TATA & HOWARD
Water and Wastewater Consultants

June 10, 2013

Mr. John Walsh
Vice President, MA & NH Operations
Aquarion Water Company of Massachusetts
900 Main Street
Hingham, MA 02043

Subject: South Shore Industrial Park Demand and Supply Evaluation

Dear Mr. Walsh:

Tata & Howard is pleased to submit the South Shore Industrial Park (SSIP) Demand and Supply Evaluation. The evaluation includes a review of potential additional development south of Route 3 in Hingham and associated water demands. Additionally, the work includes an analysis of the infrastructure needed to serve this potential development

Existing Demands

The average day demand, maximum day demand, and summer average day demand for the years 2007 through 2011 are summarized in Table No. 1. The information presented was obtained directly from the Annual Statistical Reports submitted by Aquarion to the Massachusetts Department of Environmental Protection (MassDEP).

The **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 millions of gallons per day (mgd). This demand includes all water used for domestic (residential), commercial, industrial, agricultural, and municipal purposes. Municipal use includes water consumed by system maintenance such as hydrant flushing, fire flows, street-sweeping activities, fire fighting, cleaning storm drains, and construction. In addition, the ADD includes unaccounted-for-water, water lost to unmetered water uses, and system leakage. The unaccounted-for water percentage has ranged between approximately 12 percent to approximately 19 percent over the last five years. The ADD for Hingham, Hull, and northern Cohasset ranged between 3.08 and 3.48 mgd between 2007 and 2011.

The **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 million gallons per day. Typically, the MDD occurs during the summer months, when the seasonal population reaches its peak and temperatures are also at the annual peak. MDD is a critical factor to be considered when determining the adequacy of a water supply system. One criteria used to evaluate a water

distribution system is its ability to meet maximum day demands with coincident fire demands with sufficient residual pressures. Estimates of the projected maximum day demand and an allowance for the required fire flow are used to evaluate and design pumping, transmission, and storage facilities. As shown in Table No. 1, the maximum day demands ranged from 5.23 mgd to 6.86 mgd between 2007 and 2011.

The **summer average day demand (SADD)** is estimated by averaging the three maximum demand months for the past five years. The SADD peaking factor is determined by dividing the SADD by the average ADD for each of the past five years. These peaking factors are averaged to estimate the future summer peaking factor. The average SADD/ADD ratio from 2007 through 2011 is 1.28.

Table No. 1
Existing Demands[(a)]

Year	ADD (mgd)	MDD (mgd)	MDD/ADD Ratio	SADD (mgd)
2007	3.48	5.78	1.66	4.57
2008	3.20	6.86	2.14	4.26
2009	3.08	5.23	1.70	3.67
2010	3.30	5.82	1.76	4.15
2011	3.33	6.76	2.03	4.37

(a) Demand values are based on the amount of water used from Aquarion's sources of supply (i.e. wells and reservoir) in Hingham, and exclude the amount of water from the interconnection with Cohasset, which offsets water demands at Linden Ponds.

Projected Demands

The Massachusetts Department of Conservation and Recreation (DCR) projects water usage for Massachusetts communities. The DCR follows specific guidelines when making these projections. These guidelines incorporate trends in the use of water conservation devices in homes and industry, and emphasize the importance of monitoring the distribution system through water audits and leak detection surveys to reduce unaccounted-for water. It is important to note that the DCR has a key role in the water management approval process. Water demand projections through the year 2030 were completed for the Hingham, Hull, and northern Cohasset system by DCR in November 2009 as part of the WMA permitting process. Any alternative demand projections must 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. DCR estimated ADD projections for five year time blocks from 2015 to 2030 as presented in Table No. 2.

