CAPITAL IMPROVEMENTS AND ASSET MANAGEMENT PLAN | JUNE 2021

Buzzards Bay Water District
Buzzards Bay, Massachusetts

TATA & HOWARD

Capital Improvements and Asset Management Plan
Buzzards Bay Water District
Buzzards Bay, Massachusetts

June 2021

Prepared by

TATA & HOWARD

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June 30, 2021

Mr. Steve Souza, Superintendent
Buzzards Bay Water District
15 Wallace Avenue
Buzzards Bay, MA 02532

Subject: Capital Improvements and Asset Management Plan
Buzzards Bay Water District
T&H No. 6156

Dear Mr. Souza:

In accordance with our agreement, Tata & Howard is pleased to present the Capital Improvements and Asset Management Plan for the Buzzards Bay Water District's (BBWD) water distribution system. The analysis and improvements in this report are based on the Three Circles Approach for optimum capital efficiency, which combines hydraulic and critical component considerations with an asset management rating system to evaluate the condition of the water mains in the distribution system. Supply and storage needs were also evaluated in this report. This study was partially funded through the State Revolving Fund for Asset Management Planning from the Massachusetts Department of Environmental Protection (MassDEP).

Hydraulic recommendations were developed as part of this study by updating the existing hydraulic model for the system to reflect current conditions. Critical areas of the system were identified and tested in the hydraulic model for redundancy. Finally, each segment of water main was evaluated based on age, material, diameter, water quality, break history, and soil characteristics to determine an 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 estimated costs is presented in Section 7.

An asset inventory and criticality assessment were completed on all above ground assets. The inventory includes a list of all equipment and includes the installation year, manufacturer, useful life, estimated replacement year, criticality, and condition. A Priority List of Assets (PLA) was developed and includes a list of all assets that should be replaced within the next five years. A Secondary List of Assets (SLA) was developed that includes a list of all maintenance requirements for the next ten years.

The final component of the analysis was a rate study of the existing rate structure and budget projections for the next five years. The goal of this analysis was to determine any adjustments required for the BBWD to have sufficient funding to complete the recommended improvements for both the below ground and above ground assets.

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

At this time, we wish to express our continued appreciation to the Buzzards Bay Water District for their participation in this study and for their help in collecting information and data. We appreciate the opportunity to assist the Town of Falmouth on this important project.

Sincerely,

TATA & HOWARD, INC.

Karen Gracey

Karen Gracey, P.E.
Co-President

Section 1

TATA & HOWARD

SECTION 1 – Executive Summary

1.1 General

Tata & Howard, Inc. was retained by the Buzzards Bay Water District (BBWD) to complete a Capital Improvements and Asset Management Plan for the water system. The project was funded under a Water Infrastructure Assessment and Planning Grant through the Massachusetts Department of Environmental Protection (MassDEP). The purpose of the project is to identify areas of the water distribution system in need of rehabilitation, repair, or replacement; and prioritize improvements to make the most efficient use of the BBWD's capital budget. As part of the project, an inventory of the existing above ground water infrastructure including wells, pumping and treatment facilities, and water storage tanks was created. The inventory was used to develop a Priority List of Assets (PLA) that includes assets to be replaced for each of the five annual budget years and a Secondary List of Assets (SLA) that includes the maintenance, replacement, or rehabilitation requirements for each of the next ten budget years. Finally, a rate study was completed to evaluate the rates and revenue of the BBWD over the next five years in order to fund the recommended improvements in Phase I and the PLA.

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

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

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

1.2 System Hydraulics

In their May 22, 2015 demand projection, the Massachusetts Department of Conservation and Recreation (DCR) estimated demands for the BBWD through the year 2031. This information was used to estimate the projected 2041 demand. The projected average day demand (ADD) for the year 2041 is approximately 0.71 million gallons per day (mgd) using DCR performance standards of 65 residential gallons per capita day (rgpcd) and 10 percent Unaccounted for Water (UAW). The projected average day demand (ADD) for the year 2041 is approximately 0.63 mgd assuming current usage trends of 58 rgpcd and 5.3 percent UAW. The projected 2041 ADD, historical ADD, and maximum day demand (MDD) data was used to project a 2041 MDD of approximately 1.65 mgd using DCR performance standards and 2041 MDD of 1.47 mgd assuming current trends. These demand projections were input into the hydraulic model and simulations were run to identify the system's ability to provide adequate pressure during both average day and maximum day demands. The model runs identified multiple areas where system hydraulic deficiencies may exist. The demand projections were also used to review existing and projected water supply and water storage needs for the water system.

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

1.3 Water Supply Evaluation

The existing water supply sources were evaluated relative to current and future water demands. The Buzzards Bay Water District currently does not exceed its total permitted and registered annual average daily withdrawal volume of 0.53 mgd, however the estimated projected ADD for the year 2041 shows BBWD exceeding the current authorized withdrawal volumes. However, the BBWD has a surplus of water when comparing the maximum allowable daily withdrawal rates for each source with the estimated projected 2041 MDD.

1.4 Water Storage Evaluation

The projected demands and existing water distribution system operating conditions were considered to evaluate the available storage in the system. The current and projected 2041 year using the DCR performance standards required storage in the Buzzards Bay Water District was estimated to be approximately 1.1 million gallon (mg) and 1.65 mg, respectively, and was based on storage needed to meet peak water demands and provide fire protection. The volume of usable storage, and therefore, the volume of storage deficit or surplus, varies based on which customer is considered to be at the highest elevation of the distribution system. Based on the highest customer elevation of 90 feet above mean sea level, the distribution system has a current storage surplus of 1.31 mg and a projected 2041 storage surplus of 1.20 mg.

1.5 Critical Components

A critical component assessment was performed for the water distribution system to evaluate the impact of potential water main failures on the system. The critical component assessment includes identification of critical areas served, critical water mains, and the need for redundant mains. Critical areas served were identified with input from BBWD staff and include schools and day care facilities, medical facilities and nursing homes, emergency services, and other critical institutions. Critical water mains include primary transmission lines, mains connecting water storage tanks and sources to the system, mains that will cause a system demand shortfall for a large portion of the system if a break occurs, and water mains that cross rivers, streams, waterways, and railroad tracks.

1.6 Asset Management – Buried Infrastructure

An asset management evaluation was completed on all water mains in the water distribution system. A number of factors were considered in the rating system, including installation year, diameter, material, break history, and soil characteristics and service leak history. These factors affect the decision to replace or rehabilitate a water main. Using the asset management rating approach, each water main in the system was assigned a rating based on these factors. Water mains with a total rating between zero and 30 are considered to be in good to excellent condition. Mains with a total rating between 31 and 49 are considered to be in fair to good condition, and mains with a total rating of 50 or greater are considered to be in poor to fair condition.

1.7 Asset Management - Above Ground Facilities

This report includes an inventory and preliminary assessment of the current condition of above-ground assets owned and operated by the BBWD for the supply and treatment of drinking water and recommendations for prioritization of maintenance or replacement of the assets. Recommendations to appropriate and prioritize funds for individual asset replacement are based on criticality, condition, redundancy, consequence of failure, age, and expected useful life of the asset. Tata & Howard reviewed existing documentation, record drawings, and reports for assistance in the assessment of asset condition and installation dates. A preliminary asset management database was prepared. Site visits to review all above-ground infrastructure were conducted through a combined effort by Tata & Howard and BBWD personnel.

Information collected during the site visits included equipment type, installation date, capacity/size, manufacturer, model number and serial number, and was used as the basis of the future recommendations. Condition assessment was based on visual evaluation and input from BBWD staff. All information and observations gathered were used to develop the Primary and Secondary List of Assets (PLA and SLA), a list of Prioritized Capital Improvements, and an estimate of probable construction cost for each above ground capital improvement project and asset replacement included in the lists. The estimated total cost to replace or repair all assets on the PLA is approximately $386,200 and the estimated total cost to replace or repair all assets on the SLA is approximately $201,200. The present-day budgetary costs are based on the January 2020 Engineering News Record (ENR) construction cost index for Boston, Massachusetts of 11392.

1.8 Distribution System Evaluation

Utilizing the Three Circles Approach, water main improvements were recommended and prioritized based on the aforementioned criteria. Phase I improvements generally include any recommended improvements that fall into all three circles and are hydraulically deficient, critical, and have a high asset management score. The total estimated probable construction cost of the Phase I recommended improvements is approximately $1,932,000. Phase II improvements include any recommended improvements that fall into two of the circles. The total estimated probable construction cost of the Phase II recommended improvements is approximately $3,432,000. Phase III recommendations include any recommended improvements that are needed hydraulically or any recommended improvements that have a high asset management score indicating poor to fair condition. Phase III improvements have been split into two categories. Phase IIIA improvements represent any remaining hydraulic improvements and Phase IIIB improvements are the water mains with high asset management scores that do not fall into any other circle. The total estimated probable construction cost of Phase IIIA improvements is approximately $2,551,000. The total estimated probable construction cost of Phase IIIB improvements is approximately $5,109,000. These water mains are identified on the Recommendations Maps in Appendix J.

Costs are based on the January 2020 Engineering News Record (ENR) construction cost index for Boston, Massachusetts of 11392 and do not consider escalation based on an actual planned construction date for each recommended improvement. Estimated costs for each improvement include construction costs for the water main, hydrants, services, appurtenances, and temporary and permanent pavement. A 25 to 30-percent allowance for engineering, permitting, and contingency is included in each project's estimated cost. The standard allowance for engineering and contingency is 25-percent, but for any improvements that includes a bridge crossing or horizontal directional drill, the allowance is increased to 30-percent due to the complexities associated with these projects.

1.9 Implementation of System Improvements

The purpose of this report is to provide the Buzzards Bay Water District with a water distribution system asset management database and a prioritized plan for future maintenance budget and capital improvement expenses. The BBWD will maintain the inventory database in the future by updating data on condition and installation year as assets are replaced. The BBWD will be able to use the installation date and expected useful life fields to plan routine maintenance and asset replacements at their facilities in the future.

The list of above ground and water main improvements included in Section 8 is extensive due to the nature of this report. The prioritization of the recommended improvements based on the Three Circle Approach serves as a guide for implementation of the improvements with the greatest to least benefit based on the prioritization and weighted criteria established jointly by the BBWD and Tata & Howard. The implementation of these improvements is intended to be completed over multiple years. Based on the recommended system improvements and the estimated probable construction costs presented in this report, it is recommended that all Phase I and II improvements, which will provide the greatest benefit to the system, be completed over a 10-year period.

1.10 Rate Analysis

To evaluate the feasibility of implementing the recommended improvements within the BBWD's operating budget, the existing rates were evaluated and potential new rate scenarios were analyzed. It was determined that the existing structure is sufficient to fund all Phase 1 and PLA recommended improvements except for the construction of a new transmission main along Route 25. If the BBWD intends to move forward with this project then the tiered usage rates will need to be increased by $0.50 at all levels in order to generate necessary revenue to repay the loan for this work.

Section 2

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SECTION 2 – System Description and Operations

2.1 System Description

The BBWD water distribution system consists of 45 miles of water main ranging in diameter from two inches to 16-inches. The system serves approximately 5,830 customers in the winter and 7,700 customers in the summer. Figure No. 2-1 displays the breakdown of water main size by diameter based on the miles of each size in the water distribution system. Approximately one percent of the system is 4-inch diameter water main or less, 36 percent is 6-inch diameter water main, 28 percent is 8-inch diameter water main, four percent is 10-inch diameter water main, 26 percent is 12-inch diameter water main, and five percent is 16-inch diameter water main.

The distribution system pipe materials include cement lined cast iron (CLCI), ductile iron (DI), steel, and PVC pipe. Figure No. 2-2 displays the breakdown of water main materials based on the miles of each material in the water distribution system. Approximately 46 percent of the system is CI main, 49 percent is DI main, five percent is steel main, and less than one percent is PVC main.

The BBWD has five active groundwater supply sources which are Wells No. 1, No. 2, No. 3, No. 4, and No. 5. The BBWD has two water storage facilities including the Hydro Pillar and Standpipe for a combined storage total of 2.0 million gallons. There is one interconnection with the Wareham water distribution system. A map of the existing water distribution system is included in Appendix A.

2.2 Water Supply Sources

The BBWD has one treatment facility, the Chemical Injection Facility (CIF), located off Bournedale Road. Groundwater from Well No. 3 and Well No. 5 is treated at this facility with potassium hydroxide (KOH) for pH adjustment and sodium hypochlorite (NaOCl) for disinfection. Equipment at this facility includes chemical feed equipment, instrumentation and controls, and electrical systems. The CIF was constructed in 2018 and is in excellent condition. Raw water from the remaining wells in the system is treated at individual chemical injection facilities.

Pump Station No. 1

Pump Station No. 1 (4036001-01G) is a gravel packed well located off Dry Cedar Swamp Road, installed in 1981. The well has a depth of approximately 38 feet with an 8 foot screen. The reported capacity of Pump Station No. 3, based on the Zone II approved pumping rate, is 350 gpm. The pump station for Well No. 1 consists of two buildings, Build A and Building B. Building A houses the main pumping equipment and Building B houses the electrical, instrumentation, and chemical feed equipment for the well. Equipment includes a 30 horsepower (hp) motor, vertical turbine pump, variable frequency drive, generator, and SCADA instrumentation. The raw water is treated with KOH for pH adjustment and NaOCl for disinfection.

Figure No. 2-1
Water Main Diameter Distribution

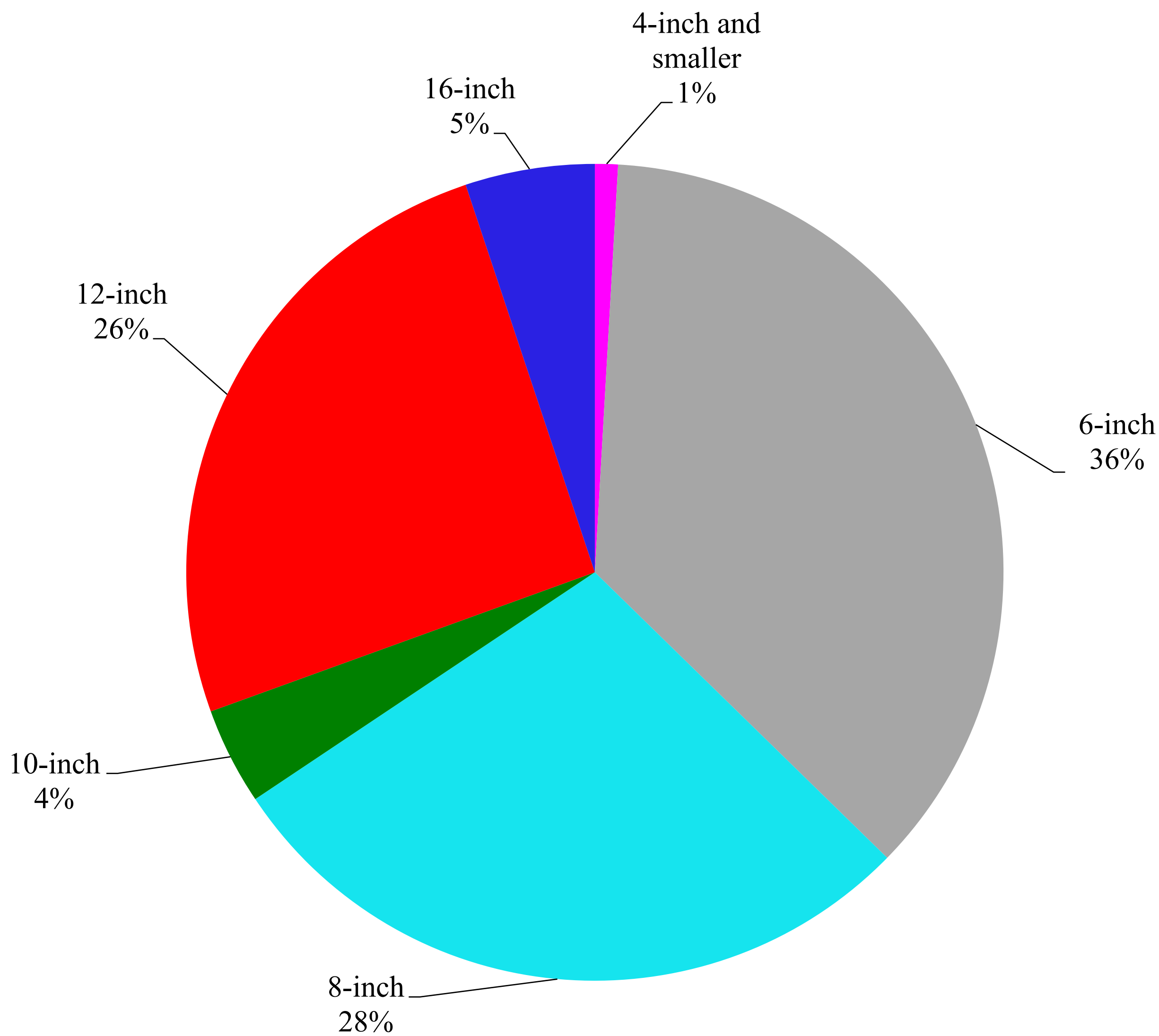
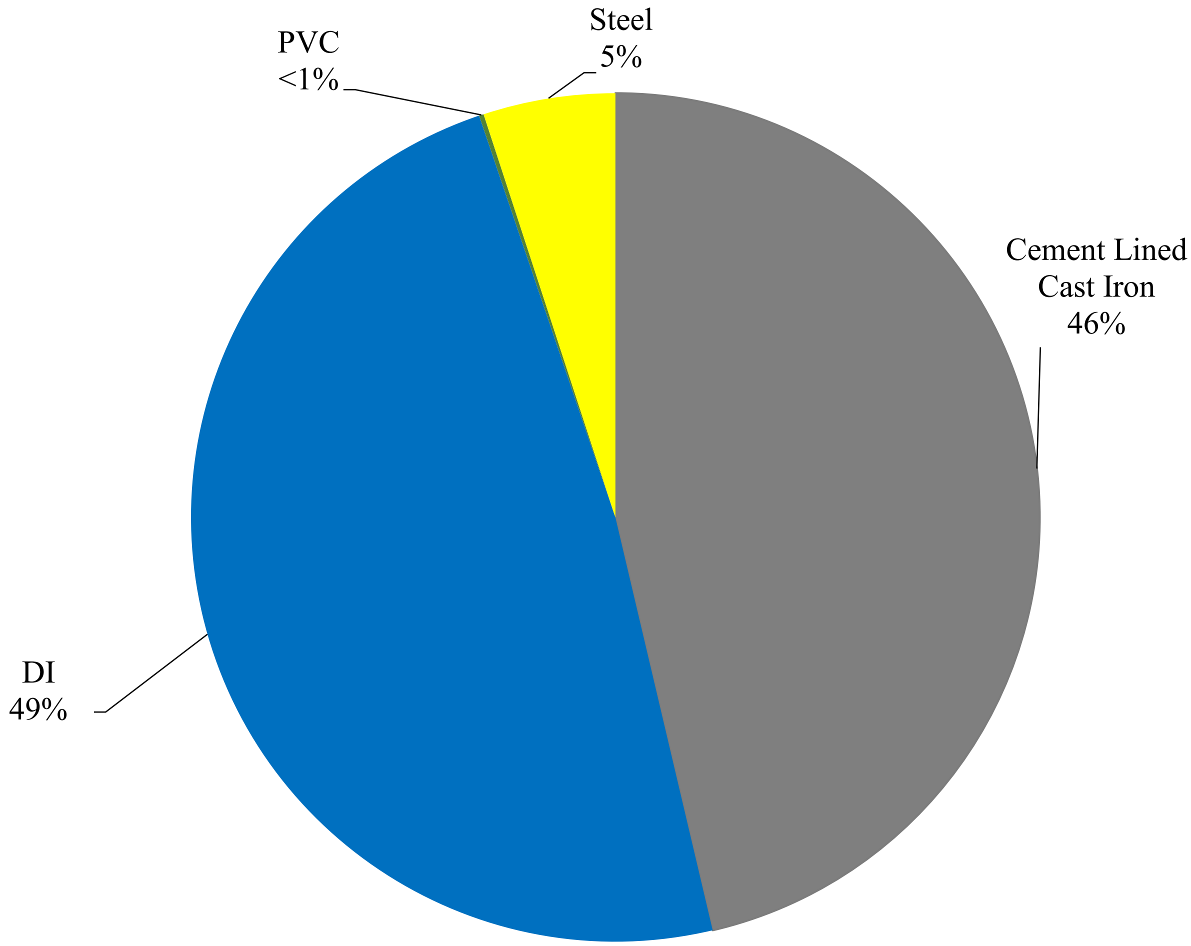


Figure No. 2-2
Water Main Material Distribution



Pump Station No. 2

Pump Station No. 2 (4036001-03G) is a gravel packed well located on Kettle Lane off Head of the Bay Road, installed in 1966. The well has a depth of approximately 43 feet with a 10 foot screen. The reported capacity of Pump Station No. 3, based on the Zone II approved pumping rate, is 300 gpm. Equipment includes a 30 horsepower (hp) motor, vertical turbine pump, variable frequency drive, generator, and SCADA instrumentation. The pumping station is in good condition. The raw water is treated with KOH for pH adjustment and NaOCL for disinfection.

Pump Station No. 3

Pump Station No. 3 (4036001-03G) is a gravel packed well located at Bournedale Road, installed in 1988. The well has a depth of approximately 89 feet with a 20 foot screen. This supply is a permitted source and has a maximum authorized daily withdrawal volume of 0.86 mgd, or 600 gpm. Equipment includes a 60 horsepower (hp) motor, vertical turbine pump, electrical, variable frequency drive, automatic transfer switch, generator, and SCADA instrumentation. The pumping station is in excellent condition.

Pump Station No. 4

Pump Station No. 4 (4036001-04G) is a gravel packed well located at Bournedale Road, installed in 1988. The well has a depth of approximately 64 feet with a 10 foot screen. This supply is a permitted source and has a maximum authorized daily withdrawal volume of 0.58 mgd, or 400 gpm. Equipment includes a 60 horsepower (hp) motor, vertical turbine pump, variable frequency drive, generator, and SCADA instrumentation. The pumping station is in excellent condition. The raw water is treated with KOH for pH adjustment and NaOCL for disinfection.

Well No. 5

Well No. 5 is a 24-inch x 18-inch gravel packed well located off Bournedale Road adjacent to Well No. 3. The well was installed in 2017 to a depth of approximately 75 feet with a 15 foot screen. This supply is a permitted source and has a maximum authorized daily withdrawal volume of 1.18 mgd, or 820 gpm. The equipment includes a 75 hp, 820 gallon per minute (gpm) submersible pump and motor and pitless adapter. The well is enclosed by a chain link fence. The well is in excellent condition. Raw water from Well No. 5 is treated with water from Well No. 3 at the Chemical Injection Facility.

2.3 Water Storage Facilities

The District has two water storage facilities with a total storage capacity of 2.0 million gallons.

Hydropillar

The Hydropillar Water Storage Tank is a 1.0 mg steel elevated storage tank located off Wagner Way. The 40 foot tall tank has an overflow elevation of approximately 215 feet above mean sea level (MSL) and is on top of a 122 foot tall pedestal, for a total height of 162 feet. The tank was constructed in 2001.

Standpipe

The Standpipe is a 1.0 mg steel standpipe located off State Highway 6. The tank has an overflow elevation of approximately 215 feet above MSL, an inside diameter of 46 feet, and a total height of 85 feet. The tank was constructed in 1972 and was repainted in 2014.

Section 3

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SECTION 3 – Water System Demands

3.1 General

Because population has a direct correlation to water consumption, population projections through the year 2041 were reviewed to determine the actual and planned growth within the BBWD. The following section reviews historical population data and presents an estimated future population based on available information from the DCR. The DCR follows specific guidelines when projecting the water usage for communities in conjunction with the Massachusetts Department of Environmental Protection (MassDEP) Water Management Act (WMA) program. It is important to note that the DCR has a key role in the water management approval process and demand projections are required to be approved by DCR before MassDEP will approve development of a new water supply source or authorize the withdrawal of additional volume from existing sources.

3.2 Population Projections

In May 2015, DCR developed final demand projections for the BBWD through the year 2031 as part of the MassDEP WMA permitting process. The DCR population projections are based on information in the BBWD's Annual Statistical Reports (ASRs) from 2009 through 2013 and rely on population and employment projections prepared by the Massachusetts Department of Transportation (DOT) and Cape Code Commission (CCC). The DCR used a base service population of 5,487. The DCR's base service population is based on 80 percent of the District population in the Town of Bourne being served and all of the District population in the Town of Plymouth being served plus an annualized seasonal population of 530. According to the District's 2019 ASR, the population served is 5,830 in the winter and 7,700 in the summer. The District should confirm the population currently served by the distribution system. A 2041 service population was projected by extending the 2016 to 2031 trends. Based on DCR projections, the estimated 2041 service population is approximately 6,520 for the Buzzards Bay Water District.

3.3 Water System Demands

The DCR follows specific guidelines when projecting the water usage for communities in conjunction with the MassDEP WMA program. It is important to note that the DCR has a key role in the water management approval process and demand projections are required to be approved by DCR before MassDEP will approve development of a new water supply source or authorize the withdrawal of additional volume from existing sources.

The Massachusetts Water Resources Commission (MWRC) has adopted Water Management Standards for all registered and permitted withdrawals. The policy includes performance standards and conditions for all registered and permitted public water suppliers in the following areas:

- Maximum residential consumption of 65 gallons per capita per day (gpcd).
- Maximum of 10 percent unaccounted-for water.

Residential Consumption

Residential consumption is calculated by dividing the volume of water supplied to residential connections by the reported population. Public Water Suppliers currently meeting the 65 gpcd standard are required to develop a Seasonal Demand Management Plan to manage non-essential outdoor water usage. Public Water Suppliers not consistently meeting the 65 gpcd are required to develop and implement MassDEP approved Compliance Plans, including the use of Best Management Practices to meet the residential consumption standard. The BBWD's residential consumption has ranged from approximately 43 to 52 gpcd between 2015 and 2019 as reported in the ASRs, with 2019 being the lowest at 43 gpcd.

Non-residential Consumption

Non-residential water usage includes commercial, industrial, municipal, and recreational water use. The 2015 through 2019 ASRs show a fairly consistent volume of non-residential usage, with the exception of 2019. From 2015 through 2019, the non-residential consumption has ranged from 34 to 43 percent of the total usage between 2015 and 2019.

Unaccounted-for Water

Unaccounted-for water may consist of undocumented water used for municipal purposes such as street cleaning, water main flushing, firefighting, meter inaccuracies, and leakage in the distribution system. To help estimate the unaccounted-for water in a system, a Confidently Estimated Municipal Use (CEMU) is first estimated for documented uses such as fire protection and training, hydrant flushing, flow testing, water main breaks, etc. To qualify as a CEMU, calculations or documentation for each estimated use must be attached to a system's ASR or provided to MassDEP. Unaccounted-for water in a system can then be estimated by taking the total amount of water supplied minus the total water metered minus the CEMU. Unaccounted-for water is typically divided by the total water supplied and expressed as a percentage. The BBWD's reported unaccounted-for water from 2015 through 2019 ranged from 7.8 to 16.6 percent. The BBWD was below 10 percent UAW for the years 2015 through 2017 and above 10 percent in 2018 and 2019.

Average Day Demand

Average day demand (ADD) is the total water supplied to a community in one year divided by 365 days. This term is commonly expressed in mgd. This demand includes all water used for domestic (residential), commercial, and municipal purposes. The municipal component includes water used for system maintenance such as water main flushing and fire flows. In addition, the ADD includes unaccounted-for water attributed to unmetered water uses and system leakage. According to the BBWD's 2015 through 2019 ASRs, the ADD supplied for the BBWD ranged from 0.46 mgd to 0.51 mgd.

DCR develops two different sets of water demand projections based on different criteria. The first set of projections is based on meeting the DCR performance standards for residential water usage and maximum unaccounted for water. The second set of projections utilizes historical residential water usage and unaccounted for water based on information from the BBWD's 2009 through 2013 ASRs. These projections assume that future water consumption will reflect current trends in residential consumption and unaccounted for water. The following criteria were used to develop the ADD for the design year 2041:

Criteria following DCR performance standards:

- Residential consumption of 65 gpcd
- Maximum of 10 percent unaccounted for water

Criteria following current trends:

- Residential consumption of 58 gpcd
- Maximum of 5.3 percent unaccounted for water

The DCR demand projection methodology also allows for a 5 percent buffer to account for uncertainty in growth projections. The use of the buffer will be discussed with MassDEP during any permit renewal process. Using DCR performance standards of 65 rgpcd and 10 percent unaccounted-for water, the projected ADD for 2041 is 0.71 mgd, including a five percent buffer. The DCR estimated the 2031 ADD to be 0.58 mgd according to existing rgpcd and unaccounted-for water trends plus a five percent buffer which projects to 0.63 mgd for 2041.

Summer Average Day Demand

MassDEP guidelines recommend that a system consider a projected summer average day demand (SADD). The current SADD is estimated by averaging demands from the three maximum months each year for the past five years. Based on available data between 2015 and 2019, the SADD ranged from 0.65 mgd to 0.77 mgd as shown in Table No. 3-1. The SADD peaking factor is determined by dividing the SADD by the annual ADD for each of the past five years. These peaking factors are averaged to estimate the future summer peaking factor. Based on the 2015 through 2019 monthly demand data, the average summer peaking factor is 1.45. Based on the projected ADD of 0.71 mgd using DCR performance standards and the average summer peaking factor of 1.45, the estimated 2041 SADD is approximately 1.03 mgd. Based on the projected ADD of 0.63 mgd using existing trends and the average summer peaking factor of 1.45, the estimated 2041 SADD is approximately 0.91 mgd.

Maximum Day Demand

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

The projected MDD can be estimated by the MDD/ADD ratio. The MDD/ADD ratio provides a relationship between the two demands which can be used to estimate future demands. As shown in Table No. 3-1, the highest MDD for the past five years was 1.11 mgd in 2016. Upon comparison of the MDD to the ADD, the ratio for 2016 was 2.23. The largest MDD to ADD ratio for the past five years of 2.33 in 2015 was used to calculate the future MDD. The resulting projected MDD for year 2041 is estimated to be 1.65 mgd based on the projected 2041 ADD of 0.71 mgd using DCR performance standards, and 1.47 mgd based on the projected 2041 ADD of 0.63 using existing trends.

