PUBLIC WATER SYSTEM ASSET MANAGEMENT PLAN | MAY 2015

Town of Exeter, New Hampshire

TATA & HOWARD

Public Water System Asset Management Plan
Exeter, New Hampshire

THE STATE OF NEW HAMPSHIRE
PAUL
E.
COTE
No. 5984
LICENSED
PROFESSIONAL ENGINEER

27 May 2015

Prepared by:

TATA & HOWARD

May 2015

TATA & HOWARD

May 27, 2015

Mr. Matthew Berube
Town of Exeter, New Hampshire
Department of Public Works
13 Newfields Road
Exeter, New Hampshire 03833

Subject: Public Water System Asset Management Plan
Town of Exeter, New Hampshire
T&H Project No. 2703

Dear Mr. Berube:

In accordance with our agreement, Tata & Howard is pleased to present you with five copies of the Public Water System Asset Management Plan. The analysis and improvements in this report are based on critical component considerations with an asset management rating system to evaluate the condition of the water mains in the distribution system. The conditions of the above ground facilities, including water supply facilities, booster pump stations, the water treatment facility, and water storage tanks, were evaluated as part of this study.

The system was surveyed for critical areas and hydraulic redundancy. Each water main was evaluated based on age, material, diameter, break history, water quality, and soil conditions to determine its asset management score. The results were combined to determine the water mains most in need of replacement and establish a prioritized set of improvements in the system. A detailed description of the improvements and their estimated costs is presented in Section 6.

During the course of this project, Mr. Paul Cote, P.E. served as Project Manager, Ms. Justine Carroll, P.E. and Ms. Helen Pottle, P.E. served as Project Engineers and Ms. Shira McWaters, P.E. and Mr. Stephen Rupar, P.E. provided technical reviews.

At this time, we wish to express our appreciation to the Town for their participation in this study and for their help in collecting information and data. Special thanks are given to you, Mr. Michael Jeffers, Ms. Jennifer Mates, Ms. Jennifer Perry, Mr. Paul Roy, and Mr. Paul

Vlasich for contributions to this report. We also appreciate the opportunity to assist the Town on this important project.

Sincerely,

TATA & HOWARD, INC.

Paul E. Cote, P.E.
Associate

Enclosures

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Section 1

TATA & HOWARD

SECTION 1 – Executive Summary

1.1 General

Tata & Howard, Inc. was retained by the Town of Exeter, New Hampshire (Town) to complete a water system asset management plan. The purpose of the plan is to identify areas of the system in need of rehabilitation, repair, or replacement and prioritize improvements to make the most efficient use of the Town's capital budget. The study evaluates the existing water infrastructure including water transmission and distribution piping and appurtenances. The condition of the above ground facilities, including wells, pump stations, water storage tanks, and the water treatment plant were also evaluated as part of this study.

1.2 Approach

Tata & Howard evaluated the water distribution system using the following evaluation criteria:

- Asset management considerations
- Critical component assessment

An asset management assessment was completed for the system. A number of factors are considered in the rating of the water mains including; age, material, diameter, break history, water quality, and soil conditions. These factors affect the decision to replace or rehabilitate a water main. Using our asset management approach, each main in the system was assigned a rating based on these factors. Water mains with a total rating of 29 or less are considered to be in good to excellent condition. Mains with a rating between 30 and 49 are considered to be in fair to good condition, and mains with a total rating of 50 or more are considered to be in poor to fair condition.

The critical component assessment includes identification of critical customers served, critical components, critical water mains, and the need for redundant mains. The critical component assessment was completed with input from the Town. Critical customers served were identified by the Town and include hospitals, doctor's offices, schools, nursing homes, and condominium and apartment complexes. Critical water mains include primary transmission mains, water mains that are difficult to access, and water mains that cross under a river, water body, or railroad tracks. Critical components include water supply sources, pump stations, water treatment facilities, and water storage tanks.

Improvements were recommended and prioritized based on a probabilistic risk assessment, which considers the aforementioned criteria of criticality and asset management rating. In general, Phase I improvements include any recommended improvements that have both high asset management scores (poor condition) and are considered critical to the water system. The total estimated probable construction cost of the Phase I Improvements is approximately $12,345,000. Phase II improvements generally include water mains that have asset management scores of 60 or greater and a critical system impact rating of zero. The total estimated probable construction cost of Phase II recommended improvements is approximately $4,189,000. Phase III Improvements include the remaining water mains with a high asset management score between 50 and 59 and a critical system impact rating of zero. The total estimated probable construction cost of the Phase III recommended improvements is approximately $6,932,000. The Phase III recommended improvements eliminate potential asset management concerns, and provide redundancy. The recommended improvements map is included in Appendix E.

The above ground asset improvements were recommended and prioritized based on installation date, anticipated life span, and current condition. Recommendations rated as Priority 1 should be completed under the Phase I improvements. Phase I improvements require the most immediate attention and should be completed in the next five to seven years. The total estimated probable construction cost of the Phase I above ground asset improvements is approximately $1,272,500. Priority 2 recommendations should be completed under the Phase II improvements and should be completed in seven to 13 years. The total estimated probable construction cost of the Phase II above ground asset improvements is approximately $50,000.

Section 2

TATA & HOWARD

SECTION 2 – Existing Water Distribution System

2.1 Distribution System Piping

The Town's water system, located in Exeter and Stratham, consists of approximately 65 miles of water main ranging in diameter from two to sixteen inches. Figure No. 2-1 shows a breakdown of the water main size distribution of the existing water system. The mains are constructed of various materials including asbestos cement (AC), unlined cast iron (CI), factory cement lined cast iron (CLCI), cement lined ductile iron (CLDI), high density polyethylene (HDPE), and polyvinyl chloride (PVC). Figure No. 2-2 shows the breakdown of material distribution of the existing water system. The system also includes two surface water sources, one active groundwater source, two inactive groundwater sources, two pump stations, one surface water treatment plant, and three water storage facilities. A map of the existing water distribution system is included in Appendix A.

2.2 Service Areas

The existing water system consists of four service areas, the Main Service Area, the Kingston Road Service Area, Colcord Pond Reduced Pressure Service Area, and the Industrial Drive High Service Area. The Main Service Area (MSA) has a hydraulic gradeline (HGL) elevation of approximately 235 feet above Mean Sea Level (MSL). All elevations referenced in this report are above MSL. Ground elevations range from approximately 9 feet to 128 feet resulting in normal system pressures ranging from approximately 95 pounds per square inch (psi) to 45 psi.

The Kingston Road Service Area (KRSA) has a HGL elevation of approximately 224 feet. Ground elevations range from approximately 47 feet to 138 feet resulting in normal system pressures ranging from approximately 75 psi to 35 psi. The Industrial Drive High Service Area (ISA) has an HGL elevation of approximately 258 feet. Ground elevations range from approximately 74 feet to 136 feet, resulting in normal system pressures ranging from approximately 80 psi to 50 psi.

The Colcord Pond Reduced Pressure Area (CPSA) has a HGL elevation of approximately 223 feet. Ground elevations range from approximately 50 feet to 94 feet resulting in normal system pressures ranging from approximately 75 to 55 psi. The CPSA is supplied water from the Industrial Drive High Service Area through two 8-inch pressure reducing valves, one located on Michael Avenue and a second on Colcord Pond Drive. According to the 2002 Camp, Dresser, and McKee (CDM) report, the reduced pressure is necessary due to concerns regarding service pipe integrity. Reportedly the service pipe to the mobile home park off Colcord Pond Road cannot withstand pressures greater than 90 psi. When the service pipe is upgraded the PRV functionality can be investigated for potential abandonment.

2.3 Water Supply Sources

The Town's water system is currently supplied by one active surface water treatment plant and one active groundwater well, Lary Lane Well. The surface water treatment plant (SWTP) located on Portsmouth Avenue treats raw water from three sources and has a capacity of 1.5 mgd. The three sources include (1) Exeter Reservoir, (2) Skinner Springs in Stratham, and (3)

Exeter River. A new 1.56 million gallon per day (mgd) groundwater treatment plant is currently under construction. The Lary Lane Groundwater Treatment Plant will provide pressure filtration treatment for iron, manganese, and arsenic for the Town's one active groundwater production well, two existing but inactive wells, and one future well.

Exeter Reservoir

The Exeter Reservoir was constructed in 1886 when Dearborn Brook was first impounded. According to U.S. Geological Survey mapping and records, the reservoir has a total drainage area of 1.7 square miles. The reservoir supplies the majority of water to the SWTP throughout the winter, approximately November to April. The annual algal bloom and plant life growth significantly diminishes water quality in warmer weather conditions.

The surface area and total volume have been cited with several different values in the available literature. The reservoir's surface area has been cited as 25 acres (Weston & Sampson, 1968) and ranging from 18 to 26 acres (U.S. Army Corp of Engineers, 1980). The 18 acre surface area determined by the Army Corps is based on the normal pool elevation with stoplogs in place and the 26 acre area is based on water reaching the top of the dam. Based on a safe yield analysis conducted by CDM and reported in the 2002 Public Water System Evaluation Study the safe yield of the Exeter Reservoir is 0.2 to 0.25 mgd.

Skinner Springs

Skinner Springs in Stratham was developed as a supplementary water source for Exeter in 1929. The facility includes production wells, a collector well, and a 10-inch diameter raw water transmission main to the SWTP. According to the CDM (2002) report, the original construction included six production wells and a collector well installed at depths ranging from 20 to 25 feet. A 1935 letter in the Town's files states that one deep artesian well was installed in bedrock. The Weston & Sampson (1968) report indicated the existence of eight production wells. The current configuration is consistent with the Whitman & Howard (1986) report which states the existence of six, 30-inch diameter production wells, two, 42-inch diameter observation wells, and one, 30-foot diameter collector well. The Weston & Sampson (1968) report stated the safe yield of Skinner Springs was 0.125 mgd and the CDM (2002) report stated that the Town reported the current yield to be in the range of 0.05 to 0.10 mgd. The water flows by gravity from the production wells to the Skinner Springs collector well and finally to the SWTP.

Exeter River Pump Station

The Exeter River Pump Station was design and constructed between 1972 and 1974. It is located on the eastern bank of the Exeter River. Access to the pump station is available through a locked gate to an access road off High Street that extends ¼ mile along land owned by Phillips-Exeter Academy. This facility supplies the majority of water to the SWTP throughout the summer months, from approximately April to November. The pump station houses two pumps that convey raw water to the SWTP through a single, 12-inch diameter water main.

According to the CDM (2002) report, the safe yield of the Exeter River, upstream of the Great Dam, including the Exeter Reservoir is estimated at 6.0 mgd. An additional safe yield was calculated for the Exeter River, excluding the area upstream of the Hydro Dam in Brentwood. The safe yield for the Exeter River, upstream of the Great Dam, including the Exeter Reservoir, but excluding the Hydro Dam in Brentwood was estimated to be 2.6 mgd.

Figure No. 2-1
Water Main Diameter Distribution

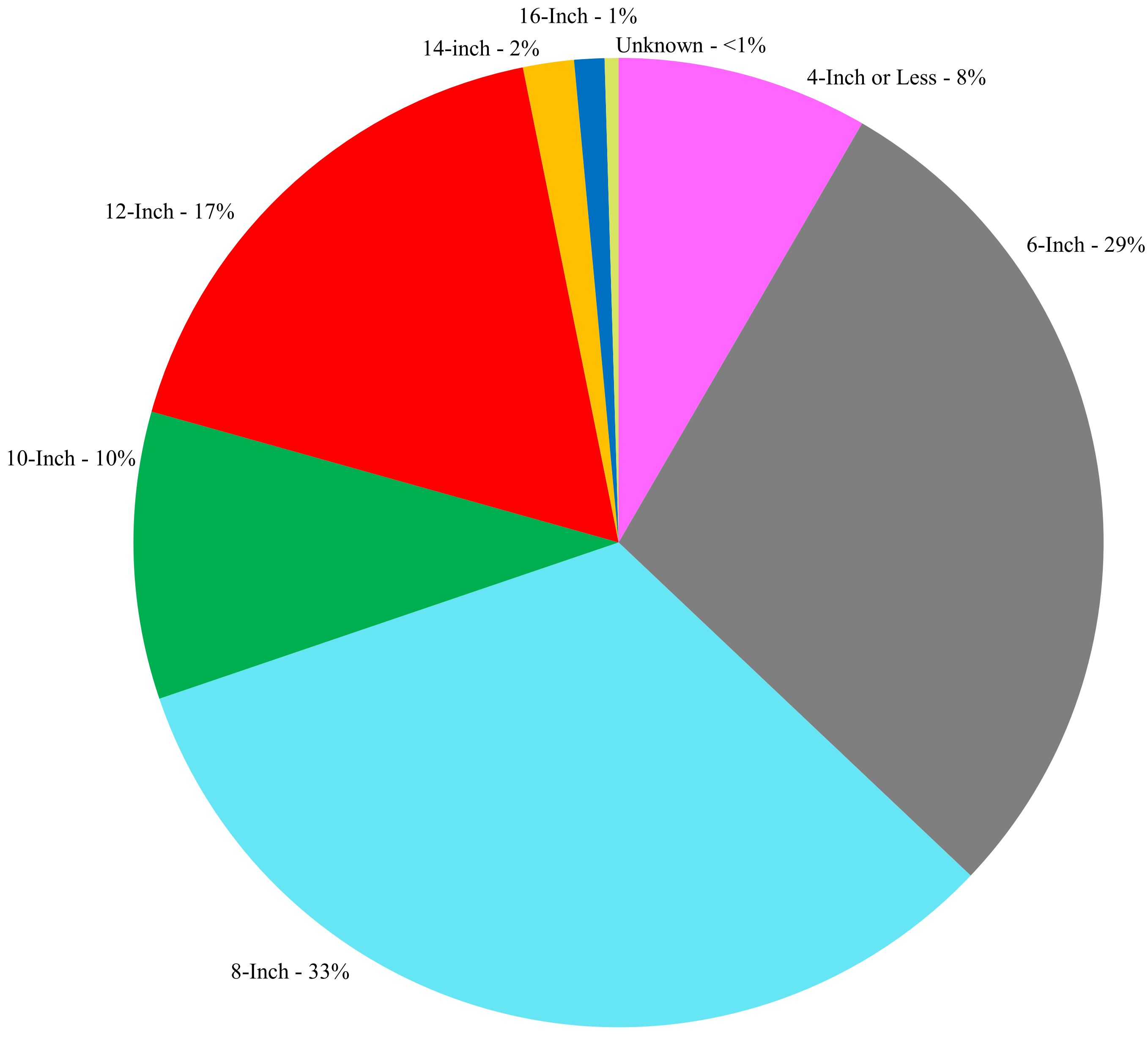
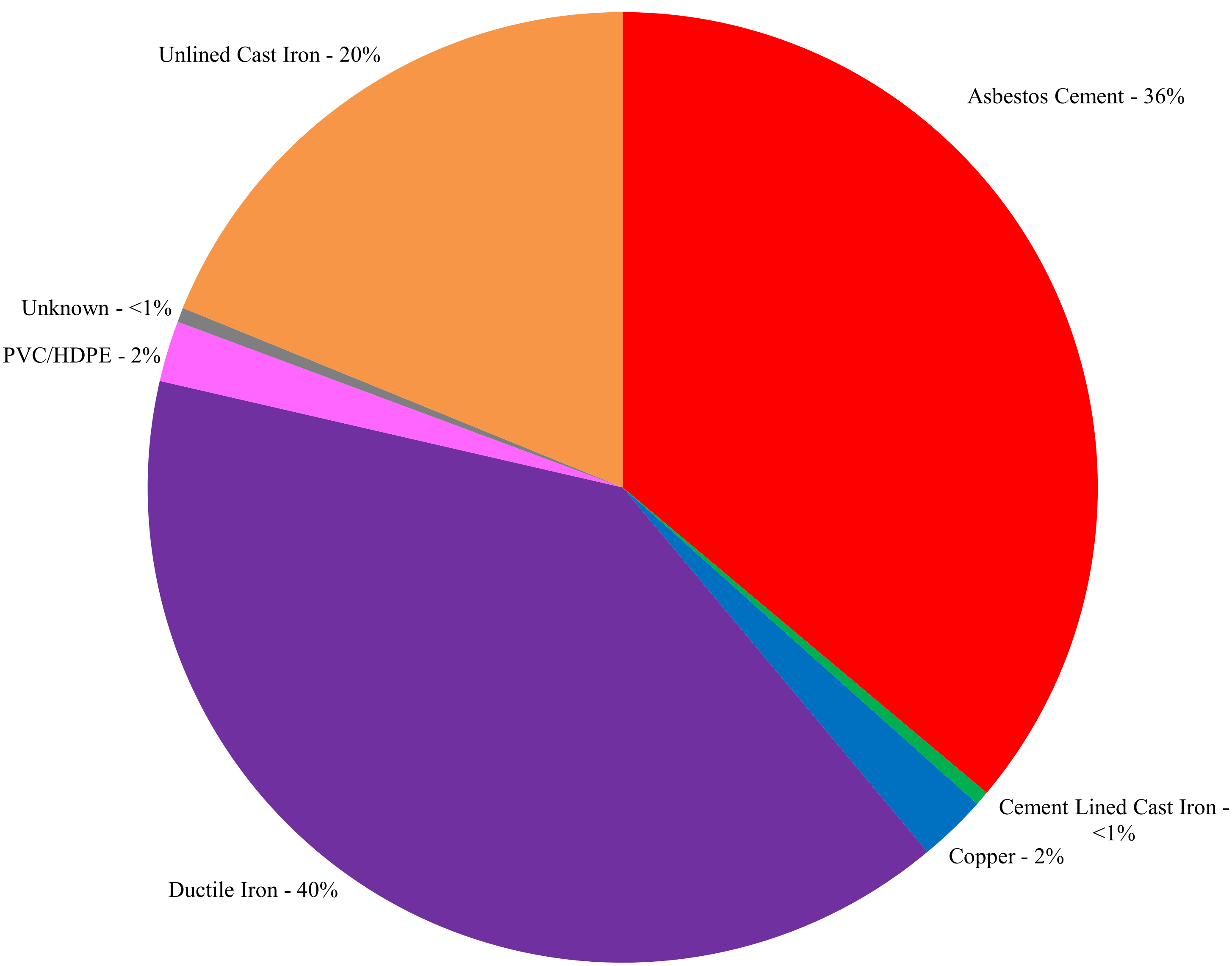


