COMPREHENSIVE ASSET MANAGEMENT PLAN (AM-77 AND AM-111)

AUGUST 2022

Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

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Letter of Transmittal

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Introduction

The Hooksett Village Water Precinct (HVWP) has taken a multi-faceted approach with respect to asset management, which is an approach to operating and maintaining a water system cost effectively while maintaining a certain level of services that is acceptable to customers and other stakeholders, and is sustainable over the long term. This approach helps decision makers plan for the care of aging assets. Founded in 1941, the HVWP follows this approach to ensure that the residents get the most value from their water system assets and have the necessary resources to rehabilitate and replace those assets. Public outreach is a critical component of their approach to asset management.

HVWP's Comprehensive Asset Management Plan began with ad hoc efforts to promote asset management in prior years. Efforts have included locating and operating assets; interviewing former HVWP staff; developing a preliminary Capital Improvements Plan (CIP); evaluating water rates on an annual basis; consideration of CIP funding in rate evaluations; significantly increasing O&M budget to better address Level of Service issues; implementing a Water Conservation Plan; and implementing outreach items such as website creation, public meetings to discuss CIP initiatives, meetings with key customers and local boards to discuss the same, and periodic newsletters.

HVWP obtained funding through the New Hampshire Department of Environmental Services (NHDES) Asset Management Program under two separate Asset Management grants (AM-77 and AM-111) to further advance their asset management efforts as summarized below. Additionally, the HVWP staff and board have integrated Asset Management principles into their day-to-day and long-term operations, including the completion of a voluntary Asset Management Plan Update that linked and complemented the grant projects.

Asset Management Condition Assessment of the Water Distribution System (AM-77)

In June 2020, an Asset Management Condition Assessment of the water distribution system was completed. The scope of this assessment was to develop a GIS based water distribution map, inventory below grade ("horizontal") assets, conduct a condition assessment on the assets, determine the life cycle costs of the assets to plan for replacement or rehabilitation, determine the Level of Service (LOS) of the HVWP and evaluate funding strategies.

In summary, the HVWP, Granite State Rural Water Association (GSRWA), and Brown Engineering collaborated on the project to collect inventory data for the water distribution system piping, hydrants, and valves and develop a GIS platform for the distribution system. Tata & Howard (T&H) was retained to perform a condition assessment for the water mains, hydrants, and valves that were part of the inventory taken by the Precinct, GSRWA, and Brown Engineering. Estimated replacement costs, useful life estimates, funding strategies, levels of service, critical risk scoring, and outreach strategies were also provided by T&H as part of this study.

The primary goal of the Asset Management Condition Assessment was to identify areas of the water distribution system in need of rehabilitation, repair, or replacement; and prioritize improvements to make the most efficient use of the Precinct's capital budget. Other goals of the

project included creating a comprehensive GIS database of the Precinct's horizontal assets to use as a tool in planning system improvements and maintenance schedules, and improving the long-term sustainability of the Precinct in accordance with the core tenets of NHDES's asset management program.

Additionally, the LOS, which defines the way in which the utility managers and operators want the system to perform over the long term and under normal circumstances, was evaluated as part of the Plan. Delivering a specified LOS to customers and regulators at an optimal life cycle cost and an acceptable level of risk with a strategy that ensures long term sustainability of public assets was determined during a workshop held with stakeholders in March 2020.

Upon review of the United States Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) jointly produced Rural and Small Systems Guidebook to Sustainable Utility Management (Guidebook), the ten key management areas identified as important to sustainably managing both the operations and infrastructure of a water utility were used to develop a LOS statement specific to the HVWP's water system.

As stated in the American Water Works Association (AWWA) Manual for Water Supply Practices, a water supplier must provide adequate water service to its customers as well as receive sufficient revenue to provide for operation and maintenance, system upgrades, and maintenance of the supplier's financial integrity. This includes covering all cash needs, debt obligations, and basic expenses required for a water system.

The HVWP's fee system was reviewed and was determined to have evolved significantly over the past seven years as the Water Commissioners embarked on an ambitious and dedicated effort to improve the overall technical, financial, and managerial capacity of the agency, with a specific focus on capital improvements. A 10 Year Capital Improvement Plan was developed in 2016-17 and every rate and fee began to be reviewed, updated, and optimized annually.

Based primarily on their water rate structure, the HVWP was observed to generate revenue to fund their operating budget, including debt service and capital improvements projects outlined in the 10 Year Capital Improvement Plan for FY2020 – 2029.

A copy of the Asset Management Condition Assessment (the HVWP's below grade Asset Management Plan) is included in Appendix A.

Asset Management Plan Update

In March 2021, the Asset Management Condition Assessment, AM-77, was updated for further investigation of the system with the potential of reprioritizing those improvements recommended based solely on asset management criteria. As part of the update, a hydraulic model was developed. The hydraulic model using field flow tests and information obtained from the asset management study was developed to identify hydraulic recommendations. Critical areas of the system were identified and evaluated in the hydraulic model for redundancy. Finally, the previous asset evaluation was incorporated with this new analysis. The results were combined to determine the water mains most in need of replacement and establish a prioritized set of improvements in the system.

The analysis and improvements are based on the Three Circles Approach for optimum capital efficiency, which combines hydraulic and critical component considerations with an asset management rating system to evaluate the condition of the water mains in the distribution system. The capital improvement projects identified will provide a direct benefit to the overall level of service to the Precinct's customers, reduce operation and maintenance costs by reducing the frequency of water main failures and the damage they cause, improve water quality, as well as improve fire protection to homeowners and businesses. Additionally, the hydraulic model developed is a useful tool for the Precinct to evaluate impacts on the distribution system from new developments, looping water mains, loss of a critical infrastructure component and other system modifications.

A copy of the Asset Management Plan Update is included in Appendix B.

Sustainable Energy Infrastructure Assessment (AM-111)

HVWP's asset management efforts extended to address the sustainability of the distribution system with respect to energy. Using less energy will reduce the strain on water supplies and its infrastructure and operating costs. Again, the HVWP obtained funding from the NHDES to complete an Energy Evaluation of the Hooksett Village Water System in September 2020. The HVWP partnered with Process Energy Services, LLC, with support of Eversource, to conduct an energy evaluation of the pump stations and building systems.

Energy usage and cost savings were developed and prioritized based on ease of implements, cost effectiveness, and ability for each project to support the subsequent measures. The recommendations were categorized as energy conservation measures (ECMs) for projects that require a capital investment, operational measures (OMs) for fast payback improvements (1 year or less) and energy supply measures (ESMs) for improvements that may reduce energy costs without reducing energy consumption (i.e. alternative energy sources and rate schedule changes). Energy management practices (EMPs) that are essential for a successful energy management program were also provided.

A copy of the Energy Evaluation is provided in Appendix C.

Upon completion of the Energy Evaluation, the HVWP rededicated themselves to energy efficiency initiatives underway prior to the study as well as committed new resources to projects recommended in the Energy Evaluation itself. In 2021, NHDES requested that the HVWP provide a summary of their past five+ years of projects and initiatives aimed at preserving the sustainability of drinking water resources. A copy of their detailed summary, which included a section focused on Energy Efficiency Highlights to date, is provided in Appendix D. Based partially on the information provided, the HVWP was honored to receive NHDES' Source Water Sustainability Award in May 2021.

As of May 2022, the HVWP had completed or partially completed all of the recommended tasks in the Energy Evaluation. Summaries of the recommendations implemented and the energy cost savings are provided in Appendix D. The HVWP routinely monitors and tracks the energy and fuel savings and costs to optimize efficiency efforts.

Sustainable Water Loss Assessment (AM-111)

HVWP's asset management efforts extended to address the sustainability of the distribution system with respect to water loss. Using less water will reduce the strain on water supplies and its infrastructure and operating costs. In 2021, the HVWP obtained funding from the NHDES Asset Management Program to complete a Water Audit using American Water Works Association M36 Water Audit and Loss Control Program. The HVWP partnered with T&H to conduct the Water Audit using the WLCC Water Audit spreadsheets, calculate water loss (apparent and real losses), non-revenue water, cost to operate and variable production costs; determine performance indicators including annual cost of apparent and real losses, non-revenue water as a percent by volume of water supplied and cost of operations: and determine operational efficiency indicators including unavoidable annual real losses, current annual real losses and Infrastructure Leak Index (ILI). Recommendations to improve the ILI score and effective practices to reduce non-revenue water are included.

A copy of the Water Audit is provided in Appendix E.

As noted above, Appendix D includes a summary of the HVWP's past five+ years of projects and initiatives aimed at preserving the sustainability of drinking water resources. A copy of their detailed summary, which included a section focused on Water Conservation Highlights, is provided in Appendix D. Based partially on the information provided, the HVWP was honored to receive NHDES' Source Water Sustainability Award in May 2021.

The HVWP's multi-faceted water-loss management program recently took another step toward improving sustainability. In 2021, the HVWP applied for NHDES' Community Water System Leak Detection Survey Grant. In their application, the water department noted that they had found and fixed easy-to-identify leaks and made significant efforts to improve water conservation as detailed in Appendix D, and are now faced with identifying hard-to-find leaks. NHDES notified the HVWP in 2022 that they would be moving forward with the project, and as a result the HVWP expects to receive professional leak detection assistance via the grant later this fall.

Above Grade Asset Inventory and Condition Assessment (AM-111)

In 2021, the HVWP obtained funding from the NHDES Asset Management Program to complete an Above Grade Asset Inventory and Condition Assessment. The HVWP partnered with Granite State Rural Water Association and T&H to compile the inventory, conduct the assessment, and incorporate the assets into the existing ArcGIS system.

Once the inventory of assets was developed, Granite State Rural Water Association inserted the AutoCAD drawings of each station and asset tables to the HVWP's ArcGIS on-line account and designed an ArcGIS online-based dashboard to facilitate the tracking of HVWP's meter replacement program. The dashboard was developed by acquiring spatial data for existing fixed network, radio-read, and manual-read meters exported from the Stiles Co. Beacon Software, which maintains spatial and tabular data pertaining to HVWP's metered customers. Customer and meter data was then manipulated to draw alongside HVWP's existing GIS data, thereby bolstering the

amount of information available to operators pertaining to the distribution system, while also providing meter replacement tracking statistics to the utility.

In addition to the Meter Replacement Dashboard, GSRWA deployed the Lead Service Line Inventory solution, developed by Esri, to the HVWP ArcGIS Online account. This provides the utility with the capacity to begin the inventory of any lead service line components that is required to be completed by the EPA under the Revised Lead and Copper Rule by October 2024.

Site visits at each of the pump station and booster pump stations were conducted with staff of the HVWP and T&H staff to develop AutoCAD drawings of each critical system component. The AutoCAD drawings were embedded into the HVWP's ArcGIS. Once drawings were developed, the HVWP compiled the inventory of equipment in each station including the age, if known and other key attributes. T&H assisted in the condition assessment and life cycle costing for the replacement of each identified asset.

The goal of this phase of the Comprehensive Asset Management Plan process was to evaluate the condition of above ground assets of the water system including the well and booster pump stations (including chemical feed/storage equipment, HVAC equipment, SCADA equipment, electrical components, PRVs and measurement devices) and storage tanks and associated assets.

This allowed for a complete inventory of water system elements (both horizontal and vertical components) and an expanded asset management plan to better tie together all of the core components listed above.

A copy of the Above Grade Asset Inventory and Condition Assessment is provided in Appendix F.

Level of Service (LOS) Review (AM-111)

As part of the 2021 Asset Management Grant funding from the NHDES Asset Management Program, the HVWP reviewed the Level of Service (LOS) performance criteria established in 2019. A meeting with the HVWP and T&H was held in March 2022 to review the performance criteria and discuss if the benchmarks were being met consistently and what items were important to the HVWP to include in the updated benchmarks. The HVWP has been achieving the majority of these goals consistently. With several new improvements in the works including the design and construction of a new water storage tank and necessary water distribution system improvements, the HVWP shows their commitment towards improvement and providing good water quality to their customers.

Revised LOS performance criteria are provided in Appendix G.

Public Outreach (AM-111) - Open House and Other Activities

Since 2016, the Precinct has made significant investments in improving the overall technical, financial, and managerial capacity of the water system. A key component to the success of the associated budget increases has been a concerted effort by the staff and Water Commissioners to

educate themselves, their customers, and stakeholders about the value of water, the story behind the infrastructure needs, and improvement opportunities at the Precinct. This public education/outreach effort was summarized in 2020 for the report generated under Asset Management Planning Grant AM-77.

Regarding this phase of their asset management project, the Precinct has already completed several key milestones. The Precinct has presented a project overview to the Water Commissioners at an Open Meeting on May 31, 2022; held a public Open House at the South Pump Station on May 5, 2022 to exhibit, discuss and demonstrate drinking water assets and asset improvement projects (see below); promoted and described Asset Management activities through numerous web site updates, notifications on quarterly bills and bill stuffers, an annual HVWP newsletter and budget summary, their CCR, the Town's May 2022 newsletter, and presentations at other public meetings; co-presented at two public Asset Management workshops/conferences; updated their Water System Asset Management brochure; and completed this report.

A detailed summary of the Precinct's public outreach efforts for this Asset Management project spanning the project period of May 2021 to May 2022 is attached in Appendix H. A copy of their update Asset Management brochure is also provided in Appendix H.

The Open House at the South Pump Station was held on May 5th during Drinking Water Week as a key method of public education and outreach. The HVWP coordinated with several partners including NHDES, local Hooksett officials and residents, Brown Engineering, Granite State Rural Water, the Hooksett Fire Department, Stiles Company, Seavey Construction and T&H. Tours of the South Pump Station were provided, as well as exhibits on the ongoing meter replacement program, the diversion structure on site, water supply sources for the HVWP, asset management, level of service, drone imagery, the existing hydraulic model and ArcGIS, meter test bench, and ongoing capital improvement projects underway for the HVWP.

Copies of pre- and post-event press releases for the Open House are provided in Appendix H.

Looking forward, the Precinct also plans to:

- Maintain and improve the asset inventory and mapping.
- Include additional project description and promotion in a Precinct newsletter.
- Continue to review and revise the funding strategy and rate structure annually.
- Use report as source material in budget work sessions and hearings.

Financial Planning Review and Funding Strategy (AM-111)

As stated in the American Water Works Association (AWWA) Manual for Water Supply Practices, a water supplier must provide adequate water service to its customers as well as receive sufficient revenue to provide for operation and maintenance, system upgrades, and maintenance of the supplier's financial integrity. This includes covering all cash needs, debt obligations, and basic expenses required for a water system.

In accordance with AWWA Principles of Water Rates, Fees and Charges (M1, sixth edition), cost-based rate making is recommended to develop water rates to fully fund the water system's needs, while providing revenue stability and fairness for the customers. The objectives of cost-based rate making is to analyze the total revenue requirements of the system, analyze the cost of service, which allocates the revenue requirements to the various customer classes of service in a fair and effective manner, and analyze the rate design to consider both the level and structure of the rate design to collect the revenue from each service class.

The Precinct has adopted these practices when establishing water rates to cover the true cost to deliver, pump, treat, operate and maintain their system assets, while addressing necessary administrative requirements and costs and capital improvements necessary to replace aging assets and/or add new assets to the water supply and distribution system. Other consideration is given to regulatory drivers from NHDES and USEPA and risks of failure of a critical asset. The Precinct also maintains a diverse base of miscellaneous fee revenue in addition to basic charges discussed below, which helps to stabilize those charges and optimize fairness.

Table No. 1
HVWP Annual Budget Summary
CY2015-2022

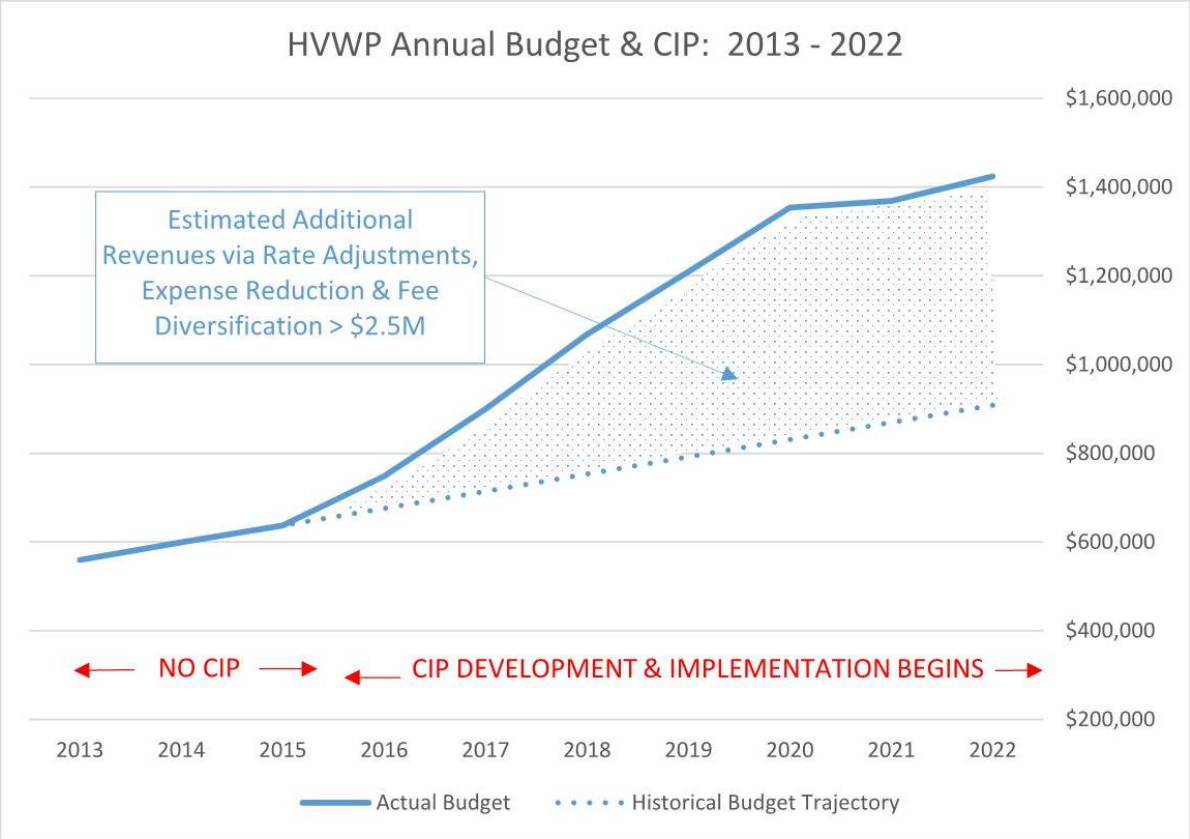
YEAR	BUDGET ($)	CHANGE ($)	CHANGE (%)
2015	$637,060	$37,484	5.9%
2016	$748,733	$111,673	14.9%
2017	$900,304	$151,571	16.8%
2018	$1,068,613	$168,309	15.8%
2019	$1,209,610	$140,997	11.7%
2020	$1,354,191	$144,581	10.7%
2021	$1,369,191	$15,000	1.1%
2022	$1,424,337	$55,146	3.9%
	Annual Avg.:	$103,095	10.1%

The Precinct's current rate / fee system (https://www.hooksettvillagewater.org/resources/billing-information) has evolved significantly over the past seven years as the Water Commissioners have embarked on an ambitious and dedicated effort to improve the overall technical, financial, and managerial capacity of the agency, with a special focus on capital improvements. A 10 Year Capital Improvement Plan was developed in 2016-17 and every rate and fee began to be reviewed, updated, and optimized annually in conjunction with the CIP via a months-long iterative process, using a series of nested predictive spreadsheets. Combined with a major effort to educate residents and public officials about the need for infrastructure investments, the Precinct has been successful in using these methods to raise awareness about the True Cost of Water.

Copies of the handouts provided to the Hooksett Budget Committee in 2022 summarizing the latest CIP, budget, rate increases and infrastructure project are attached in Appendix I. This presentation assisted the HVWP in garnering the Committee's approval for the Precinct's CY2022 budget.

Since 2015, the Precinct's operating budget has increased from $637,060 to $1,424,337, an average of approximately 10 percent per year. The Precinct estimates that these increases, in combination with fee diversification and expense reduction, have resulted in the generation of over $2.5M in additional funds to re-invest in the water system.

Figure No. 1
HVWP Annual Budget & CIP: 2013-2022



These increases covered significant investments in staffing, training/licensing, accounting, operations, recordkeeping, maintenance, engineering, and capital projects such as metering/SCADA technology, pump station rehabilitation, and tank installation. The methods behind and outcome of these investments have been highlighted by the Precinct in recent years at numerous public presentations including "Get To Know Your Water System" at the Hooksett Public Library on February 3, 2020 (https://www.hooksettvillagewater.org/about/system-overview), "Drought Preparedness" at the NH Drinking Water Exposition on October 20, 2021 (https://www.hooksettvillagewater.org/water-use/water-conservation) and the HVWP Open House on May 5, 2022 (discussed in greater detail elsewhere in this report).

The Precinct's ascending tier usage rate structure generates significant revenue from high volume including heavy irrigation users while sending a strong conservation signal in accordance with their NHDES-approved Water Conservation Plan. Additionally, there are minimum quarterly charges based on domestic/commercial service size and additional fees.

Table No. 2
Existing Quarterly Water Usage Rate Structure

Water Usage (gallons)	Rate ($/1000 gallons)
0-10,000	$4.95
10,000 – 25,000	$5.40
25,001 – 75,000	$6.80
75,001 – 150,000	$7.30
150,001-300,000	$7.45
300,001 - 500,000	$7.65
>500,000	$8.40

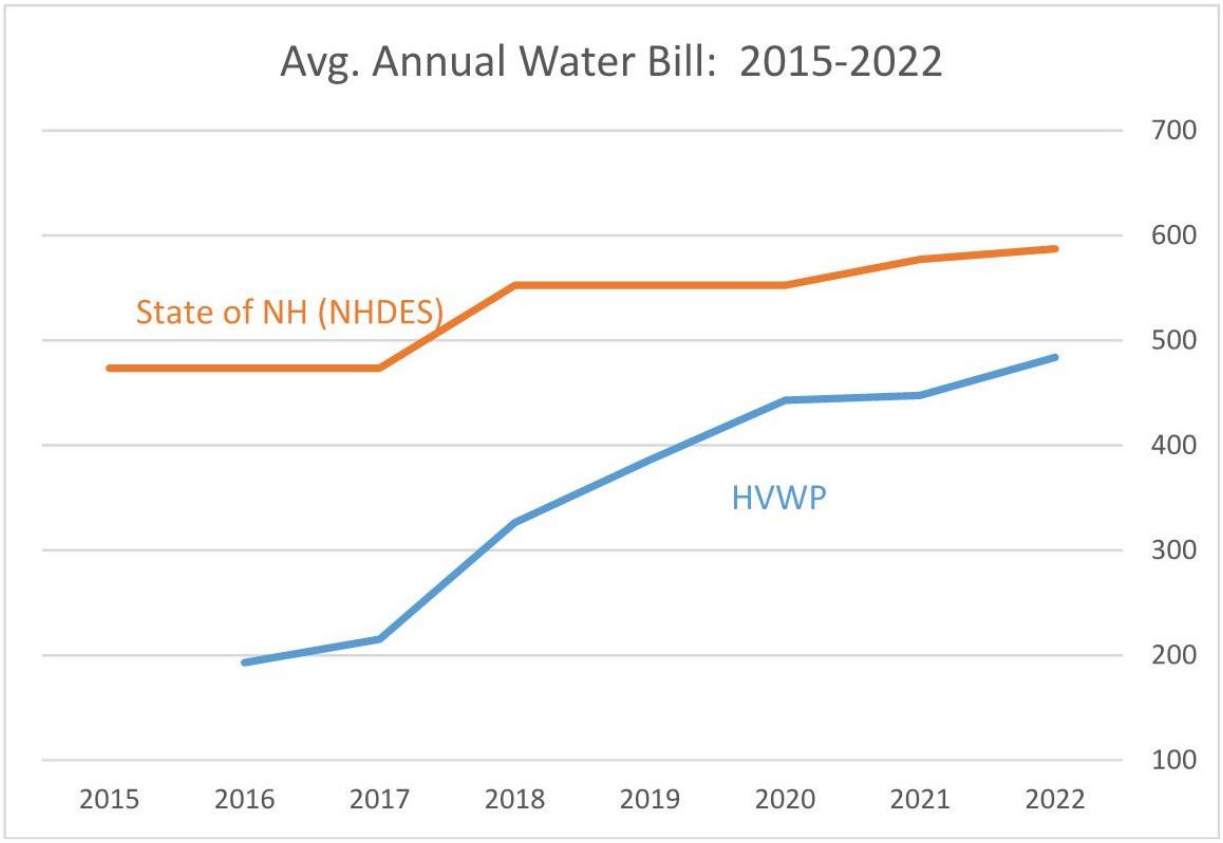
Table No. 3
Existing Quarterly Service Charge Structure

Domestic Service Size (inches)	Charge ($/quarter)
¾	$73.00
1	$102.20
1 ¼	$116.80
1 ½	$131.40
2	$211.70
3	$803.00
4	$1,022.00
6	$1,533.00
8	$2,190.00
10	$2,774.00

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The Precinct continues to evaluate their water rates and fees on an annual basis to meet the revenue requirements in a fair, equitable manner for the users. The Water Commissioners are committed to maintaining affordability and have demonstrated that commitment through consistently lower-than-average rate increases on the average user tiers; implementation of fee diversification and senior discounts; hyper-focused attention on water conservation, efficiency and asset management programs; and other investments in the overall long-term sustainability of the system. The Water Commissioners have also demonstrated affordability by increasing rates while keeping the average user's annual bill below that of the average statewide annual water bill.

Figure No. 2
Average Annual Water Bill: 2015-2022



Looking forward, by continuing to align its CIP and operating budget with the goals of its Comprehensive Asset Management Plan, the HVWP should continue to see progress toward its sustainability, cost-effectiveness and LOS goals. Although significant progress has been made, the Comprehensive Asset Management Plan indicates that additional CIP funds will be needed over the long-term to ensure that the HVWP remains on path toward this more proactive asset maintenance approach. In order to accomplish this, the HVWP will need to continue to focus on revenue generation, fee diversification, expense reduction, and the other approaches it is using. It also seeks to leverage limited resources by partnering with other entities and agencies on projects where a mutual benefit may be observed in terms of technical or financial capacity.

Asset inventories and condition assessments/life cycle costing developed under this grant program and the previous grant program will be used to determine which assets will require replacement within the next ten-year period. This does not necessarily mean that an asset in good condition needs to be replaced when it is past its theoretical expected useful life. Regular inspections and maintenance should be completed to determine the actual date of replacement.

Capital assets generally include upgrades or larger asset replacements where the scope of the upgrade or asset replacement surpasses what can be expected to be included in an annual operations and maintenance budget. Larger upgrade and improvement projects are above the

normal asset replacement plan, either replacing existing assets with more reliable models, upgrading existing instrumentation, or adding new infrastructure.

The Precinct may seek funding through various available programs. The Drinking Water State Revolving Fund (DWSRF) program administered by NHDES provides assistance in the form of low interest loans with principal forgiveness to public water systems to finance the cost of drinking water infrastructure. This program evaluates applicants and publishes the selected recipients annually in an Intended Use Plan, ranking them according to a variety of factors. Increased DWSRF funding is anticipated over the next five years as a result of the American Rescue Plan Act (ARPA) and the Bipartisan Infrastructure Bill. These programs will assist in the funding of necessary infrastructure projects and address upcoming regulatory drivers such as the Revised Lead and Copper Rule and treatment required for emerging contaminants.

Two potential models for using the available DWSRF program to fund priority below-grade improvements identified in the 2020 Asset Management Plan and 2021 Asset Management Plan Update are outlined in Appendix A. Further discussion and/or implementation of these concepts is currently on hold while a higher priority project is completed. This project includes the replacement of an old deteriorated water storage tank and completion of water transmission main to a recently installed storage tank.

The Precinct has applied for and received an ARPA grant for their water storage tank replacement and completion project through NHDES. Additional grant and loan funds for the project have been acquired from the NH Drinking Water and Groundwater (NHDWG) Trust Fund. The program is available to fund future projects with a primary focus on water treatment, but eligible projects include expansion of the distribution system to support economic development and provide gap funding for infrastructure projects when all other funding sources have been exhausted.

Appendix A

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ASSET MANAGEMENT CONDITION ASSESSMENT

JUNE 2020

Hooksett Village Water Precinct
Hooksett, New Hampshire

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June 4, 2020

Mr. Mike Heidorn, Superintendent
Hooksett Village Water Precinct
7 Riverside Street
Hooksett, NH 03106

Subject: Asset Management Condition Assessment
Hooksett Village Water Precinct
T&H No. 5919

Dear Mr. Heidorn:

In accordance with our agreement, Tata & Howard, Inc. has completed an Asset Management Condition Assessment of the water distribution system for the Hooksett Village Water Precinct. This assessment summarizes the work completed under the New Hampshire Department of Environment Services (NHDES) 2019 Asset Management Planning Grant Project No. AM-77.

In summary, the Hooksett Village Water Precinct (Precinct), Granite State Rural Water Association (GSRWA), and Brown Engineering collaborated on the project to collect inventory data for the water distribution system piping, hydrants, and valves and develop a GIS platform for the distribution system. Tata & Howard (T&H) was retained to perform a condition assessment for the water mains, hydrants, and valves that were part of the inventory taken by the Precinct, GSRWA, and Brown Engineering. Estimated replacement costs, useful life estimates, funding strategies, levels of service, critical risk scoring and outreach strategies were also provided by T&H as part of this study.

The primary goal of the Asset Management Condition Assessment portion of the project was to identify areas of the water distribution system in need of rehabilitation, repair, or replacement; and prioritize improvements to make the most efficient use of the Precinct's capital budget. Other goals of the project included creating a comprehensive GIS database of the Precinct's horizontal assets to use as a tool in planning system improvements and maintenance schedules, and improving the long-term sustainability of the Precinct in accordance with the core tenets of NHDES's asset management program.

Asset Inventory

The initial step of the process was to create a comprehensive GIS map of the distribution system. In 2019, Staff of the Precinct organized and reviewed seven decades of historical records, then located and field marked mains, hydrants, gate valves, and some service connections in the distribution system. Brown Engineering used a drone to fly over the boundaries of the Precinct to identify the locations of marked and unmarked infrastructure. This was completed throughout the project but was focused on during the spring and fall

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seasons to obtain optimal imagery with the least amount of vegetation and tree coverage. While Brown Engineering was collecting imagery, the Precinct's ArcGIS Online platform was created and optimized by GSRWA with input from Precinct staff. Once the entire distribution system was captured by the drone, the drone imagery was processed and input into ArcGIS by GSRWA and Brown Engineering.

GSRWA provided training sessions to the Precinct staff to allow GPS data points, lines, and attributes to be entered into ArcGIS purchased by the Precinct. ArcGIS was installed on the Precinct computers and an iPad, which allowed Precinct staff to field verify areas of the distribution system and to add locations of unmarked assets. Precinct staff verified the sizes, ages and materials of the mains and input the data into the shapefile attribute tables in ArcGIS. Ages of hydrants and valves were also added to the shapefile attributes in ArcGIS. Flow testing equipment was purchased by the Precinct, and every hydrant was flow tested. The resulting observed flow rates were added as hydrant attributes. Break history was researched back to 1980 and provided to T&H to add as an additional attribute for specific pipe segments.

Once the mapping and data compilation was completed, T&H assisted the Precinct in categorizing and analyzing their data for the asset management/condition assessment phase of the project. The project team reviewed the properties associated with the GIS data and created maps visualizing the distribution of pipe characteristics as described in the following section. This information was used to develop a scoring system to help guide the Precinct in locating key areas of their system to improve over the next ten years. Additionally, T&H performed a level of service analysis to help pinpoint any key benchmarks that the Precinct could use to track their effectiveness in customer service. This identified other areas outside of asset replacement that the Precinct could use to improve their system as a whole. Lastly, a preliminary evaluation of the current water rate structure was conducted to determine the ability to fund Phase I asset management recommendations.

A basic GIS water distribution system map is provided in Appendix A, showing the system as it currently exists as mapped during this project. The GIS data used to create the map is being continuously updated. However, copies of GIS inventory information and shapefiles can be shared with NHDES under separate cover as needed or required.

Water Main Condition Assessment

Information regarding the water main diameters, materials, installation years, break history, and known soil conditions, was provided by Precinct personnel and reviewed during a workshop with system managers, operators, contractors and affiliates of the Water Department nearing retirement. Water main static pressures were obtained by Precinct personnel during mapping and flow testing of the hydrants.

To prioritize water main replacement or rehabilitation, a water main grading system has been established. The grading system uses the water main characteristics such as age, material, break history, diameter, static pressures, and soil characteristics to assign point values to each pipe in the system. Each category is assigned a rating between zero and 100 with zero being the most favorable and 100 being the worst case within the category. Each category is then given a weighted percentage, which represents priorities within the system. It is at the client's discretion to adjust the weight based on system performance and condition. Our recommendation is to assign a maximum of 30 percent to any one category. The rating is then multiplied by the weight. The weighted rating for each performance criteria will be utilized to determine the overall rating per pipe within the system. Those pipes with the highest grade are most in need of replacement or rehabilitation.

To establish a rating system specific to the Hooksett Village Precinct water system, a workshop was held with the system management, operators, and retired members of the Water Department. During the discussion, it was determined that break history and material are of primary concern to the Precinct. Also, it was determined that water quality was not an issue, however, a performance criteria for water quality was added to the rating system to be used to update the asset management scores in the future, if water quality becomes an issue. The grading system is shown in Table No. 1.

The Hooksett Village Precinct has multiple locations with older iron services that have historically experienced multiple leaks. During discussions with Precinct members at the workshop, it was determined that the service pipes are failing for a variety of reasons including corrosion of the corporation stop or service saddle, poorly connected curb stops to newly replaced portions of service pipes, or unknown sections of cast iron pipe in services. Pipes with a history of multiple service leaks should be prioritized in considering the areas of the Precinct's water system that should be replaced in the immediate future.

Based on the asset management ratings, there are several areas of concern in the system. Water mains with a total rating less than 25 are considered to be in good to excellent condition. Mains with a total rating between 25 and 44 are considered to be in fair to good condition, and mains with a total rating of 45 or greater are considered to be in poor to fair condition. This rating system is specific to the Hooksett Water Precinct system and reflects the Precinct's priorities of replacing mains with a history of breaks and those with poor material. Asset management ratings are presented graphically in Appendix B and as a table in Appendix C.

Hydrant and Valve Condition Assessment

Installation dates for all gate valves and hydrants of the water system were provided by the Precinct. Estimated replacement dates were calculated for each valve and hydrant assuming an estimated useful life of 40 years for a hydrant and 50 years for a valve. It should be

noted that a more detailed assessment of hydrants and valves would take into account factors such as valve or hydrant type, valve size, and frequency of use.

Hydrants and gate valves in the system that are past their estimated useful life are presented in Appendix D. These lists also take into consideration any hydrant or valve listed as being in poor condition by the Precinct personnel during the GPS data collection of these assets. The hydrant rating scale is as follows: 1 – New; 2 – Good; 3 – Moderate; 4 – Bad; 5 – Failed. Hydrants are operated, tested, and maintained on a semi-annual basis and therefore are kept in a state of operable readiness regardless of condition. Gate valves have been historically been operated less frequently, but Precinct staff have begun the process of operating and assessing valve readiness.

Table No. 1
Asset Management Grading System

Weight	Performance Criteria	Rating	Weighted Rating
25%	Break History		
	Two or More Breaks	100	25
	One Break	75	18.75
	No History of Breaks	0	0
15%	Material		
	Asbestos Cement	100	15
	Plastic	80	12
	Copper	20	3
	Ductile Iron	10	1.5
	PVC/HDPE	5	0.75
15%	Installation Date		
	1950-1979	100	15
	1980-1989	90	13.5
	1990-1999	40	6
	2000-2010	10	1.5
	2010-present	0	0
15%	Poor Soils		
	Known Corrosive Soils	100	15
	Potentially corrosive soils	80	12
	Gravel, sand	0	0
20%	Diameter		
	Less than 4-inch	100	20
	4-inch water main	90	18
	6-inch water main	70	14
	8-inch water main	30	6
	10-inch water main	20	4
	12-inch water main	10	2
	16-inch water main	5	1
10%	Static Pressure		
	Greater than 100 psi	100	10
	80 to 100 psi	80	8
	60 to 80 psi	60	6
	Less than 60 psi	0	0
5%	Water Quality		
	Water Quality Concerns	100	5
	No Water Quality Concerns	0	0

Critical Assets

Critical areas served are locations in the distribution system that require continual water supply for public health, welfare, or financial reasons. Because water storage tanks and sources provide water and maintain pressure to critical service areas, tanks and primary sources are also considered critical components. Additional categories of critical assets include those mains that are the sole transmission main from a source or tank, and main transmission lines without a redundant main. The evaluation included a visual review of the water mains leading into and out of the critical areas and the transmission grid. Table No. 2 presents critical components of the Precinct distribution system.

Table No. 2
Critical Areas

Critical Area	
Water Storage, Source, And Distribution System Components	
	East Well
	East Pump Station
	South Well
	South Well Pump Station
	South Well Back-Up
	North Well
	North Well Pump Station
	West (Quarry) Tank
	Thompson Corner Tank
	Manor Drive Tank
	Booster Pump Station
Water Distribution Transmission Mains	
	12-inch water main from West (Quarry) Tank to Pinnacle Street
	8-inch water main from South Well to Pinnacle Street
	8-inch water main from East Well to Ardon Drive
	6-inch water main from North Well to Pine Street
	8-inch water main from Thompson Corner Tank to Main Street
	16-inch water main from Manor Drive Tank to Post Road
	12-inch water main starting at Vista Drive Connection
	12-inch water main from Booster Station to Manor Drive Tank
	12-inch water main on College Park, North Main Street, and Lilac Bridge
	12-inch water main on north end of Route 3
	6-inch water main on south end of Route 3

Recommended Improvements

Based on the asset management score of water mains, a prioritized list of improvements was created. Table No. 3 and Table No. 4 include prioritized lists of water main improvements with the associated asset management status and estimated cost. These water mains should be addressed based on available funding. Existing 6-inch diameter water mains and smaller should be replaced with 8-inch diameter water mains. It should be noted that a 6-inch diameter water main and smaller classified as in poor condition may be able to be replaced with a new 6-inch pipe and provide sufficient service for the area without increasing the diameter. Additionally, existing 8-inch diameter water mains that are considered transmission mains (i.e. Route 3 water main) were upsized to 12 inches in diameter. The diameter of the recommended water main replacement may be changed upon the completion of a hydraulic evaluation of the water distribution system, which is recommended. Cost estimates include costs associated with water services, hydrants, and other appurtenances, permanent and temporary trench pavement, and a 25 percent allowance for engineering and contingencies. Estimates do not include costs for land acquisition, easements, or legal fees. Unit costs when installing less than 1,000 feet of water main incur a higher unit rate and are accounted for in the recommendations. The recommended improvements map is included in Appendix E.

It should be noted that paving schedules and other changes to roadways were not evaluated as part of this study. These items may dramatically delay water asset improvements, or present cost obstacles or opportunities depending on the timing of the projects.

It is intended that the Phase I Improvements should be prioritized for replacement over the next ten years (2020 – 2029) with the Phase II Improvements to be prioritized for replacement in the following twenty years (2030 – 2049). Sections of water main included in Phase I all have asset management scores of above 60 and represent the areas of the Precinct system that are the most in need of attention. Sections of water main included in Phase II have asset management scores between 45 to 59 and have all had at least one break. These areas are in need of attention but are not as critical as those areas in Phase I, based on currently available data, so can be used to plan projects up to the next twenty years. Fifty three percent of the pipes have scores between 30 and 44, most located in the Pinnacle Street and Thompson Avenue neighborhoods. These areas were all developed around the same time and therefore should be all replaced around the same time. It is recommended that these areas be included in a Phase III as the Precinct moves forward beyond in Phases I and II. These areas can be re-evaluated at a later date.

It is recommended that a formal hydrant and valve maintenance program be developed. This program would assist the Precinct in exercising existing hydrants and valves and documenting hydrants and valves in need of replacement. The program would include summarizing existing maintenance procedures, identifying priority areas, and developing a hydrant and valve maintenance report form for use during the program and for recordkeeping purposes. The latest AWWA guidelines and recommendations would be

used to develop a 5-year hydrant and valve maintenance program that would include maps showing a sequenced approach by street. To the extent possible this program would incorporate lessons learned and priorities determined from existing maintenance sequences. By continuing to focus on regular maintenance and the replacement of old or broken hydrants, the Precinct will improve fire protection in the system and eliminate potential leaks. Furthermore, identifying and repairing or replacing lost, broken or partially inoperable valves in the system will continue to improve the transmission capacity of the system.

Other recommended planning and improvement programs that the Precinct should develop and implement are a service replacement program and an above ground (vertical) asset inventory. During the workshop, it was noted and discussed that service leaks are a prevalent concern for the Precinct. It is recommended that the Precinct review historical tie cards and field locate services to create a GIS database of services which can then be used to develop a phased replacement program. In addition, an above ground (vertical) asset inventory and condition assessment would help the Precinct catalog equipment at the wells, pump stations, and tanks to plan replacement and maintenance of those items.

Hydraulic Improvements

The Precinct does not currently have a hydraulic model of the distribution system, therefore the improvements recommended in the previous section were based only on physical pipe characteristics. Through field operations experience and an examination of the hydraulics and water quality dynamics associated with the current distribution system configuration, the Precinct has assembled a vision for hydraulic improvements that would improve transmission, reduce stagnation, and dramatically enhance system reliability. This vision is shown on the map included in Appendix F. The vision includes completion of five sections of water main, two interconnections, and repair or replacement of the Precinct's oldest tank. Some of these projects are currently being pursued as part of existing development or compliance initiatives, while others have yet to enter the planning stage. A Water Supply and Usage Evaluation Assessment released in May 2020 by Lewis Engineering identifies at least five of the above-referenced projects as a priority for the Precinct.

It is recommended that the Precinct's proposed hydraulic improvements be evaluated as part of a hydraulic model of the distribution system and that the Phase I and II Improvements identified in this report be re-evaluated and reprioritized as needed in light of the modeling results.

Table No. 3
Phase I Improvements

Item No.	Location	From	To	Asset Management Rating	Recommended Diameter (in)	Length (LF)	Estimated Cost
1	Route 3	69 Main Street	1580 Hooksett Road	61-69	≥12	6,800	$ 2,125,000
2	Highland Street	Dundee Avenue	Granite Street	50-72	8	1,300	$ 325,000
3	Granite Street	Merrimack Street	Route 3	63	8	3,600	$ 900,000
	Otterson Street	Granite Street	Bert Street	55			
	Chase Street	Highland Street	Granite Street	50			
4	Heather Drive	Ardon Drive	End of Heather Drive	61	8	600	$ 188,000
Total Estimated Phase I Cost:							**$ 3,538,000**

Table No. 4
Phase II Improvements

Item No.	Location	From	To	Asset Management Rating	Recommended Diameter (in)	Length (LF)	Estimated Cost
5	Scott Avenue	West River Road	Scott Avenue	57	8	2,600	$ 650,000
	Green Street	Scott Avenue	Scott Avenue	57			
6	Veterans Drive and Merrimack Street	Veterans Drive	Dundee Avenue	52-61	≥12	2,100	$ 657,000
7	Bullard Drive	Steven Drive	End of Bullard Drive	54	8	700	$ 219,000
8	West River Road	Pinnacle Street	Riverside Street	50	12	1,000	$ 344,000
9	Dale Road	Morse Drive	Wedgewood Circle	45	8	4,900	$ 1,225,000
10	West River Road	The Common Man	Windsor Terrace Apartments	46	≥8	2,100	$ 525,000
11	Bayview Terrace Road and West Bank Road	West River Road	End of West Bank Road	47	8	2,300	$ 575,000
						Total Estimated Phase II Cost:	**$ 4,195,000**

Level of Service

Level of service (LOS) defines the way in which the utility managers and operators want the system to perform over the long term and under normal circumstances. Quality, quantity, reliability, and meeting regulatory requirements are elements that can define the level of service and associated system performance goals can be developed. Performance measures established should also be relevant, achievable, and in line with customers' expectations. These performance goals can be modified as a utility's asset management program is implemented. Determining a utility's LOS helps communicate service expectations to customers and concentrate efforts and resources to meet certain performance measures.

LOS criteria to be considered include meeting state and federal drinking water standards, providing adequate water quantity and pressure to the distribution system, and providing reliable service to the customers. In 2013, the United States Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) jointly produced a *Rural and Small Systems Guidebook to Sustainable Utility Management (Guidebook)*. Within the Guidebook there are ten key management areas identified as important to sustainably managing both the operations and infrastructure of a water utility. The key management areas were used to develop a level of service statement specific to the Hooksett Village Water Precinct's water system. A table of recommended LOS criteria and benchmarks is included in Appendix G.

Funding Strategy

As stated in the American Water Works Association (AWWA) Manual for Water Supply Practices, a water supplier must provide adequate water service to its customers as well as receive sufficient revenue to provide for operation and maintenance, system upgrades, and maintenance of the supplier's financial integrity. This includes covering all cash needs, debt obligations, and basic expenses required for a water system.

The Precinct currently charges all consumers on a quarterly basis based on the volume of water metered each quarter and the size of their service. The current water rates and service charge structure effective 1/1/20 are shown in Table Nos. 6 and 7.

In addition, there are sprinkler system charges, hydrant usage charges, connection charges and miscellaneous fees that generate revenue to fund the water system.

Miscellaneous fees typically generate approximately 8% of the Precinct's revenue, but that number rose to 12% in 2019 due in large part to expansions of backflow testing and bulk water sales programs according to Precinct staff. This demonstrates how the Precinct seeks to find creative ways to fund its operations while minimizing customer rate increases. The Precinct's ascending tier usage rate structure also generates significant revenue from high irrigation users while sending a strong conservation signal in accordance with their

NHDES-approved Water Conservation Plan. Discretionary irrigation significantly impacts the Precinct's seasonal water demand and associated operational costs.

Table No. 5
Existing Quarterly Water Usage Rate Structure

Water Usage (gallons)	Rate ($/1000 gallons)
0-10,000	$4.65
10,000 – 25,000	$5.05
25,001 – 75,000	$6.60
75,001 – 150,000	$7.15
150,001-300,000	$7.25
300,001 - 500,000	$7.35
>500,000	$8.05

Table No. 6
Existing Quarterly Service Charge Structure

Domestic Service Size (inches)	Charge ($/quarter)
¾	$66.00
1	$92.40
1 ¼	$105.60
1 ½	$118.80
2	$191.40
3	$726.00
4	$924.00
6	$1,386.00
8	$1,980.00
10	$2,508.00

The Precinct's current fee system has evolved significantly over the past five years as the Water Commissioners have embarked on an ambitious and dedicated effort to improve the overall technical, financial, and managerial capacity of the agency, with a special focus on capital improvements. A 10 Year Capital Improvement Plan was developed in 2016-17 and every rate and fee began to be reviewed, updated, and optimized annually. Since 2016, the operating budget has increased from $637,060 to $1,354,191, an average of approximately 14 percent per year. These increases covered significant investments in staffing, training/licensing, accounting, operations, recordkeeping, maintenance, engineering, and capital projects such as metering/SCADA technology, pump station rehabilitation and tank installation.

Based primarily on the water rate structure, the Precinct generates revenue to fund their operating budget, including debt service and capital improvements projects outlined in their 10 Year Capital Improvement Plan for FY2020 – 2029 provided in Appendix H. That plan and the existing rate structure already include approximately $1,885,000 for Phase I water main improvements due to the proactive planning at the Precinct. Therefore, while additional sources of revenue may be needed to address the asset management recommendations the Precinct is in the highly commendable position of being prepared to act almost immediately on the Phase I recommendations of this report, unlike most water systems of its size and age.

The estimated cost of the Phase I asset management recommendations listed in Table No. 3 is $3,538,000. These recommendations could be funded in different ways.

One funding method would be to break up all but the Route 3 project into smaller projects tackled on an annual or biennial basis over a ten-year period using nothing but existing budget-generated revenues. The Route 3 project would be simultaneously funded through a combination of leveraged partnership(s), development agreement(s) and/or loan(s). Assuming the $2,125,000 Route 3 project would be completely funded through a standard 20-year loan at an estimated two percent interest, the Precinct would need additional revenues of approximately $130,000 per year for the twenty years for debt service. Assuming those new revenues would be borne by all water users equally without consideration of water usage or miscellaneous offsetting sources of funding, the rate per service connection (assuming 1,155 connections) would increase by approximately $9 per month.

Another funding scenario would be to seek a 20-year loan at two percent for all the Phase I asset management recommendations listed in Table No. 3. In this case, the Precinct would need revenues of approximately $217,000 per year for the twenty years of debt service. Assuming that this was not paid for using existing budget-generated revenues and that the new revenues are borne by all users uniformly without the beneficial effects of miscellaneous funds (e.g. other departmental revenues, capital reserve subsidies, developer contributions, etc.), the rate per service connection would increase by approximately $15 per month. Under this scenario, the Precinct incurs additional interest charges over the twenty years totaling $474,000. However, the Precinct retains its existing budget-generated revenues averaging $189,000 per year to potentially implement all of its proposed hydraulic improvements.

After the projects in Phase I are completed, a new rate evaluation should be completed to determine if further adjustments to the rate structure are needed to fund Phase II recommendations. Also, it is our recommendation that the long-term funding strategy be revisited upon completion of the hydraulic modeling analysis discussed earlier in this report. It is possible that reprioritization of the Phase I and II Improvements may occur based on potential impacts of proposed hydraulic improvements. The overlap of proposed

areas of hydraulic priority with some of the Phase I and II asset management project areas may present opportunities for completing multiple goals at once at a significant savings.

Implementation & Outreach Strategy

As noted earlier, over the last five years the Precinct has made significant investments in improving the overall technical, financial, and managerial capacity of the water system. A key component to the success of the associated budget increases has been a concerted effort by the staff and Water Commissioners to educate themselves, their customers, and stakeholders about the value of water, the story behind the infrastructure needs, and improvement opportunities at the Precinct.

Over the past few years, these educational efforts have included website creation, public meetings to discuss Capital Improvement Plan initiatives, meetings with key customers and local boards, periodic newsletters, billing inserts, sharing of asset attribute data and mapping with other Town agencies, working with the Fire Department on hydrant maintenance and testing, installation and promotion of cellular meters with web-based customer portals, presentations and publications about the recent storage tank project, historical research at the Precinct, phased SCADA installation, internal mechanical and financial systems tracking and analysis, as well as many other projects. Looking forward, the Precinct is committed to continuing to foster internal and external collaboration.

Regarding this asset management project, the Precinct has already completed several key milestones. The Precinct has presented a project overview to the Water Commissioners at an Open Meeting on January 28, 2020; held a public workshop at the Hooksett Library on March 3, 2020 to describe Precinct assets, this project and the draft report; and completed this report with the associated summary brochure. The Precinct also plans to:

- Maintain and improve the asset inventory and mapping.
- Include a project description and promotion in a Precinct newsletter.
- Present the final report to the Water Commissioners at an Open Meeting.
- Review and revise the funding strategy and rate structure annually.
- Use report as source material in budget work sessions and hearings.

On behalf of T&H, we wish to express our appreciation to the Hooksett Village Water Precinct, GSRWA, Brown Engineering, and NHDES on their participation in this project and for their help in collecting information and data. During the course of this project, Ms. Eyleen Izaguirre served as Engineer, Ms. Jenna O'Connell served as Assistant Project Engineer, Ms. Justine Carroll, P.E. provided technical reviews and conducted the workshop and the undersigned served as Project Manager. If you have any questions, please do not hesitate to contact our office.

Sincerely,

TATA & HOWARD, INC.



Jenna W. Rzasa, P.E.
Co-President

Enclosure

cc: Luis Adorno, NHDES

Appendix A

TATA & HOWARD

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1.0 mg

Booster Pump Station

Manor Drive Tank
Capacity: 1.0 mg

Thompson Corner Tank
Capacity: 0.2 mg

Merrimack River

West River Rd

Edgewater Dr

Merrimack St

Pleasant St

Hooksett Rd

Post Rd

Beaver Way

Deer Run

Pine St

Brickadyewine Dr

Spencer Rd

Heather Dr

Ardon Dr

Main St

Maple St

Rosedale St

Riverside St

Veterans Dr

N Main St

Pinnacle St

Donald Pl

Summit Dr

Vista Dr

Birch Hill Rd

College Park Dr

Campus Dr

University Dr

Thompson Ave

Roy Dr

Grant Dr

Morgan Dr

Pleasant View Dr

Blackwater Dr

Crawford Ln

Albell Ave

Morse Dr

Mulberry Ln

Dale Rd

Avon Rd

Dover Rd

Wedgewood Cir

Memorial Dr

Shannon Rd

Tay Rd

Trent Rd

Eggwes Dr

Maidstone Rd

Thames Rd

Northview Ter

Bert St

Granite St

Highland St

Bernice St

Dundee Ave

Chase St

Stevens Dr

Bullard Dr

Knights Ave

Mountain View Rd

Almeda Ln

Roy Rd

Grandview Dr

South Bow Rd

Viewpoint Dr

Orchard Dr

Mason Ave

Hilton Cir

Pearl Dr

Country Mountain Rd

Morningside Dr

Brown Rd

Goffstown Rd

Valley View Dr

Corriveau Dr

Cate Rd

Water Precinct Access Rd

Mill House Access Rd

Snow Hill Rd

Pauzzi Rd

Bayview Terrace Rd

West Bank Rd

Cross Rd

Meadowcrest Rd

Scott Ave

Green St

Gosselin Ave

Technology Dr

Quality Dr

Kimball Dr

Briar Ct

Hackett Hill Rd

Poore Rd

Bemis Savoie Rd

Riverbank Rd

Goonan Rd

Central Park Dr

Sunrise Blvd

West River Rd

Hidden Ranch Dr

Lehoux Dr

Peters Brook Dr

Industrial Park Dr

Oak Hill Rd

Legends Dr

Westview Terr

Julia Dr

Sterling Ave

Burbank Way

Virginia Ct

Nancy Ln

Gary Ave

Marlette Ave

Dartmouth St

Howard Ave

Hunt St

Kerri Ln

Maidstone Rd

Thames Rd

Depot Rd

Martins Ferry Rd

McAllister St

Whitehall Rd

Benton Rd

Glenath Ave

Harvest Dr

Menifee Dr

Jefferson Dr

Sherwood Dr

Lancelot Dr

Camelot Dr

N River Rd

No Name

Vindale Rd

Matthew Rd

3

93

N

Legend

- Blow Off Valve

Water Main Diameter

- Smaller than 4-inch
- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch

Water Distribution System
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
June 2020

Appendix B

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1.0 mg

Booster Pump Station

Manor Drive Tank
Capacity: 1.0 mg

Thompson Corner Tank
Capacity: 0.2 mg

Merrimack River

West River Rd

Edgewater Dr

Merrimack St

Pleasant St

Hooksett Rd

Post Rd

Beaver Way

Deer Run

Dudley Ave

Chase St

Highland St

Bernice St

Bart St

Granite St

Stevens Dr

Ballard Dr

Knights Ave

Northview Ter

Ardon Dr

Heather Dr

Maple St

Rosedale St

Riverside St

Pinnacle St

Summit Dr

Donald St

Vista Dr

Birch Hill Rd

Veterans Dr

N Main St

College Park Dr

Campus Dr

University Dr

Blackwater Dr

Crawford Ln

Thompson Ave

Roy Dr

Grant Dr

Morgan Dr

Pleasant View Dr

Albert Ave

Main St

Morse Dr

Mayberry Ln

Pohl Rd

Avon Rd

Dove Rd

Shannon Rd

Tay Rd

Trent Rd

Maidstone Rd

Thames Rd

Gary Ave

Marlette Ave

Dartmouth St

Hazlett Ave

Hunt St

Kerri Ln

Lehoux Dr

Peters Brook Dr

Industrial Park Dr

Oak Hill Rd

Julia Dr

Stirling Ave

Westview Terr

Burbank Way

Virginia Ct

Nancy Ln

Legends Dr

Wedgewood Cir

Memorial Dr

Eggwes Dr

Bayview Terrace Rd

West Bank Rd

Scott Ave

Green St

Meadowcrest Rd

Cross Rd

Sunrise Blvd

Westwicker Rd

Hidden Ranch Dr

Palmer Rd

Saw Hill Rd

Pine St

Brighdywine Dr

Sprinter Rd

Water Precinct Access Rd

Pol House Access Rd

Cate Rd

Mountain View Rd

Almeda Ln

Roy Rd

Grandview Dr

Pearl Dr

Country Mountain Rd

South Bow Rd

Viewpoint Dr

Orchard Dr

Mason Ave

Hilton Cir

Morningside Dr

Brown Rd

Goffstown Rd

Valley View Dr

Corriveau Dr

Hackett Hill Rd

Briar Ct

Poore Rd

Bemis Savoie Rd

W Riverbank Rd

Gosselin Ave

Technology Dr

Quality Dr

Kimball Dr

Central Park Dr

Goonan Rd

Benton Rd

Chestnut Ave

Whitehall Rd

McAllister St

Martins Ferry Rd

Depot Rd

N River Rd

Sherwood Dr

Lancelot Dr

Camelot Dr

Harvest Dr

Monroe Dr

Jefferson Dr

Madison

Legend

- Blow Off Valve

Asset Management Score

- No Score
- Good to Excellent
- Good to Fair
- Fair to Poor

Asset Management Scores
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
June 2020

Appendix C

TATA & HOWARD

Pipe Input Data
Asset Management Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

FID	Location	Length (ft)	Diameter (in)	Material	Installation Year	Pressure (psi)	Breaks	Soil Info	Asset Management Score
0	North Well	691	6	AC	2004	70	0	Gravel/Sand	31
1	Pine Street	256	6	PVC	2008	54	0	Gravel/Sand	16
2	Pine Street	271	1	Plastic		70	0	Gravel/Sand	0
3	Hummingbird Lane	302	8	AC	1966	86	0	Gravel/Sand	42
4	Heather Drive	521	8	AC	1966	85	1	Gravel/Sand	61
5	West River Road	783	12	PVC	2002	82	2	Gravel/Sand	35
6	West River Road	994	8	AC	1978	78	0	Gravel/Sand	36
7	West River Road	2,027	8	AC	1978	60	0	Gravel/Sand	36
8	Windsor Terrace Apartments	244	8	PVC	2002	74	0	Gravel/Sand	8
9	Windsor Terrace Apartments	558	8	PVC	2002	74	0	Gravel/Sand	8
10	Windsor Terrace Apartments	628	8	PVC	2003	70	0	Gravel/Sand	8
11	West River Road	1,410	12	DI	2001	82	0	Gravel/Sand	11
12	Ardon Drive	2,103	8	PVC	2006	52	0	Gravel/Sand	8
13	West River Road	1,816	12	DI	1990	84	0	Gravel/Sand	16
14	Rosedale Street	641	8	DI	1990	90	0	Gravel/Sand	20
15	Maple Street	693	6	AC		84	1	Gravel/Sand	0
16	West River Road	925	6	AC	1972	88	0	Gravel/Sand	50
17	Riverside Street	1,348	12	PVC	1982	96	0	Potentially Corrosive	32
18	North Main Street	1,365	12	DI	1990	90	1	Potentially Corrosive	44
19	Veterans Drive	490	12	HDPE	2018	92	0	Potentially Corrosive	19
20	Lafond Avenue	601	6	PVC	2002	92	0	Gravel/Sand	22
21	Lafond Avenue	496	4	PVC	2002	92	0	Gravel/Sand	26
22	Pinnacle Street	1,718	6	AC	1985	68	0	Gravel/Sand	43
23	Donald Street	460	6	AC	1963	70	0	Gravel/Sand	44
24	Vista Drive	696	8	AC	1965	70	0	Gravel/Sand	36
25	Donald Street	1,401	6	AC	1963	70	0	Gravel/Sand	44
26	Summit Drive	642	6	AC	1965	59	0	Gravel/Sand	44
27	Birch Hill Road	665	6	PVC	1992	47	0	Gravel/Sand	21
28	Birch Hill Road	781	6	AC	1957	52	0	Gravel/Sand	44
29	West Quarry Tank	2,076	12	DI	2018	68	0	Gravel/Sand	4
30	South Well	410	8	DI	1986	78	0	Gravel/Sand	21
31	West River Road	11,745	12	PVC	1982	100	0	Potentially Corrosive	34
32	Dundee Avenue	1,511	12	DI	1992	98	0	Gravel/Sand	16
33	Veterans Drive	445	8	AC	1950	98	1	Gravel/Sand	61
34	Main Street	2,867	8	AC	1958	78	0	Gravel/Sand	36
35	College Park Drive	2,607	12	DI	2006	86	0	Gravel/Sand	11

Pipe Input Data
Asset Management Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

FID	Location	Length (ft)	Diameter (in)	Material	Installation Year	Pressure (psi)	Breaks	Soil Info	Asset Management Score
36	Route 3	3,042	12	DI	1985	50	0	Gravel/Sand	17
37	Route 3	688	6	AC	1958	50	0	Gravel/Sand	44
38	Grant Drive/Morgan Drive	2,085	8	AC	1963	76	0	Gravel/Sand	36
39	Grant Drive	597	8	AC	1962	74	0	Gravel/Sand	36
40	Kennedy Drive/Albert Avenue	591	6	AC	1962	74	0	Gravel/Sand	44
41	Beauchesne Drive	671	6	AC	1963	50	0	Gravel/Sand	44
42	Thompson Avenue/Ray Drive	1,244	6	AC	1962	70	0	Gravel/Sand	44
43	Short Avenue	390	6	AC	1962	70	0	Gravel/Sand	44
44	Thompson Corner Tank	883	8	AC	1950	50	0	Gravel/Sand	36
45	Hooksett Road	3,917	6	AC	1958	66	0	Gravel/Sand	44
46	St Mary's Condominiums	654	10	DI		46	0	Gravel/Sand	0
47	Route 3	2,276	12	DI	1996	50	0	Gravel/Sand	10
48	University Circle	424	12	PVC	2016	114	0	Gravel/Sand	11
49	University Circle	668	8	PVC	2016	126	0	Gravel/Sand	17
50	University Circle	1,645	12	PVC	2006	106	0	Gravel/Sand	12
51	Blackwater Road	741	12	PVC	2006	90	0	Gravel/Sand	10
52	Crawford Lane	1,602	8	PVC	2006	52	0	Gravel/Sand	8
53	Crawford Lane	854	8	PVC	2016	63	0	Gravel/Sand	7
54	Crawford Lane	617	8	PVC	2006	84	0	Gravel/Sand	14
55	Crawford Lane	183	8	PVC	2015	100	0	Gravel/Sand	15
56	Crawford Lane	1,611	8	PVC	2015	94	0	Gravel/Sand	13
57	Blackwater Drive	1,063	12	PVC	2012	67	0	Gravel/Sand	3
58	Blackwater Drive	227	12	PVC	2012	72	0	Gravel/Sand	3
59	Balckwater Drive	460	12	PVC	2012	67	0	Gravel/Sand	3
60	University Circle	3,608	12	PVC	2006	140	0	Gravel/Sand	14
61	Hooksett Public Library	891	8	PVC	2007	126	0	Gravel/Sand	18
62	Post Road	2,704	12	PVC	2004	134	0	Gravel/Sand	14
63	Manor Drive Tank	1,193	16	PVC	2007	65	0	Gravel/Sand	3
64	Manor Drive Tank	826	8	PVC	2007	63	0	Gravel/Sand	8
65	Post Road	4,997	16	PVC	2006	132	0	Gravel/Sand	13
66	Northview Terrace	877	8	PVC	2005	89	0	Gravel/Sand	14
67	Merrimack Street	1,077	8	AC	1950	98	0	Potentially Corrosive	52
68	Highland Street	437	2	Plastic	1950	86	1	Gravel/Sand	72
69	Granite Street	2,732	6	AC	1955	56	1	Gravel/Sand	63
70	Stevens Drive/Bullard Drive	1,513	6	PVC	1968	68	0	Known Corrosive Soil	40
71	Bullard Drive	696	6	AC	1968	64	0	Known Corrosive Soil	54

Pipe Input Data
Asset Management Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

FID	Location	Length (ft)	Diameter (in)	Material	Installation Year	Pressure (psi)	Breaks	Soil Info	Asset Management Score
72	Benice Street	455	8	AC	1960	68	0	Gravel/Sand	36
73	Benice Street	1,788	8	DI	1986	68	0	Gravel/Sand	21
74	Beaver Way	319	8	DI	1986	40	0	Gravel/Sand	21
75	Bert Street	1,433	6	AC	1960	56	0	Gravel/Sand	44
76	Route	239	12	DI	1996	50	0	Gravel/Sand	10
77	Route 3	169	12	DI	1996	50	0	Gravel/Sand	10
78	Dogwood Drive	792	8	DI	2005	52	0	Gravel/Sand	9
79	Ash Street	385	8	DI	1996	50	0	Gravel/Sand	14
80	Ash Street	183	8	DI	1996	50	0	Gravel/Sand	14
81	Cedar Street	915	8	DI	2005	50	0	Gravel/Sand	9
82	Chestnut Lane	234	8	DI	2005	52	0	Gravel/Sand	9
83	West River Road	1,833	12	PVC	1995	100	0	Gravel/Sand	17
84	Scott Avenue	1,866	6	PVC	1982	74	1	Known Corrosive Soil	57
85	Scott Avenue	438	8	DI	1988	88	0	Gravel/Sand	27
86	Green Street	651	6	PVC	1982	70	1	Known Corrosive Soil	57
87	Meadowcrest Road	371	6	PVC	1992	70	0	Gravel/Sand	21
88	Sunrise Boulevard	1,012	10	PVC	1998	55	0	Gravel/Sand	11
89	Sunrise Boulevard	1,246	8	PVC	1995	102	0	Gravel/Sand	21
90	Gullane Road	444	8	PVC	1995	76	0	Gravel/Sand	13
91	Gullane Road	505	8	PVC	1995	100	0	Gravel/Sand	21
92	Bayview Terrace Road/West Bank Road	2,295	8	PVC	1983	86	1	Gravel/Sand	45
93	Memorial Drive	2,843	6	AC	1958	62	0	Gravel/Sand	44
94	Hooksett Road	671	12	DI	1985	66	0	Gravel/Sand	17
95	Dale Road	675	8	PVC	1985	66	0	Gravel/Sand	20
96	Wedgewood Circle	735	6	PVC	1986	72	0	Potentially Corrosive	38
97	Dale Road	4,815	8	PVC	1985	84	1	Gravel/Sand	45
98	Otterson Street	323	8	AC	1960	52	1	Gravel/Sand	55
99	Knights Avenue	409	6	PVC	1981	62	0	Gravel/Sand	28
100	Chase Street	499	6	AC	1960	86	0	Gravel/Sand	50
101	Highland Street	225	6	AC	1950	86	0	Gravel/Sand	50
102	Merrimack Street	529	8	AC	1950	96	0	Potentially Corrosive	52
103	Pleasant View Drive	689	6	AC	1963	58	0	Gravel/Sand	44
104	Pine Street	819	6	AC		70	2	Gravel/Sand	0
105	Summit Drive	181	6	AC	1965	59	0	Gravel/Sand	44
106	Pinnacle Street	6	12	DI	2018	92	0	Gravel/Sand	10
107	Route 3	125	12	DI	2006	134	0	Gravel/Sand	15

Pipe Input Data
Asset Management Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

FID	Location	Length (ft)	Diameter (in)	Material	Installation Year	Pressure (psi)	Breaks	Soil Info	Asset Management Score
108	Merrimack Street	420	8	PVC	2006	86	0	Gravel/Sand	14
109	Memory Lane	173	1	Copper	1985	76	0	Gravel/Sand	37
110	St Mary's Condominium	72	10	DI		46	0	Gravel/Sand	0
111	Crawford Lane	476	8	PVC	2019	50	0	Gravel/Sand	7
112	Crawford Lane	512	8	PVC	2019	94	0	Gravel/Sand	13
113	Crawford Lane	1,160	8	PVC	2019	50	0	Gravel/Sand	7
114	University Circle	49	12	PVC	2006	140	0	Gravel/Sand	14
115	Deer Run	426	2	PVC	1986	48	0	Gravel/Sand	34
116	Deer Run	179	2	PVC	1986	48	0	Gravel/Sand	34
117	Deer Run	199	2	PVC	1986	48	0	Gravel/Sand	34
118	Windsor Terrace Apartments	268	8	PVC	2002	70	0	Gravel/Sand	8
119	Windsor Terrace Apartments	127	8	PVC	2003	68	0	Gravel/Sand	8
120	Windsor Terrace Apartments	244	6	PVC	2003	70	0	Gravel/Sand	16
121	Windsor Terrace Apartments	158	6	PVC	2003	68	0	Gravel/Sand	16
122	Windsor Terrace Apartments	157	4	PVC	2003	68	0	Gravel/Sand	20
123	Windsor Terrace Apartments	38	4	PVC	2003	68	0	Gravel/Sand	20
124	Windsor Terrace Apartments	33	4	PVC	2003	68	0	Gravel/Sand	20
125	Windsor Terrace Apartments	119	4	PVC	2003	68	0	Gravel/Sand	20
126	Windsor Terrace Apartments	15	4	PVC	2003	68	0	Gravel/Sand	20
127	Windsor Terrace Apartments	20	4	PVC	2003	68	0	Gravel/Sand	20
128	Windsor Terrace Apartments	13	4	PVC	2003	68	0	Gravel/Sand	20
129	Windsor Terrace Apartments	48	4	PVC	2003	70	0	Gravel/Sand	20
130	Windsor Terrace Apartments	66	4	PVC	2003	74	0	Gravel/Sand	20
131	Windsor Terrace Apartments	47	4	Plastic	2002	74	0	Gravel/Sand	32
132	Windsor Terrace Apartments	112	4	Plastic	2002	74	0	Gravel/Sand	32
133	Windsor Terrace Apartments	63	4	Plastic	2002	70	0	Gravel/Sand	32
134	Windsor Terrace Apartments	161	4	Plastic	2002	70	0	Gravel/Sand	32
135	Windsor Terrace Apartments	39	4	Plastic	2002	70	0	Gravel/Sand	32
136	Windsor Terrace Apartments	37	4	Plastic	2002	60	0	Gravel/Sand	32
137	Windsor Terrace Apartments	80	4	Plastic	2002	66	0	Gravel/Sand	32
138		899	8	PVC	1996	100	0	Gravel/Sand	21
139	West River Road	428	8	PVC	2006	90	0	Gravel/Sand	14
140	West River Road	582	6	PVC	2015	100	0	Gravel/Sand	23
141	Rosedale Street	385	8	AC	1981	90	0	Gravel/Sand	41
142	Rosedale Street	142	6		2016	94	0	Gravel/Sand	0
143	Thompson Avenue	58	6	AC	1962	78	0	Gravel/Sand	44

Pipe Input Data
Asset Management Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

FID	Location	Length (ft)	Diameter (in)	Material	Installation Year	Pressure (psi)	Breaks	Soil Info	Asset Management Score
144	West River Road	82	6	PVC	1995	100	0	Gravel/Sand	29
145	Meadowcrest Road	123	8	Plastic		98	0	Gravel/Sand	0
146		4	8	PVC	1982	60	0	Gravel/Sand	20
147	Highland Street	632	2	Plastic	1955	66	1	Gravel/Sand	66
148	Highland Street	31	6	AC		52	0	Gravel/Sand	0
149	Route 3	254	12	DI	2018	92	0	Gravel/Sand	10
150	Veterans Drive	67	12	DI	2018	92	0	Gravel/Sand	10
151	Veterans Drive	145	8	DI	1990	92	0	Gravel/Sand	20
152	Morse Drive	4,815	8	PVC	1985	76	1	Gravel/Sand	39
153	Cyr Drive	1,401	6	AC	1957	50	0	Gravel/Sand	44
154	Hooksett Road	4,997	16	PVC	2006	134	0	Potentially Corrosive	23
155	Route 3	3,042	12	DI	1985	48	0	Potentially Corrosive	27
156	Route 3	3,042	12	DI	1985	46	0	Gravel/Sand	17
157	West River Road	2,027	8	AC	1978	74	0	Potentially Corrosive	46
158	West River Road	11,745	12	PVC	1982	103	0	Potentially Corrosive	34
159	West River Road	11,745	12	PVC	1982	100	0	Potentially Corrosive	34
160	West River Road	11,745	12	PVC	1982	97	0	Potentially Corrosive	32
161	West River Road	11,745	12	PVC	1982	97	0	Potentially Corrosive	32
162	West River Road	11,745	12	PVC	1982	97	0	Potentially Corrosive	32
163	Main Street	1,816	12	DI	1990	84	1	Gravel/Sand	34
164	Hooksett Road	3,917	6	AC	1958	66	2	Gravel/Sand	69
165	Main Street	2,867	8	AC	1958	78	2	Gravel/Sand	61
166	Main Street	2,867	8	AC	1958	78	0	Gravel/Sand	36

Appendix D

TATA & HOWARD

Hydrants Past Their Useful Life Ranked by Age
Hooksett Village Water Precinct

FID	Rating	Installation Date	Location	Estimated Useful Life	Estimated Replacement Date
99	4	1/1/1950	Merrimack Street at Granite Street	40	1/1/1990
101	4	1/1/1950	Highland Street at Chase Street	40	1/1/1990
155	3	1/1/1950	23 Main Street	40	1/1/1990
171	3	1/1/1950	69 Main Street	40	1/1/1990
97	4	1/1/1955	Highland Street at Granite Street	40	1/1/1995
31	3	1/1/1956	15 Birch Hill Road	40	1/1/1996
91	4	1/1/1956	73 Granite Street	40	1/1/1996
186	3	1/1/1956	1600 Hooksett Road / Rt. 3	40	1/1/1996
28	3	1/1/1957	7 Birch Hill Road	40	1/1/1997
32	5	1/1/1957	11 Cyr Drive	40	1/1/1997
187	3	1/1/1958	1568 Hooksett Road / Rt. 3 (CD Boil)	40	1/1/1998
194	3	1/1/1959	Memorial Drive / Rt. 3	40	1/1/1999
92	4	1/1/1959	18 Bert Street	40	1/1/1999
98	3	1/1/1960	Granite Street at Chase Street	40	1/1/2000
167	3	1/1/1962	4 Ray Drive	40	1/1/2002
196	3	1/1/1962	5 Memorial Drive (Mem. Sch.)	40	1/1/2002
168	3	1/1/1962	25 Grant Street	40	1/1/2002
175	3	1/1/1963	15 Morgan Drive	40	1/1/2003
34	3	1/1/1963	20 Donald Street	40	1/1/2003
172	2	1/1/1963	10 Beauchesne Drive	40	1/1/2003
174	2	1/1/1963	7 Morgan Drive	40	1/1/2003
35	4	1/1/1965	8 Vista Drive	40	1/1/2005
181	3	1/1/1966	12 Morse Drive	40	1/1/2006
94	4	1/1/1968	7 Bullard Street	40	1/1/2008
95	2	1/1/1970	23 Bullard Street	40	1/1/2010
27	2	1/1/1972	456 West River Rd. / Rt. 3A	40	1/1/2012
100	2	1/1/1973	30 Merrimack Street	40	1/1/2013
148	2	1/1/1976	Hooksett Road / Rt. 3 @ Campus Driv	40	1/1/2016
0	2	1/1/1977	530 West River Road	40	1/1/2017
9	3	1/1/1978	500 West River Road / Rt. 3A	40	1/1/2018
176	2	1/1/1979	Hooksett Road / Rt. 3 @ Pleasant Viev	40	1/1/2019

Valves Past Their Useful Life Ranked by Year
Hooksett Villagw Water Precinct

FID	Installation Date	Location	Diameter	Estimated Useful Life	Estimated Replacement Date
43	1/1/1950	Granite St. @ Merrimack St.	6	50	1/2/2000
66	1/1/1950	Old Tank Line @ Main St.	8	50	1/2/2000
78	1/1/1950	Highland St. @ Dundee Ave.	6	50	1/2/2000
228	1/1/1950	Hooksett Rd. @ Thompson Corner Tank	6	50	1/2/2000
230	1/1/1950	Thompson Corner Tank Line	8	50	1/2/2000
42	1/1/1955	Granite St. @ Chase St.	6	50	1/1/2005
46	1/1/1955	Bernice St. @ Granite St.	6	50	1/1/2005
75	1/1/1955	Granite St. @ Highland St.	6	50	1/1/2005
34	1/1/1956	Granite St. West Of Hooksett Rd.	6	50	1/1/2006
44	1/1/1956	Granite St. @ #73	6	50	1/1/2006
80	1/1/1957	Birch Hill Rd. @ Pinnacle St.	6	50	1/2/2007
81	1/1/1957	Cyr St. To Donald St.	6	50	1/2/2007
82	1/1/1957	Birch Hill Rd. @ #7	6	50	1/2/2007
191	1/1/1957	Pinnacle St. @ West River Rd.		50	1/2/2007
26	1/1/1960	Otterson St. @ Bert St.	6	50	1/1/2010
40	1/1/1960	Chase St. @ Highland St.	6	50	1/1/2010
41	1/1/1960	Chase St. @ Granite St.	6	50	1/1/2010
67	1/1/1960	Bernice St. @ Bert St.	8	50	1/1/2010
68	1/1/1960	Bert St. @ Bernice St.	6	50	1/1/2010
164	1/1/1960	Bert St.	6	50	1/1/2010
21	1/1/1960	Otterson St. @ Granite St.	6	50	1/1/2010
69	1/1/1960	Bert St. @ Otterson St.	6	50	1/1/2010
70	1/1/1960		6	50	1/1/2010
74	1/1/1960	Bert St. East of Otterson St.	6	50	1/1/2010
53	1/1/1962	Grant Dr. @ Morgan Dr.	6	50	1/2/2012
56	1/1/1962	Grant @ Main St.	8	50	1/2/2012
58	1/1/1962	Grant Dr. @ Thompson Ave.	8	50	1/2/2012
59	1/1/1962	Ray Dr. @ Grant Dr.		50	1/2/2012
60	1/1/1962	Kennedy Dr. @ Grant Dr.	6	50	1/2/2012
62	1/1/1962	Grant Dr. @ Short Ave.	6	50	1/2/2012
233	1/1/1962	Memorial Dr.	6	50	1/2/2012
61	1/1/1963	Albert Ave. @ Kennedy Dr.	6	50	1/1/2013
63	1/1/1963	Beauchesne Dr.	6	50	1/1/2013
64	1/1/1963	Pleasant View Dr. @ Morgan Dr.	6	50	1/1/2013
65	1/1/1963	Albert Ave. @ Morgan Dr.	8	50	1/1/2013
79	1/1/1963	Pleasant View Dr. @ Morgan Dr.	8	50	1/1/2013
257	1/1/1963	Donald St. @ Vista Dr.	6	50	1/1/2013
83	1/1/1965	Pine St. East of Ardon Dr.	6	50	1/2/2015
85	1/1/1965	Heather Dr. @ Ardon Dr.	6	50	1/2/2015
86	1/1/1965	Ardon Dr. @ Heather Dr.	8	50	1/2/2015
87	1/1/1965	Hummingbird Ln. @ Ardon Dr.	6	50	1/2/2015

Valves Past Their Useful Life Ranked by Year
Hooksett Villagw Water Precinct

94	1/1/1965	Donald St. @ Pinnacle St.	6	50	1/2/2015
95	1/1/1965	Pinnacle St. West of Donald St.	8	50	1/2/2015
96	1/1/1965	Pinnacle St. East of Donald St.	8	50	1/2/2015
108	1/1/1965	Vista Dr. @ Summit Dr.	8	50	1/2/2015
114	1/1/1966	Morse Dr. @ Hooksett Rd.		50	1/2/2016
115	1/1/1966	Memory Ln. @ Morse Dr.		50	1/2/2016
38	1/1/1968	Bullard Dr. @ #17	6	50	1/1/2018
39	1/1/1968	Stevens Dr. @ Granite St.	6	50	1/1/2018
36	1/1/1968	Bullard Dr. @ Granite St.	6	50	1/1/2018
37	1/1/1968	Stevens Dr. @ Bullard Dr.	6	50	1/1/2018

Appendix E

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

10. West River Road
New ≥8-inch water main

4. Heather Drive
New 8-inch water main

2. Highland Street
New 8-inch water main

3. Granite Street, Otterson Street, Chase Street
New 8-inch water main

Booster Pump Station

Manor Drive Tank
Capacity: 1.0 mg

7. Bullard Drive
New 8-inch water main

6. Veterans Drive and Merrimack Street
New ≥12-inch water main

Thompson Corner Tank
Capacity: 0.2 mg

1. Route 3
New ≥12-inch water main

9. Dale Road
New 8-inch water main

11. Bayview Terrace Road and West Bank Road
New 8-inch water main

5. Scott Avenue and Green Street
New 8-inch water main

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1.0 mg

8. West River Road
New 12-inch water main

Merrimack River

Edgewater Dr

West River Rd

Pine St

Brighdwynne Dr

Sprague Rd

Merrimack St

Pleasant St

Hooksett Rd

Post Rd

Beaver Way

Deer Run

Heather Dr

Ardon Dr

Main St

Maple St

Roosedale St

Riverside St

Pinnacle St

Donald St

Summit Dr

Vista Dr

Birch Hill Rd

Veterans Dr

College Park Dr

Thompson Ave

Roy Dr

Grant Dr

McBean Dr

Alpine Ave

Pleasant View Dr

Blackwater Dr

University Cir

Crawford Ln

Campos Dr

Moose Dr

Mahony Ln

DW Hwy

Wedgewood Cir

Memorial Dr

Shannon Rd

Tay Rd

Frost Rd

Dove Rd

Bayview Terrace Rd

West Bank Rd

Eagles Dr

Maidstone Rd

Thomas Rd

Cross Rd

Meadowcrest Rd

Scott Ave

Green St

Gary Ave

Marlette Ave

Dartmouth St

Hosford Ave

Hunt St

Kerri Ln

Lehoux Dr

Industrial Park Dr

Peters Brook Dr

Oak Hill Rd

Julia Dr

Stirling Ave

Westview Terr

Burbank Way

Virginia Ct

Nancy Ln

Legends Dr

Sunrise Blvd

West River Rd

Hidden Ranch Dr

Gosselin Ave

Technology Dr

Quality Dr

Kimball Dr

Depot Rd

Martins Ferry Rd

McAllister St

Whitehall Rd

Benton Rd

Chouah Ave

Harvest Dr

Monroe Dr

Jefferson Dr

N River Rd

Sherwood Dr

Lancelot Dr

Camelot Dr

Central Park Dr

Goonan Rd

Bemis Savoie Rd

Poore Rd

Hackett Hill Rd

Briar Ct

Water Precinct Access Rd

Fox House Access Rd

Cate Rd

Palmer Rd

Snow Hill Rd

Mountain View Rd

South Bow Rd

Almada Ln

Roy Rd

Grandview Dr

Pearl Dr

Quarry Mountain Rd

Viewpoint Dr

Orchard Dr

Mason Ave

Hilltop Cir

Morningside Dr

Brown Rd

Goffstown Rd

Valley View Dr

Corriveau Dr

93

3

Legend

- Blow Off Valve

Recommended Improvements

- Phase I Improvements
- Phase II Improvements

Water Main Diameter

- Less than 4-inch
- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch

Recommended Improvements
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'

June 2020

Appendix F

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

Proposed Bow Interconnection

Replace with 12-inch water main

Replace with 12-inch water main

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1.0 mg

Replace with 12-inch water main

12-inch
Transmission loop

Replace with 12-inch water main

Booster Pump Station

Manor Drive Tank
Capacity: 1.0 mg

Replace with 12-inch water main

Replace Thompson Corner Tank

Thompson Corner Tank
Capacity: 0.2 mg

Replace with 12-inch water main

Existing Central Hookset Water Precinct Interconnection

Install 12-inch river crossing

Proposed Manchester Water Works Interconnection

Edgewater Dr
West River Rd
Merrimack St
Pleasant St
Hooksett Rd
Post Rd
Beaver Way
Deer Run
Pine St
Brighdywine Dr
Spring Rd
Main St
Heather Dr
Ardon Dr
Merrimack River
Douglas Ave
Steven Dr
Bullard Dr
Knights Ave
Granite St
Northview Ter
Maple St
Rosedale St
Reverende St
Pinnacle St
Donald St
Summit Dr
Birch Hill Rd
Veterans Dr
N Main St
College Park Dr
Campus Dr
University Cir
Thompson Ave
Roy Dr
Grant Dr
Morgan Dr
Pleasant View Dr
Albert Ave
Blackwater Dr
Crawford Ln
Main St
Mountain View Rd
Almeda Ln
Roy Rd
Grandview Dr
Pearl Dr
Quimby Mountain Rd
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Morningside Dr
Brown Rd
Golf House Access Rd
Cate Rd
Turf Precinct Access Rd
Saw Mill Rd
Baker Rd
Dale Rd
Mouse Dr
Mouse Dr
Longboat Key Cir
Memorial Dr
Eagles Dr
Avon Rd
Dove Rd
Shannon Rd
Tay Rd
Grant Rd
Maidstone Rd
Thames Rd
Bayview Terrace Rd
West Bank Rd
Cross Rd
Meadowcrest Rd
Scott Ave
Green St
Gary Ave
Marlette Ave
Dartmouth St
Hosford Ave
Hunt St
Kerri Ln
Lehoux Dr
Peters Brook Dr
Industrial Park Dr
Oak Hill Rd
Griffin Ave
Julia Dr
Westview Terr
Burbank Way
Virginia Ct
Nancy Ln
Legends Dr
Sunrise Blvd
Golden Ranch Dr
Gosselin Way
Clough Ave
Benton Rd
Whitehall Rd
McAllister St
Martins Ferry Rd
Depot Rd
Harvey Dr
Monroe Dr
Madison
Jefferson Dr
Sherwood Dr
Lancelot Dr
Camelot Dr
N River Rd
Technology Dr
Quality Dr
Kimball Dr
Hackett Hill Rd
Briar Ct
Poore Rd
Bemis Savoie Rd
Goonan Rd
Central Park Dr
Goffstown Rd
Valley View Dr
Corriveau Dr

Legend

- Blow Off Valve

Water Main Diameter

- Smaller than 4-inch
- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch

Hydraulic Improvement Plan
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
June 2020

Appendix G

TATA & HOWARD

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
1	Water Resource Adequacy	Provide an adequate supply for customer demand.	$\frac{Current\ Capacity}{Peak\ Daily\ Demand} \geq 1$ $\frac{Current\ Capacity\ with\ Largest\ Well\ Offline}{Average\ Daily\ Demand} \geq 1$
2	Product Quality	Compliance with Federal and State drinking water regulations.	Maintain 99% or greater days in compliance. Determine and reassess annually. $\frac{No.\ of\ Days\ in\ Full\ Compliance}{Total\ Days\ in\ a\ Year} * 100 = \%\ of\ Days\ in\ Compliance$
3	Stakeholder Support	Improve public understanding of utility matters.	Share asset management plan information in newsletter and brochure. Quarterly update of website. Annual update and publication of Capital Improvement Plan.

