Water Supply & Distribution System Study
Hingham & Hull, Massachusetts
Aquarion Water Company

COMMONWEALTH OF MASSACHUSETTS
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4-23-07

Prepared by:
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April 2007

TATA & HOWARD

INCORPORATED

April 23, 2007

Mr. Larry Bingaman
Aquarion Water Company
900 Main Street
Hingham, MA 02043

Subject: Water Supply and Distribution System Study
Hingham/Hull, Massachusetts
T&H No. 1819

Dear Larry,

In accordance with our agreement, Tata & Howard is pleased to present you with a final copy of the Hingham/Hull Water Supply and Distribution System Study. This report was prepared in accordance with the Department of Environmental Protection (DEP) guidelines for public water suppliers, Recommended Ten States Standards for Water Works, and standard engineering practices.

The analysis and recommendations in this report are based on computer simulations of the existing water distribution system, incorporating data on future water supply, system demands, and distribution requirements. The parameters governing the study were based on data supplied by the Aquarion Water Company and the Insurance Services Office (ISO).

An evaluation of the ability of the system's existing water supply sources to meet future demands was completed. Several improvements to the distribution system are recommended to meet existing deficiencies in the water distribution system. In order to assist the Aquarion in implementing these improvements, the recommendations are presented in a prioritized approach. A detailed description of the recommended improvements is presented in Section 8.

During the course of this project, Mr. Gregory Devine served as Engineer, Ms. Karen Pighetti, P.E. served as Project Manager, with the undersigned as Project Officer.

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At this time, we wish to express our appreciation to the Aquarion for their participation in this study and for their help in collecting information and data. Special thanks is given to Mr. Robert Roland and yourself for contributions to this report. We also appreciate the opportunity to assist the Aquarion on this important project.

Sincerely,

TATA & HOWARD, INC.

Donald J. Tata, P.E.
President

Enclosure

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Section 1

Executive Summary

The Aquarion Water Company (Aquarion) retained Tata & Howard to conduct a comprehensive water supply and distribution system study. The study evaluates the overall distribution system and the supply sources relative to the ability to meet current and future demands and provides prioritized recommendations for future implementation. The water supply and distribution system study and associated analyses incorporated the three communities, Hingham, Hull and North Cohasset, serviced by the Aquarion.

The water supply and distribution system study was completed in three phases. The first phase included calibration and verification of a WaterCAD hydraulic model of the water distribution system from the existing system model. In addition, recent infrastructure improvements such as new water mains were incorporated into the model. The updated system map (Appendix A) shows water mains, supply sources and storage facilities.

A water distribution system study analysis was conducted in the second phase. Future population and water demands through the year 2025 were projected and the inherent capability of the distribution system to meet water demands was evaluated. As a whole, the new computer model provides Aquarion with a planning tool through which evaluations of impacts from new and proposed developments, and proposed system improvements, can be provided relative to their potential impacts to the water distribution system.

The analysis of current and future water demands and the ability of the system supply sources to provide adequate supply was completed in the third phase. A comparison between future water demands and the maximum yield of current supply sources revealed the need for additional water by the year 2025. In addition, the analysis incorporated anticipated changes in storage capacity within the system and fluctuations in source pumping capacity.

Tasks in this study included the following:

- Update of the hydraulic model of the system.
- Conduct fire flow tests and utilize fire flow test results to check accuracy of the model and revise as necessary.
- Estimate projected populations based upon available information from the Town Clerk's Offices, Town Planning Boards, MAPC, MISER and U.S. Census Bureau.
- Prepare demand projections through the year 2025 based on historic use and population trends.
- Recommend distribution system improvements to meet the existing and future needs of Hingham, Hull and Cohasset.
- Evaluate water supply needs based upon existing and projected demands and existing source capacity.

- Assess water storage needs based upon existing and future demands and fire flow requirements.
- Evaluate potential impacts of pending state regulations on water system operations.
- Prepare a capital improvement plan with prioritized recommendations and budget estimates for system upgrades necessary to correct existing deficiencies and meet future needs.

Once the computer model was verified and considered representative of Aquarion's existing system, hypothetical demand conditions were simulated. As a result of these simulations, distribution improvements were recommended to address deficiencies in the system and recommendations were prioritized for future implementation (Section 8). The recommendations are broken into four components as follows:

- General Operation and Maintenance Practices: General maintenance and operation practices are recommended and should be completed on an as-needed basis. Regularly scheduled maintenance programs should include hydrant flushing, meter replacement, hydrant replacement and water main replacement. An estimated annual cost of $200,000 is recommended to be allocated for these maintenance programs.

- Priority I Recommended Improvements–Water Supply: It is recommended that Aquarion maximize the yield from the Scotland Street, Free Street No. 2 and Fulling Mill Station Wells through rehabilitation and redevelopment work, conduct pumping tests at each site to verify site yield and optimize usage of the Free Street Wells. The estimated cost of the Water Supply Priority I Recommended Improvements is approximately $1,612,000.

- Priority I Recommended Improvements–Water Distribution: Priority I recommended improvements for water distribution are intended to eliminate deficiencies in storage and the main transmission grid of the system. These improvements are recommended in order to meet storage needs and to mitigate ISO fire flow deficiencies. Recommended Priority I Improvements include upgrades to the Hull Booster Pump Station, dismantling of the Strawberry Hill Tank, replacement of the water mains on Atlantic Avenue, Summit Avenue, Beach Avenue, Rockway Avenue, Wyola Road, Delwanda Road, Hampton Circle, Eastern Avenue, and Fairmont Way in Hull, and Beal Street, Keith Way, Recreation Park Drive, Washington Boulevard, East Gate Lane, Pleasant Street, Downer Street, Pine Grove Road and Main Street in Hingham. The Priority I Recommended Improvements are estimated to cost approximately $3,546,000.

- Priority II Recommended Improvements: Priority II improvements were developed to mitigate other infrastructure deficiencies in the distribution system, such as estimated fire flow requirements in residential areas and system extremities and system looping. Recommended Priority II Improvements include replacement of water mains on Dighton Street and Electric Avenue in Hull and Rockwood Road, Ledgewood Circle, Grist Mill Lane, Howland Lane, Whitcomb Avenue, Nutty Hill Road, Simmons Road, Smith Road, Hobart Street, Summit Drive, Harbor View Drive, Howe Road, Spruce Street and Carleton Road in Hingham. The Priority II Recommended Improvements are estimated to cost approximately $2,383,000.

Section 2

Existing Water Distribution System

Distribution System

Aquarion Water Company's distribution system for Hingham and Hull consists of approximately 180 miles of water mains ranging in size from four to twenty inches in diameter. These mains are constructed of various materials including cement lined ductile iron (CLDI), cast iron (CI) and asbestos cement (AC). The existing system has seven active supply sources, one emergency supply source, three water storage facilities and a water treatment facility.

The water distribution system is divided into two service areas. The main service area consists of the Town of Hingham north of the water treatment facility, the Town of Hull and a portion of North Cohasset. The high service area includes the southern portion of Hingham. The distribution system services elevations range from approximately 0 to 131 feet above mean sea level (MSL) in the main service area and approximately 49 to 180 feet above MSL in the high service area. The Hingham/Hull District Water Treatment Facility provides water to both service areas.

Water Supply Sources

The Hingham/Hull water system includes seven water supply sources and one emergency source. The supply system is comprised of six groundwater sources and one surface water source. The Accord Pond is the sole surface water source within the system and Free Street Well Nos. 2, 3/5, Downing Street Well, Prospect Street Well, Scotland Street Well and Fulling Mill Station are groundwater supply sources. Free Street Well No. 4 is currently listed as an emergency supply source.

Free Street Well No. 2

Free Street Well No. 2 is a gravel packed well located off Free Street (Lat 42^o 13' 05", Long 70^o 52' 40"). It was constructed in 1952 to a depth of approximately 73 feet. The well was cleaned and rehabilitated in March 2002. The Massachusetts Department of Environmental Protection (MassDEP) approved pumping rate for this well is 1,253 gallons per minute (gpm) or 1.80 mgd.

Free Street Well No. 3

Free Street Well No. 3 is a gravel packed well located off Free Street (Lat 42^o 13' 05", Long 70^o 52' 52"). It was constructed in 1967 to a depth of approximately 88.5 feet. The well was cleaned and rehabilitated in 1998. The MassDEP approved pumping rate for this well is 351 gpm or 0.51 mgd.

Free Street Well No. 4

Free Street Well No. 4 is a gravel packed well located off Free Street (Lat 42^o 13' 10", Long 70^o 52' 45"). It was constructed in 1983 to a depth of approximately 86 feet. The total permitted withdrawal volume for this well is 563 gpm or 0.81 mgd. Currently, Free St. Well No. 4 is an emergency source only.

Downing Street Well

Downing Street Well is a gravel packed well located off Downing Street (Lat 42^o 13' 25", Long 70^o 52' 50"). It was constructed in 1965 to a depth of approximately 66.5 feet. The well was cleaned and rehabilitated in March 2002. The MassDEP approved pumping rate for this well is 284 gpm or 0.41 mgd.

Prospect Street Well

Prospect Street Well is a gravel packed well located off Prospect Street (Lat 42^o 11' 30", Long 70^o 52' 30"). It was constructed in 1971 to a depth of approximately 58 feet. The MassDEP approved pumping rate for this well is 269 gpm or 0.39 mgd.

Scotland Street Well

Scotland Street Well is a gravel packed well located off Scotland Street (Lat 42^o 11' 25", Long 70^o 52' 20"). It was constructed in 1956 to a depth of approximately 45 feet. The well was cleaned and rehabilitated in March 2002. The MassDEP approved pumping rate for this well is 1,078 gpm or 1.55 mgd.

Fulling Mill Station

Fulling Mill Station is a dug well fed by infiltration basins located at 93 South Pleasant Street (Lat 42^o 12' 10", Long 70^o 52' 30"). It was constructed in 1903 to a depth of approximately 21.5 feet. The MassDEP approved pumping rate for this well is 941 gpm or 1.36 mgd.

Accord Pond

Accord Pond is 100 acre pond located off Whiting Street (Lat 42^o 10' 30", Long 70^o 53' 30"). The total storage capacity of the pond is approximately 523 million gallons with a drainage basin area of 1.01 square miles. The intake pipe is a gravity feed line to the treatment plant. The estimated safe yield of the pond is approximately 0.69 mgd.

Water Storage Facilities

There are three water storage facilities located within the Hingham/Hull system. The Turkey Hill Tank is located on Turkey Hill Lane. The welded steel tank is 70 feet in diameter, 70 feet tall and has a reported capacity of 2.01 million gallons (mg). It has an overflow elevation of 240 feet and is connected to the system with a 20-inch diameter water main. The Strawberry Hill Tank is located on Prospect Avenue. The welded steel tank is 50 feet in diameter, 74 feet tall and has a reported capacity of 0.51 mg. It has an overflow elevation of 186 feet and is connected to the system through a 12-inch diameter water main. The Accord Tank is located on Whiting Street. The welded steel tank is 58 feet in diameter, 112 feet tall and has a reported capacity of 0.75 mg. Accord Tank has an overflow elevation of 282 feet and is connected to the system through a 16-inch diameter water main.

Hingham/Hull District Water Treatment Facility

Aquarion operates a 7.7 mgd water treatment facility located in Hingham, which began operation in April of 1996. The treatment facility receives water from six of the seven water supply sources and satisfies the treatment requirements set forth by the United States Environmental Protection Agency (US EPA). The Hingham/Hull District Water Treatment Facility treats the raw waters via rapid mix, Superpulsator clarifiers, deep-bed GAC filters and post-filtration disinfection, pH adjustment and fluoridation. The facility also has a large holding tank for treated water to improve water pressure in the system during high demand periods.

Section 3

Population Projection

General
Population has a direct correlation to water consumption. This section reviews the basis for estimates of future population. Historical population data as reported by the US Census Bureau and the Towns of Hingham and Hull are summarized in this section. In addition, population projections from various sources through the year 2025 were reviewed and presented in this section.

Historical Population Data
The Towns of Hingham and Hull have experienced moderate growth during the past several decades. Each community experienced a surge in population during the 1950's and smaller fluctuations, gains and losses, in population during the subsequent three decades. However, during the 1990's Hingham and Hull grew at a rate of approximately eight percent, which exceeded the population growth across the state of approximately five percent.

Figure No. 3-1 presents population growth within the two communities between 1970 and 2000. The curves show the population loss during the 1970's and population growth during the 1980's and 1990's. Available land decreased as population increased within Hingham and Hull. Table No. 3-1 shows land available for development for both Towns. Based upon information available from Town Master Plans, there is 17.2 percent and 2.5 percent developable land in Hingham and Hull, respectively. The developable land could support an additional 1,500 new dwelling units within Hingham and 6 new dwelling units in Hull. The corresponding population growth would result in an increase of nearly 4,000 persons or 12 percent. It should be noted that these numbers do not reflect special permitting or variances to local zoning laws. The following discusses future population trends in both Hingham and Hull. Based on limited undeveloped land in the North Cohasset service area, the population served in North Cohasset was assumed to remain constant through 2025.

Population Projection Data
In Hingham, population projections were completed by the Metropolitan Area Planning Commission (MAPC), MISER and the Town Planning Board. MAPC completed analyses contingent upon available land, Town zoning laws and regulations surrounding sanitary sewage disposal within the community. Population projections, as estimated by MISER, differed from the results of MAPC, as these projections were based strictly upon historical population numbers and statewide population trends. The MISER projections are lower than MAPC projections and result from more conservative growth numbers. The Hingham Planning Board projections were similar to MAPC projections, but included up-to-date wetlands data and developable parcels. Each projection indicates that build-out will occur given the limited number of available parcels within the community.

Figure No. 3-1
Hingham and Hull Historical Population
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

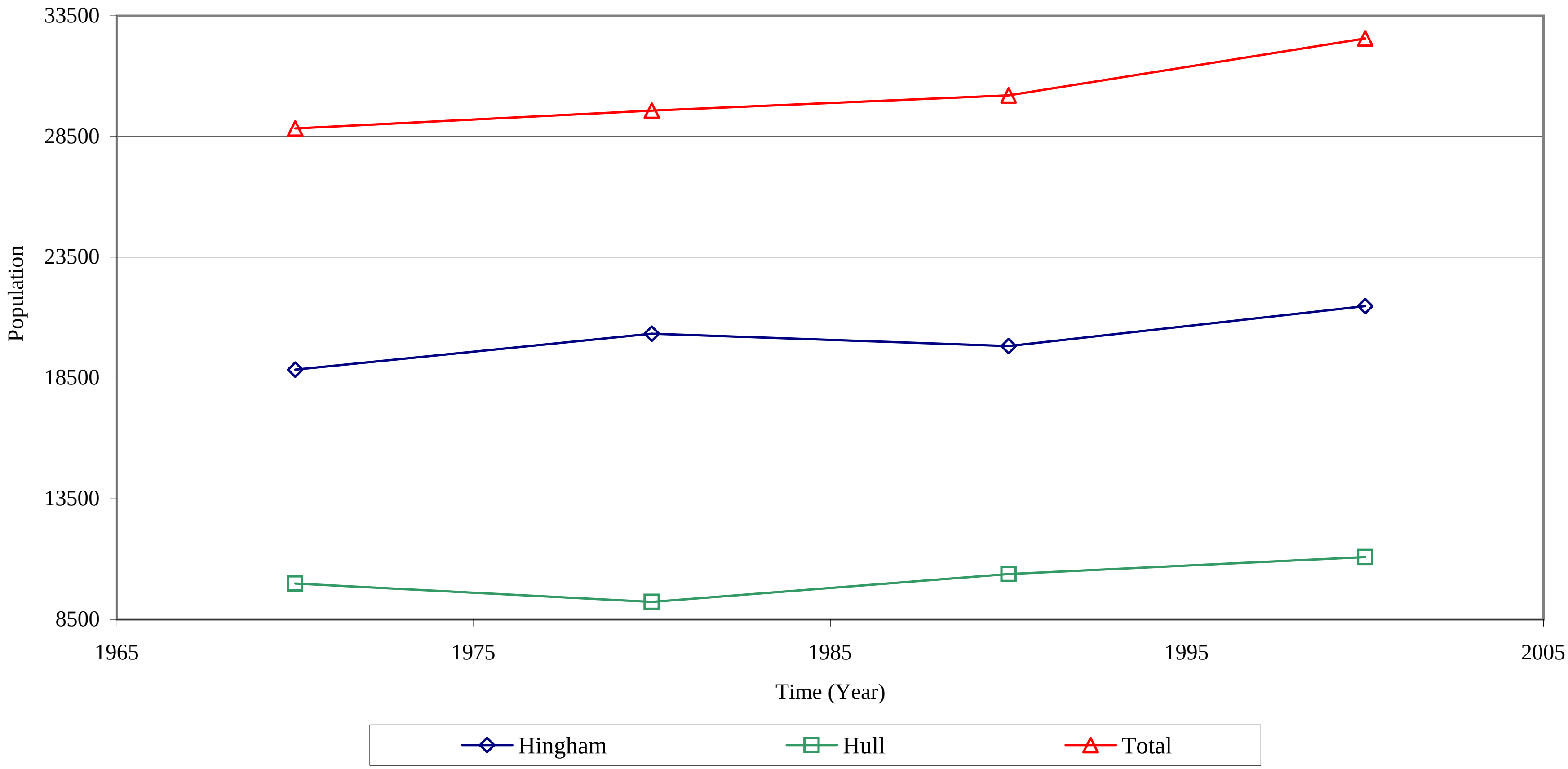

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Table No. 3-1
Residential Development within Hingham and Hull
Water Supply and Distribtion System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Town	Total Town Area (acres)	Developable Land[1] (acres)	Developable Res Land[2] (acres)	Developable Parcels[3] (number)	Developable Lots[4] (number)	Total New Units
Hingham	14,092	2,423	2,077	[5]	1,500	1,500
Hull	[6]	1,555	28	125	6	6

1. All land available for development, excluding wetlands, flood plains and protected open spaces.
2. All land available for residential development under current Town zoning laws.
3. Number of available parcels within residential open land.
4. Number of parcels satisfying zoning requirements (Total square feet, frontage, etc.).
5. Information not available due to ongoing rezoning at the time of the study.
6. Information not available from the Town Assessors Office.

The Town of Hull is limited by the land available for new development and the Town Master Plan indicates that six or less parcels can be developed under current zoning restrictions. A significant portion of recent population growth is a result of home conversions from summer homes to permanent residences.

Similar to Hingham, Hull population projections were completed by MAPC, MISER and the Town Planning Board. MAPC projections indicate slow and limited growth with build out of all available lands, and a plateau in population growth within the next two decades, while the MISER projections indicate a decrease in population by 2020. Table No. 3-2 shows various population projections from MAPC and MISER.

New Growth

The Towns of Hingham and Hull are well below the state goal of 10 percent affordable housing. It is anticipated that new 40B development, which incorporates affordable housing and bypasses current zoning regulations, will drastically alter previous population projections. Based upon information from the Hingham and Hull Town Planners, approximately 2,700 new units will be constructed within the next two decades. This growth was unforeseen and not included in previous MISER and MAPC population projections. Table No. 3-3 shows the pending housing projects within Hingham and Hull.

Information regarding permitted housing projects was obtained directly from Town Planning Boards and the Hingham Affordable Housing Plan. The majority of the proposed developments include luxury condos, luxury residences and senior living. Therefore, each new unit will host fewer persons than the current average persons per unit. The population projection presented in Figure No. 3-2 incorporates the proposed growth within Hingham and Hull and anticipated growth required to satisfy the goal of 10 percent affordable housing.

The projected service population in 2025 is approximately 45,600 and represents an approximate increase of 16 percent. These projections are based upon historical population and growth, various population statistics, known permitted housing projects, available land for development, and achieving the state goal of 10 percent affordable housing. The projections do not account for such considerations as zoning changes or major redevelopment.

Figure No. 3-2 presents three different projections. The MISER and MAPC projections are shown as solid lines and fall below the dashed line which represents the anticipated growth in Hingham and Hull through 2025. The MISER projection indicates an increase in population through 2010, but shows a decrease in population by 2020. The MAPC projection differs with a steadily increasing population in Hingham and Hull through 2020. Likewise, the third population projection (dashed line) indicates an increase in population through 2025. Although the behavior of these latter projections is similar, the population numbers differ significantly and the differences between the population projections are explained in detail in the following paragraphs.

Table No. 3-2
MAPC and MISER Population Projections
Water Supply and Distribtion System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Source	1980	1990	2000	2010	2020
Town of Hingham					
Town Clerk[1]	20,339	19,821	19,882		
MAPC[2]			19,948	20,566	21,102
MISER[3]				19,489	18,257
Town of Hull					
Town Clerk		10,466	11,050		
MAPC[2]			11,172	11,448	11,762
MISER[3]				11,759	12,136
Total					
Hingham and Hull			30,932		
MAPC			31,120	32,014	32,864
MISER				31,248	30,393

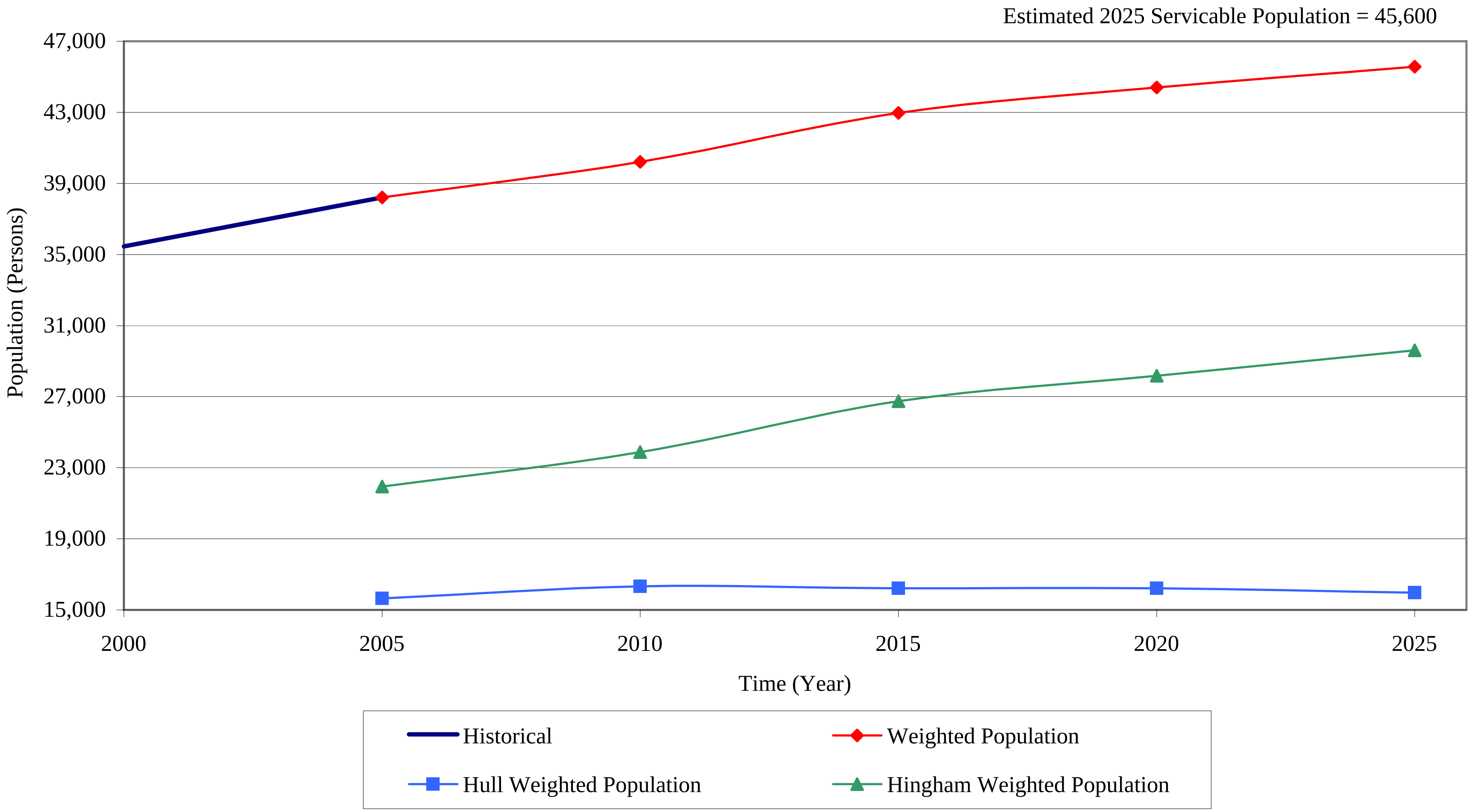
1 - Population information provided by Hingham Town Clerk.
2 - Calculated in 2005.
3 - Calculated in 2003.