Figure No. 2-2
Water Main Material Distribution



Lary Lane Well

The Lary Lane Well was constructed in 1958. The raw water is chemically treated for disinfection and iron and manganese control prior to delivery directly to the distribution system. The Weston & Sampson Exeter Water Supply Alternatives Study (2010) reported that a February 28, 2007 Town work session memorandum stated, "The Town records show a pump test run at 500 gpm when the well was first installed, but the 2001 rehab indicates a maximum flow rate of approximately 350 gpm. The current safe yield is not known, but it is thought to be much less than 500 gpm. The Town reports that continued pumping at 350 gpm has resulted in undesirable drawdown." The report went on to state that the projected future capacity of the well is 0.25 mgd, based on the previous analysis of others and a review of the available hydrogeological data for the area.

Gilman Park Well

The Gilman Park Well was constructed in 1951, and last used in 1959. The well was reportedly abandoned due to high iron content and taste and odor issues stemming from the presence of hydrogen sulfide. The well is currently inactive, but the site and well are being restored and the building is being retrofitted with a new roof and pump to feed the new groundwater treatment facility which should be online by September 2015. A 14-inch diameter HDPE raw water transmission main was installed from the Gilman Park Well site to convey the water from the restored well to the new groundwater treatment facility. According to the Weston & Sampson (2010) report, pumping tests were completed to provide a full analysis and evaluation of safe yield and delineation of the well head protection area. The report notes, "The results suggest that Gilman Well is capable of pumping at a rate of 580 gpm (0.84 MGD) when pumping individually and 330 gpm (0.47 MGD) when pumping with the Stadium Well pumping at 491 gpm."

Stadium Well

The Stadium Well was constructed in 1963 and remains inactive since being abandoned prior to 1986. Reports noted elevated iron and manganese levels and traces of hydrogen sulfide. Weston & Sampson completed a pump test and safe yield analysis in 2010. The final report states, "The results suggest that the Stadium Well is capable of pumping at a rate of 838 gpm (1.21 MGD) when pumping individually and 491 gpm (0.71 MGD) when pumping with the Gilman Well pumping at 330 gpm." Currently there is no building to house the well pump and controls. The well site is presently under redevelopment to provide water to the new groundwater treatment facility. The Town and Phillips Exeter Academy have successfully negotiated a 30 year lease agreement.

Table No. 2-1 lists the reported capacity of the water sources.

Table No. 2-1
Water Source Capacity

Name	Capacity
Exeter Reservoir and Exeter River Safe Yield	2.60 mgd
Lary Lane Well: Projected Future Capacity	0.25 mgd
Stadium Well: Projected Future Capacity	0.71 mgd
Gilman Well: Projected Future Capacity	0.47 mgd
Total Estimated Capacity	4.03 mgd

2.4 Water Storage Facilities

The Town of Exeter has three water storage facilities located in the system. Distribution storage is provided to meet peak consumer demands, such as peak hour demands and to provide a reserve for fire fighting. Storage may also serve to provide an emergency supply in the event of a temporary breakdown of the pumping facilities or for pressure regulation during periods of fluctuating demand. The total storage capacity of all tanks is approximately 2.75 million gallons (MG). Calculations to determine the adequacy of existing storage facilities were not completed as part of this report. Required storage is based on three components; equalization, fire flow requirements, and emergency storage. Usable storage is calculated based on the water level in a tank that is required to maintain a pressure of 35 psi at the highest customer in a service area. The difference between the required storage and the usable storage determines if a storage deficit or surplus exists in a service area.

Epping Road Tank

The Epping Road Tank located off Meeting Place Drive is a 1.5 MG capacity composite elevated storage tank built in 2008. The tank was constructed by Caldwell Tanks Inc. as an elevated welded steel water storage tank supported by a large diameter steel reinforced concrete support tower that extends vertically from a steel reinforced concrete foundation. The overflow elevation is approximately 235 feet and the base elevation is approximately 78.5 feet above MSL. The diameter of the steel water storage tank is approximately 86 feet and the height is approximately 39.5 feet. The construction of the Epping Road Tank increased the overflow elevation from 205 feet to 235 feet in the Main Service Area. The tank significantly improved the operability of the water treatment plant, improved hydraulic connectivity within the distribution system, and eliminated the need to operate the Kingston Booster Pump Station.

Hampton Road Standpipe

The Hampton Road Standpipe located on Fuller Lane is a welded steel standpipe that was constructed in 1958 with a capacity of 1.0 MG. The standpipe is located in the Main Service Area. The overflow elevation of the tank is approximately 205 feet, the base elevation is approximately 120 feet, and the diameter is approximately 46 feet. The Hampton Road tank was rehabilitated by Utility Service Group with a new interior and exterior coating system in 2014. A new PAX active mixing system was also installed as part of the tank rehabilitation project. Due to the increased overflow elevation of the Epping Road Tank and resulting HGL in the main service area, a new booster pump station was constructed at the Hampton Road Tank in 2008. The booster pumps are needed to overcome the additional pressure within the system from the Epping Road Tank and are used to pump water out of the Hampton Road Standpipe into the distribution system. Typically the station pumps water into the distribution system during the day and the Hampton Road Standpipe refills at night. Based on the Operation and Maintenance Manual for the Hampton Road Tank and Pump Station the pump controls are configured to start and stop based on time-of-day set points or until the Hampton Road Standpipe water level falls below 68 feet.

Cross Road Tank

The Cross Road Tank is an Aquastore® glass fused steel standpipe constructed in 1993 located in the Kingston Road Service Area. The capacity of the Cross Road tank is approximately 0.48 MG. The overflow elevation is approximately 224 feet and the base elevation is approximately 138 feet MSL. The total height is 86 feet and the diameter is approximately 30.8 feet.

Prior to 1997, Aquastore® tanks were constructed with a single layer of glass fused to the steel tank wall. This construction method caused many tanks to experience frost spalling issues. Frost spalling occurs when water infiltrates the bubble (void) structure within the glass and the materials then experiences several freeze/thaw cycles, thus causing spalling. In cases where the bubbles (voids) are close together, the spalling was observed to travel from bubble to bubble, eventually reaching the steel tank wall. Since 1997 Aquastore® has included cathodic protection and installs two layers of glass coating in all new tank construction to prevent future frost spalling.

Since the potential for a spalling problem was identified in 1995, the Cross Road Tank has been inspected several times. In 1999 Aquastore® installed cathodic protection, at no additional cost to the Town, and extended the corrosion warranty to 2018. In 2013 a leak was discovered near a seam between steel plates. The leak was repaired by Aquastore® in 2013. Based on a brief exterior visual inspection completed by Tata & Howard there were several areas along the tank base where rocks had pierced and broken through the glass layer causing rusting. There was also a leak located approximately 55 feet from the base of the tank. Aquastore® repaired this leak in the fall of 2014. Another leak was discovered by the Town in April 2015. The Town has contacted Aquastore® to report the leak and a repair will occur soon.

According to the 2002 CDM report, an accidental overfilling of the Cross Road Tank occurred during a winter in the late 1990's while ice was present within the tank. When the exterior tank warmed, the rapidly rising ice layer collided with the tank roof system, resulting in $20,000 in roof damage, which required immediate repair.

2.5 Booster Pump Stations

The Town of Exeter has two active booster pump stations located in the system. They are used to maintain adequate pressures throughout the water distribution system.

Epping Road Booster Pump Station

The Epping Road Booster Pump Station was constructed in 2008 at the base of the Epping Road water storage tank. One section of the concrete pedestal tank base was enclosed and houses one jockey pump that runs constantly, two booster pumps, and a natural gas fired booster pump. The natural gas pump is a fire pump with a capacity of 4,600 gpm. The pumps are used to pump water from the Main Service Area (235 foot HGL) to the Industrial Drive High Service Area (258 foot HGL). There is also a 60 – 80 gallon capacity hydropneumatic tank and a generator for emergency use. The hydropneumatic tank is used to maintain indicator pressure gauges located at the Epping Road Tank during power failure.

Hampton Road Booster Pump Station

The Hampton Road Booster Pump Station was constructed in 2008 at the site of the Hampton Road water storage tank. The construction of the Epping Road Tank in 2008 raised the HGL in the Main Service Area from 205 feet to 235 feet. The overflow elevation of the Hampton

Road Tank remained unchanged at 205 feet. The Main Service Area's new HGL required the installation of a duplex pitless booster pump station housing two submersible pumps at the Hampton Road Tank site. The station pumps water out of the Hampton Road Tank to assist in meeting system pressures and demands. New telemetry and electrical systems were also installed in 2008 and are housed within the storage building onsite. The storage building also houses a portable generator for emergency use. The pumps are used in conjunction with the Epping Road Tank and the water treatment plant to maintain the Main Service Area's system pressures throughout the day. At night the booster pumps shut off to allow the Hampton Road Tank to refill. The pumping system is designed to facilitate a 20 percent turnover in the Hampton Road Tank. A 6-inch diameter altitude valve is located within the vault beneath the storage building to prevent the tank from overflowing.

2.6 Pressure Reducing Facility

Kingston Road Station

The Kingston Road Station was originally constructed in 1985 as a booster pump station. In 2008, the construction of the Epping Road water storage tank raised the Main Service Area's HGL by 30 feet to 235 feet MSL. This eliminated the need for the Kingston Road Station to raise the HGL for the Kingston Road Service Area to a HGL of 224 feet MSL. In 2008, the Kingston Road facility piping was modified to remove the booster pumps and install pressure reducing valves (PRVs) that are operated based on the flow through the facility and the system pressures provided based on the water level in the Cross Road Tank. The modifications converted the facility to function as a PRV facility to control gravity flow to the Kingston Road Service Area. A chlorine analyzer was also added as part of the facility modifications. The facility no longer acts as a booster pump station, but instead is used to lower the HGL and monitor chlorine levels in the water distributed to the Kingston Road Service Area. A gate valve was also added to the existing water main within Kingston Road to allow the Kingston Road Service Area to be isolated from the Main Service Area.

2.7 Interconnections

The Town of Exeter's water distribution system does not currently maintain any interconnections. An interconnection study between the Town of Exeter and the Town of Stratham was completed by Kleinfelder in 2012. The study recommended that the two towns continue discussions toward sharing water infrastructure and service between both Towns.

The Towns continue to proceed toward a water agreement. A draft water agreement includes Exeter providing 125 gallons per day through one master meter at the Town line on Portsmouth Avenue. It is not expected that a final agreement will be reached for several years.

Section 3

TATA & HOWARD

SECTION 3 – Critical Component Assessment

3.1 General

A critical component assessment was performed to evaluate the potential impact water main failures may have on the water distribution system. The critical component assessment includes the identification of critical customers served, critical water mains, critical components in the distribution system and the need for redundant mains.

3.2 Evaluation Criteria

Critical customers served are specific types of customers in the distribution system that require continual water supply for public health, welfare, or financial reasons. Examples of critical customers include hospitals, nursing homes, schools, and business districts. All water mains within 500 feet of a critical customer are considered a critical water main. Since water storage tanks and water supply sources provide water and/or maintain pressure to critical customers, tanks and primary water supply sources are also considered critical components. Therefore, any water main within 500 feet of a water storage tank or primary source is considered a critical water main.

Any transmission main that provides water from a source or a tank that is greater than 500 feet from the critical component or customer and does not have redundancy is also considered a critical water main. For example, the entire length of the transmission main from the Exeter River Pump Station to the SWTP is considered a critical main, since it is the only main that coveys water from the pump station to the treatment plant. If this main broke it would significantly impact the Town's ability to meet systems demands. Therefore, the assessment includes an evaluation of all water mains leading into and out of critical component/customer areas and that make up the main transmission grid.

3.3 Critical Components

Critical customers served, critical components, critical mains, and redundant mains were evaluated in the Exeter water system based on the criteria described above. A system-wide review of critical customers served such as hospitals, health care facilities and schools was completed. Other critical customers were identified by Town staff. A total of 80 critical customers/components were identified in the Town's system. Table No. 3-1 provides a listing of the critical customers and components. A map of critical customers and components is included in Appendix B.

