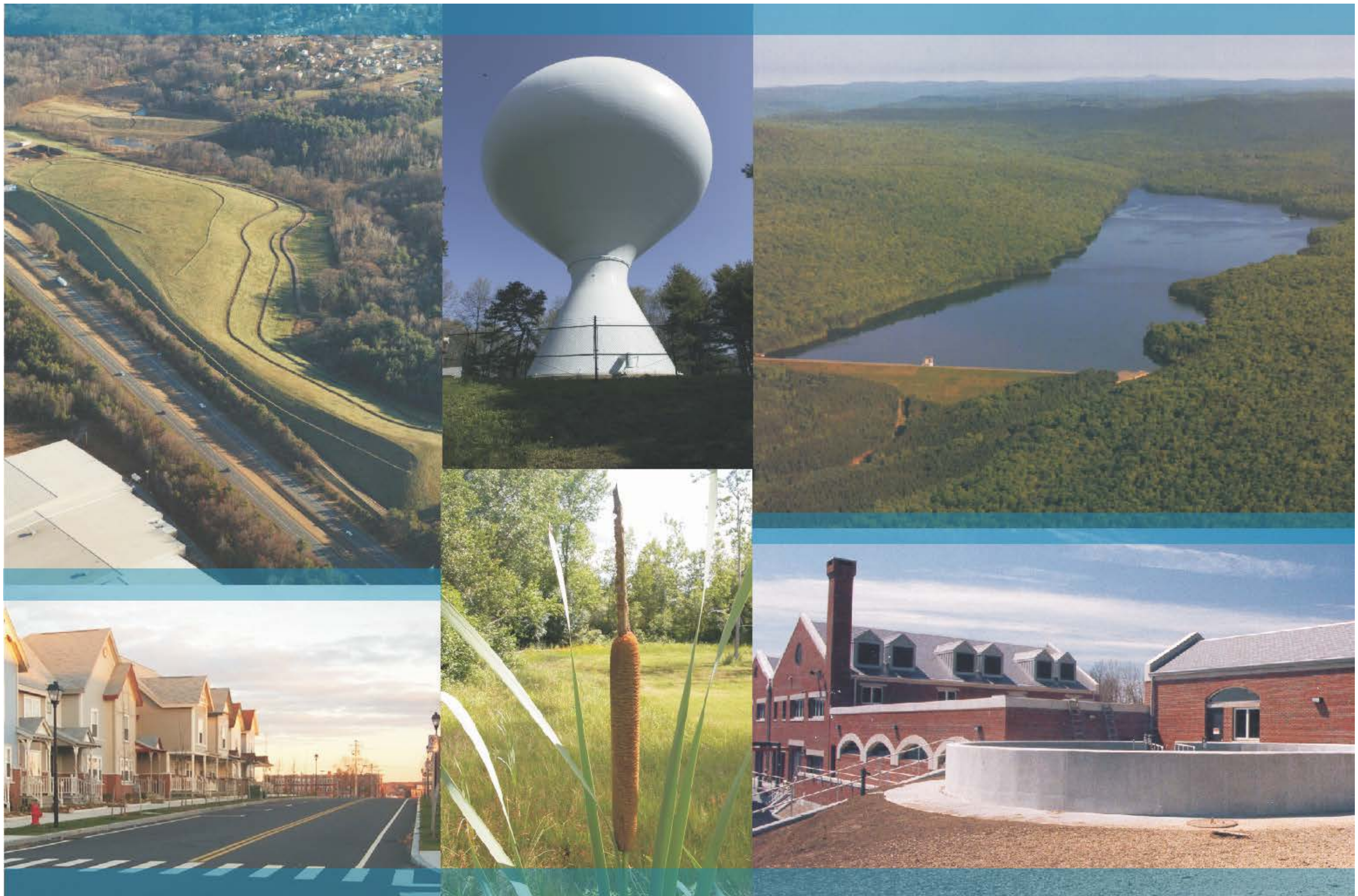

Tighe&Bond

Water System Facilities Asset Management Report

Prepared For:

Town of Jaffrey, NH

March 2018

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Section 1 Introduction

1.1 Project Overview

The Town of Jaffrey started developing a GIS-based asset inventory of its public water system in 2010. The asset management effort has been phased over several years and has focused on developing a field-verified inventory of the water system valves, hydrants, and water mains. In 2013, the New Hampshire Department of Environmental Services (NH DES) awarded the Town a matching grant to perform an asset management study focusing on the water distribution system that included scanning and integrating record plans into GIS, deploying mobile computing capabilities for GIS, performing a risk assessment, and developing a long-range capital improvement plan for the buried water infrastructure.

Apart from the buried assets, the Town's water system infrastructure also includes two storage tanks, three well facilities, and a booster pumping station. Previous asset management efforts have not addressed these facilities.

The goal of this Water System Facilities Asset Management project is to develop an asset management plan to prioritize maintenance and improvements of the water system's above-ground assets in a format that can be easily integrated with the asset management plan for the buried infrastructure. The following facilities were evaluated as part of this project:

- Turnpike Well Facility
- Contoocook Well Facility
- Squantum Well Facility
- Prospect Booster Station
- Poole Tank
- Bullet Tank

The Water System Facilities Asset Management plan was developed with the purpose of identifying, prioritizing, and budgeting for water infrastructure improvements at the facilities over a 20-year planning horizon. The plan will provide the Town with the ability to prioritize expenditures, plan for and normalize expenditures over the planning period, as well as minimize operating and maintenance costs.

1.2 Project Scope

On July 14, 2017, a kick-off meeting was conducted between the Town of Jaffrey, Tighe & Bond, and a representative from NH DES, to discuss the Water System Facility Assessment. The purpose of the meeting was to review the project's goals, objectives, and methodology, and collect documentation.

On July 7, 2017, on-site assessments of the water system facilities were conducted to evaluate the condition of the facilities and identify needed repairs and equipment replacements to maintain reliable performance. Major equipment items and systems were inventoried and nameplate data, age, condition and other available information were recorded. Based on this information, assets were classified by risk category as discussed in Section 2.

For each facility, a conditions assessment was conducted including the following:

- Civil – Access roads, pavement condition, sidewalks, fencing, gates, and drainage structures in proximity to the facilities
- Process/Mechanical – Major mechanical equipment, chemical feed systems, process valves, equipment accessibility, unit processes, and operational challenges
- Structural/Architectural – Overall integrity of foundations, roofing systems, exterior and interior walls, wall coverings, floor and floor coverings, structural frames, interior columns where appropriate, condition of miscellaneous metals and painted surfaces
- Electrical – panelboards, motors, motor starters, disconnect switches, lightning protection, lighting systems, backup power generators, and compliance with National Electric Code (NEC) guidelines
- HVAC – Condition of heating/air conditioning systems, ventilation systems, dehumidification systems, and sump pumps.
- Instrumentation and Controls – Condition of flow measurement, level control, safety devices, and SCADA functionality
- Safety – Interview operations staff and identify potential safety issues

Narratives of the on-site facilities conditions assessments are presented in Section 3. This section includes recommendations for replacing, rehabilitating, and maintaining assets. Recommendations are also provided for repairing assets and replacing parts.

During the July 14, 2017 meeting with Jaffrey and NHDES, it was discussed that DES would be conducting an energy audit of Jaffrey's water and wastewater systems. It was decided that the results of the energy audit and any associated recommendations at each of the water facilities would be incorporated into the asset management plan. Results and recommendations developed as part of the energy audit are discussed in Section 3.

Recommendations for improvements are summarized in Section 4.

1.3 Service Life of Assets

The condition assessment was based upon visual inspection, age of the equipment/structure, known deficiencies, energy efficiency, and regulatory concerns. In addition to drawing upon Tighe & Bond's experience, we considered equipment manufacturer recommendations and guidance from professional organizations to determine the expected remaining service life. Table 1-1 summarizes the expected equipment life for a variety of the types of equipment found at the facilities.

It should be noted that some equipment items have longer or shorter operating lives depending upon the quality of the original equipment and installation, the specific environment, service conditions, and operation and maintenance practices.

1.3.1 Process Equipment

The following summarizes the expected service life for most of the major equipment and systems found in Jaffrey's water system facilities.

1.3.1.1 Pumps

The typical average design life for pumps is approximately 20 to 30 years, although pumps are often in service for a longer period of time. According to our discussions with pump manufacturer representatives, pumps can be rebuilt one or two times; however, following the second rebuild, the pumps should be replaced due to a loss in operating efficiency.

1.3.1.2 Process Valves

The typical design life for process valves by today's standards is 25 to 30 years. Few control valves that are produced today will last more than 30 years. The average design life of cast iron valves is expected to be longer.

1.3.1.3 Chemical Feed Equipment

The typical average design life for metering pumps is approximately 15 years and chemical transfer pumps is approximately 5 years; however, this may vary depending on the chemical being pumped and the type of pump. Corrosive atmospheres may decrease the longevity of the pumps in these service conditions as well. The typical design life of a polyethylene tank is about 15 to 20 years; 30 to 40 years for a steel tank; and greater than 50 years for a stainless steel tank; however, this may also vary depending on the type of chemical stored, the frequency of filling, the liners provided, and the method of construction (cross linked versus linear polyethylene, etc.).

1.3.2 Instrumentation

The typical service life of monitoring equipment such as pressure and flow transmitters is 15 to 20 years, which is driven more by technological advancements than failure of the equipment.

1.3.3 Electrical

As electrical equipment ages, the equipment becomes obsolete and repair parts are no longer available off the shelf. As a result, if an existing part fails, the part may need to be replaced with a refurbished part (if available) or a custom part, and it could possibly take several weeks to either track down a suitable refurbished part or build a replacement part. In addition, replacement parts may not fit the way the original part did, which could lead to problems or even failure down the road.

Successful operation of switches and breakers is critical to the safe operation of a facility. If a circuit breaker does not open when there is a short circuit on the line it is protecting, serious equipment damage and possibly a fire or explosion could result.

As such, there is considerable risk involved in the "wait and see" approach for aging electrical equipment. Only proactive replacement of electrical equipment will provide assurance of long term reliability. As a result, recommendations for electrical equipment replacement are typically age driven, and wet/corrosive atmospheres or exposure to flooding may further reduce the recommended service life for a particular piece of equipment. Replacement of electrical equipment should be given the highest priority at critical facilities.

Panelboards and transformers have typical service life expectancies of 30 years. Electrical wiring, under optimum conditions, has a typical life expectancy of 50 years. Incandescent and fluorescent light fixtures have a useful service life of about 30 years.

1.3.4 HVAC

Like electrical equipment, the expected remaining useful lives of HVAC equipment is, in general, age driven. Considerations such as the criticality of the facility, location/remoteness of the buildings, and frequency of patrol of the facilities also factor into prioritization of equipment replacement. For example, a remote facility that is inspected once per week, where there is one unit heater and the risk of freezing is unacceptable, may receive higher priority for replacement over a facility that is inspected more frequently or has multiple unit heaters.

ASHRAE performed studies to determine service life of typical HVAC equipment. The values given depend on duty cycle, exposure to corrosive elements and maintenance but present a useful guidance to determine the state of systems.

Electric unit heaters have service life expectancies of approximately 10-15 years. External louvers and fan life is about 15-25 years and depends on the fan type. Ductwork is expected to last for 20-30 years and associated actuators for 15-30 years. Residential type dehumidifiers can last 2-8 years.

