Water System Master Plan

Town of Hanson, Massachusetts

February 2018

Environmental Partners GROUP
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REPORT

Water System Master Plan

Town of Hanson

Hanson, Massachusetts

February 13, 2018

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ACKNOWLEDGMENTS

Environmental Partners Group, Inc. would like to express our appreciation to the Hanson Water Department and Water Commissioners who assisted in the preparation of this report. We wish to especially thank Mr. Richard Muncey, the Town of Hanson's Water Superintendent, and his staff for their cooperation and assistance.

EXECUTIVE SUMMARY

Environmental Partners Group was selected by the Town of Hanson Water Department to complete a *Water System Master Plan and Hydraulic Model Update.* The assessment consisted of:

- A description of the water system
- An evaluation of the Town's current and future water demand
- An assessment of the water supply and pumping capacity and its ability to meet current and future demands
- An assessment of the water distribution storage and its ability to meet current and future demands and fire requirements
- An update to the hydraulic model and an assessment of the water distribution hydraulics
- Recommendations for water supply, storage, and distribution facilities improvements
- Preparation of a Capital Improvement Program
- A water system financing review, including a water rate study, potential future Massachusetts Department of Environmental Protection (MassDEP) mandates, and rate adjustment recommendation

A summary of the findings, conclusions, and recommendations of the Water System Master Plan are provided below:

Existing Water System

The Town of Hanson, Massachusetts is located in Plymouth County about eighteen miles south-southeast of Boston. The existing water system currently serves approximately 94 percent of the Town (approximately 9,327 people) though 3,248 service connections, all of which are metered. The Town has 0.78 Million Gallons per Day (MGD) in registered and permitted withdrawals under their Water Management Act Permit (WMA). The current permit was originally set to expire February 28, 2010, but was extended during the development and promulgation of amendments to the WMA, which are known as the Sustainable Water Management Initiative (SWMI). Hanson's permit renewal is anticipated for December 31, 2021 and will include new requirements of SWMI. The Town's water system is supplied from four groundwater wells in the Crystal Springs Wellfield and supplemented by water purchased through an interconnection with the City of Brockton. Raw water from each well is treated before distribution. Treatment includes the addition of sodium hydroxide for corrosion control and sodium hypochlorite for disinfection. Water distribution storage is provided by one tank with a total capacity of 1.0 million gallons. Hanson's water distribution system consists of approximately 71 miles of pipe, ranging in diameter from 1-inch through 16-inch.

Water Demand

The existing average-day demand is 0.61MGD, and the maximum-day demand is 0.94 MGD. Historically, approximately 1% or less of water is purchased from the City of Brockton. In 2016, 37% was purchased due to water storage tank maintenance that took the tank off line for an extended period. Water demand projections anticipate an average-day water demand of 0.71 MGD and a maximum-day water demand of 1.10 MGD by the year 2035. Residential water use accounts for approximately 90.4% of metered sales, and the average residential water use is 50 residential gallons per capita per day. Prior to 2013, the system's average unaccounted for water was 15.5%, however since that time unaccounted for water has progressively decreased to 10.9% in 2016.

Water Supply Requirements

The Town's registered and permitted withdrawal volumes allowed under its current Water Management Act Permit are sufficient to meet current and future demands. Under SWMI, if a water system anticipates that they are going to exceed their baseline withdrawal volume, 0.72 MGD, the Town will be required to develop a mitigation plan. Future demands in Hanson will approach this baseline withdrawal volumes by 2035 based on projections developed as part of this update to the Water Master Plan and as described in this report. The specific conditions associated with the WMA permit renewal will be based on a water needs forecast developed by Massachusetts Department of Conservation and Recreation (MassDCR), which is not yet available for Hanson. DEP reports that the WMA permit renewal for Hanson is not expected to be issued until sometime before December 31, 2021.

The capacity of Hanson's water supply to meet current and future demand was evaluated with the largest of the four wells offline. The pumping capacity of the three remaining wells was determined to be 0.82 MGD and is adequate to meet current and future average daily demand and summer average daily demand, but is not adequate to meet the estimated future maximum-day demand of 1.10 MGD in 2035. A feasibility study for an additional water source and a tank siting alternatives analysis are recommended, which the Town is currently evaluating with respect to an additional water source.

Water quality test results from 2012 through 2017 indicate elevated levels of manganese greater than the 0.05 mg/L secondary maximum contaminant level. A water quality study to evaluate sequestering or filtration as an approach to improving water quality is recommended.

Distribution System Assessment

The ability of the water storage tank to meet demand and fire protection volumes while also maintaining a minimum residual pressure of 20 psi to all customers was evaluated. The Town is responsible for providing 3,500 GPM fire flow for three hours. Hanson's current useable water storage is 1.0 million gallons. Without water supplied from the wells, there is a current storage deficit of over 50,000 gallons, which is anticipated to increase to over 120,000 gallons by 2035. With water supplied from the wells during the fire event, a deficit of over 5,000 gallons and over 20,000 gallons is expected by 2030 and 2035, respectively. Additional storage or the development of an additional source is recommended.

A hydraulic model of the Town's water system was updated to evaluate the ability of the distribution system to provide adequate service pressures to all areas of the distribution system. The model results conclude that the water system is capable of providing a service pressure above 35 psi under normal and maximum-day demand conditions. The model was also used to evaluate the availability of fire flows during the projected maximum-day demand periods. Areas with 6- and 8-inch mains, which comprise a large portion of the system, were specifically evaluated out of concern for the condition and carrying capacity of these mains. In many cases, the mains were well networked and the effect of their limited carrying capacity is minimized. However, several locations with fire flow deficiencies were identified in Hanson's existing network of distribution piping including at the Monponsett area, Oldham Pond area (North and South) and East Washington Street (near the Pembroke town line). Additionally, areas with mains having a diameter smaller than 6-inches do not have hydrants and are therefore considered to be fire flow deficient.

The hydraulic model was also used to evaluate pipe discontinuity. In general all of the supply sources and the water storage tank should be connected to the distribution system by large transmission mains, providing an efficient means for supply water to enter the system. Three locations where transmission main discontinuities exist were identified and are the basis of some of the recommended water system improvements.

Recommended Improvements

Improvements to the existing water distribution system were identified to correct current deficiencies, and include a tank siting alternatives analysis to be completed concurrently with new source exploration underway, an update to the Town's unidirectional flushing program, a water quality study of sequestering to manage manganese or if filtration is required, and the installation of approximately 12 miles of new 12-inch and 8-inch water mains to improve system pressures and to eliminate discontinuities.

In order to prioritize the improvements a 20-year capital improvements plan was developed, and it is recommended that they be implemented in five phases. Phase I improvements address immediate water distribution system issues, such as deficiencies in water pressure or fire flow availability, and should be implemented in the next five years (Years 1 – 5). Phase II improvements are intended to prepare the water system for the near future, ensuring its ability to meet projected demands and future fire flow requirements and should be implemented in Years 6 – 10. Phase III improvements, while not immediately critical, are intended to reinforce the water system and improve its overall performance and reliability. Phase III improvements should be implemented in Years 11 - 15. Additional improvements in Phase IV and Phase V, which should be done when funding allows over the next 20 years, include replacing vinyl-lined asbestos cement (VLAC) pipe and pipes 2-inches and smaller in diameter. The phased improvements are summarized in Table E.1.

TABLE E. 1
RECOMMENDED IMPROVEMENTS

	Recommended Improvement Description
Phase I Improvements	Tank siting alternatives analysis (concurrent with new source feasibility study) Install 0.5 million gallon elevated water storage tank Update Unidirectional Flushing Program Water quality study for manganese Install 1,550’ of 12” main Install 15,100’ of 8” main Install 1,160’ of 6” main
Phase II Improvements	Install 14,850’ of 12” main
Phase III Improvements	Install 4,900’ of 12” main Install 13,900’ of 8” main
Phase IV Improvements	Replace 70,300’ of vinyl lined asbestos cement (VLAC) pipes
Phase V Improvements	Replace 5,028’ of pipe less than or equal to 2”

Opinions of Probable Project Costs for Recommended Improvements

Environmental Partners opinions of probable project costs were established for each phase of the recommended improvements. The costs are summarized in Table E.2 in terms of 2018 dollars.

TABLE E. 2
ESTIMATED CAPITAL COST SUMMARY

	CAPITAL COST
Phase I Improvements	$7,316,750
Phase II Improvements	$3,341,250
Phase III Improvements	$4,021,500
Phase IV Improvements	$15,286,890
Phase V Improvements	$1,055,880
Total Cost	**$31,022,270**

Water System Financing

MassDEP requires water systems to cover all expenditures, including operation and maintenance costs, capital projects, and debt service with revenue from water sales. Hanson's annual revenue is derived from the sale of water. It is anticipated that projected revenue will fail to cover projected expenditures with the recommended capital improvements through FY 2020. Therefore, an adjustment to the current water rate structure is recommended. Since the Phase I recommended improvements include a tank siting alternatives analysis to be completed concurrently with a new source feasibility study, rate adjustments were made for $3 million, $2 million and $1 million in capital improvements, bonded for 20 years at three percent interest, over the next three years to allow for flexibility in study outcomes. Additional annual expenses were added to each capital improvement scenario to account for engineering services, equipment replacements and other expenses. All three proposed rate structures for water sales are shown below in Table E.3.

TABLE E.3
PROPOSED SEMI-ANNUAL BILLING WATER RATE STRUCTURE

Category	Existing Usage (cubic feet)	Existing Rate	Rate for $3 million in capital projects	Rate for $2 million in capital projects	Rate for $1 million in capital projects
1st Step	0 to 1,500	$104.50	$141.00	$124.30	$104.50
2nd Step	1,500 to 2,500	$5.21 per 100 C.F.	$7.03 per 100 C.F.	$6.20 per 100 C.F.	$5.47 per 100 C.F.
3rd Step	2,500 to 5,000	$6.24 per 100 C.F.	$8.42 per 100 C.F.	$7.43 per 100 C.F.	$6.55 per 100 C.F.
4th Step	Over 5,000	$8.19 per 100 C.F.	$11.06 per 100 C.F.	$9.75 per 100 C.F.	$8.60 per 100 C.F.

The proposed rate structure represents an increase in water rates of approximately 35%, 19% and 3% for $3 million, $2 million and $1 million in capital projects over the next three years, respectively, compared to the existing rate structure.

The net revenue from the proposed rate structure represents an annual margin of savings of approximately 2 to 5 percent over the next three year period. This net savings may be utilized to cover unforeseen expenses or applied toward completing additional recommended improvements in future years. Hanson may also be able to apply revenues earned from water and fire service charges, system connection fees, etc. to further offset the debt the recommend improvements would incur.

1. INTRODUCTION

1.1 PURPOSE

The purpose of this Water System Master Plan is to evaluate the Town of Hanson's water system including water supply, treatment, demand, storage and distribution. As part of this planning, recommendations for each of these components of the water sytem are proposed through the year 2035.

1.2 SCOPE OF WORK

The scope of work that was performed for this update to the Water Master Plan consists of the following:

Task 1: Description of the Water System

Preparation of a description of the water system infrastructure including water supply sources, distribution piping, water storage tank and well pumping stations. The capacity, engineering design and operation statistics, age, status and general condition of the water system infrastructure was documented.

Task 2: Evaluation of Supply and Demand

Developed water demand projections and requirements through the year 2035 using US Census data, available population projections, and the most recent water needs forecast completed by the Massachusetts Department of Conservation and Recreation (MassDCR). Identified water use by category and determine the historic and projected residential per capita water use. Projected future average-day and maximum-day demands. Evaluated the adequacy of the Town's existing sources to meet existing and future projected demands.

Task 3: Assessment of Water Distribution Storage

Assessed the Town's existing water storage facility with respect to its ability to provide suitable storage volumes and pressures for existing and future water demand and fire flow needs.

Task 4: Update Water System Hydraulic Model

Updated the existing hydraulic model to include upgrades and changes to the distribution system since the previous update to the model. Collected and evaluated historic flow test data, including data from the Fire Department, Insurance Services Office (ISO), previous reports, and the Water Department records. Performed hydrant fire flow tests at a minimum of eight hydrant locations, where the location of these flow tests were selected using past records of ISO testing results and an assessment of the distribution system material, age, and size. Collect general system and operational data including customer consumption information, GIS database information, water

pumping records, storage tank levels, and distribution pressure records. The model was calibrated using field test data and support documentation collected.

Task 5: Assessment of Water Distribution Hydraulics

Analyzed the distribution system using the hydraulic model by simulating existing and future supply and demand conditions as well as fire flow requirements to determine deficient areas within the distribution network. The model was used to identify deficiencies by calculating static and residual pressures, headloss, velocity and flow throughout the distribution system. Determined the need and priority for reinforcement, looping, replacement and extension of distribution system water mains to address any deficiencies and performance limiting factors that were identified.

Task 6: Recommended Improvements to Water Supply, Storage, and Distribution Facilities

A listing of recommended improvements for addressing the system deficiencies was developed, and a plan the showing recommended improvements was prepared.

Task 7: Capital Improvement Plan

A capital cost estimate for all of the recommended improvements was prepared. After reviewing these improvements with the Water Department, they were prioritized according to their level of importance (public health and safety, water quality, etc.). A recommended program for their phased implementation over a twenty year period was also developed.

Task 8: Water System Financing

Evaluated the Town's water rate structure and tiered billing system and performed a rate study. Evaluated the costs associated with potential Massachusetts Department of Environmental Protection (MassDEP) mandated water use restrictions and the water revenue requirements for maintaining compliance with these DEP programs. Recommended a rate adjustment that is estimated to be appropriate for funding proposed water system improvements.

Task 9: Master Plan Report

Prepared a draft report for the Town's review and comment. This report includes an executive summary, detailed chapters on each of the tasks outlined above, tables of any data used to support the conclusions and recommendations of the study, and a printed map of the water distribution system showing the recommended improvements highlighted in color. Environmental Partners met with the Town to review the draft report, and worked closely with the Town on the accuracy of the report and validity of recommendations and conclusions before producing the final report.

2. WATER SYSTEM OVERVIEW

2.1 GENERAL

This chapter provides a brief description of the Town and an overview of the existing water system, including distribution system piping and storage facilities. A map of the Hanson water system is presented in Figure 2-1.

2.2 TOWN DESCRIPTION

The Town of Hanson, Massachusetts is located in Plymouth County and is considered one of the inland towns of Massachusetts's South Shore. The town is bordered by Rockland and Hanover to the north, Pembroke to the east, Halifax to the south, East Bridgewater to the west, and Whitman to the northwest. Hanson is located approximately nine miles east of Brockton and eighteen miles south-southeast of Boston. The Town of Hanson is predominantly a residential community with small commercial properties, light industry, and farming (including cranberry farming.)

Hanson has a total land area of approximately 16.1 square miles. As reported in the 2016 Annual Statistical Report, there were 9,327 people served with public water for consumption and fire protection from Hanson's water system.

2.3 WATER SUPPLY

The Hanson Water Department was created in 1916 by an act of the State Legislature. Prior to the development of its own source of water in the early 1980s the Hanson Water Department purchased all of its water from the City of Brockton and the Abington/Rockland Joint Waterworks. Currently, Hanson continues to maintain interconnections with the Brockton and the Abington/Rockland water systems. Hanson operates four wells at their Crystal Spring Wellfield. The wellfield is located in the Poor Meadow Brook subbasin, tributary to the Satucket River in the Taunton River basin. It is in the western edge of the Town just east of Route 27 at the southern end of the Hanson Commerce Park. A water supply inventory is summarized in Table 2-1. A listing of detailed well characteristics is presented in Table 2-2.

FIGURE 2-1: EXISTING SYSTEM MAP

TOWN OF WHITMAN INTERCONNECTION

TOWN OF ROCKLAND

TOWN OF HANOVER INTERCONNECTION

ABINGTON/ROCKLAND INTERCONNECTION

ABINGTON/ROCKLAND INTERCONNECTION

ABINGTON/ROCKLAND INTERCONNECTION

HIGH STREET ELEVATED TANK - 1.0 MG OVERFLOW ELEV = 278'

CRYSTAL SPRINGS WELL FIELD

CITY OF BROCKTON INTERCONNECTION

CITY OF BROCKTON INTERCONNECTION

CITY OF BROCKTON INTERCONNECTION

TOWN OF HALIFAX INTERCONNECTION

TOWN OF HALIFAX INTERCONNECTION

TOWN OF WHITMAN

TOWN OF EAST BRIDGEWATER

TOWN OF PEMBROKE

TOWN OF HALIFAX

TOWN OF HALIFAX

FACTORY POND

LITTLE CEDAR SWAMP

CUSHINGS MILL POND

WAMPATUCK POND

MAQUAN POND

OLDHAM POND

INDIAN HEAD POND

GREAT CEDAR SWAMP

BURRAGE POND

OCEAN AVENUE BLEEDER

LEGEND

- HANSON WATER MAINS
- <=4"
- = 6"
- = 8"
- = 10"
- = 12"
- 2010-2017 MAIN REPLACEMENT
- 16" ABINGTON/ROCKLAND MAIN
- 24" BROCKTON MAIN

ELEVATIONS ARE IN USGS VERTICAL DATUM 1929

GRAPHIC SCALE

1000 0 1000 2000 3000

FIGURE 2-1

EXISTING SYSTEM MAP

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WATER SYSTEM MASTER PLAN
HANSON, MASSACHUSETTS
OCTOBER 2017

TOWN OF HANSON INCORPORATED 1820. MASSACHUSETTS

I:\Hanson.160\01 Water System\160-1604 Water System Master Plan Update & Model\Report\Figures\MP FIGURE 2-1 v.3.dwg

TABLE 2-1
WATER SUPPLY INVENTORY

Source	Source Type	Basin	Maximum Approved Daily Pumping Rate (MGD)
Well #1	Groundwater	Taunton River	0.500
Well #3	Groundwater	Taunton River	0.288
Well #4	Groundwater	Taunton River	0.288
Well #5	Groundwater	Taunton River	0.288
City of Brockton	Purchased Surface water	Taunton River, South Coastal	-

TABLE 2-2
WELL CHARACTERISTICS

Description	Type	Casing Diameter (ft)	Well Depth (ft)	Screen Length (ft)	Pump Column Diameter (in)	Rated Capacity (GPM)
Well #1	Gravel Packed	10	54	12.5	6	350
Well #3	Gravel Packed	10	54.6	12	3	200
Well #4	Gravel Packed	10	49.45	10	3	200
Well #5	Gravel Packed	10	49.45	10	3	200

Each well in Hanson was inspected in 2015 and 2016. Data from Wells #1, #3, #4, and #5 was tabulated in pump performance test reports dated April 9, 2015 and January 15, 2016. Table 2-3 summarizes the performance of the Town's wells. During the 2016 performance testing, the pumps at Well #1 and Well #5 tested at 35% and 16%, respectively, below the design curve and likely due to VFD (variable speed drive) operational issues. The pump at Well #4 tested 17% below the design curve, possibly due to wear or plugging in the bowl. All wells have been cleaned twice since 2008. Most recently, Wells #3 and #5 were cleaned in 2015. All wells are currently in good condition. All pumps and motors were replaced twice since 2008. Wells #3, #4, and #5 have a generator for emergency power supply, and Hanson is in the process of getting a generator for Well #1.

TABLE 2-3
WELL PERFORMANCE SUMMARY 2016

Description	Test Year	Flow Rate (GPM)	Specific Capacity (GPM/ft)	Well Performance (% from Start-up)	Pump Performance (% from Design Curve)
Well #1	2015	348	30.0	9.89%	-6.12%
	2016	354	30.57	11.98%	-35.23%
Well #3	2015 (post cleaning)	198	19.04	11.61%	-8.68%
	2016	200	21.10	0.32%	-8.26%
Well #4	2015	204	12.27	--	-21.31%
	2016	213	13.04	6.28%	-16.87%
Well #5	2015 (post cleaning)	170	12.64	24.29%	-7.79%
	2016	179	12.83	1.5%	-16.03%

The Hanson water system has interconnections with several neighboring towns including Abington/Rockland and Brockton. Three interconnections with Abington/Rockland have never been used. There are currently seven interconnections with Brockton along Route 27 Main St. An interconnection at Route 27 Main Street and Crooker Place was removed. Hanson purchases water during times of high demand from the City of Brockton using the interconnection located at Route 27 Main Street and Franklin Street. Table 2-4 summarizes the portion of Hanson's water use supplied by the City of Brockton each year from 2012 to 2016. In 2012 to 2015, Hanson purchased less than 2% of their water and in 2016, Hanson purchased 37.3%. The large portion of water supply purchased in 2016 from Brockton was due to storage tank maintenance described in Section 2.5.

TABLE 2-4
WATER SUPPLIED FROM BROCKTON INTERCONNECTION

Year	Percent Water Supplied from Interconnection
2012	<1%
2013	1.4%
2014[1]	0 %
2015[1]	0 %
2016	37.3%

Note: [1]No water was purchased from Brockton during these years

2.4 WATER QUALITY AND TREATMENT

The Town of Hanson operates one chemical addition facility for all four wells. Raw water is treated prior to entering the distribution system. The raw water is treated for corrosion control using sodium hydroxide to raise the pH. Additionally, raw water is disinfected with sodium hypochlorite. The Town has reported that when all four wells are running simultaneously, the effluent is discolored – typically a light brown "tea" color. To prevent this from occurring, the Town limits production at the site and during these periods the Town must purchase water from Brockton in order to meet the system demands.

2.5 WATER DISTRIBUTION STORAGE

Storage for the Hanson water system consists of a one (1) MG elevated steel spheroid tank and known as the High Street Tank. An assessment of Hanson's water storage requirements is presented in Section 5.2 of this report.

The size, capacity, and overflow of the High Street tank is summarized in Table 2-5. It was constructed in 1989, and is surrounded by a chain link fence with access provided by secured gate located off of High Street.

TABLE 2-5
WATER STORAGE SUMMARY

Identification	Bowl Height (ft)	Bowl Diameter (ft)	Overflow Elevation[1] (ft)	Storage Volume (MG)
High Street Tank	40	30	278	1.0

Note: [1] Elevations are in USGS vertical datum 1929.

In 2016 the tank was taken offline for rehabilitation and repainting. The project commenced in early March 2016 and was completed at the end of July 2016. The town was supplied with water exclusively from the City of Brockton while the tank was offline. The switch to water from the City of Brockton resulted in reverse water flow in some areas of the distribution system and discolored water at some customer taps. To prevent this from occurring in the future, it is recommended that Hanson review and update their unidirectional flushing program. MassDEP's Guidelines for Public Water Systems recommends that system-wide flushing be conducted annually as an effective and economical solution for removing sediments, non-solidified deposits, loose corrosion by-projects (tuberculation) and other debris from the distribution system.

2.6 WATER DISTRIBUTION PIPING

Hanson's water distribution system consists of approximately 71 miles of pipe, ranging in diameter from less than 2-inch through 16-inch. Several mains have been replaced since 2010. A list of water main replacements that have been made since 2010 is included in Table 2-6 and shown in Figure 2-1. A summary of the Hanson distribution system by pipe diameter and quantity is presented in Table 2-7. Pipe lengths 6-inches and larger in diameter are representative of the distribution pipe network that was modeled as part of the distribution system evaluation.

TABLE 2-6
WATER MAIN REPLACEMENTS 2010-2017

Year Installed	Street Name	Description	Pipe Size	Material
2011	King St	Hanover Line to East Washington St	8"	DI
2013	Woodbine Ave	Pleasant St to #499	8"	HDPE/DI
2013	Monponsett St	#92 to #154	10"	DI
2016	Monponsett St	#323 to #793	12"	DI
2017	Sandy Lane	Entire street	8"	DI
2017	Sandy Terrace	Entire street	8"	DI
2017	Crooker Place	Main St to #82	8"	DI

TABLE 2-7
WATER DISTRIBUTION PIPING BY DIAMETER

Pipe Diameter	Quantity (ft)	Percent of Total
2-inch or less	5,593	1.5%
6-inch	59,396	15.6%
8-inch	222,568	58.6%
10-inch	3,921	1.0%
12-inch	87,989	23.2%
16-inch	381	0.1%
Total	**374,255**	**100%**

The majority of the distribution piping (75.7%) is 8-inches and smaller in diameter, and the remainder (24.3%) is 10-inches and larger. The majority of the Town's distribution system piping consists of asbestos cement pipe that was installed from the 1950's through the 1970's. An approximate breakdown of the distribution system piping materials is presented in Table 2-8.

TABLE 2-8
WATER DISTRIBUTION PIPING BY MATERIAL

Pipe Material	Quantity (ft)	Percent of Total
Cast Iron	51,764	15.1%
Polyvinyl Chloride (PVC)	25,784	6.8%
Ductile Iron (DI)	100,438	26.4%
Asbestos Cement (AC)	125,959	33.2%
Vinyl-Lined Asbestos Cement (VLAC)	70,300	18.5%
Total	**374,245**	**100%**

2.7 WATER SYSTEM PRESSURES

Static water pressure refers to the pressure in a main when there is no water flowing. Recommended static water pressures for consumer use in public water supply systems range from a minimum of 35 pounds per square inch (psi) to a maximum of 100 psi (DEP Guidelines and Policies for Public Water Systems). Normal working pressures are typically in the range of 60 psi to 80 psi. Pressures greater than 100 psi can result in increased leakage throughout the distribution system and rapid discharge of water from household plumbing fixtures.

Residual water pressure refers to the available water pressure when a pipe is flowing. Residual pressure is measured as the drop in static pressure when water is withdrawn from a main during a flow test. Required fire flows from hydrants are normally expressed at a residual pressure of 20 psi, which allows for friction losses in the hydrant branch, barrel, and suction hose to the fire engine pump.

Static pressures within Hanson's water distribution system were measured in a field testing program in November 2017. Fire flow testing data is provided in Appendix A. Static and residual pressures were measured at eight locations in the town and are summarized in Table 2-9. Both static and residual pressures throughout the town meet Mass DEP guidelines.