Table No. 3-1
Critical Customers and Components
Exeter, New Hampshire

Name	Address	Type
Apartment Buildings	2 Pine Grove Road	Apartment
Apartment Buildings	2 Ernest Avenue	Apartments
Langdon Place of Exeter	17 Hampton Road	Assisted Living Facility
Chemtan Co. LLC	57 Hampton Road	Chemical Production
Buxton Oil Co.	24 Charter Street	Commercial User
Continental Microwave	11 Continental Drive	Commercial User
Gerry's Trackside Café	66 Lincoln Street	Commercial User
Hannaford's	137 Portsmouth Avenue	Commercial User
Industrial Park	2 Commerce Way	Commercial User
Osram Sylvania	129 Portsmouth Avenue	Commercial User
Sig Sauer	18 Industrial Drive	Commercial User
Exeter Mills Condominiums	10 Chestnut Street	Condominiums
Front Street Towers	156 Front Street	Condominiums
McLane Manor Condominiums	98 Portsmouth Ave	Condominiums
Norrisbrook Condominiums	50 Brookside Drive	Condominiums
Oaklands Condominiums	1-6 Brookside Drive	Condominiums
Pine Meadows Condominiums	1 Pine Meadows Drive	Condominiums
Sterling Hill Condominiums	2 Sterling Hill Lane	Condominiums
Town of Exeter Fire/Police Department	3 Bow Street	Fire and Police Department
Brewitt's Funeral Home	14 Pine Street	Funeral Home
Stockbridge Funeral Home	141 Epping Road	Funeral Home
Exeter Inn	90 Front Street	Hotel
Fairfield Inn	138 Portsmouth Avenue	Hotel
Hampton Inn	59 Portsmouth Avenue	Hotel
Inn by the Bandstand LLC	4 Front Street	Hotel
Water Street Businesses/Apartments	133 Water Street	Large Users (Downtown)
Blue Ribbon Cleaners	97 Portsmouth Ave	Laundromat
Burnham Cleaners	76 Lincoln Street	Laundromat
Front Street Laundry	168 Front Street	Laundromat
Exeter Housing Authority	82 Linden Street	Low Income Housing
Meeting Place	Meeting Place Drive	Low Income Housing
Access Sports Rehab & Fresinius Dialysis	1 Hampton Road	Medical
Dentist Office	4 Epping Road	Medical
Dentist Office	5 Hampton Road	Medical
Dentist Office	9 Hampton Road	Medical
Dentist Office	16 Hampton Road	Medical
Doctor Office	20 Hampton Road	Medical
Doctor Office	27 Hampton Road	Medical

Table No. 3-1 (Continued)
Critical Customers and Components
Exeter, New Hampshire

Name	Address	Type
Doctor Offices	19 Hampton Road	Medical
Doctor Offices	21 Hampton Road	Medical
Doctor Offices	110 High Street	Medical
Doctor Offices	112 High Street	Medical
Doctor Offices	191 High Street	Medical
Doctor Offices	193 High Street	Medical
Seacoast Mental Health	30 Prospect Avenue	Medical
Exeter Healthcare & Exeter Hospital	5 Alumni Drive	Medical/Large User
Exeter Hampton Coop	40 Hampton Road	Mobile Home Park
Exeter River Coop	10 Vincent Street	Mobile Home Park
Hayes Mobile Home Park	1 Hayes Park	Mobile Home Park
Icey Hill Mobile Home Park	93 Linden Street	Mobile Home Park
Pinecrest Mobile Home Park	5 Ashbrook Road	Mobile Home Park
Powder House Coop	93 Linden Street	Mobile Home Park
Strout's Mobile Home Park	93 Linden Street	Mobile Home Park
Exeter Center	8 Hampton Road	Nursing Home
Kingston Road Pump Station	31 Kingston Road	Pump Station
Exeter Southern District YMCA	56 Linden Street	Recreation
Exeter Housing Authority	277 Water Street	Retirement Community
Exeter River Landing	93 Linden Street	Retirement Community
RiverWoods at Exeter	7 RiverWoods Drive	Retirement Community
Exeter School District & Seacoast School of Technology	36 Linden Street	School
Lincoln Street Elementary School	25 Lincoln Street	School
Main Street School	40 Main Street	School
Phillips Exeter Academy	20 Main Street	School
Phillips Exeter Academy	9 Chadwick Lane	School
Cross Road Tank	9 Cross Road	Water Storage
Epping Road Tank	Meeting Place Drive	Water Storage
Hampton Road Tank	13 Fuller Lane	Water Storage
Gilman Park Well	45 Bell Avenue	Water Supply Source
Lary Lane Well	50 Lary Lane	Water Supply Source
Skinner Springs, thru last property on right	Squire Way	Water Supply Source
Stadium Well	33 Gilman Lane	Water Supply Source
Exeter River Pump Station	33 Gilman Lane	Water Supply Source/Pump Station
New Groundwater Treatment Plant	48 Lary Lane	Water Treatment Facility
Surface Water Treatment Plant	109 Portsmouth Avenue	Water Treatment Facility

Table No. 3-1 (Continued)
Critical Customers and Components
Stratham, New Hampshire

Name	Address	Type
Lindt Chocolate	96 Marin Way	Commercial User
Timberland	200 Domain Drive	Commercial User
Urgent Care Facility	2 Stoneybrook Lane	Medical
Exeter Coop Middle School	100 Academic Way	School

Hampton Falls, New Hampshire

Name	Address	Type
Heronfield Academy & Liberty Farms	356 Exeter Road	School

Critical Water Mains

Critical water mains were identified based on a review of the transmission and distribution system piping relative to the conveyance of water to critical customers and components. The criticality of the water main is based on the ability of the system to provide water to critical customers, or to and from critical components in the event of that water main breaking. The criticality assessment evaluates if adequate redundancy is provided, including looping, or if it is needed for certain areas of the distribution system. It is recommended that Exeter develop a contingency plan to limit the downtime associated with the repair of a critical main and identify a process to notify the critical customers affected.

A summary of the critical water mains located within the Exeter water distribution system is provided herein.

The raw water 12-inch diameter water main along Gilman Lane, Marlboro Street, High Street, and Portsmouth Avenue from the Exeter River Pump Station to the Water Treatment Plant is the only transmission main from the system's water supply source to the treatment plant and is therefore, considered critical.

The 16-inch and 12-inch diameter water mains along Portsmouth Avenue northeast of Alumni Drive are considered critical because there are no other mains that can convey water to this area and its seven critical users. A failure along this section of pipe could disrupt service to customers along all sections of Portsmouth Avenue north of Alumni Drive. If a break were to occur along this stretch of water main the water treatment plant would be required to be in operation to provide water along Portsmouth Avenue northeast of Alumni Drive.

The 10-inch diameter water main along High Street and Hampton Road is considered critical because this water main provides service to all customers east of Pleasant Street. A break along this water main would require the area to be reliant solely on the water stored in the 1.0 MG Hampton Road Tank.

Water mains that cross over major highways or entrance/exit ramps, cross streams, rivers, active railroad tracks, or major gas pipelines are also considered critical because of the costly consequences of failure. If a water main broke in these locations, there would be increased difficulty in construction and permitting involved in repair, replacement or rehabilitation.

Critical mains are highlighted on the Critical Components Map found in Appendix B.

Critical System Impact

A rating system associated with the critical components and critical water mains was established based on the type of critical component, the amount of the distribution system affected and location. Water mains are given the highest priority rating of three (3) if the main is critical due to its proximity to a system component (water supply, tank), medical facility, or school, if the water main is considered a transmission main or if a main failure would result in a significant water outage affecting a large percentage of the distribution system. A water main is considered a moderate priority and rated two (2) if the water main is within close proximity to a significant commercial or industrial user or the water main is along a highway or at a river or railroad crossing. Water mains in close proximity to the remaining critical users are given the lowest priority rating of one (1). All non-critical mains were considered non priority and given a rating of zero. Table No. 3-2 is a summary of the critical system impact ratings.

Table No. 3-2
Critical System Impact Ratings

Rating	Priority	Criteria
3	High Priority	▪ System component and/or ▪ Medical facility and/or ▪ School and/or ▪ Transmission system water main and/or ▪ A failure resulting in a significant water outage effecting a large percentage of the distribution system
2	Moderate Priority	▪ Significant commercial or industrial user and/or ▪ Highway, river or railroad crossing
1	Low Priority	▪ Other priority users
0	Non Priority	▪ Not critical

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Section 4

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SECTION 4 – Asset Management

4.1 General

The Town's water distribution system includes approximately 65 miles of water main varying in size and material. A number of factors including age, material, break history, soil conditions, pressure, and water quality affect the decision to replace or rehabilitate a water main. Using an asset management approach, each water main in the system was assigned a grade based on these factors. The grades were then used to establish a prioritized schedule for water main replacement or rehabilitation.

4.2 Data Collection

Information regarding the water main diameters and material was obtained from the 2009 hydraulic model developed by Underwood Engineers, PeopleGIS developed shapefiles, Cartographic Associates system maps, and information provided by the Town. Information regarding pipe age, pipe location, break history, and distribution system water quality was obtained from system records and other information provided by the Town.

4.3 Evaluation Criteria

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

To establish a rating system specific to Exeter's water system, a workshop was held with the Town staff. During the discussion, it was determined that history of breaks and pipe material, specifically unlined cast iron, are of primary concern to the Town. The grading system is shown in Table No. 4-1 and discussed in detail later in this section.

Age/Material

The water industry in the United States followed certain trends over the last century. The installation date of a water main correlates with a specific pipe material that was used during that time as shown on Table No. 4-2. For example, up until about the year 1958, unlined cast iron water mains were the predominant pipe material installed in water systems. Factory cement lined cast iron mains were manufactured from the late 1940s to about the mid-1970s, when pipe manufacturers switched primarily to factory cement lined ductile iron pipe.

Table No. 4-1
Asset Management Rating

Weight	Performance Criteria	Rating	Weighed Rating
30%	Break History		
	Three or more breaks	100	30
	Two breaks	80	24
	One break	70	21
	No history of breaks	0	0
30%	Material		
	Unlined Cast Iron	100	30
	Asbestos Cement	80	24
	Galvanized Iron	70	21
	Cement Lined Cast Iron	70	21
	HDPE/PVC/Copper	5	1.5
	Ductile Iron	5	1.5
20%	Diameter		
	4-inch water main or less	100	20
	6-inch water main	80	16
	8-inch water main	25	5
	10-inch water main	20	4
	12-inch water main	15	3
	14-inch water main	12.5	2.5
	16-inch water main	10	2
10%	Water Quality		
	Water quality problems	100	10
	No water quality problems	0	0
10%	Soils		
	Pipe on Rock	100	10
	Identified corrosive soils	80	8
	Cinders, landfill, contaminated soil, or shallow main	80	8
	Potentially corrosive soils	70	7
	Gravel, sand	0	0

Cast iron water mains consist of two types: pit cast and sand spun. Pit cast mains were generally manufactured up to the year 1930 while sand spun mains were generally manufactured between 1930 and 1976. Pit cast mains with diameters between 4-inch and 12-inch do not have a uniform wall thickness but are generally thicker and stronger than spun cast mains. However, pit cast mains in this range of sizes may have “air inclusions” as a result of the manufacturing process. This reduces the overall strength of the main, which makes it more prone to leaks and breaks. Although sand spun mains have a uniform wall thickness, the overall wall thickness was thinner than the pit cast mains. The uniformity provided added strength, however, the thin wall thickness made it more susceptible to corrosion and breaks. Pit cast mains 16-inch diameter and larger have very thick pipe walls and are generally stronger than the thinner walled sand spun cast mains.

While the transition to factory cement lined cast iron mains had begun in the late 1940s, most cast iron water mains that were manufactured were unlined prior to the year 1958. Unlined cast iron mains increased the potential for internal corrosion. By 1958 the majority of cast iron mains manufactured had a factory cement lining. Rubber gasket joints were also introduced around 1958. Prior to this date, joint material was jute (rope type material) packed in place with lead or a lead-sulfur compound, also known as “leadite” or “hydrotite.” Leadite type joint materials expand at a different rate than iron due to temperature changes. This can result in longitudinal split main breaks at the pipe bell. Sulfur in the leadite can promote bacteriological corrosion that can lead to circumferential breaks of the spigot end of the pipe.

The majority of the Town’s cast iron water mains are unlined. Unlined cast iron water mains make up approximately 20 percent of the water system. Approximately one percent of the system consists of water mains that are cement lined cast iron water mains. These water mains are all laterals that were installed off asbestos cement pipe. The Town has had problems with the existing unlined cast iron water main and therefore, this type of main has the highest rating score of all materials.

Factory lined cast iron was manufactured and installed up until about 1973. Overlapping this period, factory cement lined ductile iron main was manufactured from the 1950s, and continues to be manufactured today, although most New England water utilities did not begin to install ductile iron pipe until the late 1960s. Factory cement lined cast iron and ductile iron pipe provided increased protection against internal corrosion.

Approximately 40 percent of the system is cement lined ductile iron water main. According to the Ductile Iron Pipe Research Association (DIPRA), ductile iron pipe retains all of cast iron's qualities such as machinability and corrosion resistance, but also provides additional strength, toughness, and ductility.

Between the 1930s and 1970s, the water industry also utilized asbestos cement (AC) pipe for their expanding water systems. An advantage of AC pipe is that it resists tuberculation build up, resulting in less system head loss. However, depending on the water quality, the structural integrity of AC mains can deteriorate over time, thereby becoming sensitive to pressure fluctuations or nearby construction activities. In addition, external influences such as soil type and high groundwater can corrode AC mains, thus reducing the strength further. For a short time, AC pipe was lined with vinyl. It was later found that the vinyl can leach perchloroethylene (PCE) into drinking water and thus the lining was discontinued. Following the discontinuation of vinyl lined AC pipe, asphalt lined AC pipe was manufactured. The Town's system contains approximately 24 miles of AC pipe, representing approximately 36 percent of the system.

High density polyethylene (HDPE) pipe has been used in water distribution systems since the 1960s. HDPE pipe has many advantages including fused joints, which minimize leaks, and its flexible and light-weight material makes it easier to install. Because of its smooth interior, HDPE pipe resists tuberculation and generally maintains high c-values throughout its life. It should be noted that HDPE is a permeable material. Low molecular weight petroleum products and organic solvents can permeate HDPE pipe if the contaminants are found in high concentrations in the soil surrounding the pipe. Recent research by the American Water Works Association Research Foundation (AWWARF Project No. 4138) indicates that long-term exposure to chlorinated water can increase HDPE's chemical permeation potential. In addition, chemically induced degradation can result in brittle pipe, causing failure even at low stress levels. The study indicated that chemical degradation of the pipe will vary depending on the drinking water and groundwater constituents as well as temperature. HDPE generally performs better in colder climates. HDPE water mains make up approximately two percent of the Town's water system. The HDPE located within the Town is all new pipe and the Town has reported no problems with the HDPE pipe installed, likely due to the recent installation dates. The cool New Hampshire climate may minimize the negative effects identified by the AWWARF research.

A small percentage of the system is small diameter galvanized iron, polyethylene and copper pipe. Typically this pipe would be considered a water service and not be included in this study. Some of these mains in the system may serve multiple homes and were therefore, included in the analysis.

Age was not used in the water main grading system, due to the Town's uncertainty about the installation year for a majority of the system's water mains. Since water industry trends indicate a correlation between installation dates of water main and specific pipe material, pipe material was assigned a larger percentage, 30 percent, within the grading system to account for both water main age and material. It is recommended that the Town accurately assign a specific installation year to each section of water main by reviewing existing data. Once this is completed the water main grading system could be modified to include installation year as a parameter. See Table 4-2 for an example installation year grading system. The revised grading system could potentially change water main asset management scores and priority rankings for the water main replacement recommendations.

Figure No. 4-1 and Figure No. 4-2 present the installation year of the water mains and the materials, respectively.