Table No. 2
Projected Demands

Year	ADD (mgd)	MDD/ADD Ratio	MDD (mgd)	SADD (mgd)
2015	3.75	2.14	8.03	4.80
2020	3.86	2.14	8.26	4.94
2025	3.91	2.14	8.37	5.00
2030	3.97	2.14	8.50	5.08

The ADD estimated by DCR is based on information provided by the Hingham, Hull, and Cohasset Planning Boards, Tata & Howard, and Aquarion Water Company. The information includes recently completed developments and planned growth within the water system boundaries as well as normal growth projections. The ADD does not include potential build-out of the system. It is unknown when build-out may occur for the SSIP area. Therefore, the following section includes an analysis of the projected 2030 demands with complete build-out of the water system south of Route 3 and includes the Bristol Brothers property and the Avalon Development.

The projected MDD through 2030 was estimated based on the maximum MDD/ADD ratio of 2.14 as observed in 2008. The projected SADD was estimated based on the average SADD/ADD ratio of 1.28 as observed between 2007 and 2011.

South Shore Industrial Park (SSIP) Build-Out

The Town of Hingham prepared a build-out analysis of the SSIP that included projections of ADD for properties in the SSIP. The analysis included a comparison of existing buildings to the available land area for growth and development using a Floor Area Ratio (FAR) of 25 percent. For properties with existing development, the projected ADD was estimated based on existing water usage at the property and a ratio of the existing building size and the potential building size for the parcel. For undeveloped properties, the projected ADD was estimated based on the potential use of the property and zoning.

Tata & Howard developed projections of MDD for properties in the SSIP. For properties with existing development, we utilized the maximum quarterly water usage to determine the estimated MDD/ADD ratio and subsequently the projected estimated MDD per property. It was assumed that the increase in water usage from one quarter to another was largely due to irrigation for the commercial properties. Therefore, because irrigation would not vary considerably by day over the course of a billing quarter, the quarterly maximum usage was assumed to be the MDD. For undeveloped properties, an average of the MDD/ADD ratio of 2.17 was used.

See Table No. 3 for the estimated demands per property. Based on the ADD water usage provided by the Town of Hingham, the total ADD for the build-out of the SSIP is approximately 0.14 mgd. The estimated MDD for the area at build-out is 0.32 mgd. A map showing the existing properties currently served by Aquarion and the additional SSIP existing and proposed properties is included in Figure No. 1.

Additional Demands

Based on discussions with the Town of Hingham, additional developments are anticipated in the SSIP Area by Bristol Brothers and Avalon. The Bristol Brothers property is in the vicinity of Derby Street and Whiting Street. The proposed use of the property is unknown at this time, however, the Town of Hingham estimates a total sewer use of approximately 0.15 mgd. Because of the potential for irrigation on the site, an additional 25 percent was added to the proposed sewer use resulting in an estimated ADD of approximately 0.19 mgd. Utilizing the average MDD/ADD ratio, the estimated MDD for the site is approximately 0.41 mgd.

The proposed Avalon Development is an apartment project to be located off Recreation Park Drive. Recent discussions indicate that this project might not be built; however, it has been left in this analysis to ensure demand projections are conservative. Reportedly, the development will include 175 units. Based on an average household size of 2.77 for the Town of Hingham and an estimated residential consumption of 65 gpcd, the estimated ADD for the development is approximately 0.03 mgd. Based on the ratios used previously, the corresponding MDD is approximately 0.07.

The proposed Bristol Brothers property and Avalon Development are shown in Figure No. 1.

Summary of Demands

The following table provides a summary of estimated projected demands for Hingham, Hull, and northern Cohasset through 2030 including build-out of the SSIP, Bristol Brothers property, and the Avalon Development.

Table No. 4
Projected Demands – Year 2030

Water Demands	ADD (mgd)	SADD (mgd)	MDD (mgd)
DCR Projections	3.97	5.08	8.50
South Shore Industrial Park	0.14	0.18	0.32
Bristol Brothers Property	0.19	0.25	0.41
Avalon Development	0.03	0.04	0.07
Totals	4.33	5.55	9.30

Water Supply Evaluation

In accordance with MassDEP, the supply sources of a water system must be capable of meeting existing and projected MDD conditions with all sources online, and existing and projected SADD conditions with the largest source out of service. In this section, the capacity of the sources of supply is compared to the current and projected water demands.