TABLE 2-9
REPRESENTATIVE STATIC AND RESIDUAL PRESSURES

Location	Static Pressure (psi)	Residual Pressure (psi)
Joshua Lane (#4)	90	53
Pleasant Street (#382)	86	83
Monponsett Street (south) (at Hancock Street)	90	56
Rosewood Drive (end of cul-de-sac)	79	68
Brook Street (across from #283)	90	80
East Washington Street (#988)	96	84
Captain Nathaniel Drive (#311)	79	75
Tag Way (#4)	64	50

3. WATER DEMAND REQUIREMENTS

Water demand is the volume of water that must be supplied by the water system to meet the residential, commercial, industrial, agricultural and other needs of all customers supplied by the system. Evaluation of the historical and current water demand as well as the projection of future water demands are critical for assessing the adequacy of water supply, distribution storage and distribution system pipe network to supply water under a range of expected conditions. The water system must supply adequate water during both normal and seasonally high conditions while also meeting fire flow requirements. This chapter assesses the Town's ability to meet existing and future water supply needs.

3.1 HISTORICAL AND PROJECTED POPULATION

Many factors influence water demand for a system including population served, economic activity, climate conditions and conservation efforts. As Hanson is predominately a residential town, population is an important indicator of water demand. Town populations are available from the US Census Bureau which completes a full population count every ten years. Historic populations since 1940 are summarized in Table 3-1 and displayed in Figure 3-1. The Town has experienced an increasing population trend since 1940, with the greatest increases occuring in the 1960s and 1970s. Since 1980, population growth has slowed but is still increasing. According to the US Census, the population of Hanson in 2015 was 10,372.

TABLE 3-1
HISTORICAL POPULATION FOR HANSON, MASSACHUSETTS

Year	US Census Population
1940	2,570
1950	3,264
1960	4,370
1970	7,148
1980	8,617
1990	9,028
2000	9,495
2010	10,209
2015	10,372

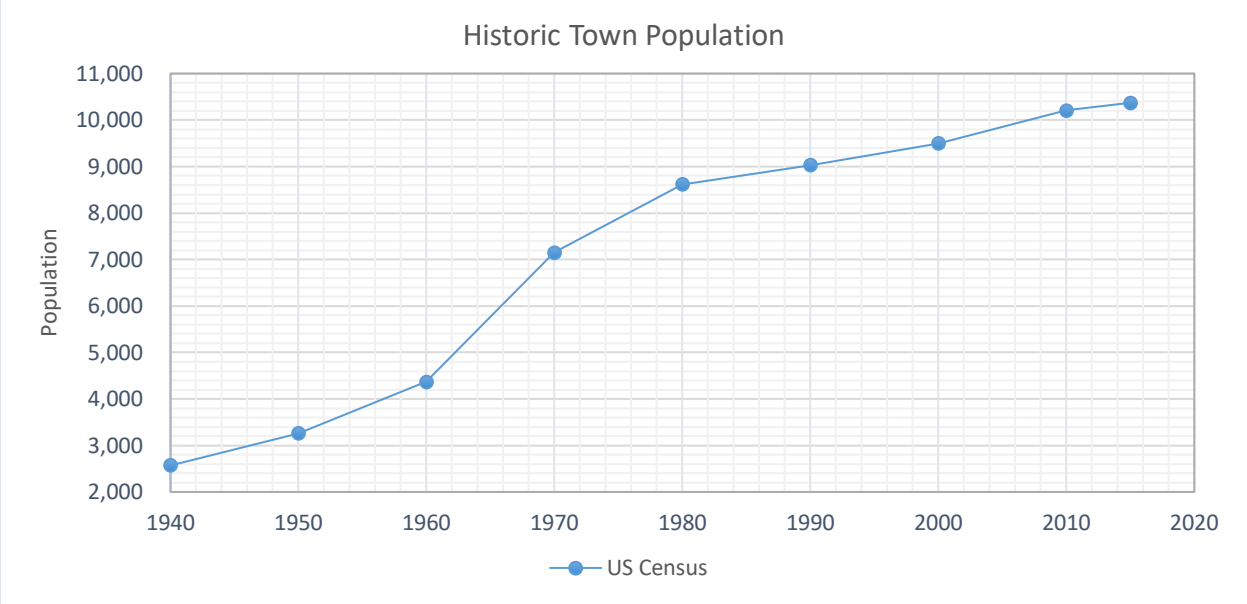


FIGURE 3-1: HISTORIC TOWN POPULATION

Projected population data for municipalities in Massachusets are available from several organizations: University of Massachusetts Donahue Institute, Massachusetts Department of Transportation, Metropolitan Area Planning Council, and Massachusetts Institue for Social and Economic Research. The historic and projected population trends are displayed in Figure 3-2.

The University of Massachusetts Donahue Institute (UMDI) is contracted by the Massachusetts Secretary of the Commonwealth to provide population projections for all muncipalities in the state. UMDI released updated projections in March 2015 for five-year intervals through 2035, refered to as the Vintage 2015 series. UMDI projections are based on town level fertility and mortality from the Massachusetts Department of Health, and regional, gross migration by age trends from the American Community Survey (ACS) data from 2005 to 2012. UMDI population projections are also available by sex and five-year age groups.

Massachusetts Department of Transportation (MassDOT) provides statewide forecasts for population, households and employment. MassDOT current projections extend to 2040. MassDOT works with state and regional agencies to develop these forecasts every few years.

The Metropoloitan Area Planning Council (MAPC) released updated projections in January 2014 for the Metro Boston region. Projections are based on 1990, 2000 and 2010 decennial census data, ACS data from 2005 to 2011, fertility and mortality information from the Massachusetts Community Health Information Profile (MassCHIP), housing production information from the Census Building Permit Survey database,

and the MAPC's Development Database. MAPC provides two projections: status quo and stronger region. The status quo projection considers continuation of the current birth, death, migration, and housing occupancy trends, while the stronger region projection predicts a more aggressive population growth due to changing trends.

The Massachusetts Institute for Social and Economic Research (MISER) released population projections for each Massachusetts municipality in 2003, based on the 2000 US Census. Population projections from MISER are not show in Figure 3-2 as other projections are based on the more recent 2010 US Census.

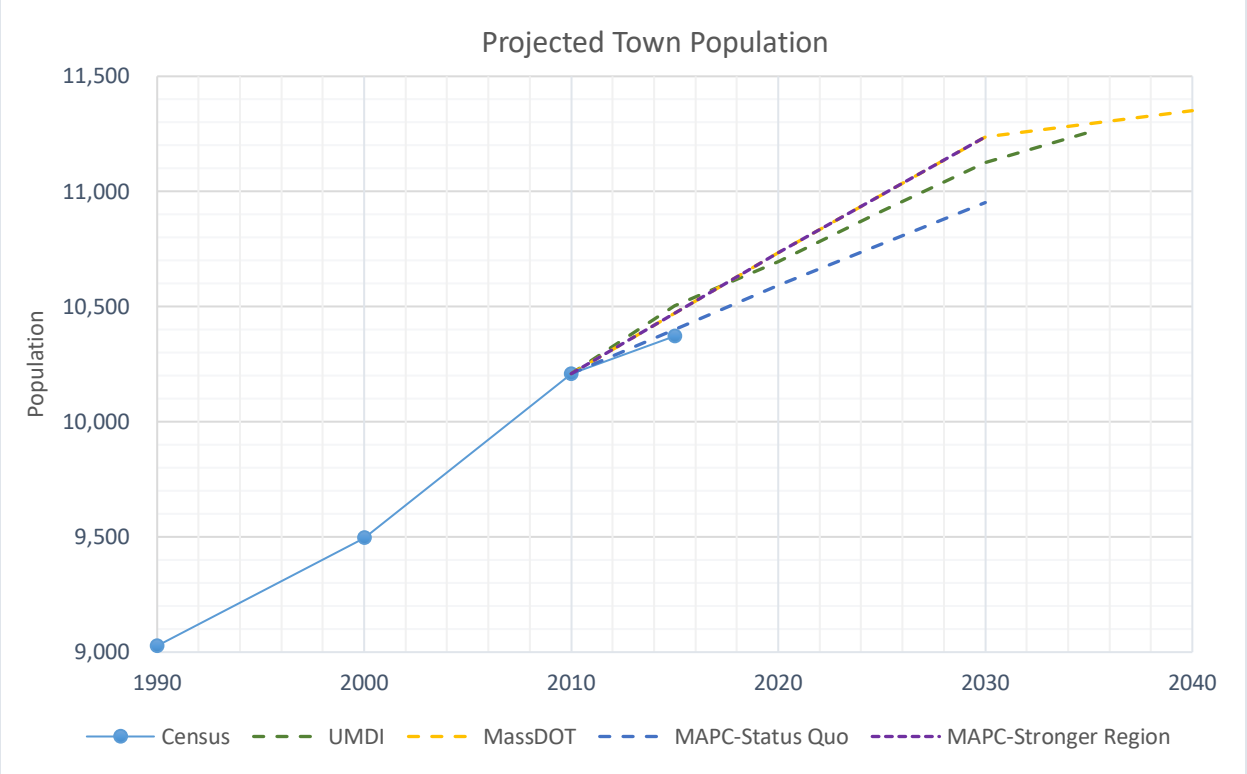


FIGURE 3-2: PROJECTED TOWN POPULATION

Population projections from UMDI were used to project the water demand for Hanson. These projections are more aggressive than the MAPC status quo projections, and more conservative than the MAPC stronger region and MassDOT projections. UMDI projections extend to 2035, the planning horizon for the Hanson Water Master Plan, and were updated in 2015. The projected population for Hanson through 2035 is provided in Table 3-2.

TABLE 3-2
PROJECTED POPULATION FOR HANSON, MASSACHUSETTS

Year	UMDI Projected Population[1]
2017	10,579
2018	10,618
2019	10,656
2020	10,694
2025	10,914
2030	11,126
2035	11,257

Note: [1]Population projections for 2017-2019 determined through interpolation

3.2 HISTORICAL WATER DEMAND

Finished water production data was compiled from the MassDEP Annual Statistical Reports. The most recent five years, 2012 to 2016, of water production data was used to calculate average-day demand and maximum-day demand.

3.2.1 Average-Day Demand

Average-day demand (ADD) is the average volume of water produced from all sources and pumped into the distribution system. ADD also includes any volume of water purchased from neighboring communities. Total water production and ADD for 2012 to 2016 are summarized in Table 3-3. The average water production for 2012 to 2016 was approximately 224 million gallons (MG) per year, or 0.614 million gallons per day (MGD).

TABLE 3-3
ANNUAL WATER CONSUMPTION AND DAILY DEMAND (2012 TO 2016)

Year	Total Water Production (MG)	Average Daily Demand (MGD)
2012	215.050	0.589
2013	221.840	0.608
2014	223.365	0.612
2015	232.322	0.636
2016	227.433	0.623
5-Year Average	**224.002**	**0.614**

3.2.2 Maximum-Day Demand

The maximum-day demand (MDD) is defined as the greatest 24-hour demand in a calendar year. The MDD is typically supplied by water available in water storage and pumping facilities, and is an essential characteristic in the evaluation of these system components. Since maximum-demand days often occur consecutively, it is important to also consider the capability of the water source to deliver the MDD. If the available yield from the water supply sources are less than the MDD, the water level in the storage tanks would drop, jeopardizing system pressures and emergency storage. MDD is typically expressed as a ratio of the average-day demand (i.e. Maximum-Day Demand ÷ Average-Day Demand).

The magnitude of the maximum-day to average-day demand ratio depends the characteristics of the individual community water system. A greater maximum-day demand ratio indicates greater seasonal fluctuation. Typically, the maximum-day demand ratio will be greater in residential communities with low population densities and minimal industry. Conversely, highly industrialized, densely populated communities experience a smaller maximum-day demand ratio as industries are generally large water consumers and are not subject to seasonal fluctuations. A summary of average-day, maximum-day, and demand ratios between the years 2012 and 2016 for the Town of Hanson is presented in Table 3-4. The five-year average maximum-day to average-day demand ratio is 1.54. This ratio will be used to project future MDD in Section 3.3.

TABLE 3-4
MAXIMUM-DAY DEMAND

Year	Average-Day Demand (MGD)	Maximum-Day Demand (MGD)	Ratio Max.-Day to Avg.-Day Demand
2012	0.589	0.950	1.61
2013	0.608	0.988	1.63
2014	0.612	0.936	1.53
2015	0.636	0.923	1.45
2016	0.623	0.916	1.47
5-Year Average	**0.614**	**0.943**	**1.54**

3.2.3 Peak Hour Demand

The peak hour demand is defined as the maximum volume of water used within a 60-minute period. The peak hour demand typically occurs in conjunction with the maximum-day demand. Because peak demands are short term and can be extremely variable, these demands are typically satisfied from distribution storage rather than from supply sources. Consequently, peak hour demand will be considered when determining the adequacy of Hanson's water distribution storage tank.

3.2.4 Residential and Non-Residential Water Consumption

MassDEP identifies seven water user categories: residential, residential institutions, commercial/business, agricultural, industrial, municipal/institution/non-profits and other. Water consumption in the Town of Hanson is over 90% residential. The remaining water consumption is municipal/institutional/non-profit (5%), commercial/business (4.1%), and industrial (0.5%). A summary of water consumption by category in 2016 is shown in Figure 3-3. Agricultural water consumption is less than 0.01% of total consumption and is not shown in Figure 3-3.

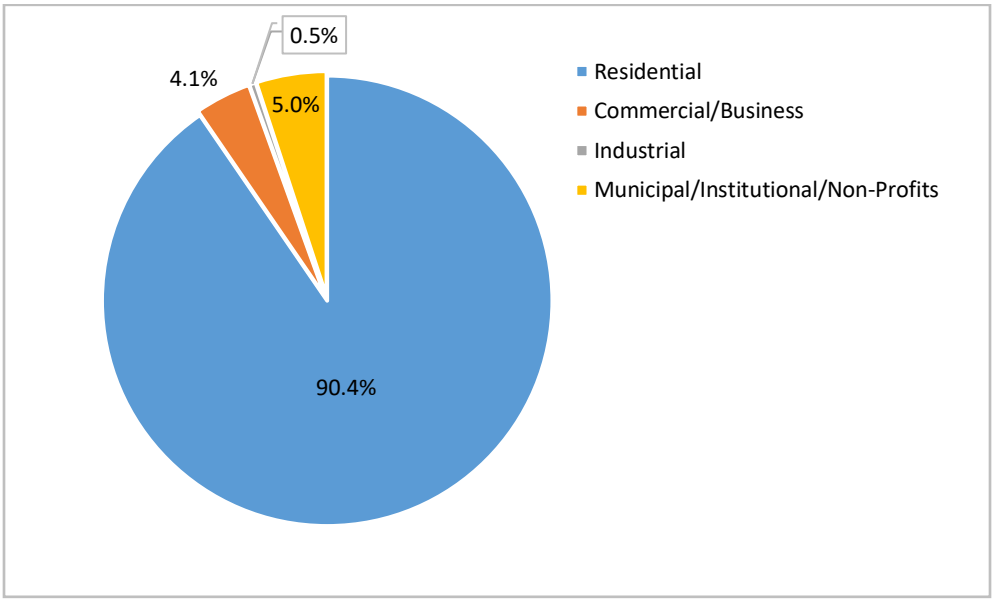


FIGURE 3-3: 2016 WATER CONSUMPTION BY DEMAND CATEGORY

Residential water use represents the greatest demand to the system. An average of 94% of the total town population is served by the system. From 2012 to 2016, average annual residential water use was 166.37 MG, or 89.6% of total water consumption in Hanson. Residential per capita water use is calculated as a measure of the average amount of water a resident uses per day. The Massachusetts Water Management Act (WMA) requires residential per capita water use to be less than 65 residential gallons per capital day (RGPCD). Hanson has a five-year historical average of 50 RGPCD, well below the WMA requirements. A summary of residential water use from 2012 to 2016 is included in Table 3-5. Figure 3-4 shows a consistent residential per capital water use in Hanson. The five-year average residential per capital water use of 50 RGPCD will be used to project future water demand in Section 3.3.

TABLE 3-5
RESIDENTIAL PER CAPITA WATER USE

Year	Residential Metered Water Sales (MG)	Percent Total Metered Water Sales	Residential Population Served	Residential Per Capita Water Use (RGPCD)
2012	160.98	92.4%	8,959	49
2013	156.28	88.4%	8,959	48
2014	162.24	88.9%	9,577	46
2015	174.87	88.1%	9,095	53
2016	177.48	90.4%	9,327	52
5-Year Average	**166.37**	**89.6%**		**50**

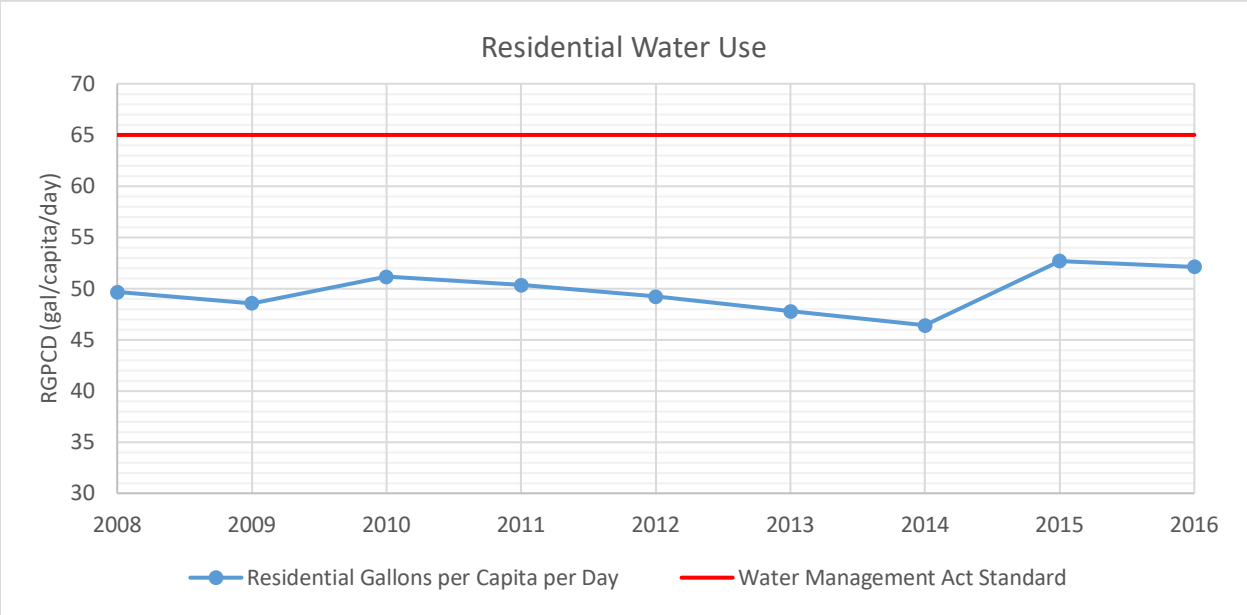


FIGURE 3-4: RESIDENTIAL WATER USE

Non-residential water demand represents less than 10% of water demand in the Town. Non-residential water use for 2012 to 21016 is summarized in Table 3-6. The five-year historical average annual non-residential water demand is 8.478 MG for commercial/business, 0.042 MG for agricultural, 0.910 MG for industrial, and 9.884 MG for municipal/institutional/non-profit use.

TABLE 3-6
NON-RESIDENTIAL WATER USE

Year	Commercial/ Business (MG)	Agricultural (MG)	Industrial (MG)	Municipal/ Institutional/ Non-Profits (MG)
2012	6.14	0.150	1.03	6.00
2013	8.23	0.013	0.845	11.39
2014	9.48	0.014	0.873	9.92
2015	10.58	0.017	0.888	12.21
2016	7.96	0.016	0.914	9.90
5-Year Average	**8.478**	**0.042**	**0.910**	**9.884**

3.2.5 Seasonal Water Demand

Water demand fluctuates seasonally. Typically, demand is greater in the summer months due to increased irrigation and recreation. Figure 3-5 shows total water production by month for 2012 to 2016. Generally,

water production increases in May, is greatest in the summer months of June, July and August, and decreases again in September. Variation between years is likely due to differences between temperature and precipitation during each individual year. The Town reads meters and bills for water use semi-annually- in fall and spring. Since the meters are not read on a monthly basis, it is difficult to attribute the increased water demand in June, July and August to a particular demand category. To project water demand during the summer months, a five-year average summer average daily demand to annual ADD ratio is calculated and summarized in Table 3-7. Summer average daily demand is the total volume of water produced from all sources and pumped into the distribution system during the months of June, July and August. The five-year average summer to annual ADD ratio is 1.13 and is used to project summer average daily demand through 2035 in Section 3.3.

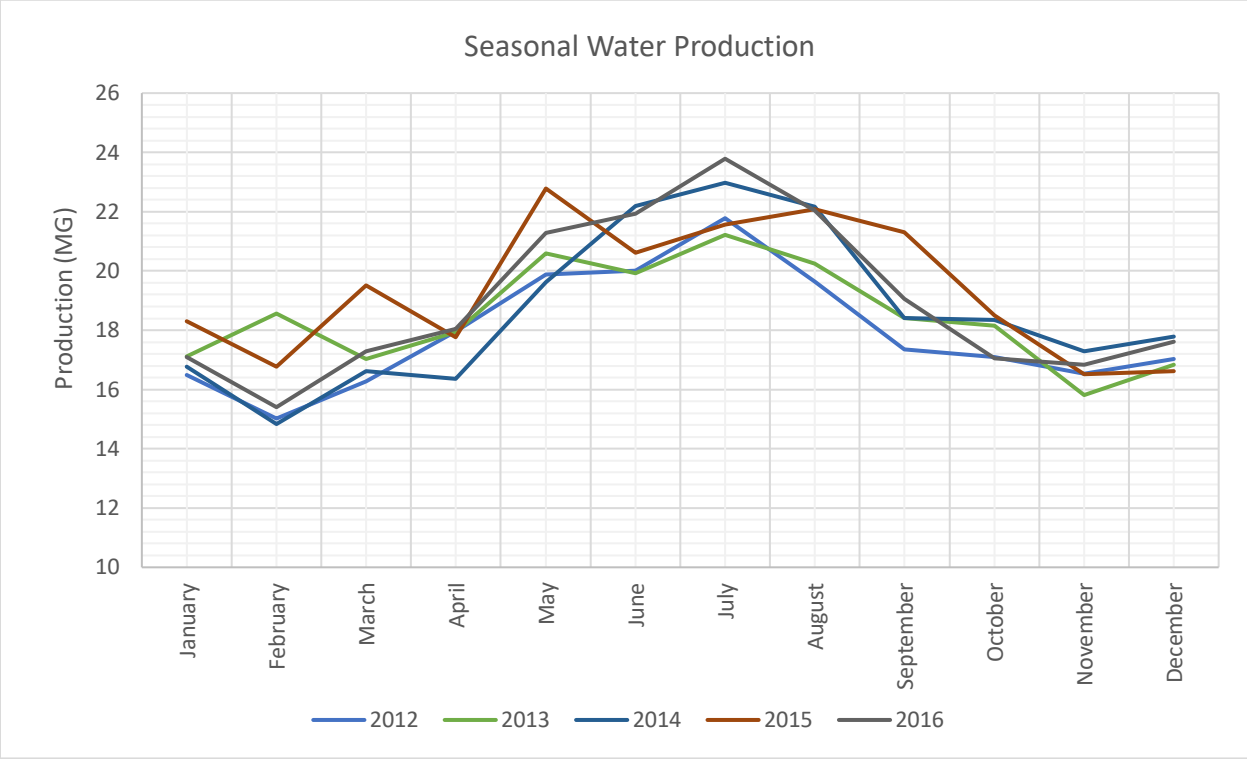


FIGURE 3-5: SEASONAL WATER PRODUCTION

TABLE 3-7
SUMMER AVERAGE DAILY DEMAND (ADD) RATIO

Year	Average Daily Demand (MGD)	Average Summer Daily Demand	Summer/Annual Average Daily Demand Ratio
2012	0.589	0.661	1.12
2013	0.608	0.667	1.10
2014	0.612	0.707	1.16
2015	0.636	0.708	1.11
2016	0.623	0.724	1.16
5-Year Average	**0.614**	**0.693**	**1.13**

3.2.6 Unaccounted-For Water

Unaccounted-for-water (UAW) is the difference between the total finished water produced and reported metered usage. Figure 3-6 shows water production and metered use each year from 2012 to 2016. UAW includes apparent and real losses. Apparent losses are losses that are consumed but not measured and typically include metering inaccuracies, unauthorized consumption, data handling errors and unmetered water use for firefighting and system flushing. Real losses are physical losses that typically include water main breaks, and distribution system and storage facility leaks. Municipal use that can be confidently estimated is added to the reported metered usage as accounted for non-revenue water and is not included in UAW. The total water production, reported metered water sales, estimated municipal use, and UAW for 2012 to 2016 are included in Table 3-8. The five-year annual average UAW is 35.526 MG, or 15.5%.