Table No. 4-2
Example Installation Date Asset Management Ratings

Performance Criteria	Rating
Installation Date	
Pre-1915	85
1915-1929	80
1930-1939	100
1940-1949	95
1950-1958	90
1959-1970	50
1971-1979	20
1980-1989	10
1990-1999	5
2000-2015	3

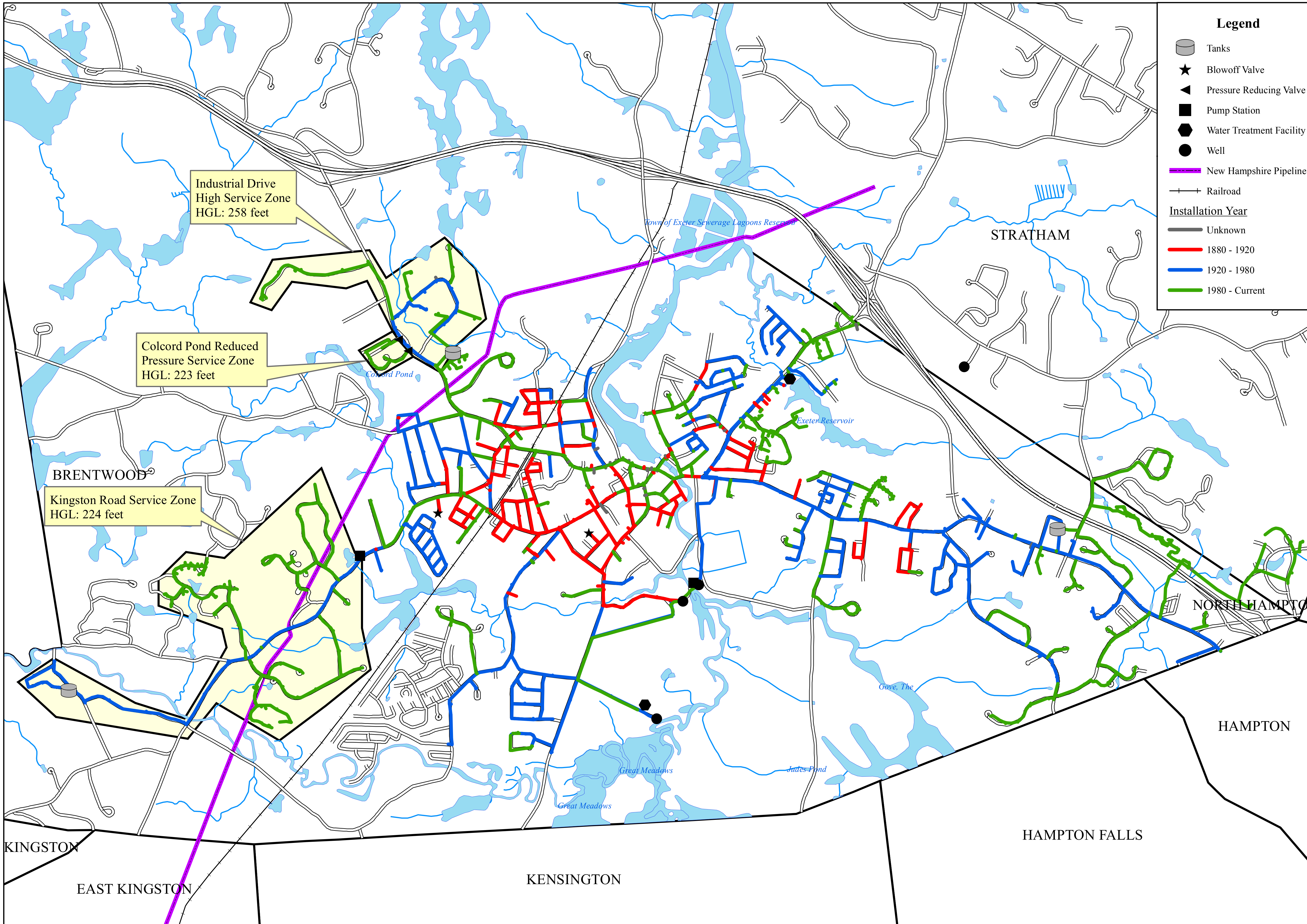

Figure No. 4-1

Water Main Installation Year

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Scale: 1:26,000

Date: May 2015

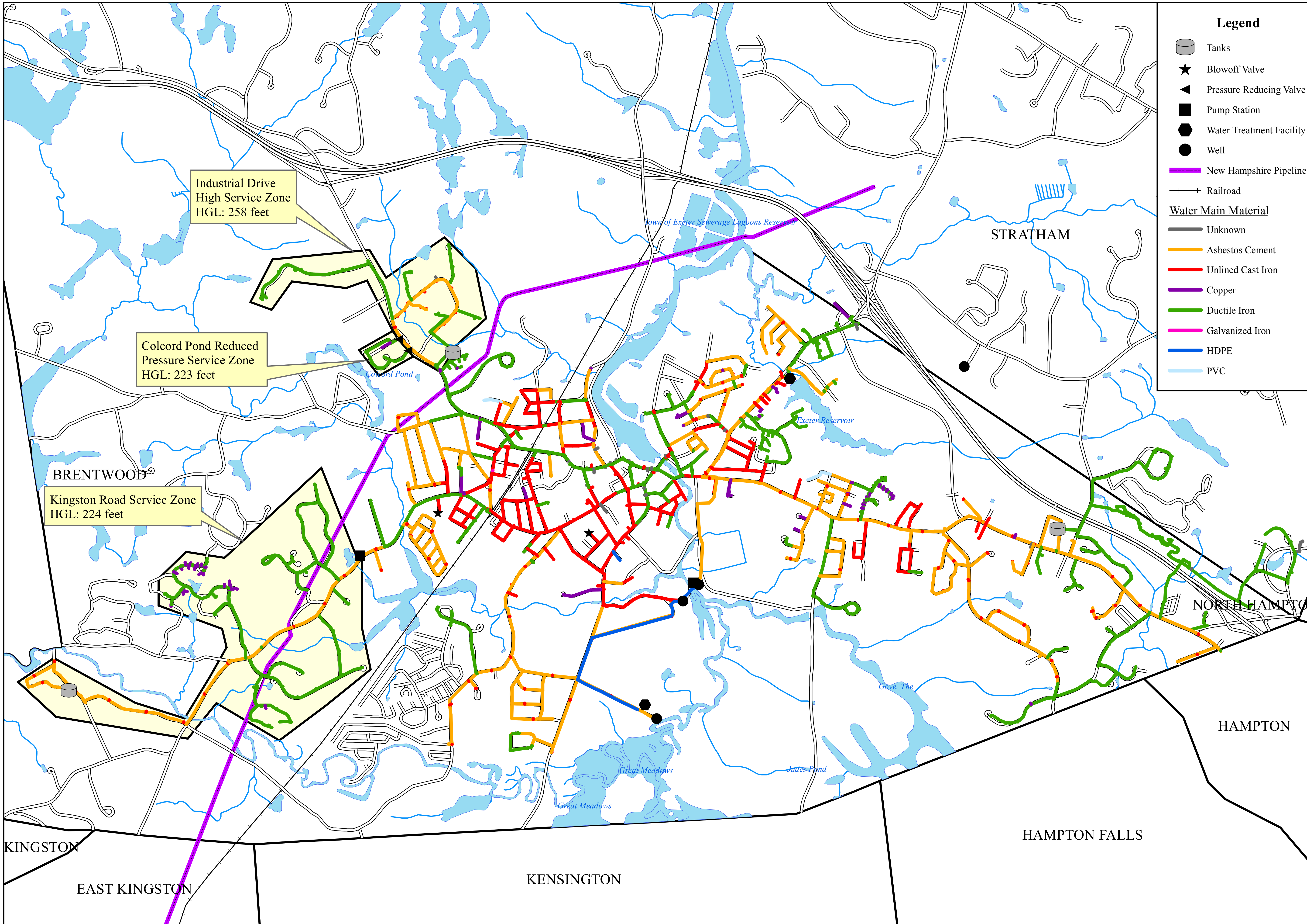

Figure No. 4-2

Water Main Material

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Scale: 1:26,000

Date: May 2015

Diameter

The Exeter system consists of water mains ranging in diameter from less than 4-inches to 16-inches. Approximately 33 percent of the system is comprised of 8-inch diameter pipes and approximately 17 percent of the system is 12-inch diameter pipes. Approximately eight percent is 4-inch and smaller diameter pipes, approximately 29 percent of the system is 6-inch diameter pipes, approximately 10 percent is 10-inch diameter pipes, two percent is 14-inch diameter pipe, and one percent is 16-inch diameter pipes.

In general, as the diameter of a pipe increases, the strength increases. In most cases, failure occurs in the form of ring cracks. This is primarily the result of bending forces on the pipe. Pipes that are 6-inch in diameter are more likely to deflect or bend than a larger diameter main. Pipes that are 8-inch in diameter are less likely to break from bending forces than 6-inch mains due to their increased diameter and resulting increased moment of inertia.

In addition, the pipe wall thickness typically increases as the pipe diameter increases. Pipes that are 16-inches in diameter and larger have significantly thicker walls than 12-inch diameter pipe and smaller diameter mains, such that in addition to superior bending resistance, they also are much more resistant to failure from pipe wall corrosion. The rating system for the diameter of the water mains follows the concept that 4-inch diameter water mains are not as strong as 16-inch diameter water mains. Therefore, a rating of 100 was given to 4-inch diameter and smaller water mains and a rating of ten was given to the 16-inch diameter water mains. Table No. 4-1 shows a significant drop in the rating score between a 6-inch diameter water main (80) and 8-inch diameter water main (25). This is due to the difference in bending strength between these main sizes, as an 8-inch diameter water main has proven to have nearly twice the bending strength of a 6-inch diameter water main. Figure No. 4-3 presents the various diameter sizes throughout the distribution system.

Break History

The Exeter water system experiences approximately seven breaks per year, on average. This number is based on conversations with Town staff and the water main failure records. In relation to the total miles of water main in the system, this equates to approximately 12 breaks per 100 miles per year. In comparison to the national average of 25 breaks per 100 miles per year, the Exeter water system is in good condition. However, each water main break costs the Town time and labor. They also cause disruption to the public and water consumers. At some point, it becomes more efficient to replace the main then to continue repairing it. Based on the water main break records, there are several mains in the system that have experienced frequent breaks. Mains that have experienced three or more breaks have a score of 100, mains that have experienced two breaks have a score of 80, and mains that have experienced one break have a score of 70. Water mains that have had no breaks have a score of zero. Figure No. 4-4 presents areas with a history of breaks.

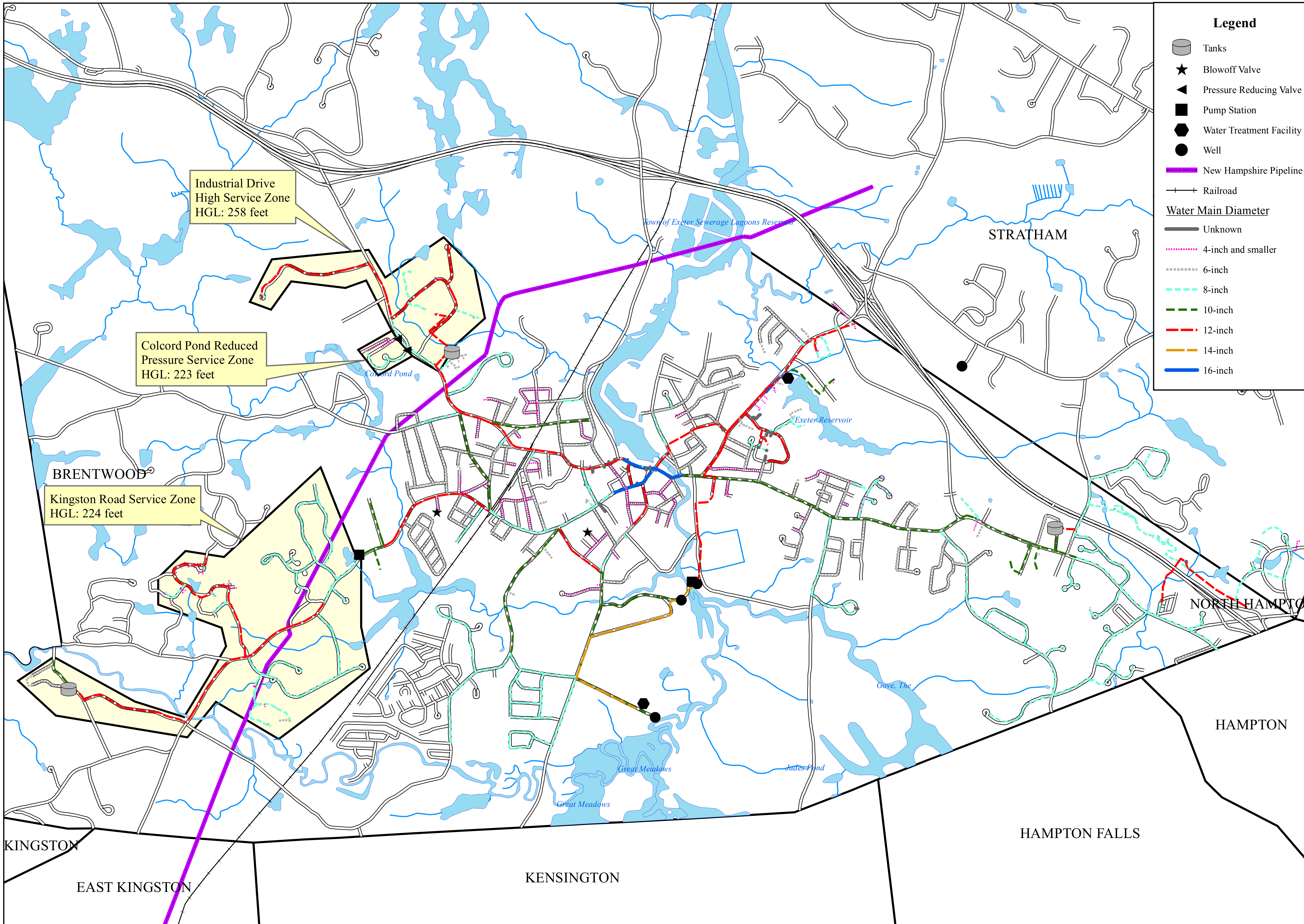

Figure No.

4-3

Water Main Diameter

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Date: May 2015

Scale: 1:26,000

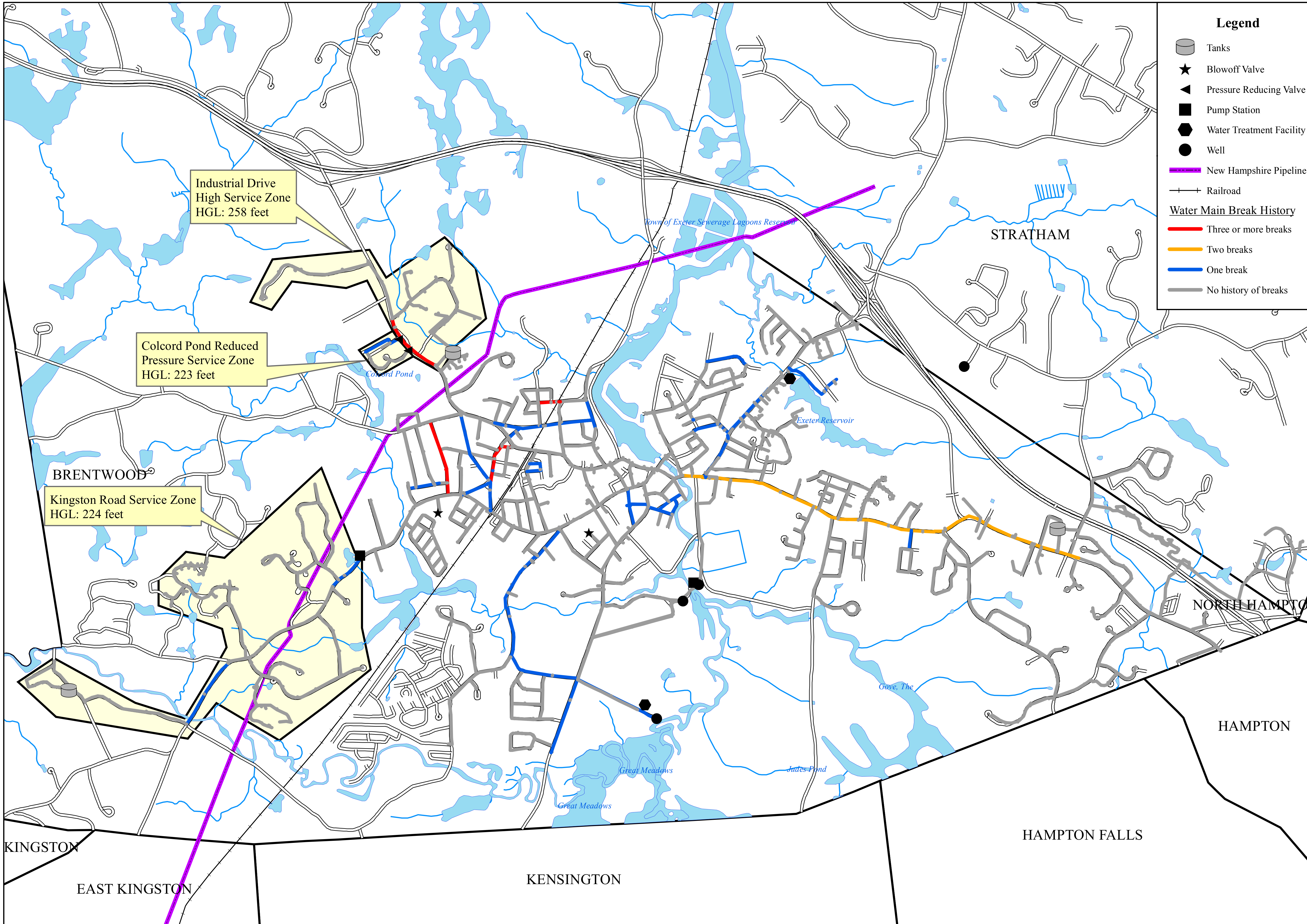

Figure No. 4-4

Areas with History of Breaks

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Scale: 1:26,000

Date: May 2015

Water Quality

In general, the water quality in the Exeter water system meets or exceeds state and federal water quality standards. However, there are occasional water quality complaints throughout the water distribution system. The Town makes an effort to track the location and frequency of customer complaints. Also, the Town spends approximately five to six weeks, twice a year flushing the water distribution system. A unidirectional flushing plan has been implemented to continue to improve the water quality. To maintain high water quality throughout the water distribution system the Town currently utilizes the reservoir surface water source which is treated at the water treatment plant in the winter months and the groundwater sources in the summer months. Areas with water quality concerns are identified in Figure No. 4-5.