In 1987, the Water Management Act (WMA) program was implemented by MassDEP to regulate withdrawal of water from the state's watershed basins. An allowable water withdrawal referred to as registered withdrawal volume was determined for each public water supply based on historical pumping rates of the water supply source(s) between 1981 and 1985. The Aquarion Water Company has a WMA Registration (Registration No. 41913101) to withdraw water from the Boston Harbor River Basin. In accordance with the registration, the system is authorized to withdraw an average daily volume of 3.51 mgd, which translates to a total annual volume of 1,281.15 million gallons per year (mgy).

As water demands increase in a public water system, the system can request to withdraw water beyond the registered volume and can seek approval to construct a new source of supply (e.g. a new well) through the MassDEP permitting process. The MassDEP's WMA program considers the need for the withdrawal, the impact of the withdrawal on other hydraulically connected water suppliers, the environmental impacts, and the water available in the river basin or subbasin (the basin safe yield).

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.

The sources of water supply in the Hingham/Hull system are listed in Table No. 5. The table provides the maximum withdrawal rates for each source based on the Zone II analysis, which defines the recharge area of the wells. The table also shows the withdrawal capacity of Accord Pond. Accord Pond has an estimated sustainable yield of 3.0 mgd for 80 days as determined by a study completed in 1984 as reported in system's WMA Registration Application. The total estimated safe yield of the pond is approximately 0.69 mgd. It should be noted that for some of the sources, the withdrawal volume is limited by the hydraulic capacity of the piping system that runs from the sources to the water treatment plant (WTP). Aquarion is planning to address these hydraulic restrictions.

Table No. 5
Estimated Yield of Existing Sources

Groundwater Source Name	Zone II Maximum Daily Withdrawal Volume (mgd)	Zone II Maximum Daily Withdrawal Volume (mgd)
Downing Street Well	0.41	0.41
Free Street Wells 2A and 4[(b)]	1.80	1.80
Free Street Wells 3/5	0.51	0.51
Fulling Mill Wells 1 and 2	1.36	1.36
Prospect Street Well	0.39	0.39
Scotland Street Wells 1 and 1A	1.55	1.55
Free Street Well 2	Emergency source	Emergency source
Surface Water Name	**Maximum Yield (mgd)**	**Safe Yield (mgd)**
Accord Pond (largest source)	3.0	0.69
Total	**9.02**	**6.71**

(b)Free Street No. 4 has a maximum withdrawal rate of 0.81 mgd. The total combined withdrawal rate from Free Street No. 2A and 4 is 1.80 mgd.

Figure No. 2 provides a comparison of the current available water supply versus the current water demands. This figure shows that:

- The current ADD is less than the WMA registered withdrawal volume, indicating that the demand for water on an average annual basis is less than the water volume that is allowed to be withdrawn from the sources of supply.
- The current SADD is less than the capacity of the sources of supply with the largest source off-line. This indicates that the wells and reservoir have enough capacity to meet the average demand for water in the summer months.
- The current MDD is less than capacity of the sources of supply with all sources on-line. This indicates that that the wells and reservoir have enough capacity to meet the maximum day demand for water.

Figure No. 2

Figure No. 3 provides a comparison of the current available water supply versus the projected demands (projected to year 2030) with and without build-out of the South Shore Industrial Park (SSIP), the Bristol Brothers property , and the Avalon Development. The figure shows that:

- Future Conditions (2030) **without** build-out of SSIP, the Bristol Brothers property, and the Avalon Development:
  - The future ADD is projected to be greater than the current WMA registered withdrawal volume, indicating that by 2030, Aquarion will have to seek approval from MassDEP for additional water withdrawals either from existing sources or new sources.
  - The future SADD is less than the capacity of the sources of supply with the largest source off-line. This indicates that the wells and reservoir have enough capacity to meet the future average demand for water in the summer months.
  - The future MDD is less than capacity of the sources of supply with all sources on-line. This indicates that that the wells and reservoir have enough capacity to meet the future maximum day demand for water.