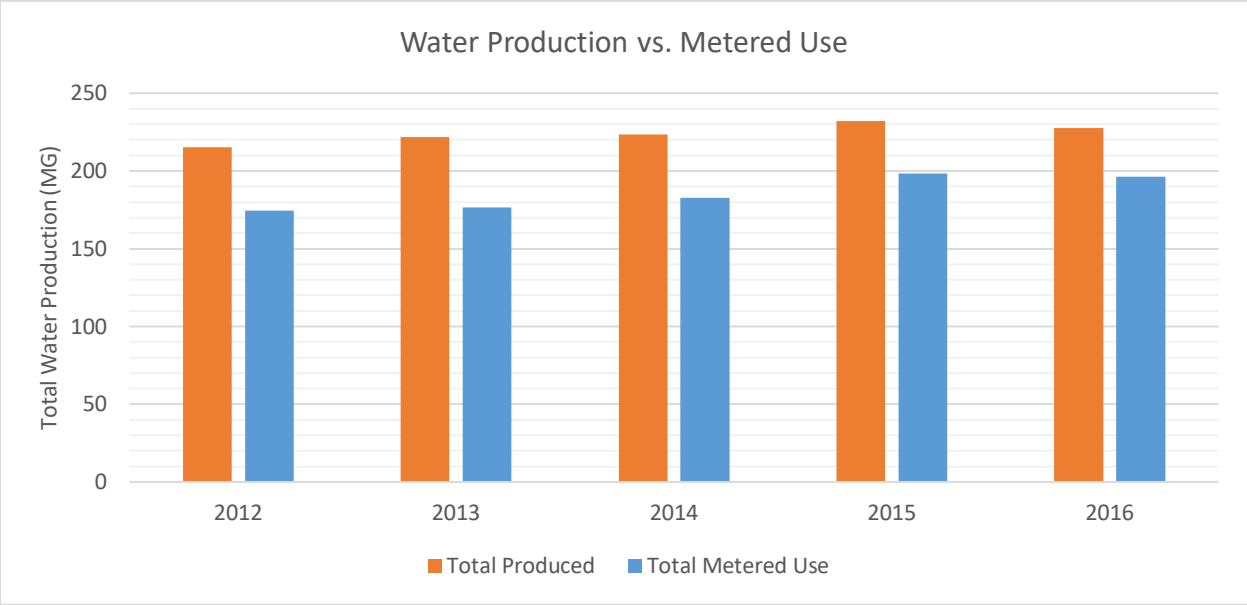


FIGURE 3-6: WATER PRODUCTION VS. METERED USE

TABLE 3-8
UNACCOUNTED FOR WATER LOSS (2012-2016)

Year	Total Water Production (MG)	Total Metered Water Sales (MG)	Accounted for Non-Revenue Water (MG)	Unaccounted for Water Loss (MG)	Percent Unaccounted for Water Loss
2012	215.050	174.300	1.820	38.930	18.1%
2013	221.840	176.758	3.915	41.167	18.6%
2014	223.365	182.527	2.599	38.239	17.1%
2015	232.322	198.565	4.335	29.422	12.7%
2016	227.433	196.270	6.290	24.873	10.9%
5-Year Average	**224.002**	**185.684**		**34.526**	**15.5%**

Under the Massachusetts WMA, public water systems using at least 100,000 GPD are required to meet a 10% UAW preference standard. Although, the five-year annual average UAW for Hanson is 15.5%, the annual UAW percent has been decreasing since 2013. The Town is required to meet the 10% UAW performance standard by December 31, 2017 according to the Town's Renewal Registration Statement from MassDEP effective January 1, 2008 through December 31, 2017. Figure 3-7 shows the percent UAW from 2008 to 2016. Although this report focuses on the most recent five years of water production data, earlier years were included here for additional context. From 2008 to 2013, the percent UAW was consistently between 16% and 19%. Since 2013, UAW decreased to 17.1% in 2014, 12.7% in 2015 and

10.9% in 2016. If this trend continues, it is anticipated that Hanson will meet the 10% UAW performance standard by the end of 2017. Based on this recent trend, the 10% UAW goal will be used in the water demand projections in Section 3.3.

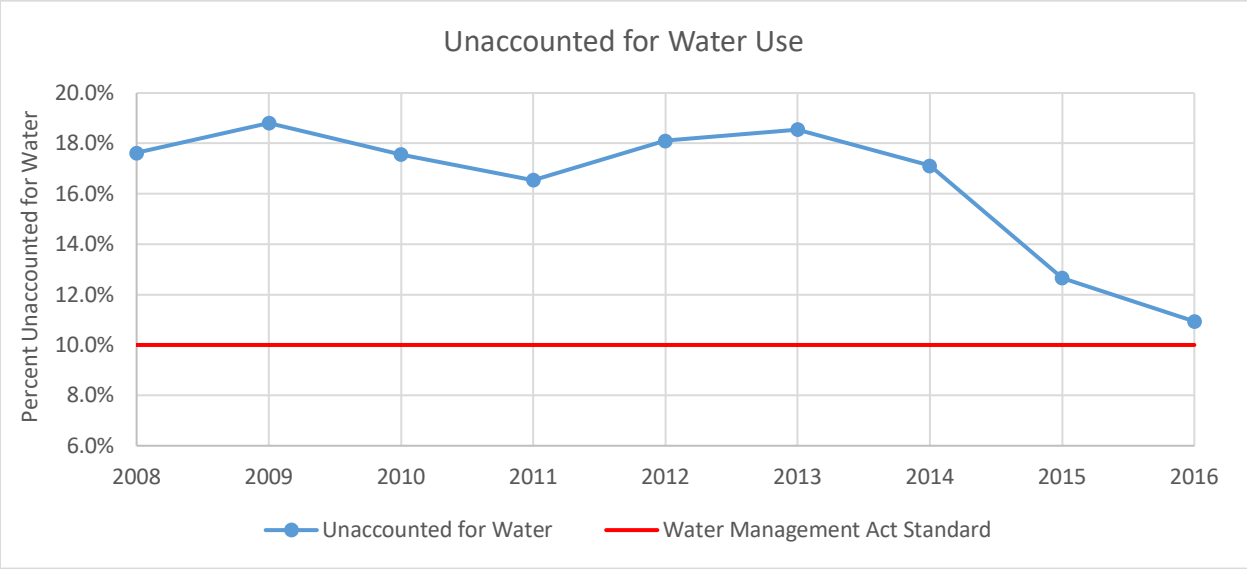


FIGURE 3-7: UNACCOUNTED FOR WATER USE

3.3 PROJECTED WATER DEMAND

3.3.1 Water Demand Projections Methodology

Water demand is projected for each of water use category for each year 2017 through 2020 and five year increments to 2035. Residential water demand is projected using population projections from UMDI and a five-year average residential gallons per capita per day of 50 RGPCD. Since a small portion of the Town is not served by the water system, population served was projected using the five-year average percent population served of 94%. A summary of projected population served is included in Table 3-9.

TABLE 3-9
PROJECTED POPULATION SERVED

Year	Projected Population (UMDI)	Percent Population Served	Projected Population Served
2017	10,579	94%	9,897
2018	10,618	94%	9,934
2019	10,656	94%	9,969

Year	Projected Population (UMDI)	Percent Population Served	Projected Population Served
2020	10,694	94%	10,005
2025	10,914	94%	10,210
2030	11,126	94%	10,409
2035	11,257	94%	10,531

For non-residential demand category use, other estimation methods were used to project demand. Figure 3-8 shows metered use for commercial/business, municipal/institutional/non-profit, agricultural and industrial use for the years 2008 to 2016. For commercial/business and municipal/institutional/non-profit use, a linear trend was used to project demand. Agricultural and industrial metered use has been consistent since 2008 and was presumed to continue to remain static.

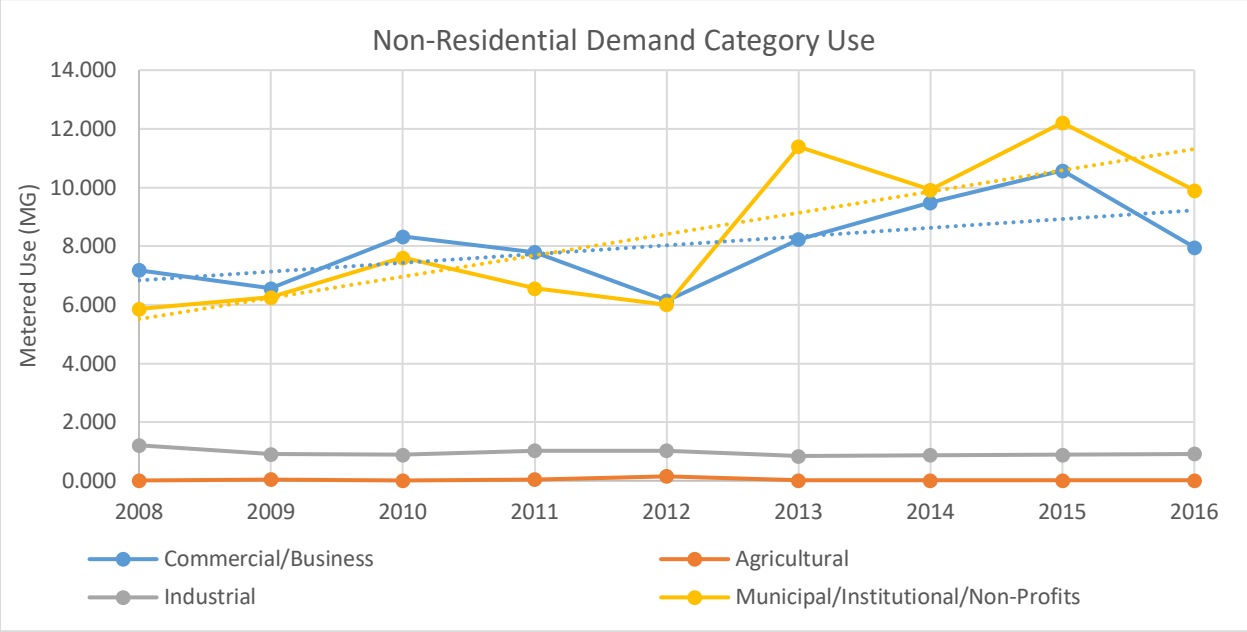


FIGURE 3-8: NON-RESIDENTIAL DEMAND CATEGORY USE

3.3.2 Projected Average- and Maximum-Day Water Demand

Total water demand is projected through 2035 assuming 10% UAW based on the WMA permit goal and 1.7% accounted for non-revenue water based on five-year historical average. Total water demand projections are summarized in Table 3-10.

TABLE 3-10
PROJECTED TOTAL METERED USE AND WATER DEMAND THROUGH 2035

Year	Population Served	Residential Metered Use (MG)	Non-Residential Metered Use (MG)[1]	Total Metered Use (MG)	Accounted For Non-Revenue Water (MG)	UAW (MG)	Total Demand (MG)	ADD (MGD)
2016	9,327	177.480	18.790	196.270	6.290	24.873	227.433	0.623
2017	9,897	180.621	22.491	203.113	3.415	20.311	226.839	0.62
2018	9,934	181.287	23.515	204.802	3.443	20.480	228.726	0.63
2019	9,969	181.933	24.539	206.471	3.471	20.647	230.589	0.63
2020	10,005	182.585	25.562	208.147	3.499	20.815	232.461	0.64
2025	10,210	186.341	30.679	217.020	3.649	21.702	242.371	0.66
2030	10,409	189.961	35.797	225.758	3.796	22.576	252.129	0.69
2035	10,531	192.197	40.914	233.112	3.919	23.311	260.342	0.71

Note: [1]Non-Residential Metered Used includes agricultural, business/commercial, industrial and municipal/ institutional/non-profit.

Table 3-11 includes projected ADD and MDD based on total projected water demand and a 1.54 MDD to ADD ratio based on five-year historical average. Five-year historical ADD and MDD are included for reference. In 2020 and 2035, the ADD is estimated to be 0.64 and 0.71 MGD, respectively, and the MDD is estimated to be 0.98 and 1.10 MGD, respectively.

TABLE 3-11
PROJECTED AVERAGE AND MAXIMUM DAILY WATER DEMAND THROUGH 2035

Year	Average Daily Demand (MGD)	Maximum Daily Demand (MGD)	Ratio of Max. Day to Avg. Day
2012	0.589	0.950	1.61
2013	0.608	0.988	1.63
2014	0.612	0.936	1.53
2015	0.636	0.923	1.45
2016	0.623	0.916	1.47
	Projected		
Year	**Average Daily Demand (MGD)**	**Maximum Daily Demand (MGD)**	**5-Year Historical Average Ratio**
2017	0.62	0.96	1.54
2018	0.63	0.96	1.54
2019	0.63	0.97	1.54
2020	0.64	0.98	1.54
2025	0.66	1.02	1.54
2030	0.69	1.06	1.54
2035	0.71	1.10	1.54

Table 3-12 includes projected summer average daily demand based on projected annual ADD and a 1.13 five year historical average ratio of summer water production to annual total water production. Five-year historical summer average daily demand are included for reference. In 2020 and 2035, the summer average daily demand is estimated to be 0.72 and 0.81 MGD, respectively.

TABLE 3-12
PROJECTED SUMMER WATER DEMAND

Year	Projected Summer Average-Day Demand
2012	0.66
2013	0.67
2014	0.71
2015	0.71
2016	0.69
2017	0.70
2018	0.71
2019	0.71
2020	0.72
2025	0.75
2030	0.78
2035	0.81

Historical ADD and MDD, projected ADD and MDD through 2035 and projected summer average-day demand are shown in Figure 3-9. Projected water demand is compared to regulatory withdrawal limits in Section 4.1 and compared to pumping capacity and available water storage in Sections 4.2 and 5.2.

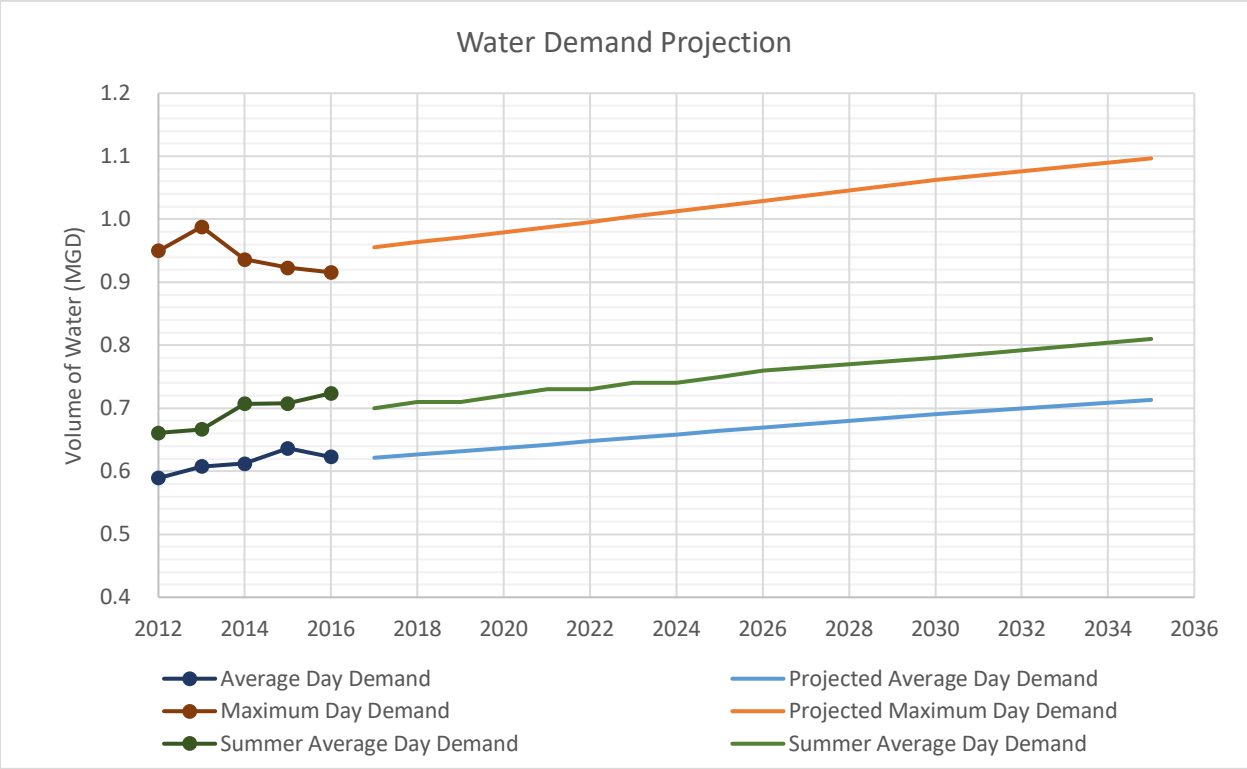


FIGURE 3-9: PROJECTED WATER DEMAND

4. WATER SUPPLY ASSESSMENT

The water supply assessment examines the adequacy of Hanson's water supply facilities to meet existing and future projected average-day and maximum-day water demands. Hanson's existing and projected water withdrawal volumes must meet regulatory compliance requirements. Additionally, water supplies must be available or developed with sufficient yields capable of meeting future projected ADD and MDD and must be adequate in the event that a supply is lost or becomes unavailable due to mechanical failure, contamination or other cause.

4.1 REGULATORY WITHDRAWAL REQUIREMENTS

In the Commonwealth of Massachusetts, all withdrawals of water for public water consumption greater than 100,000 gallons per day (GPD) must either be registered or permitted based on the requirements of the Water Management Act (310 CMR 36.00) and M.G.L. c. 21G. The Water Management Act (WMA) was promulgated in March 1986. At that time, water users could register existing water withdrawals based on water use from 1981 to 1985. Registrations are renewable, valid for a ten year period, and are not subject to safe yield limitations. Water users with unregistered water withdrawals must apply for a WMA permit. Permitted water withdrawals are subject to conditions and cannot exceed safe yield. Permits require a 20-year renewal with five year reviews. Withdrawal volumes exceeding registered and permitted limits by more than a threshold volume of 100,000 GPD are in violation of the WMA. The Town of Hanson currently holds a registration statement for water withdrawal in the amount of 0.51 million gallons per day (MGD) and a permitted withdrawal limit of 0.27 MGD in the Taunton River basin. The combined withdrawal of the Town's registered and permitted supplies is equivalent to an annual average authorized withdrawal volume of 0.78 MGD, or a total annual withdrawal of 284.70 MG. A summary of the registered and permitted withdrawals is provided in Table 4-1.

TABLE 4-1
WMA AUTHORIZED WITHDRAWAL

Authorization	Volume Authorized (MGD)	Basin
WMA Registration #4251301	0.51	Taunton River
WMA Permit #9P42524501	0.27	Taunton River
Total WMA Authorization	**0.78 (284.70 MGY)**	

The Town's current WMA permit is included in Appendix B. Special conditions associated with the permit include limits on the withdrawal volumes and maximum daily pumping rates for each well, detailed in Section 2.3.

Zone II Delineation and Wellhead Protection.

A Zone II is a DEP-defined well head protection area that delineates the production well's aquifer capture zone based on the predicted extent of the groundwater drawdown after a theoretical 180-day drought condition resulting from the well pumping at its approved rate. Hanson's sources have approved Zone II delineations. Hanson's water supplies meet DEP's wellhead protection requirements of 310 CMR 22.21(2).

Performance Standard for Residential Gallons per Capita Day Water Use

Hanson's performance standard for residential gallons per capita day (RGPCD) is 65 gallons or less. Hanson reports its RGPCD annually in the Annual Statistical Report (ASR), summarized in Section 3.2.4, and is consistently less than this 65 RGPCD. Hanson is therefore in compliance with this standard.

Performance Standard for Unaccounted for Water

Hanson's performance standard for unaccounted-for water (UAW) is 10% or less, which is reported annually in the ASR. As described in Section 3.2.6, Hanson's UAW is currently greater than 10%. In accordance with the 2005 WMA permit amendment, Hanson implemented a leak detection survey and performed leak repair work, which reduced UAW. Hanson's UAW is progressively decreasing and if the UAW trend of the last few years continues the water system may come into compliance with this standard.

Summer Limits on Withdrawals

Hanson is required to limit summer water withdrawals by implementing either a calendar or stream flow trigger for non-essential outdoor water use. Hanson has a regulation under the Board of Water Commissioners that can be used to implement non-essential outdoor water use restrictions. A streamflow trigger restriction, when implemented, prohibits sprinkler connections to the water system and limits watering by handheld hoses to certain hours of the day. There have been other circumstances when the Town has restricted non-essential water use for reasons other than the streamflow trigger. For a two-week period in 2005, for example, the Town restricted non-essential outdoor water use for two weeks while one of their water supply wells was off line. In 2016 non-essential outdoor water use was banned from March through December while maintenance was being performed on the water storage tank.

Water Withdrawals that Exceed Baseline Withdrawal Volumes

Hanson's baseline withdrawal volume is 0.72 MGD. Water withdrawal volumes are reported annually in the ASR. Hanson has not exceeded this baseline withdrawal volume in any calendar year. Should this occur, the WMA permit requires that the Town perform an Offset Feasibility Study that evaluates the cost and benefits of Best Management Practices that could be implemented to reduce withdrawals.

Water Conservation Requirements

System Audits and Leak Detection Survey

The WMA permit requires that Town to conduct a leak detection survey every three years, at a minimum, if UAW is 10% or greater. A survey is also if the UAW increases by 5% or more within one year. All field surveys for leaks and repair programs are to be in accordance with the American Water Works Association (AWWA) Manual 36, and the survey reports or records of repairs are to be made available to MassDEP. The Town must follow the following schedule for making leak repairs that are at least as stringent as the following:

- Leaks of three gallons per minute (GPM) or more are to be repaired within three months of detection.
- Leaks of less than three GPM at hydrants and appurtenances are to be repaired as soon as possible.
- Leaks of less than three GPM are to be repaired in a timely manner, but no event more than six months from detection, except that leaks in freeway, arterial or collector roadways can be repaired when other road work is being performed on the roadway.

Metering

All source and finished water meters should be calibrated annually and the date they are calibrated is to be reported in the ASR. All water distribution system users are to have properly sized service lines and meters that meet the AWWA calibration and the accuracy performance standards in AWWA Manual M6-Water Meters. The Town is to have an ongoing program to ensure service meters accurately measure volume of water used by customers including regular meter maintenance, testing, calibration, repair, replacement and checks for tampering.

Lawn and Landscape

Under the WMA permit, the Town is required to implement water use restrictions.

Pricing

Hanson shall maintain a water pricing structure that includes the full operating cost of the system including operation, maintenance, capital, and indirect costs. The pricing structure may not use decreasing block rates.

Residential and Public Sector Conservation

The Town shall meet the standards in the Federal Energy Policy Act, 1992 and the Massachusetts Plumbing code. Hanson must also meter or estimate water used by contractors from fire hydrants or for pipe flushing and construction. All municipally owned public buildings shall be retrofitted with water saving devices.

Public Education and Outreach

The Town shall develop and implement a Water Conservation Education Plan to educate customers on water conservation, and report on public education and outreach activities at the request of MassDEP.

Industrial, Commercial and Institutional Water Conservation Requirements

Hanson shall review the use records for its industrial, commercial and institutional water users and develop an inventory of the five largest water users. The Town shall develop an outreach program to inform and work with largest water users to reduce water use, and report on industrial, commercial and institutional water conservation activities at the request of MassDEP.

In summary, Hanson has implemented a water audit, leak detection survey, meter testing, leak repair and water conservation programs in 2009 and 2010 as part of the as part of the Hanson Water Conservation Grant Project funded by the Environmental Protection Agency through the MassDEP Safe Drinking Water Act State Revolving Loan Fund. Overall, the Town is in compliance with each of these WMA permit conditions.

Pleasant Street Wellfield Operation Conditions

The WMA permit places conditions on the use of the Pleasant Street Wellfield that consists of limits on maximum daily withdrawals based on water levels at the adjacent Monponsett Pond. Because Hanson has abandoned plans to withdraw water from this wellfield, the Town remains in compliance with this condition.

Wetlands Monitoring

The Town is to monitor the condition of wetlands adjacent to the Crystal Spring Well and the Crystal Spring Wellfield on an annual basis, in accordance with the plan approved by MassDEP on January 4, 2004, and report results with the ASR.

Streamflow Monitoring

The Town shall develop a streamflow monitoring plan for Poor Meadow Brook adjacent to the Crystal Springs Wellfield to monitor a minimum of one location upstream and one location downstream of the Crystal Springs Wellfield.

Reporting Requirements

The Town is required to report the raw and finished water volumes for the water system and the raw water volumes for individual withdrawal points in their ASR. Hanson provides this data in the ASR, as well as data on data on finished water volume purchased, and therefore is in compliance with this requirement.

WMA permits are effective for 20 years, and allowable water withdrawal volumes are specified for each of four five-year periods. In November 2014, following a five-year stakeholder process, WMA permit requirements were revised to incorporate the Sustainable Water Management Initiative (SWMI). SWMI was developed through the Massachusetts Executive Office of Energy and Environmental Affairs to incorporate the best available science into protecting water resources of the Commonwealth of Massachusetts. SWMI develops a balance between the health of the water resources and the water needs of businesses and communities. The Town's WMA permit (#9P42524501) was originally due to expire on February 28, 2010 but has been extended as the SWMI regulations continue to be developed. The 2010 Permit Extension Act and subsequent amendment extended all WMA permits four additional years for the development of SWMI. The WMA permit renewal for Hanson is anticipated before December 31, 2021. Under the direction of MassDEP, Hanson has continued to operate its water system under the restrictions of the "Period Four" (March 1, 2005 through February 28, 2010) requirements of their existing permit.

There are three subbasins in the Town of Hanson. The Town has registered and permitted withdrawals of 0.78 MGD in the Satucket River subbasin (#24019) in the Taunton River basin. Additionally, Hanson's WMA Permit authorized 0.75 MGD from the Middle Taunton River-Town River to Nemasket River subbasin (#24022) at the proposed Pleasant Street Wellfield Site. However, plans to develop the Pleasant Street Wellfield Site are no longer viable and the Town is investigating other options to expand water supply production. Hanson is in the design stage of an access road to drill test wells off Old Pine Road in the northeast section of the town. The area is located in the Indian Head River – Indian Head Brook to mouth subbasin. A summary of SWMI subbasins that encompass portions in Hanson is provided in Table 4-2.

TABLE 4-2
SUBBASINS WITH PORTIONS IN TOWN OF HANSON

Major Basin	Subbasin	Subbasin ID	Hanson Permitted Water Withdrawals Located in Basin
Taunton River	Satucket River	24019	Yes
Taunton River	Satucket River	24091	No
Taunton River	Middle Taunton River-Town River to Nemasket River	24021	No
Taunton River	Middle Taunton River-Town River to Nemasket River	24022	Yes[1]
South Coastal	Indian Head River-Indian Head Brook to mouth	22016, 22021, 22023	No[2]
South Coastal	Indian Head River – headwaters to Indian Head Brook	22017, 22020	No

Note: [1]Wellfield permitted for 0.75 MGD in WMA Permit originally expiring February 28, 2010. Plan to develop this wellfield is no longer viable. [2]Wellfield exploration underway.

In addition to the WMA permit requirements that existed prior to promulgation of SWMI, there are several new requirements for public water suppliers. The three core requirements include minimization of impacts in areas with the greatest groundwater depletion, coldwater fish resource (CFR) protection, and mitigation of potential impacts when new withdrawals exceed historic baseline volumes. The previous WMA permit conditions included a requirement that an Offset Feasibility Study be performed the first year that withdrawals exceeded the baseline withdrawal volume. The purpose of the study is to evaluate the cost and benefits of Best Management Practices that could be implemented to reduce withdrawals, and these practices would be implemented if in a subsequent year withdrawals exceeded the baseline again. The mitigation requirements under the revised WMA permit with SWMI provisions have taken the place of these "offset" requirements and are now more clearly defined. A Mitigation Plan will be part of the permit application process, and mitigation activates implemented after January 1, 2005 that continue to provide environmental benefit may be considered as part of the mitigation plan. Table 4-3 briefly summarizes SWMI requirements and their relationship to the Hanson's water system. Appendix C includes activities that can be evaluated for inclusion in a Minimization Plan or a Mitigation Plan.