Table No. 3-3
Confirmed New Housing Units Within Hingham and Hull
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Town	Project Name	Total No. Units	Type
Hingham	*Permitted* [1]		
	Black Rock	138	Condo
	Brewer Meadows	21	Multi-Family
	Canterbury Village	10	Special
	Christina Estates	45	Subdivision
	Fresh River Landing	7	Subdivision
	Gardner Terrace	3	Subdivision
	Habitat for Humanity	2	
	Hidden River	4	Subdivision
	Hingham Shipyard	479	Condo
	Linden Ponds	1,750	Senior
	Ridgewood Crossing	31	Over 55 Condo
	Scotland Green	28	Condo
	Viking Lane	6	Subdivision
Hingham	*Not Permitted* [1]		
	Hersey House	16	Senior
	Riley Prop. Beal St.	16	Senior
	Riley Prop. North St.	8	Mixed
	Damon Farms	8	Senior
	School Depot Tract	25	Mixed
	Housing Authority	45	Mixed
Hull	*Permitted* [1]		
	Name Unknown	102	Unknown
	TOTAL[2]	2,744	

1 - Information obtained from Town Planning Boards and Town Master Plan
2 - Growth anticipated by 2025

Figure No. 3-2
Hingham and Hull Population Projections with 40B Development
Water Supply and Distribution Study
Hingham and Hull, MA
Aquarion Water Company



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The Aquarion Water Company does not provide water to the entire population in Hingham and Hull. Several residential units and communities receive water from private wells and wholesale suppliers. Therefore, the population serviced by Aquarion is different from the total population.

The Linden Pond retirement community is one development that will not increase water demand in the area served within the Hingham/Hull system, as the community will purchase water from the Town of Cohasset through 2025. Therefore, the service population projections do not include population growth due to the development of Linden Pond. It is estimated that the Linden Pond retirement community, comprised of approximately 1,750 units, will contribute to the percent affordable housing available within Hingham, effectively reducing additional construction required to satisfy the state goal of 10 percent affordable housing.

The service population differs further from the population projections presented by MAPC and MISER. The projection presented in Figure No. 3-2 was adjusted to more accurately represent seasonal population fluctuations. The Town of Hull is a coastal community and experiences significant seasonal population growth during the summer months, while the Town of Hingham is comprised largely of year-round residences and does not exhibit such changes in population during the summer. Currently, the summer population in Hull is nearly double the winter or year-round population.

Following historical evidence, the seasonal increase in population in Hull is projected to decrease through 2025. Data collected in the 1990 and 2000 US Census indicate a sharp reduction in the number of available rental units and occupied seasonal homes. This trend is anticipated to continue due to steady conversion of seasonal and rental units to year-round homes. Hull summer population projections were adjusted to reflect this historical trend. The results shown in Figure No. 3-2 incorporate projected population growth within Hingham and Hull. The curve represents the projected service population within these two communities through 2025. The Hull weighted population was calculated as the sum of the population between September and March multiplied by seven, and the seasonal population between April and August, multiplied by five, averaged across a 12 month period. The total weighted population presented in Figure No. 3-2 is the sum of the weighted, service populations in Hingham and Hull.

As previously mentioned, the MAPC projection curve and the weighted service population curve should not be compared directly. Rather, the behavior of steady increases in the population is comparable. The continued linear growth in Hingham and Hull through 2025 is subject to 40B development. Currently, zoning laws prevent such large and rapid growth, however, high density developments and rapid growth due to MGL 40B were not accounted for in the MISER and MAPC projections.

Results

The projected service population shown above differs significantly from the population projections presented by MAPC, MISER and the Town Planning Boards. The difference between projections is directly attributed to the housing development within the two communities, especially Hingham. Despite a limited number of open parcels available for new development, construction under MGL Chapter 40B and redevelopment at the Hingham Ship Yard is responsible for the large deviation from historical growth.

Population projections indicate steady service population growth through the year 2025. The total service population within Hingham and Hull would increase by nearly 16 percent by 2025, resulting in an estimated population of 45,600. Additional housing construction, similar to the currently permitted developments, will ultimately dictate build out and the maximum service population within Hingham and Hull.

Section 4

Water System Demands

<u>General</u>
Water demands within a community vary diurnally, seasonally and annually. There are several parameters used to identify current and future water needs of a community. These parameters are defined and discussed in this section as they pertain to an evaluation of a distribution system.

The Massachusetts Department of Conservation and Recreation (DCR) and MassDEP coordinate together concerning future water demands and population projections. As previously stated, population and water consumption are directly correlated. Therefore, the specific guidelines set forth by DCR regarding population and water demand projections affect MassDEP review and approval of additional withdrawal from existing sources or approval of new water supply source development. DCR guidelines incorporate historical, community specific, trends in water consumption, conservation efforts via residential, commercial and industrial devices; and emphasize the importance of routine monitoring of the distribution system through water audits and leak detection surveys.

Based on recent developments, the Massachusetts Water Resource Commission (MWRC) has adopted new 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 (rgpcd)
- Maximum of 10 percent unaccounted for water
- Maximum seasonal withdrawal ratio of 1.2

In general, a stressed basin has been defined by the MWRC as a basin in which the quantity of streamflow has been significantly reduced, or the quality of the streamflow is degraded, or the key habitat factors are impaired. Water supply sources for Hingham and Hull are located within the Boston Harbor Basin, which includes the Weir River Basin. Based on information presented in the MWRC report entitled Stressed Basins in Massachusetts, the majority of the Boston Harbor Basin was unassessed, however, recent information suggests that this watershed may be designated as high stress. Therefore, performance standards of 65 gpcd for residential usage and 10 percent for unaccounted-for-water were used in subsequent calculations.

It is important to note that the DCR has a key role in the water management approval process. Water demand projections must be approved by DCR before the MassDEP will approve development of a new water supply source or authorize the withdrawal of additional volume from existing sources.

Seasonal Withdrawal Cap

The seasonal withdrawal cap was adopted by the MassDEP to reduce the difference between summer and winter withdrawals. The summer (May through September) to winter (November through March) ratio is based on average seasonal withdrawals for the past three years. MassDEP requires that Towns with an average summer to winter withdrawal ratio of 1.4 or greater reduce the summer to winter difference in withdrawal volumes by 50 percent. Towns with an average summer to winter withdrawal ratio between 1.2 and 1.4 are required to reduce the summer to winter ratio difference by 25 percent. A summer to winter ratio of 1.2 or less is considered acceptable, therefore, action is not required by Towns with a ratio of 1.2 or less. The Aquarion Water Company, for Hingham and Hull, has an average summer to winter ratio of 1.33 based on 1999 through 2004 withdrawals.

Historical Consumption

Historically, water demands in Hingham and Hull have corresponded to fluctuations in population. Seasonal and annual increases in population coincide with increases in water demand. Similar to historical increases in population and water demand, it is anticipated that water demand will further increase due to projected increases in population. Table No. 4-1 shows historical fluctuations in population and water demands. This table also shows the unaccounted-for-water, service population, the per capita consumption and peaking factor between maximum daily demand (MDD) and average daily demand (ADD).

Unaccounted-for Water

Unaccounted-for-water consists of unmetered water use such as street cleaning, water main flushing, unmetered losses, fire fighting, unauthorized water use and leakage in the distribution system. The term is typically expressed as a percentage of the total water supplied to the system, and can be estimated by taking the difference between the total amount of water supplied and the total water billed and dividing by the total water supplied. Unaccounted-for water ranged between 15 and 23 percent from 1999 to 2003. In 2005, unaccounted-for water fell to 10.4 percent. The projected unaccounted-for-water percentage has been projected to be 10 percent for the year 2025.

Table No. 4-1
Historical and Projected Water Use Data
Water Supply and Distribtion System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Year	Weighted Service Population	ADD (mgd)	Peaking Factor	MDD (mgd)	Peak Hour (mgd)
2000	35,456	3.47	1.57	5.45	*
2001	38,212	3.80	1.58	5.99	*
2002	35,983	3.48	1.76	6.12	*
2003	38,647	3.49	1.56	5.46	*
2004	38,184	3.45	1.61	5.57	*
2005	39,457	3.31	1.95	6.47	*
2025 (Average Peaking Factor)	45,600	4.12	1.67	6.88	11.12
2025 (Maximum Peaking Factor)	45,600	4.12	1.76	7.25	11.95

* Peak Hour information for 2000 through 2005 is not available

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Average Day Demand

Average day demand 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. 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 ADD for Hingham and Hull ranged between 3.31 and 3.80 mgd between 1998 and 2005. The following criteria were used to develop the projected ADD for the design year 2025:

Residential Consumption:	65 gpcd
Unaccounted-for-water:	10%
Residential Use:	72%
Commercial & Industrial Use:	18%
Year 2025 Service Population:	45,600

The estimated ADD for the design year 2025, based upon the above criteria is approximately 3.97 mgd. In 1991, DCR provided water demand projections through 2010. The DCR demand projections for ADD in 2000 was 3.62 mgd and the actual ADD within Hingham and Hull was 3.47. The actual ADD was less than the DCR projection by 0.15 mgd. In 1991, DCR did not account for the various water conservation measures that were implemented in Hingham and Hull in recent years. For these reasons, the DCR projections are likely to be artificially high. However, the anticipated growth in both communities will increase the ADD and future demands will be equal to or higher than the DCR projections by the design year 2025.

Maximum Day Demand

The maximum day demand is the maximum one day (24-hour) total quantity of water supplied during a one year period. This term is also 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. The distribution system must be capable of meeting maximum day demands with coincident fire demands to be considered adequate. Estimates of the projected maximum day demand and an allowance for the required fire flow are used to evaluate or design pumping, transmission and storage facilities.

The MDD/ADD ratio, or peaking factor, provides a relationship between the two demands which can be used to estimate future demands. As shown in Table No. 4-1, the maximum day demands ranged from 5.45 mgd to 6.47 mgd between 1999 and 2005.

Upon comparison of the MDD to the ADD, the ratios range from 1.56 to 1.95. To be conservative, a peaking factor of 1.76 was used to project future demands. The resulting projected MDD for the year 2025 is estimated to be 7.25 mgd, based upon the 2025 ADD of 4.12 mgd.

Peak Hour Demand

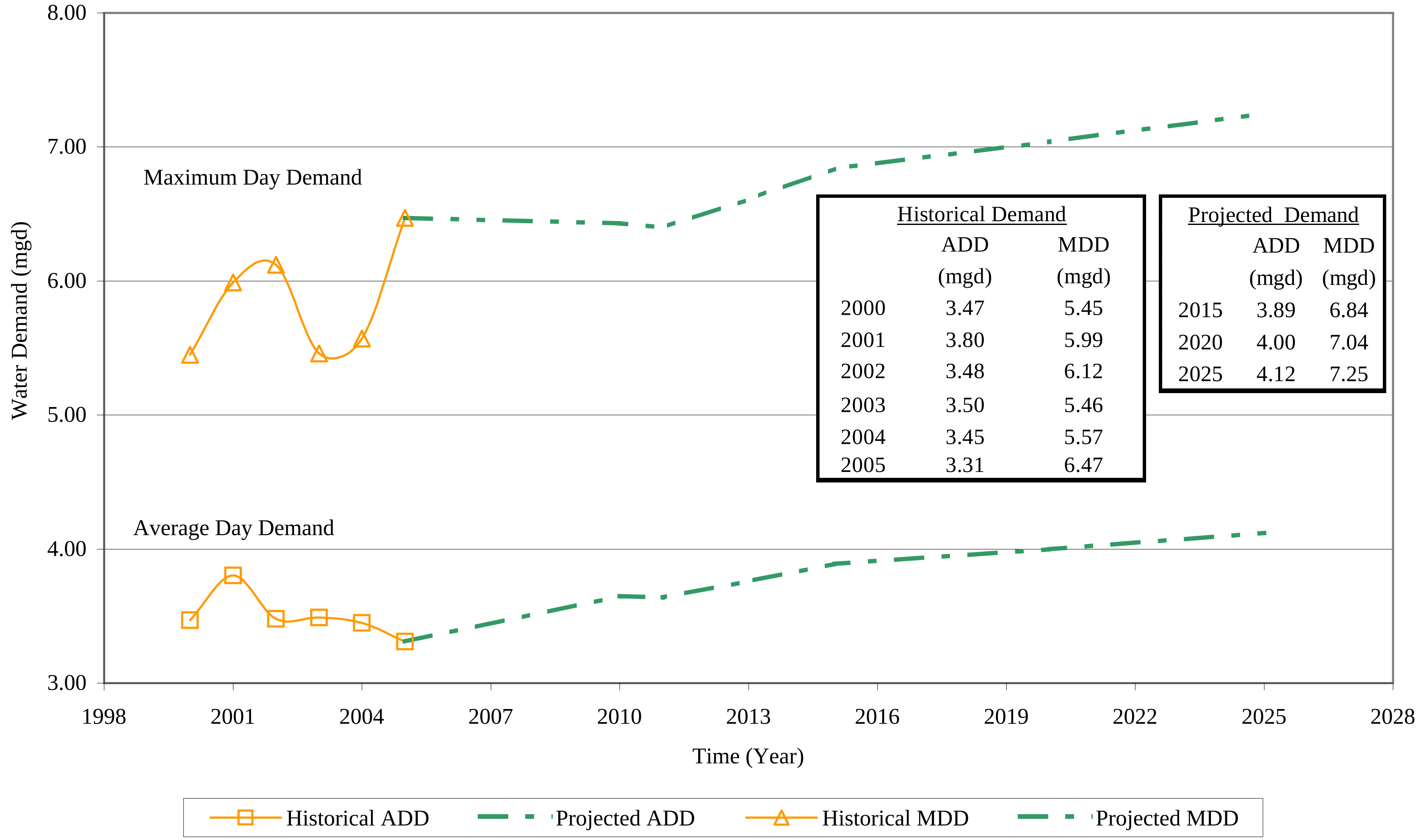
Peak hour demand is the maximum total quantity of water supplied in a single hour over a one year period typically expressed in mgd. These demands are typically met by distribution water storage facilities.

Since records of system peak hourly demands are not available, the peaking factor for the current usage and design year 2025 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 a MDD/ADD ratio of 1.76, the corresponding peak hour peaking factor for the system is approximately 2.9. Therefore, for a peak hour/ADD ratio of 2.9 and an ADD of 4.12 mgd, the projected peak hour flow for the year 2025 is estimated at 11.95 mgd.

Water Consumption

It is anticipated that water demands within Hingham and Hull will rise concurrently with population. The estimated population growth of nearly 15 percent will result in a potential consumption increase of approximately 15 percent. These water demand projections follow the above methods presented for calculating ADD and MDD. The projected water demands through the design year 2025 are shown in Figure No. 4-1. Similar to the populations, there is a noticeable rise in water consumption. However, the rate of change is not as rapid as found with population.

Figure No. 4-1
Hingham and Hull Projected Water Demands with 40B Development
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company



Historical Demand

	ADD (mgd)	MDD (mgd)
2000	3.47	5.45
2001	3.80	5.99
2002	3.48	6.12
2003	3.50	5.46
2004	3.45	5.57
2005	3.31	6.47

Projected Demand

	ADD (mgd)	MDD (mgd)
2015	3.89	6.84
2020	4.00	7.04
2025	4.12	7.25

Section 5

Water Supply Evaluation

General

In accordance with standard waterworks practices, the supply sources of a water system must be capable of meeting maximum day demand conditions and average day demand conditions with the largest source out of service. Additionally, the sources should be permitted to withdraw volumes adequate to meet the projected ADD. In this section, the safe yields of the supplies and permitted withdrawals of the existing supply sources were compared to current and future demand conditions.

Adequacy of Existing Water Supply Sources

In 1987, the Water Management Act (WMA) program was implemented by MassDEP to regulate withdrawal of water from the state's watershed basins. Under this program, all new and existing sources withdrawing more than 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. However, permits can be renewed and amended as system demands increase and additional supply sources 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.

The current Hingham and Hull system is comprised of seven supply sources and one emergency source. Table No. 5-1 provides the current withdrawal rates from each well and a summary of the MassDEP approved withdrawal rates for each of Aquarion's supply sources presented in Section 2. The total allowable withdrawal rates from existing sources is approximately 6.71 mgd without the emergency source Free Street Well No. 4, however, the estimated current withdrawal rate is only 3.85 mgd. The loss in capacity of the larger production/supply wells jeopardizes the ability of the system to meet average and maximum day demands. The ADD and MDD in 2005 were 3.31 mgd and 6.47 mgd, respectively. The current estimated yield does not adequately satisfy these demands or the projected demands in 2025. In order to eliminate this predicted deficit, a phase approach is recommended to maximize production of existing supply sources and augment the current supply with new sources or water purchase. The first phase will maximize production at several wells to satisfy current demands while the second and third phase, as appropriate, will improve source management and augment the current supply through potential new source development and water purchase.

Table No. 5-1
Estimated Yield of Existing Sources
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Source Name	Current Estimated Yield (gpm)	DEP Approved Withdrawal Rate (mgd)
Downing Street	0.32	0.41
Free Street No. 2	0.79	1.80
Free Street No. 3/5	0.37	0.51
Fulling Mill Station	0.72	1.36
Prospect Street Well	0.24	0.39
Scotland Street Well	0.71	1.55
Accord Pond	0.69	0.69
Total	3.85	6.71

Phase I

Several higher capacity supply wells within the system have experienced a gradual reduction in pumping capacity over the years. As a result, the current total available yield is 3.85 mgd. The Free Street No. 2, Scotland Street and Fulling Mill Station Wells produce less than the MassDEP approved withdrawal rate and appropriate measures should be implemented to maximize production from each source. Work related to Phase I has begun and is detailed further in the following sections.

Scotland Street Well Improvements

The maximum allowable pumping rate of the Scotland Street Well is 1.55 mgd. However, current operation of the well is approximately 0.71 mgd, or 0.84 mgd less than the approved withdrawal rate. The capacity of the well has diminished with time despite periodic well cleaning and reconditioning. Test wells were installed on site to verify the site capacity. The results indicate that a replacement well would restore the source to its approved capacity. A 24-hour pump test is required by MassDEP to determine the actual yield of the replacement well. Upon completion of the pump test and MassDEP approval, it is recommended that the existing well be pumped in conjunction with the replacement well under normal operating conditions.

Free St. Well No. 2 Improvements

Free St. Well No. 2 currently produces an average of approximately 0.79 mgd. Similar to the Scotland Street Well, the capacity of the well has diminished with time. The approved withdrawal rate is 1.8 mgd, or over twice the current production. The well and pump have undergone maintenance and redevelopment several times to increase capacity. The well is scheduled for additional maintenance and redevelopment to improve the withdrawal rate. Test wells were installed to verify the site capacity. The results indicate the replacement well would restore capacity to this source. However, a 24-hour pump test is required by MassDEP to determine the actual yield of the replacement well. Upon completion of the pump test and MassDEP approval, it is recommended that the existing well be pumped in conjunction with the replacement well under normal operating conditions.

Fulling Mill Station Well Improvements

The maximum allowable pumping rate of the Fulling Mill Station Well is 1.36 mgd. However, current operation of the well is approximately 0.72 mgd, or 0.64 mgd less than the approved withdrawal rate. The capacity of the well has also diminished with time. Three test wells were installed to verify the site capacity. The dug well and the vacuum priming system are currently in poor condition. Therefore, it is recommended that two replacement wells be installed to subrogate the existing dug well in its entirety. It is also recommended that maintenance and redevelopment of the existing well, suction and discharge lines, mechanical pump and vacuum priming system be completed. The refurbished dug well will serve as a back-up to two new replacement wells.

Adequacy of Existing Water Supply Sources after Maximization

Based on the Phase I supply improvements, it is estimated that a total of 6.34 mgd will be available from existing sources. This includes maximizing the Scotland Street Well to 1.55 mgd, Free Street Well No. 2 to 1.8 mgd and Fulling Mill Well to 1.36 mgd. Although the combined MassDEP allowable withdrawal rate from the existing sources is 6.68 mgd as shown on Table No. 5-1, it would not be cost effective to maximize the smaller capacity wells to obtain a higher yield at this time. Additional investigation may be carried out in the future to develop the remaining 0.34 mgd. In order to determine the adequacy of the existing system once maximization of the sources is completed, a maximum total yield of 6.34 mgd was used.

As stated in Section 4, the projected ADD and MDD for the year 2025 are 4.12 mgd and 7.25 mgd, respectively. According to Ten State Standards, suppliers must be capable of meeting two components in order to be considered adequate; the maximum pumping rate of the active sources must be greater than or equal to (1) the projected MDD and (2) the projected ADD with the largest source off-line. The system's total combined yield of the active supply sources upon completion of Phase I will be approximately 6.34 mgd, and compared to the projected MDD in 2025, a deficit of 0.91 mgd is estimated. Free Street No. 2 is the largest source based on sustainable yield, therefore, the available pumping rate while the largest source is off-line is 4.54 mgd. Compared to the projected ADD, a surplus of 0.42 mgd is estimated.

Phase II

Following the maximization of existing sources, additional supply must be procured to satisfy the projected demands in 2025. The goal of Phase II consists of exchanging production between Free Street No. 2 and Free Street No. 4.

Free Street No. 2, 2A and 4

Free Street No. 4 is considered an emergency source and has not operated as a daily supply well. The well has an approved safe yield of 0.81 mgd for emergency production only. Historical records indicate better water quality at Free Street No. 4 than Free Street No. 2. This may be due to Free Street No. 4 being constructed to a greater depth than Free Street No. 2. Aquarion has invested considerable time and money into permitting Free Street No. 4 as a permanent source and increasing the available yield to 1.3 mgd. However increases in yield are uncertain primarily due to environmental concerns for the Weir River and the limitations of the Interbasin Transfer Act. Based on this information, Aquarion intends to utilitze Free Street No. 4 and the new Free Street No. 2A as the permanent sources and make the existing Free Street No. 2 an emergency source. This approach does not increase the withdrawal rate from the sub-basin, only changes the point of withdrawal to Free Street No. 4 and 2A, rather than Free Street No. 2 and 2A. However, changes to the existing infrastructure, installation of new pumps and completion of various permits would be required to complete this portion of Phase II.

Phase III

Phase III incorporates longer term alternatives to supplement current system capacity. The following alternatives include the development of a new source and water purchase from adjacent and nearby water wholesale sellers. Each water purchase alternative would require an agreement between the Aquarion Water Company and another utility or private entity to meet the projected system demands. Further, new infrastructure and potentially water treatment would be required to transport and treat purchased water to the Hingham-Hull system.

New Source Development

In accordance with MassMassDEP guidelines, the development of a new source consists of four stages. The exploratory stage is for review of existing available information, evaluation of potential sites and installation of test wells. The second stage would include preparation and submittal of the request for site exam, alternatives analysis, land use survey and pumping test proposal. After approval by the MassDEP, the third stage will be the five-day pump test and accompanying pump test report completed and submitted to the MassDEP for review. The final stage consists of the design of the pump and associated water main from the source well to the system. A Water Management Act permit is required when the total withdrawal volume is greater than 100,000 gpd. In addition, all new sources will require the completion of an environmental notification form (ENF) to be submitted to the Massachusetts Environmental Policy Act office for review and public comment.

Permitting for new source development is a time consuming and costly process depending on the location and potential impact on the environment. In addition, the process does not guarantee that sufficient yield and quality will be found or that Aquarion can obtain ownership of the Zone I radius. In general, the permitting and development process could take up to five years to complete. In addition, water treatment may be required, which will increase the time and cost of the project.

The United States Geological Survey (USGS) potential aquifer yield potential maps were reviewed to identify potential well site locations within town boundaries. The areas of reasonable yield currently host one or more active supply wells. Additional gravel packed wells in these sub basins could strain these areas. Therefore, a fracture trace analysis was conducted to identify potential bedrock well locations. This type of well would withdraw water from a deeper aquifer, not immediately connected to the shallower aquifer supplying current gravel packed wells. A new bedrock supply well is permitted in the same manner as sand and gravel sources, and is constrained by the results of pump testing and MassDEP approval.

Several sites were identified during the fracture trace analysis as potential supply well locations, however, a pumping test would be required to determine the yield. The sites are located within the South Coastal Basin and the property is owned by DCR. Obtaining access to these areas may prove extremely difficult as DCR does not favor development on agency owned land. Additional evaluation will be conducted on potential sand and gravel sources and bedrock wells at existing well sites as well as appropriate locations within the service area.

Interconnection to Cohasset

All current supply sources should be maximized and potential sites investigated prior to seeking water sources across town boundaries. The Town of Cohasset currently operates and maintains the Aaron Reservoir as a water supply source. Currently, system demands only require the Town to utilize a portion of the permitted withdrawal rate. In addition, preliminary estimates indicate that a surplus of approximately 1.0 mgd may exist through 2025 based on projected demands in Cohasset. The current cost for purchasing water is approximately $4.50 per 1,000 gallons for finished water. Although it may be cost effective, at current prices, from an operation and maintenance standpoint for Aquarion to purchase raw water and treat it at the existing Hingham/Hull District Water Treatment Facility, the capital costs associated with constructing approximately four miles of raw water main from Aaron Reservoir to the treatment facility would be considerable.

MWRA Connection

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. Reportedly, the current cost for MWRA is approximately $2,400 per 1.0 million gallons with a $5,500,000 participation fee. Based on recent discussions, it is anticipated that the water rate will increase by 13 percent until year 2008.