Table No. 3-1
Current and Projected Water Use

Year	ADD (mgd)	SADD (mgd)	Peaking Factor (SADD/ADD)	MDD (mgd)	Peaking Factor (MDD/ADD)	Peak Hour (mgd)
2015	0.51	0.77	1.51	1.07	2.09	*
2016	0.50	0.76	1.53	1.11	2.23	*
2017	0.46	0.65	1.42	1.06	2.33	*
2018	0.50	0.72	1.44	0.97	1.94	*
2019	0.51	0.68	1.35	1.03	2.03	*
2041 (DCR Guidelines)	0.71	1.03	1.45	1.65	2.33	2.84
2041 (Existing Trends)	0.63	0.91	1.45	1.47	2.33	2.52

*Peak hour information for 2015 through 2019 is not available.

Peak Hour Demand

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

Since system records of peak hourly demands are not available, the peaking factor for the current usage and design year 2041 was estimated based on typical historical consumption for communities of similar size. The MDD/ADD ratio for a community can be used to estimate the peak hour/ADD peaking factor. Using the MDD/ADD ratio of 2.33, the corresponding peak hour factor for the system is approximately 4.0. Based on an ADD of 0.71 using DCR performance standards, the projected peak hour demand for the year 2041 is approximately 2.84 mgd. Using an ADD of 0.63 mgd using existing trends, the projected peak hour demand for the year 2041 is estimated at 2.52 mgd. Although BBWD has typically had low residential usage and unaccounted for water values, to be conservative, projected water use using DCR performance standards was used to evaluate future (2041) supply and storage adequacy.

3.4 Adequacy of Existing Water Supply Sources

In accordance with standard waterworks practices and current MassDEP guidelines, the sources of supply for a water system must be capable of meeting MDD conditions with all supplies online and SADD conditions with the largest source out of service. Additionally, the sources should be permitted or registered to withdraw volumes adequate to meet ADD.

In 1987, the WMA program was implemented by MassDEP to regulate withdrawal of water from the State's watershed basins. Under this program, all new sources withdrawing more than 100,000 gallons per day (gpd) and existing sources exceeding their registered withdrawal volume by 100,000 gpd are required to obtain a withdrawal permit under the WMA. When first implemented, the registered withdrawal volume for a public water system was based on that system's historical pumping rate of the water supply source(s) between 1981 and 1985.

Permits can be renewed and amended as system demands increase and additional sources of water supply are utilized. The WMA program considers the need for the withdrawal, the impact of the withdrawal on other hydraulically connected water suppliers, the environmental impacts of the withdrawal, and the water available in the river basin or subbasin (the basin safe yield) prior to issuing a permit. It is important to note that the basin safe yield is different from the safe yield of a supply. In accordance with the WMA Permit application instructions, the basin safe yield is the total water available to be withdrawn from a river basin or subbasin, whereas the safe yield of a well is the volume of water the well is capable of pumping under the most severe pumping and recharge conditions that can be realistically anticipated.

Currently, BBWD has a total WMA withdrawal authorization of 0.53 mgd based on a registered volume of 0.37 mgd and a permitted volume of 0.16 mgd. The current summary of permitted and registered volumes for each source is outlined in Table No. 3-2.

Table No. 3-2
Buzzards Bay Water District Source Summary

Well Name	DEP Source ID	WMA Status	Maximum Daily Withdrawal Rate* (mgd)
Pump Station No. 1	4036001-01G	Registered	0.50
Pump Station No. 2	4036001-02G	Registered	0.46
Pump Station No. 3	4036001-03G	Permitted	0.86
Pump Station No. 4	4036001-04G	Permitted	0.58
Well No. 5	4036001-05G	Permitted	1.18
		Total:	**3.58**

*The maximum daily withdrawal rate for the registered sources

The BBWD has a total WMA withdrawal authorization of 0.53 mgd. In 2019, the BBWD ADD was 0.51 mgd. The largest ADD of the past five years was 0.51 mgd in 2015 and 2019. With the estimated 2041 ADD at 0.71 mgd, the BBWD is currently projected to exceed their existing WMA permit over the next twenty years. The existing WMA permit was last amended in 2018 to include Well No. 5 as a new source. MassDEP has indicated that the BBWD will be receiving a new Order to Complete in 2021. The BBWD should continue to monitor the average daily water usage to determine if an increase in their permitted usage will be needed in order to request any needed increase during the Order to Complete process. It is likely that minimization and mitigation requirements will be issued in order for the BBWD to increase their permitted withdrawal.

The supply sources of a water system must be capable of meeting MDD conditions with all supplies online and SADD conditions with the largest source out of service. The system's total combined approved maximum daily withdrawal rate of all active supply sources is 3.58 mgd. The largest MDD of the past five years was 1.11 mgd in 2016. Compared to the 1.11 mgd MDD in

2016, there was a supply surplus of 2.47 mgd. Well No. 5 is the BBWD's largest source of finished water. The system's maximum available yield with Well No. 5 offline is 2.40 mgd. The largest SADD of the past five years was 0.77 mgd in 2015. Compared to the SADD of 0.77 mgd in 2015, there was a supply surplus of 1.63 mgd.

Projected demands using DCR performance standards were used to evaluate the adequacy of the supply sources in the future. The projected 2041 ADD, MDD, and SADD using DCR performance standards are 0.71 mgd, 1.65 mgd, and 1.03 mgd, respectively. Compared to the projected 2041 MDD, a surplus of 1.93 mgd is estimated. Under similar conditions, a surplus of 1.37 mgd is estimated compared to the projected 2041 SADD of 1.03 mgd if the largest source is offline.

3.5 Adequacy of Existing Water Storage Facilities

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

Equalization storage provides water from the tanks during peak hourly demands in the system. Typically, equalization storage is a percentage of the maximum day demand. The percentages can range from 15-percent to 25-percent, with 15-percent used for a large system, 20-percent for a medium sized system, and 25-percent used for a small system. A system is considered small if it has less than 3,300 customers, while a system is considered large if it has more than 50,000 customers. With a service population of approximately 7,700 people in summer months, the BBWD system was considered to be a medium system, and 20-percent of the maximum day demand should be available in the storage tanks for meeting equalization storage guidelines.

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

The emergency storage component is typically equivalent to one ADD. However, if there is emergency power available at the sources or emergency connections with surrounding communities capable of supplying at least one ADD, the emergency storage component can be waived. Emergency power is available at Well Nos. 1, 2, and 4, which combined have the capability of supplying at least one ADD.

The three components of the storage evaluation were calculated under current and projected water demand conditions. The largest MDD of the past five years was 1.11 mgd in 2016. Therefore, the 2016 data was used as the "current year" for the storage evaluation. The projected 2041 MDD is based on DCR guidelines methodology.

1. Equalization
   - Medium sized system = 20-percent of the Maximum Day Demand
   - Maximum Day Demand in year 2016 = 1.11 mgd
   - Estimated Maximum Day Demand in year 2041 = 1.65 mgd
   - Equalization (2016) = 0.20 x 1.11 = 0.22 mg
   - Equalization (2041) = 0.20 x 1.65 = 0.33 mg

2. Basic Fire Flow Requirements
   - Representative fire flow = 2,500 gpm
   - Duration of 2 hours or 120 minutes
   - Basic Fire Flow Requirement = 2,500 x 120 = 0.30 mg

3. Emergency Storage: Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2016) and projected (year 2041) total required storage is as follows:

- Total Required Storage (2016) = 0.22 mg + 0.30 mg = 0.52 mg
- Total Required Storage (2041) = 0.33 mg + 0.30 mg = 0.63 mg

A minimum pressure of 20 pounds per square inch (psi) should be maintained at the highest served customer under MDD conditions with a coincident fire flow. The highest customer in the system is located at an elevation of approximately 90 feet above mean sea level (MSL) at the Bournedale Elementary School. To maintain a minimum pressure of 20 psi at this customer, the level of the water in the storage tanks should not drop below 136 feet above MSL.

The Hydropillar storage volume is fully usable while the Standpipe has usable and unusable storage. The pedestal of the Hydropillar has a base elevation of 53 feet above MSL and a height of 162 feet. The tank itself has a height of 40 feet, an overflow elevation of 215 feet above MSL, and a diameter of 75 feet. The low water level for this tank is 175 feet above MSL which is higher than the elevation needed to maintain 20 psi at the highest served elevation, therefore, the entire tank volume is usable storage. The Standpipe has a base elevation of 130 feet above MSL, a height of 85 feet, an overflow elevation of 215 feet above MSL, and a diameter of 46 feet. Since the base elevation is below the elevation needed to maintain 20 psi at the highest served elevation, approximately 79 feet of the Standpipe would be usable which equates to approximately 0.98 mg of usable storage.

The BBWD distribution system has a total useable storage volume of 1.98 mg. Compared to the current required storage of 0.67 mg, the system currently has a storage surplus of 1.31 mg. Compared to the projected 2041 required storage of 0.78 mg, the system will have a storage surplus of 1.20 mg in 2041.

Section 4

TATA & HOWARD

SECTION 4 – Hydraulic Evaluation

4.1 General

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

4.2 Model Verification

Verification of the computer model was completed under steady state conditions based on fire flow testing and information pertaining to the BBWD's hydraulic gradeline and current operating procedures. Flow tests were conducted by the BBWD personnel and Tata & Howard at 13 locations throughout the distribution system on October 28, 2020. Flow test locations were selected to be representative of the distribution system. Table No. 4-1 presents the results of the flow testing. The data obtained from the flow tests served as input data for the model verification under steady state conditions. The data included static and residual pressure readings and measurements of flow from the hydrants tested. Each simulation in the model reflected actual field conditions at the time of the testing to properly calibrate the model.

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

4.3 Adequacy of Existing Distribution System

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

Minimum/Maximum Pressures

During 2020 and 2021 ADD, MDD, and peak hour conditions, a minimum pressure of 35 psi is met all throughout the BBWD with the exception of the Heather Hill Road and Deer Path Trail streets. These streets currently have no homes and would require a booster pump station to service the area if homes were built. As there are no customers in this area, the low pressures were not considered to be a concern during this analysis.

On the contrary to low pressures in the system, an upper limiting pressure of 120 psi is generally recommended, as older fittings in the system are generally rated at 125 to 150 psi. Pressure above this level can result in increased water use from fixtures and also increased leakage throughout the distribution system. The MassDEP published Guidelines for Public Water Systems recommends that pressure reducing devices be utilized on mains or on individual service lines when static pressures exceed 100 psi. Also, plumbing code states that water heaters in homes can be affected when pressures exceed 80 psi. Based on the hydraulic model simulations completed under various ADD, MDD, and peak hour conditions, the system does not experience pressures greater than 90 psi.

Insurance Services Office (ISO) Fire Flow Recommendations

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

The entire Bourne system was last inspected for fire insurance ratings by the ISO in September 2019. The results of the ISO inspections and fire flow testing were provided by the BBWD and are shown in Table No. 4-2. Testing was performed across the entire Town of Bourne and as such only two hydrants were tested within the BBWD's jurisdiction. The test results indicate the available flow and estimated recommended fire flow in various sections of the distribution system at the time of the tests. The estimated recommended fire flows established by ISO varied from 750 to 2,500 gpm, depending on the location and the structure. It should be noted that a water system is only required by ISO to provide a maximum of 3,500 gpm at any point in the system. Recommended fire flows greater than 3,500 gpm are not considered in determining the Public Protection Classification (PPC) of the BBWD when using the Fire Suppression Rating Schedule. ISO individually grades the protection of buildings with a recommended fire flow in excess of 3,500 gpm, and the PPC of those buildings can differ from that of the community that provides their fire protection.

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

Table No. 4-1
Flow Test Results (October 28, 2020)

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Observed Flow (gpm)	Available Flow at 20 psi (gpm)
1	End of Little Bay Lane	82	46	850	1,200
2	44 Nye Lane	79	42	800	1,100
3	16 Chandler Drive	86	65	1,200	2,700
4	16 Alderberry Road	74	64	1,060	2,500
5	31 Catskill Road	70	58	1,000	1,500
6	Heather Hill	22	20	300	300
7	25 Buttermilk Road	85	70	750	1,700
8	37 Canal View Road	85	80	1,250	4,900
10	35 Studio Drive	85	48	1,000	1,400
11	11a Lafayette Avenue	84	34	300	350
12	End of Yearling Run Road	52	40	700	1,100
13	30 Old Head of The Bay Road	82	30	650	700

Note: No field records for Test No. 9

Table No. 4-2
ISO Hydrant Flow Summary
September 2019

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Recommended Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
4	Head of the Bay Road and Puritan Road	80	60	750	4,300
14	Old Bridge Road and Main Street	78	73	2,500	4,400

Additional Flow Recommendations

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

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

4.4 Hydraulically Deficient Areas

The estimated recommended fire flows were simulated in the computer model. All scenarios were run using the projected 2041 MDD conditions. All storage tanks in the system were set five feet below their overflow elevation. Pump Station No. 1 was operating at a flow of 340 gpm. Pump Station No. 2 was operating at a flow of 300 gpm. Pump Stations No. 3, which includes Well No. 5, and No. 4 were not operating. Areas where the available fire flows did not meet the ISO recommended fire flow or estimated recommended fire flow were considered hydraulically deficient and improvements were developed to alleviate these deficiencies.

Hydraulic deficiencies were identified as part of a system wide evaluation and include deficiencies in areas that were and were not included in the most recent ISO testing, as well as addressing residential fire flow deficiencies. In general, the hydraulic deficiencies were broken down into Priority 1 and 2 deficiencies. Priority 1 deficiencies identify areas of ISO fire flow deficiencies as well as any larger industrial or commercial fire flow deficiencies or locations where a loop could be added to improve system redundancy. Priority 2 deficiencies identify areas where residential recommended fire flows were not met and locations of small diameter water mains (4-inch diameter or less) that do not have adequate fire hydrant coverage. All hydraulic deficiencies are indicated in the Priority 1 and Priority 2 Hydraulic Deficiencies map in Appendix C.

Priority 1 Hydraulic Deficiencies

1. To improve system redundancy and improve transmission of water from the sources to the large customers in the southern parts of the distribution system, it is recommended that a new 12-inch diameter water main be installed along Route 25. This will connect the existing 16-inch water main on Bournedale Road with the 12-inch cross country water main north of Heather Hill Road. This proposed location is dependent on the ability to utilize the shoulder of Route 25 or the easement for utility poles along the highway for installation of the water main. It should be noted that if neither of these locations is available for use, there will be a considerable amount of permitting and coordination with the MassDOT to complete the design and construction of this water main.

2. A recommended fire flow of 2,500 gpm was estimated for the Cape Cod Nursing Home using the 2014 ISO Published Guide for Determination of Needed Fire Flow. The available fire flow is estimated to be 900 gpm at 20 psi. It should be noted that the recommended fire flow at this location does not consider if a fire protection system is installed in the building. The ISO uses the Specific Commercial Property Evaluation Schedule (SCOPES) to evaluate sprinkler protection of a property. Where evidence is available from local fire or building officials to document the installation, approval, testing, and maintenance of the sprinkler system as defined in Chapter 6 of the National Fire Protection Association (NFPA) Standard, the needed fire flow shall be the greater of the demand at the base of the sprinkler system riser or 1,000 gpm at 20 psi. It is recommended that the BBWD determine if the building has an existing sprinkler system, and if so, if it meets the criteria as outlined in Chapter 6 of the NFPA Standard and determine if the demand at the base of the riser is more than 1,000 gpm. The estimated available fire flow at this location does not meet the 1,000 gpm at 20 psi, and requires distribution system improvements to provide the inherent capacity for the recommended flows. If the building has an adequate sprinkler system, then a new 8-inch diameter water main on Lewis Point Road is recommended to replace the existing 6-inch diameter water main.

Priority 2 Hydraulic Deficiencies

3. A new 8-inch diameter water main is recommended to replace the existing 2-inch and 6-inch diameter water mains on Buttermilk Way and Bay Drive from Harbor Place to Tower Lane. The new 8-inch diameter water main will provide the inherent capacity for the estimated fire flow of 2,500 gpm to the Massachusetts Maritime Academy, which is a critical customer with several large buildings less than 30 feet apart.

4. A new 8-inch diameter water main is recommended on Old Bridge Road from Main Street to Everett Road to replace the existing 6-inch diameter water main. This improvement will provide the inherent capacity for the recommended residential fire flow for this street and the smaller dead-end streets that branch off Old Bridge Road.

5. A new 8-inch diameter water main is recommended on Lafayette Avenue from Cohasset Avenue to Puritan Avenue to replace the existing 6-inch diameter water main. This improvement will provide the inherent capacity for the recommended residential fire flow.

6. New 8-inch diameter water mains on Knollview Road, Bog View Drive, Hideaway Road, and Nautical Way are recommended to replace the existing 6-inch diameter water mains. These streets are all within the Hideaway Village community which has very narrow streets and limited ability for construction equipment to maneuver. The recommended fire flow in this area is 1,500 gpm due to the homes being less than ten feet apart. Many of the mains serving this area are small diameter without hydrants. Increasing the diameter of the water mains on these four streets will improve the overall flow in the community.

7. There are multiple small diameter steel water mains in the BBWD system that do not currently have hydrants. For some locations, it is feasible to install a hydrant on an adjacent 8-inch diameter or larger water main to provide the inherent capacity for the recommended residential fire flow to locations along the small diameter water main that are not currently within 500 feet of existing hydrant. For all other locations, it is recommended to replace the existing small diameter water main with a new 8-inch diameter ductile iron water main including a hydrant installation near the end of the water main. Table No. 4-3 indicates the improvement options for each of these Priority 2 deficiencies.

Table No. 4-3
Priority 2 Hydraulic Deficiencies – Small Diameter Water Mains

Deficiency No.	Location	Existing Diameter (in.)	Recommended Improvement
7	Birch Street and Mildred Street	2	New 8-inch diameter water main
	Nickerson Street	2	New 8-inch diameter water main
	Cypress Street	2	New 8-inch diameter water main
	Archer Street	2	New 8-inch diameter water main
	Walnut Street	2	New 8-inch diameter water main
	Buttonwood Lane	2	New 8-inch diameter water main
	Sunset Lane	1 and 2	New 8-inch diameter water main

Section 5

SECTION 5 – Critical Component Assessment

5.1 General

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

5.2 Evaluation Criteria

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

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

5.3 Critical Components

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

Critical Areas Served

A system-wide review of critical areas served such as schools and day care facilities, medical facilities and nursing homes, emergency services, and other critical institutions was completed and identified with BBWD staff. Table No. 5-1 presents all critical areas served including critical users and critical components of the distribution system.

Critical Water Mains

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

Table No. 5-1
Critical Areas

Critical Area		Location
Schools/Day Care Facilities/Nursing Homes		
	Massachusetts Maritime Academy	101 Academy Drive
	Keystone Place	218 Main Street
	Royal Health Group	8 Lewis Point Road
	Bournedale Elementary School	41 Ernest Valeri Road
Medical Facilities		
	Cape Cod Veterinary Specialists	11 Bourne Bridge Approach
	Buzzards Bay Veterinary Associates	230 Main Street
Emergency Services		
	Bourne Police Department	35 Armory Road
	Bourne Fire Department	130 Main Street
Water Distribution System Components		
	Pump Station # 1	Dry Cedar Swamp Road
	Pump Station # 2	Off Kettle Lane
	Pump Station # 3	Off Bournedale
	Pump Station # 4	Off Bournedale
	Tank #1 Hydropillar	14 Wagner Way
	Tank #2 Stand Pipe	Route 6

Additional critical water mains were identified based on a review of the distribution system model and using the model's criticality feature. The criticality feature simulates breaks on each pipe in the model. The model calculates if the system can still be served with adequate flow and pressures after a pipe is taken out of service. This feature can identify areas served by multiple mains which would no longer be able to serve customers if one of the mains were taken out of service. The following were identified by the criticality feature in Watergems as causing a system demand shortfall of two percent or greater, and are considered critical mains:

- The 16-inch water main running cross-country from Heather Hill Road to Bournedale Road under state Route 25 providing transmission from Pump Stations No. 4 and 3 to the Standpipe and the rest of the distribution system.
- The 12-inch cross country water main under Route 25, south of Bournedale Road, providing transmission from all sources to the Standpipe.
- The segment of 12-inch water main on Head of the Bay Road near the intersection with Old Head of Bay Road and Ellis Pond, providing the only connection to the northwestern portion of the distribution system.
- The segment of 12-inch water main on Head of the Bay Road to the intersection with Pine Ridge Road, providing the only connection from the distribution system to the customers located in Plymouth.

Water mains that cross streams, rivers, Route 6, and active railroads are also considered critical because of the costly consequences of failure that could occur if a water main broke in these areas, and the difficulty in repairing the mains in these locations. Critical mains are highlighted on the Critical Components Map found in Appendix D.

Section 6

TATA & HOWARD

SECTION 6 – Asset Management Considerations

6.1 General

The existing water distribution system includes approximately 46 miles of water mains. A number of factors, including installation year, diameter, material, water quality, break history, and soil characteristics, affect the decision to replace or rehabilitate a water main. Using an Asset Management approach tailored for the Buzzard Bay system, 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, completing the third facet of the Three Circle approach.

6.2 Data Collection

Information regarding the water main diameters, materials, and installation years was obtained from the BBWD's most recent ArcGIS data layers. Information regarding break history and water quality concerns was obtained during a workshop with the system superintendent from the BBWD. Information regarding potentially corrosive soils, identified corrosive soils, landfills, and contaminated soils was obtained from data available from the Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services and supplemented with additional field observation made by the BBWD. The development of the asset management grading system and the collection of asset data was a collaborative effort with the BBWD.

6.3 Evaluation Criteria

To prioritize water main replacement or rehabilitation, a water main grading system was established. The grading system uses water main characteristics including installation year, diameter, and material, as well as known areas with water quality concerns, water main break history, and soil characteristics surrounding the water main to assign point values to each pipe in the system. The performance criteria within each asset category are assigned a rating between zero and 100, with zero being the most favorable and 100 being the least favorable within the category. Each category is then given a weighted percentage, which represents priorities within the system. Tata & Howard worked with the BBWD to adjust the weighted percentages of each category and the ratings of the performance criteria based on existing system performance and conditions. Our recommendation was to assign a maximum weight of 25 percent to any one category. The assigned rating is then multiplied by the weighted percentage to determine the weighted rating for the performance criteria in each category. The weighted rating for each performance criteria was totaled to determine an overall rating for each pipe section in the model. The pipes with the highest grade are most in need of replacement or rehabilitation.

A workshop was held with representatives of the BBWD to establish a rating system specific to the Buzzard Bay water system. During the workshop, it was determined that soil conditions are of primary concern, followed by material and diameter. The grading system is shown in Table No. 6-1 and discussed in detail later in this section.

Table No. 6-1
Asset Management Grading System

Weight	Performance Criteria	Rating	Weighted Rating
15%	Installation Year (Age)		
	Pre 1949	100	15
	1950-1959	70	10.5
	1960-1969	50	7.5
	1970-1977	40	6
	1978-1989	20	3
	1990-1999	5	0.75
	2000-Current	0	0
20%	Material		
	Steel	100	20
	Cement Lined Cast Iron	70	14
	PVC	5	1
	Ductile Iron	5	1
20%	Diameter		
	4-inch and smaller water main	100	20
	6-inch water main	90	18
	8-inch water main	40	8
	10-inch water main	15	3
	12-inch water main	10	2
	16-inch water main	5	1
15%	Break History		
	3 or More Breaks	100	15
	2 Breaks	80	12
	1 Break	50	7.5
	No History of breaks	0	0
25%	Soils		
	Identified Corrosive Soils/Tidal Influence	100	25
	Potentially Corrosive Soils	60	15
	Deep Bury	40	10
	Gravel/Sand	0	0
5%	Service Breaks/Leaks		
	History of Breaks/Leaks	100	5
	No History of Breaks/Leaks	0	0

Water Main Age/Material

The water industry in the United States has followed certain trends over the last century. The installation year of a water main generally correlates with a specific pipe material that was used during that time as shown in Table No. 6-2. For example, unlined cast iron water mains were the predominant pipe material installed in water systems until approximately 1958. Factory cement lined cast iron mains were manufactured from the 1950s to about 1970, when pipe manufacturers switched primarily to factory cement lined ductile iron pipe.

Cast iron water mains consist of two types: pit cast and sand spun. Pit cast mains were manufactured up to the year 1930 while sand spun mains were manufactured between 1930 and 1970. Pit cast mains do not have a uniform wall thickness and 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, but the thinner wall thickness actually made it more susceptible to breaks. While the transition to factory cement lined cast iron mains had begun in the late 1940s, prior to the year 1958, most cast iron water mains that were manufactured were still unlined. Unlined cast iron mains increased the potential for internal corrosion. By 1958, rubber gasket joints were also introduced. 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, which 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.

Table No. 6-2
Pipe Material and Length by Installation Year

Installation Year	Cement Lined Cast Iron (LF)	Ductile Iron (LF)	PVC (LF)	Steel (LF)	Total (LF)
Pre-1949	58,898	---	---	1,428	60,326
1950-1959	9,467	---	---	---	9,467
1960-1969	42,861	---	---	8,298	51,159
1970-1977	815	7,390	---	1,507	9,712
1978-1989	---	58,860	---	---	58,860
1990-1999	---	24,202	---	---	24,202
2000-Current	---	25,934	422	883	27,239
Total (LF)	112,040	116,386	422	12,117	**240,965**

Factory lined cast iron (CLCI) was manufactured and installed up until about 1975. Overlapping this period, factory cement lined ductile iron main was manufactured from the 1950s and continues to be manufactured today. Most New England water utilities did not begin to install ductile iron pipe until the late 1960s.

Based on information provided by the Buzzards Bay Water District, all cast iron water mains installed are cement lined. No records exist of a field lining program for the system, but based on pipe performance and operator notes during construction or repairs, all cast iron pipes appear to be cement lined. As such, it was assumed for analysis that all cast iron water mains in the system are cement lined. Approximately 46 percent of the Buzzards Bay system is cement lined cast iron pipe.

Approximately 49 percent of the system is ductile iron. 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. According to BBWD records, ductile iron pipe was introduced to the system in the early 1970s but a permanent switch to solely using the material was not made until approximately 1978.

PVC was first used in the United States in the early 1960s. Due to its resistance to both chemical and electrochemical corrosion, PVC pipe is not damaged by aggressive water or corrosive soils. In addition, the smooth interior of PVC is resistant to tuberculation. The 1994 "Evaluation of Polyvinyl Chloride (PVC) Pipe Performance" by the AWWA Research Foundation found that utilities have experienced minimal long term problems with PVC pipe. Generally, problems with PVC occurred when the area surrounding the pipe was disturbed after installation of the pipe. It should be noted that low molecular weight petroleum products and organic solvents can permeate PVC and HDPE pipe if the contaminants are found in high concentrations in the soil surrounding the pipe. Less than one percent of the system is PVC pipe. The only PVC pipe in the system is located along Wallace Point.

Approximately five percent of the Buzzards Bay system is steel water main. This material is generally limited to smaller diameter applications of 2-inch diameter or less but serve multiple properties and as such are classified as water mains rather than service lines.

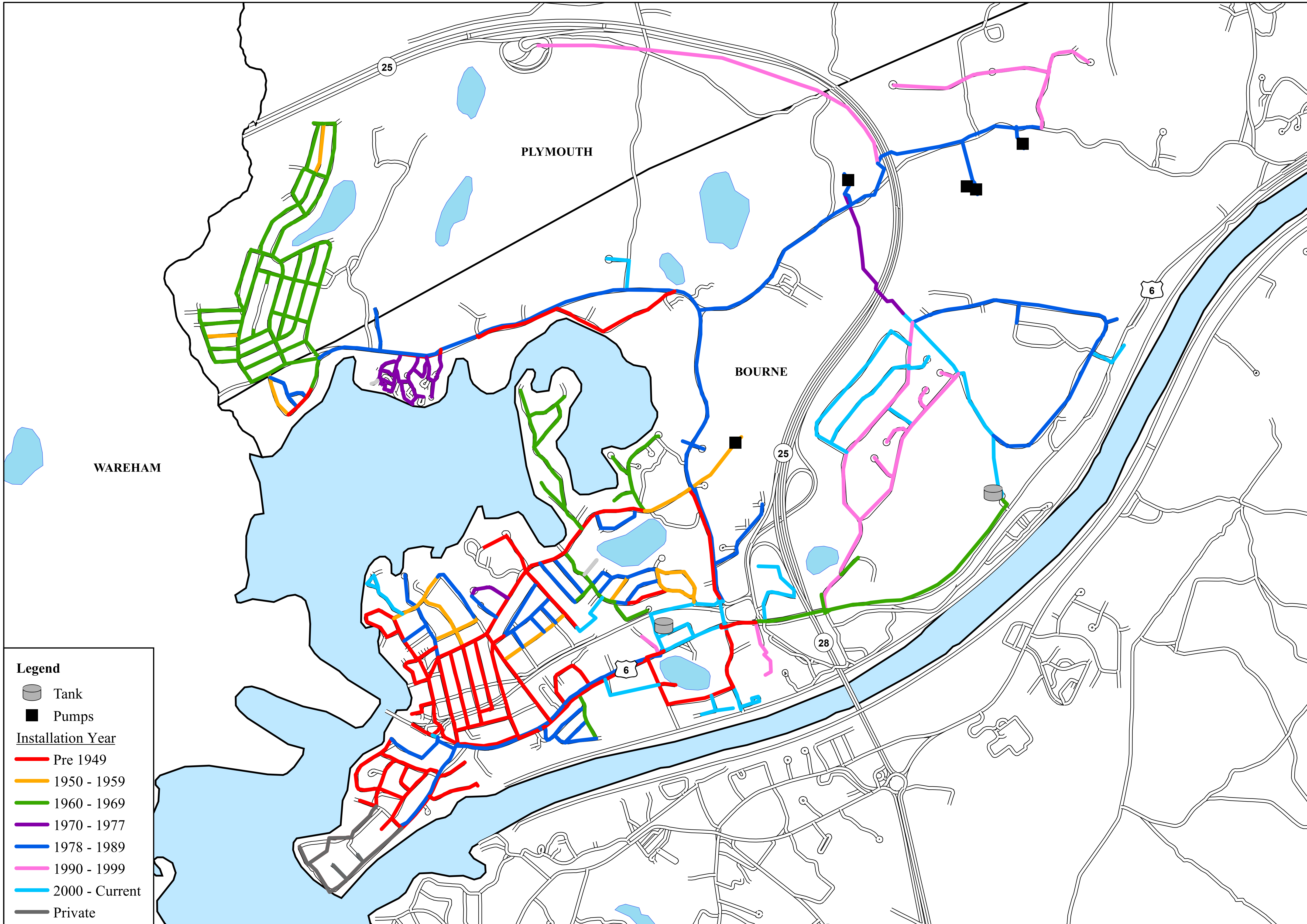
In general, the oldest water mains in the system received the highest ratings, while the newest received a rating of zero. In general, water mains in the system with materials that are most recommended to be replaced received the highest ratings. Steel mains received the highest rating due to their potential for high internal corrosion. Ductile iron and PVC water mains received the lowest rating. Figures No. 6-1 and 6-2 present the installation year and material of the water mains, respectively.