TABLE 4-3
SWMI IMPACTS TO HANSON

Permit Requirement	Description	Impact to Hanson
Standard Permit Conditions	WMA conditions include (1) Wellhead Zone II Delineations, (2) Wellhead and Source Water Protection Requirements, (3) Water Conservation, (4) Residential gallons per capita per day (RGPCD) and Unaccounted-for Water (UAW) Performance Standards, and (5) nonessential outdoor use restrictions.	**Yes:** Hanson must meet all standards for compliance
Minimization	Groundwater permittees in areas where groundwater is depleted must minimize their existing impacts, even if they are not increasing their withdrawals.	**Yes:** Hanson's withdrawals are located in a subbasin that is in the highest biological category and the highest withdrawal category (most impaired).
Coldwater Fish Resource (CFR) Protection	All permittees with withdrawals that impact streamflow at a CFR must evaluate ways to reduce impacts. Permittees whose withdrawals are increasing must evaluate ways to mitigate their increased impact.	**None at this time:** Hanson does not withdraw water from a CFR subbasin. There are two CFR subbasins with portions in Hanson (22021 and 22016/22023). Hanson is exploring areas for well development in these subbasins.
Mitigation	Permittees with withdrawals exceeding the permittee's baseline (based on 2003-2005 withdrawals) must mitigate the increased impacts of their withdrawals.	**Not yet determined:** Hanson is not anticipating withdrawals above the baseline, as detailed in Section 4. However, permit requirements will be based on a water needs forecast prepared by MassDCR.[1]

Note: [1]A water needs forecast for the Town of Hanson, prepared by the MassDCR Office of Water Resources is not yet available. Based on an alternative water demand projection, detailed in Section 4, Hanson will approach but not exceed baseline withdrawal by 2035.

Based on the water demand projection using UMDI population projections and assumptions detailed in Section 3, the average daily demand (ADD) will approach, but not exceed the baseline by 2035. However, actual permit requirements will be based on a water needs forecast developed by MassDCR, which is not yet available for Hanson. Table 4-4 presents the Town's future demands compared to the existing registered and permitted withdrawals and the baseline withdrawal volume.

TABLE 4-4
AVERAGE DAILY DEMAND ASSESSMENT THROUGH 2035

Year	Total Authorized Raw Water Withdrawal Volume		Baseline Withdrawal Volume		Future Projected Raw Water Average-Day Demand	
	Average Daily (MGD)	Total Annual (MGY)	Average Daily (MGD)	Total Annual (MGY)	Average Daily (MGD)	Total Annual (MGY)
2017	0.78	284.70	0.72	262.8	0.62	226.30
2020	0.78	284.70	0.72	262.8	0.64	232.46
2025	0.78	284.70	0.72	262.8	0.66	242.37
2030	0.78	284.70	0.72	262.8	0.69	252.13
2035	0.78	284.70	0.72	262.8	0.71	260.34

Projected ADD, MDD and summer average daily demand from 2017 to 2035 are compared to the current WMA authorized withdrawal of 0.78 MGD and Hanson's baseline withdrawal of 0.72 MGD, shown in Figure 4-1. ADD is not projected to exceed the WMA authorized withdrawal rate, but is projected to nearly meet the baseline withdrawal volume by 2035.

MDD exceeds the WMA authorized withdrawal rate, however MDD is typically supplied by the system's pumping capacity and available water in storage, which are evaluated in Sections 4.2 and 5.2. Summer average daily demand is projected to exceed the WMA authorized withdrawal rate by 2030. Summer average daily demand must be supplied by the pumping capacity, also evaluated in Section 4.2. The Town already implements seasonal water use restrictions by limiting non-essential outdoor water use under the current WMA. Since WMA permit authorized withdrawal and baseline withdrawal limits are based on annual withdrawal, summer average daily demand above this limit will not result in the Town not be in compliance with the permit. Once summer average daily demand exceeds baseline withdrawal limits, the summer demand must be offset with the lower demand at other times of the year. If the ADD exceeds SWMI baseline withdrawal limits in a year, the Town must implement the mitigation activities for withdrawals as described above. Mitigation activities are identified in a mitigation plan developed during the permit renewal process. These water demand projections should be compared to the water needs forecast developed by DCR for Hanson, when available.

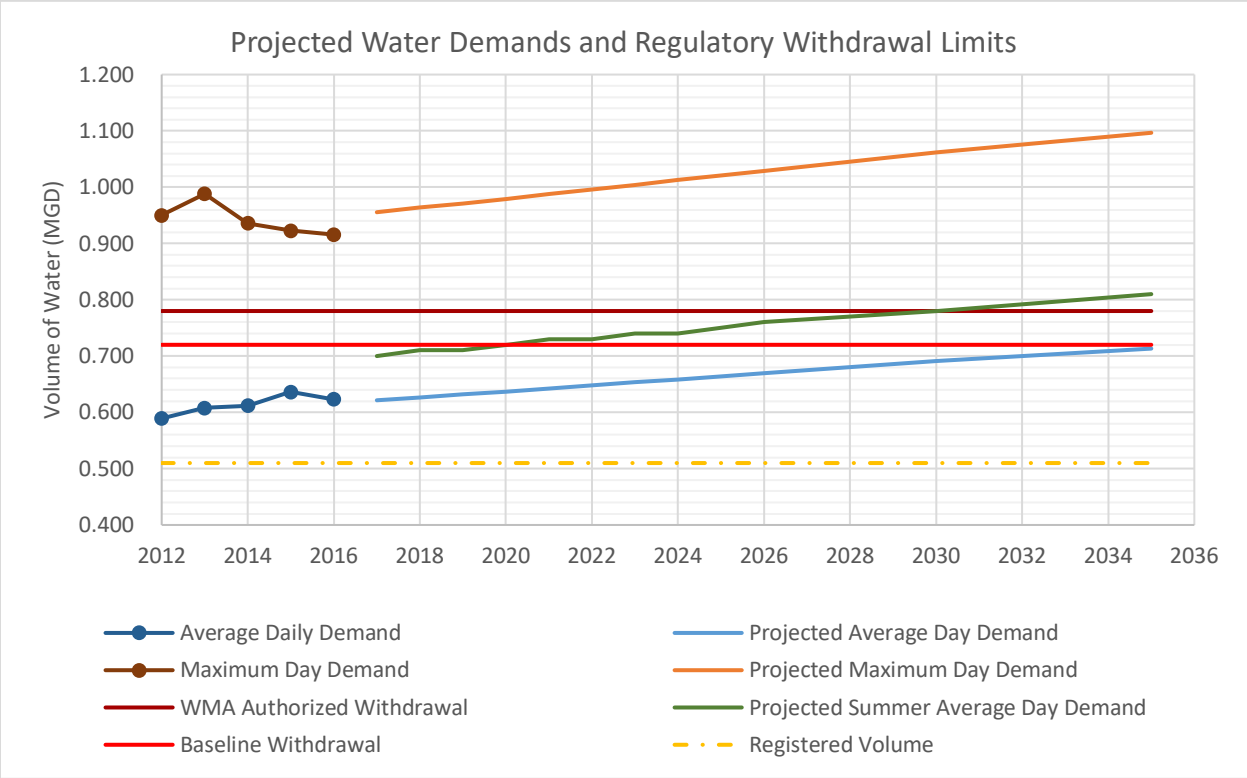


FIGURE 4-1: PROJECTED WATER DEMAND VS. REGULATORY WITHDRAWAL LIMITS

4.2 PUMPING CAPACITY

Adequacy of supply is evaluated based on the ability of design capacity and firm capacity to meet the projected maximum-day demand (MDD) through 2035. The maximum daily withdrawal rate is the allowable withdrawal rate under the WMA permit. Design capacity is defined as the rate at which pumps can deliver water without over-taxing the wells. Treatment capacity is the design capacity of each treatment facility associated with each well. Firm capacity is the design capacity with the largest single well out of service. Capacities of the Town's four wells are presented in Table 4-5. The total maximum daily withdrawal rate is 1.36 MGD. The total combined design supply capacity of Hanson's groundwater sources is 1.37 MGD. The current combined operational capacity is 1.35 MGD, the combined treatment capacity is 0.95 MGD, and the current combined firm capacity 0.82 MGD. Treatment capacity and current firm capacity, with Well #1 out of service, are compared to projected average-day demand (ADD), summer average daily demand, and MDD in Figure 4-2. Design, treatment and current firm capacities are adequate to meet projected ADD and summer average daily demand though 2035. However, the treatment and current firm capacities are inadequate to meet projected MDD.

TABLE 4-5
WELL CAPACITIES

Source	Maximum Daily Withdrawal Rate	Design Capacity (GPM)	Current Capacity (GPM)[1]	Treatment Capacity (GPM)[2]	Current Firm Capacity
Well #1	347	350	345	660	0
Well #3	600	200	176		176
Well #4		200	224		200
Well #5		200	195		195
Total (GPM)	947	950	940	660	571
Total (MGD)	1.36	1.37	1.35	0.95	0.82

Note: [1]Current capacity is the average maximum-day water pumped from each source for 2012-2015. Data from 2016 was excluded as the town was exclusively supplied water by the City of Brockton for over three months, and the water supply pumping may not be representative of a typical year.
[2]Reported in 2016 Annual Statistical Report

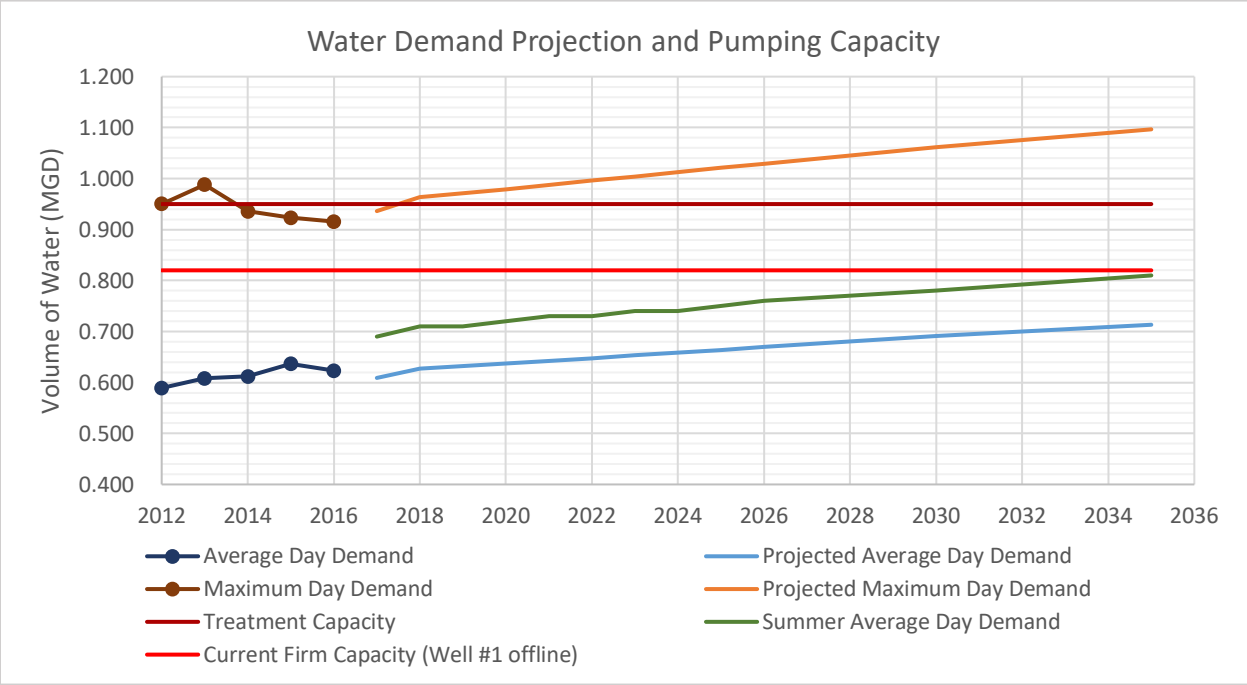


FIGURE 4-2: WATER DEMAND PROJECTION VS. PUMPING CAPACITY

4.3 WATER QUALITY

The Environmental Protection Agency (EPA) sets non-mandatory water quality standards, referred to as secondary maximum contaminant levels (SMCL), for fifteen contaminants to assist public water systems in managing drinking water aesthetics. Although not a risk to human health, concentrations above the SMCL may deter use due to taste, color and odor conditions of the water. In Massachusetts, secondary contaminants are reported in a Secondary Contaminant Report to MassDEP. Water quality samples collected from the wells in Hanson in February 2012 were analyzed for secondary contaminants and the results indicate that the water quality does not exceed SMCLs for iron, color, odor, total dissolved solids, silver, sulfate, zinc, copper, chloride and aluminum.

The recommend range for pH is between 6.5 and 8.5. The water quality analysis from February 11, 2012 indicates Hanson's water supply is slightly acidic with all four wells near or below the recommended range for pH, as shown in Table 4-6. For this reason sodium hydroxide is added to raise pH levels.

TABLE 4-6
PH - SECONDARY CONTAMINANT REPORT FEBRUARY 2012

Location	Location Type	Result
Water Department Office	Distribution System	7.2
Well #1	Source	6.5
Well #3	Source	6.0
Well #4	Source	6.0
Well #5	Source	6.4

The 2012 water quality analyses indicated elevated levels of manganese, which has an SMCL of 0.05 mg/L. Manganese concentrations above the SMCL can result in black or brown colored water, staining of plumbing fixtures, laundry and dishes, and will produce a metallic taste. The EPA has not set a health-based primary drinking water standard for manganese, but EPA published a Drinking Water Health Advisory for manganese in 2004 with suggested lifetime, 10-day and 1-day health advisories. For the general population, these health advisories are 0.3 mg/L lifetime exposure and 1.0 mg/L 10-day exposure. For infants and children under one year, consumption should be limited to less than ten days at 0.3 mg/L. The MassDEP Office of Research and Standards (ORS) establishes guidelines where no federal or state MCL is available and recommends observing these health advisory levels for manganese as a precaution.

Since 2012, Hanson has continued to monitor manganese in the drinking water supply and water system and provided the results in their secondary contaminant reports to MassDEP. Figure 4-3 shows the results of water supply samples colllected from 2012 through 2016. Wells #1, #3, #4 and #5 were analyzed separately and as combined samples in different years. The results are compared to the SMCL and lifetime health advisory. Of the samples representing multiple wells, ten of eleven exceeded the SMCL and four exceeded the health advisory. As a result, a water quality study for treatment either to sequester manganese or to plan for manganese removal via pressure filtration treatment is recommended.

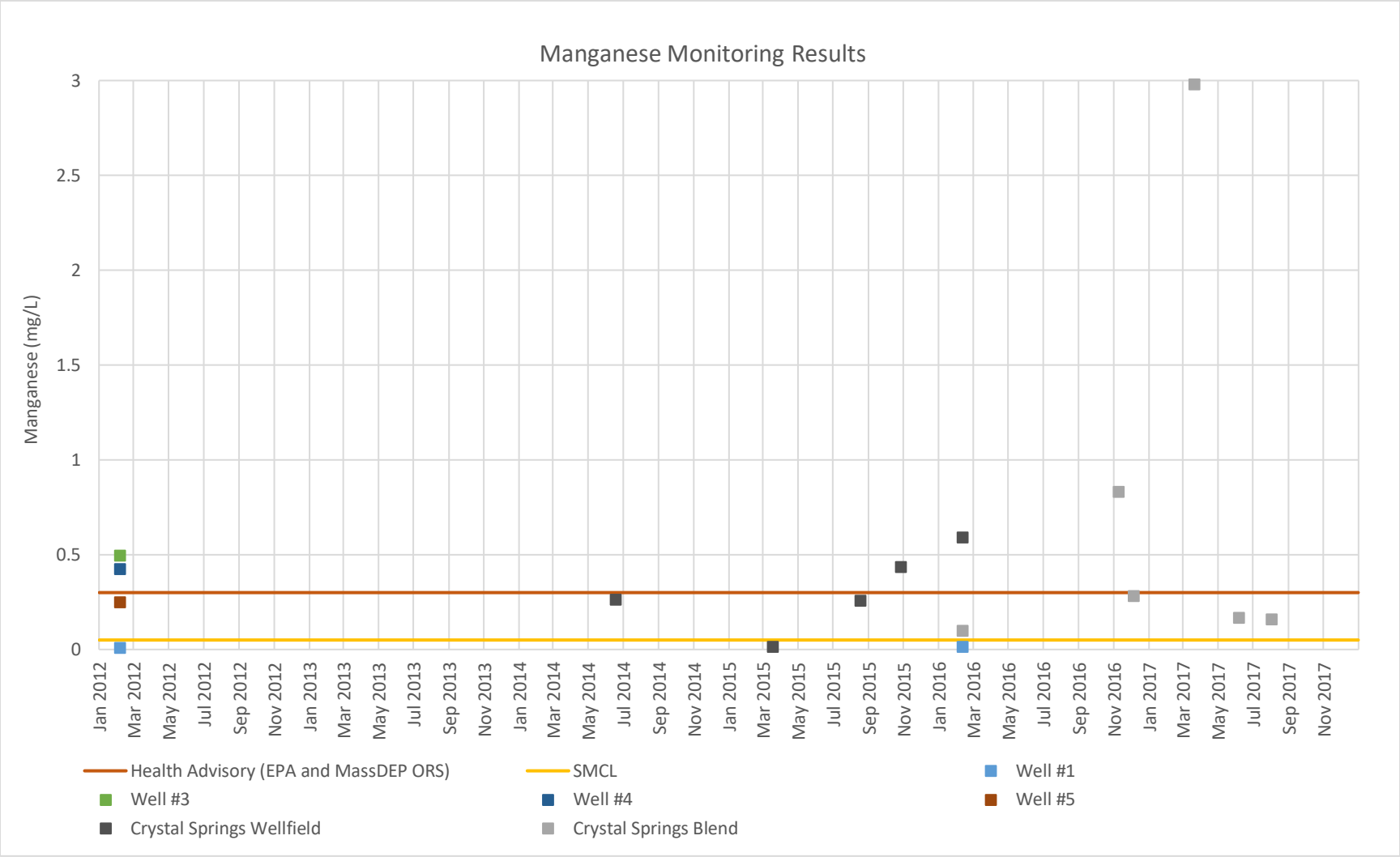


FIGURE 4-3: MANGANESE MONITORING RESULTS IN WATER SUPPLY

5. DISTRIBUTION SYSTEM ASSESSMENT

This Section reviews the evaluation performed of Hanson's water distribution system with respect to two primary areas: an assessment of the distribution system piping using a computerized hydraulic model; and an evaluation of the water storage requirements and needs.

5.1 BACKGROUND

A distribution system must have sufficient capacity to meet demands during periods of peak consumption while maintaining adequate service pressures. At the same time, the system must be capable of delivering the volume of water required for fire protection. The ability of the system to meet these conditions, both now and in the future, is determined by pipe condition tests, hydrant flow tests, an evaluation of water storage, and a comprehensive hydraulic analysis of the distribution system.

5.2 WATER DISTRIBUTION STORAGE ASSESSMENT

5.2.1 Evaluation Criteria

The purpose of water distribution storage is:

- To meet peak demands of short duration, allowing for more uniform water pumping rates.
- Provide a reserve to meet fire flow demands.
- To serve as an emergency supply in the event of a water main break, the temporary loss of a water supply or a treatment facility.
- To help to equalize pressure throughout the distribution system.

These were the criteria that were used to evaluate the adequacy of the water storage capacity of Hanson's distribution system.

5.2.2 Useable Storage

Useable storage is defined as the volume of storage in the tanks above the elevation required to provide a minimum of 35 psi (81.2 feet) static pressure throughout the distribution system. Any volume of water which is less than 81.2 feet above the highest customer is not considered. The High Street Tank's overflow elevation is 278 feet with a low water elevation of 238 ft. The Town's highest customer is at an elevation

of approximately 154 feet. Water at the lowest elevation of the tank is 84 feet above the Town's highest customer and can provide 36.3 psi, which is greater than the minimum static pressure for the distribution system (35 psi). Based on the ground surface and tank elevations, the entire volume in the tank is considered useable storage. A summary of design characteristics associated with Hanson's water distribution storage tank is provided in Table 5.1.

TABLE 5-1
SUMMARY OF STORAGE TANK DESIGN CRITERIA

Tank	Base Elevation[1] (ft)	Overflow Elevation[1] (ft)	Bowl Height (ft)	Bowl Diameter (ft)	Volume (MG)
High Street Tank	238	278	40	30	1.0

Note: [1] Elevations are in USGS vertical datum 1929.

5.2.3 Peak Hourly Demand

The amount of distribution storage required to meet peak hourly demands is a function of both the maximum daily demand and the available pumping capacity. If pumping capacity is equal to or greater than the maximum-day demand, the storage required to meet peak hourly demands is estimated to be 30 percent of the maximum-day demand, as referenced in the American Water Works Association Manual of Water Supply Practices. For this analysis, we assumed that the Town's pumping capacity and additional supply from the City of Brockton will meet current maximum-day demands.

Presuming that the Town's pumping capacity, including supply from Brockton, will remain equal to or greater than the maximum daily demand, the required storage to meet peak hourly demands is shown in Table 5-2. This analysis indicates there is currently a surplus of approximately 0.717 MG for peak hourly demand storage. Future demand projects show this surplus will decrease slightly to 0.670 MG by the year 2035 if current usable storage value remains the same.

TABLE 5-2
PEAK HOURLY DEMAND STORAGE REQUIREMENTS

Condition	Maximum-Day Demand (MDD) (MGD)	Required Peak Hourly Demand Storage (30% MDD) (MGD)	Total Storage Available (MG)	Storage Surplus or *(Deficit)* (MG)

Current (2012-2016 Average)	0.943	0.283	1.0	0.717
Future (2035)	1.10	0.330	1.0	0.670

5.2.4 Fire Protection

The quantity of distribution storage necessary for fire protection is based in part on the fire flow requirements established by the Insurance Services Office (ISO). Criteria established by ISO are used by insurance companies to set fire insurance rates. The highest fire flow required in Hanson is 4,750 GPM for the vacant Plymouth County Hospital. However, water systems are responsible for providing a maximum fire flow demand of 3,500 GPM for three hours.

Available Fire Flow Volume is the volume of water in storage tanks that can provide 20 psi throughout the distribution system, which is the volume of water at least 46.2 feet above the highest customer in Town. Any volume of water which is less than 46.2 feet above the highest customer is not considered Available Fire Flow Volume. The highest customer is at an elevation of approximately 154 feet, and the bottom of the High Street tank is at an elevation of 238 feet. The difference is 84 feet or 36.3 psi. Therefore, the total volume of water in the storage tanks is Available Fire Flow Volume. Additionally, the volume of water produced by the wells is added to the available volume, with the largest well offline (Well #1). In addition to considering the volume of water to meet the ISO Needed Fire Flow at 20 psi and required duration, there needs to be sufficient storage to meet the Equalization Demand and Depletion Volume. The Equalization Demand is the demand during the fire event at maximum-day demand rate, and the Depletion Volume is the depletion of storage prior to the start of the fire event and is assumed to be 50% of the average-day flow. The results of this calculation are presented in Table 5.3.

TABLE 5-3
FIRE PROTECTION STORAGE REQUIREMENTS

Condition	2016	2020	2025	2030	2035
Average-Day Demand (gal)	623,104	636,879	664,030	690,764	713,266
Maximum-Day Demand (gal)	915,694	979,164	1,020,908	1,062,009	1,096,604

Condition	2016	2020	2025	2030	2035
Fire Event Demand (gal) 3,500 for 3 hours[1]	630,000	630,000	630,000	630,000	630,000
Equalization Demand (gal) – Maximum-Day Usage during 3-hour Event[2]	114,462	122,396	127,613	132,751	137,076
Depletion Volume (gal) - Storage Prior to Start of Fire Event (50% of Average-Day)[3]	311,552	318,440	332,015	345,382	356,633
Total Volume Required[4] (gal)	1,056,014	1,070,835	1,089,629	1,108,133	1,123,708
Total Tank Storage[5] (gal)	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Tank Storage Surplus/Deficit (gal)	(56,014)	(70,835)	(89,629)	(108,133)	(123,708)
Volume Available from Supply (GPM)[6]	571	571	571	571	571
Total Well Volume during 3-hour Fire Event (gal)	102,780	102,780	102,780	102,780	102,780
Total Available Volume (gal)	46,766	31,945	13,151	(5,353)	(20,928)

1. *3 Hours of a 3,500 GPM Fire Demand.*
2. *3 Hours of Maximum-Day Demand rate (MDD * 3/24 hours).*
3. *50% of the Average-Day Demand.*
4. *Fire Event + Equalization Demand + Depletion Volume = Storage Required.*
5. *High Street Tank Volume.*
6. *Firm pumping capacity with the largest well (Well #1) offline.*

Hanson's water storage, without simultaneous well production, is inadequate to meet maximum-day demand and fire protection requirements. The deficit in 2016 is approximately 56,014 gallons, which is anticipated to increase to approximately a deficit of 123,708 gallons in 2035. With the volume of water produced from the wells, assuming the largest well (Well #1) is out of service, the total water volume available from supply and storage is adequate to meet demands through 2025. The total available water will be inadequate to meet fire requirements by 2030. The deficit will be approximately 5,353 gallons in 2030 and 20,928 gallons in 2035. Additional storage or development of an additional water source is recommended in order to meet the requirements. Preliminary exploration into an additional water source location is underway in Hanson. It is recommended that concurrent with new source exploration, the Town complete a tank siting alternatives analysis.

5.3 HYDRAULIC ANALYSIS OF DISTRIBUTION SYSTEM

A hydraulic analysis was conducted for Hanson's water distribution system to evaluate the capability of the water system to provide adequate service. By performing a hydraulic analysis, system deficiencies resulting from present flows, including fire flows, are determined. Additionally, proposed improvements are simulated to measure their effect on the system.

5.3.1 Hydraulic Model

The hydraulic analysis was performed using "WaterCAD Version 8i" by Bentley Systems, Inc. This program solves for the distribution of flows and hydraulic grades using the Gradient Algorithm. This method is an iterative process and is based on two principles:

1. The total flow entering the junction of two or more pipes must equal the flow leaving the junction; and
2. The change in pressure between any two points in the system must be equal by any and all paths connecting the points.

The computer software applies these two principles by assuming an initial flow pattern through the distribution system. Based on the assumed flow pattern, the software calculates head losses between the supply sources and the points of distribution. These head losses are compared and recalculated iteratively until the above stated principles are satisfied.