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No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
4	Customer Satisfaction	Maintain a customer complaint (quality, quantity, pressure) log.	Minimize complaints. Determine and assess annually. $$\frac{No.\,of\ Complaints}{No.\,Accounts} \leq 2\%$$
		Provide accurate customer billing information.	Issue 95% or greater correct bills. Determine and reassess annually. $$\frac{Total\ Bills - \ No.\ Error - Driven\ Billing\ Adjustments}{Total\ Bills} * 100 = \%\ Correct\ Bills$$
5	Community Sustainability & Economic Development	Maintain affordable rates.	Maintain an average user cost of less than 2.5% of MHI.

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No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
6	Employee & Leadership Development	Maintain employee satisfaction.	Complete an annual satisfaction level check in with employees.
		Maintain certification coverage.	Maintain 100% certification coverage. Determine and reassess annually. $\frac{No.\ Employee\ Certifications}{No.\ Required\ Certifications} * 100 = \%\ Certification\ Coverage$
7	Financial Viability	Obtain adequate revenue to cover overall expenditures.	Revenue to cover total expenditures is 95% or greater. Determine and reassess annually. $\frac{Total\ Revenue}{Total\ Expenditures} * 100 = \%\ revenue\ to\ cover\ total\ expenditures$
		Maintain sufficient reserves.	Maintain capital reserves funds of at least 30% of budget. Re-evaluate the reserves to budget ratio annually.
		Ensure financial management integrity.	Complete annual financial statement audit with the goal to present a clean opinion indicating that the financial statements fairly represent the finances of the Precinct.

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
8	Operational Optimization	Provide efficient water delivery. Implement leak detection and repair program.	Water balance is 15% or less. Determine and reassess annually through a water balance reporting. $\frac{Water\ Balance}{System\ Input\ Volume} * 100 = \%\ water\ balance$
		Maintain meter functionality. Continue water meter replacement program.	Maintain 95% or greater functioning meters. Determine and reassess annually. $\frac{Total\ No.\ Active\ Billable\ Meters - Stopped\ or\ Malfunctioning\ Meters}{Total\ No.\ of\ Active\ Billable\ Meters} * 100 = \%\ Functioning\ Meter$
		Maintain efficient distribution system and treatment systems.	Achieve treatment goals of pH ≥ 7.2 and free Cl ≤ 0.2 mg/L > 90% of the time leaving treatment plants. Review annually. Complete a hydraulic model. Evaluate looping to eliminate dead ends in system with the hydraulic model, and optimize pump/tank operations. Conduct energy audit.

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No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
9	Infrastructure Stability	Complete 'Critical' asset identification.	Complete recommendations outlined in the asset management report, including the identification and assessment of remaining above and below ground assets.
10	Operational Resiliency	Minimize water main breaks and leaks.	10 or less water main breaks per 30 miles of pipe per year. $\frac{No.\,Breaks/Leaks\,per\,Year}{Total\,Miles\,of\,Pipe} * 30 = No.\,Breaks/Leaks\,per\,Mile\,of\,Pipe$
		Maintain an all hazards emergency response plan.	Complete an all hazards vulnerability assessment. Update emergency response plan with vulnerability assessment. Complete health and safety training for all employees.

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Appendix H

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Long-Term Project Description	Year± of Last Purchase	Year± of Next Purchase	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	10-Year Project Cost	25-Year Project Cost
Tanks: (a) Installation of new correctly sized tank for Low Pressure Zone (LPZ) (via $1.8M loan in 2019-20)	2019	--	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$1,101,195	$2,299,833
(b) Repair/re-purposing of old LPZ tank	1950	2021	$0	$200,000	$0	$0	$0	$0	$0	$0	$0	$0	$200,000	$200,000
(c) Repair/upgrade High PZ (HPZ) tank	2007	2022	$0	$0	$60,000	$0	$0	$0	$0	$0	$0	$0	$60,000	$60,000
New Source Installation: For drought-contamination protection and growth (estimated $1M loan in 2024)	2007	2023-24	$25,000	$25,000	$50,000	$50,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$510,000	$1,350,000
Main Replacement/improvement: 30 miles pipe @ 1,000'/yr x $250/ft + $25K engr = $275K/yr (160-yr life cycle)	0 - 70 yrs±	Annual	$150,000	$0	$150,000	$240,000	$220,000	$255,000	$245,000	$205,000	$210,000	$210,000	$1,885,000	$5,380,000
Emergency Interconnection: Backup for west LPZ (estimated $1M loan in 2022)	1985±	2021-22	$25,000	$25,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$530,000	$1,257,500
Meters/Transmitters: Routine upgrades/replacements (10-20 year cycle)	0 - 68 yrs±	2020-23	$60,000	$60,000	$60,000	$40,000	$5,000	$5,000	$5,000	$5,000	$35,000	$35,000	$310,000	$720,000
Pump Stations: Improvements for efficiency/safety/damage prev./SCADA	10-35 yrs±	2020	$65,000	$10,000	$10,000	$0	$0	$0	$0	$0	$0	$0	$85,000	$230,525
Vehicles: Routine replacement before major repairs (12-year cycle)	1-12 yrs	2021	$0	$45,000	$0	$0	$45,000	$0	$0	$35,000	$0	$0	$125,000	$350,800
Projected CIP totals:		*$346,269 (FY2019)*	***$435,119***	***$475,119***	***$500,119***	***$500,119***	***$500,119***	***$490,119***	***$480,119***	***$475,119***	***$475,119***	***$475,119***	***$4,806,195***	***$11,848,658***
Breakdown of CIP Sources: *Trust funds:*		*$101,000*	*$40,000*	*$40,000*	*$35,000*	*$25,000*	*$25,000*	*$15,000*	*$5,000*	*$0*	*$0*	*$0*	*$185,000*	*$286,000*
Prior year surplus:		*$0*	*$45,000*	*$20,000*	*$5,000*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$70,000*	*$70,000*
Taxes:		*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Rates & fees:		*$245,269*	*$350,119*	*$415,119*	*$460,119*	*$475,119*	*$475,119*	*$475,119*	*$475,119*	*$475,119*	*$475,119*	*$475,119*	*$4,551,195*	*$11,492,658*
Projected Budget ▲ due to CIP:		*$152,456*	*$104,851*	*$65,000*	*$45,000*	*$15,000*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*		
Breakdown of Budget Needs: *CIP ▲:*		*$152,456*	*$104,851*	*$65,000*	*$45,000*	*$15,000*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*		
+ Routine O&M (inflation) ▲:		*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*		
+ Planned trust fund deposit:		*$0*	*$0*	*$10,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*		
+ Water usage factor:		*$2,350*	*$2,350*	*$2,350*	*$2,350*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*		
Approx. add'l. revenue needs ▲:		*$169,806*	*$122,201*	*$92,350*	*$87,350*	*$55,000*	*$40,000*	*$40,000*	*$40,000*	*$40,000*	*$40,000*	*$40,000*		

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Appendix B

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ASSET MANAGEMENT PLAN UPDATE

March 2021

Hooksett Village Water Precinct
Hooksett, NH

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Asset Management Plan Update
Hooksett Village Water Precinct
Hooksett, New Hampshire

March 2021

Prepared by

TATA & HOWARD

TATA & HOWARD

March 29, 2021

Mr. Mike Heidorn, Superintendent
Hooksett Village Water Precinct
7 Riverside Street
Hooksett, NH 03106

Subject: Asset Management Plan Update
Hooksett Village Water Precinct
T&H No. 6525

Dear Mr. Heidorn:

In accordance with our agreement, Tata & Howard is pleased to present this Asset Management Plan Update for the Hooksett Village Water Precinct water distribution system. The Asset Management Plan completed by Tata & Howard in May 2020 discussed the need to develop a hydraulic model for further investigation of the system with the potential of reprioritizing those improvements recommended based solely on asset management criteria. The analysis and improvements in this report are based on the Three Circles Approach for optimum capital efficiency, which combines hydraulic and critical component considerations with an asset management rating system to evaluate the condition of the water mains in the distribution system. Supply and storage needs were also evaluated in this report.

A hydraulic model using field flow tests was developed to identify hydraulic recommendations developed as part of this study. Critical areas of the system were identified and evaluated in the hydraulic model for redundancy. Finally, the previous asset evaluation completed by Tata & Howard in May 2020 was incorporated with this new analysis. The results were combined to determine the water mains most in need of replacement and establish a prioritized set of improvements in the system. A detailed description of the improvements and estimated costs is presented in Section 7.

During the course of this project, the undersigned served as Project Officer, Mr. Yogesh Jitoo, P.E. served as Project Manager, Ms. Jenna O'Connell served as Assistant Project Engineer, and Ms. Justine Carroll, P.E. provided technical reviews.

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At this time, we wish to express our continued appreciation to the Precinct for their participation in this study and for their help in collecting information and data. We appreciate the opportunity to assist the Precinct on this important project.

Sincerely,

TATA & HOWARD, INC.

Jenna Rzasa, P.E.
Co-President

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SECTION 1 – Executive Summary

1.1 General

Tata & Howard, Inc. was retained by the Hooksett Village Water Precinct (Precinct) to complete an Asset Management Plan Update for the Hooksett Village Water Precinct water system. The purpose of the Asset Management Plan Update is to update the existing Asset Management Plan completed in May 2020, to identify areas of the water distribution system in need of rehabilitation, repair, or replacement; and to prioritize improvements to make the most efficient use of the Precinct's capital budget. In addition to distribution system water mains, water supply and storage needs are evaluated and prioritized.

Tata & Howard evaluated the water distribution system piping using the Three Circle Approach, which consists of the following evaluation criteria:

- System hydraulic evaluation,
- Critical component assessment,
- Asset management considerations.

Each circle represents a unique set of evaluation criteria for each water main segment. From each set of criteria, system deficiencies are identified and then compared. Any deficiency that falls into more than one circle is given higher priority than one that falls into a single circle. Using the Three Circle Approach, recommended improvements will result in the most benefit to the system. In addition, the Three Circle Approach allows us to identify any situations that mitigate a deficiency in one circle and eliminate a deficiency in another circle. By integrating all three sets of criteria, the infrastructure improvement decision making process and overall capital efficiency are optimized.

1.2 Water Supply Evaluation

The existing water supply sources were evaluated relative to current and future water demands as part of a Water Supply and Usage Evaluation Assessment completed by Lewis Engineering, PLLC in May 2020. This study was used as the basis for the analysis of the Precinct's water supply. The 24-hour withdrawal volume is 1.87 million gallons per day (mgd) with a 16-hour withdrawal volume of 1.25 mgd. With a projected Maximum Day Demand (MDD) of 1.84 mgd, the Precinct currently does not have enough available supply volume to safely meet the needs of the system through 2030 with the completion of the proposed housing development in the HSA. Water supply evaluation is discussed further in Section 3.3.

1.3 Water Storage Evaluation

The projected demands calculated in the assessment completed by Lewis Engineering, PLLC and existing water distribution system operating conditions were considered by Tata & Howard to evaluate the available storage in the system. The projected 2030 required storage in the Precinct's Main Service Area (MSA) was estimated to be approximately 0.77 million gallons (mg). The total available storage is 1.20 mg for the MSA and was based on storage needed to meet peak water

demands and provide fire protection. This leaves the MSA with a surplus of 0.43 mg in storage in the MSA. Additionally, the High Service Area (HSA) has a projected available storage volume of 0.68 mg under 2030 demand conditions. The available storage in the HSA is 0.69 mg, which leaves the HSA with a storage surplus of 0.01 mg if the proposed housing development is completed. Water storage evaluation is discussed further in Section 3.4.

1.4 System Hydraulics

The Precinct had previously contracted Lewis Engineering, PLLC to conduct a Water Supply Assessment and evaluate the demand projections through 2030 based on historic pumping data and building development plans within the Precinct's service area. For consistency, the results of this assessment were used as demand projections for Tata & Howard's hydraulic analysis. These demand projections were input into the hydraulic model and simulations were run to identify the system's ability to provide adequate flows and pressures during both average day, maximum day and peak hour demands. The model runs identified multiple areas where system hydraulic deficiencies may exist. The demand projections were also used to review existing and projected water supply and water storage needs for the water system.

Hydraulic deficiencies were identified as part of a system wide evaluation to review transmission capabilities of the system, review the system's ability to provide Insurance Service Office (ISO) recommended fire flows, and eliminate dead ends and bottlenecks in the system, when possible. System hydraulics are discussed further in Section 4.

1.5 Critical Components

A critical component assessment was performed for the water distribution system to evaluate the impact of potential water main failures on the system. The critical component assessment includes identification of critical areas served, critical water mains, and the need for redundant mains. Critical areas served were identified by the Hooksett Village Water Precinct (Precinct) staff and include Precinct facilities, sewer department facilities, schools, top users, and emergency services. Critical water mains include primary transmission lines, mains connecting water storage tanks and sources to the system, mains that will cause a system demand shortfall if a break occurs, and water mains that cross rivers, streams, waterways, and railroad tracks. Critical components are discussed further in Section 5.

1.6 Asset Management

An asset management evaluation on all water mains in the water distribution system was previously completed for the Precinct as part of an Asset Management Grant awarded by the New Hampshire Department of Environmental Services (NHDES). A number of factors were considered in the rating system, including installation year, diameter, material, water quality, break history, and soil characteristics. These factors affect the decision to replace or rehabilitate a water main. Using the asset management rating approach, each water main in the system was assigned a rating based on these factors. Water mains with a total rating less than 25 are considered to be in good to excellent condition. Mains with a total rating between 25 and 44 are considered to be

in fair to good condition, and mains with a total rating of 45 or greater are considered to be in poor to fair condition. Asset management is discussed further in Section 6.

1.7 Distribution System Evaluation

Utilizing the Three Circles Approach, water main improvements were recommended and prioritized based on the aforementioned criteria. Phase I improvements generally include any recommended improvements that fall into all three circles and are hydraulically deficient, critical, and have a high asset management score. The total estimated probable construction cost of the Phase I recommended improvements is approximately $5,221,000. Phase II improvements include any recommended improvements that fall into two of the circles. The total estimated probable construction cost of the Phase II recommended improvements is approximately $1,643,000. Phase III recommendations include any recommended improvements that have a high asset management score indicating poor to fair condition. The total estimated probable construction cost of Phase III improvements is approximately $4,930,000. These water mains are identified on the Recommendations Maps in Appendix H.

Costs are based on recent bid tabulations and do not consider escalation based on an actual planned construction date for each recommended improvement. Estimated costs for each improvement include construction costs for the water main, hydrants, services, appurtenances, and temporary and permanent trench pavement. A 25 to 30-percent allowance for engineering, permitting, and contingency is included in each project's estimated cost. The standard allowance for engineering and contingency is 25-percent, but for any improvements that include a horizontal directional drill, the allowance is increased to 30-percent due to the complexities associated with these projects.

1.8 Implementation of System Improvements

The list of water main improvements included in Section 7 is extensive due to the nature of this report. The prioritization of the recommended improvements based on the Three Circle Approach serves as a guide for implementation of the infrastructure improvements with the greatest to least benefit based on the prioritization and weighted criteria established jointly by the Precinct Staff and Tata & Howard. The implementation of these improvements is intended to be completed over multiple years and will require close coordination with the Precinct's Board of Water Commissioners and evaluation of water rates to determine appropriate funding sources. Based on the recommended system improvements and the estimated probable construction costs presented in this report, it is recommended that all Phase I and II improvements, which will provide the greatest benefit to the system, be completed over a 10-year period.

SECTION 2 – System Description and Operations

2.1 System Description

The Precinct's water distribution system has approximately 1,200 service connections, serving a population of approximately 2,900 year round. All of the customers served are metered for water consumption and billing purposes. The distribution system includes approximately 28 miles of water main, including 4 miles of private water mains, ranging in size from two inches to 16-inches. Figure No. 2-1 displays the breakdown of water main size by diameter based on the miles of each size in the water distribution system. Approximately three percent of the system is 4-inch diameter main, 24 percent is 6-inch diameter main, 34 percent is 8-inch diameter main, one percent is 10-inch diameter main, 34 percent is 12-inch diameter main, and four percent is 16-inch diameter main.

The distribution system pipe materials include, ductile iron (DI), asbestos cement (AC), copper, polyvinyl chloride (PVC), and high density polyethylene (HDPE). Figure No. 2-2 displays the breakdown of water main materials based on the miles of each material in the water distribution system. Approximately 18 percent of the system is DI main, 28 percent is AC main, less than one percent is copper, and 54 percent is plastic, PVC, or HDPE main.

The Precinct has four active groundwater supply sources including the North Well, East Well, South Well, and South Well Backup. The Precinct has three water storage facilities including the West (Quarry) Tank, Thompson Corner (Oak Hill) Tank, and Manor Drive Tank. The system has one high pressure service area served by the booster pump station. The system also includes a water supply interconnection with the Central Hooksett Water Precinct which is for emergency service only. A map of the existing water distribution system is included in Appendix A.

2.2 Water Supply Sources

The Precinct has four groundwater sources, the North Well, located off Pine Street, the East Well, located off Ardon Drive, and South Well and South Well Backup both located off Pinnacle Street. Groundwater from each well is treated with chemical injection at each well's pump station.

North Well

North Well is a 12-inch diameter gravel packed well located off Pine Street and was constructed in 1987. The well was most recently cleaned and redeveloped in March 2020, resulting in a capacity of 18.9 gallons per minute/foot (gpm/ft) at 400 gpm following redevelopment. A new Goulds pump rated for 400 gpm at 290 feet total dynamic head (TDH) was installed at this time and the 40 horsepower (HP) motor was rehabilitated. The well is 76 feet deep and has a screen length of fifteen feet. Water from the North Well is pumped to the North Well Pump Station where it is injected at the pump station with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

Figure No. 2-1
Water Main Diameter Distribution

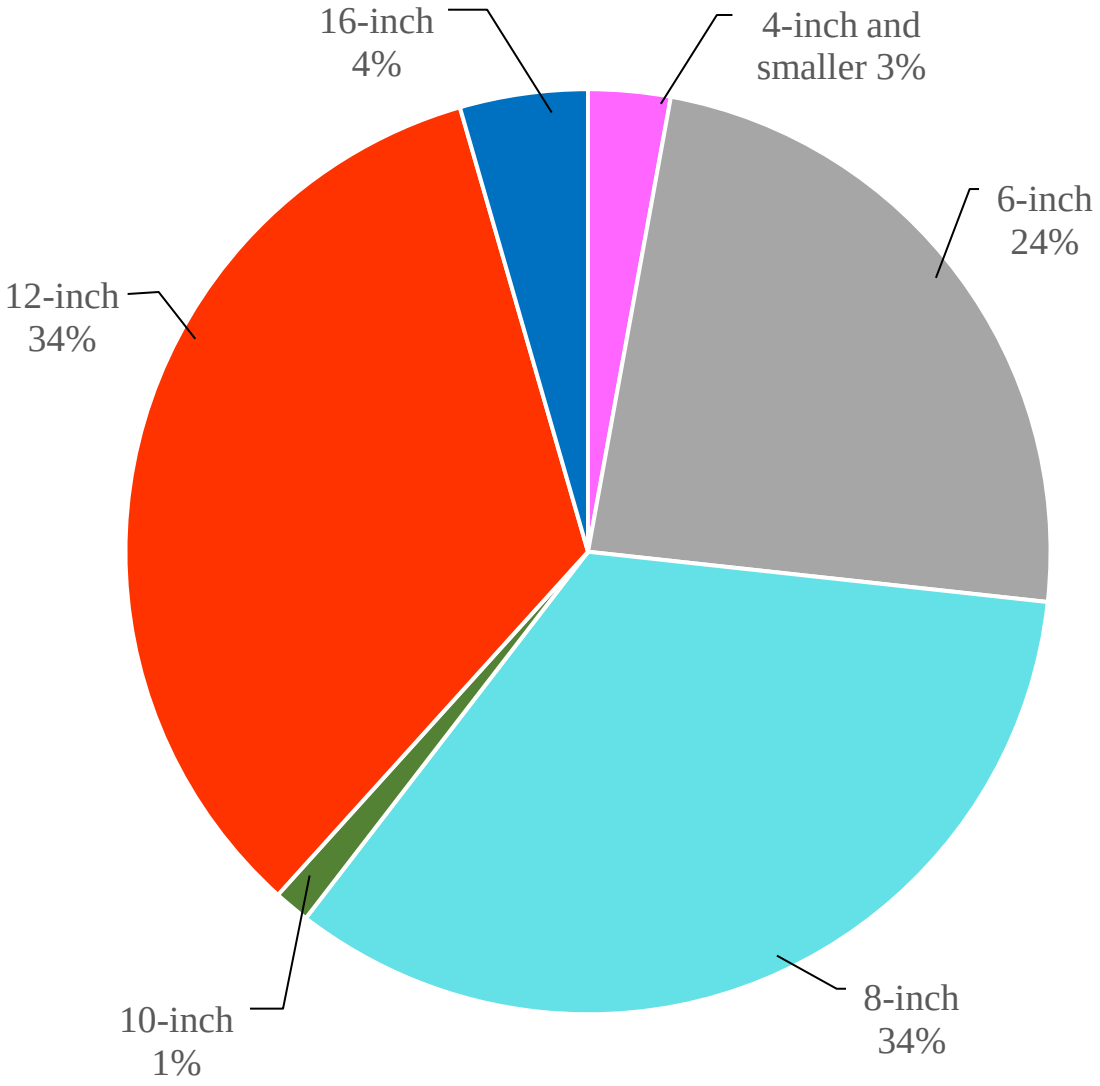
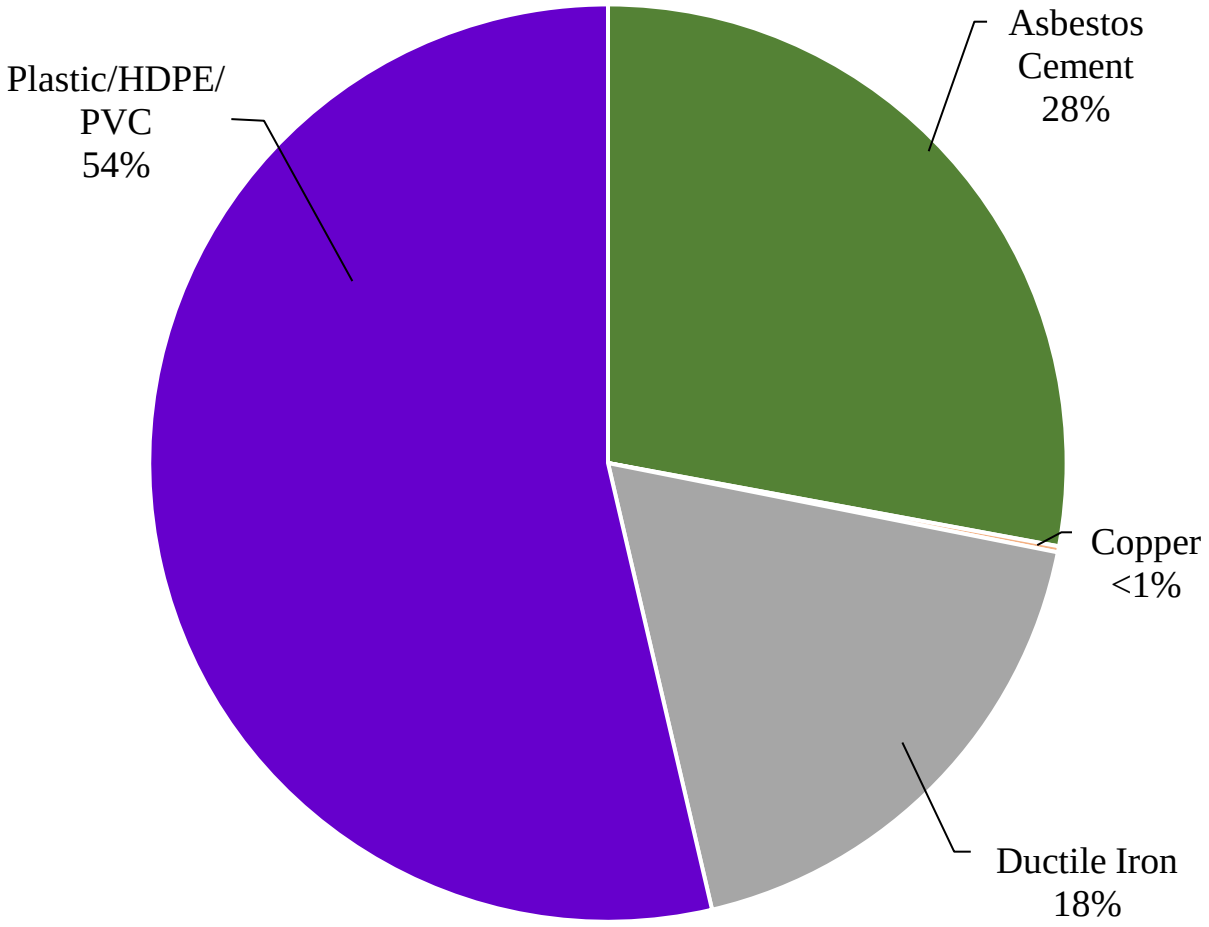


Figure No. 2-2
Water Main Material Distribution



East Well

East Well is a 12-inch diameter gravel packed well located off Ardon Drive and was constructed in 2004. The well was most recently cleaned and redeveloped in 2017, resulting in a capacity of 29 gpm/ft at 500 gpm following redevelopment. It is scheduled next for cleaning and redevelopment in 2021. The well is 79.7 feet deep and has a screen length of fifteen feet. The well has an American Marsh pump with a capacity of 400 gpm at 333 feet TDH and a 50 HP motor which were both rehabilitated in 2017. Water from the East Well is pumped to the East Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

South Well and South Well Backup

South Well is a 12-inch by 8-inch relined and gravel-packed well located off Pinnacle Street, originally constructed in 1986. The South Well Backup is a 12-inch diameter gravel-packed well in the same location and was constructed in 2003. Both wells were most recently cleaned and redeveloped in 2018, resulting in a capacity of 29.52 gpm/ft at 400 gpm for the South Well and 14.57 gpm/ft at 400 gpm for the South Well Backup following redevelopment. The South Well is 56.6 feet deep with a screen length of twelve feet. The South Well Backup is 65 feet deep with a screen length of fifteen feet. Both wells have 40 HP motors. The wells operate in tandem and only one is pumped at one time. Water is pumped from both wells to the South Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

2.3 Water Storage Facilities

The Precinct has three water storage facilities with a total storage capacity of 2.3 million gallons.

West (Quarry) Tank

The West (Quarry) Tank is a 1.0 mg glass-fused-to-steel storage tank located off Brickyard Pond Road. The tank has an overflow elevation of approximately 435 feet above mean sea level (MSL) and an inside diameter of 58.75 feet. The height of the tank from the overflow to the base is 50 feet. The tank was constructed in 2019 by Statewide Aquastore, Inc.

Thompson Corner (Oak Hill) Tank

The Thompson Corner Tank is a 200,000-gallon welded steel storage tank located off Hooksett Road. The tank has an overflow elevation of approximately 425 feet above MSL and an inside diameter of 33 feet. The height of the tank from the overflow to the base is 30 feet. The tank was constructed in 1950 by Chicago Bridge & Iron Company and is in need of repair or replacement.

Manor Drive Tank

The Manor Drive Tank is a 1.1 mg concrete storage tank located off Manor Drive. The tank has an overflow elevation of approximately 643 feet and an inside diameter of 50 feet. The height of the tank from the overflow to the base is 75 feet. The tank was constructed in 2007 by DN Tanks. This tank serves the high service area.

2.4 Interconnections

The Precinct maintains one emergency water supply interconnection with the Central Hooksett Water Precinct. The interconnection is metered and is for emergency use only. The Central Hooksett Water Precinct purchases water from Manchester Water Works and is contractually restricted by volume. Manchester Water Works provides all treatment for Central Hooksett Water Precinct, including chloramine addition. The Hooksett Village Water Precinct is currently studying the feasibility of an interconnection with the Bow Municipal Water System and a second emergency interconnection for the Main Service Area with the City of Manchester Water Works. The interconnection with the Bow system offers the possibility of both purchased and emergency water with similar chemistry and treatment, without the addition of chloramines.

SECTION 3 – Water System Demands

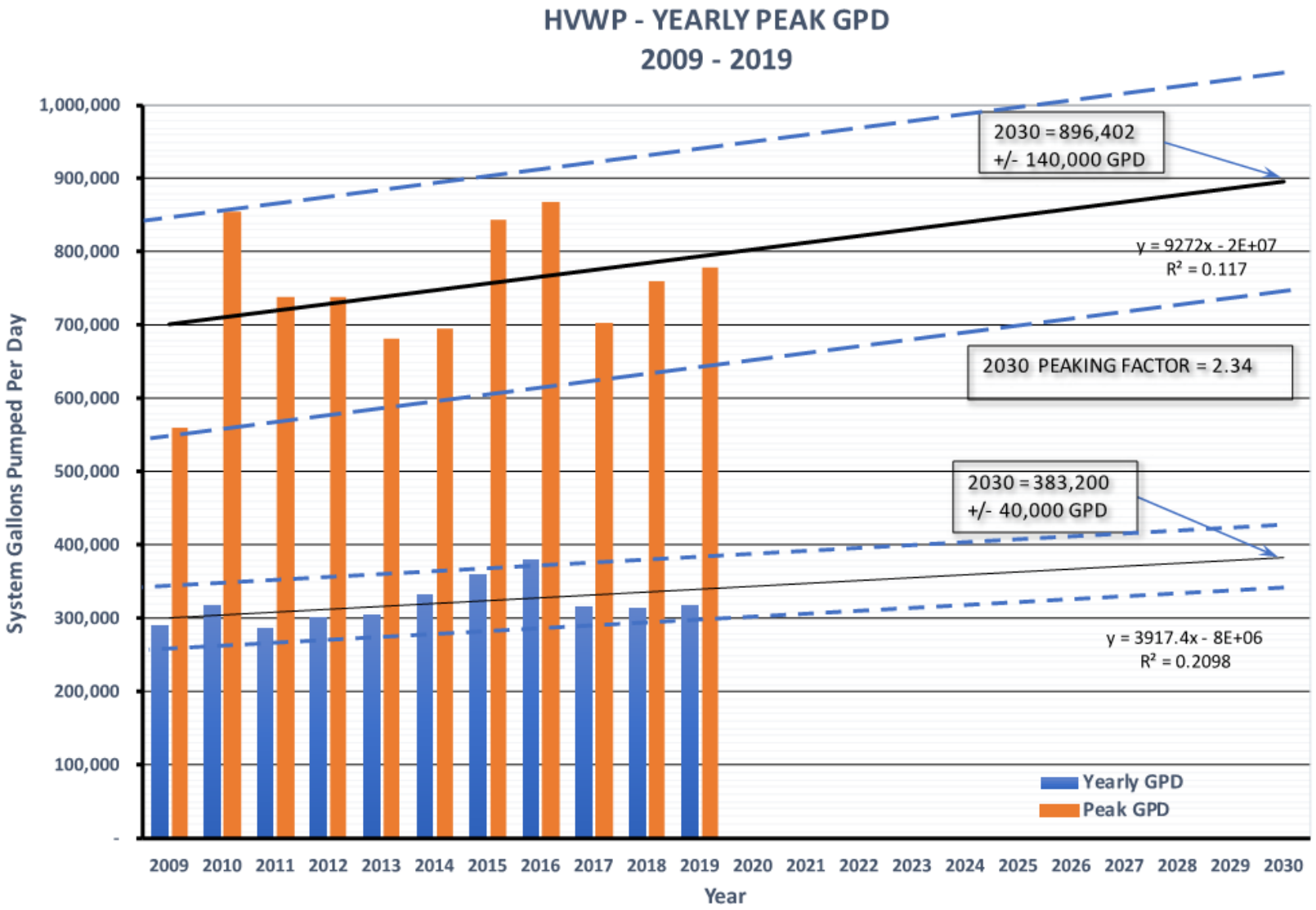
3.1 General

For the purposes of evaluating the water needs of a community, several parameters are typically reviewed to better understand the demands of a distribution system. These parameters are defined in the sections below and are presented with existing and projected demand estimates. In accordance with the NHDES and Ten State Standards, the supply sources of a water system must be capable of meeting existing and projected maximum day demand (MDD) conditions with all sources on-line and existing and projected average day demand (ADD) conditions with the largest source out of service.

3.2 Water System Demands

The Lewis Engineering Water Supply Assessment reviewed historical average daily water usage between 2009 and 2019 to determine a trend in the average daily usage. This trend was used to estimate a 2030 average day demand (ADD) of approximately 383,200 gallons per day (gpd), plus or minus 10 percent. The report also reviewed historical peak daily flows between 2009 and 2019 to estimate a 2030 maximum day demand (MDD) of approximately 896,400 gpd, plus or minus 16 percent. A housing development is slated to be built in the University Heights and Heads Pond area of Hooksett which would require an estimated additional 390,000 mgd under ADD conditions and 940,000 mgd under MDD conditions. The development was begun but construction has stalled with the recent fluctuations in the economy and the schedule for completion of this development is not currently determined. However, to be conservative in future estimates, it is assumed that this development will be completed by 2030 and these additional demands have been added into the system wide demand projections. With the development included, the projected 2030 ADD is approximately 770,000 mgd and the projected MDD is approximately 1,840,000 mgd. The Lewis Engineering Water Supply Assessment Demand Projections without the additional housing development demand are presented in Figure No. 3-1 and the Lewis Engineering report is included in Appendix B.

Figure No. 3-1
Lewis Engineering Demand Projections



Average Day Demand

Average day demand (ADD) is the total water supplied to a community in one year divided by 365 days. This term is commonly expressed in mgd. This demand includes all water used for domestic (residential), commercial, and municipal purposes. The municipal component includes water used for system maintenance such as water main flushing and fire flows. In addition, the ADD includes unaccounted-for water attributed to unmetered water uses and system leakage. According to the pumping records between 2015 and 2019, the ADD supplied for the Precinct ranged from 0.32 mgd to 0.36 mgd.

The estimated ADD for the design year 2030 based on the above criteria as determined in the Lewis Engineering Assessment and including the housing development is approximately 0.77 mgd.

Maximum Day Demand

Maximum day demand (MDD) is the maximum one-day (24-hour) total quantity of water supplied during a one-year period. This term is typically expressed in mgd.

The Lewis Engineering assessment used the historical peak day pumping rates between 2009 and 2019 to project an estimated 2030 MDD of 1.84 mgd, including demand from the housing development.

Peak Hour Demand

Peak hour demand is the maximum total quantity of water supplied in a single hour over a one-year period, typically expressed in mgd. These demands are typically met by distribution water storage facilities.

The Lewis Engineering assessment calculated a 2030 Peaking Factor of 2.34 based on the ratio of the projected 2030 ADD and MDD. The MDD/ADD ratio for a community can be used to estimate the peak hour/ADD peaking factor. Under current conditions, the MDD/ADD ratio is 0.50, with the corresponding peak hour factor for the system approximately 3.8. Using the MDD/ADD values for 2030 with the full housing development demand, the ratio is 0.40, with the corresponding peak hour factor for the system approximately 5.0.

3.3 Adequacy of Existing Water Supply Sources

The Precinct system uses four active groundwater supply sources to meet system demands. Table No. 3-2 provides the maximum withdrawal rates for each of the Precinct's supply sources. These withdrawal rates are based on reported or approved well pump capacities.

Table No. 3-1
Well Withdrawal Volumes

Source Name	Pump Capacity (gpm)	24-hour Withdrawal Rate (mgd)	16-hour Withdrawal Rate (mgd)

North Well	500	0.72	0.48
East Well	400	0.576	0.38
South Well/South Well Backup	400	0.576	0.38
Total:		**1.87**	**1.24**

Water industry guidelines recommend that a system have adequate supply to meet (1) the projected MDD with all wells online and (2) the projected ADD with the largest source offline. The projected ADD and MDD for the year 2030, including the proposed housing development, are 0.77 mgd and 1.84 mgd, respectively. The system's total combined maximum pumping rate of all active supply sources is 1.87 mgd if all wells are pumped for 24 hours. Based on the 2030 MDD of 1.84 mgd, the Precinct can meet the projected MDD only if the existing wells are pumped for 24 hours. Based on information from the Precinct, the sustainable pumping capacity is unknown and Precinct staff do not believe that the wells would be able to pump for 24 hours. If the wells were operated for 16 hours per day, the combined pumping rate is 1.24 mgd. This would result in a MDD supply deficit of 0.60 mgd. The Precinct water system would have a slight deficit of 0.01 mgd under the projected ADD of 0.77 mgd with the largest source, the North Well, offline for a combined 16 hour supply of 0.76 mgd.

The above discussion makes the basic assumption that each source is available when it is needed under the MDD/ADD scenarios described. However, the Lewis Engineering assessment points out a critical potential vulnerability in that assumption. A potential contamination incident at Pinnacle Pond, adjacent to the Interstate 93 highway and where all of the sources are located, could result in the catastrophic temporary or permanent loss of one or more of those sources. The assessment recommends the development of new wells and/or interconnections to offset this critical vulnerability. The Precinct is currently nearing completion of a joint feasibility study with the Town of Bow on a potential interconnection and has begun re-energizing its groundwater exploration program.

It is recommended that the Precinct continue these tasks, which will address the Lewis Engineering concern and help to meet the projected demands with the proposed housing development. To best address the latter, it is further recommended that the Precinct investigate the safe yield of each well to maximize existing sources. Historical test data, especially recent data that may be available for the East Well and South Well Backup, should be used to streamline the design of the safe yield investigation.

3.4 Adequacy of Existing Water Storage Facilities

Distribution storage is provided to meet peak consumer demands, such as peak hour demands, and to provide a reserve for fire-fighting purposes. Storage may also serve to provide an emergency supply in case of temporary breakdown of pumping facilities or for pressure regulation during periods of fluctuating demand. There are three components that must be considered when evaluating storage requirements. These components include equalization, fire flow requirements, and emergency storage. The three components of the storage evaluation were calculated under current and future water demand conditions for both the Main Service Area (MSA) and High Service Area (HSA). Based on 2019 pumping and usage data, on average the MSA represents

approximately 75 percent of the total demands and the HSA represents approximately 25 percent of the total demands. During peak demand periods, HSA usage approaches 39 percent of the total demand.

Equalization storage provides water from the tanks during peak hourly demands in the system. Typically, equalization storage is a percentage of the maximum day demand. The percentages can range from 15-percent to 25-percent, with 15-percent used for a large system, 20-percent for a medium sized system, and 25-percent used for a small system. A system is considered small if it has less than 3,300 customers, while a system is considered large if it has more than 50,000 customers. With a service population of approximately 2,900 people, the Precinct system was considered to be a small system, and 25-percent of the maximum day demand should be available in the storage tanks for meeting equalization storage guidelines.

The fire flow storage component is based on the representative fire flow requirement multiplied by the required duration of the flow. The basic fire flow is defined as a fire flow indicative of the quantities needed for handling fires in important districts, and usually serves to mitigate some of the higher specific fire flows. For the Precinct system, a representative fire flow of 3,500 gpm for a duration of three hours was used for the MSA, and a representative fire flow of 2,000 gpm for a duration of three hours was used for the HSA.

The emergency storage component is typically equivalent to one ADD. However, if there is emergency power available at the sources or emergency connections with surrounding communities capable of supplying at least one ADD, the emergency storage component can be waived. All of the water supply sources are located in the MSA. Emergency power is available at the each of the wells, and with the Central Hooksett Water Precinct interconnection, there is a combined capability of supplying at least one ADD. Emergency power is also available at the Booster Pump Station, which supplies water from the MSA to the HSA. Therefore, the emergency component has been waived in the storage evaluation for both service areas.

The three components of the storage evaluation were calculated under current and projected water demand conditions for both the MSA and the HSA. The peak MDD recorded in 2016 was higher than the historical peak MDD for other years reviewed, therefore, to be more conservative, the 2016 data was used as the current year for the storage evaluation. The projected 2030 MDD is based on the Lewis Engineering assessment with the completed housing development. The housing development is located entirely within the HSA and therefore, the additional 0.94 mgd was added to the HSA calculations only.

Main Service Area

1. Equalization
   - Small sized system = 25-percent of the Maximum Day Demand
   - MSA Estimated Maximum Day Demand in year 2016 = 0.53 mgd
   - MSA Projected Maximum Day Demand in year 2030 = 0.57 mgd
   - MSA Equalization (2016) = 0.25 x 0.53 = 0.13 mg
   - MSA Equalization (2030) = 0.25 x 0.57 = 0.14 mg

2. Basic Fire Flow Requirements
   - Representative fire flow = 3,500 gpm
   - Duration of 3 hours or 180 minutes
   - Basic Fire Flow Requirement = 3,500 x 180 = 0.63 mg

3. Emergency Storage: Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2016) and projected (year 2030) total required storage is as follows:

- Total MSA Required Storage (2016) = 0.13 mg + 0.63 mg = 0.76 mg
- Total MSA Required Storage (2030) = 0.14 mg + 0.63 mg = 0.79 mg

A minimum pressure of 20 pounds per square inch (psi) should be maintained at the highest served customer under MDD conditions with a coincident fire flow. To maintain a minimum pressure of 20 psi at a highest customer elevation of 335 feet on Hooksett Road north of Ash Street, the level of the water in the storage tanks should not drop below 381 feet, which is below the base elevation of both tanks. Based on this information, all the available storage in both tanks in the MSA are considered usable emergency storage. The total available useable storage is 1.21 mg for the MSA and the required storage is 0.76 mg in the 2016 MDD scenario and 0.77 mg 2030 MDD scenarios. This leaves the MSA with a surplus of 0.44 mg in storage under existing conditions and 0.43 mg in storage under projected conditions.

High Service Area

1. Equalization
   - Small sized system = 25-percent of the Maximum Day Demand
   - HSA Estimated Maximum Day Demand in year 2016 = 0.33 mgd
   - HSA Projected Maximum Day Demand in year 2030* = 1.27 mgd
   - HSA Equalization (2016) = 0.25 x 0.33 = 0.08 mg
   - HSA Equalization (2030) = 0.25 x 1.27 = 0.32 mg

   *Includes housing development

2. Basic Fire Flow Requirements
   - Representative fire flow = 2,000 gpm
   - Duration of 3 hours or 180 minutes
   - Basic Fire Flow Requirement = 2,000 x 180 = 0.36 mg

3. Emergency Storage: Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2016) and projected (year 2030) total required storage is as follows:

- Total HSA Required Storage (2016) = 0.08 mg + 0.36 mg = 0.44 mg

- Total HSA Required Storage (2030) = 0.32 mg + 0.36 mg = 0.68 mg

The highest customer in the HSA is located at an elevation of approximately 550 feet above MSL on Crawford Lane. To maintain a minimum pressure of 20 psi at this customer, the level of water in the storage tank should not drop below 596 feet, therefore, only the top 47 feet of the tank is usable volume. Based on this scenario, the Manor Drive Tank has a useable storage volume of 0.69 mg. The HSA has a storage surplus of 0.25 mg in the 2016 MDD scenario and 0.01 mg in the 2030 MDD scenario.

SECTION 4 – Hydraulic Evaluation

4.1 General

A comprehensive computer model was utilized to mathematically simulate the water distribution system to evaluate the Precinct's existing water distribution system and to obtain a basis for recommending water distribution system improvements. The hydraulic model was developed using InfoWater software. InfoWater software allows the user to conduct hydraulic simulations using mathematical algorithms in an ArcGIS environment. The computer model is represented by the node, pipe, and tank information provided in Appendix C. The hydraulic input data in Appendix C provides data on system demands, length and diameter of water mains, roughness coefficient or C-value of water mains, elevations, pumping rates of water supply sources, and overflow elevations at storage facilities.

As part of this project, the model was developed based on the most recent GIS files provided by the Precinct, and correspondence with the Precinct to confirm the accuracy of this information.

4.2 Model Verification

Verification of the computer model was completed under steady state conditions based on fire flow testing and information pertaining to the Precinct's hydraulic gradeline and current operating procedures. Flow tests were conducted by the Precinct personnel at 12 locations throughout the distribution system on September 9, 2020 and September 30, 2020. Flow test locations were selected to be representative of the entire distribution system. Table No. 4-1 presents the results of the flow testing. The data obtained from the flow tests served as input data for the model verification under steady state conditions. The data included static and residual pressure readings and measurements of flow from the hydrants tested. Each simulation in the model reflected actual field conditions at the time of the testing to properly calibrate the model.

When results of the model simulations were calibrated to within approximately five percent of the hydraulic data collected from the actual flow tests, the computer model was considered verified under steady state conditions. After completing the verification process, the model mathematically represented the physical operating conditions of the existing water distribution system.

Table No. 4-1
Flow Test Results

Location of Flowing Hydrant	Flowing Hydrant Static Pressure (psi)	Residual Hydrant A Static Pressure (psi)	Residual Hydrant A Residual Pressure (psi)	Residual Hydrant B Static Pressure (psi)	Residual Hydrant B Residual Pressure (psi)	Observed Flow (gpm)	Calculated Estimated Flow at 20 psi (gpm)
502 West River Road No. 33	66	70	42			1,100	1,500
7 Main Street	84	78	63	88	78	1,100	2,200
22 Birch Hill B	47	50	28			850	1,000
23 Bullard Street	64	64	50			750	1,400
39 Main Street	78	86	77	73	64	1,100	2,800
11 Northview	89	85	80			1,100	4,400
10 Bursar Drive	126	120	104			1,100	2,900
149 University Circle	94	88	66	60	50	1,100	1,400
55A Dale Road	92	86	54	84	50	750	1,000
2 Wedgewood No. 10	72	68	34			750	900
1 West Bank	102	100	50			1,000	1,200
9 Sunrise Boulevard	102	90	56			1,100	1,600

4.3 Adequacy of Existing Distribution System

The Hydraulic Evaluation facet of the Three Circle approach evaluates the system's ability to meet varying demand conditions. In general, a minimum pressure of 35 psi at ground level is recommended during average day, maximum day, and peak hour demand conditions. During MDD with a coincident fire flow, a minimum pressure of 20 psi is required at ground level throughout the system. To evaluate the system's ability to meet these criteria, the following hydraulic simulations were run in the model:

Minimum/Maximum Pressures

During current ADD conditions, there are locations throughout the Precinct where a minimum pressure of 35 psi is not met. Therefore, during the projected year 2030 ADD, MDD, and peak hour demand condition (no coincident fire flow), a minimum pressure of 35 psi is not met in some areas of the distribution system. Pressures near the Manor Drive Tank and the Mount Saint Mary's Condominiums have a static pressure of approximately 22 psi. These are the only areas in the system below 35 psi under current ADD conditions.

On the contrary to low pressures in the system, an upper limiting pressure of 120 psi is generally recommended, as older fittings in the system are generally rated at 125 to 150 psi. Pressure above this level can result in increased leakage from the distribution system. Also, the Ten State Standards published Recommended Standards for Water Works recommends that normal working pressures on utilized mains and services not exceed 80 psi. Based on the current operating conditions, the system experiences pressures greater than 120 psi only in the lower elevations of the High Service Area, including lower sections of University Circle, College Park Drive and Post Road as well as Hooksett Road north of Post Road. These areas have all been constructed after 2004 with newer system fittings rated for a minimum pressure of 150 psi.

Insurance Services Office (ISO) Fire Flow Recommendations

The recommended fire flow in any community is established by the ISO. The ISO determines a theoretical flow rate needed to combat a major fire at a specific location, taking into account the building structure, floor area and the building contents. In general, the flows recommended for proper fire protection are based on maintaining a residual pressure of 20 psi in the distribution system. This residual pressure is considered necessary to maintain a positive pressure in the system to allow for continued service to customers and to avoid negative pressures that could adversely impact the distribution system and potentially introduce groundwater into the system through joints and cracks in the water mains.

The Precinct system was last inspected for fire insurance ratings by the ISO in May 2016. The results of the ISO inspections and fire flow testing were provided by the Precinct and are shown in Table No. 4-2. The testing was performed across the entire Town of Hooksett and as such only two hydrants were tested within the Precinct's jurisdiction. The test results indicate the available flow and estimated recommended fire flow in various sections of the distribution system at the time of the tests. The estimated recommended fire flows established by ISO for both locations was 500 gpm. It should be noted that a water system is only required by ISO to provide a maximum of 3,500 gpm at any point in the system. Recommended fire flows greater than 3,500 gpm are not considered in determining the Public Protection Classification (PPC) of the Precinct when using

the Fire Suppression Rating Schedule. ISO individually grades the protection of buildings with a recommended fire flow in excess of 3,500 gpm, and the PPC of those buildings can differ from that of the community that provides fire protection.

According to the May 2016 ISO study, the available fire flow at both testing locations exceed the ISO recommended flow. For each ISO location, the recommended fire flow was simulated in the hydraulic model verified as part of this project. The hydraulic model results confirm that both locations exceed the ISO recommended flow.

Table No. 4-2
ISO Hydrant Flow Summary
May 2016

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Recommended Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
18	Blackwater	103	80	500	2,900
5	Main Street & Rosedale Street	91	38	500	2,000

Additional Flow Recommendations

A review of the Precinct was completed to identify the recommended fire flows in areas not tested in the latest ISO evaluation. Recommended fire flows were estimated for larger structures and facilities such as condominiums, apartment complexes, schools, hotels, and other commercial or industrial buildings. Recommended flows were estimated for these areas based on location and building size using the 2014 ISO published Guide for Determination of Needed Fire Flow. The guide uses factors such as building size, material, location, and contents to calculate the recommended fire flow. These factors were estimated based on aerial photos and street level observations. Not all information was readily available for the review and the estimated recommended fire flow should not be used for any other purpose than evaluating the adequacy of the water distribution system. It should also be noted that the Guide does not account for the use of fire protection systems, such as a sprinkler system, when estimating a recommended fire flow.

According to the 2014 ISO published Guide for Determination of Needed Fire Flow, the minimum recommended fire flow in residential areas with homes greater than 30 feet apart is approximately 500 gpm. The recommended fire flow for homes between 21 feet and 30 feet apart is approximately 750 gpm. Areas with homes between 11 feet and 20 feet apart have a recommended fire flow of 1,000 gpm. A fire flow of 1,500 gpm is recommended for homes closer than 10 feet apart. The residential neighborhoods in the Precinct were evaluated to determine average distances between homes for determination of the recommended residential fire flow in those areas. An estimated fire flow of 500 gpm was used for most residential areas of the system with homes greater than 30 feet apart.

4.4 Hydraulically Deficient Areas

The estimated recommended fire flows were simulated in the computer model. All scenarios were run using the projected 2030 MDD conditions. All storage tanks in the system were set at their

standard operating level based on information provided by Precinct staff. Sources were all set to be off to replicate the typical daytime conditions of all pumps remaining off throughout the day and only pumping for an eight-hour period overnight to refill the tanks. Areas where the available fire flows did not meet the ISO recommended fire flow or estimated recommended fire flow were considered hydraulically deficient and improvements were developed to alleviate these deficiencies.

Hydraulic deficiencies were identified as part of a system wide evaluation and include deficiencies in areas that were and were not included in the most recent ISO testing, as well as addressing residential fire flow deficiencies. In general, the hydraulic deficiencies were broken down into Priority 1 and 2 deficiencies. Priority 1 deficiencies identify areas where looping the system or eliminating bottlenecks significantly increases overall system resilience and flow efficiency. Priority 2 deficiencies identify areas with needed fire flow improvements. Areas selected for Priority 2 would provide the recommended ISO fire flow only if improvements to Priority 1 deficiencies were implemented first. The following list provides a description of each Priority 1 and 2 deficiency. All hydraulic deficiencies are shown in the Hydraulic Deficiencies map in Appendix D.

Priority 1 Hydraulic Deficiencies

1. To finish the primary feed to the new West (Quarry) Tank, it is recommended that a cross country 12-inch diameter water main be installed from the 8-inch diameter water main at the end of Vista Drive to the 12-inch diameter water main on Route 3A. In addition to this, the existing 8-inch AC water main on Vista Drive is recommended to be replaced with a new 12-inch diameter water main to connect to the existing 12-inch diameter water main on Pinnacle Street and the proposed cross country extension to Route 3A. This will increase available flow in the south western and central portions of the distribution system and help move the water stored in the West (Quarry) Tank out into the distribution system more efficiently.

2. To increase available fire flow to the southern portion of the system and to create a loop on either side of the river that will increase system resiliency and redundancy, it is recommended that the Precinct install a 12-inch diameter water main across the Merrimack River. As shown on the Deficiencies map in Appendix D, this could be connected to the 12-inch water main on Route 3A on the west side and to the 8-inch water main on Dale Street on the east side.

3. The 12-inch diameter transmission main from the West (Quarry) Tank and South Pump Station connects to 8-inch and 6-inch diameter AC water mains on Pinnacle Street and West River Road which creates a bottleneck in flow from these critical facilities to the rest of the distribution system. Replacing the 8-inch water main on Pinnacle Street and the 6-inch water main on West River Road, and the 8-inch water main on Maple Street with a new 12-inch diameter water main would improve transmission from the West (Quarry) Tank and South Pump Station to the central portion of the distribution system and will increase the available fire flow in this area. It will also improve flow availability and fire fighting capacity in the Pinnacle Street neighborhood.

4. Replacing the 8-inch and 6-inch diameter AC water mains that run south on Route 3 and Main Street from the intersection with College Park Drive to the end of the southeastern portion of the system is recommended to improve transmission and flow to the southeastern portion of the system. Replacing this section of water main with a 12-inch diameter water main increases the available fire flow to many commercial customers and important municipal facilities and increases system resiliency by providing a larger sized transmission main for the eastern portion of the system.

5. Pine Street serves as a transmission main for the North and East Wells and is currently only 6-inches in diameter. It is recommended to replace this main with a 12-inch diameter water main both to increase flow from the wells and to improve the inherent capacity for fire flow to the large residential complexes and the I-93 rest areas located north of Pine Street.

6. To complete a 12-inch diameter transmission main loop through the center of the distribution system, it is recommended that the portion of 8-inch diameter water main on Route 3A that stretches from north of Pine Street to the I-93 Rest Area be replaced with a new 12-inch diameter water main. This will improve the inherent capacity for fire flow to Windsor Terrace apartments, River Hill apartments, and the I-93 Rest areas and associated residential areas, which are top users for the system. This will also be important for transmission of water to and from the proposed interconnection with the Town of Bow which is currently being considered for a location on Route 3A north of the rest areas.

7. The Thompson Corner Tank is currently connected to Main Street with an 8-inch cross country AC water main. To improve the hydraulics of the transmission main to this tank, it is recommended that a new 12-inch water main is installed from the south end of the existing 12-inch water main on Daniel Webster Highway to the existing 6-inch water main on Main Street/Route 3, which is proposed to be upgraded to 12-inches as part of Improvement 4 as discussed above.

Priority 2 Hydraulic Deficiencies

The Priority 2 Hydraulic Deficiencies Map in Appendix D depicts the following deficiencies. It was determined that these areas would be considered Priority 2 as these improvements in conjunction with those recommended as Priority 1 deficiencies will improve the inherent capacity for recommended fire flow in these areas.

8. An estimated recommended fire flow of 1,750 gpm was calculated at the Precinct office using the 2014 ISO Published Guide for Determination of Needed Fire Flow. The available fire flow is estimated to be 1,000 gpm at 20 psi. It should be noted that the recommended fire flow at this location does not consider if a fire protection system is installed in the building. To provide the recommended fire flow at this location, a new 12-inch diameter water main is recommended on Riverside Street to replace the section of 8-inch diameter water main, and a new 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main that serves the hydrant near the Precinct office building.

SECTION 5 – Critical Component Assessment

5.1 General

The critical evaluation facet of the Three Circle approach evaluates the impact of potential water main failures and the system's ability to meet varying demand conditions. The critical component assessment includes identification of critical areas served, critical water mains, and the need for redundant mains.

5.2 Evaluation Criteria

Critical areas served are locations in the distribution system that require continual water supply for public health, welfare, or financial reasons. Examples of critical service areas include water department facilities, medical facilities, nursing homes, schools, and business districts. All water mains within 500 feet of a critical area are considered to be critical mains. Because water storage tanks and water supply sources provide water and maintain pressure to critical service areas, tanks and primary water supply sources are also considered critical components. Therefore, any water main within 500 feet of a water storage tank or primary water supply source is considered a critical component.

Additional categories of critical water mains include those mains that are the sole transmission main from a source or tank, and main transmission lines without a redundant main. The evaluation included a visual review of the water mains leading into and out of the critical areas and the transmission grid.

5.3 Critical Components

Critical areas served, critical supply mains, and redundant mains were evaluated in the Precinct water system based on the criteria described above. The following provides a listing of the areas that are considered critical components. A map of the critical components is included in Appendix E.

Critical Areas Served

A system-wide review of critical areas served such as water department facilities, medical facilities, schools, and critical institutions was completed and discussed with Precinct personnel. Table No. 5-1 presents all critical areas served including critical users and critical components of the distribution system.

Critical Water Mains

Critical water mains include primary transmission lines as well as mains connecting water storage tanks and sources to the system. Critical transmission mains are highlighted on the Critical Components Map found in Appendix E.

Additional critical water mains were identified based on a review of the distribution system model and using the model's protector tool. The protector tool simulates breaks on each pipe in the model. The model calculates if the system can still be served with adequate flow and pressures

after a pipe is taken out of service. This feature can identify areas served by multiple mains which would no longer be able to serve customers if one of the mains were taken out of service. The following were identified by the protector tool in InfoWater as causing a system demand shortfall of 3.0 percent or greater, and are considered critical mains:

- The 8-inch and 12-inch water main on Route 3A/West River Road/Main Street from the I-93 North Rest Area to the intersection with Maple Street which serves as the only connection to the northern most customers in the system.

- The segments of the 12-inch water main on Route 3A south of Riverside Street stretching to the end of the system, providing the only connection to the south western customers in the system.

- The 6-inch and 8-inch water main on Hooksett Road and Main Street from the intersection with Morse Drive to the transmission main to the Thompson Corner Tank which provides the only connection to the south eastern portion of the system.

Water mains that cross streams, rivers, and active railroads are also considered critical because of the costly consequences of failure that could occur if a water main broke in these areas, and the difficulty in repairing the mains in these locations. Critical mains are highlighted on the Critical Components Map found in Appendix E. There are two 12-inch diameter water mains that cross the Merrimack River from Riverside Street to North Main Street providing redundancy for the system, but as these are the only points in the system that connect the eastern and western portions of the system on either side of the system and due to the difficulty in repairing these mains were a break to occur, these have been considered to be critical components.

Table No. 5-1
Critical Areas

Critical Area		Location
Water Distribution System Components		
	Precinct Office Building	7 Riverside Street
	North Well Pump Station	29 Pine Street
	East Well Pump Station	19 Ardon Drive
	South Well Pump Station	38 Pinnacle Street
	Booster Pump Station	2 Post Road
	West (Quarry) Tank	81 Brickyard Pond Road
	Thompson Corner Tank	Hooksett Road
	Manor Drive Tank	20 Manor Drive
Schools		
	Hooksett Memorial School	5 Memorial Drive
Emergency Services		
	Fire Station	1 Riverside Street
	Hooksett Public Library	31 Mount St. Mary's Way
Miscellaneous		
	I-93 Rest Areas/Pennichuck Utilities	530 West River Road
	Hooksett Town Hall	35 Main Street
	Sewer Department Pump Station	Riverside Street
	Sewer Department Pump Station	Veterans Drive
	Sewer Department Pump Station	Memorial Drive
	Sewer Department Treatment Plant	1 Egawes Drive
	Department of Public Works Garage	210 West River Road

SECTION 6 – Asset Management Considerations

6.1 General

The existing water distribution system includes approximately 42 miles of water mains. A number of factors, including installation year, diameter, material, water quality, break history, and soil characteristics, affect the decision to replace or rehabilitate a water main. The Precinct previously completed an Asset Management Evaluation for their system with Tata & Howard through the NHDES Asset Management Grant Program. This evaluation used an Asset Management approach tailored for the Precinct system to assign each water main in the system a grade based on these factors. These grades were used to establish a prioritized schedule for water main replacement or rehabilitation and serves as the third facet of the Three Circle approach.

This section summarizes the process and recommendations of the previous Asset Management Evaluation which was completed in May 2020.

6.2 Evaluation Criteria

To prioritize water main replacement or rehabilitation, a water main grading system was established. The grading system uses water main characteristics including installation year, diameter, and material, as well as known areas with water quality concerns, water main break history, static pressures, and soil characteristics surrounding the water main to assign point values to each pipe in the system. The performance criteria within each asset category are assigned a rating between zero and 100, with zero being the most favorable and 100 being the least favorable within the category. Each category is then given a weighted percentage, which represents priorities within the system. Tata & Howard worked with the Precinct to adjust the weighted percentages of each category and the ratings of the performance criteria based on existing system performance and conditions. Our recommendation was to assign a maximum weight of 30 percent to any one category. The assigned rating is then multiplied by the weighted percentage to determine the weighted rating for the performance criteria in each category. The weighted rating for each performance criteria was totaled to determine an overall rating for each pipe section in the model. The pipes with the highest grade are most in need of replacement or rehabilitation.

As part of the Asset Management Evaluation project, a workshop was held with the representatives of the Precinct to establish a rating system specific to the Precinct water system. During the workshop, it was determined that break history was of primary concern to the Precinct, followed by diameter, material, and installation year. The grading system is shown in Table No. 6-1 and was used to assign scores to individual water mains.

Table No. 6-1
Asset Management Grading System

Weight	Performance Criteria	Rating	Weighted Rating
25%	Break History		
	Two or More Breaks	100	25
	One Break	75	18.75
	No History of Breaks	0	0
20%	Diameter		
	Less than 4-inch	100	20
	4-inch water main	90	18
	6-inch water main	70	14
	8-inch water main	30	6
	10-inch water main	20	4
	12-inch water main	10	2
	16-inch water main	5	1
15%	Material		
	Asbestos Cement	100	15
	Plastic	80	12
	Copper	20	3
	Ductile Iron	10	1.5
	PVC/HDPE	5	0.75
15%	Installation Date		
	1950-1979	100	15
	1980-1989	90	13.5
	1990-1999	40	6
	2000-2010	10	1.5
	2010-present	0	0
15%	Poor Soils		
	Known Corrosive Soils	100	15
	Potentially corrosive soils	80	12
	Gravel, sand	0	0
10%	Static Pressure		
	Greater than 100 psi	100	10
	80 to 100 psi	80	8
	60 to 80 psi	60	6
	Less than 60 psi	0	0
5%	Water Quality		
	Water Quality Concerns	100	5
	No Water Quality Concerns	0	0

6.3 Asset Management Areas of Concern

Based on the asset management ratings, there are several areas of concern in the system. Water mains with a total rating less than 25 are considered to be in good to excellent condition. Mains with a total rating between 25 and 44 are considered to be in fair to good condition, and mains with a total rating of 45 or greater are considered to be in poor to fair condition. This rating system is specific to the Hooksett Village Water Precinct system and reflects the Precinct's priorities of replacing mains with a history of breaks and those with poor material. Asset management ratings are presented graphically in Appendix F.

During the previous Asset Management Evaluation, completed in May 2020, two phases of recommended improvements were developed. Sections of water main included in Phase I had asset management scores of above 60 and represented the areas of the Precinct system that are the most in need of attention. Sections of water main included in Phase II had asset management scores between 45 to 59 and all had at least one break. Fifty three percent of the pipes had scores between 30 and 44, most located in the Pinnacle Street and Thompson Avenue neighborhoods. These areas were all developed around the same time and therefore, should be all replaced around the same time. It was recommended that these areas be included in a Phase III as the Precinct moves forward with improvements in Phases I and II.

The evaluation discussed the need to develop a hydraulic model for further investigation of the system with the potential of reprioritizing those improvements recommended based solely on asset management criteria. This led directly to the completion of the hydraulic model for the Precinct during this Asset Management Plan Update. The hydraulic modeling evaluation and critical component considerations discussed earlier in this report were used to evaluate each water main in conjunction with the asset rating scores from the May 2020 evaluation to develop the recommendations and conclusion discussed in the following section.

SECTION 7 – Recommendations and Conclusions

7.1 General

The following section summarizes the findings of the study and presents a prioritized plan for recommended improvements and associated costs. The prioritization of improvements allows for constructing the necessary improvements over an extended period of time as funds allow. Costs are based on recent bid tabulations and include costs associated with the water mains, valves, fittings, water services, hydrants, and other appurtenances, permanent and temporary trench pavement, and a 25 to 30 percent allowance for engineering and contingencies. The standard allowance for engineering and contingencies is 25 percent, however, for any improvements that are assumed to include a bridge crossing or horizontal directional drilling, the allowance is increased to 30 percent due to the inherent complexities associated with these projects. Estimates do not include costs for land acquisition, easements, or legal fees. Unit costs when installing less than 1,000 feet of water main are based on a higher unit rate and are accounted for in each applicable recommendation. If these projects were to be grouped, the estimated costs may decrease.

The capital improvement projects considered by this study will provide a direct benefit to the overall level of service to the Precinct's customers, reduce operation and maintenance costs by reducing the frequency of water main failures and the damage they cause, improve water quality, as well as improve fire protection to homeowners and businesses.

The Water Research Association's (formerly the American Water Works Research Foundation) study on "Cost of Infrastructure Failure," which was completed in 2002, found that in addition to direct costs paid by water utility ratepayers for water main failures, there are also societal costs which are paid by the public. Examples of direct costs include outside contractor costs, engineering costs, police assistance, fire department assistance, electrical, telephone, and gas utility damage costs, landscaping restoration costs, and laboratory costs. Examples of societal costs include the cost of traffic impacts, business customer outage impacts, public health impacts (including loss of life), property damage not covered by direct costs, and the cost of reduced fire fighting capability during a water main failure event.

Rehabilitation and replacement of one percent of a system each year (a 100 year replacement cycle) is a reasonable guideline based on industry experience and analysis. For the Precinct distribution system, this would equate to approximately 2,200 linear feet of water main replacement each year as a guideline. Regular rehabilitation of water mains reduces main failures, leakage, and water quality issues. Water main rehabilitation can also provide socio-economic benefits by reducing operational costs associated with chemical and energy usage. Additionally, rehabilitation or replacement of water mains that are inadequately sized to provide needed fire protection will improve public safety.

7.2 General Recommendations

To maintain a comprehensive database of the condition of the system, it is recommended that the Precinct regularly provide break data to Tata & Howard to update the water main database.

Currently, the Precinct maintains documentation of breaks with the nearest street address and date. In addition, the Precinct should record joint type, type of lining, and type of failure such as ring crack, lateral split, hole in the pipe, "punky" AC pipe failure, joint leak, or service connection failure, and how the pipe was repaired. If possible, the Precinct should include the apparent cause of the failure such as frost load, traffic load, direct contractor damage, settlement, water hammer, or external soil corrosion. The documentation should also be filed electronically following each event. This data can be used to create a Water Main Failure Map for identifying areas of concern in the system on an ongoing basis. The map can be used to easily identify break locations, determine if streets or areas have a higher frequency of failures, and to view any patterns in the location, type, pipe manufacturer, or other characteristics in occurrences of failure. The water main failure database will aid the Precinct in making water main rehabilitation and replacement decisions in the future. Providing data of any new water main replacements or rehabilitations performed by Precinct staff as part of regularly scheduled maintenance to Tata & Howard will also help to keep the hydraulic model up to date and as accurate as possible.

The Precinct has a requirement in their operation standards to consider all materials of water main when investigating the installation of a new water main, with ductile iron and HDPE or PVC as the main materials used throughout the system. It is recommended that the Hooksett Village Water Precinct consider changing their standard specifications to zinc coated ductile iron piping in potentially corrosive soil areas. Zinc coated ductile iron piping is more expensive than polyethylene wrapping, but installation is less sensitive to properly protect the piping. If HDPE or PVC water main is to be installed, the Precinct should verify groundwater elevations in the project area and review any history of oil or hazardous material (OHM) release as these types of contaminants may reportedly penetrate the permeable HDPE or PVC piping. Polyethylene wrapped or zinc coated ductile iron are better options in areas where OHM may be present.

The Precinct should continue to perform regularly scheduled maintenance programs, including hydrant and valve maintenance and meter testing/calibration. It is also recommended that the Precinct develop a unidirectional flushing (UDF) plan to increase the cleaning achieved by regular flushing of the water mains. The cost to develop a UDF plan for the Precinct is estimated at $16,000.

The Precinct is currently investigating mazimizing their existing sources, including a possible back up source for the North Well, as well as conducting a test well exploration program to identify and reserve a future water supply source outside of the Pinnacle Pond aquifer. The catastrophic loss of the existing sources at Pinnacle Pond due to a potential contamination incident has been identified as an important system vulnerability. It is recommended that the Precinct continue with their preventive maintenance on their wells and continue to monitor specific capacity of the existing wells in an effort to monitor and maximize their yields. It is recommended that the Precinct continue with the test well investigation program This will prepare the Precinct for new source development in the future. Given the rate of development in Hooksett and the shrinking number of possible source locations, this should be considered a priority recommendation.

As outlined in the October 2020 Sanitary Survey conducted by New Hampshire Department of Environmental Services (NHDES), corrective action is required to address the condition of the Thompson Corner Tank. To evaluate the impacts to the distribution system if the tank was taken

off-line, field studies completed in November 2020 show that fire protection on the east side of the river is cut nearly in half when this tank is taken temporarily off-line. The hydraulic model developed in this study and system field hydraulic observations by the operators further suggest that additional distribution system improvements are needed on the west side of the river to relieve a bottleneck in the Pinnacle Street area that is restricting flow from the West (Quarry) Tank constructed in 2019.

It is recommended that the Precinct complete an evaluation of the Thompson Corner Tank to identify a cost effective approach to address the Significant Deficiency outlined in the Sanitary Survey and maintain adequate fire protection in the system. The primary goal of the evaluation will be to compare tank rehabilitation or replacement options. The evaluation will include tank inspection and metal loss analysis by a certified corrosion inspection firm, which is already ongoing; identification and analysis of any sanitary, safety and hydraulic improvements needed as part of the rehabilitation effort; the preparation of budgetary cost estimates for tank repair; identification of a potential replacement tank location and associated site logistics given current site constraints; the preparation of budgetary cost estimates for tank replacement; and the modeling and analysis of any water distribution system improvements needed to be implemented when the tank repair/replacement is completed. The cost of the evaluation is $10,000.

7.3 Prioritization of Water Distribution System Improvements

Based on the Three Circles Approach including the hydraulic, critical component, and asset management circles, a prioritized list of improvements was created for the buried infrastructure. Improvements were separated into three phases. The Phase I and Phase II improvements are prioritized based on hydraulic needs, location in the distribution system (critical component), the condition of the water main (asset rating), and the professional opinion of Tata & Howard of how to best impact the distribution system. Typically, the Phase I improvements include water mains that fall into all three circles but some improvements that would add new pipes to the system to improve hydraulics and strengthen critical areas have been included in Phase I. Phase II improvements include water mains that fall into any two circles.

Phase III improvements fall into one circle. These improvements include the remaining hydraulic recommendations from Section 4 not included in the Phase I or Phase II improvements and remaining areas with a poor asset management rating. The hydraulically deficient areas, critical component considerations, and asset management ratings are combined on one Three Circles Integration Map included in Appendix G.

The list of water main improvements is extensive due to the nature of this report. The prioritization of the recommended improvements based on the Three Circle Approach serves as a guide for implementation of the infrastructure improvements with the greatest to least benefit, as it is currently perceived based on the data in this report. The implementation of these improvements is intended to be completed over several years based on available funding sources and as circumstances allow.

Table No. 7-1, at the end of this section, includes a prioritized list of Phase I improvements and the hydraulic, critical component, and asset management status of each improvement. Table No.

7-2 includes the linear feet and estimated cost of each Phase I improvement. Table No. 7-3 includes a prioritized list of Phase II improvements and the hydraulic, critical component, and asset management status of each improvement, and Table No. 7-4 includes the linear feet and estimated cost of each Phase II improvement.

Phase III improvements include the water mains that have high asset management ratings that are not included in any Phase I or Phase II improvements and should be replaced when funding becomes available. The total length of water main by pipe diameter recommended for Phase III improvements is summarized in Table No. 7-5. The estimated cost to replace these water mains is also included in Table No. 7-5. The recommended improvements maps are included in Appendix H. It should be noted that paving schedules and other improvements to roadways were not evaluated as part of this study.

Phase I Improvements

1. A new 12-inch diameter cross country main is recommended from the end of Vista Drive to Route 3A. Creating this connection will partially finalize the transmission main from the West (Quarry) Tank to the southern and central portions of the distribution system. This will provide the inherent capacity for the estimated needed fire flow to these areas and increase system resiliency. The estimated probable construction cost of 1,100 linear feet of 12-inch diameter water main is approximately $432,000. With this cross country main, it is recommended that the existing 8-inch diameter water main on Vista Drive be increased to 12-inch diameter. This will complete the connection to the West (Quarry) Tank. The estimated probable construction cost of 700 additional linear feet of 12-inch diameter water main is approximately $274,000. Completing both improvements together would be an estimated probable construction cost $706,000 if traditional open cut construction was used for the cross-country portion of water main. The cross-country portion of water main could be installed via directional drilling which has an estimated probable construction cost of $390,000. If directional drilling was utilized, the estimated probably construction cost for the 1,800 linear feet of new water main is $664,000. The directional drilling cost estimate is used for the Phase I total cost.

2. A new 12-inch diameter main is recommended to replace the existing 6-inch diameter water main on Pine Street from the North Well driveway to Main Street, the 6-inch diameter water main on the North Well driveway from the North Well to Pine Street, the 8-inch water mains on Ardon Street from the East Well to the Pine Street. The existing mains are considered critical as they serve as a transmission main from the North and East Wells. The upgrade will increase the available fire flow to the I-93 Rest Areas and the Windsor Terrace and River Hill apartment complexes, which are top users. The estimated probable construction cost of 2,400 linear feet of 12-inch diameter water main is approximately $750,000.

3. New 12-inch diameter main is recommended to replace the existing 8-inch diameter water main on Route 3A. The portions of the existing mains are considered to be in fair to poor condition with asset management ratings ranging from 36 to 46. The poor ratings are due to the age, material, and potentially corrosive soil. This portion of main is considered critical because a break here would cause at least three percent of the system to lose water

service and the main is the only connection to the I-93 Rest Areas and associated residential complexes affiliated with Pennichuck Utilities, which are top users and critical customers. The upgrade will improve the hydraulic capacity of the water mains and better provide residential fire flow in the area. The estimated probable construction cost of 3,100 linear feet of 12-inch diameter water main is approximately $853,000.

4. New 12-inch diameter main is recommended from the intersection of Main Street with College Park Road to the 12-inch water main at the South end of the distribution system. The existing water main on Main Street is considered critical because it provides the only connection to the southeastern portion of the distribution system and a break here would cause at least three percent of the system to lose water service. The mains have asset management ratings ranging from 36 to 69 and are considered to be in fair to poor condition. The poor condition is due to age, material, and history of breaks. The upgrade will improve the hydraulic capacity of the water main and provide residential fire flow in the area. The estimated probable construction cost of 7,500 linear feet of 12-inch diameter water main is approximately $2,063,000.

5. A new 12-inch diameter main is recommended along Daniel Webster Highway from the intersection with Main Street/Route 3 to the Thompson Corner Tank transmission main. The existing tank transmission main is 8-inches in diameter with an asset management rating of 36, so is considered to be in good to fair condition but is hydraulically insufficient to serve as a main transmission main to the south western portion of the system. The main is considered to be critical as it serves as a transmission main to the Thompson Corner Tank and currently the main runs through private property. Installing a new 12-inch diameter main along Daniel Webster Highway to connect to the existing 8-inch water main on Precinct owned property would be beneficial in providing easier access to a critical main and in improving the system hydraulics in this area. The estimated probable construction cost of 700 linear feet of 12-inch diameter water main is approximately $265,000.

Phase II Improvements

6. A new 12-inch diameter cross river water main is recommended to be installed across the Merrimack River between the 8-inch water main to Tritown Ice Rink and the 8-inch water main on Dale Road. This position has been chosen to utilize an existing river crossing easement owned by the Sewer Department. Creating this connection between the transmission mains on Route 3A and 3 will increase the available fire flow for the entire system and especially to the critical and large users in the southern portion of the system. This will also increase system resiliency. The cost of installing 2,400 linear feet of 12-inch diameter pipe, with approximately 550 linear feet via directional drilling, is approximately $982,000.

7. New 8-inch and 12-inch diameter water mains are recommended to replace the existing 6-inch and 8-inch diameter mains along Riverside Street to the area near the Precinct office building. The existing main is hydraulically deficient and is considered to be in fair to poor condition with an asset management rating of 41 due to size, age and material of the main. The upgrade will improve hydraulic capacity of the water main and provide increased fire flow to the Precinct office which is considered a critical building. Upgrading to a 12-inch

diameter water main on Riverside Street will complete a larger 12-inch diameter transmission loop between all major points in the system. The estimated probable construction cost of 100 linear feet of 12-inch diameter water main and 200 linear feet of 8-inch diameter water main is approximately $157,000.

8. A new 12-inch diameter main is recommended to be installed on West River Road. The existing 6-inch diameter water main on West River Road is considered to be in poor condition with an asset management rating of 50 due to the diameter, age and material. This improvement, in conjunction with the Pinnacle Street project, will eliminate a bottleneck from the West (Quarry) Tank and the center of the distribution system which will increase fire flow to this area. The need for this improvement should be re-evaluated once the Vista Drive Project is completed. The estimated probable construction cost of 1,200 linear feet of 12-inch diameter ductile iron water main is approximately $315,000.

9. A new 12-inch diameter water main is recommended on Pinnacle Street and Maple Street from Vista Drive to West River Road. This improvement will eliminate the bottleneck from the West (Quarry) Tank to the center of the distribution system and replace a problematic valve at the intersection of Pinnacle Street and West River Road. Increasing the size of the water mains in this area will greatly improve the flow in the center of the distribution system. The need for this improvement should be re-evaluated once the Vista Drive project is completed. The estimated probable construction cost for 2,300 linear feet of 12-inch diameter water main is approximately $604,000.

10. A new 12-inch diameter main is recommended to replace the existing 8-inch diameter main along Veterans Drive from the river crossing to Merrimack Street. The existing 6-inch diameter water main is considered to be in poor condition with an asset management rating of 61 due to age, material, and history of breaks. The water main is also considered critical due to its proximity to a sewer pump station which is considered a critical user. The estimated probable construction cost of 600 linear feet of 12-inch diameter water main is approximately $189,000.

Phase III Improvements – Asset Management

11. A new 8-inch diameter water main is recommended on Highland Street from Granite Street to Dundee Avenue. This water main is considered in poor condition with asset ratings ranging from 50 to 72 due to age, material, size, and history of breaks. The estimated probable construction cost for 1,000 linear feet of 8-inch diameter water main is approximately $392,000.

12. A new 8-inch diameter water main is recommended to replace the existing AC 8-inch diameter water main on Heather Drive as well as extending this main to connect to West River Road with a new 8-inch water main. The water main is considered to be in poor condition with an asset management rating of 61 due to age, material, and history of breaks and would improve the overall system if it was connected to West River Road as an additional loop. The estimated probable construction cost for 750 linear feet of 8-inch diameter water main is approximately $294,000.

13. A new 8-inch diameter water main is recommended to replace the existing 6-inch and 8-inch diameter water mains on Granite Street, Chase Street, and Otterson Street. These water mains are considered in poor condition with asset management ratings ranging between 50 to 63 due to age, size, material, and history of breaks. The estimated probable construction cost for 3,600 linear feet of 8-inch diameter water main is approximately $1,125,000.

14. A new 12-inch diameter water main is recommended on Merrimack Street from Veterans Drive to the end to replace the existing 8-inch diameter water main and to complete a loop to College Park Drive. This water main is considered to be in poor condition with an asset management rating of 52 due to age and material. The estimated probable construction cost for 1,800 linear feet of 12-inch diameter water main is approximately $704,000.

15. New 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main on Green Street and Scott Avenue. These water mains are considered to be in poor condition with an asset management rating of 57 due to size, history of breaks, and corrosive soils. The estimated probable construction cost for 2,600 linear feet of 8-inch diameter water main is approximately $813,000.

16. A new 8-inch diameter water main on Bullard Drive from Stevens Drive to the end is recommended to replace the existing 6-inch water main. This water main is considered to be in poor condition with an asset management rating of 54 due to size, age, material, and corrosive soils. The estimated probable construction cost for 700 linear feet of 8-inch diameter water main is approximately $274,000.

17. A new 8-inch diameter water main on Dale Road from Morse Drive to the end is recommended to replace the existing 8-inch diameter water main. This water main is considered to be in poor condition with an asset management rating of 45 due to age and history of breaks. The estimated probable construction cost for 3,200 linear feet of 8-inch diameter water main is approximately $1,000,000. The Precinct noted that a break occurred here recently and that the existing pipe was determined to be White PVC, which was very brittle. It is recommended that an alternate material be identified and used for the replacement of this water main.