- Future Conditions (2030) **with** build-out of SSIP, the Bristol Brothers property, and the Avalon Development:
  - The future ADD is projected to be greater than the current WMA registered withdrawal volume, indicating that by 2030, Aquarion will have to seek approval from MassDEP for additional water withdrawals either from existing sources or new sources.
  - The future SADD is less than the capacity of the sources of supply with the largest source off-line. This indicates that the wells and reservoir have enough capacity to meet the future average demand for water in the summer months. However, the margin of safety is minimal, so it would be prudent to develop additional source capacity to ensure that an adequate supply of water is available.
  - The future MDD is greater than the capacity of the sources of supply with all sources on-line. This indicates that that the wells and reservoir do not have enough capacity to meet the future maximum day demand for water. Thus, additional source capacity would have to be developed to ensure maximum day demands could be met.

Supply Improvements

To ensure an adequate supply of water, in the past few years, Aquarion has installed replacement wells at the Scotland Street Well site, Free Street Well site, and the Fulling Mill Well site. Aquarion continues to investigate the condition of the raw water system to ensure that the total current yield from the wells is available.

In addition, Aquarion and Tata & Howard have discussed with MassDEP the total combined allowable withdrawal volume from Free Street No. 2A and 4.

Figure No. 3

As noted in MassDEP correspondence dated September 24, 1998, the Zone II delineation (which defines the recharge area for the wells) was delineated and approved using withdrawal volumes of 1.80 mgd for Free Street Well No. 2 and 0.81 mgd for Free Street Well No. 4, for a total withdrawal volume of 2.61 mgd for the two wells. Since this initial approval, Well No. 2A has been installed to replace Well No. 2, Well No. 2 has been reclassified as an emergency source, and Well No. 4 has been reclassified as an active source with an approved withdrawal volume of 0.81 mgd (see MassDEP correspondence dated November 8, 2008). Currently, the combined allowable withdrawal volume for Wells No. 2A and No. 4 is 1.8 mgd, which is the original withdrawal limit for Well No. 2 alone. Aquarion has asked MassDEP to increase the withdrawal limits on Free Street Wells No. 2A and No. 4 to equal the original combined limit designated for Wells No. 2 and No. 4. This would result in an additional 0.81 mgd of available water for the system.

Aquarion has also investigated the development of wells outside of the Weir River subbasin to supplement existing sources..

As an alternative option for supply, an MWRA connection was investigated. The MWRA currently provides wholesale water to approximately 50 communities throughout Massachusetts. The closest area for Aquarion to connect to the MWRA system is the City of Quincy, Massachusetts. This would require the construction of approximately two miles of water main along Route 3A and a new pump station, to be paid for by the water system. In addition to the construction cost, MWRA charges an entrance fee. The MWRA entrance fee is approximately $5.16/gallon or $5,161,646 per 1.0 mgd. It should be noted that the actual entrance fee is calculated based on considerations of average annualized demands and peak month demands. Assuming the total amount of water to be purchased from MWRA would equal the increased demands in the SSIP, the total entrance fee would be approximately $3,000,000 based on an average usage of 0.36 mgd and a peak usage of 1.15 mgd (based on a peak hour peaking factor of 3.20). The MWRA Advisory Board has recently adopted recommendations that there be no interest charges on the entrance fee and that the entrance fee can be paid over a 25 year period. Reportedly, the current usage rate for MWRA is approximately $3,032 per 1.0 million gallons.

