the previous sections and improvements outlined in Section 6, the following implementation schedule is recommended for the Town of Wilmington's Water System and funding options. The implementation schedule is broken into phases as described below:

- Capital Improvements – Repairs, replacements or upgrades that are completed through funds in the capital reserve fund.
- Short Term Improvements – Improvements that address the most significant system deficiencies in the next 0-5 years.
- Long Term Improvements – Improvements that offer additional hydraulic benefits to the distribution system beyond significant system deficiencies in the next 5-10 years.
- Future Planning – Improvements that have been noted for the Owner to monitor and consider over the next 10+ years.

7.2 Water Rates

The Town has approximately 263 water service connections. The water service connections are not metered and a single family home pays a yearly fee of $390 for water service, which is broken down into three payments of $130 during the year, plus a usage charge.

The Town recently took over the water system through a merger so the annual operating budget is not adequately funded to implement significant work through their capital budget. Financial documents sent by the Utility department indicate that they will be operating a balanced budget, but are not able to put significant funds aside for future work. A significant portion of the expenses are bond payments at about $76,845 per year. The Utility department did suggest to the Selectboard to increase the "Water Unit Fee". For FY 24, approximately $50,000 was placed into the capital account, but this varies by year. It is suggested to begin to increase contributions to the capital account for just water capital improvements. For more in-depth details on the current budget refer to Section 3.12 for a summary of the Water Department operating budgets.

At this time, a rate adjustment is recommended to enable increased contributions to the Town's capital fund. However, the water costs for the existing customers are already high, making it difficult to raise rates until some of the debt retirement is paid off. If the Selectboard approves the rate adjustment, the Town should monitor their budget and adjust their rates to ensure adequate contributions to their capital fund.

7.3 Capital Improvements

The Water Department budget for capital projects will continue to be limited, but several items were identified that can be addressed over the next 0 to 10 years. In Tables 7.1 and 7.2 below, several items were identified for the distribution system and Control Building over the next 0 to 5 years, totaling about $28,500. Implementing these improvements should be manageable within the current capital account, spread over the 5 years by priority.

Table 7.1
Distribution Improvements (0-5 Years)

Asset	Need	Estimated Replacement Cost (dollars)
Metal Detector	Aged equipment past service life.	$2,000
Waterline Locator	Aged equipment past service life.	$3,000
Operator Computer	Critical to access remote data and operate system.	$1,000
Ray Hill Evaluation	Deficient pressures indicated on model.	$10,000
	Total	**$16,000**

Table 7.2
Control Building Improvements (0-5 Years)

Asset	Need	Estimated Replacement Cost (dollars)
Automated Control Valve	Not functioning.	$7,500
Influent Turbidity Sensor	Challenging to operate, can't interface with automated valve.	$2,500
Tank Level Sensor	Located to close to wall, relocation/replacement recommended.	$2,500
	Total	**$12,500**

Several improvements items were identified for the distribution system and Control Building over the next 5 to 10 years and are listed in Tables 7.3 and 7.4 below, totaling about $122,000.

Table 7.3
Distribution Improvements (5-10 Years)

Asset	Need	Estimated Replacement Cost (dollars)
Garage	Uninsulated.	$75,000
	Total	**$75,000**

Table 7.4
Control Building Improvements (5-10 Years)

Asset	Need	Estimated Replacement Cost (dollars)
Circuit Breaker	Original, aged.	$5,000
Filters	Overall, of filters and process piping expected. (In addition to regular cartridge replacement).	$22,500
Chlorine Pumps and Meters	Expected end of useful life.	$4,000
Soda Ash Pumps and Meters	Expected end of useful life.	$4,000
Soda Ash Mixer and Tank	Expected end of useful life.	$3,500
Unit Heater and Exhaust	Corrosion expected given proximity to chemicals.	$3,000
Flow Meters	Expected end of useful life.	$3,000
Chlorine and pH Analyzer	Expected end of useful life.	$2,000
	Total	**$47,000**

7.4 Short-Term Planning

For short-term planning over the next 0 to 5 years, the Town has the Route 9 waterline and sewer extension project in design and permitting, scheduled to go to construction in 2025. A bond vote has been conducted and the Town has secured the necessary funding. Expansion of the water service area west along Route 9 and 100 will increase the number of water customers and revenue, while promoting residential and commercial growth in this service area.

Concerns have been raised about the water quality and maintaining a chlorine residual in the early years as this project consists of a long dead end waterline. Until customers connect, there may be limited demands requiring more frequent flushing and other operational modifications to reduce water age. Alternatives were discussed with the Town and are summarized in the Memo in Appendix S. This situation will need to be monitored once the new waterline is placed into service and has been identified as a short-term priority. The operator has been performing additional sampling for the chlorine residual and the DWGPD has concurred with operating the storage tank with one cell if needed to reduce the water age.