Desalinization Plants

Currently, the Town of Hull is conducting a feasibility study regarding the construction and operation of a desalinization plant. This improvement would reduce the demands on Aquarion system and offer a potential long-term option for supplement supply. However, this option is still in the planning and discussion phase. The estimated cost for this improvement cannot be determined since it is still preliminary in nature.

A desalinization plant is proposed by Aquaria Corporation and Bluestone Energy Services in the Town of Dighton, Massachusetts. In order for Aquarion to obtain water from this plant, reportedly, approximately one mile of new 20-inch diameter water main would need to be constructed from Dighton to Brockton. Brockton would then transmit the water through existing infrastructure to Hingham and charge a wheeling fee to Aquarion. Based on information presented in previous reports, the minimum contract amount for purchasing water from Dighton would be $176,000 per year per 100,000 gallons and the current a water charge of approximately $1.23 per 1,000 gallons will be assessed in addition to the annual fee.

Water Quality Regulations

The US EPA promulgated the lead and copper rule (LCR) and the Radionuclides Rule under an amendment to the Safe Drinking Water Act (SDWA). In addition, the EPA is in the process of enacting several new water quality regulations (rules) for source water. The following is a brief description of the LCR and other proposed rules.

Lead and Copper Rule

Under the LCR, samples at consumers' taps must be analyzed for lead and copper and the resulting concentrations compared to set action levels. Water systems that fail to meet the lead and copper action levels at the 90th percentile must implement a corrosion control treatment system. Water systems that meet the lead and copper actin levels or maintain optimal corrosion control for two six-month monitoring periods, may reduce the number of tap water sampling sites and collection frequency to once per year. The action levels established by the EPA for lead and copper are 0.015 milligrams per liter (mg/L) and 1.3 mg/L, respectively. Annual water samples were collected by Aquarion from each well within the supply system. Concentration of both lead and copper were below the current MCLs.

Arsenic Rule

Arsenic is a naturally occurring material that can be found at trace levels in most soils as a result of mineral dissolution. Exposure to low concentrations of arsenic in drinking water for a long period of time can cause skin, bladder, lung and prostate cancer as well as non-carinogenic health effects such as heart disease, diabetes and anemia.

The current drinking water standard (MCL) of 0.05 mg/L was set in 1975 based on US Public Health Standards. Amendments to the SDWA approved by Congress in 1996 mandated the EPA to review the health effects of arsenic in drinking water and make recommendations regarding a new MCL. As such, the EPA formulated a research committee to assess health hazards, potential removal processes and associated costs. In October 2001, the EPA adopted a new standard of 0.01 mg/L which became effective in January 2006.

Annual water quality testing indicates that little arsenic exists in the water supply sources. The arsenic levels detected were a tenth of the new standard and the majority of the samples fell below the detection limit.

Radionuclides Rule

The Radionuclides Rule was promulgated to reduce the risk associated from exposure to radiation from radionuclides found in water supplies. During the decay of radioactive elements, alpha, beta and/or gamma radiation is emitted which can be harmful to human tissue. The rule requires systems to monitor each source quarterly for radium-226, radium-228, adjusted gross alpha emitters, beta particles and photon emitters during the initial monitoring phase (December 2003 through December 2007). If contaminant levels during initial monitoring are below the MCLs, the State may grant a waiver allowing the system to decrease the frequency of monitoring.

The MCLs for the elements regulated under the Radionuclides Rule are listed in Table No. 5-2 below:

Table No. 5-2
Proposed MCLs for Elements Regulated Under the Radionuclides Rule
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Contaminant	MCL
Gross Alpha Emitters	15 pCi/L
Gross Beta Particles and Photo Emitters	4 mrem/yr
Radium-226	5 pCi/L
Radium-228	5 pCi/L
Radon	300 pCi/L
Uranium	30 pCi/L

Radionuclides, radium-226 and –228 and gross alpha and beta emitters were tested during annual water quality analyses. Radium-226 was observed to be as high as 0.02 pCi/L and Radium-228 was not detected during the analyses. Gross Beta Particles were observed one year at 4 mrem/yr, but were not detected in other years.

Radon in Drinking Water Rule

This proposed rule will provide the state with flexibility in limiting the public's exposure to radon in indoor air as well as radon in drinking water. Radon from indoor air is a leading contributor to lung cancer in the United States while radon in drinking water increases the risk of lung cancer and presents a risk of internal organ cancer such as stomach cancer. The proposed regulation provides two options for the maximum contaminant level for radon. The first option is to develop an enhanced state program to address the health risks associated with radon in indoor air known as the Multimedia Mitigation (MMM) program. Under this option, a maximum contaminant level of 4,000 pCi/L would be set for radon. If a state chooses not to develop a MMM program, water suppliers would be required to reduce radon in water to 300 pCi/L or develop individual local MMM programs and meet the greater MCL of 4,000 pCi/L.

The best available technology for the removal of radon from drinking water for all systems is high performance aeration. This is defined as aeration technologies capable of high radon removal efficiencies (up to 99.9 percent removal) such as packed tower aeration and multi-stage bubble aeration. The SDWA directs the EPA to list Small System Compliance Technologies (SSCTs) which are affordable and technically feasible for smaller water systems. The EPA proposes to list high performance aeration, granular activated carbon (GAC) and point of entry GAC and SSTCs.

Current levels of radon were observed between 220 and 820 pCi/L. Without a State implemented program, Aquarion will be forced to reduce the level of radon within the water below 300 pCi/L. Currently, it is unclear if the State intends to develop a MMM program for the regulation of radon. If the State does not develop this program, a cost effective approach for Aquarion is to develop a local MMM program thereby increasing the MCL to 4,000 pCi/L.

Groundwater Disinfection Rule

The Ground Water Disinfection Rule (GWDR) is intended to reduce the risk associated with microbial contamination of groundwater by requiring the maintenance of a detectable disinfectant residual in the water distribution system, as currently required of surface water sources. Under this rule, all systems using groundwater would be required to disinfect supplies unless the source meets the criteria of "natural disinfection" or qualifies for a variance. A well or wellfield is considered to meet "natural disinfection" criteria if it is not vulnerable to viral contamination. If a groundwater source does not meet the "natural disinfection" criteria, suppliers will be required to maintain a residual chlorine concentration of 0.2 mg/L in the distribution system and continually monitor residual.

A ground water source will not meet the natural disinfection criteria if it is under direct influence of surface water. MassDEP has formulated exemption criteria for groundwater sources to aid communities in determining whether chlorination or microparticulate analysis (MPA) testing is required. Criteria 1 states that all communities are exempt from the Surface Water Treatment Rule (SWTR) if the well screens are separated from the surface of water features by confining layers. Criteria 2 states that all communities are exempt if the well is located 150 feet or more horizontally from a surface water feature. Criteria 3 states that a community is exempt if the top of the well screen is 50 feet or more below the ground surface, the well pumps less than 720,000 gallons per day on average, the well has properly installed sanitary seal, and the well has not had any total or fecal coliform violations over the past three year period.

Groundwater Rule

The proposed Groundwater Rule seeks to reduce the public health risk posed by contaminated groundwater sources. The rule applies to all systems that make use of groundwater or blend groundwater and surface without treatment prior to direct entry into the distribution system. The primary goal of the rule is to improve the minimum reliable level of treatment technology to 4-log removal of all viruses and implement a system of compliance monitoring following a positive Coliform sample to reduce potential illness resulting from exposure to viruses and bacteria. All groundwater systems are subject to triggered source water monitoring upon notice of a positive sample collected under the Total Coliform Rule (TCR). The rule will target high-risk systems and systems with significant deficiencies.

Long Term 2 Enhanced Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was developed to protect public water supplies against microorganisms, specifically giardia, viruses and cryptosporidium.

Under the SWTR, all surface water or groundwater under direct influence of surface water must be properly disinfected. In addition, adequate filtration is also required unless an effective watershed protection program exists. When the SWTR was promulgated, limited data were available regarding effective treatment of cryptosporidium. The Information Collection Rule (ICR) was issued to collect data nation-wide concerning effectiveness of existing treatment methods on cryptosporidium.

Several regulations were passed to improve treatment techniques for removal of cryptosporidium, giardia and viruses. The Enhanced Surface Water Treatment Rule (ESWTR) and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) implemented more effective treatment methods for removal of microorganisms and pathogens. Large public water supply systems were required to filter source waters, provide adequate disinfection and maintain a minimum disinfectant level (residual) within the distribution system.

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) was promulgated in January 2006. The LT2ESWTR extends the treatment requirements of LT1ESWTR to include all public water supplies and targets higher risk systems. The new regulation ensures public water supplies maintain adequate microbial removal despite more stringent regulation regarding disinfectants and the formation of disinfection byproducts. The new regulation promotes new and more effective technologies for cryptosporidium, giardia and pathogen removal.

Disinfection/Disinfection Byproduct Rule

The Stage 2 Disinfection/Disinfection Byproduct Rule (D/DBP) applies to all water supply systems that treat water using a chemical disinfectant. The primary goal of the Stage 2 D/DBP rule is to reduce the formation of disinfection byproducts (DBPs). DBPs are the product of reactions between a disinfectant (chlorine-based) and natural organic matter. Natural organic material is ubiquitous in both surface water and groundwater sources. The goal of the new regulation is not unlike the goal of the Stage 1 D/DBP rule that developed Maximum Residual Disinfectant Levels (MRDLs) for Chlorine, Chloramine and Chlorine Dioxide, Maximum Contaminant Levels (MCLs) for specific DBPs, Trihalomethame, Haloacetic Acid (5), Chlorite and Bromate, and required system-wide testing for these constituents. The Stage 2 D/DBP focuses on higher risk systems and enhances the Stage 1 D/DBP rule through more extensive and frequent monitoring. Promulgated in January 2006, the Stage 2 D/DBP regulation incorporates Locational Running Annual Averages (LRAA) and Initial Distribution System Evaluation (IDSE). The results of system wide evaluations will identify locations of maximum contamination within every public supply system.

These locations will then be tested on at least a quarterly basis where each location may not exceed the MRDLs or MCLs found in the table below.

Table No. 5-3
MCLGs and MCLs for Stage 2 Disinfectants and Disinfection Byproducts Rule
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Disinfection Residual	MRDL (mg/L)
Chlorine	4.0 (as Cl_2)
Chloramine	4.0 (as Cl_2)
Chlorine Dioxide	0.8 (as ClO_2)

Disinfection Byproducts	MCL (mg/L)
Total trihalomethanes (TTHM)[1]	0.080
Haloacetic acids (five) (HAA5)[2]	0.060
Chlorite	1.0
Bromate	0.010

1-Total trihalomethanes is the sum of the concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
2-Haloacetic acids (five) is the sum of the concentrations of mono, di, and trichloroacetic acids and mono and dibromoacetic acids.

Groundwater Rule

The proposed Groundwater Rule seeks to reduce the public health risk posed by contaminated groundwater water sources. The rule applies to all systems that make use of groundwater or blend groundwater and surface without treatment prior to direct entry into the distribution system. The primary goal of the rule is to improve the minimum reliable level of treatment technology to 4-log removal of all viruses and implement a system of compliance monitoring following a positive Coliform sample to reduce potential illness resulting from exposure to viruses and bacteria. All groundwater systems are subject to triggered source water monitoring upon notice of a positive sample collected under the Total Coliform Rule (TCR). The rule will target high-risk systems and systems with significant deficiencies.

Section 6

Computer Model

General

In order to evaluate Aquarion Water Company's existing water distribution system and to obtain a basis for recommending water distribution system improvements, a comprehensive computer model was utilized to mathematically simulate the water distribution system. Aquarion will be able to use the new computer model as a planning tool to assess the potential impact of proposed developments and system improvements prior to their construction.

Hydraulic computer modeling software "WaterCAD" which integrates AutoCAD Version 2004 with hydraulic analysis algorithms, was used to adjust and verify the existing model. WaterCAD allows the user to conduct hydraulic simulations using Haestad Methods algorithms while in an AutoCAD environment. As part of this study, the existing hydraulic model was evaluated and adjusted based on improvements to the existing distribution system and information pertaining to the sources and storage facilities provided by Aquarion.

Model Verification

A color-coded junction map of the water distribution system model can be found in Appendix B. The computer model is represented by the node, pipe and tank information provided in Appendix C. The node map provides information on storage facilities, water supply sources, sizes of water mains and a general layout of the distribution system. The hydraulic input data in Appendix C provides data on system demands, length and diameter of water mains, roughness coefficient or "C-value" of water mains, elevations, pumping rates at water supply sources, and overflow elevations at storage facilities.

Fire flow tests were conducted at various locations throughout the distribution system. The twenty fire flow tests were conducted on November 21-22, 2005. Table No. 6-1 presents the results of the fire flow tests conducted by Aquarion and Tata & Howard, Inc. The flow tests provided data for the computer model verification and on available fire flows and pressures in the area of each test.

The data obtained from the fire flow tests served as input data for the model verification. These data included water levels in storage tanks, pumping rates of supplies, static and residual pressure readings, and measurement of flows from hydrants. The data described above served as input data for the computer program for verifying the water system model. It is important that each computer generated simulation reflects actual field conditions at the time of testing. Actual field conditions include current demands on the system, varying flows from each water supply source and pump station that is online, as well as varying tank elevations.

Table No. 6-1
Fire Flow Tests: November 21 - 22, 2005
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Test No.	Location of Flowing Hydrant	Flowing Hydrant Static Pressure (psi)	Flowing Hydrant Pitot Reading (psi)	Residual Hydrant Static Pressure (psi)	Residual Hydrant Residual Pressure (psi)	Estimated Flow (gpm)	Estmated Flow at 20 psi (gpm)
1	Gardner St (~300' past Harvest Ln)	40	25	46	40	840	1,850
2	Old Derby Rd (near end)	47	30	56	42	920	1,530
3	180 Gardner St	60	40	52	44	1,063	2,240
4	Richards Rd (~250' past Elaine Rd)	68	35	69	50	995	1,660
5	Stagecoach Rd (~ 300' past Hitching)	90	30	90	59	888	1,370
6	19 Plymouth River Rd	90	24	86	33	822	925
7	Fort Hill Rd @ Stephens Rd	84	25	80	34	840	970
8	31 Thaxter Rd (near Kent Ln)	81	52	84	72	1,211	2,990
9	Downer St @ Merrill	90	46	92	60	1,138	1,760
10	Bulow Rd @ Fottler Rd	83	53	80	62	1,223	2,340
11	223 Central St (Town Hall)	78	47	78	66	1,150	2,693
12	Triphammer Rd (~950' from Union)	82	43	84	60	1,100	1,868
13	Turkey Hill Rd @ Pheasant Run	51	20	64	45	751	1,180
14	Rockland St @ George Washington	92	70	85	80	1,408	5,625
15	Rockland St @ Nantasket (12")	96	70	96	90	1,408	5,547
16	Hull St	72	15	80	44	650	856
17	Old Coach Rd	76	10	62	0	530	430
18	Nantasket Ave @ Shore Garden Rd	84	57	88	80	1,268	4,027
19	Nantasket Ave @ H St.	96	65	86	70	1,355	2,910
20	Main St @ High School	96	37	92	44	1,022	1,270

Verification of the computer model was then completed. The computer model was considered verified when the results of the computer runs compared to within five percent of the hydraulic data collected from the fire flow tests. The model mathematically represents the physical operating conditions of the 2005 Hingham and Hull water distribution system.

Once the hydraulic model was verified, hypothetical conditions such as increased demand rates and required fire flows were simulated on the model. The simulation of these conditions provided the opportunity to identify system deficiencies and to develop necessary improvements. Projected demands through the design year 2025 were simulated.

Section 7

Water Distribution System Analysis

General

A hydraulic analysis, using available data on the water distribution system and fire flow test results, provides an indication of the distribution system's ability to meet the criteria described in this section. A computer hydraulic analysis was conducted on the Hingham/Hull water distribution system. Recommendations set forth by the Insurance Services Office (ISO) for water storage necessary for fire protection, fire flows, and peak demands were utilized in the analysis of the distribution system.

Fire Flow Demands

The required 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 required for proper fire protection are based on maintaining a residual pressure of 20 psi. This residual pressure is considered necessary to maintain a positive pressure on the suction side of a fire department pumper truck with an allowance for frictional losses in the hydrant and fire hose.

The latest ISO information available for Hingham, Hull and Cohasset made available for this study was from 1994, 2000 and 1988, respectively. The results of the ISO inspections and fire flow testing are shown in Table No. 7-1. The test results indicate the available flow and the estimated needed fire flow in various sections of the distribution system at the time of the tests.

The estimated needed fire flows established by ISO, for all three communities varied from 750 to 6,000 gpm, depending on the location and the structures. It should be noted that Aquarion is only required to provide up to 3,500 gpm at the street. 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 purpose of this study, the basic fire flow requirement was established to be 2,000 gpm for a duration of two hours.

Table No. 7-1
ISO Fire Flow Data - Hingham
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Needed Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
1	Mast Hill Rd @ Charles St	61	27	750	950
2	Pine Grove Rd @ Rosemary Ln	65	55	4,500/3,000	2,100
3	Recreational Pk Dr @ Keith Way	52	42	3,000	2,000
4	Industrial Rd @ Commerce Rd	50	35	2,250	1,700
5	Colonial Rd @ Hancock Rd	91	62	750	1,700
6	Stanford Dr @ Camelot Dr	70	26	3,000	800
7	French St @ Manatee St	73	17	750	700
8	West Beal St @ Hillside Terr	87	80	2,000	3,400
9	Beal St @ Terry St	84	74	5,000/3,500	2,000
10	Bulow Rd @ Lincoln St	84	45	6,000/3,500	1,200
11	Downer Ave @ Plantations Fld Ln	87	68	3,000	2,500
12	Malcom St @ Standish St	80	77	750	3,800
13	Main St @ Elm St	88	84	2,500	5,000
14	Eldridge Ct @ Water St	90	87	2,250	4,600
15	Geo. Washington Blvd	86	83	2,000	6,700
16	Jerusalem Rd @ Hull St	87	82	1,000	5,200
17	Last Hyd't on E. Gate Ln	71	66	3,000	4,500
18	Pleasant St @ Downing St	66	64	3,000	5,700

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Table No. 7-1 (Continued)
ISO Fire Flow Data - Hull
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Needed Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
1	Main Street near Helen St.	84	34	3,500	1,100
2	Harbor View Rd near Battery Rd	66	17	3,000	950
3	Nantasket Ave @ T St	90	54	4,500/2,250	2,000
4	Central Ave @ L St	90	50	3,000	2,100
5	Nantasket Ave @ Bay St	92	70	3,000	3,200
6	Nantasket Ave @ Kenburma St	92	64	3,000	2,700
7	Nantasket Ave @ Park Ave	90	60	2,500	3,200
8	Atlantic Ave @ School St	79	79	2,000	2,900
9	Spring Street near Main St	92	40		1,900
10	Pt. Allerton Avenue near Glover St	82	55		1,800
11	Nantasket Ave @ Eastman Rd	88	80	2,000	2,500
12	Salisbury Street @ Barnstable St	92	52	2,000	1,200
13	Manomet Street @ Lewis St	94	60	1,750	2,200
14	Nantasket Ave @ Westminster	92	62	2,500	3,200
15	Highland @ Newton St	48	1	1,500	950
16	Bay Ave @ A St	92	58	1,500	2,100
17	Summit Ave @ Driftway	92	20	1,000	750
18	Mayflower Rd @ Hampton Cir	92	10	1,000	750

Table No. 7-1 (Continued)
ISO Fire Flow Data - Cohasset
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Test No.	Test Location	Static Pressure (psi)	Residual Pressure (psi)	Needed Flow at 20 psi (gpm)	Available Flow at 20 psi (gpm)
1	Elm St @ Border St	90	8	3,000	600
2	Jerusalem Rd @ Hull St	90	84	1,500	1,800
3	Border St @ Parker Ave	90	48	1,500	550
4	Atlantic Ave @ Lothrop Ln	84	50	750	600
5	Atlantic Ave @ nichols Rd	90	52	750	450
6	Jerusalem Rd @ Linden Dr	76	18	750	400
7	Jerusalem Rd @ Black Rock Rd	95	78	2,250	950
8	Hull St @ Lamberts Ln	68	38	750	800
9	Surrey Dr @ Forrest Ave	58	15	750	350

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Adequacy of the Existing Distribution System

A distribution system must be able to provide adequate pressures during varying demand conditions. For the purposes of this study, a minimum pressure of 35 psi at ground level was required during average day, maximum day, and peak hour demand conditions. 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. During fire flow conditions, a minimum pressure of 20 psi was required at ground level throughout the system. This 20 psi of pressure is equivalent to 46 feet in elevation and will allow water to overcome frictional resistance in house plumbing an rise to a height equivalent to about a three story building.

1. Minimum/Maximum Pressures – Maximum Day and Peak Hour (psi)

During a normal year 2025 average day, maximum day and peak hour demand conditions (no coincident fire flow), the recommended minimum pressure requirement of 35 psi is met through the distribution system. In general, elevations greater than 131 feet will experience pressure less than 35 psi during normal operating conditions.

2. Estimated Fire Flow Requirements – ISO Needed Fire Flows

Recommended improvements were developed to meet the estimated needed fire flow requirements for the deficient locations indicated in Table No. 7-1. A description of the proposed improvements is provided in Section 8.

3. Fire Flow Requirements – Extremities and Developed Residential Areas

According to the American Water Works Association (AWWA), the minimum recommended fire flow in residential areas where homes are between 31 and 100 feet apart is approximately 750 gpm. An estimated fire flow of 750 gpm at all nodes was simulated on the computer model. A few areas in system could not meet the minimum recommended fire flow. Recommended improvements to achieve 750 gpm in these areas are discussed in Section 8 – Priority II Recommended Improvements.

Adequacy of Existing Storage Facilities

Distribution storage is provided to meet peak consumer demands such as peak hour demands and additionally, to provide a reserve for fire fighting. Storage may also serve to provide an emergency supply in case of temporary breakdown of pumping facilities, or for pressure regulating 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.

Equalization storage provides water from the tanks during peak hourly demands in the system. Typically, this quantity is a percentage of the maximum day demands. The percentages can range from fifteen to twenty-five percent, with fifteen percent used for a large system, twenty percent for a mid sized system and twenty five 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. The Hingham/Hull system would be considered a medium size system. As a result, twenty percent of maximum day demand was used for the equalization storage calculations.

1. Equalization
- Mid sized system = 20 percent of the Maximum Day Demand
- Maximum Day Demand in year 2004 = 5.57 mgd
- Estimated Maximum Day Demand in year 2025 = 7.25 mgd

- Equalization (2004) = 0.20 x 5.57 = 1.11 mg
- Equalization (2025) = 0.20 x 7.25 = 1.45 mg

The fire flow storage component is based on the basic fire flow requirement multiplied by the required duration of the flow. This 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. Within the Hingham/Hull system, a basic fire flow of 2,000 gpm for a duration of two hours was used for the storage evaluation. Based on these criteria, approximately 0.18 mg is needed for fire protection.

2. Basic Fire Flow Requirement
- Representative fire flow = 2,000 gpm
- Duration of 2 hours or 120 minutes

- Basic Fire Flow Requirement = 2,000 x 120 = 0.24 mg

The emergency storage component is typically equivalent to one ADD. However, if there is emergency power available at the source(s) and the supply is sufficient to meet the ADD or there are emergency connections with surrounding communities, the emergency storage component can be waived. Therefore, the emergency storage component was not included in the storage capacity calculations.

3. Emergency - Waived

The total required storage for any given year is the equalization component plus the basic fire flow requirement. Therefore, the current (year 2004) and projected (year 2025) total required storage is as follows:

- Total Required Storage (2004) = 1.11 + 0.24 = 1.35 mg.
- Total Required Storage (2025) = 1.45 + 0.24 = 1.69 mg.

Under existing and projected ADD, MDD and peak hour demands, a minimum pressure of 20 psi should be maintained throughout the distribution system. In the Hingham/Hull system, the highest customer is at an elevation of approximately 131 feet in the main service area and 180 feet in the high service area, and in order to maintain a pressure of 20 psi at these elevations, the tank levels can drop to approximately 177 feet and 226 feet respectively. Based on this scenario, the entire Accord Tank (0.75 mg), at a base elevation of 244 feet, is usable. However, the Turkey Hill (2 mg) and Strawberry Hill (0.5 mg) Tanks have lower base elevations of 170 and 103 feet, respectively. Therefore, in order to maintain 20 psi throughout the system the Turkey Hill Tank level cannot drop below 63 feet and the Strawberry Hill Tank cannot drop below 9 feet. This reduces the usable storage in the Turkey Hill Tank to 1.81 mg and the Strawberry Hill Tank to 0.13 mg.

The total usable storage in the Hingham/Hull water distribution system is approximately 2.69 mg. The projected required storage for the design year is approximately 1.69 mg. Therefore, the system has approximately 1.00 mg of surplus storage.

Section 8

Conclusions and Recommendations

General

The following summarizes the findings of the study and presents a prioritized plan for recommended improvements and associated costs. The prioritization of improvements allows for constructing the necessary reinforcements over an extended period of time as funds allow.