The computer model is a skeletonized version of the actual water system network. The model consists of a series of lines representing pipes, nodes simulating pipe intersections, reservoirs and pumps simulating groundwater supply wells, and storage tank. The model contains all pipes of 6-inch or larger diameter.

5.3.2 Data Input

The distribution system piping network was entered into the model. Numbers were assigned to each pipe and demand node along with the following: pipe diameter, pipe length, estimated “C” value, node intersections, node elevations, pump conditions and tank elevations. The model of Hanson’s distribution system piping network from 2010 was used as a basis for the model update. Information on water mains replaced from 2010 to 2017 were obtained from Town personnel and integrated into the 2010 water system map. This information is presented in Figure 2-1 (Existing Water System Map). “C” values were based on standard design values and values used in the original model, and were adjusted based on fire flow tests performed by Environmental

Partners in November 2017. Nodal elevations were determined from state Light Detection and Ranging (LiDAR) terrain data.

The hydraulic model includes approximately 600 nodes through the distribution system. Nodal demands were based on Hanson's 2015 annual average daily flow. The average daily flow was distributed among each node according to the metered consumption by parcel identification number. The ten largest consumers simulated in the model are reported in Table 5-4. All of these nodal demands can be varied to simulate maximum-day flows.

TABLE 5-4
LARGE WATER CONSUMERS

Name	Average-Day Demand (GPM)
Elm Street Bleeder Valve	8.06
Ocean Ave Bleeder Valve	6.77
Crooker Place Bleeder Valve*	5.11
1074 West Washington Street	4.01
112 Union Street	3.58
Shaw's Supermarket	3.47
80 Meeting House Lane	2.22
Meeting House Lane Bleeder Valve	1.65
252 Main Street	1.52
60 School Street	1.31

*Removed in 2017

5.3.3 Calibration

After entering all of the data, the computer model was calibrated. The first step in calibration includes inputting actual system conditions, including tank elevations, number of pumps in the operation, pumping rates, and the total system demand as existing during each of the hydrant flow tests performed in November 2017.

The next step in the calibration procedure is to check the nodal static pressures throughout the distribution system comparing model calculated static pressure with field measured static pressure. Static pressures are determined during normal demand conditions in the system and are dependent upon elevation of each node

in the system. Eight (8) nodes were used in this step and all of the pressures were within 4 psi of the field measured static pressures for every test location.

Next in the calibration procedure is to check flowing or "dynamic" conditions. This is accomplished by inputting the hydrant flows measured in the field and comparing actual residual pressures with those calculated by the model. Again, the system conditions that existed during the field tests were entered into the model (i.e. tank elevations, number of pumps operating, pump rates, and total system demand). The same eight (8) hydrant flows were used for this test. Reasonable convergence between the actual and model residual pressures was achieved for the majority of the hydrant flows. It must be noted that the computer model is based upon system equilibrium, a condition that is likely not achieved during a few minutes of hydrant flow testing at each location. Therefore, small differences between the actual and the modeled residual pressures are attributed to this condition. In general, the model was successfully calibrated with modeled head losses within 3 psi of the field-recorded head losses for five hydrant flows and within 5 psi of the field-recorded head losses for all hydrant flows.

5.3.4 Results of Hydraulic Analysis

The distribution system model was operated using both current average-day demands and maximum-day demands. In addition, the model was used to determine the availability of fire flows. Deficiencies in the system were noted when pressures dropped below 20 psi during fire flows and below 35 psi for average-day and maximum-day demands.

5.3.4.1 Service Pressures

The results of the hydraulic analysis indicated that the existing water distribution system is capable of providing service pressure (above 35 psi) under normal operating conditions (i.e. average-day and maximum-day demands) to all customers.

Based on the hydraulic analysis, the lowest system pressures were observed in North Hanson on Whitman Street near the Whitman town line, as well as on High Street near the water storage tank. These were still above a pressure of 50 psi. It should be noted that these lower pressures are not the cause of inadequate distribution piping but the result of higher water service elevations

5.3.4.2 Fire Flow Availability

The computer model was also utilized to evaluate the availability of fire flows, with projected maximum-day demands, at all nodes throughout the distribution system. Specifically, areas served by 6-inch diameter pipes were evaluated because of concern for the condition and carrying capacity of these mains. Areas of the distribution system in the proximity of heavily developed business, industry, and schools, where fire protection is essential, were also evaluated.

The evaluation, with respect to available fire flow protection, was based on requirements set forth by the Insurance Services Office (ISO). ISO needed fire flows, for one and two family dwellings, are summarized in Table 5-5.

TABLE 5-5
ISO NEEDED FIRE FLOWS (ONE AND TWO FAMILY DWELLINGS)

Distance between Dwellings (feet)	Needed Fire Flow (GPM)
Greater than 100	500
31 – 100	750
11 – 30	1000
Less than 10	1500

ISO needed fire flows for commercial and industrial buildings are determined on an individual basis and are typically much greater than those listed Table 5-5. In the hydraulic analysis, it was assumed an average needed fire flow of 2,500 GPM for commercial and industrial developments, with the exception of the abandoned Cranberry Specialty Hospital (4,750 GPM) and Camp Kiwanee (2,750 GPM). These values were retained from the 2010 water model.

In all, over 600 nodes were evaluated for fire flow availability. The hydraulic analysis indicated adequate fire flow to many of these nodes. The results of the analysis also helped to evaluate the adequacy of the 6 and 8-inch diameter mains, which comprise a large portion of the distribution system. In cases where these mains are well networked, the effect of their limited carrying capacity is minimized. However, the hydraulic analysis did identify deficient areas with respect to available fire flow under modeled conditions. Table 5-6 and Figure 5-1, summarize the results of the hydraulic analysis at locations where fire flow deficiencies were determined. A range of available fire flow is provided for each area as the available fire flow varied by location within the area. However, even the greatest fire flow did not meet the minimum required for each area.

TABLE 5-6
AREAS WITH DEFICIENT FIRE FLOW AVAILABILITY

	Area	Type of Development	Available Fire Flow (with 20 psi residual pressure), GPM	Assumed Minimum Required Fire Flows (ISO), GPM
1	West Lake Area	Residential	257-907	1,000
2	Oldham Pond Area (North)	Residential	868-927	1,000
3	Oldham Pond Area (South)	Residential	772-848	1,000
4	East Washington Street (Pembroke town line)	Residential	544	750
5	Franklin Street (between Main Street and East Bridgewater town line)	Commercial	1,150-1,315	2,500

It was also identified that there are a number of mains with diameters smaller than 2-inches that are used to provide water to Hanson's customers. Locations with main diameters smaller than 6-inches have no hydrants for fire protection, therefore these areas were also determined to be deficient.

FIGURE 5-1: AREAS WITH DEFICIENT FIRE FLOW

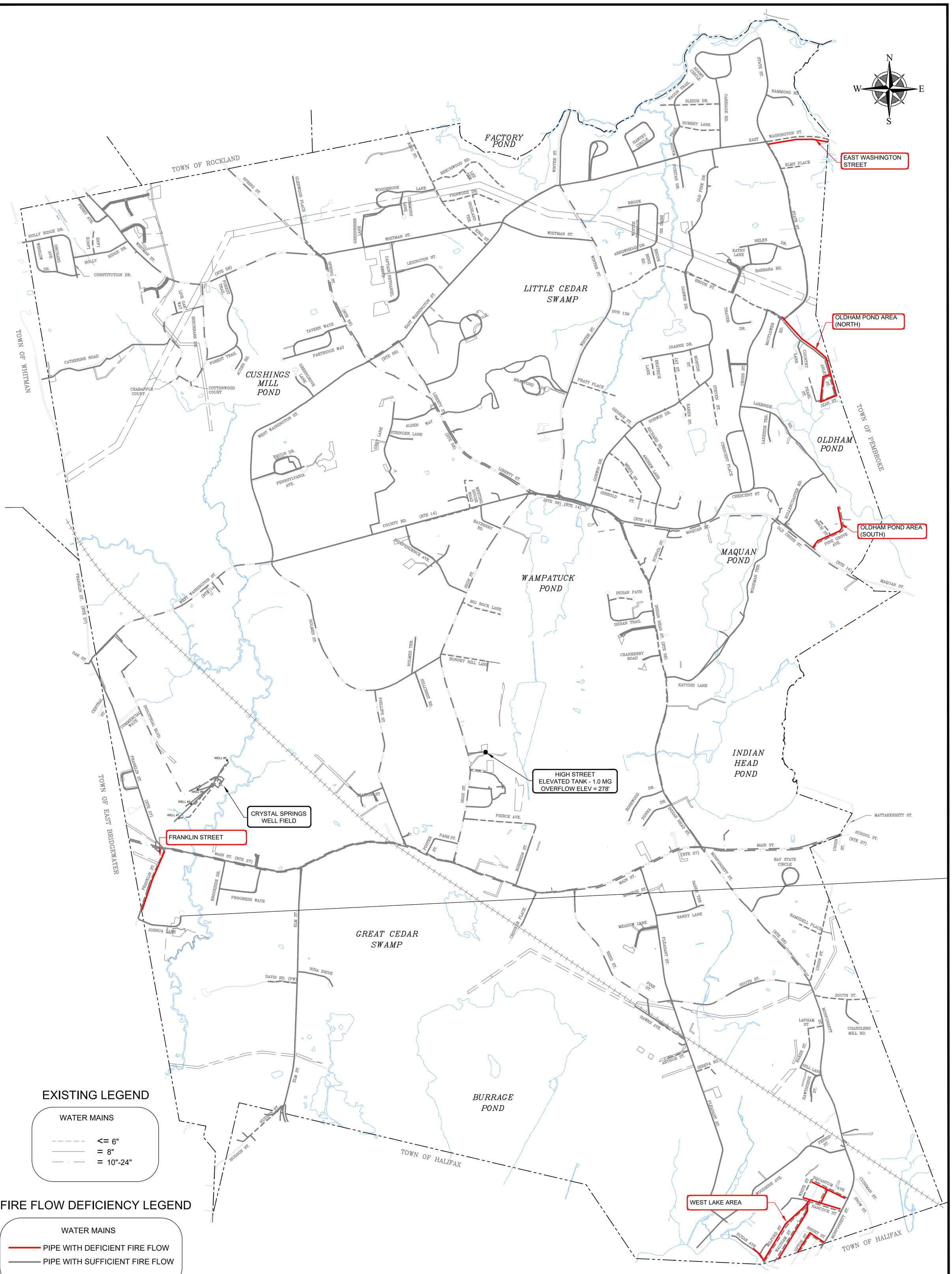


FIGURE 5-1
AREAS WITH DEFICIENT FIRE FLOW

Environmental Partners GROUP
A partnership for engineering solutions.
Quincy, MA www.envpartners.com

WATER SYSTEM MASTER PLAN
HANSON, MASSACHUSETTS
OCTOBER 2017

TOWN OF HANSON INCORPORATED 1820. MASSACHUSETTS

I:\Hanson.160\01 Water System\160-1604 Water System Master Plan Update & Model\Report\Figures\MP FIGURE 5-1 v.3.dwg

5.3.4.3 Pipe Discontinuity

In addition to identifying areas of deficient fire flow, the effectiveness of the large transmission mains, or trunk lines, in Hanson's water distribution system were analyzed. Furthermore, all sources of supply and storage should be linked together by these large transmission mains, providing an efficient means for source water to enter the distribution system. Without adequate transmission main looping, fluctuations in system pressure and storage tank levels will occur during periods of high demands.

In performing this analysis, the model was utilized to identify all of Hanson's transmission mains that are 10-inches in diameter or greater. Upon establishing the location of these large mains, gaps, or areas of discontinuity between them were identified. The analysis revealed several areas of discontinuity between these large mains. Presented in Table 5-7 is a summary of our water main discontinuity findings.

TABLE 5-7
AREAS OF TRANSMISSION MAIN DISCONTINUITY

Area	Description
Main Street (Route 27)	There is no Hanson water main on Main Street from Reed Street to Indian Head Street (Route 58).
West Washington Street	Approximately 6,300 ft of 8-inch lined cast iron main connects a 12-inch main on West Washington at Holmes Street and at Spring Street.
East Washington Street	Approximately 5,400 ft of 8-inch lined cast iron main connects a 12-inch main at Liberty Street and Winter Street.

The results of this hydraulic analysis, in addition to the water storage evaluation, form the basis of the recommendations presented in Section 6 - Recommended Water System Improvements.

6. RECOMMENDED WATER SYSTEM IMPROVEMENTS

6.1 OVERVIEW

The assessment of Hanson's existing water system provided in the previous sections identify various deficiencies and performance limiting factors. Furthermore, as future water demands increase, these deficiencies have the potential to become greater. Numerous water system improvements are recommended to address these deficiencies and are summarized in this Section.

In order to give some priority to the recommended water system improvements and to aid the Town in financing the proposed program, it is recommended that the improvements be implemented in five phases. The first three (Phases I – III) would consist of successive five-year programs over 15 years and are targeted toward fundamental improvements in treatment, storage and distribution that are deficiencies identified in the evaluations described in the previous sections. Two additional phases of improvements are also recommended that focus on water quality issues (Phase IV) and undersized water mains (Phase V) that can be implemented over the next twenty years as financing allows. However, it is not necessary that the order listed within this chapter be followed exactly. More importantly, the Town should address those issues which can be reasonably financed and which respond to local concerns.

6.2 RECOMMENDED IMPROVEMENTS

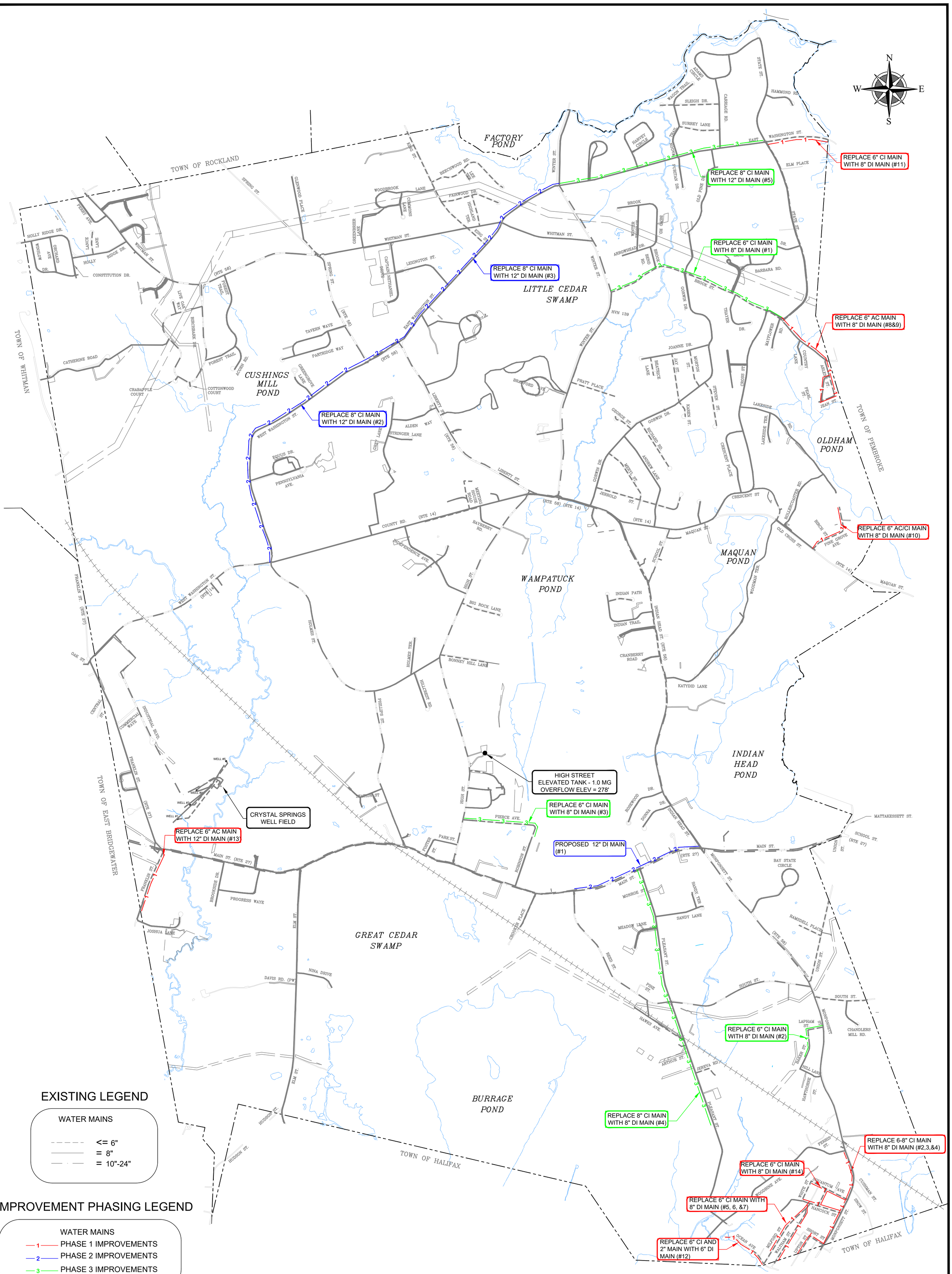
Phase I Improvements address immediate water distribution system problems, such as deficiencies in water pressure or fire flow availability, and should be implemented as soon as possible. Phase II Improvements are intended to prepare the water system for the near future, ensuring its ability to meet projected demands and fire flow requirements. Phase III Improvements, while not immediately critical, are intended to reinforce the water system and improve its overall performance and reliability. Phase IV Improvements include the replacement of vinyl-lined asbestos cement water mains. Phase V Improvements include the replacement of water mains 2-inch and smaller. Phases I, II and II are is recommended to be implemented over subsequent five year periods and Phases IV and V are recommended to be implemented as opportunities allow over the next 20 years as follows:

- Phase I (0-5 years)
- Phase II (6-10 years)
- Phase III (11-15 years)

- Phase IV and Phase V (0-20 years)

The improvements for each phase are described in detail in Table 6-1 though Table 6-3 and Phases I, II and III are also shown schematically on Figure 6-1.

FIGURE 6-1: RECOMMENDED SYSTEM IMPROVEMENTS



EXISTING LEGEND

WATER MAINS

- <= 6"
- = 8"
- = 10"-24"

IMPROVEMENT PHASING LEGEND

WATER MAINS

- 1 — PHASE 1 IMPROVEMENTS
- 2 — PHASE 2 IMPROVEMENTS
- 3 — PHASE 3 IMPROVEMENTS

ELEVATIONS ARE IN USGS VERTICAL DATUM 1929

GRAPHIC SCALE

1000 0 1000 2000 3000

FIGURE 6-1

RECOMMENDED SYSTEM IMPROVEMENTS

Environmental Partners GROUP
A partnership for engineering solutions.
Quincy, MA www.envpartners.com

WATER SYSTEM MASTER PLAN
HANSON, MASSACHUSETTS
OCTOBER 2017

TOWN OF HANSON INCORPORATED 1820. MASSACHUSETTS

I:\Hanson.160\01 Water System\160-1604 Water System Master Plan Update & Model\Report\Figures\MP FIGURE 6-1 v.3.dwg

6.2.1 Phase I Improvements

Phase I Improvements, recommended to be implemented in the next five years, are shown in Table 6-1. In conjunction with a tank siting alternatives analysis, it is recommended the Town evaluate the feasibility of developing an additional water source. This study is currently underway. The findings of this study and a tank siting alternative analysis will determine whether additional water supply or storage would best meet the Town's future fire protection needs and enhance system redundancy.

TABLE 6-1
PHASE I IMPROVEMENTS

DESCRIPTION			
Planning			
1	Complete a tank siting alternatives analysis.		
Treatment			
1	Conduct water quality study for treatment to sequester manganese or remove with pressure filtration.		
Maintenance			
1	Review and update unidirectional flushing program.		
Storage			
1	Install 0.5 million gallon elevated water storage tank.		
Distribution			
	Location	**Diameter (in.)**	**Length (ft.)**
2	Install main on Monponsett Street from Woodbine Avenue to Short Street. This will replace an 8-inch unlined cast iron main and improve fire flow availability in this area.	8	2,350
3	Install main on Short Street from Monponsett Street to Upton Street. This will replace a 6-inch unlined cast iron main and improve fire flow availability in this area.	8	400
4	Install main on Upton Street from Short Street to Halifax town line. This will replace a 6-inch unlined cast iron main and improve fire flow availability in this area.	8	500
5	Install main on Hancock Street from Monponsett Street to White Street. This will replace a 6-inch unlined cast iron main and improve fire flow availability in this area.	8	925
6	Install main on Milford Street from Hancock Street to Ocean Avenue. This will replace a 6-inch unlined cast iron main and improve fire flow availability in this area. This will also	8	1,800

DESCRIPTION			
	allow the elimination of a bleeder valve which would result in the conservation of water.		
7	Install main on Waltham Street from Hancock Street to Halifax town line. This will replace a 6-inch unlined cast iron main and improve fire flow availability in this area.	8	1,450
8	Install main on Brook Street from State Street to Pembroke town line. This will replace a 6-inch asbestos cement main and improve fire flow availability in this area.	8	1,450
9	Install main on Arlene Street, Jean Street, and Beckett Street. This will replace a 6-inch asbestos cement main and improve fire flow availability in this area.	8	2,150
10	Install main on Pine Grove Avenue. This will replace a 6-inch asbestos cement and unlined cast iron main and improve fire flow availability and water quality in this area.	8	1,375
11	Install main on East Washington Street from State Street to Pembroke town line. This will replace a 6-inch unlined cast iron main and improve fire flow availability and water quality in this area.	8	1,400
12	Install main on Ocean Avenue from Milford Street to end of road. This will replace a 6-inch unlined cast iron pipe and 2-inch main to improve fire flow availability in this area.	6	1,160
13	Install main on Franklin Street between Main Street and East Bridgewater town line. This will replace the existing 6" asbestos cement main to improve fire flow availability in this area.	12	1,550
14	Install main on Squantum Avenue and Union Park Street. This will replace a 6-inch unlined cast iron pipe and improve water quality issues and fire flow availability in this area.	8	1,300

6.2.2 Phase II Improvements

Phase II Improvements, recommended to be implemented in five to ten years, are shown in Table 6-2.

TABLE 6-2
PHASE II IMPROVEMENTS

DESCRIPTION			
Distribution			
	Location	**Diameter (in.)**	**Length (ft.)**
1	Install main on Main Street from Reed Street to Indian Head Street. This main will create a loop, eliminate the dead ended main on Pleasant Street, and improve fire flow availability in this area.	12	3,150

2	Install main on West Washington Street from County Road (Route 14) to Spring Street. This will replace an 8-inch lined cast iron pipe and improve the transmission system continuity and water quality issues.	12	6,300
3	Install main on East Washington Street from Spring St to Winter Street. This will replace an 8-inch lined cast iron pipe and improve the transmission system continuity and water quality issues.	12	5,400

6.2.3 Phase III Improvements

Phase III Improvements, recommended to be implemented in 10 to 15 years, are shown in Table 6-3.

TABLE 6-3
PHASE III IMPROVEMENTS

DESCRIPTION			
Distribution			
	Location	**Diameter (in.)**	**Length (ft.)**
1	Install main on Brook Street from Winter Street to State Street. This main will replace a 6-inch unlined cast iron and improve fire flow availability in this area.	8	4,500
2	Install main on Lapham Street and a partial portion of Baker Street. This main will replace a 6-inch unlined cast iron main and improve water quality and fire flow availability in this area.	8	1,100
3	Install main on Pierce Avenue. This main will replace a 6-inch unlined cast iron main and improve water quality and fire flow availability in this area.	8	2,000
4	Install main on Pleasant Street from Main Street (Route 27) to approximately house #621. This main will replace an 8-inch lined cast iron main and improve water quality and fire flow availability in this area.	8	6,300
5	Install main on East Washington Street from Winter Street to State Street. This will replace an 8-inch cast iron pipe and improve the transmission system continuity and water quality issues.	12	4,900

6.2.4 Phase IV Improvements

The following recommended Phase IV Improvements are not based on hydraulics but water quality. The streets included in Table 6-4 are presumed to have vinyl-lined asbestos cement (VLAC) piping. Recently,

it is has been recognized that drinking water transported in VLAC pipe may contain elevated levels of tetrachloroethylene (PCE). Based on water quality testing, the Town has installed multiple bleeder taps to continuously flush impacted areas. It is recommended that VLAC pipes be replaced with cement-lined ductile iron to reduce any possible health impacts. Phase IV Improvements are recommended to be completed in the next 20 years.

TABLE 6-4
PHASE IV IMPROVEMENTS: VINYL-LINED ASBESTOS CEMENT PIPE

Street	Diameter (in.)	Length (ft.)
Barbara Road	8	885
Bay State Circle	8	2,366
Bayberry Road	8	824
Beatrice Lane	6	430
Constitution Drive	8	412
Elm Street	8	5,964
Forest Trail	8	1,789
Glenwood Place	8	1,514
George Street	6	503
Greenbrier Lane	8	642
Hawks Avenue	12	1,380
Helen Drive	8	1,274
High Street	12	9,495
Holly Ridge Drive	8	2,959
Holmes Terrace	8	874
Indian Path	6	571
Jerrold Street	6	1,173
Joanne Drive	8	213
Karen Street	6	394
Kathy Lane	8	437
Katydid Lane	8	824
Lance Lane	6	541
Liberty Street*	12	1,173
Mayflower Road	8	757
Meetinghouse Lane	6	1,346
Orchard Avenue	8	847
Plymouth County Hospital	8	1,957
Ramsdell Place	6	572
Reed Street	12	3,870

Street	Diameter (in.)	Length (ft.)
Richard Road	6	1,253
Rollercoaster Road	8	1,538
Spring Street	12	2,989
Station Street	8	910
Whitman Street	12	6,264
Winslow Drive	8	1,605
Winter Street	12	9,755

*Note: Connecting main on Alden way with Liberty Street will enhance system continuity and improve water quality.

6.2.5 Phase V Improvements

In addition to the removal and replacement of the water mains indicated above, the Town should also plan to replace the over 5,000 feet of mains 2-inches in diameter and less listed in Table 6-5 with new 8-inch main. This will improve fire flow availability and water quality concerns throughout the Town. Phase V Improvements are recommended to be completed in the next 20 years.