Distribution System Improvements – Water Main Extensions

The Town of Hingham prepared a build-out analysis of the SSIP. The potential new customers for water service are shown in Figure No. 1. To serve these proposed new customers, Aquarion's distribution system would have to be extended to areas in the SSIP that are currently not served by Aquarion. The proposed new mains, as shown in Figure No. 4, would include new 12-inch diameter water mains on Abington Street and Sharp Street. The water mains would have to connect between Abington Street and Sharp Street at the Rockland town line. These water mains would connect to the existing system through a water main between Research Road and Abington Street. A 12-inch diameter water main is also recommended on Commerce Road from the existing 12-inch diameter water main on Commerce Road to the Rockland town line. It is recommended that a 12-inch diameter water main be installed to connect the proposed

Commerce Road water main to the proposed water main on Abington Street to provide looping. The proposed water main expansion within the SSIP is estimated to be approximately 15,000 linear feet of new 12-inch diameter water main. The total estimated probable construction cost is $3,000,000 including 25 percent for engineering and contingencies.

It has been assumed that the proposed Bristol Brothers property will be served from a new 8-inch diameter water main that connects the existing water mains on Old Derby Street and Whiting Street. The proposed water main is estimated to be approximately 1,300 linear feet and the estimated probable construction cost is $460,000 including 25 percent for engineering and contingencies. It is uncertain how the property will be developed; as such, the total length of new water within the Bristol Brothers property is uncertain.

It has been assumed that the proposed Avalon Development will be served off the existing water main on Recreation Park Drive.

Distribution System Improvement Alternatives

The water main extensions described above will provide for water service throughout the SSIP; however, additional improvements will be needed so that the water system has sufficient capacity, in particular for fire fighting purposes. The existing water system can provide a flow of approximately 1,000 gallons per minute (gpm) in the SSIP. The Insurance Service Office (ISO) recommends a flow of 2,250 gpm in the SSIP based on the current construction in the park. The typical maximum flow required of a water system for fighting fires is 3,500 gpm. Thus, we identified infrastructure improvements for the following three conditions:

A. Provide 2,250 gpm at full build-out of the SSIP
B. Provide 3,500 gpm at full build-out of the SSIP
C. Provide 3,500 gpm to the current development in the SSIP (i.e. current customer base)

The following summarizes the alternative infrastructure upgrades that would satisfy these flow recommendations while system demands are at the projected MDD in the year 2030, while maintaining a water pressure of at least 20 pounds per square inch (psi) throughout the distribution system. The alternative upgrades were identified and evaluated using a hydraulic model of the distribution system.

Cost estimates are based on the August 2012 Engineering News Record (ENR) construction cost index for Boston, MA of 12029.97, and include a 25 percent allowance for engineering and contingencies. **Estimates do not include costs for land acquisition, easements or legal fees.** For the purposes of this study, conceptual cost estimates were provided.

Option 1 – Water Main Improvements

Option 1 consists of the installation of additional water mains to provide the recommended flow to the SSIP.

Option 1A consists of new water mains needed to provide a fire flow of 2,250 gpm throughout the built-out SSIP. As shown in Figure No. 5, the new water mains would consist of a new 16-inch diameter water main from the Accord Tank to Route 3 behind the Derby Street Shops. This water main will follow Whiting Street, Derby Street, Recreation Park Drive, Keith Way, and the Derby Street Shops access road. A new 16-inch diameter water main is also recommended on Industrial Park Road from Route 3 to Commerce Road and on Commerce Road from Industrial Park Road to the end of the existing water main. Also, it is recommended that the proposed 12-inch diameter water mains within the SSIP expansion be 16-inch diameter water mains instead. The existing water main under Route 3 would not need to be replaced. The estimated probable cost for approximately 10,900 linear feet of 16-inch diameter ductile iron water main, and upsizing approximately 15,000 linear feet of 12-inch diameter water main within the SSIP expansion area to 16-inch diameter water main is $2,670,000.