Soils

Water main degradation can occur both internally and externally. Factors that increase the rate of external corrosion include high groundwater, clay soils, contaminated soils, soils with low calcium carbonate, or soils with high acidity or sulfate. The chemical and biological composition of soils and areas that vary in soil types can cause external pipe corrosion. Wetlands areas have greater potential to cause external corrosion of water main than other soil conditions. As shown on Figure No. 4-6, the Town's distribution system is mainly devoid of wetlands areas and areas with potentially corrosive soils. The few locations shown as areas with potentially corrosive soils are based on a soil survey data base obtained on New Hampshire's Statewide Geographic Information System Clearinghouse, NH GRANIT. Areas where the water system and the potentially corrosive soils coincide were considered areas of potential exterior corrosion. There were also areas identified by the Town where there is known pipe on rock, shallow water mains, and corrosion due to stray currents. Areas with pipe on rock were given the highest rating of 100. Pipe in areas of identified corrosive soils or contaminated soils, shallow mains, and pipe affected by stray currents, were given a rating of 80, and water mains identified as wetlands or potentially corrosive soils through soils maps were given a rating of 70. All other pipe was assigned a rating of zero. Water mains within potentially corrosive soils are identified in Figure No. 4-6.

Pressures

Due to the ground elevations and the existing operating scenario, there are no areas in the system with pressures greater than 120 psi and there are very few areas of the system with static pressures greater than 100. Because high static pressures are not a concern, pressure was not considered as a criterion in the asset management grading system.

4.4 Asset Management Areas of Concern

Based on the asset management ratings, there are several areas of concern in the system. Water mains with a rating from zero to 29 are considered to be in good to excellent condition. Mains with a rating from 30 to 49 are considered to be in fair to good condition, and water mains with a rating of 50 or greater are considered to be in poor to fair condition. Asset management ratings are presented graphically in Appendix C.

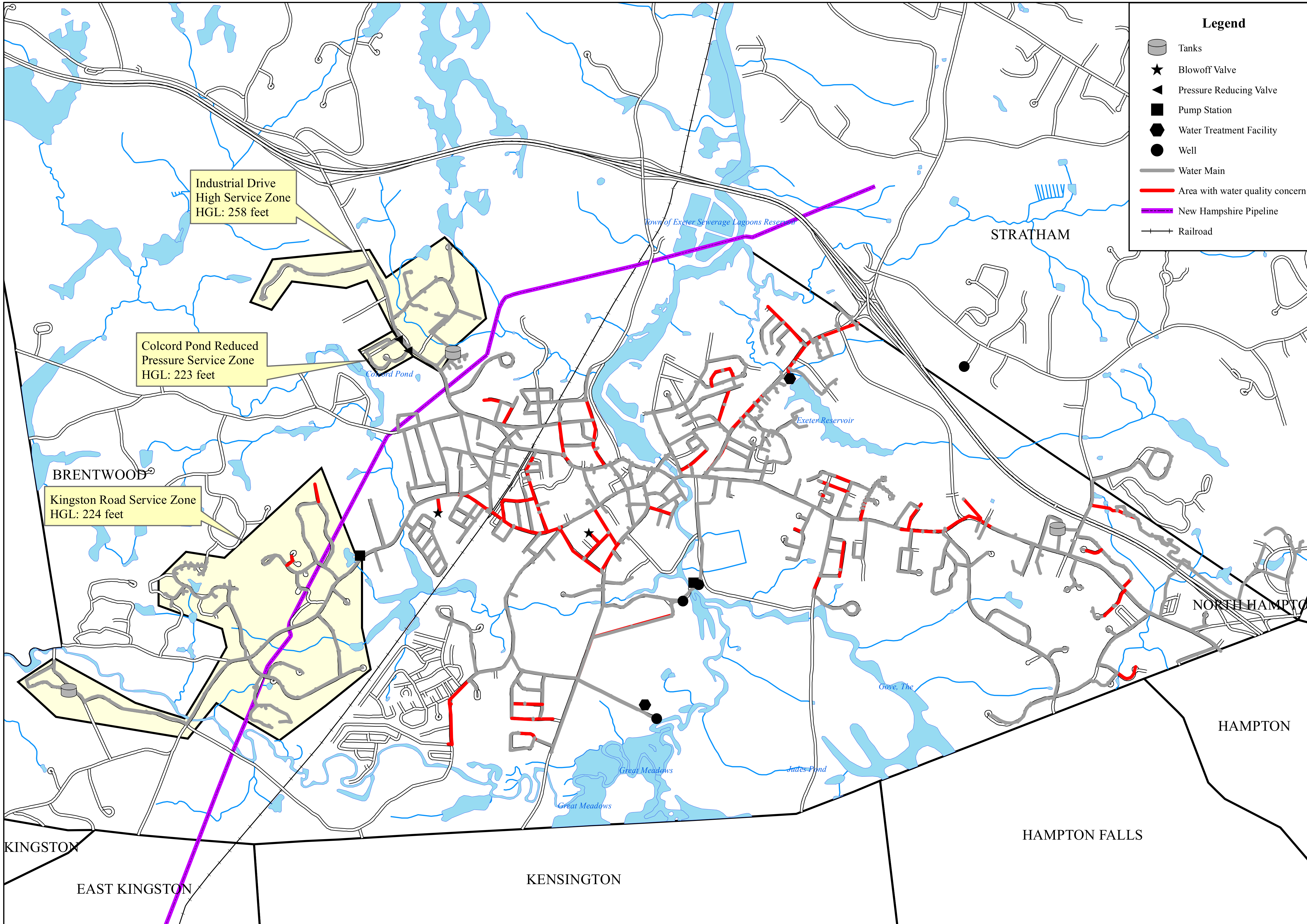

Figure No. 4-5

Areas with Water Quality Concerns

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Scale: 1:26,000

Date: May 2015

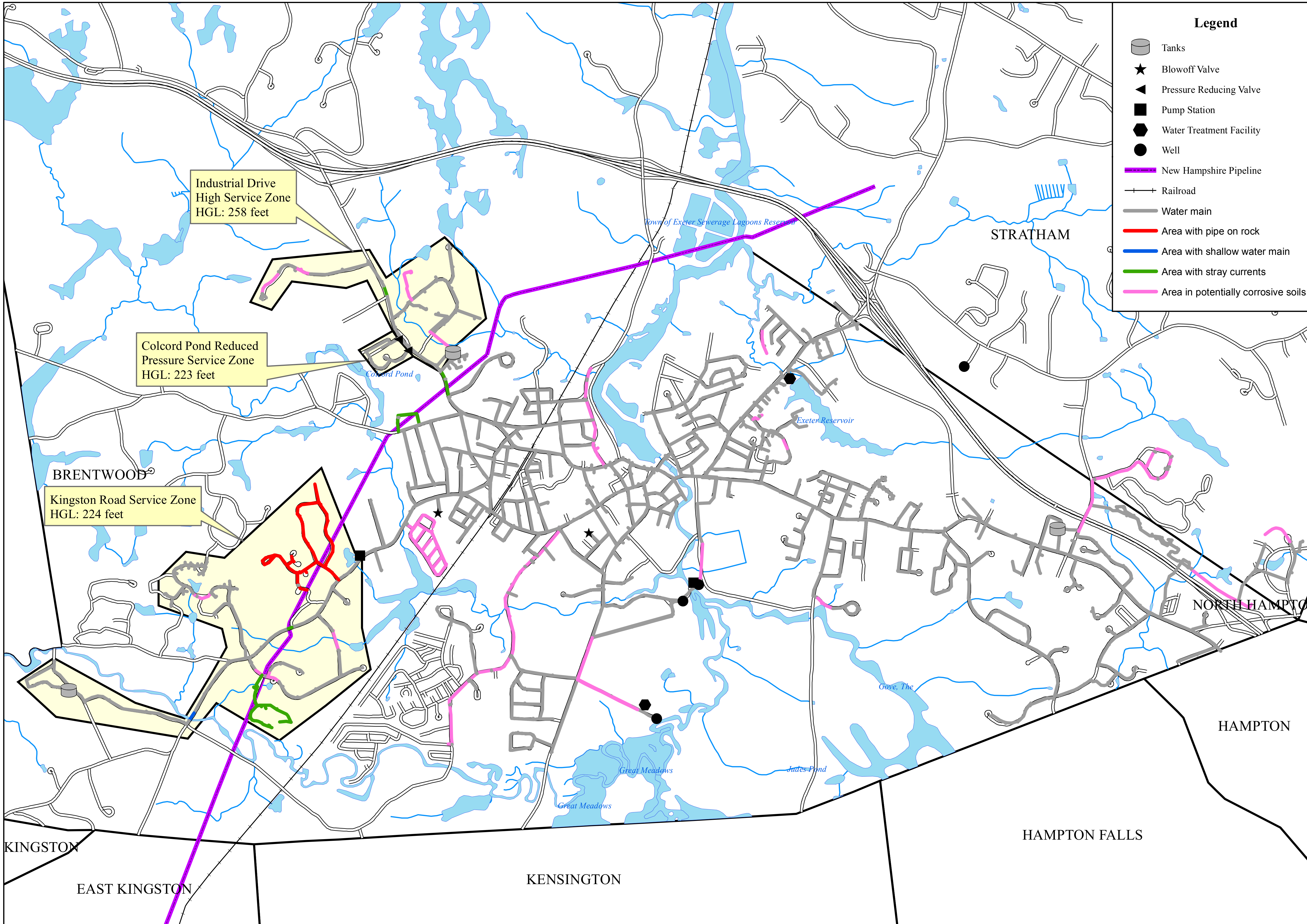

Figure No. 4-6

Potentially Corrosive Soils

Asset Management Plan
Town of Exeter, New Hampshire

TATA & HOWARD

Scale: 1:26,000

Date: May 2015

Section 5

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SECTION 5 – Above Ground Infrastructure

5.1 General

As discussed in Section 2, the water system includes one active groundwater well, two active booster pump stations, three water storage tanks, and one surface water treatment facility. In August 2014, Tata & Howard, Inc. conducted site visits to the wells, pump stations, tanks, and treatment facility to take inventory of and evaluate the condition of each structure and associated equipment.

The buildings and equipment were evaluated based on installation date, anticipated life span, and current condition. The installation dates were determined based on data provided by Town staff. The estimated life span was estimated based on AWWA papers and standard water works practices at each facility. An evaluation was conducted to determine if the estimated life span of the building or equipment should be adjusted based on its current condition. The condition and recommendations for repairs at each facility is discussed in this section. The buildings and equipment should be monitored and repaired as necessary. Routine maintenance should also be completed. It is assumed that routine repair and replacement of the building and equipment would be included in the annual maintenance budget.

5.2 Water Supply Sources and Treatment Plant

The results of the evaluation of the water supply sources (active and inactive) and water treatment plant are summarized below. Some aspects of the buildings including the exterior façade, windows, doors, and roof, and equipment, including pumps, motors, and flow meters have passed the estimated life expectancy for these assets, or will reach the life expectancy within the next 20 years. The buildings and equipment should be monitored and repaired or replaced as necessary.

Exeter River Pump Station

The Exeter River Pump Station was constructed between 1972 and 1974. It is located on the eastern bank of the Exeter River and accessed by a ¼ mile road off High Street. The entrance to the access road is gated and locked. The road serves as a right-of-way through Phillips-Exeter Academy owned land. The Exeter River Pump Station is operated from April to October each year. The water is pumped from the station through a 12-inch diameter main to the SWTP on Portsmouth Avenue.

The building consists of a concrete block structure with a flat concrete roof atop a subgrade basement and vault that houses an intake pipeline, manually-actuated sluice gate, stationary water screen, discharge piping, valving, and appurtenances. The building is locked and requires a key separate from the access gate to gain access. The facility houses two vertical turbine pumps. The facility is also equipped with a Badger Meter magnetic flowmeter, SCADA panel, and NEMA Type 1 electrical panels.

The Town has reported plans to purchase and install an emergency backup generator for this site. The Town has also reported that there are plans to remove a dam downstream that would require piping modifications at the Exeter River Pump Station. The dam removal project has reserved funding, approximately $850,000, to complete the required piping modifications.

A summary of the installation year and anticipated life span of the equipment in the Exeter River Pump Station is included in Table No. 5-1.

Table No. 5-1
Exeter River Pump Station
Installation Year and Anticipated Life Span

	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Exeter River Pump Station			
Concrete block building and basement	1974	100	2074
Magnetic flow meter	2010	25	2035
Vertical turbine pump no. 2	2009	25	2034
Vertical turbine pump no. 2 motor (50 hp)	2009	25	2034
Vertical turbine pump no. 2 motor soft starter	2009	25	2034
Concrete roof	1974	50	2024
Manually-actuated sluice gate	1974	50	2024
Stationary water screen	1974	50	2024
SCADA panel	2008	10	2018
Vertical turbine pump no. 1	1974	25	Past life expectancy
Vertical turbine pump no. 1 motor (75 hp)	1974	25	Past life expectancy
Electrical panels	1974	25	Past life expectancy

Lary Lane Well

The Lary Lane Well was constructed in 1958. The 24-inch by 18-inch diameter gravel packed well is constructed to a depth of 94 feet. The well screen extends from 79 feet to 94 feet deep, with a total length of 15 feet. The screen slot opening width is 0.080 inch for the top 5 feet and 0.120 inch for the bottom ten feet. The screen is made of Everdur, an alloy consisting of 96 percent copper. This material was a common well screen material prior to the introduction of stainless steel as the industry standard.

The facility is surrounded by a barbed wire topped chain link fence and requires a key to gain access through the locked gate. The fence is signed with a 'No Trespassing or Loitering on This Property: Violators Will Be Prosecuted' notice. The building consists of a masonry block structure atop a subgrade basement that houses discharge piping, valving, and appurtenances.

The facility houses one single speed vertical turbine pump with a 40 hp motor. The pump capacity is 350 gpm at 225 feet of head. The discharge rate of the pump is currently being reduced as part of regular operations due to high arsenic levels within the groundwater. The reduced pumping rate is used to avoid sending excess arsenic into the distribution system. The well site it being retrofitted to pump water to the new groundwater treatment facility, which will treat arsenic and eliminate the need to throttle the well pump.

The existing well pump station houses a sodium hypochlorite day tank and chemical feed pump which could be used to provide disinfection if the Lary Lane Well needed to bypass the groundwater treatment plant. The well pump station also houses a polyphosphate, CARUS™ 1000, system for iron and manganese sequestration, water level instrumentation that was updated to include a LED read out in 2001, and telemetry equipment. A water sampling location is present in basement of the well pump station. The facility is integrated with the groundwater treatment plant's generator that is used to provide emergency power.

A summary of the installation year and anticipated life span of the equipment in the Lary Lane Well is included in Table No. 5-2.