TABLE 6-5
PHASE V IMPROVEMENTS: MAINS 2-INCHES IN DIAMETER AND LESS

Street Name	Length (ft)
Birch Street	360
Elm Place	540
Ferris Street	360
Hanson Court	300
Pearl Street	780
Robinson Street	588
School Street	360
Wilbur Avenue	180
Cranberry Cove	660
Arthur Street	300
Village Road	600

7. ENVIRONMENTAL PARTNERS OPINIONS OF PROBABLE PROJECT COSTS

7.1 GENERAL

In this chapter, opinions of probable project costs (OPPC) are presented for all of the previously recommended water system improvements.

7.2 CAPITAL COSTS

The estimated capital costs presented in this section represent all the costs for the study, design, and construction, including contingencies and engineering assistance for bidding, construction administration, and resident engineering services for construction projects. All of these costs are current as of October 2017, based on recent bid results for water main projects in southeast Massachusetts. The future use of this cost data must be adjusted accordingly. The unit cost estimate, utilized in this report for new water main construction, includes the material costs for piping and appurtenances (valves, hydrants, etc.), design and engineering, installation, paving and appurtenant items required for a complete project. Unit costs for construction items are based on recent bid tabulations for similar work and are presented in Table 7-1.

TABLE 7-1
UNITS COSTS FOR CONSTRUCTION

Item	Units	$/Unit	Engineering, Design and Resident Observation	Contingency	Total ($/unit)
6” Pipe	L.F.	$140	**20%**	**20%**	$200
8” Pipe	L.F.	$150	**20%**	**20%**	$210
12” Pipe	L.F.	$160	**20%**	**20%**	$225

The OPPC for completing the recommended improvements are presented in Table 7-2 through Table 7-4.

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7.2.1 Phase I Improvements

OPPC for Phase I Improvements, recommended to be completed in the next five years, are shown in Table 7-2.

TABLE 7-2
COST OF PHASE I IMPROVEMENTS

	DESCRIPTION			OPINIONS OF PROBABLE PROJECT COST
Planning				
1	Complete a tank siting alternatives analysis.			$15,000
Treatment				
1	Conduct water quality study for treatment to sequester manganese or remove with pressure filtration.			$30,000
Maintenance				
1	Review and update unidirectional flushing program.			$20,000
Distribution				
1	Install 0.5 million gallon elevated water storage tank.			$3,500,000
	Location	**Diameter (in.)**	**Length (ft.)**	
2	Install main on Monponsett Street from Woodbine Avenue to Short Street.	8	2,350	$493,500
3	Install main on Short Street from Monponsett Street to Upton Street.	8	400	$84,000
4	Install main on Upton Street from Short Street to Halifax town line.	8	500	$105,000
5	Install main on Hancock Street from Monponsett Street to White Street.	8	925	$194,250
6	Install main on Milford Street from Hancock Street to Ocean Avenue.	8	1,800	$378,000
7	Install main on Waltham Street from Hancock Street to Halifax town line.	8	1,450	$304,500
8	Install main on Brook Street from State Street to Pembroke town line.	8	1,450	$304,500
9	Install main on Arlene Street, Jean Street, and Beckett Street.	8	2,150	$451,500
10	Install main on Pine Grove Avenue.	8	1,375	$288,750
11	Install main on East Washington Street from State Street to Pembroke town line.	8	1,400	$294,000
12	Install main on Ocean Avenue from Milford Street to end of road.	6	1,160	$232,000

13	Install main on Franklin Street between Main Street and East Bridgewater town line.	12	1,550	$348,750
14	Install main on Squantum Avenue and Union Park Street.	8	1,300	$273,000
	TOTAL			**$7,316,750**

7.2.2 Phase II Improvements

OPPC for Phase II Improvements, recommended to be completed in the next five to ten years, are shown in Table 7-3.

TABLE 7-3
COST OF PHASE II IMPROVEMENTS

DESCRIPTION				**OPINIONS OF PROBABLE PROJECT COST**
Distribution				
	Location	**Diameter (in.)**	**Length (ft.)**	
1	Install main on Main Street from Reed Street to Indian Head Street.	12	3,150	$708,750
2	Install main on West Washington Street from County Road (Route 14) to Spring Street.	12	6,300	$1,417,500
3	Install main on East Washington Street from Spring Street to Winter Street.	12	5,400	$1,215,000
	TOTAL			**$3,341,250**

7.2.3 Phase II Improvements

OPPC for Phase I Improvements, recommend to be completed in the next 10 to 15 years, are shown in Table 7-4.

TABLE 7-4
COST OF PHASE III IMPROVEMENTS

DESCRIPTION				OPINIONS OF PROBABLE PROJECT COST
Distribution				
	Location	**Diameter (in.)**	**Length (ft.)**	
1	Install main on Brook Street from Winter Street to State Street.	8	4,500	$945,000
2	Install main on Lapham Street and a partial portion of Baker Street.	8	1,100	$231,000
3	Install main on Pierce Avenue.	8	2,000	$420,000
4	Install main on Pleasant Street from Main Street (Route 27) to approximately house #621.	8	6,300	$1,323,000
5	Install main on East Washington Street from Winter Street to State Street.	12	4,900	$1,102,500
	TOTAL			**$4,021,500**

7.2.4 Phase IV Improvements

Depending on available funds that the Town obtains for water distribution system improvements in a given year, the following vinyl lined asbestos cement Pipe replacements should be accomplished during the next 20 years. OPPC for Phase IV Improvements are shown in Table 7-5.

TABLE 7-5
PHASE IV IMPROVEMENTS: VINYL-LINED ASBESTOS CEMENT PIPE

Street	Length (ft.)	OPINIONS OF PROBABLE PROJECT COST
Barbara Road	885	$185,850
Bay State Circle	2,366	$496,860
Bayberry Road	824	$173,040
Beatrice Lane	430	$90,300
Constitution Drive	412	$86,520
Elm Street	5,964	$1,252,440
Forest Trail	1,789	$375,690

Street	Length (ft.)	OPINIONS OF PROBABLE PROJECT COST
George Street	503	$105,630
Glenwood Place	1,514	$317,940
Greenbrier Lane	642	$134,820
Hawks Avenue	1,380	$310,500
Helen Drive	1,274	$267,540
High Street	9,495	$2,136,375
Holly Ridge Drive	2,959	$621,390
Holmes Terrace	874	$183,540
Indian Path	571	$119,910
Jerrold Street	1,173	$246,330
Joanne Drive	213	$44,730
Karen Street	394	$82,740
Kathy Lane	437	$91,770
Katydid Lane	824	$173,040
Lance Lane	541	$113,610
Liberty Street	1,173	$263,925
Mayflower Road	757	$158,970
Meetinghouse Lane	1,346	$282,660
Orchard Avenue	847	$177,870
Plymouth County Hospital	1,957	$410,970
Ramsdell Place	572	$120,120
Reed Street	3,870	$870,750
Richard Road	1,253	$263,130
Rollercoaster Road	1,538	$322,980
Spring Street	2,989	$672,525
Station Street	910	$191,100
Whitman Street	6,264	$1,409,400
Winslow Drive	1,605	$337,050
Winter Street	9,755	$2,194,875
TOTAL		**$15,286,890**

7.2.5 Phase V Improvements

Depending on available funds that the Town obtains for water distribution system improvements in a given year, the following replacements of mains less than or equal to two-inch diameter should be accomplished during the next twenty years. OPPC for Phase V Improvements are shown in Table 7-6.

TABLE 7-6
PHASE V IMPROVEMENTS: MAIN (≤2-INCHES) REPLACEMENTS

Street	Length (ft.)	OPINIONS OF PROBABLE PROJECT COST
Birch Street	360	$75,600
Elm Place	540	$113,400
Ferris Street	360	$75,600
Hanson Court	300	$63,000
Pearl Street	780	$163,800
Robinson Street	588	$123,480
School Street	360	$75,600
Cranberry Cove	660	$138,600
Wilber Avenue	180	$37,800
Arthur Street	300	$63,000
Village Road	600	$126,000
TOTAL		**$1,055,880**

7.3 TOTAL CAPITAL COST SUMMARY

The OPPC associated with each phase of the recommended improvements are as follows summarized in Table 7-7. Please note that the results of the studies recommended for a new source of supply or treatment options for water quality issues may raise the capital costs depending on which options are recommended.

TABLE 7-7
CAPITAL COST SUMMARY

	CAPITAL COST
Phase I Improvements	$7,316,750
Phase II Improvements	$3,341,250
Phase III Improvements	$4,021,500
Phase IV Improvements	$15,286,890
Phase V Improvements	$1,055,880
TOTAL	**$31,022,270**

8. WATER SYSTEM FINANCING

8.1 OVERVIEW

In accordance with the Town's Water Management Act Permit, revenue from water sales must cover all operational, maintenance, capital and indirect costs (environmental impacts, watershed protection). Hanson Water Department derives revenue from the sale of water, water and fire service charges, development charges, and additional miscellaneous charges. The purpose of this section is to evaluate the Town's current water rate structure, its ability to fund recommend system improvements, and recommend a rate adjustment. The current rate schedule, effective March 6, 2017, for water usage is included in Table 8-1.

TABLE 8-1
CURRENT SEMI-ANNUAL BILLING WATER RATE STRUCTURE

Category	Usage (cubic feet)	Rate
1st Step	0 to 1,500	$104.50
2nd Step	1,500 to 2,500	$5.21 per 100 C.F.
3rd Step	2,500 to 5,000	$6.24 per 100 C.F.
4th Step	Over 5,000	$8.19 per 100 C.F.

8.2 REVENUE REQUIREMENTS

Total estimated historic revenue collected under the prior rate schedule is compared to expenditures for fiscal years (FY) 2015 through 2017 in Table 8-2. Revenue includes water sales, fire and water service charges and is adjusted for credits, past due water bills, interest and demand/fees. Revenue for FY2017 includes actual revenue from the fall billing period and projected revenue for the spring billing period. Expenditures for FY2017 include actual operational expenditures and budgeted values for additional expenditures. As indicated by the information in Table 8-2, revenue did not cover expenditures in FY2016 and it is anticipated that projected revenue for 2017 will not cover budgeted expenditures.

TABLE 8-2
ANNUAL REVENUE AND EXPENDITURES FY2015-FY2017

	FY2015	FY2016	FY2017
Water Sales	$1,335,856	$1,526,425	$1,554,713
Fire Service Charges	$27,400	$27,300	$29,200
Water Service Charges	$4,440	$2,185	$2,620
Credits	($15,626)	($30,046)	($23,827)

	FY2015	FY2016	FY2017
Past Due	$308,874	$353,919	$141,517
Interest	$28,645	$30,959	$11,400
Demand/Fees	$6,475	$5,835	$188
Total Revenue	$1,696,064	$1,916,578	$1,715,811[2]
Expenditures	$1,005,301[1]	$2,396,769	$2,143,128[3]
NET	$690,763	($480,191)	($427,317)

Note: [1]Includes salaries, operating expenses, and debt service only. Does not include any capital expenses, engineering services or additional expenses.
[2]Includes actual revenue for the first 6-month period (fall billing) of FY2017 and estimated revenue for the second 6-month period (spring billing) of FY2017 estimated based on spring billing for FY2015 and FY2016.
[3]Includes actual operating expenditures, estimated salaries and additional budgeted expenditures.

8.3 PROJECTED EXPENDITURES

MassDEP requires water suppliers, through their Water Management Act Permit, to cover all operation and maintenance expenses and debt service with revenues from the sale of water, not including revenue from other sources. Projected expenditures for FY2018 through FY2020 are shown in Table 8-3 and include the cost to cover all operation and maintenance expenditures (i.e. payroll, benefits, heat, power, purchase of services, supplies, intergovernmental costs, capital outlay, etc.) and existing debt service. Operation and maintenance costs are projected at a compounded annual increase of three percent starting from FY2018 budgeted costs. Debt service is based on the existing debt service schedule and an estimated additional debt service for water main improvements completed in 2017 and identified in Section 2.6. This additional debt service was estimated as $1.5 million, bonded for ten years at three percent interest. Expenditures in FY2016 and FY2017 were significantly higher than projected expenditures for FY2018 through FY2020 due to additional expenses incurred in FY2016 and FY2017 for system improvements, equipment replacements, engineering services, water purchase from the City of Brockton and other expenses.

The ability to generate sufficient revenue to cover anticipated expenditures is dependent on the amount of water sold and the price charged. Projections for the service population and future water use, presented in Section 3 Water Demand Requirements, are used for this analysis. Future revenues were estimated using the average water use per water rate category from FY2014 to FY2017. Revenue from fire and water service charges and adjustments for credits, past due water bills, interest and demand and fees were not included. Total revenue from water sales anticipated to be collected under the current rate schedule for FY2018 through FY2020 is presented in Table 8-3. Revenue is projected to cover operation and

maintenance expenditures and existing debt service through FY2020 if no additional expenses such as engineering services and capital projects are incurred.

TABLE 8-3
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER CURRENT RATE SCHEDULE

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$1,774,502	$1,783,624	$1,792,708
Expenditures[1]	$1,503,349	$1,474,625	$1,493,967
NET	$271,153	$308,999	$298,741

Note: [1] Includes salaries, operating expenses and existing debt service. Does not include engineering services, capital projects, or any other planned or unplanned expenses.

Water system improvement projects recommended to be completed in the next five years are identified in Section 7. To allow for flexibility in the outcome of planning studies and the prioritization of distribution system projects, capital project expenditures for the next three years were added to projected expenses in increments of $1 million dollars (including $3 million, $2 million and $1 million). Capital expenditures for these increments were scheduled over the next three years, bonded for 20 years at three percent interest and added to projected expenditures as shown in Table 8-4 through Table 8-6. Projected expenditures includes operation and maintenance expenses and existing debt service but does not include engineering services, capital projects, or other expenses. For this reason, projected expenditures shown in Table 8-3 may be lower than actual expenses. If additional annual expenses of $600,000 are incurred with $3 million in capital improvements bonded for 20 years at three percent interest, $400,000 with $2 million in capital improvements, and $200,000 a with $1 million in capital improvements, annual revenue is not expected to cover total expenditures as shown in Table 8-4 and Table 8-6. Therefore, adjusting the current rate structure is recommended.

TABLE 8-4
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER CURRENT RATE SCHEDULE WITH $3 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$1,774,502	$1,783,624	$1,792,708
Expenditures[1]	$1,503,349	$1,474,625	$1,493,967
Additional Expenditures	$600,000	$600,000	$600,000
Estimated Debt Service for $3 Million in Capital Improvements[2]	$240,000	$235,500	$231,000
Total Expenditures	$2,343,349.00	$2,310,124.62	$2,324,967.41
NET	($568,846.84)	($526,500.81)	($532,259.04)

Note: [1]Includes salaries, operating expenses and existing debt service. Does not include engineering services, capital projects, or other expenses. [2]The construction of an additional 0.5 million gallon elevated storage tank is estimated to cost approximately $2.8 million including tank cost and site work.

TABLE 8-5
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER CURRENT RATE SCHEDULE WITH $2 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$1,774,502	$1,783,624	$1,792,708
Expenditures[1]	$1,503,349	$1,474,625	$1,493,967
Additional Expenditures	$400,000	$400,000	$400,000
Estimated Debt Service for $2 Million in Capital Improvements	$160,000	$157,000	$154,000
Total Expenditures	$2,063,349.00	$2,031,624.62	$2,047,967.41
NET	($288,846.84)	($248,000.81)	($255,259.04)

Note: [1]Includes salaries, operating expenses and existing debt service. Does not include engineering services, capital projects, or other expenses.

TABLE 8-6
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER CURRENT RATE SCHEDULE WITH $1 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$1,774,502	$1,783,624	$1,792,708
Expenditures[1]	$1,503,349	$1,474,625	$1,493,967
Additional Expenditures	$200,000	$200,000	$200,000
Estimated Debt Service for $1 Million in Capital Improvements	$80,000	$78,500	$77,000
Total Expenditures	$1,783,349.00	$1,753,124.62	$1,770,967.41
NET	($8,846.84)	$30,499.19	$21,740.96

Note: [1]Includes salaries, operating expenses and existing debt service. Does not include engineering services, capital projects, or other expenses.

8.4 PROPOSED RATE STRUCTURE

An adjustment to the current water rate structure is recommended over the next three fiscal years to cover anticipated expenditures and recommended improvements. A proposed rate structure for water sales to meet capital expenditures of $3 million, $2 million and $1 million over the next three years is shown in Table 8-7, Table 8-8 and Table 8-9, respectively. For capital expenditures of $3 million and additional annual expenditures of $600,000, an increase in the 1st step from $104.50 to $141 and an approximately 35% increase in the 2nd, 3rd and 4th steps compared to existing rates is required, as shown in Table 8-7.

TABLE 8-7
PROPOSED SEMI-ANNUAL BILLING WATER RATE STRUCTURE
FOR $3 MILLION IN CAPITAL PROJECTS

Category	Existing Usage (cubic feet)	Existing Rate	Proposed Rate
1st Step	0 to 1,500	$104.50	$141.00
2nd Step	1,500 to 2,500	$5.21 per 100 C.F.	$7.03 per 100 C.F.
3rd Step	2,500 to 5,000	$6.24 per 100 C.F.	$8.42 per 100 C.F.
4th Step	Over 5,000	$8.19 per 100 C.F.	$11.06 per 100 C.F.

For capital expenditures of $2 million and additional annual expenditures of $400,000, an increase in the 1st step from $104.5 to $124.30 and an approximately 19% increase in the 2nd, 3rd and 4th steps compared to existing rates is required as shown in Table 8-8.

TABLE 8-8
PROPOSED SEMI-ANNUAL BILLING WATER RATE STRUCTURE
FOR $2 MILLION IN CAPITAL PROJECTS

Category	Existing Usage (cubic feet)	Existing Rate	Proposed Rate
1st Step	0 to 1,500	$104.50	$124.30
2nd Step	1,500 to 2,500	$5.21 per 100 C.F.	$6.20 per 100 C.F.
3rd Step	2,500 to 5,000	$6.24 per 100 C.F.	$7.43 per 100 C.F.
4th Step	Over 5,000	$8.19 per 100 C.F.	$9.75 per 100 C.F.

For capital expenditures of $1 million and additional annual expenditures of $200,000, an approximately 5% increase for the 2nd, 3rd and 4th steps compared to existing rates is required as shown in Table 8-9.

TABLE 8-9
PROPOSED SEMI-ANNUAL BILLING WATER RATE STRUCTURE
FOR $1 MILLION IN CAPITAL PROJECTS

Category	Existing Usage (cubic feet)	Existing Rate	Proposed Rate
1st Step	0 to 1,500	$104.50	$104.50
2nd Step	1,500 to 2,500	$5.21 per 100 C.F.	$5.47 per 100 C.F.
3rd Step	2,500 to 5,000	$6.24 per 100 C.F.	$6.55 per 100 C.F.
4th Step	Over 5,000	$8.19 per 100 C.F.	$8.60 per 100 C.F.

The impacts of these proposed rates on the average residential customer are summarized in the following section.

8.5 ESTIMATED REVENUE GENERATED WITH PROPOSED RATE STRUCTURE

The estimated revenue generated from each proposed rate structure for the study period are shown in Table 8-10 though Table 8-12. The net revenue represents an annual margin of savings of approximately 2 to 5 percent over the next three year period for each of the proposed rate structures. The buffer that is built over the next three years could be utilized to cover unforeseen expenses or complete additional recommended improvements in future years. Hanson may also be able to apply revenues earned from water and fire service charges, system connection fees, etc. to further offset the debt the recommended improvements would incur.

TABLE 8-10
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER PROPOSED RATE STRUCTURE FOR $3 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$2,394,789	$2,407,101	$2,419,363
Total Expenditures with $3 Million in Capital Improvements	$2,343,349	$2,310,125	$2,324,967
NET	$51,440	$96,976	$94,395

TABLE 8-11
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER PROPOSED RATE STRUCTURE FOR $2 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$2,111,807	$2,122,666	$2,133,480
Total Expenditures with $2 Million in Capital Improvements	$2,063,349	$2,031,625	$2,047,967
NET	$48,458	$91,041	$85,513

TABLE 8-12
PROJECTED ANNUAL REVENUE AND EXPENDITURES FY2018-FY2020
UNDER PROPOSED RATE STRUCTURE FOR $1 MILLION IN CAPITAL PROJECTS

	FY2018	FY2019	FY2020
Total Revenue (from water sales)	$1,829,755	$1,839,332	$1,848,869
Total Expenditures with $1 Million in Capital Improvements	$1,783,349	$1,753,125	$1,770,967
NET	$46,406	$86,207	$77,902

Under the current rate structure, the average annual water bill for a single family will be approximately $435 based on the average water use per residential customer of 6,959 CF (52,056 gallons) from FY2014 through FY2017. Under the new rate structures, the average annual bill would increase approximately 35% to $588 for $3 million in capital improvements, 19% to $518 for $2 million in capital improvements or 3% to $447 for $1 million in capital improvements as shown in Table 8-13.

TABLE 8-13
HANSON CUSTOMER BILL WITH PROPOSED WATER RATES

Water Use C.F. (gallons)	Current Rate Structure	Rate Structure for $3 Million in Capital Projects	Rate Structure for $2 Million in Capital Projects	Rate Structure for $1 Million in Capital Projects
6,959 (52,056)	$435	$588	$518	$447

Using the average water use per residential customer in Hanson, Table 8-14 calculates the annual water bill for a residential customer using current water rates neighboring communities. The annual residential water bill expected under both the current and proposed rate structures are higher when compared to neighboring communities.

TABLE 8-14
WATER RATES IN AREA COMMUNITIES

Water Use C.F. (gallons)	Rockland	Hanover	E. Bridgewater	Halifax	Pembroke
6,959 (52,056)	$429	$469	$421	$233	$226

APPENDIX A
FIRE FLOW TEST DATA

Environmental Partners GROUP

Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 9:32am

Job No: 160-1604

LOCATION: ***Joshua Lane***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 42.5

Static: 90

Residual: 53

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: #4 Joshua Lane

Gauge Hydrant: #1 Joshua Lane
towards main intersection

No obvious change in elevation

Calculations

Flow: 866.3540835

Flow Available at 20 psi

1222.417159

Well Status:

CSWF Flow Rate:	593 gpm	Well 3 Level:	7.1 ft
Well 3 Flow Rate:	178.67 gpm	Well 4 Level:	18.8 ft
Well 4 Flow Rate:	165 gpm	Well 5 Level:	20.2 ft
Well 5 Flow Rate:	0.67 gpm	Well 1 Level:	11.25 ft
Well 1 Flow Rate:	264.97 gpm	Well 1 Flow Rate:	262.3 gpm

Tank Status:

Elevated Storage Tank Level:	36.88 ft
CSWF System Pressure:	100.22 psi

Wellfield Datalogger

Pressure: 97.68 psi

Personnel Conducting Test:

Alston Potts, EIT	EPG
Lauren Underwood, EIT	EPG
Steve	
Chris	

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Environmental Partners GROUP

Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 10:00am

Job No: 160-1604

LOCATION: ***Pleasant Street***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 60

Static: 86

Residual: 83

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: #382 Pleasant St, just shy of railroad tracks (railroad tracks are south)

Gauge Hydrant: intersection of Pleasant Street and Reed Street/South Street

Gauge hydrant is slightly downhill in a little downhill spot

Calculations

Flow: 1029.382041

Flow Available at 20 psi

5463.674706

Well Status:

CSWF Flow Rate:	653 gpm	Well 3 Level:	7.04 ft
Well 3 Flow Rate:	179.11 gpm	Well 4 Level:	19.62 ft
Well 4 Flow Rate:	154.89 gpm	Well 5 Level:	20.02 ft
Well 5 Flow Rate:	0 gpm	Well 1 Level:	11.26 ft
Well 1 Flow Rate:	251 gpm	Well 1 Flow Rate:	262.33 gpm

Line gate on Pleasant Street closed in intersection and paved over?

Tank Status:

Elevated Storage Tank Level: 36.94 ft

CSWF System Pressure: 103 psi

Wellfield Datalogger

Pressure: 97.85 psi

Personnel Conducting Test:

Alston Potts, EIT	EPG
Lauren Underwood, EIT	EPG
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Jerry	

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Environmental Partners GROUP

Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 10:56am

Job No: 160-1604

LOCATION: ***Monponsett Street***

No. of Outlets: 1

Diameter Outlet: 4.5

Coefficient: N/A

Pitot: 10

Static: 90

Residual: 56

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: Hancock Street at Monponsett Street

Gauge Hydrant: Squantum Street at Monponsett Street

No elevation change

Leaky valve in front

**8" CI pipe

Calculations

Flow: 1211

Flow Available at 20 psi

1788.539226

Well Status:

CSWF Flow Rate:	615 gpm	Well 3 Level:	7.2 ft
Well 3 Flow Rate:	178 gpm	Well 4 Level:	19.2 ft
Well 4 Flow Rate:	161.78 gpm	Well 5 Level:	20.2 ft
Well 5 Flow Rate:	0 gpm	Well 1 Level:	11.27 ft
Well 1 Flow Rate:	265 gpm	Well 1 Flow Rate:	262.1 gpm

Tank Status:

Elevated Storage Tank Level:	37.29 ft
CSWF System Pressure:	101 psi

Wellfield Datalogger

Pressure:	97.78 psi

Personnel Conducting Test:

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Environmental Partners GROUP

Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 11:24am

Job No: 160-1604

LOCATION: ***Rosewood Drive***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 60

Static: 79

Residual: 68

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: end of cul-de-sac

Gauge Hydrant: #98 Rosewood Drive

No significant elevation change; flow hydrant a little bit higher

Calculations

Flow: 1029.382041

Flow Available at 20 psi

2549.673812

Well Status:

CSWF Flow Rate:	647 gpm	Well 3 Level:	6.91 ft
Well 3 Flow Rate:	184 gpm	Well 4 Level:	17.78 ft
Well 4 Flow Rate:	168 gpm	Well 5 Level:	20.19 ft
Well 5 Flow Rate:	0 gpm	Well 1 Level:	11.36 ft
Well 1 Flow Rate:	273.09 gpm	Well 1 Flow Rate:	258.5 gpm

Tank Status:

Elevated Storage Tank Level:	37.2 ft
CSWF System Pressure:	96 psi

Wellfield Datalogger

Pressure: 98.67 psi

Personnel Conducting Test:

Alston Potts, EIT	EPG
Lauren Underwood, EIT	EPG
Steve	
Jerry	

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Environmental Partners GROUP

Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 12:10pm

Job No: 160-1604

LOCATION: ***Brook Street***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 17.5

Static: 90

^75 at house #283 - tested before moving & conducting actual test

Residual: 80

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: across from #283 Brook Street

Gauge Hydrant: #75 Brook Street

Consistent elevation

Calculations

Flow: 555.9298404

Flow Available at 20 psi

1589.911416

Well Status:

CSWF Flow Rate:	573 gpm	Well 3 Level:	7 ft
Well 3 Flow Rate:	181 gpm	Well 4 Level:	19.4 ft
Well 4 Flow Rate:	166.11 gpm	Well 5 Level:	20.2 ft
Well 5 Flow Rate:	4.44 gpm	Well 1 Level:	11.34 ft
Well 1 Flow Rate:	265.4 gpm	Well 1 Flow Rate:	259.1 gpm

Tank Status:

Elevated Storage Tank Level:	37.42 ft
CSWF System Pressure:	101 psi

Wellfield Datalogger

Pressure:	98.5 psi

Personnel Conducting Test:

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Lauren Underwood, EIT	EPG
Steve	
Jerry	

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Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 12:44pm

Job No: 160-1604

LOCATION: ***East Washington Street***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 60

Static: 96

Residual: 84

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: #988 East Washington Street

Gauge Hydrant: #944 East Washington Street

Flow hydrant slightly higher?