Option 1B consists of new water mains needed to provide a fire flow of 3,500 gpm throughout the built-out SSIP. As shown in Figure No. 6, the new water mains would consists of a new 20-inch diameter water main from the Tank to Route 3 behind the Derby Shops and a 16-inch water main extending to Abington Street along Industrial Park Road and Research Road, and cross country between Research Road and Abington Street. Additionally, a parallel 16-inch diameter water main would need to be installed under Route 3. Installing a water main under Route 3 would require directional drilling. Also, it is recommended that the proposed 12-inch diameter water mains within the SSIP expansion be 16-inch diameter water mains instead. The estimated probable construction cost for approximately 9,200 linear feet of 20-inch diameter water main, approximately 5,500 linear feet of new 16-inch diameter water main, including the parallel 16-inch diameter water main under Route 3, and upsizing approximately 15,000 linear feet of 12-inch diameter water main within the SSIP expansion area to 16-inch diameter water main is $3,800,000.

Option 1C consists of new water mains needed to provide a fire flow of 3,500 gpm throughout the current extents of the water system in the SSIP. As shown in Figure No. 7, the required water main upgrades would be similar to those required for Option 1B with the exception that instead of a 20-inch diameter main from the Accord Tank to Route 3 behind the Derby Shops, a new 16-inch diameter water main is needed. A 16-inch diameter water main is also recommended on Industrial Park Road and Research Road. The total probable construction cost for Option 1C is $2,830,000 for approximately 12,400 linear feet of new 16-inch diameter water main and a parallel 16-inch diameter water main under Route 3.

Option 2 – Water Main Improvements and Booster Pump Station

Option 2 consists of the installation of additional water mains and a booster pump station to provide the required flow to the SSIP.

Option 2A consists of a new pump station and new water mains needed to provide a fire flow of 2,250 gpm throughout the built-out SSIP. As shown in Figure No. 8, the booster pump station would be located on the existing 12-inch water main that feeds the SSIP off Industrial Park Drive. To provide adequate suction pressure at the pump station, a new 16-inch diameter water main is recommended on Whiting Street from the Accord Tank driveway to Accord Pond Drive, on Keith Way, and on Recreation Park Drive from Derby Street to Keith Way. The estimated probable construction cost for the booster pump station and approximately 4,100 linear feet of 16-inch diameter ductile iron water main is $1,400,000.

Option 2B consists of a new pump station and new water mains needed to provide a fire flow of 3,500 gpm throughout the built-out SSIP. As shown in Figure No. 9, the booster pump station would be located on the existing 12-inch main that feeds the SSIP off Industrial Park Drive. To provide adequate suction pressure at the pump station, a new 16-inch diameter water main is recommended on Whiting Street from the Accord Tank driveway to Derby Street, on Derby Street from Whiting Street to Recreation Park Drive, on Keith Way, and on Recreation Park Drive from Keith Way to Derby Street. The estimated probable cost for the booster pump station, and approximately 7,700 linear feet of 16-inch diameter ductile iron water main, is $2,200,000.

Option 2C consists of a new pump station and new water mains needed to provide a fire flow of 3,500 gpm throughout the current extents of the water system in the SSIP. As shown in Figure No. 10, this would require the same improvements as described for Option 2B. Therefore, the total estimated probable construction for Option 2C is approximately $2,200,000.

Option 3 - Water Main Improvements and Second Feed to SSIP

Option 3 consists of the installation of a second transmission line from the area near Accord Tank to the SSIP to provide the required flow to the SSIP.

Option 3A consists of a second transmission main to provide a fire flow of 2,250 gpm throughout the built-out SSIP. As shown in Figure No. 11, this second transmission main would consist of a new 16-inch diameter water main from Whiting Street to the proposed water main expansion on Commerce Road. The water main route would include Accord Pond Drive, Gardner Street, Harvest Lane, Devon Terrace, and Deerfield Road. A new 16-inch diameter water main would need to be installed under Route 3. Installing a water main under Route 3 would require directional drilling. It is recommended that the proposed water main expansion between Commerce Road and Abington Street be 16-inch diameter instead of the 12-inch diameter main proposed as part of the water main extensions described previously in this report. The estimated probable cost for approximately 7,700 linear feet of 16-inch diameter water main, and upsizing approximately 2,500 linear feet of 12-inch diameter water main to 16-inch diameter is $1,840,000. It should be noted that the Town of Hingham is investigating the potential of directional drilling under Route 3 for the sewer system. The Town owns land on each side of Route 3 and is willing to allow use of the land for the water main jacking. There may be a cost

savings if directional drilling the sewer and water main were completed at the same time. However, for the purposes of this study, the potential cost savings was not included.