1.3.5 Water Mains

Typical service lives for cast iron, ductile iron, asbestos cement, and PVC water mains were based on the estimates presented in *Buried No Longer: Confronting America's Water Infrastructure Challenge,* American Water Works Association, 2013.

TABLE 1-1

Asset Life Expectancy Summary [1]

Jaffrey Water System Facilities Asset Management Plan

Equipment	Typical Life Expectancy (Years)	Source
Structural		
Concrete/Masonry Building Structures	70	Tighe & Bond experience/US EPA
Timber framed structures	50	Tighe & Bond Experience
Preengineered Metal Buildings	50	Tighe & Bond Experience
Metal Doors	20	Tighe & Bond Experience
Concrete Foundation	50	Tighe & Bond Experience
Chemical Floor Coating Systems	20	Tighe & Bond Experience
Roof Joists	50	Tighe & Bond Experience
Roofing	25	Tighe & Bond Experience
Gutters	25	Tighe & Bond Experience
Tank Ladder/Guardrail	30	Tighe & Bond Experience
Tank Hatch	30	Tighe & Bond Experience
Burried Concrete Water Storage Tanks	50	Tighe & Bond Experience
Concrete Water Storage Tanks	50	Tighe & Bond Experience
Prefabricated Structures	50	Tighe & Bond experience/US EPA
Shingles - Architectural	25	Tighe & Bond experience/Equipment Manufacturers
Buried Concrete Water Storage Tanks	50	Tighe & Bond Experience
Site Civil		
Fencing	20	Tighe & Bond Experience
Pavement	20	Tighe & Bond experience/Manufacturers
Pavement Maintenance	10	Tighe & Bond experience/Manufacturers
Access Gate	10	Tighe & Bond Experience
Process/Mechanical		
Pump [2]	30	Tighe & Bond experience/Equipment Manufacturers
Magnetic Flow Meters	15	Tighe & Bond experience/Equipment Manufacturers
Metering Pumps	15	Tighe & Bond experience/Equipment Manufacturers
Containment Pallets	15	Tighe & Bond Experience
Process Valves - Cast Iron	30	Tighe & Bond experience/Equipment Manufacturers
Process Piping - Ductile Iron	50	Tighe & Bond Experience/AWWA
Pressure Relief Valves	20	Tighe & Bond Experience
Pressure Reducing Valves	25	Tighe & Bond Experience
Actuators	25	Equipment Manufacturers
Process Piping and Valves - Chemical Systems	15	Tighe & Bond experience/Equipment Manufacturers
Chemical Injection Ports	10	Tighe & Bond Experience
Ultrasonic Tank Level	10	Tighe & Bond Experience
Tanks - High Density Polyethylene	20	Tighe & Bond experience/Equipment Manufacturers
Tanks - High Density Crosslinked Polyethylene	20	Tighe & Bond experience/Equipment Manufacturers
Transfer Pumps	5	Tighe & Bond experience/Equipment Manufacturers
Accu-Tab Chemical Feed System	25	Tighe & Bond Experience
Exterior Bulk Fill Containment Boxes	15	Tighe & Bond experience/Equipment Manufacturers
Sump Pumps	10	Tighe & Bond experience/Equipment Manufacturers
Booster Pumps	25	Tighe & Bond experience/Equipment Manufacturers
Instrumentation		
PLCs	15	Tighe & Bond Experience
Chlorine Residual Analyzer	15	Tighe & Bond Experience
Differential Pressure Transmitter	15	Tighe & Bond experience/Equipment Manufacturers
pH Analyzers	15	Tighe & Bond experience/Equipment Manufacturers
Pressure Gauges	15	Tighe & Bond experience/Equipment Manufacturers
Tank Level	15	Tighe & Bond Experience
Float Switches	15	Equipment Manufacturers
HVAC		
Domestic Water Heater	30	ASHRAE
Pressure Transducer	10	Tighe & Bond Experience
Exhaust Fans	35	ASHRAE
Unit Heaters - Electric	15	ASHRAE/Tighe & Bond experience
Unit Heaters - Gas	15	ASHRAE/Tighe & Bond experience
Wall Furnace	15	Tighe & Bond Experience
Gas Piping	30	Tighe & Bond Experience
Mixing Valve	15	ASHRAE/Tighe & Bond experience
Water Heater	15	ASHRAE/Tighe & Bond experience
Water Service Piping	30	Tighe & Bond experience/Equipment Manufacturers
Sink	30	Tighe & Bond Experience
Louver, Dampers and Actuators	20	ASHRAE
Ductwork	25	ASHRAE/Tighe & Bond experience
Emergency Shower and Eyewash	25	Tighe & Bond Experience
Thermostat	15	Tighe & Bond Experience
Electrical		
Alarm Systems	15	Tighe & Bond Experience
Standby Generators	25	Equipment Manufacturers

TABLE 1-1

Asset Life Expectancy Summary [1]

Jaffrey Water System Facilities Asset Management Plan

Equipment	Typical Life Expectancy (Years)	Source
Surge Protectors	10	Tighe & Bond Experience
PLCs	10	Tighe & Bond Experience
Motor Control Centers	30	Tighe & Bond experience/Equipment Manufacturers
Variable Frequency Drives/Soft Starters	15	Equipment Manufacturers
Panelboards	30	Tighe & Bond experience/Equipment Manufacturers
Switchboards	30	Tighe & Bond experience/Equipment Manufacturers
Transformers	30	Tighe & Bond experience/Equipment Manufacturers
Automatic Transfer Switches	30	Tighe & Bond experience/Equipment Manufacturers
Wiring	50	Equipment Manufacturers
Incandescent/Fluorescent Lights	30	Tighe & Bond experience/Equipment Manufacturers
Smoke Detectors	15	Tighe & Bond experience/Equipment Manufacturers
Water Mains		
Cast Iron	115	AWWA
Ductile Iron	110	AWWA
Asbsetos Cement	100	AWWA
PVC	100	AWWA

1. Equipment life expectancies will vary greatly depending on a multitude of factors such as moisture, heat, chemical delivered, hourly use, and maintenance frequency.

2. Pumps can be rebuilt one or two times; however, following the second rebuild, the pumps should be replaced due to a loss of operating efficiency.

Section 2
Asset Management Approach

2.1 About Asset Management

Infrastructure asset management is an integrated set of strategies aiming to optimize the operational and maintenance costs of utility assets while minimizing risk. We utilized an asset management approach with the goals of:

1. Inventorying and determining the current state of the assets in Jaffrey's water system facilities
2. Identifying and categorizing maintenance and repair needs
3. Identifying the critical assets
4. Prioritizing capital improvement recommendations based on risk, using a ranking system that can be applied to buried infrastructure as well as above-ground facilities

Our approach includes identifying maintenance and repair needs, as well as providing recommendations for capital improvements, consisting of rehabilitation or replacement of significant assets.

2.2 Repair and Maintenance Items

For each of the facilities included in this study, we identified recommended maintenance and repair items and categorized them as follows: Immediate, A, B, and C. These categories reflect the immediacy of need, as described in Table 2-1.

Table 2-1 Maintenance & Repair Items Classifications

Category	Description
Immediate	Items that have an immediate need for maintenance or repair because of their condition or importance, or where there are safety or code concerns. Recommendations for ongoing maintenance at intervals of less than one year are included in this category.
A	Repair or maintenance needed within the next 5 years, or ongoing maintenance on 1 to 5 year intervals
B	Repair or maintenance needed in 6 to 10 years, or ongoing maintenance on 6 to 10 year intervals
C	Repair or maintenance needed in 10 to 15 years, or ongoing maintenance on 10 to 15 year intervals

Repair and maintenance items also include replacement of parts or minor items. Repair and maintenance items are considered separately from rehabilitation or replacement of *assets*, which we define as significant pieces of equipment or systems. Prioritization of asset replacement and prioritization is discussed in the following section.

2.3 Risk-Based Prioritization of Capital Improvements

The methodology for prioritizing the rehabilitation or replacement of assets is discussed in this section. Assets are defined as significant pieces of equipment or systems. Rehabilitation or replacement of assets often requires major expenditures, and with limited budgets, it is important to maximize the value received from each capital expenditure. The object of risk-based prioritization of capital improvements is to target assets for replacement or rehabilitation that pose the greatest failure risk: i.e., assets that are likeliest to fail and/or would have the most significant consequences if they did fail.

Risk is defined as the product of the Likelihood of failure (LoF) and the consequences of that failure (CoF). Failure refers to the state of not meeting a desirable or intended objective. The likelihood of failure of an asset reflects the possibility of that asset not meeting its desired or intended objective. In the context of water system facilities and equipment, failure can mean that the asset is inoperable, but it also includes the state of being operational but not providing the desired level of service. For example, a new pump that is undersized and cannot produce the design flow rate and head is considered failed.

Consequences of failure are direct negative outcomes resulting from the failure of an asset. Consequences represent what is important to prevent. In the framework of risk analysis the emphasis is on the negative: outcomes that should be avoided such as regulatory infractions, health and safety hazards, or economic losses. Three main consequence factors are what constitute the triple-bottom-line (TBL): social, environmental, and economic consequences. In the context of water system facilities, these consequence factors are categorized as health and safety impacts; operations/economic impacts, and environmental and regulatory impacts.

The risk model used in this project uses a rating system between 1 and 4 for both Likelihood of Failure and Consequence of Failure.

2.3.1 Likelihood of Failure

Likelihood of failure for the above-ground facility assets is determined primarily by the asset’s age and condition. For each asset, a remaining service life is determined from the asset’s age and expected service life. Deficiencies in level of service are also considered. Assets that do not provide the required level of service are considered “failed” and assigned a Likelihood of Failure score of 4. In some cases, a piece of equipment that is recommended but does not currently exist (e.g., a redundant pump) is included in the analysis and is assigned a Likelihood of Failure score of 4. Likelihood of Failure ratings are summarized in Table 2-2.

TABLE 2-2
Likelihood of Failure Ratings for Facilities

Remaining Service Life (years)	Rating	Likelihood of Failure
2	4	Very High
5	3	High
7	2	Medium
>7	1	Low

2.3.2 Consequence of Failure Factors

Three consequence factors were considered for the facilities: impacts to health and safety, impacts to operations and costs, and regulatory compliance incidents. These ratings range from 1 (minimal to no impacts) to 4 (severe impacts). For the facilities, we assigned consequence rating scores to assets under those four categories, based on our understanding of the system. The Consequence of Failure Ratings are summarized in Table 2-3.

TABLE 2-3
Consequence of Failure Ratings for Facilities

Category	Rating	Health & Safety	Operations/Economic	Environmental & Regulatory Compliance
Severe	4	Severe impact to staff, or public	Major Disruption - Failure would result in inability to operate the facility	Multiple or ongoing non-compliance
Significant	3	Action recommended - safety concern/risk of fire	Moderate Disruption - Process disruption or short downtime of the facility	Major non-compliance (1 time)
Moderate	2	Some damage might occur from failure - chemical spill or other	Minor disruption - once identified, repair can be made with facility online	Minor non-compliance
Low	1	Minimal to no consequence	Minimal to no consequence	In compliance

2.3.4 Integration with Buried Infrastructure Prioritization

The Town's water main system was evaluated in 2013 and recommendations for 18 prioritized water main upgrade projects were provided in the February 2014 *Water System Asset Management* memorandum. For this study, the rating system used in the 2014 memorandum was modified so that above-ground facility and the water main infrastructure improvements can be compared on the same prioritization scale.