Water Main Diameter

The Buzzards Bay water distribution system consists of water mains ranging in diameter from less than 4-inches to 16-inches. Approximately 28 percent of the system is comprised of 8-inch diameter piping and approximately 36 percent is 6-inch diameter piping.

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-inches in diameter are more likely to deflect or bend than a larger diameter main. Pipes that are 8-inches in diameter are less likely to break from bending forces due to the increased wall thickness and increased moment of inertia.

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. Therefore, in addition to having a greater resistance to bending, larger diameter pipes also are more resistant to failure from pipe wall corrosion due to the thicker walls.



Water Main Installation Year

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

Figure No. 6-1

TATA & HOWARD

Date: May 2021

Scale: 1" = 1,700'

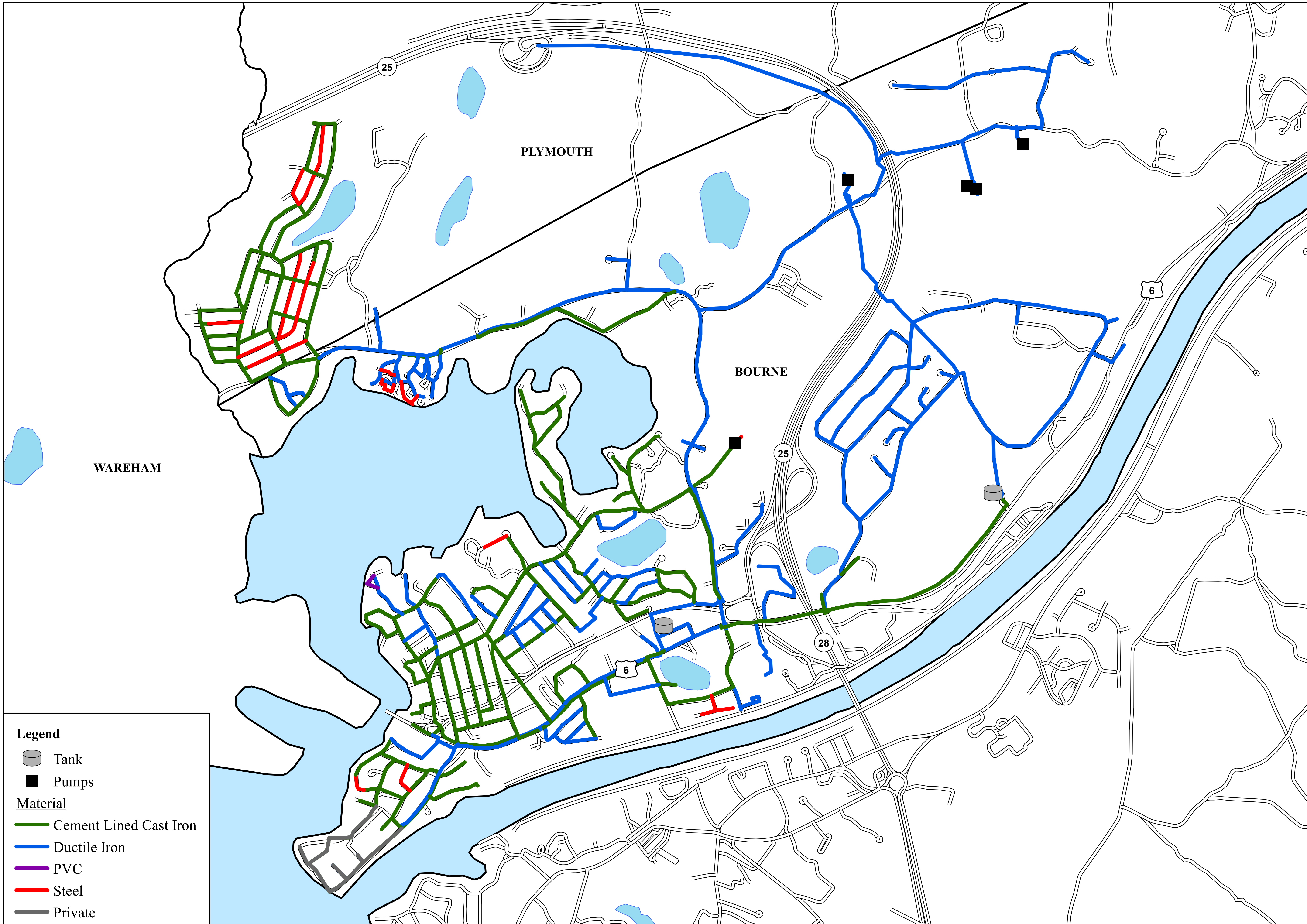


Figure No. 6-2

Water Main Material

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

TATA & HOWARD

Date: May 2021

Scale: 1" = 1,700'

The rating system for the diameter of the water mains follows the concept that smaller water mains are not as strong as larger mains. For example, 4-inch diameter water mains are not as strong as 6-inch diameter water mains. A rating of 100 was given to 4-inch diameter and smaller water mains and a rating of five was given to the 16-inch diameter water mains. The two most common piping sizes in the distribution system are 8-inch and 6-inch diameter pipe. Table No. 6-1 does show a drop in the rating score between a 6-inch diameter water main (90) and 8-inch diameter water main (40). The drop in rating is due to wall thickness and field experience. An 8-inch diameter water main has proven to have nearly twice the bending strength of a 6-inch diameter water main. In general, 8-inch diameter water mains are stronger and less likely to break than 6-inch diameter pipes. Figure No. 6-3 presents the various water main diameters throughout the distribution system.

Break History

Based on data provided by the BBWD, the water system experienced an average of two breaks per year over the past fifteen years. In relation to the total miles of water main in the system, this equates to approximately 4 breaks per 100 miles per year. In comparison to the national average of 25 breaks per 100 miles per year, the Buzzards Bay system experiences a relatively low break rate. Each water main break costs time and labor. Breaks cause disruption to the public and water consumers especially when the breaks are reoccurring. Buzzards Bay has several areas where pipes have experienced multiple breaks. At some point, it becomes more efficient to replace the main than to continue making repairs. Based on BBWD water main break records, pipes with three breaks or more were assigned a rating of 100, pipes with two breaks were given a rating of 80, pipes with one break were given a rating of 50, and pipes with no known breaks received a rating of zero. Water main areas that have a history of breaks are identified on Figure No. 6-4.

Soil Characteristics

Water main degradation can occur both internally and externally. Factors that increase the rate of external corrosion include high groundwater, soils with low calcium carbonate, or soils with high acidity or sulphates. Wetlands areas have greater potential to cause external corrosion of water mains than other soil conditions. Specific to Buzzards Bay, there are several areas on the system in areas affected by tidal conditions with the potential for external corrosion from salt water. Areas identified by the BBWD where pipe was installed in known corrosive soil or tidally affected areas were assigned a rating of 100. Areas of potentially corrosive soils, including wetlands, received a rating of 60. Areas identified by the BBWD where pipe was installed in areas of deep bury due to street regrading received a rating of 40. All other pipes were assigned a rating of zero. Areas where soil characteristics are of concern are highlighted on Figure No. 6-5.

Service Breaks

The Buzzards Bay water system has multiple locations with service leaks that historically have been caused by a number of reasons such as problems with the pipe itself or the associated fittings. The records provided also included a large number of locations with broken curb stops that were replaced. These locations were not included in the pipe break analysis as these instances could not be confirmed to be associated with a pipe failure. Locations of service leaks were provided by the BBWD. The areas identified as having experienced a history of services leaks have been given a rating of 100 while areas with no known history of leaks received a rating of zero. These areas are shown in Figure No. 6-6.

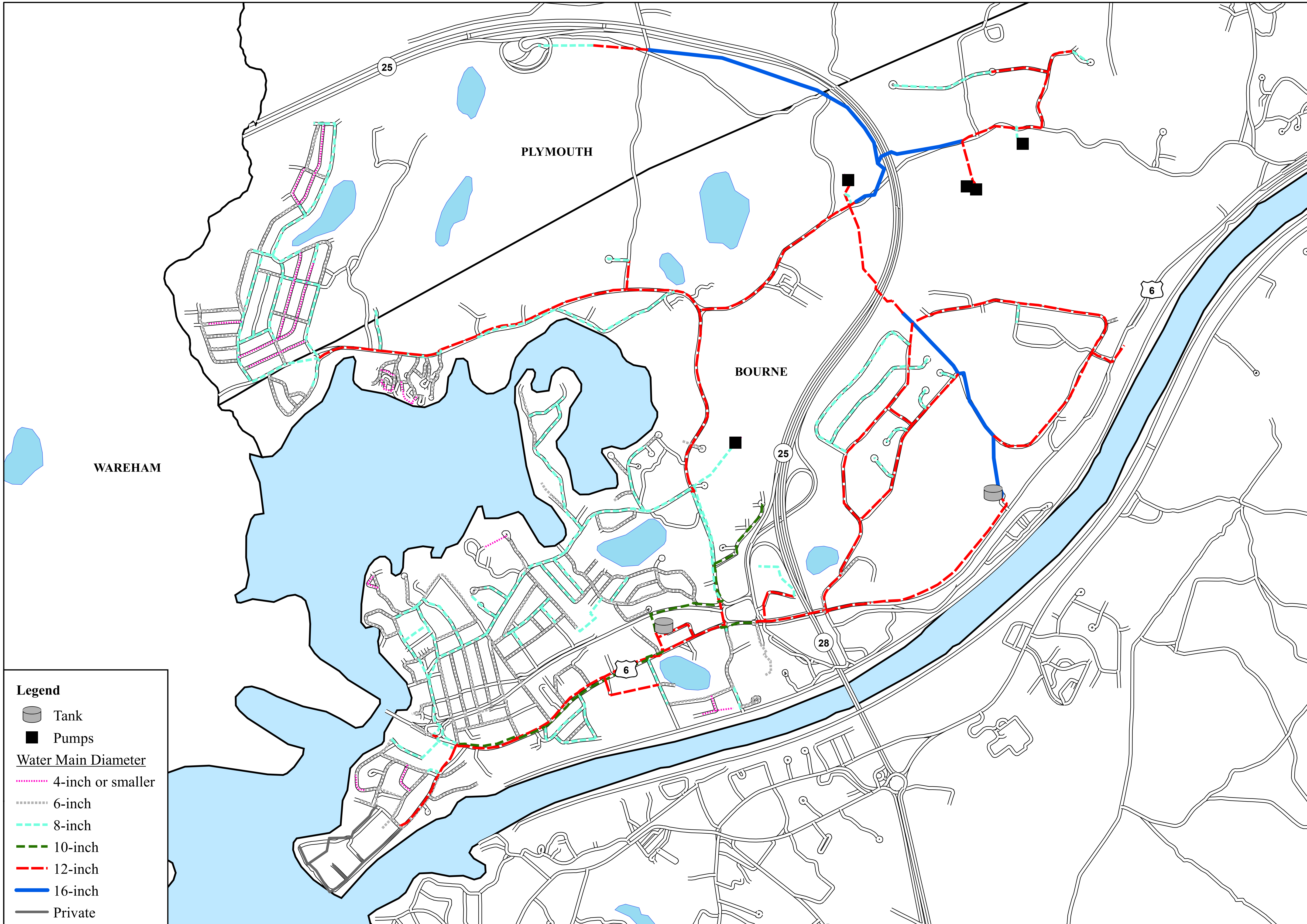


Figure No. 6-3

Water Main Diameter

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

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Date: May 2021

Scale: 1" = 1,700'

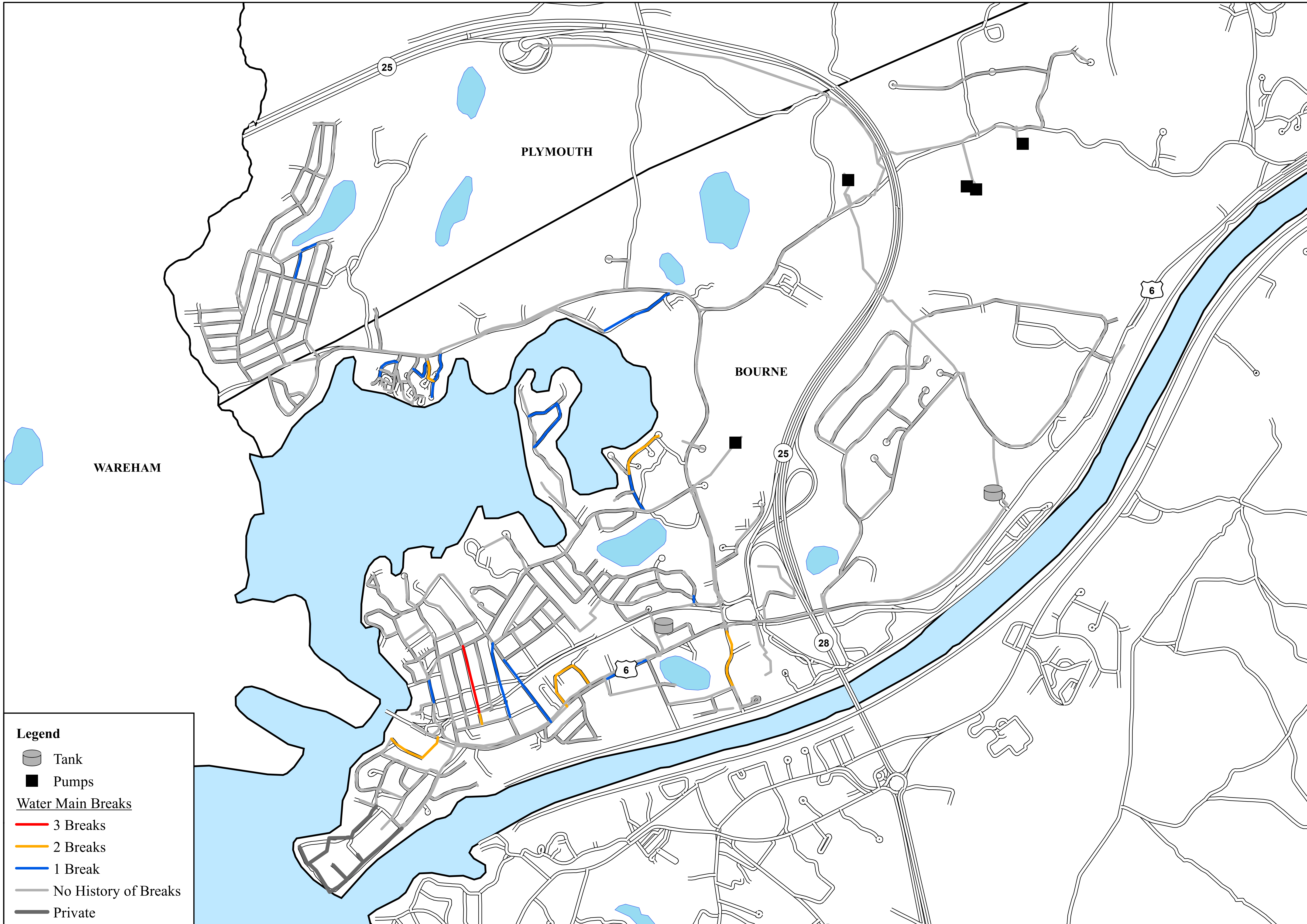

Figure No. 6-4

Water Main Breaks

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

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Date: May 2021

Scale: 1" = 1,700'

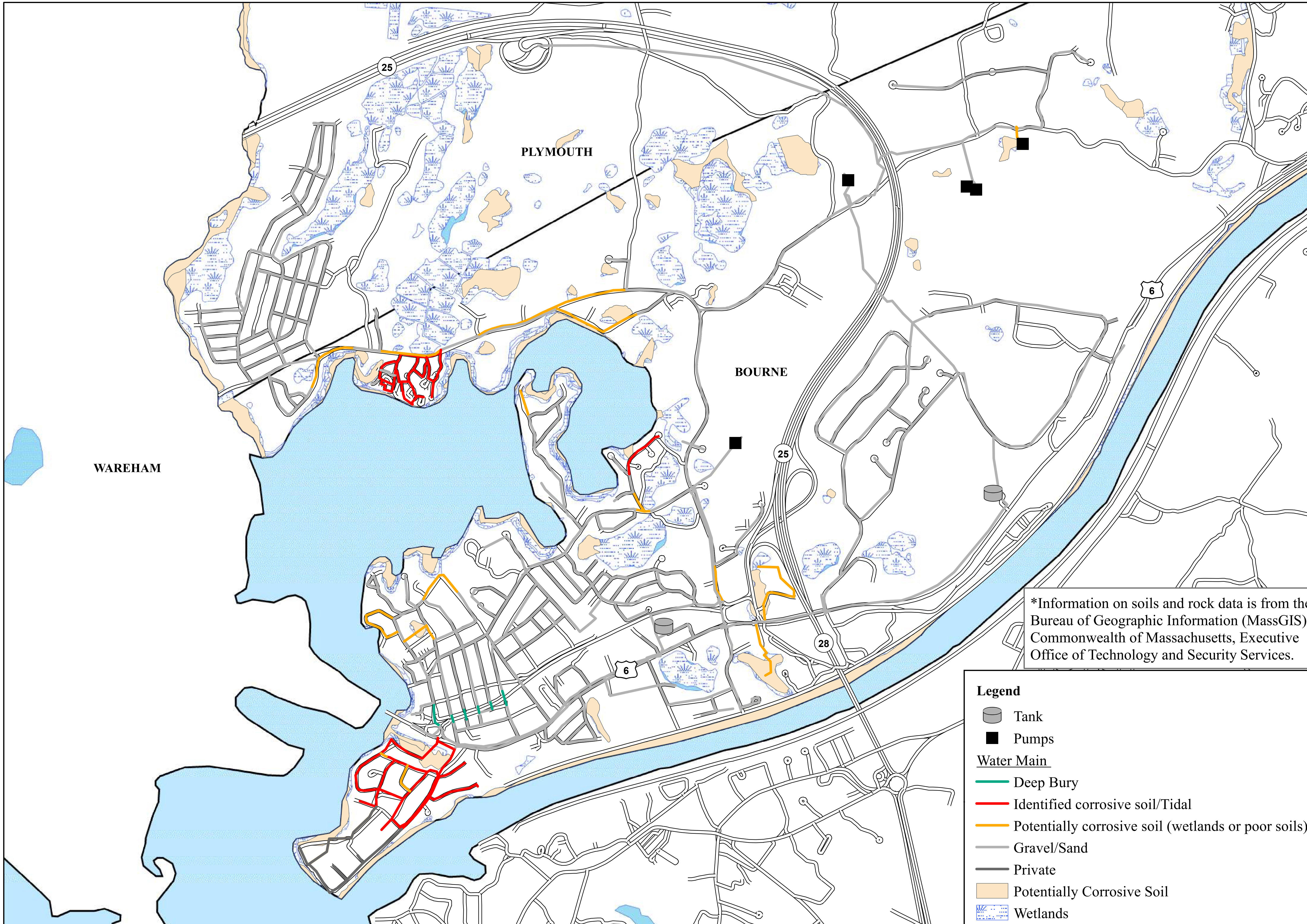

Figure No. 6-5

Potentially Corrosive Soils

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

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Scale: 1" = 1,700'

Date: May 2021

Figure No. 6-6

Service Breaks/Leaks

Capital Improvements and Asset Management Plan
Buzzards Bay Water District

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Date: May 2021

Scale: 1" = 1,700'

6.4 Asset Management Areas of Concern

Based on the asset management ratings, there are several areas of concern in the system. Water mains with a total rating between zero and 30 are considered to be in good to excellent condition. Mains with a total rating between 31 and 49 are considered to be in fair to good condition, and mains with a total rating of 50 or greater are considered to be in poor to fair condition. This rating system is specific to the Buzzard Bay system and reflects the BBWD's priorities of replacing older, smaller diameter steel water mains in areas with poor soil conditions. Asset management ratings are presented graphically in Appendix E.

Section 7

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SECTION 7 – Above Ground Facilities Asset Assessment

7.1 Overview

The Buzzards Bay Water District's above ground assets include five public water supply sources with associated pump stations, the Chemical Injection Facility, and two water storage tanks. An inventory of assets was developed based on BBWD records and a site visit to each individual facility to record asset information as part of this assessment. The inventory includes type, capacity, size, age, manufacturer, model number and serial number for the above ground equipment operated and maintained by the Buzzards Bay Water District. The following section provides a general overview of assets and existing condition. A detailed listing of all assets is included in the Asset Management Database in Appendix F.

7.2 Water Supply Sources and Pump Stations

7.2.1 Pump Station No. 1

Pump Station No. 1 (4036001-01G) is a gravel packed well located off Dry Cedar Swamp Road, installed in 1981. The associated well has a depth of approximately 38 feet with an 8 foot screen. The pump station for Well No. 1 consists of two buildings, Building A and Building B. Building A houses the main pumping equipment and Building B houses the electrical, instrumentation, and chemical feed equipment for the well. The well and buildings are in good to fair condition.

The chemical feed systems in both buildings have been partially upgraded, with several major electrical components being replaced in 1992 in Building A and the chemical feed equipment being replaced in 2020. As the chemical feed equipment is less than one year old, it is considered to be in excellent condition. The electrical equipment is almost thirty years old and as such is nearing the end of its useful life. The BBWD should begin preparing to replace this equipment. A new propane tank was also installed in 2020. The buildings themselves are both older brick buildings. Neither is in poor condition, but as Building A was constructed in 1937 it has reached the end of its useful life. Extra maintenance costs for this building was included in the PLA and the BBWD should be prepared for increased maintenance costs to both buildings as they continue to age.

7.2.2 Pump Station No. 2

Pump Station No. 2 (4036001-02G) is a gravel packed well located on Kettle Lane off Head of the Bay Road, installed in 1966. The associated well has a depth of approximately 42.75 feet with a 10 foot screen. The pumping station building is in good condition. The equipment in this station has been upgraded over several years, with new chemical feed equipment being installed in 1993. The potassium hydroxide system is in fair to poor condition and should be considered for replacement. The well pump was also installed in 1992 and is approaching the end of its useful life and it is recommended that the BBWD begin preparing for its replacement. The building itself is in good condition, but the interior floor is in fair condition and could benefit from resurfacing. The electrical equipment was installed in 1992 and as such is nearing the end of its expected useful life. The BBWD should begin preparing for its replacement.

7.2.3 Pump Station No. 3

Pump Station No. 3 (4036001-03G) is a gravel packed well located at Bournedale Road, installed in 1988. The associated well has a depth of approximately 89 feet with a 20 foot screen. The pumping station is in good condition. A majority of the equipment inside the pump station was replaced in 2018, including the electrical equipment and internal piping. This station and its equipment are in good condition and are not in need of replacement. The chemical feed equipment for this station is housed in the Chemical Injection Facility.

7.2.4 Pump Station No. 4

Pump Station No. 4 (4036001-04G) is a gravel packed well located at Bournedale Road, installed in 1988. The associated well has a depth of approximately 64 feet with a 10 foot screen. The pumping station is in good condition. The equipment in this station has been replaced in part between 1993 and 2018 with various upgrades to the electrical, SCADA, and chemical feed equipment. The well pump motor was recently replaced but the well pump is reaching the end of its estimated useful life. The BBWD should begin to prepare for its replacement along with the electrical equipment which is nearing the end of its expected useful life.

7.2.5 Well No. 5

Well No. 5 (4036001-05G) is a 24"x18" gravel packed well located off Bournedale Road adjacent to Pump Station No. 3. The well was installed in 2017 to a depth of approximately 70 feet with a 15 foot screen. The well is in good condition. Raw water from Well No. 5 is treated with water from Pump Station No. 3 at the Chemical Injection Facility. This well is the BBWD's newest source and as such is not a concern for maintenance or replacement. The well is not housed in a building but is surrounded by a chain link fence with the electrical equipment mounted on posts.

7.3 Water Treatment Facilities

7.3.1 Chemical Injection Facility

The Chemical Injection Facility (4018000-05T) is a water treatment facility located on Bournedale Road. Raw water from Pump Station No. 3 and Well No. 5 is treated with potassium hydroxide (KOH) for pH adjustment and sodium hypochlorite (NaOCl) for disinfection. Equipment at this facility includes chemical feed equipment, instrumentation and controls, and electrical systems. The Chemical Injection Facility was constructed in 2018 and as the building and all equipment are only three years old, it is in good condition. The BBWD should continue to monitor the facility and its equipment in order to keep everything in good condition with regular maintenance.

7.4 Water Storage Facilities

7.4.1 Hydropillar

The Hydropillar Water Storage Tank is a 1.0 mg steel elevated storage tank located off Wagner Way. The 40 foot tall tank has an overflow elevation of 215 feet and is on top of a 125 foot tall pedestal. The tank was constructed in 2001 and is in good condition. New SCADA and exterior lighting were installed at the site in 2017 and are in good condition. This tank should be inspected at least every five years.

7.4.2 Standpipe

The Standpipe is a 1.0 mg steel standpipe located off State Highway 6. The tank has an overflow elevation of 215 feet, an inside diameter of 46 feet, and a total height of 85 feet. The tank was constructed in 1972 and was fully rehabilitated in 2005. The tank was then repainted in 2014. The Standpipe was most recently inspected in 2020 by Haley Ward and was found to be in good condition with no major concerns either on the interior or exterior of the tank. The report recommended that spot rehab to the exterior coating be performed on the tank.

7.6 Asset Assessment

In addition to the asset inventory, assets were evaluated for condition, redundancy, consequence of failure, and useful life. These criteria were based on discussions with the BBWD primary operators, visual observations, review of existing reports, and professional judgement.

The complete list of assets by facility is included in Appendix F. The inventory includes a summary of assets, asset size, type, condition, redundancy, status, consequence of failure, installation date, expected useful life, and estimate of replacement and/or major rehabilitation date. The assets are grouped within the major infrastructure component and each was assigned a consequence of failure based upon the potential impact of failure on water quality, public health and/or the ability of the BBWD to maintain adequate water supply and fire protection.

7.7 Useful Life

Each asset has been assigned a preliminary useful life. The useful life was estimated based on AWWA papers and standard water works practices. An inspection of each facility was conducted to determine if the estimated life span of a particular piece of equipment should be adjusted based on its current condition. The useful life of assets was only adjusted if significant information was available to suggest an extended useful life for a particular asset. Maintenance records and future inspections may be used to continue to update the estimated useful life of assets.

The inventory data is sorted by each asset's end of useful life. This information can be used for planning of annual maintenance budgets, as well as capital improvements. The estimated expected useful life is intended to be used only as a planning tool; assets should be evaluated annually to determine ongoing condition and maintenance/replacement needs. Assets with Catastrophic, Major, or Moderate consequence of failure should be given higher priority over Minor or Insignificant.

7.8 Criticality

Criticality is measured by the consequence of failure for each asset. It measures the degree of the impact if the asset were to fail unexpectedly. The consequence of each asset failure ranges from insignificant to catastrophic based on the criteria indicated in Table No. 7-1. The consequence of failure includes impacts on regulatory compliance, local government, customers, and the community. The larger the impact, the higher the level of criticality. Assets with a catastrophic, major, or moderate consequence of failure should be given higher priority over a minor or insignificant category.

For this application, the catastrophic consequence of failure was given if the BBWD would be unable to meet the demands of the system. For example, the tanks were given a catastrophic consequence of failure because each hold at least 1 mg of water. If the tank fails, the BBWD could experience pressure and fire protection issues. If one well pump stopped working, but the BBWD could still meet system demands, the consequence of failure would be major, not catastrophic. Also, a chemical feed system failure is more serious than if the finished water flow meter were to fail. A failure of the chemical feed system could result in water quality issues or the BBWD potentially not meeting demand if those sources are taken offline.

An assessment on the current condition was performed to develop recommendations for prioritization of maintenance or replacement of the assets. The assessment and prioritization are based on operational capabilities, age, condition, useful life estimates, integrity, and replacement or alternative needs. A criticality assessment was completed for each asset based on the consequence of failure and the importance to the operation of the system and maintaining level of service. The evaluation is used to prioritize each asset and develop a prioritized replacement schedule.

Table No. 7-1
Consequence of Failure

Category	Criteria
Catastrophic	If the asset fails, the water distribution system capacity would be impacted to the extent that it would not be able to meet the maximum day demand and sustain acceptable system pressures.
Major	If the asset goes down, the facility at which the asset is located would not be able to operate at 100% capacity and water distribution system may be impacted, but maximum day demand and acceptable system pressures can still be met. Assets with 100% redundancy are not usually classified as *Major*. Note: *Major* also applies to assets which would impact public health and worker safety, such as an emergency shower/eyewash.
Moderate	If the asset goes down, the facility's operation would be impacted, but not completely interrupted. Additionally, important assets with 100% redundancy are usually placed in this category.
Minor	Asset does not directly impact the flow capacity. HVAC, some instrumentation, less important assets with 100% redundancy, and assets with quick replacement times are typically included in this category.
Insignificant	Asset has been abandoned or is still operational but is not typically used.

Section 8

TATA & HOWARD

SECTION 8 – Recommendations and Conclusions

8.1 General

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

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

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

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

8.2 General Recommendations

To maintain a comprehensive database of the condition of the system, it is recommended that the BBWD continue to regularly update the water main database. Currently, the BBWD maintains documentation of breaks with the nearest street address and date. In addition, the BBWD should record joint type, type of lining, and type of failure such as ring crack, lateral split, hole in the pipe, or joint leak, and how the pipe was repaired. If possible, the BBWD should include the apparent cause of the failure such as frost load, traffic load, direct contractor damage, settlement, water hammer, or external soil corrosion. The documentation should also be filed electronically following each event. This data can be used to create a Water Main Failure Map for identifying areas of concern in the system on an ongoing basis. The map can be used to easily identify break locations, determine if streets or areas have a higher frequency of failures, and to view any patterns in the location, type, pipe manufacturer, or other characteristics in occurrences of failure. The water main failure database will aid the BBWD in making water main rehabilitation and replacement decisions in the future.