The recommendations are broken into two components; Priority I and II recommendations for system improvements relative to the water distribution system. Priority I improvements are intended to eliminate insufficient storage and supply as well as strengthen the transmission capabilities of the system and mitigate estimated ISO fire flow deficiencies. Priority II improvements were identified as part of a system wide evaluation and identify improvements required at or near system extremities and in developed residential areas. Tables No. 8-1 and No. 8-2 present the estimated costs for the Priority I recommended improvements for supply and water distribution. Costs are based on the April 2006 Engineering News Record (ENR) index of 7695.10, and include a 25 percent allowance for engineering and contingencies and costs associated with water services, hydrants and permanent and temporary trench pavement. Estimates do not include costs for land acquisition, easements or legal fees. The recommended improvements are described herein and shown on the Priority I and II Improvements Map provided in Appendix D.

General Maintenance and Operations Practices

Aquarion Water Company should continue performing regularly scheduled maintenance programs, including hydrant flushing, and routine inspection and maintenance at the pump stations and meter testing/calibration. Aquarion should continue the ongoing annual meter replacement program in which older meters are scheduled for replacement. AWWA recommends meter replacement every seven to ten years depending on water quality of the system and the use of the meter.

Aquarion should also implement a valve replacement program during which valves that do not function as intended are identified and replaced. By eliminating valves in the system that are broken, Aquarion can continue to improve the transmission capacity of the system.

Whenever improvements or expansion of a water distribution system occur, factors such as size and location of the main should be considered in order to provide adequate flows and pressures. Water mains that extend for 600 feet or more without an interconnection should have a minimum diameter of 8 inches. Wherever possible, dead end mains should be eliminated by looping or interconnecting and all water mains should be interconnected at reasonable intervals. All older and smaller water mains that are not able to meet fire flow requirements in an area should be replaced with larger diameter mains. In addition, "bottlenecks" such as smaller water mains being the sole means of transporting water between larger mains should be eliminated.

In various portions of the system, older 2-inch, 4-inch and 6-inch diameter water mains are used to service dead end streets and residential neighborhoods. It is recommended as part of an annual replacement program that these older mains be replaced by new 8-inch diameter mains. However, prior to replacement of these mains, Aquarion may consider conducting fire flow tests to determine the available flow and condition of the water main. This will allow Aquarion to prioritize replacement of these mains as funds become available.

It is recommended that Aquarion implement a general water main replacement program that will help eliminate the above water distribution system inadequacies. During this program, all sections of the water distribution system piping that have a history of breaks or are considered bottlenecks or dead end mains are identified and scheduled for replacement.

In addition, the availability of the updated hydraulic computer model will provide Aquarion Water Company with an important tool in evaluating expansion or changes in the future, particularly when evaluating impacts of proposed new developments or water main replacement.

Priority I Recommended Improvements – Water Supply
As stated in Sections 4 and 5, the current water supply available to the Hingham and Hull system will not adequately meet future demands. Water consumption projections indicate a deficit of approximately 0.91 mgd during a maximum day demand scenario in 2025. A series of tasks, including maximization of existing sources through installation of replacement wells at Scotland Street Well, Free Street Well No. 2 and Fulling Mill Station Well must be completed during Phase I. In Phase II, Aquarion intends to further maximize existing sources by utilizing Free Street Well No. 4 in place of Free Street Well No. 2 as the primary supply well in the area. The third phase includes long term development of a new supply source and/or procurement of a water purchase agreement. Priority I Recommended Improvements are summarized in Table No. 8-1.

1. The maximum allowable pumping rate of the Scotland Street Well is 1.55 mgd. However, current operation of the well is approximately 0.74 mgd, or 0.84 mgd less than the approved withdrawal rate. The capacity of the well has diminished with time despite periodic well cleaning and reconditioning. It is recommended that a 24"x18" diameter replacement well be installed to work in conjunction with the existing well. This improvement will include completion of a 48-hour pump test, installation of the well, pitless adapter, water main, electric and signal wire, instrumentation and controls, generator, submersible pump, engineering, permitting and contingencies. The estimated cost of this improvement is $282,000.

2. Free Street Well No. 2 currently produces an average of approximately 0.79 mgd. Similar to the Scotland Street Well, the capacity of the well has diminished with time. The approved withdrawal rate is 1.8 mgd, or over twice the current production. The well and mechanical pump have undergone maintenance and redevelopment several

times to increase capacity. It is recommended that an 18”x12” diameter replacement well be installed adjacent to the existing well to maximize the withdrawal rate from this site. This improvement will include completion of a 48 hour pump test, installation of the well, pitless adapter, water main, electric and signal wire, instrumentation and controls, generator, submersible pump, engineering, permitting and contingencies. The estimated cost of this improvement is $290,000.

3. The maximum allowable pumping rate of the Fulling Mill Station Well is 1.36 mgd. However, current operation of the well is approximately 0.72 mgd, or 0.64 mgd less than the approved withdrawal rate. The capacity of the well has diminished with time. To maximize withdrawal from this site, installation of two 18”x12” diameter replacement wells is recommended adjacent to the existing well. This improvement will include completion of a five day pump test, installation of wells, pitless adapters, water main, electric and signal wire, instrumentation and controls, generator, submersible pumps, engineering, permitting and contingencies. The estimated cost of this improvement is $440,000.

4. Free Street Well No. 4 is currently registered as an emergency source with an approved withdrawal rate of 0.81 mgd. Historical records indicate better water quality at Free Street Well No. 4 than Free Street Well No. 2 due to its construction at a greater depth. The “switching” of Free Street Well No. 4 and No. 2 will require completion of a Water Management Act permit. In addition, upgrades at Free Street Well No. 4 will be required including, a new building, water main, electric service, generator, instrumentation and controls, engineering, permitting and contingencies. The estimated cost of this improvement is $600,000.

5. Potential long term alternatives to augment the current water supply may include new source development, establishing interconnections with the Cohasset system and the MWRA system and water purchase from proposed desalination plants located in Dighton and Hull, Massachusetts. It is recommended that upon completion of maximizing approved yields at existing sources, evaluation of the potential need for supplemental supply be determined. Investigation of options should be conducted as appropriate based on the estimated need and available options.

<u>Priority I Recommended Improvements – Water Distribution</u>

6. R.L. Merithew, Inc. performed inspections on the Turkey Hill, Accord and Strawberry Hill Water Storage Tanks. The Turkey Hill and Accord Tanks were considered to be in good condition and neither facility required immediate rehabilitation. The Strawberry Hill Tank requires immediate rehabilitation to preserve the structural integrity and operating capacity of the tank. R.L. Merithew recommends complete removal of the interior and exterior paint systems, improvements to the riser pipe, ladder system, walkways and handrail surfaces, roof vents and all sway rods connected to the leg columns. The tank appears to be rapidly approaching the end of its service life. As discussed in Section 7, the system currently has approximately 1.00 mg in surplus storage. The Strawberry Hill Tank provides 0.13 mg of usable storage. If the tank were removed from the system, rather than rehabilitated, the system would have 0.87

mg of surplus storage. Hydraulic simulations indicate that the tank does not contribute to fire flow availability in Hull. Therefore, it is recommended that the Strawberry Hill Tank be disconnected from the system and dismantled. The estimated probable cost for dismantling of the tank is $50,000.

7. In order to provide a nominal capacity of 2,000 gpm at the end of Nantasket Avenue, it is recommended that the existing Hull Booster Pump Station be upgraded to include fire pumps. The fire pumps would provide additional fire flow to all services north of the pump station. The estimated probable construction cost for upgrades to the Hull Booster Pump Station, including design, construction and contingencies is $150,000.

8. The water main on Beach Avenue has experienced frequent breaks and has required numerous repairs. In addition, its location within the sand dunes along the beach impedes repair cost and inhibits substantial maintenance efforts. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Beach Avenue be replaced with 12-inch diameter cement lined ductile iron water main. The proposed water main will be installed along an existing utility easement adjacent to Beach Avenue. The estimated probable construction cost for installation of approximately 1,800 linear feet of 12-inch diameter water main, including design, coordination with gas and sewer utilities, construction and contingencies, is $244,000.

9. In order to provide ISO needed fire flow of 3,500 gpm on Beal Street, it is recommended that the existing 8-inch diameter water main that runs along Beal Street be replaced with 12-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,950 linear feet of 12-inch diameter water main, including design, construction and contingencies is $269,000.

10. In order to provide ISO needed fire flow of 3,000 gpm on Atlantic Avenue, it is recommended that the existing 6-inch diameter water main that runs along Atlantic Avenue from Richards Road to Forest Avenue be replaced with 12-inch diameter cement lined ductile iron water main. Additionally, we recommend that the existing 6-inch diameter water main that runs along Summit Avenue be replaced with 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 5,110 linear feet of 12-inch diameter water main and approximately 450 linear feet of 8-inch diameter water main, including design, construction and contingencies is $754,000.

11. In order to provide ISO needed fire flow of 3,000 gpm on Keith Way, it is recommended that the existing 8-inch diameter water main that runs along Recreation Park Drive from Derby Street to Keith Way and along Keith Way be replaced with 16-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 2,150 linear feet of 16-inch diameter water main, including design, construction and contingencies is $323,000.

12. In order to provide ISO needed fire flow of 3,500 gpm on George Washington Boulevard, it is recommended that the existing 8-inch diameter water main that runs

along George Washington Boulevard be replaced with 12-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 2,360 linear feet of 12-inch diameter water main, including design, construction and contingencies is $325,000.

13. In order to provide ISO needed fire flow of 3,000 gpm on East Gate Lane, it is recommended that the existing 8-inch diameter water main that runs along East Gate Lane be replaced with 12-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,380 linear feet of 12-inch diameter water main, including design, construction and contingencies is $190,000.

14. In order to provide ISO needed fire flow of 3,000 gpm on Pleasant Street, it is recommended that the existing 6-inch diameter water main that runs along Pleasant Street from Main Street to Middle Street be replaced with 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,490 linear feet of 8-inch diameter water main, including design, construction and contingencies is $168,000.

15. In order to provide ISO needed fire flow of 3,000 gpm on Rockway Avenue, it is recommended that the existing 6-inch diameter water main that runs along Rockway Avenue from Wyola Road to Rock View Road be replaced with 8-inch diameter cement lined ductile iron water main. Additionally, we recommend that the existing 6-inch diameter water mains that run along Wyola Road from Rock View Road to Logan Avenue and Delawanda Road from Rock View Road to Logan Avenue be replaced with 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 2,660 linear feet of 8-inch diameter water main, including design, construction and contingencies is $300,000.

16. In order to provide ISO needed fire flow of 3,000 gpm on Hampton Circle, it is recommended that the existing 6-inch diameter water main that runs along Hampton Circle from Andrea Road to Standish Road be replaced with 8-inch diameter cement lined ductile iron water main. Additionally, we recommend that the existing 6-inch diameter water mains that run along Eastern Avenue and Fairmont Way from Rock View Road to Moreland Avenue be replaced with 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,770 linear feet of 8-inch diameter water main, including design, construction and contingencies is $201,000.

17. In order to provide ISO needed fire flow of 3,000 gpm on Downer Avenue, it is recommended that the existing 8-inch diameter water main that runs along Downer Avenue from Gov. Andrew Road to Planters Field Lane be replaced with 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,520 linear feet of 8-inch diameter water main, including design, construction and contingencies is $171,000.

18. In order to provide ISO needed fire flow of 3,000 gpm on Pine Grove Road, it is recommended that the existing 8-inch diameter water main that runs along Main Street from Pine Grove Road to Gardner Road and along Pine Grove Road be replaced with 12-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 2,910 linear feet of 12-inch diameter water main, including design, construction and contingencies is $401,000.

Table No. 8-1
Priority I Recommended Improvements - Water Supply
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Item No.	Location	Estimated Cost
1	Scotland Street Improvements	$282,000
2	Free St. No. 2 Improvements	$290,000
3	Fulling Mill Station Improvements	$440,000
4	Free St. No. 4 and Free St. No. 2 Switch	$600,000
5	Long Term Feasibility Report	-
	Total Priority I Improvements - Water Supply:	$1,612,000

Prepared by or under the supervision of: Robert L. Roland

Table No. 8-1 (Continued)
Priority I Recommended Improvements - Distribution
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Item No.	Location	From	To	Length (feet)	Estimated Cost
6	Dismantle the Strawberry Hill Tank				$50,000
7	Upgrade the Hull Booster Pump Station				$150,000
8	Beach Avenue (12")	L Street	X Street	1,770	$244,000
9	Beal Street (12")	William Terry Driv	Tuckers Lane	1,950	$269,000
10	Atlantic Avenue (12")	Richards Road	Forest Avenue	5,110	$1,174,000
	Summit Avenue (8")			450	$51,000
				Subtotal:	$1,225,000
11	Keith Way (16")			830	$125,000
	Recreation Park Drive (16")	Derby Street	Keith Way	1,320	$198,000
				Subtotal:	$323,000
12	Washington Boulevard (12")			2,360	$325,000
13	East Gate Lane (12")			1,380	$190,000
14	Pleasant Street (8")	Main Street	Middle Street	1,490	$168,000
15	Rockway Avenue (8")	Wyola Road	Shore Garden Road	310	$35,000
	Wyola Road (8")	Rock View Road	Logan Avenue	1,410	$159,000
	Delawanda Road (8")	Rock View Road	Logan Avenue	940	$106,000
				Subtotal:	$300,000
16	Hampton Circle (8")	Andrea Road	Standish Road	360	$41,000
	Eastern Avenue (8")			1,080	$122,000
	Fairmont Way (8")	Roosevelt Avenue	Moreland Avenue	330	$38,000
				Subtotal:	$201,000
17	Downer Street (8")	Gov. Andrew Road	Planters Field Lane	1,520	$171,000
18	Pine Grove Road (12")			1,130	$156,000
	Main Street (12")	Pine Grove Road	Gardner Road	1,780	$245,000
				Subtotal:	$401,000
			Total Priority I Improvements - Infrastructure:		$4,017,000

Prepared by or under the supervision of: Robert L. Roland

Priority II Recommended Improvements

A minimum fire flow of 750 gpm was applied to each junction in the hydraulic model to evaluate the overall fire preparedness of the water distribution system. Several locations could not meet the minimum fire flow requirement. The following improvements are recommended to improve the fire flow at the deficient locations. Priority II Recommended Improvements are summarized in Table No. 8-2.

1. In order to provide the inherent capacity for fire flow, an 8-inch diameter cement lined ductile iron water main is recommended on Rockwood Road from East Street to Ledgewood Circle and on Ledgewood Circle. The estimated probable construction cost for installation of approximately 3,380 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $382,000.

2. In order to provide the inherent capacity for fire flow, it is recommended that the existing water mains on Grist Mill Lane, Howland Lane from Grist Mill Lane to Whitcomb Avenue and Whitcomb Avenue from High Street to Howland Lane be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 3,520 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $397,000.

3. In order to provide the inherent capacity for fire flow, it is recommended that the existing water mains on Nutty Hill Road and Whitehorse Road from High Street to Nutty Hill Road be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,500 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $170,000.

4. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Electric Avenue be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 220 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $25,000.

5. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Simmons Road be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 610 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $69,000.

6. In order to provide the inherent capacity for fire flow, it is recommended that the existing water mains on Smith Road and Hobart Street from New Bridge Road to Smith Road be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 3,280 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $370,000.

7. In order to provide the inherent capacity for fire flow, it is recommended that the existing water mains on Summit Drive and Harbor View Drive from Thaxter Street to Summit Drive be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,800 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $203,000.

8. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Dighton Street be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 3,530 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $398,000.

9. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Howe Road be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 1,970 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $222,000.

10. In order to provide the inherent capacity for fire flow, it is recommended that the existing water main on Spruce Street from Hull Street to Oak Street be replaced with an 8-inch diameter cement lined ductile iron water main. The estimated probable construction cost for installation of approximately 900 linear feet of 8-inch diameter water main, including design, construction and contingencies, is $102,000.

11. In order to provide the inherent capacity for fire flow, it is recommended that the existing 6-inch water main on Carleton Road be extended to High Street. The estimated probable construction cost for installation of approximately 500 linear feet of 6-inch diameter water main, including design, construction and contingencies, is $45,000.

Table No. 8-2
Priority II Recommended Improvements
Water Supply and Distribution System Study
Hingham and Hull, Massachusetts
Aquarion Water Company

Item No.	Location	From	To	Length (feet)	Estimated Cost
1	Rockwood Road (8")	East Street	Ledgewood Circle	2,970	$335,000
	Ledgewood Circle (8")			410	$47,000
				Subtotal:	$382,000
2	Grist Mill Lane (8")			850	$96,000
	Howland Lane (8")	Whitcomb Avenue	Grist Mill Lane	1,190	$134,000
	Whitcomb Avenue (8")	High Street	Howland Lane	1,480	$167,000
				Subtotal:	$397,000
3	Nutty Hill Road (8")			680	$77,000
	Whitehorse Road (8")	High Street	Nutty Hill Road	820	$93,000
				Subtotal:	$170,000
4	Electric Avenue (8")			220	$25,000
5	Simmons Road (8")			610	$69,000
6	Smith Road (8")			1,960	$221,000
	Hobart Street (8")	New Bridge Road	Smith Road	1,320	$149,000
				Subtotal:	$370,000
7	Summit Drive (8")			1,190	$134,000
	Harbor View Drive (8")	Thaxter Street	Summit Drive	610	$69,000
				Subtotal:	$203,000
8	Dighton Street (8")			3,530	$398,000
9	Howe Road (8")			1,970	$222,000
10	Spruce Street (8")	Hull Street	Oak Street	900	$102,000
11	Carleton Road (6")			500	$45,000
			Total Priority II Improvements:		$2,383,000

Prepared by or under the supervision of: Robert L. Roland


N
Legend
Service Area Boundary
Water Main Diameter
2-Inch
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
20-Inch
24-Inch
Hull Booster Pump Station
Strawberry Hill Tank
Capacity: 0.51 mg
Overflow Elevation: 186 feet
Atlantic Ocean
HULL
Turkey Hill Standpipe
Capacity: 2.0 mg
Overflow Elevation: 240 feet
Downing Street Well
HINGHAM
COHASSET
Free Street Well No. 2
Free Street Well No. 4
Free Street Well No. 3
Free Street Well No. 5
Fulling Mill Well
Main Service Area
High Service Area
Hingham/Hull District Water Treatment Facility
Capacity: 7.7 mgd
Prospect Street Well
SCITUATE
Scotland Street Well
NORWELL
Accord Tank
Capacity: 0.75 mg
Overflow Elevation: 282 feet
Water Distribution System
Hingham/Hull, Massachusetts
Aquarion Water Company
Approximate Scale: 1" = 1,500'
Tata & Howard, Inc.
Westborough, MA
April 2007


N
Legend
Water Main Diameter
2-Inch
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
20-Inch
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Hull Booster Pump Station
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Hingham Water Treatment Facility
Capacity: 7.7 mgd
Prospect Street Well
SCITUATE
Scotland Street Well
NORWELL
Accord Tank
Capacity: 0.75 mg
Overflow Elevation: 282 feet
Node Map
Hingham/Hull, Massachusetts
Aquarion Water Company
Approximate Scale: 1" = 1,500'
Tata & Howard, Inc.
Westborough, MA
April 2007