Similar to the above-ground facilities, a remaining service life was determined for each water main based on the expected service life and year of installation. A likelihood of structural failure score based on age was determined for each main, as shown in Table 2-4.

TABLE 2-4
Likelihood of Structural Failure Ratings for Water Mains

Remaining Service Life < Than	Rating	Likelihood of Failure
5	4	Very High
10	3	High
15	2	Medium
>15	1	Low

Water mains were also assigned a Level of Service Failure rating, as presented in Table 2-5.

TABLE 2-5
Level of Service Failure Ratings for Water Mains

Rating	Failure Mode Description
4	Inadequate hydraulic capacity/significantly restricts available fire flow
3	Undersized (< 8") – restricts local available fire flow
2	Inadequate redundancy: proposed pipe would create loop
1	No hydraulic deficiency identified

The overall Likelihood of Failure rating was determined as the larger of the Structural Failure and Level of Service Failure ratings.

Consequence of Failure factors for water mains were based on hydraulic importance and whether the water main serves critical facilities. Mains serving critical customers were assigned Critical Customer rating of 4, all other mains were assigned a rating of 1. Mains were assigned a Hydraulic Importance Rating of 1 to 4 based on the main's model-predicted average flow. Consequence of Failure ratings for water mains are summarized in Table 2-6.

TABLE 2-6
Consequence of Failure Ratings for Water Mains

Rating	Critical Customer Factor	Hydraulic Importance Factor
4	Serves Critical Customer: e.g. Hospitals, Schools	Transmission line- loss would affect large area of system
3		Affects ability to deliver fire flow to significant area
2		Serves moderate number of customers/branch lines
1	Does not serve critical customer	Serves small number of customers

The overall Consequence of Failure Score was determined as the larger of the Critical Customer Rating and the Hydraulic Importance Rating.

2.3.5 Risk Prioritization

With Probability of Failure and Consequence of Failure factors calculated for both water mains and water system facility assets, the next step is to calculate the risk factors, by multiplying the Likelihood of Failure score times the Consequence of Failure Score. With ratings for both the consequence of failure and likelihood of failure ranging between 1 and 4, the risk scoring ranges between 1 and 16, as displayed in Figure 2-1 below.

For this evaluation, a consequence of failure rating of 4 is the criticality threshold. That means that assets with consequence scores smaller than 4 will be considered not critical. This value is called the criticality threshold. Similarly, the probability of failure threshold is set at 4. This relates to the level of service expected from the assets. Based on those two thresholds, the following quadrants in the risk space are defined: High Risk, Critical/Monitoring, Important, and Low Risk.

Risk Model

Likelihood of Failure		Low 1	Moderate 2	Significant 3	Severe 4
4	Very High	4	8	12	16
3	High	3	6	9	12
2	Medium	2	4	6	8
1	Low	1	2	3	4

Consequence of Failure

Quadrant
High Risk
Important
Critical-Monitoring
Low Risk

Figure 2-1 Water System Asset Risk Quadrants

Risk-based prioritization consists of identifying the assets that fall into the "High Risk" quadrant as first order of priority. These assets are critical (consequence of failure and likelihood of failure are both greater than the respective thresholds). With threshold values of 4 for criticality and 4 for likelihood of failure, only assets with a risk score of 16 will be considered critical.

The next group of assets in the priority list are the ones that fall into the "Important" quadrant. These assets have a probability of failure above the threshold, although the consequences of their failure are tolerable since their criticality is smaller than the threshold.

Assets that fall into the Critical/Monitoring quadrant have high criticality, but their failure probability is below the threshold. As these assets age, their probability of failure will increase. There is danger of these assets moving into the high-risk quadrant over time. For that reason these assets need to be monitored and maintained over time, as a way of mitigating the risks associated with their failure. The rest of the assets fall into the low risk quadrant.

2.4 NHDES/NHOEP Energy Evaluation

The NHDES and the New Hampshire Office of Energy and Planning (NHOEP) contracted with Process Energy Services (PES) to perform a comprehensive and preliminary process energy evaluation of the Jaffrey Water System. The goal of this evaluations was to identify opportunities for cost savings associated with reducing energy use throughout the Jaffrey Water System. A copy of the energy evaluations conducted by PES is included in Appendix C. The Jaffrey Water Department spent $46,574 on electric costs and $6,373 on propane energy costs from Jan 2016 through Dec 2016, a total of $52,947. The energy evaluation provides recommendations for energy reducing measures that total $6,940.

The costs associated with operating each of the Jaffrey facilities were evaluated. The evaluation shows that the cost of pumping water differs at each facility.

PES performed a site visit to review the water system pumping equipment with staff and collect operational data, and develop recommendations to reduce energy use throughout the Jaffrey Water System. Pump efficiency testing was conducted at the following facilities:

- Turnpike Well Facility
- Contoocook Well Facility
- Squantum Well Facility
- Prospect Booster Pump Station

The following section summarizes the recommendations developed in the energy evaluation. PES classified recommendations in the following categories:

- energy management practices (EMPs) – recommendations that cannot be justified based on quantifiable energy savings, but are considered to be good energy efficient practices that will provide long-term benefits
- energy conservation measures (ECMs) – projects that require a larger capital investment with simple paybacks exceeding one year.
- operational measures (OMs) – Low cost improvements that can be made without a substantial capital investment and typically pay for themselves in less than one year.
- energy supply measures (ESMs) - recommended improvements that do not qualify as energy saving projects, but provide cost savings

The following recommendations were presented by PES.

1. **EMP #1 -** Utilize energy use benchmarks with operational data to continue developing the energy management program. This included enhancing the Water Department's existing energy use spreadsheet by separating the data into monthly totals and collecting the following additional data:
    a. Track thermostat settings on daily log sheets during the cold weather months.
    b. Record average monthly VFD speeds.
    c. Expand the existing electric bill spreadsheet to include billed peak demand.

This measure is not anticipated to directly reduce energy costs.

2. **ESM #1** – Replace existing electric heaters in the TWF and CWF with ceiling mounted propane unit heaters and install low temperature wall thermostats that can maintain at 45 to 50 degrees. This recommendation is anticipated to save the Water Department $3,538 per year.

3. **OM #1 & #2**– Reduce the TWF run times from 3,737 hours to 1,000 hours, increase the SWF hours of operation from 945 hours to 3,890 hours, and operate the SWF pump at full speed. If feasible to implement, this recommendation would save the Water Department an estimated $1,266 per year (*see comments below regarding permit limitations to pumping the SWF*).

4. **OM #3** – Maintain thermostat settings as low as possible to provide freeze protection only. Reducing the thermostat settings is anticipated to reduce the energy cost by $592 per year.

5. **ECM #1** – Reduce flow rate of the PBPS pumps to reduce friction head and install VFDs on each pump. Installation of VFDs and reduction of pump rate is anticipated to reduce energy costs by $1,544 per year.

EMP #1 and OM#3 do not involve maintenance, repair, or replacement of assets and are therefore not incorporated in our recommendations.

ESM #2, replacing electric unit heaters with gas heater, is incorporated in our recommendations as developed in Section 3.

OM #1 and #2 recommend reducing the number of hours that the TWF operates and recommends increasing the SWF operation hours to offset the TWF reduction. The recommendation of operating the well at the maximum rate for 3,890 hours per year will result in a total withdrawal of 75,855,000 gallons. The SWF operation levels are regulated by the NHDES Large Groundwater Withdrawal Permit No. LGWP-2010-0001. The facility is restricted to the following groundwater withdrawals:

- 170,000 gallons over any 24-hour period from April 1st through October 31st
- 360,000 gallons over any 24-hour period from November 1st through March 31st

The permit further restricts the withdrawal by the level of the bordering Wetlands as follows:

- Stage I Management Procedure: If Tier Three triggers are met as part of the Wetlands monitoring program, the well shall be reduced to 75% of the permitted withdrawal volume: 127,500 gallons over any 24-hour period
- Stage II Management Procedure: If Tier Three triggers continue to be met for seven or more consecutive days after reducing production from the SWF under Stage I Management Procedures, production from the SWF shall be reduced to 50% of the permit withdrawal: 85,000 gallons over any 24-hour period
- Stage III Management Procedure: If Tier Three triggers continue to be met for seven or more consecutive days after reducing production from the SWF under Stage II Management Procedures, production from the SWF shall be reduced to of the permit withdrawal to less than 57,600 gallons over any 24-hour period

We reviewed the wetland data for the past 5 years to determine how often the bordering wetlands has limited the operation of the SWF. The SWF is typically not able to operate in April and May due to the impact on the Dug Pond at the SWF site, and has been limited to 180 gpm when rotating duty with the other wells during the remainder of the year.

Another factor that causes the TWF to operate more than the other facilities is that it operates whenever the Prospect Booster Station is running to ensure that the supply and pressure delivered to the PBS is adequate.

Therefore, for the reasons stated above, and we do not believe OM #1 and OM#2 are feasible and have not incorporated them in our recommendations.

ECM #2 recommends installing VFDs at the PBS to allow operating at a lower flow rate, which would potentially reduce hydraulic friction losses and reduce energy consumption. While we agree that there is some potential for reducing friction losses, we note that the suction side pressure observed on the day of the DES visit was significantly lower than the typical pressure. The reason for this is not clear, but it likely exaggerated the potential energy savings from this measure. Therefore, we recommend additional evaluation before implementation of ECM #2.

Section 3
Field Findings

On July 7,2017 Tighe & Bond conducted facility inspections to inventory assets and assess conditions at six of the Town's water system facilities. The following facilities were inspected:

- Turnpike Well Facility
- Contoocook Well Facility
- Squantum Well Facility
- Prospect Booster Station
- Poole Tank
- Bullet Tank

Narratives discussing our findings for these facilities are provided in Sections 3.1 through 3.6. Appendix A contains tables presenting the asset inventory and recommended improvements. Appendix B contains process and HVAC equipment inventories with nameplate data and additional details. Appendix C contains the NHDES/NHOEP Energy Evaluation report referenced in Section 2.5. Appendix D contains photographs taken during the site visits. Asset identification codes used to identify assets and recommendations throughout this report are assigned as follows:

- Each identification begins with a facility code:
    - Turnpike Well Facility: TWF
    - Contoocook Well Facility: CWF
    - Squantum Well Facility: SWF
    - Prospect Booster Station: PBS
    - Bullet Tank: BT
    - Poole Tank: PT
- An asset type designation follows the facility code
    - P for Process/Mechanical
    - I for Instrumentation and Controls
    - S for Structural/Architectural
    - E for Electrical/Standby Power
    - H for HVAC
    - C for Civil/Security (Facility Name Code -C101, C102, etc.)
- A 3-digit number follows the asset type code. For example, TWF-P101 would designate a Process/Mechanical asset such as a pump.
- Recommendations are referenced with the Asset ID followed by a one-digit task identification number. For example, TWF-P101-1 would designate a recommendation for a Process/Mechanical asset at the Turnpike Well Facility.