Option 3B consists of a second transmission main to provide a fire flow of 3,500 gpm throughout the built-out SSIP. As shown in Figure No. 12, this second transmission main would consist of a new 20-inch diameter water main from the Accord Tank to the proposed water main expansion on Commerce Road. The water main route would include Whiting Street, Accord Pond Drive, Gardner Street, Harvest Lane, Devon Terrace and Deerfield Road. A new 20-inch diameter water main would need to be installed under Route 3. Installing a water main under Route 3 would require directional drilling. It is recommended that the proposed water main expansion between Commerce Road and Abington Street be 16-inch diameter instead of the 12-inch diameter main proposed as part of the water main extensions described previously in this report. The estimated probable cost for approximately 9,200 linear feet of 20-inch diameter water main, and upsizing approximately 2,500 linear feet of 12-inch diameter water main to 16-inch diameter is $2,370,000.

Option 3C consists of a second transmission main to provide a fire flow of 3,500 gpm throughout the current extents of the water system in the SSIP. As shown in Figure No. 13, this second transmission main would include a new 16-inch diameter water main from Whiting Street to the existing water main on Commerce Road, including directional drilling a new 16-inch diameter water main under Route 3. The water main would be installed on Whiting Street, Accord Pond Drive, Gardner Street, Devon Terrace, and Deerfield Road and cross country through the proposed SSIP area. A 16-inch diameter water main is also recommended on Commerce Road, Industrial Park Road from Commerce Road to Research Road and on Research Road. The estimated probable construction cost for approximately 15,000 linear feet of new 16-inch diameter water main is approximately $3,410,000.

Option 4 – New Water Storage Tank

Option 4 consists of the construction of a new water tank in the SSIP to provide the required flow to the SSIP.

As shown in Figure No. 14, Option 4A consists of a new water storage tank in the SSIP to provide a fire flow of 3,500 gpm throughout the built-out SSIP. The water storage tank would be utilized for fire protection and to maintain adequate pressure during peak hour demands. The water storage tank would have a capacity of approximately 750,000 gallons and constructed to an overflow of 282 feet to match the existing hydraulic gradeline of the Accord Tank. Aquarion does not currently own property in the SSIP. The Town of Hingham owns property within the SSIP area; however, the ground elevations in these areas are about 125 feet. To provide a tank with an overflow elevation of 282 feet on these Town parcels would require a tank more than 150 feet tall. Thus, we have proposed a tank location at the highest elevations in the developable area, which is along Commerce Way within the 0 Commerce Road property. This property has an elevation of approximately 170 feet, which means a tank of approximately 110 foot height would be required. The estimated probable cost for a new water storage tank and associated

water mains is $2,000,000. This estimate does not include costs associated land acquisition, easements, legal work, or significant site work.

Based on the Capital Efficiency Plan™ for Aquarion's Hingham/Hull system prepared by Tata & Howard, the total usable storage in the Hingham/Hull water distribution system is approximately 2.56 mg. The projected required storage for the design year 2030 is approximately 2.10 mg. Therefore, the system has approximately 0.46 mg of surplus storage. Thus, there is a risk that water in the new tank could become stagnant, therefore, a mixing system is recommended to maintain good water quality within the proposed storage tank.