18. It is recommended that the existing 8-inch diameter water main on Bayview Terrace Road and West Bank Road be replaced with a new 8-inch water main. The water main is considered in poor condition with an asset management rating of 45 due to age and history of breaks. The estimated probable construction cost of 1,300 linear feet of 8-inch diameter water main on Bayview Terrace Road and West Bank Road is approximately $407,000.

Table No. 7-1
Prioritization of Improvements – Phase I

Item No.	Location	From	To	Hydraulic Priority	Asset Management Rating	Critical
1	Vista Drive and Cross Country	Pinnacle Street	Route 3A	1	36	N
2	Pine Street, North Well, and Ardon Drive	Main Street	North/East Wells	-	35	Y
3	Route 3A	12-Inch tie in	I-93 Rest Area	1	36 -46	Y
4	Route 3	College Park Road	End of System	1	36 - 69	Y
5	Daniel Webster Highway	Main Street/Route 3	Thompson Corner Tank Property	-	36	Y

Table No. 7-2
Estimated Improvement Cost – Phase I

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
1	Vista Drive and Cross Country	Pinnacle Street	Route 3A	12	1,800	$664,000
2	Pine Street, North Well, and Ardon Drive	Main Street	North/East Wells	12	2,400	$750,000
3	Route 3A	12-Inch tie in	I-93 Rest Area	12	3,100	$853,000
4	Route 3	College Park Road	End of System	12	7,500	$2,063,000
5	Daniel Webster Highway	Main Street/Route 3	Thompson Corner Tank Property	12	700	$265,000
Total Estimated Phase I Cost:						**$4,595,000**

Table No. 7-3
Prioritization of Improvements – Phase II

Item No.	Location	From	To	Hydraulic Priority	Asset Management Rating	Critical
6	River Crossing	Route 3A	Dale Road	1	-	-
7	Riverside Street	Main Street	Precinct Office	2	41	Y
8	West River Road	Route 3A	Maple Street	1	50	N
9	Pinnacle Street	West (Quarry) Tank	West River Road	1	43	Y
	Maple Street	Route 3A	Main Street	1	-	N
10	Veterans Drive	River Crossing	Merrimack Street	-	52	Y

Table No. 7-4
Estimated Improvement Cost – Phase II

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
6	River Crossing	Route 3A	Dale Road	12	2,400	$982,000
7	Riverside Street	Main St	Precinct Office	12	900	$157,000
8	West River Road	Route 3A	Maple Street	12	800	$315,000
9	Pinnacle Street	West (Quarry) Tank	West River Road	12	1,800	$604,000
	Maple Street	Route 3A	Main Street	12	400	
10	Veterans Drive	River Crossing	Merrimack Street	12	500	$189,000
Total Estimated Phase II Cost						**$2,247,000**

Table No. 7-5
Estimated Improvement Cost – Phase III

Item No.	Location	From	To	Asset Management Rating	Proposed Diameter (in)	Length (LF)	Estimated Cost
11	Highland Street	Granite Street	Dundee Ave	72	8	1,000	$392,000
12	Heather Drive	Ardon Drive	End	61	8	600	$294,000
13	Granite Street	Hooksett Road	Merrimack Street	63	8	3,555	$1,125,000
	Otterson Street	Granite Street	Highland Street	55			
	Chase Street	Granite Street	Bert Street	50			
14	Merrimack Street	Veterans Drive	End	52	12	1,800	$704,000
15	Scott Avenue	West River Road	End	57	8		
	Green Street	Scott Avenue	End	57	8	2,500	$813,000
16	Bullard Drive	Stevens Drive	End	54	8	700	$274,000
17	Dale Road	Morse Drive	End	45	8	3,200	$1,000,000
18	Bayview Terrace Road	West River Road	End	45	8	1,300	$407,000
						Total Estimated Phase III Cost:	**$5,009,000**

7.4 20-Year Improvement Plan

In addition to the prioritized recommended improvements outlined in Section 7.3, it is beneficial for the Precinct to have an annual plan for construction of improvements. If feasible based on available resources and funding, it is recommended that Phase I and II improvements be completed over an initial 10-year interval since these improvements will provide the greatest benefit to the system. Phase III improvements are recommended to be implemented in the second 10-year interval.

The five Phase I improvements represent approximately ten percent of the total length of the Precinct's water distribution system with 15,000 linear feet of new water main and adding an additional 1,500 linear feet of new water main to areas that currently do not have water mains. The five Phase II improvements represent approximately five percent of the total length with 6,800 linear feet of new water main and adding an additional 2,400 linear feet of water main for the Merrimack River crossing. The eight Phase III improvements represent approximately ten percent of the system with 14,700 linear feet of new water main and adding approximately 200 linear feet of new water main to connect Merrimack Street and College Park Drive. In total, the estimated cost for all three phases of improvements is approximately $11,851,000 and would replace approximately 25 percent of the total system length.

To complete all 18 improvements over a 20-year interval, the Precinct would need to budget approximately $592,550 per year. Table No. 7-6 indicates the total estimated value and length for all three phases of improvements, as well as the estimated annual cost and length of improvements over the 20-year improvement plan. The total overall cost and length of improvements has increased by approximately $4,000,000 and approximately 17,000 linear feet relative to those originally identified in the May 2020 Asset Management Plan.

It should be noted that while these costs are considerable. This study reviews the entire distribution system in detail for the first time from a longterm perspective. The nature of this evaluation is very in depth and as a result highlights the key components of a distribution system's water mains that should be prioritized and invested in gradually as funds become available. Improving the water mains listed in this set of recommendations will lead to an additional 3,900 linear feet of water main to create two redundant loops in the Precinct's system and strengthen the system overall, while also replacing approximately 23 percent of the system's below ground infrastructure. The recommended improvements should be considered in conjunction with any necessary capital improvements to the Precinct's above ground infrastructure when developing the budget for system improvements. Cost savings may be incurred by coordinating these improvement projects and employing a variety of other approaches including but not limited to:

- Periodic re-evaluation of improvement needs and priorities as other improvements are completed,
- Application for grant opportunities and low-interest loans,
- Leveraging water main extension opportunities with developers,
- Favorable timing of competitive bidding when possible,
- Coordinating with other planned roadway and sewer main projects,

- Focusing on small, proactive, and regular rate increases rather than large, infrequent rate hikes.

Finally, Tata & Howard is ready to assist the Precinct with determining other alternative or creative phased funding strategies as needed to accomplish these critical improvements.

Table No. 7-6
20-Year Improvement Plan

Recommended Improvements	Total Estimated Value	Total Length (feet)
Phase I	**$4,595,000**	15,500
Phase II	**$2,247,000**	6,800
Phase III	**$5,009,000**	14,700
Total	**$11,851,000**	**37,000**
Annual Improvements over 20-Year Interval	$592,550	1,850

Appendix A

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Merrimack River

West River Rd
Edgewater Dr
Merrimack St
Pleasant St
Hooksett Rd
Post Rd
Beaver Way
Deer Run
Springer Rd
Pine St
Brighdewine Dr
Heather Dr
Arclon Dr
Main St
Maple St
Rosedale St
Riverside St
Veterans Dr
N Main St
College Park Dr
Pinnacle St
Summit Dr
Vista Dr
Donald St
Birch Hill Rd
Dupont Ave
Highland St
Bernice St
Chase St
Stevens Dr
Bullard Dr
Knights Ave
Bart St
Granite St
Northview Ter
Campus Dr
University Dr
Thompson Ave
Roy Dr
Grant Dr
Morgan Dr
Albert Ave
Pleasant View Rd
Blackwater Dr
Crawford Ln
Main St
Water Precinct Access Rd
Fire House Access Rd
Cate Rd
Mountain View Rd
Almeda Ln
Roy Rd
Grandview Dr
Pearl Dr
Quimby Mountain Rd
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Morningside Dr
Brown Rd
Stow Hill Rd
Palmer Rd
Morse Dr
Mortuary Ln
Dale Rd
Wedgewood Cir
Memorial Dr
Eastview Dr
Avon Rd
Dove Rd
Shannon Rd
Tay Rd
Trent Rd
Maidstone Rd
Thames Rd
Bayview Terrace Rd
West Bank Rd
Cross Rd
Meadowcrest Rd
Scott Ave
Green St
Gary Ave
Marlette Ave
Dartmouth St
Howard Ave
Hunt St
Kerri Ln
Lehoux Dr
Peters Brook Dr
Industrial Park Dr
Oak Hill Rd
Sterling Ave
Julia Dr
Westview Terr
Burbank Way
Virginia Ct
Nancy Ln
Legends Dr
Sunrise Blvd
West River Rd
Hidden Ranch Dr
Gosselin Ave
Technology Dr
Quality Dr
Kimball Dr
Benton Rd
O'Neagh Ave
Whitehall Rd
McAllister St
Martins Ferry Rd
Depot Rd
Harvest Dr
Menifee Dr
Jefferson Dr
N River Rd
Sherwood Dr
Lancelot Dr
Camelot Dr
Goffstown Rd
Valley View Dr
Corriveau Dr
Hacker Hill Rd
Briar Ct
Poore Rd
Bemis Savoie Rd
W Riverbank Rd
Goonan Rd
Central Park Dr

Legend

- Blow Off Valve

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains

Water Distribution System
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Appendix B

TATA & HOWARD

Placeholder for Lewis Engineering Report

Appendix C

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Edgewater Dr
West River Rd
Springer Rd
Pine St
Bridgewater Dr
Merrimack St
Pleasant St
Hooksett Rd
Post Rd
Beaver Way
Rum Brook
Merrimack River
Maple St
Rosedale St
Riverside St
Pinnacle St
Donald Dr
Summit Dr
Vista Dr
Birch Hill Rd
Veterans Dr
Village Park Dr
Thompson Ave
Grant Dr
Allegan Dr
Pleasant View Dr
Alden Dr
Beacon St
Highland St
Bellard Ln
Knights Ave
Granite St
Stevens Dr
Dupaw Ave
Northview Ter
Manor Dr
Blackwater Dr
University Dr
Crawford Ln
Water Precinct Access Rd
Fire House Access Rd
Cate Rd
Snow Hill Rd
Palluzzi Rd
Almeda Ln
Roy Rd
Mountain View Rd
Grandview Dr
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Quimby Mountain Rd
Pearl Dr
Morningside Dr
Brown Rd
Goffstown Rd
Valley View Dr
Corriveau Dr
Morse Dr
Mallory Ln
Dale Rd
Westwood Cir
Memorial Dr
Shannon Rd
Dove Rd
Tay Rd
Trent Rd
Thames Rd
Maidstone Rd
Meadowcrest Rd
Scout Ave
Green St
Lehoux Dr
Industrial Park Dr
Peters Brook Dr
Oak Hill Rd
Sunrise Blvd
Westview Terr
Julia Dr
Stirling Ave
Burbank Way
Virginia Ct
Nancy Ln
Legends Dr
Hidden Ranch Dr
Gosselin Ave
Technology Dr
Quality Dr
Kimball Dr
Central Park Dr
Groonan Rd
Bemis Savoie Rd
W Riverbank Rd
Poore Rd
Hacker Hill Rd
Briar Ct
Depot Rd
N River Rd
Martins Ferry Rd
McAllister St
Whitehall Rd
Benton Rd
Clough Ave
Harvest Dr
Memphis Dr
Jefferson Dr
Sherwood Dr
Lancelot Dr
Camelot Dr
Gary Ave
Marlette Ave
Dartmouth St
Hewlett Ave
Hunt St
Kent Ln
Avon Rd

Legend

- Junction
- Water Main
- High Service Area

Link Map
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
0	6	AC	2004	130	691	Gravel/Sand	0	31
1	6	PVC	2008	130	256	Gravel/Sand	0	16
2	1	Plastic		130	271	Gravel/Sand	0	0
3	8	AC	1966	130	302	Gravel/Sand	0	42
4	8	AC	1966	130	521	Gravel/Sand	1	61
6	8	AC	1978	95	783	Gravel/Sand	2	35
7	8	DI	2030	95	994	Gravel/Sand	0	36
8	8	PVC	2002	130	2027	Gravel/Sand	0	36
9	8	PVC	2002	130	244	Gravel/Sand	0	8
10	8	PVC	2003	130	558	Gravel/Sand	0	8
11	12	DIP	2001	120	628	Gravel/Sand	0	8
12	8	PVC	2006	130	1410	Gravel/Sand	0	11
13	12	DIP	1990	100	2103	Gravel/Sand	0	8
14	8	DIP	1990	90	1816	Gravel/Sand	0	16
15	6	DI	2030	105	641	Gravel/Sand	0	20
17	12	PVC	1982	115	693	Gravel/Sand	1	0
18	12	DI	1990	120	925	Gravel/Sand	0	50
19	12	HDPE	2018	130	1348	Potentially Corrosive	1	32
20	6	PVC	2002	130	1365	Potentially Corrosive	1	44
21	4	PVC	2002	130	490	Potentially Corrosive	0	19
22	6	DI	2030	105	601	Gravel/Sand	0	22
23	6	AC	1963	105	496	Gravel/Sand	0	26
24	8	DI	2030	130	1718	Gravel/Sand	0	43
25	6	AC	1963	105	460	Gravel/Sand	0	44
26	6	AC	1965	130	696	Gravel/Sand	0	36
27	6	PVC	1992	110	1401	Gravel/Sand	0	44
28	6	AC	1957	105	642	Gravel/Sand	0	44
29	12	DIP	2018	120	665	Gravel/Sand	0	21
30	8	DI	1986	110	781	Gravel/Sand	0	44

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
31	12	PVC	1982	130	2076	Gravel/Sand	0	4
32	12	DIP	1992	120	410	Gravel/Sand	0	21
33	8	AC	1950	130	11745	Potentially Corrosive	0	34
34	8	PVC	2030	130	1511	Gravel/Sand	0	16
35	12	DIP	2006	120	445	Gravel/Sand	1	61
36	12	DIP	1985	120	2867	Gravel/Sand	0	36
37	6	AC	1958	130	2607	Gravel/Sand	0	11
38	8	AC	1963	130	3042	Gravel/Sand	0	17
39	8	AC	1962	90	688	Gravel/Sand	0	44
40	6	AC	1962	90	2085	Gravel/Sand	0	36
41	6	AC	1963	90	597	Gravel/Sand	0	36
42	6	AC	1962	130	591	Gravel/Sand	0	44
43	6	AC	1962	130	671	Gravel/Sand	0	44
44	8	PVC	2030	90	1244	Gravel/Sand	0	44
45	6	PVC	2030	130	390	Gravel/Sand	0	44
46	10	DIP		120	883	Gravel/Sand	0	36
47	12	DI	1996	120	3917	Gravel/Sand	0	44
48	12	PVC	2016	130	654	Gravel/Sand	0	0
49	8	PVC	2016	130	2276	Gravel/Sand	0	10
50	12	PVC	2006	130	424	Gravel/Sand	0	11
51	12	PVC	2006	130	668	Gravel/Sand	0	17
52	8	PVC	2006	130	1645	Gravel/Sand	0	12
53	8	PVC	2016	130	741	Gravel/Sand	0	10
54	8	PVC	2006	130	1602	Gravel/Sand	0	8
55	8	PVC	2015	130	854	Gravel/Sand	0	7
56	8	PVC	2015	130	617	Gravel/Sand	0	14
57	12	PVC	2012	130	183	Gravel/Sand	0	15
58	12	PVC	2012	130	1611	Gravel/Sand	0	13
59	12	PVC	2012	130	1063	Gravel/Sand	0	3

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
60	12	PVC	2006	130	227	Gravel/Sand	0	3
61	8	PVC	2007	130	460	Gravel/Sand	0	3
62	12	PVC	2004	130	3608	Gravel/Sand	0	14
63	16	PVC	2007	130	891	Gravel/Sand	0	18
64	8	PVC	2007	130	2704	Gravel/Sand	0	14
65	16	PVC	2006	130	1193	Gravel/Sand	0	3
66	8	PVC	2005	130	826	Gravel/Sand	0	8
67	8	AC	1950	130	4997	Gravel/Sand	0	13
68	2	Plastic	1950	130	877	Gravel/Sand	0	14
69	6	AC	1955	115	1077	Potentially Corrosive	0	52
70	6	HDPE/PVC?	1968	105	437	Gravel/Sand	1	72
71	6	AC	1968	130	2732	Gravel/Sand	1	63
72	8	AC	1960	130	1513	Known Corrosive Soil	0	40
73	8	DIP	1986	110	696	Known Corrosive Soil	0	54
74	8	DIP	1986	110	455	Gravel/Sand	0	36
75	6	AC	1960	130	1788	Gravel/Sand	0	21
76	12	Ductile Iron	1996	120	319	Gravel/Sand	0	21
78	8	DIP	2005	110	1433	Gravel/Sand	0	44
79	8	DIP	1996	110	239	Gravel/Sand	0	10
80	8	DIP	1996	110	169	Gravel/Sand	0	10
81	8	DIP	2005	110	792	Gravel/Sand	0	9
82	8	DIP	2005	110	385	Gravel/Sand	0	14
83	12	PVC	1998	130	183	Gravel/Sand	0	14
84	6	PVC	1982	130	915	Gravel/Sand	0	9
85	8	DIP	1988	110	234	Gravel/Sand	0	9
86	6	PVC	1982	130	1833	Gravel/Sand	0	17
87	8	PVC	1992	130	1866	Known Corrosive Soil	1	57
88	10	PVC	1998	130	438	Gravel/Sand	0	27
89	8	PVC	1995	130	651	Known Corrosive Soil	1	57

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
90	8	PVC	1995	130	371	Gravel/Sand	0	21
91	8	PVC	1995	130	1012	Gravel/Sand	0	11
92	8	PVC	1983	68	1246	Gravel/Sand	0	21
93	6	AC	1968	130	444	Gravel/Sand	0	13
94	12	DIP	1985	120	505	Gravel/Sand	0	21
95	8	PVC	1985	130	2295	Gravel/Sand	1	45
96	6	PVC	1986	130	2843	Gravel/Sand	0	44
97	8	PVC	1985	105	671	Gravel/Sand	0	17
98	8	AC	1960	130	675	Gravel/Sand	0	20
99	6	PVC	1981	130	735	Potentially Corrosive	0	38
100	6	AC	1960	130	4815	Gravel/Sand	1	45
101	6	AC	1950	130	323	Gravel/Sand	1	55
102	8	AC	1950	130	409	Gravel/Sand	0	28
103	6	AC	1963	130	499	Gravel/Sand	0	50
104	6	DI	2030	130	225	Gravel/Sand	0	50
105	6	AC	1965	130	529	Potentially Corrosive	0	52
106	12	DIP	2018	120	689	Gravel/Sand	0	44
107	12	DIP	2006	120	819	Gravel/Sand	2	0
108	8	PVC	2006	130	181	Gravel/Sand	0	44
109	1	Copper	1985	100	6	Gravel/Sand	0	10
110	10	DI		120	125	Gravel/Sand	0	15
111	8	PVC	2019	130	420	Gravel/Sand	0	14
112	8	PVC	2019	130	173	Gravel/Sand	0	37
113	8	PVC	2019	130	72	Gravel/Sand	0	0
114	12	PVC	2006	130	476	Gravel/Sand	0	7
115	2	PVC	1986	130	512	Gravel/Sand	0	13
116	2	PVC	1986	130	1160	Gravel/Sand	0	7
117	2	PVC	1986	130	49	Gravel/Sand	0	14
118	8	PVC	2002	130	426	Gravel/Sand	0	34

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
119	8	PVC	2003	130	179	Gravel/Sand	0	34
120	6	PVC	2003	130	199	Gravel/Sand	0	34
121	6	PVC	2003	130	268	Gravel/Sand	0	8
122	4	PVC	2003	130	127	Gravel/Sand	0	8
123	4	PVC	2003	130	244	Gravel/Sand	0	16
124	4	PVC	2003	130	158	Gravel/Sand	0	16
125	4	PVC	2003	130	157	Gravel/Sand	0	20
126	4	PVC	2003	130	38	Gravel/Sand	0	20
127	4	PVC	2003	130	33	Gravel/Sand	0	20
128	4	PVC	2003	130	119	Gravel/Sand	0	20
129	4	PVC	2003	130	15	Gravel/Sand	0	20
130	4	PVC	2003	130	20	Gravel/Sand	0	20
131	4	Plastic	2002	130	13	Gravel/Sand	0	20
132	4	Plastic	2002	130	48	Gravel/Sand	0	20
133	4	Plastic	2002	130	66	Gravel/Sand	0	20
134	4	Plastic	2002	130	47	Gravel/Sand	0	32
135	4	Plastic	2002	130	112	Gravel/Sand	0	32
136	4	Plastic	2002	130	63	Gravel/Sand	0	32
137	4	Plastic	2002	130	161	Gravel/Sand	0	32
138	8	PVC	1996	130	39	Gravel/Sand	0	32
139	8	PVC	2006	130	37	Gravel/Sand	0	32
140	6	PVC	2015	130	80	Gravel/Sand	0	32
141	12	DIP	2018	120	899	Gravel/Sand	0	21
142	6	DI	2016	110	428	Gravel/Sand	0	14
143	6	AC	1962	130	582	Gravel/Sand	0	23
144	6	PVC	1995	130	385	Gravel/Sand	0	41
145	6	Plastic		130	142	Gravel/Sand	0	0
146	8	PVC	1982	130	58	Gravel/Sand	0	44
147	2	Plastic	1955	130	82	Gravel/Sand	0	29

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
148	6	AC		130	123	Gravel/Sand	0	0
149	12	DIP	2018	120	4	Gravel/Sand	0	20
150	12	DIP	2018	120	632	Gravel/Sand	1	66
151	8	DI	1990	110	31	Gravel/Sand	0	0
152	8	PVC	1985	105	254	Gravel/Sand	0	10
153	6	AC	1957	105	67	Gravel/Sand	0	10
154	16	PVC	2006	130	145	Gravel/Sand	0	20
155	12	DIP	1985	120	4815	Gravel/Sand	1	39
156	12	DIP	1985	120	1401	Gravel/Sand	1	44
157	8	DI	2030	95	4997	Potentially Corrosive	0	23
158	12	PVC	1982	130	3042	Potentially Corrosive	0	27
159	12	PVC	1982	130	3042	Gravel/Sand	0	17
160	12	PVC	1982	130	2027	Potentially Corrosive	0	46
161	12	PVC	1982	130	11745	Potentially Corrosive	0	34
162	12	PVC	1982	130	11745	Potentially Corrosive	0	34
163	12	DIP	1990	90	11745	Potentially Corrosive	0	32
164	6	PVC	2030	115	11745	Potentially Corrosive	0	32
165	8	PVC	2030	90	11745	Potentially Corrosive	0	32
166	8	PVC	2030	90	1816	Gravel/Sand	1	34
171	12	DIP	2001	120	3917	Gravel/Sand	2	69
P11	8	PVC	2003	130	2867	Gravel/Sand	2	61
P13	8	PVC	2003	130	2867	Gravel/Sand	0	36
P15	8	PVC	2003	130			0	0
P17	8	PVC	2003	130			0	0
P19	8	PVC	2003	130			0	0
P21	8	PVC	2003	130	225848		0	0
P23	8	PVC	2002	130	42.77		0	11
P25	12	PVC	2002	110			0	0
P27	6	PVC	2030	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P29	6	AC	2004	130				
P33	6	PVC	2030	130				
P35	8	PVC	2006	130				
P37	12	PVC	2006	130				
P39	12	PVC	2006	130				
P41	12	DIP	1990	100				
P43	12	DIP	1990	100				
P45	12	DI	1990	120				
P47	8	AC	1981	130				
P49	6	DI	2016	110				
P53	12	DIP	1996	120				
P55	6	AC	1955	130				
P57	6	AC	1955	130				
P59	6	AC	1955	115				
P61	6	AC	1955	130				
P63	6	HDPE/PVC?	1968	105				
P65	16	PVC	2007	130				
P67	12	PVC	2004	130				
P69	12	DI	1990	120				
P71	12	DIP	2006	120				
P73	8	PVC	2019	130				
P75	6	DI	2030	105				
P77	6	DI	2030	105				
P79	6	DI	2030	105				
P83	6	PVC	2015	130				
P85	6	PVC	2015	130				
P87	6	PVC	2015	130				
P89	8	PVC	2006	130				
P91	12	PVC	1982	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P93	16	PVC	2006	130				
P95	16	PVC	2006	130				
P99	16	PVC	2007	130				
P101	16	PVC	2007	130				
P103	12	PVC	2004	130				
P105	12	PVC	2004	130				
P107	12	PVC	2004	130				
P109	12	PVC	2006	130				
P111	12	PVC	2006	130				
P113	12	PVC	2006	130				
P115	12	PVC	2006	130				
P117	12	PVC	2006	130				
P119	8	PVC	2006	130				
P121	8	PVC	2006	130				
P123	12	PVC	2012	130				
P125	12	PVC	2006	130				
P127	12	PVC	2012	130				
P129	12	PVC	2012	130				
P131	12	PVC	2016	130				
P133	12	DIP	2006	120				
P135	12	DIP	1985	120				
P137	12	DIP	1985	120				
P139	12	DIP	1985	120				
P141	12	DI	1996	120				
P143	12	DIP	2006	120				
P145	12	DI	1990	120				
P147	12	DIP	2018	120				
P149	6	PVC	2002	130				
P151	6	PVC	2002	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P153	8	PVC	2030	130				
P155	8	PVC	2030	130				
P157	8	PVC	2030	130				
P159	8	PVC	2030	130				
P161	12	DIP	1985	120				
P163	8	AC	1963	130				
P165	8	AC	1963	130				
P167	12	DIP	1985	120				
P169	6	AC	1963	130				
P171	8	AC	1963	130				
P173	8	AC	1963	130				
P175	8	AC	1962	100				
P177	6	AC	1962	130				
P179	8	AC	1963	130				
P181	6	AC	1962	130				
P183	8	AC	1963	130				
P185	8	PVC	2030	130				
P187	8	PVC	2030	90				
P189	6	AC	1963	130				
P191	6	AC	1962	90				
P193	8	PVC	2002	130				
P195	8	PVC	2002	130				
P197	8	PVC	2002	130				
P199	8	PVC	2002	130				
P201	8	PVC	2002	130				
P203	8	PVC	2002	130				
P205	8	PVC	2002	130				
P207	8	PVC	2002	130				
P209	8	PVC	2003	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P211	8	PVC	2003	130				
P213	6	PVC	2003	130				
P215	6	PVC	2003	130				
P217	6	AC	2004	130				
P219	6	AC	2004	130				
P221	12	DIP	1990	100				
P223	6	DI	2030	105				
P225	6	DI	2030	105				
P227	6	DI	2030	105				
P229	6	AC	1957	105				
P231	12	DIP	2018	100				
P233	8	DI	1986	110				
P235	8	DI	1986	110				
P237	12	DIP	2018	100				
P239	12	DIP	2018	120				
P241	6	DI	2030	105				
P243	6	AC	1963	105				
P245	8	DI	2030	130				
P247	12	PVC	1982	130				
P249	12	DIP	1990	100				
P251	8	AC	1950	115				
P253	8	AC	1950	130				
P255	12	DIP	1992	120				
P257	6	AC	1950	130				
P259	6	AC	1960	130				
P261	6	AC	1955	115				
P263	6	AC	1955	115				
P265	6	AC	1955	115				
P269	8	AC	1960	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P271	8	DIP	1986	110				
P273	8	DIP	1986	110				
P275	8	DIP	1986	110				
P277	6	AC	1960	130				
P279	12	Ductile Iron	1996	120				
P281	8	DIP	2005	110				
P283	8	DIP	1996	110				
P285	8	DIP	1996	110				
P287	8	DIP	2005	110				
P289	8	DIP	2005	110				
P291	8	PVC	1995	130				
P293	12	PVC	1995	130				
P295	12	PVC	1995	130				
P297	12	PVC	1982	130				
P299	6	PVC	1982	130				
P301	6	PVC	1982	130				
P303	6	PVC	1982	130				
P305	12	PVC	1982	130				
P307	12	PVC	1982	130				
P309	8	PVC	1983	68				
P311	12	PVC	1982	85				
P313	8	PVC	1996	130				
P315	8	PVC	1985	130				
P317	6	PVC	2030	130				
P319	6	PVC	2030	130				
P321	6	AC	1968	130				
P323	8	PVC	1985	105				
P325	6	PVC	2030	130				
P327	12	PVC	1982	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P329	16	PVC	2006	130				
P331	8	DI	2030	130				
P333	12	DIP	1992	120				
P335	12	DIP	2006	120				
P337	12	DIP	2006	120				
P339	12	DIP	2006	120				
P341	12	DIP	1990	120				
P343	12	DIP	1990	90				
P345	12	DIP	1990	90				
P347	6	PVC	1992	130				
P349	8	PVC	2005	130				
P351	8	PVC	2016	130				
P353	8	PVC	2016	130				
P355	8	PVC	2015	130				
P357	8	PVC	1985	130				
P359	8	PVC	1985	125				
P361	8	PVC	1985	110				
P363	6	PVC	1986	130				
P365	6	PVC	1986	120				
P367	8	PVC	1983	130				
P369	8	PVC	1983	130				
P371	8	PVC	1995	110				
P373	8	PVC	1995	130				
P375	8	DI	2030	130				
P377	8	AC	1960	130				
P379	8	PVC	1992	130				
P381	8	DI	1986	110				
P383	12	DI	1996	120				
P385	4	Plastic	2002	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P387	8	PVC	2002	130				
P389	6	HDPE/PVC?	1968	105				
P391	8	PVC	2030	90				
P393	8	PVC	2030	130				
P395	8	PVC	2030	90				
P397	16	PVC	2007	130				
P399	12	PVC	1982	130				
P401	12	PVC	2006	130				
P403	6	AC	1958	130				
P405	6	AC	1962	130				
P407	6	PVC	1999	130				
P409	6	AC	1962	130				
P411	8		1983	100				
P413	8	PVC	2019	130				
P415	12	PVC	2012	130				
P417	8	PVC	2020	130				
P419	8	PVC	2020	130				
P421	2	Copper	2001	100				
P423	12			100				
P425	2	Copper	2001	100				
P427	12	DI	1996	120				
P429	12	DIP	1996	120				
P431	12	DIP	1996	120				
P433	12	DIP	1996	120				
P435	8	DIP	2005	110				
P437	8	DIP	2005	110				
P439	8	DIP	1986	110				
P441	8	DIP	1986	110				
P443	12	DIP	1990	100				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P445	12	DIP	1990	100				
P447	12	PVC	1982	130				
P449	12	DIP	2018	120				
P451	8	AC	1981	130				
P453	12	PVC	1982	130				
P455	8	PVC	1987	120				
P457	8	PVC	1987	120				
P459	12	DIP	2006	120				
P461	8	DI	2030	95				
P463	8	AC	1978	95				
P465	12	DIP	1990	100				
P467	8	PVC	2007	130				
P469	8	PVC	2030	90				
P471	8	PVC	1985	130				
P473	4	PVC	2002	130				
P475	8	PVC	2012	130				
P477	12	PVC	2006	130				
P479	8	DIP	1990	90				
P481	8	PVC	2003	130				
P483	6	DI	2016	110				
P485	6	PVC	2030	130				
P487	8	PVC	1985	130				
P489	8	PVC	1996	130				
P491	8	PVC	1996	130				
P493	8	PVC	2020	130				
P495	12	DI	1996	120				
P497	12	PVC	2030	130				
P499	12	PVC	2030	130				
P501	12	PVC	2030	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P503	8	PVC	1985	130				
P505	12	PVC	2030	130				
P507	12	DI	1996	120				

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J14	297.29	0.15	72.29
J18	299.26	0.3	71.22
J20	273.00	1.35	82.03
J22	274.53	0.6	81.37
J24	276.90	1.05	80.23
J26	272.00	0.75	82.36
J30	246.43	0.45	79.49
J32	257.84	0	74.54
J34	290.69	0	60.3
J36	289.24	0.3	60.93
J40	263.00	0	72.3
J42	259.00	0	74.03
J44	265.99	0	71
J46	244.31	0	80.4
J52	225.11	0.15	87.79
J60	220.55	1.2	89.33
J64	206.95	0.3	94.98
J72	179.82	0	106.66
J74	181.88	0	105.7
J78	214.98	0	90.72
J92	263.39	0.6	70.53
J94	260.88	0.3	71.62
J98	300.73	1.05	54.37
J100	260.51	1.2	71.79
J102	286.25	1.2	60.64
J104	303.00	0	53.39
J106	313.65	0.6	48.78
J114	197.98	0	98.87
J116	193.66	0	100.73
J120	198.93	0.6	98.03
J124	191.82	1.05	101.31
J126	210.81	0.3	92.9
J128	261.04	0.15	70.27
J132	314.00	0	47.59
J134	298.82	0.15	53.92
J136	325.22	0.45	42.23
J138	306.93	0.45	50.06
J140	323.00	0.75	43.1
J144	244.14	0.75	77.61
J154	266.21	0.3	68.01
J156	299.86	0.6	53.45

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J168	288.05	1.05	58.41
J170	271.98	0	65.37
J172	317.04	0	46.28
J174	366.00	0	25.06
J178	312.10	0.75	48.41
J180	356.88	0	110.17
J182	392.44	0	94.76
J186	338.57	0	118.1
J188	397.06	0	92.76
J192	431.31	0	77.92
J196	511.85	0	43.02
J198	474.46	0.15	59.22
J200	523.39	0.3	38.02
J206	408.16	0.3	87.95
J208	450.13	0	69.76
J212	487.00	0	53.79
J216	478.99	0	57.26
J228	333.00	0.3	120.52
J232	317.00	0	46.28
J236	571.00	0	17.33
J238	485.00	0.45	54.6
J240	491.88	0	51.62
J242	467.25	0.15	62.29
J244	328.98	0	122.21
J248	428.91	0.6	78.91
J252	230.63	0.45	84.27
J254	264.55	0.6	69.57
J256	203.33	0.3	96.14
J266	271.00	1.35	66.46
J270	278.43	0.3	63.18
J272	293.82	0	56.51
J274	308.96	0	49.95
J276	275.70	1.5	64.36
J282	316.25	0	46.61
J286	301.31	0.75	53.14
J290	315.00	0	47.15
J294	309.00	0.3	49.81
J298	301.16	0.75	53.21
J300	306.72	0.75	50.8
J302	299.31	0	54.01
J304	231.46	0.75	84.36

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J306	236.00	0.15	82.39
J314	203.38	0.3	96.52
J322	184.49	0.9	104.71
J326	285.77	0.15	60.82
J330	196.31	0	99.59
J332	212.75	0.45	92.46
J334	212.42	0.45	92.61
J336	208.75	0.45	94.19
J340	190.21	0.75	102.23
J344	190.16	0.15	100.82
J346	287.02	0	58.85
J350	261.47	1.8	69.92
J354	258.35	0.3	71.27
J356	228.53	1.65	84.19
J360	297.00	0.3	55.01
J364	276.64	0.45	63.92
J374	191.49	0	101.26
J384	269.73	0.6	67.79
J388	265.87	0	69.46
J394	194.86	0.15	99.73
J398	288.00	0.3	58.38
J400	314.00	0	47.59
J404	541.18	0	30.31
J408	494.70	0	50.45
J414	310.03	0	130.47
J418	317.96	0.3	46.05
J422	289.37	0.15	58.44
J426	295.00	0.15	56
J430	272.46	0.15	68.2
J434	275.00	0	67.1
J436	275.00	0	67.1
J438	272.00	0	68.4
J440	266.86	0	70.63
J442	270.00	0.3	69.27
J444	273.00	0.15	67.97
J446	271.87	0	68.45
J448	273.20	0	67.88
J450	270.79	0	68.92
J452	271.32	0	68.69
J456	273.34	0.15	67.82
J460	272.00	0.15	68.4

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J462	271.00	0	68.83
J466	268.01	0	70.13
J470	265.33	0	71.29
J474	266.96	0.15	70.58
J478	266.09	0.15	70.96
J480	268.85	0.15	69.77
J484	273.00	0.15	67.97
J488	275.04	0.15	67.08
J490	268.90	0	69.74
J494	270.52	0.15	69.04
J498	273.61	0.15	67.71
J504	189.00	0	102.76
J508	243.27	0.15	79.24
J514	199.00	0	98.36
J516	213.63	0	92.13
J520	198.64	0.15	98.51
J522	240.45	0.3	79.21
J526	229.00	0	85.42
J530	190.49	0	102.11
J534	195.63	0	99.89
J536	269.63	0.75	67.05
J538	241.87	0.3	79.07
J544	195.00	0	99.99
J552	326.91	0.3	123.1
J554	298.54	0.15	54.11
J556	311.05	0	48.87
J558	190.00	0.3	102.32
J560	191.76	0.9	101.56
J562	202.04	0.45	97.11
J564	298.59	0.75	53.85
J566	282.52	0.45	60.86
J584	239.73	0	82.38
J590	267.20	0.3	70.48
J592	267.38	0	70.4
J594	273.09	0	67.93
J596	234.26	1.5	84.77
J598	238.71	0.45	83.89
J600	272.77	0.3	82.91
J602	274.99	0.15	81.77
J604	260.37	0.9	86.83
J606	212.91	0	92.47

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J608	213.26	0	92.29
J610	193.00	0	101.01
J612	199.00	0	98.36
J614	199.00	0.15	98.36
J618	314.94	0.45	47.18
J620	301.42	1.35	53.1
J622	281.19	1.35	61.95
J624	268.87	1.65	67.46
J626	276.00	1.2	64.24
J628	270.00	1.8	66.89
J630	469.26	0	61.43
J632	471.19	1.35	60.59
J634	211.25	0.15	92.71
J636	212.14	0.15	92.3
J638	531.80	0	34.38
J640	235.32	0.3	82.76
J642	269.84	0.6	67.78
J644	210.31	0.45	93.53
J648	198.79	0	98.51
J650	212.33	0	92.64
J652	194.66	0	100.3
J654	198.59	0	98.6
J656	190.40	0	102.15
J658	191.00	0	101.89
J660	334.00	1.8	120.03
J662	426.79	2.4	79.83
J668	313.41	0	129.04
J670	365.44	0.45	106.46
J672	366.03	0	106.21
J674	357.85	0.45	109.75
J676	405.51	0.9	89.1
J678	312.22	0	129.52
J680	424.90	0.15	80.7
J682	450.00	0.45	69.82
J684	511.06	0.9	43.36
J686	488.38	0	53.19
J688	429.56	0	78.68
J690	488.82	0	53
J692	482.78	0	55.62
J694	359.07	0	109.22
J696	310.36	0	49.19

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J702	313.62	0	47.71
J704	306.45	0.15	50.88
J706	212.89	0	91.92
J708	222.73	0	87.91
J710	196.00	0.15	99.57
J712	214.73	0.45	90.83
J714	216.58	0.6	90.03
J716	226.92	1.05	85.55
J718	292.84	0.15	56.34
J724	302.00	0	52.52
J726	288.96	0.6	58.18
J728	285.01	1.05	59.89
J730	302.00	1.35	52.52
J732	266.10	0.6	68.08
J734	265.06	0.75	68.54
J736	256.00	0.3	72.47
J738	252.80	0.6	73.86
J740	265.00	0.45	68.57
J742	256.76	0.75	72.14
J744	258.95	1.35	71.19
J746	244.39	1.2	77.5
J748	249.91	0.45	75.14
J752	277.61	0.9	63.09
J754	275.05	0.9	64.21
J756	259.97	0	73.61
J758	268.91	0.15	69.74
J760	262.93	0.15	72.33
J762	259.05	0	74.01
J764	270.45	0.15	69.07
J766	273.04	0	67.95
J768	258.77	0	74.14
J770	260.92	0	73.2
J772	264.87	0	71.49
J774	265.38	0	71.27
J776	272.17	0.15	68.32
J778	272.00	0	68.4
J782	274.79	0.15	81.88
J786	233.32	1.2	83.67
J788	233.41	1.8	83.58
J790	310.00	0.75	50.35
J792	303.00	1.95	53.39

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J794	255.51	0.15	73.95
J802	265.07	0	69.81
J806	292.24	0.9	58.05
J808	259.00	1.2	72.44
J810	193.64	0.15	100.75
J812	198.71	0	98.55
J814	199.22	1.5	97.93
J816	193.11	0.75	100.56
J818	203.88	1.2	95.89
J820	221.69	0.6	88.15
J822	227.00	0.45	85.83
J824	248.70	0.75	76.39
J826	269.39	0.9	67.15
J828	274.08	0.3	65.08
J832	291.36	0.15	57.58
J834	292.00	0	57.3
J836	305.00	0	51.67
J838	297.57	1.65	54.76
J840	312.99	0	48.02
J842	295.16	0	55.81
J844	303.52	0.75	52.18
J846	313.00	0.15	48.08
J854	235.79	0.15	82.48
J856	236.97	0.45	81.97
J858	222.53	0.45	88.22
J860	185.86	1.05	104.12
J862	191.04	0.75	101.87
J864	191.87	1.2	101.51
J866	200.15	0	97.92
J868	194.00	0.15	100.59
J870	186.73	0.45	103.74
J872	199.16	0.6	98.35
J874	188.87	0.15	102.81
J876	268.48	0.3	66.88
J878	278.81	1.2	62.41
J880	273.08	0.3	64.89
J882	201.48	0.15	95.91
J884	287.07	1.8	58.83
J886	291.52	0.75	56.91
J888	195.44	0.15	99.97
J890	330.66	0.15	121.48

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J892	290.76	0.45	60.27
J894	191.86	1.5	101.1
J896	220.73	0	88.48
J898	258.07	0	72.17
J900	279.68	0.15	62.68
J904	225.00	0.6	87.7
J906	237.09	1.2	83.08
J908	305.81	0.9	52.17
J910	427.53	0.75	79.5
J912	346.79	0	114.54
J914	338.41	0	118.17
J916	423.49	0	81.31
J918	219.75	2.4	88
J920	217.27	0.9	89.07
J922	218.66	0.6	88.47
J924	264.55	0.3	68.59
J926	264.07	0.9	68.8
J928	189.00	0.6	102.76
J930	190.00	1.05	102.32
J932	212.34	0.15	92.64
J934	195.61	0.75	99.89
J940	187.87	0.15	103.25
J942	0.00	0	185.42
J946	269.92	0	69.3
J948	258.28	0	74.35
J950	270.31	0.6	66.75
J952	235.99	1.05	81.44
J954	219.68	0.6	88.85
J956	251.79	0	74.32
J958	191.02	0.75	101.88
J960	406.00	0.15	88.89
J962	197.51	0.15	97.63
J964	249.68	0	75.03
J966	0.00	0	183.22
J968	220.60	0.15	87.63
J970	0.00	0.9	183.22
J972	515.23	0	41.56
J974	0.00	0	264.81
J976	0.00	0	264.81
J978	0.00	0	264.81
J980	0.00	0	183.64

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J982	0.00	0.15	183.64
J984	0.00	0	183.64
J986	0.00	0	183.64
J988	0.00	0.15	183.64
J990	0.00	0.3	183.64
J992	316.24	0.15	46.61
J994	0.00	0	183.7
J998	0.00	0.45	183.7
J1000	295.98	0.3	55.45
J1002	287.17	0	59.39
J1004	288.14	0.15	58.97
J1006	213.47	0.45	92.22
J1008	0.00	0	184.69
J1010	0.00	0	184.69
J1012	198.89	0.6	98.47
J1014	198.97	0	98.37
J1016	0.00	0	184.65
J1018	0.00	0.15	184.66

Pump Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Head (Design) (ft)	Flow (Design) (gpm)
North Well Pump Station	255	330	300
East Well Pump Station	303	385	300
South Wells Pump Station	249	282	350
Booster Pump Station	317	240	130

Tank Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (ft)	Elevation (Base) (ft)	Level (Maximum) (ft)	Level (Initial) (ft)
West(Quarry) Tank	58.75	385	50	38
Thompson Corner Tank	33	395	30	23
Manor Drive tank	50	568	75	56

Appendix D

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

6. Route 3A
New 12-inch Water Main

5. Pine Street
New 12-inch Water Main

3. Pinnacle Street, West River Road, and Maple Street
New 12-Inch Water Main

1. Vista Drive and Cross Country
New 12-inch Water Main

8. Riverside Street
New 12-inch and
8-inch Water Main

7. Daniel Webster Hwy
New 12-inch Water Main

4. Main Street and Route 3
New 12-inch Water Main

2. River Crossing
New 12-inch Water Main

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Legend

- Priority 1 Hydraulic Deficiencies
- Priority 2 Hydraulic Deficiencies

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains
- High Service Area


Hydraulic Deficiencies
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Appendix E

TATA & HOWARD



Critical Water Mains
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD


Approximate Scale: 1" = 1,000'

March 2021

Appendix F

TATA & HOWARD

Asset Management Ratings
Hooksett Village Water Precinct
Hooksett, New Hampshire



TATA & HOWARD

Approximate Scale: 1" = 1,000'

March 2021

Appendix G

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Legend

- Priority I Hydraulic
- Priority II Hydraulic
- Critical Area

Critical Users

- Other
- School

- Private Mains

AM_Score, Proposed

- No Score
- Excellent to Good
- Good to Fair
- Fair to Poor
- High Service Area

Three Circles Integration
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Appendix H

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

3. Route 3A
New 12-inch Water Main

2. Ardon Drive, Well Access Road, and Pine Street
New 12-inch Water Main

7. Riverside Street
New 12-inch and
8-inch Water Main

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

North Pump Station

North Well

East Pump Station

East Well

9. Pinnacle Street and Maple Street
New 12-Inch Water Main

10. Veterans Drive
New 12-inch Water Main

South Well Back-Up

South Pump Station

South Well

8. West River Road
New 12-Inch Water Main

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

1. Vista Drive and Cross Country
New 12-inch Water Main

4 Main Street and Route 3
New 12-inch Water Main

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

5. Daniel Webster Hwy
New 12-inch Water Main

6. River Crossing
New 12-inch Water Main

Merrimack River

West River Rd

Post Rd

Pleasant St

Merrimack St

Hooksett Rd

Main St

Maple St

Veterans Dr

Thompson Ave

Dartmouth St

Maidstone Rd

Lehoux Dr

Industrial Park Dr

Oak Hill Rd

Londonderry Tpke

Whitehall Rd

Martins Ferry Rd

Cross Rd

Meadowcrest Rd

Scott Ave

Gosselin Ave

Technology Dr

Quality Dr

Kimball Dr

Sunrise Blvd

Ridden Ranch Dr

Driveway A159

Driveway A472

Interstate 93 N

Interstate 293 S

I-93 NB Exit 10 Off ramp (I-293 SB)

I-93 SB Exit 11 Off (Hackett Hill Rd)

I-93 NB Exit 11 Off (Hackett Hill Rd)

I-93 Exit 11 (Hackett Hill Rd)

I-93 SB Exit 11 On ramp (I-293 NB)

I-93 NB Exit 10 On ramp (NH 3A)

Legend

- Phase I IImprovements
- Phase II Improvements


Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains
- High Service Area

Phase I and II Improvements
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021



N
Allenstown
Bow
Hooksett Village
Dunbarton
Goffstown
Manchester
Merrimack River
North Pump Station
North Well
East Pump Station
East Well
South Well Back-Up
South Pump Station
South Well
West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft
11. Highland Street
New 8-inch Water Main
12. Heather Drive and Cross Country
New 8-inch Water Main
13. Granite Street, Otterson Street, Chase Street
New 8-inch Water Main
14. Merrimack Street
New 12-inch Water Main
15. Scott Avenue and Green Street
New 8-inch Water Main
16. Bullard Drive
New 8-inch Water Main
17. Dale Road
New 8-inch Water Main
18. Bayview Terrace and West Bank Road
New 8-inch Water Main
Booster Pump Station
Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft
Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft
Legend
Phase III A Improvements
Phase III B Improvements
Water Main Diameter
4-Inch or Smaller
6-Inch
8-Inch
12-Inch
16-Inch
Private Mains
High Service Area
Phase III Improvements
Hooksett Village Water Precinct
Hooksett, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
March 2021

TATA & HOWARD

OFFICE LOCATIONS:
MA | NH | CT | ME | VT | AZ

800-366-5760
www.tataandhoward.com

Appendix C

TATA & HOWARD

ENERGY EVALUATION

Hooksett Village Water Precinct
Water System Pump Stations
Hooksett, NH



PROCESS ENERGY SERVICES, LLC

WATER ♦ WASTEWATER ♦ INDUSTRIAL

ENERGY EVALUATION

for the

HOOKSETT VILLAGE WATER SYSTEM

September 2020

Hooksett, NH

Performed by:

Process Energy Services, LLC
2 Lafayette Rd.
Londonderry, New Hampshire 03053
(603) 537-1286

Supported by:

New Hampshire Department of Environmental Services

Eversource

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APPENDIX A: ELECTRIC RATE SCHEDULE

APPENDIX B: PRODUCT DATA SHEET

While the recommendations in this report have been reviewed for technical accuracy, Process Energy Services is not liable if the projected savings are not achieved. The recommendations are based on an analysis of conditions observed at the time of the evaluation; information provided by facility staff and estimated costs for equipment and labor based on similar projects. Actual savings and project costs will depend on many factors, including varying process flows and loads, recommendations implemented, seasonal variations in fuel costs and weather, and proper equipment operation. Before implementation of the measures presented in this report, Process Energy Services recommends a more detailed analysis to verify savings and project costs.

SECTION 1. EXECUTIVE SUMMARY

1.1 Overview

In 2016, the New Hampshire Department of Environmental Services (NHDES), the New Hampshire Office of Energy and Planning (NHOEP) and New Hampshire electric utilities secured funding to perform comprehensive and preliminary process energy evaluations at selected New Hampshire Wastewater Treatment Facilities. Due to the success of this initial program, NHDES Clean Water State Revolving Fund (CWSRF) provided funding to continue conducting energy audits at New Hampshire's water and wastewater treatment facilities and pump stations. The NHDES CWSRF program is also providing loan forgiveness to encourage implementation of the energy audit findings. The loan forgiveness is in addition to any incentives offered by NHSaves.

Process Energy Services (PES) was selected as the consultant to perform the energy evaluation. PES specializes in water/wastewater system process energy evaluations and has performed evaluations throughout New England.

The enclosed energy saving recommendations for the Hooksett Village Water System Stations are based on site visits to review the station pumping equipment and building systems.

1.2 Report Organization

As cost savings projects were developed, each measure was prioritized based on ease of implementation, cost effectiveness and ability for each project to support subsequent measures. The projects have been categorized as energy conservation measures (ECMs) for projects that require a capital investment, operational measures (OMs) for fast payback improvements (1 year or less) and energy supply measures (ESMs) for improvements that may reduce energy costs without reducing energy consumption (i.e. alternative energy sources and rate schedule changes). We have also included energy management practices (EMPs) that are essential for a successful energy management program.

The report organization includes an Executive Summary to provide an overview of the recommended project savings and costs. Section 2 reviews energy management initiatives and benchmarking facility energy use. Section 3 contains an energy related overview of each water pump system and Section 4 includes a detailed review of each proposed energy measure.

1.3 Measure Cost Estimates

Once potential energy savings are identified, there are often multiple ways to improve equipment operation to realize the projected energy savings. Process Energy Services makes an effort to select the simplest, lowest cost solution for municipalities to insure the projects are cost effective and potentially qualify for utility incentives.

The project evaluation summary is presented in Table 1.1 and a summary of the qualified measures and their associated savings is presented in Table 1.2.

Table 1.1: Project Evaluation Summary

2019 Baseline Annual Electric Energy Costs

North Well Pump Station Electric	$ 14,342
South Well Pump Station Electric	$ 11,208
East Well Pump Station Electric	$ 14,792
Granite Booster Station Electric	$ 17,143
Manor Tank Electric	$ 1,078
Thompson Tank Electric	$ 534
Water Department Administration Building Electric	$ 1,895
Total System Annual Electric Costs	**$ 60,992**

2019 Baseline Propane/Fuel Oil/Natural Gas Energy Costs

North Well Propane	$ 3,260
South Well Propane	$ 1,172
Booster Station Natural Gas	$ 861
Quarry Tank Propane	$ 1,221
Water Department Administration Building Fuel Oil	$ 2,820
Total Annual Fuel Oil/NG/Propane Costs	**$ 9,334**

Projected Annual Cost and Savings Summary

	Calculated Savings	Percent of Costs
Electric Cost Savings	$ 25,277	41 %
Fuel Oil/NG/Propane Savings	$ 309	3 %
Net Annual Savings/Percent of Energy Costs	**$ 25,586**	**36%**

Project Costs/Payback

Estimated Cost of Projects	**$14,100**
Simple Payback	**<1 Year**

Electric Energy Reduced Power Plant Emissions

In addition to the energy cost savings, reducing facility energy use will also provide environmental benefits by reducing greenhouse gas emissions (GHG) that include CO_2, N_2O and CH_4. The information in this evaluation can be used by the Precinct to develop a GHG inventory plan in accordance with the EPA's Climate Leadership Program. Reduced power plant emission is based on 32,456 kWh annual savings.

Carbon Dioxide (1.37 lbs/kWh)	44,465	lbs/year
Sulfur Oxides (0.0035 lbs/kWh)	114	lbs/year
Nitrous Oxides (0.0010 lbs/kWh)	32	lbs/year

Emission unit source: U.S. EPA eGrid 2007 and U.S. EPA Office of Air Quality Planning & Standards *(www.epa.gov/cleanenergy/energy-resources/egrid/faq.html).*

Table 1.2: Recommended Cost Saving Projects

No	Cost Saving Measures	Annual Energy Savings (kWh)	First Year Annual Savings ($)	Initial Cost ($)	Simple Payback (yrs)
	ENERGY MANAGEMENT PRACTICES				
EMP 1	Benchmark Energy Use with Operational Data	--	--	--	--
	Total for EMPs	--	--	**--**	--
	OPERATIONAL MEASURES				
OM 1	North Well VFD Savings	8,937	$2,691	--	--
OM 2	Operate South Wells More Hours	6,794	$5,602	**--**	--
OM 3	Reduce Generator Block Heater Setpoint	3,825	$463	**--**	**--**
OM 4	Install Setback Thermostat for Office	**--**	$309	$100	<1
	Total for OMs	**19,556**	**$8,581**	**$100**	**<1**
	ENERGY CONSERVATION MEASURES				
ECM 1	Install Booster Station Natural Gas Unit Heater	8,900	$633	$2,000	3.2
ECM 2	Install Wall Thermostats for Electric Heaters	4,000	$484	$2,000	4.1
	Total for ECMs	**12,900**	**$1,117**	**$4,000**	**3.6**
	ENERGY SUPPLY MEASURES				
ESM 1	Booster Station Controls Adjustment	--	$8,671	--	--
ESM 2	Investigate TOD Schedule Change	--	$7,217	$10,000	1.4
	Total for ESMs	**--**	**$15,888**	**$10,000**	**<1**
	Electric Energy Cost Savings	32,456	$25,277	$14,000	<1
	Propane/Fuel Oil Cost Savings	**--**	$309	$100	<1
	Total	**32,456**	**$25,586**	**$14,100**	**<1**

The calculated savings for the measures are interactive in the order shown in Table 1.2 to avoid taking credit for savings that may be realized by implementing a previous measure.

SECTION 2. ENERGY MANAGEMENT

2.1 Energy Management Program

An effective energy management program provides a systematic approach to reducing facility energy use and costs. A successful program is structured to provide an on-going process that can be used to continually evaluate new projects, track savings and encourage efforts within the organization to improve efficiency.

The EPA 2008 Energy Management Guidebook for Water and Wastewater Utilities (*www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf)* presents a management system approach for water and wastewater utilities for energy conservation. Based on the successful Plan-Do-Check-Act process, the guidebook provides information on establishing and prioritizing energy conservation targets (Plan), implementing specific practices to meet these targets (Do), monitoring and measuring energy performance improvements and cost savings (Check), and periodically reviewing progress and making adjustments to energy programs (Act).

The most effective way to maintain system efficiency is to benchmark system energy use with flow (kWh/MG). EMP #1 reviews collecting the following data each month to help relate station energy/fuel use to equipment operation.

- Track energy use, peak electric demand and all monthly energy costs.
- Track fuel oil/propane/natural gas use and costs and relate usage to thermostat settings and generator run time.

Collecting this additional data on a regular basis is useful to verify savings of the proposed measures and determine when pump upgrades or heating system improvements can be justified.

2.2 Benchmarking Facility Energy Use

Energy benchmarking can be accomplished using internal or external comparisons. Internal benchmarking allows an organization to evaluate facility energy use year to year to monitor facility efficiency changes. The results can be used within an organization to track performance over time, identify best practices and increase management's understanding of how to analyze and interpret energy data.

For external benchmarking, a facility can be compared to similar regional facilities. When process and energy use data is assembled, the information can be used to assess performance and encourage staff to investigate why performance is lower than expected, or to confirm efficiency efforts by receiving a high performance rating relative to other facilities.

The benchmarking data for the Hooksett Village Water System is compared in Table 2.1 with several other New Hampshire Water Systems. This simple comparison does not account for elevation differences or the type of heating system (electric, propane, fuel oil or natural gas), but helps encourage staff to evaluate system energy use in more detail to determine why system benchmark data is higher or lower compared to other New Hampshire communities.

As shown in Table 2.1, the kWh/MG for the Hooksett Village Water System is reasonable compared to other New Hampshire groundwater type systems.

Table 2.1: NH Water System Benchmarking Data

Water System	Total Annual System Energy Usage (kWh)	Annual System Flow (MG)	Annual kWh/MG	Type of System
Warner Village Water District	48,342	18.9	2,557	Wells / 1 Zone
Town of Peterborough	544,915	214.4	2,541	Wells / 2 Zones
Hooksett Village	**263,431**	**121.8**	**2,163**	**Wells/2 Zones**
North Conway (NCWP)	604,458	283.5	2,132	Wells / 3 Zones
Conway Village (CVFD)	180,023	90.3	1,994	Wells/1 Zone
Town of Jaffrey	295,117	151.8	1,944	Wells / 2 Zones
City of Lebanon	1,048,409	544.1	1,927	Surface Water Treatment /4 Zones
Town of Colebrook	229,741	122.0	1,883	Wells / 1 Zone
Plymouth (PVW&SD)	259,090	139.9	1,852	Wells / 2 Zones
Antrim/Bennington System	87,792	50.8	1,728	Wells / 2 Zones
Town of Bristol	146,271	95.3	1,535	Wells/2 Zones
City of Rochester	1,058,854	745.4	1,432	Surface Water Treatment / Well/ 4 Zones
Town of Hanover	427,289	298.3	1,407	Surface Water Treatment / 3 Zones
Winchester Water Department	159,812	114.6	1,394	Wells / 1 Zone
City of Concord	1,540,339	1,546	996	Surface Water Treatment/3 zones
*City of Keene	695,226	752.3	924	Surface Water Treatment/ Wells/5 Zones
*City of Claremont	210,455	326.0	646	Surface Water Treatment/3 zones
*Town Of Wolfeboro	37,056	142.4	260	Surface Water Treatment / 2 Zones

*These water systems benefit from a high elevation reservoir with no raw water pumping.

If the identified measures in Table 1.2 are implemented, annual system electric energy use for the Hooksett Village Water System could be reduced by 32,456 kWh. The new kWh/MG benchmark value, after implementing the proposed projects, is summarized below.

Table 2.2: New Potential Benchmark Value after Energy Project Implementation

Year	Total Annual Energy Usage (kWh)	Total Annual Flow Pumped (MG)	Annual kWh/MG	Total New Energy Cost	Annual Energy Cost/MG
2020	230,975	121.8	1,896	$35,715	$18.80

The projected 12% energy kWh savings will continue progress towards improving system efficiency and reduce the Hooksett Village Water System benchmark value. The 41% electric energy cost savings will provide significant operational savings after control system adjustments are made and after switching electric rate schedules to operate the wells off peak.

A review of the water pumping systems, along with supporting data for the recommended improvements identified by Process Energy Services, has been presented in Section 3.

SECTION 3. WATER SYSTEM

3.1 Overview

The Hooksett Village Water Precinct (HVWP) provides domestic water and fire protection to approximately 1,114 service connections serving an estimated population of 2,800 people. The average daily use in 2019 was approximately 318,493 gallons per day (GPD).

The water system is comprised of approximately 18 miles of pipe, four gravel packed wells, a booster pump station, three storage tanks having a capacity of 2.35 million gallons, and an interconnection with the Central Hooksett Water System.

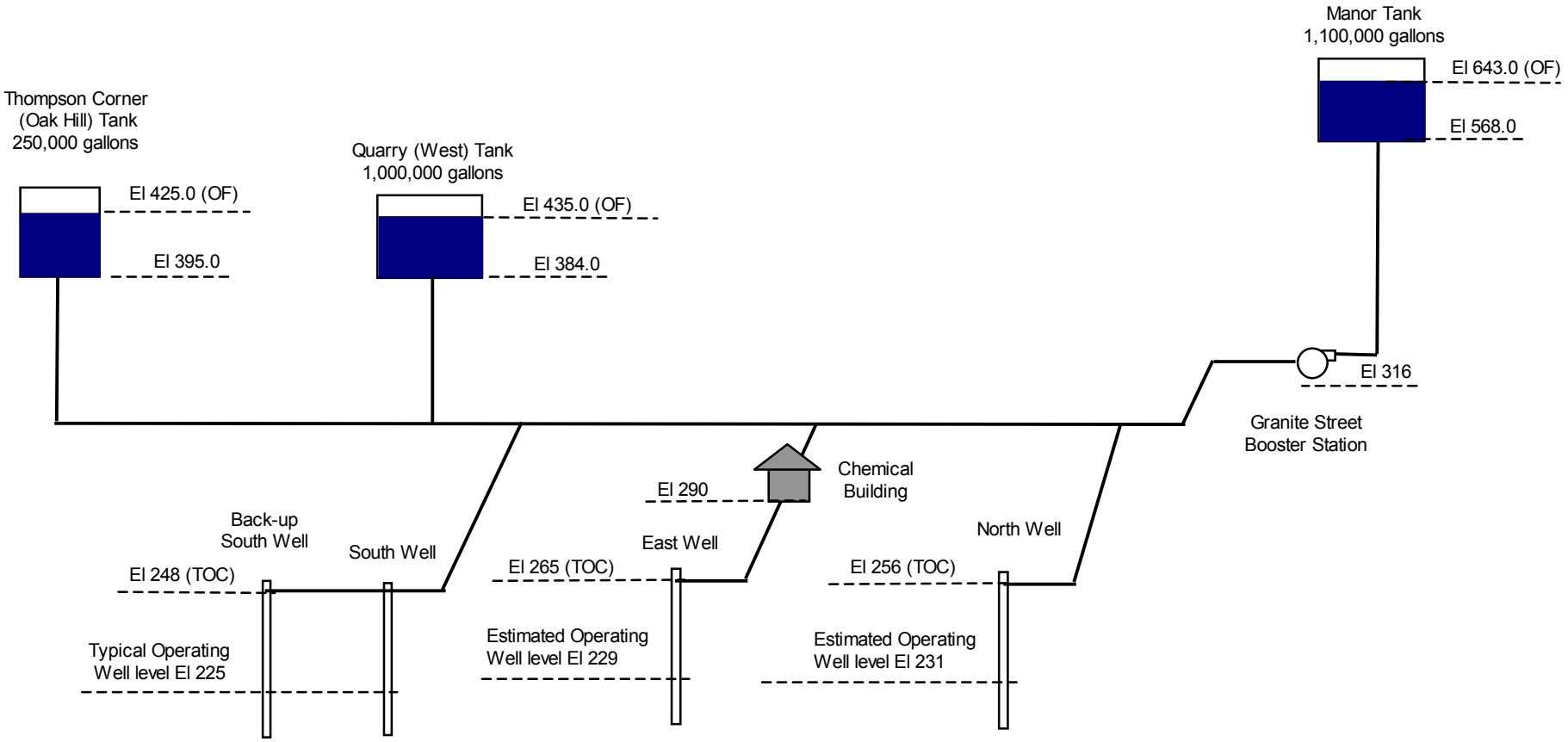
A summary of the system electric and fuel energy use/costs are shown below.

Table 3.1: 2019 System Energy Use and Costs

Facility	Annual Electric Energy Use (kWh)	Annual Electric Cost	Annual Propane/NG/Fuel Oil Use	Annual Propane/NG/Fuel Oil Cost
North Well	67,938	$14,342	1,139 gal propane	$3,260
South Well	52,763	$11,208	430 gal propane	$1,172
East Well	75,969	$14,792	--	--
Booster Station	53,400	$17,143	147 therms	$861
Manor Tank	4,965	$1,078	--	--
Quarry Tank (Brookyard)	(solar)	--	600 gal propane	$1,221
Thompson Tank	903	$534	--	--
Office	8,393	$1,895	976 gal fuel oil	$2,820
Total	**263,431**	**$60,992**	**--**	**$9,334**

A simple schematic of the water system with tank elevations is shown in Figure 3.1.

Figure 3.1: Hooksett Village Water System Schematic



3.2 Non-Revenue Water

Water loss control represents the efforts of water utilities to provide accountability in their operation by reliably auditing their water supplies and implementing controls to minimize system losses. Utilities incur real losses from pipeline leakage and apparent losses when customer water consumption is not properly measured or billed.

Losses in utilities include the physical escape of water from the pressurized piping system as leakage - an occurrence known as real losses. Losses also occur due to inaccurate metering of customer consumption, theft of service, and the utility's own errant billing and accounting practices; all of which are collectively known as apparent losses. Non-revenue Water (NRW) includes the real plus apparent losses, along with unbilled authorized consumption, which represents water used in miscellaneous activities such as hydrant flushing. The HVWP has implemented an aggressive approach to NRW. This has included public outreach and leak detection and repair programs, customer meter web based portals for leak detection monitoring and source meter upgrades (10-15% error identified).

The HVWP reviews the billing and production data annually to evaluate NRW. Based on the 2019 data collected, the average NRW in the system was only 5%. With the NHDES recommending a water conservation goal of 15%, the HVWP data is excellent compared to other New Hampshire municipalities. These percentages and figures should always be put into context to fully understand the true impact of the water loss. The impact of water loss as it applies to energy savings is summarized below.

Table 3.2: 2019 Water Production & Non Revenue Water

Water Source	Well Flow (gal)	HVWP Flow Correction (gal)	Chemical Treatment Flow (gal)	Net Flow (gal)
East Well	42,470,000	424,700	101,076	41,944,224
North Well	40,853,000	4,085,300	126,290	36,641,410
South Well	19,033,015	133,231	102,820	18,796,964
South Back-up Well	19,475,104	-77,900	0	19,553,004
Central Hookset Water Connection	55,000	396	0	54604
New Tank Filling (April 2019)	--	--	--	-740,000
2019 Water Flow into Distribution System	**--**	**--**	**--**	**116,250,206**
Water Billed Metered:				108,689,700
Water Unbilled Metered:				1,791,999
Total Metered Flow				110,481,699
2019 Non Revenue Water:				**5,768,507**

Summary	
Percent Non Revenue Water	5%
2019 Pumping Energy Benchmark	2,163 kWh/MG
Energy Cost of UAW (using $0.121/kWh)	**$1,510**

There are other economical and environmental benefits that come with the reduction of water loss that are not illustrated in this report. More information on water loss audits can be found at the following site: https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control.

3.3 North Well Station



The North Well was installed in 1982 and is located at the northerly end of Pinnacle Pond. The station site includes a Pump/Chemical Building and an abandoned building no longer used.

The Pump Building includes a concrete foundation, block walls and wood frame roof with asphalt shingles. The amount of insulation in the walls and ceiling is unknown.

A 60 kW Olympian propane emergency generator mounted in it's own outdoor enclosure is located next to the pump building. A thermal reading of the 1500-watt block heater was found to be 118 degree F, which is within the 100 to 120 degree F range typically recommended by most manufacturers.

The gravel packed well was originally drilled in 1982 and was last redeveloped in April 2020. The well is equipped with a Goulds vertical turbine pump with 40 hp motor and VFD. The VFD was installed in December 2019 and is not reflected in the 2019 baseline energy use shown in Table 3.3. However, the energy savings benefit of maintaining the VFD at the current 55.4 Hz speed compared to the 2019 full speed pump operation is reviewed in OM #1.

The chemical systems include calciquest polyphosphate for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for alkalinity. The soda ash system requires heated water approximately 1 hour/day that is supplied with a hybrid water heater (heat pump/electric). The chemical feed equipment is low energy and does not contribute significantly to the station energy use.



Space heating for the building is provided with a 7.5 kW electric heater in the chemical room and a ceiling mounted propane heater in the pump room (shown in photo). Staff indicated that the propane heater was not working and needs to be replaced or removed. The electric heater is controlled with a high-low knob (set to maintain 60 degrees) and was the primary heater in 2019. The potential savings of a new propane unit heater was reviewed to evaluate if the project would be cost effective. However, based on 2019 propane unit costs, the existing electric heater unit appears to be the lower cost option at this time. To optimize use of the heaters, wall thermostats are recommended in ECM #2.

Electric service for the station is provided on the Eversource "G" Rate Schedule. The 2019 station flow and electric billed energy use data is summarized in Table 3.3. Staff provided the pump run time and recorded monthly flow. Pump energy use was estimated using a power draw of 30 kW for the well pump, which was an estimated value since the VFD was installed in 12/19 and a field measurement without the VFD could not be taken.

Table 3.3: North Well Site 2019 Energy & Operating Data

2019 Month	Energy Use (kWh)	Billed Demand (kW)	Pump Energy Use (kWh)	Misc. Energy Use (kWh)	Well Hours	Total Flow (MG)	KWh/MG
Jan	4,676	36.3	2,892	1,784	96.4	2.17	2,160
Feb	4,952	36.3	2,634	2,318	87.8	1.98	2,501
Mar	4,260	35.8	2,964	1,296	98.8	2.22	1,916
Apr	4,840	34.9	3,645	1,195	121.5	2.79	1,737
May	5,103	35.0	3,996	1,107	133.2	3.19	1,599
Jun	6,706	34.8	5,835	871	194.5	4.70	1,427
Jul	7,602	34.9	7,743	-141	258.1	6.22	1,222
Aug	9,055	34.9	6,963	2,092	232.1	5.57	1,626
Sep	6,737	34.9	5,259	1,478	175.3	4.17	1,616
Oct	5,500	35.2	4,623	877	154.1	3.83	1,438
Nov	5,111	35.5	2,820	2,291	94	2.32	2,203
Dec	3,396	35.3	2,238	1,158	74.6	1.70	1,996
Totals/Avg	**67,938**	**423.8**	**51,612**	**16,326**	**1720**	**40.9**	**1,787**

The billed electric energy costs are shown below.

Table 3.4: North Well Site 2019 Energy Costs

2019 Month	Billed Energy Use (kWh)	Billed Demand (kW)	Demand Cost	KWh Cost	Monthly Fee	Supplier Cost	Delivery Cost	Estimated Total Bill
Jan	4,676	36.3	$480	$159	$30	$398	$669	$1,067
Feb	4,952	36.3	$480	$170	$30	$422	$680	$1,102
Mar	4,260	35.8	$472	$129	$30	$363	$631	$994
Apr	4,840	34.9	$458	$147	$30	$412	$635	$1,048
May	5,103	35.0	$460	$155	$30	$435	$644	$1,079
Jun	6,706	34.8	$457	$212	$32	$571	$701	$1,272
Jul	7,602	34.9	$489	$251	$32	$648	$772	$1,420
Aug	9,055	34.9	$489	$313	$32	$771	$835	$1,606
Sep	6,737	34.9	$489	$254	$32	$574	$775	$1,349
Oct	5,500	35.2	$494	$212	$32	$469	$738	$1,207
Nov	5,111	35.5	$499	$187	$32	$435	$718	$1,154
Dec	3,396	35.3	$496	$229	$32	$289	$757	$1,046
Totals	**67,938**	**423.8**	**$5,763**	**$2,417**	**$374**	**$5,788**	**$8,554**	**$14,342**

The electric energy use and cost data revealed the following:

- The miscellaneous energy use was not always aligned since the electric meter reading dates were on the 17th/18th each month and well flow/run time data on the first of the month. However, as expected the average energy use during the winter months was higher due to the electric heat.

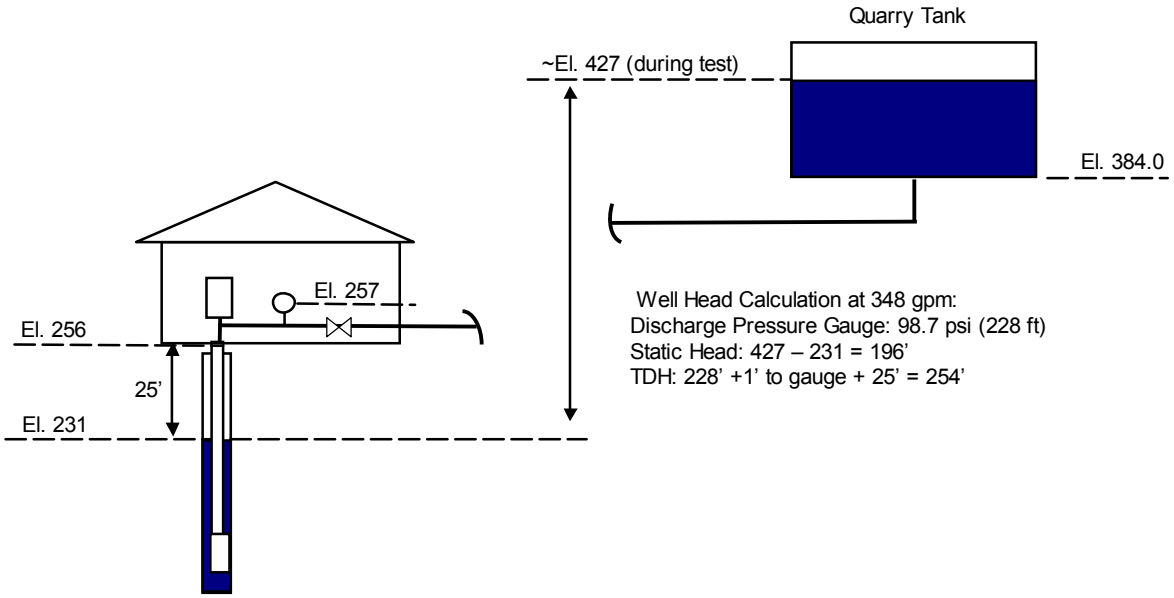
- The 35.3 kW average electrical demand shown in Table 3.4 for the 2019 baseline has now been reduced to 26.2 kW (based on the first 6 months of data for 2020). This reduction was seen after the

VFD was installed in December and the current practice of operating the new VFD at 55.4 Hz. The energy savings benefit of operating the VFD at the lower speed is reviewed in OM #1.

Well Pump System

The well pump is a Goulds 9 RCLC 7 stage vertical turbine pump rated for 400 gpm @ 290' TDH. The pump includes a 40 hp U.S. motor and VFD. A simple representation of the well system elevations is shown in Figure 3.2 A sample head calculation was calculated for the 348 gpm typical flow rate.

Figure 3.2: North Well Elevations and Sample Head Calculation



During the site visit, staff manually operated the well pump at three different VFD speeds while discharge pressure, flow and power draw were recorded. As shown in Table 3.5, the existing pump efficiency was excellent at each of the tested speeds. A VFD speed of 49.8 Hz was determined to be the most efficient speed based on kWh/MG. However, the 1,362 kWh potential annual savings (1044-1007 kWh/MG * 36.8 MG) is not significant enough (~$150 in cost savings) to make a difference compared to the 55.4 Hz current setpoint.

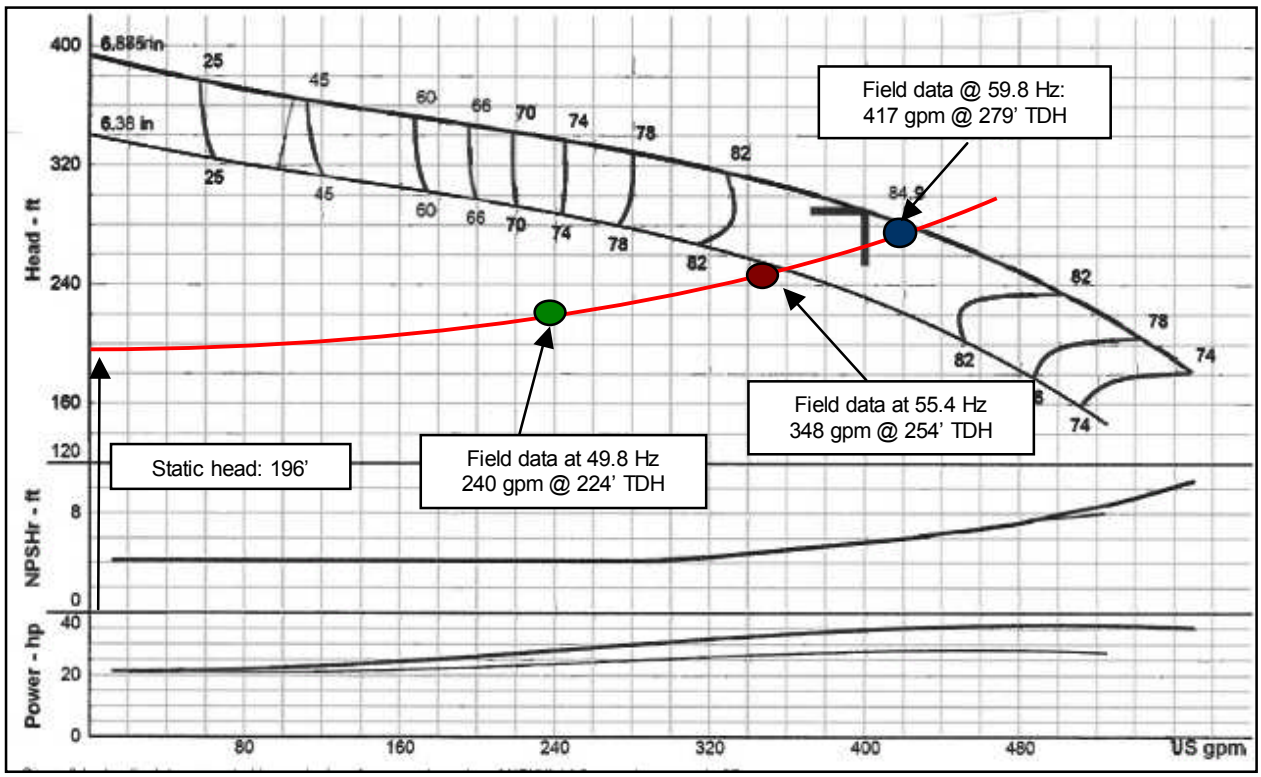
Table 3.5: North Well Pump Measurements & Efficiency Calculations

Pump	VFD Speed (Hz)	Flow (gpm)	Discharge Pressure (psi)	Distance to Well Water Level (ft)	TDH (ft)	Power (kW)	Calculated Pump Efficiency	Pump Curve Efficiency	KWh/MG
North Well	59.8	417	106.2	33	279	28.3	**85%**	**85%**	1,131
	55.4	348	98.7	25	254	21.8	**85%**	**84%**	1,044
	49.8	240	89.3	17	224	14.5	**77%**	**78%**	1,007

TDH = Discharge pressure * 2.31 + 1' casing level to gauge + well level
Estimated 93% motor efficiency (40 hp motor) and 97% VFD efficiency

The operating points at the three tested VFD speeds have been plotted on the original pump curve in Figure 3.3. The system curve matched well with the operating points and the calculated static head based on the storage tank/well elevations.

Figure 3.3: North Well Pump Curve



Additional Savings Opportunities

The data collected shows that the North Well operation is very efficient. However additional savings can be realized using a "systems approach" that includes the following strategies:

- If the South Wells are operated in the lead position more often, the overall system efficiency (kWh/MG) will be improved and total system energy use will be reduced. The opportunity also exists to have the East and North Wells operated every other month to reduce demand charges. Both of these operational adjustments are reviewed in OM #2.

- The concept of operating pump systems off peak to potentially take advantage of time of day (TOD) rates requires the use of stored water during the day and operating pumps during off-peak hours. Eversource offers a time of day (TOD) rate schedule that provides lower energy rates during the off peak hours and higher rates during on-peak hours (7:00 AM to 8:00 PM). For this time period, the well pumps would need to remain off to provide savings. The savings for this measure is reviewed in ESM #2.

3.4 East Well Station



The East Well Pump Station was installed in 2007 and is located along the easterly shore of Pinnacle Pond. The station includes separate buildings for the well pump and chemical systems. Both buildings are single story structures with concrete foundations, block walls and truss roof with asphalt shingles. The Pump Building includes foam board insulation on the interior walls and the Chemical Building includes vinyl siding on the exterior. Staff indicated that the ceilings for both buildings include two layers of fiberglass insulation.

A 100 kW CAT diesel emergency generator is mounted in it's own outdoor enclosure next to the Chemical Building. A thermal reading of the 1000-watt block heater was found to be 157 degree F, which is higher than the 100 to 120 degree F range typically recommended by most manufacturers. The energy savings for reducing the thermostat setpoint is reviewed in OM #3.



The gravel packed well was originally drilled in 2007 and was last redeveloped in April 2017. The well includes an American Marsh vertical turbine pump with 50 hp motor and VFD. In 2019, the VFD was operated at approximately 51 Hz to achieve a target flow rate of 350 gpm.

The chemical systems include calciquest polyphosphate for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for alkalinity. The soda ash system requires heated water approximately 1 hour/day that is supplied with an electric hot water heater. The chemical feed equipment is low energy and does not contribute significantly to the station energy use.

Space heating for the Chemical Building is provided with a 7.5 kW electric heater in the hallway, 3 kW heater in the electric room and a 7.5 kW electric heater in the chemical area. All the heaters are controlled with high-low knobs on the heater units. A 3 kW unit heater is located in the Pump Building. In ECM #2, wall thermostats are recommended for tighter control of the heater units compared to the existing high-low knobs.

Electric service for the station is provided on the Eversource "G" Rate Schedule. The 2019 station flow and electric billed energy use data is summarized in Table 3.6. Pump energy use was estimated using the 29.7 kW well pump power draw measured at a typical VFD speed of 57 Hz. Staff provided the pump run time and recorded monthly flow.

Table 3.6: East Well Site 2019 Energy & Operating Data

2019 Month	Energy Use (kWh)	Billed Demand (kW)	Pump Energy Use (kWh)	Misc. Energy Use (kWh)	Well Hours	Total Flow (MG)	KWh/MG
Jan	7,439	35.9	3,358	4,081	146	2.99	2,490
Feb	8,074	37.2	3,160	4,914	137	2.81	2,871
Mar	6,790	36.8	3,114	3,676	135	2.77	2,455
Apr	6,712	36.9	3,443	3,269	150	3.07	2,189
May	5,658	33.9	3,549	2,109	154	3.20	1,771
Jun	5,662	29.2	4,779	883	208	4.32	1,312
Jul	6,801	29.2	6,408	393	279	5.81	1,172
Aug	7,755	29.4	5,476	2,279	238	4.97	1,562
Sep	5,690	29.7	4,379	1,311	190	3.97	1,435
Oct	4,340	29.8	2,670	1,670	116	2.42	1,795
Nov	5,203	29.6	3,160	2,043	137	2.86	1,818
Dec	5,845	31.4	3,652	2,193	159	3.31	1,765
Totals/Avg	**75,969**	**389.0**	**47,150**	**28,819**	**2050**	**42.5**	**1,886**

The 2019 billed electric energy costs are shown below.