A complete inspection of the Water Department Administration Building was outside the scope of this study; however, the emergency generator was considered. Adminstration Building assets are assigned the facility code “AD”.

3.1 Turnpike Well

The original Turnpike Well was constructed in 1965 and originally consisted of a one-room brick and concrete block facility. At the time, the facility treated one well (Well #1). A second redundant well was constructed in 2006 (Well #2). The following major upgrade projects have been completed since the facility’s original construction:

- 1986 – A building addition was completed that added a second room for chemical storage tanks and chemical feed equipment for sodium hypochlorite and sodium hydroxide

- 1994 – Electrical and mechanical improvements were completed including replacing the motor control center (MCC), installing a generator, replacing unit heaters and exhaust fans, and replacing the chemical metering pumps.

- 2006 - An electrical room was added to the north side of the facility and a permanent storage area with overhang was added to the south side of the facility. The MCC, automatic transfer switch (ATS), and remote telemetry unit (RTU) were relocated to the new electrical room. A polyphosphate chemical feed system was added to the facility in the pump room. The piping and valves within the facility were replaced and Well No.2 was constructed and connected to the system.

3.1.1 Civil/Security

The facility has a bituminous concrete driveway and parking area that wraps around the building. The pavement is in fair condition with several areas of cracking observed in the pavement grass growing up through the cracks. The typical lifetime for new bituminous concrete is 20 years, with crack sealing recommended at least once during that period. Once pavement begins to deteriorate, a mill/overlay can be completed to provide an estimated 10 additional years of service life, or the pavement can be completely replaced. A mill/overlay typically costs around 40% less than a full replacement, but provides only half the expected service life. Therefore, full replacement is generally recommended if sufficient capital funding is available. Jaffrey should budget for crack and overlay within the next 5 years (TWF-C101-1).

There is no fencing at the facility, but a 16-foot wide slide gate was installed in 2009. However, the slide gate is typically left open. Given that there appear to be no issues with trespassing or vandalism at the facility, no other security measures are recommended at this time.

3.1.2 Process/Instrumentation

The Turnpike Well facility treats water from Well #1, which is pumped via a vertical turbine pump in the facility, and Well #2 which utilizes a submersible well pump and is located approximately 10 ft west of the facility. The submersible pump was placed in service as part of the upgrades project in 2006 and the pump and motor were replaced six or seven years ago after the motor burned out.

Jaffrey records indicate that Well #1 had the motor reconditioned and bearings were replaced in March 2000 after the motor burned out. We contacted Barrie Miller who does much of the pump maintenance work for the Town. He noted that he could not recall when Well #1 was last rebuilt or replaced and he noted that he thought all of the Town's wells and pumps were due to be rehabilitated. He also noted that the Town no longer performs annual servicing of their pumps. Annual inspections of the pumps are recommended (TWF-P101-2, TWF-P102-1). Annual inspections and maintenance will diagnose any issues with the pumps before they result in an emergency failure and would lengthen the useful life of the pumps. Every 5 to 7 years a full pump and well rehabilitation is recommended. The pump rehabilitation would include completely taking apart the pump, replacing as needed metal parts subject to corrosion, cleaning and recoating pump components, and reconditioning the motor. Barrie Miller thought that pump rehabilitation along with well rehabilitation could be completed for around $12,000 to $15,000 per well (TWF-P101-2, TWF-P102-2).

The floor plates for the pipe supports in the pump room are severely corroded and should be replaced (TWF-P104-1).

Chemical feed systems at the facility include sodium hydroxide (caustic), calcium hypochlorite, and phosphate. The phosphate chemical feed system is located in the pump room, while the caustic and calcium hypochlorite systems are located in an adjacent room. The caustic and hypo room has a sumped floor for secondary containment of the chemicals.

The chlorination system is an Accu-Tab system that uses solid calcium hypochlorite tablet. With proper preventative maintenance, Accu-Tab systems can generally operate for 15 or more years without a major rebuild or replacement. There is no redundant Accu-Tab feeder-if the system stopped functioning, then Jaffrey's backup plan is to bring in carboys to feed liquid sodium hypochlorite while the Accu-Tab system is repaired and brought back into service. However, no sodium hypochlorite feed system is currently in place. We recommend installation of a small liquid hypochlorite feed system with a means to quickly switch it over automatically or manually in the event of a failure of the Accu-Tab system (TWF-P111-1). There is space within the secondary containment area for the Accu-Tab system for a small liquid chemical feed system.

3.1.3 Structural/Architectural

The Turnpike Wellhouse is a single-story structure which was built in three different phases. The building is divided into four distinct areas. From north to south there are: the Electrical Room, the Pump Room, the Chemical Storage Room, and a Storage Area. The building is approximately 39.5 feet long by 22 feet wide. The Chemical Storage Room was added to the Pump Room in 1986, the Electric Room and the Storage Area were added in 2006.

The Pump Room has interior concrete masonry unity (CMU) walls with a brick veneer, concrete roof and floor slabs. Overall this area is in good condition. The door hardware on the single man door between the Pump and Chemical Rooms is in poor condition.

The finished floor in the Chemical Room is roughly 2 ft lower than in the adjacent rooms. The Chemical Room has concrete roof and floor slabs, partially exposed concrete foundation walls and a single wythe of 8-inch, scored, CMU. Sodium hydroxide is stored on the west side of the room. The chemical resistant floor slab coating appears to have failed. On the east side of the room, the concrete foundation walls exhibit signs of deterioration likely due to a previous exposure to stored chemicals. The chlorine tablet system is currently located in this area. There is chemical on the floor in much of this room, especially in the caustic area and there is no sign of a floor coating in these areas. Caustic and other corrosive chemicals can severely corrode concrete if the concrete is exposed to it long term. To preserve the concrete floor, we recommend having this chemical cleaned off the floor and installing a chemical resistant coating in the containment areas.

The Electrical Room was part of the 2006 expansion and is in good overall condition. The structural systems include CMU cavity walls with a brick veneer, concrete floor, and roof slabs.

The Storage area has cavity walls on the east and west sides and to the north a common wall with the Chemical Room. The south side of the area is open. The roof framing consists of exposed timber joists. There are a concrete foundation walls and a concrete slab-on-grade. The Storage area was constructed as part of the 2006 expansion and is in satisfactory overall condition.

We recommend the following repairs:

- Replace door hardware on the single man door (TWF-S101-1).
- Paint the double door and frame (TWF-S101-2
- Repair deteriorated concrete on the interior face of the concrete foundation walls in the Chemical Room and install a chemical resistant coating (TWF-S104-1).
- Remove and replace the stair nosings on the stairs from the Pump Room to the Chemical Room (TWF-S104-1).
- Apply preservative to the roof joists in the storage area (TWF-S104-2).

3.1.4 HVAC/Plumbing

The HVAC system consists of louvers and dampers, two exhaust fans, two wall furnace heaters and an electric unit heater.

The chemical room exhaust fan should be replaced as the surrounding areas as well as the fan shutter show signs of corrosion (TWF-H101-1). The location of the fan discharge should be changed in compliance with the International Mechanical Code (IMC) and for operator protection. The current version of the IMC, 2009 for NH, states the discharge should be 10 feet from operable building openings and not be directed onto walkways. Currently, the exhaust fan discharge is located adjacent to the door into the chemical room and discharges under the roof of the storage area and in the direction of the walkway to the Chemical Room door. The exhaust discharge should be relocated outside the storage area (TWF-H101-1).

The chemical room electric unit heater is estimated to be 23 years old and should be replaced due to age and signs of corrosion. We recommend replacing the electric unit heater with a gas unit heater to reduce energy costs (TWF-H102-1). Refer to the analysis in the NHDES/NHOEP Energy Evaluation Report included in Appendix C.

The wall furnaces in the older building section show signs of corrosion and should be replaced (TWF-H104-1). The furnace in the new building section is expected to last for at least 5 more years.

All damper actuators in the building's older section show signs of corrosion and should be replaced (TWF-H106-2). The motorized damper serving the exhaust fan in the newer section of the building should also be replaced. It is not functioning and is constantly propped open which increases heating cost during cold seasons (TWF-H106-2).

The safety shower and eyewash station is supplied by cold water only and the installation of a domestic water heater, hot water piping, and mixing valve should be considered to comply with current code requirements (TWF-H108-1).

The plumbing system consists of propane gas piping, domestic water piping, regulator, sample sink, and emergency shower and eyewash. The existing plumbing system is in good condition, but requires some modifications to comply with current code requirements. The outdoor gas piping shows some signs of corrosion. Cleaning and re-painting should be performed soon (TWF-H109-1). The secondary pressure regulator is located close to the exhaust of one wall furnace. The regulator vent should be piped away to provide at least five feet of clearance (TWF-H109-2).

3.1.5 Electrical

The Turnpike station electrical service is a 277/480V, three phase service fed to the equipment via an external 200A main power disconnect switch to an ATS. Power is further distributed within the building via a three section MCC. The MCC includes two pump soft starters, various circuit breakers, a lighting transformer, and a 120/240V lighting panel. An outdoor generator backs up power to the station.

The electrical distribution equipment throughout the building is old and is near the end of its useful life. Main disconnect switch is beginning to rust, and is becoming old and unreliable and should be replaced (TWF-E101-1). There is a missing cover on a pull-box in the Chemical Room (TWF-E101-2).

During the winter, the outdoor generator often goes into an overspeed condition generating an alarm. The outdoor generator should be replaced in the near future (TWF-E103-1). The Surge Protection Device within the station is functioning properly, but has logged more than 1,000 events.

The surge protection device (SPD) should be scheduled for replacement in the near future with a robust unit capable of withstanding a high frequency of surge events. The replacement SPD should be rated for at least 300 kA/phase given the high frequency of surge events (TWF-E104-1).

There are no emergency lighting units or illuminated exit signs in the building. It is recommended that emergency lighting and exit signs be installed throughout the building as soon as possible to improve safety (TWF-E105-1, TWF-E105-2).

3.2 Contoocook Well Facility

The Contoocook Well Facility was constructed in the late 1970s and was placed in service in 1980. The facility treats a single well. The original one-room facility was upgraded in 1986, adding a separate chemical room. In 1994 upgrades were completed that replaced the MCC, installed a standby generator at the site, provided new unit heaters and exhaust fans, and replaced the chemical feed pumps. Since that time, very few upgrades have been completed apart from the well pump being rebuilt between 2008 and 2011 based on conversations with the system operator. The existing pump has a capacity of 350 gpm at 245 ft TDH. Much of the electrical, HVAC, and process equipment is beyond or approaching the end of its useful life and needs repair. Individual recommendations from each discipline are provided below, but a more cost-effective approach to upgrades at this facility may be a comprehensive improvements project, rather than replacing pieces of equipment individually.

3.2.1 Civil / Security

There is a swing gate at the opening of the driveway to the Contoocook Well facility to prevent vehicular access. It was open on the day the facility visit was conducted and it is not clear if it is locked regularly. There is no fencing at the site. The access drive into the site is approximately 750 feet long with the first 400 feet paved and in fair condition. Jaffrey should budget for a full replacement of the access road in 5 to 10 years.