In general, it is recommended along streets with parallel water mains that the BBWD connect all hydrants to the larger of the water mains. It is recommended that prior to installation of all new ductile iron water main, the BBWD should test the soils in the area of the new main to determine corrosion potential. If the soil is found to be potentially corrosive or the proposed water main is located in an area under tidal influence, the BBWD should consider installing HDPE or PVC water main, wrapping ductile iron water main with polyethylene, or installing zinc coated ductile iron piping to protect against external corrosion. Polyethylene wrapping is a relatively inexpensive practice that can extend the life of new ductile iron pipe, but proper installation is necessary to properly isolate and protect the piping. Zinc coated ductile iron piping is more expensive than traditional ductile iron pipe, but when installed with polyethylene wrapping it provides the most protection from external factors. If HDPE or PVC water main is to be installed, the BBWD should verify groundwater elevations in the project area and review any history of oil or hazardous material (OHM) release as these types of contaminants can penetrate the permeable HDPE or PVC piping. Polyethylene wrapped or zinc coated ductile iron are better options in areas where OHM may be present.

The BBWD owns and operates a transmission main that runs cross country parallel to Route 25 that was intended for service of a MassDOT owned rest area. This rest are has been closed and no other customers are fed off this transmission main. In order to maintain water quality on this main, the BBWD has been flushing it semi-regularly. It is recommended that the BBWD consider other options to keep this water main serviceable in the event that the rest area is opened again. Flushing this main results in a large amount of water pumped out to waste, and if a hydrant is opened in an area near the connection of this main the unused stagnant water could be pulled into the distribution system to fill the demand from the opened hydrant. This would result in poor water quality delivered to customers. It is recommended that the district either close a valve at the start of the transmission main and drain the pipe, or cut, cap, and drain this main. If the rest area is opened again, the BBWD could easily reconnect the transmission main and inspect the pipe for structural integrity prior to chlorinating it and returning it to service.

8.3 Above Ground Facility Improvements

The prioritization of the assets is based on condition, redundancy, condition of failure, and replacement year. The replacement year was calculated based on the asset installation date and expected useful life. Many assets have surpassed the estimated replacement year; however, due to high costs to replace all outdated assets, it is recommended that the BBWD first replace assets based on condition and criticality to ensure an adequate level of service. It is recommended that the BBWD plan to replace assets or perform inspections of the assets with a consequence of failure of Major or Catastrophic as the end of the useful life approaches. In many cases, these assets shall be recommended for replacement, regardless of condition. All assets that have exceeded the useful life are included in the prioritized list of assets.

Many of the BBWD's above ground assets are listed as being in Excellent or Good condition but have also exceeded their expected useful life. Because of this, it is recommended that the BBWD begins to track the maintenance on these items and begin to prioritize funding to replacing them. Many of the items listed in the Priority List of Assets are larger items of electrical equipment that would lead to service disruptions from the water supply sources were they to fail. While these items are in good condition, they are past their Expected Useful Life and due to their age could pose challenges to the BBWD in terms of finding replacement parts or knowledgeable service technicians. In general, it is recommended that the BBWD replace assets based on the current condition and criticality before taking into account when the estimated replacement year is for each asset. The estimated replacement year is meant to act as a planning tool for the BBWD for incorporating asset replacement into both capital and maintenance plans so that the staff is prepared to replace aging components.

The BBWD should follow the manufacturer's recommended maintenance schedule for all equipment. Proper maintenance will help ensure an asset remains in good working condition. Critical equipment should be prioritized for repair or replacement when assets have reached the end of their useful lives.

This prioritized list of improvements includes assets to be replaced for each of the first ten annual budget years (2021 through 2031). Assets with a replacement date later than 2031 and in good condition are not included in prioritized lists. We recommend routine maintenance and inspection for the assets that are in good condition but are reaching the end of their useful life by 2031. The estimated cost to replace or repair all assets listed on the PLA is approximately $386,200 and the estimated cost to replace or repair all assets listed on the SLA is approximately $181,200. Increased yearly maintenance costs for the buildings and roofs of the older pump stations may be needed as these facilities continue to age and near their expected useful lifespan.

It is recommended that the BBWD perform well inspection and cleaning on a regular basis to maintain capacity. Costs for well cleaning should be included in the BBWD's operation budget. If the well performs well, cleanings could be scheduled every ten years; however, wells with higher iron concentrations should be cleaned every three to five years.

It is also recommended that the BBWD should plan to budget for tank inspections for both tanks every five years as required by MassDEP. These regular inspections will help the BBWD to identify any immediate or future potential components of each tank that will need to be incorporated into the maintenance budget.

Priority List of Assets (PLA)

A Priority List of Assets (PLA) has been developed to address all assets that have currently exceeded the estimated useful life and has a replacement year of 2026 or earlier. These assets have been prioritized based on condition, consequence of failure, and replacement year. This list is extensive. The BBWD must begin to budget money each year to address these assets. These items will either need to be replaced, repaired, or re-inspected. The BBWD should perform a more detailed inspection on the assets in good condition to determine if the useful life and replacement year can be adjusted. The PLA is included in Appendix G.

Secondary List of Assets (SLA)

The Secondary List of Assets (SLA) includes all assets with a replacement year from 2026 to 2036. These should be addressed in years six through ten of a budget plan. The SLA has been sorted by condition, consequence of failure, and replacement year. The SLA is included in Appendix H.

8.4 Prioritization of Water Distribution System Improvements

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

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

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

Table No. 8-1, at the end of this section, includes a prioritized list of Phase I improvements and the hydraulic, critical component, and asset management status of each improvement. Table No. 8-2 includes the linear feet and estimated cost of each Phase I improvement. Table No. 8-3 includes a prioritized list of Phase II improvements and the hydraulic, critical component, and asset management status of each improvement, and Table No. 8-4 includes the linear feet and estimated cost of each Phase II improvement.

Phase III improvements have been divided into two sections (Phase IIIA and IIIB). Phase IIIA improvements represent the remaining hydraulic improvements from Section 4 not included in any Phase I or Phase II improvements. Phase IIIB improvements include the water mains that have high asset management ratings that are not included in any Phase I or Phase II improvements, and should be replaced when funding becomes available. Table No. 8-5 includes a list of Phase IIIA improvements and the hydraulic, critical, and asset management status of each improvement. Table No. 8-6 includes the linear feet and estimated cost of each Phase IIIA improvement. The total length of water main by pipe diameter recommended for Phase IIIB improvements is summarized in Table No. 8-7. The estimated cost to replace these water mains is also included in Table No. 8-7. The recommended improvements maps are included in Appendix J. It should be noted that paving schedules and other improvements to roadways were not evaluated as part of this study.

Phase I Improvements

1. A new 12-inch diameter transmission main is recommended along Route 25 from the 16-inch diameter transmission main north of Bournedale Road to the existing 12-inch diameter dead end water main north of Mirasol Drive. This new transmission main will provide system

redundancy and create a second transmission main from the three sources east of Route 25 to the tanks in the southern portion of the distribution system. Currently, this is the only main from the wells that crosses Route 25. It should be noted that an easement may be required to install this water main either along the shoulder of Route 25 or along the power lines trail that runs parallel to Route 25. The estimated probable construction cost of approximately 3,000 linear feet of 12-inch diameter water main is approximately $1,032,000.

2. New 8-inch diameter water main is recommended to replace the existing 6-inch and 4-inch diameter water mains on Buttermilk Way and Bay Drive. The existing mains are considered to be in fair to poor condition with asset management ratings ranging from 72 to 78. The poor ratings are due to age, material, and size of the mains. This main is considered to be critical as it serves the Massachusetts Maritime Academy, which is a critical customer for the BBWD. Improving these water mains will also improve redundancy to the area. The upgrade will improve the hydraulic capacity of the water mains and provide increased fire flow within Massachusetts Maritime Academy. The estimated probable construction cost of approximately 2,100 linear feet of 8-inch diameter water main is $525,000.

3. New 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main on Lafayette Avenue from Puritan Road to Cohasset Avenue. The existing main is considered to be in fair to poor condition with asset management ratings ranging from 47 – 62. These poor ratings are due to age, material, size and depth of bury under Route 6. This main is considered to be critical due to the crossing of Route 6. The upgrade will improve the hydraulic capacity of the water main and increase the inherent capacity for the recommended residential fire flow to the neighborhood. The estimated probable construction cost of approximately 1,500 linear feet of 8-inch diameter water main is $375,000.

Phase II Improvements

4. A new 8-inch diameter water main is recommended on Old Bridge Road to replace the existing 6-inch diameter water main from Everett Road to Main Street. The water main is considered to be in fair to poor condition with an asset management rating of 69. This poor rating is due to age, size, material, and history of breaks in the water main. This upgrade will improve the inherent capacity for the recommended residential fire flow to the homes on Honora Lane. The estimated probable construction cost of approximately 1,100 linear feet of 8-inch diameter water main is approximately $344,000.

5. A new 8-inch diameter water main is recommended on Lewis Point Road to replace the existing 6-inch diameter water main that branches off Lewis Point Road and serves the Cape Cod Nursing Home. This main serves the Cape Cod Nursing Home which is a critical customer. This upgrade will improve the hydraulic capacity of the water main and provide inherent capacity for the recommended fire flow at the Cape Cod Nursing Home. The estimated probable construction cost of approximately 700 linear feet of 8-inch diameter water main is $219,000.

6. A new 8-inch diameter water main is recommended on Wallace Avenue to replace the existing 6-inch diameter water main from St. Margaret Street to Cohasset Avenue. This water main is considered to be in fair to poor condition with an asset management rating between 47 and 65.

This poor rating is due to the age, material, size and depth of bury, and history of breaks. This water main is considered to be critical due the Route 6 crossing. The estimated probable construction cost of approximately 1,800 linear feet of 8-inch diameter water main is approximately $495,000.

7. A new 8-inch diameter water main is recommended on Buzzards Bay Avenue to replace the existing 6-inch diameter water main from Puritan Road to Cohasset Avenue. This water main is considered to be in fair to poor condition with asset management ratings between 59 and 62. These poor ratings are due to age, size, material, depth of bury, and history of breaks. This water main is considered to be critical due the Route 6 crossing. The estimated probable construction cost of approximately 1,500 linear feet of 8-inch diameter water main is approximately $413,000.

8. A new 8-inch diameter water main is recommended on Washington Avenue to replace the existing 6-inch diameter water main from Puritan Road to Main Street. This water main is considered to be in fair to poor condition with asset management ratings of 47 to 62. These poor ratings are due to age, size, material, depth of bury, and history of breaks. This water main is considered to be critical due to the Route 6 crossing. The estimated probable construction cost of approximately 1,700 linear feet of 8-inch diameter water main is approximately $468,000.

9. A new 8-inch diameter water main is recommended on St. Margarets Street to replace the existing 6-inch diameter water main from Main Street to Alden Avenue. This water main is considered to be in poor condition with an asset management rating of 55. This poor rating is due to age, size, material, depth of bury, and history of breaks. This water main is considered to be critical due to the Route 6 crossing. The estimated probable construction cost of approximately 1,900 linear feet of 8-inch diameter water main is $523,000.

10. New 8-inch diameter water mains are recommended on Knollview Road, Bog View Road, Hideaway Road, and Nautical Way within the Hideaway Village community to replace existing 6-inch diameter water mains. These water mains serve as the primary mains within the community and increasing the size of these water mains will increase the hydraulic capacity in the area. When these water mains are replaced, it is recommended that they are connected to the 12-inch diameter water main on Head of the Bay Road and the existing 8-inch diameter parallel water main on Head of the Bay Road be abandoned. This will remove a redundant main that is in poor condition. The three 6-inch diameter water mains are considered to be in fair to poor condition with asset management ratings between 50 and 58. These poor ratings are due to size, age, and tidally influenced soils in the area. This upgrade will provide the inherent capacity for the recommended 1,500 gpm recommended fire flow. It should be noted that construction in this community will be difficult due to narrow roadways and dirt roads. The estimated probable construction cost of all three water mains which are approximately 2,600 linear feet is approximately $707,000.

11. A new 8-inch diameter water main is recommended on Head of the Bay Road from Knollview Road to Hideaway Road to replace the existing parallel 8-inch diameter water main that serves the Hideaway Village community. This water main is considered to be in fair to poor condition

with an asset management rating of 62. This poor rating is due to age, material, and tidally influenced soils in the area. The estimated probably construction cost of approximately 800 linear feet of 8-inch diameter water main is approximately $263,000.

Phase IIIA Improvements – Hydraulic

12. There are multiple small diameter steel water mains in the BBWD system that do not allow for sufficient fire protection due to the inability for hydrants to be installed on these mains. For some locations, it is feasible to install a hydrant on an adjacent 6-inch diameter or larger water main to provide the inherent capacity for the recommended residential fire flow to locations along the small diameter water main that are not currently within the maximum recommended distance to a hydrant of 500 feet. For all other locations, it is recommended to replace the existing small diameter water main with a new 8-inch diameter ductile iron water main including a hydrant installation near the end of the water main. These mains should be considered when reviewing road paving schedules and other buried utility work.

    These small diameter water mains are identified on the Phase III Improvements Map found in Appendix J. This recommendation includes water mains on Birch Street, Mildred Street, Nickerson Street, Archer Street, Walnut Street, Buttonwood Lane, Cypress Street, and Sunset Lane. The total length of Phase IIIA recommended water main improvements is summarized in Table No. 8-5 with estimated probable construction costs summarized in Table No. 8-6. In total, these water mains are approximately 9,600 linear feet and have an estimated probable construction cost of $2,551,000. It is recommended that each water main is replaced with an 8-inch diameter water main.

Phase IIIB Improvements – Asset Management

13. A new 8-inch diameter water main is recommended on Bourne Neck Drive from Wright Lane to Tower Lane and on Tower Lane from Bourne Neck Drive to Academy Drive to replace the existing 6-inch diameter water mains. These mains are considered to be in fair to poor condition with asset management ratings between 72 and 80. These poor ratings are due to age, size, material, and tidally affected soils in the area. The estimated probable construction cost of approximately 1,500 linear feet of 8-inch diameter water main is approximately $394,000.

14. A new 8-inch diameter water main is recommended on Little Bay Lane from Puritan Road to the end of the existing main to replace the existing 8-inch and 6-inch diameter water mains. This main is considered to be in fair to poor condition with asset management ratings from 35 to 77. These poor ratings are due to age, size, material, history of breaks, and potentially corrosive soils in the area. The estimated probable construction cost of approximately 1,800 linear feet of 8-inch diameter water main is approximately $482,000.

15. New 8-inch diameter water mains are recommended on Bay Drive from Saltworks Lane to Wright Lane and on Saltworks Lane from Bay Drive to Bourne Neck Drive to replace the existing 6-inch diameter water mains. These mains are considered to be in fair to poor condition with an asset management rating of 72. This poor rating is due to age, size, material, and tidally affected soils in the area. The estimated probable construction cost of approximately 1,200 linear feet of 8-inch diameter water main is approximately $375,000.

16. A new 8-inch diameter water main is recommended on Taylor Road from Academy Drive to the end of the existing main to replace the existing 6-inch diameter water main. This main is considered to be in fair to poor condition with an asset management rating of 72. This poor rating is due to the age, size, material, and tidally influenced soils in the area. The estimated probable construction cost of approximately 600 linear feet of 8-inch diameter water main is approximately $188,000.

17. A new 8-inch diameter water main is recommended on Wright Lane from Buttermilk Way to Academy Drive to replace the existing 8-inch and 6-inch diameter water mains. These water mains are considered to be in fair to poor condition with asset management ratings of 72. This poor rating is due to age, size, material, and tidally influenced soils in the area. The estimated probable construction cost of approximately 1,300 linear feet of 8-inch diameter water main approximately $325,000.

18. A new 8-inch diameter water main is recommended on Plaza Lane from Wright Lane to Bourne Neck Drive to replace the existing 2-inch diameter water main. This water main is considered to be in fair to poor condition with an asset management rating of 68. This poor rating is due to age, size, material, and tidally influenced soils in the area. The estimated probable construction cost of approximately 600 linear feet of 8-inch diameter water main is approximately $188,000.

19. A new 8-inch diameter water main is recommended on Rip Van Winkle Way from Sleepy Hollow Lane to the end of the loop on Rip Van Winkle Way to replace the existing 6-inch diameter water main. This water main is considered to be in fair to poor condition with an asset management score of 62. This poor rating is due to age, size, material, and potentially corrosive soils in the area. The estimated probable construction cost of approximately 1,500 linear feet of 8-inch diameter water main is approximately $375,000.

20. A new 8-inch diameter water main is recommended to replace the existing 6-inch diameter water main on the Harrison Avenue loop off Main Street. This water main is considered to be in fair to poor condition with an asset management rating of 59. This poor rating is due to age, size, material, and history of breaks. The estimated probable construction cost of approximately 1,400 linear feet of 8-inch water main is approximately $350,000.

21. A new 8-inch diameter water main is recommended on Wolf Road from Catskill Road to Crows Nest Drive to replace the existing 6-inch diameter water main. This water main is considered to be in fair to poor condition with an asset management rating of 58. This poor rating is due to age, size, material, and potentially corrosive soils in the area. The estimated probable construction cost of approximately 500 linear feet of 8-inch diameter water main is approximately $157,000.

22. A new 8-inch diameter water main is recommended on Lewis Point Road from Nye Lane to the end of the existing water main to replace the existing 6-inch diameter water main. This water main is considered to be in fair to poor condition with an asset management rating of 55. This poor rating is due to age, size, material, and potentially corrosive soils in the area. The

estimated probable construction cost of approximately 600 linear feet of 8-inch diameter water main is approximately $188,000.

23. A new 6-inch diameter water main is recommended to replace the existing 2-inch diameter cross country water main that branches off Quamhasset Road. This water main is considered to be in fair to poor condition with an asset management rating of 55. This poor rating is due to age, size, and material. The estimated probable construction cost of approximately 500 linear feet of 6-inch diameter water main is approximately $125,000. This water main is meant to serve a potential future development.

24. A new 8-inch diameter water main is recommended to replace the existing 8-inch diameter water main on Old Head of the Bay Road to replace the existing 8-inch diameter water main loop that branches off Head of the Bay Road. This water main is considered to be in fair to poor condition with an asset management rating between 37 and 62. This poor rating is due to age, material, and potentially corrosive soils in the area. The estimated probable construction cost of approximately 2,600 linear feet of 8-inch diameter water main is approximately $650,000.

25. A new 8-inch diameter water main is recommended to replace the existing 8-inch diameter water main on Puritan Road from Wall Street to the private road. This water main is considered to be in fair to poor condition with an asset management rating of 52. This poor rating is due to age, material, and potentially corrosive soils in the area. The estimated probable construction cost of approximately 400 linear feet of 8-inch diameter water main is approximately $125,000.

26. New 8-inch diameter water mains are recommended to replace the existing 6-inch and 2-inch diameter water mains in the Hideaway Village Community that were not included in Improvement No. 11. These water mains are all considered to be in fair to poor condition with asset management scores ranging from 50 to 71. These poor ratings are due to age, size, material, history of breaks, and tidally influenced soils in the area. As these water mains are on smaller roads where construction may be difficult, they have been grouped as one improvement to potentially streamline the construction process. Table No. 8-7 lists each improvement individually. The estimated probable construction cost for all remaining streets in Hideaway Village for a total of approximately 4,200 linear feet of 8-inch diameter water main is approximately $1,313,000.

Table No. 8-1
Prioritization of Improvements – Phase I

<table>
<tr><th>Item No.</th><th>Location</th><th>From</th><th>To</th><th>Hydraulic Priority</th><th>Asset Management Rating</th><th>Critical</th></tr>
<tr><td>1</td><td>Along Route 25</td><td>Mirasol Drive</td><td>Bournedale Road</td><td>1</td><td>-</td><td>Y</td></tr>
<tr><td rowspan="4">2</td><td rowspan="3">Buttermilk Way</td><td>Harbor Place</td><td>Existing 4-inch water main</td><td rowspan="4">2</td><td>72</td><td rowspan="4">Y</td></tr>
<tr><td>Existing 4-inch water main</td><td>Existing 6-inch water main</td><td>78</td></tr>
<tr><td>Existing 6-inch water main</td><td>Bay Drive</td><td>72</td></tr>
<tr><td>Bay Drive</td><td>Buttermilk Way</td><td>Tower Lane</td><td>72</td></tr>
<tr><td>3</td><td>Lafayette Avenue</td><td>Puritan Road</td><td>Cohasset Avenue</td><td>2</td><td>47-62</td><td>Y</td></tr>
</table>

Table No. 8-2
Estimated Improvement Cost – Phase I

<table>
<tr><th>Item No.</th><th>Location</th><th>From</th><th>To</th><th>Proposed Diameter (in)</th><th>Length (LF)</th><th>Estimated Cost</th></tr>
<tr><td>1</td><td>Along Route 25</td><td>Mirasol Drive</td><td>Bournedale Road</td><td>12</td><td>3,000</td><td>$ 1,032,000</td></tr>
<tr><td rowspan="4">2</td><td rowspan="3">Buttermilk Way</td><td>Harbor Place</td><td>Existing 4-inch water main</td><td>8</td><td>1,000</td><td rowspan="4">$ 525,000</td></tr>
<tr><td>Existing 4-inch water main</td><td>Existing 6-inch water main</td><td>8</td><td>400</td></tr>
<tr><td>Existing 6-inch water main</td><td>Bay Drive</td><td>8</td><td>300</td></tr>
<tr><td>Bay Drive</td><td>Buttermilk Way</td><td>Tower Lane</td><td>8</td><td>400</td></tr>
<tr><td>3</td><td>Lafayette Avenue</td><td>Puritan Road</td><td>Cohasset Avenue</td><td>8</td><td>1,500</td><td>$ 375,000</td></tr>
<tr><td colspan="6">Total Estimated Phase I Cost:</td><td>$ 1,932,000</td></tr>
</table>

Table No. 8-3
Prioritization of Improvements – Phase II

<table>
<tr><th>Item No.</th><th>Location</th><th>From</th><th>To</th><th>Hydraulic Priority</th><th>Asset Management Rating</th><th>Critical</th></tr>
<tr><td>4</td><td>Old Bridge Road</td><td>Existing 8-inch</td><td>Main Street</td><td>2</td><td>69</td><td>N</td></tr>
<tr><td>5</td><td>Lewis Point Road</td><td>Existing 8-inch</td><td>Cape Cod Nursing Home</td><td>1</td><td>40</td><td>Y</td></tr>
<tr><td>6</td><td>Wallace Avenue</td><td>St. Margarets Street</td><td>Cohasset Avenue</td><td>-</td><td>47 - 65</td><td>Y</td></tr>
<tr><td>7</td><td>Buzzards Bay Avenue</td><td>Puritan Road</td><td>Cohasset Avenue</td><td>-</td><td>59-62</td><td>Y</td></tr>
<tr><td>8</td><td>Washington Avenue</td><td>Puritan Road</td><td>Main Street</td><td>-</td><td>47-62</td><td>Y</td></tr>
<tr><td>9</td><td>St. Margarets Street</td><td>Main Street</td><td>Alden Avenue</td><td>-</td><td>55</td><td>Y</td></tr>
<tr><td rowspan="3">10</td><td>Knollview Road</td><td rowspan="3">Head of the Bay Road</td><td rowspan="3">End</td><td rowspan="3">2</td><td>50</td><td rowspan="3">N</td></tr>
<tr><td>Bog View Drive</td><td>50</td></tr>
<tr><td>Hideaway Road & Nautical Way</td><td>58</td></tr>
<tr><td>11</td><td>Head of the Bay Road</td><td>Knollview Road</td><td>Hideaway Road</td><td>-</td><td>62</td><td>Y</td></tr>
</table>

Table No. 8-4
Estimated Improvement Cost – Phase II

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
4	Old Bridge Road	Existing 8-inch	Main Street	8	1,100	$ 344,000
5	Lewis Point Road	Existing 8-inch	Cape Cod Nursing Home	8	700	$ 219,000
6	Wallace Avenue	St. Margarets Street	Cohasset Avenue	8	1,800	$ 495,000
7	Buzzards Bay Avenue	Puritan Road	Cohasset Avenue	8	1,500	$ 413,000
8	Washington Avenue	Puritan Road	Main Street	8	1,700	$ 468,000
9	St. Margarets Street	Main Street	Alden Avenue	8	1,900	$ 523,000
10	Knollview Road	Head of the Bay Road	End	8	700	$ 707,000
	Bog View Drive			8	1,000	
	Hideaway Road & Nautical Way			8	900	
11	Head of the Bay Road	Knollview Road	Hideaway Road	8	800	$ 263,000
					Total Phase II Cost:	**$ 3,748,000**

Table No. 8-5
Prioritization of Improvements – Phase IIIA

Item No.	Location	From	To	Hydraulic Priority	Asset Management Rating	Critical
12	Birch Street & Mildred Street	Worcester Street	Nickerson Street	2	46	N
	Nickerson Street	Shady Pine Lane	Mildred Street	2	46-48	N
	Archer Street	Packard Street	Existing 6-inch water main	2	46	N
	Walnut Street	Cypress Street	Buzzards Bay Drive	2	36-43	N
	Buttonwood Lane	Packard Street	Buzzards Bay Drive	2	40-46	N
	Cypress Street	Packard Street	Existing 8-inch water main	2	46	N
	Sunset Lane	Everett Road	End	2	40	N

Table No. 8-6
Estimated Improvement Cost – Phase IIIA

Item No.	Location	From	To	Proposed Diameter (in)	Length (LF)	Estimated Cost
12	Birch Street & Mildred Street	Worcester Street	Nickerson Street	8	800	$ 250,000
	Nickerson Street	Shady Pine Lane	Mildred Street	8	1,700	$ 425,000
	Archer Street	Packard Street	Existing 6-inch water main	8	700	$ 219,000
	Walnut Street	Cypress Street	Buzzards Bay Drive	8	1,700	$ 425,000
	Buttonwood Lane	Packard Street	Buzzards Bay Drive	8	1,300	$ 325,000
	Cypress Street	Packard Street	Existing 8-inch water main	8	2,500	$ 625,000
	Sunset Lane	Everett Road	End	8	900	$ 282,000
					Total Estimated Phase IIIA Cost:	**$ 2,551,000**

Table No. 8-7
Estimated Improvement Cost – Phase IIIB

Item No.	Location	From	To	Asset Management Rating	Proposed Diameter (in)	Length (LF)	Estimated Cost
13	Bourne Neck Drive	Wright Lane	Tower Lane	72-82	8	1,500	$ 375,000
	Tower Lane	Bourne Neck Drive	Academy Drive	72	8		
14	Little Bay Lane	Fabyan Road	End	35-77	8	1,800	$ 450,000
	Little Bay Lane	Puritan Road	Snow Circle	52			
15	Bay Drive	Saltworks Lane	Wright	72	8	1,200	$ 300,000
	Saltworks Lane	Bay Drive	Bourne Neck Drive	72	8		
16	Taylor Road	Academy Drive	End	72	8	600	$ 188,000
17	Wright Lane	Buttermilk Way	Academy Drive	62-72	8	1,300	$ 325,000
18	Plaza Lane	Wright Lane	Bourne Neck Drive	68	8	600	$ 188,000
19	Rip Van Winkle Way	Sleepy Hollow Lane	Rip van Winkle Way	62	8	1,500	$ 375,000
20	Harrison Avenue	Loop, from Main Street		59	8	1,400	$ 350,000
21	Wolf Road	Catskill Road	Crows Nest Drive	58	8	500	$ 157,000
22	Lewis Point Road	Nye Lane	End	55	8	600	$ 188,000
23	Cross Country	Off Quamhasset Road		55	6	500	$ 125,000
24	Old Head of the Bay Road	Loop, from Head of the Bay Road		42-52	8	2,600	$ 650,000
25	Puritan Road	Wall Street	Private Road	52	8	400	$ 125,000
26	Bakers Lane	Bog View Drive	Hideaway Road	58	8	600	$ 1,313,000
	Hideaway Road	Head of the Bay Road	Nautical Way	50-65	8	600	
	Thompson Road	Knollview Road	Deep Water Way	58	8	600	
	Wild Rose Drive	Thompson Road	Knollview Road	71	8	300	
	Deep Water Way	Thompson Road	Knollview Road	50	8	300	
	Knollview Road	Knollview Road	Bog View Drive	50	8	500	
	Windy Hill Road	Windy Road	Overlook Lane	69	8	700	
	Cross Country	Deep Water Way	Knollview Road	69	8	600	
						Total Estimated Phase III Cost:	**$ 5,109,000**

8.5 20-Year Water Main Improvement Plan

In addition to the prioritized recommended improvements outlined in Section 8.4, it is beneficial for the BBWD to have an annual plan for construction of improvements. If feasible based on available resources and funding, it is recommended that Phase I and II improvements be completed over an initial 10-year interval since these improvements will provide the greatest benefit to the system. Phase IIIA and IIIB improvements are recommended to be implemented in the second 10-year interval.

The three Phase I improvements represent approximately three percent of the total length of the BBWD's water distribution system. The eight Phase II improvements represent approximately five percent of the total system length. The seven Phase IIIA improvements, grouped as one item, represent approximately four percent of the total system length. The thirteen Phase IIIB improvements represent approximately eight percent of the total system length. In total, the estimated cost for all three phases of improvements is approximately $13,024,000 and would replace approximately 23 percent of the total system length.

To complete all 26 improvements over a 20-year interval, the BBWD would need to budget approximately $652,000 per year. Table No. 8-8 indicates the total estimated value and length for all three phases of improvements, as well as the estimated annual cost and length of improvements over the 20-year improvement plan.

Table No. 8-8
20-Year Improvement Plan

Recommended Improvements	Total Estimated Value	Total Length (feet)
Phase I	**$ 1,932,000**	6,600
Phase II	**$ 3,432,000**	12,100
Phase IIIA	**$ 2,551,000**	9,600
Phase IIIB	**$ 5,109,000**	18,700
Total	**$ 13,024,000**	**47,000**
Annual Improvements over 20-Year Interval	$ 652,000	2,350

Section 9

TATA & HOWARD

SECTION 9 – Rate Analysis

In order to fund the recommended improvements in Phase I, the Priority List of Assets, and as many of Phase II recommendations as possible, the BBWD's current rates were evaluated and projected for the next five years.

9.1 Current Water Rates and Revenue

As stated in the American Water Works Association (AWWA) Manual for Water Supply Practices, a water supplier must provide adequate water service to its customers as well as receive sufficient revenue to provide for operation and maintenance, system upgrades, and maintenance of the supplier's financial integrity. This includes covering all cash needs, debt obligations, and basic expenses required for a water system. The Massachusetts Department of Environmental Protection (MassDEP) also requires establishment of a rate structure to maintain the prescribed service standards and an operations and maintenance program, and recommends an ascending block rate structure to provide a reliable source of income and promote water conservation.