Calculations

Flow: 1029.382041

Flow Available at 20 psi

2789.061263

Well Status:

CSWF Flow Rate:	607 gpm	Well 3 Level:	6.9 ft
Well 3 Flow Rate:	177 gpm	Well 4 Level:	19.8 ft
Well 4 Flow Rate:	157 gpm	Well 5 Level:	19.9 ft
Well 5 Flow Rate:	4 gpm	Well 1 Level:	11.26 ft
Well 1 Flow Rate:	254 gpm	Well 1 Flow Rate:	259.5 gpm

Tank Status:

Elevated Storage Tank Level:	37.93 ft
CSWF System Pressure:	103 psi

Wellfield Datalogger

Pressure:	98.18 psi

Personnel Conducting Test:

Alston Potts, EIT	EPG
Lauren Underwood, EIT	EPG
Steve	
Jerry	

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Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 1:10pm

Job No: 160-1604

LOCATION: ***Captain Nathanial Drive***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 52.5

Static: 79

Residual: 75

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow hydrant: #311 Captain Nathanial Drive

Gauge Hydrant: #53 Captain Nathanial Drive

Calculations

Flow: 962.898729

Flow Available at 20 psi

4118.397906

Well Status:

CSWF Flow Rate:	599 gpm	Well 3 Level:	7.1 ft
Well 3 Flow Rate:	172 gpm	Well 4 Level:	18.8 ft
Well 4 Flow Rate:	162.78 gpm	Well 5 Level:	20 ft
Well 5 Flow Rate:	0.56 gpm	Well 1 Level:	20.45 ft
Well 1 Flow Rate:	256.4 gpm	Well 1 Flow Rate:	0 gpm

Tank Status:

Elevated Storage Tank Level:	38.11 ft
CSWF System Pressure:	105 psi

Wellfield Datalogger

Pressure:	98.55 psi

Personnel Conducting Test:

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Project: Hanson Master Plan Update

Date: November 7, 2017

Client: Town of Hanson

Time: 1:31pm

Job No: 160-1604

LOCATION: ***Tag Way***

No. of Outlets: 1

Diameter Outlet: 2.25

Coefficient: 0.88

Pitot: 42.5

Static: 64

Residual: 50

Flow

$29.83 \times D^2 \times \sqrt{Pitot} \times Coeff.$

Flow Available at 20 psi

$Flow \times (Static - 20)^{.54} / (Static - Residual)^{.54}$

Location Description

Flow Hydrant: #4 Tag Way, closer to cul-de-sac

Gauge Hydrant: across from #5 Tag Way

Calculations

Flow: 866.3540835

Flow Available at 20 psi

1607.869262

Well Status:

CSWF Flow Rate:	618 gpm	Well 3 Level:	6.84 ft
Well 3 Flow Rate:	178.33 gpm	Well 4 Level:	18.39 ft
Well 4 Flow Rate:	172.67 gpm	Well 5 Level:	19.99 ft
Well 5 Flow Rate:	0 gpm	Well 1 Level:	20.58 ft
Well 1 Flow Rate:	276 gpm	Well 1 Flow Rate:	0 gpm

Tank Status:

Elevated Storage Tank Level:	38.25 ft
CSWF System Pressure:	97 psi

Wellfield Datalogger

Pressure:	99.05 psi

Personnel Conducting Test:

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Jerry	

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APPENDIX B

WATER MANGMENT ACT PERMIT (ORGINALLY EXPIRING 2010)

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHEAST REGIONAL OFFICE
20 RIVERSIDE DRIVE, LAKEVILLE, MA 02347 508-946-2700

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

April 17, 2008

Board of Selectmen
Town Hall, First Floor
542 Liberty Street
Hanson, MA 02341

RE: HANSON – WMA
PWS ID # 4123000
Water Management Act
Permit #9P425123.01
Transmittal #W061340

Dear Sirs,

Attached please find:

- Amended WMA Permit #9P425123.01 for the Town of Hanson, and
- Findings of Fact in Support of Amended Permit #9P425123.01

The signature on this cover letter indicates formal issuance of the attached document.

If you have any questions regarding this information, please contact Leslie O'Shea at (508) 946-2837 or via e-mail at leslie.o'shea@state.ma.us.

Very truly yours,

Richard J. Rondeau, Chief
Drinking Water Program
Bureau of Resource Protection

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Water Dept
BOARD OF SELECTMEN

Y:\DWP Archive\SERO-Hanson–WMA–PERMIT 9P425123.01-2008-04-17

ecc: Richard Hartley, DFW
Margret Kearns, Riverways Program
Thomas French, NHESP
Duane LeVangie, DEP, Boston
Old Colony Planning Council
Jill Cowie, WAA
Heidi Ricci, Massachusetts Audubon

cc: Camp Dresser McKee
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Communication for Non-English Speaking Parties (310 CMR 1.03(5)(a))

English

This document is important and should be translated immediately.

Spanish

Este documento es importante y se debe traducir inmediatamente.

Portuguese

Este original é importante e deve ser traduzido imediatamente.

Italian

Questo documento è importante e dovrebbe essere tradotto immediatamente.

Greek

Αυτό το έγγραφο είναι σημαντικό και πρέπει να μεταφραστεί αμέσως.

French

Ce document est important et devrait être traduit immédiatement.

Chinese (traditional)

這 個 文件 重要 和 應該 立刻 被翻譯 。

这个文件重要 和应该立刻被翻译。

Findings of Fact in Support of Permit Amendment
RE: Water Management Permit #9P-4-25-123.01

The Department of Environmental Protection ("the Department") hereby amends the permit of the Town of Hanson ("Hanson") in accordance with the Water Management Act, M.G.L. c.21G. As required by M.G.L. c.21G § 11, 310 CMR 36.26 and 310 CMR 36.00, the Department makes the following Findings of Fact in support of the Hanson Water Management Act ("WMA") permit, and includes herewith the reasons for amending this permit and for imposing the conditions of the permit.

The attached amended permit supersedes WMA Permit #9P-4-25-123.01 issued to Hanson on October 20, 2005.

FINDINGS OF FACT

As required by M.G.L. c.21G § 11 and 310 CMR 36.00, the Department makes the following Findings of Fact in support of the permit, and includes herewith its reasons for approving the permit and for imposing the conditions of approval.

The Water Management Act requires the Department to issue permits that balance a variety of factors including:

- Reasonable protection of existing water uses, land values, investments and enterprises;
- Reasonable conservation consistent with efficient water use;
- Reasonable protection of public drinking water supplies, water quality, wastewater treatment capacity, waste assimilation capacity, groundwater recharge areas, navigation, hydropower resources, water-based recreation, wetland habitat, fish and wildlife, agriculture, flood plains; and
- Reasonable economic development and job creation.

To achieve the balance of competing water uses mandated by the Act, the Department has adopted the *Water Management Policy For Permit and Permit Amendment Applications and 5-Year Reviews, Effective Date: April 2, 2004* (the Policy) and the *Guidance Document for Water Management Act Permitting Policy, Effective Date: January 17, 2006* (Guidance), which can be found at:

http://www.mass.gov/dep/water/laws/policies.htm#wmgt.

The Policy and Guidance identify the Performance Standards to be applied to new Water Management permits, and existing permits at the time they are modified or amended.

In applying the Performance Standards the Department relies upon the determinations of relative stress established in the Massachusetts Water Resources Commission (WRC) report, *Stressed Basins in Massachusetts* (approved December 13, 2001). The Department also reviews other available research, including reports by the United States Geological Society (USGS), the Department's Water Quality Assessment Reports and other pertinent reports available for specific river basins.

The Water Resources Commission report identifies the Taunton River Basin upstream of the USGS gage station (#01108000) on the Bridgewater/ Middleboro town line as being medium stress. Hanson's groundwater withdrawal sources are located in the medium stress portion of the Taunton River Basin.

The stressed basins map can be reviewed at:

http://www.mass.gov/dep/water/laws/policies.htm#wmgt

The Performance Standards for medium stress basins are:

1. Residential gallons per capita day water use (RGPCD) of 65 gallons or less;
2. Unaccounted-for water (UAW) of 10% or less;
3. Summer limits on withdrawals implemented through either a calendar trigger or a streamflow trigger; and
4. Offset feasibility studies for withdrawals that exceed the Baseline* withdrawal volume established for each Permit.

The Performance Standards of 65 gallons per day (gpd) or less for residential per capita water use and 10% or less for unaccounted for water are taken from the WRC's performance standards for effective water conservation for public water suppliers. The Department believes these standards are reasonable based on studies and data developed throughout the country, the 1996 AWWA Leak Detection and Water Accountability Committee report on water accountability (AWWA Journal; July 1996; pp. 108-111), and the fact that the average values in 2005 for Massachusetts were 71 RGPCD, and 11% UAW. Further, the Department believes that through effective water conservation and implementation of the WMA Permit conditions, Permittees may be able to reduce RGPCD below 65 gpd and UAW below 10%.

The Guidance provides implementation and enforcement guidelines, including:

- timelines for compliance with the Performance Standards;
- procedures and requirements for Permittees who fail to comply with the Performance Standards within those timelines;
- enforcement margins and enforcement forbearance for Permittees in high and medium stress basins.

See Section II, paragraph 3 and Section III, paragraph 3 of the Guidance for more information on enforcement margins and forbearance.

Hanson WD submitted a BRP WM02 permit amendment application requesting to add the Pleasant Street Wellfield as a new source. No additional withdrawal volume was requested by the amendment application.

The Department has completed the review of the permit amendment application. The Town of Hanson's WMA permit has amended to add the Pleasant Street Wellfield as a source and to incorporate standards of the WMA policy. As noted above, this amendment does not increase Hanson's authorized water withdrawal volume.

The public notice and public comment regarding the amendment application were conducted by the applicant and the Department in accordance with 310 CMR 36.22 and 36.23. In addition, a draft of this amended permit was distributed for public comment from January 18, 2008 through February 18, 2008.

The Department has reviewed the results of the model conducted by CDM for the Pleasant Street Wellfield and concurs with the results of this model. The operating conditions imposed in Special Condition 10 of this permit will be protective of Monponsett Pond and the resource areas.

Findings of Fact for Specific Permit Conditions

Special Conditions:

Special Condition #1, Authorized Annual Average Withdrawal Volume: this permit authorizes the Town of Hanson to withdraw 98.55 MGY (million gallons per year), or an average of 0.27 MGD (million gallons per day), for the period of March 1, 2005 through February 28, 2010.

This permitted volume is in addition to Hanson's Registered volume of 0.51 MGD.

Summary of the Town of Hanson's WMA Authorizations		
Basin	**WMA Authorization**	**Volume Authorized**
Taunton River	Registration #425123.01	0.51 MGD (186.15 MGY)
	Permit #9P425245.01	0.27 MGD (98.55 MGY) 3/1/2005 to 2/28/2010
Total Authorization		0.78 MGD (284.70 MGY)

The permitted volume authorized to the Town of Hanson has not been increased by this amendment. The Town of Hanson is in compliance with its WMA authorized withdrawal volumes. In 2007 the Town's average daily water use was 0.65 MGD.

Special Condition 2, Maximum Authorized Daily Withdrawal Volumes: reflects the Department approved Zone II rates for the permitted wells.

Special Condition 3, Zone of Contribution Delineations: notes the Department's approval of Hanson's Zone II delineations; no additional delineations are required as a condition of this permit.

Special Condition 4, Wellhead Protection: notes the approval of Hanson's wellhead protection program; no additional wellhead protection work is required as a condition of this permit.

Special Condition 5, Performance Standard for Residential Gallons Per Capita Day Water Use: as noted above, Hanson's standard for RGPCD is 65 gpd or less.

As required by the October 20, 2005 permit amendment, beginning in calendar year 2006, should the Town not meet the standard for RGPCD, Hanson shall develop an enhanced conservation plan. The requirements for this enhanced plan are now spelled out in Appendix A. Hanson's reported 2007 RGPCD is 54.52 gpd based.

Special Condition 6, Performance Standard for Unaccounted for Water: as noted above, Hanson's standard for UAW is 10% or less.

As required by the October 20, 2005 permit amendment, beginning in calendar year 2006, should the Town not meet the standard for UAW, Hanson shall conduct a water audit. The requirements for a UAW compliance plan are now spelled out in Appendix B. Hanson reported an UAW of 14% for the year ending 2007.

Special Condition 7, Summer Limits on Withdrawals: states the Department's minimum requirements for limits on nonessential outside water use from May through September.

This condition states, "Nothing in this permit shall prevent Hanson from implementing water use restrictions stricter than those set forth in Options 1 and 2." Hanson does have a regulation of the Board of Water Commissioners which is used to implement mandatory outside water use restrictions. This regulation prohibits sprinkler systems from being connected to the public water system. In addition, the regulation only allows the use of hand-held hoses between the hours of 7 to 9 am and 5 to 7 pm daily. In accordance with Department policy, hand-held hoses can be used before 9 am and after 5 pm seven days a week.

Hanson did implement water use restrictions in 2007.

Hanson's summer to winter ratio for the period of November 2003 through September 2006 was 1.22.

Special Condition 8, Water Withdrawals that Exceed Baseline Withdrawal Volumes: Hanson's baseline volume is 0.72 MGD as established in the October 20, 2005 permit amendment.

As required by the October 20, 2005 permit amendment, should Hanson exceed the baseline volume in any calendar year, the Town shall develop a plan to offset the impacts of additional withdrawal. This condition outlines the requirements for the offset feasibility study.

Special Condition 9, Water Conservation Requirements: incorporates the Water Conservation Standards for the Commonwealth of Massachusetts approved by the WRC in July 2006.

Special Condition 10, Pleasant Street Wellfield Operating Conditions: limits withdrawals from the Pleasant Street Wellfield based on Monponsett Pond levels. This condition also requires the development of an operation and monitoring plan to ensure that the operating conditions are met.

Special Condition 11, Wetlands Monitoring: Hanson shall continue the annual monitoring of wetlands adjacent to the Crystal Spring Well and the Crystal Spring Wellfield.

Special Condition 12, Streamflow Monitoring: in conjuction with the Department, Hanson shall develop a plan to monitor streamflow of Poor Meadow Brook adjacent to the Crystal Springs Wellfield.

Special Condition 13, Reporting Requirements: ensures that the information necessary to evaluate compliance with the permit conditions is accurately reported.

Special Condition 14, General Permit Conditions: outlines the general conditions applicable to all WMA Permittees.

Appendix A – Residential Gallons Per Capita Day: outlines actions to be taken if Performance Standard for Residential Per Capita Water Use is not met.

Appendix B – Unaccounted for Water: outlines actions to be taken if Performance Standard for Unaccounted-for Water is not met.

Appendix C – Summer Limits on Withdrawals: provides information regarding implementation of the summer limits on withdrawals.

The Department's Findings of Fact and summary of Permit Conditions are not intended to, and should not be construed as, modifying any of the Permit conditions. In the event of any conflict or ambiguity between the Findings of Fact and the Permit, the Permit language shall control.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHEAST REGIONAL OFFICE
20 RIVERSIDE DRIVE, LAKEVILLE, MA 02347 508-946-2700

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

WATER WITHDRAWAL PERMIT
MGL c 21G

This permit is approved pursuant to the Massachusetts Water Management Act (WMA) for the sole purpose of authorizing the withdrawal of a volume of water as stated below and subject to the following special and general conditions. This permit conveys no right in or to any property beyond the right to withdraw the volume of water for which it is issued.

PERMIT NUMBER: 9P-4-25-123.01 **RIVER BASIN:** Taunton

PERMITTEE: Town of Hanson
Hanson Water Department
1073 West Washington Street
Hanson, Massachusetts

EFFECTIVE DATE: June 1, 1991

AMENDMENT DATE: April 17, 2008

EXPIRATION DATE: February 28, 2010

TYPE AND NUMBER OF WITHDRAWAL POINTS: Groundwater: 5
Surface Water: 0

USE: Public Water Supply

DAYS OF OPERATION: 365

AUTHORIZED WITHDRAWAL POINTS:

Table 1: Withdrawal Point Identification	
Source	**Source Code**
Crystal Springs Well	4123000-01G
Crystal Spring Wellfield	4123000-03G 4123000-04G 4123000-05G
Pleasant Street Wellfield	*

* Source Code to be assigned upon construction of well.

SPECIAL CONDITIONS – PERMIT #9P425123.01

1. Authorized Annual Average Withdrawal Volume from the Taunton River Basin

This permit authorizes the Town of Hanson ("Hanson") to withdraw water from the Taunton River Basin at the rate described in Table 2 below. The volume reflected by this rate is in addition to the 0.51 MGD previously authorized to the Hanson under WMA Registration #4-25-123.01 for withdrawal from the Taunton River Basin. The permitted volume is expressed both as an average daily withdrawal rate (million gallons per day or MGD), and as a total annual withdrawal volume (million gallons per year or MGY) for each five-year period of the permit term.

The Department of Environmental Protection ("the Department") bases these withdrawal volumes on the raw water withdrawn from the authorized water sources, and will use the raw water amount to assess compliance with the registered and permitted withdrawal volumes.

Table 2: Authorized Withdrawal Volumes – Taunton River Basin

5-Year Periods		Total Raw Water Withdrawal Volumes			
		Permit		Permit + Registration	
		Daily Average (MGD)	Total Annual (MGY)	Daily Average (MGD)	Total Annual (MGY)
Period One Years 1-5	6/1/1991 to 2/28/1995	0.25	91.25	0.76	277.40
Period Two Years 6-10	3/1/1995 to 2/28/2000	0.27	98.55	0.78	284.70
Period Three Years 11-15	3/1/2000 to 2/29/2005	0.27	98.55	0.78	284.70
Period Four Years 16-20	3/1/2005 to 2/28/2010	0.27	98.55	0.78	284.70

* Volume noted is in effect only if no change to registered volume occurs after the January 1, 2008 date of expiration of all WMA Registrations.

2. Maximum Daily Withdrawal Rates from the Authorized Taunton River Basin Withdrawal Points

Withdrawals from Hanson's permitted Taunton River Basin sources are not to exceed the approved maximum daily rates listed in Table 3 below without advance approval from the Department.

Table 3: Maximum Daily Withdrawal Volume

Source	Maximum Daily Rate
Crystal Springs Well, 4123000-01G	0.50 MGD
Crystal Spring Wellfield, 4123000-03G, 4123000-04G, 4123000-05G	Combined Maximum Daily Rate of 0.864 MGD
Pleasant Street Wellfield*	0.75 MGD**

* Source code will be assigned at time of issuance of permit to construct.
** See Special Condition #10 for operating conditions for the Pleasant Street Wellfield.

3. Zone II Delineation

Department records show that Hanson's sources have approved Zone II delineations, therefore, no further Zone II work is required.

4. Wellhead Protection

Department records indicate that Hanson's sources meet the requirements of 310 CMR 22.21(2), therefore, no further wellhead protection work is required.

5. Performance Standard for Residential Gallons Per Capita Day Water Use

The Town of Hanson's performance standard for residential gallons per capita day (RGPCD) is 65 gallons or less. Hanson shall be in compliance with the performance standard by December 31, 2006.

Hanson's RGPCD shall be reported in its Annual Statistical Report (ASR), along with the calculation used to derive the RGPCD, the source of the data used to establish the service population and the year in which this data was developed.

Appendix A provides the additional requirements if the Performance Standard for RGPCD is not met in any year.

6. Performance Standard for Unaccounted for Water

The Town of Hanson's Performance Standard for Unaccounted for Water (UAW) is 10% or less of overall water withdrawal. Hanson shall be in compliance with the performance standard by December 31, 2006.

Hanson's UAW shall be reported in its Annual Statistical Report (ASR), along with the calculation used to derive the UAW.

Appendix B provides the additional requirements if the Performance Standard for UAW is not met in any year.

7. Summer Limits on Withdrawals

The Town of Hanson shall limit summer water withdrawals by implementing one of the following two options: Option 1: Calendar Trigger or Option 2: Stream Flow Trigger. Nothing in this permit shall prevent Hanson from implementing water use restrictions stricter than those set forth in Options 1 and 2.

Table 4: Summer Limits on Withdrawals	
Option 1: Calendar Trigger At a minimum, implement the following restrictions on nonessential outdoor water use between May 1st and September 30th. • No nonessential outdoor water use allowed, except that sprinklers may be used for lawn watering outside the hours of 9 AM to 5 PM up to **two (2)** days per week. • Upon the declaration of a drought level of "Watch" (or higher drought designation) by the Massachusetts Drought Management Task Force for the region in which Town of Hanson's withdrawal sources are located*, the restrictions set forth in Option 2 must be implemented and remain in place until the drought level is returned to "Advisory" or "Normal".	**Option 2: Stream Flow Trigger** At a minimum, implement the following restrictions on nonessential outdoor water use whenever stream flow falls below a mean daily streamflow of 0.50 cubic feet per second per square mile (cfsm) for **three (3)** consecutive days between May 1st and September 30th. Stream flow shall be measured at the USGS River Gage 01108000 Taunton River near Bridgewater, MA (the Taunton River Gage)**. At the Taunton River Gage, 0.50 cfsm is equal to 130.5 cubic feet per second (cfs). • No nonessential outdoor water use allowed, except that sprinklers may be used for lawn watering outside the hours of 9 AM to 5 PM **one (1)** day per week. • Once implemented, the restrictions shall remain in place until streamflow at the Taunton River Gage meets or exceeds 130.5 cfs for 7 consecutive days.

*This information is available at:
http://www.mass.gov/dcr/waterSupply/rainfall/drought.htm.

**Readings for Gage 01108000 can be accessed at:

http://waterdata.usgs.gov/ma/nwis/uv/?site_no=01108000&PARAmeter_cd=00065,00060

For additional guidance on nonessential outdoor water use and accessing mean daily streamflows, see Appendix C.

Hanson shall choose either Option 1 or Option 2 above, and implement and enforce the required restrictions starting no later than May 1, 2008. Hanson shall document its compliance with the summer limits on withdrawal requirements annually in its ASR for 2008, and each year thereafter.

Option 1: Calendar Trigger

If the Town of Hanson chooses Option 1, then Hanson shall notify its customers each year by April 15th of the restrictions and the consequences for failing to adhere to the restrictions.

Notice must include:

- The need to limit water use, especially nonessential outdoor water use, to protect streamflow for aquatic life and to ensure a sustainable drinking water supply;
- Ways individual homeowners can limit water use, especially nonessential outdoor water use;
- A detailed description of the restrictions and penalties for violating the restrictions.

Notice that restrictions have been put in place shall be filed each year with the Department within 14 days of the restriction's effective date. Filing shall be in writing on the Water Use Restrictions Form at:

http://www.mass.gov/dep/water/approvals/wmgforms.htm#conserve.

Option 2: Stream Flow Trigger

If the Town of Hanson chooses Option 2, when streamflow falls below 0.50 cfsm (130.5 cfs) at Gage 01108000 for three (3) consecutive days, Hanson shall notify its customers as soon as possible, and in any event no more than three days after implementation, of the restrictions and the consequences for failing to adhere to the restrictions. Notice must include:

- The streamflow value triggering the required notification;
- The need to limit water use, especially nonessential outdoor water use, to protect streamflow for aquatic life and to ensure a sustainable drinking water supply;
- Ways individual homeowners can limit water use, especially nonessential outdoor water use;
- A detailed description of the restrictions and penalties for violating the restrictions.

Notice that restrictions have been put in place shall be filed with the Department within 14 days of the restriction's effective date. Filing shall be in writing on the Water Use Restrictions Form at:

http://www.mass.gov/dep/water/approvals/wmgforms.htm#conserve.

Notice to customers and the Department need not be provided if Hanson has already implemented water use restrictions that conform to the applicable restrictions and those restrictions are still in force.

Should the reliability of flow measurement at Gage 01108000 be so impaired as to question its accuracy, the Town of Hanson may request the Department's review and approval for the trigger mechanism to be transferred to another gage. The Department reserves the right to require use of a different gage.

8. Water Withdrawals that Exceed Baseline Withdrawal Volumes

The Town of Hanson's baseline withdrawal volume (Baseline) for the Taunton River Basin is 0.72 MGD.

Hanson shall make a written evaluation of the cost and benefits of adopting and implementing each of the of the following Best Management Practices (BMPs) in an Offset Feasibility Study (Study) the first time water withdrawals for a calendar year exceed the Baseline of 0.72 MGD.

BMP's to be evaluated:

- Low Impact Development, Conservation Development and Smart Growth bylaw or regulations. Land clearing/development bylaws (loam, native vegetation site clearing limitation, lawn size limitations)

Water Bank
- Traditional water bank
- Institute "hook-up" fee for all new development with revenues to be dedicated to water conservation programs such as rebate programs for homeowners (efficient appliances)

Outdoor Water Use Controls
- Private well regulations to ensure outdoor water use restriction apply to all
- Bylaw prohibiting or restricting in-ground irrigations systems
- Rebate for rainwater recovery systems or rainwater cisterns at cost

Stormwater Management and Recharge
- Stormwater Utility or dedicated stormwater fees used to build and maintain stormwater infiltration facilities
- By-law implementing MA stormwater recharge standards townwide beyond the wetland areas required in the MA Stormwater Policy
- By-law requiring stormwater recharge above the rates required in the MA Stormwater Policy

If Hanson is required to perform an Offset Feasibility Study (Study), Hanson shall:

- Within 60 days of the filing of an ASR indicating that a Study is required, submit a Study Scope of Work to the Department for approval;
- Within 6 months of the Department's approval of the Study Scope of Work, submit the completed Study to the Department for approval;
- The Department's approval of the Study Scope of Work and the completed Study will be presumed if the Department does not issue a written approval or denial of such submission within 60 days of the date submitted to the Department for approval.