3.2.2 Process / Instrumentation

The process equipment at the facility consists of the single vertical turbine well pump and associated piping; chemical feed systems for calcium hypochlorite, sodium hydroxide, and phosphate; analyzers; and instrumentation. The operator believed that the well pump had been rebuilt approximately 8 years ago, but Barrie Miller could not recall that and there was no record of it. The pump is due to be rehabilitated and annual servicing is also recommended (CWF-P201-1, CWF-P201-2). The following additional recommendations should be prioritized at the facility:

- Pipe supports for the ductile iron piping are corroded and should be replaced (CWF-P202-1).
- The main ductile iron piping in the facility has several areas of corrosion. The piping should be sandblasted and recoated (CWF-P202-2).
- An Accu-Tab calcium hypochlorite tablet system is utilized at this facility for chlorination. As for Turnpike Well, the Town should plan for a major rebuild of this unit within the next 5 years (CWF-P203-1), and a spare pump should be kept on site for the system. The installation of a small liquid hypochlorite feed system is also recommended with a means to quickly switch it over automatically or manually in the event of a failure of the Accu-Tab system (CWF-P204-1). There is space within the secondary containment area for the Accu-Tab system for a small liquid chemical feed system.

- There are several areas where zip-ties are being utilized to support the chemical feed pipe on electrical conduit or other process piping. Proper pipe supports should be installed (CWF-P207-1)
- In several cases in the facility, chemical feed piping is routed in gray PVC piping that matches the electrical conduit and there are no distinguishing labels on the piping. This piping should be clearly labeled so that there is no confusion for any operations staff or contractors working in the facility (CWF-P207-1).
- There is a 1,000-gallon bulk tank for sodium hydroxide at the facility and a 50 gallon day tank. The day tank is no longer in use because the transfer pump, which appears to be at least 20 years old, is no longer functioning. The operator indicated that they prefer operating without a day tank, but an additional tank is recommended for this facility for redundancy (CWF-P208-1).
- The caustic injection point is crusted over with chemical and should be cleaned/replaced (CWF-P212-1)
- There is no secondary containment for the blended phosphate drum. A secondary containment pallet should be installed (CWF-P214-1).
- The phosphate and caustic chemical feed systems at the facility are not flow-paced. The caustic system has the controls in place for flow-pacing but it is currently adjusted manually. The well pump operates on a variable frequency drive (VFD) and can run at varying flows. Flow-pacing of all chemicals is recommended for more consistent water quality (CWF P206-1, CWF-P211-1).

Based on FEMA flood maps, it appears that the finished floor elevation at the facility may be below the 100-year flood elevation; however, the actual finished floor elevation could not be confirmed from the as-builts. As part of any major upgrade project undertaken at this facility, the existing finished floor relative to the 100-year flood should be evaluated and a determination made as to whether the facility should be raised.

3.2.3 Structural/Architectural

The exterior dimensions of the Contoocock wellhouse are 32'-6" by 15'-4" with a floor to ceiling height of 10'. The structure was constructed in two phases. The wellhouse area of the building has a slab-on-grade at grade level with an unknown date of construction. An addition, approximately 14'-4" long by 15'-4" wide was added in 1986. The floor slab to this area is a little more than 2' below the elevation of the wellhouse finished floor. The lower area houses chemicals, chlorine tablets and caustic.

The building structure consists of a concrete roof slab, single-wythe 12" CMU walls, concrete foundation walls and concrete slab-on-grade floors. The structural components are in overall satisfactory condition. There are small areas of deterioration on the interior face of the CMU in the chemical room, likely due to previous chemical exposure.

The architectural systems include: a ballasted roof system of unknown vintage, paint coatings on both sides of the single-wythe CMU, a failed floor slab coating in the chemical room, oversized double doors and FRP grating at the Caustic storage area. We noted deficiencies to isolated components of the architectural system. The double door is reinforced with a steel plate. The door does not open freely/smoothly likely due to the increased weight of the steel plate.

We recommend the prioritizing the following items for repair:

- Worn areas on the slab-on-grade floor should be repaired with a cementitious repair mortar (CWF-S201-1).
- Exterior of CMU walls should be prepared and painted (CWF-S210-2).
- There is no visible chemical resistant coating in the chemical areas. Both caustic and hypochlorite will degrade concrete over time. A chemical resistant coating should be applied to the chemical storage areas (CWF-S201-3).
- A hand rail and new nosing should be installed on the stairs to the chemical area (CWF-S201-4).
- Isolated areas of damage to the interior of the CMU should be repaired (CWF-S201-5).
- The door and frame should be painted and the door hardware should be replaced (CWF-S202-1).

3.2.4 HVAC

The equipment consists of louvers, motorized dampers, a wall propeller exhaust fan, one electric and one gas fired unit heater, piping and ductwork.

Based on the life expectancy, the equipment conditions, and the year of installation (1995), most equipment has reached or will soon reach the end of its life and should be considered for replacement.

We recommend replacing the unit heaters within five years (CWF-H203-1, CWF-H204-1). The gas fired unit heater reportedly has functional problems and the electric unit heater is in fair condition. We recommend replacing the electric unit heater with a gas unit heater to reduce the energy cost. Refer to the analysis in the NHDES/NHOEP Energy Evaluation Report provided in Appendix C.

Due to age and rust stains below the exhaust fan on the building outside we recommend replacement of the fan and hood within five years (CWF-H205-3).

The current version of the IMC, 2009 for NH, describes required distances of combustion exhaust in relation to air intakes and building openings. The required distance is three feet above any forced air inlet within ten feet. The gas fired unit heater flue is approximately one foot away from the intake louver. We recommend relocating the gas fired unit heater's exhaust to vent out the roof or extend the existing flue up to terminate three feet above the intake louver (CWF-H203-2).

The intake louver shows signs of rust and should be replaced. The associated damper and actuator should also be replaced (CWF-H205-1).

The plumbing system consisting of propane gas piping, domestic water piping, regulator, sample sink, and emergency shower and eyewash, is in good to poor condition.

The station doesn't contain a water heater. IMC 2009 refers to ISEA Z358.1 which requires the water for eyewash and emergency showers to be tepid (60-100°F). Installation of a water heater and mixing valve are recommended (CWF-H206-1). The emergency shower and eyewash station itself is in good condition.

The sample sink is stained but appears to be good working condition. The domestic water valves and fittings in the vicinity of the sink are rusty. We recommend replacing the corroded components with items made of lead-free brass or bronze (CWF-H207-2). The outdoor hose bibbs appears to be corroded as well and should be replaced (CWF-H207-3). The domestic water pressure reducing valve is nearing the end of its useful service life and should be replaced. (CWF-H207-1).

Propane gas piping within the building is in good condition and the above grade piping exposed to the outdoors is in poor condition. The outdoor piping should be replaced between the connection to the underground piping and the point of entering the building (CWF-H208-1). The pressure regulator vent should be piped away from the louver to provide at least five feet to the ventilation air intake per NFPA 58 (CWF-H208-1).

3.2.5 Electrical

The Contoocook electrical service is a 480/277V, three-phase service fed via an internal main power disconnect to an ATS. Distribution throughout the facility comes from a three section MCC containing various circuit breakers, lighting transformer, 120/240V lighting panel, and a soft starter. An outdoor generator backs up power to the station.

The electrical distribution equipment throughout the building is old and is nearing the end of its useful life. Distribution equipment throughout the facility replacement should be budgeted within the next 5 years.

The radiator on the propane generator was leaking and was replaced in November 2017. The enclosure is beginning to rust, and the generator is nearing the end of its useful life. We recommend replacing the generator (CWF-E203-1).

The programmable logic controller (PLC) display is unreliable, and should be replaced in the near future (CWF-I201-1).

The VFD for the 30 hp pump occasionally causes issues. In these cases, the old soft-starter within the MCC is capable of driving the pump. The VFD was originally installed to replace the soft-starter. The VFD should be replaced with a new, reliable unit, and the soft starter should be removed from the MCC in the future (CWF-E206-1).

There is no surge protection device installed at the facility. Surge protection of at least 120 kA/phase should be installed to protect the electrical equipment throughout the facility (CWF-E205-1).

There are no emergency lighting units or illuminated exit signs in the building. It is recommended that emergency lighting and exit signs be installed throughout the building as soon as possible to improve safety (CWF-E204-1).

3.3 Squantum Well Facility

The Squantum Well Facility is the newest of Jaffrey's well facilities. It was constructed in 2010 and treats water from a single well located approximately 330 feet southwest of the facility. The majority of the equipment and components at this facility are in very good condition.

Civil/Security

The facility has a paved driveway that provides access to the front and south side of the building. The pavement and site appurtenances are in good overall condition. Maintenance of the pavement by sealing cracks is recommended (SWF-C301-1).

The building is locked with door contacts present on the doors, but there is no fencing around the site. There was no sign of vandalism or trespassing at the site and the building is in a residential area. There does not appear to be any need to add additional security measures here unless trespassing and vandalism become a problem in the future.

3.3.1 Process/Instrumentation

The Squantum Well is equipped with a 25-HP submersible pump. Annual maintenance of the pump is recommended (SWF-P301-1). We recommend budgeting for pump rehabilitation every 5 to7 years (SWF-P301-2).

Chemical feed systems at this facility include sodium hydroxide, calcium hypochlorite, and phosphate. The sodium hypochlorite system consists of two bulk storage tanks in a curbed containment area. A recent incident occurred in which the tubing on one of the caustic metering pumps failed and resulted in chemical leaking out of the containment area.

Jaffrey utilizes 55 gallon blended phosphate drums for the phosphate feed system. The drums sit on 8" high pallets in the west side of the chemical room. The 55 gallon drums are moved onto the pallets utilizing a ramp and hand trolley. The operator noted that the ramp does not fit well into the space and it is awkward moving the drums up onto the pallet. There are manufacturers that now make secondary containment vessels which have sides that can be folded down in order to move drum tanks into and out of the containment. Jaffrey may want to replace the raised pallets with one of these collapsible-wall containment vessels (SWF-P306-1).

The chlorination system at Squantum is an Accu-Tab system as is utilized at the other facilities. As with the other well facilities, there is no redundancy on the chlorination system present at this facility. There is piping and a metering pump shelf in place so that a metering pump and chlorine drum could be brought in if the Accu-Tab system stopped working. It is recommended that a metering pump be installed and connected so that an operator could quickly switch over to the use of liquid chlorine in the event of an Accu-Tab system failure (SWF-P302-1). With proper maintenance, the Accu-Tab system at the Squantum Well facility will likely function for another 10 years before requiring a rebuild

3.3.2 Structural/Architectural

The Squantum Road wellhouse is a single-story structure constructed in 2010. The structure is a pre-engineered metal building with a reinforced concrete slab-on-grade and foundations. The exterior of the building has fiber cement siding boards, with metal doors, standing seam metal roof, and gutters.

The interior is separated into Chemical, Generator, and Electric Rooms by CMU partition walls. There are metal liner panels on the interior face of the exterior walls as well as the on the underside of the roof. Other architectural systems include metal-veneer doors and double hung windows.

The structural and architectural systems are in good overall condition. We noted open cracking in the concrete slab-on-grade which likely is an as-built condition and very light surface rust on the exit device of the chemical room exterior door. We also noted an isolated area of impact damage to the gutter system.