In 2017, Tata & Howard performed a similar rate evaluation for the BBWD, and the recommended rate changes were implemented, with a second rate increase set to go into effect on July 1, 2021 with the first billing at this rate in January, 2022. The BBWD currently charges residential customers on a bi-annual basis while commercial customers are billed on a quarterly basis. The BBWD will be increasing the minimum service charge of $81 per billing cycle to $85.05 in July 2021. All customers are charged a usage rate based upon the volume of water metered each billing period. The existing usage rates are an ascending block rate structure based on 1,000 gallon increments. Table No. 9-1 includes the existing usage rates as well as the rates scheduled to be effective as of July 2021.

Table No. 9-1
Existing Usage Rates

Water Usage (Gallons)	Current Rate Per 1,000 Gallons	July 2021 Rate Per 1,000 Gallons
Base Charge	$81.00	$85.05
0 – 15,000	$3.00	$3.15
15,001 – 40,000	$5.53	$5.81
40,001 and greater	$7.00	-
40,001 – 100,000	-	$7.35
101,000 – 150,000	-	$8.50
150,001 and greater	-	$9.75

In addition, the BBWD charges a variety of non-rate commitment service fees for services as requested or required by consumers that contribute to the revenue for the District. The existing non-rate commitment service fees are identified in Table No. 9-2.

Table No. 9-2
Existing Non-Rate Commitment Service Fees

District Service	Parameter	Non-Rate Fee
System Development Charges		$1,035
Main to Curb Stop / Apartments, Duplex, Condo Per Unit	Up to 1"	$1,500
	1.5"	$2,000
	2"	$3,000
	4"	$8,000
	Greater than 4"	TBD by Board of Commissioners
Fire Sprinkler Annual Fee	Per line	$300
Fire Sprinkler Development Charges	2"	$3,000 per building
	4"	$8,000 per building
	6"	$18,000 per building
	8"	$25,000 per building
Set and Removal of Hydrant Meter		$135
Hydrant Flow Testing	Per test	$135
Meters	5/8"	$245
	Greater than 5/8"	Direct Cost
Meter test	1.5" and smaller	$50
Independent Testing Company Test		$140
Damaged Meter Replacement		$225
New Service Meters	5/8" Service and Turn On	$325
	Greater than 1"	Direct Cost
Cross Connection Device Testing	Per testable device	$67.50
Cross Connection Survey		$75
Inspection Charges	Normal Working Hours	$40
	After Working Hours	$200
Final Meter Read		$50
Emergency Turn Off/On		$65
Service Call After Hours	Per Call	$200

The current rate structure for metered usage and non-metered water are comparable to neighboring towns and water districts.

9.2 Future Water System Improvements

New water mains, supply sources, treatment facilities, pumping stations, and storage facilities allow the District to provide reliable service and high-quality water to consumers. In addition, upgrades to the existing facilities and distribution system are required to meet the stringent regulations set forth by State and Federal authorities. The District has identified future system improvement projects through the Capital Plan to address system deficiencies through FY41. The District presents projects included in the Capital Plan each year at the Annual District Meeting. For the purpose of this study, the recommended future water improvements planned for the next five years and associated estimated costs of improvements were examined. The District's current capital improvement projects through FY25 are include in Table No. 9-3.

Table No. 9-3
District Capital Improvement Projects

Project	FY21	FY22	FY23	FY24	FY25
Distribution Rehab.		$200,000			
SCADA Upgrade	$100,000			$100,000	
Pump Station Upgrade		$150,000			
Tank Maintenance			$60,000		$50,000
Total:	**$100,000**	**$350,000**	**$60,000**	**$100,000**	**$50,000**

9.3 Projected Budgets

Information regarding the District's operating budget was obtained from the Districts FY22 Budget Request Summary. The budget identifies FY17, FY18, FY19, FY20 expended budget, FY21 current budget, and FY21 expenditures to date. The budget includes expenses for the daily operations of the District, staff, maintenance, and distribution system, existing debt, and additional expenses including borrowing articles, system improvements under the Capital Plan, and transfers to stabilization funds.

The FY22 Budget Request Summary was used as a baseline to estimate annual operating expenses through FY26. Historical trends were evaluated and discussed with the District to determine if budget items were expected to increase in future years, as well as the rate of increases. The projected water budget summary for the study period is included in Table No. 9-4. The following is a list of assumptions made in determining projected budgets for future years:

- Future District salaries and wages were increased by three percent annually, and elected official salaries increased three percent annually.
- Future administration and clerical operating expenses, including legal and engineering expenses, were estimated to remain constant through the study period years.
- The existing debt service includes scheduled annual payments for completed water system improvement projects that include the hydropillar construction and painting of the standpipe.
- Select budget items for operations and maintenance, including facility electricity, were estimated to remain constant through the study period years, and SCADA monitoring was held constant at $10,000 annually based on recent trends in budget requests.

- Distribution expenses and service connections were estimated to remain constant through the study period years based on recent trends in budget requests.
- Future insurance expenses were increased by three percent biannually based on recent trends in budget requests.
- Miscellaneous expenses were estimated to remain constant through the study period years.
- County Retirement Assessment was estimated to increase by $4,000 annually.
- $25,000 is transferred to the Reserve Fund each year.
- Additional expenses include scheduled payments for borrowing articles, scheduled transfers to stabilization funds, and costs for Capital Plan projects.
    - The District budget includes two stabilization funds, one for future storage tank maintenance, and the other for special purpose associated with future capital outlay expenses.
- Water Main Rehabilitation and Capital Improvement amounts were estimated to include the PLA and Phase 1 Priority Improvements as outlined in the previous report sections.
    - It is intended that engineering costs are paid from the Water Main Rehab fund in the first year with the construction costs from the same fund in the following year.
    - The recommended transmission main along Route 25 is a top priority for BBWD but is the most expensive recommended improvement. All costs for this improvement have been included in the FY26 budget but a proposed schedule for this project has not been determined.

Table No. 9-4
Projecting Operating Budgets

Year	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Operating Expenses							
Wages & Salaries	$436,782	$450,591	$475,031	$489,282	$503,961	$519,079	$534,651
Elected Officials	$15,004	$18,245	$19,297	$19,876	$20,472	$21,086	$21,719
Administration and Clerical	$172,925	$157,475	$155,672	$160,000	$160,000	$160,000	$160,000
Pump Station Operations	$129,678	$130,314	$130,314	$130,400	$130,400	$130,400	$130,400
General Facility Operations	$9,200	$9,200	$9,200	$9,200	$9,200	$9,200	$9,200
Distribution Expense	$263,700	$264,200	$264,400	$264,500	$264,500	$264,500	$264,500
Legal Expense	$9,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Engineering Expense	$21,500	$21,500	$21,500	$21,500	$21,500	$21,500	$21,500
Insurance Expense	$117,445	$141,375	$144,375	$145,000	$145,000	$150,000	$150,000
Miscellaneous Expense	$133,815	$112,986	$117,833	$121,000	$125,000	$129,000	$133,000
Existing Debt	$290,284	$309,288	$309,788	$310,000	$310,000	$310,000	$310,000
Total Operating Expenses:	***$1,599,333***	***$1,621,174***	***$1,653,410***	***$1,676,757***	***$1,696,032***	***$1,720,765***	***$1,740,970***
Additional Expenses							
Tank Stab. Fund	$15,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Capital Outlay Stab. Fund	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
Capital Improvements			$400,000		$100,000		$825,000
Water Main Rehab	$150,000	$247,500	$150,000	$420,000	$150,000	$300,000	$210,000
Other Articles	$220,000	$276,500	$100,000	$200,000	$200,000	$200,000	$200,000
Total Additional Expenses:	***$485,000***	***$644,000***	***$770,000***	***$740,000***	***$570,000***	***$620,000***	***$1,355,000***
TOTAL OPERATING BUDGET:	**$2,084,333**	**$2,265,174**	**$2,423,410**	**$2,416,757**	**$2,266,032**	**$2,340,765**	**$3,095,970**

9.4 Estimated Revenue Needed

The District collects non-rate revenues to supplement the revenue collected from water rates to offset annual expenses. Non-rate revenues include commitment service fees as identified in Table No. 9-5, bank interest, tax interest, real estate and personal property commitments from the Towns of Bourne and Plymouth, and water liens revenue from the Towns of Bourne and Plymouth. The Bourne Real Estate and Personal Property amounts were estimated based on the FY20 reported tax revenue, and it was assumed that since Buzzards Bay accounts for 18 percent of the Town of Bourne's population they also captured 18 percent of the tax revenue. The Water District tax rate is $0.56/$1,000. The Plymouth Real Estate and Personal Property amounts as well as the water lien revenues were calculated based on the average collected amount in FY18 – FY20.

For the purpose of this study, the District's budgeted revenue for FY21 was included, and future non-rate revenues were based on the FY21 budgeted revenue less the revenue generated from new service installations (approximately $10,000), and assumed to remain constant through the study period. Revenue from new service installations for future years is included as revenue from anticipated new users and is discussed in subsequent sections of this report.

In addition, the District has rental contracts with Sprint, Verizon, and T-Mobile cellular providers. Each contract includes scheduled annual payments to the District through the term of the contract. The cellular contract payments are included in the revenue for future years. Table No. 9-5 presents the balance of revenue needed from water rates less non-rate revenue. The total operating budget costs were obtained from Table No. 9-4.

Table No. 9-5
Total Projected Revenue Needed

Year	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Total Operating Budget:	**$2,084,333**	**$2,265,174**	**$2,423,410**	**$2,416,757**	**$2,266,032**	**$2,340,765**	**$3,095,970**
Revenue							
Fees	$57,000	$57,000	$57,000	$57,000	$57,000	$57,000	$57,000
Bank Interest Income	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500
Interest on Taxes	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
Bourne Real Estate	$496,000	$496,000	$496,000	$496,000	$496,000	$496,000	$496,000
Bourne Personal Property	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000
Plymouth Real Estate	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000
Plymouth Personal Property	$25	$25	$25	$25	$25	$25	$25
Water Liens – Bourne	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Water Liens – Plymouth	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
Cellular Tower Revenue	$118,000	$123,000	$128,000	$133,000	$138,000	$143,000	$148,000
Total Revenue:	*$762,525*	*$767,525*	*$772,525*	*$777,525*	*$782,525*	*$787,525*	*$792,525*
BALANCE OF REVENUE NEEDED:	**$1,321,808**	**$1,497,649**	**$1,650,885**	**$1,639,232**	**$1,484,507**	**$1,553,240**	**$2,303,545**

9.5 Projected Consumption

The increase in water demands and usage were estimated as part of the hydraulic evaluation in previous sections of this report. Using the DCR demand projections for the BBWD, it was determined that demands would increase 2 percent annually until 2025 at which point demands would increase by 4 percent annually. Quarterly billing data from 2019 was used for previous hydraulic evaluations as part of this report and this data was used as the starting point for demand and revenue projections for this rate analysis.

In keeping with the previous rate analysis, a total of five new services per year was assumed for new users each year during the demand projections. The previously established fee of $6,300 in non-rate revenue to account for the new development base charge and meter turn on inspections was held constant for the revenue projections. As the DCR projections accounted for population growth, it was assumed that these new users were accounted for in the annual increase of existing demands.

9.6 Comparison of Current Rates and Projected Revenue Needed

To determine the adequacy of existing water rates to sustain future costs, the existing rates were applied to projected water consumption to determine estimated future revenue. The existing rates were applied to the FY19 actual usage by account to determine the revenue generated from rates, and then increased annually by the percentages set by the DCR demand projections. The biannual base charge was also added into the usage billings for each account.

In addition, the adequacy of the existing base charge to maintain future costs was evaluated. The number of accounts included under biannual and quarterly billing was obtained from the District for FY20. The existing base charge was applied to the number of accounts per respective billing cycle to determine the total annual revenue generated from the base charge. The existing number of biannual and quarterly accounts was used as the baseline, and an estimate of new services per year was determined for future years. Table No. 9-6 presents the comparison of the total operating budget, the total rate and base charge revenue using current rates, balance of revenue needed, and the cumulative free cash over this time period.

Table No. 9-6
Comparison of Current Rates and Projected Needed Revenue

Year	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Total Operating Budget	$2,084,333	$2,265,174	$2,423,410	$2,416,757	$2,266,032	$2,340,765	$3,095,970
Total Rate Based Revenue	$1,601,454	$1,627,147	$1,655,873	$1,684,797	$1,716,243	$1,775,149	$1,836,422
New User Revenue	$6,300	$6,300	$6,300	$6,300	$6,300	$6,300	$6,300
Total Other Revenue	$762,525	$767,525	$772,525	$777,525	$782,525	$787,525	$792,525
Surplus/Deficit	$285,946	$135,798	$11,288	$51,865	$239,036	$228,209	($460,723)
Cumulative Free Cash	$285,946	$421,744	$433,032	$484,897	$723,933	$952,142	$491,419

As shown in Table No. 9-6, the total revenue based on current rates and projected revenues from future demand increases is adequate to address all of the recommended improvements each year including the proposed transmission main along Route 25. With no increase in water rates, the District will still have approximately $490,000 in free cash at the end of FY26, however, this is dependent on DCR's projected increase in water usage of two percent each year and a four percent increase in FY26. If demands do not increase as DCR has projected or other costs for the District increase more than projected, the cumulative free cash would be less and may not cover the cost of the transmission main improvement along Route 25. It should be noted that the analysis assumes that free cash would be available to pay for the improvement in full without seeking a loan.

9.7 Transmission Main Funding

It is recommended that the BBWD pursue funding for the design, permitting, and construction of this transmission main from the MassDEP State Revolving Fund (SRF) twenty year low interest loan allowing the District to spread the cost over twenty years. Assuming this funding is secured, an estimated payment of $64,000 per year will be needed to repay the loan. This payment amount assumes an interest rate of two percent. While a sufficient surplus is noted in some years to cover this amount, relying on this to pay for the project in FY26 could impede the BBWD to fund other projects. It is also not guaranteed that demands will increase as much as the DCR projections predict, therefore increasing the rates in a way to cover this loan payment is the most beneficial to the BBWD.

9.8 Proposed Rate Structure, Rate Increases, and Base Charge

As the proposed transmission main is the highest priority improvement as recommended through previous evaluations in this report, it is recommended that the BBWD install the water main within the five years included in this rate analysis. As such, it is assumed that smaller improvements will be implemented first, as those can be covered without a rate increase, and that this transmission main will be designed and constructed in FY26. It is proposed that the tiered usage charge for each tier is increased by $0.50 in FY26 to cover the annual payments for the loan. Table No. 9-7 shows these proposed increases.

Table No. 9-7
Existing and Proposed Usage Rates

Water Usage (Gallons)	July 2021 Rate Per 1,000 Gallons	Proposed Rate Increase (FY2026)
Base Charge	$85.05	$85.05
0 – 15,000	$3.15	$3.65
15,001 – 40,000	$5.81	$6.31
40,001 – 100,000	$7.35	$7.85
101,000 – 150,000	$8.50	$9.00
150,001 and greater	$9.75	$10.25

All other fees are to remain the same. When compared to neighboring towns and water districts, the base charge and other non-rate based charges were either on the higher end of the scale or comparable. The base charge was increased significantly as a result of the previous rate study with the most recent increase scheduled for the July 2021 billing cycle. As such, it is not recommended that the base charge or other non-rate based charges are increased.

The proposed rate scenario would take place in the July 2026 billing cycle, which is one increase after a five year period of consistent rates. The percent increase per tier is 13 percent for the lowest tier, 8 percent for the second tier, 7 percent for the third tier, 6 percent for the fourth tier, and 5 percent for the fifth tier. It is estimated that with the projected demands for 2026, the proposed tiered usage charges would provide an additional $87,250 in revenue for the BBWD. This would cover the estimated loan repayment and provide a small amount of additional revenue for other improvements.

9.9 No Increase Alternative

The BBWD can cover the costs for the recommended transmission main along Route 25 without a rate increase, however this is dependent on an increase in usage based on DCR's projections. If the BBWD chooses to keep rates constant through the next five years, the transmission main project will need to be held off until it rates are increased if demand does not increase as projected by DCR. The current rate structure, if demands do not increase, is only sufficient to cover operating budgets and smaller improvements for both above ground and below ground assets. Table No. 9-8 shows the current rates with projected operations budgets and no demand increases past FY21 with the resulting surplus/deficit for each year and cumulative free cash.

Table No. 9-8
Comparison of Current Rates and Projected Needed Revenue with No Demand Increase

Year	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Total Operating Budget	$2,084,333	$2,265,174	$2,423,410	$2,416,757	$2,266,032	$2,340,765	$3,095,970
Total Rate Based Revenue	$1,601,454	$1,627,147	$1,627,147	$1,627,147	$1,627,147	$1,627,147	$1,627,147
New User Revenue	$6,300	$6,300	$6,300	$6,300	$6,300	$6,300	$6,300
Total Other Revenue	$762,525	$767,525	$772,525	$777,525	$782,525	$787,525	$792,525
Surplus/Deficit	$285,946	$135,798	($17,438)	($5,785)	$149,940	$80,207	($669,998)
Cumulative Free Cash	$285,946	$421,744	$404,306	$398,521	$548,641	$628,668	($41,330)

If demands remain constant from the FY21 usage through FY26, the BBWD will not have the available free cash needed to complete the transmission main project. Utilizing all the free cash and budget surpluses to save for the funding of the transmission main project will limit the BBWD's ability to complete other projects during FY23 through FY26 if rates are not increased.

9.10 Potential Impacts of Rate Change on Consumers

Based on reported usage from the 2019 Annual Statistical Report, the estimated annual water usage per service connection is approximately 38,000 gallons per year. Existing and proposed rates (including base charge) were applied to the average annual usage for comparison of the average residential service cost in FY21. The annual cost for an average residential service connection with the existing rates is approximately $391, or $32.58 per month. The annual cost for an average residential service connection with the proposed 2026 rates (Table No. 9-7) is approximately $410 ($34.17 per month), or a $19 annual increase.

9.12 Conclusions and Recommendations

The existing rate structure is sufficient to meet the BBWD yearly operating budget. The revenue collected from customer usage, non-usage based charges, and tax revenue from Bourne and Plymouth, as well as the cell tower rentals, is enough to provide for all operating expenses and cover the estimated costs of some of the smaller proposed improvements from this report. If the BBWD plans to move forward with the transmission main along Route 25, the rates will need to be increased to cover the loan obtained for the project if the demands do not increase as projected by DCR. This can be achieved through a minor increase to the tiered usage rates and does not need to be implemented until the funding is secured and the project is scheduled to begin.

Appendix A


Water Distribution System
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021
N
Legend
Water Main Diameter
4-inch or smaller
6-inch
8-inch
10-inch
12-inch
16-inch
Private
Pump Station No. 1
Pump Station No. 2
Pump Station No. 3 and Well No.5
Pump Station No. 4
Standpipe
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Hydropillar
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Interconnection with Wareham
PLYMOUTH
WAREHAM
BOURNE
Weeks Pond
Mare Pond
Goat Pond
Ellis Pond
Queen Sewell Pond
Nightingale Pond
Bourne Pond
Sand Pond
BOURNEDALE ROAD
HEAD OF THE BAY ROAD
OLD HEAD OF THE BAY ROAD
PLYMOUTH LANE
BOURNE ROAD
OLD MANS PATH
ERNEST VALERI ROAD
HEATHER HILL ROAD
DEERPATH TRAIL
FAWN HOLLOW WAY
TANAGER LANE
MIRASOL DRIVE
SETTLERS WAY
HIGH RIDGE DRIVE
DESERT DRIVE
NIGHTINGALE POND ROAD
SCENIC HIGHWAY
SANDWICH ROAD
BUZZARDS BAY BYPASS
ARMORY ROAD
PURITAN ROAD
LEWIS POINT ROAD
LEWIS POINT WAY
WALL STREET
CYPRESS STREET
EVERETT ROAD
SUNSET LANE
OLD BRIDGE ROAD
PERRY AVENUE
COHASSET AVENUE
WASHINGTON AVENUE
TAYLOR ROAD
ACADEMY DRIVE
BUTTERMILK WAY
HARBOR PLACE
WRIGHT LANE
TOWER LANE
SUMMER STREET
HOLT ROAD
WINDMILL ROAD
RIP VAN WINKLE WAY
SHADY PINE LANE
BIRCH STREET
NICKERSON STREET
LAKE DRIVE
WORCESTER STREET
BURBANK STREET
CORAL STREET
WILLOW STREET
PACKARD STREET
ASH STREET
WALNUT STREET
CYPRESS STREET
BUZZARD BAY DRIVE
MILFORD STREET
ARCHER STREET
JACKSON STREET
JUNIPER STREET
DOWNEY STREET
KELLY STREET
BUTTONWOOD LANE
RED BROOK ROAD
OAKLEY AVENUE
EMERSON AVENUE
VETERANS WAY
TROWBRIDGE ROAD
SANDY LANE
MACARTHUR BOULEVARD
KEENE STREET
SERVICE ROAD
SHIPS WAY
APTUCXET ROAD
PERRY AVENUE
COTUIT ROAD
SHORE ROAD
BELL ROAD
COUNTY ROAD
DAWE LANE
WATERHOUSE ROAD
JEFFERSON ROAD
LONG BOAT ROAD
JARVIS ROAD
HERRING POND ROAD
CLARISSA JOSEPH ROAD
HEMLOCK ROAD
25
28
6

Appendix B

TATA & HOWARD

Link Map
Buzzards Bay Water District

TATA & HOWARD

Approximate Scale: 1" = 700'

June 2021

Pipe Input Data
Capital Improvements and Asset Management Plan
Buzzards Bay Water District

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-985	6	Cast iron	1937	80	340	0	Identified corrosive soil/Tidal	72
P-940	6	Cast iron	1949	80	484	0	Identified corrosive soil/Tidal	72
P-960	6	Cast iron	1949	80	431	0	Identified corrosive soil/Tidal	72
P-980	6	Cast iron	1937	80	958	0	Gravel/Sand	47
P-977	6	DI	2009	80	175	0	Gravel/Sand	19
P-975	6	Cast iron	1937	80	794	0	Identified corrosive soil/Tidal	72
P-970	6	Cast iron	1937	80	430	0	Identified corrosive soil/Tidal	72
P-910	12	DI	1988	100	1,217	0	Identified corrosive soil/Tidal	31
P-935	6	Cast iron	1937	75	630	0	Identified corrosive soil/Tidal	72
P-945	6	Cast iron	1949	45	331	0	Identified corrosive soil/Tidal	72
P-915	8	Cast iron	1949	80	277	0	Identified corrosive soil/Tidal	62
P-820	12	DI	1985	100	556	0	Gravel/Sand	6
P-825	8	Ductile Iron	1983	100	426	0	Gravel/Sand	12
P-830	8	Ductile Iron	1983	100	252	0	Gravel/Sand	12
P-845	6	Ductile Iron	1983	100	564	0	Gravel/Sand	22
P-780	10	CI	1937	80	1,152	0	Gravel/Sand	32
P-800	10	CI	1937	90	141	0	Gravel/Sand	32
P-860	10	CI	1937	90	416	0	Gravel/Sand	32
P-875	10	CI	1937	90	322	0	Gravel/Sand	32
P-880	8	CI	1969	90	265	0	Gravel/Sand	40
P-450	8	Ductile Iron	1983	100	766	0	Gravel/Sand	12
P-850	8	CI	1969	90	255	0	Gravel/Sand	40
P-870	12	DI	1985	100	661	0	Gravel/Sand	6
P-7001	12	DI	1985	80	362	0	Gravel/Sand	6
P-7000	12	DI	1985	80	137	0	Gravel/Sand	6
P-890	10	CI	1937	90	263	0	Gravel/Sand	32
P-120	6	DI	1992	80	1,156	0	Potentially corrosive soil (wetlands or poor soils)	35
P-115	12	CI	1963	80	182	0	Gravel/Sand	24
P-110	12	DI	2004	80	323	0	Potentially corrosive soil (wetlands or poor soils)	18
P-1505	12	CI	1963	80	3,302	0	Gravel/Sand	24

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-1510	12	CI	1963	80	185	0	Gravel/Sand	24
P-101	12	DI	1992	80	312	0	Gravel/Sand	4
P-102	12	DI	1992	80	462	0	Gravel/Sand	4
P-1508	12	CI	1963	80	153	0	Gravel/Sand	24
P-1520	12	DI	1987	100	344	0	Gravel/Sand	6
P-1525	12	DI	1987	100	1,009	0	Gravel/Sand	6
P-1530	12	DI	1987	100	706	0	Gravel/Sand	6
P-1555	12	DI	2003	100	424	0	Gravel/Sand	3
P-1560	12	DI	2003	100	392	0	Gravel/Sand	3
P-1535	8	DI	1987	100	368	0	Gravel/Sand	12
P-1545	6	DI	1987	80	211	0	Gravel/Sand	22
P-1600	16	DI	2008	120	246	0	Gravel/Sand	2
P-1605	12	DI	1971	80	311	0	Gravel/Sand	9
P-1610	12	DI	1971	80	505	0	Gravel/Sand	9
P-1615	12	DI	1971	80	1,831	0	Gravel/Sand	9
P-1625	8	DI	1985	80	257	0	Gravel/Sand	12
P-1635	16	DI	1985	100	350	0	Gravel/Sand	5
P-1640	16	DI	1985	100	1,352	0	Gravel/Sand	5
P-1650	12	DI	1985	100	1,096	0	Gravel/Sand	6
P-2500	12	DI	1985	100	281	0	Gravel/Sand	6
P-2505	12	DI	1985	100	174	0	Gravel/Sand	6
P-2515	8	DI	1991	80	357	0	Gravel/Sand	10
P-1645	12	DI	1987	80	943	0	Gravel/Sand	6
P-1655	8	DI	1987	80	388	0	Potentially corrosive soil (wetlands or poor soils)	27
P-1617	12	DI	1985	100	2,057	0	Gravel/Sand	6
P-213	12	DI	1985	100	1,562	0	Gravel/Sand	6
P-215	12	DI	1988	100	1,747	0	Gravel/Sand	6
P-210	12	DI	1988	100	871	0	Gravel/Sand	6
P-190	8	DI	1985	80	1,508	0	Gravel/Sand	12
P-180	10	DI	1985	80	734	0	Potentially corrosive soil (wetlands or poor soils)	22

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-175	12	DI	2003	80	531	0	Gravel/Sand	3
P-1620	12	DI	1985	80	289	0	Gravel/Sand	6
P-1005	6	Ductile Iron	1988	80	183	0	Gravel/Sand	22
P-205	6	DI	1988	80	237	0	Gravel/Sand	22
P-185	10	DI	1978	80	1,553	0	Gravel/Sand	7
P-5015	16	DI	1995	100	5,121	0	Gravel/Sand	3
P-1765	8	CI	1968	100	1,228	0	Gravel/Sand	30
P-1760	6	CI	1968	100	244	0	Gravel/Sand	40
P-1770	2	Steel	1952	100	947	0	Gravel/Sand	46
P-1755	8	CI	1968	100	824	0	Gravel/Sand	30
P-1730	8	CI	1968	100	248	0	Gravel/Sand	30
P-1725	6	CI	1968	100	1,208	0	Gravel/Sand	40
P-1735	8	CI	1968	100	1,030	0	Gravel/Sand	30
P-1395	8	CI	1968	100	792	0	Gravel/Sand	30
P-1705	8	CI	1968	100	332	0	Gravel/Sand	30
P-1405	8	CI	1968	100	229	0	Gravel/Sand	40
P-1720	2	Steel	1968	100	554	1	Gravel/Sand	43
P-1435	8	CI	1968	100	481	0	Gravel/Sand	30
P-1740	6	Cast iron	1968	100	361	1	Gravel/Sand	47
P-1745	6	Cast iron	1968	100	1,041	0	Gravel/Sand	40
P-1325	8	Cast iron	1968	100	721	0	Gravel/Sand	30
P-1305	8	Cast iron	1968	100	348	0	Gravel/Sand	30
P-1300	8	Cast iron	1968	100	409	0	Gravel/Sand	30
P-1270	8	CI	1968	100	637	0	Gravel/Sand	30
P-1350	2	Steel	1968	100	453	0	Gravel/Sand	36
P-1440	2	Steel	1968	100	687	0	Gravel/Sand	36
P-1380	8	CI	1968	100	234	0	Gravel/Sand	30
P-1385	8	CI	1968	100	150	0	Gravel/Sand	30
P-1430	6	CI	1968	100	838	0	Gravel/Sand	40
P-1410	6	CI	1968	100	710	0	Gravel/Sand	40

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-1420	6	CI	1952	100	624	0	Gravel/Sand	40
P-1275	8	CI	1968	100	364	0	Gravel/Sand	30
P-1280	6	CI	1952	100	79	0	Gravel/Sand	43
P-1250	6	CI	1952	100	797	0	Gravel/Sand	43
P-1245	6	CI	1947	100	212	0	Gravel/Sand	47
P-1260	6	DI	1983	100	234	0	Gravel/Sand	22
P-1255	6	DI	1983	100	563	0	Gravel/Sand	22
P-1265	6	DI	1983	100	402	0	Gravel/Sand	22
P-1240	6	CI	1947	100	248	0	Gravel/Sand	47
P-1220	8	DI	1988	80	172	0	Gravel/Sand	12
P-1225	8	DI	1988	80	612	0	Gravel/Sand	12
P-1065	8	CI	1937	80	328	0	Identified corrosive soil/Tidal	62
P-1060	8	CI	1937	80	157	0	Identified corrosive soil/Tidal	62
P-1040	8	CI	1937	80	271	0	Identified corrosive soil/Tidal	62
P-1090	6	DI	1973	80	179	0	Identified corrosive soil/Tidal	50
P-1095	6	DI	1973	80	137	0	Identified corrosive soil/Tidal	50
P-1080	6	DI	1973	80	264	0	Identified corrosive soil/Tidal	50
P-1070	6	DI	1973	80	260	0	Identified corrosive soil/Tidal	50
P-1075	6	DI	1973	80	528	1	Identified corrosive soil/Tidal	58
P-1050	6	DI	1973	80	294	1	Identified corrosive soil/Tidal	58
P-1045	6	DI	1973	80	570	1	Identified corrosive soil/Tidal	58
P-770	8	CI	1937	80	522	0	Gravel/Sand	37
P-765	8	CI	1937	80	489	0	Deep Bury	37
P-760	6	CI	1947	80	564	0	Gravel/Sand	47
P-755	8	CI	1937	80	447	1	Gravel/Sand	45
P-646	6	CI	1937	80	970	0	Gravel/Sand	47
P-648	8	CI	1937	80	421	0	Gravel/Sand	37
P-1130	8	CI	1937	80	436	0	Gravel/Sand	37
P-1160	8	CI	1937	80	217	0	Gravel/Sand	37
P-1165	6	CI	1937	80	1,457	0	Potentially corrosive soil (wetlands or poor soils)	62