Table 3.7: East Well Site 2019 Energy Costs

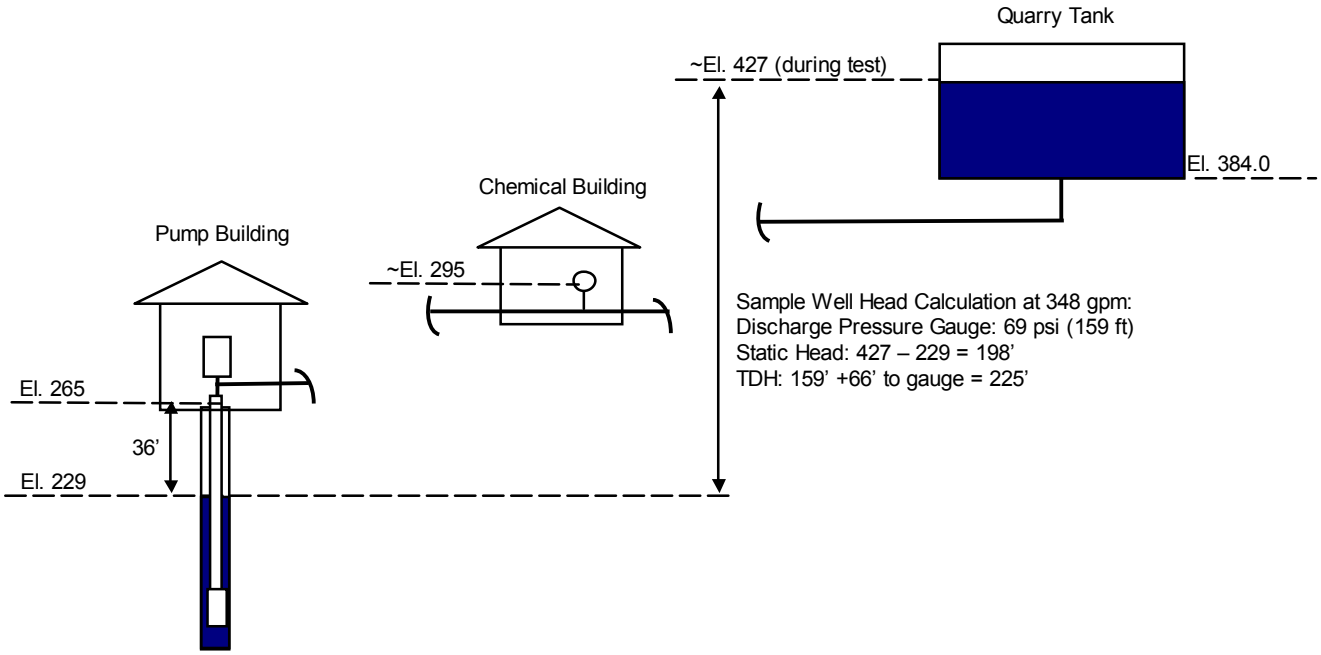
2019 Month	Billed Energy Use (kWh)	Billed Demand (kW)	Demand Cost	KWh Cost	Monthly Fee	Supply Cost	Delivery Cost	Total Bill
Jan	7,439	35.9	$473	$253	$30	$634	$756	$1,390
Feb	8,074	37.2	$493	$277	$30	$688	$801	$1,489
Mar	6,790	36.8	$487	$205	$30	$579	$722	$1,301
Apr	6,712	36.9	$489	$204	$30	$572	$723	$1,295
May	5,658	33.9	$443	$171	$30	$482	$644	$1,126
Jun	5,662	29.2	$371	$179	$32	$482	$582	$1,064
Jul	6,801	29.2	$396	$224	$32	$579	$652	$1,232
Aug	7,755	29.4	$399	$268	$32	$661	$700	$1,361
Sep	5,690	29.7	$404	$214	$32	$485	$651	$1,135
Oct	4,340	29.8	$406	$167	$32	$370	$605	$975
Nov	5,203	29.6	$403	$190	$32	$443	$625	$1,068
Dec	5,845	31.4	$432	$394	$32	$498	$858	$1,356
Totals	**75,969**	**389.0**	**$5,197**	**$2,748**	**$374**	**$6,473**	**$8,319**	**$14,792**

The miscellaneous energy use is high and follows a seasonal profile indicating that the electric heaters are the primary users for this portion of the station energy use. This is also reflected in the higher peak electrical demand during the winter months. As discussed, in OM #4, low temperature wall thermostats are recommended for more precise control of the heater units compared to the high-low knobs. Propane heaters were considered, but this measure did not appear to be cost effective based on the 2019 propane unit costs paid by the HVWP.

Pump System

The well pump is an American Marsh Model 9LC vertical turbine 8 stage pump originally rated for 360 gpm @ 336' TDH The pump is driven with a 40 hp vertical inverter duty motor and VFD. A simple representation of the well system elevations is shown in Figure 3.4. One key part of this diagram that factored into calculating total dynamic head (TDH) was the location of the pressure transducer at the Chemical Building instead of directly on the pump discharge.

Figure 3.4: East Well Elevations and Sample Head Calculation



During the site visit, staff manually operated the well pump at three different VFD speeds while discharge pressure, flow and power draw was recorded. This data was used to calculate pump efficiency and determine the VFD speed where the pump operated at the lowest kWh/MG. As shown in Table 3.8, the current practice of operating the pump at 51 Hz (selected by staff) has the lowest kWh/MG value for the speeds tested.

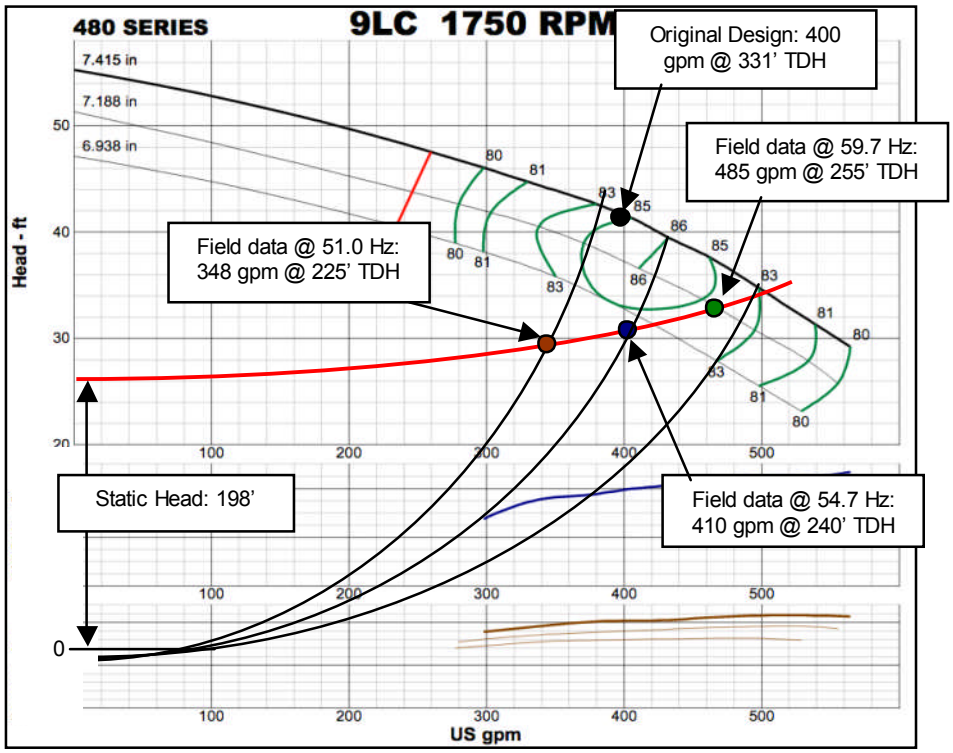
Table 3.8: East Well Pump Measurements & Efficiency Calculations

Pump	VFD Speed (Hz)	Recorded Flow (gpm)	Discharge Pressure (psi)	Distance to Well Water Level (ft)	Level from Casing	TDH (ft)	Measured kW	Calculated Pump Efficiency	Curve Pump Efficiency	KWh/MG
East Well	59.7	485	80.0	19.6	40.4	255	38.3	**67%**	**84%**	1,316
	54.7	410	74.5	22.2	37.8	240	29.3	**69%**	**86%**	1,191
	51.0	**348**	**69.0**	**24.2**	**35.8**	**225**	**23.0**	**70%**	**84%**	**1,101**

TDH = Discharge pressure * 2.31 + 30' casing level to gauge + well level
Estimated 94% motor efficiency (50 hp motor) and 97% VFD efficiency
Level from casing based on 60' transducer level

The operating points at the three different VFD speeds have been plotted on the original pump curve in Figure 3.5 (Head x 8 for the eight stage pump). Although the system curve matched well with the operating points and the calculated static head (based on the storage tank/well elevations), the pump is operating below the original design point and the calculated pump efficiency was lower than the curve values. The actual TDH compared to the original TDH should be reviewed in more detail to determine if the elevation data is accurate.

Figure 3.5: East Well Pump Curve



Additional Savings Opportunities

The data collected shows that the East Well efficiency is low compared to the North & South Wells. If the well hours are reduced using the "systems approach" discussed previously, the lower efficiency will have less of an impact on energy costs. As discussed for the North Well, these strategies are summarized below.

- If the South Wells are operated in the lead position more often, the overall system efficiency (kWh/MG) will be improved and system energy use will be reduced (reviewed in OM #2).

- Operating the well off peak to potentially take advantage of time of day (TOD) rates may be an option for the HVWP. The savings for this measure is reviewed in ESM #2.

3.5 South Well Station



The South Well Pump Station is located at the southerly end of Pinnacle Pond and was originally constructed in 1986. The station building includes the original South Well and a second back up well installed in 2004.

The building construction consists of a concrete foundation, block walls with split face CMU and truss roof with asphalt shingles. The amount of insulation in the walls and ceiling is unknown. Board insulation has been installed for the interior of the building where the original well is located. Two ceiling mounted propane heaters are used for station heating. Each thermostat was set at approximately 55 degrees.

A 100 kW CAT propane emergency generator is mounted in it's own outdoor enclosure. A thermal reading of the 1000-watt block heater was found to be 150 degree F, which is higher than the 100 to 120 degree F range typically recommended by most manufacturers. The energy savings for reducing the block heater thermostat setpoint is reviewed in OM #3.

The chemical systems include calciquest polyphosphate for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for alkalinity. As discussed for the East Well, the soda ash system requires heated water approximately 1 hour/day that is supplied with a standard electric hot water heater. The chemical feed equipment is low energy and does not contribute significantly to the station energy use.

Electric service for the station is provided on the Eversource "G" Rate Schedule. The 2019 station flow and electric billed energy use data is summarized below. Staff records the pump run time and monthly flow routinely. Pump energy use was estimated using a 18.2 kW pump power draw at 51.8 Hz for the original South Well and 19.8 kW for the back-up South Well pump operating at 52.3 Hz.

Table 3.9: South Well Site 2019 Energy & Operating Data

2019 Month	Energy Use (kWh)	Billed Demand (kW)	Pump Energy Use (kWh)	Misc. Energy Use (kWh)	South Well Hours	South Back-up Hours	Total Flow (MG)	KWh/MG
Jan	3,840	30.6	2,086	1,754	57.4	52.6	2.4	1,613
Feb	3,777	30.3	1,783	1,994	46.2	47.6	1.9	1,976
Mar	3,322	30.7	2,103	1,219	49.2	61	2.3	1,476
Apr	3,704	30.6	2,434	1,270	62.6	65.4	2.6	1,407
May	4,113	30.8	2,677	1,436	68.3	72.4	2.9	1,417
Jun	4,810	26.6	3,943	867	107.2	100.6	4.3	1,115
Jul	5,846	26.5	5,245	601	141.2	135.1	5.7	1,019
Aug	6,674	27.1	4,482	2,192	124	112.4	4.9	1,360
Sep	5,170	27.2	3,680	1,490	101.8	92.3	4.0	1,283
Oct	4,540	26.9	2,845	1,695	84.3	66.2	3.1	1,456
Nov	3,836	26.9	2,090	1,746	43.9	65.2	2.3	1,689
Dec	3,131	26.9	1,898	1,233	40	59.1	2.1	1,524
Totals/Avg	**52,763**	**341.1**	**35,267**	**17,496**	**926**	**930**	**38.5**	**1,445**

The 2019 billed electric energy costs are shown below.

Table 3.10: South Well Site 2019 Energy Costs

2019 Month	Billed Energy Use (kWh)	Billed Demand (kW)	Demand Cost	KWh Cost	Monthly Fee	Delivery Cost	Supplier Cost	Total Bill
Jan	3,840	30.6	$392	$131	$30	$327	$553	$880
Feb	3,777	30.3	$388	$130	$30	$322	$547	$869
Mar	3,322	30.7	$394	$100	$30	$283	$524	$807
Apr	3,704	30.6	$392	$113	$30	$316	$535	$851
May	4,113	30.8	$395	$125	$30	$350	$550	$900
Jun	4,810	26.6	$331	$152	$32	$410	$515	$925
Jul	5,846	26.5	$352	$193	$32	$498	$577	$1,075
Aug	6,674	27.1	$362	$231	$32	$569	$625	$1,193
Sep	5,170	27.2	$363	$195	$32	$440	$590	$1,031
Oct	4,540	26.9	$359	$175	$32	$387	$565	$952
Nov	3,836	26.9	$359	$140	$32	$327	$531	$858
Dec	3,131	26.9	$359	$211	$32	$267	$601	$868
Totals	**52,763**	**341.1**	**$4,445**	**$1,895**	**$374**	**$4,495**	**$6,713**	**$11,208**

The energy data in Tables 3.9 and 3.10 revealed the following potential opportunities for energy cost savings.

- The miscellaneous energy use column shows a seasonal variation that is consistent with electric space heat. However, with propane space heaters, the usage is most likely due to the generator block heater, which was operating at an excessive temperature and may have a higher wattage than the 1 kW value estimated. OM #3 reviews the savings for adjusting the thermostat setpoint to a lower level.

- As discussed for the North & East Wells, the potential for operating the well pump systems off peak to take advantage of time of day (TOD) rates is reviewed in ESM #2.

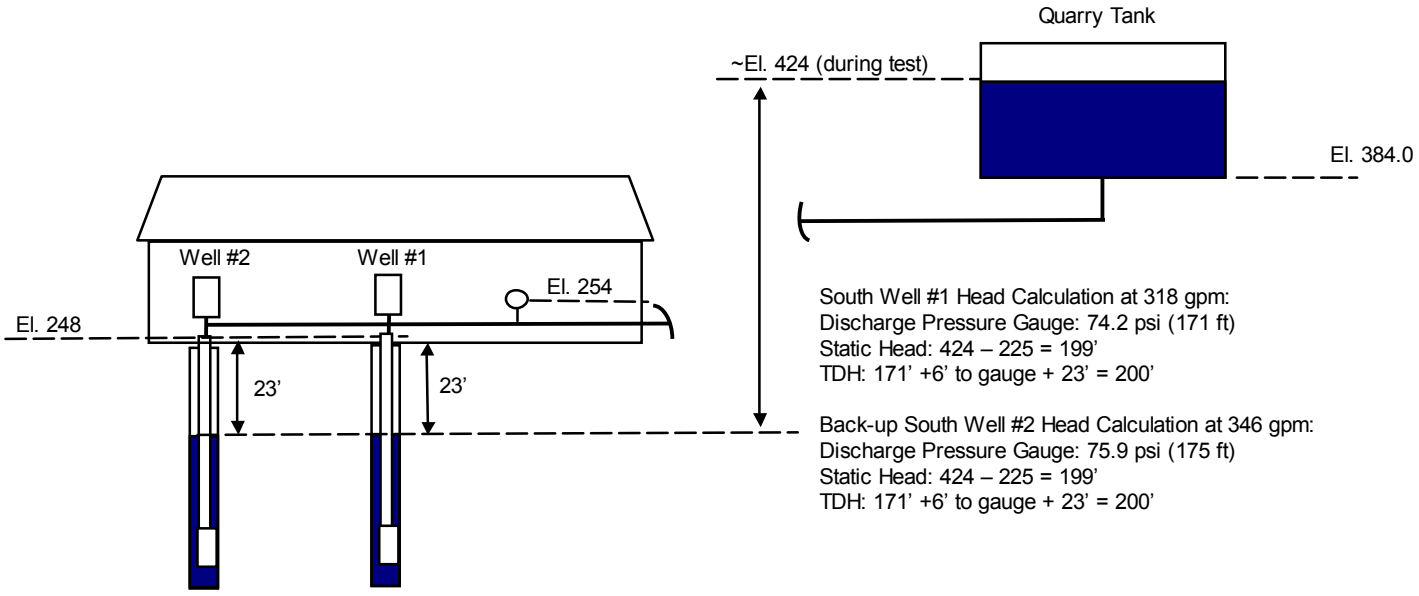
- As an alternative to operating the wells off peak, the HVWP can also reduce demand charges by using the South Station Wells as the primary system supply source and alternating the East and North Station Wells every other month to reduce demand charges. The cost savings for this measure is reviewed in OM #2.

- In 2019, the South Well Station used 430 gallons of propane at a cost of $1,172 for space heating. The thermostats indicated a setting of 55 degrees, which is appropriate for the soda ash chemical system that requires a temperature above 54 degrees to avoid crystallization.

Pump System

A simple representation of the well system elevations is shown in Figure 3.6. A sample pump head calculation is also included.

Figure 3.6: South Well Elevations and Sample Head Calculation



The South Well pump is an American Marsh Model 8EHCZ vertical turbine 11 stage pump originally rated for 350 gpm @ 280' TDH. The pump is driven with a 40 hp US motor and variable frequency drive (VFD). The pump was last reconditioned in March 2018 and the motor was replaced in July 2020.

The South Back-up Well includes a Goulds 9RCLC 7 stage vertical turbine pump that was installed in 2006. The pump is rated for 400 gpm @ 280' TDH and is driven with a 40 hp US motor and VFD. The pump was last reconditioned in March 2018.

Pump Testing

During the site visit, staff manually operated the well pump at three different VFD speeds while discharge pressure, flow and power draw was recorded. This data was used to calculate pump efficiency and determine the VFD speed where the pump operated at the lowest kWh/MG.

As shown in Table 3.11, the existing pump efficiency was reasonable at each of the tested speeds. The existing practice of operating the VFD at a speed of 51.8% is an efficient speed based on kWh/MG. The slightly lower efficiency compared to the original pump curve efficiency is not significant enough to require refurbishing. Both the South Well pumps have a lower kWh/MG then the East and North Wells. Adjusting the operating hours to use the South Wells more often to reduce system energy costs is reviewed in OM #2.

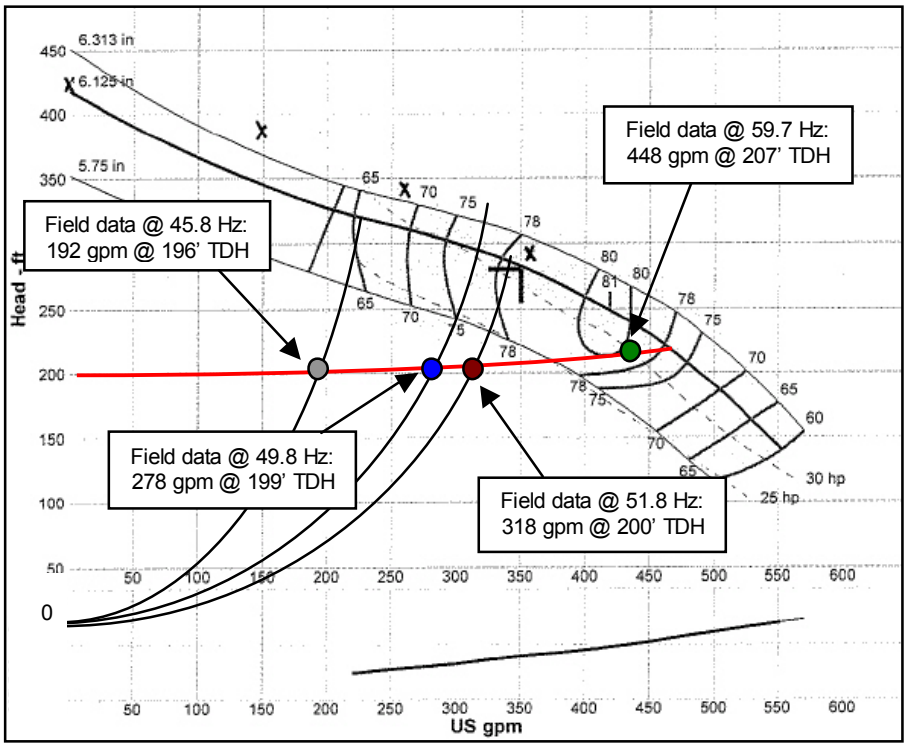
Table 3.11: South Well Pump Measurements & Efficiency Calculations

Pump	VFD Speed (Hz)	Recorded Flow (gpm)	Discharge Pressure (psi)	Distance to Well Water Level (ft)	Level from Casing	TDH (ft)	Measured kW	Calculated Pump Efficiency	Curve Pump Efficiency	KWh/MG
South Well	59.7	448	75.0	28	57.5	207	28.6	**67%**	**78%**	1064
	51.8	**318**	**74.2**	**23**	**47.0**	**200**	**18.2**	**72%**	**79%**	**954**
	49.8	278	74.0	22	43.0	199	15.9	**72%**	**76%**	953
	45.8	192	74.0	19	36.0	196	11.5	**68%**	**66%**	998

TDH = Discharge pressure * 2.31 + 6' casing level to gauge + well level
94% nameplate motor efficiency (40 hp motor) and 97% VFD efficiency

The operating points at the four different VFD speeds have been plotted on the original pump curve in Figure 3.7. The system curve matched well with the operating points and the calculated static head based on the storage tank/well elevations.

Figure 3.7: South Well American Marsh Pump Curve



South Back-up Well

The same testing procedure was performed for the South Back-up Well. As shown in Table 3.12, the existing pump efficiency was very good at each of the tested speeds. A VFD speed of 52.3% was determined to be the most efficient speed based on kWh/MG (current mode of operation).

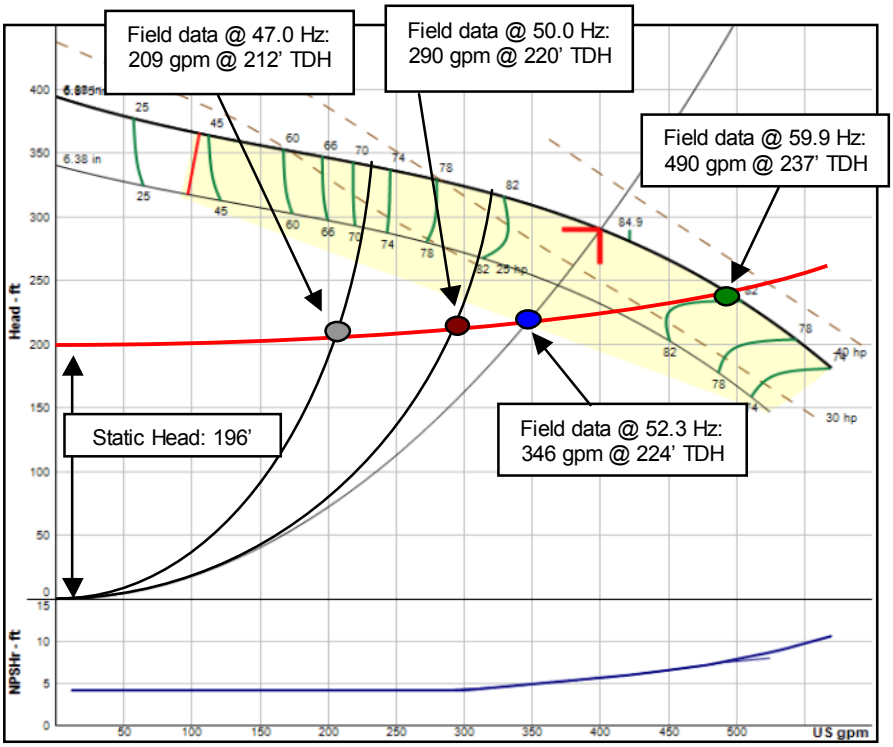
Table 3.12: South Back-up Well Pump Measurements & Efficiency Calculations

Pump	VFD Speed (Hz)	Recorded Flow (gpm)	Discharge Pressure (psi)	Distance to Well Water Level (ft)	Level from Casing	TDH (ft)	Measured kW	Calculated Pump Efficiency	Curve Pump Efficiency	KWh/MG
South Back-up Well	59.9	490	76.9	2.5	57.5	237	30.7	**79%**	**82%**	1,044
	52.3	**346**	**75.9**	**13.0**	**47.0**	**224**	**19.8**	**82%**	**84%**	**954**
	50.0	290	75.6	17.0	43.0	220	16.7	**80%**	**80%**	960
	47.0	209	75.2	24.0	36.0	212	12.2	**76%**	**72%**	973

TDH = Discharge pressure * 2.31 + 2' casing level to gauge + well level
Estimated 93% motor efficiency (40 hp motor) and 97% VFD efficiency

The operating points at the four different VFD speeds are plotted on the original pump curve in Figure 3.8. The system curve matched well with the operating points and the calculated static head based on the storage tank/well elevations.

Figure 3.8: South Back-up Well Pump Curve



Additional Savings Opportunities

If the well hours are reduced using a "systems approach" the lower efficiency will have less of an impact on energy costs. As discussed for the North & East Wells, these strategies include operating the South Wells as the lead pumps more often to improve system efficiency (kWh/MG), and considering a time of day (TOD) rate schedule to reduce costs.

3.6 Granite Street Booster Pump Station



The Granite Street Booster Station is located at the base of Post Road. The station was built as part of the Carriage Home development, to provide a higher-pressure zone. Water is pumped up through the development to the one million gallon Manor Tank at the top of the hill.

The station building construction includes a concrete slab, block interior walls, wood truss/asphalt shingle roof and vinyl siding exterior. The interior includes a pump room and separate generator room.

The pump and mechanical systems consist of three domestic centrifugal pumps, two fire pumps, and bypass valving that can feed flow from the high-pressure zone to the low-pressure zone if needed.

The station includes a 130 kW Katolight natural gas emergency generator equipped with a 2,500-watt (estimated) block heater. During the site visit, the block heater temperature was measured to be 168 degrees, which is higher than an efficient range of 100 to 120 degrees. The savings for reducing the heater setpoint temperature is reviewed in OM #3.

Electric service for the station is provided on the Eversource "G" Rate Schedule. The 2019 station electric billed monthly energy use and pump run time is summarized below. Based on a measured power draw of 34.2 kW for the three booster pumps (pumps are operated in parallel) and a 27.5 kW power draw for each of the fire pumps, the calculated pump energy use was estimated below.

Table 3.13: Booster 2019 Energy and Operational Data

Month	Pump #1	Pump #2	Pump #2	Fire Pump #1	Fire Pump #2	Monthly Flow (MG)	Pump Energy Use (kWh)	Estimated Energy Use (kWh) for Misc. Equipment	Station Billed Energy Use (kWh)
Jan	18	18	18.1	39.6	31.7	1.25	2,580	1,120	3,700
Feb	8.7	8.8	8.7	0	39.2	1.11	1,376	2,194	3,570
Mar	9.3	9.3	9.3	0	44.1	1.24	1,531	1,949	3,480
Apr	9.9	9.8	9.8	0	44.2	1.25	1,551	1,759	3,310
May	11.3	11.3	11.3	0	71.4	1.89	2,350	480	2,830
Jun	20.7	20.7	20.7	0	148	3.42	4,778	-498	4,280
Jul	33	33	33.1	0	233	6.19	7,540	-1,560	5,980
Aug	32.1	32.1	32	0	169.3	4.53	5,750	2,840	8,590
Sep	23.7	23.7	23.7	2.9	134.4	3.74	4,586	1,914	6,500
Oct	43.9	44	44.1	0.4	24.4	1.83	2,190	2,650	4,840
Nov	20.2	20.3	20.3	0	27.5	1.25	1,451	1,439	2,890
Dec	18.2	18.1	18.1	26	5.1	1.25	1,474	1,956	3,430
Total/Avg	**249**	**249**	**249**	**69**	**972**	**28.9**	**37,156**	**16,244**	**53,400**

After deducting the pump system energy from the billed use, the remaining 16,244 kWh was for the miscellaneous equipment at the station. The energy use in this column includes a 7.5 kW electric space

heater in the pump room. A natural gas unit heater is used in the generator room. To reduce station electric energy use, ECM #1 recommends replacing the 7.5 kW electric heater with a natural gas unit to provide lower cost heating for the station.

The 2019 electric energy cost billing data for the station is summarized in Table 3.14.

Table 3.14: Booster 2019 Electric Energy Use and Costs

Month	Energy Use (kWh)	Billed Demand (kW)	Demand Cost	Delivery (kWh) Cost	Monthly Fee	Energy Supply Cost	Total Delivery Cost	Total Cost
Jan	3,700	40.7	$547	$126	$30	$315	$703	$1,018
Feb	3,570	64.7	$915	$123	$30	$304	$1,067	$1,371
Mar	3,480	66.9	$948	$105	$30	$296	$1,084	$1,380
Apr	3,310	65.7	$930	$101	$30	$282	$1,061	$1,343
May	2,830	64.8	$916	$86	$30	$241	$1,032	$1,273
Jun	4,280	64.3	$908	$135	$32	$365	$1,076	$1,440
Jul	5,980	64.8	$979	$197	$32	$509	$1,208	$1,718
Aug	8,590	66.1	$1,000	$297	$32	$732	$1,329	$2,061
Sep	6,500	65.4	$989	$245	$32	$554	$1,266	$1,819
Oct	4,840	65.5	$990	$186	$32	$412	$1,209	$1,621
Nov	2,890	39.6	$566	$106	$32	$246	$704	$950
Dec	3,430	41.2	$593	$231	$32	$292	$856	$1,148
Totals	**53,400**	**709.7**	**$10,282**	**$1,938**	**$374**	**$4,550**	**$12,593**	**$17,143**

With the exception of January and December, the billed demand in Table 3.14 was consistent for operating one fire pump and all three-booster pumps. This mode of operation has resulted in high demand costs, which represented 60% of the total billed energy costs in 2019.

In 2020, Lewis Engineering performed a Water Supply Evaluation. The engineer indicated that the booster station uses a significant portion of the total well capacity when the pumps are operated and recommended that the HWVP should adjust the booster station operation to dampen the current surge in flow required when the boosters are activated to fill the Manor Tank. The report suggested either lengthening the duration of the fill at a lower flow rate, or timing the operation of the tank filling to coincide with a lower demand elsewhere in the system.

If the HWVP adjusts the pump control system to use more storage capacity and operate one of the booster pumps or one of the fire pumps for a longer duration, significant electric demand savings could be realized. The cost savings for this adjustment is reviewed in ESM #1.

Booster Pumps

The pump system is a packaged pump skid with three Grundfos vertical centrifugal pumps that are each rated for 147 gpm @ 308' TDH. The pumps are equipped with 9 kW (nameplate) Baldor motors, pressure transducers, flow meter and control panel.

During the site visit flow, pressure and kW data was recorded for the three-booster pumps operated in parallel at a VFD speed of 60 Hz (typical operation). One pump (Unit #3) was also operated independently. Pump efficiency and gallons/kWh are calculated in Table 3.15.

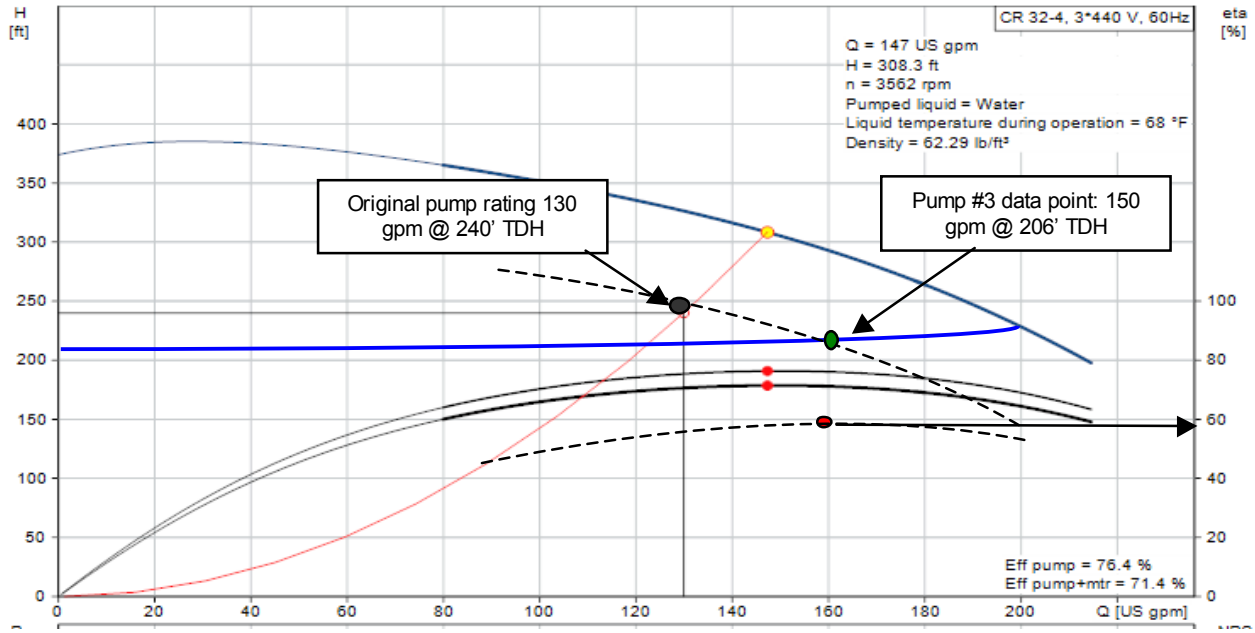
Table 3.15: Booster Field Measurements and Efficiency Calculation

Pump	VFD Speed	Recorded Flow (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	TDH (ft)	Measured kW	Pump Efficiency	Original Curve Efficiency	KWh/MG
Three Pumps	60 Hz	450	45	135	208	34.2	58%	N/A	1267
Pump #3	60 Hz	150	45	134	206	11.6	57%	N/A	1289

Motor efficiency estimated to be 91% and VFD efficiency was estimated to be 97%

The measured data point for Pump #3 was plotted on the original pump curve shown in Figure 3.9. The tested value (measured at 60 Hz) matches up with the curve at the lower head measurement. However, the efficiency appears to be 10% to 15% less than the original curve.

Figure 3.9: Booster Pump Curve



Fire Pumps

The station pump equipment also includes two Griswold Model R3GM fire pumps with 40 hp motors. Each pump is rated to provide 400 gpm @ 250' TDH. To determine typical performance, data was collected for both pumps at a programmed VFD speed of 55 Hz. This data is summarized in Table 3.16.

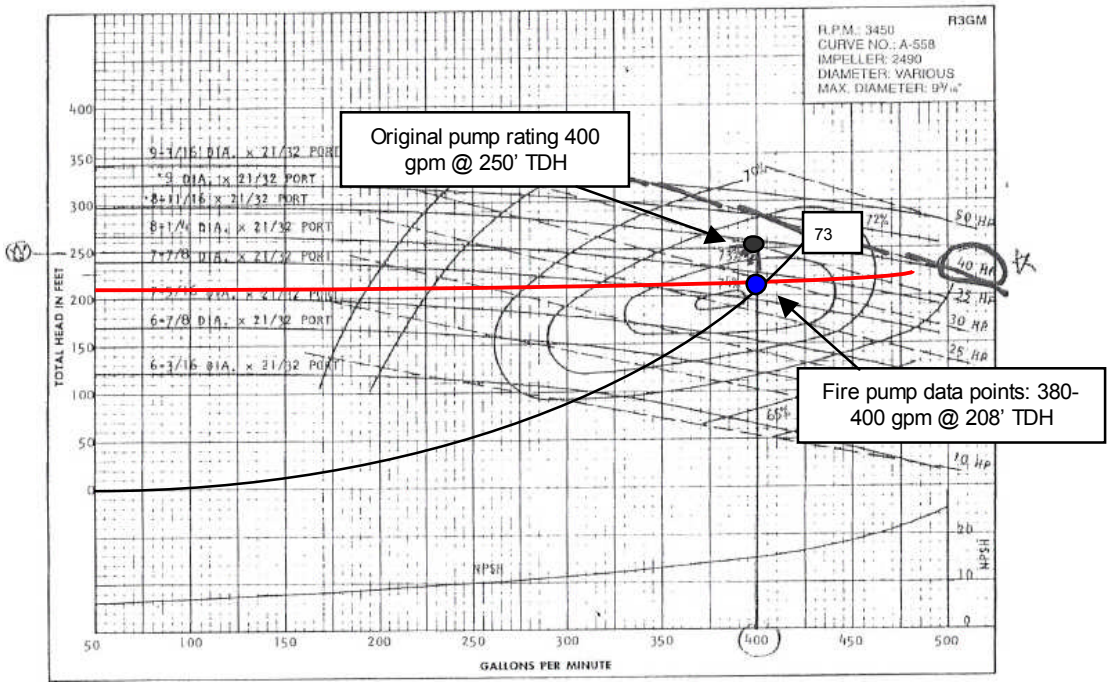
Table 3.16: Booster Field Measurements and Efficiency Calculation

Pump	VFD Speed	Recorded Flow (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	TDH (ft)	Measured kW	Pump Efficiency	Original Curve Efficiency	Gallons/ kWh
Fire Pump #1	55 Hz	400	45	135	208	28.2	64%	73%	1175
Fire Pump #2	55 Hz	380	45	135	208	26.8	64%	73%	1175

Nameplate motor efficiency of 90% and VFD efficiency was estimated to be 97%

The measured data points for the pumps are plotted on the original pump curve in Figure 3.10. As was the case for the booster pumps, the calculated efficiency appears to be lower than the original pump curve value.

Figure 3.10: Fire Pump Curve



Recommended Cost Saving Measures

Even though the pump efficiency for all the pump units appear to be lower than the original curve value, the improvement that will have the greatest impact on reducing station energy costs is to fully utilize the tank capacity during peak demand periods and allow one of the small pumps or one of the fire pumps (at a reduce VFD speed) to operate for a longer duration. With a total pumped flow of 28.9 MG in 2019, one of the small pumps could be operated at a flow rate of 150 gpm for 3200 hours annually (37% of the time) to satisfy total flow requirements. The savings for this mode of operation is reviewed in ESM #1.

3.7 Storage Tanks



The water system includes three storage tanks. The Oak Hill and Quarry (Westside) Tanks are supplied with the wells to pressurize the main zone. The Manor Tank is supplied with flow from the Granite Street Booster Pump Station.

Oak Hill Storage Tank

The Oak Hill (Thompson) storage tank is a 250,000-gallon welded steel tank constructed in 1951. The tank operates between elevations 26 and 30 feet, with an overflow elevation at 32 feet. The tank includes a meter pit but no heater is used. A small panel heater is required for a piping stub on the tank and staff indicated they plan on replacing the panel heater with heat tape.

Manor Tank

The 1.1 million-gallon Manor Tank was placed in service in 2007. The pre-stressed concrete tank is supplied from the Granite Street Booster Station. The tank site includes heat tape on a tank stub and a small plug-in heater used in a below grade metering pit that has minimal energy use.

Annual energy use and costs for the Manor & Oak Hill Tank is summarized below.

Table 3.17: Manor & Oak Hill Tank 2019 Energy & Cost Data

Month	Manor Tank		Oak Hill Tank	
	Energy Use (kWh)	Total Cost	Energy Use (kWh)	Total Cost
Jan	611	$114	101	$31
Feb	700	$127	130	$36
Mar	612	$116	108	$33
Apr	636	$131	89	$31
May	632	$135	72	$29
Jun	550	$118	53	$25
Jul	253	$55	29	$20
Aug	10	$17	19	$19
Sep	9	$17	24	$20
Oct	10	$17	30	$21
Nov	17	$18	98	$35
Dec	25	$19	150	$40
Totals	**4,065**	**$884**	**903**	**$340**

Quarry Tank

The one million gallon Quarry (Westside) Tank was placed in service in 2019. Staff indicated that the tank capacity is limited to 800,000 gallons due to the lower operating level of the Thompson Tank. The HVWP is considering installing an altitude valve at the Thompson Tank to allow full use of the Quarry Tank capacity. This improvement would be beneficial as part of implementing ESM #2 for operating the wells off peak to take advantage of the Eversource TOD rate schedule.

The tank control system is off grid and does not have an electric service. The minimal power for the control system is provided with a solar array that is supplemented with a 10 kW propane generator. A 12" main connects the tank to the existing 8" main on Pinnacle Drive. Staff indicated that a cross country main is planned down Vista Road to connect with an existing 12" main on Route 3A by Hackett Hill Road. After this improvement is made, the tank utilization will be improved.

3.8 Water Department Administration Building

The Water Department Administration Building is located on Riverside Street and consists of a two-story wood frame structure used for offices, a meeting room, maintenance shop, bathroom and storage.



The building is heated with an oil-fired Hallmark furnace and Beckett burner that is controlled with a centrally located wall thermostat to maintain 68 degrees. The office area on the south side of the building includes a heat pump to supplement the central heating system and provide air conditioning.

A summary of the 2019 electric energy use for the Administration Building is summarized below.

Table 3.18: Administration Building 2019 Energy & Cost Data

2019 Month	Billed Energy Use (kWh)	Billed Demand (kW)	Demand Cost	KWh Cost	Monthly Fee	Delivery Cost	Supplier Cost	Total Bill
Jan	957	0	$0	$73	$15	$82	$88	$170
Feb	931	0	$0	$70	$15	$79	$85	$164
Mar	833	0	$0	$66	$15	$71	$81	$152
Apr	670	0	$0	$65	$15	$57	$80	$137
May	535	0	$0	$56	$15	$46	$71	$117
Jun	432	0	$0	$44	$15	$37	$59	$96
Jul	802	0	$0	$57	$15	$68	$72	$141
Aug	875	0	$0	$117	$15	$75	$132	$206
Sep	484	0	$0	$67	$15	$41	$82	$123
Oct	436	0	$0	$51	$15	$37	$66	$103
Nov	640	0	$0	$74	$15	$55	$89	$143
Dec	798	0	$0	$66	$15	$68	$81	$149
Totals	**8,393**	**0.0**	**$0**	**$806**	**$180**	**$715**	**$986**	**$1,701**

In 2019, the office heating system used 976 gallons of fuel at a cost of $2,820. To reduce this cost, OM #4 recommends installing a setback thermostat for the system and reducing the setting to 60 degrees during unoccupied periods.

SECTION 4. RECOMMENDED MEASURES

This section describes the proposed energy management practices (EMPs), operational measures (OMs), energy conservation measures (ECMs) and energy supply measures (ESMs) discussed in the report. The measures are interactive in the order they are listed. All project costs and savings figures are preliminary and should be verified before proceeding with each project.

4.1 Energy Management Practices

Energy management practices (EMPs) cannot be justified based on quantifiable energy savings, but considered to be good energy efficient practices that will provide long-term benefits.

4.1.1 EMP #1 Benchmark Energy Use with Operational Data

Description

An effective energy management program provides a systematic approach to reducing facility energy use and costs. A successful program is structured to provide an on-going process that can be used to continually evaluate new projects, track savings and encourage efforts within the organization to improve efficiency.

The most effective way to maintain system efficiency is to benchmark system energy use with flow (kWh/MG). In addition, collecting the following data each month will also help relate station energy/fuel use to equipment operation.

- Track energy use, peak electric demand and all monthly energy costs.
- Track fuel oil/propane/natural gas use and costs and relate usage to thermostat settings and generator run time.

Collecting this additional data on a regular basis is useful to verify savings of the proposed measures and determine when pump upgrades or heating system improvements can be justified.

Calculations

This measure is an important part of a successful efficiency program to insure savings for the energy projects are realized

Preliminary Cost Estimate

Cost is expected to be minimal for this measure.

4.2 Operational Measures

Operational measures (OMs) are low cost improvements that can be made without a substantial capital investment and typically pay for themselves in less than one year.

4.2.1 OM #1 North Well VFD Adjustment

Description

The North Pump Station well pump is a Goulds 9 RCLC 7 stage vertical turbine pump rated for 400 gpm @ 290' TDH. In December 2019, the HVWP installed a VFD for the well and the motor speed was reduced to 55.4 Hz. The VFD application reduced the average pump station electrical demand from 35.3 kW to 26.2 kW (based on 6 months of data from 2020). With Eversource not charging for the first 5 kW of demand, this corresponds to approximately 30 kW for the baseline value.

This measure estimates the energy and demand savings for the VFD project based on 2019/2020 energy bills and 2020 field measurements.

Savings

Based on data collected during the site visit, it is estimated that the original kWh/MG before the VFD was installed was 1071 kWh/MG. As shown in Table 4.1, the benchmark value of operating the VFD at 55.4 Hz is 1044 kWh/MG with a power draw of approximately 21. 8 kW.

Table 4.1: North Well Pump Measurements & Efficiency Calculations

Pump	VFD Speed (Hz)	Flow (gpm)	Discharge Pressure (psi)	Distance to Well Water Level (ft)	TDH (ft)	Power (kW)	Calculated Pump Efficiency	Pump Curve Efficiency	KWh/MG
North Well	59.8	417	106.2	33	279	28.3	**85%**	**85%**	1,131
	55.4	348	98.7	25	254	21.8	**85%**	**84%**	1,044
	49.8	240	89.3	17	224	14.5	**77%**	**78%**	1,007

TDH = Discharge pressure * 2.31 + 1' casing level to gauge + well level
Estimated 93% motor efficiency (40 hp motor) and 97% VFD efficiency

In 2019 the North Well was operated 1720 hours producing 40.853 MG. (396 gpm average). After the addition of the VFD, the current 55.4 Hz VFD setting (348 gpm) would require 1957 hours to pump the same flow. The energy and demand savings for operating at the lower speed is reviewed below.

Baseline operation: 30 kW * 1720 hours = 51,600 kWh
Pump energy use with VFD: 21.8 kW * 1957 hours = 42,663 kWh
Energy savings: 8,937 kWh
Demand savings: 30 kW – 21.8 kW = 8.2 kW * 12 months = 98.4 kW

Preliminary Cost Estimate

The HVWP installed the VFD in December 2019. This measure provides an estimate of the energy bill savings realized.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below.

Annual Energy (kWh) Savings	8,937 kWh	$0.121/kWh	$ 1,081
Annual Demand (kW) Savings	98.4 kW	$16.37/kW	$ 1,611
Total Energy Cost Savings			**$ 2,691**
Project Cost			**N/A**
Simple Payback			**N/A**

4.2.2 OM #2 Operate South Wells More Often

Description

HVWP staff alternates the available wells as required to satisfy water system demands. After performing pump testing, Process Energy Services developed a kWh/MG for each well.

As discussed, the South Wells are more efficient (based on kWh/MG) than the North and East Wells. Besides component efficiency, the total dynamic head is also a factor when calculating kWh/MG.

If the South Wells can be operated more hours during the year, the overall water system efficiency will increase and energy costs/MG will be reduced. Scheduling the East and North Wells to operate every other month to reduce utility demand charges will enhance the cost savings for this measure.

Savings

Table 4.2 provides a baseline energy use, 2019 hours, average flow and the kWh/MG from test data. The baseline energy use for the North Well includes the savings already calculated in OM #1. Table 4.3 calculates the system energy use after adjusting annual hours to achieve the same total flow.

Table 4.2: 2019 Well Operation & Energy Use

Well	Hours	Avg. Flow (gpm)	KWh/MG	Total Flow (MG)	Energy Use (kWh)
North Well (55.4 Hz after OM #1)	1957	348	1044	40.853	42,651
East Well (51 Hz)	2050	345	1101	42.469	46,758
South Well (51.8 Hz)	926	343	954	19.033	18,157
Back-up South Well (52.3 Hz)	930	349	954	19.475	18,579
Total				**121.83**	**126,145**

Table 4.3: Proposed Well Operation & Energy Use

Well	Hours	Avg. Flow (gpm)	KWh/MG	Total Flow (MG)	Energy Use (kWh)
North Well (55.4 Hz after OM #1)	633	348	1044	13.21704	13,799
East Well (51 Hz)	634	345	1101	13.1238	14,449
South Well (51.8 Hz)	2300	343	954	47.334	45,157
Back-up South Well (52.3 Hz)	2300	349	954	48.162	45,947
Total				**121.83**	**119,351**
Savings					**6,794**

The annual energy (kWh) savings would amount to 6,794 kWh. However, the more significant electric bill savings would be the demand charges if the East and North Wells can be alternated monthly for back-up operation to the South Wells. With the East Well electric demand averaging 32 kW and the North Well averaging 26.2 kW (based on 2020 data after the VFD installation). Demand savings are summarized below:

East Well 32.4 kW – 5 kW (first 5 kW no charge) * 6 months = 164.4 kW
East Well 26.2 kW – 5 kW (first 5 kW no charge) * 6 months = 127.2 kW

Total demand savings = 292 kW

Preliminary Cost Estimate

Cost is expected to be minimal.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below

Annual Energy (kWh) Savings	6,794 kWh	$0.121/kWh	$ 822
Annual Demand (kW) Savings	292 kW	$16.37/kW	$ 4,780
Total Energy Cost Savings			**$ 5,602**
Project Cost			**--**
Simple Payback			**Immediate**

4.2.3 OM #3 Adjust Generator Block Heater Setpoint

Description

A thermal review of the pump station generator block heaters was performed during the site visit to identify excessive operating temperatures. Manufacturers typically recommend a 100 to 120 degree operating range to bring the generator up to operating temperatures quickly when activated. Only the North Station block heater was operating within this range.

Savings

A summary of the existing station energy use and estimated block heater energy use and savings after reducing the temperature setpoint is reviewed below.

Table 4.4: Block Heater Estimated Energy Use

Station/Block Heater Watts (estimated)	Annual Energy Use (kWh)	Non-Pumping Electric Use (kWh)	Measured Block Temp (Deg F)	Estimated Block Heater Energy Use (kWh)	Estimated Percent Savings	Annual Electric Savings (kWh)
East Station (1000 W)	75,969	28,819	157	4,000	30%	1,200
South Station (1000 W)	52,763	17,496	150	3,500	25%	875
Booster Station (2500 W)	53,400	16,244	168	5,000	35%	1,750
Annual Electric Savings						**3,825**

Preliminary Cost Estimate

Cost for the measure is expected to be minimal. Purchasing a $30 thermal indicator would be worthwhile to check the generator temperature periodically.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below.

Annual Energy (kWh) Savings	3,825 kWh	$0.121/kWh	$ 463
Annual Demand (kW) Savings	0 kW	$16.37/kW	$ 0
Total Energy Cost Savings			**$ 463**
Project Cost			**Minimal**
Simple Payback			**Immediate**

4.2.4 OM #4 Install Setback Thermostat for Administration Building

Description

The Administration Building is heated with an oil-fired Hallmark furnace with Beckett burner that is controlled with a centrally located wall thermostat to maintain 68 degrees. The office area on the south side of the building includes a heat pump to supplement the central heating system and provide air conditioning.

In 2019, the heating system used 976 gallons of fuel at a cost of $2,820. To reduce heating costs, this measure recommends installing a setback thermostat for the system and reducing the setting to 60 degrees during unoccupied periods. This setback temperature can be reduced further for additional savings, but staff indicated that it might be challenging for the heating system to bring the building up to temperature on very cold mornings.

Savings Calculations

The savings have been estimated below using the 2% heating cost savings for every one degree that the temperature can be reduced. Based on this, maintaining the temperature at 60 degrees when the building is unoccupied (approximately 70% of the time) will provide the following savings:

Operations Building:

68º F degrees average existing – 60º F degrees proposed * 2% * 70% of the time = 11% savings

Using the 976 gallons of fuel oil use in 2019, savings would be approximately 107 gallons.

Preliminary Cost Estimate

Cost for the measure is expected to be $100 for replacing the building thermostat.

Cost and Savings Summary

The cost and savings estimate for this OM is summarized below.

Annual Fuel Oil Savings	107 gallons	$2.89/gallon	$ 309
Total Energy Cost Savings			**$ 309**
Project Cost			**$ 100**
Simple Payback			**< 1 year**

4.3 Energy Conservation Measures

The recommendations discussed in this section are categorized as energy conservation measures or "ECMs" for projects that require a larger capital investment with simple paybacks exceeding one year.

4.3.1 ECM #1 Install Booster Station Natural Gas Heater

Description

The Booster Station is heated with a 7.5 kW electric heater in the pump room and a ceiling mounted natural gas heater in the generator room. This measure recommends extending the natural gas line to the pump room and replacing the electric space heater with a natural gas heater.

Savings

The baseline energy use for the station is shown below. The portion of the miscellaneous energy use for the electric heat is estimated to be 8,900 kWh.

Table 4.5: Booster Station 2019 Energy Data & Potential Savings

Month	Station Billed Energy Use (kWh)	Pump Energy Use (kWh)	Estimated Energy Use (kWh) for Misc. Equipment	Estimated Electric Savings Using Natural Gas Heater
Jan	3,700	2,580	1,120	800
Feb	3,570	1,376	2,194	1200
Mar	3,480	1,531	1,949	1200
Apr	3,310	1,551	1,759	1,000
May	2,830	2,350	480	0
Jun	4,280	4,778	-498	0
Jul	5,980	7,540	-1,560	0
Aug	8,590	5,750	2,840	0
Sep	6,500	4,586	1,914	1,200
Oct	4,840	2,190	2,650	1,500
Nov	2,890	1,451	1,439	800
Dec	3,430	1,474	1,956	1,200
Total/Avg	**53,400**	**37,156**	**16,244**	**8,900**

To calculate savings for using natural gas instead of electric heat, a heating value of 3412 Btu/kWh was used for the existing electric heat and 100,000 Btu/therm for natural gas.

8,900 kWh * 3412 Btu/kW /1,000,000 = 30.4 MMBtu
30.4 MMBtu * 1,000,000 /100,000 Btu/therm / 82% system efficiency = 370 therms

Preliminary Cost Estimate

With natural gas already available at the station for the emergency generator and unit heater in the generator room, the only costs would be for a wall mounted heater, piping and installation work. Total cost is expected to be less than $2,000.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below. Cost/therm is based on the Booster Station 2019 natural gas bills.

Annual Energy Savings	8,900 kWh	$0.121/kWh	$ 1,077
Annual Demand Savings	0 kW	$ 16.37/kW	$ 0
Annual Additional Natural Gas	370 therms	$ 1.20/therm	($ 444)
Total Energy Cost Savings			**$ 633**
Project Cost			**$ 2,000**
Simple Payback			**3.2 years**

4.3.2 ECM #2 Install Wall Thermostats & Maintain Low Setpoints

Description

The North Well Pump Station is heated with a 7.5 kW electric heater in the chemical room and a ceiling mounted propane heater in the pump room. The electric heater is controlled with a high-low knob (set to maintain 60 degrees) and has been the primary unit heater over the last year.

For the East Station, space heating for the Chemical Building is provided with a 7.5 kW electric heater in the hallway, a 3 kW heater is used in the electric room and a 7.5 kW electric heater in the chemical area. All the heaters are controlled with high-low knobs mounted on the units. A 3 kW unit heater is also located in the Pump Building. To calculate potential savings, a baseline thermostat setting of 60 degrees was used.

For this measure, low temperature wall thermostats are recommended for more precise control of the heater units compared to the high-low knobs. This improvement will also allow staff to maintain a tighter temperature setpoint of 50 to 55 degrees.

Savings

Applying the relationship of 2% cost savings for every one degree of temperature reduction was used to estimate energy savings below.

Table 4.6: Space Heating Electric Energy Use and Savings

Pump Station	Annual Energy Use (kWh)	Non-Pumping Electric Use (kWh	Estimated Space Heater Energy (kWh)	Existing Temp (deg F)	Reduced Temp (deg F)	Percent Savings	Annual Electric Savings (kWh)
North Well	67,938	16,326	5,000	60	50	20%	1,000
East Well	75,969	28,819	15,000	60	50	20%	3,000
Total Electric Savings							**4,000**

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below. The cost for installing the new thermostats at the stations is expected to be less than $2,000 (wiring & thermostats).

Annual Energy (kWh) Savings	4,000 kWh	$0.121/kWh	$ 484
Annual Demand (kW) Savings	0 kW	$16.37/kW	$ 0
Total Energy Cost Savings			**$ 484**
Project Cost			**$ 2,000**
Simple Payback			**4.1 years**

4.4 Energy Supply Measures

Energy supply measures (ESMs) are recommended improvements that may not reduce energy (kWh) consumption, but provides energy related cost savings.

4.4.1 ESM #1 Booster Station Control System Adjustments

Description

The Granite Booster Pump Station includes three Grundfos vertical centrifugal pumps rated for 147 gpm @ 308' TDH and two Griswold Model R3GM rated to provide 400 gpm @ 250' TDH. The pumps supply flow to the one million gallon Manor Tank.

Normal operation is to operate three booster pumps together with a fire pump activated if needed. As shown in Table 4.7, with the exception of January and December, the peak demand was consistent for operating one fire pump and all three-booster pumps. This mode of operation has resulted in high demand costs, which represented 60% of the total billed 2019 energy costs for the station as shown below.

Table 4.7: Booster 2019 Electric Energy Use and Costs

Month	Energy Use (kWh)	Billed Demand (kW)	Demand Cost	Delivery (kWh) Cost	Monthly Fee	Energy Supply Cost	Total Delivery Cost	Total Cost
Jan	3,700	40.7	$547	$126	$30	$315	$703	$1,018
Feb	3,570	64.7	$915	$123	$30	$304	$1,067	$1,371
Mar	3,480	66.9	$948	$105	$30	$296	$1,084	$1,380
Apr	3,310	65.7	$930	$101	$30	$282	$1,061	$1,343
May	2,830	64.8	$916	$86	$30	$241	$1,032	$1,273
Jun	4,280	64.3	$908	$135	$32	$365	$1,076	$1,440
Jul	5,980	64.8	$979	$197	$32	$509	$1,208	$1,718
Aug	8,590	66.1	$1,000	$297	$32	$732	$1,329	$2,061
Sep	6,500	65.4	$989	$245	$32	$554	$1,266	$1,819
Oct	4,840	65.5	$990	$186	$32	$412	$1,209	$1,621
Nov	2,890	39.6	$566	$106	$32	$246	$704	$950
Dec	3,430	41.2	$593	$231	$32	$292	$856	$1,148
Totals	**53,400**	**709.7**	**$10,282**	**$1,938**	**$374**	**$4,550**	**$12,593**	**$17,143**

In 2020, Lewis Engineering performed a Water Supply Evaluation. The engineer indicated that the booster station uses a significant portion of the total well capacity when the pumps are operated and recommended that the HWVP should adjust the booster station operation to dampen the current surge in flow required when the boosters are activated to fill the Manor Tank. The report suggested either lengthening the duration of the fill at a lower flow rate, or timing the operation of the tank filling to coincide with a lower demand elsewhere in the system.

This measure recommends adjusting the pump control system to use more storage capacity and allow one of the small pumps or one of the fire pumps (at a reduced VFD speed) to operate for a longer

duration. With a total 2019 pumped flow of 28.9 MG, one of the small pumps could be operated at a flow rate of 150 gpm for 3,200 hours annually (37% of the time) to satisfy total flow requirements.

Savings

The potential demand savings for using one of the smaller pumps (power draw measured to be 11.6 kW) to satisfy flow requirements is calculated below.

Table 4.8: Booster Demand Savings

Month	2019 Billed Demand (kW)	New Billed Demand (kW)	Demand (kW) Savings
Jan	40.7	15.0	25.7
Feb	64.7	15.0	49.7
Mar	66.9	15.0	51.9
Apr	65.7	15.0	50.7
May	64.8	15.0	49.8
Jun	64.3	15.0	49.3
Jul	64.8	15.0	49.8
Aug	66.1	15.0	51.1
Sep	65.4	15.0	50.4
Oct	65.5	15.0	50.5
Nov	39.6	15.0	24.6
Dec	41.2	15.0	26.2
Totals	**709.7**	**180.0**	**529.7**

Preliminary Cost Estimate

Cost is expected to be minimal.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below

Annual Energy (kWh) Savings	0 kWh	$0.121/kWh	$ 0
Annual Demand (kW) Savings (6 months)	529.7 kW	$16.37/kW	$ 1,670
Total Energy Cost Savings			**$ 8,671**
Project Cost			**--**
Simple Payback			**Immediate**

4.4.2 ESM #2 Request TOD Rate Schedule Change

Description

The concept of operating pump systems off peak to potentially take advantage of time of day (TOD) rates requires the use of stored water during the day and operating pumps during off-peak hours. In 2019, the Hooksett average daily flow was 334,000 gallons. With a total tank capacity of 1,250,000 gallons for the main pressure zone, this corresponds to 27% of the available storage. As discussed, there are limitations to the available capacity at this time, but as system improvements are made, there is a potential for operating the wells off peak to take advantage of the Eversource TOD rate schedule.

The time of day (TOD) G rate schedule provides lower energy rates during the off peak hours and higher rates during on-peak hours (7:00 AM to 8:00 PM). For the on-peak period, the pumps at the well sites would need to remain off the majority of the time to provide net savings.

Savings

Savings for operating the wells during off-peak hours is estimated below.

Table 4.9: Well Pump Station Off-Peak Rate Savings

Operation	Energy Use (kWh)	Billed Demand (kW)	Pump Energy Use (kWh)	Misc. Energy Use (kWh)	Demand Cost	Monthly Fee	Total
2019 Well Total	196,670	1154	134,029	62,641	$15,405	$1,122	$40,343
Adjusted after OM s	173,114	764	118,298	54,817	$12,507	$1,122	$30,794

Operation	Energy Use (kWh)	Demand (kW)	On-Peak (kWh)	Off-Peak (kWh)	New Demand Cost	Monthly Cost	Total
With Off Peak Rates	173,114	764	118,298	54,817	$3,170	$2,160	$23,577
Savings							**$7,217**

Total Cost Savings: $7,217

The savings have been calculated using the latest Eversource TOU G rate schedule (in Appendix A) with the miscellaneous energy use column split between the on-peak and off-peak cost calculation.

Preliminary Cost Estimate

It will take more research to determine the SCADA cost for adjusting the current well activation control system from the current level based system to a time based system with the level controls available as a secondary method of pump activation. A $10,000 placeholder cost has been included for adding this feature.

Cost and Savings Summary

The cost and savings estimate for this measure is summarized below.

Annual Energy Savings	---	---	---
Annual Demand Savings	---	---	---
Total Energy Cost Savings			**$ 7,217**
Project Cost			**$ 10,000**
Simple Payback			**1.4 years**

APPENDIX A: ELECTRIC RATE SCHEDULE

GENERAL DELIVERY SERVICE RATE G

AVAILABILITY

Subject to the Terms and Conditions of the Tariff of which it is a part, this rate is for Delivery Service for any use. It is available to (1) those Customers at existing delivery points who were receiving service hereunder on General Service Rate G on January 1, 1983, and who have continuously received service under that rate and this successor since that date, and (2) all other Customers whose loads as defined for billing purposes do not exceed 100 kilowatts. Service rendered hereunder shall exclude all backup and standby service provided under Backup Delivery Service Rate B.

Customers taking service under this rate shall provide any necessary transforming and regulating devices on the Customer's side of the meter. Controlled electric service for thermal storage devices is available under Load Controlled Service Rate LCS and outdoor area lighting is available under Outdoor Lighting Delivery Service Rate OL.

CHARACTER OF SERVICE

Delivery Service supplied under this rate will be 60 hertz, alternating current, either (a) single-phase, normally three-wire at a nominal voltage of 120/240 volts, or (b) three-phase, normally at a nominal voltage of 120/208 or 277/480 volts. Three-phase, three-wire service at a nominal voltage of 240, 480 or 600 volts is available only to those Customers at existing locations who were receiving such service on February 1, 1986, and who have continuously received such service since that date. In underground secondary network areas, Delivery Service will be supplied only at a nominal voltage of 120/208 volts.

RATE PER MONTH

	Single-Phase Service	Three-Phase Service
Customer Charge	$14.89 per month	$29.76 per month

Customer's Load Charges:

	Per Kilowatt of Customer Load in Excess of 5.0 Kilowatts
Distribution Charge	$8.72
Transmission Charge	$5.26
Stranded Cost Recovery	$0.96

Issued: February 1, 2019 Issued by: /s/ William J. Quinlan
William J. Quinlan

Effective: February 1, 2019 Title: President and Chief Operating Officer

Energy Charges:

	Per Kilowatt-Hour
Distribution Charges:	
First 500 kilowatt-hours	6.986¢
Next 1,000 kilowatt-hours	1.731¢
All additional kilowatt-hours	0.612¢
Transmission Charge	
First 500 kilowatt-hours	1.900¢
Next 1,000 kilowatt-hours	0.715¢
All additional kilowatt-hours	0.383¢
Stranded Cost Recovery	1.069¢

WATER HEATING - UNCONTROLLED

Uncontrolled water heating service is available under this rate when such service is supplied to approved water heaters equipped with either (a) two thermostatically-operated heating elements, each with a rating of no more than 5,500 watts, so connected or interlocked that they cannot operate simultaneously, or (b) a single thermostatically-operated heating element with a rating of no more than 5,500 watts. The heating elements or element shall be connected by means of an approved circuit to a separate water heating meter. Service measured by this meter will be billed monthly as follows:

Meter Charge ..... $4.47 per month

Energy Charges:

Distribution Charge..... 2.030¢ per kilowatt-hour

Transmission Charge ..... 1.578¢ per kilowatt-hour

Stranded Cost Recovery..... 1.338¢ per kilowatt-hour

WATER HEATING - CONTROLLED

Controlled off-peak water heating is available under this rate for a limited period of time at those locations which were receiving controlled off-peak water heating service hereunder on Customer Choice Date and which have continuously received such service hereunder since that

date. Service under this rate at such locations shall continue to be available only for the remaining life of the presently-installed water heating equipment. No replacement water heaters shall be permitted to be installed for service under this rate at locations which otherwise would qualify for this service.

For those locations which qualify under the preceding paragraph, controlled off-peak water heating service is available under this rate when such service is supplied to approved storage type electric water heaters having an off-peak heating element with a rating of no more than 1,000 watts, or 20 watts per gallon of tank capacity, whichever is greater. The off-peak element shall be connected by means of an approved circuit to a separate water heating meter. Electricity used will be billed monthly as follows:

Meter Charge.....$7.88 per month

Energy Charges:

Distribution Charge..... 0.120¢ per kilowatt-hour

Transmission Charge ..... 1.578¢ per kilowatt-hour

Stranded Cost Recovery..... 0.790¢ per kilowatt-hour

SPACE HEATING SERVICE

Space heating service is available under this rate at those locations which were receiving space heating service under the Transitional Space Heating Service Rate TSH prior to Customer Choice Date and which have continuously received such service since that date. Customers at such locations who have elected this rate shall have the electricity for such service billed separately on a monthly basis as follows:

Meter Charge.....$2.98 per month

Energy Charges:

Distribution Charge..... 3.426¢ per kilowatt-hour

Transmission Charge ..... 1.900¢ per kilowatt-hour

Stranded Cost Recovery..... 1.666¢ per kilowatt-hour

Space heating equipment served under this rate, including heat pumps and associated air circulating equipment, shall be wired by means of approved circuits to permit measurement of such equipment's additional demand and energy use.

Customers taking space heating service under this rate at locations where the regular power and lighting service is delivered at primary voltage level or above shall be required to provide at the Customers' expense suitable transforming, controlling and regulating apparatus, acceptable to and approved by the Company, for the space heating service in the same manner as for the power and lighting service, so that deliveries of all electric service may be made by the Company at the same voltage level.

CUSTOMER'S LOAD

Customer's load is defined as the greatest rate of taking Delivery Service in kilowatts for any thirty (30) minute interval during the current monthly billing period.

Customer's load shall be measured whenever (a) such load is known or estimated to be 5.0 kilowatts or more, or (b) the Customer's use of service is 750 kilowatt-hours or more per month for three (3) consecutive months. However, any Customer's load may be measured at the Company's option. When measured, Customer's load shall be determined to the nearest one-tenth (0.1) kilowatt for billing purposes.

SERVICE CHARGE

When the Company establishes or re-establishes a Delivery Service account for a Customer at a meter location, the Company will be entitled to assess a service charge in addition to all other charges under this rate. The service charge will be $14.00 if the Company does not have to send an employee to the meter location to establish or re-establish Delivery Service. When it is necessary for the Company to send an employee to the meter location to establish or re-establish Delivery Service, the service charge will be $35.00. When it is necessary for the Company to send an employee to the meter location outside of normal working hours to establish or re-establish Delivery Service, the service charge will be $70.00. The Company will be entitled to assess an $18.00 service charge when it is necessary to send an employee to the Customer location to collect a delinquent bill. This charge shall apply regardless of any action taken by the Company including accepting a payment, making a deferred payment arrangement or leaving a collection notice at the Customer’s premises.

Short-term, seasonal or transient Customers who take service at temporary locations shall pay for the cost of installing and removing the necessary poles, wires, transformers, cable and other equipment in addition to the foregoing service charge.

GENERAL TIME-OF-DAY DELIVERY SERVICE RATE G-OTOD

AVAILABILITY

Subject to the Terms and Conditions of the Tariff of which it is a part, this rate is for Delivery Service to Customers who utilize electric thermal storage devices and other applications approved by the Company. It is available to Customers whose loads as defined for billing purposes do not exceed 100 kilowatts. Service is available at the Customer's option to those Customers who have completed a written Application for Service and signed a Service Agreement, and who receive all of their Delivery Service requirements hereunder, except that outdoor area lighting is available under Outdoor Lighting Service Rate OL.

Customers taking service under this rate shall provide any necessary transforming and regulating devices on the Customer's side of the meter.

LIMITATIONS ON AVAILABILITY

The availability of this rate to particular Customers is contingent upon the availability of time-of-use meters and personnel to administer the rate, all as determined by the Company.

Because the Company's distribution system and Customer service facilities have a limited electrical capacity, large and/or intermittent and irregular electrical loads can result in the overloading and damaging of said facilities and can adversely affect the quality of service to other Customers of the Company. Therefore, service under this rate shall not be available where, in the Company's judgment, sufficient distribution system capacity and Customer service facilities do not exist in order to supply the electrical requirements of the applicant unless the Service Agreement provides for a suitable cash payment or a satisfactory revenue guarantee to the Company, or both. Further, in the event that a Customer receiving service under this rate shall propose to materially increase the amount of Delivery Service required, the Customer shall give the Company prior written notice of this fact, thereby allowing the Company to ascertain whether sufficient distribution system capacity and Customer service facilities exist to serve the proposed increased requirement. Where the capacity or facilities do not exist, the Customer will not make the proposed increase until the Service Agreement shall be amended to provide for a suitable cash payment or a satisfactory revenue guarantee to the Company, or both.

SERVICE AGREEMENT

The term of the Service Agreement shall be one year, and shall continue thereafter until canceled by one month's notice to the Company by the Customer. The Customer will not be permitted to change from this rate to any other rate until the Customer has taken service under this rate for at least twelve months. However, upon payment by the Customer of a suitable termination charge, the Company may, at its option, waive this provision where a substantial hardship to the Customer would otherwise result.

CHARACTER OF SERVICE

Service supplied under this rate will be 60 hertz, alternating current, either (a) single-phase, normally three-wire at a nominal voltage of 120/240 volts or (b) three-phase, normally at a nominal voltage of 120/208 or 277/480 volts. Three-phase, three-wire service at a nominal voltage of 240, 480 or 600 volts is available only to those Customers at existing locations who were receiving such service on February 1, 1986, and who have continuously received such service since that date. In underground secondary network areas, service will be supplied only at a nominal voltage of 120/208 volts.

RATE PER MONTH	Single-Phase Service	Three-Phase Service
Customer Charge	$39.18 per month	$55.98 per month

Customer's Load Charges:

	Per Kilowatt of Customer Load
Distribution Charge	$12.34
Transmission Charge	$ 4.07
Stranded Cost Recovery	$ 0.06

Energy Charges:

	Per Kilowatt-Hour
Distribution Charges:	
On-Peak Hours (7:00 a.m. to 8:00 p.m. weekdays excluding Holidays)	4.978¢
Off-Peak Hours (all other hours)	0.780¢
Stranded Cost Recovery	0.019¢

Issued: July 7, 2016 Issued by: /s/ William J. Quinlan
William J. Quinlan

Effective: July 1, 2016 Title: President and Chief Operating Officer

Authorized by NHPUC Order No. 25,913 in Docket Nos. DE 09-035, DE 11-250 and DE 14-238, dated June 28, 2016;Authorized by NHPUC Order No. 25,912 in Docket No. DE 16-566, dated June 28, 2016; and Authorized by NHPUC Order No. 25,909 in Docket No. DE 15-416, dated June 28, 2016.

CUSTOMER'S LOAD

Customer's load is defined as the greatest rate of taking service in kilowatts for any thirty (30) minute interval during on-peak hours of the current monthly billing period. On-peak hours shall be the hours of 7:00 a.m. through 8:00 p.m. weekdays excluding Holidays as defined in this Tariff.

SERVICE CHARGE

When the Company establishes or re-establishes a Delivery Service account for a Customer at a meter location, the Company will be entitled to assess a service charge in addition to all other charges under this rate. The service charge will be $14.00 if the Company does not have to send an employee to the meter location to establish or re-establish Delivery Service. When it is necessary for the Company to send an employee to the meter location to establish or re-establish Delivery Service, the service charge will be $35.00. When it is necessary for the Company to send an employee to the meter location outside of normal working hours to establish or re-establish Delivery Service, the service charge will be $70.00. The Company will be entitled to assess an $18.00 service charge when it is necessary to send an employee to the Customer location to collect a delinquent bill. This charge shall apply regardless of any action taken by the Company including accepting a payment, making a deferred payment arrangement or leaving a collection notice at the Customer’s premises.

APPENDIX B: PRODUCT DATA

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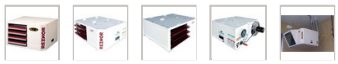
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REZNOR

SKU	Brand	Rating
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Appendix D

TATA & HOWARD

SOURCE WATER SUSTAINABILITY ACTIVITIES

Hooksett Village Water Precinct, PWS ID#1181020, 2016-2021

WATER USE MANAGEMENT HIGHLIGHTS:

- **Annual Source Well Redevelopment** – Specific capacity increases routinely range from 5% to 22% and up to 11 GPM/ft, in addition to preventive maintenance benefits.
- **Water System Capacity Study** – A comprehensive review of 60 years of water supply and demand data was completed in 2020. The study identified our current and future capacity to provide water for community growth under a variety of simulated conditions, and included detailed recommendations to assist with CIP planning such as source needs, distribution system modifications, drought considerations, further enhancements to our conservation program and methods for optimizing pump station output such as redevelopment and surge management.
- **Interconnection Availability Research** – The Precinct's vulnerabilities to potential source losses or main breaks in critical areas, and serious limits associated with its current interconnection to Central Hooksett Water Precinct, led it to complete research in 2016-18 on possible emergency interconnections with the neighboring communities of Pembroke, Bow and Manchester.
- **Bow Interconnection Feasibility Study** – The Precinct and the Town of Bow are nearly finished on an engineering evaluation of the location, cost and technical criteria for connecting the two existing water systems along the Route 3A corridor, for both emergency purposes for the two towns and also for the potential sale of water to Hooksett and increased demand to Bow.
- **Manchester Interconnection Design** – In 2019-20, the Town of Hooksett and the Precinct worked together on the local Tax Increment Finance (TIF) Committee to develop an infrastructure plan for the Route 3A TIF District. As part of this plan, the Town has agreed to design a new emergency interconnection for us with Manchester on Route 3A.
- **Brickyard Brook Diversion** – A deteriorated diversion intake structure, rotted pond gage and storm-damaged stilling well were repaired and/or replaced between 2016-18. An unreliable, inaccurate flow meter in the periodically and only partially full 16" gravity transmission main proved difficult to diagnose and replace in 2017-19 but is now returning accuracies of ≤1%. The new meter was tied directly into our real-time SCADA system in 2020.
- **Diversion Mapping & Easement(s)** – To reduce the uncertainty associated with potential access/maintenance issues associated with the diversion, a critical source of aquifer recharge, the Precinct reviewed historical files, dug test pits, video-inspected the pipeline and hired a professional land surveyor to assess the condition/location of the mile-long transmission main. By 2020, an Easement Plan securing our access rights was filed at the County Registry.
- **Merrimack River Crossing** - A new river crossing was activated at Lilac Bridge in 2018 in partnership with the Town of Hooksett, following a major main break on the only other river crossing in our system in 2016, at the Main Street Bridge. The $200K crossing provides vital backup in the event of another emergency, significantly increasing resiliency and sustainability.
- **SCADA System** – A complete control system overhaul and upgrade was completed in 2019-20, revolutionizing Precinct operations and culminating a 5-year and 2-phase investment of over $250K. Outdated, poorly-performing components (software, communications and alarms) were removed and a new unified radio-based VTSCADA system was installed. The new system connects all stations, treatment plants, tanks and the office and provides continuous level, flow,

concentration and pressure monitoring, as well as user-programmed alarms in real-time. Tank levels continue to be monitored for leak signatures. Operators have observed quicker event response times and a significant improvement in understanding system hydraulics.

- **Aquifer Preservation** – The Precinct's 2020 capacity study confirmed that it is critical to quickly identify and preserve any remaining potential drinking water sources in and around the Precinct's service area due to strong development pressures along the I93 corridor. In the last several years, the Precinct has begun compiling historic local groundwater exploration studies and planning for some test well drilling but readily accessible sites have not materialized.
- **Drought Response Plan** - During the 2016 Drought Emergency, water levels 15 feet below normal were observed at the wells and poor recoveries were noted. Even though demand was relatively low we were forced to limit and stagger well operations to reduce drawdown; supplement pond levels to provide limited indirect aquifer recharge; and implement an outdoor water ban. As a result, the Precinct developed a simple source-specific water level-based action plan that could be used as a guide for future drought responses. This plan was put to the test during the June-December 2020 Drought. Thanks to the plan, we were able to carefully navigate this drought without a water ban while demand was relatively high.
- **South Backup Well Permit Adjustment** – During the 2016 Drought, it became apparent that the 720 hour/year operating limit on the South Backup Well was hindering not only routine operation of the well for maintenance purposes but also reducing the Precinct's ability to respond to the drought. Working with NHDES, this seemingly arbitrary permit restriction was lifted and the well was brought into a normal rotation, improving sustainability.

<u>WATER CONSERVATION HIGHLIGHTS</u>:

- **Source Meter Replacement & Testing** – Between 2018 and 2020, all source meters, with historical accuracies ranging from 2% to 11%, were replaced. New Foxboro 9500A mag meters were installed with improved upstream/downstream clearances and an average field accuracy of 0.6%. The new meters are tied into the new SCADA system for real-time flow monitoring and leak detection. Meter calibration is verified annually through independent third party testing.
- **Service Meter Upgrade Program** – An aggressive in-house service meter upgrade program began in 2016. Meter change-outs occur more or less continuously throughout the year (807 to date). Badger E-series ultrasonic meters are being installed with Badger Orion cellular AMR/AMI endpoints/transmitters and the meter data is managed using Badger Beacon AMA analytics. The AMA allows for frequent checks of meter "health" and anomalies from the office and near-continuous monitoring of leaks beyond the meter; enrolled customers (12% to date) also have on-line access to their meter data. Relatively new Badger Recordall disc meters that have not exceeded their life expectancy yet are being retrofitted with Orion cellular transmitters. Our goal is to replace all old meters or transmitters with cellular-based technology and remove our fixed-base Badger Galaxy receivers (not needed with cellular transmitters) by 2024.
- **Water Balance** – The Precinct's annual water balance improvement success is the sum result of many of the other sustainability activities listed on this summary sheet including but not limited to improvements made in the areas of metering, leak detection/repair, flushing, and tracking other forms of metered/unmetered consumption. Between 2015-20, our Water Balance decreased from 15% to nearly 0% (1% if unmetered consumption is included).

- **Leak Detection** – Automatic meter reading technology is increasingly used to easily monitor service leaks by either the customer or the supplier, as discussed above. Leak detection techniques regularly employed by the Precinct also include continuous SCADA pressure, level and alarm monitoring; acoustic screening with Sonoscopes after spring/fall hydrant flushing or during service meter change-outs; historical detective work (mining of files and "old timers" memory banks); field observations; and responses to called-in reports of unusual conditions. If the leak status is uncertain, follow-up detection is completed with more sophisticated leak detection equipment such as the HL-5000 or DLD. Sometimes Cl testing is helpful. System-wide leak surveys completed in-house every 3 years have demonstrated that the system is tight, with the occasional exception of several hydrants or hydrant valves which need to be reseated.
- **Leak Repair** – A total of 27 (8 main, 19 service) leaks were reported between 2015-20, which upon repair stopped a total loss of approximately 16M gallons or 2.6 MG/year. The average number of reported leaks decreased from 6/year to 3/year during that period, presumably due to the overdue repair of some historical leaks and our more vigilant leak detection efforts. As our new crew worked through the backlog and honed their repair skills, the maximum repair response time decreased from 8 weeks (2015) to less than a week (2017-2020).
- **Pressure Management** - Pressure is managed by (A) routine 24/7 monitoring of new SCADA gauges/alarms at 4 pump stations and 3 storage tanks; (B) VFDs at all stations; (C) pressure reducing valves at the Booster Station; (D) optional pressure-based operations at all wells; (E) required surge valves or PRVs at customer homes/facilities; (F) atmospheric storage tank surge relief and (G) rigorous standards for new construction and emergency repairs.
- **Comprehensive, sustainability-driven funding strategy** -
    - Annual reviews of CIP, rates, budget and reserves – these comprehensive, integrated reviews have provided a springboard for positive Budget Committee discussions
    - Creative and fair revenue models (diversified sources, senior discounts, etc.) – average annual water bill has risen from $193 (2015) to $447 (2021) but still far below NH avg.
    - Integration of CIP and Asset Management Plan
    - Carefully increase rates to pay for full system costs – estimated additional operating revenues generated via rate / fee diversification from 2016-21 = approx. $2M
    - Tiered conservation rate structure – inclining block rate focuses highest rates on residential irrigation, big business and other large water users
    - Maintain/build capital reserves
    - CIP funded in operating budget – including water main repair/replacement!
    - Water tasks/projects prioritized in plans
    - Integrated road works planning – the Town is beginning to develop a GIS system and a master plan for road improvements; we intend to look for joint project opportunities
    - Leveraging, networking and partnerships – positive relationship building pays dividends not only in a positive work environment but also in project opportunities, etc.
    - Reuse of debt service decreases
    - Seek grants/low interest loans – applied for $4M Community Project Fund grant via Congressman Pappas' office recently; likely to apply for NHDES SRF loan again in June
    - Proactive vs. reactive mindset

- **Billing Practices** – The Precinct routinely follows a series of strict, repetitive QA/QC procedures intended to assure the accuracy of its billings as well as the billed metered component of the Water Balance accounting process. Readings are collected automatically using cellular technology when possible. Other readings are entered manually into the billing software. Once all readings are collected, they are processed, reviewed for errors and flagged for further evaluation due to unusual usage or charges (high, low or zero). Once any outstanding issues are resolved (corrected readings, scheduled meter repairs, etc.) and the final review is completed, the final bills are processed. Estimated readings are not allowed to drag on indefinitely. This simple yet tedious process, repeated on a quarterly basis since 2016, has uncovered hundreds of errors that cumulatively have saved the Precinct untold dollars and vastly improved confidence.
- **Outreach** – Conservation education is incorporated in nearly every piece of public outreach that we are involved with. Every bill that goes out has at least one conservation message on the front and a half page of conservation tips on the back; conservation bill stuffers are often also employed. Our office lobby is filled with conservation flyers. Our CCR has conservation tips. Our newsletters, annual reports, public outreach sessions and committee presentations discuss conservation-related initiatives. Our web site is filled with conservation information.
- **Large User Initiative** – An effort to identify the largest water users in the Precinct was initiated in 2020 as an outgrowth of the Asset Management Plan project. The work ultimately involved a comprehensive review and update of our billing software for all 1,167 metered accounts to improve consistency of user/street naming and account/street numbering. Once the billing software update was completed, the top 15 water users were identified by correctly "lumping" together multiple accounts for single large users like commercial residential complexes and municipal recreational facilities. The initial goal was simply to better understand who our largest users are, for critical customer emergency communications. Our next goal was to work with these customers on metering initiatives and conservation outreach efforts. In 2020, we:

  • Replaced the old meter heads at the Pennichuck / RT93 Rest Area vault, our largest user (over 8 MG in 2019). This resolved a billing system error, and allowed the customer to be integrated into the Beacon system as described above. This has already resulted in the timely cessation of at least 2 recent leaks downstream of the meters. Also, since 2019 we voluntarily instituted meter testing at the vault. Testing showed an accuracy of ±1%.