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
23	7.41	7	Main Zone
A Street	7.68	0	Main Zone
Aberdeen Rd	4.20	52	Main Zone
Academy Ln	7.14	32	Main Zone
Accord Pond Dr.	2.19	154	High Zone
Adam St	4.73	5	Main Zone
Alden Ave	3.64	40	Main Zone
Alden ST	4.54	6	Main Zone
Alexandra Way	7.14	45	Main Zone
Amber Rd/Anderson Rd	1.32	102	High Zone
Andora Lane	1.32	104	Main Zone
Andrew Ave	5.77	85	Main Zone
Andrew Rd/Hampton Cir	6.45	17	Main Zone
Andrews Isle	5.47	49	Main Zone
Apple Tree Ln	1.17	72	High Zone
Atlantic Ave	7.19	30	Main Zone
Autumn Cir	1.94	82	Main Zone
B Street	7.68	0	Main Zone
Bailer Rd	2.30	49	Main Zone
Barns Rd	3.01	28	Main Zone
Bates St	4.37	2	Main Zone
Bates Way Ave	6.12	51	Main Zone
Battery Rd @ Harbor View Rd	3.69	40	Main Zone
Bay St	0.00	15	Main Zone
Bay St/Water St	4.31	10	Main Zone
Bayberry Rd	9.79	20	Main Zone
Beach Ln	11.21	10	Main Zone
Beacham Pl	3.01	79	Main Zone
Beacon Ave	3.64	24	Main Zone
Beacon Rd	3.64	8	Main Zone
Beal St	7.25	10	Main Zone
Beal St @ Lincoln St	7.25	10	Main Zone
Beals Cove Rd	7.25	7	Main Zone
Belair Rd	7.41	26	Main Zone
Belmont St	4.37	2	Main Zone
Berkley @ High St	1.94	93	Main Zone
Berkley Rd	3.01	79	Main Zone
Black Horse Rd	4.37	56	Main Zone
Black Horse Road	4.37	62	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Blaisdell Rd	1.23	128	High Zone
Blue Sky Dr @ Hobbart St	5.74	88	Main Zone
Bonnie Briar Cir	2.63	14	Main Zone
Boulder Glen	3.01	47	Main Zone
Bradford Ave	3.64	47	Main Zone
Bradford Rd	6.12	50	Main Zone
Bradley Hill Rd	7.14	49	Main Zone
Bradley park	5.00	58	Main Zone
Bradley Woods Dr	9.79	18	Main Zone
Brewer Way	5.74	51	Main Zone
Brewster Rd	1.80	98	High Zone
Broad Cove Rd	7.11	10	Main Zone
Broad Cove St	7.04	20	Main Zone
Brook Line Ave	4.32	3	Main Zone
Bucket Mill Ln	2.44	49	Main Zone
Bulow Rd	9.79	20	Main Zone
Burditt Ave	7.14	49	Main Zone
Burditt Ave @ Otis St	7.14	30	Main Zone
Burr Rd @ Central St	6.12	50	Main Zone
Burr St	6.12	62	Main Zone
Burtons Ln	4.01	21	Main Zone
Button Cove Rd	3.01	16	Main Zone
C Street	7.68	0	Main Zone
Camelot Dr	3.01	68	Main Zone
Camelot Drive	4.37	53	Main Zone
Cantubury St/Lamberts Ln @ Hull St	5.92	58	Main Zone
Capt Thomas Ln	1.32	136	High Zone
Captain Ln	1.13	114	High Zone
Carleton Rd	2.30	91	Main Zone
Catha Ln	3.14	49	Main Zone
Cedar St @ Hersey St	4.34	49	Main Zone
Center Ave	4.32	8	Main Zone
Central St	6.18	49	Main Zone
Chamberlain Run	3.87	49	Main Zone
Channel St	5.77	10	Main Zone
Charles Everett Rd	5.96	45	Main Zone
Charles St	1.40	121	High Zone
Charles Street	5.17	69	Main Zone
Chatman Cir	3.01	45	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Cherry St	2.63	15	Main Zone
Chestnut Pl	3.03	6	Main Zone
Chestnut RD	3.03	5	Main Zone
Chief Justice Cushing Hwy	2.63	59	Main Zone
Christine Rd	3.69	40	Main Zone
Churchill Rd	7.25	41	Main Zone
Clark Rd	4.20	49	Main Zone
Clifford Court @ Fresh River Ave	5.96	45	Main Zone
Coburn	4.32	9	Main Zone
Colby St	5.33	49	Main Zone
Colonial @ Brewster	1.80	96	High Zone
Colonial Rd	1.80	84	High Zone
Colony Rd	2.21	36	Main Zone
Commerce Rd	2.36	147	High Zone
Common St	4.10	52	Main Zone
Concord Cir	1.17	99	High Zone
Condito Way	9.79	10	Main Zone
Constitution Rd	2.64	98	High Zone
Cottage St	6.18	49	Main Zone
Country Dr	3.62	147	High Zone
Country Ln	1.23	147	High Zone
Crabberry Ln	2.30	49	Main Zone
Craig Ln	2.60	128	High Zone
Crestwood Rd	1.94	90	Main Zone
Crooked Meadow Ln.	5.17	49	High Zone
Cross St	4.39	49	Main Zone
Crowe Point Ave	9.79	10	Main Zone
Crowe Point/Downer Ave	6.70	10	Main Zone
Croyden Rd	3.01	7	Main Zone
Cushing @ Whiting	1.23	135	High Zone
Cushing Ave	4.05	17	Main Zone
Cushing St	1.23	147	High Zone
Cushing Street	1.17	84	High Zone
Cutter Hill Rd	1.32	102	High Zone
D Street	6.10	10	Main Zone
Deerfield Rd.	2.19	147	High Zone
Delprete Dr	4.85	59	Main Zone
Derby St	1.23	145	High Zone
Derby Street	2.36	147	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Devon Terr.	2.19	147	High Zone
Dighton St	11.62	15	Main Zone
Douglas Ave	3.69	95	Main Zone
Downer Ave/Otis St	6.79	35	Main Zone
Draper Ave	4.37	3	Main Zone
Dwiggens Pathe	5.96	47	Main Zone
E Street	6.10	10	Main Zone
East Gate Ln	5.11	47	Main Zone
East St	3.87	46	Main Zone
Eastern Ave	4.31	42	Main Zone
Eastman Rd	7.19	20	Main Zone
Edgar Walker Dr	5.96	45	Main Zone
Edgewater Rd	3.43	3	Main Zone
Elaine Rd	1.13	118	High Zone
Eldridge Court/Green St	9.76	21	Main Zone
Electric Ave	3.78	11	Main Zone
Elizabeth Ln	5.11	125	Main Zone
Elm Ave	7.19	46	Main Zone
Elm St	4.32	18	Main Zone
Elm St @ Central St	4.85	53	Main Zone
Elm St @ Main St	7.14	48	Main Zone
Emerald St @ Elm St	4.85	55	Main Zone
Estate Dr	7.19	30	Main Zone
Evergreen Ln	3.01	40	Main Zone
F Street	6.10	0	Main Zone
Fairfield Rd	1.13	128	High Zone
Fairmont Way	4.31	20	Main Zone
Fairmont Way @ Bay St	5.33	20	Main Zone
Fairview St	5.33	49	Main Zone
Farina Rd	3.69	98	Main Zone
Farm Hills Ln	3.62	138	High Zone
Farm Hills Ln@Gardner St	2.19	167	High Zone
Fearing Rd @ North St	6.18	49	Main Zone
Fifth St	5.00	21	Main Zone
Fisher Rd	4.16	40	Main Zone
Flintlock Cir.	1.34	82	High Zone
Floret Circle	4.29	49	Main Zone
Foley Beach Rd	11.21	30	Main Zone
Forest Ave	2.00	16	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Forest Ln	2.60	128	High Zone
Forest Notch	5.47	78	Main Zone
Fottler Rd	6.23	59	Main Zone
Fottler Rd @ Lincoln St	9.79	21	Main Zone
Fountainbleu Dr	5.47	49	Main Zone
Fox Run	5.47	65	Main Zone
Franklin Rogers Rd	5.96	48	Main Zone
Franklin Rogers Road	5.96	45	Main Zone
Free Street	7.85	49	Main Zone
French St	1.94	52	Main Zone
Fresh River Avenue	5.96	40	Main Zone
Friend St @ Main St	3.49	49	Main Zone
Fulling Mill Ln.	5.17	49	Main Zone
G St @ Cadish Ave	4.35	0	Main Zone
G Street	4.35	10	Main Zone
Gallop Hill	1.35	69	Main Zone
Gardner @ Main St	2.50	124	High Zone
Gardner @ Whiting	1.30	150	High Zone
Gardner St	2.19	147	High Zone
Gardner Street	2.19	147	High Zone
Garrison Rd	6.12	56	Main Zone
Gatehouse Ln	7.19	49	Main Zone
George Washington Blvd	3.03	21	Main Zone
Gilford Rd	3.01	9	Main Zone
Glenwood Rd	5.47	49	Main Zone
Glover Ave	1.33	20	Main Zone
Golf View Dr	5.74	93	Main Zone
Governor Andrew Rd	7.11	52.5	Main Zone
Governor Long Rd	7.11	30	Main Zone
Grace Dr	5.92	10	Main Zone
Grenadier @ Main St	2.44	110	High Zone
Grenadier Rd	1.17	104	High Zone
Grismill Ln.	4.37	49	Main Zone
Guild St	4.37	2	Main Zone
H St @ Cadish Ave	4.35	0	Main Zone
H Street	5.80	0	Main Zone
Halvorsen Ave	4.32	7	Main Zone
Hampton Cir	6.45	13	Main Zone
Hancock	3.32	90	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Hancock Rd	3.32	82	High Zone
Harbor View Rd	3.69	20	Main Zone
Harborview Dr/Parkview Dr	5.00	49	Main Zone
Harvard Dr	3.54	71	Main Zone
Harvest Ln	2.19	147	High Zone
Hawthorne Rd	3.58	20	Main Zone
Hazelwood Dr	3.62	147	High Zone
Heritage Rd	1.17	103	High Zone
Hersey St @ South St	5.75	49	Main Zone
High St	2.44	49	Main Zone
High View Dr	7.41	10	Main Zone
Highland Ave	5.77	20	Main Zone
Hingfield Rd	2.64	102	High Zone
Hitching Post Ln	1.80	72	High Zone
HJ-3	2.36	147	High Zone
HJ-6	2.36	147	High Zone
HJ-10	2.36	147	High Zone
HJ-12	2.36	147	High Zone
HJ-13	2.36	147	High Zone
HJ-14	2.36	147	High Zone
HJ-15	2.36	148	High Zone
HJ-16	2.36	147	High Zone
HJ-17	2.36	147	High Zone
HJ-18	2.36	147	High Zone
HJ-21	2.36	147	High Zone
HJ-22	2.36	147	High Zone
HJ-23	2.36	147	High Zone
HJ-26	2.19	147	High Zone
HJ-27	2.19	147	High Zone
HJ-36	3.62	147	High Zone
HJ-40	3.62	138	High Zone
HJ-43	1.23	147	High Zone
HJ-44	1.23	147	High Zone
HJ-46	2.19	147	High Zone
HJ-47	3.62	147	High Zone
HJ-48	2.50	128	High Zone
HJ-50	1.13	129	High Zone
HJ-54	1.23	113	High Zone
HJ-58	1.23	128	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
HJ-62	1.23	134.5	High Zone
HJ-63	1.23	134	High Zone
HJ-64	3.62	150	High Zone
HJ-68	1.23	114	High Zone
HJ-69	1.23	114	High Zone
HJ-70	1.23	132	High Zone
HJ-72	1.23	127	High Zone
HJ-73	1.23	126	High Zone
HJ-76	2.50	124	High Zone
HJ-78	1.13	121	High Zone
HJ-80	1.13	121	High Zone
HJ-81	1.13	121	High Zone
HJ-84	1.13	128	High Zone
HJ-85	1.13	128	High Zone
HJ-87	1.13	128	High Zone
HJ-88	1.13	128	High Zone
HJ-90	1.13	128	High Zone
HJ-91	1.13	128	High Zone
HJ-93	1.13	124	High Zone
HJ-94	1.13	125	High Zone
HJ-95	1.13	119	High Zone
HJ-97	1.13	118	High Zone
HJ-99	1.23	108	High Zone
HJ-100	2.54	107	High Zone
HJ-102	1.17	104	High Zone
HJ-104	1.17	103	High Zone
HJ-105	1.17	103	High Zone
HJ-109	1.17	103	High Zone
HJ-112	1.17	99	High Zone
HJ-113	1.17	99	High Zone
HJ-114	1.17	99	High Zone
HJ-116	1.17	104	High Zone
HJ-123	1.32	131	High Zone
HJ-124	1.32	141	High Zone
HJ-129	1.80	92	High Zone
HJ-130	1.80	94	High Zone
HJ-132	1.17	80	High Zone
HJ-136	1.17	74	High Zone
HJ-138	1.17	58	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
HJ-143	1.80	76	High Zone
HJ-146	1.80	88	High Zone
HJ-147	1.80	91	High Zone
HJ-152	1.34	98	High Zone
HJ-154	1.80	95	High Zone
HJ-156	1.34	83	High Zone
HJ-159	4.56	95	High Zone
HJ-160	1.34	71	High Zone
HJ-162	1.34	60	High Zone
HJ-166	4.06	98	High Zone
HJ-171	1.17	98	High Zone
HJ-172	1.17	98	High Zone
HJ-175	2.64	108	High Zone
HJ-176	1.80	98	High Zone
HJ-178	1.17	71	High Zone
HJ-179	3.62	158	High Zone
HJ-180	1.17	98	High Zone
HJ-183	2.82	118	High Zone
HJ-185	1.32	98.42	High Zone
HJ-186	1.32	101.7	High Zone
HJ-189	1.32	98.42	High Zone
HJ-190	1.32	98.42	High Zone
HJ-191	1.32	98.42	High Zone
HJ-195	1.32	101.7	High Zone
HJ-209	0.00	81	Main Zone
HJ-211	1.32	125	Main Zone
HJ-300	0.00	103	High Zone
HJ-301	5.62	82	High Zone
HJ-302	5.62	82	High Zone
HJ-303	5.62	82	High Zone
HJ-304	5.62	82	High Zone
HJ-305	5.62	82	High Zone
HJ-306	5.62	82	High Zone
HJ-1019	2.36	146	Main Zone
HJ-1037	1.32	112	High Zone
HJ-1038	1.32	125	Main Zone
HJ-1039	2.64	108	High Zone
Hobbart @ Hersey	4.20	49	Main Zone
Hobbart St	2.30	45	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Hockley Dr	7.25	49	Main Zone
Holly St	9.79	10	Main Zone
Holy Hock Ln	5.33	54	Main Zone
Home Meadow Ln	7.14	45	Main Zone
Hoover Rd	2.60	128	High Zone
Hope Rd	2.60	128	High Zone
House Ave	7.19	45	Main Zone
Howe Rd	12.03	20	Main Zone
Howe St	4.05	75.5	Main Zone
Howland Ln.	3.20	49	Main Zone
Huckleberry Ln.	5.17	95	Main Zone
Hull St	4.16	31	Main Zone
Independence Ln	1.80	95	High Zone
Indian Rock Ln	5.11	49	Main Zone
Industrial Park Rd.	2.36	147	High Zone
Industrial Park Road	2.36	147	High Zone
Irving St	5.74	49	Main Zone
Irwin St	4.73	19	Main Zone
Island View	5.33	20	Main Zone
Issac Sprague Dr	5.96	46	Main Zone
Issac Sprague Drive	5.96	45	Main Zone
J-67	1.23	113	High Zone
J-182	3.83	69	High Zone
J-196	1.32	100	Main Zone
J-201	5.17	49	Main Zone
J-202	5.17	69	Main Zone
J-207	5.17	95	Main Zone
J-212	5.17	49	Main Zone
J-213	5.17	95	Main Zone
J-214	5.17	79	Main Zone
J-215	5.17	39	Main Zone
J-216	5.17	72.2	Main Zone
J-222	5.33	49	Main Zone
J-223	4.37	49	Main Zone
J-224	4.37	49	Main Zone
J-227	4.37	61	Main Zone
J-229	4.37	49	Main Zone
J-230	4.37	49	Main Zone
J-238	5.33	49	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-241	5.33	49	Main Zone
J-244	1.94	72	Main Zone
J-245	1.94	80	Main Zone
J-247	1.94	87	Main Zone
J-250	2.30	82	Main Zone
J-252	2.30	91	Main Zone
J-258	3.01	64	Main Zone
J-262	2.20	84	Main Zone
J-264	3.01	87	Main Zone
J-267	1.94	57	Main Zone
J-270	3.01	49	Main Zone
J-272	1.94	57	Main Zone
J-273	1.08	56	Main Zone
J-274	3.01	60	Main Zone
J-277	3.01	48	Main Zone
J-279	2.30	49	Main Zone
J-280	3.01	45	Main Zone
J-283	3.01	45	Main Zone
J-284	3.01	44	Main Zone
J-285	3.01	45	Main Zone
J-286	3.01	45	Main Zone
J-287	3.01	45	Main Zone
J-290	2.30	46	Main Zone
J-292	5.74	86	Main Zone
J-294	5.74	58	Main Zone
J-297	3.01	65	Main Zone
J-299	2.70	61	Main Zone
J-300	2.70	73	Main Zone
J-304	4.29	49	Main Zone
J-305	5.47	49	Main Zone
J-308	4.29	52	Main Zone
J-309	4.29	49	Main Zone
J-310	4.29	49	Main Zone
J-311	4.29	49	Main Zone
J-317	4.29	49	Main Zone
J-319	5.47	49	Main Zone
J-320	5.47	49	Main Zone
J-325	4.10	51	Main Zone
J-331	5.47	49	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-335	4.00	50	Main Zone
J-337	4.00	49	Main Zone
J-338	5.74	52	Main Zone
J-339	5.74	49	Main Zone
J-342	6.12	52	Main Zone
J-343	6.12	59	Main Zone
J-344	6.12	54	Main Zone
J-347	6.12	61	Main Zone
J-350	5.74	57	Main Zone
J-356	5.33	49	Main Zone
J-358	5.33	49	Main Zone
J-360	5.33	49	Main Zone
J-362	5.74	51	Main Zone
J-364	5.33	49	Main Zone
J-366	5.33	49	Main Zone
J-368	5.74	45	Main Zone
J-371	5.11	49	Main Zone
J-374	5.11	49	Main Zone
J-379	5.11	45	Main Zone
J-380	5.11	96	Main Zone
J-383	5.74	98	Main Zone
J-385	5.74	76	Main Zone
J-386	5.74	61	Main Zone
J-387	5.74	86	Main Zone
J-388	5.74	91	Main Zone
J-391	5.74	46	Main Zone
J-397	5.96	45	Main Zone
J-398	5.96	49	Main Zone
J-399	5.96	49	Main Zone
J-402	5.96	47	Main Zone
J-406	5.96	45	Main Zone
J-407	5.96	45	Main Zone
J-409	5.96	49	Main Zone
J-410	5.96	45	Main Zone
J-414	6.12	49	Main Zone
J-420	6.12	49	Main Zone
J-423	5.00	30	Main Zone
J-426	5.00	50	Main Zone
J-427	5.00	50	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-430	9.76	49	Main Zone
J-432	6.18	49	Main Zone
J-439	7.14	45	Main Zone
J-443	6.18	49	Main Zone
J-444	7.25	46	Main Zone
J-445	7.25	46	Main Zone
J-448	1.78	47	Main Zone
J-449	7.25	47	Main Zone
J-452	7.25	37	Main Zone
J-454	7.25	19	Main Zone
J-455	9.79	59	Main Zone
J-457	7.25	15	Main Zone
J-458	7.25	19	Main Zone
J-459	7.25	19	Main Zone
J-460	7.25	19	Main Zone
J-461	7.25	19	Main Zone
J-462	7.25	19	Main Zone
J-463	7.25	19	Main Zone
J-464	7.25	21	Main Zone
J-465	7.25	21	Main Zone
J-466	7.25	20	Main Zone
J-467	7.25	21	Main Zone
J-468	7.25	20	Main Zone
J-469	7.25	21	Main Zone
J-472	7.25	13	Main Zone
J-473	2.65	9.84	Main Zone
J-477	7.25	8	Main Zone
J-478	7.25	47	Main Zone
J-479	7.25	47	Main Zone
J-480	7.25	46	Main Zone
J-481	7.25	46	Main Zone
J-482	9.79	30	Main Zone
J-483	4.44	59	Main Zone
J-484	5.00	59	Main Zone
J-485	5.00	75	Main Zone
J-486	5.00	89	Main Zone
J-489	4.44	59	Main Zone
J-491	5.00	79	Main Zone
J-492	5.00	101	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-496	7.14	49	Main Zone
J-498	7.14	49	Main Zone
J-500	7.14	49	Main Zone
J-505	4.85	55	Main Zone
J-509	6.12	49	Main Zone
J-511	7.14	41	Main Zone
J-513	7.14	49	Main Zone
J-515	7.14	49	Main Zone
J-518	9.76	20	Main Zone
J-520	3.01	14	Main Zone
J-522	3.01	20	Main Zone
J-524	3.01	20	Main Zone
J-527	3.01	12	Main Zone
J-528	3.01	34	Main Zone
J-531	5.11	47	Main Zone
J-535	5.47	49	Main Zone
J-537	4.50	40	Main Zone
J-541	5.47	43	Main Zone
J-542	5.47	34	Main Zone
J-543	5.47	45	Main Zone
J-545	5.47	43	Main Zone
J-550	3.03	32	Main Zone
J-552	3.03	24	Main Zone
J-553	3.01	42	Main Zone
J-555	2.21	36	Main Zone
J-556	5.11	45	Main Zone
J-557	5.11	40	Main Zone
J-559	3.39	40	Main Zone
J-560	4.16	27	Main Zone
J-561	2.21	40	Main Zone
J-563	4.16	30	Main Zone
J-564	5.11	32	Main Zone
J-566	4.16	79	Main Zone
J-567	1.52	33	Main Zone
J-569	4.16	27	Main Zone
J-571	4.16	49	Main Zone
J-572	1.32	121	Main Zone
J-575	9.79	15	Main Zone
J-577	9.79	22	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-580	9.79	20	Main Zone
J-582	9.79	20	Main Zone
J-589	9.79	13	Main Zone
J-590	9.79	13	Main Zone
J-594	6.70	46	Main Zone
J-598	7.14	39	Main Zone
J-602	7.11	78.7	Main Zone
J-604	7.11	85.3	Main Zone
J-607	5.31	30	Main Zone
J-609	6.81	20	Main Zone
J-610	11.21	20	Main Zone
J-612	11.21	11.5	Main Zone
J-617	11.21	36	Main Zone
J-618	11.21	10	Main Zone
J-621	7.41	23	Main Zone
J-627	7.41	21	Main Zone
J-628	7.41	20	Main Zone
J-629	4.19	49	Main Zone
J-630	4.05	85	Main Zone
J-631	4.05	85	Main Zone
J-632	2.96	69	Main Zone
J-635	4.05	52.5	Main Zone
J-639	4.05	23	Main Zone
J-640	4.05	40	Main Zone
J-642	2.96	40	Main Zone
J-644	4.05	7	Main Zone
J-645	4.05	16	Main Zone
J-648	4.05	30	Main Zone
J-650	3.01	30	Main Zone
J-652	3.69	0	Main Zone
J-655	3.01	3	Main Zone
J-657	3.01	29	Main Zone
J-659	3.01	1	Main Zone
J-662	3.01	6	Main Zone
J-663	3.01	0	Main Zone
J-669	2.63	11	Main Zone
J-672	4.16	40	Main Zone
J-673	3.03	10	Main Zone
J-675	3.03	8	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-679	3.03	5	Main Zone
J-681	3.03	3	Main Zone
J-683	3.03	0	Main Zone
J-685	3.03	4	Main Zone
J-687	4.16	62	Main Zone
J-689	4.16	58	Main Zone
J-691	5.92	45	Main Zone
J-696	12.03	70	Main Zone
J-697	5.47	46	Main Zone
J-698	5.47	46	Main Zone
J-702	5.47	70	Main Zone
J-704	5.47	52	Main Zone
J-706	5.47	62	Main Zone
J-709	12.03	45	Main Zone
J-711	3.20	20	Main Zone
J-713	8.75	34	Main Zone
J-715	8.75	45	Main Zone
J-717	5.83	0	Main Zone
J-718	8.75	39	Main Zone
J-719	7.19	45	Main Zone
J-721	7.19	45	Main Zone
J-724	7.19	39	Main Zone
J-725	2.63	39	Main Zone
J-726	7.19	39	Main Zone
J-730	7.19	20	Main Zone
J-732	7.19	10	Main Zone
J-733	7.19	25	Main Zone
J-734	4.16	10	Main Zone
J-738	7.19	47	Main Zone
J-739	7.19	30	Main Zone
J-741	7.19	33	Main Zone
J-742	7.19	25	Main Zone
J-743	7.19	20	Main Zone
J-746	7.19	45	Main Zone
J-751	11.62	3	Main Zone
J-752	11.62	3	Main Zone
J-754	11.62	11	Main Zone
J-755	11.62	3	Main Zone
J-760	11.62	0	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-762	6.45	10	Main Zone
J-763	3.78	10	Main Zone
J-766	5.33	49	Main Zone
J-770	6.45	20	Main Zone
J-772	6.45	13	Main Zone
J-774	6.45	15	Main Zone
J-776	6.45	13	Main Zone
J-778	6.45	13	Main Zone
J-782	5.33	49	Main Zone
J-784	5.33	50	Main Zone
J-785	5.33	10	Main Zone
J-787	4.31	10	Main Zone
J-788	5.33	0	Main Zone
J-790	5.33	10	Main Zone
J-791	4.54	0	Main Zone
J-792	5.33	6	Main Zone
J-794	5.00	19	Main Zone
J-795	5.00	38	Main Zone
J-801	3.43	2	Main Zone
J-802	3.43	9	Main Zone
J-803	3.43	19	Main Zone
J-805	4.45	19	Main Zone
J-807	5.00	8	Main Zone
J-810	4.37	4	Main Zone
J-812	4.37	5	Main Zone
J-813	4.37	4	Main Zone
J-814	4.22	15	Main Zone
J-815	4.37	0	Main Zone
J-818	4.37	4	Main Zone
J-819	4.37	10	Main Zone
J-820	4.37	10	Main Zone
J-821	4.37	12	Main Zone
J-823	4.22	16	Main Zone
J-824	16.41	4	Main Zone
J-826	4.37	4	Main Zone
J-828	4.37	4	Main Zone
J-830	4.37	7	Main Zone
J-832	4.37	4	Main Zone
J-833	0.00	30	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-834	4.37	12	Main Zone
J-835	4.37	12	Main Zone
J-836	4.37	3	Main Zone
J-837	0.00	59	Main Zone
J-838	0.00	59	Main Zone
J-839	4.32	9	Main Zone
J-840	0.00	49	Main Zone
J-841	4.32	8	Main Zone
J-842	0.00	30	Main Zone
J-843	4.32	10	Main Zone
J-844	4.20	19	Main Zone
J-845	0.00	8	Main Zone
J-846	4.32	27	Main Zone
J-847	4.32	5	Main Zone
J-848	0.00	10	Main Zone
J-849	4.32	8	Main Zone
J-850	7.16	15	Main Zone
J-851	4.32	3	Main Zone
J-852	4.32	3	Main Zone
J-853	0.00	10	Main Zone
J-854	7.16	15	Main Zone
J-855	4.73	19	Main Zone
J-856	4.73	0	Main Zone
J-857	7.16	19	Main Zone
J-858	4.73	19	Main Zone
J-859	4.22	19	Main Zone
J-860	7.16	19	Main Zone
J-861	4.73	19	Main Zone
J-862	4.73	15	Main Zone
J-863	4.54	6	Main Zone
J-864	4.73	15	Main Zone
J-865	0.00	25	Main Zone
J-868	7.68	6	Main Zone
J-870	4.73	15	Main Zone
J-871	4.73	10	Main Zone
J-872	4.73	19	Main Zone
J-873	4.20	19	Main Zone
J-877	4.20	19	Main Zone
J-878	4.73	20	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-879	4.20	15	Main Zone
J-880	4.32	47	Main Zone
J-883	0.00	40	Main Zone
J-884	4.32	35	Main Zone
J-885 (Simmons Rd)	7.11	50	Main Zone
J-886	4.32	18	Main Zone
J-887	4.32	14	Main Zone
J-888	4.32	4	Main Zone
J-889	0.00	49	Main Zone
J-890	7.16	10	Main Zone
J-891	7.68	0	Main Zone
J-892	7.68	0	Main Zone
J-893	7.68	10	Main Zone
J-894	5.43	10	Main Zone
J-896	7.16	12	Main Zone
J-897	0.00	95	Main Zone
J-898	4.73	9	Main Zone
J-899	7.16	10	Main Zone
J-900	4.32	27	Main Zone
J-901	4.54	10	Main Zone
J-902	4.73	7	Main Zone
J-903	4.73	10	Main Zone
J-904	4.54	10	Main Zone
J-905	0.00	9.4	Main Zone
J-906	7.68	10	Main Zone
J-907	0.00	10	Main Zone
J-908	6.10	10	Main Zone
J-909	6.10	0	Main Zone
J-910	7.68	10	Main Zone
J-911	0.00	0	Main Zone
J-912	0.00	0	Main Zone
J-913	0.00	0	Main Zone
J-914	0.00	0	Main Zone
J-915	0.00	0	Main Zone
J-916	0.00	0	Main Zone
J-917	6.10	0	Main Zone
J-918	6.10	0	Main Zone
J-919	4.35	10	Main Zone
J-920	0.00	0	Main Zone

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Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-921	5.80	10	Main Zone
J-922	5.80	10	Main Zone
J-923	5.12	10	Main Zone
J-924	0.00	0	Main Zone
J-925	0.00	0	Main Zone
J-926	0.00	0	Main Zone
J-927	0.00	0	Main Zone
J-928	0.00	0	Main Zone
J-929	0.00	0	Main Zone
J-930	0.00	0	Main Zone
J-931	0.00	0	Main Zone
J-932	5.80	10	Main Zone
J-933	5.80	10	Main Zone
J-934	0.00	0	Main Zone
J-935	0.00	0	Main Zone
J-936	8.20	10	Main Zone
J-937	7.55	10	Main Zone
J-938	5.80	0	Main Zone
J-939	0.00	10	Main Zone
J-940	12.44	0	Main Zone
J-941	0.00	0	Main Zone
J-942	0.00	0	Main Zone
J-943	8.20	10	Main Zone
J-944	0.00	0	Main Zone
J-945	12.44	12	Main Zone
J-946	6.45	0	Main Zone
J-947	0.00	0	Main Zone
J-948	3.64	47	Main Zone
J-949	0.00	0	Main Zone
J-950	3.64	59	Main Zone
J-951	0.00	0	Main Zone
J-952	0.00	0	Main Zone
J-953	3.64	100	Main Zone
J-954	3.64	47	Main Zone
J-955	0.00	0	Main Zone
J-956	3.64	24	Main Zone
J-957	0.00	0	Main Zone
J-958	3.64	36	Main Zone
J-959	3.64	98	Main Zone