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-1155	6	CI	1937	80	243	0	Gravel/Sand	47
P-1135	8	DI	1983	80	508	0	Potentially corrosive soil (wetlands or poor soils)	27
P-1145	8	Ductile Iron	1983	80	390	0	Gravel/Sand	12
P-1168	6	Ductile Iron	1983	80	207	0	Gravel/Sand	12
P-1170	6	Ductile Iron	1983	80	476	0	Gravel/Sand	12
P-1175	8	CI	1959	80	190	0	Gravel/Sand	33
P-670	8	CI	1959	80	887	0	Gravel/Sand	33
P-655	6	CI	1959	65	425	0	Gravel/Sand	43
P-1140	8	Ductile Iron	1983	80	317	0	Potentially corrosive soil (wetlands or poor soils)	27
P-660	8	CI	1959	80	321	0	Gravel/Sand	33
P-635	8	CI	1937	60	267	0	Gravel/Sand	37
P-640	8	CI	1937	60	241	0	Gravel/Sand	47
P-645	8	DI	1983	80	199	0	Gravel/Sand	12
P-650	8	DI	1983	80	134	0	Gravel/Sand	12
P-647	6	CI	1937	80	388	0	Gravel/Sand	47
P-750	8	CI	1937	60	437	0	Gravel/Sand	37
P-745	6	CI	1937	80	249	0	Gravel/Sand	47
P-725	6	CI	1937	80	262	0	Gravel/Sand	47
P-735	6	CI	1937	80	539	0	Gravel/Sand	47
P-730	6	CI	1937	80	226	2	Gravel/Sand	59
P-710	6	CI	1947	80	253	0	Gravel/Sand	47
P-600	6	CI	1947	80	216	0	Gravel/Sand	47
P-625	8	CI	1937	60	248	0	Gravel/Sand	37
P-630	8	CI	1937	60	248	0	Gravel/Sand	37
P-605	8	CI	1937	60	355	0	Gravel/Sand	47
P-615	8	CI	1937	60	418	0	Gravel/Sand	37
P-620	8	CI	1937	60	601	0	Gravel/Sand	37
P-505	8	CI	1937	60	317	0	Gravel/Sand	37
P-315	8	CI	1937	60	272	0	Gravel/Sand	37
P-330	8	DI	1983	100	859	0	Gravel/Sand	12

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-325	6	CI	1967	90	228	0	Gravel/Sand	40
P-550	6	CI	1947	80	378	0	Gravel/Sand	47
P-555	6	CI	1950	80	428	0	Gravel/Sand	43
P-560	6	CI	1950	80	486	0	Gravel/Sand	43
P-565	6	CI	1950	80	276	0	Gravel/Sand	43
P-570	6	CI	1950	80	240	0	Gravel/Sand	43
P-525	6	CI	1947	80	413	0	Gravel/Sand	47
P-544	8	DI	1983	80	239	0	Gravel/Sand	12
P-541	8	DI	1983	80	278	0	Gravel/Sand	12
P-540	8	DI	1983	80	414	0	Gravel/Sand	12
P-575	8	DI	1983	80	352	0	Gravel/Sand	12
P-580	6	DI	1983	80	376	0	Gravel/Sand	22
P-585	8	DI	1983	80	404	0	Gravel/Sand	12
P-520	6	CI	1947	80	379	0	Gravel/Sand	47
P-535	6	DI	1983	80	1,171	0	Gravel/Sand	22
P-515	6	CI	1947	80	289	0	Gravel/Sand	47
P-510	6	CI	1937	80	757	0	Gravel/Sand	47
P-530	6	CI	1947	80	337	0	Gravel/Sand	47
P-335	6	CI	1967	90	239	0	Gravel/Sand	40
P-310	8	CI	1937	60	236	0	Gravel/Sand	37
P-345	6	DI	1983	90	299	0	Gravel/Sand	22
P-360	6	DI	1981	90	192	0	Gravel/Sand	22
P-365	6	DI	1981	90	305	0	Gravel/Sand	22
P-370	8	CI	1952	80	552	0	Gravel/Sand	43
P-350	6	CI	1967	90	214	0	Gravel/Sand	40
P-355	6	DI	1981	90	398	0	Gravel/Sand	22
P-400	6	DI	1984	90	569	0	Gravel/Sand	22
P-395	6	CI	1958	80	210	0	Gravel/Sand	43
P-390	6	DI	1983	80	798	0	Gravel/Sand	22
P-380	6	CI	1967	80	825	0	Gravel/Sand	40

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-405	6	CI	1947	80	830	0	Gravel/Sand	47
P-410	6	CI	1958	80	253	0	Gravel/Sand	43
P-415	6	CI	1958	80	518	0	Gravel/Sand	43
P-170	10	DI	2000	80	581	0	Gravel/Sand	4
P-165	10	DI	2000	80	1,214	0	Gravel/Sand	4
P-7010	6	DI	1997	80	462	0	Gravel/Sand	20
P-305	8	CI	1937	60	543	0	Gravel/Sand	37
P-265	8	CI	1937	60	402	0	Gravel/Sand	37
P-255	6	DI	1983	80	1,112	0	Gravel/Sand	22
P-270	8	CI	1960	85	492	0	Gravel/Sand	30
P-275	6	CI	1960	80	659	0	Gravel/Sand	40
P-280	8	CI	1960	90	1,338	0	Gravel/Sand	30
P-300	6	CI	1960	100	594	0	Gravel/Sand	40
P-295	6	CI	1960	80	507	0	Potentially corrosive soil (wetlands or poor soils)	55
P-230	8	CI	1965	75	421	1	Potentially corrosive soil (wetlands or poor soils)	52
P-240	8	CI	1965	75	343	1	Gravel/Sand	37
P-235	6	CI	1965	80	399	0	Gravel/Sand	40
P-245	6	CI	1965	80	447	0	Gravel/Sand	40
P-1750	8	Cast iron	1968	100	372	0	Gravel/Sand	30
P-336	2	Steel	1957	140	155	0	Gravel/Sand	51
P-337	4	Ductile Iron	1987	80	97	0	Gravel/Sand	24
P-338	4	Ductile Iron	1987	80	92	0	Gravel/Sand	24
P-339	4	Ductile Iron	1985	80	137	0	Gravel/Sand	24
P-334	12	Ductile Iron	1991	110	1,089	0	Gravel/Sand	4
P-341	12	DI	1991	80	696	0	Gravel/Sand	4
P-342	12	Ductile Iron	1993	110	1,087	0	Gravel/Sand	4
P-344	8	CI	1937	80	237	0	Gravel/Sand	37
P-763	6	CI	1937	80	416	0	Gravel/Sand	47
P-347	8	DI	1983	80	412	0	Identified corrosive soil/Tidal	37
P-348	12	DI	2003	80	110	0	Gravel/Sand	3

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-351	16	DI	2008	120	1,285	0	Gravel/Sand	2
P-356	12	DI	2003	80	571	0	Gravel/Sand	3
P-359	12	DI	1992	80	1,395	0	Gravel/Sand	4
P-361	12	DI	1992	80	1,129	0	Gravel/Sand	4
P-363	12	DI	1992	80	412	0	Gravel/Sand	4
P-366	2	Steel	1968	100	660	0	Gravel/Sand	48
P-367	12	DI	1983	110	1,173	0	Potentially corrosive soil (wetlands or poor soils)	21
P-368	12	DI	1983	110	731	0	Gravel/Sand	6
P-369	8	CI	1937	80	60	0	Identified corrosive soil/Tidal	62
P-371	8	CI	1937	40	405	0	Gravel/Sand	37
P-373	12	CI	1963	80	593	0	Gravel/Sand	24
P-374	12	CI	1963	80	584	0	Gravel/Sand	24
P-372	8	CI	1937	40	515	0	Gravel/Sand	37
P-379	12	DI	2003	80	102	0	Gravel/Sand	3
P-383	12	DI	2003	130	621	0	Gravel/Sand	3
P-386	12	DI	2003	130	264	0	Gravel/Sand	3
P-387	12	DI	2003	130	195	0	Gravel/Sand	3
P-388	12	DI	2003	130	417	0	Gravel/Sand	3
P-389	12	DI	2003	130	152	0	Gravel/Sand	3
P-391	12	DI	1987	130	2,101	0	Gravel/Sand	6
P-392	16	DI	2008	120	1,208	0	Gravel/Sand	2
P-393	16	DI	2008	120	1,418	0	Gravel/Sand	2
P-394	12	DI	1987	130	729	0	Gravel/Sand	6
P-396	12	DI	1983	110	2,937	0	Potentially corrosive soil (wetlands or poor soils)	21
P-398	12	DI	2000	110	547	0	Gravel/Sand	3
P-399	8	DI	2000	110	417	0	Gravel/Sand	9
P-40001	6	DI	0	130	6,317	0	Gravel/Sand	0
P-40002	6	DI	0	130	3,942	0	Gravel/Sand	0
P-40003	6	DI	0	130	124	0	Gravel/Sand	0
P-775(1)	6	CI	1937	80	255	0	Gravel/Sand	47

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Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-775(2)	6	CI	1937	80	182	0	Gravel/Sand	47
P-545(1)	8	DI	1983	80	191	0	Gravel/Sand	12
P-545(2)	6	CI	1949	80	246	0	Gravel/Sand	47
P-401	6	CI	1937	80	83	0	Gravel/Sand	47
P-865(1)	6	CI	1937	80	69	2	Gravel/Sand	59
P-865(2)	6	CI	1937	80	1,386	2	Gravel/Sand	59
P-895(2)	10	CI	1937	90	362	1	Gravel/Sand	40
P-385(1)	6	DI	1983	90	211	0	Gravel/Sand	22
P-385(2)	6	CI	1967	90	74	0	Gravel/Sand	40
P-420(1)	6	CI	1955	80	1,039	0	Gravel/Sand	43
P-420(2)	6	CI	1955	80	112	1	Gravel/Sand	50
P-260(1)	8	CI	1937	60	180	0	Potentially corrosive soil (wetlands or poor soils)	52
P-260(2)	8	CI	1937	60	731	0	Gravel/Sand	37
P-354(2)	12	DI	1992	80	1,102	0	Gravel/Sand	4
P-397(1)	12	DI	1983	100	897	0	Gravel/Sand	6
P-397(2)	12	DI	1983	110	618	0	Gravel/Sand	6
P-1055(1	6	DI	1973	80	91	0	Identified corrosive soil/Tidal	50
P-1055(2	6	DI	1973	80	425	2	Identified corrosive soil/Tidal	62
P-995(2)	6	Cast iron	1937	50	1,854	0	Potentially corrosive soil (wetlands or poor soils)	62
P-403	6	Cast iron	1937	70	360	0	Gravel/Sand	47
-995(1)(1	6	Cast iron	1937	50	441	0	Gravel/Sand	47
-995(1)(2	6	Cast iron	1937	50	1,082	0	Gravel/Sand	47
P-404	6	DI	2009	70	372	0	Gravel/Sand	19
P-405	6	Cast iron	1949	80	276	0	Identified corrosive soil/Tidal	72
P-965(1)	6	Cast iron	1949	80	207	0	Identified corrosive soil/Tidal	72
P-965(2)	6	Cast iron	1949	80	57	0	Identified corrosive soil/Tidal	72
P-408	6	CI	1937	130	534	0	Identified corrosive soil/Tidal	72
P-409	6	CI	1937	130	991	0	Identified corrosive soil/Tidal	72
P-410	6	Cast iron	1949	75	276	0	Identified corrosive soil/Tidal	72
P-411	6	Cast iron	1949	130	326	0	Identified corrosive soil/Tidal	72

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Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-900(1)	12	DI	1988	80	52	0	Gravel/Sand	6
P-900(2)	12	DI	1988	80	60	0	Gravel/Sand	6
P-785(1)	6	CI	1947	80	381	0	Gravel/Sand	47
P-785(2)	6	CI	1947	80	53	0	Gravel/Sand	47
P-815(1)	12	DI	1988	100	116	0	Gravel/Sand	6
P-805(1)	10	CI	1937	90	444	0	Gravel/Sand	32
P-805(2)	10	CI	1937	90	89	0	Gravel/Sand	32
P-412	12	DI	1985	80	39	0	Gravel/Sand	6
P-885(1)	12	DI	1985	100	520	0	Gravel/Sand	6
P-135(1)	8	DI	2006	130	400	0	Gravel/Sand	9
P-135(2)	8	DI	2006	130	46	0	Gravel/Sand	9
P-413	6	DI	2006	100	254	0	Gravel/Sand	19
P-414	6	DI	2006	100	88	0	Gravel/Sand	19
P-415	6	DI	2006	100	210	0	Gravel/Sand	19
P-416	6	DI	2006	100	120	0	Gravel/Sand	19
P-417	6	CI	1937	40	314	0	Gravel/Sand	47
P-897(1)	12	DI	1985	80	369	0	Gravel/Sand	6
P-897(2)	12	DI	1985	80	768	0	Gravel/Sand	6
-895(1)(1	10	CI	1937	90	294	0	Gravel/Sand	32
-895(1)(2	10	CI	1937	90	520	1	Gravel/Sand	40
P-418	12	DI	1985	80	58	0	Gravel/Sand	6
P-381(1)	12	DI	2003	130	224	0	Gravel/Sand	3
P-381(2)	12	DI	2003	130	48	0	Gravel/Sand	3
P-377(1)	10	CI	1937	80	285	0	Gravel/Sand	32
P-377(2)	10	CI	1937	80	102	0	Gravel/Sand	32
P-130(1)	8	DI	2003	40	87	0	Gravel/Sand	9
P-130(2)	6	CI	1937	40	1,093	2	Gravel/Sand	69
P-384(1)	12	DI	2003	130	544	0	Gravel/Sand	3
P-384(2)	12	DI	2003	130	89	0	Gravel/Sand	3
P-125(1)	10	CI	1937	80	126	0	Gravel/Sand	32

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-125(2)	10	CI	1937	80	568	0	Gravel/Sand	32
P-419	12	DI	2004	80	725	0	Potentially corrosive soil (wetlands or poor soils)	18
P-420	8	DI	2004	130	1,032	0	Potentially corrosive soil (wetlands or poor soils)	24
P-421	6	CI	1967	70	448	0	Gravel/Sand	40
P-1500(1)	12	CI	1963	80	100	0	Gravel/Sand	24
P-1500(2)	12	CI	1963	80	753	0	Gravel/Sand	24
P-422	12	CI	1963	80	130	0	Gravel/Sand	24
P-423	6	CI	1967	70	353	0	Gravel/Sand	40
P-362(1)	12	DI	1992	80	866	0	Gravel/Sand	4
P-362(2)(1	12	DI	1992	80	50	0	Gravel/Sand	4
P-362(2)(2	12	DI	1992	80	395	0	Gravel/Sand	4
P-424	8	DI	2010	110	478	0	Gravel/Sand	9
P-364(1)	8	DI	2003	80	339	0	Gravel/Sand	9
P-364(2)	8	DI	2003	80	3,177	0	Gravel/Sand	9
P-425	8	DI	2010	110	2,135	0	Gravel/Sand	9
P-354(1)(1	12	DI	1999	80	168	0	Gravel/Sand	4
P-426	8	DI	1999	110	527	0	Gravel/Sand	10
354(1)(2)	12	DI	1999	80	890	0	Gravel/Sand	4
354(1)(2)	12	DI	1999	80	1,056	0	Gravel/Sand	4
P-427	8	DI	1999	110	513	0	Gravel/Sand	10
P-353(2)	12	DI	1999	80	394	0	Gravel/Sand	4
P-428	8	DI	1999	110	466	0	Gravel/Sand	10
P-353(1)(1	12	DI	1999	80	92	0	Gravel/Sand	4
P-353(1)(2	12	DI	1999	80	788	0	Gravel/Sand	4
P-429	8	DI	1999	110	279	0	Gravel/Sand	10
P-1630(1)	12	DI	1985	100	108	0	Gravel/Sand	6
P-1630(2)	16	DI	1985	100	1,047	0	Gravel/Sand	5
P-195(1)	8	CI	1957	80	51	0	Gravel/Sand	33
P-195(2)	8	CI	1957	80	1,128	0	Gravel/Sand	33
P-500(1)	12	DI	1988	100	842	0	Gravel/Sand	6

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Score
P-500(2)	12	DI	1988	80	147	0	Gravel/Sand	6
P-220(1)	8	CI	1937	80	2,075	0	Gravel/Sand	37
P-220(2)	8	CI	1937	80	67	0	Gravel/Sand	37
P-610(1)	8	CI	1975	80	505	0	Gravel/Sand	28
-610(2)(1	6	CI	1975	80	310	0	Gravel/Sand	38
-610(2)(2	8	DI	1983	80	606	0	Gravel/Sand	12
P-665(2)	6	CI	1959	70	486	0	Potentially corrosive soil (wetlands or poor soils)	58
-665(1)(1	6	CI	1959	65	508	0	Gravel/Sand	43
P-1150(1	8	CI	1959	80	303	0	Gravel/Sand	33
P-1150(2	8	CI	1959	80	177	0	Gravel/Sand	33
P-250(1)	8	CI	1965	75	671	2	Identified corrosive soil/Tidal	67
P-250(2)	6	CI	1965	70	300	2	Identified corrosive soil/Tidal	77
P-1235(1	6	CI	1947	100	231	0	Gravel/Sand	47
P-1235(2	8	CI	1968	100	551	0	Potentially corrosive soil (wetlands or poor soils)	45
P-1710(1	8	CI	1968	100	60	0	Gravel/Sand	30
P-1710(2	8	Cast iron	1968	100	171	0	Gravel/Sand	30
P-1700(1	8	CI	1968	100	174	0	Gravel/Sand	30
P-1700(2	6	CI	1968	100	1,231	0	Gravel/Sand	40
P-1370(2	8	CI	1968	100	111	0	Gravel/Sand	30
P-431	6	CI	1968	100	532	0	Gravel/Sand	40
P-1425(1	6	CI	1968	100	253	0	Gravel/Sand	40
P-432	6	CI	1968	100	133	0	Gravel/Sand	40
P-1400(1	6	CI	1968	100	230	0	Gravel/Sand	40
P-1400(2	6	CI	1968	100	258	0	Gravel/Sand	40
P-1375(1	8	CI	1968	100	327	0	Gravel/Sand	30
P-1375(2	8	CI	1968	100	318	0	Gravel/Sand	30
P-433	8	CI	1968	100	111	0	Gravel/Sand	40
P-434	8	CI	1968	100	178	0	Gravel/Sand	40
P-1445(1	8	CI	1968	100	330	0	Gravel/Sand	30
P-1445(2	8	CI	1968	100	202	0	Gravel/Sand	30

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-435	6	CI	1968	100	240	0	Gravel/Sand	40
P-1340(1	6	CI	1968	100	240	0	Gravel/Sand	40
P-1340(2	6	CI	1968	100	239	0	Gravel/Sand	40
P-1330(1	8	CI	1968	100	240	0	Gravel/Sand	30
P-1330(2	8	CI	1968	100	234	0	Gravel/Sand	30
P-436	2	Steel	1968	100	61	0	Gravel/Sand	46
P-437	2	Steel	1968	100	542	0	Gravel/Sand	46
P-438	2	Steel	1968	100	710	0	Gravel/Sand	46
P-439	2	Steel	1968	100	383	0	Gravel/Sand	46
P-1390(1	8	CI	1968	100	257	0	Gravel/Sand	30
P-1390(2	8	CI	1968	100	217	0	Gravel/Sand	30
P-440	2	Steel	1968	100	621	0	Gravel/Sand	46
-1370(1)(	8	CI	1968	100	58	0	Gravel/Sand	30
-1370(1)(	8	CI	1968	100	153	0	Gravel/Sand	30
P-441	2	Steel	1968	100	762	0	Gravel/Sand	46
P-1360(1	8	CI	1968	100	194	0	Gravel/Sand	30
P-1360(2	8	CI	1968	100	637	0	Gravel/Sand	30
P-442	6	Cast iron	1968	100	113	0	Gravel/Sand	40
P-1355(1	6	CI	1968	100	238	0	Gravel/Sand	40
P-1355(2	6	CI	1968	100	240	0	Gravel/Sand	40
P-443	2	Steel	1968	100	658	0	Gravel/Sand	46
P-444	2	Steel	1968	100	506	0	Gravel/Sand	46
P-445	2	Steel	1968	100	233	0	Gravel/Sand	46
P-446	2	Steel	1968	100	521	0	Gravel/Sand	46
P-1780(1	6	CI	1968	100	39	0	Gravel/Sand	40
P-1780(2	6	CI	1968	100	170	0	Gravel/Sand	40
P-1775(1	8	CI	1968	100	93	0	Gravel/Sand	30
P-1775(2	8	CI	1968	100	101	0	Gravel/Sand	30
P-447	6	CI	1968	100	888	0	Gravel/Sand	40
P-1200(1	6	Ductile Iron	1973	80	375	1	Identified corrosive soil/Tidal	58

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-1200(2)	6	Ductile Iron	1973	80	153	1	Identified corrosive soil/Tidal	58
P-1210(1)	6	Ductile Iron	1973	80	180	0	Identified corrosive soil/Tidal	50
P-1210(2)	6	Ductile Iron	1973	80	112	0	Identified corrosive soil/Tidal	50
P-448	2	Steel	1973	140	288	0	Identified corrosive soil/Tidal	71
P-1205(1)	6	Ductile Iron	1973	80	58	0	Identified corrosive soil/Tidal	50
P-1205(2)	6	Ductile Iron	1973	80	236	0	Identified corrosive soil/Tidal	50
P-449	2	Steel	1973	140	521	0	Identified corrosive soil/Tidal	69
P-1097(1)	6	Ductile Iron	1973	80	286	0	Identified corrosive soil/Tidal	50
P-1097(2)	6	Ductile Iron	1973	80	136	0	Identified corrosive soil/Tidal	50
P-1085(1)	6	Ductile Iron	1973	80	343	0	Identified corrosive soil/Tidal	50
P-1085(2)	6	Ductile Iron	1973	80	116	0	Identified corrosive soil/Tidal	50
P-451	2	Steel	1973	140	698	0	Identified corrosive soil/Tidal	69
P-720(2)	6	CI	1937	28	82	0	Gravel/Sand	47
P-430(1)	6	Ductile Iron	2006	100	693	0	Gravel/Sand	19
P-430(2)	6	Ductile Iron	2006	100	247	0	Gravel/Sand	19
P-452	2	PVC	2006	150	422	0	Gravel/Sand	21
P-453	2	Steel	1949	100	386	0	Identified corrosive soil/Tidal	78
P-925(1)	6	Cast iron	1949	60	388	0	Identified corrosive soil/Tidal	72
P-925(2)	6	Cast iron	1949	60	257	0	Identified corrosive soil/Tidal	72
P-920(1)	6	Cast iron	1949	80	192	0	Identified corrosive soil/Tidal	82
P-920(2)	6	Cast iron	1949	80	481	0	Identified corrosive soil/Tidal	72
P-454	2	Steel	1949	140	578	0	Potentially corrosive soil (wetlands or poor soils)	68
P-455(1)	8	CI	1960	80	72	0	Gravel/Sand	40
P-455(2)	8	CI	1960	80	119	0	Gravel/Sand	40
P-290(1)	8	CI	1960	95	243	1	Gravel/Sand	37
P-290(2)	8	CI	1960	80	346	1	Gravel/Sand	37
P-285(1)	8	CI	1960	80	412	1	Gravel/Sand	37
P-285(2)	8	CI	1960	80	587	1	Gravel/Sand	37
P-1415(1)	6	CI	1968	100	165	0	Gravel/Sand	40
P-1415(2)	6	CI	1968	100	68	0	Gravel/Sand	40

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
-1425(2)(	6	CI	1968	100	56	0	Gravel/Sand	40
-1425(2)(	6	CI	1968	100	193	0	Gravel/Sand	40
P-320(1)	8	Ductile Iron	1983	90	276	0	Gravel/Sand	12
ʼ-320(2)(1	8	Ductile Iron	1983	90	472	0	Gravel/Sand	12
ʼ-320(2)(2	8	Ductile Iron	1983	90	227	0	Gravel/Sand	12
665(1)(2)	6	DI	1983	70	574	0	Gravel/Sand	22
665(1)(2)	6	DI	1983	70	527	0	Potentially corrosive soil (wetlands or poor soils)	37
P-1550(1)	12	Ductile Iron	1987	100	215	0	Gravel/Sand	6
P-1550(2)	12	Ductile Iron	1987	100	430	0	Gravel/Sand	6
P-1540(1)	12	Ductile Iron	1987	100	1,245	0	Gravel/Sand	6
P-1540(2)	12	Ductile Iron	1987	100	458	0	Gravel/Sand	6
P-955(1)	6	Cast iron	1949	45	436	0	Identified corrosive soil/Tidal	72
P-955(2)	6	Cast iron	1949	130	203	0	Identified corrosive soil/Tidal	72
P-930(1)	6	Cast iron	1949	55	167	0	Identified corrosive soil/Tidal	72
P-930(2)	6	Cast iron	1949	55	123	0	Identified corrosive soil/Tidal	62
P-840(2)	8	CI	1969	90	53	0	Gravel/Sand	40
ʼ-840(1)(1	8	CI	1969	90	58	0	Gravel/Sand	40
ʼ-840(1)(2	8	CI	1969	90	259	0	Gravel/Sand	40
P-835(1)	8	Ductile Iron	1983	100	57	0	Gravel/Sand	12
P-835(2)	8	Ductile Iron	1983	100	527	0	Gravel/Sand	12
ʼ-720(1)(2	6	CI	1937	28	76	0	Gravel/Sand	47
P-715(1)	6	CI	1937	80	723	3	Gravel/Sand	62
720(1)(1)	6	CI	1937	28	724	0	Gravel/Sand	47
P-343(1)	8	Ductile Iron	1999	110	1,242	0	Gravel/Sand	10
P-343(2)	8	Ductile Iron	1999	110	639	0	Gravel/Sand	10
P-1020(2)	8	CI	1948	45	118	0	Gravel/Sand	37
-1020(1)(	8	CI	1948	45	735	1	Potentially corrosive soil (wetlands or poor soils)	60
-1020(1)(	8	CI	1948	45	690	1	Gravel/Sand	45
P-1018(2)	8	CI	1948	45	638	0	Potentially corrosive soil (wetlands or poor soils)	52
P-740(1)	6	CI	1937	80	160	0	Deep Bury	47

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-740(2)	6	CI	1937	80	1,067	0	Gravel/Sand	62
20(1)(1)(2	6	CI	1937	28	368	0	Gravel/Sand	62
20(1)(1)(2	6	CI	1937	28	187	0	Deep Bury	47
'-715(2)(1	6	CI	1937	80	425	3	Gravel/Sand	62
'-715(2)(2	6	CI	1937	80	119	3	Deep Bury	62
P-705(1)	6	CI	1947	80	168	0	Deep Bury	47
P-705(2)	6	CI	1947	80	1,143	0	Gravel/Sand	47
P-700(2)	6	CI	1947	80	907	1	Gravel/Sand	65
'-700(1)(1	6	CI	1947	80	241	1	Gravel/Sand	55
'-700(1)(2	6	CI	1947	80	269	1	Deep Bury	55
P-810(2)	6	CI	1947	80	362	1	Gravel/Sand	55
'-810(1)(1	6	CI	1947	80	833	1	Gravel/Sand	55
'-810(1)(2	6	CI	1947	80	249	1	Gravel/Sand	55
P-905(1)	12	Ductile Iron	1988	100	109	0	Identified corrosive soil/Tidal	31
P-905(2)	12	Ductile Iron	1988	100	477	0	Identified corrosive soil/Tidal	31
P-346(1)	8	Ductile Iron	1983	65	1,003	2	Identified corrosive soil/Tidal	49
P-346(2)	8	Ductile Iron	1983	65	180	2	Identified corrosive soil/Tidal	49
'-815(2)(1	12	Ductile Iron	1988	100	970	0	Gravel/Sand	6
'-815(2)(2	12	Ductile Iron	1988	100	124	0	Gravel/Sand	6
P-140(1)	6	CI	1937	40	442	0	Gravel/Sand	47
P-140(2)	6	CI	1937	40	828	0	Gravel/Sand	47
P-456	2	Steel	2006	140	288	0	Gravel/Sand	40
P-375(1)	6	CI	1967	90	171	0	Gravel/Sand	40
P-375(2)	6	CI	1967	90	103	0	Gravel/Sand	40
P-458	8	Ductile Iron	2018	120	370	0	Gravel/Sand	9
P-459	8	Ductile Iron	2018	120	611	0	Gravel/Sand	9
P-460	12	DI	2019	130	302	0	Gravel/Sand	3
P-461	12	DI	2019	130	929	0	Gravel/Sand	3
P-457(1)	1	Steel	2018	140	326	0	Gravel/Sand	40
P-1715(1)	8	Cast iron	1968	100	423	0	Gravel/Sand	30

Label	Diameter (in)	Material	Installation Year	Hazen-Williams C	Length (Scaled) (ft)	Number of Breaks	Soil Code	Asset Management Scoore
P-1715(2)	8	Cast iron	1968	100	181	0	Gravel/Sand	30
P-464	8	Cast iron	1968	100	292	0	Gravel/Sand	30
P-465	2	Steel	1937	140	464	0	Gravel/Sand	55
P-1230(1)	12	DI	1983	110	703	0	Potentially corrosive soil (wetlands or poor soils)	21
P-1230(2)	12	DI	1983	110	477	0	Gravel/Sand	6
-1018(1)(	8	CI	1948	45	1,605	0	Gravel/Sand	37
-1018(1)(	8	CI	1948	45	324	0	Potentially corrosive soil (wetlands or poor soils)	52
P-225(1)	8	CI	1950	80	124	0	Potentially corrosive soil (wetlands or poor soils)	52
P-225(2)	8	CI	1950	80	819	0	Gravel/Sand	37
P-466	12	Ductile Iron	1995	100	1,026	0	Gravel/Sand	4
P-467	8	Ductile Iron	1995	100	1,028	0	Gravel/Sand	10
P-469	6	Ductile Iron	0	130	434	0	Gravel/Sand	0
P-470	6	Ductile Iron	0	130	994	0	Gravel/Sand	0
P-471	6	Ductile Iron	0	130	892	0	Gravel/Sand	0
P-472	6	Ductile Iron	0	130	523	0	Gravel/Sand	0
P-473	1	Steel	2018	140	269	0	Gravel/Sand	40
P-340(1)	6	CI	1967	90	214	0	Gravel/Sand	40
P-340(2)	6	CI	1967	90	605	0	Gravel/Sand	40
P-474	6	Ductile Iron	2020	130	350	0	Gravel/Sand	19
P-475	6	Ductile Iron	1973	80	36	0	Identified corrosive soil/Tidal	50
P-476	6	Ductile Iron	2020	130	98	0	Identified corrosive soil/Tidal	44