  • Replaced the old meter at the River Hill Residences (formerly Merrimack Heights) complex, our eighth largest user (1.8 MG in 2019). This has presumably improved accuracy and allowed the customer to be integrated into the Beacon system as described above.

ASSET MANAGEMENT HIGHLIGHTS:

- **GIS & Asset Management Plan** – GIS mapping of the distribution system was completed in 2019-20 with grant assistance from NHDES. The mapping program included a thorough inventory of historical Precinct files; a review of leak repair history; the location of buried valves and "missing" mains; the development of a comprehensive distribution system Asset Management Plan; a public information session about the water system, including conservation efforts, at the Hooksett Library; and the use of aerial drones to improve accuracy of imaging. The mapping is housed in ArcGIS Online and further enhances our leak detection, leak repair, pressure management, service maintenance and customer outreach activities.

- **Asset Management Plan Update** – The Precinct completed an Asset Management Plan Update in 2020-21 which combines, for the first time, hydraulic and critical component considerations with an asset management rating system to determine the water mains most in need of replacement and establish a re-prioritized set of improvements in the distribution system. The new hydraulic model developed for this project was also used to verify the presence of a flow restriction on the west side of the system and to demonstrate the dramatic loss of fire flow and pressure caused when the Thompson Corner (Oak Hill) Tank is taken off-line.
- **Vertical Asset Management Plan** – NHDES has offered grant assistance in 2021-22 to expand the Asset Management Plan effort to our vertical assets including the pump stations and tanks.
- **Pump Station Retrofits** - Over the course of the last five years, the Precinct has steadily reinvested over $250K into updating and optimizing the efficient and safe operations of all four of its pump stations / treatment plants. By designing and overseeing the completion of these modernization efforts in-house, we estimate that we have saved our customers at least another $250K in outside fees. Chemical and electrical usage is now minimized and monitored effectively. Compliance with modern health and safety criteria is now a standard feature, and new meters, valves and piping ensure that flows are unimpeded and accurately controlled and accounted for. Water level transducers are used to ensure that the pumps don't cavitate. The completion of the North Station in 2020 marks the end of this major long-term project.
- **Neglected Hydrant Program** – For a few years beginning back in 2016, we focused on bringing the dozen or so inoperable hydrants around the Precinct back to life. Upon digging, some of those hydrants were observed to have been leaking near the base for many years. Those hydrants have either been replaced or repaired at this point. Our focus now is on replacing the oldest remaining hydrants that are difficult to work on, and on raising hydrants that are too low to the ground. All public and private hydrants were freshly painted in 2019 and 2020.
- **Flow Testing Initiative** – After significant research, the Precinct invested in a Hose Monster Big Boy Hydrant Flow Testing Kit in 2019. Since that time, we completed comprehensive hydrant flow testing using this new and innovative technique which allowed us to collect a large amount of metered data during routine flushing, over a period of weeks instead of months. The data are used to calculate hydrant capacities at a nominal pressure of 20 psi and color code all hydrants in accordance with national fire standards. This has not only strengthened our partnership with the Fire Dept. but also educated us about the presence of multiple areas of partially closed gate valves that we were not aware of. Looking forward, this will be a routine tool.
- **Abandoned & Anomalous Services** – Every so often we run into these, and we do our best to bring them into compliance. Sometimes they have water loss implications. Examples include improperly abandoned services, services that are no longer compliant (e.g. crossing someone else's property), non-compliant materials (e.g. drain pipe and hose clamps), one service to multiple buildings, "spaghetti" piping, unmetered services, etc. In 2020, we found that an account had mysteriously disappeared from the billing system in 2004 but still had a service with no meter. Worse yet, it was leaking and in a big old industrial building with the likelihood of a history of leakage. We resolved the situation and brought the owner into compliance by calculating a back bill, installing a meter and backflow device and making them repair the leak.
- **Missing Valve Program** – We still haven't found all of them, but we've made a significant dent! Each one is notable, but one very notable recent discovery is worth mentioning. This valve eluded our old operators since the day it was installed by contractors in 2005, and apparently was promptly buried and forgotten until 2020 when our new operators did some fine detective

work and uncovered it. After opening the valve for the first time in 15 years, a nearby elderly residential complex became looped and experienced a doubling of fire flow from 800 GPM to 1,600 GPM and a decrease in water quality and pressure complaints.

ENERGY EFFICIENCY HIGHLIGHTS:

- **Pump Motor Drive Improvements** – Variable frequency drives (VFDs) were installed at the North, South and Booster Stations between 2017-20 to either replace old soft-start valves or an outdated/failed VFD, in addition to preventive maintenance benefits. In 2020, this resulted in a savings of 7,610 kWh and $3,449 at the North Station, despite pumping the same volume as in 2019 (41MG) and over a longer period (300 more hours); the payback period = 2.6 years.
- **NHDES Energy Audit** – The Precinct received a generous NHDES grant and completed a comprehensive water system process energy evaluation in 2020-21 for all of its pumping equipment and building systems. A variety of cost-saving measures were proposed, potentially resulting in a first-year annual savings of up to 32,456 kWh and $25,586. Nearly 8 of the 9 measures have been implemented already to date.
- **Booster Station Pumping Schedule** – The Precinct's Booster Station typically generates its largest annual electric bill ($17.6K in 2019). In 2020, the Precinct began better managing its peak demand at this key facility by timing the fill cycles associated with its storage tank to more frequently occur during lower demand periods. This saved $3K in 2020. In 2021, we switched to operating the station completely off-peak to take advantage of Time-of-Day rates. Initial billing changes suggest an additional annual savings of approximately $7K.
- **West (Quarry) Tank** – Design of this 1MG glass-fused steel tank began in earnest in 2016 and construction was completed in 2019. Goals included addressing a decades old storage deficit, improving system reliability with modern tank technology and reducing excessive well cycling. Installation of this tank has allowed the Precinct to reduce the number of summer fill cycles from a maximum of 10-12X per day in 2015-16 to approximately 2X per day in 2020. This facility is completely off-the-grid, with a solar-powered generator and control building.
- **Fleet Improvements** – Modernized truck fleet and reduced fuel costs 51% since 2015.
- **Heating System Upgrades** – Water and space heating systems were repaired, upgraded or replaced at the pump stations and office from 2016-20 including: New water heaters for the chemical feed systems at the North and South Stations (note: an Energy Star heat pump water heater at the North Station), a new more efficient electric space heater at the North Station, a new high efficiency (≥90%) natural gas condensing unit heater at the Booster station (replaced an old inefficient electric space heater), oil-fired hot air furnace improvements at the office including plenum modifications, ductwork repairs and the addition of an electric mini-split to more efficiently heat a remote zone. Annual heating oil costs have dropped 65% since 2016.
- **Lighting Improvements** – Fluorescent strip light fixtures at all of the pump stations and the office workshop were replaced with brighter and more efficient LED strip light fixtures.
- **Overall Electrical Efficiency** – Overall improvements from 2015-20 have resulted in an average annual decrease in total Precinct electrical costs of approximately $10K.

HVWP Energy Audit Progress Summary

May 2022

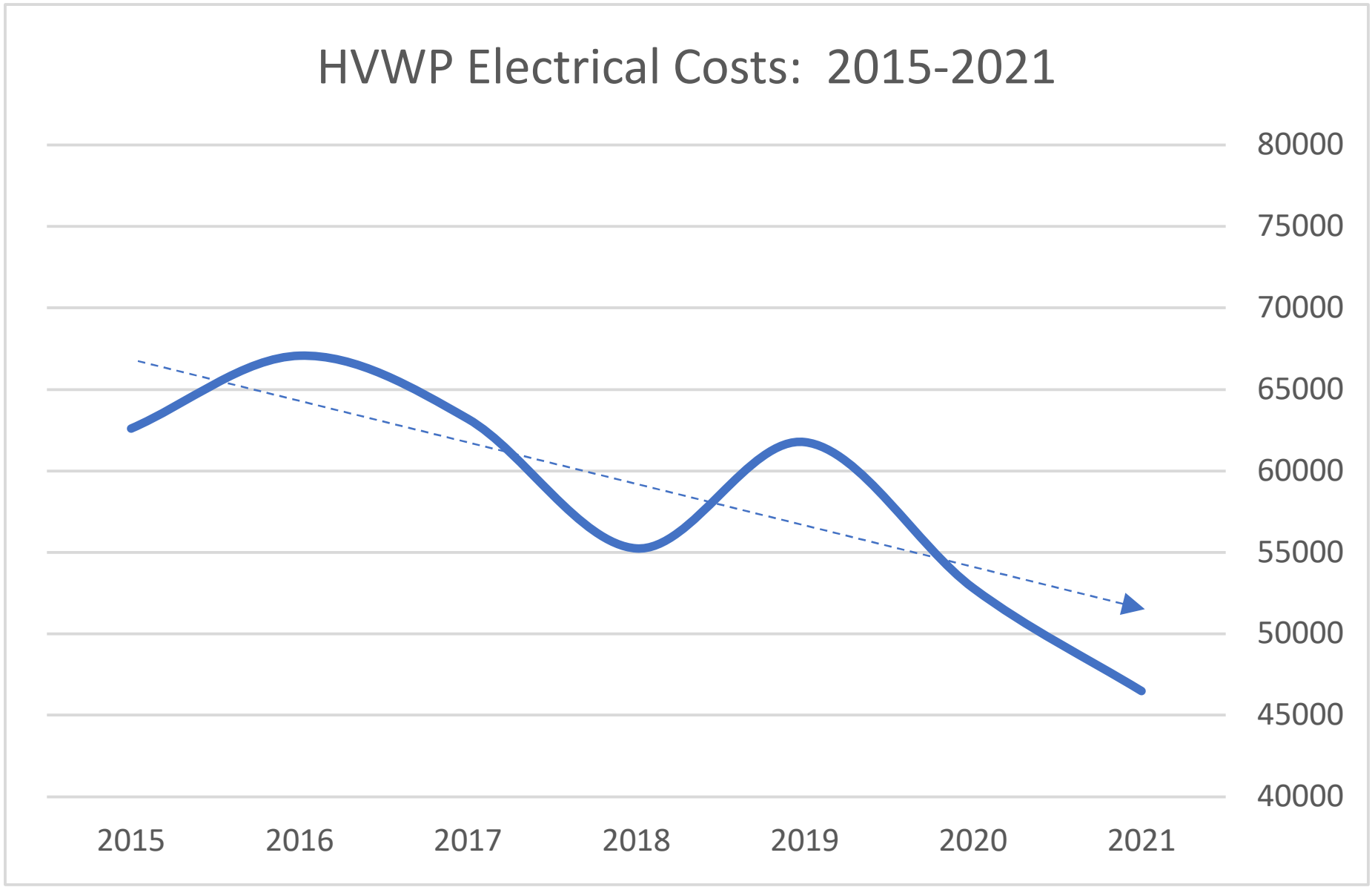
NO.	RECOMMENDATION	STATUS
EMP-1	Benchmark energy use.	Completed/ongoing.
OM-1	Adjust North Well VFD.	Completed.
OM-2	Operate South Wells more.	Partially completed/under investigation.
OM-3	Adjust generator block heater setpoints.	Completed.
OM-4	Install office setback thermostat.	Completed.
ECM-1	Install Booster Station NG unit heater.	Completed.
ECM-2	Install wall thermostats for electric heaters.	Completed.
ESM-1	Adjust Booster Station controls.	Completed.
ESM-2	Investigate TOD schedule change.	Partially completed/under investigation.

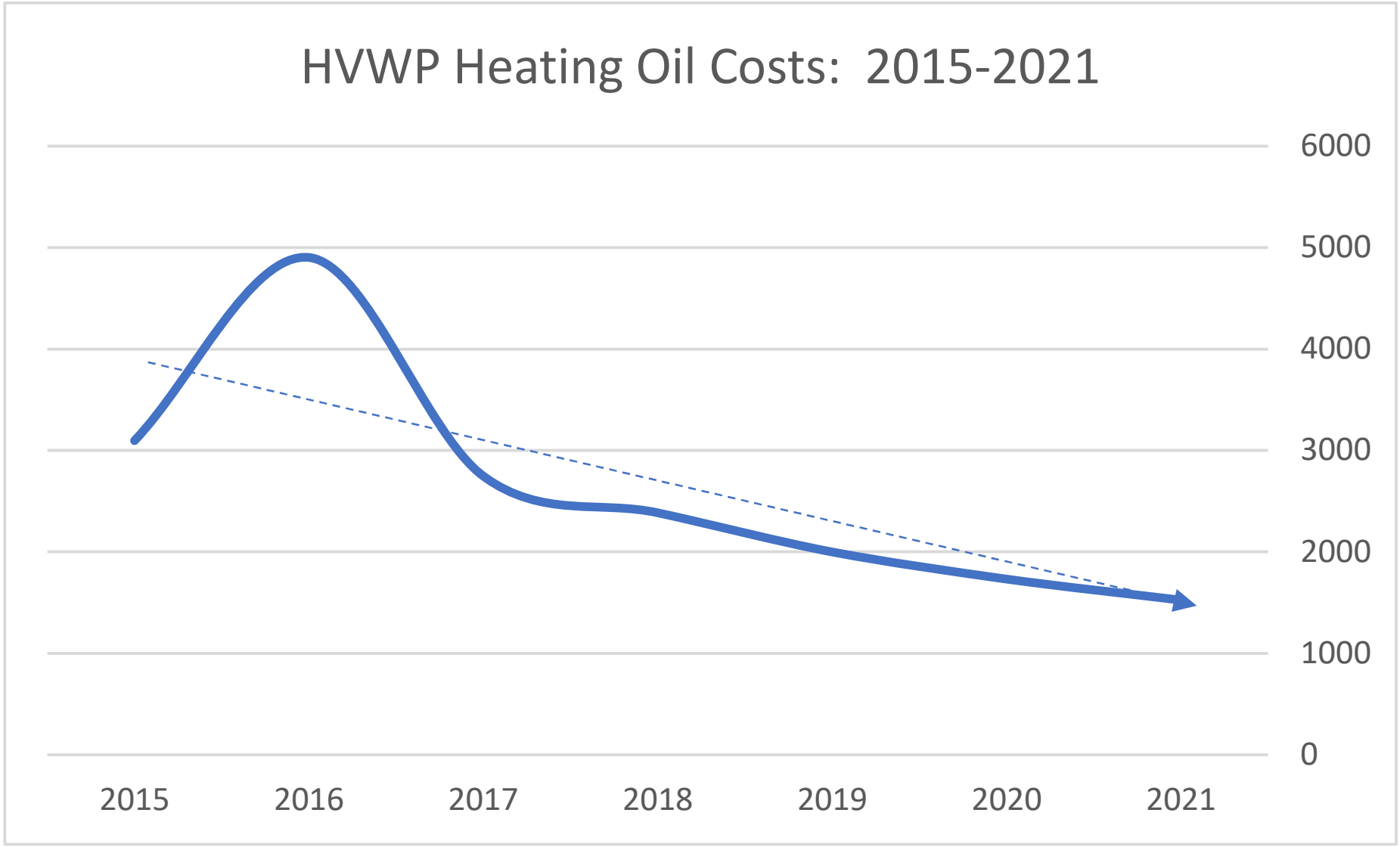
HVWP Electrical Energy Benchmarking Summary

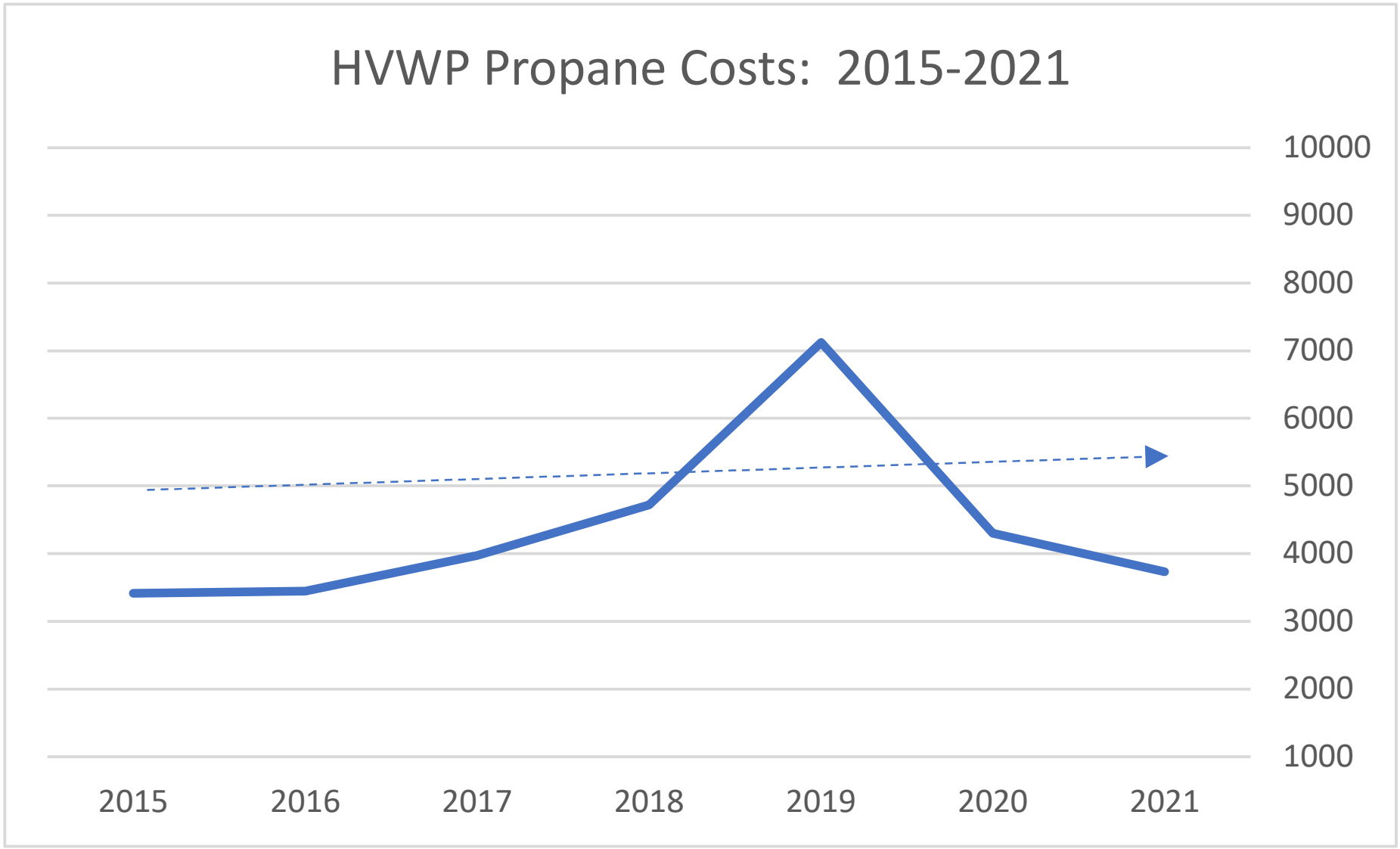
2019 - Present

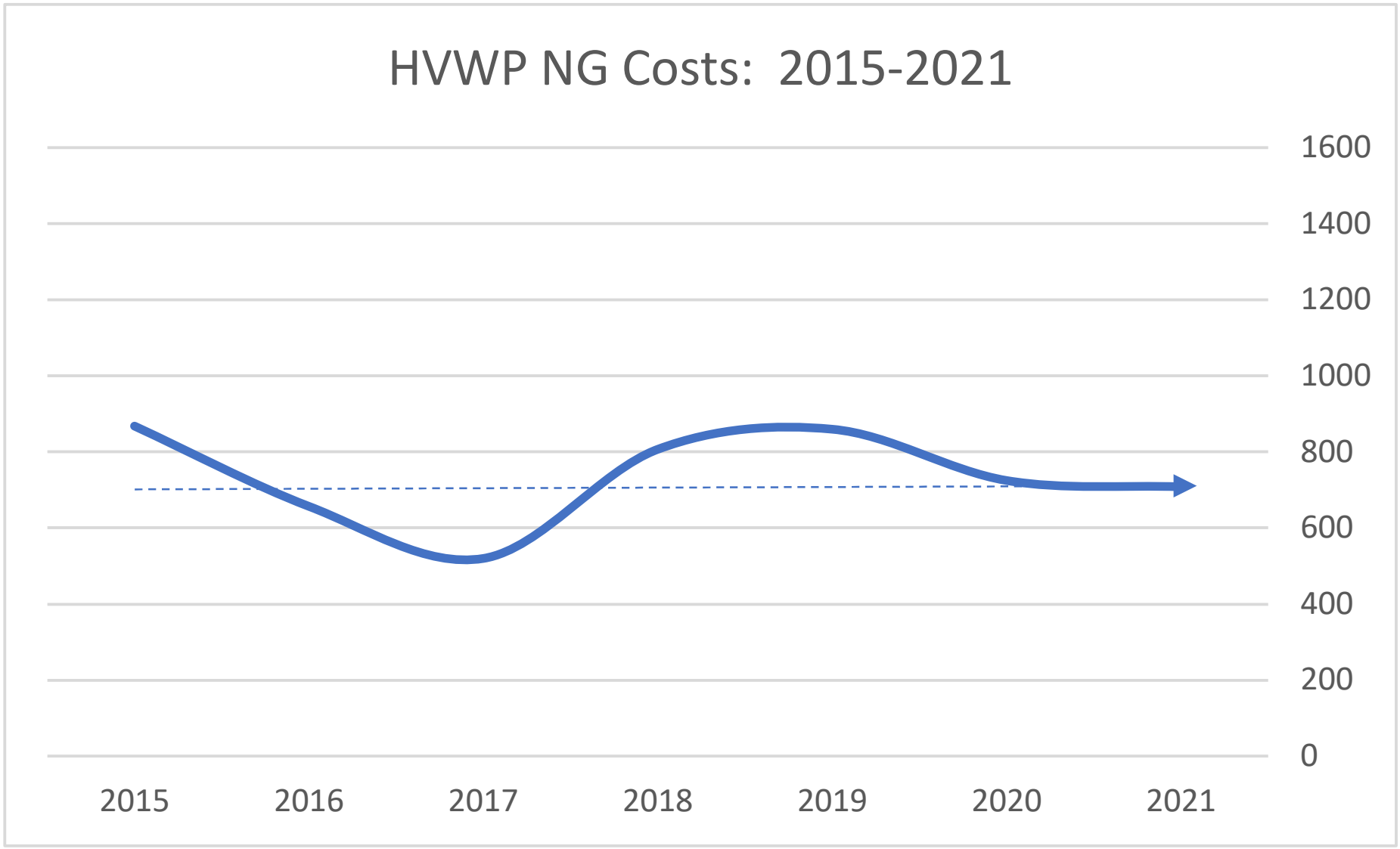
YEAR	NORTH (kWh)	SOUTH (kWh)	EAST (kWh)	BOOSTER (kWh)	MANOR (kWh)	QUARRY (KWh)	THOMPSON (kWh	OFFICE (kWh)	TOTAL (kWh)	MG*	kWh/MG
2019	67938	52763	75969	53400	4065	--	903	8393	263431	117.2	2248
2020	60328	58750	74501	61020	4255	--	725	8387	267966	128.6	2084
2021	55118	48419	57807	53110	277	--	478	8598	223807	111.0	2016

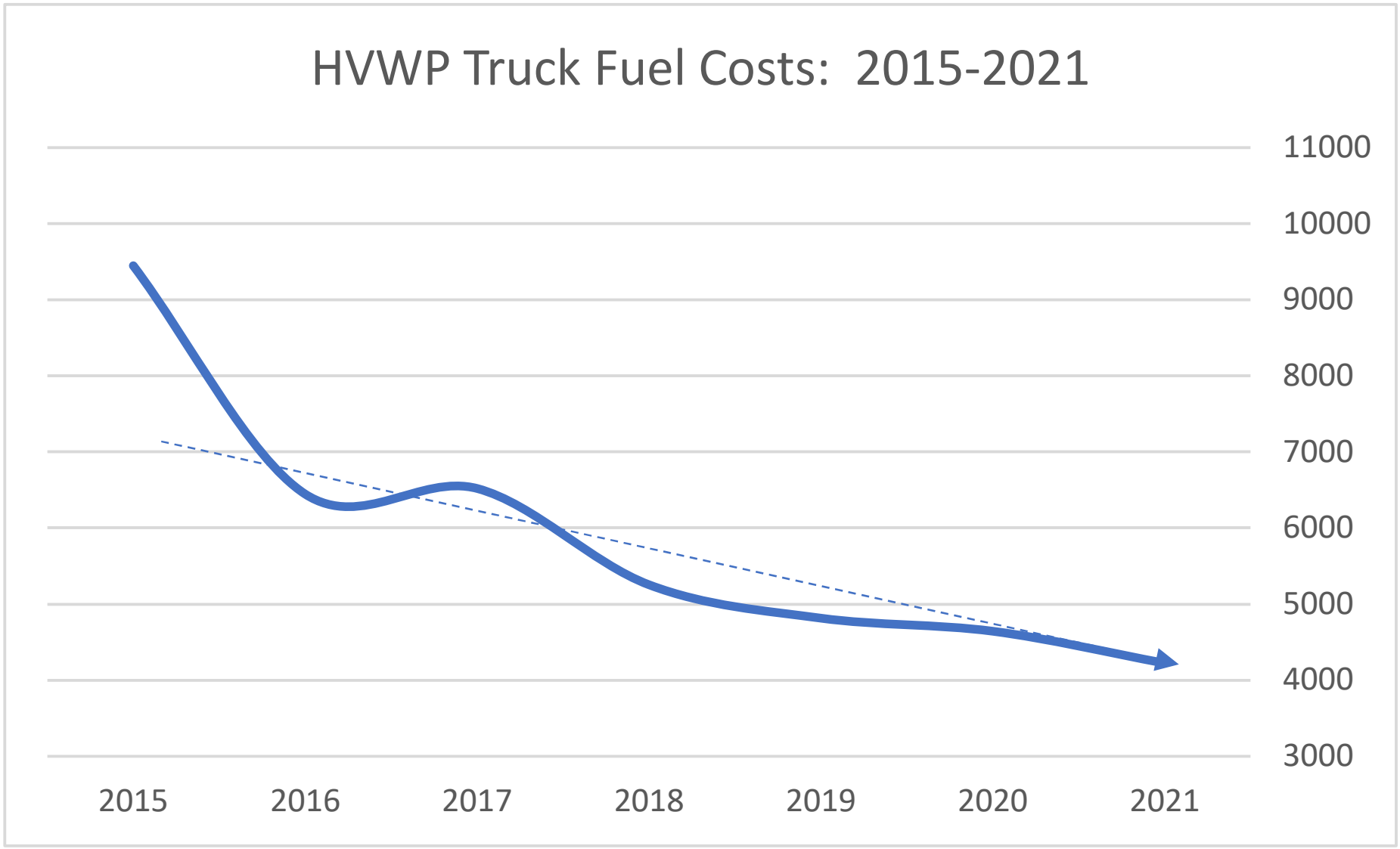
**Note: The annual total pumped from the sources (in millions of gallons, or MG) has been corrected for source meter calibration errors, if any. An uncorrected value of 121.8 MG was used in September 2020 energy audit, inadvertently resulting in an estimated annual benchmark of 2,163 kWh/MG.*


HVWP Electrical Costs: 2015-2021
80000
75000
70000
65000
60000
55000
50000
45000
40000
2015
2016
2017
2018
2019
2020
2021


HVWP Heating Oil Costs: 2015-2021
6000
5000
4000
3000
2000
1000
0
2015
2016
2017
2018
2019
2020
2021


HVWP Propane Costs: 2015-2021
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
2015
2016
2017
2018
2019
2020
2021


HVWP NG Costs: 2015-2021
1600
1400
1200
1000
800
600
400
200
0
2015
2016
2017
2018
2019
2020
2021


HVWP Truck Fuel Costs: 2015-2021
11000
10000
9000
8000
7000
6000
5000
4000
3000
2015
2016
2017
2018
2019
2020
2021

Appendix E

TATA & HOWARD





M36 WATER AUDIT REPORT (AM-111) | AUGUST 2022

Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

TATA & HOWARD

30 YEARS 1992-2022

August 23, 2022

Mr. Mike Heidorn, Superintendent
Hooksett Village Water Precinct
7 Riverside Street
Hooksett, NH 03106

Subject: M36 Water Audit (AM-111)
Hooksett Village Water Precinct
Hooksett, New Hampshire
T&H No. 6629

Dear Mike:

Tata & Howard is pleased to present this final report for the M36 Water Audit, funded through the New Hampshire Department of Environmental Services (NHDES) Public Water System Asset Management Planning Grant (AM-111).

At this time, we wish to express our appreciation to the HVWP for their participation in this audit and for their help in collecting information and data. We appreciate the opportunity to assist the HVWP on this important project. Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,

TATA & HOWARD, INC.

Jenna Rzasa, P.E.
Co-President

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Other Offices
MA | NH | CT | AZ

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SECTION 1 - EXECUTIVE SUMMARY

1.1 General

Tata & Howard, Inc. was retained by the Hooksett Village Water Precinct (HVWP) to complete a water audit of the water distribution system based on data and system information for the calendar year 2021. The project included assessing the amount of lost water using the American Water Works Association (AWWA) water audit methods. The report estimates the volume of lost water in terms of non-revenue water, identifies potential sources of lost water, and estimates system performance indicators.

1.2 Purpose of Water Audit

The purpose of a water audit is to quantify the amount of water that is being produced or supplied by a water system, but is not being delivered or billed to customers. By examining in detail how water is being used in a system, sources of lost water can be identified, and an action plan can be developed to control or reduce water losses.

Sources of lost water may include:

- Inaccurate Master Meters – This can lead a community to believe water delivered to the system from sources is greater than the actual volume delivered.
- Inaccurate Customer Meters – It is important that all service meters are properly sized and installed. A meter that is too large may not register low flows, and a meter that is too small may produce excessive drops in pressure, causing it to wear out in a short period of time.
- Unmetered Authorized Uses – These may include water used for new water and sewer main testing or flushing, firefighting, firefighting training, bleeders, and backwash waters.
- Unauthorized Uses – These include unauthorized connections and theft.
- Leakage – Underground leakage is principally caused by soil movement and corrosive soil conditions in the ground around a water main. Leakage also tends to occur in the older pipes in the system. The volume of underground leakage is usually determined by a leak detection survey.

During the preparation of this water audit, it was necessary to review and analyze the volume of water pumped from each source and total finished water supplied to the distribution system, master meter error/calibration, billed and unbilled consumption, and unauthorized consumption. To properly analyze this data, the water audit followed standard AWWA methods.

1.3 American Water Works Association – Water Audit

The AWWA *Water Audits and Loss Control Programs, Manual of Water Supply Practices - M36, Fourth Edition,* published in 2016 and revised in 2020, was used to complete the water audit. The AWWA M36 worksheets were completed using HVWP data from 2021, and are included in Appendix A.

The AWWA water audit method allows for a comprehensive quantification of both consumption and losses within the distribution system. The AWWA audit assigns a monetary value to each component of loss. The AWWA audit also determines a validity score for the data used in the audit. Besides determining the volume and cost of lost water, the AWWA audit standardizes water accounting definitions and produces a number of performance indicators, including Current Annual Real Losses (CARL), Unavoidable Annual Real Losses (UARL), and the Infrastructure Leakage Index (ILI), allowing a utility to compare its water loss performance with utilities across the nation. This approach helps to identify system components that may require further investigation and validation in future audits. Properly performing the AWWA water audit and executing the recommended loss control programs provide benefits in four key areas: water resource management, financial performance, operational performance, and system integrity. Improvements in these areas help reduce unnecessary or wasteful water withdrawals, optimize revenue recovery, reduce system interruptions, increase efficiency, increase the reliability of the system data, and reduce the potential for contamination within the distribution system.

The AWWA water audit uses a water balance calculation summarizing system inputs, consumption, and losses. There is no unaccounted-for water component with this approach. All water is considered either revenue or non-revenue water. Revenue water is that which is billed to a customer. Non-revenue water is the water supplied that is not billed, does not generate revenue, and includes unbilled metered water, unbilled unmetered water and both apparent and real water losses.

Apparent losses are losses associated with the distribution system that occur when water is successfully delivered to the customer but is not measured or recorded accurately. These losses have two major impacts on the utility. First, by under billing a customer, the utility does not collect all the revenue it is entitled to, and second, by under recording the amount of customer consumption, the utility may not be able to properly make decisions regarding the appropriate capacity of its water supply infrastructure and conservation practices. There are three components of apparent losses: customer meter inaccuracy, consumption data handling errors, and unauthorized consumption. These components are further discussed in Section 6.

Real losses are physical losses of water from the distribution system that occur because of breaks and leaks in water mains, service connection pipes, joints, and fittings. Additionally, real losses can occur because of leaks or overflows at storage facilities. Real losses have two major impacts on the utility. The first is the additional cost to treat and deliver water throughout the distribution system that does not provide any benefit to the utility or its customers. The second is the additional cost to build and maintain additional or larger capacity treatment facilities, storage facilities, and pumping facilities designed and constructed to accommodate the water that will be lost. Real losses are further discussed in Section 6.

The audit process produces a number of performance indicators including an estimate of ILI, a dimensionless indicator that tracks aspects of the management of a water utility and takes into consideration both real and apparent losses. The ILI allows water utilities to benchmark and compare their water loss control performance to other utilities, both locally and nationally.

Results and Recommendations

The AWWA water audit results (Appendix A) showed that the HVWP's non-revenue water by volume was approximately 4.733 million gallons (mg) (or 4.23%) in 2021. The associated annual cost of water lost was approximately $7,263 in 2021, based on 2021 water rates and pumping and treating costs, including the sum of the costs associated with real losses and apparent losses. The non revenue water volumes and costs observed in 2021 demonstrate the overall effectiveness of the HVWP financial and technical operations and agrees with the water balance report provided to New Hampshire Department of Environmental Services (NHDES) for 2021.

The Infrastructure Leakage Index (ILI) in 2021 was 0.1. The ILI is used as a benchmarking tool to compare leakage among different utilities. It is a ratio of Current Annual Real Losses (CARL) to the Unavoidable Annual Real Losses (UARL) and quantifies how well a water system is managed for leakage control. An ILI of less than 1.0 can be achieved in small systems of less than 3,000 service connections, validating the effectiveness of the system's leakage management controls.

The Data Validity Score given for the audit period is 79 out of 100 giving the HVWP a Data Validity Tier of IV. The Data Validity Tier is on a scale from I to V where I indicates the community must focus on improving records and V indicates the highest level of accurate record keeping. The Data Validity Score is a confidence factor for the accuracy of the water audit and associated data, and it does not have a direct effect on the various performance indicators, including ILI. A Tier IV score for the HVWP on its first AWWA audit reflects its comprehensive commitment to billing and metering excellence and is unusual for a small system in our experience.

Recommendations to reduce water losses and to further improve the Data Validity Score in future audits are presented in Section 9. The HVWP should consider annual volumetric testing on master meters at multiple flow rates and verify recorded flows from the master meters match the SCADA system. The HVWP should also continue their customer meter replacement program and begin a regular customer meter testing program.

SECTION 2 – SYSTEM DESCRIPTION AND OPERATIONS

2.1 System Description

The Precinct's water distribution system has approximately 1,198 service connections, serving a population of approximately 2,900 year round according to the New Hampshire Department of Environmental Services (NHDES). All of the customers served are metered for water consumption and billing purposes. The distribution system includes approximately 28 miles of public water main, including 4 miles of private water mains, ranging in size from two inches to 16-inches. Figure No. 2-1 displays the breakdown of water main size by diameter based on the miles of each size in the water distribution system. Approximately three percent of the system is 4-inch diameter main, 24 percent is 6-inch diameter main, 34 percent is 8-inch diameter main, one percent is 10-inch diameter main, 34 percent is 12-inch diameter main, and four percent is 16-inch diameter main.

The distribution system pipe materials include ductile iron (DI), asbestos cement (AC), copper, polyvinyl chloride (PVC), and high density polyethylene (HDPE). Approximately 18 percent of the system is DI main, 28 percent is AC main, less than one percent is copper, and 54 percent is plastic, PVC, or HDPE main.

The Precinct has four active groundwater supply sources including the North Well, East Well, South Well, and South Well Backup. The Precinct has three water storage facilities including the West (Quarry) Tank, Thompson Corner (Oak Hill) Tank, and Manor Drive Tank. The system has one high pressure service area served by the Booster Pump Station. The system also includes a water supply interconnection with the Central Hooksett Water Precinct which is for emergency service only.

2.2 Water Supply Sources

The Precinct has four groundwater sources, the North Well, located off Pine Street, the East Well, located off Ardon Drive, and South Well and South Well Backup both located off Pinnacle Street. Groundwater from each well is treated with chemical injection at each well's pump station.

North Well

North Well is a 12-inch diameter gravel packed well located off Pine Street and was constructed in 1987. The well was most recently cleaned and redeveloped in March 2020, resulting in a capacity of 18.9 gallons per minute/foot (gpm/ft) at 400 gpm following redevelopment. A new Goulds pump rated for 400 gpm at 290 feet total dynamic head (TDH) was installed at this time and the 40 horsepower (HP) motor was rehabilitated. The well is 76 feet deep and has a screen length of 15 feet. Water from the North Well is pumped to the North Well Pump Station where it is injected at the pump station with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

Figure No. 2-1
Water Main Diameter Distribution

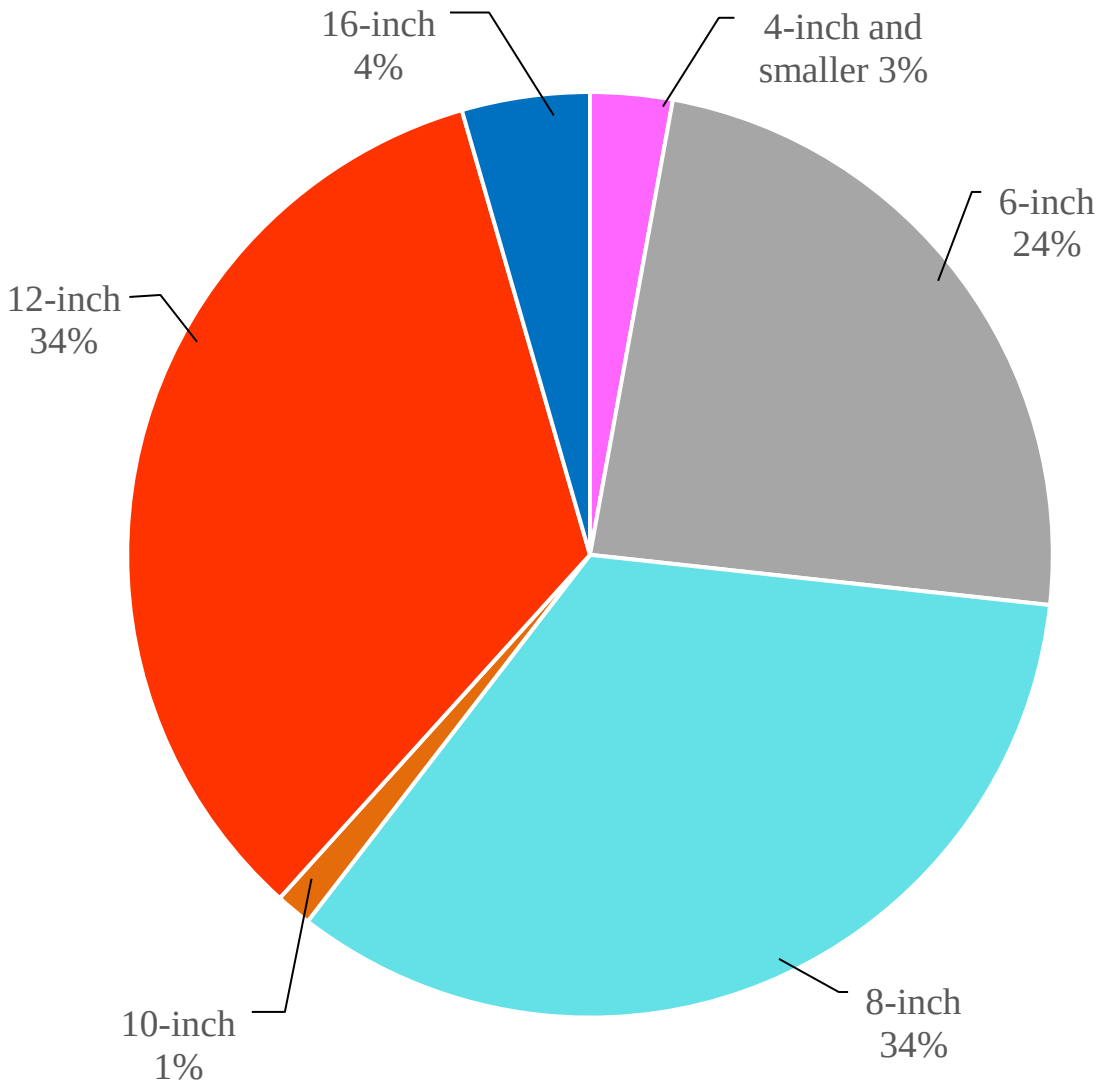
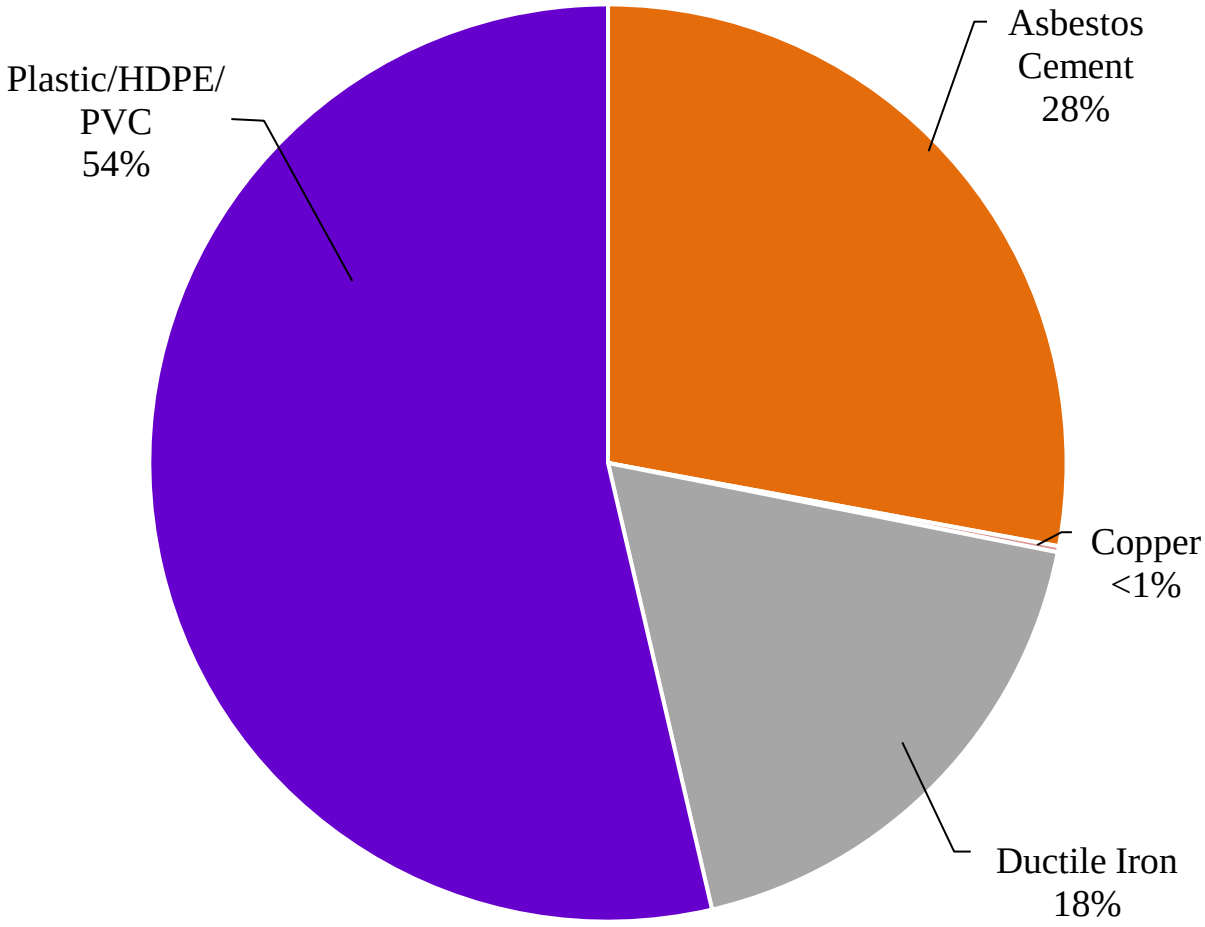


Figure No. 2-2
Water Main Material Distribution



East Well

East Well is a 12-inch diameter gravel packed well located off Ardon Drive and was constructed in 2004. The well was most recently cleaned and redeveloped in 2021, resulting in a capacity of 28 gpm/ft at 500 gpm following redevelopment. The well is 79.7 feet deep and has a screen length of 15 feet. The well has an American Marsh pump with a capacity of 400 gpm at 333 feet TDH and a 50 HP motor which were both rehabilitated in 2017. Water from the East Well is pumped to the East Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

South Well and South Well Backup

South Well is a 12-inch by 8-inch relined and gravel-packed well located off Pinnacle Street, originally constructed in 1986. The South Well Backup is a 12-inch diameter gravel-packed well in the same location and was constructed in 2003. Both wells were most recently cleaned and redeveloped in 2021, resulting in a capacity of 30.2 gpm/ft at 350 gpm for the South Well and 15.7 gpm/ft at 399 gpm for the South Well Backup following redevelopment. The South Well is 56.6 feet deep with a screen length of 12 feet. The South Well Backup is 65 feet deep with a screen length of 15 feet. Both wells have 40 HP motors. The wells operate in tandem and only one is pumped at one time. Water is pumped from both wells to the South Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

The Precinct has three water storage facilities with a total storage capacity of 2.3 million gallons.

West (Quarry) Tank

The West (Quarry) Tank is a 1.0 mg glass-fused-to-steel storage tank located off Brickyard Pond Road. The tank has an overflow elevation of approximately 435 feet above mean sea level (MSL) and an inside diameter of 58.75 feet. The height of the tank from the overflow to the base is 50 feet. The tank was constructed in 2019 by Statewide Aquastore, Inc.

Thompson Corner (Oak Hill) Tank

The Thompson Corner Tank is a 200,000-gallon welded steel storage tank located off Hooksett Road. The tank has an overflow elevation of approximately 425 feet above MSL and an inside diameter of 33 feet. The height of the tank from the overflow to the base is 30 feet. The tank was constructed in 1950 by Chicago Bridge & Iron Company and is in need of repair or replacement.

Manor Drive Tank

The Manor Drive Tank is a 1.1 mg concrete storage tank located off Manor Drive. The tank has an overflow elevation of approximately 643 feet and an inside diameter of 50 feet. The height of the tank from the overflow to the base is 75 feet. The tank was constructed in 2007 by DN Tanks. This tank serves the high service area.

2.4 Interconnections

The Precinct maintains one emergency water supply interconnection with the Central Hooksett Water Precinct. The interconnection is metered and is for emergency use only. The Central Hooksett Water Precinct purchases water from Manchester Water Works and is contractually

restricted by volume. Manchester Water Works provides all treatment for Central Hooksett Water Precinct, including chloramine addition. The Hooksett Village Water Precinct is currently studying the feasibility of an interconnection with the Bow Municipal Water System and a second emergency interconnection for the Main Service Area with the City of Manchester Water Works. The interconnection with the Bow system offers the possibility of both purchased and emergency water with similar chemistry and treatment, without the addition of chloramines.

Water Conservation Efforts

The HVWP is committed to promoting water conservation and educating customers. Water conservation tips are readily available on the HVWP's website and pamphlets are mailed as bill stuffers. The HVWP strives to operate all facilities cost effectively and conservatively. To promote water conservation, the HVWP adjusted the tiered rate structure to increase water rates based on usage. Customers that conserve water pay at a lower rate in a lower tier than those that use a higher volume of water and pay at a higher tier.

The Hooksett Village Water Precinct implements drought response actions and water use restrictions based on water levels in the wells. A color code system is used as outlined below:

- Code Yellow – Increase water level evaluation to weekly; Direct water from Brickyard Brook to Pinnacle Pond, if possible, in accordance with the terms of the NHDES Diversion Permit.

- Code Orange – Increase water level evaluation to daily; Adjust gpm to minimize drawdown in wells; Consider implementing voluntary water use restrictions, Alternate wells, if possible.

- Code Red – Increase water level evaluation to hourly while wells are running; Implement outdoor water ban if more than one well is Code Red; Adjust gpm to further minimize drawdown in well. Interconnection use possible.

In 2021, the HVWP received the NHDES' Source Water Sustainability Award for its outstanding effort to maintain the sustainability of the Precinct's groundwater sources through asset modernization, strategic planning, and water efficiency outreach, as well as a commitment to proactive water loss control.

SECTION 3 – WATER SUPPLIED TO DISTRIBUTION SYSTEM

3.1 Sources

The HVWP has four gravel packed wells around Pinnacle Pond on the western side of Hooksett. The gravel packed wells include the North, East, South and South Backup Wells. The Permitted Production Capacity of the wells is approximately 1.872 million gallons per day (mgd) or approximately 1,300 gallons per minute (gpm).

The reported and approved volumes for each source are listed in Table No. 3-1.

Table No. 3-1
Daily Capacity Withdrawal Volumes

Name of Supply	Approved Volumes (mgd)
North Well [1]	0.72
East Well	0.576
South Well	0.576
South Well Back Up[2]	0.576
Total:	**1.872**

[1] No approved volume by New Hampshire Department of Environmental Services
[2] Only one of the two South Wells can be operated at a time.

The HVWP produced approximately 111.628 mg of finished water to supply the distribution system in 2021. The HVWP purchased approximately 0.173 mg of water from Hooksett Central Water Precinct (HCWP). The average day demand (ADD) was 0.304 mgd in 2021. The total volume of finished water produced from each source is shown in Table No. 3-2.

Table No. 3-2
Finished Water Production in 2021

Source	Finished Water Production (mg)
East Well	34.748
North Well	40.595
South Well	16.501
South Well Back Up	19.758
HCWP	0.173
Total:	**111.775**

3.2 Master Meters

The HVWP uses magnetic meters for measuring its source water production and monitors a turbine meter at the Central Hooksett Water Precinct interconnection. The North Well and East Well magnetic meters were installed in May 2020. The South Street and South Street Back Up Well magnetic meters were installed in October 2018. The master meters that were used in the system during the audit period in 2021 are summarized in Table No. 3-3.

The HVWP tests and calibrates its water master meters installed at the four sources on at least an annual basis. Third party calibration testing was completed with a reference meter in January 2021 and November 2021, each time at a single flow rate selected to coincide with the well's normal pumping rate. With the exception of one test at the North Well, all HVWP's master meter test results showed the meters measured the acceptable flow rate of +/- 1.5% accuracy. The January 2021 test results at the North Well measured the flow rate within +1.6% accuracy. The CHWP 2021 test results also measured a flow rate within +1.6% accuracy.

The master meter adjustment for the water audit is based on the finished water meter calibrations because the water audit is based on finished water entering the water distribution system.

Table No. 3-3
2021 Master Meter Data

Location	Meter Size & Type	Manufacturer	Model	Tested Accuracy*
North Well	4" Magnetic	Foxboro	9500A	1.05%
South Well	4" Magnetic	Foxboro	9500A	0.7%
South Back Up Well	4" Magnetic	Foxboro	9500A	0.4%
East Well	6" Magnetic	Foxboro	9500A	0.8%
Central Hooksett Water Precinct	6" Turbo	Badger	T2000	1.61%

*Average accuracy.

The master meter configurations at the North Well, South Well, South Well Back Up and East Well were reviewed to determine if any upstream or downstream obstructions could be affecting meter accuracy. Straight pipe distances are required to optimize meter accuracy by reducing turbulent water. Obstructions can include valves, fittings, bends, or chemical feed injections, which can alter the viscosity of the fluid through the meter and result in an inaccurate reading. Distances between the meter and the first obstruction upstream and between the meter and the first downstream fitting were calculated based on site plans of each station developed as part of the Above Ground Asset Management Grant.

The Foxboro magnetic flow meters require five pipe diameters upstream and two pipe diameters downstream for meter accuracy purposes. The Badger turbo flow meters require five pipe diameters upstream and two pipe diameters downstream for accuracy purposes. Table No. 3-4 shows the measured upstream and downstream straight pipe length at each master meter location. Based on a review of the meter settings, each of the HVWP master meters had reducers immediately upstream and downstream. CHWP has a reducer immediately downstream and a Hymax coupling located upstream. Therefore, technically speaking, the HVWP and the CHWP meters do not meet the tradition straight pipe diameter criteria as outlined in M36.

Table No. 3-4
Master Meter Upstream and Downstream Straight Pipe Summary

Meter Location	Upstream Length Required (inches)	Current Upstream Length (inches)	Downstream Length Required (inches)	Current Downstream Length (inches)
North Well	20	0* (36)	8	0* (104)
South Well	20	0* (33)	8	0* (28)
South Well Backup	20	0* (37)	8	0* (18)
East Well	30	0* (41)	12	0*(47)
Central Hooksett Water Precinct	30	10	12	0

* See reducer exclusion for magnetic meter discussed below.

All of the master meters currently measure flow within or slightly above AWWA accuracy standards, suggesting that the actual impact of the reducers on flow measurements is minimal. According to Foxboro, the magnetic meter manufacturer, reducers can be directly connected to the meters without significantly impacting pressures/velocities and calculated flows. Concentric reducers with a taper angle of 8 degrees or less are preferred. Because reducers can be effectively excluded from the straight pipe analysis, corrected upstream and downstream pipe lengths excluding reducers are shown in parentheses in Table No. 3-4 above for the HVWP magnetic meters.

3.3 SCADA System Records

Readings and measurements collected through the SCADA system may contain errors or inconsistencies affecting volumetric accounting of water use in a system. Below is a list of typical errors and inconsistencies often found in SCADA data:

- Negative values for items such as flow or tank levels,
- Zero values for items like tank levels when tanks were not empty,
- Tank levels reading higher than the tank overflow,
- Missing time periods,
- Repeat values,
- Duplicate dates and times,
- Impossible values,
- Missing data or data not recorded,
- Values in tables not matching what is shown on the SCADA screen,
- Multiple flow descriptions,
- Minor variations between data recorded by redundant PLCs,
- Values, such as flow rate, remaining constant,
- Averaging errors,
- Rounding.

The HVWP water system's functions are monitored and controlled by a SCADA system. The HVWP provided 24-hour data from the SCADA system for ten randomly selected days in 2018. The SCADA information is included in Appendix B. The SCADA information was provided in graphical format for the wells. An overall review of the SCADA information was conducted, rather than a detailed analysis. No abnormalities were determined based on the data reviewed. Therefore, no value for SCADA processing errors was included in this report.

SECTION 4 – METERED CONSUMPTION

4.1 Service Meters and Billing

According to the HVWP, 100-percent of customers served by the water distribution system are metered. The HVWP supplies water to a diverse community of residential and commercial users. Meters in the system are primarily Badger water meters and range in size from 5/8-inch to 4-inch in diameter according to a meter inventory provided by the HVWP.

The service meter records and billing information for the audit period were obtained from the 2021 and are summarized in Table No. 4-1. The total metered and billed consumption for 2021 was 106,138,000 gallons as reported by the HVWP.

Table No. 4-1
Uncorrected Total of Metered Water Usage

Service Type	Calendar Year 2021	
	# of Service Connections	Metered Volume (mg)
Residential	1,102	82.475
Commercial/Business	60	14.590
Municipal/Institutional	26	7.536
Other*	10	0
Other – Metered Hydrant Sales	-	1.537
Total:	**1,198**	**106.138**

*Inactive services

There are no unmetered accounts that are billed water use from 2021. There were three unbilled metered accounts in 2021, one at the Precinct office (7 Riverside St.) and two for unique customers that receive free water in exchange for a historical benefit to the Precinct (17 Ardon Drive and 20 Pinnacle Street). The unbilled water use is accounted for in the water audit worksheet in Appendix A.

The HVWP bills all customers on a quarterly basis during each year. Quarterly readings are collected in the months of January, April, July, and October, on or about the 10th of the month. Readings are sent to the office automatically via radio/cellular transmitters with Read Center/Beacon software customized for Badger meters. Older meters that have not been replaced (approximately 16% as of March 2022), are currently read manually by the field crew. Radio/cellular readings are downloaded directly into the billing software, Continental Utility Solutions (CUSI). Manual readings are entered into the CUSI software. The Office Manager prints the route/reading sheets with the radio/cellular readings and the route/reading sheets with the manual reads. Erratic, irregular, or missing readings are investigated by the field crew at the time of the reading or upon review of the route/reading

sheets. The Office Manager's Bill Processing and Superintendent's Bill Review Checklists, which are provided in Appendix C, are used to promote consistency and accuracy of the billing process.

Usage is measured and billed in units of gallons (gal). The water billing rates are the same for residential users and commercial customers. The HVWP charges the same administration fee per quarter to all customers regardless of service and meter type. Services with deduct meters are charged an additional $5.00 per quarter. The HVWP's 2021 water rates and service charges are shown in Table No. 4-2 and Table No. 4-3, respectively. HVWP also has service charges associated with sprinkler systems by size as shown on Table No. 4-4 and hydrant service charges as shown on Table No. 4-5. As calculated by the HVWP, the average annual residential customer bill was $447 for 2021.

Table No. 4-2
2021 Water Billing Rates

Volume of Water (gallons)	Water Rates ($/1,000 gal)
0-10,000	$4.65
10,001 – 25,000	$5.05
25,001 – 75,000	$6.60
75,001 – 150,000	$7.15
150,001 – 300,000	$7.25
300,001 -500,000	$7.35
> 500,000	$8.05

Table No. 4-3
2021 Water Service Charges

Meter Size (inches)	Charge per Quarter ($/quarter)
¾”	$66.00
1”	$92.40
1 ¼”	$105.60
1 ½”	$118.80
2”	$191.40
3”	$726.00
4”	$924.00
6”	$1,386.00
8”	$1,980.00
10”	$2,508.00

Table No. 4-4
2021 Sprinkler Service Charges

Meter Size (inches)	Charge per Quarter ($/quarter)
2”	$170.00
4”	$220.00
6”	$345.00
8”	$645.00
10”	$1,045.00

The HVWP completes a comprehensive review of its rates, charges and fees on an annual basis in conjunction with an evaluation of its capital improvement plan and preparation of its budget for the upcoming fiscal year. Over $2M in additional revenues have been generated since 2016 through this strategic planning effort and associated rate adjustments, expense reductions and fee diversification. The funds have been used to support a variety of high priority capital improvement and asset management projects, including those required or recommended by the NH Department of Environmental Services.

4.2 Metered and Unbilled Authorized Usage

There are metered and unbilled, but authorized, uses of water in a public water system including water for periodic maintenance of hydrants, source meter calibration, well development, and hydrant usage. The total metered, unbilled authorized use reported in 2021 was 3,141,679 gallons and accounts for approximately 2.8 percent of the total finished water supplied to the distribution system. A breakdown of metered and unbilled, but authorized, water uses for the audit period is provided in Table No. 4-5.

Table No. 4-5
Metered and Unbilled Authorized Uses of Water in 2021

Metered and Unbilled Authorized Water Uses	Volume (gal)
Unbilled Metered Accounts	74,000
Source Meter Calibration Testing	18,268
Hydrant/Water Main Flushing	2,384,876
Well Redevelopment/Repair Flushing	658,235
DPW Hydrant Usage	6,300
Total:	**3,141,679**

4.3 Unbilled Metered Accounts

There were three unbilled metered accounts in 2021, one at the Precinct office (7 Riverside Street) and two for unique customers that receive free water in exchange for a historical benefit to the Precinct (17 Ardon Drive and 20 Pinnacle Street). There are agreements with the unique customers provided in Appendix D.

4.4 Source Meter Calibration Testing

The HVWP calibrated their source meters in 2021. The metered amount of water used was 18,268 gallons in 2021 for calibration purposes as shown in Table No. 4-5.

4.5 Hydrant/Water Main Flushing

The HVWP flushed water mains and hydrants in the spring and fall in 2021. The metered amount of water used was 2,384,867 gallons in 2021 for flushing purposes as shown in Table No. 4-5.

4.6 Well Redevelopment/Repair Flushing

The metered amount of water used was 658,235 gallons for well redevelopment at East Well in March 2021 and well redevelopment/repairs at the South Station in December 2021 based on the information provided and as shown in Table No. 4-5.

4.7 DPW Hydrant Usage

The metered amount of water used by the Hooksett DPW for hydrant flushing was 6,300 gallons in 2021 as shown in Table No. 4-5.

SECTION 5 – UNMETERED UNBILLED AUTHORIZED CONSUMPTION

5.1 General

There are numerous unmetered and unbilled, but authorized, uses of water in a public water system including water for periodic maintenance of hydrants, fire flow tests, water main flushing programs, system bleeders, storage tank overflow and drainage, and street cleaning. The construction of new water mains may use unmetered water for testing and disinfection purposes. Unmetered water may be used by the local Fire Department for firefighting and training. Unmetered, unbilled uses of water were obtained from the HVWP for the audit year. The total unmetered authorized use reported in 2021 was 47,500 gallons accounts (approximately 0.04 percent of the total finished water supplied to the distribution system). A breakdown of unmetered and unbilled, but authorized, water uses for the audit period is provided in Table No. 5-1.

Table No. 5-1
Unmetered Authorized Uses of Water in 2021

Unmetered Authorized Water Uses	Volume (gal)
Flushing and Flow Testing	47,500
Total:	**47,500**

5.2 Flow Testing/Water Main Flushing

The HVWP estimated that 47,500 gallons of unmetered water were used in 2021 for flushing and flow testing purposes as shown in Table No. 5-1.

5.3 Street Cleaning

No water was used for street cleaning in the audit period.

5.4 Bleeders and Blow Offs

The HVWP did not release water through bleeders or blow offs in 2021 based on information provided.

5.5 Tank Overflow and Drainage

The HVWP did not discharge any water through tank overflows or drainage in 2021 based on the information provided.

SECTION 6 – SYSTEM LOSSES

6.1 Apparent Losses – Customer Meter Inaccuracy

Customer meters can be a major source of apparent losses. Under registering meters result in lost water revenue. In addition to providing information used for billing purposes, data from customer meters can be used to evaluate consumption trends, which can be used for long term planning and to evaluate water loss control and conservation programs. The three main components of meter accuracy are physical accuracy, appropriate meter size, and meter type.

The physical accuracy relates to a meter functioning properly. Past practices attributed meter inaccuracies to the age of the meters, largely due to the wearing of mechanical components within the meter. The normal life expectancy of water meters varies from 7-15 years. A study in the Journal of the AWWA determined water meter accuracy based on statistical sampling of water meter age and material. Meter accuracy degraded by 0.3 to 0.5-percent each year in service based on the results of the study, but newer model water meters may hold their accuracy better over time. Meters should be periodically tested and repaired or replaced, if necessary, to maximize accuracy. Meter testing was not conducted as part of this water audit. However, meter testing data completed/collected by the HVWP is included in this water audit. Table No. 6-1 shows the AWWA recommended testing frequency for water meters.

Meter accuracy testing for the HVWP water system was primarily provided by Badger Meters in 2021 as part of the ongoing meter replacement program. Approximately 213 new meters were installed and tested. All were within specification with an average accuracy of approximately 100%. The HVWP installed a Ford meter testing bench installed at the South Well Pump Station in December 2021. An in-house service meter testing program with the test bench was initiated in January 2022.

Table No. 6-1
AWWA Recommended Water Meter Testing Frequency

Meter Size (inches)	Type	Frequency (Years)
5/8-3/4	Positive Displacement	10
1-2	Positive Displacement	5
≥3	Compound/Turbine/Fire	1

To estimate the apparent losses due to customer metering inaccuracies, the meter testing data from Badger and other meter testing data was used. Based on the weighted average accuracy of the meter testing data and estimated from HVWP, the apparently losses due to customer metering inaccuracies in 2021 are estimated to be 0.515 mg.

In addition to water meter age, inaccuracies in service meters can be due to the size and type of the meter, water quality, and low flow conditions. Meter size should be based on

typical water usage, minimum and maximum flow rates, and the percentage of water volume that is registered within certain flow ranges. Many utilities determine meter size based on AWWA Manual M22, *Sizing of Water Service Lines and Meters*. This methodology is based on the flow requirements of all fixtures installed in a building. Sizing meters based on all fixtures may lead to meters being oversized as meters that accurately register the larger flows may not be as accurate during lower, more common flows at a customer location. Meter sizing is typically more of a concern when reviewing larger, commercial meters compared to 1-inch and smaller residential meters.

The appropriate meter type is another factor in determining the accuracy of a customer meter. Different meters are designed for different flow rates and flow patterns. A study titled, "Accuracy of In-Service Water Meters at Low and High Flow Rates," was published in 2011 and was sponsored by the Water Research Foundation and the U.S. Environmental Protection Agency (EPA). The study identifies inaccuracies based on meter type and rate of flow. Turbine meters are accurate at high flows but much less accurate at measuring lower flows. Compound meters containing a turbine and positive displacement meter are capable of measuring both high and low flows accurately, but with more mechanical parts, the compound meters require more frequent testing and maintenance. Compound meters typically drop in accuracy at certain intermediate flow rates where the changeover from the positive displacement to the turbine side meter occurs.

Another example of the need for proper meter type is having a separate meter rated for fire connections. Fire service connections will be seldom used but will have a very high flow rate when in use. Smaller meters also operate over a wide range of flows but need to be able to measure very low flow rates, including leakage inside of customers' homes. The above-mentioned study by the Water Research Foundation also noted that nutating disc meters appear to be able to register very low flows, which may be caused by small leaks at a customer location, at a much higher accuracy than other types of meters. Newer technology ultrasonic and electromagnetic meters are being used more regularly now for customer meters as well to accurately record flow rates lower than typical nutating disc or oscillating piston positive displacement water meters which were historically used for residential water meters.

The HVWP indicated the HVWP water system is 100-percent metered. The HVWP uses Badger E-series ultrasonic water meters with cellular automatic meter reading (AMR)/automatic meter information (AMI) endpoints/transmitters. Most readings are sent to the office automatically via radio/cellular transmitters with special software (Read Center/Bacon) customized for Badger meters. Older meters that need replacement are read manually by the field crew. Continental Utility Solutions, Inc. (CUSI) is the billing software used to interface with the AMR software for water usage billing purposes. All water meters are read quarterly and accounted for in terms of water usage.

The latest meter replacement program was initiated in 2016 and is scheduled to be completed in 2023. The water system currently has approximately 955 domestic meters (as of March 2022) that are equipped with the Badger E Series with cellular AMR/AMI endpoints/transmitters for reading through the mobile AMR system, which is

approximately 84 percent of the accounts in the water system. The HVWP plans to install Badger E Series meters and Orion cellular AMR/AMI endpoints on the remaining 16 percent of meter accounts currently not equipped. After all meter accounts are equipped with a Badger E-series ultrasonic meter, the HVWP intends to continue a meter replacement program based on changing older meters and meters with reading difficulties.

6.2 Apparent Losses – Systematic Data Handling Adjustments/Errors

Data handling errors are those that occur during the data transfer, billing, or archival processes and result in an incorrect accounting of the customer consumption. System wide data handling errors can result in large discrepancies for the distribution system. Table No. 6-3 illustrates ways customer consumption data may be compromised.

Table No. 6-3
Potential Data Handling Errors

Data Transfer Errors	Manual meter reading errors.
	AMI/AMR equipment failure.
	Procedural/data entry errors during meter change-outs.
Data Analysis Errors	Estimating volumes in place of meter readings.
	Customer billing adjustments given by altering actual metered consumption data.
	Customer account management errors, including accounts not activated, lost, or transferred incorrectly.
	Some customers left unmeasured or unread.
Policy and Procedure Shortcomings	Customer accounts allowed to be made non-billed.
	Adjustment policies that allow manipulation of actual customer data.
	Bureaucratic regulations or performance lapses that cause delays in permitting, metering, or billing operations.
	Organizational divisions that prevent data to be accessed by all appropriate personnel.

The HVWP bills quarterly in February, May, August, and November, for both residential and commercial users. All readings are collected the month prior to billing the customers. For example, a meter reading is collected in July and the bill is sent to the customer in August. Radio transmitter readings are pulled from Read Center and cellular endpoint readings are pulled from Beacon software and are downloaded/recorded on the appropriate Route Sheets. Route Sheets are given to the field crew so the remaining manual reads may be collected. When a manual reading takes place, the HVWP employee enters the reading into Route Sheets, and the reading is then uploaded to the billing software by the Office Manager. Completed Route Sheets are delivered to the Office Manager for input into the CUSI billing software. If no usage appears on the account or the reading looks suspect, the field crew may be asked to double check the reading or check for a vacant home/building.

The HVWP uses Continental Utility Solutions, Inc. (CUSI) billing software. After all readings are input into CUSI, the Office Manager verifies that the usage totals by Route are consistent with the reading edit lists and the billing edits lists. Upon usage verifications, the reading edit lists and the billing edit lists are given to the Superintendent along with the Route Sheets for review and spot checked for accuracy. Annotated Route Sheets, reading edit lists and billing edit lists from the Superintendent are processed. Any errors are followed up on or corrected and the lists/sheets are finalized for billing.

To identify whether a reading is high or low, exceptions reports are generated by the billing software. The exceptions reports will identify accounts that appear to be roll over accounts or if the meter reading is lower than the previous reading. A roll over account occurs when a meter reaches the highest value it can display and then the reading starts again at zero. These reports are reviewed to determine whether the readings are too high or low. The field personnel are sent out to collect a second reading and verify the meter readings for these accounts with potential high or low meter readings. An appointment is scheduled for the field personnel to access the water meter to inspect the meter. Field personnel check if there are any apparent reasons why the meter is not reading accurately. After the investigation, the account will be noted with field personnel's findings and flagged in the event the customer calls questioning the bill. If the meter is found to be reading incorrectly, it will be tested on the Ford meter testing bench at South Well Pump Station.

The billing records for 2021 do not specifically represent the 2021 water usage since the customer meter reads and associated bills do not align exactly with the calendar year. However, since most of the users are residential, no adjustment was made for the audit period. It is likely the water usage is similar year over year in residential usage. Therefore, no systematic data handling adjustments were calculated. The apparent losses due to systematic data handling adjustments were assumed to be the default rate as shown in the AWWA M36 Water Audit Reporting Worksheet in Appendix A.

6.3 Apparent Losses – Unauthorized Consumption

Unauthorized consumption usually occurs when customers or other people deliberately take water without paying for it and occurs in virtually all drinking water systems. Unauthorized consumption can occur in many ways, including:

- Illegal connections,
- Open bypasses,
- Buried or obscured meters,
- Misuse of fire hydrants and fire-fighting systems (unmetered fire lines),
- Meter tampering,
- Illegally opening intentionally closed valves or curb stops at customer service locations that have been shut off or discontinued for nonpayment,
- Illegally opening intentionally closed valves to neighboring water distribution systems designed for emergency or special use,
- Failing to notify the utility to activate a billing account after water use has been initiated.

The HVWP does not have an estimate of unauthorized water consumption. According to MVWP, isolated cases of unauthorized consumption have occurred in the past, but they are infrequent and tend to be difficult to quantify accurately. All cases of unauthorized consumption are resolved swiftly, and no cases were reported for 2021. Vigilance in billing controls, advances in metering technology, bi-annual inspections of fire lines and other routine activities reduce the likelihood of unauthorized consumption events.

AWWA suggests using a value of 0.25 percent of the finished water supplied to the system, or approximately 0.25 mg in 2021. These estimated apparent losses for unauthorized consumption have been included in AWWA M36 Water Audit Reporting Worksheet in Appendix A.

The total estimated apparent losses on the Water Audit Reporting Worksheet in Appendix A are approximately 1.015 mg in 2021.

6.4 Real Losses

The majority of real losses occur because of leakage from the pipes in the distribution system network. The HVWP works to conduct leak detection surveys on a regular basis, with the last leak detection survey conducted by the HVWP staff in December 2020 and resurveyed on March 10, 2021. The entire system was surveyed using SebaKMT Hydrolux HL5000 equipment. The leak detection survey detected one hydrant not fully closed, which was then closed, and one hydrant leaking associated with the hydrant drain, which was shut off. No estimates of flow were provided on the survey results. Additionally, two gate valves and five hydrants were flagged for further leak investigation. Based on the resurvey conducted, no leaks were identified at these locations. However, HVWP estimated leakage in the distribution system of approximately 385,000 gallons over the audit period due to a water main break that occurred and was repaired in the Pinnacle Street area in late October-early November 2021.

Real water losses occur underground and are not seen until the water either becomes visible on the surface or causes damage that can be seen at the ground surface. Leakage can be categorized into three basic types; surfacing leaks, non-surfacing leaks, and background leakage. Background leakage is leakage that occurs at very low rates of flow and is usually not considered economically worth fixing individually compared with the larger surfacing and non-surfacing leaks. Water system pressure reduction is a means of reducing background leakage where possible. Leakage within the distribution system can be caused by several different factors including inferior or defective materials, pipe breaks due to poor craftsmanship or materials, operational errors, corrosion (both external and internal), seasonal stresses, poor quality of repair work, poorly aligned fittings and appurtenances, and accidental or deliberate damage to the distribution system.

The total real losses on the Water Audit Reporting Worksheet in Appendix A are assumed to be approximately 0.530 mg in 2021. It is noted that the HVWP records regarding leak detection, water main breaks, etc. are not included in the AWWA's calculation for real losses. Per the AWWA M36 water audit process of determining water losses, the real

losses are calculated by subtracting apparent losses from the total water loss. Real losses are not based on actual water loss numbers or data recorded by the HVWP.

SECTION 7 – COST OF LOSSES

To properly assess the impact that water losses have on the HVWP water system, a value or cost must be applied to both real losses and apparent losses. The value associated with lost water demonstrates the cost to the utility for the real and apparent losses.

7.1 System Operating Costs

In general, there are two components that make up the costs needed to supply customers with water. The first component includes the costs associated with personnel salaries and benefits, water system operations and maintenance, capital costs for system improvements, technical services, supplies, equipment, insurance, and all other administrative costs that exist to sustain the drinking water supply. The second component includes the direct costs associated with pumping and treating the raw and finished water, and includes variable costs for chemical supply, fuel supply, and electrical usage.

The total annual cost of operating the water system, including all direct and non-direct costs in 2021 was approximately $1,369,191 . The direct costs associated with pumping and treating water during the audit period are summarized in Table No. 7-1, including chemical and electrical costs. There were no direct fuel costs based on typical operations by the HVWP. Based on the HVWP's operations and maintenance records, the annual direct costs to pump and treat water were $51,437, which equates to a variable production cost of approximately $465 per million gallons in 2021 based on a finished water production of 111.602 mg.

Table No. 7-1
2021 Pumping and Treating Costs

Item	2021 Expenditures
Chemical	$16,065
Electrical	$35,372
Fuel	$0
Total:	**$51,437**

7.2 Apparent Losses

Apparent losses are valued at the retail rate charged to customers, as these losses represent water that reached the customer, but was not billed to the customer. There are three components of apparent losses: customer meter inaccuracy, consumption data handling errors, and unauthorized consumption. The weighted average retail rate for water purchased in 2021 was $5.53 per 1,000 gallons. Service charges, connection fees, and other fees are disregarded since they are not dependent on the volume of water a customer uses. Apparent losses within the distribution system and their revenue value are shown in Table No. 7-2.

Table No. 7-2
Apparent Losses

Year	Apparent Losses (mg)	Estimated Apparent Lost Revenue ($)
2021	1.015	$5,535

7.3 Real Losses

Real losses are physical losses of water from the distribution system and occur because of breaks and leaks in water mains, service connection pipes, joints and fittings. Real losses are valued at their production costs. Production costs include the variable costs to extract, treat, purchase, and deliver water to the customer. The direct production costs including chemical and electrical costs were shown in Table No. 7-1 for the HVWP at $51,437, which equates to a variable production cost of $465/million gallons in 2021. Since labor costs and other indirect costs are not dependent on the volume of water produced, they are not factored into the value of real losses. The volume of calculated real losses per the AWWA M36 Water Audit Reporting Worksheet in Appendix A, including unavoidable background losses, and the associated costs are shown in Table No. 7-3.

Table No. 7-3
Real Losses

Year	Real Losses (mg)	Estimated Real Losses Cost ($)
2021	0.530	$246

SECTION 8 – WATER AUDIT RESULTS

8.1 Performance Indicator Dashboard

The AWWA recommends a suite of eight key performance indicators (KPI) as recommended by the Water Loss Control Committee (WLCC) 2020 Position on KPIs. These indicators can be used to assess the performance of the water system and are categorized as financial or operational KPIs. Table No. 8-1 provides a list of the eight performance indicators evaluated in the water audit as shown on the dashboard of the water audit spreadsheet. Percentiles on KPI gauges for each indicator come from Level 1 validated data from Water Loss Control Committee (WLCC) Reference Water Audit Dataset. While some of the AWWA performance indicators are specifically intended for use by larger water systems, the indicators may be used as a benchmark to allow the HVWP to track performance and help determine the effectiveness of improvements made to the water system. Descriptions of the purposes, uses and limitation of each indicator is found in Table No. 1 in Appendix A.

Table No. 8-1
Performance Indicators Dashboard Summary

Performance Indicator	Score/Units	Description
Financial		
Total Loss Cost Rate	Below 10th percentile ($ lost/service connection/year)	Value of apparent water loss plus real loss
Apparent Loss Cost Rate	Slightly below median percentile ($ lost/service connection/year)	Value of loss due to data errors, customers meter inaccuracies and unauthorized consumption
Real Loss Cost Rate	Below 10th percentile ($ lost/service connection/year)	Value of loss due to leakage
Operational		
Unit Total Losses	Below 10th percentile (gallon/service connection/day)	Volume of apparent plus real loss
Unit Apparent Losses	Slightly below 25th percentile (gallon/service connection/day)	Volume of loss due to data errors, customer meter inaccuracies and unauthorized consumption
Unit Real Losses	Below 10th percentile (gallon/service connection/day) (gallon/mile/day)	Volume of loss due to leakage

Performance Indicator	Score/Units	Description
Unavoidable Annual Real Losses (UARL)	9.9 mg/yr 22.7 gallons/service connection/day	The theoretical reference value for the technical low limit of leakage that can be achieved if today's best technology is successfully applied
Infrastructure Leakage Index (ILI)	0.1 (dimensionless)	Ratio of Current Annual Real Losses to Unavoidable Annual Real Losses

8.2 Performance Indicators

The AWWA M36 Water Audit Form summarizing the audit findings is included in Appendix A. The key results for the KPIs are highlighted in Table No. 8-2.

Table No. 8-2
Key Performance Indicators Results

Performance Indicator	2021 Result	Description
Financial		
Nonrevenue Water by Volume	4.23%	Volume of nonrevenue water as a percentage of the volume of water supplied
Nonrevenue Water by Cost	0.53%	Value of nonrevenue water as a percentage of annual cost of running the water system
Operational		
Apparent Losses per Service Connection	2.3	Gallons per service connection per day
Real Losses per Service Connection	1.2	Gallons per service connection per day
Current Annual Real Losses (CARL)	0.53	Estimated annual real losses (mg/year)
Unavoidable Annual Real Losses (UARL)	9.9	The theoretical reference value for the technical low limit of leakage that can be achieved if today's best technology is successfully applied (mg/year)
Infrastructure Leakage Index	0.1	Ratio of Current Annual Real Losses to Unavoidable Annual Real Losses

The two financial indicators which are useful in assessing the fiscal cost of the nonrevenue water use in the HVWP system include Nonrevenue Water by Volume and Nonrevenue Water by Cost. Nonrevenue Water by Volume allows the HVWP to track the volume of water produced that does not generate revenue. Nonrevenue water includes bleeder usage, construction projects, system maintenance, hydrant usage, water used by the HVWP at its

municipal wells and other facilities, and real and apparent losses. The Nonrevenue Water by Cost performance indicator gives a monetary value to the nonrevenue water and is expressed as a percentage of the annual costs of operating the water system. This indicator provides insight into the real cost of water used for nonrevenue purposes. Many of these uses are necessary to operate the water system; however, these indicators can be used to help determine if the water can be used more efficiently.

The operational performance indicators examine losses, both apparent and real, that occur throughout the water system. The HVWP's apparent losses are measured in gallons lost per service connection per day. The Apparent Loss indicator can be multiplied by the billing rate to identify the revenue not being earned by the HVWP from water delivered to the customer that is not accounted for properly. The Real Loss indicator measures the volume of real losses per service connection per day. This indicator can be multiplied by the direct production cost of the water to indicate costs for the HVWP to produce water that is not reaching its customers.

The UARL is a theoretical value that represents the technical low limit of leakage that can be achieved if all of today's best technology is successfully applied to the system. The UARL equation was developed by the International Water Association's Water Loss Task Force published in 2000. The calculation is based on leakage data gathered from well-maintained and well-managed systems. The UARL equation is as follows:

UARL (gallons/year) = (5.41Lm + 0.15Nc + 7.5Lc) x P x D:

Lm = length of water mains (miles)
Nc = number of service connections
Lc = total length of private pipe (miles) = Nc x average distance from curb stop to customer meter, Lp
P = average system pressure (psi)
D = number of days per year

Information to calculate the UARL was obtained from several different sources. The GIS database and hydraulic model provided the length of water mains and the number of service connections. The total length of water mains was approximately 28 miles during the audit year, and the number of service connections was 1,198. The median system pressure, 68 psi, was determined using the HVWP's hydraulic model. The average length of service connections between the curb stop and water meter, 41 feet, was an estimated value using GIS database. The UARL calculated for the HVWP water system in 2021 was 9.9 mg and is listed in Table No. 8-2.

The UARL calculation has not yet been specifically proven valid for small system with less than 3,000 service connections like HVWP as noted in M36; however, the UARL calculation was performed anyway for comparative purposes since the HVWP's size places it not far below the cut off criteria

The ILI is used as a benchmarking tool to compare leakage among different utilities. ILI is a ratio of the Current Annual Real Losses (CARL) to the UARL and quantifies how well

a water system is managed for leakage control. Lower ILI values represent systems which are well managed for leakage control. The ILI value for the audit period of 2021 is shown in Table No. 8-3 at 0.1 based on an estimated CARL value of 0.530 mg and the theoretical UARL value of 9.9 mg.

Table No. 8-3
CARL, UARL and ILI

Year	CARL (mg)	UARL (mg)	ILI
2021	0.530	9.9	0.1

According to AWWA, an ILI value of less than 1.0 can be achieved in small systems of less than 3,000 service connection if the system is consistently applying comprehensive leak management controls. As noted in Section 2, the HVWP won the New Hampshire Department of Environmental Services' (NHDES) Source Water Sustainability Award in 2021 partially as a result of its commitment to proactive water loss control.

Additional performance indicator volumes and their corresponding percentages of the total finished water volume supplied to the water system are summarized in Table No. 8-4. The UARL for HVWP in the audit period equates to 8.9%, indicating that with all current best technology applied, the HVWP could theoretically lose up to 8.9% of their water according to the M36 Water Audit and still be consistent with industry standards. This is clearly not the goal of the HVWP conservation program and the NHDES but it is an interesting result of the audit.