With the extension of the waterline and other new development, there have been questions raised about the available water source capacity. Even though the Permit to Operate shows sufficient water source capacity, use of the Haystack Pond surface water would require treatment improvements at a significant capital and operation and maintenance costs. The Town continues to closely monitor the available source capacity, and with the planned waterline extension along Route 9, opportunities are opened up for exploration of a new groundwater source. The Town initiated a study of groundwater availability by Hoffer Consulting Inc. and several potential well sites were identified. A copy of this report is provided in Appendix T.

7.5 Long-Term Planning

As the Town is able to free up some of the debt retirement, the following long-term improvements should be considered in the next 5-10 years, or more. These waterline segments were prioritized because they carry a higher risk of failure due to the age, pipe material, and are also undersized.

Fairview Avenue (FVA-4-1902)
The total length of the waterline on Fairview Avenue is approximately 150', which means replacement would not require a Permit-to-Construct. This waterline is an original 4" cast iron pipe that was installed in 1902. Replacement due to age and an increase in pipe size is recommended. The estimated construction cost for replacement with a larger pipe size is approximately $41,250.

Castle Hill Road (CHR-4-1902)
The total length of this section of waterline on Castle Hill Road is approximately 530', which means replacement would require a Permit-to-Construct. The waterline is an original 4" cast iron pipe that was installed in 1902. Replacement due to age and an increase in pipe size is recommended. The estimated construction for replacement with a larger pipe size is approximately $145,750.

North Main Street (NMS-4-1902)
The total length of this section of waterline on North Main Street is approximately 720', which means replacement would require a Permit-to-Construct. The waterline is an original 4" cast iron pipe that was installed in 1902. Replacement due to age and an increase in pipe size is recommended. The estimated construction for replacement with a larger pipe size is approximately $198,000.

Lisle Hill Road (LRH-4-1902)
The total length of this section of waterline on Lisle Hill Road is approximately 710', which means replacement would require a Permit-to-Construct. The waterline is an original 4" cast iron pipe that was installed in 1902. Replacement due to age and an increase in pipe size is recommended. The estimated construction for replacement with a larger pipe size is approximately $195,250.

Winter Haven Drive (WHD-4-1902)
The total length of this section of waterline on Winter Haven Drive is approximately 1,600', which means replacement would require a Permit-to-Construct. The waterline is an original 4" cast iron pipe that was installed in 1902. Replacement due to age and an increase in pipe size is

recommended. The estimated construction for replacement with a larger pipe size is approximately $440,000.

Some of these waterlines identified above could be combined into a larger project as these waterlines are connected and within close proximity. If the Town chooses to pursue funding from the Drinking Water State Revolving Fund (DWSRF) a preliminary engineering report would need to be completed for each project(s).

7.6 Future Planning

In addition to the other recommended improvements, several waterlines were identified for monitoring and a list is provided in Table 6.6. The critical waterlines are the original transmission mains which run cross country and convey the spring water to the storage tank.

7.7 Funding Options

The following funding options would be recommended for larger projects which the Town cannot fund through operating budgets or capital reserves. These funding sources would require voter approval.

Drinking Water State Revolving Fund (DWSRF)

The State of Vermont offers low interest loans for planning, design, and construction of drinking water infrastructure improvements through the Drinking Water State Revolving Fund (DWSRF) loan program. The DWSRF program provides loans with interest rates ranging from 0% and 3% for a term of 20 to 30 years, depending on the projected median household income (MHI) and the projected user cost criteria. The DWSRF also offer loan subsidies to assist communities with funding projects and maintaining reasonable user rates. Loan subsidies can reach up to 40%. The funding schedule depends on the individual project's priority ranking in comparison with other projects.

USDA Rural Development – Water & Waste Disposal Loan/Grants

The USDA RD – Water & Waste Disposal program includes both grants and loans, depending on the project and the community's ability to pay. USDA RD eligibility is determined based on the system's water rates, and the community's median household income (MHI). For a community to be eligible for a grant/loan combination the annual water rates must be greater than or equal to $450/user. The amount of grant a community would be eligible for once that criterion is met would be based on the community's MHI. The current market rates through Rural Development are 3.125% and loan terms can extend to 40 years.

Any funding disbursed through the USDA RD, requires that the water system either have, or plan to install, individual water meters. An additional condition of the USDA RD program is that pipe material must be bid thru competitive process, which essentially limits pipeline material options to PVC.