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-381	154	0	24.3
J-382	154	0.9	24.3
J-1540	150	0	26
J-1545	150	0	26
J-1550	130	0	34.6
J-1555	130	0	34.6
J-1560	130	0	34.6
J-1510	110	0	43.3
J-259	90	0	51.9
School	90	0	52
J-1505	85	0	54.1
J-239	85	2.8	54.5
J-392	82	1.59	55.8
J-238	81	3.21	56.2
J-246	80	12.17	56.3
J-243	80	0	56.3
J-1530	80	2.17	56.3
J-326	79.28	0.45	56.6
J-1640	80	0.77	56.7
J-1635	80	0.21	56.7
J-1630	80	0	56.7
J-264	80	0	56.7
J-1535	75	0	58.5
J-1525	75	0.13	58.5
J-328	75.47	0.07	58.6
J-2510	75	1.08	58.8
J-2515	75	0.3	58.8
J-1625	75	0	58.8
J-316	74.06	4.38	58.9
J-317	73.71	3.25	59
J-324	73.09	2.87	59.3
J-1515	71.93	0.39	59.8
J-248	71	4.56	60.2
J-237	71	2.51	60.5
J-244	70	1.05	60.6
J-1520	70	0	60.6
J-1600	70	1.18	60.6
J-1605	70	0	60.7
J-320	69.14	1.55	61
J-2505	70	0.43	61
J-1610	65	0	62.9
J-322	64.58	3.13	63
J-2500	65	0.79	63.1
J-1650	65	0.07	63.1
J-319	61.06	6.85	64.5

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-1500	60	0.41	64.9
J-247	60	3.12	64.9
J-1775	60	0.46	65.2
J-274	59.16	1.99	65.3
J-213	60	1.18	65.3
J-1615	60	0	65.4
J-361	57.4	0.44	66.3
J-1765	55	1.7	67.3
J-263	55	1.21	67.4
J-254	50	0.11	69.2
J-255	50	0.32	69.2
J-257	50	0.06	69.2
J-160	50	0.79	69.2
J-312	50	1.52	69.2
J-2000	50	0.4	69.2
J-1725	50	2.93	69.5
J-1325	50	0.98	69.5
J-262	48	0	70.5
J-1750	45	2.65	71.6
J-1730	45	2.46	71.6
J-352	44.93	1.16	71.7
J-261	44	0.69	72.2
J-380	42	0.83	72.6
J-380	40	1.16	73.5
J-530	39.64	0.85	73.6
J-1760	40	1.5	73.8
J-1395	40	2.3	73.8
J-1745	40	2.71	73.8
J-349	40	0.99	73.8
J-346	40	0.49	73.8
J-1390	40	2.64	73.8
J-1400	40	0.65	73.8
J-1405	40	1.03	73.8
J-1445	40	2.06	73.8
J-350	40	0.86	73.8
J-1375	40	1.35	73.8
J-1305	40	1.73	73.8
J-1235	40	1	73.8
J-351	37.5	1.39	74.9
J-339	37.05	0.78	75.1
J-265	35.43	0.43	75.5
J-360	35.93	0.45	75.6
J-1150	35	2.68	75.6
J-336	35	0.06	75.6
J-1145	35	0.72	75.6

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-665	35	0.95	75.6
J-540	35	0.94	75.6
J-565	35	1.17	75.7
J-560	35	0.97	75.7
J-505	35	3.08	75.7
J-520	35	0.67	75.7
J-275	35	1.47	75.8
J-354	35.41	1.01	75.8
J-180	35	0.24	75.8
J-250	35	2.24	75.9
J-225	35	0.67	76
J-1780	35	1.29	76
J-1740	35	1.43	76
J-1345	35	0.88	76
J-1340	35	1.36	76
J-1255	35	2.47	76
J-1300	35	1.64	76
J-185	35	1.04	76.1
J-378	34	2.59	76.1
J-331	34.66	0.77	76.3
J-314	33.52	0.36	76.4
J-1160	33	1.05	76.5
J-329	33.89	0.44	76.7
J-275	33.36	0.99	76.8
J-330	33.39	0	76.8
J-358	32.48	1.62	77.1
J-347	32.39	1.51	77.1
J-348	32	0.19	77.3
J-393	31.96	0.14	77.4
J-379	31	1.15	77.4
J-374	31	0.49	77.5
J-341	31.24	0.74	77.6
J-655	30	1.07	77.8
J-650	30	0.77	77.8
J-745	30	3.42	77.8
J-645	30	1.12	77.8
J-750	30	1.61	77.8
J-640	30	1.13	77.8
J-555	30	1.86	77.8
J-515	30	0.72	77.8
J-510	30	1.33	77.8
J-525	30	0.82	77.8
J-315	30	0.84	77.8
J-320	30	1.35	77.9
J-375	30	0.68	77.9

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-405	30	0.92	77.9
J-313	30	0	77.9
J-100	30	0	77.9
J-165	30	0.22	77.9
J-285	30	0.68	77.9
J-375	30	1.13	77.9
Nursing Home	30	0.46	78
J-272	29.84	1.58	78
J-175	30	2.77	78
J-1700	30	1.34	78.1
J-1385	30	1.42	78.1
J-1275	30	1.47	78.2
J-1250	30	1.07	78.2
J-1270	30	0.98	78.2
J-1240	30	0.4	78.2
J-1210	30	0.83	78.2
J-1225	30	1.4	78.2
J-1215	30	1.6	78.2
J-205	30	2.58	78.3
J-340	29.04	1.16	78.6
J-335	28	0.83	78.6
J-270	27.4	0.31	79
J-1155	25	1.59	79.9
J-660	25	1.71	79.9
J-630	25	1.19	79.9
J-535	25	0.74	80
J-550	25	1.11	80
J-500	25	1.33	80
J-330	25	1.55	80
J-395	25	1.51	80
J-315	25	0	80.1
J-101	25	0.25	80.1
J-170	25	4.94	80.1
J-280	25	0.37	80.1
J-372	25	0.41	80.1
J-270	25	0.31	80.1
J-260	25	1.71	80.1
J-1710	25	1.99	80.3
J-1715	25	1.94	80.3
J-413	25	0	80.3
J-1370	25	0.89	80.3
J-1025	25	0	80.4
J-249	25	0.07	80.4
J-210	25	0.59	80.4
J-373	24	0.08	80.5

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-409	23.75	0.58	80.6
J-428	23.69	0	80.6
J-417	24.05	0	80.7
J-391	23	2.26	80.8
J-342	23.27	0.68	81.1
J-356	22.33	0.09	81.5
J-338	22	1.06	81.6
J-357	22	2.28	81.6
J-355	20.9	0.61	82.1
J-334	20	1.92	82.1
J-646	20	1.93	82.1
J-755	20	0.05	82.1
J-763	20	0.43	82.1
J-760	20	0	82.1
J-620	20	0.58	82.1
J-600	20	0.46	82.1
J-605	20	1.72	82.1
J-333	20	1.37	82.1
J-332	20	0.99	82.1
J-610	20	2.11	82.1
J-545	20	2.26	82.1
J-310	20	1.16	82.2
J-350	20	0.5	82.2
J-305	20	1.09	82.2
J-385	20	1.86	82.2
J-390	20	1.89	82.2
J-300	20	1.67	82.2
J-130	20	0	82.2
J-115	20	2.71	82.2
J-290	20	0.34	82.3
J-389	19.29	2.83	82.4
J-240	20	1.68	82.5
J-235	20	0.84	82.5
J-1365	20	0.92	82.5
J-1245	20	1.09	82.5
J-1030	20	0	82.5
J-1085	20	0	82.5
J-308	19.29	0.82	82.5
J-1065	20	4.29	82.5
J-1060	20	0	82.5
J-1055	20	0	82.5
J-276	20	0	82.5
J-1040	20	0	82.5
J-1045	20	0	82.5
J-1020	20	1.58	82.5

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-305	19.15	4.03	82.6
J-200	20	0.93	82.6
J-1000	20	0.39	82.6
J-195	20	0.41	82.6
J-307	18.86	3.55	82.7
J-400	18.6	1.32	82.7
J-309	18.39	1.61	82.9
J-402	17.49	0.3	83.2
J-396	16.96	1.24	83.4
J-401	16.7	0	83.5
J-398	15.94	0.74	83.9
J-397	15.88	0.43	83.9
J-403	15.77	1.94	84
J-399	15.64	0.36	84
J-1130	15	2.67	84.3
J-1135	15	2.14	84.3
J-735	15	0.53	84.3
J-710	15	0.22	84.3
J-720	15	0.88	84.3
J-705	15	0.92	84.3
J-700	15	1.31	84.3
J-394	16	0.12	84.3
J-870	15	1.59	84.3
J-865	15	0.28	84.3
J-355	15	1.34	84.3
J-370	15	1.71	84.3
J-155	15	0	84.4
J-256	15	6.47	84.4
J-120	15	0.06	84.4
J-110	15	0	84.4
J-252	15	1.94	84.4
J-273	14.94	1.67	84.6
J-230	15	1.67	84.6
J-1425	15	1.43	84.6
J-1075	15	0	84.7
J-1050	15	0	84.7
J-1018	15	0.69	84.7
J-245	14	0.87	85.1
J-304	13.31	7.22	85.1
J-264	12.61	1.05	85.3
J-368	12.48	0.29	85.3
J-365	13.38	0	85.4
J-420	13.28	0	85.4
J-344	12.48	0.42	85.7
J-345	12	1.37	85.9

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-377	12	0.47	85.9
J-388	11	0.28	86
J-291	10.61	0.77	86.2
J-367	11.26	4.29	86.3
J-269	10.33	0.69	86.4
J-1165	10	1.1	86.4
J-900	10	0	86.4
J-290	10	0	86.4
Mass Maritime	10	0	86.4
J-715	10	1.53	86.4
J-406	10	2.15	86.4
J-306	10.17	0.61	86.4
J-292	10	1.89	86.4
J-780	10	0.15	86.4
J-294	10	0.07	86.5
J-295	10	0.22	86.5
J-805	10	0.16	86.5
J-800	10	0.09	86.5
J-820	10	2.48	86.5
J-825	10	0.39	86.5
J-835	10	1.6	86.5
J-840	10	0.24	86.5
J-860	10	0.66	86.5
J-299	10	0.55	86.5
J-298	10	0	86.5
J-300	10	0	86.5
J-140	10	0	86.5
J-297	10	0.14	86.5
J-135	10	2.02	86.5
J-150	10	0.88	86.5
J-340	10	1.4	86.5
J-268	9.71	1.5	86.6
J-407	9.65	1.24	86.6
J-369	9.19	3.23	86.8
J-220	10	0.56	86.8
J-1415	10	0.71	86.8
J-1410	10	1.14	86.8
J-278	9	0	86.8
J-404	9.07	0	86.8
J-1080	10	0	86.8
J-1090	10	0	86.8
J-251	9	0.83	86.9
J-145	9	0.85	86.9
J-362	9.35	0	87.1
J-287	7	0	87.3

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-386	8	0.2	87.3
J-376	8	0.52	87.7
J-363	8.08	0	87.7
J-383	7	0.6	87.7
J-384	7	0.79	87.7
J-412	7.07	0	87.8
J-387	7	2.41	87.8
J-970	5	0.48	88.2
J-975	5	0	88.5
J-910	5	0.85	88.5
J-977	5	0	88.5
J-277	5	0	88.5
J-279	5	0	88.5
J-955	5	0.56	88.5
J-282	5	0.31	88.6
J-920	5	1.2	88.6
J-289	5	0.39	88.6
J-980	5	1.08	88.6
J-935	5	0.58	88.6
J-288	5	0.35	88.6
J-371	5	1.13	88.6
J-925	5	1.03	88.6
J-370	5	1.1	88.6
J-950	5	1.09	88.6
J-930	5	0.74	88.6
J-915	5	0.28	88.6
J-905	5	0.05	88.6
J-940	5	0.13	88.6
J-830	5	0.54	88.6
J-385	5	0.46	88.6
J-419	5.86	0	88.7
J-125	5	0	88.7
J-303	4.5	1.67	88.9
J-364	5	4.29	89
J-1200	5	0	89
J-1205	5	0	89
J-395	3	0.68	89.9
J-286	0	31.4	90.1
J-283	0	30.64	90.1
J-296	1.03	0.68	90.4
J-405	0.76	1.57	90.4
J-281	0	30.31	90.7
J-280	0	0	90.7
J-337	0	0.46	90.7
J-242	0	0	90.8

Junction Input Data
Capital Improvements and Asset Management Plan
Buzzards Bay Water District

Label	Elevation (ft)	Demand (gpm)	Pressure (psi)
J-241	0	0	90.8
J-416	0	0	90.8
J-266	0	2.09	90.8
J-411	0	0	90.8
J-301	0	0.65	90.8
J-408	0	0.98	90.8
J-426	0	0	90.8
J-410	0	0	90.8
J-253	0	0.69	90.8
J-427	0	0	90.8
J-6020	0	0.96	90.8
J-6010	0	0.01	90.8
J-311	0	0.22	90.9
J-310	0	3.35	90.9
J-323	0	2.53	90.9
J-321	0	3.39	90.9
J-325	0	1.68	90.9
J-327	0	1.26	90.9
J-318	0	1.47	90.9
J-271	0	0	90.9
J-423	0	0	91
J-359	0	1.67	91.1
J-353	0	0.83	91.1
J-424	0	0	91.1
J-429	0	0	91.2
J-430	0	0	91.2
J-425	0	0	91.2
J-421	0	0	91.3
J-422	0	0	91.3

Tank Input Data
Capital Improvements and Asset Management Plan
Buzzards Bay Water District

Label	Diameter (ft)	Elevation (Base) (ft)	Elevation (Maximum) (ft)	Elevation (Initial) (ft)
Stand Pipe	46	130	215	210
Hydropillar	10	53	215	210

Pump Input Data
Capital Improvements and Asset Management Plan
Buzzards Bay Water District

Label	Elevation (ft)	Hydraulic Grade (Discharge) (ft)	Head (Design) (ft)	Flow (design) (gpm)	Pump Head (ft)	Flow (Absolute) (gpm)
Pump Definition - 2 (Pump Station #2)	12	216.47	241.18	268	217.92	298
Pump Definition - 3 (Pump Station #3)	32	210.95	225	510	224.84	510.87
Pump Definition - 4 (Pump Station #4)	48	210.95	226	375	226.52	375.94
Pump Definition - 5 (Pump Station #1)	30	211.38	252.93	230	211.55	327

Appendix C

TATA & HOWARD

PLYMOUTH
WAREHAM
BOURNE
N
7. Birch Street and Mildred Street New 8-inch Water Main
7. Nickerson Street New 8-inch Water Main
7. Cypress Street New 8-inch Water Main
7. Archer Street New 8-inch Water Main
7. Walnut Street New 8-inch Water Main
7. Buttonwood Lane New 8-inch Water Main
6. Knoxview Road New 8-inch Water Main
6. Bog View Drive New 8-inch Water Main
6. Hideaway Road and Nautical Way New 8-inch Water Mains
Pump Station No. 1
Pump Station No. 4
Pump Station No. 3 and Well No.5
1. Along Route 25 New 12-inch Water Main
2. Lewis Point Road New 8-inch Water Main
Pump Station No. 2
Standpipe Capacity: 1.0 mg Overflow Elevation: 215 feet
Hydropillar Capacity: 1.0 mg Overflow Elevation: 215 feet
5. Lafayette Avenue New 8-inch Water Main
4. Old Bridge Road New 8-inch Water Mains
Interconnection with Wareham
7. Sunset Lane New 8-inch Water Main
3. Buttermilk Way and Bay Drive New 8-inch Water Mains
Legend
Hydraulic Deficiencies
Priority 1
Priority 2
Water Main Diameter
4-inch or smaller
6-inch
8-inch
10-inch
12-inch
16-inch
Private
Hydraulic Deficiencies
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021

Appendix D

TATA & HOWARD

Critical Areas
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021
N
Legend
Critical Customer
Emergency
Medical
Nursing Home
School/Daycare
Critical Component
Water Main Diameter
4-inch or smaller
6-inch
8-inch
10-inch
12-inch
16-inch
Private
Railroad
Pump Station No. 1
Pump Station No. 2
Pump Station No. 3 and Well No.5
Pump Station No. 4
Standpipe
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Hydropillar
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Interconnection with Wareham
PLYMOUTH
WAREHAM
BOURNE
BOURNE
Weeks Pond
Mare Pond
Goat Pond
Ellis Pond
Queen Sewell Pond
Nightingale Pond
Bourne Pond
Sand Pond

Appendix E

TATA & HOWARD

Asset Management Scores
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021
Legend
Asset Management Score
Fair to Good
Good to Excellent
Poor to Fair
Private
PLYMOUTH
BOURNE
WAREHAM
Pump Station No. 1
Pump Station No. 2
Pump Station No. 3 and Well No. 5
Pump Station No. 4
Standpipe
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Hydropillar
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Interconnection with Wareham
Weeks Pond
Mare Pond
Goat Pond
Ellis Pond
Queen Sewell Pond
Nightingale Pond
Bourne Pond
Sand Pond
N

Appendix F

TATA & HOWARD

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Chemical Injection Facility	NaOCl/ ph Analyzer	Treatment	Analyzer		Good	0%	Major	2018	20.0		
Chemical Injection Facility	Electric Unit Heater	Treatment	Buildings		Good	0%	Moderate	2018	30.0		
Chemical Injection Facility	Electric Thermostat	Treatment	Buildings		Good	0%	Moderate	2018	20.0		
Chemical Injection Facility	Gas Unit Heater	Treatment	Buildings		Good	0%	Moderate	2018	30.0	UDAS	REZNOR
Chemical Injection Facility	Gas Thermostat	Treatment	Buildings		Good	0%	Moderate	2018	10.0		
Chemical Injection Facility	GUH-1 Exhaust Pipe	Treatment	Buildings		Good	0%	Moderate	2018	10.0		
Chemical Injection Facility	NaOCl Metering Pump	Treatment	Chemical Feed Pumps		Good	100%	Major	2018	20.0		
Chemical Injection Facility	NaOCl Metering Pump	Treatment	Chemical Feed Pumps		Good	100%	Major	2018	20.0		
Chemical Injection Facility	KOH Metering Pump	Treatment	Chemical Feed Pumps		Good	100%	Major	2018	20.0	MRA11-E105XCPPENNY	mRoy
Chemical Injection Facility	KOH Metering Pump	Treatment	Chemical Feed Pumps		Good	100%	Major	2018	20.0	MRA11-E105XCPPENNY	mRoy
Chemical Injection Facility	RTU	Treatment	Electrical Equipment		Good	0%	Major	2018	10.0		
Chemical Injection Facility	Pressure Gauge	Treatment	Instrument		Good	0%	Insignificant	2018	30.0		
Chemical Injection Facility	Sample Sink PRV	Treatment	Instrument		Good	0%	Insignificant	2018	10.0		
Chemical Injection Facility	Rotameter	Treatment	Instrument		Good	0%	Insignificant	2018	10.0		
Chemical Injection Facility	Water Heater Pressure Gauge	Treatment	Instrument		Good	0%	Insignificant	2018	10.0		
Chemical Injection Facility	Sample Water Meter	Treatment	Meters		Good	0%	Insignificant	2018	10.0		
Chemical Injection Facility	8" Magnetic Flow Meter	Treatment	Supply Meters	8"	Good	0%	Major	2018	20.0		
Chemical Injection Facility	Water Heater PRV	Treatment	Valves		Good	0%	Insignificant	2018	10.0		
Chemical Injection Facility	Water Heater	Treatment	Other	72 KW	Good	0%	Insignificant	2019	10.0		
Chemical Injection Facility	NaOCl Chemical Injector	Treatment	Chemical Feed Equipment		Good	0%	Moderate	2018	15.0		
Chemical Injection Facility	KOH Chemical Injector	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	15.0		
Chemical Injection Facility	Chemical Injector Shield	Treatment	Chemical Feed Equipment		Good	0%	Moderate	2018	15.0		
Chemical Injection Facility	Emergency Shower/Eyewash	Treatment	Treatment Equipment		Good	100%	Major	2018	15.0		Haws
Chemical Injection Facility	Roof	Treatment	Buildings		Good	0%	Major	2018	100.0		
Chemical Injection Facility	Propane Tank	Treatment	Concrete & Metal Storage Tanks	500 gal	Good	0%	Minor	2018	20.0		
Chemical Injection Facility	Exhaust Fan	Treatment	Buildings		Good	0%	Moderate	2018	20.0		
Chemical Injection Facility	Tankless Water Heater	Treatment	Buildings	72 KW	Good	0%	Major	2018	20.0	SpecAdvantage with PhD	FW Webb

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Chemical Injection Facility	NaOCl Metering Pump Control Panel	Treatment	Chemical Feed Equipment		Good	100%	Major	2018	20.0		
Chemical Injection Facility	NaOCl Metering Pump Control Panel	Treatment	Chemical Feed Equipment		Good	100%	Major	2018	20.0		
Chemical Injection Facility	KOH Metering Pump Control Panel	Treatment	Chemical Feed Equipment		Good	100%	Major	2018	20.0	X71	CTI Dynamix
Chemical Injection Facility	KOH Metering Pump Control Panel	Treatment	Chemical Feed Equipment		Good	100%	Major	2018	20.0	X71	CTI Dynamix
Chemical Injection Facility	KOH Bulk Tank	Treatment	Chemical Feed Equipment	3000 gal	Good	0%	Major	2018	20.0		Poly Processing
Chemical Injection Facility	KOH Day Tank	Treatment	Chemical Feed Equipment	230 gal	Good	0%	Major	2018	20.0		Poly Processing
Chemical Injection Facility	NaOCl Bulk Tank	Treatment	Chemical Feed Equipment	325 gal	Good	0%	Major	2018	20.0		Poly Processing
Chemical Injection Facility	NaOCl Day Tank	Treatment	Chemical Feed Equipment	55 gal	Good	0%	Major	2018	20.0		Poly Processing
Chemical Injection Facility	NaOCl Bulk Tank Vent	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	NaOCl Day Tank Vent	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	KOH Bulk Tank Vent	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	KOH Day Tank Vent	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	NaOCl Fill Station	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	KOH Fill Station	Treatment	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	KOH Bulk Tank Overflow	Treatment	Chemical Feed Equipment		Good	0%	Insignificant	2018	20.0		
Chemical Injection Facility	NaOCl Bulk Tank Overflow	Treatment	Chemical Feed Equipment		Good	0%	Insignificant	2018	20.0		
Chemical Injection Facility	Lighting Ballast (9)	Treatment	Electrical Equipment		Good	0%	Insignificant	2018	20.0		
Chemical Injection Facility	Intake Louver	Treatment	Intake Structures		Good	0%	Moderate	2018	20.0		Greenheck
Chemical Injection Facility	Sample Sink	Treatment	Lab / Monitoring Equipment		Good	0%	Insignificant	2018	20.0		
Chemical Injection Facility	NaOCl Transfer Pump Control Panel	Treatment	Pumping Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	KOH Transfer Pump Control Panel	Treatment	Pumping Equipment		Good	0%	Major	2018	20.0		
Chemical Injection Facility	NaOCl Transfer Pump	Treatment	Pumps	18 GPM	Good	0%	Major	2018	20.0	KM-510-1/4T1	Sethco
Chemical Injection Facility	KOH Transfer Pump	Treatment	Pumps	50 GPM	Good	0%	Major	2018	20.0	PM-1035NT-3/4T1	Sethco
Chemical Injection Facility	Double Cantilever Slide Gate	Treatment	Security Equipment	40'	Good	0%	Minor	2018	20.0		
Chemical Injection Facility	Power Panel Board	Treatment	Transformers / Switchgears / Wiring		Good	0%	Catastrophic	2018	20.0		
Chemical Injection Facility	Lighting Panel Board	Treatment	Transformers / Switchgears / Wiring		Good	0%	Major	2018	20.0		
Chemical Injection Facility	Transformer Board	Treatment	Transformers / Switchgears / Wiring		Good	0%	Major	2018	20.0		

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Chemical Injection Facility	Building	Treatment	Buildings		Good	0%	Major	2018	75.0		
Chemical Injection Facility	Double Door	Treatment	Buildings		Good	0%	Moderate	2018	50.0		
Chemical Injection Facility	Gutters	Treatment	Buildings		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Attic Door	Treatment	Buildings		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	FRP Railing	Treatment	Buildings		Good	0%	Minor	2018	50.0		
Chemical Injection Facility	Tank Concrete Pads	Treatment	Buildings		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Hydrant	Treatment	Hydrants		Good	100%	Minor	2018	50.0		
Chemical Injection Facility	Hydrant	Treatment	Hydrants		Good	100%	Minor	2018	50.0		
Chemical Injection Facility	Smooth Nosed Sample Tap W/ Ball Valve	Treatment	Lab / Monitoring Equipment		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Dry Well	Treatment	Other	6' diameter	Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Chain Link Fence	Treatment	Security Equipment		Good	0%	Minor	2018	50.0		
Chemical Injection Facility	Double Pipe Swing Gate	Treatment	Security Equipment	30'	Good	0%	Minor	2018	50.0		
Chemical Injection Facility	Double Gate	Treatment	Security Equipment	12'	Good	0%	Minor	2018	50.0		
Chemical Injection Facility	Double Gate	Treatment	Security Equipment	12'	Good	0%	Minor	2018	50.0		
Chemical Injection Facility	Hydrant Gate Valve	Treatment	Valves		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Hydrant Gate Valve	Treatment	Valves		Good	0%	Insignificant	2018	50.0		
Chemical Injection Facility	Building Envelope	Treatment	Buildings		Good	0%	Major	2018	80.0		
Hydropillar	Control Panel	Storage	Concrete & Metal Storage Tanks		Good	0%	Major	2017	20.0		
Hydropillar	Surge Protection Box	Storage	Concrete & Metal Storage Tanks		Good	0%	Major	2017	20.0		
Hydropillar	SCADA Panel	Storage	Concrete & Metal Storage Tanks		Good	0%	Moderate	2017	20.0		
Hydropillar	LED Lights	Storage	Concrete & Metal Storage Tanks		Good	0%	Minor	2017	20.0		
Hydropillar	Tank	Storage	Concrete & Metal Storage Tanks		Good	0%	Catastrophic	2001	80.0		
Pump Station No. 1 Building A	Louvre	Pumping Facility	Buildings		Good	50%	Moderate	1981	30.0		
Pump Station No. 1 Building A	Exhaust Fan	Pumping Facility	Buildings		Good	0%	Minor	1981	30.0		
Pump Station No. 1 Building A	Pump	Pumping Facility	Pumps		Good	0%	Major	1981	35.0	DWT Ser:111921	Gould
Pump Station No. 1 Building A	Pump Motor	Pumping Facility	Pumps	30 HP	Good	0%	Major	1981	30.0	V06-V12103696T	US Electric
Pump Station No. 1 Building A	Pressure Gauge	Pumping Facility	Pumping Equipment		Good	0%	Minor	1981	30.0		Weiss

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Pump Station No. 1 Building A	Level Gauge	Pumping Facility	Pumping Equipment		Good	0%	Moderate	1981	20.0		
Pump Station No. 1 Building A	Check Valve	Pumping Facility	Pumping Equipment	6"	Good	0%	Major	1981	30.0		
Pump Station No. 1 Building A	Propane Heater	Pumping Facility	Buildings	36500 BTU	Good	0%	Moderate	1992	25.0	EX38CTP	Rinnai
Pump Station No. 1 Building A	Totalizer	Pumping Facility	Pumping Equipment	6"	Good	0%	Major	1992	20.0	Mag 5000	Siemens
Pump Station No. 1 Building A	Emergency Light	Pumping Facility	Buildings		Good	0%	Minor	1981	25.0		
Pump Station No. 1 Building A	MCC	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	1992	25.0	Cutler Hammer	Eaton
Pump Station No. 1 Building A	Electrical Panel	Pumping Facility	Electrical Equipment		Good	0%	Catastrophic	1992	25.0		
Pump Station No. 1 Building A	Alarm	Pumping Facility	Security Equipment		Good	0%	Major	1992	25.0		
Pump Station No. 1 Building A	VFD	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	1992	10.0	AF-300 F11	Fuji Electirc
Pump Station No. 1 Building A	Building A	Pumping Facility	Buildings		Good	0%	Major	1981	75.0		
Pump Station No. 1 Building A	Chain Fence	Pumping Facility	Security Equipment	8'	Good	0%	Minor	1981	50.0		
Pump Station No. 1 Building A	Generator	Pumping Facility	Generators		Good	0%	Major	1981	50.0	F2TE-6015-BA	Ford
Pump Station No. 1 Building A	Right Angle Drive	Pumping Facility	Pumping Equipment	30 HP	Good	0%	Major	1981	50.0	C60A186198	Amarillo
Pump Station No. 1 Building A	Butterfly Valve	Pumping Facility	Pumping Equipment	6"	Good	0%	Insignificant	1981	50.0		Clow
Pump Station No. 1 Building A	SCADA Panel	Pumping Facility	Pumping Equipment		Good	0%	Major	2016	20.0		Aquatrol
Pump Station No. 1 Building A	Light Ballasts (4)	Pumping Facility	Buildings		Good	0%	Insignificant	2019	20.0	LED	
Pump Station No. 1 Building A	Pressure Gauge	Pumping Facility	Pumping Equipment		Good	0%	Minor	2019	20.0	IGP10-A22D1F	Invensys
Pump Station No. 1 Building A	Propane Tank	Pumping Facility	Concrete & Metal Storage Tanks	1,000 gal	Good	0%	Moderate	2020	20.0		
Pump Station No. 1 Building A	Well	Pumping Facility	Wells		Good	0%	Major	1981	75.0		
Pump Station No. 1 Building B	Building A	Treatment	Buildings		Fair (Average)	0%	Major	1937	75.0	Brick	
Pump Station No. 1 Building B	Propane Heater	Treatment	Buildings		Good	0%	Moderate	1992	25.0		Empire
Pump Station No. 1 Building B	Free Chlorine display	Treatment	Chemical Feed Equipment		Good	0%	Minor	1992	20.0	Q46	ATI
Pump Station No. 1 Building B	Chlorine Meter Pump	Treatment	Chemical Feed Equipment		Good	0%	Moderate	1992	20.0		Milton Roy
Pump Station No. 1 Building B	Circuit Panel	Treatment	Electrical Equipment		Good	0%	Catastrophic	1992	30.0		Squre D
Pump Station No. 1 Building B	Transfer Switch	Treatment	Electrical Equipment		Good	0%	Moderate	1992	20.0		Kohler
Pump Station No. 1 Building B	Generator Disconnect	Treatment	Electrical Equipment		Good	0%	Minor	1992	20.0		Eaton
Pump Station No. 1 Building B	Propane Heater	Treatment	Buildings		Good	0%	Moderate	1992	25.0		Hot Dawg