We recommend addressing the following items:

- Repair impact damage to the gutter (SWF-C301-1)
- Monitor for a change in extents of the slab-on-grade cracking (SWF-S302-1)
- Monitor for a progression of the corrosion of the interior door hardware (SWF-S303-1)

3.3.3 HVAC/Plumbing

The HVAC system consists of louvers and motorized dampers, three roof exhaust fans and three wall furnace heaters.

The HVAC equipment is 7 years old and is in overall good condition. The only item not functioning is the intake air damper for the electric room. The actuator should be replaced (SWF-H305-1).

The plumbing system consists of propane gas piping, regulator, domestic water piping, and an emergency shower and eyewash.

The plumbing system is new and in good condition. One item of concern is the location of the secondary propane gas regulator vent near a wall furnace exhaust. The regulator vent pipe should be extended so that its end is at least five feet away from this source of ignition (SWF-H306-1). The distance must be five feet per NFPA 58.

Safety shower and eyewash station are connected to hot and cold water. All components including the water heater are in excellent condition.

3.3.4 Electrical

The Squantum Well electrical service is a 480V, three-phase service fed via an external 200A main disconnect into an internal ATS. The electrical distribution equipment consists of the utility meter, main disconnect switch, ATS, lighting transformer and separate circuit breaker, 120/208V lighting panel, and various motor controls including a VFD for the well pump. Power throughout the facility is backed up by an internal Cummins propane standby generator and associated transfer switch. Power to the PLC is further backed up via a small Uninterruptable Power Supply (UPS) located within the PLC enclosure. The electrical distribution equipment was all installed less than 10 years ago. Overall, the electrical distribution equipment throughout the building is in good condition. The UPS within the PLC enclosure has occasional problems. This UPS should be replaced with a new UPS similar to the ones used at the other sites (SWF-I-302-1).

3.4 Prospect Booster Pump Station

The Prospect Booster Pump Station is located on Main Street near the intersection with Prospect Street. The station pumps water from the lower (main) pressure zone to the high pressure zone and operates based on the water level in the Poole Reservoir. Prospect Booster Station was constructed in 1994. In 2016 a new pressure reducing and backpressure sustaining valve was added to the facility. The valve functions to allow water from the high pressure zone to flow back to the low pressure zone in the event of an emergency in the low pressure zone, while also functioning as a surge relief on the high pressure zone. A new flow meter was also added to the facility at that time. The two pumps in the station are 20 HP horizontal end suction pumps designed for 250 gpm at 205 FT TDH.

3.4.1 Civil/Security

The small bituminous driveway and parking at the facility is in good condition with some linear cracks observed between the main pull-in area and the parking area and at the edge of the driveway apron. Jaffrey should plan for repaving of the parking area in 10 to 15 years. The building is locked with door contacts present on the doors, but there is no fencing around the site. There was no sign of vandalism or trespassing at the site and the building is in a residential area. Given that the building is fairly inconspicuous in its location, there is likely no need to add additional security measures here unless trespassing and vandalism become a problem in the future. It was raining the day of the site visit and some water was ponding outside the entrance of the facility. The grading here should be fixed when the parking lot is repaved.

3.4.2 Process/Instrumentation

The station has two horizontal end suction pumps with design flows of 250 gpm at 205 ft TDH. Pump No. 1 was rebuilt in 2016 which was its first rebuild since installation in 1994. Pump No. 2 has not been rebuilt yet, but should be scheduled for rebuild soon (PBPS-P402-1). New soft starts were added to both pumps in 2016. Annual maintenance is recommended for both pumps (PBS-P401-2, PBS-P402-2), and rehabilitation of both pumps is recommended every 5-7 years (PBS-P401-3).

The piping in the facility is in good condition with much of it replaced or re-painted as part of the project to add the control valve in 2016. Corrosion was noted in the following areas that should be addressed in the short term:

- A small pressure reducing valve (PRV) on the piping to the utility sink and shower was heavily corroded. This is likely original to the facility and should be replaced (PBPS-H404-1)
- Corrosion was visible on the pump head of Pump No. 1. This corrosion should be sanded off and new coating applied to protect this pump (PBPS-P401-1)

Sodium hypochlorite is fed at this facility using 55-gallon drums and an LMI metering pump. Only a single LMI metering pump is present at the facility, but spares are kept at the water department shop. This chlorination equipment is not normally used, but is used occasionally in the summer to maintain a disinfectant residual in the far reaches of the distribution system. There is no secondary containment for the chlorine drums. Installation of a secondary containment pallet is recommended to protect the concrete floor and other equipment in the event of a spill (PBPS-P405-1).

The metering pump is not flow paced. While the pumps do not have VFDs, flow can vary depending on system head and whether on or both pumps are running. Flow-pacing is recommended to maintain a stable chlorine residual under varying flow conditions (PBPS-P403-1).

The flow meter and control valve at the facility were installed in 2016 and will likely not require replacement for over 10 years.

3.4.3 Structural/Architectural

The Prospect Booster Pump Station is a single-story building reportedly constructed in 1994 with interior dimensions of 22 feet x 19 feet with a 10 foot floor to ceiling height. The structural systems include a concrete slab-on-grade floor and concrete foundation walls. The available drawings indicate that the walls are framed with timber 2 x 6 studs at 16 inches on center. The stud walls are not visible due to painted gypsum wallboard on the interior and vinyl siding on the exterior. The attic space was not accessed but per the drawings the roof is framed with timber trusses. Overall, the structural systems are in good condition with no significant deficiencies noted.

In addition to the wall coverings noted above the architectural systems include asphalt shingle roofing, solid core, metal-veneer double doors and a paint coating on the slab-on-grade. The architectural systems are in good overall condition. The paint coating on the exterior of the doors is worn and faded.

We recommend addressing the following items:

- The asphalt shingles should be replaced within 5 years (PBPS-S401-1)
- The exterior of the double door should be painted to prevent the onset of corrosion, and kickstands should be added to each leaf of the door (PBPS-S403-1).

3.4.4 HVAC/Plumbing

The HVAC system consists of louvers and motorized dampers, a wall propeller exhaust fan, and a gas fired unit heater.

The exhaust fan and unit heater are over twenty years old. The fan appears to be in good condition. According to the expected service life, the fan and controls should be replaced in 5-10 years.

The unit heater reportedly has functional problems and should be replaced (PBPS-H401-1).

The stations louvers and damper actuators are in good condition and are expected to last for another 10 to 15 years.

The plumbing system consists of propane gas piping, domestic water piping, regulator, sample sink, and emergency shower and eyewash. The plumbing system is in good to fair condition.

The secondary propane pressure regulator is installed adjacent to the air intake. The regulator vent should be piped away from the louver to create a minimum five feet separation (PBS-H405-1). The outdoor propane gas piping should be cleaned and repainted (PBS-H405-1).

The stations safety shower is supplied by cold water only. To comply with current codes the installation of a water heater and thermostatic mixing valve should be considered (PBPS-H406-1). The emergency shower and eyewash station is in good condition.

3.4.5 Electrical

The Prospect station electrical service is a 277/480V, three-phase service fed to the equipment via an external 200A main power disconnect switch to an ATS. Power is further distributed via a three-section Allen Bradley MCC located inside the building. The MCC contains the booster pump soft starters, lighting transformer, and 120/240V lighting panel. Power throughout the facility is backed up by an internal propane generator with an underground propane tank. Power to the PLC is further backed up via a small UPS located within the PLC enclosure. Overall, the electrical distribution equipment is in good condition, however, the majority of the equipment is original and was installed around 1994. The electrical distribution equipment throughout the facility will be reaching the end of its useful service life in the next 10 to 15 years. The main disconnect switch is beginning to rust, is becoming old and unreliable, and should be replaced in the next 5 years (PBS-E401-1).

There is no surge protection installed at the facility. A surge protection device of at least 120 kA/phase should be installed to protect the electrical equipment throughout the facility (PBPS-E404-1).

There are no emergency lighting units or illuminated exit signs in the building; it is recommended that emergency lighting and exit signs be installed throughout the building for improved safety (PBPS-E405-1). The interior light fixtures are inefficient and near the end of their service lives and should be replaced (PBS-E405-2).

3.5 Bullet Tank

The Bullet Tank is a 750,000 gallon partially buried prestressed concrete water storage tank constructed in 1994 located off Cathedral Road in the Town of Rindge. The tank is 80 feet in diameter and 20 feet tall to its overflow. The tank was last cleaned and inspected in November of 2013. The operator noted that divers inspect and clean the Town's storage tanks every five years.

3.5.1 Civil / Security

The area around the tank is well-maintained and trees are cut back to prevent any limbs from falling on the tank. The site does not have a gate or fence to prevent unauthorized access and there were some signs of trespassing, but no vandalism was observed. The tank hatch is locked, and the onsite building is locked with door contacts installed. The Town may want to consider adding fencing and/or no trespassing signs to the facility to prevent unauthorized access (BT-C502-1).

3.5.2 Process / Instrumentation

The overflow and vents both have screens, but the overflow screen is a 4 Mesh. A 24 Mesh is recommended per 10 State Standards for overflows on ground elevation tanks. The mesh should be replaced with 24 mesh (BT-P503). 10 State Standards also recommends that the overflow pipes open downward or have a duckbill valve attached. A duckbill valve would be an easy addition at this location and costs have been provided for that (BT-P502-1).

3.5.3 Structural / Architectural

The Bullet Tank building was constructed in 1994 and has interior dimensions of 10-10" long by 9' wide with an 8-foot floor to ceiling height. Overall the facility is in good condition.

The building is timber framed with timber stud walls and timber roof trusses. The floor is a concrete slab-on-grade. Below the slab is a level transmitter vault which appears to be a precast concrete manhole type structure. A section of removable grating in the floor slab covers the opening to the vault. There is not a ladder extension device attached to the manhole rungs in the vault.

The architectural systems include: painted timber cladding boards, asphalt shingle roofing, a true hollow-metal, single man door and painted plywood interior wall and ceiling coverings.

We recommend addressing the following items:

- Install a ladder extension device on the manhole rungs (BT-S503-1)
- Prepare and paint the door and frame (BT-S502-1)

3.5.4 HVAC/Plumbing

The building has no HVAC equipment. High and low temperature alarms and a heater are integral to the control cabinet and not considered HVAC. The building has no domestic plumbing equipment.

3.5.5 Electrical

The Bullet Tank electrical service is a 60A, 120/240V, single-phase service to the equipment via a manual transfer switch currently configured as the main disconnect switch located inside the tank shed. The main disconnect feeds a small 120/240V power panel which distributes power to the remaining equipment. A weatherproof exterior generator connection point feeds directly into the main disconnect switch. No generator or ATS is currently used on site. Overall, the electrical distribution equipment at the site is in good condition.

Surge protection fuses have been installed within the PLC enclosure to protect the PLC equipment. The fuses installed within PLC enclosure for surge protection should be replaced with a more robust stand-alone surge protection device of at least 70 kA/phase (BT-E502-1).

The existing interior lights are old and inefficient. The fixtures should be replaced (BT-E-503-1). No exterior or emergency lighting is installed on the tank shed. Exterior lighting and an interior emergency light should be installed in the near future (BT-E503-2, BT-E503-3).