Table No. 8-4
Performance Indicator Results Summary

Performance Indicator	Volume (mg)	Percentage of Volume Supplied to System (%)
Apparent Losses	1.015	0.92%
Real Losses	0.530	0.48%
Total Water Losses	1.544	1.39%
Unavoidable Annual Real Losses	9.9	8.94%

8.3 Data Validity

A data validity workshop was held with the HVWP to review the Interactive Data Grading Worksheet in the Water Audit Worksheet for each function area. The data from each category is given a validity score based on the interactive data grading worksheet. Table No. 8-5 summarizes the grade for each category. The grading matrix, which explains in general how the validity score for each category is arrived at, can be found in Appendix A.

There are five tiers of data validity scores -- Tier 1 (1-25), Tier 2 (26-50), Tier 3 (51-70), Tier 4 (71-90) and Level 5 (91-100). For example, the category "volume from own sources" received a score of seven (7) because all production sources are metered and less

than ten percent of the meters were found to be outside of +/- 6% accuracy. Having SCADA calibration procedures will improve this score.

The Data Validity Score on the audit during the audit period is 79 out of 100 giving the HVWP a Data Validity Tier IV. Both the Data Validity Score and Data Validity Level do not have a direct effect on the ILI or other performance indicators. The Data Validity Score is a confidence factor for how accurate the water audit is. The Data Validity Level provides a guideline for water loss control planning. The Water Loss Control Planning Guide, which includes the Data Validity Tier, is included in Appendix A.

Table No. 8-5
Data Validity Scores

Category	Score	Reason for Score	Recommendation to Improve Score
Volume From Own Sources	7	100% of production sources are metered and less than 10% of meters are found outside of +/- 6% accuracy.	Confirm SCADA reading at time of annual master meter calibrations.
Master Meter and Supply Error Adjustment	8	Production data is logged and reviewed by the HVWP.	Regularly calibrate SCADA and source meters.
Water Imported	4		Review data from CHWP on a quarterly basis.
Water Imported Error Adjustment	9	Written agreement with system	
Water Exported	N/A		None
Billed Metered Authorized Consumption	7	All accounts have volume based billing. Good customer meter records exist with computerized billing.	Conduct annual customer meter testing.
Billed Unmetered Authorized Consumption	N/A		None
Unbilled Metered Authorized Consumption	5	HVWP has 3 water department accounts that have meters but are not billed. These meters were read at least annually during audit period.	Read unbilled metered accounts are now billed quarterly. Conduct regular auditing of unbilled metered accounts.
Unbilled Unmetered Authorized Consumption	10	Clear policies and good record keeping exist to track unbilled unmetered water. Calculations and estimates are used to quantify use.	None
Systematic Handling Data Errors	6	Policies and procedures for account activation exist and a computerized billing system is used. Periodic internal checks of billing data are conducted.	Assess policies and review data handling errors annually internally.

Table No. 8-5
Data Validity Scores

Category	Score	Reason for Score	Recommendation to Improve Score
Customer Metering Inaccuracies	8	The HVWP does not have a routine customer meter testing program. Inaccuracy volume is an estimate.	Continue with the ongoing meter replacement program and regular meter accuracy testing.
Unauthorized Consumption	6	The HVWP has no record of unauthorized consumption.	Continue to be aware of any potential unauthorized consumption and keep record of any incidents.
Length of Mains	10	Electronic record keeping exists in GIS and asset management is used to store and manage data.	None
Number of Active and Inactive Service Connections	10	Policies and procedures for account activation and overall billing operations are written and well structured. Computer information is well managed.	None
Average Length of Customer Service Line	10	A clear policy exists to define utility/customer responsibility for service connection piping. Paper records of service connections are well-maintained.	None
Average Operating Pressure	9	Well managed pressure zones, SCADA system and hydraulic model exist to determine a precise average operating pressure.	Conduct frequent model updates and deploy additional devices throughout the system.
Customer Retail Unit Cost	10	Effective water rate structure is enforced and applied reliably in billing operations. Rate is a weighted average including multiple account types.	None
Variable Production Cost	10	Reliable, electronic cost accounting system is in place with all pertinent water system operating costs tracked.	None

SECTION 9 – RECOMMENDATIONS

9.1 Recommendations

1. The HVWP master meters meet the AWWA accuracy and manufacturer installation specifications. However, the HVWP should increase the straight pipe upstream and downstream of their master meters to further improve their meter calibrations. Similar changes should be made for the CHWP interconnection master meter. The estimated cost of piping configuration changes is $1,500 per station or $7,500 if the work is completed by the HVWP staff.

2. The HVWP should begin to volumetrically test the source master meters annually over multiple flow rates to confirm accuracy of all flows and verify recorded flows from the master meters match the SCADA system. The estimated cost to annually volumetrically test the meters is approximately $8,000.

3. The HVWP should begin to volumetrically test all metered interconnections that could be utilized during the course of a year using multiple flows to confirm accuracy of all flows and verify recorded flows from the master meters match the SCADA system. The valves at all the interconnections should be tested to ensure each are completely closed. The estimated cost to annually volumetrically test the metered interconnections is approximately $2,000.

4. The HVWP should continue with their ongoing meter replacement program and test service meters for inaccuracy.

5. Implement recommendation to further improve the data validity score as outlined in Table No. 8-5.

AWWA Free Water Audit Software v6.0

FWAS v6.0

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This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format and is not meant to take the place of a full-scale, comprehensive water audit format. Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

Table of Contents (TOC)

Start Page	The current sheet. Enter contact information and basic audit details.
Worksheet	Enter the required data on this worksheet to calculate the water balance and data grading.
Interactive Data Grading	Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.
Dashboard	Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.
Notes	Enter notes to explain how values were calculated, document data sources, and related information about data management practices.
Blank Sheet	By popular demand! A blank sheet. The world is your canvas.
Water Balance	The values entered in the Worksheet automatically populate the Water Balance.
Loss Control Planning	Use this sheet to interpret the results of the audit validity score and performance indicators.
Definitions	Use this sheet to understand the terms used in the audit process.
Service Connection Diagram	Diagrams depicting possible customer service connection line configurations.
Acknowledge-ments	Acknowledgements for development of the AWWA Free Water Audit Software v6.0.

AWWA Web Resources for Water Loss Control

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

Enter Basic Information

Name of Utility:	Hooksett Village Water Precinct
Name of Contact Person:	Michael Heidorn, P.G., Superintendent
Email:	
Telephone | Ext.:	
City/Town/Municipality:	Hooksett Village Water Precinct
State / Province:	New Hampshire (NH)
Country:	United Sates
Audit Preparation Date:	May 01 2022
Audit Year:	2021
Audit Year Label:	Calendar (Fiscal, Calendar, etc)
Audit Period Start Date:	Jan 01 2021
Audit Period End Date:	Dec 31 2021
Volume Reporting Units:	Million gallons (US)
Water System Structure:	Retail
Water Type:	Potable Water
System ID Number:	20310
Validator Name/ID:	
Validator Email:	
Estimated Total Population Served by Water Utility:	3,300

Key of Input Acronyms

In order of appearance in the Worksheet

VOS	Volume from Own Sources
VOSEA	VOS Error Adjustment
WI	Water Imported
WIEA	WI Error Adjustment
WE	Water Exported
WEEA	WE Error Adjustment
BMAC	Billed Metered Authorized Consumption
BUAC	Billed Unmetered Authorized Consumption
UMAC	Unbilled Metered Authorized Consumption
UUAC	Unbilled Unmetered Authorized Consumption
SDHE	Systematic Data Handling Errors
CMI	Customer Metering Inaccuracies
UC	Unauthorized Consumption
Lm	Length of mains
Nc	Number of service connections
Lp	Average length of (private) customer service line
AOP	Average Operating Pressure
CRUC	Customer Retail Unit Charge
VPC	Variable Production Cost

Color Key User input | Calculated | Optional default

Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

1.00%	percent	*or*	
	volume		25.000

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

0.25%	default	*or*	
	custom		75.000

Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.



After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input **7**

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources)

Limiting

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.

Water Audit Report for: Hooksett Village Water Precinct

Audit Year: 2021 | Jan 01 2021 - Dec 31 2021 | Calendar

Click 'n' to add notes

Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g						
VOS	Volume from Own Sources:	n	g	7	111.602	MG/Yr	n	g	8	volume	0.901	MG/Yr	over-registration	VOSEA
WI	Water Imported:	n	g	4	0.173	MG/Yr	n	g	9	volume	0.003	MG/Yr	over-registration	WIEA
WE	Water Exported:	n	g	n/a	0.000	MG/Yr								WEEA
	WATER SUPPLIED:				110.871	MG/Yr								

AUTHORIZED CONSUMPTION

choose entry option:

		n	g						
BMAC	Billed Metered:	n	g	7	106.138	MG/Yr			
BUAC	Billed Unmetered:	n	g	n/a	0.000	MG/Yr			
UMAC	Unbilled Metered:	n	g	5	3.142	MG/Yr			
UUAC	Unbilled Unmetered:	n	g	10	0.048	MG/Yr	custom	0.048	MG/Yr
	AUTHORIZED CONSUMPTION:				109.327	MG/Yr			

WATER LOSSES

1.544 MG/Yr

Apparent Losses

choose entry option:

		n	g							
SDHE	Systematic Data Handling Errors:	n	g	6	0.250	MG/Yr	custom	0.250	MG/Yr	
CMI	Customer Metering Inaccuracies:	n	g	8	0.515	MG/Yr	volume	0.515	MG/Yr	under-registration
UC	Unauthorized Consumption:	n	g	6	0.250	MG/Yr	custom	0.250	MG/Yr	
	Apparent Losses:				1.015	MG/Yr				

Real Losses

Real Losses: 0.530 MG/Yr

WATER LOSSES: 1.544 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 4.733 MG/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	28.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	10	1,198		(active *and* inactive)
	Service connection density:				43	conn./mile main	
	Are customer meters typically located at the curbstop/property line?				No		
Lp	Average length of (private) customer service line:	n	g	10	40.4	ft	(average distance between property line and meter)
AOP	Average Operating Pressure:	n	g	9	68.0	psi	

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	10	$5.53	$/1000 gallons (US)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	10	$464.56	$/Million gallons	$1,369,191	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier IV (71-90). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Billed Metered (BMAC)
3: Unauthorized Consumption (UC)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

2021

White = incomplete
Orange = complete
Use acronyms for navigation

Limiting criteria (see Start Page for details)

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go to input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

vos	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vos.0	Did the water utility supply any water from its own sources during the audit year?	Yes	
vos.1	What percent of own supply volume is metered?	>99%	
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume. **In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume. **Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include conversion to mA, meter transmitter or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.		
vos.2	What is the frequency of electronic calibration?	Annually	
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s), but not to tertiary device(s)	Limiting
vos.4	Is the most recent electronic calibration documentation available for review?	Yes	
vos.5	What is the frequency of in-situ flow accuracy testing?	Annually	
vos.6	Is the most recent in-situ flow accuracy testing documentation available for review?	Yes	
vos.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	At or within ±3%	
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	Yes	
vos.9	Which best describes the frequency of finished water meter readings?	Continuous	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Daily	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**7**	

go to input

Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria

go to notes

vosea	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vosea.1	Are tank levels monitored automatically & recorded daily?	Yes	
vosea.2	Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity?	No	Limiting
vosea.3	Is the annual net distribution storage change included in either the VOS input or the VOSEA input?	Yes	
vosea.4	Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit?	Yes, results are analyzed and incorporated	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**8**	

go to input

Water Imported (WI) - Data Grading Criteria

go to notes

wi	Criteria Question	Select Best-Fit Answers to All Visible Questions	
wi.0	Did the water utility import any water during the audit year?	Yes	
wi.1	What percent of water imported is metered?	>99%	
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water imported volume. **In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume. **Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include conversion to mA, meter transmitter or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.		
wi.2	What is the frequency of electronic calibration?	Annually	
wi.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are not checked, or not sure	Limiting
wi.4	Is the most recent electronic calibration documentation available?	Yes	
wi.5	What is the frequency of in-situ flow accuracy testing?	Annually	
wi.6	Is the most recent in-situ flow accuracy testing documentation available?	Yes	
wi.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	At or within ±3%	
wi.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	Yes	
wi.9	Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)?	Continuous	
wi.10	What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	More frequently than monthly, but not every day	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**4**	

go to input

Water Imported Error Adjustment (WIEA) - Data Grading Criteria

go to notes

wiea	Criteria Question	Select Best-Fit Answers to All Visible Questions	
wiea.1	Is an agreement in place between Exporting and Importing Utility for the purchase of water?	Yes, written	
wiea.2	Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement?	Yes, and stipulated frequency as annual	Limiting
wiea.3	Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit?	Yes, results are analyzed and incorporated	
wiea.4	Who has access to the import meter readings including current and archived data?	Exporting and Importing Utility	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**9**	

go to input

Water Exported (WE) - Data Grading Criteria

go to notes

we	Criteria Question	Select Best-Fit Answers to All Visible Questions
we.0	Did the water utility export any water during the audit year?	No
we.1		

For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water exported volume.
In-situ flow accuracy testing = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.
Electronic calibration = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
Secondary device can include conversion to mA, meter transmitter or similar instrumentation.
Tertiary device can include SCADA, historian or other computerized archival system.

we.2		
we.3		
we.4		
we.5		
we.6		
we.7		
we.8		
we.9		
we.10		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**n/a**

go to input

Water Exported Error Adjustment (WEEA) - Data Grading Criteria

go to notes

weea	Criteria Question	Select Best-Fit Answers to All Visible Questions
weea.1		
weea.2		
weea.3		
weea.4		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**n/a**

go to input

Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

go to notes

bmac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
bmac.0	Were any customers metered in the audit year?	Yes	
bmac.1	For billed metered accounts, what % of bills are estimated in a typical billing cycle?	5% or less	
bmac.2	How often does the utility read its customer meters? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Quarterly	Limiting
bmac.3	Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period?	No	
bmac.4	How frequently does internal review by utility staff of the BMAC volumes occur?	Every billing cycle	
bmac.5	What level of detail is examined in the internal review of BMAC volumes?	Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption	
bmac.6	When was the most recent billing data review by someone who is independent of the utility billing process?	Within last 3 years	
bmac.7	What level of detail was examined in the review by someone who is independent of the utility billing process?	Full billing database query and analysis of raw data to verify the summary consumption volumes	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**7**	

go to input

Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria

go to notes

buac	Criteria Question	Select Best-Fit Answers to All Visible Questions
buac.0	Was there any billed consumption on unmetered accounts in the audit year?	No
buac.1		
buac.2		
buac.3		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**n/a**

go to input

Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria

go to notes

umac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
umac.0	Did the water utility have any unbilled-metered consumption in the audit year?	Yes	
umac.1	Does the water utility policy articulate which accounts are exempt from billing?	Policy includes specific exemptions	
umac.2	How many unbilled metered accounts exist?	Monitored, count available	
umac.3	How often is each unbilled customer meter read? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Less than annually	Limiting
umac.4	How often are unbilled metered volumes reviewed for error?	Annually	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**5**	

go to input

Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria

go to notes

uuac	Criteria Question	Select Best-Fit Answers to All Visible Questions
uuac.0	On the Worksheet, the status of the default option is:	A system specific volume has been entered
uuac.1	How well-understood is the extent of unbilled unmetered use?	Complete inventory exists
uuac.2	Which best describes the records that are kept for events of unbilled unmetered use?	Each event is documented
uuac.3	How is the majority of unbilled unmetered use estimated?	Entirely from event-specific estimates
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

go to input

Systematic Data Handling Error (SDHE) - Data Grading Criteria

go to notes

sdhe	Criteria Question	Select Best-Fit Answers to All Visible Questions	
sdhe.0	On the Worksheet, the status of the default option is:	A system specific volume has been entered	
sdhe.1	Which best describes how the input was derived?	Extrapolated from discovered instances of erroneous unbilled consumption (that were not back-billed)	Limiting
sdhe.2	Which best describes validation performed in the billing software for multipliers (conversions between unit of meter reading and unit of billing)?	All meter multipliers have been analyzed to confirm multiplier conversion in the billing system is correct	
sdhe.3	Which best describes the policy for new service accounts to ensure there is no lapse between start of customer water usage and start of measurement/billing?	Policy is clear, and adherance in practice is consistent	
sdhe.4	Which best describes auditing that takes place on the billing process?	Detailed analysis conducted within 3 years of the audit period on stuck meters, extended estimations, & miscoded multipliers	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**6**	

go to input

Customer Metering Inaccuracies (CMI) - Data Grading Criteria

go to notes

cmi	Criteria Question	Select Best-Fit Answers to All Visible Questions	
cmi.0	Was there any metered customer usage during the audit period?	Yes	
cmi.1	Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)?	Reactive testing conducted	
cmi.2	For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)?	Recurring, within 5 years prior to audit period	Limiting
cmi.3	Which best describes what meters are included in the proactive small size customer meter testing activities?	Proactive - representative sample (for small meters)	
cmi.4	For mid and large size customer meters, which best describes the frequency of the proactive testing program?	Ongoing, conducted annually	
cmi.5	Which best describes what meters are included in the proactive mid- and large customer meter testing activities?	Proactive - all large meters are on a testing schedule	
cmi.6	Which best describes how the input was derived?	Calculated based on most recent meter accuracy tests, but not comprehensive of all meter performance	Limiting
cmi.7	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	Yes	
cmi.8	To what extent does meter replacement occur and for which meters?	Annual proactive replacement of subset of meters (i.e. by age or throughput)	
cmi.9	Which best describes the reliability of meter installation records?	Records are kept for meter installations, and they include data on installation date, type, size, and manufacturer	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**8**	

go to input

Unauthorized Consumption (UC) - Data Grading Criteria

go to notes

uc	Criteria Question	Select Best-Fit Answers to All Visible Questions	
uc.0	On the Worksheet, the status of the default option is:	A system specific volume has been entered	
uc.1	Which best describes how the input was derived?	Estimation for custom volume extrapolated from observed instances of unauthorized consumption (that were not back-billed)	Limiting
uc.2	Which best describes the extent of unauthorized consumption tracking and oversight?	All discovered events are recorded	Limiting
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**6**	

go to input

Length of Mains (Lm) - Data Grading Criteria

go to notes

Lm	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lm.1	How was the input derived?	Derived directly from Mains inventory (GIS, ledger, etc)
Lm.2	Are hydrant laterals included in the input derivation?	Yes
Lm.3	Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date?	Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually
Lm.4	Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished (i.e. in daily operations or specific validation projects)
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

go to input

Number of Service Connections (Nc) - Data Grading Criteria

go to notes

Nc	Criteria Question	Select Best-Fit Answers to All Visible Questions
Nc.1	How was the input derived?	Extracted from Services inventory (GIS, billing system, etc)
Nc.2	What is the count of services based on?	Premise based, i.e. service connection count, location ID count
Nc.3	Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered.	Yes
Nc.4	Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date?	Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually
Nc.5	Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished for the entire system (i.e. in daily operations or specific validation projects)
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

go to input

Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria

go to notes

Lp	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lp.0	Are customer meters typically located at the curbstop or property line?	No
Lp.1	How was the input derived?	Derived from full mapping and customer inventory
Lp.2	Which best describes how the Customer Service Line and Meter Locations mapping is kept up to date?	Additions or subtractions are updated in the service line and meter locations inventory, at least annually
Lp.3	Which best describes how the Customer Service Line mapping is validated to what is in the field?	Field validation is accomplished (i.e. through normal work order processes or specific validation projects)
Lp.4	Which best describes the policy to define where the utility's ownership of the service line ends, and the customer's ownership of the service line begins?	Policy is clear, and adherance in practice is consistent
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

go to input

Average Operating Pressure (AOP) - Data Grading Criteria

go to notes

aop	Criteria Question	Select Best-Fit Answers to All Visible Questions	
aop.1	Which best describes checks on the boundary integrity for the system's pressure zone(s)?	Normally-closed boundary valves between zones have been confirmed within the past 3 years to be fully closed	
aop.2	Which best describes how one-time pressure readings (i.e. from hydrants) are collected?	Collected annually during routine system flushing and/or hydrant testing	
aop.3	Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected?	At zone boundary conditions, plus some locations inside the zone(s) but not representing the full pressure profile	Limiting
aop.4	Which best describes how continuous pressure data is collected?	Year-round data collection via permanent monitoring	
aop.5	How was the input derived?	Derived from hydraulic model, where model has been field calibrated in the last 5 years	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**9**	

go to input

Customer Retail Unit Charge (CRUC) - Data Grading Criteria

go to notes

cruc	Criteria Question	Select Best-Fit Answers to All Visible Questions
cruc.0	Was any metered consumption billed on a volumetric basis in the audit period?	Yes
cruc.1	Which best describes the use and reliability of the current rate structure?	Customer bill calculations have been checked to confirm the rate structure is correctly implemented
cruc.2	Choose the option that best describes how the input was derived	A volume-weighted average of all rates was calculated
cruc.3	Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer?	No
cruc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	Yes
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

go to input

Variable Production Cost (VPC) - Data Grading Criteria

go to notes

vpc	Criteria Question	Select Best-Fit Answers to All Visible Questions
vpc.1	Choose the option that best describes how the input was derived	Multiple sources of water exist, and a volume-weighted average was calculated for all sources
vpc.2	Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following: - chemicals + power for treatment, typically applicable if the utility is producing/treating water - power for distribution, typically applicable if pumps exist in the distribution network - water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	All applicable short-run marginal costs are included
vpc.3	Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following: - water treatment residuals management, typically applicable if solids are produced from water treatment process - accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc) - payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility - accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarecity costs in water scarce areas - full cost pricing that includes all lifecycle costs and externalities (internalized or not) Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	Long-run marginal costs have been evaluated for applicability, and all applicable costs are included
vpc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	Yes
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**10**

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AWWA Free Water Audit Software: Dashboard

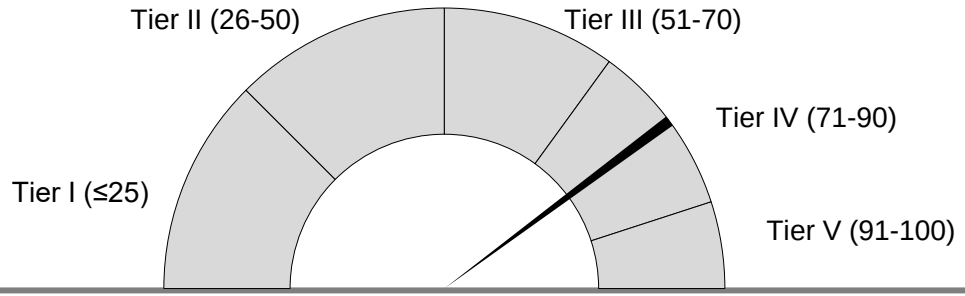
FWAS v6.0

Water Audit Report for: Hooksett Village Water Precinct **Audit Year: 2021 Calendar Jan**

Data Validity

Data Validity Score: 79 **Data Validity Tier:** Tier IV (71-90)

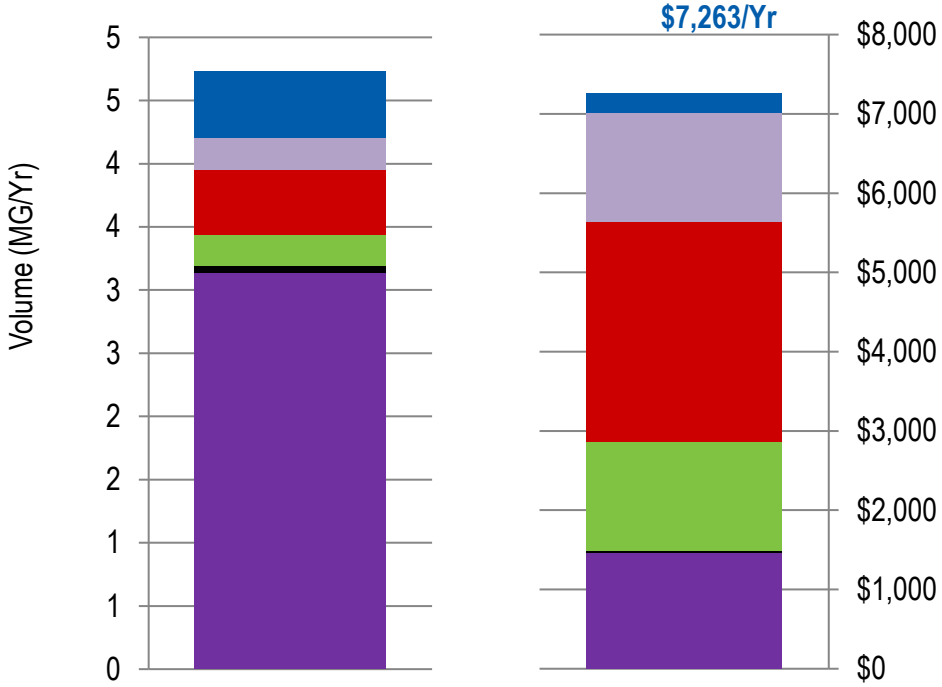
See Loss Control Planning for Tier Details



NRW Components Summary

Total Volume of NRW = 5 MG/Yr

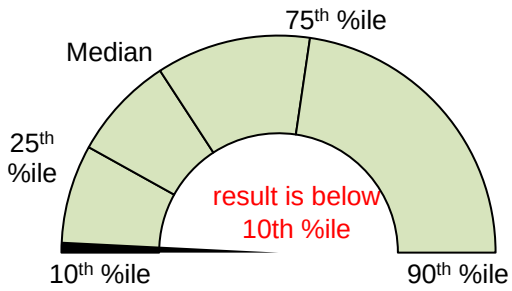
Total Cost of NRW = $7,263/Yr



Actual KPI result

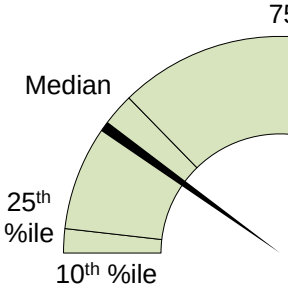
Key Performanc

gauge %iles per validat



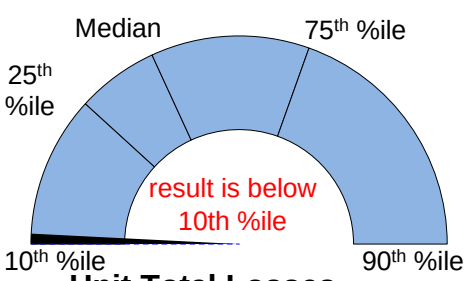
Total Loss Cost Rate

4.83 $/conn/year



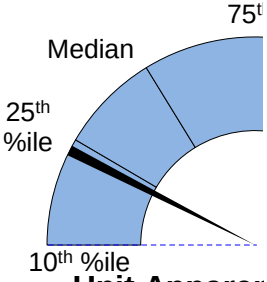
Apparent Loss

4.62



Unit Total Losses

3.5 gal/conn/day

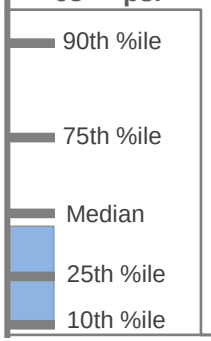


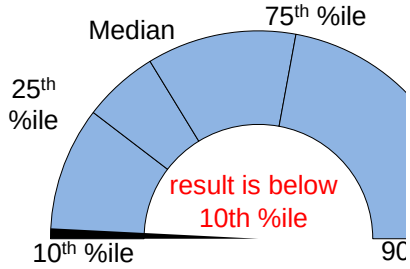
Unit Apparer

2.3

Average Operating Pressure

68 psi





Infrastructure Leakage Index

0.1 dimensionle

See UARL definition for additional guidanc

Real Losses
Systematic Data Handling Errors
Customer Metering Inaccuracies
Unauthorized Consumption
Unbilled Unmetered Auth Cons
Unbilled Metered Authorized Cons

	Volume MG/Yr	Value $/Yr	Basis of Valuation
Apparent Losses	1.0	$5,535	CRUC
Real Losses	0.5	$246	VPC
Unbilled Authorized Cons	3.2	$1,482	VPC
Non-Revenue Water	4.7	$7,263	Blended

(UARL) Unavoidable Annual Real Losses

Guidance Information fo

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)[2].
- KPI %iles shown above are not segregated by cohorts. Limited

Table 1 Source: AWWA Water Loss Contr

2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicat

Type	Indicator	Description	Suitable Purposes				
			Assessment	Bench-Marking	Target-Setting	Planning	Tracking
Attribute	Apparent Loss Volume	Calculated by Free Water Audit Software	✓				✓
	Apparent Loss Cost	Calculated by Free Water Audit Software	✓				✓
	Real Loss Volume	Calculated by Free Water Audit Software	✓				✓
	Real Loss Cost	Calculated by Free Water Audit Software	✓				✓
	Unavoidable Annual Real Loss (UARL)	Calculated by Free Water Audit Software	✓				✓
Volume	Unit Apparent Losses (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓
	Unit Real Losses[A] (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓
	Unit Real Losses[B] (vol/pipeline length/ day)	Strong and understandable indicator for use by utilities with low connection density.	✓	✓	✓	✓	✓
	Unit Total Losses (vol/conn/day) **New KPI**	Strong and understandable indicator, suitable for high-level performance measurement.	✓				✓
	Infrastructure Leakage Index (ILI)	Robust, specialized ratio KPI; can be influenced by pressure and connection density.	✓	✓			✓
Value	Apparent Loss Cost Rate (value/conn/year) **New KPI**	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓
	Real Loss Cost Rate (value/conn/year) **New KPI**		✓			✓	✓
Validity	Data Validity Tier (DVT)	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓



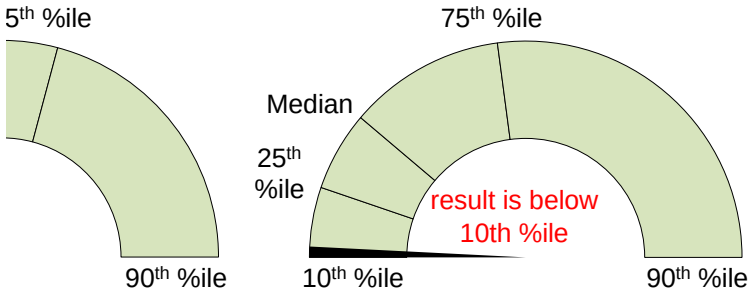
go to worksheet | go to grading | go to references

01 2021 - Dec 31 2021

ce Indicators

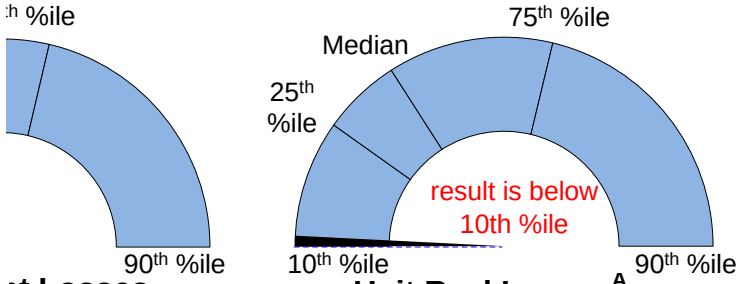
Target (see Worksheet)

ed industry ranges[2]



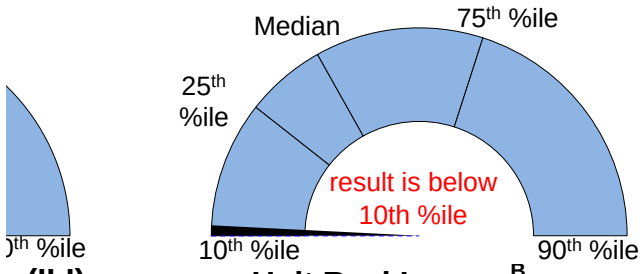
s Cost Rate
$/conn/year

Real Loss Cost Rate
0.21 $/conn/year



nt Losses
gal/conn/day

Unit Real Losses[A]
1.2 gal/conn/day



x (ILI)
ess

Unit Real Losses[B]
52 gal/mile/day

ce on the ILI

9.9	MG/Yr	22.7	gal/conn/day

or Key Performance

KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)[5].

Actual KPI results that fall below 10th %ile or above 90th %ile do not necessarily imply error, but should be viewed with scrutiny.

Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.

See UARL and ILI in Definitions tab for discussion of size and pressure limitations.

Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

rol Committee Report (2020)[1], with naming conventions updated

tors: Uses and Limitations

	Uses and Limitations	Principal Users
	Assess loss level	Utility, Regulators
	Assess cost loss level	Utility, Regulators
	Assess loss level	Utility, Regulators
	Assess loss cost level	Utility, Regulators
	Reveal theoretical technical low level of leakage	Utility, Regulators
	Used for performance tracking and target-setting	Utility, Regulators
	Used for performance tracking and target-setting	Utility, Regulators, Policy Makers
	Data collection and assessment of systems with “low” connection density	Utility, Regulators, Policy Makers
	High level indicator for trending analysis. Not appropriate for target-setting or benchmarking	Utilities, Customers
	Benchmarking after pressure management is implemented	Utilities
	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
		Utilities, Regulators, Customers
	Assess caliber of data inputs of the water audit	Regulators, Utilities



AWWA Free Water Audit Software
Water Balance



Water Audit Report for: Hooksett Village Water Precinct
Audit Year: 2021 Jan 01 2021 - Dec 31 2021
Data Validity Tier: Tier IV (71-90)

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Water Exported (WE) (corrected for known errors) *0.000*

Billed Water Exported

Revenue Water (Exported) 0.000

Volume from Own Sources (VOS) (corrected for known errors) *110.701*

Water Imported (WI) (corrected for known errors) *0.170*

System Input Volume *110.871*

Water Supplied *110.871*

Authorized Consumption *109.327*

Billed Authorized Consumption *106.138*

Billed Metered Consumption (BMAC) (water exported is removed) *106.138*

Billed Unmetered Consumption (BUAC) *0.000*

Revenue Water 106.138

Unbilled Authorized Consumption *3.189*

Unbilled Metered Consumption (UMAC) *3.142*

Unbilled Unmetered Consumption (UUAC) *0.048*

Non-Revenue Water (NRW) *4.733*

Water Losses *1.544*

Apparent Losses *1.015*

Systematic Data Handling Errors (SDHE) *0.250*

Customer Metering Inaccuracies (CMI) *0.515*

Unauthorized Consumption (UC) *0.250*

Real Losses *0.530*

Leakage on Transmission and/or Distribution Mains *Not broken down*

Leakage and Overflows at Utility's Storage Tanks *Not broken down*

Leakage on Service Connections *Not broken down*

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Water Audit Report for: Hooksett Village Water Precinct
Audit Year: 2021 Jan 01 2021 - Dec 31 2021
Data Validity Tier: Tier IV (71-90)

Water Loss Control Planning Guide

	Water Audit Data Validity Tier (Score Range)				
Functional Focus Area	**Tier I (1-25)**	**Tier II (26-50)**	**Tier III (51-70)**	**Tier IV (71-90)**	**Tier V (91-100)**
Audit Data Collection	Launch auditing and loss control team; address supply metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs; Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses	Performance Benchmarking with PIs is meaningful in comparing real loss standing	Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

AWWA Free Water Audit Software: Definitions

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Item Name	Description
Apparent Losses Find	= systematic data handling errors + customer metering inaccuracies + unauthorized consumption Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use). NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.
AUTHORIZED CONSUMPTION Find	= billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes. Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.** Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption)
View Service Connection Diagram **Average Length of (private) Customer Service Line (Lp)** Find	This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping. If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10. If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system. Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.
Average Operating Pressure (AOP) Find	This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all “nodes” in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the “nodes” are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (<32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered.
Billed Authorized Consumption	All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.

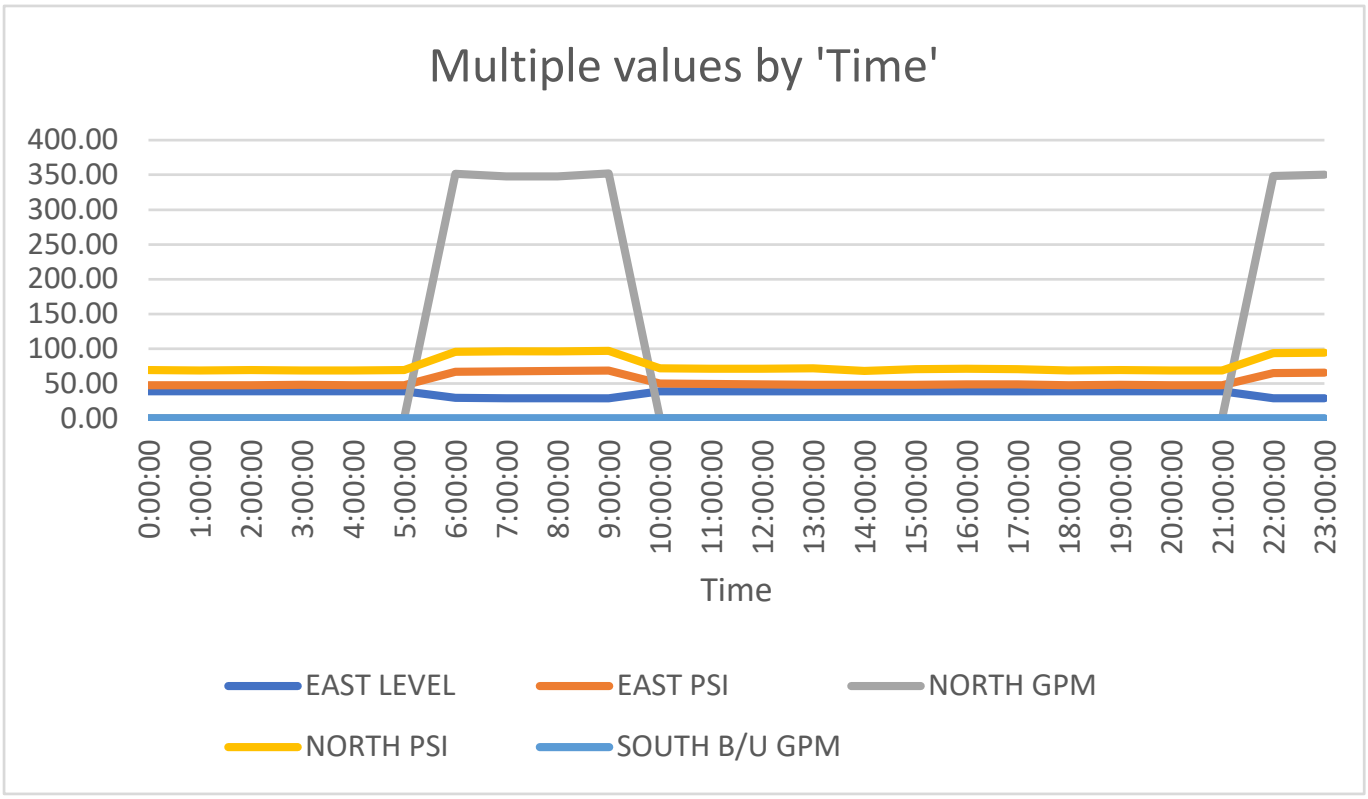
Item Name	Description
Billed Metered Authorized Consumption (BMAC) Find	All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.
Billed Unmetered Authorized Consumption (BUAC) Find	All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.**
Customer Metering Inaccuracies (CMI) Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger. The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly. Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population. The formula for caculating a volume of CMI from a percentage input is as follows: CMI volume = (BMAC+UMAC)/(1-CMI%)-(BMAC+UMAC)
Customer Retail Unit Charge (CRUC) Find	The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed. For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer. Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, $.
Infrastructure Leakage Index (ILI) Find	The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless. **NOTES ON THE UARL AND ILI:** 1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons. 2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.

Item Name	Description
Length of Mains (Lm) Find	Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as: Length of Mains, miles = (total pipeline length, miles) + [{(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile] or Length of Mains, kilometres = (total pipeline length, kilometres) + [{(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre]
NON-REVENUE WATER Find	= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.
Number of Service Connections (Nc) Find	Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, **whether active or inactive**. This may differ substantially from the number of customers (or number of accounts). **Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be included in the "Length of mains" input, and excluded from the Number of service connections input.**
Real Losses Find	Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.
Revenue Water	Those components of System Input Volume that are billed and have the potential to produce revenue.
Service Connection Density Find	=number of customer service connections / length of mains
Systematic Data Handling Errors (SDHE) Find	Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.** Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors. Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors. If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component. Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any
Total annual operating cost (optional input) Find	*This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.

Item Name	Description
Unauthorized Consumption (UC) Find	Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system.
Unavoidable Annual Real Losses (UARL) Find	The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). UARL (gallons) = (5.41Lm + 0.15Nc + 7.5Lc) x P x 365 d/year, or UARL (litres) = (18.0Lm + 0.8Nc + 25.0Lc) x P x 365 d/year where: Lm = length of mains (miles or kilometres) Nc = number of customer service connections Lp = the average length of customer service connection piping (feet or metres) (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp) Lc = total length of customer service connection piping (miles or km) Lc = Nc X Lp (miles or kilometres) P = Average operating pressure (psi or metres) (see Average Operating Pressure definition) **NOTES ON THE UARL AND ILI:** 1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons. 2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.
Unbilled Authorized Consumption	All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information.
Unbilled Metered Authorized Consumption (UMAC) Find	Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.**
Unbilled Unmetered Authorized Consumption (UUAC) Find	Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component. This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location upstream of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption. This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit. Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system.
Units and Conversions	The user may develop an audit based on one of three unit selections: 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units): Enter Units: **100** | Convert From… **Million Gallons (US)** = **Converts to…..** **306.888329** **Acre-feet**

Item Name	Description
	(conversion factor = 3.0689)
Variable Production Cost (VPC) (applied to Real Losses) Find	The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included. It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost.
Volume from Own Sources (VOS) Find	The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line suppling potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.
Volume from own sources: error adjustment Find	An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.**
Water Exported (WE) Find	The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transfering the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water. Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.**
Water Exported: Error Adjustment (WEEA) Find	An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.**
Water Imported (WI) Find	The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.
Water Imported: Error Adjustment (WIEA) Find	An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.**

Item Name	Description
Water Supplied Error Adjustments Find	**Disclaimer**: The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any. **General**: For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet. 1. **Meter error:** measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended. 2. **Data transfer error**: inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system). 3. **Net distribution storage change**: The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes. **Derivation Guidance**: If an Error Adjustment input is being calculated as a volume, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite volume to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown. If an Error Adjustment input is being calculated as a percent, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the Disclaimer. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter. 1. Meter error: If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the *meter accuracy %* may be determined as follows: $meter\ accuracy\ \% = System\ input\ meter(s)\ volume\ /\ Reference\ volume$ Then, the *meter error %* may be determined as follows: $meter\ error\ \% = meter\ accuracy\ \% - 100\%$ 2. Data transfer error: If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the *data transfer accuracy %* may be determined as follows: $data\ transfer\ accuracy\ \% = Tertiary\ device\ volume\ /\ Reference\ volume\ (typically\ at\ Secondary\ device)$ Then, the *data transfer error %* may be determined as follows: $data\ transfer\ error\ \% = data\ transfer\ accuracy\ \% - 100\%$ If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a *data transfer error %* adjustment is not typically recommended. 3. Net distribution storage change. If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable. The final step is to add *meter error %* and *data transfer error %:* $Error\ Adjustment\ \% = meter\ accuracy\ \% + data\ transfer\ error\ \%$ If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.
WATER LOSSES Find	= apparent losses + real losses = water supplied - authorized consumption Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit.


Multiple values by 'Time'
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0:00:00
1:00:00
2:00:00
3:00:00
4:00:00
5:00:00
6:00:00
7:00:00
8:00:00
9:00:00
10:00:00
11:00:00
12:00:00
13:00:00
14:00:00
15:00:00
16:00:00
17:00:00
18:00:00
19:00:00
20:00:00
21:00:00
22:00:00
23:00:00
Time
EAST LEVEL
EAST PSI
NORTH GPM
NORTH PSI
SOUTH B/U GPM

BILLING PROCEDURES POLICY

Overview: The purpose of this policy is to promote consistency, accuracy and fairness in the procedures employed by HVWP employees during routine quarterly billing.

Metering Equipment: Meters form the heart of the billing system. Meters are required to be installed for all accounts. The Precinct initiated a full-scale meter replacement program in 2016, with an anticipated minimum meter design life of 20 years. Badger E-Series ultrasonic meters with an accuracy of 1.5% +/- are currently specified; the meters include a variety of features to improve the quality of billing and responses to customer inquiries, such as reverse flow indication, rate of flow measurement, and tamper alarms. All meters are carefully installed in accordance with standard industry practices.

Meter Readings: Quarterly readings are collected in the months of January, April, July and October, on or about the 10th of the month. Readings are sent to the office automatically via radio/cellular transmitters with special software (Read Center/Beacon) customized for Badger meters. Older meters that have not been replaced yet (about 16% of total as of March 2022) are currently read manually by the field crew. The Precinct's goal is to eventually collect all readings automatically to maximize efficiency, transparency and consistency.

Review: Radio/cellular readings are downloaded directly into the billing software by the meter (Badger) software. The Office Manager prints the Route (reading) Sheets with the radio/cellular readings and the field crew collects and enters the manual readings for the Route Sheets. Erratic or irregular or missing readings are either investigated and rectified by the field crew at the time of reading or noted on the Route Sheets. Route Sheets are delivered to the Office Manager, who enters any manual readings into the billing software (CUSI). The Office Manager then processes and troubleshoots all readings as described in the *Office Manager's Bill Processing Checklist* (attached). The Office Manager produces Reading Edit Lists and Billing Edit Lists for the Superintendent's review, as described in the *Superintendent's Bill Review Checklist* (attached). The reviewed lists, with any questionable readings or billing amounts flagged for further evaluation, are provided back to the Office Manager for final processing and any necessary corrections. When the Office Manager is satisfied with the results of the review(s) and any outstanding issues are addressed (via correction of readings, scheduling of meter repair/replacement, etc.), the final bills are prepared, printed and mailed.

Follow-up: Following the mailing of the final bills, customer questions/complaints, if any, are evaluated immediately upon receipt. Customer inquiries are mostly addressed by the Office Manager, and referred to the Superintendent as needed. A reasonable attempt is made to respond to each inquiry in as timely a fashion as possible.

OFFICE MANAGER'S BILL PROCESSING CHECKLIST

- Automated meter readings are pulled over from the automated meter software (Read Center/Beacon) into the billing program (CUSI) quarterly on/about the 10th of the month in January, April, July and October. Charges are placed on customer accounts on or about the 1st of February, May, August and November, respectively. Charges are due on or about the 3rd of March, June, September and December, respectively.
- Radio transmitter readings are pulled from Read Center and cellular endpoint readings are pulled from Beacon software and are downloaded/recorded on the appropriate Route Sheets.
- Route Sheets are given to the field crew so that the remaining manual reads may be collected.
- Completed Route Sheets are delivered to the Office Manager for input to CUSI. If odd readings or no usage appears on an account, the field crew may be asked to double check the reading or check for a vacant home/building. The customer may be contacted and door tags may be placed on homes/buildings that need further investigation and/or replacement of inside meter.
- After all readings are put into CUSI, the Office Manager verifies that the usage totals by Route are consistent between the Reading Edit Lists and Billing Edit Lists. Upon usage verification, Reading Edit Lists and Billing Edit Lists are printed out and given to the Superintendent along with the Route Sheets for review and spot checked for accuracy. Annotated Route Sheets, Reading Edit Lists and Billing Edit Lists from the Superintendent are processed; any anomalies or errors are followed up on or corrected and the lists/sheets are finalized for billing.
- Copies of final Reading Edit Sheets are set aside to be given to the Hooksett Sewer Dept. so they may complete their Sewer bills.
- Upon Superintendent's approval, water bills are then printed out, placed in envelopes each with a return envelope and sorted by zip code. All "03106" zip codes are counted and recorded on a postal form to receive a presorted discount and brought to the Suncook Post Office. All others with the remaining zip codes are mailed with regular postage stamps.
- A separate Excel spreadsheet is maintained and filled in to record quarterly billing totals by route. Bills are typically closed the day after they are mailed to avoid adjustments, if necessary. The spreadsheet is compared to prior quarters and prior year to look for anomalies.
- Customer questions or complaints, if any, are reviewed and addressed immediately. If an adjustment is to be made, the Superintendent approves, signs and dates the edit made in the billing system by the Office Manager.

SUPERINTENDENT'S BILL REVIEW CHECKLIST

1. Obtain Route Sheets, Reading Edit Lists and Billing Edit Lists from Office Manager. Check Reading Edit List vs Route Sheet for transcription errors (10% ±).

2. Check Route Sheet for estimates & unusual notes. Note or flag for further investigation. Note any deduct readings that haven't been transferred to Billing Edit List.

3. Transfer notes (e.g., EST, N.O., VAC, TCU) to Billing Edit List. Check Billing Edit List for zero, unusually low and unusually high usages. Flag zero usages that are not due to hydrants, sprinklers, deducts, unused high flow compound meters @ University Heights or NO/VAC/TCU for further investigation. Flag unusually low/high readings for verification, if not due to VAC/NO/TCU (low) or irrigation (low or high, depending on the season). (EST = Estimate; N.O. = New Owner; VAC = Vacation; TCU = 'Til Caught Up)

   Typical Quarterly Usages*

Elderly or single occupant	2,000 – 5,000 ±
Single Family	5,000 – 20,000 ±
Multi Family	20,000 – 90,000 ±
Irrigation	≥ Multi family

   *May vary; for baseline comparison purposes only

4. Finalize any error corrections and estimated readings in coordination with Office Manager. Estimates are to be avoided whenever possible; metered readings are preferred. When required, estimates are calculated using a quantifiable methodology that is fair and reasonable in the judgement of the Superintendent and/or Office Manager. These methodologies may include, but are not limited to, averaging of prior quarterly readings, calculation of anticipated water usage, etc.

   In all cases, errors and estimates require the entry of a corrective volume or reading to ensure that the customer's account is as accurate and up to date as possible at all times.

5. Check current charge calculation on Billing Edit List. Spot check about 10% ± of calculations (roughly 2/page minimum). Try to do a variety of usage ranges. Note or flag anything unusual for verification or further investigation (e.g. deduct charge = 0; hydrant charges missing; basic calculation errors; etc.).

6. Return annotated Route Sheets, Reading Edit Lists and Billing Edit Lists to Office Manager.

AGREEMENT

This Agreement made this _th day of day of July 5, 2006, by and between Burleigh H. Cooper and Roberta G. Cooper, of 17 Ardon Drive, Hooksett, NH 03106, hereinafter collectively known as ("Grantor"), and Hooksett Village Water Precinct, 7 Riverside Street, Hooksett, NH 03106, hereinafter known as ("Grantee"), in consideration of the mutual covenants contained herein, and One Dollar, the receipt of which is hereby acknowledged, is made on the following terms and conditions which by signing this Agreement the parties do accept.

1. Transfer of Easement over Real Property. In consideration of the mutual covenants and agreements herein contained, Grantor and Grantee agree that Grantor shall convey an easement to Grantee for continuous access to construct and maintain a pump house to furnish water to be utilized for the completion of its statutory and organizational duties and goals.

2. Consideration. The Grantor and the Grantee agree that there shall be no monetary consideration for this transfer, but that Grantee agrees to provide water without cost to Grantor and Grantor's children and grandchildren who have a homestead on the real estate presently owned by the Grantor in the geographical area served by the Grantee, as long as said children and grandchildren live in said area. The parties agree that the Grantee shall pay the transfer tax on this transfer, should it be required.

3. Location of Easement. The Grantor shall convey the easement to Grantee to construct a pump house at such place as the Grantor and Grantee may agree. Grantor's property which is described in a deed from Paul A. Boucher and Jeannette E. Boucher recorded at B. 1133, P. 85 in the Merrimack County Registry of Deeds. If the parties can not agree, they agree that this agreement may be voided without any obligation.

4. Maintenance of Gates. Grantee agrees to construct and maintain gates to prevent unauthorized access to the pump house over the easement.

5. Grantee's Exercise of Duties. The parties agree that if the Hooksett Village Water Precinct shall cease to exist, or is no longer functioning as the party that supplies water to the area of Hooksett where the pump house is located, this agreement and the easement shall terminate, and the Grantor may prevent any further access to the pump house on Grantor's land.

IN WITNESS WHEREOF, the parties have made this Agreement as of the date indicated above.

Hooksett Water Precinct

BY: _____
Roger Hebert, Chairman

_____
Witness

_____
Witness
Leo Hebert, Commissioner

_____
Witness
Anthony F. Amato, Commissioner

_____
Witness
Raymond Pascucelli, Commissioner

_____
Witness
Michael Jache, Commissioner

_____
Witness
Burleigh H. Cooper, Individually

_____
Witness
Roberta G. Cooper, Individually

10145

Doc# 621293
Bk 2827
Pg 1590 - 1593
Filed & Recorded
10/03/2005 2:06PM
KATHI L. GUAY, CPO, REGISTER

MERRIMACK COUNTY REGISTRY OF DEEDS

RECORDING	$	22.00
SURCHARGE	$	2.00
POSTAGE	$	0.37

2237
2-

#1 R. PEPPE
PO BOX 208
PEMBROKE, NH 03275

Book 2827 Page 1590

QUITCLAIM DEED

KNOW ALL MEN BY THESE PRESENTS that Arthur James Locke, married, of Hooksett, Merrimack County, New Hampshire 03106; for consideration paid, grant to Hooksett Village Water Precinct, of 7 Riverside Street, Hooksett, Merrimack County, New Hampshire 03106,

An easement for the Sanitary Protective Radius Area, being defined as a the real estate in a circle centered on the well known as the East Well on the Real Estate of Arthur James Locke and Lorraine C. Locke, with a Radius of Four Hundred Feet (400'); said easement being over land in Hooksett New Hampshire being described as follows:

1. A certain tract or parcel of land, with buildings thereon, situated in Hooksett, bounded and described as follows: Beginning at the corner of the stone wall at the Northwest corner of Daniel S. Dutton's land, now or formerly; thence running Westerly by said Dutton's land and a highway to land of George A. Robie, now or formerly; thence Westerly by said Robie's land to Pinnacle Pond; thence Northerly by the pond to Amos Rowell's land, now or formerly; thence Easterly by said Rowell's land and now or formerly Amoskeag Mfg. Co. land to the highway; thence Southerly by the highway about four rods to land now or formerly of George A. Colby, formerly Independence Gile; thence Westerly by said Colby's land about three rods; thence Southerly by said Colby's land to an oak stump at the end of a stone wall; thence Southerly by Amoskeag Mfg. Co's land, now or formerly, to the place of beginning.

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2. Also a certain lot of land situate in Hooksett, in the County of Merrimack and State aforesaid and bounded and measuring as follows: Beginning at a point which is the Southeasterly corner of the land hereby conveyed and on the West line of the Turnpike; thence running Westerly ten hundred twenty three feet to a stake; thence Northerly two hundred fifty five feet nine inches to a stake; thence Easterly eight hundred feet to a stake; thence Southerly eighty two feet six inches to a stake; thence Easterly one hundred fifty three feet nine inches to a stake on the Westerly line of the turnpike; thence Southerly by the Westerly line of the Turnpike one hundred seventy eight feet eleven inches to the point of beginning. Said granted premises being known as lot #7 as shown on a plan of lands of the Amoskeag Mfg. Co. in the Village of Hooksett, N.H. sold by auction Jan. 29, 1880 and recorded in the Registry of Deeds for Merrimack County. Said granted premises contain about five and 54/100 acres. Subject forever to the right and privilege in said Company, its successors and assigns, to build, erect, complete and maintain its present stone dam or any other dam, to the present height of said stone dam, and to any other height or heights across Merrimack River on or near Amoskeag Falls, so called, in Manchester, and the right and privilege to place and keep flashboards thereon at any height above the top of said dam or dams at any height or heights and thereby to flow said premises, and to raise and lower the water of said river. (See MCRD Book 255, Page 544)

3. Also one other piece of land in Hooksett bounded as follows: Northerly by land now or formerly of Davis; Easterly by land now or formerly of Lawrence and the Turnpike; Southerly and Westerly by land formerly of Martha A. Carbee, or the parcel described above.

Reserving and excepting from the above described tracts land heretofore conveyed by Martha A. Carbee to Albert Colby (George A. Colby) by deed dated November 11, 1898, and recorded in Merrimack County Records at Book 333, Page 25;

And reserving and excepting from the above described tracts land heretofore conveyed by Alpheus T. Locke to Henry E. Locke by his warranty deed dated March 18, 1943 and recorded in said Registry, Book 598, Page 454.

Meaning and intending to describe the same premises as conveyed by Alpheus T. Locke to Lena C. Locke by warranty deed dated March 18, 1943, recorded in said Registry of Deeds, Book 598, Page 455, grantor having derived title to same by Will of the late Lena Carbee Locke, who died October 30, 1957 (see records at the Merrimack County Registry of Probate).

Excepting and reserving the tract conveyed by Lena C. Locke to Norman E. Bailey by deed dated January 8, 1955 and recorded in said Registry, Book 763, Page 473;

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And excepting and reserving the tract conveyed by Arthur J. Locke and Lorraine Locke, husband and wife, to the Town of Hooksett by warranty deed dated June 19, 1973 and recorded in said Registry, Book 1178, Page 412;

And excepting and reserving the slope release conveyed by Arthur James Locke to the State of New Hampshire by instrument dated March 2, 1989 and recorded in said Registry, Book 1781, Page 1100.

For reference, see Deed of Arthur James Locke dated August 16, 1989, recorded at Merrimack County Registry of Deeds, Book 1805, Page 0648, and the corrective deed of Arthur J. Locke, Sandra L. Ingalls, and Linda L. Parkin dated May 6, 2005, and recorded at B. 2775, P. 1748. Although this is my homestead, it is not my spouse's homestead as she is institutionalized and under a guardianship.

The purpose of the easement is to establish a protective area to prevent contamination of the aforementioned water supply well. Hereafter, and for so long as the well is used for a source of public water supply, the area of the above described easement shall be kept in a natural state. No used of the area shall be permitted which could directly of indirectly degrade the quality of the aforementioned well water. Uses that would be prohibited include:

Transportation corridors;
Underground utilities or structures except those that are associated with potable water, electricity or communication.
The storage, handling, transport, treatment, or disposal of the following:
Domestic or industrial wastewater; or,
Hazardous or regulated substances such as pesticides, gas and oil, and other chemicals; or
Hazardous or solid wastes; or
Fertilizers.
Any other use that the New Hampshire Department of Environmental Services determines would be detrimental to water quality.

No change in use of the area of the protective easement may be undertaken without approval from the New Hampshire Department of Environmental Services, which approval shall not be unreasonably withheld.

The grantors and their successors in interest shall retain full ownership interests in the area of the protective easement.

Transfer of Easement Over Real Property. Grantor conveys an easement to Grantee for continuous access to construct and

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maintain a well to furnish water to be utilized for the completion of its statutory organizational duties and goals.

Consideration. The Grantor and the Grantee agree that there shall be no monetary consideration for this transfer, but that Grantee agrees to provide water without cost to Grantor's children and grandchildren who have a homestead on the real estate presently owned by the Grantor in the geographical area served by the Buyer, as long as said children and grandchildren live in said area. The parties agree that the Grantee shall pay the transfer tax on this transfer.

Location of Easement. The Grantor conveys the easement to Grantee to construct a well at such place as the Grantor and Grantee have agreed.

Maintenance of Gates. Grantee agrees to construct and maintain gates to prevent unauthorized access to the well over the easement.

Grantee's Exercise of Duties. The parties agree that if the Hooksett Village Water Precinct shall cease to exist, or is no longer functioning as the party that supplies water to the location where the well is located, this agreement and the easement shall terminate, and the grantor may prevent any further access to the well on Grantor's land.

No transfer tax due. This is a conveyance to a village water precinct.

IN WITNESS WHEREOF, this instrument is executed this 29 day of SEPT, 2005.

Arthur James Locke

Arthur James Locke

STATE OF NEW HAMPSHIRE
MERRIMACK COUNTY

On this 29 day of SEPT, 2005, before me, the undersigned officer, personally appeared the above-named Arthur James Locke, known to me (or satisfactorily proven) to be the person whose names is subscribed to the within instrument and acknowledged that he executed the same for the purposes therein contained.

In witness whereof I hereunto set my hand and official seal.

Date 9/29/05

Justice of the Peace/
Notary Public RICHARD R. DEADE
MY COMMISSION EXPIRES 4/11/06.

MERRIMACK COUNTY RECORDS
Kathi L. Guay, CPO, Register

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TATA & HOWARD

OFFICE LOCATIONS:
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Appendix F

TATA & HOWARD

ASSET MANAGEMENT PLAN UPDATE

March 2021

Hooksett Village Water Precinct
Hooksett, NH

TATA & HOWARD

Asset Management Plan Update
Hooksett Village Water Precinct
Hooksett, New Hampshire

March 2021

Prepared by

TATA & HOWARD

TATA & HOWARD

March 29, 2021

Mr. Mike Heidorn, Superintendent
Hooksett Village Water Precinct
7 Riverside Street
Hooksett, NH 03106

Subject: Asset Management Plan Update
Hooksett Village Water Precinct
T&H No. 6525

Dear Mr. Heidorn:

In accordance with our agreement, Tata & Howard is pleased to present this Asset Management Plan Update for the Hooksett Village Water Precinct water distribution system. The Asset Management Plan completed by Tata & Howard in May 2020 discussed the need to develop a hydraulic model for further investigation of the system with the potential of reprioritizing those improvements recommended based solely on asset management criteria. The analysis and improvements in this report are based on the Three Circles Approach for optimum capital efficiency, which combines hydraulic and critical component considerations with an asset management rating system to evaluate the condition of the water mains in the distribution system. Supply and storage needs were also evaluated in this report.

A hydraulic model using field flow tests was developed to identify hydraulic recommendations developed as part of this study. Critical areas of the system were identified and evaluated in the hydraulic model for redundancy. Finally, the previous asset evaluation completed by Tata & Howard in May 2020 was incorporated with this new analysis. The results were combined to determine the water mains most in need of replacement and establish a prioritized set of improvements in the system. A detailed description of the improvements and estimated costs is presented in Section 7.

During the course of this project, the undersigned served as Project Officer, Mr. Yogesh Jitoo, P.E. served as Project Manager, Ms. Jenna O'Connell served as Assistant Project Engineer, and Ms. Justine Carroll, P.E. provided technical reviews.

Tata & Howard
67 Forest Street | Marlborough, MA 01752
T: 508-303-9400 | F: 508-449-9400
www.tataandhoward.com

Other Offices
MA | NH | CT | VT | AZ

At this time, we wish to express our continued appreciation to the Precinct for their participation in this study and for their help in collecting information and data. We appreciate the opportunity to assist the Precinct on this important project.

Sincerely,

TATA & HOWARD, INC.

Jenna Rzasa, P.E.
Co-President

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SECTION 1 – Executive Summary

1.1 General

Tata & Howard, Inc. was retained by the Hooksett Village Water Precinct (Precinct) to complete an Asset Management Plan Update for the Hooksett Village Water Precinct water system. The purpose of the Asset Management Plan Update is to update the existing Asset Management Plan completed in May 2020, to identify areas of the water distribution system in need of rehabilitation, repair, or replacement; and to prioritize improvements to make the most efficient use of the Precinct's capital budget. In addition to distribution system water mains, water supply and storage needs are evaluated and prioritized.

Tata & Howard evaluated the water distribution system piping using the Three Circle Approach, which consists of the following evaluation criteria:

- System hydraulic evaluation,
- Critical component assessment,
- Asset management considerations.

Each circle represents a unique set of evaluation criteria for each water main segment. From each set of criteria, system deficiencies are identified and then compared. Any deficiency that falls into more than one circle is given higher priority than one that falls into a single circle. Using the Three Circle Approach, recommended improvements will result in the most benefit to the system. In addition, the Three Circle Approach allows us to identify any situations that mitigate a deficiency in one circle and eliminate a deficiency in another circle. By integrating all three sets of criteria, the infrastructure improvement decision making process and overall capital efficiency are optimized.

1.2 Water Supply Evaluation

The existing water supply sources were evaluated relative to current and future water demands as part of a Water Supply and Usage Evaluation Assessment completed by Lewis Engineering, PLLC in May 2020. This study was used as the basis for the analysis of the Precinct's water supply. The 24-hour withdrawal volume is 1.87 million gallons per day (mgd) with a 16-hour withdrawal volume of 1.25 mgd. With a projected Maximum Day Demand (MDD) of 1.84 mgd, the Precinct currently does not have enough available supply volume to safely meet the needs of the system through 2030 with the completion of the proposed housing development in the HSA. Water supply evaluation is discussed further in Section 3.3.

1.3 Water Storage Evaluation

The projected demands calculated in the assessment completed by Lewis Engineering, PLLC and existing water distribution system operating conditions were considered by Tata & Howard to evaluate the available storage in the system. The projected 2030 required storage in the Precinct's Main Service Area (MSA) was estimated to be approximately 0.77 million gallons (mg). The total available storage is 1.20 mg for the MSA and was based on storage needed to meet peak water

demands and provide fire protection. This leaves the MSA with a surplus of 0.43 mg in storage in the MSA. Additionally, the High Service Area (HSA) has a projected available storage volume of 0.68 mg under 2030 demand conditions. The available storage in the HSA is 0.69 mg, which leaves the HSA with a storage surplus of 0.01 mg if the proposed housing development is completed. Water storage evaluation is discussed further in Section 3.4.

1.4 System Hydraulics

The Precinct had previously contracted Lewis Engineering, PLLC to conduct a Water Supply Assessment and evaluate the demand projections through 2030 based on historic pumping data and building development plans within the Precinct's service area. For consistency, the results of this assessment were used as demand projections for Tata & Howard's hydraulic analysis. These demand projections were input into the hydraulic model and simulations were run to identify the system's ability to provide adequate flows and pressures during both average day, maximum day and peak hour demands. The model runs identified multiple areas where system hydraulic deficiencies may exist. The demand projections were also used to review existing and projected water supply and water storage needs for the water system.

Hydraulic deficiencies were identified as part of a system wide evaluation to review transmission capabilities of the system, review the system's ability to provide Insurance Service Office (ISO) recommended fire flows, and eliminate dead ends and bottlenecks in the system, when possible. System hydraulics are discussed further in Section 4.

1.5 Critical Components

A critical component assessment was performed for the water distribution system to evaluate the impact of potential water main failures on the system. The critical component assessment includes identification of critical areas served, critical water mains, and the need for redundant mains. Critical areas served were identified by the Hooksett Village Water Precinct (Precinct) staff and include Precinct facilities, sewer department facilities, schools, top users, and emergency services. Critical water mains include primary transmission lines, mains connecting water storage tanks and sources to the system, mains that will cause a system demand shortfall if a break occurs, and water mains that cross rivers, streams, waterways, and railroad tracks. Critical components are discussed further in Section 5.

1.6 Asset Management

An asset management evaluation on all water mains in the water distribution system was previously completed for the Precinct as part of an Asset Management Grant awarded by the New Hampshire Department of Environmental Services (NHDES). A number of factors were considered in the rating system, including installation year, diameter, material, water quality, break history, and soil characteristics. These factors affect the decision to replace or rehabilitate a water main. Using the asset management rating approach, each water main in the system was assigned a rating based on these factors. Water mains with a total rating less than 25 are considered to be in good to excellent condition. Mains with a total rating between 25 and 44 are considered to be

in fair to good condition, and mains with a total rating of 45 or greater are considered to be in poor to fair condition. Asset management is discussed further in Section 6.

1.7 Distribution System Evaluation

Utilizing the Three Circles Approach, water main improvements were recommended and prioritized based on the aforementioned criteria. Phase I improvements generally include any recommended improvements that fall into all three circles and are hydraulically deficient, critical, and have a high asset management score. The total estimated probable construction cost of the Phase I recommended improvements is approximately $5,221,000. Phase II improvements include any recommended improvements that fall into two of the circles. The total estimated probable construction cost of the Phase II recommended improvements is approximately $1,643,000. Phase III recommendations include any recommended improvements that have a high asset management score indicating poor to fair condition. The total estimated probable construction cost of Phase III improvements is approximately $4,930,000. These water mains are identified on the Recommendations Maps in Appendix H.

Costs are based on recent bid tabulations and do not consider escalation based on an actual planned construction date for each recommended improvement. Estimated costs for each improvement include construction costs for the water main, hydrants, services, appurtenances, and temporary and permanent trench pavement. A 25 to 30-percent allowance for engineering, permitting, and contingency is included in each project's estimated cost. The standard allowance for engineering and contingency is 25-percent, but for any improvements that include a horizontal directional drill, the allowance is increased to 30-percent due to the complexities associated with these projects.

1.8 Implementation of System Improvements

The list of water main improvements included in Section 7 is extensive due to the nature of this report. The prioritization of the recommended improvements based on the Three Circle Approach serves as a guide for implementation of the infrastructure improvements with the greatest to least benefit based on the prioritization and weighted criteria established jointly by the Precinct Staff and Tata & Howard. The implementation of these improvements is intended to be completed over multiple years and will require close coordination with the Precinct's Board of Water Commissioners and evaluation of water rates to determine appropriate funding sources. Based on the recommended system improvements and the estimated probable construction costs presented in this report, it is recommended that all Phase I and II improvements, which will provide the greatest benefit to the system, be completed over a 10-year period.

SECTION 2 – System Description and Operations

2.1 System Description

The Precinct's water distribution system has approximately 1,200 service connections, serving a population of approximately 2,900 year round. All of the customers served are metered for water consumption and billing purposes. The distribution system includes approximately 28 miles of water main, including 4 miles of private water mains, ranging in size from two inches to 16-inches. Figure No. 2-1 displays the breakdown of water main size by diameter based on the miles of each size in the water distribution system. Approximately three percent of the system is 4-inch diameter main, 24 percent is 6-inch diameter main, 34 percent is 8-inch diameter main, one percent is 10-inch diameter main, 34 percent is 12-inch diameter main, and four percent is 16-inch diameter main.

The distribution system pipe materials include, ductile iron (DI), asbestos cement (AC), copper, polyvinyl chloride (PVC), and high density polyethylene (HDPE). Figure No. 2-2 displays the breakdown of water main materials based on the miles of each material in the water distribution system. Approximately 18 percent of the system is DI main, 28 percent is AC main, less than one percent is copper, and 54 percent is plastic, PVC, or HDPE main.

The Precinct has four active groundwater supply sources including the North Well, East Well, South Well, and South Well Backup. The Precinct has three water storage facilities including the West (Quarry) Tank, Thompson Corner (Oak Hill) Tank, and Manor Drive Tank. The system has one high pressure service area served by the booster pump station. The system also includes a water supply interconnection with the Central Hooksett Water Precinct which is for emergency service only. A map of the existing water distribution system is included in Appendix A.

2.2 Water Supply Sources

The Precinct has four groundwater sources, the North Well, located off Pine Street, the East Well, located off Ardon Drive, and South Well and South Well Backup both located off Pinnacle Street. Groundwater from each well is treated with chemical injection at each well's pump station.

North Well

North Well is a 12-inch diameter gravel packed well located off Pine Street and was constructed in 1987. The well was most recently cleaned and redeveloped in March 2020, resulting in a capacity of 18.9 gallons per minute/foot (gpm/ft) at 400 gpm following redevelopment. A new Goulds pump rated for 400 gpm at 290 feet total dynamic head (TDH) was installed at this time and the 40 horsepower (HP) motor was rehabilitated. The well is 76 feet deep and has a screen length of fifteen feet. Water from the North Well is pumped to the North Well Pump Station where it is injected at the pump station with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

Figure No. 2-1
Water Main Diameter Distribution

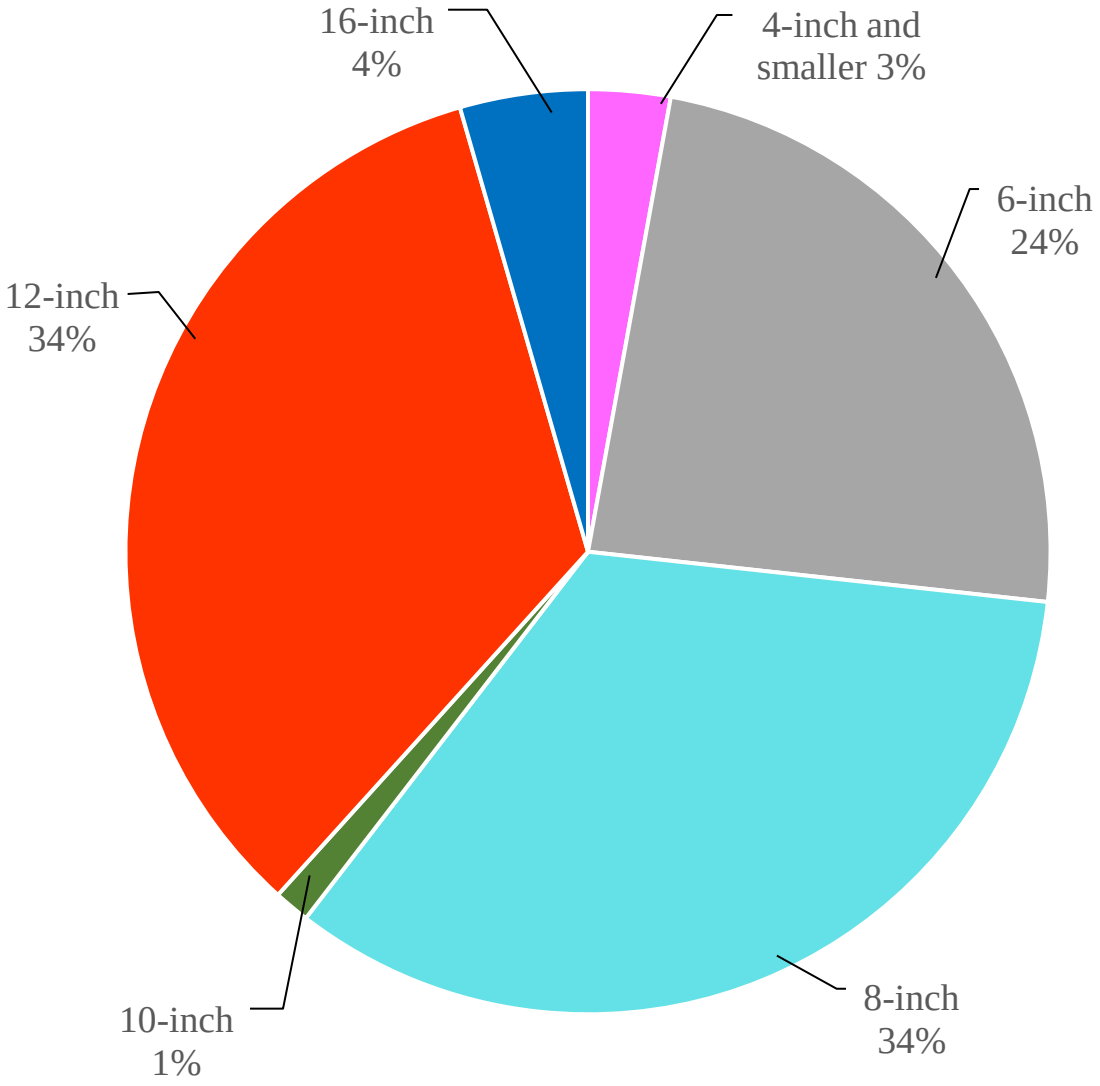
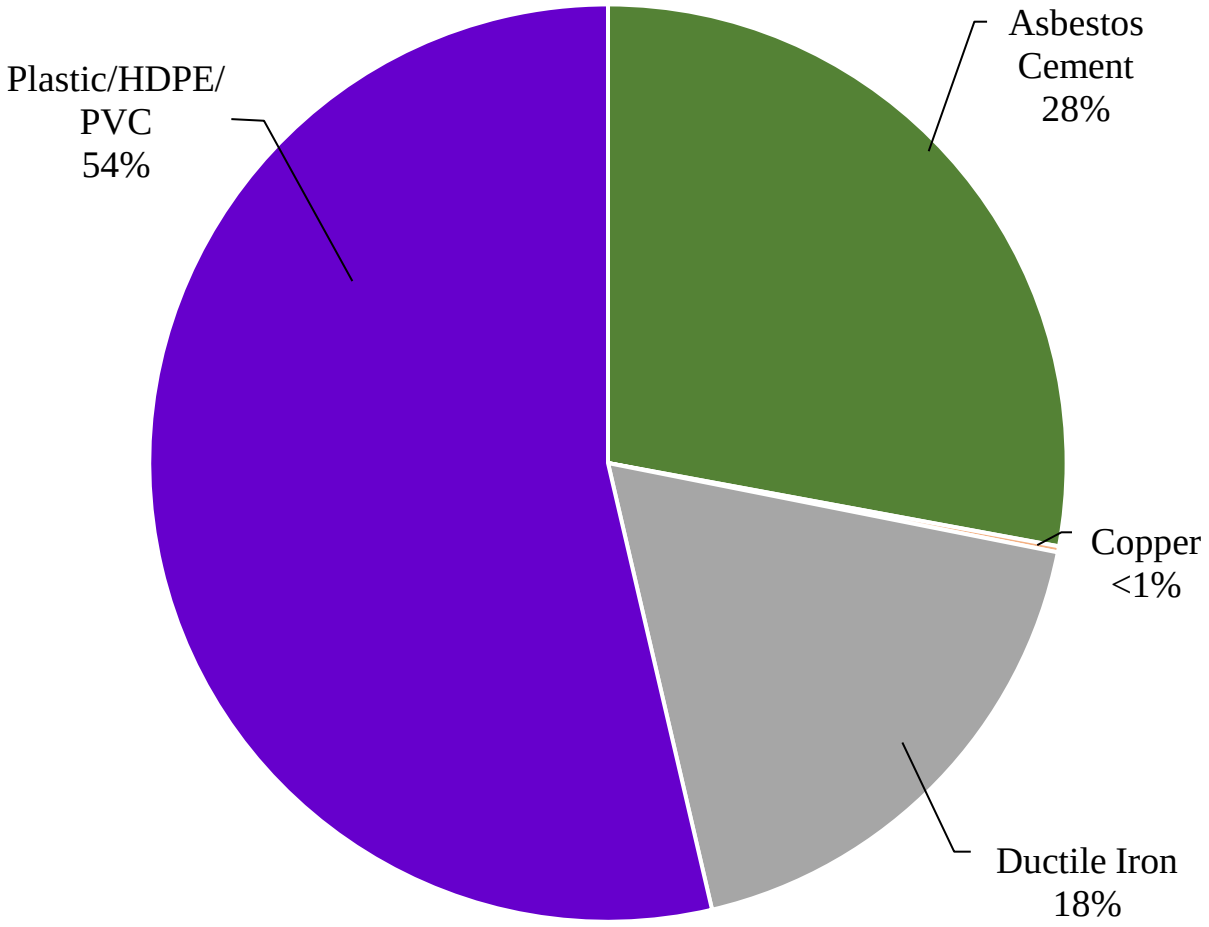


Figure No. 2-2
Water Main Material Distribution



East Well

East Well is a 12-inch diameter gravel packed well located off Ardon Drive and was constructed in 2004. The well was most recently cleaned and redeveloped in 2017, resulting in a capacity of 29 gpm/ft at 500 gpm following redevelopment. It is scheduled next for cleaning and redevelopment in 2021. The well is 79.7 feet deep and has a screen length of fifteen feet. The well has an American Marsh pump with a capacity of 400 gpm at 333 feet TDH and a 50 HP motor which were both rehabilitated in 2017. Water from the East Well is pumped to the East Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

South Well and South Well Backup

South Well is a 12-inch by 8-inch relined and gravel-packed well located off Pinnacle Street, originally constructed in 1986. The South Well Backup is a 12-inch diameter gravel-packed well in the same location and was constructed in 2003. Both wells were most recently cleaned and redeveloped in 2018, resulting in a capacity of 29.52 gpm/ft at 400 gpm for the South Well and 14.57 gpm/ft at 400 gpm for the South Well Backup following redevelopment. The South Well is 56.6 feet deep with a screen length of twelve feet. The South Well Backup is 65 feet deep with a screen length of fifteen feet. Both wells have 40 HP motors. The wells operate in tandem and only one is pumped at one time. Water is pumped from both wells to the South Well Pump Station where it is injected with Calciquest liquid for sequestering and corrosion control, sodium hypochlorite for disinfection, and soda ash for pH adjustment.

2.3 Water Storage Facilities

The Precinct has three water storage facilities with a total storage capacity of 2.3 million gallons.

West (Quarry) Tank

The West (Quarry) Tank is a 1.0 mg glass-fused-to-steel storage tank located off Brickyard Pond Road. The tank has an overflow elevation of approximately 435 feet above mean sea level (MSL) and an inside diameter of 58.75 feet. The height of the tank from the overflow to the base is 50 feet. The tank was constructed in 2019 by Statewide Aquastore, Inc.

Thompson Corner (Oak Hill) Tank

The Thompson Corner Tank is a 200,000-gallon welded steel storage tank located off Hooksett Road. The tank has an overflow elevation of approximately 425 feet above MSL and an inside diameter of 33 feet. The height of the tank from the overflow to the base is 30 feet. The tank was constructed in 1950 by Chicago Bridge & Iron Company and is in need of repair or replacement.

Manor Drive Tank

The Manor Drive Tank is a 1.1 mg concrete storage tank located off Manor Drive. The tank has an overflow elevation of approximately 643 feet and an inside diameter of 50 feet. The height of the tank from the overflow to the base is 75 feet. The tank was constructed in 2007 by DN Tanks. This tank serves the high service area.

2.4 Interconnections

The Precinct maintains one emergency water supply interconnection with the Central Hooksett Water Precinct. The interconnection is metered and is for emergency use only. The Central Hooksett Water Precinct purchases water from Manchester Water Works and is contractually restricted by volume. Manchester Water Works provides all treatment for Central Hooksett Water Precinct, including chloramine addition. The Hooksett Village Water Precinct is currently studying the feasibility of an interconnection with the Bow Municipal Water System and a second emergency interconnection for the Main Service Area with the City of Manchester Water Works. The interconnection with the Bow system offers the possibility of both purchased and emergency water with similar chemistry and treatment, without the addition of chloramines.