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Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-960	3.64	118	Main Zone
J-961	3.64	43	Main Zone
J-962	0.00	0	Main Zone
J-963	3.64	78	Main Zone
J-964	0.00	0	Main Zone
J-965	0.00	0	Main Zone
J-966	0.00	0	Main Zone
J-967	3.64	10	Main Zone
J-968	0.00	0	Main Zone
J-969	0.00	0	Main Zone
J-971	3.69	59	Main Zone
J-973	3.69	62	Main Zone
J-974	3.69	59	Main Zone
J-975	3.69	72	Main Zone
J-976	3.69	72	Main Zone
J-978	3.69	98	Main Zone
J-979	3.69	20	Main Zone
J-980	3.69	27	Main Zone
J-981	5.77	20	Main Zone
J-982	1.35	9	Main Zone
J-983	3.69	3	Main Zone
J-986	3.69	57	Main Zone
J-988	5.77	20	Main Zone
J-989	5.77	20	Main Zone
J-990	5.77	13	Main Zone
J-992	5.77	20	Main Zone
J-994	5.77	20	Main Zone
J-996	5.77	20	Main Zone
J-999	5.77	18	Main Zone
J-1002	3.69	14	Main Zone
J-1004	3.69	10	Main Zone
J-1005	5.77	10	Main Zone
J-1009	6.12	50	Main Zone
J-1010	5.17	112	Main Zone
J-1011	2.82	97	Main Zone
J-1013	5.88	8	Main Zone
J-1014	3.64	10	Main Zone
J-1015	3.64	8	Main Zone
J-1016	3.64	8	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
J-1018	6.10	0	Main Zone
J-1021	4.37	0	Main Zone
J-1022	5.47	0	Main Zone
J-1023	5.96	0	Main Zone
J-1024	4.01	21	Main Zone
J-1025	9.76	12	Main Zone
J-1026	3.01	0	Main Zone
J-1027	11.21	26	Main Zone
J-1028	5.47	78	Main Zone
J-1029	8.75	42	Main Zone
J-1030	11.62	15	Main Zone
J-1031	11.62	25	Main Zone
J-1032	6.45	10	Main Zone
J-1033	5.00	3	Main Zone
J-1034	4.32	7	Main Zone
J-1035	5.80	10	Main Zone
J-1036	3.64	59	Main Zone
J-1040	7.25	9.84	Main Zone
J-1041	5.47	76	Main Zone
J-1042	12.03	20	Main Zone
J-1043	5.00	60	Main Zone
J-1044	4.44	59	Main Zone
J-1045	2.65	30	Main Zone
J St @ Sunset Ave/Cadish Ave	4.35	0	Main Zone
Jarvis Ave	4.05	20	Main Zone
Jerusalem Rd	8.55	10	Main Zone
John Hazlitt Ln	5.96	49	Main Zone
Jones St	5.11	49	Main Zone
Juniper Rd	9.79	20	Main Zone
K St @ Cadish Ave	5.80	0	Main Zone
K Street	5.80	10	Main Zone
Keith Way	2.36	147	High Zone
Kenberma St	4.37	3	Main Zone
Kenberma St @ Beach Ave	4.54	6	Main Zone
Kenton Ave	3.64	79	Main Zone
Kilby St @ East St	2.97	47	Main Zone
Kilby St @ Rockland St	2.63	11	Main Zone
Kimball Beach Rd	11.21	49	Main Zone
King Phillip Path	1.13	128	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Knoll Rd	1.23	141	High Zone
Kress Farm Rd @ Leavitt St	5.11	49	Main Zone
L St @ Central Ave	5.12	10	Main Zone
L Street	5.12	0	Main Zone
Lafayette Ave	3.69	1	Main Zone
Lafayette Ln	6.18	49	Main Zone
Langle Rd	9.79	20	Main Zone
Lantern Ln	6.18	49	Main Zone
Lazell Street	5.17	69	Main Zone
Leavitt St @ East St	3.87	49	Main Zone
Leclair Dr	1.17	62	High Zone
Levitt St	5.74	49	Main Zone
Lewis St	4.20	17	Main Zone
Liberty Pole Rd	2.66	93	High Zone
Liberty Rd.	2.50	122	High Zone
Lincoln Ave	6.45	19	Main Zone
Lincoln St	7.25	9.84	Main Zone
Lincoln St @ North St	7.14	49	Main Zone
Lincoln St @ Thaxter St	14.72	20	Main Zone
Lincoln Street	4.22	19	Main Zone
Linscott Rd	4.05	49	Main Zone
Logan Ave @ Washington Blvd	11.62	20	Main Zone
Long Meadow Rd	1.23	128	High Zone
Loring Hill Rd	2.82	89	High Zone
Lyndon Rd	3.01	10	Main Zone
Lynn Ave	4.32	3	Main Zone
M Street @ Cadish Ave	8.20	0	Main Zone
Main St	5.77	6.5	Main Zone
Main St @ Central St	4.34	49	Main Zone
Malta St	4.22	15	Main Zone
Manatee Rd	1.94	45	Main Zone
Manor Dr	2.21	36	Main Zone
Maple Rd	7.14	51	Main Zone
Marginal Rd	5.33	20	Main Zone
Mark Ln	1.13	129	High Zone
Marsh Grove	7.41	48	Main Zone
Marshall Rd	5.33	49	Main Zone
Martins Cove Ln	3.01	4	Main Zone
Martins Cove Rd	3.01	14	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Martins Ln	3.01	50	Main Zone
Mast Hill Rd	1.32	121	Main Zone
Mead Ave	8.75	41	Main Zone
Meadow Rd	2.63	16	Main Zone
Meridian Ave	3.64	20	Main Zone
Merrill Rd	5.33	20	Main Zone
Merrymount Rd	5.33	49	Main Zone
Michael Rd	1.13	118	High Zone
Middledge Ave	7.19	49	Main Zone
Miles Rd	7.14	49	Main Zone
Milford St/Prospect St	4.20	0	Main Zone
Mill River Ln	1.32	131	High Zone
Mill St	9.76	19	Main Zone
Minuteman Rd	1.34	64	High Zone
Monument Cir	1.17	103	High Zone
Moreland Ave	4.31	20	Main Zone
Myers Farm Rd	5.33	49	Main Zone
Nantasket Ave/Spring St	2.68	10	Main Zone
Nantasket Rd	5.00	3	Main Zone
New Bridge St	5.74	58	Main Zone
New Bridge St @ Fort Hill St	5.96	47	Main Zone
New Towne Dr	4.85	62	Main Zone
Newport Rd	4.37	5	Main Zone
Nichols Rd	3.01	49	Main Zone
Nineth St	5.00	4	Main Zone
Nokomis Rd	11.21	10	Main Zone
North St @ Beal St	6.66	20	Main Zone
North Turo St	11.62	20	Main Zone
Nutty Hill Rd	2.30	93	Main Zone
Oak Crest Rd	3.01	53	Main Zone
Oak Rd	3.03	0	Main Zone
Ocean Ave	3.46	10	Main Zone
Ocean Side Dr	7.19	20	Main Zone
Ocean View Dr	7.41	26.3	Main Zone
Old Coach Rd	2.00	88	Main Zone
Old Colony Rd	6.45	19	Main Zone
Old County Rd	1.17	81	High Zone
Old Derby Rd	1.23	145	High Zone
Old Mine Rock Way	2.36	147	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Olmstead Dr	5.74	84	Main Zone
Otis Hill Rd	7.11	10	Main Zone
Otis St @ Cottage St	9.76	12	Main Zone
P Street	8.20	10	Main Zone
Packard Ave	4.32	3	Main Zone
Paige St	4.05	52.5	Main Zone
Paolo Rd	5.33	49	Main Zone
Park Ave	11.62	10	Main Zone
Park Cir/Daley Rd	7.41	46	Main Zone
Park Rd	7.19	39	Main Zone
Parker Driveway	4.05	16	Main Zone
Parkview Place	5.00	69	Main Zone
Partridge Dr	1.94	49	Main Zone
Patriots Way	1.34	52	High Zone
Paul Revere Rd	1.17	122	High Zone
Peter Hobart St	3.62	150	High Zone
Pheasant Run	5.11	98	Main Zone
Phipps St	4.73	16	Main Zone
Pilgrim Rd	1.80	96	High Zone
Pine Grove Rd	2.50	130	High Zone
Pinecrest Rd	2.30	92	Main Zone
Pioneer Rd.	1.34	49	High Zone
Pioneer Rd@Liberty Pole Rd	1.34	79	High Zone
Planters Field Ln	9.41	10	Main Zone
Planters Ln	11.21	16	Main Zone
Pleasant St @ Main St	6.20	53	Main Zone
Pleasant St @ Middle St	4.10	49	Main Zone
Plymouth River Road	1.17	65	High Zone
Polk St	1.13	128	High Zone
Pond Park Rd.	2.36	147	High Zone
Pond Park Road	2.36	147	High Zone
Popes Ln @ Leavitt St	5.11	54	Main Zone
Popes Ln @Kress Farm Rd	3.74	49	Main Zone
Porters Cove Rd	3.01	35	Main Zone
Private Main	5.00	30	Main Zone
Prospect	2.60	128	High Zone
Prospect St	1.32	119	High Zone
Prospect Street	3.84	118	High Zone
Puritan Rd	1.80	95	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
PVT WAY	2.50	130	High Zone
Q St @ Cadish Ave	7.55	10	Main Zone
Q Street	7.55	10	Main Zone
Queen Ann Lane	1.13	130	High Zone
R St @ Cadish Ave	12.44	10	Main Zone
R Street	12.44	10	Main Zone
R/W Berkley Rd	3.01	62	Main Zone
Rear Whiting	1.23	135	High Zone
Recreation Park Dr.	2.36	147	High Zone
Research Rd.	2.36	147	High Zone
Research Road	2.36	147	High Zone
Revere St	4.37	2	Main Zone
Reveredge Rd	7.19	10	Main Zone
Rhodes Cr @ Fottler Rd	9.79	59	Main Zone
Rice Rd	7.11	101.7	Main Zone
Richards Rd	8.75	39	Main Zone
Ridge Hill Rd	3.01	76	Main Zone
Ridgewood Crossing (proposed)	0.00	108	Main Zone
Ring Bolt Rd	2.63	20	Main Zone
Ripley Rd	3.69	69	Main Zone
Riverview Rd	4.00	49	Main Zone
Rock View Rd	11.62	15	Main Zone
Rockaway Wyola Rd	11.62	20	Main Zone
Rockland House Rd	6.88	25	Main Zone
Rockwood Rd @ Chief Justice Cushing Hy	3.10	30	Main Zone
Rockwood Rd @ Old East St	4.97	49	Main Zone
Rowley St	11.62	15	Main Zone
Russell St	4.37	2	Main Zone
S Street	12.44	10	Main Zone
Salisbury St	11.62	10	Main Zone
Sarahway	9.79	13	Main Zone
Saw Mill Pond	1.32	125	Main Zone
Sayles Rd	5.74	93	Main Zone
School St	5.47	49	Main Zone
School Street	2.63	47	Main Zone
Scotland St	1.13	121	High Zone
Scotts Ln	4.01	21	Main Zone
Seal Cove Ln	3.01	27	Main Zone
Seal Cove Rd	3.01	33	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Sentinel Rd	1.13	124	High Zone
Service Road	3.80	147	High Zone
Seventh St	5.00	7	Main Zone
Sewer Station	7.25	9.84	Main Zone
Sherman Way @ Fort Hill St	5.96	48	Main Zone
Ship St	9.76	31	Main Zone
Shipyard Dr	7.25	13	Main Zone
Smith Rd	8.69	79	Main Zone
Smith Rd @ Hobbart St	5.74	49	Main Zone
South Ln	9.76	49	Main Zone
South Main St	5.77	18	Main Zone
South Pleasant St	4.71	65.6	Main Zone
South Pleasant St/Charles St	5.17	79	Main Zone
South St	5.96	45	Main Zone
South St @ Main St	9.76	45	Main Zone
Spin Drift Ln	5.47	59	Main Zone
Spring St	4.10	49	Main Zone
Spring St/Main St	3.69	20	Main Zone
Spring Valley	7.19	37	Main Zone
Spruce St @ Hull St	5.92	62	Main Zone
Stagecoach Rd	1.80	80	High Zone
Standish Ave	3.64	72	Main Zone
Standish Rd	6.45	19	Main Zone
Standish St	4.05	59	Main Zone
Stanford Dr	1.94	85	Main Zone
Stoddard Rd	5.47	49	Main Zone
Stoddard Rd @ Pleasant St	5.47	49	Main Zone
Stone Gate Ln	3.01	48	Main Zone
Strawberry Hill	3.69	40	Main Zone
Studley Rd	5.47	49	Main Zone
Summer St	2.21	40	Main Zone
Summer St @ East St	2.97	40	Main Zone
Summer St @ Green St	3.01	9	Main Zone
Summer St @ Rockland St	3.01	50	Main Zone
Summer Street	2.21	36	Main Zone
Summit Ave	8.75	16	Main Zone
Summit Ave @ Atlantic Ave	8.75	16	Main Zone
Summit Dr	5.00	128	Main Zone
Sunset Lane	1.17	87	High Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Sunset Ln	1.17	76	High Zone
Surry Dr	5.47	46	Main Zone
Surry Rd	3.01	20	Main Zone
Sycamore Ln	9.79	10	Main Zone
Talbot Rd	7.11	131.2	Main Zone
Taurasi Rd	5.33	50	Main Zone
Thaxter Park	5.00	37	Main Zone
Thaxter St @ North St	4.01	23	Main Zone
Third St/Newport Rd	3.43	7	Main Zone
Thistle Patch	4.29	49	Main Zone
Thistle Patch @ Free St	4.29	49	Main Zone
Thomas Way PVT	3.01	12	Main Zone
Tierney Ave	3.64	34	Main Zone
TO SCHOOL	1.23	123	High Zone
Touraine Ave	4.32	3	Main Zone
Tower Brook Rd	5.33	49	Main Zone
Tower Brook Rd @Main St	5.33	49	Main Zone
Tower Rd	2.44	52	Main Zone
Town Way	5.77	10	Main Zone
Triphammer Rd	4.29	49	Main Zone
Tucker's Dr @ Hockley Dr	7.25	46	Main Zone
Tucker's Lane	7.25	59	Main Zone
Tupelo Dr	9.79	13	Main Zone
Union St @ Free St	4.29	49	Main Zone
Upland Dr	1.32	144	High Zone
Upland Dr/Wanders Dr	1.32	134	High Zone
US Bates Rd	4.37	55	Main Zone
Valley Beach Ave	7.19	0	Main Zone
Vautrinot Ave @ Highland Ave	5.77	44	Main Zone
Vernon Ave	4.32	3	Main Zone
Village Ln	5.11	47	Main Zone
Volunteer Rd	1.34	53	High Zone
Waltham St	4.37	2	Main Zone
Wanders Dr	1.32	141	High Zone
Ward St	3.01	62	Main Zone
Warfield Ave	4.37	4	Main Zone
Warren St	4.20	19	Main Zone
Water St	7.14	46	Main Zone
Weir St	3.03	19	Main Zone

Appendix C
Hydraulic Input Data
Junction Nodes

Label	Base Flow (gpm)	Elevation (ft)	Zone
Western Ave	5.77	90	Main Zone
Westminster Rd	5.00	8	Main Zone
Westmoreland Rd	1.17	98	High Zone
Weston Rd	6.12	62	Main Zone
Weston St	7.16	10	Main Zone
Wharf Ave	6.45	13	Main Zone
Whitcomb Ave	2.44	55	Main Zone
White Horse Rd	2.30	90	Main Zone
Whitehead Ave	3.78	13	Main Zone
Whiting St @ Main St	3.62	167	High Zone
Whiting Street	1.23	108	High Zone
Whitton Ave	4.05	33	Main Zone
Willow Cir	1.17	70	High Zone
Windsor Dr	3.03	33	Main Zone
Windy Hill Rd	6.40	20	Main Zone
Winfield Rd	2.19	167	High Zone
Winthorp Ave	3.64	30	Main Zone
Winthrop Rd	3.14	95	High Zone
Wompatuck Rd	11.21	11.5	Main Zone
Woodbridge Rd	5.33	49	Main Zone
Woodlock Rd	2.30	86	Main Zone
Woodlock Rd @ French St	2.30	49	Main Zone
Worrick Rd	7.19	10	Main Zone