3.5.6 Fall Protection

The Bullet Tank is partially buried with the east side of the tank roof about 2' above grade and the west side of the tank shell mostly exposed and the edge of the dome beginning 16' from grade. The roof of the tank is accessed easily from the east side, but an operator must walk to the west side to access the dome hatch. A guardrail on the east side in the area of the hatch is recommended to make inspection of the hatch and work near the hatch safer (BT-C501-1). During the interior tank inspection performed by Underwater Solutions in 2013, it was noted that the fall prevention device on the interior ladder had failed due to corrosion. This fall prevention device should be repaired to provide safe access of the interior (BT-C501-2). Underwater Solutions may be able to perform this repair with the tank online.

3.6 Poole Tank

The Poole Tank is a 500,000 gallon buried concrete tank constructed in 1994 and located on Town-owned land adjacent to Monadnock State Park and accessed through the Poole Road park entrance. The tank is 80 feet in diameter and 13 feet deep from floor to overflow. The tank was last cleaned and inspected in November 2013 and no issues were noted at the time of the inspection. The tank is cleaned and inspected on a five-year cycle.

3.6.1 Civil/Security

There is a swing gate at the entrance to the Poole Tank site which prevents vehicular access but there is no fencing to prevent trespassing on foot. Beer bottles were present adjacent to the facility gatehouse, indicating trespassing, but there were no signs of vandalism.

3.6.2 Process/Instrumentation

The tank overflow discharges at a rock headwall 8 inches above grade. It is recommended that the tank overflow be modified to discharge downward and the discharge area be regraded to provide a gap of 12 inches between the overflow discharge point and the ground (PT-P601). The screen on the tank overflow is 4 mesh and is constructed of two pieces of 4 mesh that are bolted together in the center. The screening should be replaced with a single piece of 24 mesh to meet 10 state standard recommendations (PT-P601). The vent screen appeared to be 24 mesh (PT-P601-1).

10 State Standards also recommends that manholes on buried tanks be elevated at least 24 inches above the top of the tank covering. The access hatch on the tank is located 11" above the tank grade. Costs have been provided for modifying the manhole to bring it a minimum of 24 inches above the covering of the tank (PT-S605-1).

10 State Standards recommends that impermeable membrane coverings be considered on concrete reservoirs with earthen cover. The Poole Tank appears to have a cast-in-place concrete roof without any obvious seams, so a watertight membrane covering is likely not needed for this tank.

3.6.3 Structural/Architectural

The building at the Poole Tank is a small, single-story structure with interior dimensions of 11 ft x 7 ft and an 8 ft floor to ceiling height. The building appears to be a stick built timber structure. Access to the hipped roof was not provided. Based on the configuration of the roof, we assume that the roof is timber framed. The structural wall framing was not visible due to painted plywood sheathing on the interior and painted horizontal timber cladding on the exterior.

The building rests on a concrete slab on grade; concrete foundation walls were not visible. Other architectural components include asphalt shingles and one metal-veneer, single man door.

The building is in overall good condition with only minor deficiencies. The paint on the timber door frame should be touched-up (PT-S603-1). The date of installation of the asphalt shingles is unknown; we estimate that the shingles have a remaining service life of up to 10 years. There is an isolated area of damaged shingles at the eave, we recommend that the shingles in this area are replaced (PT-S601-1).

3.6.4 HVAC/Plumbing

The on-site building has high and low temperature alarms and a heater integral to the control cabinet. Two electric plug-in space heaters are in the building. One is operational and one is not functioning. We recommended replacement of the non-functional heater with an industrial grade unit (PT-H601-1). Neither tank nor building have any domestic plumbing related equipment.

3.6.5 Electrical

The Poole Tank electrical service is a 60A, 120/240V, single-phase service fed to the equipment via a manual transfer switch which is currently configured as a main disconnect switch located inside the tank shed. The utility meter and underground service to the tank shed is located down the road on a utility pole alongside other metering equipment for the adjacent state park. The main disconnect feeds a small 120/240V power panel which distributes power to the remaining equipment. A weatherproof exterior generator connection point feeds directly into the main disconnect switch. No generator is currently used on site. Overall, the electrical distribution equipment throughout the facility is in fair condition, but is old and approaching the end of its useful service life.

There have been lightning surge issues at this facility in the past. Surge protection fuses have been installed within the PLC enclosure to protect the PLC equipment. The fuses installed within PLC enclosure for surge protection should be replaced with a more robust stand-alone surge protection device of at least 70 kA/phase (PT-E602-1).

No exterior or emergency lighting is installed at the facility. Exterior lighting and an interior emergency light should be installed in the near future (PT-E601-1).

3.6.6 Fall Protection

There is a ladder with a fall protection device on the interior of tank that was noted to be in good condition during the last inspection in 2013, although some corrosion was noted on the ladder. The condition of the ladder should be monitored in future inspections and the ladder replaced when necessary (PT-S604-1).

Section 4 Recommendations

4.1 Listing of Recommendations

Recommendations developed in Section 3 are summarized in this section. Complete lists of assets and recommendations are provided in Appendix A.

Table 4-1 presents a listing of recommended improvements for the "High-Risk" assets. These are the highest priority recommendations, as these assets have been identified as both critical and having a high likelihood of failure. Only the facilities assets identified in Table 4-1 were classified as "High Risk" assets.

TABLE 4-1
Recommendations: "High Risk" Assets

Asset/Task ID	Asset Description	Description	Proposed Improvement	Estimated Cost
TWF-E103-1	Generator	End of Service Life	Replace generator	$63,000
CWF-E203-1	Generator	End of Service Life	Replace generator	$85,000
CWF-P208-1	Caustic Tanks	Tank is old - no redundant tank	Provide redundant tank	$12,000
AD-E701-1	Generator	Asset is near the end of its service life	Replace generator	$61,000

Table 4-2 presents recommendations for the "Important" facilities assets. These recommendations have second-tier priority and are recommended to be completed within the next 5 years.

TABLE 4-2
Recommendations: "Important" Assets

Asset/Task ID	Asset Description	Description	Proposed Improvement	Estimated Cost
BT-E502-1	Surge Protector	No stand-alone surge protection installed at the facility	Provide surge protection on the main service to protect electrical equipment	$2,500
CWF-E205-1	Surge Protector	Facility does not have a surge protector	Install surge protector	$4,100
PBS-E404-1	Surge Protector	No surge protection installed at the facility	Install surge protector	$4,100
PT-E602-1	Surge Protector	Lighting surge issues have been an problem for the PLC	Install surge protector	$3,300
TWF-E104-1	Surge Protector	End of Service Life	Replace surge protector	$11,000

Asset/Task ID	Asset Description	Description	Proposed Improvement	Estimated Cost
CWF-H203-1	Unit Heaters	Gas unit heater does not function properly	Replace unit heater	$17,000
CWF-H204-1	Unit Heaters	End of Service Life	Replace electric unit heater with gas unit heater	$17,000
PBS-H401-1	Unit Heater	End of Service Life	Replace gas unit heater	$12,000
CWF-E206-1	VFD	VFD does not operate properly	Replace VFD and remove soft starter from MCC	$22,000
BT-C501-1	Tank Guardrail/ Ladder	No fall protection on tank roof	Provide guardrail on east side of tank roof	$8,000
CWF-H206-1	Eyewash Station	Eyewash station provides cold water only	Install a water heater and mixing valve for tepid water	$10,000
CWF-P214-1	Phosphate Containment System	No containment for phosphate	Provide containment pallet	$1,200
PBS-P405-1	Sodium Hypochlorite Containment	Hypochlorite drums do not have secondary containment	Provide containment pallet	$800
CWF-S203-1	Roof	End of service life	Replace roof	$29,000
TWF-H102-1	Unit Heater	End of service life	Replace electric unit heater with gas unit heater	$17,000
TWF-H104-1	Wall Furnace - Pump Room	Well room wall furnace is corroded	Replace wall furnace	$3,600

Table 4-3 presents recommendations for maintenance of the major pumping equipment and wells.

TABLE 4-3
Pump Maintenance Recommendations

Asset ID	Asset Description	Estimated Cost	Remarks
Annual Inspection/ servicing			
TWF-P101-1	Vertical Turbine Well Pump	$1,300	
TWF-P102-1	Submersible Well Pump	$1,300	
CWF-P201-1	Vertical Turbine Well Pump	$1,300	
SWF-P301-1	Well Pump	$1,300	
PBS-P401-2	Pump 1	$1,300	
PBS-P402-2	Pump 2	$1,300	

Asset ID	Asset Description	Estimated Cost	Remarks
Pump and well rehabilitation – recommended every 5-7 years			
PBS-P402-1	Pump 2	$12,000	Highest priority - Pump has not been rebuilt since it was new
CWF-P201-2	Vertical Turbine Well Pump	$17,000	
SWF-P301-2	Well Pump	$17,000	
TWF-P101-2	Vertical Turbine Well Pump	$17,000	
TWF-P102-2	Submersible Well Pump	$17,000	
PBS-P401-3	Pump 1	$12,000	

Table 4-4 presents recommendations for repairs/replacement of parts etc. These items have been assigned action categories of "Immediate" (action recommended within 1 year) and "A" (action recommended within 5 years). A complete list of repair items including Category B and C items (no action recommended for >5) years is presented in Appendix A.

TABLE 4-4
Repairs/Small Items

Asset/Task ID	Asset Description	Reason for Improvement	Proposed Improvement	Estimated Cost
"Immediate" Category Items				
BT-E503-3	Lighting	No emergency lighting present inside or outside of the building	Install exit sign in electrical building and exterior lighting	$1,200
CWF-E204-1	Lighting	Facility does not have emergency lighting or illuminated exit signs.	Provide emergency lights and illuminated exit signs in electrical/pump room and the chemical room as required by code	$5,400
CWF-H208-1	Gas Piping	Exterior piping is corroded and regulator is too close to intake louver	Replace exterior piping and route regulator away from louver	$3,300
CWF-P207-1	Blended Phosphate Chemical Feed Piping	Chemical piping is supported by zip ties; Chemical piping is not labeled	Install pipe supports for chemical piping; Label chemical piping	$800
CWF-P212-1	Caustic Chemical Feed Piping	Injection point crusted over with chemical; Chemical piping is supported by zip ties; Chemical piping is not labeled	Clean chemical and replace injector; Install pipe supports for chemical piping; Label chemical piping	$2,500
PBS-E405-1	Lighting	No emergency lighting present inside or outside of the building and no illuminated exit signs present	Install emergency lighting and exit signs	$3,300