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Pump Station No. 1 Building B	Thermostat	Treatment	Buildings		Good	0%	Minor	1992	20.0		Pro
Pump Station No. 1 Building B	Emergency Alarm Panel	Treatment	Electrical Equipment		Good	0%	Major	1992	20.0		
Pump Station No. 1 Building B	Chlorine Tank	Treatment	Chemical Feed Equipment		Good	0%	Major	1992	25.0		
Pump Station No. 1 Building B	KOH Fill	Treatment	Chemical Feed Equipment		Good	0%	Moderate	1993	20.0		
Pump Station No. 1 Building B	KOH Meter Pump	Treatment	Chemical Feed Equipment		Excellent	0%	Major	2020	20.0		Milton Roy
Pump Station No. 1 Building B	Transfer Pump Motor	Treatment	Chemical Feed Equipment		Excellent	0%	Moderate	2020	20.0		Leeson
Pump Station No. 1 Building B	Transfer Pump	Treatment	Chemical Feed Equipment		Excellent	0%	Moderate	2020	10.0		FII
Pump Station No. 1 Building B	SCADA	Treatment	Lab / Monitoring Equipment		Good	0%	Major	2018	20.0		
Pump Station No. 1 Building B	Chemical Feed Pump Switches	Treatment	Chemical Feed Equipment		Excellent	0%	Major	2020	20.0		R.E. Erickson
Pump Station No. 1 Building B	KOH Bulk Tank	Treatment	Chemical Feed Equipment		Excellent	0%	Major	2020	25.0		
Pump Station No. 1 Building B	KOH Day Tank	Treatment	Chemical Feed Equipment		Excellent	0%	Major	2020	25.0		
Pump Station No. 1 Building B	Transfer Pump Switch	Treatment	Chemical Feed Equipment		Excellent	0%	Moderate	2020	20.0		Electrical Installations Inc.
Pump Station No. 1 Building B	Generator	Treatment	Generators	17 KW	Good	0%	Major	1992	50.0	Fast Respond II	Kohler
Pump Station No. 1 Building B	Sink	Treatment	Buildings		Good	0%	Insignificant	1992	50.0		
Pump Station No. 2	Electric Space Heater	Pumping Facility	Buildings		Good	50%	Minor	1992	35.0		
Pump Station No. 2	Propane Tank	Pumping Facility	Buildings	1,000 gal	Good	0%	Moderate	1992	20.0		
Pump Station No. 2	Peerless Pump	Pumping Facility	Pumps		Fair (Average)	0%	Major	1992	30.0		Peerless
Pump Station No. 2	Eye Wash Station	Pumping Facility	Buildings		Good	0%	Insignificant	1992	20.0		
Pump Station No. 2	Check Valve	Pumping Facility	Buildings	8"	Good	0%	Major	1992	30		GA Industries
Pump Station No. 2	KOH Fill	Pumping Facility	Chemical Feed Equipment		Poor	0%	Moderate	1993	20.0		
Pump Station No. 2	KOH Bulk Tank	Pumping Facility	Chemical Feed Equipment		Fair (Average)	0%	Major	1993	25.0		
Pump Station No. 2	KOH Day Tank	Pumping Facility	Chemical Feed Equipment		Good	0%	Major	1993	25.0		
Pump Station No. 2	Storage Tank Vent	Pumping Facility	Chemical Feed Equipment		Good	0%	Major	1993	20.0		
Pump Station No. 2	Chem Feed Control Box	Pumping Facility	Chemical Feed Equipment		Good	0%	Moderate	1993	20.0		
Pump Station No. 2	Security System	Pumping Facility	Security Equipment		Good	0%	Minor	1993	20.0		
Pump Station No. 2	MCC	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	1992	25.0		
Pump Station No. 2	VFD	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	2006	10.0		

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Pump Station No. 2	Space Heater	Pumping Facility	Buildings		Good	50%	Moderate	2015	20.0		Hot Dawg
Pump Station No. 2	Pump Motor	Pumping Facility	Pumps	30 HP	Good	0%	Major	2016	35.0	FB99	NEMA Premium
Pump Station No. 2	Chlorine Tank	Pumping Facility	Chemical Feed Equipment		Good	0%	Moderate	2018	20.0		
Pump Station No. 2	SCADA Panel	Pumping Facility	Motor Controls / Drives		Good	0%	Major	2018	20.0		
Pump Station No. 2	Mag Meter	Pumping Facility	Pumping Equipment	8"	Good	0%	Major	2019	20.0		Krohne
Pump Station No. 2	Chain Link Fence	Pumping Facility	Security Equipment	8'	Good	0%	Minor	1992	50.0		
Pump Station No. 2	Butterfly Valve	Pumping Facility	Pumping Equipment		Good	0%	Minor	1992	50.0		
Pump Station No. 2	Generator	Pumping Facility	Generators		Good	0%	Major	2006	50.0		Kohler
Pump Station No. 2	Building	Pumping Facility	Buildings		Good	0%	Major	1966	100.0		
Pump Station No. 3	Mag Meter	Pumping Facility	Pumping Equipment	6"	Good	0%	Insignificant	2016	10.0	Mag-5000	Siemens
Pump Station No. 3	Generator Breaker	Pumping Facility	Electrical Equipment		Good	0%	Major	2018	20.0		
Pump Station No. 3	ATS	Pumping Facility	Transformers / Switchgears / Wiring		Good	0%	Major	2018	20.0		
Pump Station No. 3	LP Gas Unit Heater	Pumping Facility	Buildings		Good	0%	Minor	2018	20.0	V3SC	Reznar
Pump Station No. 3	Thermostat	Pumping Facility	Buildings		Good	0%	Minor	2018	20.0		
Pump Station No. 3	Exhaust Fan	Pumping Facility	Buildings		Good	0%	Minor	2018	20.0		
Pump Station No. 3	Propane Tank	Pumping Facility	Concrete & Metal Storage Tanks	2,000 gal	Good	0%	Moderate	2018	20.0		
Pump Station No. 3	Pump	Pumping Facility	Pumps	600 GPM	Good	0%	Major	2018	35.0		
Pump Station No. 3	Motor	Pumping Facility	Pumps	60 HP	Good	0%	Major	2018	35.0	BF56A	Emerson Motors
Pump Station No. 3	Butterfly Valve	Pumping Facility	Valves	6"	Good	0%	Insignificant	2011	30.0		
Pump Station No. 3	Well No. 5 VFD	Pumping Facility	Electrical Equipment		Good	0%	Major	2018	10.0		
Pump Station No. 3	Pump Station No. 3 VFD	Pumping Facility	Electrical Equipment		Good	0%	Major	2018	10.0		
Pump Station No. 3	MCC-A	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	2018	25.0	Freedom 2100	Eaton
Pump Station No. 3	Main Circuit Breaker	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	2018	25.0		
Pump Station No. 3	Hydrant Gate Valve	Pumping Facility	Valves		Good	0%	Insignificant	2018	25.0		
Pump Station No. 3	Gate Valve	Pumping Facility	Valves	12'	Good	0%	Insignificant	2018	25.0		
Pump Station No. 3	Gate Valve	Pumping Facility	Valves	8"	Good	0%	Insignificant	2018	25.0		
Pump Station No. 3	Digital Pressure Gauge	Pumping Facility	Pumping Equipment		Good	0%	Insignificant	2016	30.0	IGP10-A22D1F	Invensys

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Pump Station No. 3	Electric Gas Vaporizor	Pumping Facility	Pumping Equipment		Good	0%	Major	2018	30.0		
Pump Station No. 3	Standby Generator	Pumping Facility	Generators	240 KW	Good	0%	Major	2018	50.0	350REZXB	Kohler
Pump Station No. 3	Hydrant	Pumping Facility	Hydrants		Good	0%	Minor	2018	50.0		
Pump Station No. 3	Sample Sink	Pumping Facility	Lab / Monitoring Equipment		Good	0%	Insignificant	2018	50.0		
Pump Station No. 3	Building	Pumping Facility	Pumping Equipment		Good	0%	Major	2018	75.0		
Pump Station No. 3	Building Envelope	Pumping Facility	Pumping Equipment		Good	0%	Major	2018	75.0		
Pump Station No. 3	Chain Link Fence w/ Barbed Wire	Pumping Facility	Security Equipment	8'	Good	0%	Minor	2018	50.0		
Pump Station No. 3	Double Gate	Pumping Facility	Security Equipment	12'	Good	0%	Minor	2018	50.0		
Pump Station No. 3	Double Gate	Pumping Facility	Security Equipment	12'	Good	0%	Minor	2018	50.0		
Pump Station No. 3	Well	Source	Wells	24"x48"	Good	0%	Major	1988	75.0		
Pump Station No. 4	Electric Heater	Pumping Facility	Buildings		Good	0%	Insignificant	1988	35.0		
Pump Station No. 4	Emergency Light	Pumping Facility	Electrical Equipment		Good	0%	Minor	1988	20.0		
Pump Station No. 4	Pressure Gauge	Pumping Facility	Pumping Equipment		Good	0%	Minor	1988	30.0		H.O.
Pump Station No. 4	Vent Motor	Pumping Facility	Buildings		Good	0%	Minor	1988	20.0		Honeywell
Pump Station No. 4	MCC	Pumping Facility	Motor Controls / Drives		Good	0%	Catastrophic	1988	25.0	8000 Line	General Electric
Pump Station No. 4	KOH Bulk Tank	Pumping Facility	Chemical Feed Equipment	500 Gal	Good	0%	Major	1993	25.0		
Pump Station No. 4	Propane Tank	Pumping Facility	Buildings		Fair (Average)	0%	Moderate	1997	20.0		
Pump Station No. 4	Chlorine Pump	Pumping Facility	Chemical Feed Pumps		Good	0%	Major	2016	20.0		
Pump Station No. 4	Free Chlorine Monitor	Pumping Facility	Treatment Equipment		Good	0%	Moderate	2016	20.0	Q46	ATI
Pump Station No. 4	KOH Pump	Pumping Facility	Chemical Feed Pumps		Good	0%	Major	2016	20.0	C911460SI	Milton Roy
Pump Station No. 4	Pump Motor	Pumping Facility	Pumping Equipment		Good	0%	Major	2016	35.0	DT93	NEMA Premium
Pump Station No. 4	KOH Day Tank	Pumping Facility	Chemical Feed Equipment	55 Gal	Good	0%	Major	2016	25.0		
Pump Station No. 4	Chain Link Fence	Pumping Facility	Security Equipment		Good	0%	Minor	1988	50.0		
Pump Station No. 4	Building	Pumping Facility	Buildings		Good	0%	Major	1988	75.0		
Pump Station No. 4	LED Light Ballasts	Pumping Facility	Electrical Equipment		Good	0%	Minor	2018	20.0		
Pump Station No. 4	Propane Space Heater	Pumping Facility	Buildings		Good	0%	Minor	2018	20.0		Hawt Dawg
Pump Station No. 4	Emergency Alarm Panel	Pumping Facility	Security Equipment		Good	0%	Major	2018	20.0		

Location	Asset Name	AssetCategory	Asset Class	Asset Size	Condition	Redundancy	CoF	Installation Date	Expected Useful Life	Model Number	Manufacturer
Pump Station No. 4	Chem Feed Pump Switches	Pumping Facility	Treatment Equipment		Good	0%	Major	2018	20.0		R.E.Erickson Co.
Pump Station No. 4	KOH Fill Pipe	Pumping Facility	Chemical Feed Equipment		Good	0%	Major	2018	20.0		
Pump Station No. 4	Generator	Pumping Facility	Generators	4 Cyl	Good	0%	Major	1997	50.0	4 Cyl	Ford
Pump Station No. 4	Chemical Taps	Pumping Facility	Treatment Equipment		Good	0%	Major	1993	20.0		
Pump Station No. 4	Pump	Pumping Facility	Pumps	60 HP	Good	0%	Major	1988	30.0	106708CH60	Crane Johnson
Pump Station No. 4	Check Valve	Pumping Facility	Valves	8"	Good	0%	Major	2012	30.0		
Pump Station No. 4	Pressure Gauge	Pumping Facility	Pumping Equipment		Good	0%	Minor	2012	30.0	IGP10-A22D1F	Invensys
Pump Station No. 4	SCADA Panel	Pumping Facility	Computer Equipment / Software		Good	0%	Major	2014	20.0		
Pump Station No. 4	Butterfly Valve	Pumping Facility	Valves		Good	0%	Major	1988	50.0		
Pump Station No. 4	VFD	Pumping Facility	Pumping Equipment		Good	0%	Catastrophic	2017	10.0	AF 300 F11	Fuji
Pump Station No. 4	Mag Meter	Pumping Facility	Pumping Equipment	6"	Good	0%	Major	2019	25.0	Mag 5000	Siemens
Standpipe	Heater	Storage	Concrete & Metal Storage Tanks		Good	0%	Moderate	2016	15.0	Plug in	
Standpipe	Heater	Storage	Concrete & Metal Storage Tanks		Good	100%	Moderate	2016	15.0	Plug in	
Standpipe	SCADA Cabinet	Storage	Concrete & Metal Storage Tanks		Good	0%	Major	2016	20.0		
Standpipe	Tank	Storage	Concrete & Metal Storage Tanks		Good	0%	Catastrophic	1965	80.0		
Standpipe	Sample Box	Storage	Concrete & Metal Storage Tanks		Good	0%	Moderate	2016	100.0		
Well No. 5	Pump	Pumping Facility	Pumping Equipment	820 GPM	Good	0%	Major	2018	35.0	VIS-WF 9RCLC	GOULDS
Well No. 5	Motor	Pumping Facility	Pumping Equipment	75 HP	Good	0%	Major	2018	35.0		CentiPro
Well No. 5	Chain Link Fence	Pumping Facility	Security Equipment	8'	Good	0%	Minor	2018	50.0		
Well No. 5	Wide Double Swing Gate	Pumping Facility	Security Equipment	12'	Good	0%	Minor	2018	50.0		
Well No. 5	Gravel Access Road	Pumping Facility	Buildings		Good	0%	Moderate	2018	100.0		
Well No. 5	Well	Source	Wells	18" diameter	Good	0%	Major	2018	75.0		

Appendix G

TATA & HOWARD

Priority List of Assets
Infrastructure Inventory and Assessment
Buzzards Bay Water District

AssetName*	Location*	Condition*	Redundancy*	CoF*	Installation Date	Repalcement Year	Cost	Capital/ Maintenance
KOH Fill	Pump Station No. 2	Poor	0%	Moderate	1993	2013	$ 2,000.00	Maintenance
Building B	Pump Station No. 1 Building B	Fair (Average)	0%	Major	1937	2012	$ 20,000.00	Maintenance
KOH Bulk Tank	Pump Station No. 2	Fair (Average)	0%	Major	1993	2018	$ 6,000.00	Maintenance
Propane Tank	Pump Station No. 4	Fair (Average)	0%	Moderate	1997	2017	$ 2,000.00	Capital
VFD	Pump Station No. 1 Building A	Good	0%	Catastrophic	1992	2002	$ 10,000.00	Capital
MCC	Pump Station No. 4	Good	0%	Catastrophic	1988	2013	$ 70,000.00	Maintenance
VFD	Pump Station No. 2	Good	0%	Catastrophic	2006	2016	$ 10,000.00	Capital
MCC	Pump Station No. 1 Building A	Good	0%	Catastrophic	1992	2017	$ 70,000.00	Maintenance
Electrical Panel	Pump Station No. 1 Building A	Good	0%	Catastrophic	1992	2017	$ 5,000.00	Maintenance
MCC	Pump Station No. 2	Good	0%	Catastrophic	1992	2017	$ 70,000.00	Capital
Pump Motor	Pump Station No. 1 Building A	Good	0%	Major	1981	2011	$ 10,000.00	Maintenance
Check Valve	Pump Station No. 1 Building A	Good	0%	Major	1981	2011	$ 5,000.00	Maintenance
Totalizer	Pump Station No. 1 Building A	Good	0%	Major	1992	2012	$ 5,000.00	Capital
Emergency Alarm Panel	Pump Station No. 1 Building B	Good	0%	Major	1992	2012	$ 2,000.00	Maintenance
Storage Tank Vent	Pump Station No. 2	Good	0%	Major	1993	2013	$ 5,000.00	Maintenance

Priority List of Assets
Infrastructure Inventory and Assessment
Buzzards Bay Water District

AssetName*	Location*	Condition*	Redundancy*	CoF*	Installation Date	Repalcement Year	Cost	Capital/ Maintenance
Chemical Taps	Pump Station No. 4	Good	0%	Major	1993	2013	$ 3,000.00	Capital
Pump	Pump Station No. 1 Building A	Good	0%	Major	1981	2016	$ 25,000.00	Maintenance
Chlorine Tank	Pump Station No. 1 Building B	Good	0%	Major	1992	2017	$ 3,000.00	Maintenance
Alarm	Pump Station No. 1 Building A	Good	0%	Major	1992	2017	$ 2,000.00	Maintenance
KOH Day Tank	Pump Station No. 2	Good	0%	Major	1993	2018	$ 3,000.00	Maintenance
KOH Bulk Tank	Pump Station No. 4	Good	0%	Major	1993	2018	$ 6,000.00	Maintenance
Pump	Pump Station No. 4	Good	0%	Major	1988	2018	$ 10,000.00	Maintenance
Level Gauge	Pump Station No. 1 Building A	Good	0%	Moderate	1981	2001	$ 500.00	Maintenance
Chlorine Meter Pump	Pump Station No. 1 Building B	Good	0%	Moderate	1992	2012	$ 5,000.00	Maintenance
Transfer Switch	Pump Station No. 1 Building B	Good	0%	Moderate	1992	2012	$ 7,000.00	Capital
Propane Tank	Pump Station No. 2	Good	0%	Moderate	1992	2012	$ 2,000.00	Maintenance
KOH Fill	Pump Station No. 1 Building B	Good	0%	Moderate	1993	2013	$ 2,000.00	Maintenance
Chem Feed Control Box	Pump Station No. 2	Good	0%	Moderate	1993	2013	$ 2,000.00	Maintenance
Propane Heater	Pump Station No. 1 Building A	Good	0%	Moderate	1992	2017	$ 500.00	Maintenance
Propane Heater	Pump Station No. 1 Building B	Good	0%	Moderate	1992	2017	$ 500.00	Maintenance

Priority List of Assets
Infrastructure Inventory and Assessment
Buzzards Bay Water District

AssetName*	Location*	Condition*	Redundancy*	CoF*	Installation Date	Repalcement Year	Cost	Capital/ Maintenance
Propane Heater	Pump Station No. 1 Building B	Good	0%	Moderate	1992	2017	$ 2,000.00	Maintenance
Emergency Light	Pump Station No. 1 Building A	Good	0%	Minor	1981	2006	$ 1,000.00	Maintenance
Emergency Light	Pump Station No. 4	Good	0%	Minor	1988	2008	$ 1,000.00	Maintenance
Vent Motor	Pump Station No. 4	Good	0%	Minor	1988	2008	$ 1,000.00	Capital
Exhaust Fan	Pump Station No. 1 Building A	Good	0%	Minor	1981	2011	$ 1,500.00	Maintenance
Pressure Gauge	Pump Station No. 1 Building A	Good	0%	Minor	1981	2011	$ 500.00	Maintenance
Free Chlorine display	Pump Station No. 1 Building B	Good	0%	Minor	1992	2012	$ 1,500.00	Maintenance
Generator Disconnect	Pump Station No. 1 Building B	Good	0%	Minor	1992	2012	$ 500.00	Capital
Thermostat	Pump Station No. 1 Building B	Good	0%	Minor	1992	2012	$ 200.00	Maintenance
Security System	Pump Station No. 2	Good	0%	Minor	1993	2013	$ 10,000.00	Maintenance
Pressure Gauge	Pump Station No. 4	Good	0%	Minor	1988	2018	$ 500.00	Maintenance
Eye Wash Station	Pump Station No. 2	Good	0%	Insignificant	1992	2012	$ 1,000.00	Maintenance
Louvre	Pump Station No. 1 Building A	Good	50%	Moderate	1981	2011	$ 2,000.00	Maintenance

Appendix H

Secondary List of Assets
Infrastructure Inventory and Assessment
Buzzards Bay Water District

Asset Name	Location	Condition	Redundancy	CoF	Installation Date	Repalcement Year	Cost	Capital/ Maintenance
Peerless Pump	Pump Station No. 2	Fair (Average)	0%	Major	1992	2022	$25,000.00	Maintenance
Circuit Panel	Pump Station No. 1 Building B	Good	0%	Catastrophic	1992	2022	$5,000.00	Maintenance
VFD	Pump Station No. 4	Good	0%	Catastrophic	2017	2027	$10,000.00	Maintenance
Check Valve	Pump Station No. 2	Good	0%	Major	1992	2022	$2,500.00	Maintenance
RTU	Chemical Injection Facility	Good	0%	Major	2018	2028	$15,000.00	Capital
Well No. 5 VFD	Pump Station No. 3	Good	0%	Major	2018	2028	$10,000.00	Capital
Pump Station No. 3 VFD	Pump Station No. 3	Good	0%	Major	2018	2028	$10,000.00	Capital
Generator	Pump Station No. 1 Building A	Good	0%	Major	1981	2031	$30,000.00	Maintenance
Right Angle Drive	Pump Station No. 1 Building A	Good	0%	Major	1981	2031	$5,000.00	Maintenance
Gas Thermostat	Chemical Injection Facility	Good	0%	Moderate	2018	2028	$200.00	Capital
Pipe	Injection Facility	Good	0%	Moderate	2018	2028	$2,000.00	Capital
Heater	Standpipe	Good	0%	Moderate	2016	2031	$2,000.00	Capital
Chain Fence	Pump Station No. 1 Building A	Good	0%	Minor	1981	2031	$25,000.00	Maintenance
Electric Heater	Pump Station No. 4	Good	0%	Insignificant	1988	2023	$ 2,000.00	Maintenance
Mag Meter	Pump Station No. 3	Good	0%	Insignificant	2016	2026	$5,000.00	Capital
Sample Sink PRV	Chemical Injection Facility	Good	0%	Insignificant	2018	2028	$500.00	Maintenance

Secondary List of Assets
Infrastructure Inventory and Assessment
Buzzards Bay Water District

Asset Name	Location	Condition	Redundancy	CoF	Installation Date	Repalcement Year	Cost	Capital/ Maintenance
Rotameter	Chemical Injection Facility	Good	0%	Insignificant	2018	2028	$2,000.00	Maintenance
Water Heater Pressure Gauge	Chemical Injection Facility	Good	0%	Insignificant	2018	2028	$500.00	Capital
Sample Water Meter	Chemical Injection Facility	Good	0%	Insignificant	2018	2028	$2,000.00	Maintenance
Water Heater PRV	Chemical Injection Facility	Good	0%	Insignificant	2018	2028	$500.00	Maintenance
Water Heater	Chemical Injection Facility	Good	0%	Insignificant	2019	2029	$15,500.00	Maintenance
Butterfly Valve	Pump Station No. 1 Building A	Good	0%	Insignificant	1981	2031	$2,500.00	Capital
Electric Space Heater	Pump Station No. 2	Good	50%	Minor	1992	2027	$2,000.00	Maintenance
Heater	Standpipe	Good	100%	Moderate	2016	2031	$2,000.00	Capital
Transfer Pump	Pump Station No. 1 Building B	Excellent	0%	Moderate	2020	2030	$5,000.00	Maintenance

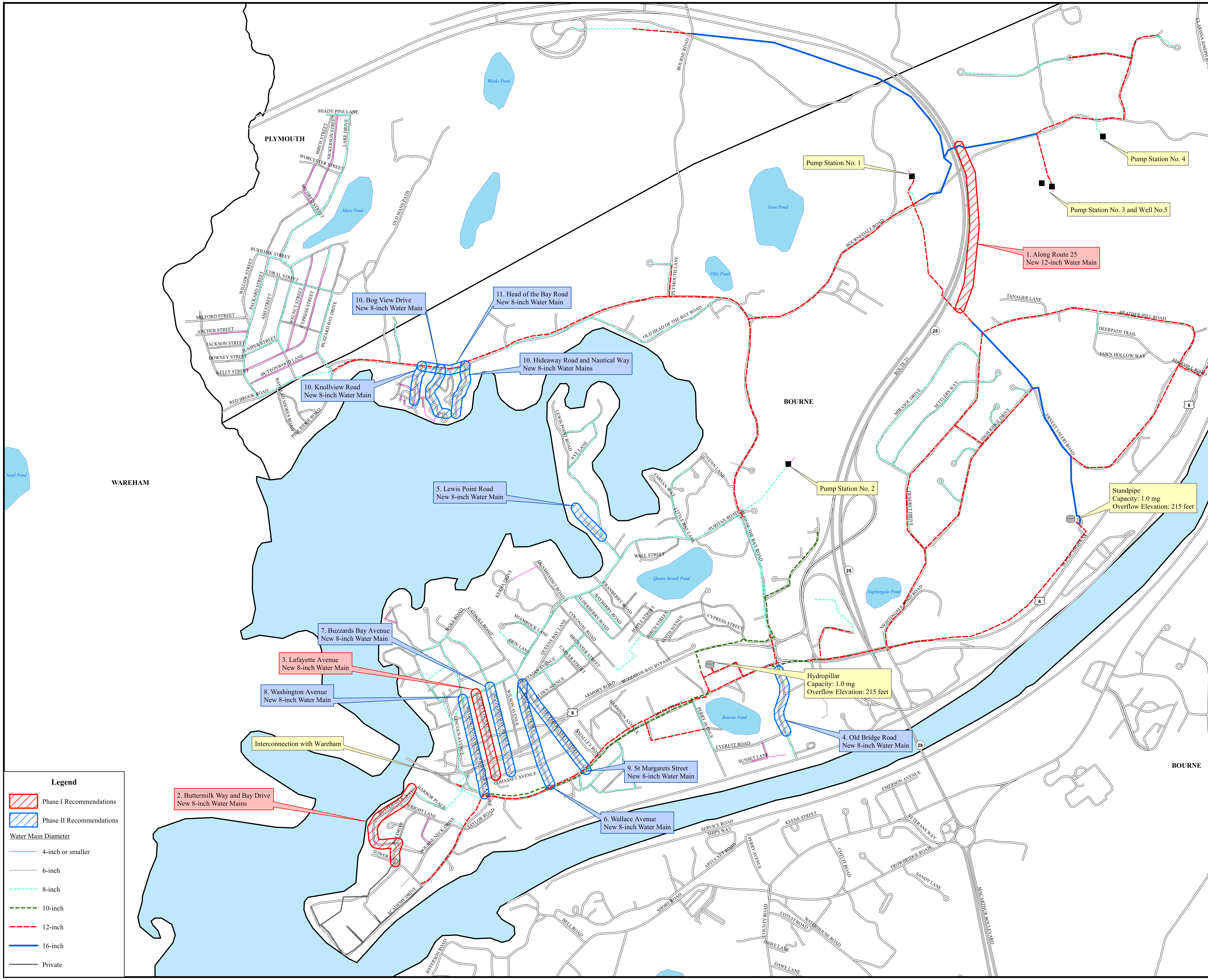
Appendix I

TATA & HOWARD

Three Circles Integration
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021
N
Legend
Critical Customer
Emergency
Medical
Nursing Home
School/Daycare
Critical Component
Hydraulic Deficiencies
Priority 1
Priority 2
Asset Management Score
Good to Excellent
Fair to Good
Poor to Fair
Private
Pump Station No. 1
Pump Station No. 2
Pump Station No. 3 and Well No. 5
Pump Station No. 4
Standpipe
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Hydropillar
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Interconnection with Wareham
PLYMOUTH
WAREHAM
BOURNE
BOURNE
Weeks Pond
Mare Pond
Goat Pond
Ellis Pond
Queen Sewell Pond
Nightingale Pond
Bourne Pond
Sand Pond

Appendix J

TATA & HOWARD



Phase I & II Recommendations
Buzzards Bay Water District

TATA & HOWARD

Approximate Scale: 1" = 700'

June 2021

PLYMOUTH
WAREHAM
BOURNE
N
12. Birch Street and Mildred Street
New 8-inch Water Main
12. Nickerson Street
New 8-inch Water Main
12. Walnut Street
New 8-inch Water Main
12. Cypress Street
New 8-inch Water Main
12. Archer Street
New 8-inch Water Main
12. Buttonwood Lane
New 8-inch Water Main
24. Old Head of the Bay Road
New 8-inch Water Main
26. Hideaway Village
New 6-inch Water Mains
26. Hideaway Village
New 6-inch Water Mains
22. Lewis Point Road
New 8-inch Water Main
14. Little Bay Lane
New 8-inch Water Main
25. Puritan Road
New 12-inch Water Main
23. Cross Country
New 6-inch Water Main
21. Wolf Road
New 8-inch Water Main
19. Rip Van Winkle Way
New 8-inch Water Main
Interconnection with Wareham
17. Wright Lane
New 8-inch Water Main
15. Bay Drive and Saltworks Lane
New 8-inch Water Main
13. Bourne Neck Drive and Tower Lane
New 8-inch Water Main
16. Taylor Road
New 8-inch Water Main
18. Plaza Lane
New 8-inch Water Main
20. Harrison Avenue
New 8-inch Water Main
12. Sunset Lane
New 8-inch Water Main
Pump Station No. 1
Pump Station No. 2
Pump Station No. 4
Pump Station No. 3 and Well No.5
Standpipe
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Hydropillar
Capacity: 1.0 mg
Overflow Elevation: 215 feet
Legend
Phase IIIA Recommendations
Phase IIIB Recommendations
Water Main Diameter
4-inch or smaller
6-inch
8-inch
10-inch
12-inch
16-inch
Private
Phase III Recommendations
Buzzards Bay Water District
TATA & HOWARD
Approximate Scale: 1" = 700'
June 2021

TATA & HOWARD

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

800-366-5760
www.tataandhoward.com