SECTION 3 – Water System Demands

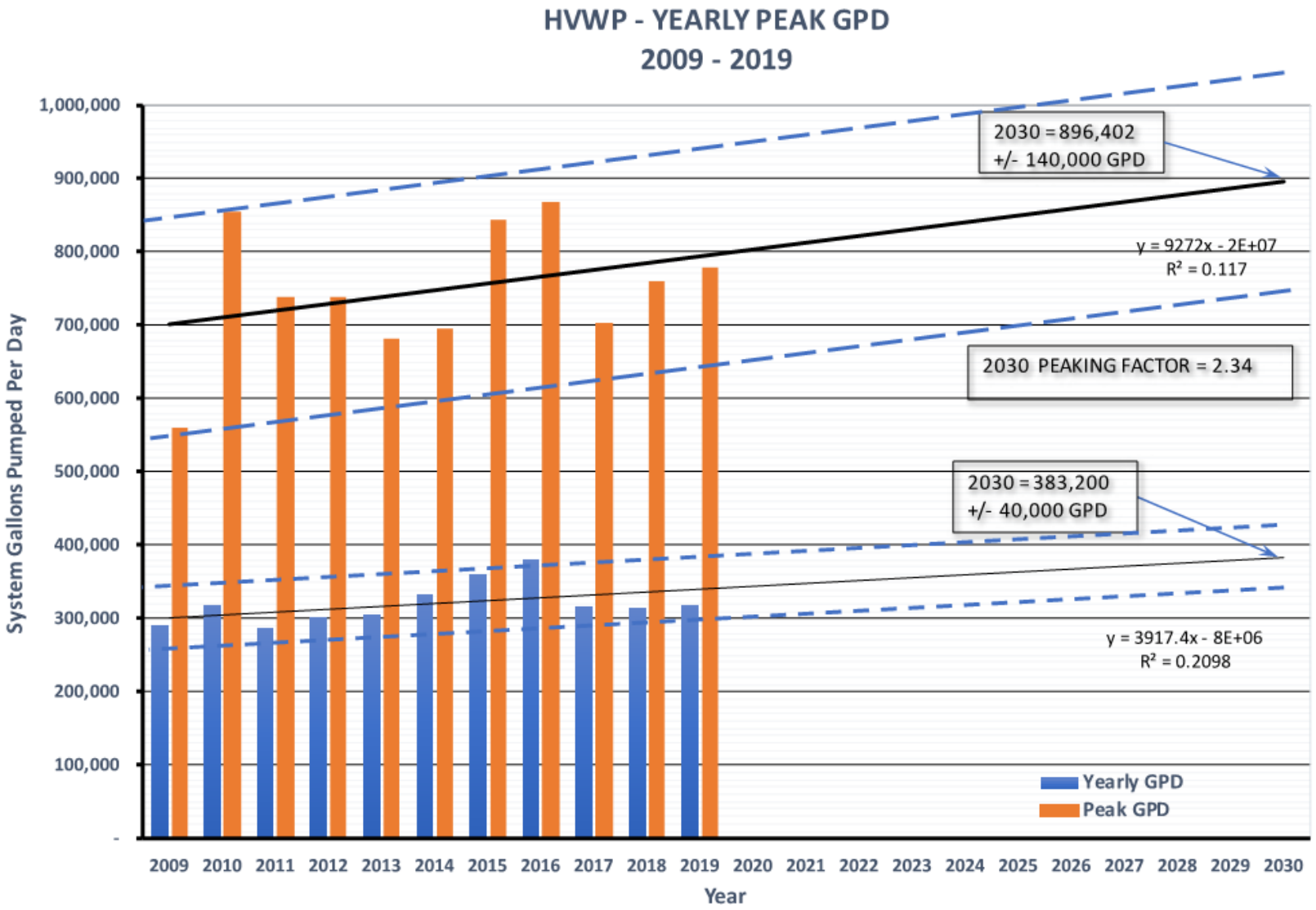
3.1 General

For the purposes of evaluating the water needs of a community, several parameters are typically reviewed to better understand the demands of a distribution system. These parameters are defined in the sections below and are presented with existing and projected demand estimates. In accordance with the NHDES and Ten State Standards, the supply sources of a water system must be capable of meeting existing and projected maximum day demand (MDD) conditions with all sources on-line and existing and projected average day demand (ADD) conditions with the largest source out of service.

3.2 Water System Demands

The Lewis Engineering Water Supply Assessment reviewed historical average daily water usage between 2009 and 2019 to determine a trend in the average daily usage. This trend was used to estimate a 2030 average day demand (ADD) of approximately 383,200 gallons per day (gpd), plus or minus 10 percent. The report also reviewed historical peak daily flows between 2009 and 2019 to estimate a 2030 maximum day demand (MDD) of approximately 896,400 gpd, plus or minus 16 percent. A housing development is slated to be built in the University Heights and Heads Pond area of Hooksett which would require an estimated additional 390,000 mgd under ADD conditions and 940,000 mgd under MDD conditions. The development was begun but construction has stalled with the recent fluctuations in the economy and the schedule for completion of this development is not currently determined. However, to be conservative in future estimates, it is assumed that this development will be completed by 2030 and these additional demands have been added into the system wide demand projections. With the development included, the projected 2030 ADD is approximately 770,000 mgd and the projected MDD is approximately 1,840,000 mgd. The Lewis Engineering Water Supply Assessment Demand Projections without the additional housing development demand are presented in Figure No. 3-1 and the Lewis Engineering report is included in Appendix B.

Figure No. 3-1
Lewis Engineering Demand Projections



Average Day Demand

Average day demand (ADD) is the total water supplied to a community in one year divided by 365 days. This term is commonly expressed in mgd. This demand includes all water used for domestic (residential), commercial, and municipal purposes. The municipal component includes water used for system maintenance such as water main flushing and fire flows. In addition, the ADD includes unaccounted-for water attributed to unmetered water uses and system leakage. According to the pumping records between 2015 and 2019, the ADD supplied for the Precinct ranged from 0.32 mgd to 0.36 mgd.

The estimated ADD for the design year 2030 based on the above criteria as determined in the Lewis Engineering Assessment and including the housing development is approximately 0.77 mgd.

Maximum Day Demand

Maximum day demand (MDD) is the maximum one-day (24-hour) total quantity of water supplied during a one-year period. This term is typically expressed in mgd.

The Lewis Engineering assessment used the historical peak day pumping rates between 2009 and 2019 to project an estimated 2030 MDD of 1.84 mgd, including demand from the housing development.

Peak Hour Demand

Peak hour demand is the maximum total quantity of water supplied in a single hour over a one-year period, typically expressed in mgd. These demands are typically met by distribution water storage facilities.

The Lewis Engineering assessment calculated a 2030 Peaking Factor of 2.34 based on the ratio of the projected 2030 ADD and MDD. The MDD/ADD ratio for a community can be used to estimate the peak hour/ADD peaking factor. Under current conditions, the MDD/ADD ratio is 0.50, with the corresponding peak hour factor for the system approximately 3.8. Using the MDD/ADD values for 2030 with the full housing development demand, the ratio is 0.40, with the corresponding peak hour factor for the system approximately 5.0.

3.3 Adequacy of Existing Water Supply Sources

The Precinct system uses four active groundwater supply sources to meet system demands. Table No. 3-2 provides the maximum withdrawal rates for each of the Precinct's supply sources. These withdrawal rates are based on reported or approved well pump capacities.

Table No. 3-1
Well Withdrawal Volumes

Source Name	Pump Capacity (gpm)	24-hour Withdrawal Rate (mgd)	16-hour Withdrawal Rate (mgd)

North Well	500	0.72	0.48
East Well	400	0.576	0.38
South Well/South Well Backup	400	0.576	0.38
Total:		**1.87**	**1.24**

Water industry guidelines recommend that a system have adequate supply to meet (1) the projected MDD with all wells online and (2) the projected ADD with the largest source offline. The projected ADD and MDD for the year 2030, including the proposed housing development, are 0.77 mgd and 1.84 mgd, respectively. The system's total combined maximum pumping rate of all active supply sources is 1.87 mgd if all wells are pumped for 24 hours. Based on the 2030 MDD of 1.84 mgd, the Precinct can meet the projected MDD only if the existing wells are pumped for 24 hours. Based on information from the Precinct, the sustainable pumping capacity is unknown and Precinct staff do not believe that the wells would be able to pump for 24 hours. If the wells were operated for 16 hours per day, the combined pumping rate is 1.24 mgd. This would result in a MDD supply deficit of 0.60 mgd. The Precinct water system would have a slight deficit of 0.01 mgd under the projected ADD of 0.77 mgd with the largest source, the North Well, offline for a combined 16 hour supply of 0.76 mgd.

The above discussion makes the basic assumption that each source is available when it is needed under the MDD/ADD scenarios described. However, the Lewis Engineering assessment points out a critical potential vulnerability in that assumption. A potential contamination incident at Pinnacle Pond, adjacent to the Interstate 93 highway and where all of the sources are located, could result in the catastrophic temporary or permanent loss of one or more of those sources. The assessment recommends the development of new wells and/or interconnections to offset this critical vulnerability. The Precinct is currently nearing completion of a joint feasibility study with the Town of Bow on a potential interconnection and has begun re-energizing its groundwater exploration program.

It is recommended that the Precinct continue these tasks, which will address the Lewis Engineering concern and help to meet the projected demands with the proposed housing development. To best address the latter, it is further recommended that the Precinct investigate the safe yield of each well to maximize existing sources. Historical test data, especially recent data that may be available for the East Well and South Well Backup, should be used to streamline the design of the safe yield investigation.

3.4 Adequacy of Existing Water Storage Facilities

Distribution storage is provided to meet peak consumer demands, such as peak hour demands, and to provide a reserve for fire-fighting purposes. Storage may also serve to provide an emergency supply in case of temporary breakdown of pumping facilities or for pressure regulation during periods of fluctuating demand. There are three components that must be considered when evaluating storage requirements. These components include equalization, fire flow requirements, and emergency storage. The three components of the storage evaluation were calculated under current and future water demand conditions for both the Main Service Area (MSA) and High Service Area (HSA). Based on 2019 pumping and usage data, on average the MSA represents

approximately 75 percent of the total demands and the HSA represents approximately 25 percent of the total demands. During peak demand periods, HSA usage approaches 39 percent of the total demand.

Equalization storage provides water from the tanks during peak hourly demands in the system. Typically, equalization storage is a percentage of the maximum day demand. The percentages can range from 15-percent to 25-percent, with 15-percent used for a large system, 20-percent for a medium sized system, and 25-percent used for a small system. A system is considered small if it has less than 3,300 customers, while a system is considered large if it has more than 50,000 customers. With a service population of approximately 2,900 people, the Precinct system was considered to be a small system, and 25-percent of the maximum day demand should be available in the storage tanks for meeting equalization storage guidelines.

The fire flow storage component is based on the representative fire flow requirement multiplied by the required duration of the flow. The basic fire flow is defined as a fire flow indicative of the quantities needed for handling fires in important districts, and usually serves to mitigate some of the higher specific fire flows. For the Precinct system, a representative fire flow of 3,500 gpm for a duration of three hours was used for the MSA, and a representative fire flow of 2,000 gpm for a duration of three hours was used for the HSA.

The emergency storage component is typically equivalent to one ADD. However, if there is emergency power available at the sources or emergency connections with surrounding communities capable of supplying at least one ADD, the emergency storage component can be waived. All of the water supply sources are located in the MSA. Emergency power is available at the each of the wells, and with the Central Hooksett Water Precinct interconnection, there is a combined capability of supplying at least one ADD. Emergency power is also available at the Booster Pump Station, which supplies water from the MSA to the HSA. Therefore, the emergency component has been waived in the storage evaluation for both service areas.

The three components of the storage evaluation were calculated under current and projected water demand conditions for both the MSA and the HSA. The peak MDD recorded in 2016 was higher than the historical peak MDD for other years reviewed, therefore, to be more conservative, the 2016 data was used as the current year for the storage evaluation. The projected 2030 MDD is based on the Lewis Engineering assessment with the completed housing development. The housing development is located entirely within the HSA and therefore, the additional 0.94 mgd was added to the HSA calculations only.

Main Service Area

1. Equalization
   - Small sized system = 25-percent of the Maximum Day Demand
   - MSA Estimated Maximum Day Demand in year 2016 = 0.53 mgd
   - MSA Projected Maximum Day Demand in year 2030 = 0.57 mgd
   - MSA Equalization (2016) = 0.25 x 0.53 = 0.13 mg
   - MSA Equalization (2030) = 0.25 x 0.57 = 0.14 mg

2. Basic Fire Flow Requirements
   - Representative fire flow = 3,500 gpm
   - Duration of 3 hours or 180 minutes
   - Basic Fire Flow Requirement = 3,500 x 180 = 0.63 mg

3. Emergency Storage: Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2016) and projected (year 2030) total required storage is as follows:

- Total MSA Required Storage (2016) = 0.13 mg + 0.63 mg = 0.76 mg
- Total MSA Required Storage (2030) = 0.14 mg + 0.63 mg = 0.79 mg

A minimum pressure of 20 pounds per square inch (psi) should be maintained at the highest served customer under MDD conditions with a coincident fire flow. To maintain a minimum pressure of 20 psi at a highest customer elevation of 335 feet on Hooksett Road north of Ash Street, the level of the water in the storage tanks should not drop below 381 feet, which is below the base elevation of both tanks. Based on this information, all the available storage in both tanks in the MSA are considered usable emergency storage. The total available useable storage is 1.21 mg for the MSA and the required storage is 0.76 mg in the 2016 MDD scenario and 0.77 mg 2030 MDD scenarios. This leaves the MSA with a surplus of 0.44 mg in storage under existing conditions and 0.43 mg in storage under projected conditions.

High Service Area

1. Equalization
   - Small sized system = 25-percent of the Maximum Day Demand
   - HSA Estimated Maximum Day Demand in year 2016 = 0.33 mgd
   - HSA Projected Maximum Day Demand in year 2030* = 1.27 mgd
   - HSA Equalization (2016) = 0.25 x 0.33 = 0.08 mg
   - HSA Equalization (2030) = 0.25 x 1.27 = 0.32 mg

   *Includes housing development

2. Basic Fire Flow Requirements
   - Representative fire flow = 2,000 gpm
   - Duration of 3 hours or 180 minutes
   - Basic Fire Flow Requirement = 2,000 x 180 = 0.36 mg

3. Emergency Storage: Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2016) and projected (year 2030) total required storage is as follows:

- Total HSA Required Storage (2016) = 0.08 mg + 0.36 mg = 0.44 mg

- Total HSA Required Storage (2030) = 0.32 mg + 0.36 mg = 0.68 mg

The highest customer in the HSA is located at an elevation of approximately 550 feet above MSL on Crawford Lane. To maintain a minimum pressure of 20 psi at this customer, the level of water in the storage tank should not drop below 596 feet, therefore, only the top 47 feet of the tank is usable volume. Based on this scenario, the Manor Drive Tank has a useable storage volume of 0.69 mg. The HSA has a storage surplus of 0.25 mg in the 2016 MDD scenario and 0.01 mg in the 2030 MDD scenario.

SECTION 4 – Hydraulic Evaluation

4.1 General

A comprehensive computer model was utilized to mathematically simulate the water distribution system to evaluate the Precinct's existing water distribution system and to obtain a basis for recommending water distribution system improvements. The hydraulic model was developed using InfoWater software. InfoWater software allows the user to conduct hydraulic simulations using mathematical algorithms in an ArcGIS environment. The computer model is represented by the node, pipe, and tank information provided in Appendix C. The hydraulic input data in Appendix C provides data on system demands, length and diameter of water mains, roughness coefficient or C-value of water mains, elevations, pumping rates of water supply sources, and overflow elevations at storage facilities.

As part of this project, the model was developed based on the most recent GIS files provided by the Precinct, and correspondence with the Precinct to confirm the accuracy of this information.

4.2 Model Verification

Verification of the computer model was completed under steady state conditions based on fire flow testing and information pertaining to the Precinct's hydraulic gradeline and current operating procedures. Flow tests were conducted by the Precinct personnel at 12 locations throughout the distribution system on September 9, 2020 and September 30, 2020. Flow test locations were selected to be representative of the entire distribution system. Table No. 4-1 presents the results of the flow testing. The data obtained from the flow tests served as input data for the model verification under steady state conditions. The data included static and residual pressure readings and measurements of flow from the hydrants tested. Each simulation in the model reflected actual field conditions at the time of the testing to properly calibrate the model.

When results of the model simulations were calibrated to within approximately five percent of the hydraulic data collected from the actual flow tests, the computer model was considered verified under steady state conditions. After completing the verification process, the model mathematically represented the physical operating conditions of the existing water distribution system.

Table No. 4-1
Flow Test Results

Location of Flowing Hydrant	Flowing Hydrant Static Pressure (psi)	Residual Hydrant A Static Pressure (psi)	Residual Hydrant A Residual Pressure (psi)	Residual Hydrant B Static Pressure (psi)	Residual Hydrant B Residual Pressure (psi)	Observed Flow (gpm)	Calculated Estimated Flow at 20 psi (gpm)
502 West River Road No. 33	66	70	42			1,100	1,500
7 Main Street	84	78	63	88	78	1,100	2,200
22 Birch Hill B	47	50	28			850	1,000
23 Bullard Street	64	64	50			750	1,400
39 Main Street	78	86	77	73	64	1,100	2,800
11 Northview	89	85	80			1,100	4,400
10 Bursar Drive	126	120	104			1,100	2,900
149 University Circle	94	88	66	60	50	1,100	1,400
55A Dale Road	92	86	54	84	50	750	1,000
2 Wedgewood No. 10	72	68	34			750	900
1 West Bank	102	100	50			1,000	1,200
9 Sunrise Boulevard	102	90	56			1,100	1,600

4.3 Adequacy of Existing Distribution System

The Hydraulic Evaluation facet of the Three Circle approach evaluates the system's ability to meet varying demand conditions. In general, a minimum pressure of 35 psi at ground level is recommended during average day, maximum day, and peak hour demand conditions. During MDD with a coincident fire flow, a minimum pressure of 20 psi is required at ground level throughout the system. To evaluate the system's ability to meet these criteria, the following hydraulic simulations were run in the model:

Minimum/Maximum Pressures

During current ADD conditions, there are locations throughout the Precinct where a minimum pressure of 35 psi is not met. Therefore, during the projected year 2030 ADD, MDD, and peak hour demand condition (no coincident fire flow), a minimum pressure of 35 psi is not met in some areas of the distribution system. Pressures near the Manor Drive Tank and the Mount Saint Mary's Condominiums have a static pressure of approximately 22 psi. These are the only areas in the system below 35 psi under current ADD conditions.

On the contrary to low pressures in the system, an upper limiting pressure of 120 psi is generally recommended, as older fittings in the system are generally rated at 125 to 150 psi. Pressure above this level can result in increased leakage from the distribution system. Also, the Ten State Standards published Recommended Standards for Water Works recommends that normal working pressures on utilized mains and services not exceed 80 psi. Based on the current operating conditions, the system experiences pressures greater than 120 psi only in the lower elevations of the High Service Area, including lower sections of University Circle, College Park Drive and Post Road as well as Hooksett Road north of Post Road. These areas have all been constructed after 2004 with newer system fittings rated for a minimum pressure of 150 psi.

Insurance Services Office (ISO) Fire Flow Recommendations

The recommended fire flow in any community is established by the ISO. The ISO determines a theoretical flow rate needed to combat a major fire at a specific location, taking into account the building structure, floor area and the building contents. In general, the flows recommended for proper fire protection are based on maintaining a residual pressure of 20 psi in the distribution system. This residual pressure is considered necessary to maintain a positive pressure in the system to allow for continued service to customers and to avoid negative pressures that could adversely impact the distribution system and potentially introduce groundwater into the system through joints and cracks in the water mains.

The Precinct system was last inspected for fire insurance ratings by the ISO in May 2016. The results of the ISO inspections and fire flow testing were provided by the Precinct and are shown in Table No. 4-2. The testing was performed across the entire Town of Hooksett and as such only two hydrants were tested within the Precinct's jurisdiction. The test results indicate the available flow and estimated recommended fire flow in various sections of the distribution system at the time of the tests. The estimated recommended fire flows established by ISO for both locations was 500 gpm. It should be noted that a water system is only required by ISO to provide a maximum of 3,500 gpm at any point in the system. Recommended fire flows greater than 3,500 gpm are not considered in determining the Public Protection Classification (PPC) of the Precinct when using

the Fire Suppression Rating Schedule. ISO individually grades the protection of buildings with a recommended fire flow in excess of 3,500 gpm, and the PPC of those buildings can differ from that of the community that provides fire protection.

According to the May 2016 ISO study, the available fire flow at both testing locations exceed the ISO recommended flow. For each ISO location, the recommended fire flow was simulated in the hydraulic model verified as part of this project. The hydraulic model results confirm that both locations exceed the ISO recommended flow.

Table No. 4-2
ISO Hydrant Flow Summary
May 2016

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Recommended Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
18	Blackwater	103	80	500	2,900
5	Main Street & Rosedale Street	91	38	500	2,000

Additional Flow Recommendations

A review of the Precinct was completed to identify the recommended fire flows in areas not tested in the latest ISO evaluation. Recommended fire flows were estimated for larger structures and facilities such as condominiums, apartment complexes, schools, hotels, and other commercial or industrial buildings. Recommended flows were estimated for these areas based on location and building size using the 2014 ISO published Guide for Determination of Needed Fire Flow. The guide uses factors such as building size, material, location, and contents to calculate the recommended fire flow. These factors were estimated based on aerial photos and street level observations. Not all information was readily available for the review and the estimated recommended fire flow should not be used for any other purpose than evaluating the adequacy of the water distribution system. It should also be noted that the Guide does not account for the use of fire protection systems, such as a sprinkler system, when estimating a recommended fire flow.

According to the 2014 ISO published Guide for Determination of Needed Fire Flow, the minimum recommended fire flow in residential areas with homes greater than 30 feet apart is approximately 500 gpm. The recommended fire flow for homes between 21 feet and 30 feet apart is approximately 750 gpm. Areas with homes between 11 feet and 20 feet apart have a recommended fire flow of 1,000 gpm. A fire flow of 1,500 gpm is recommended for homes closer than 10 feet apart. The residential neighborhoods in the Precinct were evaluated to determine average distances between homes for determination of the recommended residential fire flow in those areas. An estimated fire flow of 500 gpm was used for most residential areas of the system with homes greater than 30 feet apart.

4.4 Hydraulically Deficient Areas

The estimated recommended fire flows were simulated in the computer model. All scenarios were run using the projected 2030 MDD conditions. All storage tanks in the system were set at their

standard operating level based on information provided by Precinct staff. Sources were all set to be off to replicate the typical daytime conditions of all pumps remaining off throughout the day and only pumping for an eight-hour period overnight to refill the tanks. Areas where the available fire flows did not meet the ISO recommended fire flow or estimated recommended fire flow were considered hydraulically deficient and improvements were developed to alleviate these deficiencies.

Hydraulic deficiencies were identified as part of a system wide evaluation and include deficiencies in areas that were and were not included in the most recent ISO testing, as well as addressing residential fire flow deficiencies. In general, the hydraulic deficiencies were broken down into Priority 1 and 2 deficiencies. Priority 1 deficiencies identify areas where looping the system or eliminating bottlenecks significantly increases overall system resilience and flow efficiency. Priority 2 deficiencies identify areas with needed fire flow improvements. Areas selected for Priority 2 would provide the recommended ISO fire flow only if improvements to Priority 1 deficiencies were implemented first. The following list provides a description of each Priority 1 and 2 deficiency. All hydraulic deficiencies are shown in the Hydraulic Deficiencies map in Appendix D.

Priority 1 Hydraulic Deficiencies

1. To finish the primary feed to the new West (Quarry) Tank, it is recommended that a cross country 12-inch diameter water main be installed from the 8-inch diameter water main at the end of Vista Drive to the 12-inch diameter water main on Route 3A. In addition to this, the existing 8-inch AC water main on Vista Drive is recommended to be replaced with a new 12-inch diameter water main to connect to the existing 12-inch diameter water main on Pinnacle Street and the proposed cross country extension to Route 3A. This will increase available flow in the south western and central portions of the distribution system and help move the water stored in the West (Quarry) Tank out into the distribution system more efficiently.

2. To increase available fire flow to the southern portion of the system and to create a loop on either side of the river that will increase system resiliency and redundancy, it is recommended that the Precinct install a 12-inch diameter water main across the Merrimack River. As shown on the Deficiencies map in Appendix D, this could be connected to the 12-inch water main on Route 3A on the west side and to the 8-inch water main on Dale Street on the east side.

3. The 12-inch diameter transmission main from the West (Quarry) Tank and South Pump Station connects to 8-inch and 6-inch diameter AC water mains on Pinnacle Street and West River Road which creates a bottleneck in flow from these critical facilities to the rest of the distribution system. Replacing the 8-inch water main on Pinnacle Street and the 6-inch water main on West River Road, and the 8-inch water main on Maple Street with a new 12-inch diameter water main would improve transmission from the West (Quarry) Tank and South Pump Station to the central portion of the distribution system and will increase the available fire flow in this area. It will also improve flow availability and fire fighting capacity in the Pinnacle Street neighborhood.

4. Replacing the 8-inch and 6-inch diameter AC water mains that run south on Route 3 and Main Street from the intersection with College Park Drive to the end of the southeastern portion of the system is recommended to improve transmission and flow to the southeastern portion of the system. Replacing this section of water main with a 12-inch diameter water main increases the available fire flow to many commercial customers and important municipal facilities and increases system resiliency by providing a larger sized transmission main for the eastern portion of the system.

5. Pine Street serves as a transmission main for the North and East Wells and is currently only 6-inches in diameter. It is recommended to replace this main with a 12-inch diameter water main both to increase flow from the wells and to improve the inherent capacity for fire flow to the large residential complexes and the I-93 rest areas located north of Pine Street.

6. To complete a 12-inch diameter transmission main loop through the center of the distribution system, it is recommended that the portion of 8-inch diameter water main on Route 3A that stretches from north of Pine Street to the I-93 Rest Area be replaced with a new 12-inch diameter water main. This will improve the inherent capacity for fire flow to Windsor Terrace apartments, River Hill apartments, and the I-93 Rest areas and associated residential areas, which are top users for the system. This will also be important for transmission of water to and from the proposed interconnection with the Town of Bow which is currently being considered for a location on Route 3A north of the rest areas.

7. The Thompson Corner Tank is currently connected to Main Street with an 8-inch cross country AC water main. To improve the hydraulics of the transmission main to this tank, it is recommended that a new 12-inch water main is installed from the south end of the existing 12-inch water main on Daniel Webster Highway to the existing 6-inch water main on Main Street/Route 3, which is proposed to be upgraded to 12-inches as part of Improvement 4 as discussed above.

Priority 2 Hydraulic Deficiencies

The Priority 2 Hydraulic Deficiencies Map in Appendix D depicts the following deficiencies. It was determined that these areas would be considered Priority 2 as these improvements in conjunction with those recommended as Priority 1 deficiencies will improve the inherent capacity for recommended fire flow in these areas.

8. An estimated recommended fire flow of 1,750 gpm was calculated at the Precinct office using the 2014 ISO Published Guide for Determination of Needed Fire Flow. The available fire flow is estimated to be 1,000 gpm at 20 psi. It should be noted that the recommended fire flow at this location does not consider if a fire protection system is installed in the building. To provide the recommended fire flow at this location, a new 12-inch diameter water main is recommended on Riverside Street to replace the section of 8-inch diameter water main, and a new 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main that serves the hydrant near the Precinct office building.

SECTION 5 – Critical Component Assessment

5.1 General

The critical evaluation facet of the Three Circle approach evaluates the impact of potential water main failures and the system's ability to meet varying demand conditions. The critical component assessment includes identification of critical areas served, critical water mains, and the need for redundant mains.

5.2 Evaluation Criteria

Critical areas served are locations in the distribution system that require continual water supply for public health, welfare, or financial reasons. Examples of critical service areas include water department facilities, medical facilities, nursing homes, schools, and business districts. All water mains within 500 feet of a critical area are considered to be critical mains. Because water storage tanks and water supply sources provide water and maintain pressure to critical service areas, tanks and primary water supply sources are also considered critical components. Therefore, any water main within 500 feet of a water storage tank or primary water supply source is considered a critical component.

Additional categories of critical water mains include those mains that are the sole transmission main from a source or tank, and main transmission lines without a redundant main. The evaluation included a visual review of the water mains leading into and out of the critical areas and the transmission grid.

5.3 Critical Components

Critical areas served, critical supply mains, and redundant mains were evaluated in the Precinct water system based on the criteria described above. The following provides a listing of the areas that are considered critical components. A map of the critical components is included in Appendix E.

Critical Areas Served

A system-wide review of critical areas served such as water department facilities, medical facilities, schools, and critical institutions was completed and discussed with Precinct personnel. Table No. 5-1 presents all critical areas served including critical users and critical components of the distribution system.

Critical Water Mains

Critical water mains include primary transmission lines as well as mains connecting water storage tanks and sources to the system. Critical transmission mains are highlighted on the Critical Components Map found in Appendix E.

Additional critical water mains were identified based on a review of the distribution system model and using the model's protector tool. The protector tool simulates breaks on each pipe in the model. The model calculates if the system can still be served with adequate flow and pressures

after a pipe is taken out of service. This feature can identify areas served by multiple mains which would no longer be able to serve customers if one of the mains were taken out of service. The following were identified by the protector tool in InfoWater as causing a system demand shortfall of 3.0 percent or greater, and are considered critical mains:

- The 8-inch and 12-inch water main on Route 3A/West River Road/Main Street from the I-93 North Rest Area to the intersection with Maple Street which serves as the only connection to the northern most customers in the system.

- The segments of the 12-inch water main on Route 3A south of Riverside Street stretching to the end of the system, providing the only connection to the south western customers in the system.

- The 6-inch and 8-inch water main on Hooksett Road and Main Street from the intersection with Morse Drive to the transmission main to the Thompson Corner Tank which provides the only connection to the south eastern portion of the system.

Water mains that cross streams, rivers, and active railroads are also considered critical because of the costly consequences of failure that could occur if a water main broke in these areas, and the difficulty in repairing the mains in these locations. Critical mains are highlighted on the Critical Components Map found in Appendix E. There are two 12-inch diameter water mains that cross the Merrimack River from Riverside Street to North Main Street providing redundancy for the system, but as these are the only points in the system that connect the eastern and western portions of the system on either side of the system and due to the difficulty in repairing these mains were a break to occur, these have been considered to be critical components.

Table No. 5-1
Critical Areas

Critical Area		Location
Water Distribution System Components		
	Precinct Office Building	7 Riverside Street
	North Well Pump Station	29 Pine Street
	East Well Pump Station	19 Ardon Drive
	South Well Pump Station	38 Pinnacle Street
	Booster Pump Station	2 Post Road
	West (Quarry) Tank	81 Brickyard Pond Road
	Thompson Corner Tank	Hooksett Road
	Manor Drive Tank	20 Manor Drive
Schools		
	Hooksett Memorial School	5 Memorial Drive
Emergency Services		
	Fire Station	1 Riverside Street
	Hooksett Public Library	31 Mount St. Mary's Way
Miscellaneous		
	I-93 Rest Areas/Pennichuck Utilities	530 West River Road
	Hooksett Town Hall	35 Main Street
	Sewer Department Pump Station	Riverside Street
	Sewer Department Pump Station	Veterans Drive
	Sewer Department Pump Station	Memorial Drive
	Sewer Department Treatment Plant	1 Egawes Drive
	Department of Public Works Garage	210 West River Road

SECTION 6 – Asset Management Considerations

6.1 General

The existing water distribution system includes approximately 42 miles of water mains. A number of factors, including installation year, diameter, material, water quality, break history, and soil characteristics, affect the decision to replace or rehabilitate a water main. The Precinct previously completed an Asset Management Evaluation for their system with Tata & Howard through the NHDES Asset Management Grant Program. This evaluation used an Asset Management approach tailored for the Precinct system to assign each water main in the system a grade based on these factors. These grades were used to establish a prioritized schedule for water main replacement or rehabilitation and serves as the third facet of the Three Circle approach.

This section summarizes the process and recommendations of the previous Asset Management Evaluation which was completed in May 2020.

6.2 Evaluation Criteria

To prioritize water main replacement or rehabilitation, a water main grading system was established. The grading system uses water main characteristics including installation year, diameter, and material, as well as known areas with water quality concerns, water main break history, static pressures, and soil characteristics surrounding the water main to assign point values to each pipe in the system. The performance criteria within each asset category are assigned a rating between zero and 100, with zero being the most favorable and 100 being the least favorable within the category. Each category is then given a weighted percentage, which represents priorities within the system. Tata & Howard worked with the Precinct to adjust the weighted percentages of each category and the ratings of the performance criteria based on existing system performance and conditions. Our recommendation was to assign a maximum weight of 30 percent to any one category. The assigned rating is then multiplied by the weighted percentage to determine the weighted rating for the performance criteria in each category. The weighted rating for each performance criteria was totaled to determine an overall rating for each pipe section in the model. The pipes with the highest grade are most in need of replacement or rehabilitation.

As part of the Asset Management Evaluation project, a workshop was held with the representatives of the Precinct to establish a rating system specific to the Precinct water system. During the workshop, it was determined that break history was of primary concern to the Precinct, followed by diameter, material, and installation year. The grading system is shown in Table No. 6-1 and was used to assign scores to individual water mains.

Table No. 6-1
Asset Management Grading System

Weight	Performance Criteria	Rating	Weighted Rating
25%	Break History		
	Two or More Breaks	100	25
	One Break	75	18.75
	No History of Breaks	0	0
20%	Diameter		
	Less than 4-inch	100	20
	4-inch water main	90	18
	6-inch water main	70	14
	8-inch water main	30	6
	10-inch water main	20	4
	12-inch water main	10	2
	16-inch water main	5	1
15%	Material		
	Asbestos Cement	100	15
	Plastic	80	12
	Copper	20	3
	Ductile Iron	10	1.5
	PVC/HDPE	5	0.75
15%	Installation Date		
	1950-1979	100	15
	1980-1989	90	13.5
	1990-1999	40	6
	2000-2010	10	1.5
	2010-present	0	0
15%	Poor Soils		
	Known Corrosive Soils	100	15
	Potentially corrosive soils	80	12
	Gravel, sand	0	0
10%	Static Pressure		
	Greater than 100 psi	100	10
	80 to 100 psi	80	8
	60 to 80 psi	60	6
	Less than 60 psi	0	0
5%	Water Quality		
	Water Quality Concerns	100	5
	No Water Quality Concerns	0	0

6.3 Asset Management Areas of Concern

Based on the asset management ratings, there are several areas of concern in the system. Water mains with a total rating less than 25 are considered to be in good to excellent condition. Mains with a total rating between 25 and 44 are considered to be in fair to good condition, and mains with a total rating of 45 or greater are considered to be in poor to fair condition. This rating system is specific to the Hooksett Village Water Precinct system and reflects the Precinct's priorities of replacing mains with a history of breaks and those with poor material. Asset management ratings are presented graphically in Appendix F.

During the previous Asset Management Evaluation, completed in May 2020, two phases of recommended improvements were developed. Sections of water main included in Phase I had asset management scores of above 60 and represented the areas of the Precinct system that are the most in need of attention. Sections of water main included in Phase II had asset management scores between 45 to 59 and all had at least one break. Fifty three percent of the pipes had scores between 30 and 44, most located in the Pinnacle Street and Thompson Avenue neighborhoods. These areas were all developed around the same time and therefore, should be all replaced around the same time. It was recommended that these areas be included in a Phase III as the Precinct moves forward with improvements in Phases I and II.

The evaluation discussed the need to develop a hydraulic model for further investigation of the system with the potential of reprioritizing those improvements recommended based solely on asset management criteria. This led directly to the completion of the hydraulic model for the Precinct during this Asset Management Plan Update. The hydraulic modeling evaluation and critical component considerations discussed earlier in this report were used to evaluate each water main in conjunction with the asset rating scores from the May 2020 evaluation to develop the recommendations and conclusion discussed in the following section.

SECTION 7 – Recommendations and Conclusions

7.1 General

The following section summarizes the findings of the study and presents a prioritized plan for recommended improvements and associated costs. The prioritization of improvements allows for constructing the necessary improvements over an extended period of time as funds allow. Costs are based on recent bid tabulations and include costs associated with the water mains, valves, fittings, water services, hydrants, and other appurtenances, permanent and temporary trench pavement, and a 25 to 30 percent allowance for engineering and contingencies. The standard allowance for engineering and contingencies is 25 percent, however, for any improvements that are assumed to include a bridge crossing or horizontal directional drilling, the allowance is increased to 30 percent due to the inherent complexities associated with these projects. Estimates do not include costs for land acquisition, easements, or legal fees. Unit costs when installing less than 1,000 feet of water main are based on a higher unit rate and are accounted for in each applicable recommendation. If these projects were to be grouped, the estimated costs may decrease.

The capital improvement projects considered by this study will provide a direct benefit to the overall level of service to the Precinct's customers, reduce operation and maintenance costs by reducing the frequency of water main failures and the damage they cause, improve water quality, as well as improve fire protection to homeowners and businesses.

The Water Research Association's (formerly the American Water Works Research Foundation) study on "Cost of Infrastructure Failure," which was completed in 2002, found that in addition to direct costs paid by water utility ratepayers for water main failures, there are also societal costs which are paid by the public. Examples of direct costs include outside contractor costs, engineering costs, police assistance, fire department assistance, electrical, telephone, and gas utility damage costs, landscaping restoration costs, and laboratory costs. Examples of societal costs include the cost of traffic impacts, business customer outage impacts, public health impacts (including loss of life), property damage not covered by direct costs, and the cost of reduced fire fighting capability during a water main failure event.

Rehabilitation and replacement of one percent of a system each year (a 100 year replacement cycle) is a reasonable guideline based on industry experience and analysis. For the Precinct distribution system, this would equate to approximately 2,200 linear feet of water main replacement each year as a guideline. Regular rehabilitation of water mains reduces main failures, leakage, and water quality issues. Water main rehabilitation can also provide socio-economic benefits by reducing operational costs associated with chemical and energy usage. Additionally, rehabilitation or replacement of water mains that are inadequately sized to provide needed fire protection will improve public safety.

7.2 General Recommendations

To maintain a comprehensive database of the condition of the system, it is recommended that the Precinct regularly provide break data to Tata & Howard to update the water main database.

Currently, the Precinct maintains documentation of breaks with the nearest street address and date. In addition, the Precinct should record joint type, type of lining, and type of failure such as ring crack, lateral split, hole in the pipe, "punky" AC pipe failure, joint leak, or service connection failure, and how the pipe was repaired. If possible, the Precinct should include the apparent cause of the failure such as frost load, traffic load, direct contractor damage, settlement, water hammer, or external soil corrosion. The documentation should also be filed electronically following each event. This data can be used to create a Water Main Failure Map for identifying areas of concern in the system on an ongoing basis. The map can be used to easily identify break locations, determine if streets or areas have a higher frequency of failures, and to view any patterns in the location, type, pipe manufacturer, or other characteristics in occurrences of failure. The water main failure database will aid the Precinct in making water main rehabilitation and replacement decisions in the future. Providing data of any new water main replacements or rehabilitations performed by Precinct staff as part of regularly scheduled maintenance to Tata & Howard will also help to keep the hydraulic model up to date and as accurate as possible.

The Precinct has a requirement in their operation standards to consider all materials of water main when investigating the installation of a new water main, with ductile iron and HDPE or PVC as the main materials used throughout the system. It is recommended that the Hooksett Village Water Precinct consider changing their standard specifications to zinc coated ductile iron piping in potentially corrosive soil areas. Zinc coated ductile iron piping is more expensive than polyethylene wrapping, but installation is less sensitive to properly protect the piping. If HDPE or PVC water main is to be installed, the Precinct should verify groundwater elevations in the project area and review any history of oil or hazardous material (OHM) release as these types of contaminants may reportedly penetrate the permeable HDPE or PVC piping. Polyethylene wrapped or zinc coated ductile iron are better options in areas where OHM may be present.

The Precinct should continue to perform regularly scheduled maintenance programs, including hydrant and valve maintenance and meter testing/calibration. It is also recommended that the Precinct develop a unidirectional flushing (UDF) plan to increase the cleaning achieved by regular flushing of the water mains. The cost to develop a UDF plan for the Precinct is estimated at $16,000.

The Precinct is currently investigating mazimizing their existing sources, including a possible back up source for the North Well, as well as conducting a test well exploration program to identify and reserve a future water supply source outside of the Pinnacle Pond aquifer. The catastrophic loss of the existing sources at Pinnacle Pond due to a potential contamination incident has been identified as an important system vulnerability. It is recommended that the Precinct continue with their preventive maintenance on their wells and continue to monitor specific capacity of the existing wells in an effort to monitor and maximize their yields. It is recommended that the Precinct continue with the test well investigation program This will prepare the Precinct for new source development in the future. Given the rate of development in Hooksett and the shrinking number of possible source locations, this should be considered a priority recommendation.

As outlined in the October 2020 Sanitary Survey conducted by New Hampshire Department of Environmental Services (NHDES), corrective action is required to address the condition of the Thompson Corner Tank. To evaluate the impacts to the distribution system if the tank was taken

off-line, field studies completed in November 2020 show that fire protection on the east side of the river is cut nearly in half when this tank is taken temporarily off-line. The hydraulic model developed in this study and system field hydraulic observations by the operators further suggest that additional distribution system improvements are needed on the west side of the river to relieve a bottleneck in the Pinnacle Street area that is restricting flow from the West (Quarry) Tank constructed in 2019.

It is recommended that the Precinct complete an evaluation of the Thompson Corner Tank to identify a cost effective approach to address the Significant Deficiency outlined in the Sanitary Survey and maintain adequate fire protection in the system. The primary goal of the evaluation will be to compare tank rehabilitation or replacement options. The evaluation will include tank inspection and metal loss analysis by a certified corrosion inspection firm, which is already ongoing; identification and analysis of any sanitary, safety and hydraulic improvements needed as part of the rehabilitation effort; the preparation of budgetary cost estimates for tank repair; identification of a potential replacement tank location and associated site logistics given current site constraints; the preparation of budgetary cost estimates for tank replacement; and the modeling and analysis of any water distribution system improvements needed to be implemented when the tank repair/replacement is completed. The cost of the evaluation is $10,000.

7.3 Prioritization of Water Distribution System Improvements

Based on the Three Circles Approach including the hydraulic, critical component, and asset management circles, a prioritized list of improvements was created for the buried infrastructure. Improvements were separated into three phases. The Phase I and Phase II improvements are prioritized based on hydraulic needs, location in the distribution system (critical component), the condition of the water main (asset rating), and the professional opinion of Tata & Howard of how to best impact the distribution system. Typically, the Phase I improvements include water mains that fall into all three circles but some improvements that would add new pipes to the system to improve hydraulics and strengthen critical areas have been included in Phase I. Phase II improvements include water mains that fall into any two circles.

Phase III improvements fall into one circle. These improvements include the remaining hydraulic recommendations from Section 4 not included in the Phase I or Phase II improvements and remaining areas with a poor asset management rating. The hydraulically deficient areas, critical component considerations, and asset management ratings are combined on one Three Circles Integration Map included in Appendix G.

The list of water main improvements is extensive due to the nature of this report. The prioritization of the recommended improvements based on the Three Circle Approach serves as a guide for implementation of the infrastructure improvements with the greatest to least benefit, as it is currently perceived based on the data in this report. The implementation of these improvements is intended to be completed over several years based on available funding sources and as circumstances allow.

Table No. 7-1, at the end of this section, includes a prioritized list of Phase I improvements and the hydraulic, critical component, and asset management status of each improvement. Table No.

7-2 includes the linear feet and estimated cost of each Phase I improvement. Table No. 7-3 includes a prioritized list of Phase II improvements and the hydraulic, critical component, and asset management status of each improvement, and Table No. 7-4 includes the linear feet and estimated cost of each Phase II improvement.

Phase III improvements include the water mains that have high asset management ratings that are not included in any Phase I or Phase II improvements and should be replaced when funding becomes available. The total length of water main by pipe diameter recommended for Phase III improvements is summarized in Table No. 7-5. The estimated cost to replace these water mains is also included in Table No. 7-5. The recommended improvements maps are included in Appendix H. It should be noted that paving schedules and other improvements to roadways were not evaluated as part of this study.

Phase I Improvements

1. A new 12-inch diameter cross country main is recommended from the end of Vista Drive to Route 3A. Creating this connection will partially finalize the transmission main from the West (Quarry) Tank to the southern and central portions of the distribution system. This will provide the inherent capacity for the estimated needed fire flow to these areas and increase system resiliency. The estimated probable construction cost of 1,100 linear feet of 12-inch diameter water main is approximately $432,000. With this cross country main, it is recommended that the existing 8-inch diameter water main on Vista Drive be increased to 12-inch diameter. This will complete the connection to the West (Quarry) Tank. The estimated probable construction cost of 700 additional linear feet of 12-inch diameter water main is approximately $274,000. Completing both improvements together would be an estimated probable construction cost $706,000 if traditional open cut construction was used for the cross-country portion of water main. The cross-country portion of water main could be installed via directional drilling which has an estimated probable construction cost of $390,000. If directional drilling was utilized, the estimated probably construction cost for the 1,800 linear feet of new water main is $664,000. The directional drilling cost estimate is used for the Phase I total cost.

2. A new 12-inch diameter main is recommended to replace the existing 6-inch diameter water main on Pine Street from the North Well driveway to Main Street, the 6-inch diameter water main on the North Well driveway from the North Well to Pine Street, the 8-inch water mains on Ardon Street from the East Well to the Pine Street. The existing mains are considered critical as they serve as a transmission main from the North and East Wells. The upgrade will increase the available fire flow to the I-93 Rest Areas and the Windsor Terrace and River Hill apartment complexes, which are top users. The estimated probable construction cost of 2,400 linear feet of 12-inch diameter water main is approximately $750,000.

3. New 12-inch diameter main is recommended to replace the existing 8-inch diameter water main on Route 3A. The portions of the existing mains are considered to be in fair to poor condition with asset management ratings ranging from 36 to 46. The poor ratings are due to the age, material, and potentially corrosive soil. This portion of main is considered critical because a break here would cause at least three percent of the system to lose water

service and the main is the only connection to the I-93 Rest Areas and associated residential complexes affiliated with Pennichuck Utilities, which are top users and critical customers. The upgrade will improve the hydraulic capacity of the water mains and better provide residential fire flow in the area. The estimated probable construction cost of 3,100 linear feet of 12-inch diameter water main is approximately $853,000.

4. New 12-inch diameter main is recommended from the intersection of Main Street with College Park Road to the 12-inch water main at the South end of the distribution system. The existing water main on Main Street is considered critical because it provides the only connection to the southeastern portion of the distribution system and a break here would cause at least three percent of the system to lose water service. The mains have asset management ratings ranging from 36 to 69 and are considered to be in fair to poor condition. The poor condition is due to age, material, and history of breaks. The upgrade will improve the hydraulic capacity of the water main and provide residential fire flow in the area. The estimated probable construction cost of 7,500 linear feet of 12-inch diameter water main is approximately $2,063,000.

5. A new 12-inch diameter main is recommended along Daniel Webster Highway from the intersection with Main Street/Route 3 to the Thompson Corner Tank transmission main. The existing tank transmission main is 8-inches in diameter with an asset management rating of 36, so is considered to be in good to fair condition but is hydraulically insufficient to serve as a main transmission main to the south western portion of the system. The main is considered to be critical as it serves as a transmission main to the Thompson Corner Tank and currently the main runs through private property. Installing a new 12-inch diameter main along Daniel Webster Highway to connect to the existing 8-inch water main on Precinct owned property would be beneficial in providing easier access to a critical main and in improving the system hydraulics in this area. The estimated probable construction cost of 700 linear feet of 12-inch diameter water main is approximately $265,000.

Phase II Improvements

6. A new 12-inch diameter cross river water main is recommended to be installed across the Merrimack River between the 8-inch water main to Tritown Ice Rink and the 8-inch water main on Dale Road. This position has been chosen to utilize an existing river crossing easement owned by the Sewer Department. Creating this connection between the transmission mains on Route 3A and 3 will increase the available fire flow for the entire system and especially to the critical and large users in the southern portion of the system. This will also increase system resiliency. The cost of installing 2,400 linear feet of 12-inch diameter pipe, with approximately 550 linear feet via directional drilling, is approximately $982,000.

7. New 8-inch and 12-inch diameter water mains are recommended to replace the existing 6-inch and 8-inch diameter mains along Riverside Street to the area near the Precinct office building. The existing main is hydraulically deficient and is considered to be in fair to poor condition with an asset management rating of 41 due to size, age and material of the main. The upgrade will improve hydraulic capacity of the water main and provide increased fire flow to the Precinct office which is considered a critical building. Upgrading to a 12-inch

diameter water main on Riverside Street will complete a larger 12-inch diameter transmission loop between all major points in the system. The estimated probable construction cost of 100 linear feet of 12-inch diameter water main and 200 linear feet of 8-inch diameter water main is approximately $157,000.

8. A new 12-inch diameter main is recommended to be installed on West River Road. The existing 6-inch diameter water main on West River Road is considered to be in poor condition with an asset management rating of 50 due to the diameter, age and material. This improvement, in conjunction with the Pinnacle Street project, will eliminate a bottleneck from the West (Quarry) Tank and the center of the distribution system which will increase fire flow to this area. The need for this improvement should be re-evaluated once the Vista Drive Project is completed. The estimated probable construction cost of 1,200 linear feet of 12-inch diameter ductile iron water main is approximately $315,000.

9. A new 12-inch diameter water main is recommended on Pinnacle Street and Maple Street from Vista Drive to West River Road. This improvement will eliminate the bottleneck from the West (Quarry) Tank to the center of the distribution system and replace a problematic valve at the intersection of Pinnacle Street and West River Road. Increasing the size of the water mains in this area will greatly improve the flow in the center of the distribution system. The need for this improvement should be re-evaluated once the Vista Drive project is completed. The estimated probable construction cost for 2,300 linear feet of 12-inch diameter water main is approximately $604,000.

10. A new 12-inch diameter main is recommended to replace the existing 8-inch diameter main along Veterans Drive from the river crossing to Merrimack Street. The existing 6-inch diameter water main is considered to be in poor condition with an asset management rating of 61 due to age, material, and history of breaks. The water main is also considered critical due to its proximity to a sewer pump station which is considered a critical user. The estimated probable construction cost of 600 linear feet of 12-inch diameter water main is approximately $189,000.

Phase III Improvements – Asset Management

11. A new 8-inch diameter water main is recommended on Highland Street from Granite Street to Dundee Avenue. This water main is considered in poor condition with asset ratings ranging from 50 to 72 due to age, material, size, and history of breaks. The estimated probable construction cost for 1,000 linear feet of 8-inch diameter water main is approximately $392,000.

12. A new 8-inch diameter water main is recommended to replace the existing AC 8-inch diameter water main on Heather Drive as well as extending this main to connect to West River Road with a new 8-inch water main. The water main is considered to be in poor condition with an asset management rating of 61 due to age, material, and history of breaks and would improve the overall system if it was connected to West River Road as an additional loop. The estimated probable construction cost for 750 linear feet of 8-inch diameter water main is approximately $294,000.

13. A new 8-inch diameter water main is recommended to replace the existing 6-inch and 8-inch diameter water mains on Granite Street, Chase Street, and Otterson Street. These water mains are considered in poor condition with asset management ratings ranging between 50 to 63 due to age, size, material, and history of breaks. The estimated probable construction cost for 3,600 linear feet of 8-inch diameter water main is approximately $1,125,000.

14. A new 12-inch diameter water main is recommended on Merrimack Street from Veterans Drive to the end to replace the existing 8-inch diameter water main and to complete a loop to College Park Drive. This water main is considered to be in poor condition with an asset management rating of 52 due to age and material. The estimated probable construction cost for 1,800 linear feet of 12-inch diameter water main is approximately $704,000.

15. New 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main on Green Street and Scott Avenue. These water mains are considered to be in poor condition with an asset management rating of 57 due to size, history of breaks, and corrosive soils. The estimated probable construction cost for 2,600 linear feet of 8-inch diameter water main is approximately $813,000.

16. A new 8-inch diameter water main on Bullard Drive from Stevens Drive to the end is recommended to replace the existing 6-inch water main. This water main is considered to be in poor condition with an asset management rating of 54 due to size, age, material, and corrosive soils. The estimated probable construction cost for 700 linear feet of 8-inch diameter water main is approximately $274,000.

17. A new 8-inch diameter water main on Dale Road from Morse Drive to the end is recommended to replace the existing 8-inch diameter water main. This water main is considered to be in poor condition with an asset management rating of 45 due to age and history of breaks. The estimated probable construction cost for 3,200 linear feet of 8-inch diameter water main is approximately $1,000,000. The Precinct noted that a break occurred here recently and that the existing pipe was determined to be White PVC, which was very brittle. It is recommended that an alternate material be identified and used for the replacement of this water main.

18. It is recommended that the existing 8-inch diameter water main on Bayview Terrace Road and West Bank Road be replaced with a new 8-inch water main. The water main is considered in poor condition with an asset management rating of 45 due to age and history of breaks. The estimated probable construction cost of 1,300 linear feet of 8-inch diameter water main on Bayview Terrace Road and West Bank Road is approximately $407,000.

Table No. 7-1
Prioritization of Improvements – Phase I

Item No.	Location	From	To	Hydraulic Priority	Asset Management Rating	Critical
1	Vista Drive and Cross Country	Pinnacle Street	Route 3A	1	36	N
2	Pine Street, North Well, and Ardon Drive	Main Street	North/East Wells	-	35	Y
3	Route 3A	12-Inch tie in	I-93 Rest Area	1	36 -46	Y
4	Route 3	College Park Road	End of System	1	36 - 69	Y
5	Daniel Webster Highway	Main Street/Route 3	Thompson Corner Tank Property	-	36	Y

Table No. 7-2
Estimated Improvement Cost – Phase I

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
1	Vista Drive and Cross Country	Pinnacle Street	Route 3A	12	1,800	$664,000
2	Pine Street, North Well, and Ardon Drive	Main Street	North/East Wells	12	2,400	$750,000
3	Route 3A	12-Inch tie in	I-93 Rest Area	12	3,100	$853,000
4	Route 3	College Park Road	End of System	12	7,500	$2,063,000
5	Daniel Webster Highway	Main Street/Route 3	Thompson Corner Tank Property	12	700	$265,000
Total Estimated Phase I Cost:						**$4,595,000**

Table No. 7-3
Prioritization of Improvements – Phase II

Item No.	Location	From	To	Hydraulic Priority	Asset Management Rating	Critical
6	River Crossing	Route 3A	Dale Road	1	-	-
7	Riverside Street	Main Street	Precinct Office	2	41	Y
8	West River Road	Route 3A	Maple Street	1	50	N
9	Pinnacle Street	West (Quarry) Tank	West River Road	1	43	Y
	Maple Street	Route 3A	Main Street	1	-	N
10	Veterans Drive	River Crossing	Merrimack Street	-	52	Y

Table No. 7-4
Estimated Improvement Cost – Phase II

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
6	River Crossing	Route 3A	Dale Road	12	2,400	$982,000
7	Riverside Street	Main St	Precinct Office	12	900	$157,000
8	West River Road	Route 3A	Maple Street	12	800	$315,000
9	Pinnacle Street	West (Quarry) Tank	West River Road	12	1,800	$604,000
	Maple Street	Route 3A	Main Street	12	400	
10	Veterans Drive	River Crossing	Merrimack Street	12	500	$189,000
Total Estimated Phase II Cost						**$2,247,000**

Table No. 7-5
Estimated Improvement Cost – Phase III

Item No.	Location	From	To	Asset Management Rating	Proposed Diameter (in)	Length (LF)	Estimated Cost
11	Highland Street	Granite Street	Dundee Ave	72	8	1,000	$392,000
12	Heather Drive	Ardon Drive	End	61	8	600	$294,000
13	Granite Street	Hooksett Road	Merrimack Street	63	8	3,555	$1,125,000
	Otterson Street	Granite Street	Highland Street	55			
	Chase Street	Granite Street	Bert Street	50			
14	Merrimack Street	Veterans Drive	End	52	12	1,800	$704,000
15	Scott Avenue	West River Road	End	57	8		
	Green Street	Scott Avenue	End	57	8	2,500	$813,000
16	Bullard Drive	Stevens Drive	End	54	8	700	$274,000
17	Dale Road	Morse Drive	End	45	8	3,200	$1,000,000
18	Bayview Terrace Road	West River Road	End	45	8	1,300	$407,000
						Total Estimated Phase III Cost:	**$5,009,000**

7.4 20-Year Improvement Plan

In addition to the prioritized recommended improvements outlined in Section 7.3, it is beneficial for the Precinct to have an annual plan for construction of improvements. If feasible based on available resources and funding, it is recommended that Phase I and II improvements be completed over an initial 10-year interval since these improvements will provide the greatest benefit to the system. Phase III improvements are recommended to be implemented in the second 10-year interval.

The five Phase I improvements represent approximately ten percent of the total length of the Precinct's water distribution system with 15,000 linear feet of new water main and adding an additional 1,500 linear feet of new water main to areas that currently do not have water mains. The five Phase II improvements represent approximately five percent of the total length with 6,800 linear feet of new water main and adding an additional 2,400 linear feet of water main for the Merrimack River crossing. The eight Phase III improvements represent approximately ten percent of the system with 14,700 linear feet of new water main and adding approximately 200 linear feet of new water main to connect Merrimack Street and College Park Drive. In total, the estimated cost for all three phases of improvements is approximately $11,851,000 and would replace approximately 25 percent of the total system length.

To complete all 18 improvements over a 20-year interval, the Precinct would need to budget approximately $592,550 per year. Table No. 7-6 indicates the total estimated value and length for all three phases of improvements, as well as the estimated annual cost and length of improvements over the 20-year improvement plan. The total overall cost and length of improvements has increased by approximately $4,000,000 and approximately 17,000 linear feet relative to those originally identified in the May 2020 Asset Management Plan.

It should be noted that while these costs are considerable. This study reviews the entire distribution system in detail for the first time from a longterm perspective. The nature of this evaluation is very in depth and as a result highlights the key components of a distribution system's water mains that should be prioritized and invested in gradually as funds become available. Improving the water mains listed in this set of recommendations will lead to an additional 3,900 linear feet of water main to create two redundant loops in the Precinct's system and strengthen the system overall, while also replacing approximately 23 percent of the system's below ground infrastructure. The recommended improvements should be considered in conjunction with any necessary capital improvements to the Precinct's above ground infrastructure when developing the budget for system improvements. Cost savings may be incurred by coordinating these improvement projects and employing a variety of other approaches including but not limited to:

- Periodic re-evaluation of improvement needs and priorities as other improvements are completed,
- Application for grant opportunities and low-interest loans,
- Leveraging water main extension opportunities with developers,
- Favorable timing of competitive bidding when possible,
- Coordinating with other planned roadway and sewer main projects,

- Focusing on small, proactive, and regular rate increases rather than large, infrequent rate hikes.

Finally, Tata & Howard is ready to assist the Precinct with determining other alternative or creative phased funding strategies as needed to accomplish these critical improvements.

Table No. 7-6
20-Year Improvement Plan

Recommended Improvements	Total Estimated Value	Total Length (feet)
Phase I	**$4,595,000**	15,500
Phase II	**$2,247,000**	6,800
Phase III	**$5,009,000**	14,700
Total	**$11,851,000**	**37,000**
Annual Improvements over 20-Year Interval	$592,550	1,850

Appendix A

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Merrimack River

West River Rd
Edgewater Dr
Merrimack St
Pleasant St
Hooksett Rd
Post Rd
Beaver Way
Deer Run
Springer Rd
Pine St
Brighdewine Dr
Heather Dr
Arclon Dr
Main St
Maple St
Rosedale St
Riverside St
Veterans Dr
N Main St
College Park Dr
Pinnacle St
Summit Dr
Vista Dr
Donald St
Birch Hill Rd
Dupont Ave
Highland St
Bernice St
Chase St
Stevens Dr
Bullard Dr
Knights Ave
Bart St
Granite St
Northview Ter
Campus Dr
University Dr
Thompson Ave
Roy Dr
Grant Dr
Morgan Dr
Albert Ave
Pleasant View Rd
Blackwater Dr
Crawford Ln
Main St
Water Precinct Access Rd
Fire House Access Rd
Cate Rd
Mountain View Rd
Almeda Ln
Roy Rd
Grandview Dr
Pearl Dr
Quimby Mountain Rd
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Morningside Dr
Brown Rd
Stow Hill Rd
Palmer Rd
Morse Dr
Mortuary Ln
Dale Rd
Wedgewood Cir
Memorial Dr
Eastview Dr
Avon Rd
Dove Rd
Shannon Rd
Tay Rd
Trent Rd
Maidstone Rd
Thames Rd
Bayview Terrace Rd
West Bank Rd
Cross Rd
Meadowcrest Rd
Scott Ave
Green St
Gary Ave
Marlette Ave
Dartmouth St
Howard Ave
Hunt St
Kerri Ln
Lehoux Dr
Peters Brook Dr
Industrial Park Dr
Oak Hill Rd
Sterling Ave
Julia Dr
Westview Terr
Burbank Way
Virginia Ct
Nancy Ln
Legends Dr
Sunrise Blvd
West River Rd
Hidden Ranch Dr
Gosselin Ave
Technology Dr
Quality Dr
Kimball Dr
Benton Rd
O'Neagh Ave
Whitehall Rd
McAllister St
Martins Ferry Rd
Depot Rd
Harvest Dr
Menifee Dr
Jefferson Dr
N River Rd
Sherwood Dr
Lancelot Dr
Camelot Dr
Goffstown Rd
Valley View Dr
Corriveau Dr
Hacker Hill Rd
Briar Ct
Poore Rd
Bemis Savoie Rd
W Riverbank Rd
Goonan Rd
Central Park Dr

Legend

- Blow Off Valve

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains

Water Distribution System
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Appendix B

TATA & HOWARD

Placeholder for Lewis Engineering Report

Appendix C

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Edgewater Dr
West River Rd
Springer Rd
Pine St
Bridgewater Dr
Merrimack St
Pleasant St
Hooksett Rd
Post Rd
Beaver Way
Rum Brook
Merrimack River
Maple St
Rosedale St
Riverside St
Pinnacle St
Donald Dr
Summit Dr
Vista Dr
Birch Hill Rd
Veterans Dr
Village Park Dr
Thompson Ave
Grant Dr
Allegan Dr
Pleasant View Dr
Alden Dr
Beacon St
Highland St
Bellard Ln
Knights Ave
Granite St
Stevens Dr
Dupaw Ave
Northview Ter
Manor Dr
Blackwater Dr
University Dr
Crawford Ln
Water Precinct Access Rd
Fire House Access Rd
Cate Rd
Snow Hill Rd
Palluzzi Rd
Almeda Ln
Roy Rd
Mountain View Rd
Grandview Dr
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Quimby Mountain Rd
Pearl Dr
Morningside Dr
Brown Rd
Goffstown Rd
Valley View Dr
Corriveau Dr
Morse Dr
Mallory Ln
Dale Rd
Westwood Cir
Memorial Dr
Shannon Rd
Dove Rd
Tay Rd
Trent Rd
Thames Rd
Maidstone Rd
Meadowcrest Rd
Scout Ave
Green St
Lehoux Dr
Industrial Park Dr
Peters Brook Dr
Oak Hill Rd
Sunrise Blvd
Westview Terr
Julia Dr
Stirling Ave
Burbank Way
Virginia Ct
Nancy Ln
Legends Dr
Hidden Ranch Dr
Gosselin Ave
Technology Dr
Quality Dr
Kimball Dr
Central Park Dr
Groonan Rd
Bemis Savoie Rd
W Riverbank Rd
Poore Rd
Hacker Hill Rd
Briar Ct
Depot Rd
N River Rd
Martins Ferry Rd
McAllister St
Whitehall Rd
Benton Rd
Clough Ave
Harvest Dr
Memphis Dr
Jefferson Dr
Sherwood Dr
Lancelot Dr
Camelot Dr
Gary Ave
Marlette Ave
Dartmouth St
Hewlett Ave
Hunt St
Kent Ln
Avon Rd

Legend

- Junction
- Water Main
- High Service Area

Link Map
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
0	6	AC	2004	130	691	Gravel/Sand	0	31
1	6	PVC	2008	130	256	Gravel/Sand	0	16
2	1	Plastic		130	271	Gravel/Sand	0	0
3	8	AC	1966	130	302	Gravel/Sand	0	42
4	8	AC	1966	130	521	Gravel/Sand	1	61
6	8	AC	1978	95	783	Gravel/Sand	2	35
7	8	DI	2030	95	994	Gravel/Sand	0	36
8	8	PVC	2002	130	2027	Gravel/Sand	0	36
9	8	PVC	2002	130	244	Gravel/Sand	0	8
10	8	PVC	2003	130	558	Gravel/Sand	0	8
11	12	DIP	2001	120	628	Gravel/Sand	0	8
12	8	PVC	2006	130	1410	Gravel/Sand	0	11
13	12	DIP	1990	100	2103	Gravel/Sand	0	8
14	8	DIP	1990	90	1816	Gravel/Sand	0	16
15	6	DI	2030	105	641	Gravel/Sand	0	20
17	12	PVC	1982	115	693	Gravel/Sand	1	0
18	12	DI	1990	120	925	Gravel/Sand	0	50
19	12	HDPE	2018	130	1348	Potentially Corrosive	1	32
20	6	PVC	2002	130	1365	Potentially Corrosive	1	44
21	4	PVC	2002	130	490	Potentially Corrosive	0	19
22	6	DI	2030	105	601	Gravel/Sand	0	22
23	6	AC	1963	105	496	Gravel/Sand	0	26
24	8	DI	2030	130	1718	Gravel/Sand	0	43
25	6	AC	1963	105	460	Gravel/Sand	0	44
26	6	AC	1965	130	696	Gravel/Sand	0	36
27	6	PVC	1992	110	1401	Gravel/Sand	0	44
28	6	AC	1957	105	642	Gravel/Sand	0	44
29	12	DIP	2018	120	665	Gravel/Sand	0	21
30	8	DI	1986	110	781	Gravel/Sand	0	44

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
31	12	PVC	1982	130	2076	Gravel/Sand	0	4
32	12	DIP	1992	120	410	Gravel/Sand	0	21
33	8	AC	1950	130	11745	Potentially Corrosive	0	34
34	8	PVC	2030	130	1511	Gravel/Sand	0	16
35	12	DIP	2006	120	445	Gravel/Sand	1	61
36	12	DIP	1985	120	2867	Gravel/Sand	0	36
37	6	AC	1958	130	2607	Gravel/Sand	0	11
38	8	AC	1963	130	3042	Gravel/Sand	0	17
39	8	AC	1962	90	688	Gravel/Sand	0	44
40	6	AC	1962	90	2085	Gravel/Sand	0	36
41	6	AC	1963	90	597	Gravel/Sand	0	36
42	6	AC	1962	130	591	Gravel/Sand	0	44
43	6	AC	1962	130	671	Gravel/Sand	0	44
44	8	PVC	2030	90	1244	Gravel/Sand	0	44
45	6	PVC	2030	130	390	Gravel/Sand	0	44
46	10	DIP		120	883	Gravel/Sand	0	36
47	12	DI	1996	120	3917	Gravel/Sand	0	44
48	12	PVC	2016	130	654	Gravel/Sand	0	0
49	8	PVC	2016	130	2276	Gravel/Sand	0	10
50	12	PVC	2006	130	424	Gravel/Sand	0	11
51	12	PVC	2006	130	668	Gravel/Sand	0	17
52	8	PVC	2006	130	1645	Gravel/Sand	0	12
53	8	PVC	2016	130	741	Gravel/Sand	0	10
54	8	PVC	2006	130	1602	Gravel/Sand	0	8
55	8	PVC	2015	130	854	Gravel/Sand	0	7
56	8	PVC	2015	130	617	Gravel/Sand	0	14
57	12	PVC	2012	130	183	Gravel/Sand	0	15
58	12	PVC	2012	130	1611	Gravel/Sand	0	13
59	12	PVC	2012	130	1063	Gravel/Sand	0	3

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
60	12	PVC	2006	130	227	Gravel/Sand	0	3
61	8	PVC	2007	130	460	Gravel/Sand	0	3
62	12	PVC	2004	130	3608	Gravel/Sand	0	14
63	16	PVC	2007	130	891	Gravel/Sand	0	18
64	8	PVC	2007	130	2704	Gravel/Sand	0	14
65	16	PVC	2006	130	1193	Gravel/Sand	0	3
66	8	PVC	2005	130	826	Gravel/Sand	0	8
67	8	AC	1950	130	4997	Gravel/Sand	0	13
68	2	Plastic	1950	130	877	Gravel/Sand	0	14
69	6	AC	1955	115	1077	Potentially Corrosive	0	52
70	6	HDPE/PVC?	1968	105	437	Gravel/Sand	1	72
71	6	AC	1968	130	2732	Gravel/Sand	1	63
72	8	AC	1960	130	1513	Known Corrosive Soil	0	40
73	8	DIP	1986	110	696	Known Corrosive Soil	0	54
74	8	DIP	1986	110	455	Gravel/Sand	0	36
75	6	AC	1960	130	1788	Gravel/Sand	0	21
76	12	Ductile Iron	1996	120	319	Gravel/Sand	0	21
78	8	DIP	2005	110	1433	Gravel/Sand	0	44
79	8	DIP	1996	110	239	Gravel/Sand	0	10
80	8	DIP	1996	110	169	Gravel/Sand	0	10
81	8	DIP	2005	110	792	Gravel/Sand	0	9
82	8	DIP	2005	110	385	Gravel/Sand	0	14
83	12	PVC	1998	130	183	Gravel/Sand	0	14
84	6	PVC	1982	130	915	Gravel/Sand	0	9
85	8	DIP	1988	110	234	Gravel/Sand	0	9
86	6	PVC	1982	130	1833	Gravel/Sand	0	17
87	8	PVC	1992	130	1866	Known Corrosive Soil	1	57
88	10	PVC	1998	130	438	Gravel/Sand	0	27
89	8	PVC	1995	130	651	Known Corrosive Soil	1	57

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
90	8	PVC	1995	130	371	Gravel/Sand	0	21
91	8	PVC	1995	130	1012	Gravel/Sand	0	11
92	8	PVC	1983	68	1246	Gravel/Sand	0	21
93	6	AC	1968	130	444	Gravel/Sand	0	13
94	12	DIP	1985	120	505	Gravel/Sand	0	21
95	8	PVC	1985	130	2295	Gravel/Sand	1	45
96	6	PVC	1986	130	2843	Gravel/Sand	0	44
97	8	PVC	1985	105	671	Gravel/Sand	0	17
98	8	AC	1960	130	675	Gravel/Sand	0	20
99	6	PVC	1981	130	735	Potentially Corrosive	0	38
100	6	AC	1960	130	4815	Gravel/Sand	1	45
101	6	AC	1950	130	323	Gravel/Sand	1	55
102	8	AC	1950	130	409	Gravel/Sand	0	28
103	6	AC	1963	130	499	Gravel/Sand	0	50
104	6	DI	2030	130	225	Gravel/Sand	0	50
105	6	AC	1965	130	529	Potentially Corrosive	0	52
106	12	DIP	2018	120	689	Gravel/Sand	0	44
107	12	DIP	2006	120	819	Gravel/Sand	2	0
108	8	PVC	2006	130	181	Gravel/Sand	0	44
109	1	Copper	1985	100	6	Gravel/Sand	0	10
110	10	DI		120	125	Gravel/Sand	0	15
111	8	PVC	2019	130	420	Gravel/Sand	0	14
112	8	PVC	2019	130	173	Gravel/Sand	0	37
113	8	PVC	2019	130	72	Gravel/Sand	0	0
114	12	PVC	2006	130	476	Gravel/Sand	0	7
115	2	PVC	1986	130	512	Gravel/Sand	0	13
116	2	PVC	1986	130	1160	Gravel/Sand	0	7
117	2	PVC	1986	130	49	Gravel/Sand	0	14
118	8	PVC	2002	130	426	Gravel/Sand	0	34

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
119	8	PVC	2003	130	179	Gravel/Sand	0	34
120	6	PVC	2003	130	199	Gravel/Sand	0	34
121	6	PVC	2003	130	268	Gravel/Sand	0	8
122	4	PVC	2003	130	127	Gravel/Sand	0	8
123	4	PVC	2003	130	244	Gravel/Sand	0	16
124	4	PVC	2003	130	158	Gravel/Sand	0	16
125	4	PVC	2003	130	157	Gravel/Sand	0	20
126	4	PVC	2003	130	38	Gravel/Sand	0	20
127	4	PVC	2003	130	33	Gravel/Sand	0	20
128	4	PVC	2003	130	119	Gravel/Sand	0	20
129	4	PVC	2003	130	15	Gravel/Sand	0	20
130	4	PVC	2003	130	20	Gravel/Sand	0	20
131	4	Plastic	2002	130	13	Gravel/Sand	0	20
132	4	Plastic	2002	130	48	Gravel/Sand	0	20
133	4	Plastic	2002	130	66	Gravel/Sand	0	20
134	4	Plastic	2002	130	47	Gravel/Sand	0	32
135	4	Plastic	2002	130	112	Gravel/Sand	0	32
136	4	Plastic	2002	130	63	Gravel/Sand	0	32
137	4	Plastic	2002	130	161	Gravel/Sand	0	32
138	8	PVC	1996	130	39	Gravel/Sand	0	32
139	8	PVC	2006	130	37	Gravel/Sand	0	32
140	6	PVC	2015	130	80	Gravel/Sand	0	32
141	12	DIP	2018	120	899	Gravel/Sand	0	21
142	6	DI	2016	110	428	Gravel/Sand	0	14
143	6	AC	1962	130	582	Gravel/Sand	0	23
144	6	PVC	1995	130	385	Gravel/Sand	0	41
145	6	Plastic		130	142	Gravel/Sand	0	0
146	8	PVC	1982	130	58	Gravel/Sand	0	44
147	2	Plastic	1955	130	82	Gravel/Sand	0	29

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
148	6	AC		130	123	Gravel/Sand	0	0
149	12	DIP	2018	120	4	Gravel/Sand	0	20
150	12	DIP	2018	120	632	Gravel/Sand	1	66
151	8	DI	1990	110	31	Gravel/Sand	0	0
152	8	PVC	1985	105	254	Gravel/Sand	0	10
153	6	AC	1957	105	67	Gravel/Sand	0	10
154	16	PVC	2006	130	145	Gravel/Sand	0	20
155	12	DIP	1985	120	4815	Gravel/Sand	1	39
156	12	DIP	1985	120	1401	Gravel/Sand	1	44
157	8	DI	2030	95	4997	Potentially Corrosive	0	23
158	12	PVC	1982	130	3042	Potentially Corrosive	0	27
159	12	PVC	1982	130	3042	Gravel/Sand	0	17
160	12	PVC	1982	130	2027	Potentially Corrosive	0	46
161	12	PVC	1982	130	11745	Potentially Corrosive	0	34
162	12	PVC	1982	130	11745	Potentially Corrosive	0	34
163	12	DIP	1990	90	11745	Potentially Corrosive	0	32
164	6	PVC	2030	115	11745	Potentially Corrosive	0	32
165	8	PVC	2030	90	11745	Potentially Corrosive	0	32
166	8	PVC	2030	90	1816	Gravel/Sand	1	34
171	12	DIP	2001	120	3917	Gravel/Sand	2	69
P11	8	PVC	2003	130	2867	Gravel/Sand	2	61
P13	8	PVC	2003	130	2867	Gravel/Sand	0	36
P15	8	PVC	2003	130			0	0
P17	8	PVC	2003	130			0	0
P19	8	PVC	2003	130			0	0
P21	8	PVC	2003	130	225848		0	0
P23	8	PVC	2002	130	42.77		0	11
P25	12	PVC	2002	110			0	0
P27	6	PVC	2030	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P29	6	AC	2004	130				
P33	6	PVC	2030	130				
P35	8	PVC	2006	130				
P37	12	PVC	2006	130				
P39	12	PVC	2006	130				
P41	12	DIP	1990	100				
P43	12	DIP	1990	100				
P45	12	DI	1990	120				
P47	8	AC	1981	130				
P49	6	DI	2016	110				
P53	12	DIP	1996	120				
P55	6	AC	1955	130				
P57	6	AC	1955	130				
P59	6	AC	1955	115				
P61	6	AC	1955	130				
P63	6	HDPE/PVC?	1968	105				
P65	16	PVC	2007	130				
P67	12	PVC	2004	130				
P69	12	DI	1990	120				
P71	12	DIP	2006	120				
P73	8	PVC	2019	130				
P75	6	DI	2030	105				
P77	6	DI	2030	105				
P79	6	DI	2030	105				
P83	6	PVC	2015	130				
P85	6	PVC	2015	130				
P87	6	PVC	2015	130				
P89	8	PVC	2006	130				
P91	12	PVC	1982	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P93	16	PVC	2006	130				
P95	16	PVC	2006	130				
P99	16	PVC	2007	130				
P101	16	PVC	2007	130				
P103	12	PVC	2004	130				
P105	12	PVC	2004	130				
P107	12	PVC	2004	130				
P109	12	PVC	2006	130				
P111	12	PVC	2006	130				
P113	12	PVC	2006	130				
P115	12	PVC	2006	130				
P117	12	PVC	2006	130				
P119	8	PVC	2006	130				
P121	8	PVC	2006	130				
P123	12	PVC	2012	130				
P125	12	PVC	2006	130				
P127	12	PVC	2012	130				
P129	12	PVC	2012	130				
P131	12	PVC	2016	130				
P133	12	DIP	2006	120				
P135	12	DIP	1985	120				
P137	12	DIP	1985	120				
P139	12	DIP	1985	120				
P141	12	DI	1996	120				
P143	12	DIP	2006	120				
P145	12	DI	1990	120				
P147	12	DIP	2018	120				
P149	6	PVC	2002	130				
P151	6	PVC	2002	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P153	8	PVC	2030	130				
P155	8	PVC	2030	130				
P157	8	PVC	2030	130				
P159	8	PVC	2030	130				
P161	12	DIP	1985	120				
P163	8	AC	1963	130				
P165	8	AC	1963	130				
P167	12	DIP	1985	120				
P169	6	AC	1963	130				
P171	8	AC	1963	130				
P173	8	AC	1963	130				
P175	8	AC	1962	100				
P177	6	AC	1962	130				
P179	8	AC	1963	130				
P181	6	AC	1962	130				
P183	8	AC	1963	130				
P185	8	PVC	2030	130				
P187	8	PVC	2030	90				
P189	6	AC	1963	130				
P191	6	AC	1962	90				
P193	8	PVC	2002	130				
P195	8	PVC	2002	130				
P197	8	PVC	2002	130				
P199	8	PVC	2002	130				
P201	8	PVC	2002	130				
P203	8	PVC	2002	130				
P205	8	PVC	2002	130				
P207	8	PVC	2002	130				
P209	8	PVC	2003	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P211	8	PVC	2003	130				
P213	6	PVC	2003	130				
P215	6	PVC	2003	130				
P217	6	AC	2004	130				
P219	6	AC	2004	130				
P221	12	DIP	1990	100				
P223	6	DI	2030	105				
P225	6	DI	2030	105				
P227	6	DI	2030	105				
P229	6	AC	1957	105				
P231	12	DIP	2018	100				
P233	8	DI	1986	110				
P235	8	DI	1986	110				
P237	12	DIP	2018	100				
P239	12	DIP	2018	120				
P241	6	DI	2030	105				
P243	6	AC	1963	105				
P245	8	DI	2030	130				
P247	12	PVC	1982	130				
P249	12	DIP	1990	100				
P251	8	AC	1950	115				
P253	8	AC	1950	130				
P255	12	DIP	1992	120				
P257	6	AC	1950	130				
P259	6	AC	1960	130				
P261	6	AC	1955	115				
P263	6	AC	1955	115				
P265	6	AC	1955	115				
P269	8	AC	1960	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P271	8	DIP	1986	110				
P273	8	DIP	1986	110				
P275	8	DIP	1986	110				
P277	6	AC	1960	130				
P279	12	Ductile Iron	1996	120				
P281	8	DIP	2005	110				
P283	8	DIP	1996	110				
P285	8	DIP	1996	110				
P287	8	DIP	2005	110				
P289	8	DIP	2005	110				
P291	8	PVC	1995	130				
P293	12	PVC	1995	130				
P295	12	PVC	1995	130				
P297	12	PVC	1982	130				
P299	6	PVC	1982	130				
P301	6	PVC	1982	130				
P303	6	PVC	1982	130				
P305	12	PVC	1982	130				
P307	12	PVC	1982	130				
P309	8	PVC	1983	68				
P311	12	PVC	1982	85				
P313	8	PVC	1996	130				
P315	8	PVC	1985	130				
P317	6	PVC	2030	130				
P319	6	PVC	2030	130				
P321	6	AC	1968	130				
P323	8	PVC	1985	105				
P325	6	PVC	2030	130				
P327	12	PVC	1982	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P329	16	PVC	2006	130				
P331	8	DI	2030	130				
P333	12	DIP	1992	120				
P335	12	DIP	2006	120				
P337	12	DIP	2006	120				
P339	12	DIP	2006	120				
P341	12	DIP	1990	120				
P343	12	DIP	1990	90				
P345	12	DIP	1990	90				
P347	6	PVC	1992	130				
P349	8	PVC	2005	130				
P351	8	PVC	2016	130				
P353	8	PVC	2016	130				
P355	8	PVC	2015	130				
P357	8	PVC	1985	130				
P359	8	PVC	1985	125				
P361	8	PVC	1985	110				
P363	6	PVC	1986	130				
P365	6	PVC	1986	120				
P367	8	PVC	1983	130				
P369	8	PVC	1983	130				
P371	8	PVC	1995	110				
P373	8	PVC	1995	130				
P375	8	DI	2030	130				
P377	8	AC	1960	130				
P379	8	PVC	1992	130				
P381	8	DI	1986	110				
P383	12	DI	1996	120				
P385	4	Plastic	2002	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P387	8	PVC	2002	130				
P389	6	HDPE/PVC?	1968	105				
P391	8	PVC	2030	90				
P393	8	PVC	2030	130				
P395	8	PVC	2030	90				
P397	16	PVC	2007	130				
P399	12	PVC	1982	130				
P401	12	PVC	2006	130				
P403	6	AC	1958	130				
P405	6	AC	1962	130				
P407	6	PVC	1999	130				
P409	6	AC	1962	130				
P411	8		1983	100				
P413	8	PVC	2019	130				
P415	12	PVC	2012	130				
P417	8	PVC	2020	130				
P419	8	PVC	2020	130				
P421	2	Copper	2001	100				
P423	12			100				
P425	2	Copper	2001	100				
P427	12	DI	1996	120				
P429	12	DIP	1996	120				
P431	12	DIP	1996	120				
P433	12	DIP	1996	120				
P435	8	DIP	2005	110				
P437	8	DIP	2005	110				
P439	8	DIP	1986	110				
P441	8	DIP	1986	110				
P443	12	DIP	1990	100				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P445	12	DIP	1990	100				
P447	12	PVC	1982	130				
P449	12	DIP	2018	120				
P451	8	AC	1981	130				
P453	12	PVC	1982	130				
P455	8	PVC	1987	120				
P457	8	PVC	1987	120				
P459	12	DIP	2006	120				
P461	8	DI	2030	95				
P463	8	AC	1978	95				
P465	12	DIP	1990	100				
P467	8	PVC	2007	130				
P469	8	PVC	2030	90				
P471	8	PVC	1985	130				
P473	4	PVC	2002	130				
P475	8	PVC	2012	130				
P477	12	PVC	2006	130				
P479	8	DIP	1990	90				
P481	8	PVC	2003	130				
P483	6	DI	2016	110				
P485	6	PVC	2030	130				
P487	8	PVC	1985	130				
P489	8	PVC	1996	130				
P491	8	PVC	1996	130				
P493	8	PVC	2020	130				
P495	12	DI	1996	120				
P497	12	PVC	2030	130				
P499	12	PVC	2030	130				
P501	12	PVC	2030	130				

Pipe Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (ft)	Soil Code	Breaks	Asset Management Score
P503	8	PVC	1985	130				
P505	12	PVC	2030	130				
P507	12	DI	1996	120				

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J14	297.29	0.15	72.29
J18	299.26	0.3	71.22
J20	273.00	1.35	82.03
J22	274.53	0.6	81.37
J24	276.90	1.05	80.23
J26	272.00	0.75	82.36
J30	246.43	0.45	79.49
J32	257.84	0	74.54
J34	290.69	0	60.3
J36	289.24	0.3	60.93
J40	263.00	0	72.3
J42	259.00	0	74.03
J44	265.99	0	71
J46	244.31	0	80.4
J52	225.11	0.15	87.79
J60	220.55	1.2	89.33
J64	206.95	0.3	94.98
J72	179.82	0	106.66
J74	181.88	0	105.7
J78	214.98	0	90.72
J92	263.39	0.6	70.53
J94	260.88	0.3	71.62
J98	300.73	1.05	54.37
J100	260.51	1.2	71.79
J102	286.25	1.2	60.64
J104	303.00	0	53.39
J106	313.65	0.6	48.78
J114	197.98	0	98.87
J116	193.66	0	100.73
J120	198.93	0.6	98.03
J124	191.82	1.05	101.31
J126	210.81	0.3	92.9
J128	261.04	0.15	70.27
J132	314.00	0	47.59
J134	298.82	0.15	53.92
J136	325.22	0.45	42.23
J138	306.93	0.45	50.06
J140	323.00	0.75	43.1
J144	244.14	0.75	77.61
J154	266.21	0.3	68.01
J156	299.86	0.6	53.45