~~If the Town of Hanson files a subsequent ASR indicating that withdrawals for a calendar year again~~ have exceeded its Baseline, then Hanson shall:

- Implement the results of the Study;
- Document such implementation annually at the time it files its ASR; and
- Continue to implement the results of the Study as long as withdrawals exceed Baseline.

9. Water Conservation Requirements

At a minimum, the Town of Hanson shall implement the following conservation measures forthwith and shall be in compliance with these measures on or before the end date of this permit, February 28, 2010.

The Department recognizes that the Town of Hanson is currently implementing a number of these requirements. Compliance with the water conservation requirements shall be reported to the Department upon request, unless otherwise noted below.

Table 5: Minimum Water Conservation Requirements
System Audits and Leak Detection
1. Provided UAW is 10% or less, the Town of Hanson shall conduct leak detection of the entire system every three years at a minimum. The next leak detection survey of the entire system shall be conducted by December 31, 2009.
2. Hanson shall conduct leak detection of the entire distribution system within one year whenever the percentage of UAW increases by 5% or more (for example an increase from 3% to 8%) over the percentage reported on the ASR for the prior calendar year. Within 60 days of completing the leak detection survey, Hanson shall submit to the Department a report detailing the survey, any leaks uncovered as a result of the survey or otherwise, dates of repair and the estimated water savings as a result of the repairs.
3. Hanson shall conduct field surveys for leaks and repair programs in accordance with the AWWA Manual 36.
4. Hanson shall have repair reports available for inspection by the Department. Hanson shall establish a schedule for repairing leaks that is at least as stringent as the following: - Leaks of 3 gallons per minute or more shall be repaired within 3 months of detection. - Leaks of less than 3 gallons per minute at hydrants and appurtenances shall be repaired as soon as possible. - Leaks of less than 3 gallons per minute shall be repaired in a timely manner, but in no event more than 6 months from detection, except that leaks in freeway, arterial or collector roadways shall be repaired when other roadwork is being performed on the roadway. Leaks shall be repaired in accordance with the Town of Hanson's priority schedule including leaks up to the property line, curb stop or service meter, as applicable. Hanson shall have water use regulations in place that require property owners to expeditiously repair leaks on their property.
Metering
1. Town of Hanson shall calibrate all source and finished water meters at least annually and report date of calibration on the ASR.
2. Town of Hanson reports its system is 100% metered. All water distribution system users shall have properly sized service lines and meters that meet AWWA calibration and accuracy performance standards as set forth in AWWA Manual M6 – Water Meters, by the permit end date of November 30, 2010.
3. Town of Hanson shall have an ongoing program to ensure that all service meters accurately measure the volume of water used by your customers. The metering program shall include regular meter maintenance, including testing, calibration, repair, replacement and checks for tampering to identify and correct illegal connections. The plan shall continue to include placement of sufficient funds in the Town of Hanson's annual water budget to calibrate, repair, or replace meters as necessary.
Lawn and Landscape
1. Town of Hanson shall continue to implement and enforce water use restrictions as necessary and as required by this permit. In accordance with 310 CMR 22.15(8)(a) the Town of Hanson shall notify MassDEP in writing within 14 business days of implementing mandatory water use restrictions.

Table 5: Minimum Water Conservation Requirements
Pricing
1. Town of Hanson shall maintain a water pricing structure that includes the full cost of operating the water supply system. Evaluate rates at a minimum every three to five years and adjust costs as needed. Full cost pricing factors all costs - operations, maintenance, capital, and indirect costs (environmental impacts, watershed protection) - into prices.
2. Town of Hanson shall not use decreasing block rates. Decreasing block rates which charge lower prices as water use increases during the billing period, are not allowed by M.G.L. Chapter 40 Section 39L.
Residential and Public Sector Conservation
1. Town of Hanson shall meet the standards set forth in the Federal Energy Policy Act, 1992 and the Massachusetts Plumbing Code.
2. Town of Hanson shall meter or estimate water used by contractors using fire hydrants for pipe flushing and construction.
3. Town of Hanson has reported that all municipally owned public buildings within the Water Department's service area have been retrofitted with water saving devices (faucet aerators, low flow shower heads and low flow toilets). The Town of Hanson shall continue to ensure that water savings devices are installed in all municipal buildings.
Public Education and Outreach
1. The Town of Hanson shall develop and implement a Water Conservation Education Plan designed to educate the District's water customers on ways to conserve water. Without limitation, Hanson's plan may include the following actions: • Include in bill stuffers and/or bills, a work sheet to enable customers to track water use and conservation efforts and estimate the dollar savings; • Public space advertising/media stories on successes (and failures); • Conservation information centers perhaps run jointly with electric or gas company; • Speakers for community organizations; • Public service announcements; radio/T.V./audio-visual presentations; • Joint advertising with hardware stores to promote conservation devices; • Use of civic and professional organization resources; • Special events such as Conservation Fairs; • Develop materials that are targeted to schools with media that appeals to children, including materials on water resource projects and field trips; and • Provide multilingual materials as needed.
2. Upon request of the Department, Hanson shall report on its public education and outreach effort, including a summary of activities developed for specific target audiences, any events or activities sponsored to promote water conservation and copies of written materials.

Table 5: Minimum Water Conservation Requirements
Industrial, Commercial and Institutional Water Conservation
1. The Town of Hanson shall review the use records for its industrial, commercial and institutional water users and develop an inventory of the five (5) largest water users. Town of Hanson shall develop and implement an outreach program designed to inform and (where appropriate) work with its largest industrial, commercial and institutional water users on ways to reduce their water use by the permit end date of February 28, 2010. Such outreach plans can include, but are not limited to: information on water audits, meter sizing, water reuse, low-flow plumbing fixtures, mandatory outdoor water use restrictions, suggestions for contacting trade associations for process specific information on water use reductions, and information on contacting the Executive Office of Environmental Affairs Office of Technical Assistance for Toxics Use Reduction (OTA) which offers a range of assistance and information to help facilities improve water use efficiency and reduce wastewater discharge. OTA can be contacted at (617) 626-1060 or at www.mass.gov/envir/ota.
2. Upon request by the Department, Hanson shall report on industrial, commercial and institutional water conservation including the results of its review of water use records for industrial, commercial and institutional water users, the inventory of the largest water users, copies of any outreach materials distributed to industrial, commercial and institutional water users, and to the extent practical, a summary of water use reductions or savings that have resulted. Upon receipt of this report, the Department will take whatever action it deems appropriate to promote the interests of the Water Management Act, including without limitation requiring Town of Hanson to take additional actions to reduce industrial, commercial and institutional water use.

10. Pleasant Street Wellfield Operating Conditions

The Pleasant Street Wellfield shall be operated in accordance with the following conditions. The Department must be notified immediately of any change in the use and/or operation of the Pleasant Street Wellfield.

The maximum daily volume of withdrawal from the Pleasant Street Wellfield is dependent upon the following Monponsett Pond water level:

Table 6: Monponsett Pond Levels	
Monponsett Pond Water Level	**Maximum Daily Volume**
At and Above Mean Sea Level (MSL) 52.0'	0.75 MGD
Between MSL 52.0' to 51.9'	0.50 MGD
Between MSL 51.9' to 51.7'	0.25 MGD
Below MSL 51.7'	No Withdrawal Authorized

To ensure operation of the Pleasant Street Wellfield within the authorized withdrawal range, a monitoring and operations plan shall be developed. At a minimum the plan shall include:

- Provisions for collecting daily pond level measurements;
- A contingency plan to address potential impacts to the seven (7) private wells located on Woodbine Avenue Extension and Pleasant Street. Proposed remedial actions must be mutually agreed upon by the owners of the private wells and the operator of the Pleasant Street Wellfield;

- Provisions for monitoring wetlands adjacent to the Pleasant Street Wellfield, including baseline monitoring to be conducted prior to operation of the Pleasant Street Wellfield;
- Provisions for annual reports.

This plan shall be submitted to the Department with the pilot for the Pleasant Street Wellfield. Once the monitoring plan has been finalized, all of the operational and monitoring requirements contained in the plan shall be incorporated into this permit and made enforceable hereunder.

11. Wetlands Monitoring

The Town of Hanson shall continue the monitoring of wetlands adjacent to the Crystal Spring Well and the Crystal Spring Wellfield on an annual basis, in accordance with the plan approved by the Department on January 7, 2004. Reports detailing the results of the wetlands monitoring shall be submitted annually with Hanson's Annual Statistical Report.

12. Streamflow Monitoring

In coordination with the Department, the Town of Hanson shall develop a plan to monitor streamflow of Poor Meadow Brook adjacent to the Crystal Springs Wellfield. At a minimum, Hanson shall monitor at one location upstream and one location downstream of the Crystal Springs Wellfield.

This plan shall be submitted to the Department by July 1, 2008. Once the monitoring plan has been finalized, all of the monitoring requirements contained in the plan shall be incorporated into this permit and made enforceable hereunder.

13. Reporting Requirements

The Town of Hanson shall report annually on its ASR the raw water volumes and finished water volumes for the entire water system and the raw water volumes for individual water withdrawal points.

14. General Permit Conditions (applicable to all permittees)

No withdrawal in excess of 100,000 gallons per day over the registered volume (if any) shall be made following the expiration of this permit, unless before that date the Department has received a renewal permit application pursuant to 310 CMR 36.00.

1. **Duty to Comply** The permittee shall comply at all times with the terms and conditions of this permit, the Act and all applicable State and Federal statutes and regulations.

2. **Operation and Maintenance** The permittee shall at all times properly operate and maintain all facilities and equipment installed or used to withdraw up to the authorized volume so as not to impair the purposes and interests of the Act.

3. **Entry and Inspections** The permittee or the permittee's agent shall allow personnel or authorized agents or employees of the Department to enter and examine any property for the purpose of determining compliance with this permit, the Act or the regulations published pursuant thereto, upon presentation of proper identification and an oral statement of purpose.

4. **Water Emergency** Withdrawal volumes authorized by this permit are subject to restriction in any water emergency declared by the Department pursuant to MGL c 21G ss 15-17, MGL c 111 ss 160, or any other enabling authority.

5. **Transfer of Permits** This permit shall not be transferred in whole or in part unless and until the Department approves such transfer in writing, pursuant to a transfer application on forms provided by the Department requesting such approval and received by the Department at least thirty (30) days before the effective date of the proposed transfer. No transfer application shall be deemed filed unless it is accompanied by the applicable transfer fee established by 310 CMR 36.37.

6. **Duty to Report** The permittee shall submit annually, on a form provided by the Department, a certified statement of the withdrawal, such report to be received by the Department by the date specified by the Department. Such report must be mailed or hand delivered to the address specified on the report form.

7. **Duty to Maintain Records** The permittee shall be responsible for maintaining withdrawal records as specified by this permit.

8. **Metering** Withdrawal points shall be metered. Meters shall be calibrated annually. Meter shall be maintained and replaced as necessary to ensure the accuracy of the withdrawal records.

APPEAL RIGHTS AND TIME LIMITS

This permit is a decision of the Department. Any person aggrieved by this decision may request an adjudicatory hearing. Any such request must be made in writing, by certified mail and received by the Department within twenty-one (21) days of the date of receipt of this permit.

No request for an appeal of this permit shall be validly filed unless a copy of the request is sent by certified mail, or delivered by hand to the local water resources management official in the community in which the withdrawal point is located; and for any person appealing this decision, who is not the applicant, unless such person notifies the permit applicant of the appeal in writing by certified mail or by hand within five (5) days of mailing the appeal to the Department.

CONTENTS OF HEARING REQUEST

310 CMR 1.01(6)(b) requires the request to include a clear and concise statement of the facts which are the grounds for the request and the relief sought. In addition, the request must include a statement of the reasons why the decision of the Department is not consistent with applicable rules and regulations, and for any person appealing this decision who is not the applicant, a clear and concise statement of how that person is aggrieved by the issuance of his permit.

FILING FEE AND ADDRESS

The hearing request, together with a valid check, payable to the Commonwealth of Massachusetts in the amount of $100 must be mailed to:

Commonwealth of Massachusetts
Department of Environmental Protection
P.O. Box 4062
Boston, MA 02211

The request shall be dismissed if the filing fee is not paid, unless the appellant is exempt or granted a waiver as described below.

EXEMPTIONS

The filing fee is not required if the appellant is a municipality (or municipal agency), county, district of the Commonwealth of Massachusetts, or a municipal housing authority.

WAIVER

The Department may waive the adjudicatory hearing filing fee for any person who demonstrates to the satisfaction of the Department that the fee will create an undue financial hardship. A person seeking a waiver must file, together with the hearing request, an affidavit setting forth the facts which support the claim of undue hardship.

Appendix A – Residential Gallons Per Capita Day

I. RGPCD Compliance Plan Requirement

If the Town of Hanson fails to document compliance with the RGPCD performance standard in its 2006 ASR, or in any year's ASR thereafter, then Hanson shall file with that ASR a Residential Gallons Per Capita Day Compliance Plan (RGPCD Plan) which shall:

1. meet the requirement set forth below in Section II;
2. include measures to be implemented to meet the performance standard, and
3. include the schedule for implementing such measures.

The filing of a RGPCD plan shall not constitute a return to compliance, nor shall it affect the Department's authority to take action in response to Hanson's failure to meet the performance standard.

If a RGPCD plan is required, the Town of Hanson shall:

1. submit information and supporting documentation sufficient to demonstrate compliance with its RGPCD plan annually at the time it files its ASR, and
2. continue to implement the RGPCD plan until it complies with the performance standard and such compliance is documented in Hanson's ASR for the calendar year in which the standard is met.

II. Contents of a Residential Gallons Per Capita Day Compliance Plan

At a minimum, all RGPCD compliance plans must include a detailed:

1. description of the actions taken during the prior calendar year to meet the performance standard;
2. analysis of the cause of the failure to meet the performance standard;
3. description and schedule of the actions that will be taken to meet the performance standard, and
4. analysis of how the actions described in c. will address the specific circumstances that resulted in the failure to meet the performance standard.

RGPCD plans may be amended to revise the actions that will be taken to meet the performance standard. Amended RGPCD plans must include the information set forth in paragraph above.

At a minimum, all RGPCD plans for failure to meet the RGPCD performance standard must include implementation of at least one of the following residential conservation programs:

1. a program that provides water saving devices such as faucet aerators and low flow shower heads at cost;
2. a program that provides rebates or other incentives for the purchase of low water use appliances (washing machines, dishwashers, and toilets), or
3. the adoption and enforcement of an ordinance, bylaw or regulation to require the installation of moisture sensors or similar climate related control technology on all automatic irrigation systems.

If the Town of Hanson is already implementing one or more of these programs, it must include in its RGPCD plan the continued implementation of such program(s), as well as implementation of at least one additional program. All programs must include a public information component designed to inform customers of the program and to encourage participation in the program.

Without limitation, RGPCD plans for failure to meet the RGPCD performance standard may include the following actions in addition to those outlined in the paragraph above:

1. the use of an increasing block water rate or a seasonal water rate structure as a tool to encourage water conservation;
2. a program that provides rebates or other incentives for the installation of moisture sensors or similar climate related control technology on automatic irrigation systems;
3. the adoption and enforcement of an ordinance, bylaw or regulation to require that all new construction include water saving devices and low water use appliances;
4. the adoption and enforcement of an ordinance, bylaw or regulation to require that all new construction minimize lawn area and/or irrigated lawn area, maximize the use of drought resistant landscaping, and maximize the use of top soil with a high water retention rate;
5. the implementation of a program to encourage the use of cisterns or rain barrels for outside watering, and
6. the implementation of monthly or quarterly billing.

Appendix B – Unaccounted for Water

Unaccounted-for Water (UAW) is defined as the residual resulting from the total amount of water supplied to a distribution system as measured by master meters, minus the sum of all amounts of water measured by consumption meters in the distribution systems, and minus confidently estimated and documented amounts used for certain necessary purposes.

Examples of UAW include, but are not limited to: leakage, meter inaccuracies (unless they fall under the category of adjustment per results of source meter calibration described in the ASR), errors in estimation of stopped meters, unauthorized hydrant openings, illegal connections, data processing errors, and undocumented fire fighting uses.

Examples of uses that can be confidently estimated and documented in writing include storage tank overflow and drainage; water main flushing and flow testing; fire fighting; bleeding or blow-offs; sewer and stormwater system flushing; and cleaning and street cleaning. Generally, leakage is considered to be UAW, however, individual water main breaks can be discounted on a case-by-case basis. Any adjustment in the calculation of UAW made as a result of confidently estimated uses shall be documented as required in the ASR.

I. UAW Compliance Plan Requirement

If the Town of Hanson fails to document compliance with the UAW performance standard in its 2006 ASR, or in any year's ASR thereafter, then Hanson shall file with that ASR a UAW Compliance Plan (UAW Plan) which shall:

1. meet the requirements set forth below in Section II;
2. include measures to be implemented to meet the performance standard, and
3. include the schedule for implementing such measures.

The filing of a UAW plan shall not constitute a return to compliance, nor shall if affect the Department's authority to take action in response to Hanson's failure to meet the performance standard.

If a UAW plan is required, the Town of Hanson shall:

1. submit information and supporting documentation sufficient to demonstrate compliance with its UAW plan annually at the time it files its ASR, and
2. continue to implement the UAW plan until it complies with the performance standard and such compliance is documented in Hanson's ASR for the calendar year in which the standard is met.

II. Contents of an UAW Compliance Plan

The Town of Hanson has the choice to file a UAW plan with measures tailored to the specific needs of its water supply system (Individualized UAW plan) or a UAW plan that includes Best Management Practices (BMP UAW plan).

At a minimum, all UAW plans must include a detailed:

1. description of the actions taken during the prior calendar year to meet the applicable performance standard;
2. analysis of the cause of the failure to meet the performance standard;
3. description and schedule of the actions that will be taken to meet the performance standard, and
4. analysis of how the actions described in c. will address the specific circumstances that resulted in the failure to meet the performance standard.

UAW plans may be amended to revise the actions that will be taken to meet the performance standard. Amended UAW plans must include the information set forth in the paragraph above.

Individualized UAW Compliance Plan
Without limitation, individualized UAW compliance plans for failure to meet the UAW performance standard may include any of the actions set forth in the BMP UAW compliance plan below.

BMP UAW Compliance Plan
At a minimum, all BMP UAW plans for failure to meet the UAW performance standard must include all of the following actions:

1. within one year of filing the UAW plan, complete a water audit and leak detection survey of the entire system and submit completed audit and survey to the Department;
2. within one year of completing the audit and leak detection survey, conduct sufficient repairs to reduce by 75% (by water volume) all leaks detected in the survey; and within one year of completing such repairs, conduct additional repairs of leaks detected in the survey as may be necessary to reduce Hanson's UAW to 10% or less;
3. implementation of a program that ensures the inspection and evaluation of all water meters and, as appropriate, the repair, replacement and calibration of water meters in accordance with the following schedule:
   Large Meters (2" or greater) - within one year of filing the BMP UAW plan
   Medium Meters (1" or greater and less than 2") - within two years of filing the BMP UAW plan
   Small Meters (less than 1") – within three years of filing the BMP UAW Plan.;
4. implementation of monthly or quarterly billing within three years of filing the BMP UAW Plan. , and
5. within one year of filing the UAW Plan, implementation of a water pricing structure that achieves sufficient revenues to pay the full cost of operating the system including, without limitation, the costs of repairs under paragraph a., the costs of meter repairs, replacements and calibrations under paragraph b., the costs of employees and equipment, and ongoing maintenance and capital costs.

Appendix C – Summer Limits on Withdrawals

I. Nonessential Outdoor Water Use

Nonessential outdoor water use includes uses that are not required:

1. for health or safety reasons;
2. by regulation;
3. for the production of food and fiber;
4. for the maintenance of livestock, or
5. to meet the core functions of a business.

Examples of **nonessential** outdoor water uses include:

1. irrigation of lawns, except by means of a hand-held hose outside the hours of 9AM and 5PM;
2. washing of vehicles other than by means of a commercial car wash, except as necessary for operator safety, and
3. washing of exterior building surfaces, parking lots, driveways or sidewalks, except as necessary to apply paint, preservatives, stucco, pavement or cement.

Examples of **acceptable** outdoor water uses outside the hours of 9 AM and 5 PM include:

1. irrigation to establish a new lawn during the months of May and September;
2. irrigation for the production of food and fiber or the maintenance of livestock;
3. irrigation by plant nurseries as necessary to maintain stock;
4. irrigation by golf courses as necessary to maintain tees and greens only, and
5. irrigation of public parks and recreational fields.

II. Accessing Mean Daily Streamflows for Gage 01108000 Via the USGS Website

The USGS Steamflow website default shows Massachusetts streamflows in real time, i.e., the most recent periodic, usually quarterly hourly, reading made at each USGS stream gage. This real-time data can vary widely over the course of a day and is not used to trigger the Water Management Permit Summer Limits on Withdrawals.

To trigger the Summer Limits on Withdrawals, the Department relies on the mean daily streamflows. The mean daily cannot be calculated until after midnight each day when USGS computes the hourly data into a mean daily streamflow.

Go to http://waterdata.usgs.gov/ma/nwis/uv/?site_no=01108000&PARAmeter_cd=00065,00060 for daily mean streamflow data at Gage 01108000. If you need assistance navigating the USGS web site to find the mean daily streamflow, contact Tom Lamonte, Water Management Program staff hydrologist, at (617) 292-5532, or Leslie O'Shea at (508) 946-2837.

The USGS web site for Massachusetts gages can be accessed at:

http://waterdata.usgs.gov/ma/nwis/current/?type=flow.

APPENDIX C

SWMI MIMIZATION AND MITIGATION ACTIVITIES FOR PUBLIC WATER SUPPLIERS

MINIMIZATION ACTIVITIES FOR PUBLIC WATER SYSTEMS

Minimization activities to be evaluated for inclusion in a Minimization Plan required of Permittees with groundwater withdrawals in subbasins with an August net groundwater depletion of 25% or more	
• Operational changes aimed at minimizing impacts to stream flow from groundwater withdrawals (optimization)	
• Surface water releases from water supply impoundments to improve the timing, magnitude and duration of downstream flows to more closely mimic natural conditions without compromising other in-lake uses	
• Water returns that result in improvements to the quantity and timing of streamflow, including o stormwater recharge, o infiltration/inflow improvements, and o wastewater discharges	
• Prescribed nonessential outdoor watering restrictions	
Additional conservation activities outlined below	
Conservation Measures to Reduce Demand	• Implement a rebate program for residential customers for high-efficiency WaterSense-labeled products (toilets, lavatory faucets, showerheads, and irrigation controllers) and Energy Star-labeled clothes washers • Offer incentives for those seeking municipal approvals to install high-efficiency WaterSense-labeled products and Energy Star-labeled appliances in new construction and renovations. Document numbers of products installed in annual report • Evaluate rate structure every two years and increase rates for the highest rate block • Implement a seasonal rate structure that sets higher rates from May 1 to September 30 • Increase billing frequency to at least quarterly • On water bills, provide customers with water consumption information in gallons and show consumption history
Conservation Measures to Reduce Water Loss	• Conduct comprehensive water audit of water system every five years • Develop and implement a meter replacement program to ensure that all nonresidential water use is properly accounted for • Establish penalties and fines for stealing water • Install an automated, remote meter reading system • Install an automated, remote leak detection system

Conservation Measures to Reduce Nonessential Outdoor Watering	• Include some or all of the following provisions in an outdoor water use bylaw or ordinance to ensure proper installation and efficient operation of automatic sprinkler systems: o require registration of automatic irrigation systems; o minimize installation of high water use landscape areas; o restrict land clearing and lawn size in new developments and require a minimum 6-inch depth of topsoil on all cleared areas to help retain moisture; and, o prohibit topsoil stripping • Provide incentives to improve efficiency of automatic irrigation systems • On municipal properties with automatic irrigation systems, install WaterSense-labeled weather-based controllers • Target highest water users with monthly mailing about their use from May 1 through Sept. 30. Provide information comparing their use with most efficient customers • Extend seasonal limits on nonessential outdoor water use to private well users • Provide incentives for customers to infiltrate rainwater; infiltrate rainwater on municipal properties • Provide incentives for customers to enhance soil health; enhance soil health on municipal properties

MITIGATION ACTIVITIES FOR PUBLIC WATER SYSTEMS

Mitigation activities to be evaluated for inclusion in a Mitigation Plan required of Permittees with withdrawals exceeding a permittee's baseline, based on 2003-2005 withdrawals	
• Infiltration and inflow (I/I) – completed rehabilitation work and follow-up analyses o Infiltration is groundwater that enters collection systems through sources such as defective pipes, pipe joints and manhole walls o inflow is water that enters the collection systems through catch basins, manhole covers, cross connections with storm drains, sump pumps, foundation drains and downspouts ▪ direct mitigation credit is not given for I/I program plans and studies done prior to undertaking rehabilitation work	
• Activities that physically return wastewater to groundwater	
• Activities or releases that will offset impacts to fishery resources	
Indirect Mitigation – Activities undertaken to compensate for streamflow impacts resulting from withdrawals. Indirect mitigation activities are not generally amenable to volumetric calculation	
Habitat Improvement	• Remove a dam or other flow barrier • Culvert replacement to meet stream crossing standards • Stream restoration (riparian planting and daylighting) • Install and maintain fish passage • Establish and contribute to an aquatic habitat restoration fund

Habitat Protection	• Acquire property in Zone II of public water supply wells to protect source water quality • Acquire property for other natural resource protection
Wastewater	• Infiltration and inflow (I/I) program plan and studies (not completed I/I rehabilitation work)
Optimization	• Make withdrawals from a subbasin adjacent to stream reach surcharged by discharge flows
Stormwater	• Stormwater bylaw that exceeds MS 4 requirements • Other MS4 implementation (not work that results in increased stormwater infiltration) • Stormwater utility resulting in increased groundwater recharge
Bylaws (non-stormwater)	• By-law regulating non-essential outdoor water use from privately owned wells • Wetlands bylaw • By-law regulating the nutrient content of fertilizer
Water Quality Improvements	• TMDL implementation activities • Septic system maintenance program • Other water quality improvements

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