Table No. 5-2
Lary Lane Well
Installation Year and Anticipated Life Span

	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Lary Lane Well			
Concrete block building	1958	100	2058
Vertical turbine pump	2015	25	2040
Vertical turbine motor (40 hp)	2015	25	2040
Magnetic flow meter	2015	25	2040
Sodium hypochlorite day tank	2015	7	2022
Sodium hypochlorite pump	2015	7	2022
Water level instrumentation	2001	20	2021
SCADA panel	2008	10	2018
Concrete roof w/membrane	1958	50	Past life expectancy
Perimeter fencing	1958	50	Past life expectancy
Polyphosphate system	2000	7	Past life expectancy

Gilman Park Well

The Gilman Park Well was constructed in 1951. The well is 51-feet deep and 24-inches in diameter with a 5 foot long well screen. The well was last used in 1959 and is currently inactive, but in the process of being reactivated. The rehabilitation will include a new coat of paint on the building exterior. The facility is a concrete block building with a concrete roof and is equipped with a unit heater. The well was reportedly abandoned due to high iron content and taste and odor issues stemming from the presence of hydrogen sulfide. Currently the site is being restored and the building is being retrofitted with a new roof and pump to feed the new groundwater treatment facility which should be online by September 2015. A 14-inch diameter HDPE raw water transmission main was installed from the Gilman Park Well site to convey the produced water from the restored well to the new groundwater treatment facility.

A summary of the installation year and anticipated life span of the equipment in the Gilman Park Well is included in Table No. 5-3.

Table No. 5-3
Gilman Park Well
Installation Year and Anticipated Life Span

	Installation Year	Typical Life Span (Years)	Anticipated Replacement /Rehabilitation Year
Gillman Park Well			
Concrete Roof	2015	50	2065
Concrete Block Building	1951	100	2051

Stadium Well

The Stadium Well was constructed in 1963 and remains inactive since being abandoned prior to 1986. The 36-inch by 24-inch diameter originally constructed gravel-packed well was between 54 and 59 feet deep. Currently there is no building to house the well pump and controls. The well site is being considered to provide water to the new groundwater treatment facility, and in April 2015 a 30 year lease was executed between the Town of Exeter and Phillips Exeter Academy. When this well is reactivated, all new equipment and controls will be required.

Epping Road Booster Pump Station

The Epping Road Booster Pump Station was constructed in 2008 at the base of the Epping Road water storage tank. The concrete pedestal tank base was split into two separate compartments. One section is enclosed and houses one jockey pump that runs continuously and two booster pumps that operate based on demand. They are used to pump water from the Main Service Area to the 258 foot HGL of the Industrial Drive High Service Area. The facility also houses one natural gas fired, high service fire pump with a capacity of 4,600 gpm. The facility includes a hydropneumatic tank, SCADA equipment, and miscellaneous electrical equipment. Within the tank and booster pump station perimeter fencing is an enclosed generator on a concrete pad.

A summary of the installation year and anticipated life span of the equipment in the Epping Road Booster Pump Station is included in Table No. 5-4.

Table No. 5-4
Epping Road Booster Pump Station
Installation Year and Anticipated Life Span

	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Epping Road Booster Pump Station			
Enclosed generator	2008	50	2058
Booster pump no. 1	2008	25	2033
Booster pump no. 1 motor (3 hp)	2008	25	2033
Booster pump no. 2	2008	25	2033
Booster pump no. 2 motor (7.5 hp)	2008	25	2033
Booster pump no. 3	2008	25	2033
Booster pump no. 3 motor (7.5 hp)	2008	25	2033
High service fire pump	2008	25	2033
High service fire pump motor	2008	25	2033
Hydropneumatic tank	2008	25	2033
SCADA equipment	2008	10	2018
Electrical panels	2008	10	2018

Kingston Road Station

The Kingston Road Station was originally constructed in 1985 as a booster pump station. In 2008 the Epping Road water storage tank was constructed and raised the main service area HGL by 30 feet to 235 feet. This eliminated the need for a booster pump station to raise the HGL to the Kingston Road Service Area HGL of 224 feet. In 2008, the Kingston Road facility piping was modified to remove the pumps and install PRVs that are operated based on the flow through the facility and the Cross Road Tank water level. The modifications converted the facility to function as a PRV facility to control gravity flow to the Kingston Road Service Area. A chlorine analyzer was also added as part of the facility modifications. The facility no longer acts as a booster pump station, but instead is used to lower the HGL and monitor chlorine levels in the water distributed to the Kingston Road Service Area. A gate valve was also

added to the existing water main within Kingston Road to allow the Kingston Road Service Area to be isolated from the Main Service Area.

The facility is located on Kingston Road, approximately 150 feet north of Brickyard Pond Park. The facility is constructed of precast concrete panels and supports a concrete plank roof. The facility houses a magnetic flow meter, two (2) electric butterfly valves and pressure transducers, a calcium hypochlorite booster chlorination system, and a portable generator. The chlorination unit is a Power Pro calcium hypochlorite tablet feed chlorination unit by Accu-Tab Systems which was installed to boost chlorine residuals.

A summary of the installation year and anticipated life span of the equipment in the Kingston Road Station is included in Table No. 5-5.

Table No. 5-5
Kingston Road Station
Installation Year and Anticipated Life Span

	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Kingston Road Station			
Concrete block building	1985	100	2085
Portable generator	2008	50	2058
Concrete roof w/membrane	1985	50	2035
Magnetic flow meter (4-inch)	2008	25	2033
Electric butterfly pressure reducing valves	2008	25	2033
Calcium hypochlorite system	2010	7	2017

Exeter Surface Water Treatment Plant

The Exeter Surface Water Treatment Plant was constructed in 1886. The original brick building is in poor condition and was condemned in 1992 due to deterioration of the floor timbers.

The treatment plant filter building was constructed in 1906. The facility was updated and expanded in 1972. The brick building houses laboratory equipment, a SCADA system, carbon feed machine, three finished water pumps, four carbon filters, filter mag meters, a polyaluminum chloride tank, two polyaluminum metering pumps, a caustic tank, and two caustic metering pumps. This facility houses two 50 hp backwash pumps. The roof was replaced in 2014.

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The garage was built in 1972 to house chemical feed equipment for the water treatment plant. The chemical feed equipment includes chlorine tanks and metering pumps, a permanganate tank and metering pumps, and a filter aid tank and filter aid metering pumps. The two active garage doors are currently in need of replacement.

The metal clarifier building was constructed in 1972 with a flat roof. The roof was replaced in 2014. A standby generator is located onsite for emergency use.

A summary of the installation year and anticipated life span of the equipment in the Water Treatment Plant is included in Table No. 5-6.

Table No. 5-6
Exeter Surface Water Treatment Plant
Installation Year and Anticipated Life Span

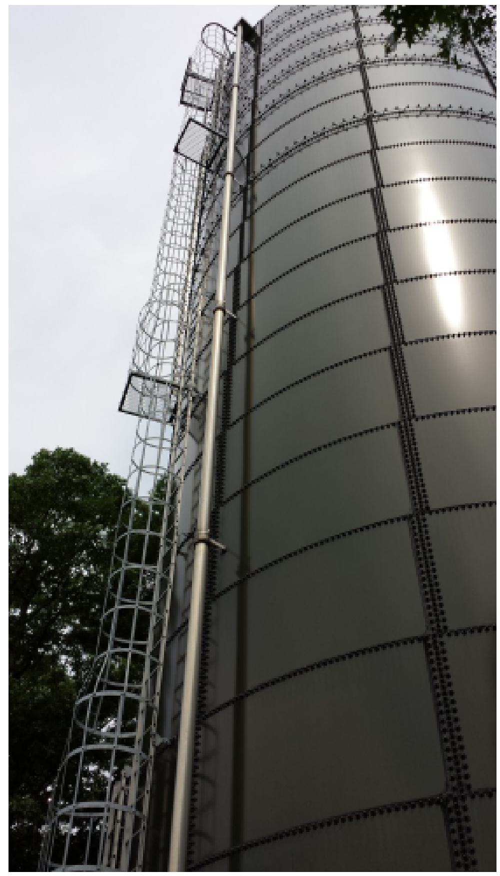
	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Original Building			
Brick building	1886	100	Past life expectancy
Slate roof	1886	100	Past life expectancy
Garage Building			
Brick building	1972	100	2072
Permanganate metering pumps (2)	1 – 2014 1 – 2013	10	1 – 2024 1 – 2023
Filter aid meter pumps (3)	3 – 2013	10	3 – 2023
Garage doors	1972	50	2022
Chlorine Blue-White metering pumps (3)	1 – 2014 2 – 2006	10	1 – 2024 2 – 2016
Polypropylene chlorine tanks (3)	3 – 2004	10	1 – 2019 1 – 2017 1 – 2015
Filter aid tank (250 gal)	1994	10	Past life expectancy
Permanganate tank (2)	1994	10	Past life expectancy
Asphalt shingled roof	1972	20	Past life expectancy
Filter Building			
Brick building	1972	100	2074
Parallel pre-oxidation basins (2)	1992	50	2042
Filter magnetic meters (4)	2012	25	2037
EPDM flat roof	2014	20	2034

	Installation Year	Typical Life Span (Years)	Anticipated Replacement/ Rehabilitation Year
Polyaluminum metering pumps (2)	2 – 2015	10	2025
Acrison carbon feed machine	2014	10	2024
Finished Water Pump 3	Rebuilt 2014 Original 1998	10	2024
Finished Water Pumps 1 & 2	Rebuilt 2013 Original 1992	10	2023
Caustic meter pumps (2)	2 – 2013	10	2 – 2023
pH meter	2013	10	2023
Carbon filters and media (4)	3 – 2010 1,2,4 – 2008	10	3 – 2020 1,2,4 – 2018
SCADA system	2008	10	2018
Backwash pumps 50 hp w/ soft start motor (2)	2 – 1992	25	2 – 2017
Turbidity meter	1994	10	Past life expectancy
Polyaluminum chloride tank	1992	10	Past life expectancy
Caustic tank	1992	10	Past life expectancy
Clarifier Building			
Adsorption clarifiers	1992	50	2042
Blowers (3)	1 – 2014 2 – 1992	25	1 – 2039 2 – 2017
Intermediate transfer pumps (3)	2 – 2009 1 – 1992	25	2 – 2034 1 – 2017
EPDM flat roof	2014	20	2034
Sludge pump	Rebuilt 2013 Original 1972	10	2023
Metal building	1972	50	2022
Exterior			
Inlet chamber splitter box	Rebuilt 2011	20	2031
Solids lagoons (3)	Rehabilitated 2013	10	2023
Katolight Generator	1992	25	2017
Potassium permanganate feed at reservoir outlet	1985	25	Past life expectancy

5.3 Water Storage Tanks

The results of the evaluation of the water storage tanks are discussed below and the recommendations are summarized and prioritized in Table No. 6-1. The estimated costs are based on estimates and include a 25 percent allowance for engineering and contingencies.

Cross Road Water Storage Tank



The Town's Cross Road Water Storage Tank is a glass fused to steel standpipe constructed in 1993. The tank has a capacity of approximately 0.48 MG and stands approximately 86 feet tall and is approximately 31 feet in diameter. The overflow elevation is 224 feet. A GridBee GS 12 tank mixer was installed in November 2014.

We would anticipate the life span of this tank to be beyond the 20 year planning period for this study. Based on the fairly recent tank construction, the tank is in good condition. However, during the tour the tank was leaking and there were several locations along the bottom ring that were missing the glass layer, likely due to rock damage. Two leaks were repaired by Aquastore in the fall of 2014. The tank should be closely monitored and inspected a minimum of every three years per the NHDES standard recommendation. The Cross Road Water Storage Tank is scheduled to receive inspections by Aquastore every three years. The next inspection is due in early 2018. Since the tank is surrounded by foliage it may soon require an exterior pressure wash to remove organic material and mold that can accumulate on the exterior walls. A security fence does not exist at this site. It is recommended that a security fence be installed to deter malicious tampering and graffiti.

There is an existing small wooden telemetry building with an asphalt shingle roof constructed near the tank. This building was constructed in 1993 and contains tank level transmitting equipment, a unit heater, and telemetry equipment. It is recommended to add a perimeter fence topped with barbed wire and a locked access gate to prevent unauthorized access. A summary of recommendations is included in Table No. 6-1.

Hampton Road Water Storage Tank

The Hampton Road Water Storage Tank is a steel standpipe constructed in 1958. The tank has a capacity of approximately 1.0 mg and stands approximately 85 feet tall and is approximately 46 feet in diameter. The standpipe appears to be in good condition, and we would anticipate the life span of this tank to be beyond our planning period. A full interior and exterior rehabilitation was completed by Utility Service Company in the fall of 2014. The rehabilitation included installation of an active PAX mixing system. A portable generator is located at the standpipe. In 2014, the Town executed a 12 year contract with Utility Service Group to provide inspection and maintenance services for the Hampton Road Tank. NHDES standards recommended that tanks are inspected every three years. The Hampton Road Water Storage Tank would be due for an inspection in early 2018.

There is an existing concrete vault and wood framed telemetry, storage, monitoring, and pump station building constructed near the tank. This building was constructed in 2008. The vault contains a 10-inch check valve, a 6-inch electric actuated butterfly valve, which acts as an inlet isolation valve, and a 6-inch altitude valve. The automatic settings of the inlet isolation valve close the valve when one or more booster pumps are running and open the valve when no pumps are running. The valve may be placed in manual mode, and would allow an operator override the settings.

The building contains a Generac portable generator, wall mounted unit heater, pressure transducer, pump controls, chlorine analyzer, PAX mixing system control box, and SCADA panel. The building and equipment appear to be in excellent condition. Constructed in 2008, east of the building, was a duplex pitless booster pump station housing two 210 gpm submersible pumps. The site is fenced and the access gate is locked to prevent unauthorized access. The recommendations are summarized in Table No. 6-1 of the Recommendations Section.

Epping Road Water Storage Tank

The Epping Road Water Storage Tank is a composite elevated tank constructed in 2008. The tank has a capacity of approximately 1.5 MG, maintains a water depth of approximately 40 feet, and is approximately 87 feet in diameter. Measured from the ground elevation at the tank base, the height to the bottom of the tank is 117.5 feet and the height to overflow is 157 feet. The overflow elevation is approximately 235 feet. The tank serves the main service area. The tank appears to be in excellent condition, and we would anticipate the life span of this tank to be well beyond our planning period. NHDES recommends that tanks are inspected every three years. The Epping Road Tank is due for an inspection in 2015.

The concrete base of the tank is divided into two sections. One side is open and provides general storage, the other side is enclosed and houses several pumps, a hydropneumatic tank, SCADA equipment, and miscellaneous electrical equipment. An emergency generator is located outside the tank base. All equipment was installed in 2008. The equipment appears to be in excellent condition and the anticipated life span is well beyond our planning period. The water storage tank does not contain a mixer, however the Town is planning to install a mixer in this tank. The Town is considering entering a service contract with Utility Service Group to inspect and maintain the Epping Road tank. The recommendations are summarized in Table No. 6-1 of the Recommendations Section.

Section 6

TATA & HOWARD

SECTION 6 – Recommendations and Conclusions

6.1 General

The following summarizes the findings of the study and presents a prioritized plan for recommended improvements and associated costs. The prioritization of improvements allows for constructing the necessary improvements over an extended period of time as funds allow. Costs are based on bid results of similar projects and the February 2015 Engineering News Record (ENR) construction cost index for Boston, MA of 12473.56 and include costs associated with water services, hydrants, and permanent and temporary trench pavement and a 25 percent allowance for engineering and contingencies. Estimates do not include costs for land acquisition, easements, or legal fees. Costs for water main recommendations with construction lengths less than 500 linear feet were increased to account for increased mobilization costs. However, if several projects were bid together, increasing the total linear footage of the construction project to greater than 500 linear feet, the costs would likely decrease.

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

Replacement of one percent of a system each year (a 100 year replacement cycle) is a reasonable guideline, based on industry experience and analysis, for water systems that have historically maintained a regular replacement schedule. Although the Town has recently adopted a regular water main replacement program, a large backlog of work remains due to a historical lapse in regular replacement. In this case it is not unreasonable to expect replacement of up to two percent of the system per year. This would equate to approximately 6,900 linear feet of water main replacement each year as a guideline. Regular rehabilitation of water mains reduces main failures, leakage, and water quality issues. Water main rehabilitation can also provide socio-economic benefits by reducing operational costs associated with chemical and energy usage. Rehabilitation or replacement of water mains that are inadequately sized to provide needed fire protection will improve public safety.