Asset/Task ID	Asset Description	Reason for Improvement	Proposed Improvement	Estimated Cost
PBS-E405-2	Lighting	Existing light fixtures are at the end of their service life and inefficient	Replace interior and exterior lighting with new, efficient LED fixtures in the future. Use motion detectors with exterior lighting to improve security	$5,000
PBS-H405-1	Gas Piping	Propane pressure regulator is installed adjacent to the air intake; exterior piping is corroded	Relocate regulator vent five feet away from the louver; Clean and recoat exterior gas piping	$1,200
PT-E601-1	Lighting	No emergency lighting present inside or outside of the building and no exterior lighting installed	Install interior exit signs and lighting and exterior lighting	$1,200
SWF-H305-1	Louvers and Dampers	Electrical room air damper is not functioning	Replace actuator.	$1,700
SWF-H306-1	Wall Furnaces	Propane gas regulator is near a wall furnace exhaust	Pipe regulator vent 5 feet from the exhaust	$800
TWF-E101-2	Power Distribution/MCC	The cover is missing on a pull box on the conduit within the chemical room.	Provide a cover to contain internal wiring	$200
TWF-E105-1	Lighting	No emergency lighting or illuminated exit signs are installed within the facility	Provide emergency lights and illuminated exit signs throughout the facility as required by code	$4,100
TWF-H101-1	Exhaust Fans	Chemical room exhaust fan corroded; Fan discharge does not meet IMC; Exhaust duct requires cleaning	Replace chemical room exhaust fan; Relocated exhaust fan discharge; clean exhaust duct	$6,600
TWF-H109-2	Gas Piping	Secondary pressure regulator is located within 5 feet of the exhaust.	Reroute regulator vent 5 feet from pressure regulator.	$800
Category “A” Items (Action recommended within next 5 years)				
BT-C501-2	Tank Guardrail/Ladder	Fall protection device on tank interior is corroded	Replace fall protection device	$1,700
BT-P502-1	Overflow piping	Overflow piping has 4 Mesh; Overflow piping does not open downward or have a duckbill valve	Install 24 Mesh on overflow piping; Install a duckbill valve	$4,100
BT-S501-1	Tank	Fall protection device on tank interior	Install fall protection device on tank interior	$2,500

Asset/Task ID	Asset Description	Reason for Improvement	Proposed Improvement	Estimated Cost
BT-S502-1	Electrical Building	Paint on door and frame is deteriorating	Prepare and paint door and frame	$1,200
BT-S503-1	Vault	Lack of ladder extension at vault access	Install ladder extension device	$1,200
CWF-H203-2	Unit Heaters	Gas unit heater Vent too close to intake	Reroute gas unit heater vent	$4,600
CWF-H205-1	Louvers, Dampers, and Actuators	Intake louver and damper are rusted	Replace intake louver, damper, amd actuator	$4,600
CWF-H205-3	Louvers, Dampers, and Actuators	Exhaust fan and hood - end of service life	Replace exhaust fan and grill	$4,100
CWF-H207-1	Water and Sampling Piping & Fixtures	End of Service Life	Replace Pressure Reducing Valve	$500
CWF-H207-2	Water and Sampling Piping & Fixtures	Sample sink fittings are rusting	Replace corroded fittings	$2,500
CWF-H207-3	Water and Sampling Piping & Fixtures	Exterior hose bibs are corroded	Replace exterior hose bibs	$5,000
CWF-I201-1	PLC/RTU	PLC display is unreadable	Replace PLC display	$2,000
CWF-P202-1	Ductile Iron Piping	End of service life	Replace pipe supports	$800
CWF-P202-2	Ductile Iron Piping	Piping is corroded	Sandblast and recoat piping	$2,100
CWF-P206-1	Blended Phosphate Metering Pump	Chemical is not flow-paced	Install provisions for flow-pacing phosphate	$600
CWF-P211-1	Caustic Metering Pump	Caustic is not flow-paced	Update controls to flow-pace chemical	$600
CWF-S201-1	Building Structure	Wear on concrete slab-on-grade	Repair area with a cementitious repair mortar	$800
CWF-S201-2	Building Structure	Paint condition on CMU	Prep and paint exterior of CMU walls	$12,000
CWF-S201-3	Building Structure	Cracking in concrete containment curb; Failed coating on floor in chemical area	Rout and gravity feed/seal cracks; Remove existing and install chemical resistant floor coating system	$3,300
CWF-S201-4	Building Structure	Concrete stairs lack handrail; Failed nosings at concrete stairs	Install handrail at stairs; Install new nosings at stairs	$2,500
CWF-S201-5	Building Structure	Isolated areas of damage to interior of CMU; Isolated areas of failed paint coating on CMU	Repair isolated deteriorated CMU; Spot Paint interior CMU	$2,100

Asset/Task ID	Asset Description	Reason for Improvement	Proposed Improvement	Estimated Cost
CWF-S202-1	Doors	Door is difficult to open/operate; Paint condition on double man door and frame	Install new door hardware including new hinges; Prep and paint frame and door	$4,100
PBS-H404-1	Water and Sampling Piping & Fixtures	Corrosion on PRV	Replace PRV	$300
PBS-P401-1	Pump 1	Pump head is corroded	Sand off corrosion and re-coat	$2,500
PBS-P403-1	Sodium Hypochlorite Metering Pump	Chemical is not flow-paced	Install provisions for flow-pacing sodium hypochlorite	$800
PBS-S403-1	Doors	Double door and frame paint condition; Doors need a hold-open device	Prep and paint double door and frame; Install hold-open device on each door leaf	$2,400
PT-H601-1	Unit Heater	One space heater is not functioning	Replace space heater with a electric unit heater.	$1,700
PT-S601-1	Roofing	Damaged roof shingles at eave	Repair damaged shingles	$300
PT-S603-1	Electrical Building	Paint on door frame is chipped	Prepare and paint door frame	$300
PT-S604-1	Tank Ladder & Appurtenances	Corrosion on tank ladder	Monitor corrosion on tank ladder	$0
SWF-C301-1	Pavement	Maintenance	Seal Cracks	$4,100
SWF-I302-1	Pressure Transmitters	UPS is not operating properly	Replace UPS	$1,700
SWF-P302-1	Calcium Hypochlorite Tablet System	No redundant feed system	Install sodium hypochlorite metering pump	$3,600
SWF-S301-1	Roofing & Gutters	Impact Damage	Repair impact damaged gutter and downspout	$1,200
SWF-S302-1	Building	Cracking in slab on grade	Monitor for change in crack widths or extents	$0
SWF-S303-1	Doors	Light surface rust on chemical room exterior door	Monitor progression of corrosion of the interior door hardware.	$0
TWF-H106-2	Louvers	Damper actuators in the well room are corroded; Damper serving the exhaust fan is not functioning	Replace well and chemical room actuators; Replace exhaust fan damper	$11,000
TWF-H108-1	Eyewash Station	Cold water only	Install a domestic water heater, and mixing valve.	$10,000
TWF-H109-1	Gas Piping	Gas piping corroding	Clean and repaint gas piping	$300
TWF-P104-1	Ductile Iron Process Piping	Pipe Supports are corroded	Replace pipe supports	$0

Asset/Task ID	Asset Description	Reason for Improvement	Proposed Improvement	Estimated Cost
TWF-S101-1	Door	Condition of door hardware	Replace door hardware on interior single man door	$1,200
TWF-S104-1	Building - Chemical Room	Deterioration of stair nosing anchorage; Stairs lack handrail	Replace failed fasteners, replace isolated nosing plates; Install handrail at Chemical Room stairs	$2,100
TWF-S104-2	Building - Chemical Room	Exposed timber roof joists are untreated	Apply preservative to exposed timber framing	$1,600
TWF-S104-3	Building - Chemical Room	Interior concrete foundation wall deterioration; Chemical build-up on floor slab	Saw cut and remove deteriorated concrete, install repair mortar; Clean concrete and install chemical resistant coating system	$10,000

4.2 Contoocook Well Facility Upgrade

Table 4-5 presents a summary of the recommendations for replacements, rehabilitation, and repairs developed in Section 3, organized by facility.

TABLE 4-5
Summary of Recommendations by Facility

Facility	Replace/ Rehabilitate	Repair/Small Item	Total
Contoocook	$225,300	$64,200	$289,500
Turnpike	$120,600	$55,300	$175,900
Squantum	$0	$13,900	$13,900
Prospect	$38,900	$20,500	$59,400
Bullet	$10,500	$13,800	$24,300
Poole	$10,900	$3,500	$14,400
Admin. Building	$61,000	$0	$61,000
Totals	$467,200	$171,200	$638,400

As indicated in the table, a large fraction of the recommendations is associated with the Contoocook Well Facility. The Contoocook Well Facility has not had a significant upgrade since the mid-1980s and most equipment and systems are approaching the end of their useful lives and require upgrades or replacement. Because of the large amount of repairs and replacements required, a major upgrade of the facility is recommended rather than addressing the recommended items individually. The proposed building upgrade will include repairing the existing concrete slab-on-grade floors and masonry walls and constructing an addition so that the generator can be housed inside the building and the electrical equipment can be separated from the pumping and chemical feed equipment. The project will include a new roof, new HVAC, electrical, and chemical feed equipment, redeveloping the well, and rehabilitating or replacing the well pump. The recommended budget for this upgrade is $800,000. A detailed cost estimate is included in Appendix A.

4.3 Water Main Projects

As stated in Section 2, an objective of this study is to provide a prioritization rating system that ranks water main improvements and facilities improvements on the same scale so that their respective priorities can be compared. Three out of the 18 water main improvement projects recommended in the 2014 *Water System Asset Management* memorandum have been completed, and none of the remaining projects are rated "High Risk". Table 4-6 summarizes the highest priority remaining water main projects, which are in the "Important" risk space quadrant and have a risk score of 12. These projects have a lower priority rating than the "High Risk" assets listed in Table 4-1, but are equivalent to the highest priority items in the "Important" assets listed in Table 4-2. Note that Table 4-6 includes only the highest-priority remaining water main projects. Refer to Appendix A for a listing of the 18 water main project recommendations presented in the 2014 *Water System Asset Management* memorandum.

TABLE 4-6
Highest Priority Water Main Projects

Asset ID	Item Description	Date of Installation	Estimated Remaining Service Life (yrs)	Reason for Replacement	Estimated Replacement Cost
DS-WM8	School Street	1899	0	Age/Critical customer	$485,000
DS-WM9	Squantum Rd Section 1	1920	17	Hydraulic capacity/ Improve AFF	$1,758,000
DS-WM10	Squantum Rd Section 2	1920	17	Hydraulic capacity/ Improve AFF	$1,183,000
DS-WM11	Squantum Rd Section 3	1920	17	Hydraulic capacity/ Improve AFF	$586,000
DS-WM12	Stratton Rd	1920	17	Hydraulic capacity/ Improve AFF/Critical customer	$1,746,000

4.4 Recommended Budget

Table 4-7 presents budget recommendations for facilities projects for the next five years. All the "High Risk" items, which are the highest priority, are included in the top three items in Table 4-7. The "Miscellaneous Items" include rehabilitation or replacement of assets in the "Important" risk quadrant, and repairs/replacements of small items in the "Immediate" and "A" action categories. These items are recommended for action within the next five years.

TABLE 4-7

Budget Recommendations – Next 5 years (2018 dollars)

Item		Recommended Budget
Contoocook overhaul		$800,000
Turnpike generator		$63,000
Administration building generator		$61,000
Miscellaneous Items[1, 2]:		
Turnpike	$80,000	
Squantum	$13,000	
Prospect	$32,000	
Bullet	$22,000	
Poole	$7,000	
Subtotal - misc. items		$154,000
Pump maintenance[3]:		
Annual pump maintenance	$39,000	
Pump rehabilitation	$29,000	
Subtotal - pump maintenance		$68,000
Total		**$1,146,000**

[1]Includes "Important" replacement/rehabilitation items and "Immediate" and "A" category repairs and small items.
[2]Note: All CWF items are included in the "Contoocook overhaul"
[3]Includes annual maintenance for 5 years for pumps at TWF, CWF, SWF, and PBS; and rehabilitation of PBS Pump No. 2 and the SWF well pump.

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