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
Andrews Isle	1,423	6	100	Cast iron
Atlantic Ave	3,588	10	120	Cast iron
Beach Ave	892	6	100	Cast iron
Beal St	771	6	100	Cast iron
Berkley Rd	1,059	8	130	Cast iron
Brewster Rd	1,159	8	115	Asbestos Cement
Broad Cove Rd	3,130	8	110	Ductile Iron
Cedar St	949	12	130	Cast iron
Central St	1,248	8	115	Asbestos Cement
Charles St	1,221	8	115	Cast iron
Chief Justice Cushing Hwy	2,125	8	115	Cast iron
Cushing Street	1,568	12	130	Ductile Iron
Downer Ave	669	8	120	Cast iron
Downer Avenue	1,209	10	130	Cast iron
East St	2083	20	130	Ductile Iron
East St.	284	20	130	Cast iron
East Str	1,956	6	100	Cast iron
East Street	2,119	6	100	Cast iron
Fort Hill St	547	8	115	Cast iron
Fottler Rd	883	8	115	Asbestos Cement
Fox Run	1,062	8	115	Cast iron
Free St	1,262	8	115	Cast iron
French St	1,161	12	130	Cast iron
Fresh River Ave	486	8	115	Cast iron
George Washington Blvd	2,352.00	10	120	Cast iron
Hersey St	3,213	12	130	Cast iron
Hersey Str	1,577	12	130	Cast iron
Hersey Street	1,632	6	100	Cast iron
High St	819	8	115	Asbestos Cement
Hobart St	1,564	8	120	Ductile Iron
Hockley Dr	1,590	8	115	Ductile Iron
HP-1	1,064	12	120	Cast iron
HP-2	93	12	105	Cast iron
HP-3	431.00	8	115	Ductile Iron
HP-4	219	8	115	Ductile Iron
HP-5	888	8	115	Ductile Iron
HP-7	1,228	8	115	Cast iron
HP-8	846	8	115	Cast iron
HP-9	1,025	8	115	Ductile Iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-10	356	12	120	Cast iron
HP-11	1,121	12	120	Cast iron
HP-12	923	12	120	Cast iron
HP-13	991.00	12	120	Cast iron
HP-15	387	12	130	Cast iron
HP-16	504	10	130	Cast iron
HP-17	454	12	130	Cast iron
HP-18	324	12	120	Cast iron
HP-19	280	6	100	Cast iron
HP-20	914	12	120	Cast iron
HP-21	826	16	130	Cast iron
HP-22	668	8	115	Cast iron
HP-23	1,440	12	130	Cast iron
HP-24	1,319	16	130	Cast iron
HP-25	1,394	8	115	Cast iron
HP-26	644	8	115	Cast iron
HP-28	612	8	115	Cast iron
HP-29	398	8	115	Cast iron
HP-30	773	8	115	Cast iron
HP-31	1,980	8	115	Cast iron
HP-32	480	6	100	Asbestos Cement
HP-33	1,537	6	100	Asbestos Cement
HP-34	1,422	8	115	Asbestos Cement
HP-35	35	8	115	Asbestos Cement
HP-36	1,165	6	100	Asbestos Cement
HP-37	575	12	120	Cast iron
HP-38	286	12	120	Cast iron
HP-39	328	12	105	Ductile Iron
HP-40	376	12	120	Ductile Iron
HP-41	1,603	8	115	Cast iron
HP-42	319	6	100	Asbestos Cement
HP-43	448	6	100	Asbestos Cement
HP-44	213	6	100	Cast iron
HP-45	458	12	120	Ductile Iron
HP-46	2,214	6	100	Asbestos Cement
HP-48	459	8	115	Ductile Iron
HP-49	702	8	115	Cast iron
HP-50	438	8	115	Cast iron
HP-51	219	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-52	412	6	100	Cast iron
HP-53	1,083	8	115	Cast iron
HP-56	86	12	130	Cast iron
HP-57	1040	12	105	Ductile Iron
HP-58	1,529	12	130	Ductile Iron
HP-59	1,139	8	115	Ductile Iron
HP-60	223	12	130	Ductile Iron
HP-61	375	8	115	Cast iron
HP-62	25	12	130	Ductile Iron
HP-63	606	12	105	Ductile Iron
HP-64	68	12	130	Ductile Iron
HP-65	1,378	8	115	Asbestos Cement
HP-66	1,471	12	120	Cast iron
HP-67	758	12	120	Cast iron
HP-69	439.00	12	105	Cast iron
HP-70	54	12	130	Cast iron
HP-74	448	12	120	Cast iron
HP-75	226	8	110	Cast iron
HP-76	345	8	110	Asbestos Cement
HP-77	594	6	100	Cast iron
HP-78	507	8	115	Cast iron
HP-79	901	12	120	Cast iron
HP-80	228	12	120	Cast iron
HP-81	1,145	12	120	Cast iron
HP-82	972	8	115	Ductile Iron
HP-83	905	8	115	Ductile Iron
HP-84	595	8	115	Cast iron
HP-86	32	8	115	Cast iron
HP-87	43	8	115	Cast iron
HP-88	467	8	115	Cast iron
HP-89	730	12	130	Asbestos Cement
HP-90	245.00	8	115	Asbestos Cement
HP-91	327	6	100	Asbestos Cement
HP-92	103	8	115	Cast iron
HP-93	87.00	8	115	Cast iron
HP-94	20.00	8	115	Asbestos Cement
HP-95	301	6	100	Ductile Iron
HP-96	37	8	115	Cast iron
HP-97	613	8	115	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-98	142.00	8	115	Cast iron
HP-99	1,036.00	12	130	Asbestos Cement
HP-100	448	8	115	Cast iron
HP-101	670	8	115	Cast iron
HP-102	360	12	130	Asbestos Cement
HP-103	309	12	130	Asbestos Cement
HP-104	547.00	8	115	Cast iron
HP-105	1165	6	100	Cast iron
HP-106	491	8	115	Cast iron
HP-107	1180	6	100	Cast iron
HP-109_1	480	12	140	Ductile Iron
HP-110	1,252	8	110	Cast iron
HP-111	227	8	110	Cast iron
HP-112	351	8	110	Cast iron
HP-113	195	8	110	Cast iron
HP-114	298	8	110	Cast iron
HP-115	634	8	110	Cast iron
HP-116	358	8	115	Cast iron
HP-117_3	481	8	115	Cast iron
HP-118_2	481	8	115	Cast iron
HP-119	614	8	115	Ductile Iron
HP-120	157	8	115	Cast iron
HP-121	374	8	115	Cast iron
HP-122	357	8	110	Cast iron
HP-123	336	6	100	Cast iron
HP-124	401	6	100	Cast iron
HP-125	967	8	115	Cast iron
HP-126	325	8	115	Ductile Iron
HP-127_1	392	8	115	Cast iron
HP-128	2371	12	140	Ductile Iron
HP-128_1	797	6	100	Cast iron
HP-129_2	392	8	115	Cast iron
HP-133	1106	8	100	Cast iron
HP-135	1643	8	100	Cast iron
HP-137	509	8	115	Cast iron
HP-138	640	6	100	Cast iron
HP-139	746	8	115	Cast iron
HP-140	608	8	115	Ductile Iron
HP-141	1331	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-142	562	8	115	Cast iron
HP-145	1292	8	110	Cast iron
HP-146	195	12	130	Cast iron
HP-147	1890	8	110	Cast iron
HP-149	401	8	115	Cast iron
HP-150	613	8	115	Cast iron
HP-152	665	8	115	Ductile Iron
HP-153	554	8	115	Cast iron
HP-154	664	8	115	Cast iron
HP-155	279	8	115	Cast iron
HP-157	67	8	115	Asbestos Cement
HP-158	520	8	115	Asbestos Cement
HP-159	96	6	100	Asbestos Cement
HP-161	186	6	100	Asbestos Cement
HP-163	285	12	130	Ductile Iron
HP-164	245	8	115	Ductile Iron
HP-165	387	8	115	Asbestos Cement
HP-166	343	8	115	Asbestos Cement
HP-167	754	6	100	Asbestos Cement
HP-169	568	6	100	Asbestos Cement
HP-170	516	8	115	Asbestos Cement
HP-171	1160	8	115	Asbestos Cement
HP-173	115	8	115	Asbestos Cement
HP-174	1921	6	100	Asbestos Cement
HP-175	1139	6	100	Asbestos Cement
HP-176	163	8	115	Asbestos Cement
HP-177	296	8	115	Asbestos Cement
HP-178	1008	6	100	Asbestos Cement
HP-179	435	6	100	Asbestos Cement
HP-180	268	6	100	Asbestos Cement
HP-181	1013	6	100	Asbestos Cement
HP-182	405	8	115	Cast iron
HP-183	524	6	100	Cast iron
HP-184	389	8	115	Cast iron
HP-185	1282	6	100	Cast iron
HP-186	917	6	100	Cast iron
HP-187	382	8	115	Cast iron
HP-189	331	8	115	Cast iron
HP-190	845	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-192	272	6	100	Asbestos Cement
HP-193	453	6	100	Asbestos Cement
HP-194	371	6	100	Cast iron
HP-195	782	6	100	Cast iron
HP-196	1283	6	100	Cast iron
HP-197	514	8	115	Cast iron
HP-200	763	16	130	Ductile Iron
HP-201	296	8	115	Cast iron
HP-202	537	6	100	Cast iron
HP-203	106	6	100	Cast iron
HP-204	620	6	100	Asbestos Cement
HP-205	355	6	100	Cast iron
HP-211	707	6	100	Asbestos Cement
HP-213_1	475	6	100	Cast iron
HP-214	401	6	100	Cast iron
HP-215	586	6	100	Asbestos Cement
HP-217_1	266	6	100	Cast iron
HP-218	1015	8	100	Cast iron
HP-219	40	6	100	Cast iron
HP-221	1212	6	100	Asbestos Cement
HP-222	93	6	100	Asbestos Cement
HP-223	296	6	100	Asbestos Cement
HP-224	252	6	100	Asbestos Cement
HP-225	1231	6	100	Asbestos Cement
HP-226	290	6	100	Cast iron
HP-227	430	6	100	Cast iron
HP-228	605	6	100	Cast iron
HP-229	479	8	115	Ductile Iron
HP-231	718	6	100	Cast iron
HP-232	338	6	100	Cast iron
HP-233	154	6	100	Asbestos Cement
HP-234	87	8	115	Cast iron
HP-235	428	8	115	Cast iron
HP-237	380	8	115	Cast iron
HP-245	741	8	115	Ductile Iron
HP-300	1228	8	130	Cast iron
HP-301	830	8	130	Cast iron
HP-303	363	8	130	Cast iron
HP-304	198	8	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
HP-305	200	8	130	Cast iron
HP-306	383	8	130	Cast iron
HP-307	367	8	130	Cast iron
HP-1287	439	6	100	Cast iron
HP-1352	391	6	100	Cast iron
HP-1354	1141	12	140	Ductile Iron
HP-1355	249	12	140	Ductile Iron
HP-1356	422	12	140	Cast iron
HP-1357	340	8	115	Ductile Iron
HP-1358	996	8	115	Ductile Iron
HP-1359	606	6	100	Cast iron
HP-1360	402	6	100	Cast iron
HP-1361	1301	8	115	Cast iron
Hull Shore Drive	2035	12	130	Cast iron
Kilby St	553	20	130	Ductile Iron
Kilby Str	3294	20	130	Cast iron
Leavitt St	880	8	115	Asbestos Cement
Leavitt Str	465	20	130	Cast iron
Lincoln Str	830	8	115	Cast iron
Lincoln Street	606	6	100	Cast iron
Main Str	1469	20	130	Cast iron
Main Street	1664	8	110	Cast iron
Martins Ln	905	8	115	Cast iron
Meadow Rd	1171	8	95	Cast iron
Middle St	2051	20	130	Ductile Iron
Nantasket Ave	1313	12	130	Cast iron
Nantasket Avenue	1073	12	130	Cast iron
New Bridge St	2607	8	115	Ductile Iron
North Street	1478	10	130	Cast iron
Otis Str	1545	12	130	Cast iron
P-3	543	8	115	Cast iron
P-4	179	8	115	Cast iron
P-5	8954	8	130	Cast iron
P-199	310	24	130	Asbestos Cement
P-207	592	8	115	Ductile Iron
P-237	1248	8	115	Cast iron
P-238	538	24	130	Ductile Iron
P-239	479	12	130	Cast iron
P-240	75	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-242	410	8	115	Ductile Iron
P-246	911	8	115	Cast iron
P-249	1332	12	130	Cast iron
P-251	1317	8	115	Cast iron
P-252	341	8	115	Ductile Iron
P-254	53	8	115	Cast iron
P-255	1005	8	115	Cast iron
P-259	1208	8	115	Cast iron
P-260	783	8	115	Asbestos Cement
P-262	789	12	120	Asbestos Cement
P-263	89	8	115	Asbestos Cement
P-264	823	12	120	Asbestos Cement
P-265	953	8	115	Cast iron
P-266	1037	8	115	Ductile Iron
P-267	1412	8	115	Cast iron
P-268	1262	8	115	Cast iron
P-269	491	12	120	Cast iron
P-270	489	8	110	Cast iron
P-271	389	6	100	Cast iron
P-273	717	8	110	Asbestos Cement
P-274	42	8	110	Asbestos Cement
P-276	804	8	110	Cast iron
P-277	375	24	130	Ductile Iron
P-278	919	12	120	Asbestos Cement
P-279	644	24	130	Ductile Iron
P-281	1339	20	130	Cast iron
P-282	1901	8	115	Asbestos Cement
P-283	330	8	115	Asbestos Cement
P-284	486	8	115	Cast iron
P-285	384	8	115	Cast iron
P-288	392	6	100	Cast iron
P-289	105	8	115	Ductile Iron
P-290	389	8	115	Cast iron
P-291	211	8	115	Cast iron
P-292	1354	12	120	Cast iron
P-293	134	6	100	Cast iron
P-294	249	6	100	Cast iron
P-295	208	8	115	Asbestos Cement
P-296	180	8	115	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-297	421	8	130	Asbestos Cement
P-299	719	8	115	Cast iron
P-300	802	8	115	Ductile Iron
P-301	683	6	110	Cast iron
P-302	407	6	100	Cast iron
P-303	133	6	110	Cast iron
P-304	265	6	100	Cast iron
P-305	1157	6	100	Cast iron
P-306	677	6	110	Cast iron
P-308	260	8	115	Cast iron
P-309	1054	8	130	Cast iron
P-310	368	8	115	Cast iron
P-311	755	8	115	Cast iron
P-313	299	8	115	Asbestos Cement
P-314	244	8	115	Cast iron
P-316	796	8	115	Cast iron
P-318	576	8	115	Cast iron
P-319	1104	8	120	Cast iron
P-321	255	12	130	Ductile Iron
P-322	121	8	115	Asbestos Cement
P-323	977	8	115	Ductile Iron
P-324	296	8	115	Asbestos Cement
P-325	47	8	115	Asbestos Cement
P-327	378	8	115	Cast iron
P-330	363	8	115	Cast iron
P-331	267	8	115	Cast iron
P-332	130	12	130	Cast iron
P-333	1166	8	115	Cast iron
P-334	1409	8	115	Cast iron
P-337	446	8	115	Ductile Iron
P-338	62	8	115	Ductile Iron
P-339	229	8	115	Ductile Iron
P-340	652	8	115	Cast iron
P-341	343	8	115	Ductile Iron
P-342	230	8	115	Ductile Iron
P-343	218	8	115	Ductile Iron
P-344	571	12	130	Ductile Iron
P-345	1240	8	120	Ductile Iron
P-346	262	8	115	Ductile Iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-347	1776	8	120	Ductile Iron
P-348	656	8	115	Ductile Iron
P-350	39	8	115	Ductile Iron
P-351	602	8	115	Cast iron
P-352	1319	8	110	Cast iron
P-353	718	8	115	Cast iron
P-354	1354	8	115	Cast iron
P-355	315	8	115	Cast iron
P-356	373	8	115	Cast iron
P-357	1453	12	120	Cast iron
P-358	531	12	120	Cast iron
P-359	526	6	100	Cast iron
P-360	425	10	120	Cast iron
P-361	401	10	120	Cast iron
P-362	799	8	115	Cast iron
P-363	1703	20	130	Ductile Iron
P-364	3757	20	130	Ductile Iron
P-366	1626	8	115	Cast iron
P-368	213	8	115	Ductile Iron
P-369	443	6	100	Ductile Iron
P-370	439	8	115	Ductile Iron
P-371	520	8	115	Ductile Iron
P-372	292	8	115	Cast iron
P-373	483	8	115	Cast iron
P-374	1212	8	115	Cast iron
P-375	284	8	115	Cast iron
P-378	308	8	115	Cast iron
P-379	1151	8	115	Cast iron
P-381	672	6	100	Cast iron
P-386	807	8	115	Cast iron
P-387	726	20	130	Ductile Iron
P-390	191	6	100	Cast iron
P-391	465	6	100	Asbestos Cement
P-392	783	6	100	Cast iron
P-393	553	8	115	Asbestos Cement
P-395	544	6	100	Asbestos Cement
P-397	529	6	100	Asbestos Cement
P-399	662	8	115	Asbestos Cement
P-401	1110	8	115	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-403	496	10	130	Cast iron
P-406	233	20	130	Cast iron
P-407	43	20	130	Cast iron
P-408	558	12	130	Cast iron
P-410	473	12	130	Cast iron
P-412	399	8	115	Ductile Iron
P-413	152	8	115	Ductile Iron
P-414	228	6	100	Cast iron
P-415	1018	6	100	Ductile Iron
P-417	425	8	115	Cast iron
P-418	545	6	100	Cast iron
P-419	461	8	115	Ductile Iron
P-421	606	20	130	Cast iron
P-422	619	6	100	Cast iron
P-423	341	20	130	Cast iron
P-424	838	20	130	Cast iron
P-427	170	6	100	Cast iron
P-428	343	20	130	Cast iron
P-429	360	6	100	Cast iron
P-430	604	6	100	Cast iron
P-431	1017	6	100	Cast iron
P-432	816	8	115	Ductile Iron
P-433	1342	6	100	Cast iron
P-435	678	8	110	Cast iron
P-436	1280	8	110	Asbestos Cement
P-437	669	20	130	Cast iron
P-438	723	6	100	Asbestos Cement
P-439	385	20	130	Cast iron
P-440	598	6	100	Cast iron
P-441	623	20	130	Cast iron
P-442	313	20	130	Cast iron
P-444	627	8	115	Cast iron
P-447	852	8	115	Cast iron
P-448	409	8	115	Asbestos Cement
P-449	520	8	115	Cast iron
P-450	1669	8	115	Cast iron
P-451	551	8	115	Cast iron
P-452	479	8	115	Asbestos Cement
P-453	694	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-454	362	8	115	Cast iron
P-456	1128	6	100	Cast iron
P-458	916	8	115	Ductile Iron
P-459	1601	8	115	Ductile Iron
P-460	625	8	115	Ductile Iron
P-461	27	8	115	Ductile Iron
P-462	420	8	115	Ductile Iron
P-463	321	8	115	Ductile Iron
P-464	267	8	115	Ductile Iron
P-465	1051	8	115	Ductile Iron
P-466	912	8	115	Ductile Iron
P-467	623	8	115	Ductile Iron
P-468	147	8	115	Ductile Iron
P-470	1175	8	115	Cast iron
P-473	1266	8	115	Cast iron
P-474	660	8	115	Cast iron
P-475	632	8	115	Ductile Iron
P-476	889	8	115	Ductile Iron
P-477	471	8	115	Ductile Iron
P-478	584	8	115	Ductile Iron
P-479	617	8	115	Ductile Iron
P-480	771	8	115	Ductile Iron
P-481	965	8	115	Ductile Iron
P-483	381	8	115	Ductile Iron
P-484	358	8	115	Ductile Iron
P-485	208	8	115	Ductile Iron
P-486	785	8	115	Ductile Iron
P-487	377	8	115	Ductile Iron
P-488	706	8	115	Ductile Iron
P-489	638	8	115	Ductile Iron
P-490	514	8	115	Ductile Iron
P-491	302	8	115	Cast iron
P-494	1148	8	115	Ductile Iron
P-498	2185	8	120	Asbestos Cement
P-500	896	8	115	Ductile Iron
P-501	819	8	115	Ductile Iron
P-502	520	12	130	Cast iron
P-503	1180	8	120	Cast iron
P-505	367	6	100	Ductile Iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-506	279	8	115	Cast iron
P-507	682	8	115	Cast iron
P-509	602	8	115	Cast iron
P-510	221	8	115	Cast iron
P-511	611	8	115	Ductile Iron
P-512	257	6	100	Cast iron
P-513	340	8	115	Ductile Iron
P-514	270	8	115	Cast iron
P-516	534	6	100	Cast iron
P-518	403	8	115	Ductile Iron
P-520	713	8	115	Asbestos Cement
P-521	695	6	100	Cast iron
P-522	390	8	115	Cast iron
P-524	701	10	130	Cast iron
P-525	1287	8	115	Cast iron
P-526	428	8	115	Cast iron
P-527	243	8	115	Cast iron
P-528	183	12	130	Cast iron
P-529	728	6	100	Cast iron
P-530	635	8	115	Cast iron
P-531	303	8	115	Cast iron
P-532	305	8	115	Cast iron
P-533	139	6	100	Cast iron
P-535	695	12	130	Cast iron
P-536	159	8	115	Cast iron
P-537	78	8	115	Cast iron
P-540	601	6	100	Asbestos Cement
P-542	35	12	130	Cast iron
P-543	452	8	115	Asbestos Cement
P-544	199	12	130	Ductile Iron
P-546	941	12	120	Cast iron
P-547	252	12	120	Cast iron
P-548	132	6	100	Cast iron
P-549	940	6	100	Cast iron
P-550	129	8	115	Ductile Iron
P-551	72	8	115	Ductile Iron
P-552	81	8	115	Ductile Iron
P-553	204	12	120	Cast iron
P-554	314	8	115	Ductile Iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-556	489	8	115	Ductile Iron
P-557	92	8	115	Ductile Iron
P-558	1398	8	115	Ductile Iron
P-559	552	12	120	Cast iron
P-561	256	8	115	Asbestos Cement
P-562	90	8	115	Asbestos Cement
P-563	333	8	115	Ductile Iron
P-564	1065	8	115	Cast iron
P-566	224	12	130	Ductile Iron
P-569	526	8	115	Cast iron
P-570	47	12	100	Ductile Iron
P-571	71	12	130	Ductile Iron
P-573	1084	8	115	Ductile Iron
P-574	1328	8	115	Ductile Iron
P-575	627	8	115	Cast iron
P-576	401	8	115	Ductile Iron
P-577	271	8	115	Cast iron
P-578	238	8	115	Cast iron
P-579	348	8	115	Cast iron
P-580	80	8	115	Cast iron
P-581	285	6	100	Cast iron
P-582	808	8	115	Asbestos Cement
P-583	1810	6	100	Cast iron
P-586	184	8	110	Cast iron
P-587	582	6	100	Cast iron
P-589	846	8	115	Cast iron
P-590	27	8	110	Cast iron
P-591	34	8	110	Cast iron
P-592	846	8	115	Asbestos Cement
P-593	364	8	110	Cast iron
P-594	203	8	110	Asbestos Cement
P-595	981	8	110	Asbestos Cement
P-596	251	6	100	Asbestos Cement
P-597	227	6	100	Asbestos Cement
P-598	1505	6	100	Asbestos Cement
P-599	1812	6	100	Asbestos Cement
P-602	317	8	115	Cast iron
P-604	181	8	115	Asbestos Cement
P-607	362	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-608	490	6	100	Asbestos Cement
P-609	1739	6	100	Cast iron
P-610	865	8	115	Cast iron
P-611	629	12	130	Cast iron
P-612	676	12	130	Cast iron
P-613	714	8	115	Cast iron
P-614	817	12	130	Cast iron
P-615	464	6	100	Cast iron
P-616	671	6	100	Cast iron
P-617	362	6	100	Cast iron
P-618	85	6	100	Cast iron
P-619	1018	8	115	Ductile Iron
P-620	592	12	130	Ductile Iron
P-621	573	6	100	Cast iron
P-623	409	6	100	Cast iron
P-624	488	8	115	Cast iron
P-625	1045	12	130	Ductile Iron
P-626	504	6	100	Cast iron
P-627	606	12	130	Ductile Iron
P-628	762	8	115	Ductile Iron
P-629	295	12	130	Ductile Iron
P-630	532	6	100	Asbestos Cement
P-631	893	12	130	Ductile Iron
P-633	657	12	130	Ductile Iron
P-634	294	12	130	Cast iron
P-635	1128	12	130	Cast iron
P-637	233	6	100	Cast iron
P-638	341	6	100	Cast iron
P-639	732	6	100	Cast iron
P-640	495	12	130	Cast iron
P-642	734	8	115	Ductile Iron
P-643	559	12	130	Cast iron
P-644	435	12	130	Cast iron
P-645	514	6	100	Cast iron
P-646	792	6	100	Asbestos Cement
P-647	567	20	130	Cast iron
P-648	611	20	130	Ductile Iron
P-649	1502	8	115	Cast iron
P-651	893	14	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-652	958	8	110	Cast iron
P-653	112	6	100	Cast iron
P-654	2355	14	130	Cast iron
P-655	48	14	130	Cast iron
P-656	365	14	130	Cast iron
P-659	81	8	110	Cast iron
P-663	225	8	115	Cast iron
P-664	408	8	110	Asbestos Cement
P-665	347	8	115	Cast iron
P-667	76	12	130	Ductile Iron
P-669	103	6	100	Asbestos Cement
P-670	471	6	100	Cast iron
P-671	106	8	115	Cast iron
P-672	711	8	115	Cast iron
P-673	451	6	100	Asbestos Cement
P-674	279	6	100	Cast iron
P-675	238	8	115	Ductile Iron
P-676	537	6	100	Asbestos Cement
P-680	210	12	130	Asbestos Cement
P-681	512	10	120	Asbestos Cement
P-682	867	10	120	Cast iron
P-684	1678	20	130	Ductile Iron
P-685	261	8	115	Cast iron
P-687	284	8	115	Ductile Iron
P-689	339	20	130	Ductile Iron
P-690	135	6	100	Asbestos Cement
P-691	764	6	100	Asbestos Cement
P-692	952	20	130	Ductile Iron
P-694	673	20	130	Ductile Iron
P-696	830	6	100	Cast iron
P-697	564	6	90	Cast iron
P-699	699	6	90	Cast iron
P-700	389	8	115	Cast iron
P-704	135	8	115	Cast iron
P-705	591	8	115	Cast iron
P-706	267	8	115	Cast iron
P-707	533	6	100	Asbestos Cement
P-708	280	6	100	Cast iron
P-709	196	6	100	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-710	496	6	100	Asbestos Cement
P-711	696	8	115	Asbestos Cement
P-712	1006	6	100	Asbestos Cement
P-713	485	8	115	Asbestos Cement
P-714	761	8	115	Asbestos Cement
P-716	414	8	115	Ductile Iron
P-717	572	8	115	Ductile Iron
P-718	216	8	115	Ductile Iron
P-719	395	8	115	Ductile Iron
P-720	515	8	115	Cast iron
P-721	1018	8	110	Ductile Iron
P-722	804	12	120	Ductile Iron
P-723	142	12	130	Ductile Iron
P-724	501	12	120	Ductile Iron
P-725	470	6	90	Cast iron
P-726	558	6	90	Cast iron
P-727	40	8	115	Cast iron
P-729	34	12	130	Cast iron
P-730	538	12	130	Cast iron
P-732	674	8	115	Cast iron
P-733	335	12	130	Cast iron
P-736	485	8	115	Asbestos Cement
P-738	401	8	115	Asbestos Cement
P-739	1321	12	120	Cast iron
P-740	468	6	100	Cast iron
P-742	1141	6	100	Cast iron
P-743	1227	6	100	Asbestos Cement
P-744	221	6	100	Cast iron
P-746	534	8	95	Asbestos Cement
P-747	851	8	120	Cast iron
P-748	1216	8	95	Cast iron
P-749	783	8	115	Cast iron
P-750	159	8	115	Cast iron
P-751	163	8	115	Cast iron
P-752	1260	6	100	Asbestos Cement
P-753	220	8	115	Cast iron
P-754	2484	8	110	Cast iron
P-755	1579	6	100	Cast iron
P-756	312	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-757	344	6	100	Cast iron
P-758	90	6	100	Cast iron
P-760	706	6	100	Asbestos Cement
P-761	588	6	100	Asbestos Cement
P-762	638	6	100	Asbestos Cement
P-764	323	6	100	Asbestos Cement
P-765	270	6	100	Asbestos Cement
P-766	1029	8	115	Cast iron
P-767	1303	6	100	Asbestos Cement
P-768	504	8	115	Cast iron
P-769	740	6	100	Asbestos Cement
P-770	1059	6	100	Asbestos Cement
P-771	874	6	100	Asbestos Cement
P-772	1579	6	100	Asbestos Cement
P-773	404	6	100	Asbestos Cement
P-774	142	8	115	Cast iron
P-775	143	8	115	Cast iron
P-777	365	8	115	Cast iron
P-778	264	8	115	Cast iron
P-779	382	6	100	Asbestos Cement
P-780	1127	8	115	Cast iron
P-781	370	10	130	Cast iron
P-782	394	10	130	Cast iron
P-783	141	6	100	Cast iron
P-784	867	6	100	Cast iron
P-785	475	6	100	Cast iron
P-787	243	8	115	Ductile Iron
P-789	1038	8	115	Ductile Iron
P-790	519	10	130	Cast iron
P-792	951	8	115	Ductile Iron
P-793	31	6	100	Cast iron
P-794	653	6	100	Cast iron
P-795	436	8	115	Cast iron
P-797	419	8	115	Cast iron
P-799	1228	6	100	Cast iron
P-802	320	8	115	Asbestos Cement
P-803	469	8	115	Cast iron
P-804	1141	6	100	Cast iron
P-805	380	6	100	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-806	371	6	100	Asbestos Cement
P-807	1638	6	100	Asbestos Cement
P-808	435	6	100	Asbestos Cement
P-809	504	6	100	Asbestos Cement
P-810	447	8	115	Ductile Iron
P-811	390	8	115	Ductile Iron
P-813	1231	8	115	Asbestos Cement
P-814	1195	6	100	Asbestos Cement
P-815	250	8	115	Ductile Iron
P-816	531	8	115	Ductile Iron
P-817	456	8	115	Ductile Iron
P-818	140	8	115	Ductile Iron
P-821	442	8	115	Ductile Iron
P-822	1741	12	130	Cast iron
P-824	18	20	130	Cast iron
P-825	679	16	130	Cast iron
P-826	1172	12	130	Cast iron
P-827	683	6	100	Cast iron
P-828	1785	8	115	Cast iron
P-829	484	12	130	Cast iron
P-830	518	6	100	Cast iron
P-833	507	6	100	Asbestos Cement
P-834	131	6	100	Ductile Iron
P-835	124	6	100	Ductile Iron
P-836	190	6	100	Ductile Iron
P-837	499	6	100	Asbestos Cement
P-838	154	6	100	Ductile Iron
P-839	558	12	130	Cast iron
P-840	704	6	100	Cast iron
P-841	1013	6	90	Cast iron
P-842	894	8	110	Cast iron
P-844	751	8	115	Cast iron
P-846	549	8	115	Asbestos Cement
P-851	174	6	100	Cast iron
P-852	1963	8	110	Asbestos Cement
P-853	92	8	115	Cast iron
P-858	706	6	100	Cast iron
P-860	209	6	100	Asbestos Cement
P-861	574	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-863	1245	8	125	Cast iron
P-865	44	8	115	Cast iron
P-866	266	6	100	Cast iron
P-867	1522	10	120	Cast iron
P-868	449	8	115	Cast iron
P-871	395	10	130	Cast iron
P-872	663	6	100	Cast iron
P-874	106	10	130	Cast iron
P-875	252	10	130	Cast iron
P-876	430	6	100	Cast iron
P-877	131	12	130	Cast iron
P-878	1047	6	100	Cast iron
P-879	256	12	130	Cast iron
P-880	543	6	100	Cast iron
P-881	315	6	100	Ductile Iron
P-882	104	6	100	Ductile Iron
P-883	295	12	130	Cast iron
P-884	565	12	130	Ductile Iron
P-885	242	8	115	Ductile Iron
P-886	301	8	115	Ductile Iron
P-887	287	8	115	Ductile Iron
P-888	104	8	115	Ductile Iron
P-889	449	12	130	Cast iron
P-890	246	20	130	Cast iron
P-891	477	6	100	Cast iron
P-892	4649	16	130	Cast iron
P-893	628	20	120	Cast iron
P-894	85	6	100	Cast iron
P-895	1294	12	130	Cast iron
P-896	773	20	130	Cast iron
P-897	348	8	115	Ductile Iron
P-899	396	8	115	Ductile Iron
P-900	204	8	115	Ductile Iron
P-901	495	8	115	Ductile Iron
P-902	207	8	115	Ductile Iron
P-903	269	8	115	Ductile Iron
P-905	920	20	130	Cast iron
P-906	351	20	130	Cast iron
P-907	500	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-908	822	8	115	Cast iron
P-910	978	10	130	Cast iron
P-913	554	8	110	Cast iron
P-916	472	8	115	Cast iron
P-917	1407	8	115	Cast iron
P-919	499	6	100	Cast iron
P-920	472	6	100	Asbestos Cement
P-921	529	6	100	Asbestos Cement
P-922	511	8	110	Asbestos Cement
P-923	468	6	100	Asbestos Cement
P-924	563	8	110	Asbestos Cement
P-925	871	6	100	Asbestos Cement
P-926	539	8	110	Asbestos Cement
P-927	1356	8	110	Asbestos Cement
P-931	6895	20	130	Cast iron
P-932	1075	12	130	Cast iron
P-933	378	8	115	Cast iron
P-934	1078	8	115	Cast iron
P-935	770	8	115	Cast iron
P-936	325	6	100	Cast iron
P-937	35	8	115	Cast iron
P-938	410	8	115	Asbestos Cement
P-940	820	6	100	Cast iron
P-941	434	6	100	Cast iron
P-942	98	6	62	Cast iron
P-943	564	6	62	Cast iron
P-944	192	6	62	Cast iron
P-945	502	6	100	Cast iron
P-946	196	6	62	Cast iron
P-947	451	6	100	Cast iron
P-948	611	6	100	Cast iron
P-949	102	6	62	Cast iron
P-950	660	6	100	Cast iron
P-951	381	6	65	Asbestos Cement
P-952	140	6	80	Cast iron
P-953	490	6	100	Cast iron
P-954	349	6	100	Cast iron
P-955	413	6	100	Cast iron
P-956	223	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-957	418	6	100	Cast iron
P-958	178	6	100	Cast iron
P-959	226	6	100	Cast iron
P-960	481	6	100	Cast iron
P-961	1293	12	130	Cast iron
P-962	272	6	100	Cast iron
P-963	44	12	130	Cast iron
P-964	255	12	130	Ductile Iron
P-966	58	8	115	Ductile Iron
P-968	512	6	100	Cast iron
P-969	348	6	100	Cast iron
P-970	214	6	100	Cast iron
P-971	213	8	110	Cast iron
P-972	1765	6	100	Cast iron
P-973	594	6	100	Cast iron
P-974	465	6	100	Cast iron
P-975	1410	6	100	Cast iron
P-977	1481	8	115	Cast iron
P-978	305	6	100	Ductile Iron
P-979	465	8	115	Cast iron
P-980	476	8	115	Cast iron
P-981	274	6	100	Ductile Iron
P-982	275	6	100	Cast iron
P-983	2129	6	100	Cast iron
P-984	259	12	130	Cast iron
P-986	849	8	115	Cast iron
P-987	770	6	100	Cast iron
P-988	109	8	115	Cast iron
P-989	625	8	115	Cast iron
P-990	120	6	100	Cast iron
P-991	608	8	115	Ductile Iron
P-992	512	6	100	Cast iron
P-993	604	6	100	Asbestos Cement
P-995	19	12	130	Asbestos Cement
P-996	118	12	130	Asbestos Cement
P-997	247	6	100	Cast iron
P-998	232	12	130	Asbestos Cement
P-999	221	6	100	Cast iron
P-1000	614	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1001	239	6	100	Cast iron
P-1002	318	6	100	Cast iron
P-1003	343	6	100	Cast iron
P-1004	176	12	130	Asbestos Cement
P-1005	26	6	100	Cast iron
P-1006	839	6	100	Cast iron
P-1007	2693	12	130	Asbestos Cement
P-1008	194	6	100	Cast iron
P-1009	203	6	100	Cast iron
P-1010	464	6	100	Cast iron
P-1011	270	6	100	Cast iron
P-1012	227	6	100	Cast iron
P-1013	730	6	100	Cast iron
P-1014	360	6	100	Cast iron
P-1015	230	6	100	Cast iron
P-1016	780	6	100	Cast iron
P-1017	215	6	100	Cast iron
P-1018	210	6	100	Cast iron
P-1019	782	6	100	Cast iron
P-1020	217	6	100	Cast iron
P-1021	220	6	100	Asbestos Cement
P-1022	93	6	100	Asbestos Cement
P-1023	245	6	100	Cast iron
P-1024	247	6	100	Cast iron
P-1025	1102	6	100	Asbestos Cement
P-1026	237	6	100	Cast iron
P-1027	1012	6	100	Cast iron
P-1028	201	8	115	Ductile Iron
P-1029	377	8	115	Ductile Iron
P-1030	1022	8	115	Ductile Iron
P-1031	237	8	115	Ductile Iron
P-1032	1054	6	100	Asbestos Cement
P-1033	221	8	115	Ductile Iron
P-1034	295	6	100	Asbestos Cement
P-1035	587	6	100	Cast iron
P-1036	340	6	100	Asbestos Cement
P-1037	1467	6	100	Cast iron
P-1038	675	6	100	Cast iron
P-1039	217	6	100	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1040	594	6	100	Asbestos Cement
P-1041	197	6	100	Asbestos Cement
P-1043	595	8	150	Cast iron
P-1044	444	6	100	Asbestos Cement
P-1045	80	8	115	Ductile Iron
P-1046	687	20	130	Cast iron
P-1047	1517	12	130	Cast iron
P-1048	264	6	100	Cast iron
P-1049	249	6	100	Cast iron
P-1050	257	12	130	Cast iron
P-1051	385	12	130	Cast iron
P-1052	855	6	100	Cast iron
P-1053	700	6	100	Cast iron
P-1054	652	6	100	Cast iron
P-1055	249	6	100	Cast iron
P-1056	648	6	100	Cast iron
P-1057	234	6	100	Cast iron
P-1058	194	6	100	Cast iron
P-1059	793	12	130	Cast iron
P-1060	758	6	100	Cast iron
P-1061	296	8	115	Cast iron
P-1062	210	8	115	Cast iron
P-1063	737	6	100	Cast iron
P-1064	652	6	100	Cast iron
P-1065	332	6	100	Ductile Iron
P-1066	239	8	120	Cast iron
P-1067	251	6	100	Ductile Iron
P-1068	356	8	115	Cast iron
P-1069	211	8	115	Cast iron
P-1070	700	6	100	Cast iron
P-1071	281	8	120	Cast iron
P-1072	435	12	130	Cast iron
P-1073	235	6	100	Cast iron
P-1074	607	12	130	Cast iron
P-1075	238	6	100	Cast iron
P-1077	179	6	100	Cast iron
P-1078	509	8	115	Cast iron
P-1079	212	6	100	Cast iron
P-1080	217	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1081	233	6	100	Cast iron
P-1082	779	6	100	Cast iron
P-1083	1019	6	100	Cast iron
P-1084	470	6	100	Cast iron
P-1085	328	6	100	Cast iron
P-1086	211	12	130	Cast iron
P-1087	622	6	100	Cast iron
P-1088	302	6	100	Asbestos Cement
P-1089	1518	6	100	Cast iron
P-1090	946	6	100	Cast iron
P-1092	419	8	115	Ductile Iron
P-1093	574	12	130	Cast iron
P-1094	310	6	100	Cast iron
P-1095	725	6	100	Asbestos Cement
P-1096	388	6	100	Cast iron
P-1097	44	12	130	Cast iron
P-1098	593	6	100	Cast iron
P-1099	739	8	115	Cast iron
P-1100	354	6	100	Cast iron
P-1101	545	6	100	Asbestos Cement
P-1102	772	12	130	Asbestos Cement
P-1103	869	6	100	Cast iron
P-1105	599	12	130	Asbestos Cement
P-1106	359	6	100	Cast iron
P-1107	292	6	100	Cast iron
P-1108	288	8	115	Ductile Iron
P-1109	572	12	130	Cast iron
P-1110	597	6	100	Cast iron
P-1111	188	6	100	Cast iron
P-1112	285	6	100	Cast iron
P-1113	617	8	115	Ductile Iron
P-1114	97	8	115	Ductile Iron
P-1115	166	8	115	Cast iron
P-1116	250	8	115	Cast iron
P-1117	723	8	115	Cast iron
P-1118	473	12	130	Cast iron
P-1119	175	6	100	Cast iron
P-1120	282	6	100	Cast iron
P-1121	187	6	100	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1122	144	12	130	Cast iron
P-1123	330	12	130	Cast iron
P-1124	274	8	115	Ductile Iron
P-1125	419	12	130	Cast iron
P-1126	386	8	115	Cast iron
P-1127	502	6	100	Cast iron
P-1128	463	6	100	Cast iron
P-1129	463	6	100	Cast iron
P-1130	199	6	100	Cast iron
P-1131	457	6	100	Cast iron
P-1132	322	8	115	Cast iron
P-1133	224	8	115	Cast iron
P-1134	253	6	100	Cast iron
P-1135	216	12	130	Cast iron
P-1136	873	6	100	Cast iron
P-1137	464	12	130	Cast iron
P-1138	747	6	100	Asbestos Cement
P-1139	532	6	100	Asbestos Cement
P-1140	482	6	100	Cast iron
P-1141	419	6	100	Cast iron
P-1142	221	6	100	Cast iron
P-1143	916	6	100	Cast iron
P-1144	501	8	115	Cast iron
P-1145	1470	12	130	Cast iron
P-1146	448	6	100	Cast iron
P-1147	895	12	130	Cast iron
P-1148	213	6	100	Cast iron
P-1149	677	6	100	Asbestos Cement
P-1150	156	6	100	Cast iron
P-1151	436	6	100	Cast iron
P-1152	591	12	130	Cast iron
P-1153	589	12	130	Cast iron
P-1154	443	6	100	Asbestos Cement
P-1155	609	6	100	Cast iron
P-1156	217	12	130	Cast iron
P-1157	218	12	130	Cast iron
P-1158	454	12	130	Cast iron
P-1159	878	12	130	Cast iron
P-1160	224	12	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1161	224	12	130	Cast iron
P-1162	207	12	130	Cast iron
P-1163	232	6	100	Asbestos Cement
P-1164	217	6	100	Cast iron
P-1165	245	6	100	Cast iron
P-1166	463	6	100	Cast iron
P-1167	240	6	100	Cast iron
P-1168	218	6	100	Cast iron
P-1169	207	6	100	Cast iron
P-1170	268	6	100	Cast iron
P-1171	869	6	100	Cast iron
P-1172	213	6	100	Cast iron
P-1173	426	8	115	Ductile Iron
P-1174	335	6	95	Asbestos Cement
P-1175	712	6	100	Cast iron
P-1176	676	6	100	Cast iron
P-1177	760	8	115	Ductile Iron
P-1178	600	6	100	Cast iron
P-1179	754	8	115	Cast iron
P-1180	678	6	100	Cast iron
P-1181	512	6	100	Cast iron
P-1182	1766	6	100	Cast iron
P-1183	758	6	100	Cast iron
P-1184	760	6	100	Cast iron
P-1185	706	6	100	Cast iron
P-1186	815	8	115	Cast iron
P-1187	281	6	100	Cast iron
P-1188	180	6	100	Cast iron
P-1189	95	6	100	Cast iron
P-1190	170	8	115	Cast iron
P-1191	535	8	115	Cast iron
P-1192	96	8	130	Cast iron
P-1193	150	8	120	Cast iron
P-1194	2019	8	150	Cast iron
P-1195	101	8	125	Cast iron
P-1197	541	8	115	Ductile Iron
P-1198	289	8	115	Ductile Iron
P-1199	566	16	130	Cast iron
P-1200	256	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1202	486	8	115	Cast iron
P-1203	276	8	115	Cast iron
P-1204	223	8	115	Cast iron
P-1205	126	8	115	Ductile Iron
P-1206	1326	6	90	Cast iron
P-1207	1220	6	100	Cast iron
P-1208	728	6	100	Cast iron
P-1209	226	6	100	Cast iron
P-1210	1135	8	115	Cast iron
P-1211	1209	6	100	Cast iron
P-1212	543	6	100	Asbestos Cement
P-1213	546	6	100	Cast iron
P-1214	274	6	100	Asbestos Cement
P-1215	185	6	100	Asbestos Cement
P-1216	738	6	100	Asbestos Cement
P-1217	282	6	100	Cast iron
P-1218	532	6	100	Cast iron
P-1219	209	6	100	Cast iron
P-1220	276	6	100	Asbestos Cement
P-1221	530	6	100	Cast iron
P-1222	517	8	115	Asbestos Cement
P-1223	217	16	130	Cast iron
P-1224	237	6	100	Asbestos Cement
P-1226	881	16	130	Cast iron
P-1227	2637	16	130	Cast iron
P-1228	399	8	115	Asbestos Cement
P-1229	1733	12	120	Asbestos Cement
P-1230	552	12	120	Cast iron
P-1231	231	12	120	Cast iron
P-1232	2154	6	100	Cast iron
P-1233	699	6	100	Cast iron
P-1234	236	8	115	Ductile Iron
P-1235	115	8	115	Ductile Iron
P-1236	97	8	115	Ductile Iron
P-1237	753	8	115	Ductile Iron
P-1238	874	8	115	Cast iron
P-1239	156	8	115	Cast iron
P-1240	96	12	130	Ductile Iron
P-1241	483	8	115	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1242	884	12	130	Ductile Iron
P-1244	212	8	115	Cast iron
P-1245	292	8	115	Cast iron
P-1246	310	8	115	Cast iron
P-1247	826	16	130	Cast iron
P-1248	405	6	100	Cast iron
P-1249	1016	16	130	Cast iron
P-1251	292	6	100	Cast iron
P-1252	520	8	115	Ductile Iron
P-1253	701	16	130	Cast iron
P-1254	832	8	115	Cast iron
P-1256	84	16	130	Cast iron
P-1257	96	16	130	Cast iron
P-1258	804	6	100	Asbestos Cement
P-1259	1567	8	115	Cast iron
P-1260	202	16	130	Cast iron
P-1261	1329	6	100	Cast iron
P-1262	273	8	115	Cast iron
P-1263	1218	6	100	Cast iron
P-1264	303	16	130	Cast iron
P-1265	176	16	130	Cast iron
P-1266	276	8	115	Cast iron
P-1267	1019	6	100	Cast iron
P-1268	259	16	130	Cast iron
P-1269	986	16	130	Cast iron
P-1271	67	16	130	Cast iron
P-1272	415	6	100	Cast iron
P-1273	217	16	130	Cast iron
P-1274	1292	6	100	Cast iron
P-1275	528	6	100	Cast iron
P-1276	862	6	100	Cast iron
P-1277	780	16	130	Cast iron
P-1278	252	16	115	Cast iron
P-1279	407	8	115	Cast iron
P-1280	627	6	100	Asbestos Cement
P-1283	478	6	100	Cast iron
P-1284	355	8	115	Asbestos Cement
P-1285	438	6	100	Cast iron
P-1290	352	8	115	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1291	405	24	140	Cast iron
P-1292	415	8	115	Asbestos Cement
P-1293	575	12	130	Cast iron
P-1294	2306	24	140	Ductile Iron
P-1296	331	24	140	Cast iron
P-1297	306	24	140	Cast iron
P-1298	607	8	110	Copper
P-1299	345	12	130	Cast iron
P-1300	333	8	115	Cast iron
P-1301	467	16	130	Cast iron
P-1302	100	16	130	Cast iron
P-1303	290	12	130	Cast iron
P-1304	100	20	130	Cast iron
P-1305	456	16	130	Cast iron
P-1306	1334	8	130	Cast iron
P-1308	98	8	115	Cast iron
P-1309	123	8	115	Cast iron
P-1310	165	8	120	Cast iron
P-1311	298	8	115	Cast iron
P-1312	620	8	115	Cast iron
P-1314	667	12	130	Cast iron
P-1315	436	6	100	Cast iron
P-1316	354	8	130	Cast iron
P-1316a	1384	8	115	Ductile Iron
P-1317	363	8	130	Cast iron
P-1317a	1355	8	115	Cast iron
P-1318	1514	8	130	Cast iron
P-1318a	779	6	100	Asbestos Cement
P-1319	708	6	100	Cast iron
P-1319 (Proposed)	509	12	110	CLDI
P-1320	990	8	110	Cast iron
P-1321	471	8	110	Asbestos Cement
P-1322	420	6	100	Asbestos Cement
P-1323	1067	8	115	Cast iron
P-1324	1211	8	115	Asbestos Cement
P-1325	205	8	115	Asbestos Cement
P-1326	332	8	115	Cast iron
P-1327	846	12	130	Cast iron
P-1328	1229	10	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1329	367	12	130	Cast iron
P-1330	330	12	130	Ductile Iron
P-1331	1238	6	100	Asbestos Cement
P-1332	566	6	100	Cast iron
P-1333	386	8	115	Cast iron
P-1334	567	8	115	Cast iron
P-1335	496	6	100	Cast iron
P-1336	401	6	100	Ductile Iron
P-1337	333	10	130	Cast iron
P-1338	309	8	115	Cast iron
P-1339	932	8	115	Cast iron
P-1340	1057	8	115	Cast iron
P-1341	298	8	115	Cast iron
P-1342	189	6	100	Cast iron
P-1343	986	8	115	Cast iron
P-1344	719	6	100	Cast iron
P-1345	402	6	100	Cast iron
P-1346	491	6	100	Asbestos Cement
P-1347	363	6	100	Asbestos Cement
P-1348	395	6	100	Cast iron
P-1349	356	6	100	Asbestos Cement
P-1350	257	6	100	Asbestos Cement
P-1351	116	6	100	Cast iron
P-1352	242	12	140	Cast iron
P-1353	366	12	140	Cast iron
P-1354	145	8	130	Cast iron
P-1355	725	8	130	Cast iron
P-1356	564	8	130	Cast iron
P-1357	167	20	130	Cast iron
P-1358	429	12	130	Asbestos Cement
P-1359	386	12	130	Asbestos Cement
P-1361	218	12	130	Ductile Iron
P-1362	1148	12	130	Ductile Iron
P-1363	431	8	115	Cast iron
P-1364	1552	8	115	Cast iron
P-1365	821	8	150	Cast iron
P-1366	1065	8	150	Cast iron
P-1367	315	6	100	Asbestos Cement
P-1368	376	6	100	Asbestos Cement