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J168	288.05	1.05	58.41
J170	271.98	0	65.37
J172	317.04	0	46.28
J174	366.00	0	25.06
J178	312.10	0.75	48.41
J180	356.88	0	110.17
J182	392.44	0	94.76
J186	338.57	0	118.1
J188	397.06	0	92.76
J192	431.31	0	77.92
J196	511.85	0	43.02
J198	474.46	0.15	59.22
J200	523.39	0.3	38.02
J206	408.16	0.3	87.95
J208	450.13	0	69.76
J212	487.00	0	53.79
J216	478.99	0	57.26
J228	333.00	0.3	120.52
J232	317.00	0	46.28
J236	571.00	0	17.33
J238	485.00	0.45	54.6
J240	491.88	0	51.62
J242	467.25	0.15	62.29
J244	328.98	0	122.21
J248	428.91	0.6	78.91
J252	230.63	0.45	84.27
J254	264.55	0.6	69.57
J256	203.33	0.3	96.14
J266	271.00	1.35	66.46
J270	278.43	0.3	63.18
J272	293.82	0	56.51
J274	308.96	0	49.95
J276	275.70	1.5	64.36
J282	316.25	0	46.61
J286	301.31	0.75	53.14
J290	315.00	0	47.15
J294	309.00	0.3	49.81
J298	301.16	0.75	53.21
J300	306.72	0.75	50.8
J302	299.31	0	54.01
J304	231.46	0.75	84.36

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J306	236.00	0.15	82.39
J314	203.38	0.3	96.52
J322	184.49	0.9	104.71
J326	285.77	0.15	60.82
J330	196.31	0	99.59
J332	212.75	0.45	92.46
J334	212.42	0.45	92.61
J336	208.75	0.45	94.19
J340	190.21	0.75	102.23
J344	190.16	0.15	100.82
J346	287.02	0	58.85
J350	261.47	1.8	69.92
J354	258.35	0.3	71.27
J356	228.53	1.65	84.19
J360	297.00	0.3	55.01
J364	276.64	0.45	63.92
J374	191.49	0	101.26
J384	269.73	0.6	67.79
J388	265.87	0	69.46
J394	194.86	0.15	99.73
J398	288.00	0.3	58.38
J400	314.00	0	47.59
J404	541.18	0	30.31
J408	494.70	0	50.45
J414	310.03	0	130.47
J418	317.96	0.3	46.05
J422	289.37	0.15	58.44
J426	295.00	0.15	56
J430	272.46	0.15	68.2
J434	275.00	0	67.1
J436	275.00	0	67.1
J438	272.00	0	68.4
J440	266.86	0	70.63
J442	270.00	0.3	69.27
J444	273.00	0.15	67.97
J446	271.87	0	68.45
J448	273.20	0	67.88
J450	270.79	0	68.92
J452	271.32	0	68.69
J456	273.34	0.15	67.82
J460	272.00	0.15	68.4

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J462	271.00	0	68.83
J466	268.01	0	70.13
J470	265.33	0	71.29
J474	266.96	0.15	70.58
J478	266.09	0.15	70.96
J480	268.85	0.15	69.77
J484	273.00	0.15	67.97
J488	275.04	0.15	67.08
J490	268.90	0	69.74
J494	270.52	0.15	69.04
J498	273.61	0.15	67.71
J504	189.00	0	102.76
J508	243.27	0.15	79.24
J514	199.00	0	98.36
J516	213.63	0	92.13
J520	198.64	0.15	98.51
J522	240.45	0.3	79.21
J526	229.00	0	85.42
J530	190.49	0	102.11
J534	195.63	0	99.89
J536	269.63	0.75	67.05
J538	241.87	0.3	79.07
J544	195.00	0	99.99
J552	326.91	0.3	123.1
J554	298.54	0.15	54.11
J556	311.05	0	48.87
J558	190.00	0.3	102.32
J560	191.76	0.9	101.56
J562	202.04	0.45	97.11
J564	298.59	0.75	53.85
J566	282.52	0.45	60.86
J584	239.73	0	82.38
J590	267.20	0.3	70.48
J592	267.38	0	70.4
J594	273.09	0	67.93
J596	234.26	1.5	84.77
J598	238.71	0.45	83.89
J600	272.77	0.3	82.91
J602	274.99	0.15	81.77
J604	260.37	0.9	86.83
J606	212.91	0	92.47

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J608	213.26	0	92.29
J610	193.00	0	101.01
J612	199.00	0	98.36
J614	199.00	0.15	98.36
J618	314.94	0.45	47.18
J620	301.42	1.35	53.1
J622	281.19	1.35	61.95
J624	268.87	1.65	67.46
J626	276.00	1.2	64.24
J628	270.00	1.8	66.89
J630	469.26	0	61.43
J632	471.19	1.35	60.59
J634	211.25	0.15	92.71
J636	212.14	0.15	92.3
J638	531.80	0	34.38
J640	235.32	0.3	82.76
J642	269.84	0.6	67.78
J644	210.31	0.45	93.53
J648	198.79	0	98.51
J650	212.33	0	92.64
J652	194.66	0	100.3
J654	198.59	0	98.6
J656	190.40	0	102.15
J658	191.00	0	101.89
J660	334.00	1.8	120.03
J662	426.79	2.4	79.83
J668	313.41	0	129.04
J670	365.44	0.45	106.46
J672	366.03	0	106.21
J674	357.85	0.45	109.75
J676	405.51	0.9	89.1
J678	312.22	0	129.52
J680	424.90	0.15	80.7
J682	450.00	0.45	69.82
J684	511.06	0.9	43.36
J686	488.38	0	53.19
J688	429.56	0	78.68
J690	488.82	0	53
J692	482.78	0	55.62
J694	359.07	0	109.22
J696	310.36	0	49.19

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J702	313.62	0	47.71
J704	306.45	0.15	50.88
J706	212.89	0	91.92
J708	222.73	0	87.91
J710	196.00	0.15	99.57
J712	214.73	0.45	90.83
J714	216.58	0.6	90.03
J716	226.92	1.05	85.55
J718	292.84	0.15	56.34
J724	302.00	0	52.52
J726	288.96	0.6	58.18
J728	285.01	1.05	59.89
J730	302.00	1.35	52.52
J732	266.10	0.6	68.08
J734	265.06	0.75	68.54
J736	256.00	0.3	72.47
J738	252.80	0.6	73.86
J740	265.00	0.45	68.57
J742	256.76	0.75	72.14
J744	258.95	1.35	71.19
J746	244.39	1.2	77.5
J748	249.91	0.45	75.14
J752	277.61	0.9	63.09
J754	275.05	0.9	64.21
J756	259.97	0	73.61
J758	268.91	0.15	69.74
J760	262.93	0.15	72.33
J762	259.05	0	74.01
J764	270.45	0.15	69.07
J766	273.04	0	67.95
J768	258.77	0	74.14
J770	260.92	0	73.2
J772	264.87	0	71.49
J774	265.38	0	71.27
J776	272.17	0.15	68.32
J778	272.00	0	68.4
J782	274.79	0.15	81.88
J786	233.32	1.2	83.67
J788	233.41	1.8	83.58
J790	310.00	0.75	50.35
J792	303.00	1.95	53.39

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J794	255.51	0.15	73.95
J802	265.07	0	69.81
J806	292.24	0.9	58.05
J808	259.00	1.2	72.44
J810	193.64	0.15	100.75
J812	198.71	0	98.55
J814	199.22	1.5	97.93
J816	193.11	0.75	100.56
J818	203.88	1.2	95.89
J820	221.69	0.6	88.15
J822	227.00	0.45	85.83
J824	248.70	0.75	76.39
J826	269.39	0.9	67.15
J828	274.08	0.3	65.08
J832	291.36	0.15	57.58
J834	292.00	0	57.3
J836	305.00	0	51.67
J838	297.57	1.65	54.76
J840	312.99	0	48.02
J842	295.16	0	55.81
J844	303.52	0.75	52.18
J846	313.00	0.15	48.08
J854	235.79	0.15	82.48
J856	236.97	0.45	81.97
J858	222.53	0.45	88.22
J860	185.86	1.05	104.12
J862	191.04	0.75	101.87
J864	191.87	1.2	101.51
J866	200.15	0	97.92
J868	194.00	0.15	100.59
J870	186.73	0.45	103.74
J872	199.16	0.6	98.35
J874	188.87	0.15	102.81
J876	268.48	0.3	66.88
J878	278.81	1.2	62.41
J880	273.08	0.3	64.89
J882	201.48	0.15	95.91
J884	287.07	1.8	58.83
J886	291.52	0.75	56.91
J888	195.44	0.15	99.97
J890	330.66	0.15	121.48

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J892	290.76	0.45	60.27
J894	191.86	1.5	101.1
J896	220.73	0	88.48
J898	258.07	0	72.17
J900	279.68	0.15	62.68
J904	225.00	0.6	87.7
J906	237.09	1.2	83.08
J908	305.81	0.9	52.17
J910	427.53	0.75	79.5
J912	346.79	0	114.54
J914	338.41	0	118.17
J916	423.49	0	81.31
J918	219.75	2.4	88
J920	217.27	0.9	89.07
J922	218.66	0.6	88.47
J924	264.55	0.3	68.59
J926	264.07	0.9	68.8
J928	189.00	0.6	102.76
J930	190.00	1.05	102.32
J932	212.34	0.15	92.64
J934	195.61	0.75	99.89
J940	187.87	0.15	103.25
J942	0.00	0	185.42
J946	269.92	0	69.3
J948	258.28	0	74.35
J950	270.31	0.6	66.75
J952	235.99	1.05	81.44
J954	219.68	0.6	88.85
J956	251.79	0	74.32
J958	191.02	0.75	101.88
J960	406.00	0.15	88.89
J962	197.51	0.15	97.63
J964	249.68	0	75.03
J966	0.00	0	183.22
J968	220.60	0.15	87.63
J970	0.00	0.9	183.22
J972	515.23	0	41.56
J974	0.00	0	264.81
J976	0.00	0	264.81
J978	0.00	0	264.81
J980	0.00	0	183.64

Junction Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J982	0.00	0.15	183.64
J984	0.00	0	183.64
J986	0.00	0	183.64
J988	0.00	0.15	183.64
J990	0.00	0.3	183.64
J992	316.24	0.15	46.61
J994	0.00	0	183.7
J998	0.00	0.45	183.7
J1000	295.98	0.3	55.45
J1002	287.17	0	59.39
J1004	288.14	0.15	58.97
J1006	213.47	0.45	92.22
J1008	0.00	0	184.69
J1010	0.00	0	184.69
J1012	198.89	0.6	98.47
J1014	198.97	0	98.37
J1016	0.00	0	184.65
J1018	0.00	0.15	184.66

Pump Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Elevation (ft)	Head (Design) (ft)	Flow (Design) (gpm)
North Well Pump Station	255	330	300
East Well Pump Station	303	385	300
South Wells Pump Station	249	282	350
Booster Pump Station	317	240	130

Tank Input Data - Capital Efficiency Plan™
Hooksett Village Water Precinct

Label	Diameter (ft)	Elevation (Base) (ft)	Level (Maximum) (ft)	Level (Initial) (ft)
West(Quarry) Tank	58.75	385	50	38
Thompson Corner Tank	33	395	30	23
Manor Drive tank	50	568	75	56

Appendix D

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

6. Route 3A
New 12-inch Water Main

5. Pine Street
New 12-inch Water Main

3. Pinnacle Street, West River Road, and Maple Street
New 12-Inch Water Main

1. Vista Drive and Cross Country
New 12-inch Water Main

8. Riverside Street
New 12-inch and
8-inch Water Main

7. Daniel Webster Hwy
New 12-inch Water Main

4. Main Street and Route 3
New 12-inch Water Main

2. River Crossing
New 12-inch Water Main

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Legend

- Priority 1 Hydraulic Deficiencies
- Priority 2 Hydraulic Deficiencies

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains
- High Service Area


Hydraulic Deficiencies
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021


Appendix E

TATA & HOWARD


Critical Water Mains
Hooksett Village Water Precinct
Hooksett, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
March 2021
N
Allenstown
Bow
Hooksett Village
Dunbarton
Goffstown
Manchester
North Pump Station
North Well
East Pump Station
East Well
South Well Back-Up
South Pump Station
South Well
West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft
Booster Pump Station
Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft
Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft
Legend
Critical Area
Critical Users
Other
School
Water Main Diameter
4-Inch or Smaller
6-Inch
8-Inch
12-Inch
16-Inch
Private Mains
High Service Area

Appendix F

TATA & HOWARD



Asset Management Ratings
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'

March 2021

Appendix G

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

Legend

- Priority I Hydraulic
- Priority II Hydraulic
- Critical Area

Critical Users

- Other
- School

- Private Mains

AM_Score, Proposed

- No Score
- Excellent to Good
- Good to Fair
- Fair to Poor
- High Service Area

Three Circles Integration
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

Appendix H

TATA & HOWARD

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

3. Route 3A
New 12-inch Water Main

2. Ardon Drive, Well Access Road, and Pine Street
New 12-inch Water Main

7. Riverside Street
New 12-inch and
8-inch Water Main

Booster Pump Station

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

North Pump Station

North Well

East Pump Station

East Well

9. Pinnacle Street and Maple Street
New 12-Inch Water Main

10. Veterans Drive
New 12-inch Water Main

South Well Back-Up

South Pump Station

South Well

8. West River Road
New 12-Inch Water Main

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

1. Vista Drive and Cross Country
New 12-inch Water Main

4 Main Street and Route 3
New 12-inch Water Main

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

5. Daniel Webster Hwy
New 12-inch Water Main

6. River Crossing
New 12-inch Water Main

Merrimack River

West River Rd

Post Rd

Pleasant St

Merrimack St

Hooksett Rd

Main St

Maple St

Veterans Dr

Thompson Ave

Dartmouth St

Maidstone Rd

Lehoux Dr

Industrial Park Dr

Oak Hill Rd

Londonderry Tpke

Whitehall Rd

Martins Ferry Rd

Cross Rd

Meadowcrest Rd

Scott Ave

Gosselin Ave

Technology Dr

Quality Dr

Kimball Dr

Sunrise Blvd

Ridden Ranch Dr

Driveway A159

Driveway A472

Interstate 93 N

Interstate 293 S

I-93 NB Exit 10 Off ramp (I-293 SB)

I-93 SB Exit 11 Off (Hackett Hill Rd)

I-93 NB Exit 11 Off (Hackett Hill Rd)

I-93 Exit 11 (Hackett Hill Rd)

I-93 SB Exit 11 On ramp (I-293 NB)

I-93 NB Exit 10 On ramp (NH 3A)

Legend

- Phase I IImprovements
- Phase II Improvements

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains
- High Service Area

Phase I and II Improvements
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

N

Allenstown

Bow

Hooksett Village

Dunbarton

Goffstown

Manchester

North Pump Station

North Well

East Pump Station

East Well

South Well Back-Up

South Pump Station

South Well

West (Quarry) Tank
Capacity: 1 mg
Overflow Elevation: 435 ft

12. Heather Drive and Cross Country
New 8-inch Water Main

11. Highland Street
New 8-inch Water Main

13. Granite Street, Otterson Street, Chase Street
New 8-inch Water Main

Booster Pump Station

14. Merrimack Street
New 12-inch Water Main

16. Bullard Drive
New 8-inch Water Main

Manor Drive Tank
Capacity: 1.1 mg
Overflow Elevation: 643 ft

Thompson Corner Tank
Capacity: 0.2 mg
Overflow Elevation: 425 ft

17. Dale Road
New 8-inch Water Main

18. Bayview Terrace and West Bank Road
New 8-inch Water Main

15. Scott Avenue and Green Street
New 8-inch Water Main

Edgewater Dr
West River Rd
Pine St
Bridgewine Dr
Springer Rd
Hooksett Tpke
Interstate 93 S
No Name
Main St
Beaver Way
Deer Run
Pleasant St
Merrimack St
Hooksett Rd
Post Rd
Bernice St
Highland St
Bullard Dr
Knights Way
Granite St
Bay St
Stevens Dr
Maple St
Riverside St
Veterans Dr
College Park Dr
Campus Dr
University Cir
Thompson Ave
Grant Dr
Ray Dr
Morgan Dr
Kibbali Ave
Pleasant View Dr
Blackwater Dr
Crawford Ln
Merrimack River
Ayer Rd
Morse Dr
Mallory Ln
Wedgewood Cir
Memorial Dr
Shannon Rd
Tay Rd
Trent Rd
Dove Rd
Avon Rd
Maidstone Rd
Thames Rd
Gary Ave
Marlette Ave
Dartmouth Dr
Hewitt Ave
Hunt St
Kerri Ln
Post Rd
No Name
Avon Dr
Pine St
Summit Dr
Vista Dr
Donald St
Birch Hill Rd
Interstate 93 N
Interstate 93 S
I-93 NB Exit 11 On ramp
I-93 SB Exit 11 Off (Hackett Hill Rd)
I-93 Exit 11 (Hackett Hill Rd)
I-93 NB Exit 11 Off (Hackett Hill Rd)
Water Precinct Access Rd
Fell House Access Rd
Cate Rd
Saw Hill Rd
Paluzzi Rd
Mountain View Rd
Almeda Ln
Roy Rd
Grandview Dr
Quimby Mountain Rd
Pearl Dr
South Bow Rd
Viewpoint Dr
Orchard Dr
Mason Ave
Hilltop Cir
Morningside Dr
Brown Rd
Cross Rd
Meadowcrest Rd
Bayview Terrace Rd
West Bank Rd
Scott Ave
Green St
Driveway A159
Sunrise Blvd
West River Rd
Hidden Ranch Dr
Driveway A159
Gosselin Ave
No Name
Technology Dr
Quality Dr
Kimball Dr
Central Park Dr
Lehoux Dr
Peters Brook Dr
Industrial Park Dr
Legends Dr
Oak Hill Rd
Westview Terr
Julia Dr
Lindsay Rd
Burbank Way
Virginia Ct
Nancy Ln
Sterling Ave
Londonderry Tpke
Clough Ave
Benton Rd
Whitehall Rd
McAllister St
Driveway A472
Martins Ferry Rd
Harvest Dr
Morphes Dr
Maidstone Rd
Lancelot Dr
Camelot Dr
Sherwood Dr
N River Rd
Power Rd
Hackett Hill Rd
Briar Ct
Poore Rd
Bemis Savoie Rd
W Riverbank Rd
Groonan Rd
Interstate 293 S
Interstate 293 N
I-93 NB Exit 10 Off ramp (I-293 SB)
I-93 SB Exit 10 On ramp (I-293 NB)
I-93 NB Exit 10 On ramp (NH 3A)
Valley View Dr
Corriveau Dr
Goffstown Rd

Legend

- Phase III A Improvements
- Phase III B Improvements

Water Main Diameter

- 4-Inch or Smaller
- 6-Inch
- 8-Inch
- 12-Inch
- 16-Inch
- Private Mains
- High Service Area

Phase III Improvements
Hooksett Village Water Precinct
Hooksett, New Hampshire

TATA & HOWARD

Approximate Scale: 1" = 1,000'
March 2021

TATA & HOWARD

OFFICE LOCATIONS:
MA | NH | CT | ME | VT | AZ

800-366-5760
www.tataandhoward.com

Appendix G

TATA & HOWARD

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
1	Water Resource Adequacy	Provide an adequate supply for customer demand.	$\frac{Current\ Capacity}{Peak\ Daily\ Demand} \geq 1$ $\frac{Current\ Capacity\ with\ Largest\ Well\ Offline}{Average\ Daily\ Demand} \geq 1$
2	Product Quality	Compliance with Federal and State drinking water regulations.	Maintain 99% or greater days in compliance. Determine and reassess annually. $\frac{No.\ of\ Days\ in\ Full\ Compliance}{Total\ Days\ in\ a\ Year} * 100 = \%\ of\ Days\ in\ Compliance$
3	Stakeholder Support	Improve public understanding of utility matters.	Share asset management plan information in newsletter and brochure. Quarterly update of website. Annual update and publication of Capital Improvement Plan.

TATA & HOWARD

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
4	Customer Satisfaction	Maintain a customer inquiry log (quality, quantity, pressure) log.	Minimize system related inquiries. Respond to customer inquiries/concerns within 2 working business days. Determine and assess annually. $\frac{No.of\ Complaints}{No.Accounts} \leq 2\%$
		Provide accurate customer billing information.	Issue 95% or greater correct bills. Determine and reassess annually. $\frac{Total\ Bills - No.\ Error - Driven\ Billing\ Adjustments}{Total\ Bills} * 100$ $= \%\ Correct\ Bills$
5	Community Sustainability & Economic Development	Maintain affordable rates.	Maintain an average user cost of less than 2.5% of MHI.

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
6	Employee & Leadership Development	Maintain employee satisfaction.	Provide opportunities for training and professional development. Complete an annual satisfaction level check in with employees.
		Maintain certification coverage.	Maintain 100% certification coverage. Determine and reassess annually. $\frac{No.\ Employee\ Certifications}{No.\ Required\ Certifications} * 100 = \%\ Certification\ Coverage$
7	Financial Viability	Obtain adequate revenue to cover overall expenditures.	Revenue to cover total expenditures is 95% or greater. Determine and reassess annually. $\frac{Total\ Revenue}{Total\ Expenditures} * 100 = \%\ revenue\ to\ cover\ total\ expenditures$
		Maintain sufficient reserves.	Maintain capital reserves funds of at least 30% of budget. Re-evaluate the reserves to budget ratio annually.
		Ensure financial management integrity.	Complete annual financial statement audit with the goal to present a clean opinion indicating that the financial statements fairly represent the finances of the Precinct.

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
8	Operational Optimization	Provide efficient water delivery. Implement leak detection and repair program.	Water balance is 15% or less. Determine and reassess annually through a water balance reporting. $\frac{Water\ Balance}{System\ Input\ Volume} * 100 = \%\ water\ balance$
		Maintain meter functionality. Continue water meter replacement program.	Maintain 95% or greater functioning meters. Determine and reassess annually. $\frac{Total\ No. Active\ Billable\ Meters - Stopped\ or\ Malfunctioning\ Meters}{Total\ No. of\ Active\ Billable\ Meters} * 100 = \%\ Functioning\ Meter$
		Maintain efficient distribution system and treatment systems.	Achieve treatment goals of pH ≥ 7.2 and free Cl ≥ 0.2 mg/L > 90% of the time leaving treatment plants. Review annually. Prioritize looping to eliminate dead ends in system with the hydraulic model, and optimize pump/tank operations. Track energy use and savings annually from energy audit implementation. Calculate savings form implementation.

TATA & HOWARD

No.	Key Management Area	Levels of Service	
		Performance Measures	**Performance Targets**
9	Infrastructure Stability	Complete 'Critical' asset identification.	Complete recommendations outlined in the asset management report, including the identification. Assessment of remaining above and below ground assets.
10	Operational Resiliency	Minimize water main breaks and leaks.	10 or less water main breaks per 28 miles of pipe per year. $\frac{No.\,Breaks/Leaks\,per\,Year}{Total\,Miles\,of\,Pipe} * 28 = No.\,Breaks/Leaks\,per\,Mile\,of\,Pipe$
		Maintain an all hazards emergency response plan.	Update emergency response plan with vulnerability assessment. Complete health and safety training for all employees.

TATA & HOWARD

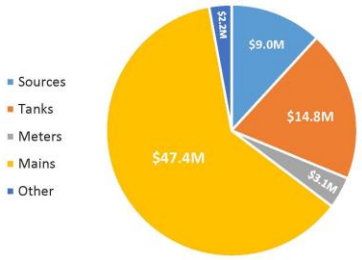
TATA & HOWARD

Appendix H

TATA & HOWARD

Life Cycle Costs

The Precinct's Asset Management and Capital Improvement Plans lay out estimated system costs for the next 20-25 years. Projecting forward to a major asset life span of 100 years, the refurbishment & replacement life costs as currently understood are likely to be:



Funding Strategy

- Integration of AMP and CIP
- Annual reviews of CIP, rates, budget and reserves
- Creative and fair revenue models
- Maintain/build capital reserves
- CIP funded in operating budget
- Projects prioritized in plans
- Integrated road works planning
- Reuse debt service decreases
- Seek grants / low-interest loans
- Proactive vs. reactive

What People Are Saying

"I really appreciate that you are working so diligently to update the infrastructure" …Resident/Customer/Local Official

"[you're]…doing a wonderful job with the limited resources that you have at your disposal…keep up the great work!"…NHDES

"I…have seen many pump station sites … and I have NEVER seen them so clean and taken care of as yours"…Contractor

Looking Forward

We need your support! To continue providing safe, secure drinking water and fire protection, the Precinct will need residents, officials, builders, funders and other stakeholders to work with us as we seek to promote a better understanding of critical water infrastructure resources and needs. Working together, the future is bright.

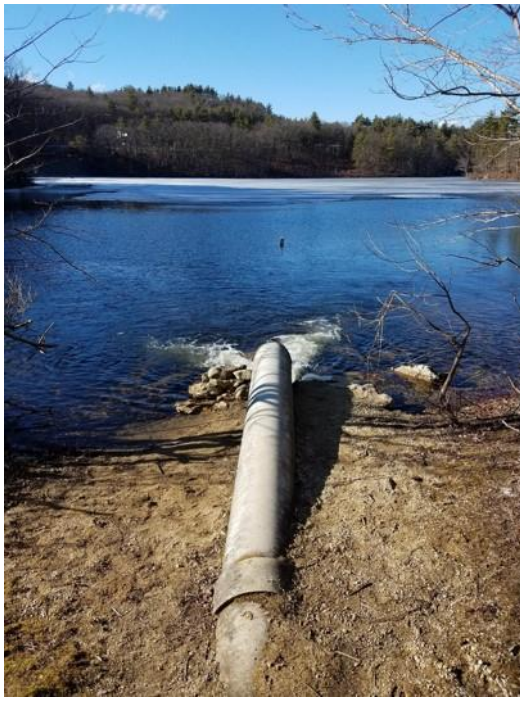
Contact Us

Hooksett Village Water Precinct

7 Riverside Street
Hooksett, NH 03106
(603) 485-3392
inbox@hooksettvillagewater.org

Water System Asset Management

…in Hooksett Village, NH



HOOKSETT VILLAGE WATER PRECINCT
Quality on Tap



What is Asset Management?

Asset management is an approach to operating and maintaining a water system cost-effectively while maintaining a level of service that is acceptable to customers and sustainable over the long-term.

This approach helps decision-makers plan for the care of aging assets. Founded in 1941, the Hooksett Village Water Precinct follows this approach to ensure that our residents get the most value from their water system assets and that we have the resources to rehabilitate and replace those assets as needed.

Asset Management Plans include:

- **Asset Inventory** - *What the system owns*
- **Level of Service** – *How the system performs*
- **Critical Assets** – *Identifying the most important risks/assets*
- **Life Cycle Costing** – *Costs of maintaining the system*
- **Funding Strategy** – *How the system pays the costs*

Project History

The best Asset Management Plans are living documents that evolve over time. With our partners Tata & Howard, Granite State Rural Water Assoc., Brown Engineering and NHDES, the Precinct completed a comprehensive plan in 2022. The plan built upon extensive field, rate review and capital improvement studies begun in 2016 and included:

- *Total hydrant flow testing*
- *GIS & SCADA systems development with aerial drone mapping*
- *Valve & meter program upgrades*
- *Energy & water loss audits*

The Village Water System (Asset Inventory/Critical Assets)

Sources: Four wells @ Pinnacle Pond, 1,200 gals/min, 111 million gals/yr

Treatment: Chlorine (disinfection), soda ash/phosphate (color/corrosion)

Storage: Three tanks, 2.2 million gals

Distribution: 32 miles of water main, 196 fire hydrants, 1,200+ services

System Performance Metrics ("Level of Service")

Affordability: 0.65% (Goal <2.5%)

Average Cost per Gallon: $0.01

Water "Balance": 1.5% (Goal <15%; unauthorized/unmetered use)

Breaks/Leaks per Year: 3 (Goal <10)

Available Capacity: >79,000 gals/day with primary well off-line

Violations: None



FOR IMMEDIATE RELEASE **CONTACT: inbox@hooksettvillagewater.org**
April 21, 2022

Hooksett Village Water Precinct kicks off Drinking Water Week by celebrating tap water being "There When You Need It"

Hooksett, NH – Hooksett Village Water Precinct and partners throughout North America are kicking off Drinking Water Week celebrations by showcasing the different ways tap water is "*There When You Need It.*" Drinking Water Week is May 1-7 this year.

HVWP is observing Drinking Water Week by recognizing the vital role of tap water in daily life, the infrastructure that is required to carry it to and from homes and businesses, and the critical work that water professionals accomplish 24/7 to ensure the delivery of quality tap water.

"Tap water plays an integral role in meeting our daily health, hygiene and hydration needs," said American Water Works Association CEO David LaFrance. "Water sector professionals, the infrastructure they work to design, create and maintain and the treatment process all work in harmony to ensure safe tap water is '*There When You Need It.*'"

HVWP Superintendent Mike Heidorn noted that "water is our most valuable natural resource and the Precinct is committed to proactively maintaining and upgrading local water infrastructure to protect public health, safeguard the environment and allow our economy to prosper. We are actively implementing capital improvement and asset management plans and projects that demonstrate this long-term sustainable commitment to our community."

To celebrate Drinking Water Week, water organizations, governments, environmental groups, schools and others around the world are encouraging consumers to learn more about the importance of water services and water infrastructure, especially in times of crisis. HVWP is hosting a public **Open House** at its South Pump Station at 38 Pinnacle Street on May 4th (rain date May 5th) from 10AM – 2PM, including hands-on displays, exhibits and snacks.

About Drinking Water Week
For several decades, Drinking Water Week has provided a unique opportunity for both water professionals and the communities they serve to join together in recognizing the vital role water plays in daily lives. Free materials for download and additional information about Drinking Water Week are available on AWWA's Drinking Water Week webpage.

# # #

HOOKSETT VILLAGE WATER PRECINCT
Quality on Tap

Drinking Water Week22
There When You Need It
May 1-7, 2022

FOR IMMEDIATE RELEASE **CONTACT: inbox@hooksettvillagewater.org**
May 7, 2022

Hooksett Village Water celebrates Drinking Water Week

Hooksett, NH – Hooksett Village Water Precinct and its partners tapped into national Drinking Water Week celebrations on May 5th by hosting an Open House at their South Pump Station on Pinnacle Pond. The event included hands-on displays, exhibits and snacks as well as live drone demonstrations and generous local support from the Hooksett Fire Department.

HVWP would like to thank all of the residents, businesses, officials and others who attended. Superintendent Mike Heidorn noted "we truly enjoyed this opportunity to give something back to the community. Tap water is vital to daily life, the economy and fire protection. But most of what we work on is buried below ground so it's nice to share info on it in a visible, fun setting."



Members of the HVWP Open House Team at Pinnacle Pond are, from left, top row: Brian Vose, Granite State Rural Water Assoc.; Justin Shaw, GSRWA; Mario Focareto, Brown Engineering; Matt Norris, Asst. Supt., HVWP; Nancy Philibotte, Office Mgr., HVWP; Gary Hebert, Operator, HVWP; Arthur Menezes, Stiles Co.; Matt O'Dowd, Tata & Howard; Jenna Rzasa, Tata & Howard. From left, bottom row: Mike Jache, Commissioner, HVWP; Mike Heidorn, Supt., HVWP; Dennis Bell, Operator, HVWP. Not shown: Kent Brown, Brown Engr.; Bruce Seavey, Seavey Construction; Annie Wheeler, Statewide Aquastore; Evan Young, Hooksett Fire Dept.

In honor of Hooksett's Bicentennial, the history of the Precinct was highlighted during the Open House. The Precinct was formed in 1941 by joining two much older private water systems, the Hooksett Aqueduct Co. and the Dundee Mills System. A unique HVWP feature is the Brickyard Brook diversion, a 1960s-era engineering feat that maintains Pinnacle Pond.

Recent modernization, conservation and asset management projects were also highlighted at the Open House, including $2.5M in upcoming water distribution and storage tank improvements. HVWP proactively maintains local water infrastructure as per its capital improvement plan, paying close attention to rate impacts and levels of service.

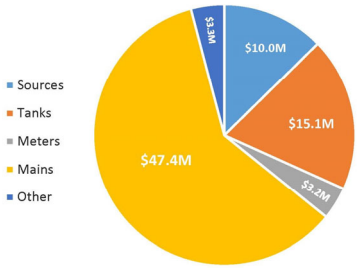
For more information on HVWP or to learn more about the importance of water services and water infrastructure, visit https://www.hooksettvillagewater.org.

HOOKSETT VILLAGE WATER PRECINCT
Quality on Tap

Drinking Water Week22
There When You Need It
May 1-7, 2022

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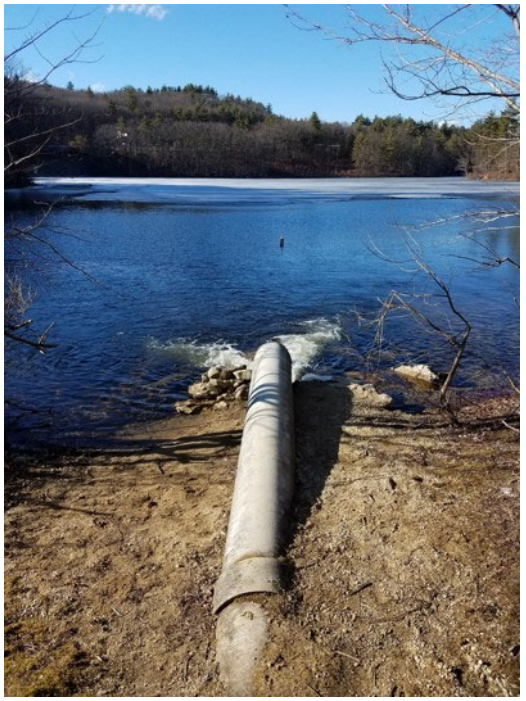
Contact Us

Hooksett Village Water Precinct

7 Riverside Street
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Water System Asset Management

…in Hooksett Village, NH



HOOKSETT VILLAGE WATER PRECINCT
Quality on Tap



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Available Capacity: >79,000 gals/day with primary well off-line

Violations: None



Appendix I

TATA & HOWARD

HVWP Water Distribution & Storage Improvement Project

PROJECT INFORMATION PACKAGE

Hooksett Budget Committee Meeting
January 20, 2022

Project History Highlights

2015: HVWP recognizes need for improvements. Budget Committee recommends CIP.

2016-17: 10-year CIP and 5-year rate projections initiated annually. Tank, water main, pump station and control/alarm projects identified as priorities in CIP, in agreement with NHDES directives (tank = top priority). Search for new tank site (over a dozen sites). Quarry site selected early 2017.

2017-18: Easements (DOT/Town/PSNH/private). Site/subdivision plans. $1.85M NHDES SRF loan (2%, 20yr) secured for quarry tank, associated water main out to RT3A, and demo of old tank.

2018: Bidding/contracts. Scope reduced to quarry tank and main at Pinnacle/Vista due to cost. Loan extension secured. Initial construction started, includes successful 400' boring 40' under I93. $728K grant application to NH DWGTF (unsuccessful) for remaining water main.

2018-19: $20K NHDES Asset Management Plan (AMP) grant complements project - included flow testing, missing valve location and drone mapping of distribution system, plus GIS implementation.

2019: Initial construction completed. HVWP suggests water projects inclusion for RT3A TIF and works jointly with Town to resubmit grant application to NH DWGTF ($744K, unsuccessful).

2020: $839K SRF loan application for remaining water main (unsuccessful). A detailed engineering study of future water system capacity completed voluntarily by HVWP confirms the need for ongoing source, storage and distribution projects. $7K NHDES energy audit grant received; audit indicates source-storage balancing may yield energy savings pending further studies.

2020-21: AMP Update completed voluntarily by HVWP - hydraulic modeling of distribution system shows where "imbalances" are and prioritizes 7 miles of water main improvements @ $12M, including the unfinished quarry tank main. Also shows old tank is critical for fire flow on east side. NHDES lists old tank as "Significant Deficiency" due to coating failure.

2021: Engineering evaluation of old tank – replacement recommended. $2M Congress Community Project grant and $2.2M SRF loan applications (both unsuccessful) for old tank replacement plus unfinished quarry tank main. Completed complementary 5-year, $500K+ investment in proactive update of pump stations and system controls/alarms which ties in tanks and mains.

2021-22: Repackaged old tank – unfinished main as TIF project. Successful pre-authorization for $1.2M DWGTF loan (1.3%, 20yr) and $1.2M+ in grants from various sources. Successful second $20K AMP grant application to further update AMP to include tanks and pump stations.



The Quarry ("Pike") Tank. This 1MG glass-fused-to-steel water storage tank went on-line without incident in May 2019. It is 59' wide and 51' tall. Treated water is pumped into the tank from the Pinnacle Pond area. The tank feeds the water into the Village under I93 by gravity.

Hooksett TIF District - Phase I Water Distribution & Storage Improvement Project

2021-22 NH Drinking Water & Groundwater Trust Fund (DWGTF) and NHDES American Rescue Plan Act (ARPA) Funds Applicant

This project consists of the construction of (a) 1,800 linear feet of distribution system improvements in the Vista Drive area and (b) a new 0.29 million gallon capacity glass-fused-to-steel tank and 700 linear feet of associated transmission main on the Daniel Webster Highway. The project is the first of three major drinking water components of the RT3A Tax Increment Financing (TIF) District economic development initiative sponsored by the Town of Hooksett.

The Precinct has been partnering with the Town, Sewer Commission, local businesses, committees, residents and area developers to encourage TIF-based infrastructure projects. TIF can be used to fund improvements that benefit the whole community by attracting new development, revitalizing blight, and/or enacting quality of life projects. This can significantly expand the tax base and provide more or easier access to services for residents, with less financial impact.

Hydraulic modeling studies completed in 2020 as part of the Precinct's asset management program showed that distribution improvements are needed in the Vista Drive area to relieve a bottleneck that is critically restricting flow from the existing West Tank and nearby wells. The Vista Drive area water main replacement/extension was listed as a Top Priority in the Precinct's March 2021 Asset Management Plan Update. This area is the closest and primary source of water and fire protection for the TIF District. As noted by the Town in its recent MOU with the Precinct, a direct connection to the area is imperative to efficiently transmit water to the TIF District.

The existing Thompson Corner Tank is critical to water system hydraulics, not only for fire flow purposes but also for engineered redundancy, emergency resiliency and operational flexibility. It is inextricably linked to the operation of the West Tank and the TIF District. Unfortunately, it has deteriorated to the point where it needs to be replaced. The new, slightly larger replacement tank that is proposed will, when completed, allow the West Tank to be taken off-line as needed for O&M or emergencies; provide backup storage for the TIF district; allow the West Tank to operate at 100% capacity; and improve overall energy efficiency by increasing off-peak operations.

Replacement of the existing Thompson Corner Tank would also serve as the permanent action plan to address a Significant Deficiency outlined by the New Hampshire Department of Environmental Services (NHDES) in October 2020. The deficiency identified was severe deterioration of the coating on the inside and outside of the tank. NHDES is requiring that funding be authorized by March 2022 and a tank construction contract be awarded by October 2022.

The estimated cost to replace the Thompson Corner tank and install the Vista Drive area water main is $2,464,000.

HVWP 2021 TRUST FUND PROJECT AREA

ROUTE 3A TIF DISTRICT

August 24, 2021

ZONE 1

ZONE 2

ZONE 3

X LOW POINT

X HIGH POINT

X LOW POINT

X HIGH POINT

PROPOSED SEWER DESIGN - 2020 CONSTRUCT - 2021

PROPOSED SEWER PHASE 3 DESIGN - 2021 CONSTRUCT - 2023

PROPOSED SEWER PHASE 5 DESIGN - 2021 CONSTRUCT - 2025

PROPOSED SEWER PHASE 4 DESIGN - 2021 CONSTRUCT - 2023

PROPOSED SEWER PHASE 2 DESIGN - 2020 CONSTRUCT - 2021

PROPOSED FORCEMAIN UPGRADES CONSTRUCT - 2021

MARTIN'S FERRY ROAD PUMPSTATION UPGRADES

PROPOSED RIVER CROSSING

EXISTING SEWER CROSSING TWIN 8"HDP PIPES

VISTA DRIVE WATER MAIN REPLACEMENT & EXTENSION

THOMPSON CORNER TANK rEPLACEMENT & MAIN

HEALTHCARE CENTER

FIRE STATION

POULTRY PRODUCTS

BASS PRO SHOPS

WALMART

UNITED HEALTH CARE

MARKET BASKET

POLARIS DIRECT

REGAL CINEMAS

IRVING OIL

NEW ENGLAND DRY ICE

MWW

POLKA DOT CHILD CARE/ RIVERSIDE NAIL

HOME DEPOT

GREAT CLIPS

WENDY'S

TARGET

PETCO

DUNKIN DONUTS

SELF STORAGE FACILITY

KOHLS

BJ'S/ AMAZON

ICE DEN

BLUE COAST BEVERAGES

LANG DOOR AND HARDWARE

SPORTS ARENA

MOW TOWN POWER EQUIP

THE PIZZA MAN

MDS

GRANITE WOODS

HILLSIDE COMMONS (CARHARTT/HOOKSETT CHRISTIAN FELLOWSHIP)

CONDOS

TRI-TOWN ICE ARENA

HSC

RICHIE BROTHERS

KEYLAND

PUBLIC WORKS

NORTHEAST RECORD RETENTION

L & F AUTO WORKS

GIOVANNI'S

PURE ENCHANTMENT SALON AND SPA

LEHOUX DRIVE

WELCH STATION

BOSTON & MAINE RAILROAD

HOOKSETT SEWER COMMISSION

JOHN G. MACLELLAN, INC.

OLDCASTLE LAWN & GARDEN INC.

MANCHESTER SAND & GRAVEL

BGH HOOKSETT LLC

CMI LEASING CORP.

HOOKSETT SCHOOL DISTRICT

SHIPLEY, K. JULIANNE

TOWN OF HOOKSETT

VILGRAIN, MANOUCHEKA

SWEENEY, DENNIS J.

WC REALTY INC

COPACON LLC

SUNSET ROCK LLC

PURE HOOKSETT LLC

LACO CORPORATION

HOOKSETT RECYCLING&PROCESSING CENTER INC

ROB RA KE RO LLC

CREW, JAMES A.

STATE OF NEW HAMPSHIRE

CENTRAL HOOKSETT WATER PRECINCT

GENERAL ELECTRIC CORPORATION

NTD SALES LLC

NORTHERN NEW ENGLAND TEL OPS LLC

1370 HOOKSETT RD REALTY LLC

1368 HOOKSETT ROAD LLC

BBR HOOKSETT ROAD REALTY LLC

PUBLIC SERVICE CO OF NH

UNDERBROOK LLC

SOUTHERN NH UNIVERSITY

ZIMMERMAN REV TRUST, GLEN A. & THERESE L

STATE OF NEW HAMPSHIRE

Town of Hooksett, New Hampshire

0 0.125 0.25 0.5 0.75 1 Miles

Legend

- PROPOSED WATER - PHASE 5
- PROPOSED WATER - PHASE 3
- PROPOSED WATER - PHASE 1
- PROPOSED SEWER - PHASE 5
- PROPOSED SEWER - PHASE 4
- PROPOSED SEWER - PHASE 3
- PROPOSED SEWER - PHASE 2
- PROPOSED SEWER - PHASE 1
- PROPERTIES PROPOSED FOR TIF EXPANSION
- EXISTING FORCE MAIN
- PROPOSED PUMP STATION
- ZONES
- BUILDING FOOTPRINT
- TIF STUDY AREA BORDER
- EXISTING SEWER MAIN (DRY)
- TIF PROPERTIES

LEGEND

PROPOSED 12" WATERLINE
EXISTING 16" A.C.P. WATERLINE

HVWP Water Distribution & Storage Projects

Pinnacle Street Area: 2018-2023

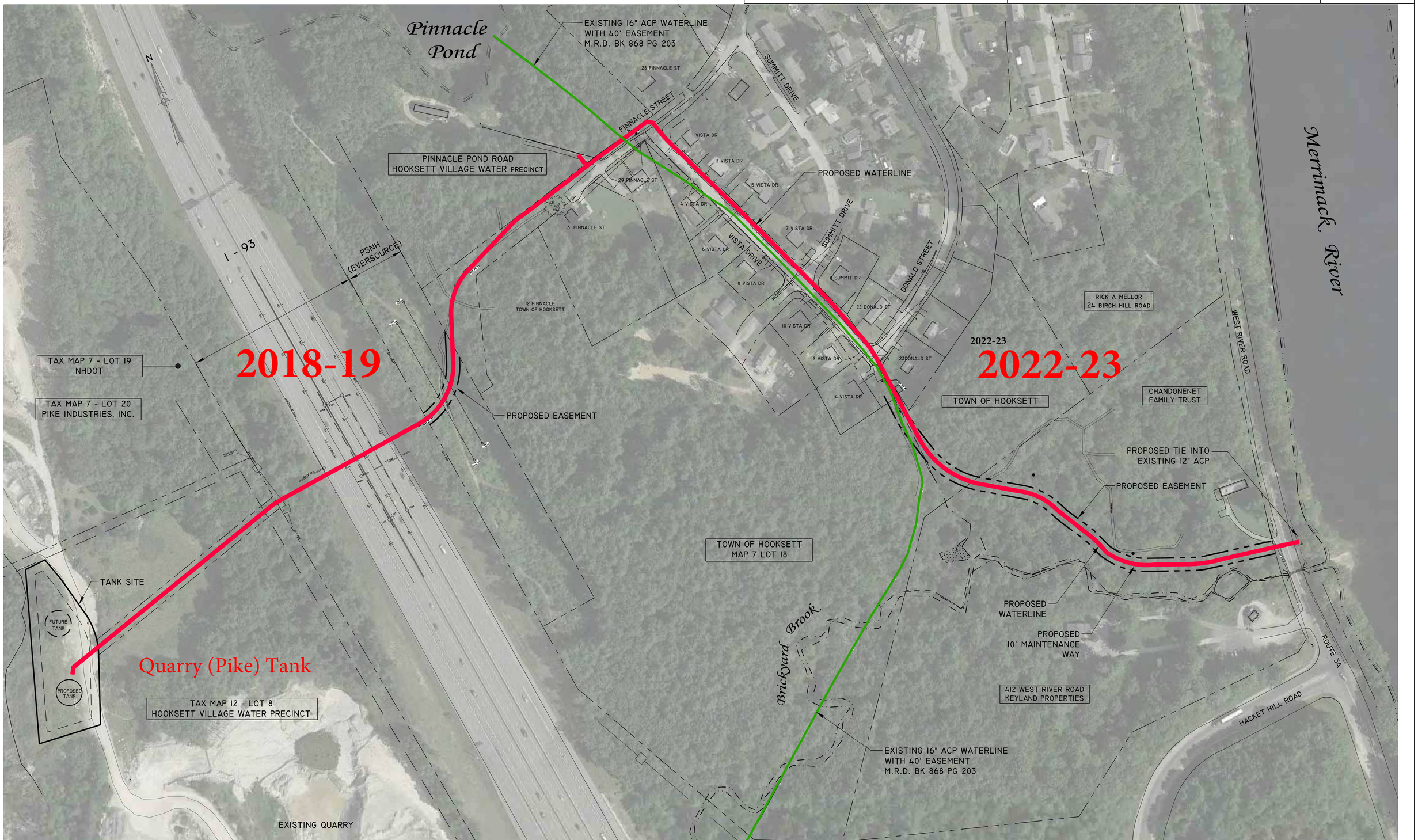
BROWN ENGINEERING /SURVEYING

civil engineers, surveyors construction managers
345 NH ROUTE 104, SUITE 7
NEW HAMPTON, NH. 03256
Tel: (603) 744-1044
www.brownengineeringllc.com

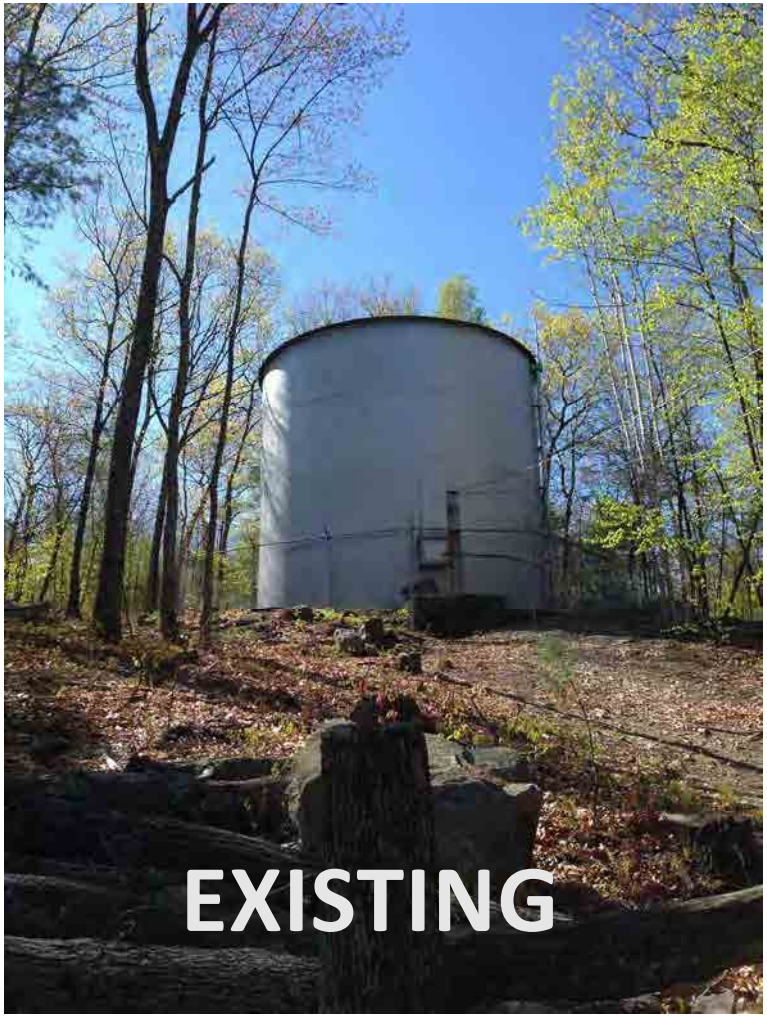
OVERALL PROPOSED WATERLINE PLAN
TAX MAP 12 LOT 8
STORAGE TANK REPLACEMENT PROJECT
HOOKSETT, NEW HAMPSHIRE
OWNED BY
HOOKSETT VILLAGE WATER PRECINCT
7 RIVERSIDE STREET, HOOKSETT NH, 03106

SCALE
50 0 100 (H)
SCALE: 1"=100'

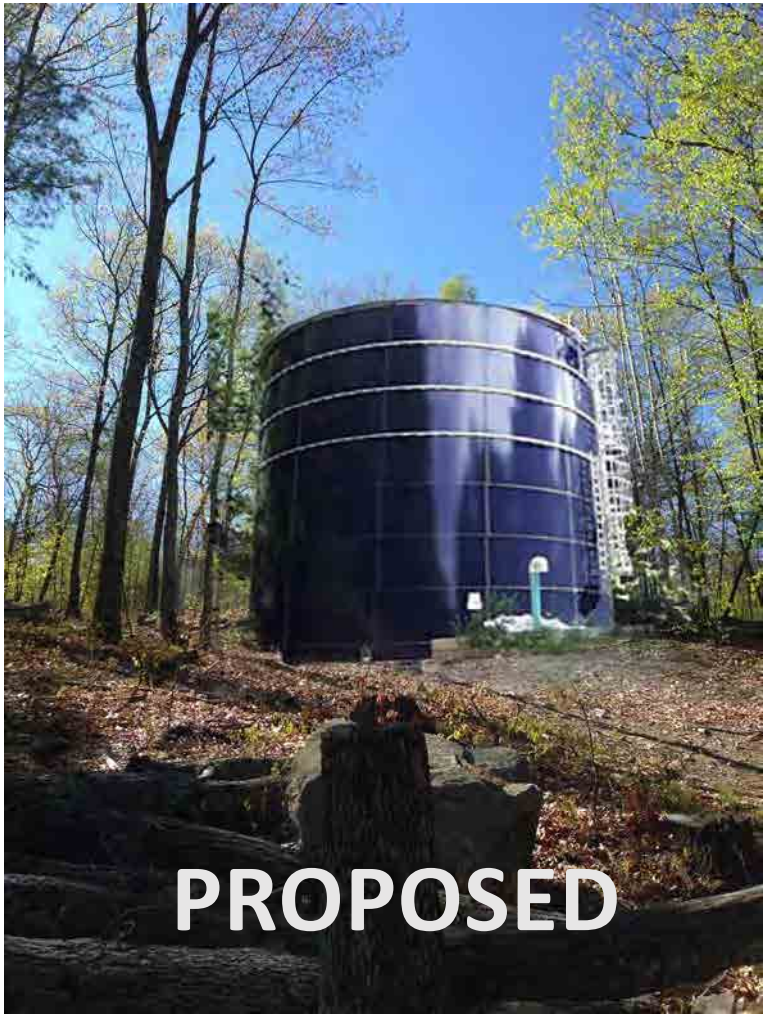
1 OF 1
4100-02



HVWP Water Distribution & Storage Improvement Project



Old Tank
(2022-23)



"Why Does the Project Matter?"



PRESSURE

FLOW





QUALITY

"Why Does the Project Matter?"

LOCAL GROWTH/TAXES

OPERATIONS EFFICIENCY

REGULATORY COMPLIANCE

EQUIPMENT REPLACEMENT

PLANNED MAINTENANCE

Savings



Revenues

“Why Does the Project Matter?”



Example of a flow-tested and marked hydrant at Donati Park. Blue indicates estimated flows >1,500 GPM at 20 PSI. Markers are reflective to improve nighttime emergency visibility.

BLAZE DAMAGES TWO-FAMILY HOME IN MANCHESTER - Firefighters challenged by weather conditions, the cause of the fire is under investigation.
Union Leader, January 18, 2021

5-ALARM BLAZE INJURES THREE, INCLUDING 2 FIREFIGHTERS - Fire destroyed building, which housed Cobblestone Ale House.
Union Leader, January 10, 2021

FATAL FIRE -
A baby was among the six rescued from burning apartment building.
Union Leader, November 8, 2021

FIRE PROTECTION

Project Next Steps*

JAN. 2022:	Budget Committee meeting.
FEB. 2022:	HVWP Annual meeting.
SPRING 2022:	Final NH DWGTF/NHDES ARPA applications/agreements. Governor/Executive Council approvals. Bidding/agreements (Vista Dr - RT3A water main).
SUMMER/FALL 2022:	Water main construction.
FALL/WINTER 2022:	Bidding/agreements (Old tank replacement).
SPRING 2023:	Tank construction.

**Note: All funding and construction scheduling is tentative and subject to change.*

HOOKSETT VILLAGE WATER PRECINCT

CY2022 BUDGET SUMMARY

The Hooksett Village Water Precinct (HVWP) is pleased to present a summary of its proposed CY22 budget. Formed in 1941, we have a long, proud history of providing effective water service in the Village and surrounding areas. Our goal is to continue to provide the best, most affordable service possible while responsibly managing and maintaining many miles of aging mains, hydrants, valves, tanks, pumps, wells, etc.

Capital Improvement Plan (CIP): On an annual basis, HVWP reviews and updates its 10-year CIP to better and more proactively address concerns over aging assets. The CIP focuses on the most pressing and important infrastructure needs, primarily those items identified by the State (NHDES) as requiring immediate attention. Those items include the old tank upgrade, new source development, emergency connection(s), meter upgrades, water main and facility improvements, and continuation of our asset management program.

In 2021, we further evaluated future capital needs, likely costs and potential funding sources. Out of this ongoing process, the CIP was updated into its current form covering the period from 2022 to 2031. While the structure, content and ultimate bottom line of the CIP remain essentially the same, particular attention was paid to crafting revised budget estimates for CY22. The revisions reflect our best understanding of project priorities and available funds, including a mixture of operating budget contributions and outside subsidies.

This past year we strengthened the CIP by updating and expanding our *Asset Management Plan*, to ensure that residents get the most value from their water system assets and that we have the resources to rehabilitate/replace those assets as needed. It is crucial that the CIP implementation continue to move forward in a timely fashion. Without reinvestment, infrastructure failures will increase; O&M costs will be unnecessarily high; and water shortages and decreased water quality are more likely. Many small towns are struggling with this – but Hooksett can avoid a negative future by continuing to make positive changes.

2022 Expenses: HVWP has spent a considerable amount of time evaluating this past year's expenses and activities, as well as this coming year's needs and priorities. During the past year, spending focused on significant challenges relative to metering/meter testing, compliance reporting, quarry lease renewal, well repairs, office safety (backup generator and electrical code updates), asset management studies and fundraising for the tank replacement project. Unanticipated water main project delays, combined with savings from in-house technical expertise and production efficiencies associated with recent pump station improvements, significantly reduced expenses in CY21 and ultimately caused us to come in ~$109K under budget.

For the coming year, we are projecting a 4% or $55K increase in the operating budget, which approximately mirrors the average 2021 U.S. inflation rate of 4.7%. This adjustment puts us back on track to better care for water system infrastructure in accordance with the *Asset Management Plan* and CIP in the future, despite the temporary pause in the budget increase that was planned for last year (due to the pandemic).

Within the CY22 expense budget, line item increases are associated mainly with engineering/implementation of the old tank replacement project; continuation of the metering upgrades; wage COLAs; additional pump station improvements; well redevelopment; supplemental pond monitoring requirements and ongoing planning for a new source. The third loan payment for the quarry tank project is fully contained within the budget.

CIP goals continue to be incorporated into the expense budget. As per NHDES recommendations, the long-term goal is to create an operating budget that accurately reflects the real cost of providing water and allows HVWP to proactively maintain/replace aging infrastructure and expand the infrastructure as needed. CY22 CIP projects that are not fully funded in the budget will be subsidized by the Precinct's trust and unrestricted funds. We anticipate a total subsidy of approximately $60K in 2022, which further minimizes the budget increase.

2022 Revenues: HVWP spent considerable additional time evaluating how we are currently collecting revenue and what we could do to most fairly raise the additional revenue needed for CY22 and beyond. As a result, we updated our comprehensive *Rate & Fee Schedule* (attached). The updated schedule includes a limited number of new standard rates and fees and supports our desire for transparency, fairness and consistency of application.

Due to the significant costs associated with CIP implementation, the Precinct continued to investigate a variety of additional revenue strategies to lessen the impact to water ratepayers. We consider taxation each year but continued to feel that we did not want to take this approach unless it was a catastrophic event. The adopted strategy focuses on partially subsidizing the increase through trust and unrestricted fund contributions totaling $60K. We also continued to aggressively pursue grant funds to offset revenue needs, and are pleased to announce the planned receipt of ~$1.2M in grants beginning this year. While most of the grant funds are dedicated to the mandatory old tank replacement project, portions of the grants may also be used to partially offset tank and asset management project expenses in the CY22 budget.

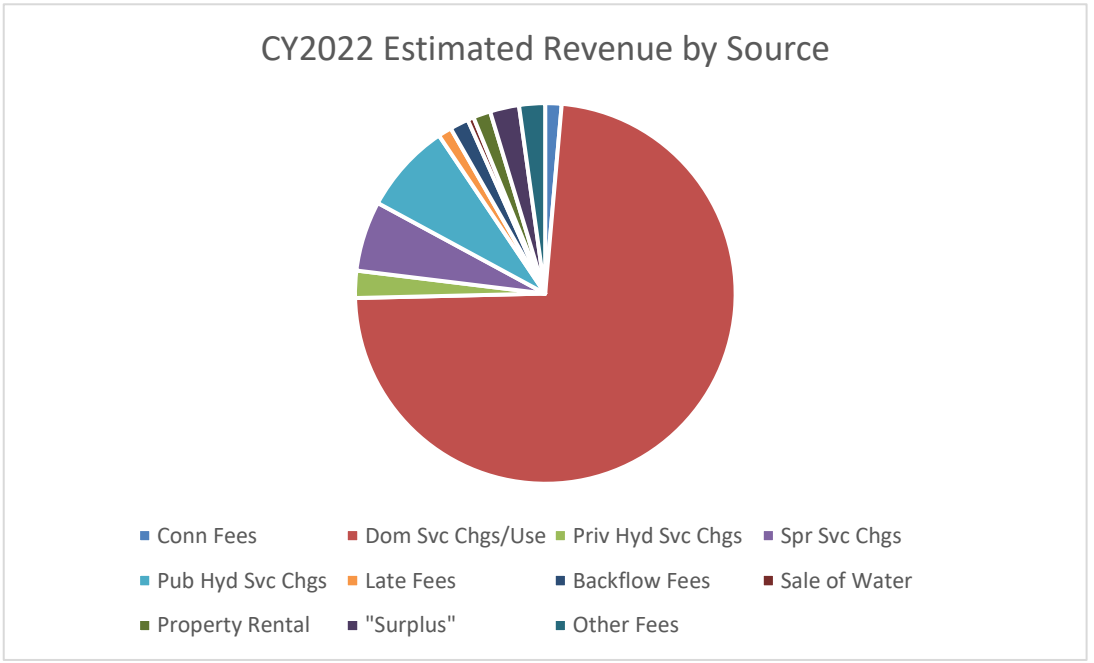
In CY22, increased revenues will be mainly generated by adjustments to domestic usage rates, minimum charges and sprinkler/hydrant/testing/inspection fees. Usage rates also continue to increase at higher levels of water usage, to encourage conservation as required by the State. For the average customer, the net result of the adopted rate changes will be an increase of about $3/month (from $37/mo. to $40/mo.).

2022 Warrant: In addition to the operating budget, warrant articles are proposed for authorization of a $1.2M low-interest loan toward the mandatory old tank replacement project and $305K in transfers from unrestricted funds into our trust fund accounts. The loan matches the above-referenced grants and is the highly sought-after result of a competitive application process. The transfers are intended to begin rebuilding the trust funds after a multi-year period of using those funds to subsidize the start of our CIP implementation program.

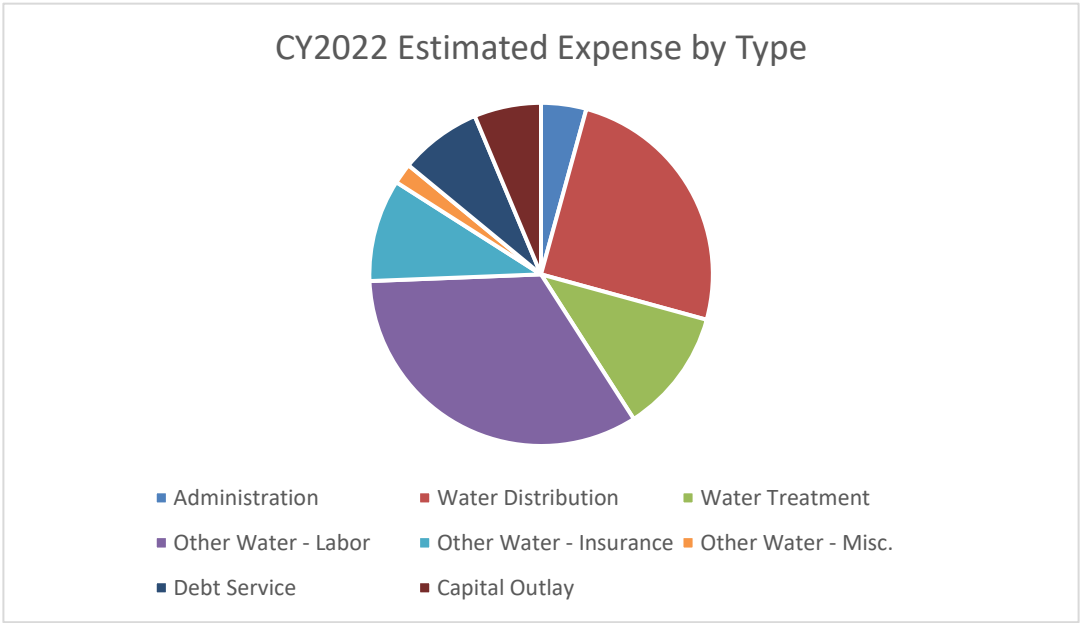
2022 Summary & Beyond: We believe that the proposed budget is realistic based on our industry experience, and reflects our goal of affordable but responsible management. Our debt is low, our rates are still reasonable (~$103 below the 2021 statewide annual average) and we maintain modest reserves for upcoming improvements. It is our intent to continue this strong financial standing while aggressively investing in our aging system and maintaining our commitment to compliance, reliability and customer service. Furthermore, the attached CIP plan and 5-year rate evaluation show how we are effectively transitioning into performing CIP tasks over 5 to 10 years, as the rates slowly begin to sustain the needed infrastructure on our normal operating budget and our focus shifts to rebuild the trust funds. We believe this responsible planning will help future generations inherit a strong independent water system only reliant upon our Town's desire to grow and prosper.



Category	Revenue	%
Conn Fees	19764	1.4%
Dom Svc Chgs/Use	1043206	73.2%
Priv Hyd Svc Chgs	32790	2.3%
Spr Svc Chgs	84760	6.0%
Pub Hyd Svc Chgs	109520	7.7%
Late Fees	16500	1.2%
Backflow Fees	22585	1.6%
Sale of Water	7500	0.5%
Property Rental	21222.63	1.5%
"Surplus"	35000	2.5%
Other Fees	31490	2.2%
Total:	*1424337*	*100%*



Category	Expense	%
Administration	60450	4.2%
Water Distribution	356460	25.0%
Water Treatment	166115	11.7%
Other Water - Labor	476341	33.4%
Other Water - Insurance	137427	9.6%
Other Water - Misc.	27425	1.9%
Debt Service	110119.5	7.7%
Capital Outlay	90000	6.3%
Total:	*1424337*	*100%*



HOOKSETT VILLAGE WATER PRECINCT

RATE AND FEE SCHEDULE

(Effective 1/1/2022)

DOMESTIC SERVICE RATES

0-10,000 gallons	$4.95/1000 gallons
10,001-25,000 gallons	$5.40/1000 gallons
25,001-75,000 gallons	$6.80/1000 gallons
75,001- 150,000 gallons	$7.30/1000 gallons
150,001 – 300,000 gallons	$7.45/1000 gallons
300,001 – 500,000 gallons	$7.65/1000 gallons
≥ 500,001 gallons	$8.40/1000 gallons

DOMESTIC SERVICE CHARGES

¾" Service	$73.00/ quarter
1" Service	$102.20/ quarter
1 ¼" Service	$116.80/ quarter
1 ½" Service	$131.40/ quarter
2" Service	$211.70/ quarter
3" Service	$803.00/ quarter
4" Service	$1022.00/ quarter
6" Service	$1533.00/ quarter
8" Service	$2190.00/ quarter
10" Service	$2774.00/ quarter

Services with Deduct Meters: $5.00/quarter (additional)

SPRINKLER SERVICE CHARGES

10"	$1060.00 / quarter
8"	$660.00 / quarter
6"	$360.00 / quarter
4"	$235.00 / quarter
2"	$185.00 / quarter

HYDRANT SERVICE CHARGES

Private Hydrants $185.00/qtr
Public Hydrants $185.00/qtr
Bulk Hydrant Use $8.40/1000 gals
(designated hydrant; requires prior approval)

MISCELLANEOUS FEES

Final Bill Fee $75.00 ($125.00 ≤ 48 hrs)
New Service Application Fee $100.00
Turn on / Reconnection / Turn off Fee $50.00/event (on or off)
Tampering / Unauthorized Use $250.00 + 50,000 gallons (min.)

Returned check Fee $45.00/check
Shutoff notification Fee $15.00/notice
Late payment Fee 12% of quarterly balance ($35 min.)
Backflow device inspection $50.00/inspection $25.00/re-inspection
Backflow device test/re-test $50.00/each
Backflow device permit $35.00 (permit renewal $10/year)
Private hydrant flushing $75.00/hydrant/flush
Fire flow test $150.00/test
Bacteria test $75.00/test
Construction plan review and construction site labor $85.00/hr min.
Non-construction site labor $50.00/hr ($75/hr after hrs; 3 hr min.)
Parts/materials/subcontractors @ Cost + 15%

TERMS OF PAYMENT

Quarterly water bills are rendered on or about February 1, May 1, August 1 and November 1. All bills, including those rendered at other times for miscellaneous services, are due and payable upon presentation. Bills may be estimated if needed.

A late payment charge will be added to any bill not paid by the due date, and a shutoff notice may be issued after the due date. Bills unpaid by the end of the quarter are also subject to 12% interest charges. Service may be discontinued for nonpayment of water bills or for a violation of the *Schedule for Water Service*.

The Precinct's terms and conditions in effect from time to time, where not inconsistent with any specific provision hereof, are a part of this *Rate and Fee Schedule*. A 5% senior citizen (ages 65+) discount is available on domestic services ≤1" for <10,000 gals/qtr.

SERVICE CONNECTION FEES

Service connection fees shall apply to any new or extended service connection utilizing Hooksett Village Water Precinct's water supply resources, regardless of whether the water main or service line being connected to is Precinct-owned or privately owned.

Service connection fees are one-time fees and are NOT related to other customer-borne expenses for any physical connection to HVWP infrastructure described in the *Schedule for Water Service*.

- Residential Connection: $900.00/Bedroom, min. $2,000.00
- Commercial Connection: $6.00/Gal/Day, min. $2,000.00
- Source Development: 50% of Res./Comm. Fee, min. $1,000.00
- Fire System Connection: $5,500/ISLD (inch svc. line diameter)

* 2022 RATE CHANGE SUMMARY

Proposed Sources of Additional Non-Grant Revenue Needs

Hooksett Village Water Precinct, FY2022-26

NHDES 2021 Statewide Average Annual Water Bill: $587.35 ($48.95/mo)

Type	Amount	Scenario	Results
			Avg. Resid. Customer:
Domestic service rates	$30,423	Alt. #1	$5.18 $/yr: $/mo:
Domestic service charges	$42,006	Alt. #1	$73.00 **$483.89** $40.32
Sprinkler service charges	$4,440	Alt. #1	$185-1060
Hydrant service charges	$7,800	Alt. #1	$185/185 *(priv/pub)*
Water taxes	$0	--	$0 Total tax ≤ $0
TOTAL:	$84,669	**2022**	From trust: $25,000
Domestic service rates	$30,802	Alt. #2	$5.53 $/yr: $/mo:
Domestic service charges	$36,005	Alt. #2	$79.00 $520.87 $43.41
Sprinkler service charges	$4,440	Alt. #2	$200-1075
Hydrant service charges	$7,800	Alt. #2	$195/195 *(priv/pub)*
Water taxes	$0	--	$0 Total tax ≤ $0
TOTAL:	$79,048	**2023**	From trust: $45,000
Domestic service rates	$22,063	Alt. #3	$5.68 $/yr: $/mo:
Domestic service charges	$36,005	Alt. #3	$85.00 $550.43 $45.87
Sprinkler service charges	$2,960	Alt. #3	$210-1085
Hydrant service charges	$3,900	Alt. #3	$200/200 *(priv/pub)*
Water taxes	$0	--	$0 Total tax ≤ $0
TOTAL:	$64,928	**2024**	From trust: $35,000
Domestic service rates	$20,058	Alt. #4	$5.83 $/yr: $/mo:
Domestic service charges	$36,005	Alt. #4	$91.00 $579.99 $48.33
Sprinkler service charges	$1,480	Alt. #4	$215-1090
Hydrant service charges	$3,900	Alt. #4	$205/205 *(priv/pub)*
Water taxes	$0	--	$0 Total tax ≤ $0
TOTAL:	$61,443	**2025**	From trust: $20,000
Domestic service rates	$19,388	Alt. #5	$5.95 $/yr: $/mo:
Domestic service charges	$30,004	Alt. #5	$96.00 $604.63 $50.39
Sprinkler service charges	$1,480	Alt. #5	$220-1095
Hydrant service charges	$3,900	Alt. #5	$210/210 *(priv/pub)*
Water taxes	$0	--	$0 Total tax ≤ $0
TOTAL:	$54,772	**2026**	From trust: $10,000

*Note: Range of DSR/DSC:	2021	4.65-8.05 / 66-2508	*0-10k to 500+ gals / 0.75" to 10"*
	2022	4.95-8.40 / 73-2774	"
Avg. resid.	2023	5.30-8.80 / 79-3002	"
customer uses:	2024	5.45-9.10 / 85-3230	"
9,270	2025	5.60-9.35 / 91-3458	"
gals/qtr	2026	5.70-9.60 / 96-3648	"

See details (attached)

* 2021 RATE CHANGE DETAILS

SUPPORTING CALCULATIONS - 2022-26 BUDGET RATE EVALUATION

Hooksett Village Water Precinct

DSR:

DOMESTIC SERVICE RATES EVAL. (2022-26)

# bills	% distrib	Tier	Gal/yr	Current	Current	Alt. #1	2022 Alt. #1	Alt. #2	2023 Alt. #2	Alt. #3	2024 Alt. #3	Alt. #4	2025 Alt. #4	Alt. #5	2026 Alt. #5
2455	0.52	0-10K*	13,504,000	4.65	$62,323	4.95	$66,343	5.30	$71,034	5.45	$73,045	5.60	$75,055	5.70	$76,396
1525	0.32	10-25K	23,390,000	5.05	$118,120	5.40	$126,306	5.75	$134,493	5.90	$138,001	6.05	$141,510	6.20	$145,018
508	0.11	25-75K	22,683,000	6.60	$149,708	6.80	$154,244	7.00	$158,781	7.20	$163,318	7.35	$166,720	7.50	$170,123
209	0.04	75-150K	21,208,000	7.15	$151,637	7.30	$154,818	7.35	$155,879	7.50	$159,060	7.65	$162,241	7.80	$165,422
32	0.01	150-300K	6,422,000	7.25	$46,560	7.45	$47,844	7.65	$49,128	7.80	$50,092	7.95	$51,055	8.10	$52,018
11	0.00	300-500K	4,798,000	7.35	$35,265	7.65	$36,705	8.10	$38,864	8.35	$40,063	8.65	$41,503	8.95	$42,942
21	0.00	500K+	22,211,000	8.05	$178,799	8.40	$186,572	8.80	$195,457	9.10	$202,120	9.35	$207,673	9.60	$213,226
4,761	1	Total:	114,216,000	--	$742,410	--	$772,833	--	$803,636	--	$825,698	--	$845,756	--	$865,144
(estim '21)			*(estim '21)*	Change:	$0	--	$30,423	--	$30,802	--	$22,063	--	$20,058	--	$19,388

**Note: Assumes 15% of first tier bills are subject to 5% senior citizen discount (@12% as of Oct 2021).*

DSC:

DOMESTIC SERVICE CHARGE EVAL. (2022-26)

# svcs	% distrib	Tier	Current	Current	Alt. #1	2022 Alt. #1	Alt. #2	2023 Alt. #2	Alt. #3	2024 Alt. #3	Alt. #4	2025 Alt. #4	Alt. #5	2026 Alt. #5
838	0.70	3/4"*	66.00	$219,573	73.00	$242,861	79.00	$262,822	85.00	$282,783	91.00	$302,744	96.00	$319,379
305	0.25	1"	92.40	$112,728	102.20	$124,684	110.60	$134,932	119.00	$145,180	127.40	$155,428	134.40	$163,968
0	0.00	1.25"	105.60	$0	116.80	$0	126.40	$0	136.00	$0	145.60	$0	153.60	$0
1	0.00	1.5"	118.80	$475	131.40	$526	142.20	$569	153.00	$612	163.80	$655	172.80	$691
53	0.04	2"	191.40	$40,577	211.70	$44,880	229.10	$48,569	246.50	$52,258	263.90	$55,947	278.40	$59,021
0	0.00	3"	726.00	$0	803.00	$0	869.00	$0	935.00	$0	1001.00	$0	1056.00	$0
4	0.00	4"	924.00	$14,784	1022.00	$16,352	1106.00	$17,696	1190.00	$19,040	1274.00	$20,384	1344.00	$21,504
0	0.00	6"	1386.00	$0	1533.00	$0	1659.00	$0	1785.00	$0	1911.00	$0	2016.00	$0
1	0.00	8"	1980.00	$7,920	2190.00	$8,760	2370.00	$9,480	2550.00	$10,200	2730.00	$10,920	2880.00	$11,520
0	0.00	10"	2508.00	$0	2774.00	$0	3002.00	$0	3230.00	$0	3458.00	$0	3648.00	$0
1,202	1	Total:		$396,057	--	$438,063	--	$474,068	--	$510,073	--	$546,078	--	$576,083
(estim '21)			Change:	$0	--	$42,006	--	$36,005	--	$36,005	--	$36,005	--	$30,004

**Note: Assumes 15% of first tier bills are subject to 5% senior citizen discount (@12% as of Oct 2021).*

size	AWWA std ratio						
0.75	1.0	73	79	85	91	96	
1	1.4	102.2	110.6	119	127.4	134.4	
1.25	1.6	116.8	126.4	136	145.6	153.6	
1.5	1.8	131.4	142.2	153	163.8	172.8	
2	2.9	211.7	229.1	246.5	263.9	278.4	
3	11.0	803	869	935	1001	1056	
4	14.0	1022	1106	1190	1274	1344	
6	21.0	1533	1659	1785	1911	2016	
8	30.0	2190	2370	2550	2730	2880	
10	38.0	2774	3002	3230	3458	3648	

SSC:

SPRINKLER SERVICE CHARGE EVAL. (2022-26)

# spr svc	% distrib	Tier	Current	+0.00	Alt. #1	2022 Alt. #1	Alt. #2	2023 Alt. #2	Alt. #3	2024 Alt. #3	Alt. #4	2025 Alt. #4	Alt. #5	2026 Alt. #5
6	0.08	2"	170.00	$4,080	185.00	$4,440	200.00	$4,800	210.00	$5,040	215.00	$5,160	220.00	$5,280
48	0.65	4"	220.00	$42,240	235.00	$45,120	250.00	$48,000	260.00	$49,920	265.00	$50,880	270.00	$51,840
16	0.22	6"	345.00	$22,080	360.00	$23,040	375.00	$24,000	385.00	$24,640	390.00	$24,960	395.00	$25,280
3	0.04	8"	645.00	$7,740	660.00	$7,920	675.00	$8,100	685.00	$8,220	690.00	$8,280	695.00	$8,340
1	0.01	10"	1045.00	$4,180	1060.00	$4,240	1075.00	$4,300	1085.00	$4,340	1090.00	$4,360	1095.00	$4,380
74	1	Total:		$80,320		$84,760		$89,200		$92,160		$93,640		$95,120
(estim '21)			Change:	$0		$4,440		$4,440		$2,960		$1,480		$1,480

HSC:

HYDRANT SERVICE CHARGE EVAL. (2022-26)

# hyd	% distrib	Tier	Current	Current	Alt. #1	2022 Alt. #1	Alt. #2	2023 Alt. #2	Alt. #3	2024 Alt. #3	Alt. #4	2025 Alt. #4	Alt. #5	2026 Alt. #5
45	0.23	Private	175.00	$31,500	185.00	$33,300	195.00	$35,100	200.00	$36,000	205.00	$36,900	210.00	$37,800
150	0.77	Public	175.00	$105,000	185.00	$111,000	195.00	$117,000	200.00	$120,000	205.00	$123,000	210.00	$126,000
195	1	Total:		$136,500	--	$144,300	--	$152,100	--	$156,000	--	$159,900	--	$163,800
(estim '21)			Change:	$0	--	$7,800	--	$7,800	--	$3,900	--	$3,900	--	$3,900

10-Year Capital Improvement Plan for FY2022-31

Long-Term Project Description	Year± of Last Purchase	Year± of Next Purchase	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	10-Year Project Cost	25-Year Project Cost
Tanks: (a) Installation of new correctly sized tank for Low Pressure Zone (LPZ) (via $1.8M SRF loan in 2016 - 2019)	2019	--	35 surplus 75 budget $110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$110,119	$1,101,195	$2,092,270
(b) Repair/replacement of old LPZ tank and completion of transmission main for new LPZ tank (estim. $1.55M SRF loan - 2022)	1950	2022	95 budget $95,000	$95,000	$95,000	$95,000	$95,000	$95,000	$95,000	$95,000	$95,000	$95,000	$950,000	$1,925,000
(c) Repair/recoat High PZ (HPZ) tank	2020	2033	— $0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$192,500
New Source Installation: For drought/contamination protection and growth (estimated $1M loan in 2025)	2007	2024	25 budget 25 trust $50,000	$25,000	$40,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$535,000	$1,335,000
Main Replacement/improvement: 25 miles pipe @ 1,000'/yr x $350/ft = $350K/yr goal (assumes 132-yr life cycle)	0 - 70 yrs±	Annual	105 budget $105,000	62500 34440 12500 $90,000	Constr costs engr $205,000	$185,000	$115,000	$185,000	$185,000	$140,000	$185,000	$185,000	$1,580,000	$5,135,000
Emergency Interconnection: Backup for west LPZ (estim. $750K loan in 2023)	1985±	2024	25 budget $25,000	$45,530	$45,530	$45,530	$45,530	$45,530	$45,530	$45,530	$45,530	$45,530	$434,770	$935,600
Meters/Transmitters: Routine upgrades/replacements (10-20 year cycle)	0 - 68 yrs±	2022+	50 budget $50,000	$40,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$130,000	$780,000
Facilities: Improvements for efficiency/safety/damage prev./SCADA	1-35 yrs±	Unk	15 budget $15,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15,000	$33,000
Vehicles: Routine replacement before major repairs (12-year cycle)	2-12 yrs	2023	$0	$95,000	$0	$0	$70,000	$0	$0	$45,000	$0	$0	$210,000	$520,000
Projected CIP totals:		*$373,119 (FY2021)*	***$450,119***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$500,649***	***$4,955,965***	***$12,948,370***
Breakdown of CIP Sources: *Trust funds:*		*$0*	*$25,000*	*$45,000*	*$35,000*	*$20,000*	*$10,000*	*$0*	*$0*	*$0*	*$0*	*$0*	*$135,000*	*$135,000*
Prior year surplus:		*$50,720*	*$35,000*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$35,000*	*$85,720*
Taxes:		*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Rates & fees:		*$322,399*	*$390,119*	*$455,649*	*$465,649*	*$480,649*	*$490,649*	*$500,649*	*$500,649*	*$500,649*	*$500,649*	*$500,649*	*$4,785,965*	*$12,727,650*
Projected Budget ▲ due to CIP:		*$0*	*$67,720*	*$65,530*	*$10,000*	*$15,000*	*$10,000*	*$10,000*	*$0*	*$0*	*$0*	*$0*		
														$12,948,370
Breakdown of Budget Needs: *CIP ▲:*		*$0*	*$67,720*	*$65,530*	*$10,000*	*$15,000*	*$10,000*	*$10,000*	*$0*	*$0*	*$0*	*$0*		
+ Routine O&M (inflation) ▲:		*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*		
+ Planned trust fund deposit:		*$0*	*$0*	*$0*	*$40,000*	*$35,000*	*$30,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*		
Approx. add'l. annual revenue needs ▲:		*$15,000*	*$82,720*	*$80,530*	*$65,000*	*$65,000*	*$55,000*	*$50,000*	*$40,000*	*$40,000*	*$40,000*	*$40,000*		
Maximum budget impact:		*1%*	*6%*	*6%*	*5%*	*5%*	*4%*	*4%*	*3%*	*3%*	*3%*	*3%*		

Project Funding "Quilt"*

Q1/Q2 2022:	Design/bid Vista/RT3A water main	$114K HVWP
Q3/Q4 2022:	Vista/RT3A main construction	$300K Town
	Design/bid tank and tank water main	$655.2K ARPA Grant (NHDES)
Q1/Q2 2023:	Tank and tank main construction	$1.176M NH Trust Fund Loan
		$218K NH Trust Fund Grant

**Note: All funding and construction scheduling is "best guess" as of 1/21/22 (tentative and subject to change).*

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