The capital improvement projects recommended by this study will provide a direct benefit to the overall level of service to the Town's customers, reduce operational costs by reducing the risk of water main failures and the damage they cause, as well as improve fire protection to the homeowners, businesses, and other critical customers.

6.2 General Recommendations

To maintain a comprehensive database of the condition of the system, it is recommended that the Town establish a water main failure database. Water main failures should be recorded along with the nearest street address and the properties of the failed main such as diameter, material, joint type, type of lining, and type of failure such as ring crack, lateral split, hole in the pipe, "punky" AC pipe failure, or joint leak. If possible, the Town should include the apparent cause of the failure such as frost load, traffic load, direct contractor damage, settlement, water hammer, external soil corrosion, or stray current. This data can be used to create a Water Main Failure Map for identifying areas of concern in the system on an ongoing basis. The map can be used to easily identify break locations and determine if streets or areas have a higher frequency of failures and to view any patterns in the location, type, pipe manufacturer, or other patterns in occurrences of failure. The water main failure database will aid the Town in making water main rehabilitation and replacement decisions in the future. In addition, it is recommended that the Town maintain data on pipe crushing results from water mains that have failed. At the time of a main failure, a one foot section of the water main should be cut from the pipe that will remain in place (adjacent to the repair). The sample should be marked with collection date, installation date, diameter, location, and any information regarding the type of main failure. It is then recommended that this coupon is analyzed further and data is recorded on results. It is also recommended that the Town continue to update the database of new or rehabilitated water mains. The database should include water main diameter, material, lining, joint type, soil conditions, and date of installation.

It is recommended that prior to installation of all new ductile iron water mains, the Town test the soils in the area of the new main to determine corrosion potential. If the soil is found to be potentially corrosive, the Town should consider wrapping the main with polyethylene to protect against external corrosion. Wrapping is a relatively inexpensive practice that can extend the life of new ductile iron pipe. In addition, wrapping helps to protect the pipe from stray currents that may develop near the main.

General Operation and Maintenance Practices

1. The Town should continue to perform regularly scheduled maintenance programs, including hydrant flushing, valve exercising, meter testing/calibration, and inspection and maintenance at the tanks, pump stations, wells, and treatment facility. It was reported that a bi-annual unidirectional flushing program is currently being utilized. It is our experience the implementation of a unidirectional flushing program can be time intensive. Also, discrepancies in mapped valve, hydrant, and water main locations force field changes to be made during implementation. If problems persist while conducting unidirectional flushing the current plan should be reviewed and updated. Technical field support can be provided to assist during implementation of the program. A field engineer would accompany the flushing crew to collect data on hydrant flows, volume and clarity of water flushed, recorded water pressures, and field modifications to the plan.

2. The Town should continue the existing replacement program during which hydrants and valves that do not function as intended are identified and replaced. These deficiencies are normally identified through routine operation and during the system-wide flushing program. It is recommended that a formal hydrant and valve maintenance program be developed. This program would assist the Town in exercising existing hydrants and valves and documenting hydrants and valves in need of replacement. The program would include summarizing existing maintenance procedures, identifying priority areas, and developing a hydrant and valve maintenance report form for use during the program and for recordkeeping purposes. The latest AWWA guidelines and recommendations would be used to develop a 5-year valve maintenance program that would include maps showing a sequenced approach by street. By replacing old or broken hydrants, the Town will improve fire protection in the system and eliminate potential leaks. Eliminating broken valves in the system will continue to improve the transmission capacity of the system. The cost associated with developing a formal hydrant and valve maintenance program is approximately $5,000.

3. We recommend replacing the service pipe to the mobile home park off Colcord Pond Road. Reportedly the service pipe cannot withstand pressures greater than 90 psi. When the service pipe is upgraded the functionality of the PRVs on Michael Avenue and Colcord Pond Drive can be investigated for potential abandonment.

4. We also recommend that the water distribution system piping be evaluated to determine if there are any hydraulic deficiencies in the water system. Water mains that are hydraulically deficient, have a high asset management score and are categorized as critical should have a higher priority of replacement than a water main that only falls under two of the criteria. The completion of a hydraulic assessment of the system would likely re-prioritize the improvements presented herein. The estimated cost to conduct a hydraulic evaluation of the water distribution system is $40,000.

6.3 Above Ground Asset Recommendations

As discussed in Section 5, the above ground facilities, including chemical treatment buildings and equipment, tanks, and pump stations are generally in good condition. Recommendations for the above ground facilities are discussed in Section 5. Recommendations for the buildings and equipment are based on installation date, expected useful life, and current condition. Recommendations for above ground assets are listed in Table 6-1. An additional 25 percent was added to the cost estimates to include engineering, design, permitting, and contingencies.

6.4 Water Distribution System Improvements

Based on probabilistic risk assessment, a prioritized list of improvements was created. Improvements were separated into three phases. The Phase I Improvements are prioritized based on critical system impact rating determined by the water main location in the distribution system and the asset management rating determined by the condition of the water main.

Phase II Improvements generally include water mains that have asset management ratings of 60 and greater and a critical system impact rating of zero. Phase III improvements include areas with high asset management ratings between 50 and 59 and a critical system impact rating of zero. These improvements eliminate potential asset management concerns and provide redundancy. Phase II and III Improvements should be completed as funds become available and considered when reviewing road paving schedules. The critical component considerations and asset management ratings are combined on one Probabilistic Risk Assessment Map included in Appendix D.

It should be noted that the list of improvements is extensive due to the nature of this report. This results in a high associated cost if all of the suggested improvements were constructed. The intent of the prioritization, therefore, is to serve as a guide for implementation from the most needed to the least needed improvements based on the prioritization and weighted criteria established jointly by the Town and Tata & Howard. These improvements would most logically be constructed over an extended period of time.

Table No. 6-2, at the end of this section, includes a prioritized list of Phase I Water Distribution System Improvements and the critical rating and asset management status of each improvement. Table No. 6-3 includes the linear footage and estimated cost of each Phase I Improvement. Table No. 6-4 includes a prioritized list of Phase II Water Distribution System Improvements and Table No. 6-5 includes the linear footage and estimated cost of each Phase II Improvement. Phase III Improvements include the water mains with high asset management ratings that should be replaced when funding becomes available. Table No. 6-6 includes a list of Phase III Improvements and the critical rating and asset management status of each improvement. Table No. 6-7 includes the linear footage, and estimated cost of each Phase III Improvement.

A recommended improvements map is included in Appendix E. It should be noted that sewer pipe replacement projects, paving schedules, and highway improvements were not evaluated as part of this study. The Town may reprioritize the recommendations if sewer pipe replacement, paving, or road work is scheduled on any of the roads recommended for water main improvements.

Phase I Improvements

1. The existing 10-inch diameter asbestos cement water main on Lary Lane should be replaced with a new 12-inch diameter water main from the new groundwater treatment plant to Court Street. It is estimated that 12-inch diameter water main will provide adequate hydraulic capacity to convey the finished water into the system; however this has not been verified with a hydraulic model. The hydraulic model may also indicate a need for new 12-inch diameter water main on Court Street from Lary Lane to the existing 12-inch diameter water main at the intersection of Elm Street and Court Street. The new water main along Court Street would replace the existing 10-inch, 8-inch, and 6-inch diameter water mains that create a bottleneck between the new

groundwater treatment plant and the downtown area. The water main along Lary Lane has an asset management rating of 56 and is considered poor to fair condition due to material integrity, break history, and soil conditions. The water main has a high critical system impact due to the critical rating of three. This water main is the sole transmission main from the groundwater treatment plant to the water distribution system. The estimated probable construction cost of approximately 1,800 linear feet of 12-inch diameter water main is $630,000.

2. The existing 6-inch diameter unlined cast iron and asbestos cement water main on Water Street from the dead end to Main Street should be replaced with a new 8-inch diameter water main. The water main along Water Street has an asset management rating ranging from 57 to 84 and is considered in poor to fair condition due to water quality issues, material integrity, and break history. The water main has a high critical system impact due to the critical ratings ranging from one to three, which is due to the water main's proximity to the Exeter Housing Authority and Phillips Exeter Academy. The estimated probable construction cost of approximately 1,800 linear feet of 8-inch diameter water main is $597,000.

3. The existing 10-inch diameter asbestos cement water mains on High Street and Hampton Road from Pleasant Street to Hunter Place have asset management scores ranging from 52 to 62 and a critical rating of three. The high asset management score is due to material integrity, break history, and water quality issues. High Street has a high critical rating because a water main failure would result in a large portion of the system being cut off from the supply sources. The area would be reliant solely on the 1.0 MG Hampton Road water storage tank to meet demands until the main is repaired. Recommended improvement No. 3 provides a recommendation to add redundancy to the eastern portion of the water distribution system, with the construction of a new 12-inch diameter water main. The estimated probable construction cost for approximately 10,100 linear feet of 12-inch diameter water main is $4,066,000.

4. To provide redundancy to the eastern portion of the Exeter water distribution system it is recommended to install a new 12-inch diameter water main on Holland Way from Portsmouth Avenue to High Street. Currently there is no water main along this length of road and the water main along High Street, east of Portsmouth Avenue is considered critical because a water main failure would result in a large portion of the system out of service. The estimated probable construction cost for approximately 6,050 linear feet of 12-inch diameter water main is $2,118,000.

5. A new 8-inch diameter water main is recommended on Lincoln Street from Front Street to Tremont Street. The existing water main has a high asset management score of 56 and a critical rating ranging from 1 to 3. The water main's high asset management score is due to material integrity and water quality issues. The criticality rating is based on the water mains location near several critical users, including the Lincoln Street Elementary School. The high asset management score indicates a higher probability of failure and the high criticality rating increases the consequence of failure. This combination increases the potential risk associated with the existing

water main. The estimated probable construction cost of approximately 1,900 linear feet of 8-inch diameter water main is $630,000.

6. The existing 6-inch diameter unlined cast iron water main along Winter Street and Main Street between Front Street and Route 27 (Main Street) should be replaced with 8-inch diameter water main. The existing water main has a high asset management rating ranging from 71 to 76 due to material integrity, break history, and diameter. The criticality rating of the pipe rages from 0 to 3 due to its proximity to identified critical users. The estimated probable construction cost for approximately 2,000 linear feet of 8-inch diameter water main is $663,000.

7. The existing 10-inch diameter asbestos cement water main located on Linden Street between Front Street and Gary Street should be replaced with a 12-inch diameter water main. The asset management score for the water main is 56 due to material integrity, break history, and existing soil conditions. The water main has a high critical system impact due to the critical ratings ranging from zero to three. The critical rating of three is due to the water mains proximity to the Exeter School District and Seacoast School of Technology. The estimated probable construction cost for approximately 3,550 linear feet of 12-inch diameter water main is $1,243,000.

8. A new 12-inch diameter water main is recommended to be directionally drilled across Perkins Brook along Kingston Road between Juniper Ridge Road and the end of the brook. The asset management score of the pipe is 55 due to material integrity and soil conditions. The water main is currently very shallow and visible within the river bed. The criticality rating is a two because the water main crosses a river bed which limits its accessibility for maintenance and repairs. The estimated probable construction cost of 250 linear feet of 12-inch diameter water main is approximately $150,000.

9. A new 12-inch diameter water main is recommended on Portsmouth Avenue from Green Hill Road to the existing 16-inch diameter water main to replace the existing 12-inch diameter asbestos cement water main. The existing water main has an asset management rating of 58 due to material integrity, break history, and water quality issues. The water main has a criticality rating of two because it provides water service to several commercial businesses. The estimated probable construction cost of 1,750 linear feet of 12-inch diameter water main is approximately $705,000.

10. The existing 4-inch diameter unlined cast iron water main on Maple Street between Elm Street and Court Street should be replaced with a new 8-inch diameter water main. The asset management rating of 71 is due to material integrity, break history, and diameter. The criticality rating of one is due to the water mains proximity to the Town of Exeter Fire and Police Department headquarters. The estimated probable construction cost of 500 linear feet of 8-inch diameter water main is approximately $166,000.

11. The existing 8-inch diameter asbestos cement water main on Epping Road between the existing 12-inch diameter water main and the north entrance of Industrial Drive should

be replaced with a 12-inch diameter water main. The asset management score of the existing water main is 59 due to material integrity and break history. The criticality rating ranges from zero to one because the water main is located near an identified critical user and provides a redundant source of water to several large, critical users in the Industrial Park. It also eliminates a bottleneck the existing 8-inch diameter main is creating between two 12-inch diameter water mains. The estimated probable construction cost of 1,850 linear feet of 12-inch diameter water main is $648,000.

12. New 8-inch diameter water main is recommended on Garfield Street and Kossuth Street from Front Street to Lincoln Street. The existing 4-inch diameter, unlined cast iron water mains have asset management scores of 60. This is due to diameter, material integrity, and water quality issues. The water main criticality rating ranges from zero to three. This water main provides a source of redundancy to the Lincoln Street Elementary School and is located near several large residential areas along Front Street. The estimated probable construction cost for approximately 1,350 linear feet of 8-inch diameter water main is $464,000.

13. A new 8-inch diameter water main is recommended on Union Street from Front Street to Garfield Street. The existing 4-inch diameter unlined cast iron water main has a high asset management score of 50 due to material integrity and diameter. The criticality rating ranges from zero to three. The water main received a critical rating of three due to its proximity to the Lincoln Street Elementary School and its ability to provide redundancy to the identified critical user. The estimated probable construction cost for approximately 800 linear feet of 8-inch diameter water main is $265,000.

Phase II Improvements

14 – 27. Numerous water mains are considered to be in poor condition based on asset management ratings. Phase II improvements have asset management ratings of 60 and greater. Although there are several water mains with asset management scores higher than noted in the Phase I improvements, all Phase II recommendations have criticality ratings of zero. The criticality rating of zero represents a lower consequence of failure. Table No. 6-5 lists the recommendations for water mains with high asset management ratings and the estimated probable construction costs. These water mains should be addressed based on available funding. Existing 6-inch diameter water mains and smaller should be replaced with 8-inch diameter water mains. Existing 10-inch diameter water mains should be replaced with 12-inch diameter water mains. All other water mains may be replaced with new water mains of the existing size.

Phase III Improvements

28 – 48. Numerous water mains are considered to be in poor condition based on asset management ratings. Phase III improvements have asset management ratings ranging from 50 to 60. These water mains have the lowest asset management rating of all water mains that are considered to be in fair to poor condition. All Phase III recommendations have criticality ratings of zero. Table No. 6-7 shows the recommendations for water mains with high asset management ratings and the

estimated probable construction costs. These water mains should be addressed based on available funding. Existing 6-inch diameter water mains and smaller should be replaced with 8-inch diameter water mains. Existing 10-inch diameter water mains should be replaced with 12-inch diameter water mains. All other water mains may be replaced with new water mains of the existing size.