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1369	333	8	115	Cast iron
P-1370	612	8	115	Cast iron
P-1371	911	8	110	Ductile Iron
P-1372	985	12	130	Cast iron
P-1373	561	8	110	Ductile Iron
P-1374	3396	8	110	Ductile Iron
P-1375	1743	8	115	Asbestos Cement
P-1376	411	8	115	Asbestos Cement
P-1377	817	8	115	Cast iron
P-1378	735	8	115	Cast iron
P-1379	747	8	115	Cast iron
P-1380	355	8	115	Cast iron
P-1381	204	8	115	Ductile Iron
P-1382	2548	8	115	Ductile Iron
P-1383	1300	12	130	Cast iron
P-1384	261	12	130	Cast iron
P-1385	1502	12	130	Cast iron
P-1386	371	12	130	Cast iron
P-1387	398	6	90	Cast iron
P-1388	446	6	90	Cast iron
P-1389	832	8	115	Cast iron
P-1390	318	8	115	Cast iron
P-1391	163	12	130	Cast iron
P-1392	626	12	130	Cast iron
P-1393	894	12	130	Cast iron
P-1394	136	12	130	Cast iron
P-1395	377	12	130	Cast iron
P-1396	89	12	130	Cast iron
P-1397	140	12	130	Cast iron
P-1398	312	8	130	Cast iron
P-1399	204	8	130	Cast iron
P-1400	620	8	120	Asbestos Cement
P-1401	250	8	120	Asbestos Cement
P-1402	737	8	115	Asbestos Cement
P-1403	751	8	115	Asbestos Cement
P-1404	257	12	120	Cast iron
P-1405	436	12	120	Cast iron
P-1406	530	12	130	Cast iron
P-1407	876	12	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
P-1408	2768	6	100	Cast iron
P-1409	398	6	100	Cast iron
P-1410	333	8	115	Cast iron
P-1411	401	8	115	Cast iron
P-1412	188	8	115	Cast iron
P-1413	168	8	115	Cast iron
P-1414	618	8	150	Cast iron
P-1415	698	8	150	Cast iron
P-1416	100	16	130	Cast iron
P-1417	1636	24	130	Ductile Iron
P-1418	1593	24	130	Ductile Iron
P-1418 (Proposed)	2300	12	120	Cast iron
P-1419	132	8	130	Asbestos Cement
P-1419 (Proposed Main)	400	6	115	Cast iron
P-1419 (Proposed)	350	6	115	Cast iron
P-1420	263	6	110	Cast iron
P-1421	1074	8	130	Asbestos Cement
P-1422	524	6	110	Cast iron
P-1424	94	12	130	Ductile Iron
P-1425	302	8	130	Cast iron
P-1427	92	12	130	Ductile Iron
P-1428	330	8	130	Cast iron
P-1429	294	12	130	Ductile Iron
P-1430	68	12	130	Ductile Iron
P-1431	198	8	130	Cast iron
Pilgrim Rd	326	6	100	Asbestos Cement
Pioneer Rd	1259	6	100	Asbestos Cement
Pioneer Road	1191	8	115	Cast iron
Prospect St	1608	8	100	Cast iron
Puritan Rd	349	6	100	Asbestos Cement
Richards Rd	371	8	115	Cast iron
Rockland Street	1210	12	130	Cast iron
Rockwood Rd	1922	8	110	Asbestos Cement
Sentinel Rd	1198	8	115	Ductile Iron
Short Street	471	20	130	Cast iron
South Pleasant St	1722	24	130	Ductile Iron
South Street	858	8	115	Asbestos Cement
Summer St	579	6	100	Cast iron
Summer Street	652	12	130	Cast iron

Appendix C
Hydraulic Input Data
Pipes

Label	Length (ft)	Diameter (in)	Hazen- Williams C	Material
Surry Dr	3371	8	115	Cast iron
Union St	788	8	115	Cast iron
Union Street	458	20	130	Ductile Iron
Upland Dr	1237	8	115	Cast iron
Wanders Dr	2483	8	115	Cast iron
Ward St	853	12	130	Cast iron
Whiting Street	1575	12	120	Ductile Iron
Winthrop Rd	2175	8	110	Asbestos Cement

Appendix C
Hydraulic Input Data
Pumps

Label	Elevation (ft)	Intake Pump Grade (ft)	Discharge Pump Grade (ft)
Downing St Pump	20	18.25	244.54
Main Pump 1	112	118.00	411.33
Main Pump 2	112	117.71	247.96
HULL BPS	8.1	218.14	218.13
High Pump 2	112	117.91	324.80
High Pump 1	112	117.17	325.20

Appendix C
Hydraulic Input Data
Tanks

Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial HGL (ft)	Maximum Elevation (ft)	Diameter (ft)	Calculated Hydraulic Grade (ft)	Calculated Level (ft)
Turkey Hill StandPipe	170.00	170.00	232.70	240.00	70	232.7	89.6
Strawberry Hill Tank	103.00	147.00	184.00	186.00	50	184	94.9
Accord Tank	172.00	253.00	270.00	282.00	58	270	58.6


N
Legend
Priority I Improvement
Priority II Improvement
Service Area Boundary
Water Main Diameter
2-Inch
6-Inch
8-Inch
10-Inch
12-Inch
14-Inch
16-Inch
20-Inch
24-Inch
1. Scotland Street Well Improvements
2. Free Street Well No. 2 Improvements
3. Fulling Mill Station Improvements
4. Free Street No. 4 and Free Street No. 2 Switch
5. Long Term Feasibility Report
Hull Booster Pump Station
8. Beach Avenue New 12" Water Main
7. Hull Booster Pump Station Upgrades
6. Dismantle Strawberry Hill Tank
Strawberry Hill Tank Capacity: 0.51 mg Overflow Elevation: 186 feet
Atlantic Ocean
16. Hampton Circle, Eastern Avenue and Fairmont Way New 8" Water Main
15. Rockway Avenue, Wyola Road and Delawanda Road New 8" Water Main
4. Electric Avenue New 8" Water Main
10a. Atlantic Avenue New 12" Water Main
10b. Summit Avenue New 8" Water Main
8. Dighton Street New 8" Water Main
9. Howe Road New 8" Water Main
12. Washington Boulevard New 12" Water Main
HULL
17. Downer Street New 8" Water Main
5. Simmons Road New 8" Water Main
7. Summit Drive and Harbor View Drive New 8" Water Main
10. Spruce Street New 8" Water Main
9. Beal Street New 12" Water Main
Turkey Hill Standpipe Capacity: 2.0 mg Overflow Elevation: 240 feet
13. East Gate Lane New 12" Water Main
Downing Street Well
1. Rockwood Road and Ledgewood Circle New 8" Water Main
6. Smith Road and Hobart Street New 8" Water Main
14. Pleasant Street New 8" Water Main
HINGHAM
COHASSET
Free Street Well No. 2
11. Carleton Road New 6" Water Main
Free Street Well No. 4
Free Street Well No. 3
Free Street Well No. 5
2. Grist Mill Lane, Howland Lane, and Whitcomb Avenue New 8" Water Main
3. Nutty Hill Road and Whitehorse Road New 8" Water Main
Fulling Mill Well
Main Service Area
High Service Area
Hingham/Hull District Water Treatment Facility Capacity: 7.7 mgd
Prospect Street Well
SCITUATE
Main Service Area
High Service Area
Scotland Street Well
NORWELL
11. Keith Way and Recreation Park Drive New 16" Water Main
18. Pine Grove Road and Main Street New 12" Water Main
Accord Tank Capacity: 0.75 mg Overflow Elevation: 282 feet
Recommended Improvements
Hingham/Hull, Massachusetts
Aquarion Water Company
Approximate Scale: 1" = 1,500'
Tata & Howard, Inc.
Westborough, MA
April 2007