As shown in Figure No. 15, Option 4B consists of a new water storage tank in the SSIP to provide a fire flow of 3,500 gpm throughout the existing water system in the SSIP. The proposed location of the water tank is discussed above for Option 4A. To provide 3,500 gpm to existing customers, 12-inch diameter water main would be needed from the proposed tank site to Commerce Way and a 16-inch diameter water main is recommended on Industrial Park Road from Commerce Road to Research Road and on Research Road. The total estimated cost of the new tank, approximately 2,400 linear feet of 12-inch diameter water main, and approximately 2,100 linear feet of 16-inch diameter water main is approximately $2,940,000.

Table No. 6 provides a summary of the cost estimates for each of the alternative infrastructure upgrades. Table No. 7 provides a summary of advantages and disadvantages for each of the alternative infrastructure upgrades.

Recommendations

For the complete build-out of the SSIP, it is recommended that Aquarion pursue Option 4, the new water storage tank, to provide adequate flow and pressure to the area. The water storage tank should be constructed at the same overflow elevation of the Accord Tank. The most favorable location for the new storage tank would be at the higher elevations along Commerce Road. The elevated water storage tank should be approximately 0.75 mg. There are no parcels in this area owned by Aquarion or the Town of Hingham. Easements would have to be established to construct the tank along the proposed water main expansion route. This option has less operation and maintenance costs as well as capital costs than some of the other options, and will cause less disruption to the existing distribution system.

Sincerely,
TATA & HOWARD, INC.

Karen Gracey

Karen L. Gracey, P.E.
Associate

Table No. 6
Summary of Estimated Costs[c]

Option	Estimated Cost of Alternative	Estimated Cost of Main Extensions in SSIP [d]	Total Estimated Cost
1A – Water main improvements (2,250 gpm) for build-out	$2,670,000	$3,000,000	$5,670,000
1B – Water main improvements (3,500 gpm) for build-out	$3,800,000	$3,000,000	$6,800,000
1C – Water main improvements (3,500 gpm) for **existing customers**	$2,830,000	NA	$2,830,000
2A – Booster pump station (2,250 gpm) for build-out	$1,400,000	$3,000,000	$4,400,000
2B – Booster pump station (3,500 gpm) for build-out	$2,200,000	$3,000,000	$5,200,000
2C – Booster pump station (3,500 gpm) for **existing customers**	$2,200,000	NA	$2,200,000
3A – Second feed into SSIP (2,250 gpm) for build-out	$1,840,000	$3,000,000	$4,840,000
3B – Second feed into SSIP (3,500 gpm) for build-out	$2,370,000	$3,000,000	$5,370,000
3C – Second feed into SSIP (3,500 gpm) for **existing customers**	$3,410,000	NA	$3,410,000
4A – New water storage tank for build-out (3,500 gpm)	$2,000,000	$3,000,000	**$5,000,000**
4B – New water storage tank for **existing customers** (3,500 gpm)	$2,940,000	NA	$2,940,000

(c) Estimates do not include costs for land acquisition, easements or legal fees.
(d) The estimated cost of main extensions in the SSIP includes 12-inch diameter pipe. The added costs for alternatives that include larger diameter pipe in the SSIP are included in the Estimated Cost of Alternative.

Table No. 7
Primary Advantages and Disadvantages

Option	Advantage	Disadvantage
1 – Water Main Improvements	No need to acquire land for a tank or pump station.	Highest capital cost (ignoring the cost of acquiring property for a tank or pump stations for the other alternatives)
2 – Booster Pump Station	Will likely be easier to site a pump station than a tank.	Requires land to site a pump station. Could be complex permitting to site a pump station. Additional O&M.
3 – Second feed into SSIP	Provides a redundant feed into SSIP. Hingham is considering directional drilling for sewer in same location. No need to acquire land for a tank or pump station.	Requires directional drilling under Route 3.
4 – New Water Storage Tank	Lowest capital cost (ignoring potential property acquisition and permitting costs). Provides water storage within the SSIP, which is beneficial for fire fighting and in case of main breaks between Accord Tank and the SSIP.	Must find suitable site. Complex permitting process.