Table No. 6-1
Above Ground Infrastructure Recommendations

	Recommendation	Estimated Cost
Phase I		
	Reassess SWTP condemned building to determine repair and/or replacement options.	$50,000
	Repair the Cross Road Tank leak.	-
	Install generator at the Exeter River Pump Station.	$260,000
	Install mixing system in the Epping Road Tank.	$50,000
	Inspect the Epping Road Tank.	$10,000
	Complete analysis of existing electrical and SCADA systems at the Exeter River Pump Station.	$15,000
	Replace or rehabilitate vertical turbine pump and motor no. 1 at the Exeter River Pump Station and install VFDs.	$100,000
	Review Table No. 5-6 which identifies equipment within the SWTP that is beyond or close to reaching its anticipated life span. Replace or repair equipment as needed.	-
	Install perimeter fence topped with barbed wire and a locked access gate around the Cross Road Tank.	$15,000
	Provide signage on all fencing surrounding Town owned water infrastructure stating 'No Trespassing or Loitering on This Property: Violators Will Be Prosecuted'.	$2,500
	Reactivate Stadium Well, including construction of a new building and installation of new equipment and controls.	$750,000
	Inspect the Hampton Road and Cross Road Tanks in 2018.	$20,000
Phase II		
	Investigate alternate groundwater well locations.	-
	Review all SCADA and electrical systems for code compliance and update as needed.	$50,000

Table No. 6-2
Prioritization of Improvements - Phase I

Item No.	Location	From	To	Critical Rating	Asset Management Rating
1	Lary Lane	Groundwater Treatment Plant	Court Street	3	56
2	Water Street	Dead End	Main Street	1/3	84/57
3	High Street/Hampton Street	Pleasant Street	Hunter Place	3/0	58/52/62
4	Holland Way	Portsmouth Avenue	High Street	-	-
5	Lincoln Street	Front Street	Tremont Street	3/1	56
6	Winter Street/Main Street	Front Street	Route 27/111A (Main Street)	0/1/3	71/76
7	Linden Street	Front Street	Gary Street	0/1/3	56
8	Kingston Road	Juniper Ridge Road	Perkins Brook	2	55
9	Portsmouth Avenue	Green Hill Road	New 16-inch	1	58
10	Maple Street	Elm Street	Court Street	1	71
11	Epping Road	New 12-Inch	Industrial Drive (North Entrance)	0/1	59
12	Garfield Street	Kossuth Street	Lincoln Street	0/3	60
	Kossuth Street	Front Street	Garfield Street	0/1	60
13	Union Street	Front Street	Garfield Street	0/3	50

Table No. 6-3
Estimated Improvement Cost - Phase I

Item No.	Location	From	To	Water Main Diameter (in)	Length (LF)	Estimated Cost
1	Lary Lane	Groundwater Treatment Plant	Court Street	12	1,800	$630,000
2	Water Street	Dead End	Main Street	8	1,800	$597,000
3	High Street/Hampton Street	Pleasant Street	Hunter Place	12	10,100	$4,066,000
4	Holland Way	Portsmouth Avenue	High Street	12	6,050	$2,118,000
5	Lincoln Street	Front Street	Tremont Street	8	1,900	$630,000
6	Winter Street/Main Street	Front Street	Route 27/111A (Main Street)	8	2,000	$663,000
7	Linden Street	Front Street	Gary Street	12	3,550	$1,243,000
8	Kingston Road	Juniper Ridge Road	Perkins Brook	12	250	$150,000
9	Portsmouth Avenue	Green Hill Road	New 16-inch	12	1,750	$705,000
10	Maple Street	Elm Street	Court Street	8	500	$166,000
11	Epping Road	New 12-Inch	Industrial Drive (North Entrance)	12	1,850	$648,000
12	Garfield Street	Kossuth Street	Lincoln Street	8	1,000	$332,000
	Kossuth Street	Front Street	Garfield Street	8	350	$132,000
13	Union Street	Front Street	Garfield Street	8	800	$265,000
					Total Estimated Phase I Cost:	**$12,345,000**

Table No. 6-4
Prioritization of Improvements - Phase II

Item No.	Location	From	To	Critical Rating	Asset Management Rating
14	River Street Extension	Court Street	River Street	0	77
15	Washington Street	Park Street	Front Street	0	70/76
16	Salem Street	Walnut Street	Summer Street	0	76
17	Elm Street	Front Street	Court Street	0	71
18	River Street	River Street Extension	South Street	0	71
19	Daniel Street/Tremont Street	Lincoln Street	Lincoln Street	0	71
20	Park Street	Main Street	Cass Street	0	55/67
21	South Street	River Street Extension	Franklin Street	0	67
22	Whippoorwill Lane	High Street	Blossom Lane	0	61/67
23	Webster Avenue	Jady Hill Avenue	Dead End	0	61
24	McKinley Street	Wentworth Street	Hobart Street	0	61
25	Cottage Street	Front Street	Dead End	0	60
26	Grove Street	Pine Street	Elliot Street	0	60
27	Hilliard Circle	Grove Street	Dead End	0	60

Table No. 6-5
Estimated Improvement Costs - Phase II

Item No.	Location	From	To	Water Main Diameter (in)	Length (LF)	Estimated Cost
14	River Street Extension	Court Street	River Street	8	600	$199,000
15	Washington Street	Park Street	Front Street	8	1,850	$613,000
16	Salem Street	Walnut Street	Summer Street	8	800	$265,000
17	Elm Street	Front Street	Court Street	8	950	$315,000
18	River Street	River Street Extension	South Street	8	450	$169,000
19	Daniel Street/Tremont Street	Lincoln Street	Lincoln Street	8	850	$282,000
20	Park Street	Main Street	Cass Street	12	2,000	$700,000
21	South Street	River Street Extension	Franklin Street	8	700	$232,000
22	Whippoorwill Lane	High Street	Blossom Lane	8	450	$169,000
23	Webster Avenue	Jady Hill Avenue	Dead End	8	1,150	$381,000
24	McKinley Street	Wentworth Street	Hobart Street	8	800	$265,000
25	Cottage Street	Front Street	Dead End	8	400	$150,000
26	Grove Street	Pine Street	Elliot Street	8	900	$299,000
27	Hilliard Circle	Grove Street	Dead End	8	400	$150,000
					Total Estimated Phase II Cost:	**$4,189,000**

Table No. 6-6
Prioritization of Improvements - Phase III

Item No.	Location	From	To	Critical Rating	Asset Management Rating
28	Appledore Avenue	High Street	Star Street	0	56
29	Elliot Street	Front Street	Court Street	0	56
30	Green Hill Road	Portsmouth Avenue	Jady Hill Circle	0	54
31	Jady Hill Circle	Green Hill Road	Woodlawn Circle	0	54
32	Spring Street	Front Street	Main Street	0	50
33	Crawford Avenue	Court Street	Bell Avenue	0	50
34	Pleasant View Drive	Drinkwater Road	Drinkwater Road	0	50
35	Robin Lane	Wheelwright Avenue	Dead End	0	50
36	Thornton Street	Wheelwright Avenue	Towle Avenue	0	50
37	Auburn Avenue	Portsmouth Avenue	Buzell Avenue	0	50
38	Ridgecrest Drive	Douglass Way	Douglass Way	0	50
39	Bonnie Drive	Green Hill Road	Haven Lane	0	50
40	Allen Street	Portsmouth Avenue	Dead End	0	50
41	Browns Court	River Street Extension	Dead End	0	50
42	Gary Lane	Linden Street	Court Street	0	50
43	Court Street	Lary Lane	Dead End	0	50
44	Cass Street	Park Street	Main Street	0	50
45	Oak Street	Park Street	Forest Street	0	50
46	Walnut Street/Forest Street	Oak Street	Oak Street	0	50
47	Locust Street	Park Street	Hale Street	0	50
48	Dartmouth Street	Harvard Street	Dead End	0	50

Table No. 6-7
Estimated Improvement Costs - Phase III

Item No.	Location	From	To	Water Main Diameter (in)	Length (LF)	Estimated Cost
28	Appledore Avenue	High Street	Star Street	8	600	$199,000
29	Elliot Street	Front Street	Court Street	8	1,050	$348,000
30	Green Hill Road	Portsmouth Avenue	Jady Hill Circle	12	400	$150,000
31	Jady Hill Circle	Green Hill Road	Woodlawn Circle	12	700	$245,000
32	Spring Street	Front Street	Main Street	8	750	$249,000
33	Crawford Avenue	Court Street	Bell Avenue	8	2,100	$696,000
34	Pleasant View Drive	Drinkwater Road	Drinkwater Road	8	1,700	$564,000
35	Robin Lane	Wheelwright Avenue	Dead End	8	700	$232,000
36	Thornton Street	Wheelwright Avenue	Towle Avenue	8	550	$183,000
37	Auburn Avenue	Portsmouth Avenue	Buzell Avenue	8	1,300	$431,000
38	Ridgecrest Drive	Douglass Way	Douglass Way	8	950	$315,000
39	Bonnie Drive	Green Hill Road	Haven Lane	8	850	$282,000
40	Allen Street	Portsmouth Avenue	Dead End	8	1,150	$381,000
41	Browns Court	River Street Extension	Dead End	6	350	$123,000
42	Gary Lane	Linden Street	Court Street	8	1,850	$613,000
43	Court Street	Lary Lane	Dead End	8	1,850	$613,000
44	Cass Street	Park Street	Main Street	8	800	$265,000
45	Oak Street	Park Street	Forest Street	8	900	$299,000
46	Walnut Street/Forest Street	Oak Street	Oak Street	8	1,350	$448,000
47	Locust Street	Park Street	Hale Street	8	550	$183,000
48	Dartmouth Street	Harvard Street	Dead End	8	300	$113,000
					Total Estimated Phase III Cost:	**$6,932,000**

Appendix A

TATA & HOWARD


Water Distribution System
Exeter, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
May 2015
N
Industrial Drive
High Service Zone
HGL: 258 feet
Epping Road Tank
Capacity: 1.5 mgd
Overflow: 235 feet
Colcord Pond Reduced
Pressure Service Zone
HGL: 223 feet
Water Treatment Plant
Skinner Springs Wells
Hampton Road Tank
Capacity: 1.0 mg
Overflow Elevation: 205 ft
Kingston Road Service Zone
HGL: 224 feet
Kingston Road Station
Exeter River Pump Station
Gilman Park Well (Inactive)
Stadium Well (Inactive)
Groundwater Treatment Plant
Lary Lane Well
Cross Street Tank
Capacity: 0.5 mgd
Overflow: 224 feet
BRENTWOOD
STRATHAM
NORTH HAMPTON
HAMPTON
KENSINGTON
EAST KINGSTON
Legend
Blowoff Valve
Pressure Reducing Valve
Pump Station
Water Treatment Facility
Well
Tanks
New Hampshire Pipeline
Railroad
Water Main Diameter
4-Inch or less
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
Unknown
Service Areas

Appendix B

TATA & HOWARD

Critical Components
Exeter, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
May 2015
Legend
Blowoff Valve
Pressure Reducing Valve
Pump Station
Water Treatment Facility
Well
Tanks
Critical Users
Miscellaneous
Apts, Condos, MH Parks
Commercial User
Doctor/Dentist
Nursing Home
School
Critical Buffer
New Hampshire Pipeline
Railroad
Water Main Diameter
4-Inch or less
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
Unknown
Service Areas
Industrial Drive
High Service Zone
HGL: 258 feet
Epping Road Tank
Capacity: 1.5 mgd
Overflow: 235 feet
Colcord Pond Reduced
Pressure Service Zone
HGL: 223 feet
Water Treatment Plant
Skinner Springs Wells
Hampton Road Tank
Capacity: 1.0 mg
Overflow Elevation: 205 ft
Kingston Road Service Zone
HGL: 224 feet
Kingston Road Station
Exeter River Pump Station
Gilman Park Well (Inactive)
Stadium Well (Inactive)
Groundwater Treatment Plant
Lary Lane Well
Cross Street Tank
Capacity: 0.5 mgd
Overflow: 224 feet
BRENTWOOD
STRATHAM
NORTH HAMPTON
HAMPTON
KENSINGTON
EAST KINGSTON
N

Appendix C

TATA & HOWARD


Asset Management Ratings
Exeter, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
May 2015
Legend
Blowoff Valve
Pressure Reducing Valve
Pump Station
Water Treatment Facility
Well
Tanks
New Hampshire Pipeline
Railroad
Asset Management Rating
Good to Excellent
Fair to Good
Poor to Fair
Service Areas
Industrial Drive High Service Zone HGL: 258 feet
Epping Road Tank Capacity: 1.5 mgd Overflow: 235 feet
Colcord Pond Reduced Pressure Service Zone HGL: 223 feet
Water Treatment Plant
Skinner Springs Wells
Hampton Road Tank Capacity: 1.0 mg Overflow Elevation: 205 ft
Kingston Road Service Zone HGL: 224 feet
Kingston Road Station
Exeter River Pump Station
Gilman Park Well (Inactive)
Stadium Well (Inactive)
Groundwater Treatment Plant
Lary Lane Well
Cross Street Tank Capacity: 0.5 mgd Overflow: 224 feet
BRENTWOOD
STRATHAM
NORTH HAMPTON
HAMPTON
KENSINGTON
EAST KINGSTON
N

Appendix D

APPENDIX D

TATA & HOWARD


Probabilistic Risk Assessment
Exeter, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
May 2015
Legend
Blowoff Valve
Pressure Reducing Valve
Pump Station
Water Treatment Facility
Well
Tanks
Critical Users
Miscellaneous
Apts, Condos, MH Parks
Commercial User
Doctor/Dentist
Nursing Home
School
Asset Management Rating
Good to Excellent
Fair to Good
Poor to Fair
Critical System Impact Rating
Low Priority
Moderate Priority
High Priority
New Hampshire Pipeline
Railroad
Service Areas
Industrial Drive
High Service Zone
HGL: 258 feet
Epping Road Tank
Capacity: 1.5 mgd
Overflow: 235 feet
Colcord Pond Reduced
Pressure Service Zone
HGL: 223 feet
Kingston Road Service Zone
HGL: 224 feet
Kingston Road Station
Cross Street Tank
Capacity: 0.5 mgd
Overflow: 224 feet
Water Treatment Plant
Skinner Springs Wells
Hampton Road Tank
Capacity: 1.0 mg
Overflow Elevation: 205 ft
Exeter River Pump Station
Gilman Park Well (Inactive)
Stadium Well (Inactive)
Groundwater Treatment Plant
Lary Lane Well
BRENTWOOD
STRATHAM
NORTH HAMPTON
HAMPTON
KENSINGTON
EAST KINGSTON
N

Appendix E

APPENDIX E

TATA & HOWARD

Recommended Improvements
Exeter, New Hampshire
TATA & HOWARD
Approximate Scale: 1" = 1,000'
May 2015
Additional Recommendations
27. - 48. New Water Mains
See Table No. 6-7
Legend
Blowoff Valve
Pressure Reducing Valve
Pump Station
Water Treatment Facility
Well
Tanks
Water Main Diameter
4-Inch or less
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
Unknown
Recommended Improvements
Phase I Improvements
Phase II Improvements
Phase III Improvements
New Hampshire Pipeline
Railroad
Service Areas
Industrial Drive
High Service Zone
HGL: 258 feet
11. Epping Road
New 12-inch Water Main
Colcord Pond Reduced
Pressure Service Zone
HGL: 223 feet
Epping Road Tank
Capacity: 1.5 mgd
Overflow: 235 feet
23. Webster Avenue
New 8-inch Water Main
16. Salem Street
New 8-inch Water Main
2. Water Street
New 8-inch Water Main
20. Park Street
New 12-inch Water Main
6. Winter Street/Main Street
New 8-inch Water Main
15. Washington Street
New 8-inch Water Main
12. Garfield Street & Kossuth Street
New 8-inch Water Main
24. McKinley Street
New 8-inch Water Main
25. Cottage Street
New 8-inch Water Main
19. Daniel & Tremont Street
New 8-inch Water Main
Additional Recommendations
21. South Street
New 8-inch Water Main
14/18. River Street & Extension
New 8-inch Water Main
10. Maple Street
New 8-inch Water Main
17. Elm Street
New 8-inch Water Main
13. Union Street
New 8-inch Water Main
5. Lincoln Street
New 8-inch Water Main
26. Grove Street
New 8-inch Water Main
27. Hilliard Circle
New 8-inch Water Main
7. Linden Street
New 12-inch Water Main
1. Lary Lane
New 12-inch Water Main
Water Treatment Plant
9. Portsmouth Avenue
New 12-inch Water Main
4. Holland Way
New 12-inch Water Main
3. High Street/Hampton Street
New 12-inch Water Main
Skinner Springs Wells
Hampton Road Tank
Capacity: 1.0 mg
Overflow Elevation: 205 ft
22. Whippoorwill Lane
New 8-inch Water Main
Exeter River Pump Station
Gilman Park Well (Inactive)
Stadium Well (Inactive)
Groundwater Treatment Plant
Lary Lane Well
Kingston Road Service Zone
HGL: 224 feet
Kingston Road Station
8. Kingston Road
New 12-inch Water Main
Cross Street Tank
Capacity: 0.5 mgd
Overflow: 224 feet
BRENTWOOD
STRATHAM
NORTH HAMPTON
HAMPTON
KENSINGTON
EAST KINGSTON
N

TATA & HOWARD

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

800-366-5760
www.tataandhoward.com